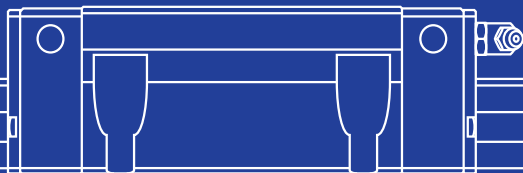
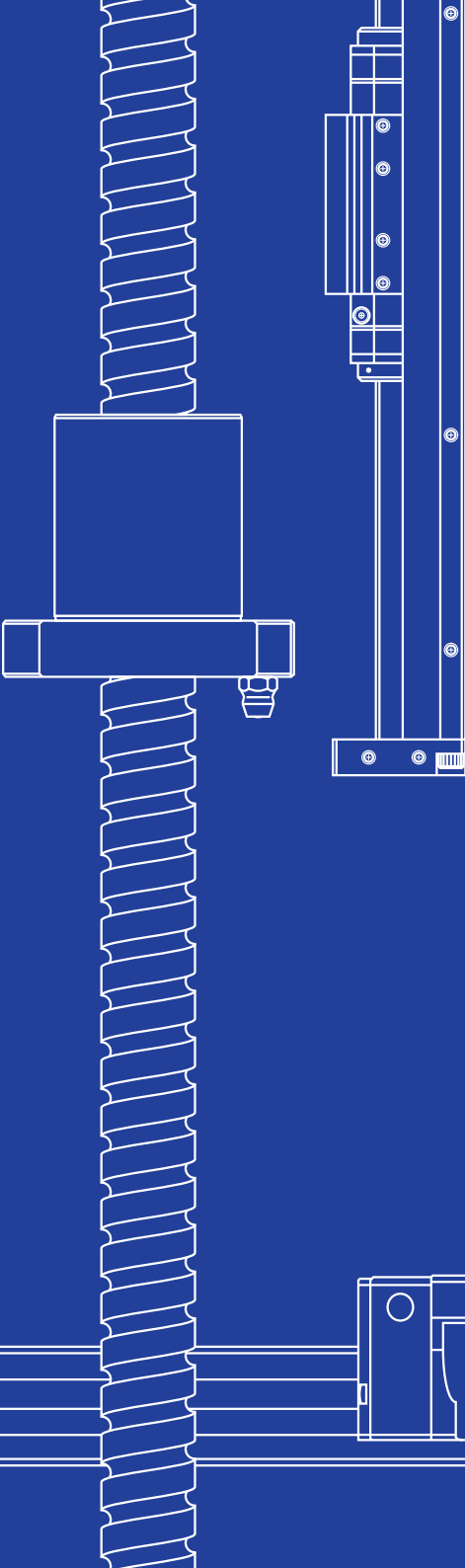


MOTION & CONTROL™

NSK

Precision Machine Components

NSK Linear Guides™
Ball Screws
Monocarrier™



A. NSK Linear Rolling Guide Products

**A1
–
A406**

B. Ball Screws

**B1
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B568**

C. Monocarrier™

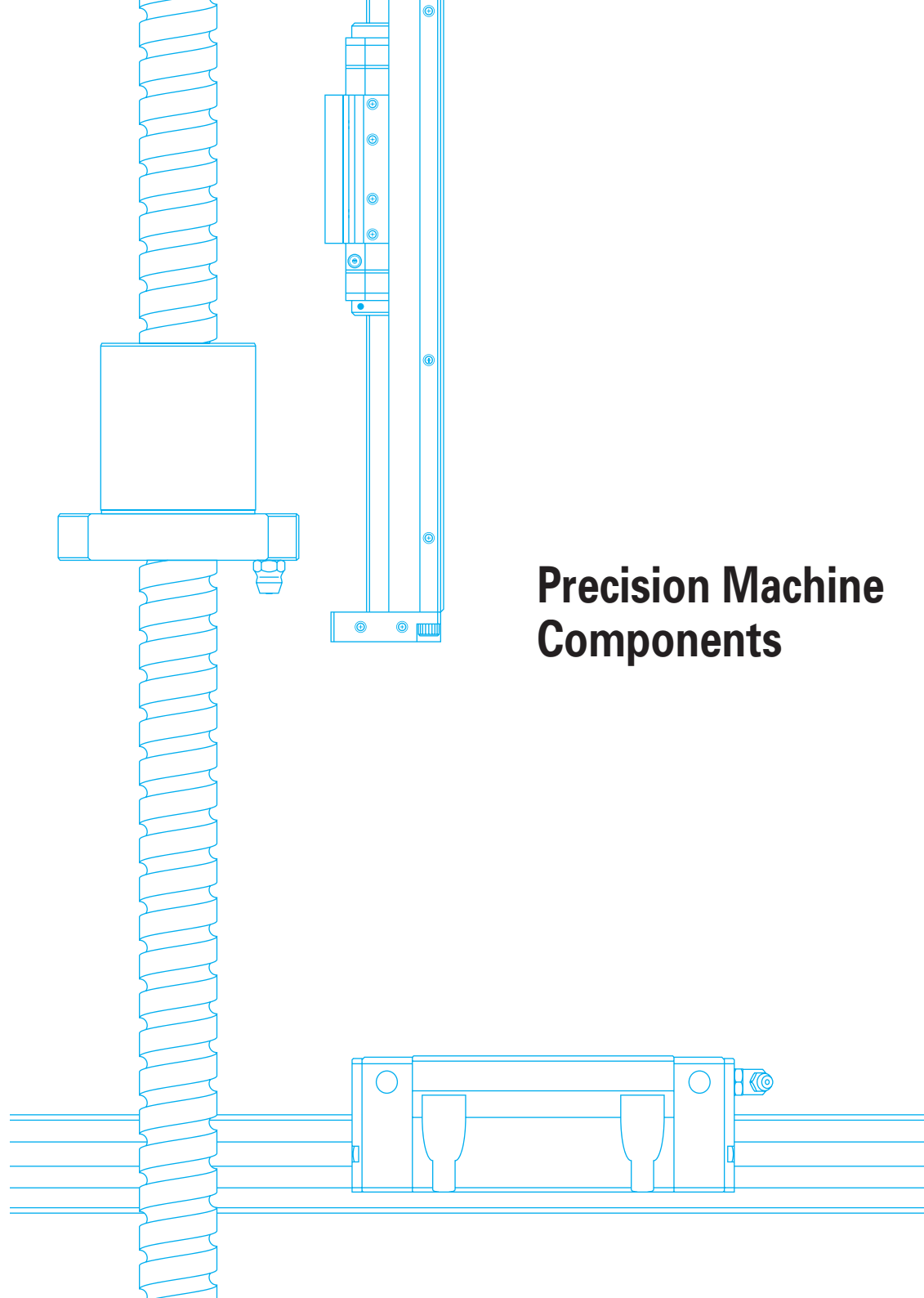
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C148**

D. Other

**D1
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D24**

E. Appendices

**E1
–
E10**



Precision Machine Components

Preface

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

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

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

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

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

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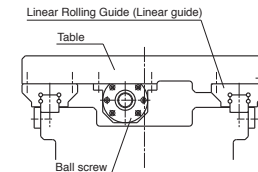
A-1 Characteristics of NSK Linear Rolling Guides

Characteristics of NSK linear rolling guides:

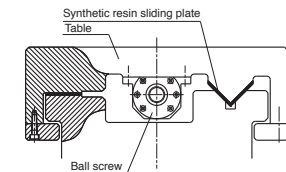
- Designs are simple and economic. This contributes to a highly accurate and low cost guide way system.
- Low friction coefficient facilitates a compact and low cost driving mechanism.
- Ultra-high purity of materials and superb processing technology ensure long-term reliable operation.
- Prompt delivery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

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

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



Example rolling guide



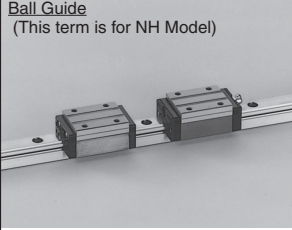
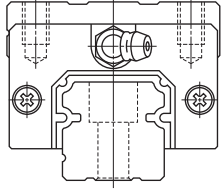
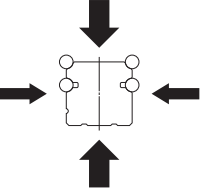

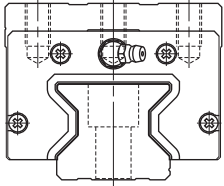
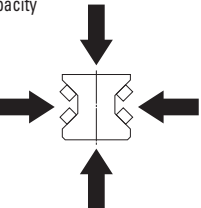

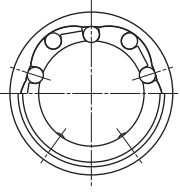
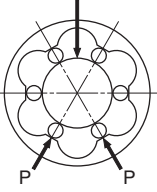
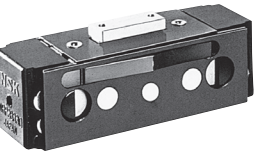
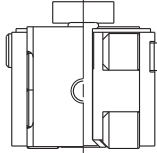
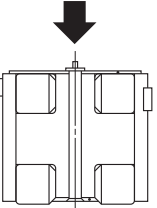
Example sliding guide

Comparative characteristics of rolling and sliding guideways

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

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

A-1-2 Types of NSK Linear Rolling Guides

Product	Appearance	Shape	Rolling element	Load capacity
NSK Linear Guides	<p>Ball Guide (This term is for NH Model)</p> 		Ball	<p>High vertical load carrying capacity</p> 
	<p>Roller Guide</p> 		Roller	<p>Four-way equal load carrying capacity</p> 
Linear rolling bushing			Ball	
Roller pack			Roller	

Rigidity: ☆, Extremely high; ◎, High; ○, Medium; ○, Low

Friction: ◎, Low; ○, Normal

Ease of installation: ◎, Good; ○, Fair

Rigidity	Friction	Ease of installation	Major applications	Page
◎	◎	◎	<ul style="list-style-type: none"> Industrial robots Materials handling equipment Semiconductor manufacturing equipment Laser cutting machines Electric discharge machines Packaging/packing machines 	A105
☆	◎	◎	<ul style="list-style-type: none"> Machining centers NC lathes Heavy cutting machine tools Various types of NC grinders Gear-cutting machines Press machines Electric discharge machines 	A303
○	◎	○	<ul style="list-style-type: none"> Materials handling equipment Packaging/packing machines Medical equipment Pneumatic equipment Office equipment Assembling machines 	A389
◎	◎	○	<ul style="list-style-type: none"> Large machine tools Conveyor system for heavy objects (guide ways for heavy loads) 	A399

A-2 NSK Linear Guides™

A-2-1 Structure of NSK Linear Guides

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

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

A-2-2 Characteristics of NSK Linear Guides

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

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

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

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

(1) High precision and quality

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

(2) High reliability and durability

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

(3) Abundant types for any purpose

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

(4) Development of interchangeable parts for short delivery time

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

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

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

(6) Ultra high load capacity lineup

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

By installing rollers with the largest possible diameter and length, NSK roller linear guides realize ultra-high load capacity far superior to various competing products.

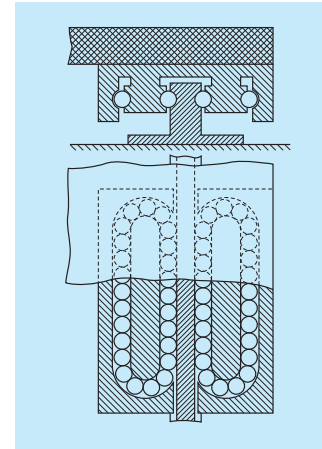


Fig. 1 • French Patent in 1932.
• Inventor: Gretsh (German)

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

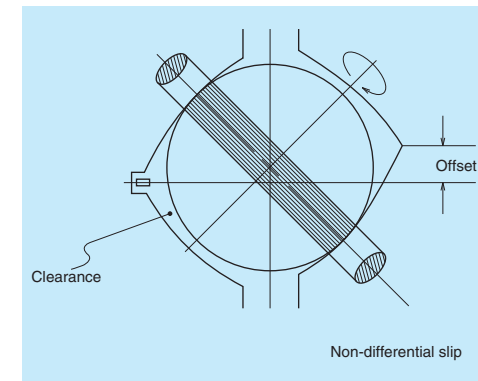


Fig. 3 Two contact point at offset Gothic arch groove

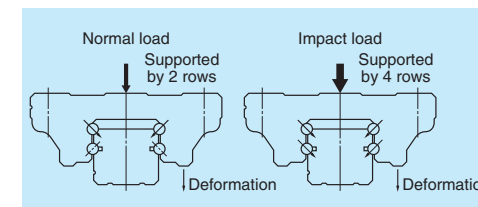


Fig. 5 Shock-resistance

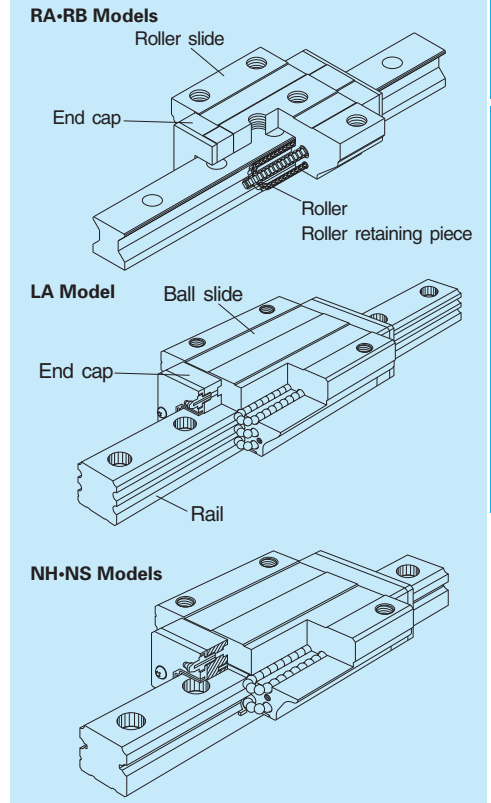


Fig. 2 Structure of NSK linear guides

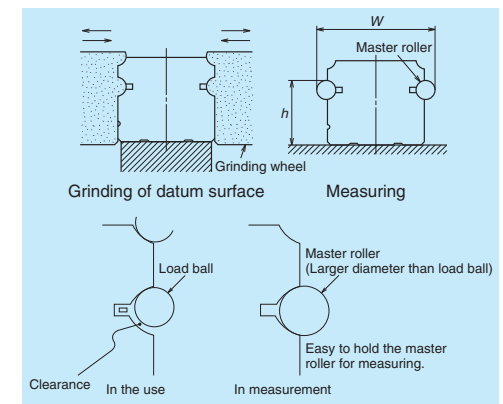


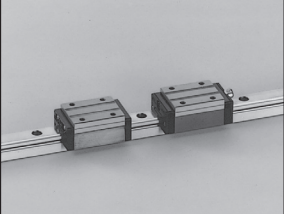
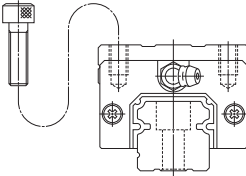
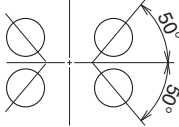
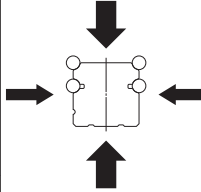
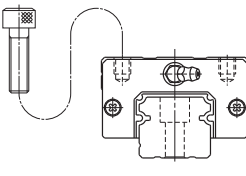
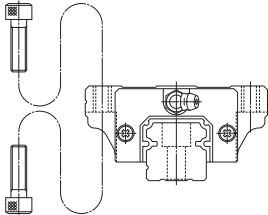
Fig. 4 Processing and measuring grooves

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

A-2-3 Linear Guide Models

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

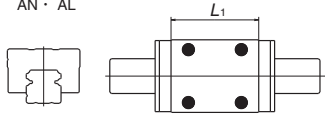
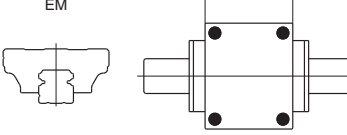
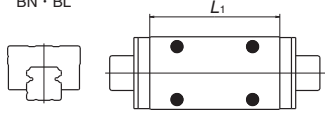
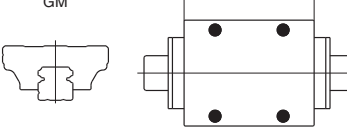
A-2-4 Types and Characteristics of NSK Linear Guides

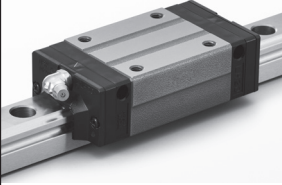
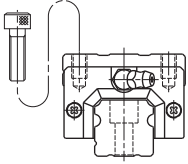
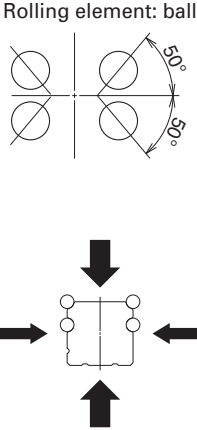
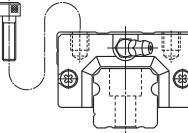
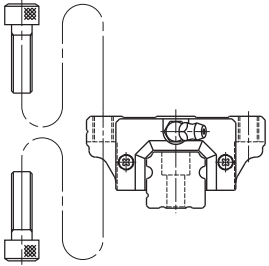
Series	Model	Category/appearance	Slide shape code	Shape/installation method	Rolling element contact structure/ Load direction, capacity
General Purpose Series	NH	 <p>High vertical load carrying capacity Self-aligning</p>	AN BN		<p>Rolling element: ball</p>  
			AL BL		
			EM GM		




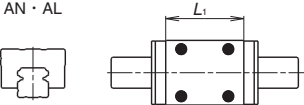
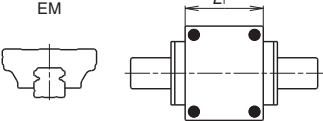
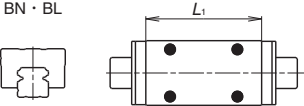
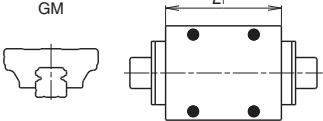
Rigidity: ☆, Extremely high; ◎, High; ○, Medium; ○, Low

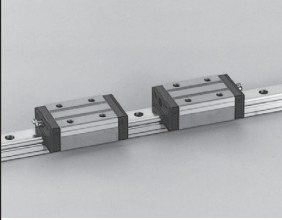
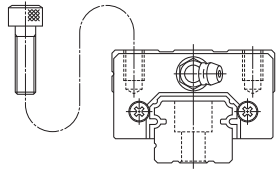
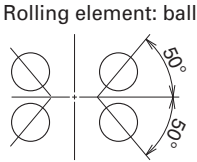
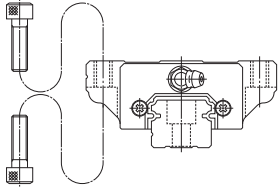
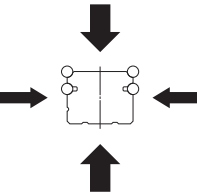
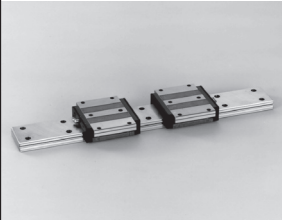
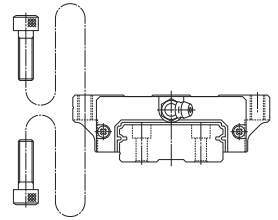
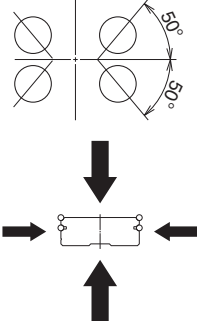
Friction: ◎, Low; ○, Normal

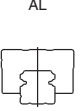
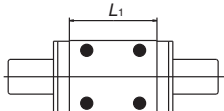
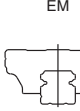
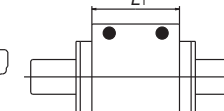
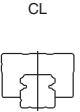
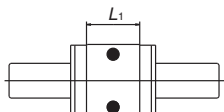

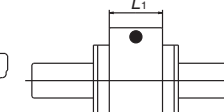
Ease of installation: ◎, Good; ○, Fair

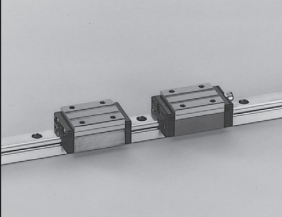
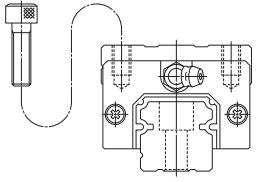
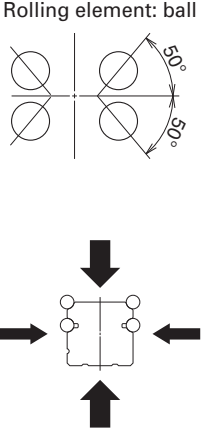
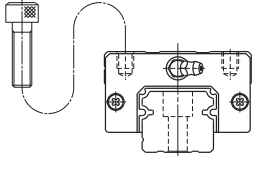
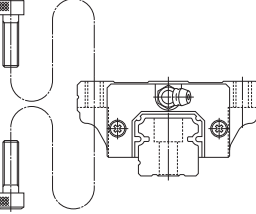
Features	Characteristics	Applications	Page
<p>Rigidity: ◎</p> <p>Friction: ◎</p> <p>Ease of installation: ◎</p>	<p>The NH model is applicable across a wide range, from general industrial use to high-accuracy applications. Interchangeable rails and ball slides are standard.</p> <ul style="list-style-type: none"> ● The contact angle between the ball and ball groove is set at 50 degrees. This design increases the load carrying capacity against vertical directions, which is the main load acting direction in most operations. ● The DF contact structure greatly absorbs installation error in the perpendicular direction to the rail. ● Balls make contact at two points thanks to the offset Gothic arch groove. This keeps friction to a minimum. ● High resistance against shock load due to the unique load-carrying structure. ● Gothic arch groove makes measuring of grooves accurate and easy. ● Rails and slides can be purchased separately in the standard interchangeable lineup. ● Stainless steel standard is also available for small sizes (NH15 to NH30). 	<ul style="list-style-type: none"> • Cartesian type robots • Robots that remove plastic molds from injection machine • Material handling equipment • Food processing machines • Packaging/packing machines • Printing machines • Woodworking machines • Paper manufacturing machines • Measuring equipment • Inspecting equipment • Semiconductor manufacturing equipment • Flat panel display manufacturing equipment • Medical equipment • Electric discharge machines • Laser cutting machines • Press machines • Tool grinders • Flat surface grinders • NC lathes • Machining centers • Automatic tool changers 	A127
<p>High-load types</p> <p>AN · AL</p>  <p>EM</p> 	<p>Super-high-load types</p> <p>BN · BL</p>  <p>GM</p> 		




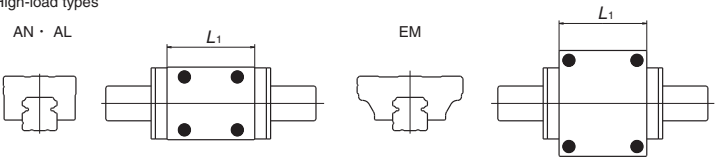
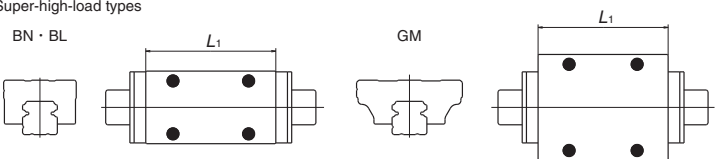
Series	Model	Category/appearance	Slide shape code	Shape/installation method	Rolling element contact structure/ Load direction, capacity
General Purpose Series	High-resistant VH	 <p>High vertical load carrying capacity Self-aligning</p>	AN BN		<p>Rolling element: ball</p> 
			AL BL		
			EM GM		

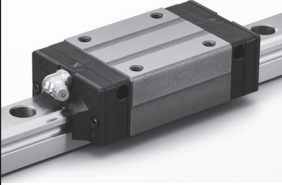
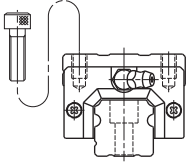
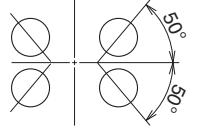
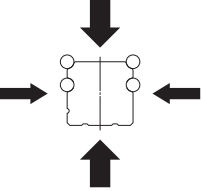
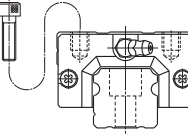
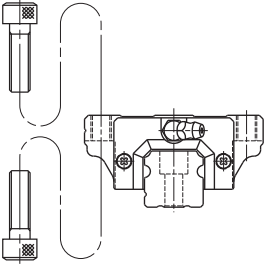
Features	Characteristics	Applications	Page
<p>Rigidity: </p> <p>Friction: </p> <p>Ease of installation: </p>	<p>The VH model delivers outstanding dust-resistant functionality and thus ensures long operating life under contaminated environments. Interchangeable rails and ball slides are standard.</p> <ul style="list-style-type: none"> ● The contact angle between the ball and the raceway is set at 50 degrees. This design increases the load carrying capacity against vertical directions, which is the main load acting direction in most operations. ● The DF contact structure greatly absorbs installation error in the perpendicular direction to the rail. ● Thanks to the offset Gothic arch groove, balls make contact at two points. This keeps friction to a minimum. ● High resistance against shock load due to the unique load carrying structure. ● Gothic arch groove makes measuring grooves accurate and easy. ● Rails and slides can be purchased separately in the standard interchangeable lineup. ● Penetration of fine contaminants has been reduced by 90% or more. ● Operating life under contaminated environments is more than 5 times longer. 	<ul style="list-style-type: none"> • Automotive manufacturing equipment • Press machines • Machine tools loader/un-loader • Tire molding machines • Woodworking machines • Automatic doors 	A127
<p>High-load types AN · AL</p>  <p>EM</p> 	<p>Super-high-load types BN · BL</p>  <p>GM</p> 		





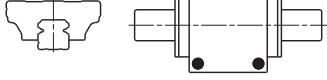
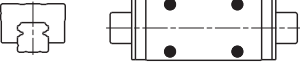
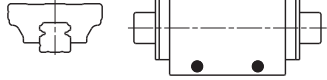
Series	Model	Category/appearance	Slide shape code	Shape/installation method	Rolling element contact structure/ Load direction, capacity
General Purpose Series	NS	<p>High vertical load carrying capacity Self-aligning</p> 	AL CL		<p>Rolling element: ball</p> 
			EM JM		
	LW	<p>High vertical load carrying capacity High moment capacity</p> 	EL		<p>Rolling element: ball</p> 

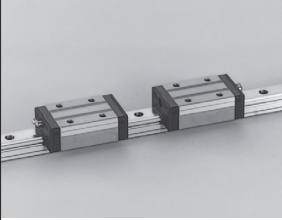
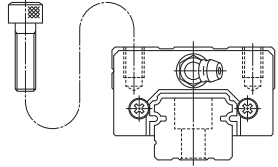
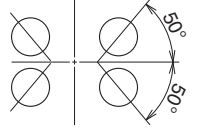
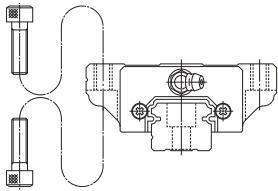
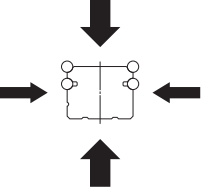
Features	Characteristics	Applications	Page
<p>Rigidity: ○</p> <p>Friction: ○</p> <p>Ease of installation: ○</p>	<p>The NS model is low in height and is applicable across a wide range, from general industrial use to high-accuracy applications. Interchangeable rails and ball slides are standard.</p> <ul style="list-style-type: none"> ● Compact and low profile. ● The contact angle between the ball and the groove is set at 50 degrees. This design increases the load carrying capacity against vertical directions, which is the main load direction prevalent in most operations. ● The DF contact structure greatly absorbs installation error in the perpendicular direction of the rail. ● Thanks to the offset Gothic arch groove, balls make contacts at two points. This keeps friction to a minimum. ● High resistance against shock load due to the unique load carrying structure. ● Gothic arch groove makes measuring grooves accurate and easy. ● Rails and slides can be purchased separately in the standard interchangeable lineup. ● Stainless steel is also available. 	<ul style="list-style-type: none"> • Cartesian robots • Robots that remove plastic molds from injection machine • Material handling equipment • Food processing machines • Packaging/packing machines • Printing machines • Woodworking machines • Paper manufacturing machines • Measuring equipment • Inspection equipment • Semiconductor manufacturing equipment • Flat panel display manufacturing equipment • Medical equipment • Electric discharge machines • Laser cutting machines • Press machines 	A147
	<p>High-load types</p> <p>AL   EM  </p> <p>Medium-load types</p> <p>CL   JM  </p>	<p>High-moment rigidity and low profile products are most suited for a single rail linear guideway system. Interchangeable rails and ball slides are standard.</p> <ul style="list-style-type: none"> ● The wide rail contributes to a high rolling moment carrying capacity and to great moment rigidity of a single rail linear guideway system. ● Balls contact at two points in the Gothic arch groove, thus keeping friction to a minimum. ● High resistance against shock load ● Rails and slides can be purchased separately in the standard interchangeable lineup. 	<ul style="list-style-type: none"> • Semiconductor manufacturing equipment • Flat panel display manufacturing equipment • Conveyor systems • Medical equipment • Microscope XY stages


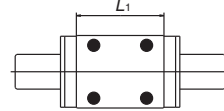

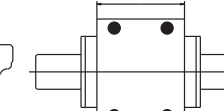

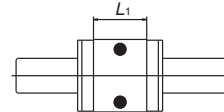

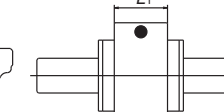
Series	Model	Category/appearance	Slide shape code	Shape/installation method	Rolling element contact structure/ Load direction, capacity
Long-Life Series	DH	<p>High vertical load carrying capacity Self-aligning</p> 	AN BN		<p>Rolling element: ball</p> 
			AL BL		
			EM GM		


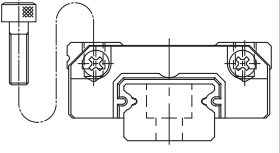
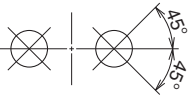
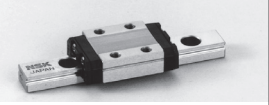
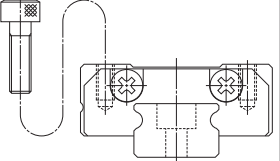
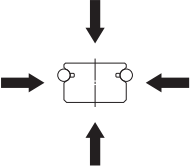

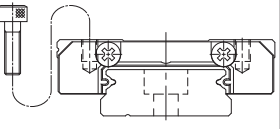
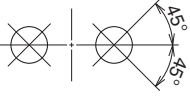

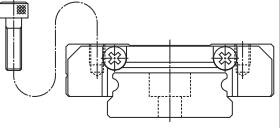
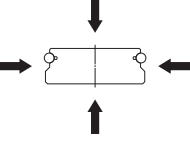

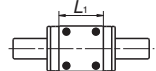
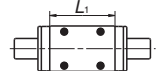
Features	Characteristics	Applications	Page
<p>Rigidity: </p> <p>Friction: </p> <p>Ease of installation: </p>	<p>The DH model is applicable across a wide range, from general industrial use to high accuracy applications.</p> <ul style="list-style-type: none"> ● The contact angle between the ball and ball groove is set at 50 degrees. This design increases the load carrying capacity against the vertical directions, which is the main load acting direction in most operations. ● Applying our special TF heat treatment, life is doubled compared to NH model. ● The DF contact structure greatly absorbs the installation error in the perpendicular direction to the rail. ● Balls make contact at two points thanks to the offset Gothic arch groove. This keeps friction to a minimum. ● A High resistance against shock load due to the unique load-carrying structure. ● Gothic arch groove makes measuring of grooves accurate and easy. 	<ul style="list-style-type: none"> • Cartesian type robots • Robots that remove plastic molds from injection machine • Material handling equipment • Printing machines • Woodworking machines • Paper manufacturing machines • Semiconductor manufacturing equipment • Flat panel display manufacturing equipment • Electric discharge machines • Laser cutting machines • Press machines • Tool grinders • Flat surface grinders • NC lathes • Machining centers • Automatic tool changers 	A183
<p>High-load types</p> <p>AN · AL EM</p>  <p>Super-high-load types</p> <p>BN · BL GM</p> 			


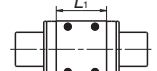

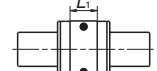
Series	Model	Category/appearance	Slide shape code	Shape/installation method	Rolling element contact structure/ Load direction, capacity
Long-Life Series	High-resistant DV	 <p>High vertical load carrying capacity Self-aligning</p>	AN BN		<p>Rolling element: ball</p>  
			AL BL		
			EM GM		

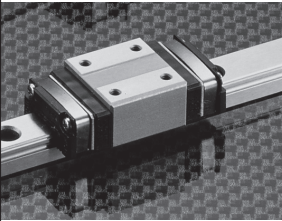
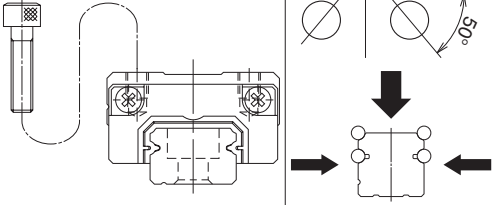
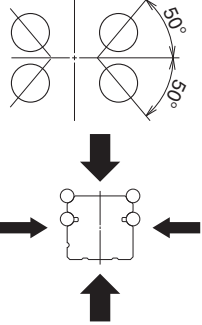
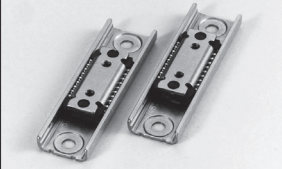
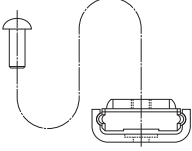
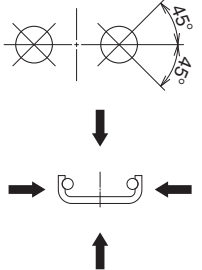
Features	Characteristics	Applications	Page
<p>Rigidity: </p> <p>Friction: </p> <p>Ease of installation: </p>	<p>The VH model delivers outstanding dust-resistant functionality and thus ensures long operating life under contaminated environments.</p> <ul style="list-style-type: none"> ● Applying our special TF heat treatment, life is doubled compared to VH model. ● The contact angle between the ball and the raceway is set at 50 degrees. This design increases the load carrying capacity against vertical directions, which is the main load acting direction in most operations. ● The DF contact structure greatly absorbs installation error in the perpendicular direction to the rail. ● Thanks to the offset Gothic arch groove, balls make contact at two points. This keeps friction to a minimum. ● High resistance against shock load due to the unique load carrying structure. ● Gothic arch groove makes measuring grooves accurate and easy. ● Penetration of fine contaminants has been reduced by 90% or more. ● Operating life under contaminated environments is more than 5 times longer. 	<ul style="list-style-type: none"> • Automotive manufacturing equipment • Press machines • Machine tools loader/un-loader • Tire molding machines • Woodworking machines • Automatic doors 	A203
<p>High-load types AN · AL</p>  <p>EM</p>  <p>Super-high-load types BN · BL</p>  <p>GM</p> 			







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

Features	Characteristics	Applications	Page
<p>Rigidity: ○</p> <p>Friction: ○</p> <p>Ease of installation: ○</p>	<p>The DS model is low in height and is applicable across a wide range, from general industrial use to high-accuracy applications.</p> <ul style="list-style-type: none"> ● Applying our special TF heat treatment, life is doubled compared to DS model. ● Compact and low profile. ● The contact angle between the ball and the groove is set at 50 degrees. This design increases the load carrying capacity against vertical directions, which is the main load direction prevalent in most operations. ● The DF contact structure greatly absorbs installation error in the perpendicular direction of the rail. ● Thanks to the offset Gothic arch groove, balls make contacts at two points. This keeps friction to a minimum. ● High resistance against shock load due to the unique load carrying structure. ● Gothic arch groove makes measuring grooves accurate and easy. 	<ul style="list-style-type: none"> • Cartesian robots • Robots that remove plastic molds from injection machine • Material handling equipment • Printing machines • Woodworking machines • Paper manufacturing machines • Semiconductor manufacturing equipment • Flat panel display manufacturing equipment • Electric discharge machines • Laser cutting machines • Press machines 	A221
	<p>High-load types</p> <p>AL   EM  </p> <p>Medium-load types</p> <p>CL   JM  </p>		

Series	Model	Category/appearance	Slide shape code	Shape/installation method	Rolling element contact structure/ Load direction, capacity		
Miniature Series	PU	Four-way equal load carrying capacity/Standard 	AL TR UR BL		Rolling element: ball 		
	LU	Four-way equal load carrying capacity/Standard 	AL TL AR TR BL UL				
	PE	Four-way equal load carrying capacity/High moment capacity 	AR TR UR BR		Rolling element: ball 		
	LE	Four-way equal load carrying capacity/High moment capacity 	AL TL AR TR BL UL CL SL				
		Standard types	High-load types				
		PU · LU	AL · TL · AR · TR	BL · UL · UR			
							

Features	Characteristics	Applications	Page		
Rigidity: ○ Friction: ○ Ease of installation: ○	Low inertia and low dust generation miniature model. ● Low dust generation and highly smooth operation ● Super-compact size ● Stainless steel is the standard material. ● A ball retainer is standard equipment. ● Rails and slides can be purchased separately in the standard interchangeable lineup.	● Semiconductor manufacturing equipment ● Flat panel display manufacturing equipment ● Medical equipment ● Optical stages ● Microscope XY stages ● Conveying system of optical fibers	A241		
Rigidity: ○ Friction: ○ Ease of installation: ○	Miniature model ● Extremely compact size ● Stainless steel is the standard material. ● A ball retainer is standard equipment. ● Rails and slides can be purchased separately in the standard interchangeable lineup.	● Miniature robots ● Computer peripherals ● Pneumatic equipment	A251		
Rigidity: ○ Friction: ○ Ease of installation: ○	Wide rail miniature with low inertia and low dust generation. ● Low dust generation and highly smooth operation ● Super-compact size ● Stainless steel is the standard material. ● A ball retainer is standard equipment. ● Rails and slides can be purchased separately in the standard interchangeable lineup.	● Semiconductor manufacturing equipment ● Flat panel display manufacturing equipment ● Medical equipment ● Optical stages ● Microscope XY stages ● Conveying system of optical fibers	A263		
Rigidity: ○ Friction: ○ Ease of installation: ○	Miniature wide model ● Super-small size in wide rail type ● Stainless steel is the standard material. ● A ball retainer is standard equipment. ● Rails and slides can be purchased separately in the standard interchangeable lineup.	● Miniature robots ● Computer peripherals ● Pneumatic equipment	A273		
		Standard types	High-load types	Medium-load types	
		PE · LE	AL · TL · AR · TR	BL · UL · BR · UR	CL · SL (LE only)
					

Series	Model	Category/appearance	Slide shape code	Shape/installation method	Rolling element contact structure/ Load direction, capacity
Miniature Series	LH	High vertical load carrying capacity Self-aligning 	AN		Rolling element: ball 
	LL	Four-way equal load carrying capacity/Standard 	PL		Rolling element: ball 

Features	Characteristics	Applications	Page
<p>Rigiidity: </p> <p>Friction: </p> <p>Ease of installation: </p>	<p>High vertical load carrying capacity and selfaligning miniature model</p> <ul style="list-style-type: none"> ● The contact angle between the ball and ball groove is set at 50 degrees. This design increases the load carrying capacity against vertical directions, which is the main load acting direction in most operations. ● The DF contact structure greatly absorbs installation error in the perpendicular direction to the rail. ● Balls make contact at two points thanks to the offset Gothic arch groove. This keeps friction to a minimum. ● High resistance against shock load due to the unique load-carrying structure. ● Gothic arch groove makes measuring of ball grooves accurate and easy. ● A ball retainer is standard equipment. (LH10~12) ● Stainless steel type is standard. 	<ul style="list-style-type: none"> • Semiconductor manufacturing equipment • Flat panel display manufacturing equipment • Medical equipment • Optical stages • Microscope XY stages • Miniature robots • Computer peripherals • Pneumatic equipment 	A287
<p>Rigiidity: </p> <p>Friction: </p> <p>Ease of installation: </p>	<p>The LL model is a compact and lightweight miniature linear guide for press molding.</p> <ul style="list-style-type: none"> ● Rails and ball slides are made of thin steel plate, and thus making them very light. ● Stainless steel is the standard material. 	<ul style="list-style-type: none"> • Platter pen heads • Robot hands • Pneumatic equipment 	A297

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

Features	Characteristics	Applications	Page
Rigidity: ☆ Friction: ◎ Ease of installation: ◎	RA model roller guides have realized the world's highest load capacity. Super-high rigidity and smooth motion contribute to higher performance of machine tools. <ul style="list-style-type: none"> ● Unique and optimum design of rollers and other components facilitates high-load capacity and high rigidity. ● The installation of a retaining piece achieves smooth motion. ● Rails and slides can be purchased separately in the standard interchangeable lineup. ● Also available dust-resistant V1 end seals with enhanced abrasion resistance (RA25~65). 	<ul style="list-style-type: none"> • Machining centers • NC lathes • Heavy cutting machine tools • Gear cutters • Electric discharge machines • Press machines • Various types of grinders 	A303
Rigidity: ☆ Friction: ◎ Ease of installation: ◎	With low mounting height, the RB model is effective for compact machine design, while maintaining the load capacity of the RA model. <ul style="list-style-type: none"> ● Unique and optimum design of rollers and other components facilitates high-load capacity and high rigidity. ● The installation of a retaining piece achieves smooth motion. 	<ul style="list-style-type: none"> • Machining centers • NC lathes • Heavy cutting machine tools • Gear cutters • Electric discharge machines • Press machines • Various types of grinders 	A325

Series	Model	Category/appearance	Slide shape code	Shape/installation method	Rolling element contact structure/ Load direction, capacity
High-rigidity series	LA	Four-way equal load carrying capacity/Super rigid	AN BN		Rolling element: ball
			AL BL		
			EL GL		
			FL HL		
High-accuracy series	HA	Four-way equal load carrying capacity/Super rigid/ High accuracy	AN		Rolling element: ball
			AL		
			EM		

Features	Characteristics	Applications	Page
Rigidity: Friction: Ease of installation:	The LA model provides top class high-load capacity for ball linear guides. This model is most suited for machine tools. ● The contact angle between the ball and the raceway is set at 45 degrees. This makes load carrying capacity and rigidity equal in vertical and lateral directions. ● Six-row ball grooves support the load from vertical and lateral directions, enhancing rigidity and increasing load carrying capacity. ● Appropriate friction ● Best suited for machine tools.	<ul style="list-style-type: none"> • Machining centers • NC lathes • Heavy cutting machine tools • Gear cutters • Electric discharge machines • Press machines • Various types of grinders 	A341
	High-load types AN · AL EL · FL Super-high-load types BN · BL GL · HL		
Rigidity: Friction: Ease of installation:	HA Model ball guide with high-precision and high-load carrying capacity, featuring highmotion accuracy equivalent to hydrostatic linear bearings. ● Ball passage vibration has been reduced to one-third that of conventional models thanks to ultra-long ball slides and new design specifications. ● The contact angle between the ball and the raceway is set at 45 degrees. This makes load carrying capacity and rigidity equal in vertical and lateral directions. ● High motion accuracy is realized by a superfinished ball groove (optional). ● End seals, bottom seals, and inner seals of highly dust-resistant specifications are standard equipment. ● Contributes to higher quality machined surfaces.	<ul style="list-style-type: none"> • Die molding machines • High precision processing machine • Heavy cutting machine tools • Gear cutters • Press machines • Various types of NC grinders 	A361
	AN · AL EM		

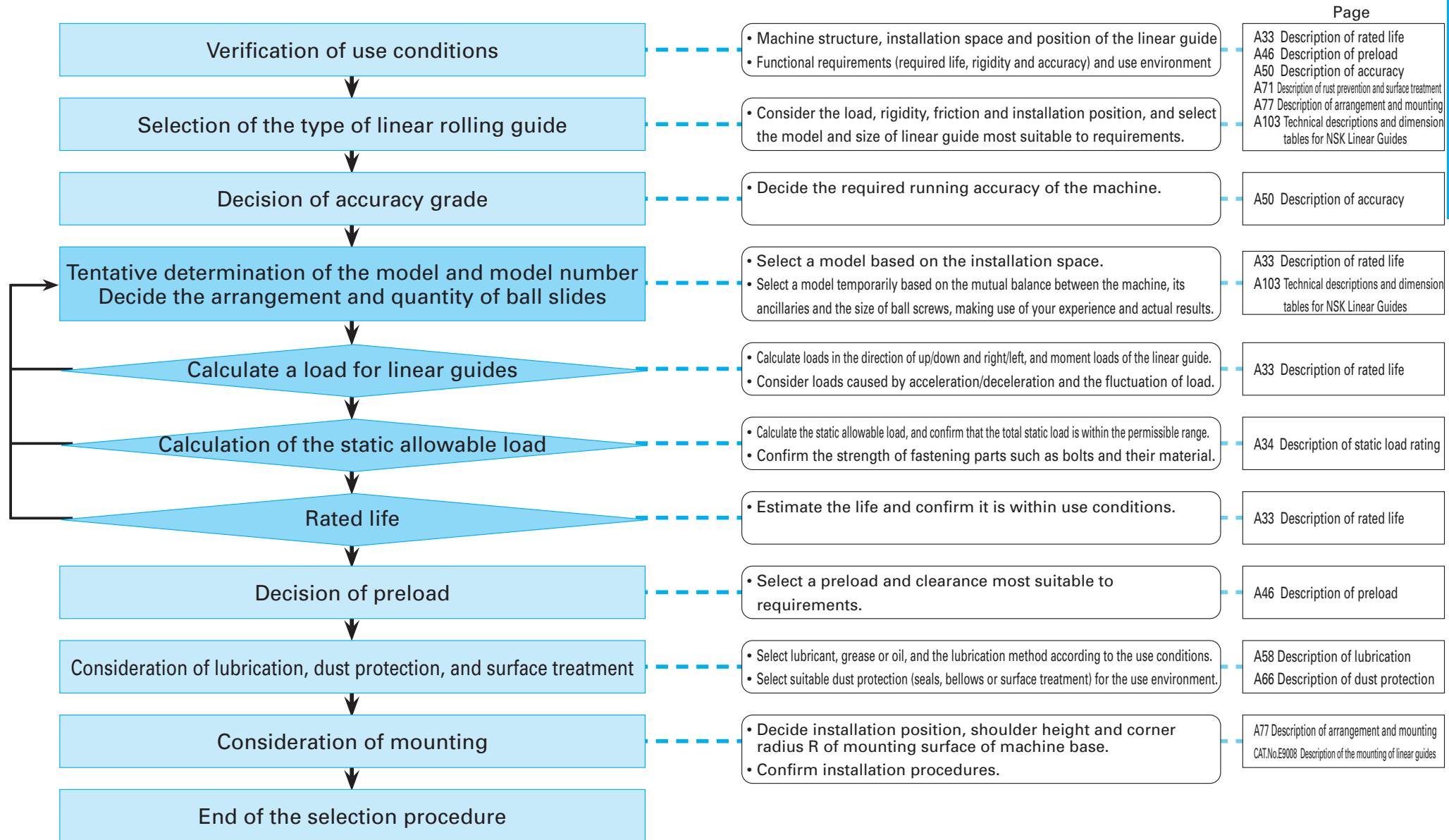
Series	Model	Category/appearance	Slide shape code	Shape/installation method	Rolling element contact structure/ Load direction, capacity
High-accuracy series	HS	High vertical load carrying capacity Self-aligning/High accuracy	AL		Rolling element: ball
			EM		

Features	Characteristics	Applications	Page
<p>Rigidity: </p> <p>Friction: </p> <p>Ease of installation: </p>	<p>HS Model ball guide with high-precision featuring high-motion accuracy equivalent to hydrostatic linear bearings.</p> <ul style="list-style-type: none"> ● Ball passage vibration has been reduced to one-third that of conventional models thanks to ultra-long ball slides and new design specifications. ● The contact angle between the ball and the raceway is set at 50 degrees. The load carrying capacity against vertical directions, which is the main load acting direction in most operations, increases by this design. ● The DF contact structure greatly absorbs installation error in the perpendicular direction of the rail. ● Thanks to the offset Gothic arch groove, balls make contact at two points, thus keeping friction low. 	<ul style="list-style-type: none"> • High precision processing machines • Electric discharge machines • Various types of NC grinders • Flat panel display manufacturing equipment 	A375

A-3 Selection of NSK Linear Rolling Guides

A-3-1 Selection Flow Chart

The flow chart below shows the basic steps for selection.



A-3-2 Rating Life and Basic Load Rating

A-3-2.1 Life and Basic Load Rating

1. Life

Although used in appropriate conditions, the linear guide deteriorates after a certain period of operation, and eventually becomes unusable. Broadly, this period until the linear guide becomes unusable is called "life." There is also "fatigue life" caused by flaking, and "accuracy life" resulting from wear of components.

2. Rating fatigue life

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

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

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

3. Basic load ratings in compliance with ISO standard

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

The basic load ratings listed in "A-4 Technical Descriptions and Dimension Table for NSK Linear Guides" comply with the ISO standard.

ISO: International Organization for Standardization

[Basic dynamic load ratings]

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

Part 1: Dynamic load ratings and rating life

[Basic static load ratings]

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

Part 2: Static load ratings

4. Basic dynamic load rating

- ISO international standard basic dynamic load rating, which indicates load carrying capacity of the linear guide, is a load whose direction and volume do not change, and which furnishes 100 km of rating fatigue life.
- In case of the linear guides, it is a constant load applied downward to the center of the slide.
- For balls as rolling elements, some linear guide manufacturers in Japan and Asian countries define the load for the basic fatigue life of 50 km as the basic dynamic load rating.

- The following formula may be used to convert the basic dynamic load rating for 50 km (C_{50}) into the dynamic load rating for 100 km (C_{100}) rated fatigue life.

$$C_{100} = \frac{C_{50}}{1.26}$$

$$C_{100} = \frac{C_{50}}{1.23}$$

5. Calculation of rating fatigue life

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

[For balls as rolling elements] The third power of the index.

For the basic dynamic load rating for 100 km

$$L = 100 \times \left(\frac{C_{100}}{F} \right)^3$$

For the basic dynamic load rating for 50 km

$$L = 50 \times \left(\frac{C_{50}}{F} \right)^3$$

[For rollers as rolling elements] The ten third power of the index.

For the basic dynamic load rating for 100 km

$$L = 100 \times \left(\frac{C_{100}}{F} \right)^{\frac{10}{3}}$$

For the basic dynamic load rating for 50 km

$$L = 50 \times \left(\frac{C_{50}}{F} \right)^{\frac{10}{3}}$$

L ; Rating fatigue life (km)

C_{100} ; Basic dynamic load rating for 100 km rated fatigue life (N)

C_{50} ; Basic dynamic load rating for 50 km rated fatigue life (N)

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

6. Dynamic equivalent load

- Loads applied to the linear guide (slide load) come from various directions up/down and right/left and/or as moment loads. Sometimes more than one type of load is applied simultaneously. Sometimes the volume and direction of the load may change.

Various loads cannot be used as they are to calculate the life of the linear guide. Therefore, it is necessary to use a hypothetical load on the slide with a constant volume, which would generate a value equivalent to an actual fatigue life. This is called "dynamic equivalent load." For actual calculations, refer to "A-3-2.2 3. Calculation of dynamic equivalent load"

7. Basic static load rating

- When an excessive load or a momentary large impact is applied to the linear guide, local permanent deformation takes place on the rolling elements and on the rolling contact surfaces. After exceeding a certain level, the deformation hampers smooth linear guide operation.
- Basic static load rating is a static load when: [Permanent deformation of the rolling elements] + [permanent deformation of the rolling contact surfaces] becomes approximately 0.0001 times of the rolling element diameter.
- In the case of linear guides, it is a load which is applied in downward direction to the center of the slide.
- Values of basic static load rating C_0 are shown in "A-4 Technical Descriptions and Dimension Tables for NSK Linear Guides."

8. Basic static moment load rating

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

" M_0 ," which is the limit of static moment load, and calculated from permanent deformation in such use is shown in "A-4 Technical Descriptions and Dimension Tables for NSK Linear Guides."

9. Basic load rating by load direction

- The basic load rating is considered to be a downward load to the slide and is indicated in the dimension tables as the dynamic load rating C and the static load rating C_0 respectively. However, the load may be applied to a slide in upward or lateral directions in actual use. As shown in Table 2.1. For example, basic dynamic/static load ratings for RA, LA, etc. models are the same regardless of load direction, whereas the load ratings for NH, NS, etc. models differ based on direction as shown.

Table 2.1 Basic load ratings by load direction

Model	Load rating Load direction			Basic dynamic load rating			Basic static load rating		
	Downward	Upward	Lateral	Downward	Upward	Lateral	Downward	Upward	Lateral
NH, VH, NS, LW, DH, DS, DV, LH, HS	C	C	0.84C	C_0	0.78 C_0	0.65 C_0			
PU, LU, PE, LE, LL, RA, RB, LA, HA	C	C	C	C_0	C_0	C_0			

A-3-2.2 How to Calculate the Life

1. Setting operating condition of linear guide

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

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

2. Calculating load to a slide

- **Table 2.2** shows a formula to calculate loads applied to each assembled slide in a machine. The Table shows six typical patterns of linear guide installation.

- In the Tables, directions indicated by arrows denote "plus" for the applied loads (F_{xr} , F_{yr} , F_{zk}) and the loads which are applied to the slides. (F_{sr} , M_r , M_{pr} , M_y)

- Codes in the Tables are as follows:

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

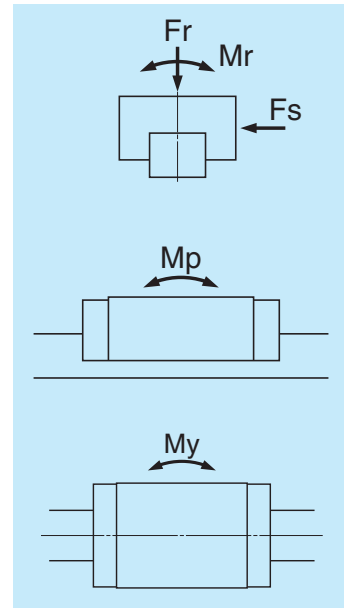


Fig. 2.1

Table 2.2 Loads applied to the slides

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

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

5	<p>Center of driving mechanism (X_b, Y_b, Z_b)</p> <p>Center line of driving mechanism</p>	$Fr_1 = \frac{\sum_{k=1}^n F_{Zk}}{6} + \frac{M_1}{3L} + \frac{M_2}{2l}, \quad Fr_2 = \frac{\sum_{k=1}^n F_{Zk}}{6} + \frac{M_1}{3L}$ $Fr_3 = \frac{\sum_{k=1}^n F_{Zk}}{6} + \frac{M_1}{3L} - \frac{M_2}{2l}, \quad Fr_4 = \frac{\sum_{k=1}^n F_{Zk}}{6} - \frac{M_1}{3L} + \frac{M_2}{2l}$ $Fr_5 = \frac{\sum_{k=1}^n F_{Zk}}{6} - \frac{M_1}{3L}, \quad Fr_6 = \frac{\sum_{k=1}^n F_{Zk}}{6} - \frac{M_1}{3L} - \frac{M_2}{2l}$ $Fs_1 = Fs_4 = \frac{\sum_{j=1}^n F_{Yj}}{6} + \frac{M_3}{2l}, \quad Fs_2 = Fs_5 = \frac{\sum_{j=1}^n F_{Yj}}{6}$ $Fs_3 = Fs_6 = \frac{\sum_{j=1}^n F_{Yj}}{6} - \frac{M_3}{2l}$ $M_1 = \sum_{j=1}^n (F_{Yj} \cdot Z_j) + \sum_{k=1}^n (F_{Zk} \cdot Y_{ck})$ $M_2 = \sum_{i=1}^n \{F_{X_i} \cdot (Z_{xi} - Z_b)\} + \sum_{k=1}^n (F_{Zk} \cdot X_{ck})$ $M_3 = -\sum_{i=1}^n \{F_{X_i} \cdot (Y_{xi} - Y_b)\} + \sum_{j=1}^n (F_{Yj} \cdot X_{yj})$ $\delta x = Y_d \cdot \frac{Fs_3 - Fs_1}{l \cdot K_s} + Z_d \cdot \frac{Fr_1 - Fr_3}{l \cdot Kr}$ $\delta y = \frac{\sum_{j=1}^n F_{Yj}}{6 \cdot K_s} + X_d \cdot \frac{Fs_1 - Fs_3}{l \cdot K_s} + Z_d \cdot \frac{Fr_1 - Fr_4}{l \cdot Kr}$ $\delta z = \frac{\sum_{k=1}^n F_{Zk}}{6 \cdot Kr} + X_d \cdot \frac{Fr_1 - Fr_3}{l \cdot Kr} + Y_d \cdot \frac{Fr_1 - Fr_4}{l \cdot Kr}$
---	---	---

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

3. Calculation of dynamic equivalent load

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

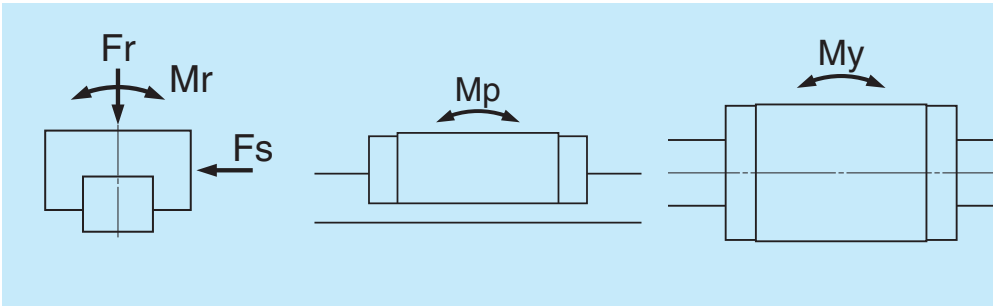


Fig. 2.2

Table 2.3 Loads by arrangement

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

- Use the dynamic equivalent coefficient ϵ in the table below for an easy conversion of moment loads to the dynamic equivalent load.
- The coefficient of each moment direction is as follows.
 - ϵ_r : Rolling direction
 - ϵ_p : Pitching direction
 - ϵ_y : Yawing direction

Table 2.4 Dynamic equivalent coefficients

Unit: 1/m

Model No.	ϵ_r	ϵ_p	ϵ_y	Model No.	ϵ_r	ϵ_p	ϵ_y	Model No.	ϵ_r	ϵ_p	ϵ_y
NH15	188	111	132	DH45L	60	30	36	LE12	90	125	125
NH15L	188	72	86	DH55	51	31	37	LE12S	90	233	233
NH20	142	81	97	DH55L	51	25	30	LE12L	90	86	86
NH20L	142	57	68	DH65	43	27	32	LE15	50	102	102
NH25	123	68	81	DH65L	43	20	24	LE15S	50	174	174
NH25L	123	51	61	DV15	188	111	132	LE15L	50	68	68
NH30A	98	70	83	DV15L	188	72	86	LH08	316	269	321
NH30E	98	58	69	DV20	142	81	97	LH10	253	203	242
NH30L	98	44	52	DV20L	142	57	68	LH12	223	136	162
NH35	78	51	61	DV25	123	68	81	RA15	105	95	95
NH35L	78	36	43	DV25L	123	51	61	RA15L	105	70	70
NH45	60	38	45	DV30A	98	70	83	RA20	79	74	74
NH45L	60	30	36	DV30E	98	58	69	RA20L	79	55	55
NH55	51	31	37	DV30L	98	44	52	RA25	71	64	64
NH55L	51	25	30	DV35	78	51	61	RA25L	71	50	50
NH65	43	27	32	DV35L	78	36	43	RA30	56	58	58
NH65L	43	20	24	DV45	60	38	45	RA30L	56	44	44
VH15	188	111	132	DV45L	60	30	36	RA35	46	52	52
VH15L	188	72	86	DV55	51	31	37	RA35L	46	39	39
VH20	142	81	97	DV55L	51	25	30	RA45	37	40	40
VH20L	142	57	68	DS15	177	116	138	RA45L	37	30	30
VH25	123	68	81	DS15S	177	174	208	RA55	32	33	33
VH25L	123	51	61	DS20	127	94	112	RA55L	32	24	24
VH30A	98	70	83	DS20S	127	136	162	RA65	26	28	28
VH30E	98	58	69	DS25	111	70	83	RA65L	26	19	19
VH30L	98	44	52	DS25S	111	108	129	RB30	56	58	58
VH35	78	51	61	DS30	94	63	75	RB30L	56	44	44
VH35L	78	36	43	DS30S	94	102	121	RB35	46	52	52
VH45	60	38	45	DS35	76	54	64	RB35L	46	39	39
VH45L	60	30	36	DS35S	76	87	104	RB45	37	40	40
VH55	51	31	37	PU09	215	222	222	RB45L	37	30	30
VH55L	51	25	30	PU09L	215	136	136	RB55	32	33	33
NS15	177	116	138	PU12	163	204	204	RB55L	32	24	24
NS15S	177	174	208	PU12L	163	125	125	RB65	26	28	28
NS20	127	94	112	PU15	133	174	174	RB65L	26	19	19
NS20S	127	136	162	PU15L	133	102	102	LA25	122	76	76
NS25	111	70	83	LU05	385	359	359	LA25L	122	47	47
NS25S	111	108	129	LU07	286	305	305	LA30	105	63	63
NS30	94	63	75	LU09	217	242	242	LA30L	105	43	43
NS30S	94	102	121	LU09L	217	138	138	LA35	84	54	54
NS35	76	54	64	LU09R	217	203	203	LA35L	84	37	37
NS35S	76	87	104	LU12	167	204	204	LA45	60	41	41
LW17	66	125	149	LU12L	167	116	116	LA45L	60	31	31
LW21	59	108	129	LU15	133	174	174	LA55	51	33	33
LW27	53	76	91	LU15L	133	94	94	LA55L	51	26	26
LW35	32	51	61	PE09	123	161	161	LA65	43	29	29
LW50	25	38	46	PE09L	123	108	108	LA65L	43	20	20
DH15	188	111	132	PE12	90	136	136	HA25	122	33	33
DH15L	188	72	86	PE12L	90	90	90	HA30	105	27	27
DH20	142	81	97	PE15	50	111	111	HA35	84	23	23
DH20L	142	57	68	PE15L	50	72	72	HA45	60	20	20
DH25	123	68	81	LE05	196	248	248	HA55	51	16	16
DH25L	123	51	61	LE05S	196	323	323	HS15	177	45	54
DH30A	98	70	83	LE07	141	188	188	HS20	127	39	47
DH30E	98	58	69	LE07S	141	349	349	HS25	111	33	39
DH30L	98	44	52	LE07L	141	122	122	HS30	94	27	32
DH35	78	51	61	LE09	123	149	149	HS35	76	23	28
DH35L	78	36	43	LE09S	123	277	277				
DH45	60	38	45	LE09L	123	102	102				

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

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

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

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

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

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

4. Calculation of mean effective load

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

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

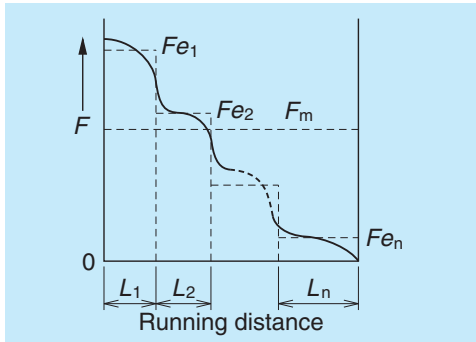


Fig. 2.3 Stepwise load change

- Running distance while full dynamic equivalent load F_{e1} is applied: L_1
- Running distance while full dynamic equivalent load F_{e2} is applied: L_2
- Running distance while full dynamic equivalent load F_{e3} is applied: L_3
-
- Running distance while full dynamic equivalent load F_{e_n} is applied: L_n

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

For balls:

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

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

L : Running distance (ΣL_n)

For rollers:

$$F_m = \sqrt[10]{\frac{1}{L} (F_{e1}^{10} L_1 + F_{e2}^{10} L_2 + \dots + F_{e_n}^{10} L_n)}$$

$\frac{10}{3}$

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

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

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

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

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

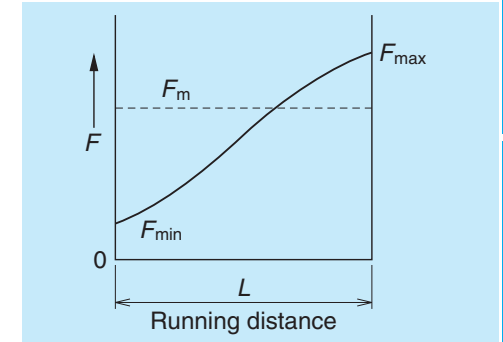


Fig. 2.4 Linear load change

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

(Fig. 2.5)

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

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

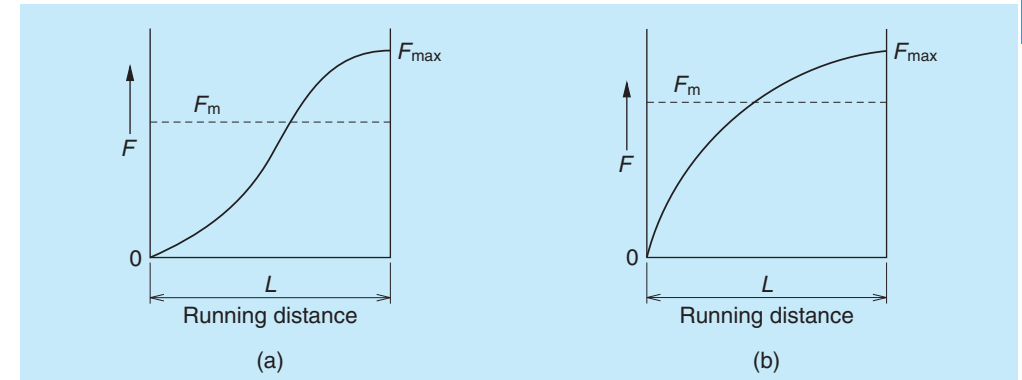


Fig. 2.5 Load that changes in a sinusoidal pattern

5. Various coefficients

(1) Load factors

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

Table 2.5 Load factor f_w

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

(2) Hardness coefficient

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

$C_H = f_H \cdot C$
 $C_{OH} = f_H' \cdot C_0$
 C_H : Basic dynamic load rating adjusted by hardness coefficient
 f_H : Hardness coefficient (Refer to Fig. 2.6)
 C_{OH} : Basic static load rating adjusted by hardness coefficient
 f_H' : Static hardness coefficient (Refer to Fig. 2.6)

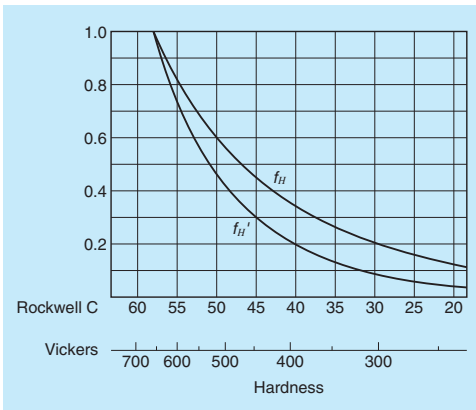


Fig. 2.6 Hardness coefficient

(3) Reliability coefficient

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

6. Calculation of rating life

(1) Life calculation formula

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

[For balls as rolling elements]
 For the basic dynamic load rating for 100 km

$$L = 100 \times \left(\frac{f_H \cdot C_{100}}{f_w \cdot F_m} \right)^3$$

For the basic dynamic load rating for 50 km

$$L = 50 \times \left(\frac{f_H \cdot C_{50}}{f_w \cdot F_m} \right)^3$$

[For rollers as rolling elements]
 For the basic dynamic load rating for 100 km

$$L = 100 \times \left(\frac{f_H \cdot C_{100}}{f_w \cdot F_m} \right)^{\frac{10}{3}}$$

For the basic dynamic load rating for 50 km

$$L = 50 \times \left(\frac{f_H \cdot C_{50}}{f_w \cdot F_m} \right)^{\frac{10}{3}}$$

 L : Rating fatigue life (km)
 C_{100} : Basic dynamic load rating for 100 km rated fatigue life (N)
 C_{50} : Basic dynamic load rating for 50 km rated fatigue life (N)
 f_H : Hardness coefficient
 f_w : Load coefficient
 F_m : Average load (N)

Note: Do not use the basic static load rating C_0 or basic static moment ratings M_{ro} , M_{po} or M_{yo} for calculations of life.

(2) Life as an entire guide way system

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

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

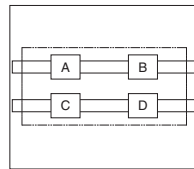


Fig. 2.7 Life of a system

7. Examination of the basic static load rating

(1) Considerations for the basic static load rating

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

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

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

For NH, VH, NS, LW, DH, DV, DS, LH, and HS Models:

If compressed load and lateral load are combined

$$P_0 = Fr + 1.54Fs$$

If tensile load and lateral load are combined

$$P_0 = 1.28Fr + 1.54Fs$$

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

$$P_0 = Fr + Fs$$

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

Table 2.6 Slides with balls as rolling elements

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

Table 2.7 Slides with rollers as rolling elements

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

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

(2) Considerations for static moment load rating

- Examine the static permissible moment load M_0 from the basic static moment load M_{po} and the static permissible load factor f_s .

$$f_s = \frac{M_{po}}{M_0}$$

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

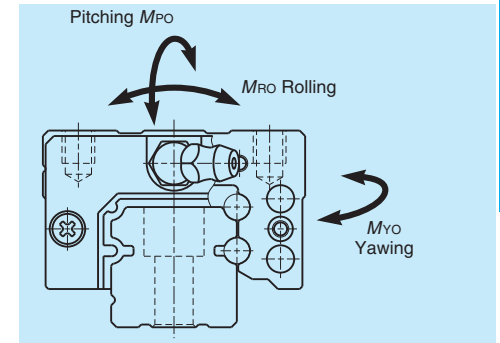


Fig. 2.8 Moment load directions

8. Design precautions regarding life

The following points must be heeded in examining life.



In case of oscillating motion

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



When applying pitching or yawing moments

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



When an extraordinary high load is applied during stroke

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



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

- In such cases, the contact pressure to the rolling elements and the rolling contact surface is extraordinarily high.
 - If the linear guides are operated under such states continually, their life is significantly affected by the loss of lubrication and the presence of dust, and thus the actual life becomes shorter than calculated.
 - Reduce load on the slides by reviewing the linear guide arrangement, the number of slides, and the model or Model No.
 - It is necessary to consider preload for calculation of rating life when selecting Z3 (medium preload) or Z4 (heavy preload) as a preload. For the calculation of full dynamic equivalent loads that consider preload, see "A-3-3 6" on page A49.
- (*) For DH, DV, and DS models, less than 6 000 km.



Application at high speed

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

A-3-3 Preload

1. Objective of preload

- Eliminating the clearance between the raceway and rolling elements allows mechanical play to be eliminated.
- When a preload is applied, the deformation of linear guides by external vertical load is further improved thus increasing the system stiffness.
- Preloading method
The preload is applied by inserting rolling elements slightly bigger than the space of two raceways as shown in Fig. 3.1.

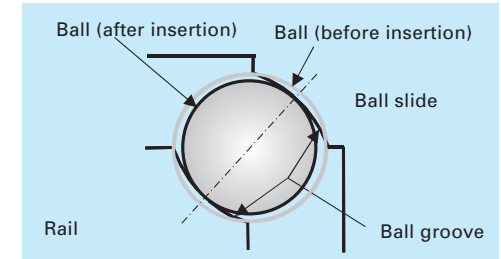


Fig. 3.1 Preloading method

2. Preload and rigidity

- In NSK linear guides, slight size changes of rolling elements, which are inserted in the slide, control the clearance and amount of preload.
- In NSK linear guides, rigidity is further increased and elastic deformation is reduced by applying preload.
- In general, the load range of ball guide system in which the preload is effective is about 2.8 times the preload (Fig. 3.2). For roller guide system, it becomes about 2.2 times the preload.
- Fig. 3.3 shows the relationship between ball slide deformation and external vertical load under a specified preload. NH35 is used as an example.
- The following show the definition of linear guide rigidity.
 - (1) Radial rigidity: Rigidity of vertical and lateral directions, up/down and right/left (Fig. 3.4).
 - (2) Moment rigidity: Three moment directions, pitching, rolling, and yawing (Fig. 3.5).

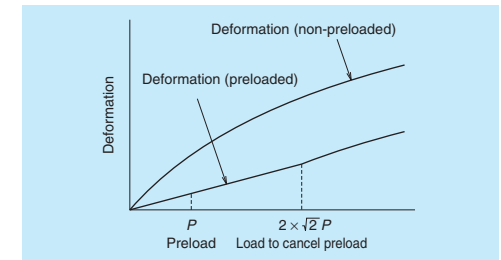


Fig. 3.2 Elastic deformation

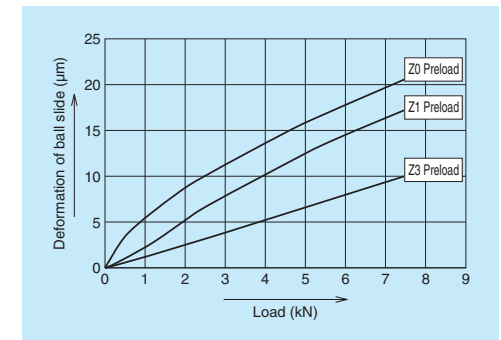


Fig. 3.3 Rigidity of NH35, downward direction load (example)

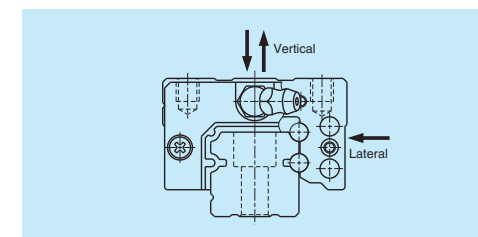


Fig. 3.4 Radial rigidity

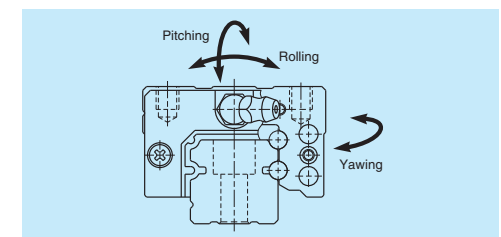


Fig. 3.5 Moment rigidity

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

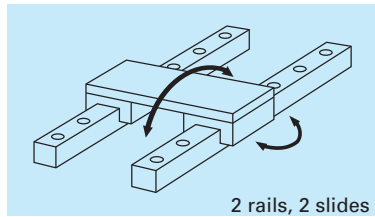


Fig. 3.6 Pitching and yawing direction

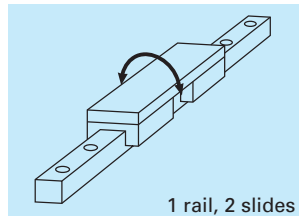


Fig. 3.7 Rolling direction

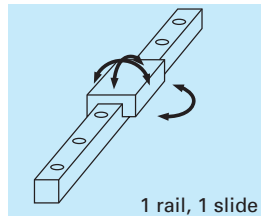


Fig. 3.8 All directions

3. Selection of preload classification

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

Table 3.1 Classification of preload by model

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

Table 3.2 Selection criteria for preload

Classification of preload	Use condition	Applications
Z0 and ZT (Fine clearance)	<ul style="list-style-type: none"> • A set of two parallel linear guides (four slides/two rails) is used to sustain a unidirectional load with low vibration and impact. • Accuracy is not very necessary but a friction force must be minimized. 	Welding machines, Glass processing machines, Packaging/packing machines, Materials handling equipment
Z1 and ZZ (Slight preload)	<ul style="list-style-type: none"> • Moment loads are applied. • Highly accurate operation. 	Industrial robots, Inspection/measuring equipment, Laser cutting machine, Electric discharge machines, PCB drillers, Chip mounters
Z3, ZH, and Z4 (Medium preload, Heavy preload)	<ul style="list-style-type: none"> • Extremely high stiffness is essential. • Vibration and impact load will be applied. 	Machining centers, Lathes, Milling machines, Boring machines, Grinders

4. Estimation of elastic deformation

Load and deformation have the following relationship:

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

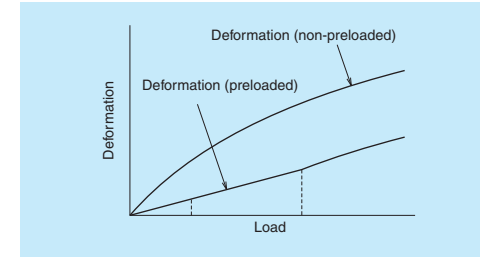


Fig. 3.9 Elastic deformation

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

<Required conditions to calculate deformation>

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

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

5. Application examples of preload

Table 3.3 shows typical NSK linear guide applications for the type of preload.

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

Table 3.3 Application examples of preload

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

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

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

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

For balls as rolling elements

$$F_{e_p} = P \left(1 + \frac{F_e}{2.83 \times P} \right)^{\frac{3}{2}}$$

P: Preload (N)

However, when the full dynamic equivalent load taking account of preload is larger than the load at which preload is removed, $F_{e_p} = F_e$.

For this case, preload is lost at $F_{p0} = 2^{\frac{3}{2}} P$

For rollers as rolling elements

$$F_{e_p} = P \left(1 + \frac{F_e}{2.16 \times P} \right)^{\frac{10}{9}}$$

P: Preload (N)

However, when the full dynamic equivalent load taking preload into account is larger than the load at which preload is removed, $F_{e_p} = F_e$.

For this case, preload is lost at $F_{p0} = 2^{\frac{10}{9}} P$

7. Calculating friction force by preload

- Dynamic friction force per one slide of the ball guide can be calculated from a preload value.
- The following is a simple calculation to obtain the criterion of dynamic friction force.

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

$$F = iP$$

F : Dynamic friction force (N)

P : Preload (N)

i : Contact coefficient

Use the following contact coefficient values (i).

NH, VH, NS, LW, DH, DV, DS, LH, and HS Models

: 0.004

LA and HA Models

: 0.010

PU, LU, PE, and LE Models

: 0.026

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

Calculation example

In case of NH35AN - Z3

$i = 0.004$

$P = 2\,350$ (N) (refer to NH model preload)

$F = iP$

$= 0.004 \times 2\,350 = 9.4$ (N)

Therefore, the criteria of the dynamic friction force of NH35AN - Z3 is 9.4 N.

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

A-3-4 Accuracy

1. Accuracy standard

The accuracy of a particular model of linear guide is specified by its assembled height, assembled width, and running parallelism. We also specify the mutual variation of a pair of linear guides in the assembled height and assembled width. The accuracy of the table equipped with a set of linear guides is depending on other accuracies and many factors besides the accuracy of linear guides. Those are the accuracy of the mounting surface of the machine, the mounting span between two linear guides, the span of ball slides, the number of ball slides, and the location of the point where accuracy is required. The accuracy of a linear guide can be selected to match your application.

2. Definition of accuracy

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

Table 4.1 Definition of accuracy

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

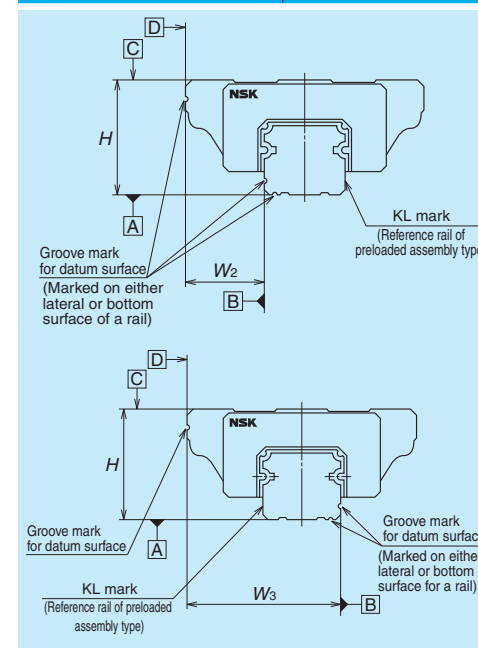


Fig. 4.1 Assembled dimensions

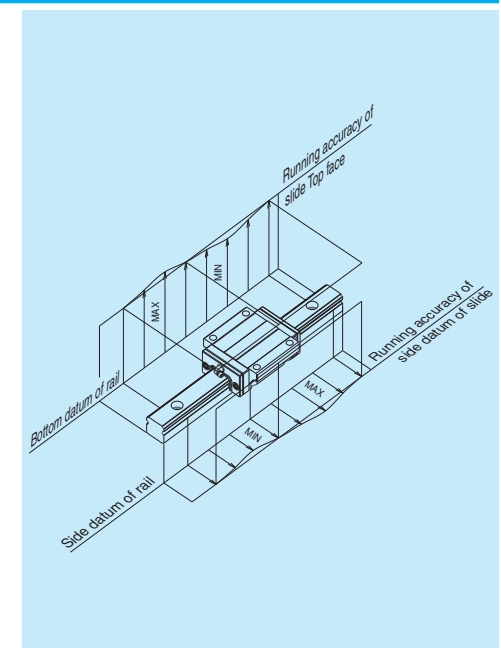


Fig. 4.2 Running parallelism of slide

Mounting width: W_2 and W_3

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

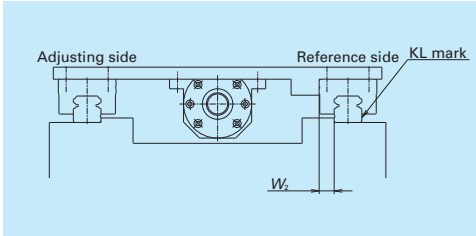


Fig. 4.3 Mounting width W_2

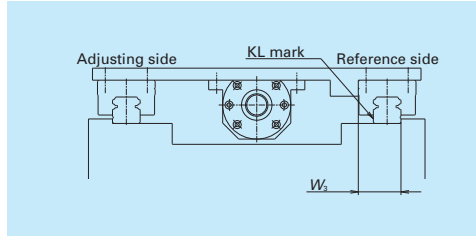


Fig. 4.4 Mounting width W_3

Running Parallelism of Slide

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

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

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

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

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

3. Application examples of accuracy grade and preload

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

Table 4.4 Application examples of accuracy grade and preload

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

Note: Only Z1 and Z0 are available for PN grade. For interchangeable types, preload "ZH" and "ZZ" are available for PH grade. For PC grade, "ZH", "ZZ" and "ZT" are available.

4. Combination of accuracy grade and preload

(1) Accuracy grades

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

Table 4.5 Accuracy grades and applicable models

Model	Preloaded assembly (not interchangeable)					Interchangeable type	
	Ultra precision	Super precision	High precision	Precision grade	Normal grade	High precision	Normal grade
	P3	P4	P5	P6	PN	PH	PC
NH, NS	○	○	○	○	○	○	○
VH	○	○	○	○	○		○
LW			○	○	○		○
DH, DS	○	○	○	○	○		
DV	○	○	○	○	○		
PU, LU, PE, LE		○	○	○	○		○
Miniature LH		○	○	○	○		
LL					○		
RA	○	○	○	○		○*	
RB	○	○	○	○			
LA	○	○	○	○			
HA, HS	○	○	○	○			

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

(2) Preload

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

Table 4.6 Classification of preload

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

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

(3) Combinations of accuracy grade and preload

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

Table 4.7 Combinations of accuracy grade and preload type

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

- *1) The interchangeable type is available for models RA25 to RA65. PH grade is set for the accuracy.
 *2) ZH and ZZ preload are available for the PH accuracy grade.

A-3-5 Maximum Rail Length

General-Purpose Models

Unit: mm

Model	Size		15	20	25	30	35	45	55	65
	Material									
NH	Special high carbon steel		2 980	3 960	3 960	4 000	4 000	3 990	3 960	3 900
	Stainless steel		1 800	3 500	3 500	3 500				
VH	Special high carbon steel		2 000	3 960	3 960	4 000	4 000	3 990	3 960	
	Stainless steel		1 800	3 500	3 500	3 500				
NS	Special high carbon steel		2 920	3 960	3 960	4 000	4 000			
	Stainless steel		1 800	3 500	3 500	3 500	3 500			

Unit: mm

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

Long-Life Series

Unit: mm

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

Miniature Models

Unit: mm

Model	Size		05	07	08	09	10	12	15
	Material								
PU	Stainless steel					600		800	1 000
LU	Special high carbon steel					1 200		1 800	2 000
	Stainless steel		210	375		600		800	1 000
PE	Stainless steel					800		1 000	1 200
LE	Stainless steel		150	600		800		1 000	1 200
LH	Stainless steel				375		600	800	

High Rigidity Models

Unit: mm

Model	Size		15	20	25	30	35	45	55	65
	Material									
RA	Special high carbon steel		2 000	3 000	3 900	3 900	3 900	3 650	3 600	3 600
RB	Special high carbon steel					3 900	3 900	3 650	3 600	3 600
LA	Special high carbon steel				3 960	4 000	4 000	3 990	3 960	3 900

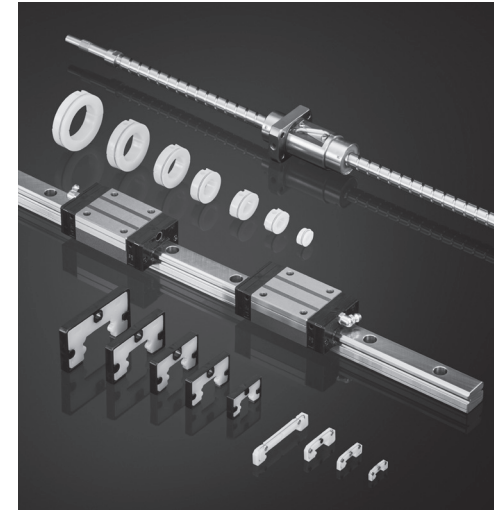
High-Accuracy Models

Unit: mm

Model	Size		15	20	25	30	35	45	55
	Material								
HA	Special high carbon steel				3 960	4 000	4 000	3 990	3 960
HS	Special high carbon steel		2 000	3 960	3 960	4 000	4 000		
	Stainless steel		1 300	3 500	3 500	3 500	3 500		

A-3-6 Lubrication

1. NSK K1™/K1-L™ lubrication units



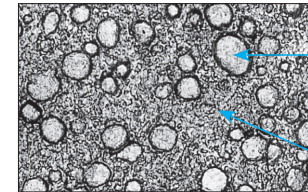
NSK K1 and K1-L lubrication units reduce costs and environmental impacts.

Long-term, maintenance-free operation

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

Unique lubricating structure

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



Polyolefin

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

Lubrication oil

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

The revolutionary NSK K1 lubrication unit

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

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

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

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

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

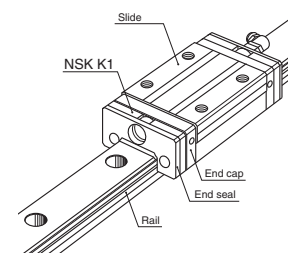


Fig. 6.1

(1) Features

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

1) Extended maintenance intervals

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

For automotive component processing lines, etc.

2) Clean and efficient

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

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

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

(2) Functionality

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

1) Durability test at high speed with no other lubrication

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

Test Conditions

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

3) Excels in wet environments

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

Food processing equipment, housing/construction machines, etc.

4) Maintains lubrication in environments with dust

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

Woodworking machines, etc.

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

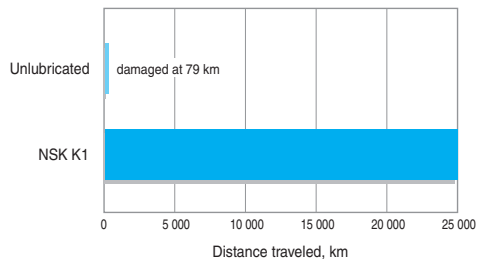


Fig. 6.2 Durability test at high speed, with no lubrication (lubricated by NSK K1 only)

2) Immersion test

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

Test Conditions

Sample : LS30 Stainless steel (preload Z1)
 Travel speed : 24 m/min
 Stroke : 400 mm
 Load : 4 700 N/Slide
 Lubricant : Fully packed with grease
 (*) Exclusively for food processing machines
 Immersion conditions:
 Immersed and traveled once per week for 24 hours at a time.

* Grease made in U.S.A.

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

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

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

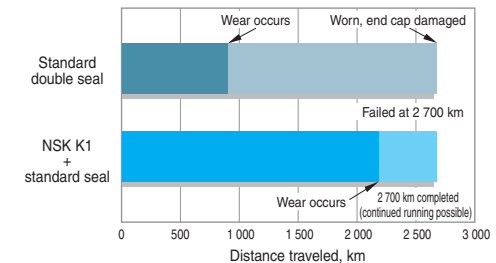


Fig. 6.3 Durability test immersed in water

4) Dust generation

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

3) Durability test with wood chips

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

Test Conditions

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

Seal specifications/lubricant:

Standard double Seal Standard double Seal + AS2 Grease
 NSK K1..... NSK K1 + Standard seal + AS2 Grease

Wood chip conditions:

- 1.....Volume of wood chips: Large
- 2.....Volume of wood chips: Medium

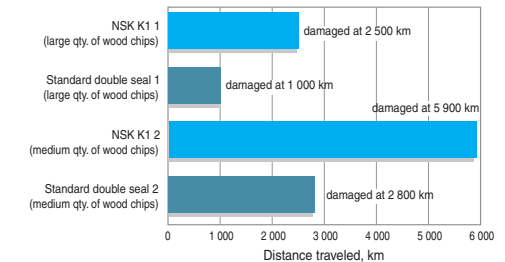


Fig. 6.4 Durability test with wood chips

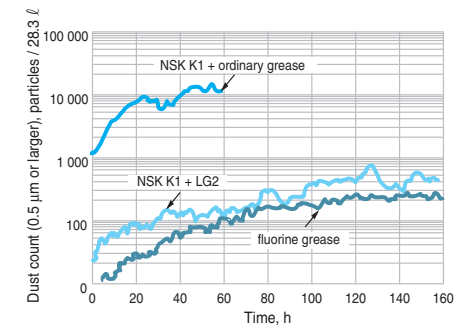


Fig. 6.5 Comparison of dust emissions

(3) Specifications

1) Applicable models and sizes

- a) NSK K1
Can be installed in LW, PU, LU, PE, LE, LH, RA, RB, LA, and HA models.
- b) NSK K1-L
Can be installed in NH, VH, NS, DH, DV, DS, and HS models. NSK K1-L is standard equipment for the VH model.
- c) Can be used with stainless steel materials and surface-treated items.

2) Standard specifications

- a) NSK K1/NSK K1-L units are installed between the end seal and end cap.
(Double-seal specifications and specifications with a protector are also available upon request.)
- b) NSK standard grease is packed inside the slide. (The type of grease may be specified.)
- c) Accuracy and preload classifications are the same as standard items. (Dynamic friction will increase slightly when NSK K1/NSK K1-L units are present.)

3) Number of installed NSK K1

Normally, one NSK K1 unit should be installed on both ends (two K1 units for one slide).
However, more NSK K1 units may be required under more stringent operating conditions and environments.
Please consult NSK for details in such cases.

Handling Precautions

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

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

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

2. Types of Lubrication

Linear guides generally use either grease or oil lubrication.

Use a lubricant agent and method most suitable to conditions, requirements, and purpose to optimize linear guide functions.

In general, lubricants with low base oil kinematic viscosity are used in low temperatures and in high-speed operations where thermal expansion has a large impact.

Lubricants with high base oil kinematic viscosity are used in high temperatures and under oscillating operations or low speeds.

The following provides more details on grease and oil lubrication methods.

(1) Grease Lubrication

Grease lubrication is widely used because it does not require a special oil supply system or piping.

Grease lubrication accessories available from NSK include:

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

1) NSK grease lubricants

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

Table 6.2 Grease lubricant for linear guides

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

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

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

2) How to replenish grease

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

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

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

3) Volume of grease to be replenished

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

Here are a few methods:

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

4) Intervals of checks and replenishments

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

Table 6.3 Intervals of checks and replenishments for grease lubrication

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

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

- Grease viscosity varies by temperature. Viscosity is particularly high in winter due to low temperatures. Pay attention to increases in linear guide sliding resistance in such occasions.

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

This method eliminates grease waste and is efficient.

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

- If using a grease pump:

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

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

Do not operate the machine immediately after replenishing.

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

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

NH, DH Models

Unit: cm³

Model No.	NH, DH	
	High-load type	Super-high-load type
15	3	4
20	6	8
25	9	13
30	13	20
35	22	30
45	47	59
55	80	100
65	139	186

VH, DV Models

Unit: cm³

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

NS, DS Models

Unit: cm³

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

LW Model

Unit: cm³

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

Table 6.4 Internal space of the slide

PU, LU Models

Unit: cm³

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

PE, LE Models

Unit: cm³

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

Miniature LH Model

Unit: cm³

Model No.	LH
08	0.2
10	0.4
12	1.2

RA Model

Unit: cm³

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

LA Model

Unit: cm³

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

RB Model

Unit: cm³

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

HA, HS Models

Unit: cm³

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

(2) Oil lubrication

The required amount of new oil is regularly supplied by:

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

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

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

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

For ball-type linear guides excluding the LA model:

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

For LA, RA, and RB models:

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

n : Linear guide size code

e.g. When NH45 is used,

$$n = 45,$$

Therefore,

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

Table 6.7 Intervals of checks and replenishments

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

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

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

3) When using oil mist lubricating systems, please confirm oil supply amounts at each outlet port.

For oil lubrication supplied by gravity, the oil supply position and installation position of the slide are crucial. In linear guides, unless installed in a horizontal position, oil will only drip downward and not spread to all raceway surfaces.

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

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

Table 6.7 shows the criteria for oil checks and replenishments.

A-3-7 Dust Resistance

1. Standard specification parts

- To keep foreign matter from entering inside the slide, NSK linear guides have end seals on both ends, bottom seals at the bottom surfaces, and an inner seal in the inside of slide.
- **Table 7.1** shows standard specification seals by model.
- Seal friction force for a standard slide is shown in the dust resistance section of a model's technical description.

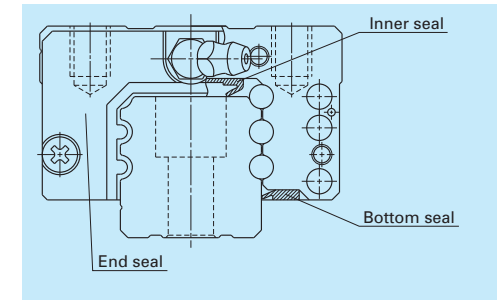


Fig. 7.1

Table 7.1 Standard seals

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

○ : Equipped as a standard feature

△ : Available upon request

2. Dust-resistant parts

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

Table 7.2 Optional dust-resistant parts

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

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

(1) Double seal

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

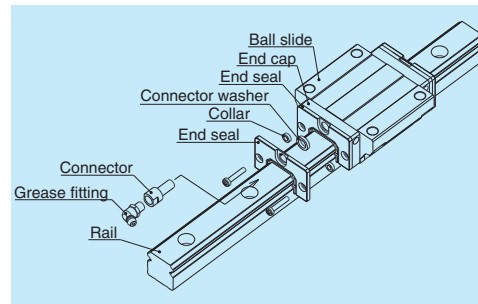


Fig. 7.2 Double seal

(2) Protector

- A protector is usually installed outside the end seal to prevent high-temperature fine particles such as welding spatter and other hard foreign matter from entering the slide.
- Same as the case with the double seal, when the protector is installed, the slide becomes longer. Take this thickness of slide into consideration for determining the relevant dimensions such as the system stroke and the ball slide installation envelope. Refer to the dust resistance section of a model's technical description for details on dimensional increases in the rail axial direction when installing a protector.
- Protectors are available from stock and can be installed to standard assemblies upon request. Refer to the dust resistance section of a model's technical description for details on protector reference numbers.
- Attaching a grease fitting to the end cap after the protector is equipped requires the connector shown in **Fig. 7.3**. Please specify the connector set when ordering linear guides.
- For VH, DV, RA, RB, LA, HA, and HS Models, the protector can only be installed only before shipping from the factory.

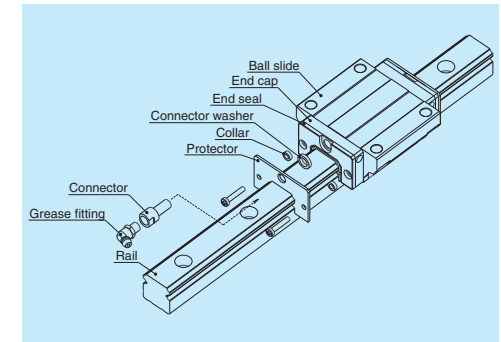


Fig. 7.3 Protector

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

- After the rail is mounted to the machine base, a bolt-hole cap is used to plug the bolt hole to prevent foreign matter from clogging up the hole and from entering into the slide (**Fig. 7.4**).
- The bolt-hole cap is made of synthetic resin which has superb resistance to oil and abrasion.
- Refer to the dust resistance section of a model's technical description for details on bolt sizes and reference numbers.
- To insert the cap into the rail bolt hole, use a flat dolly block (**Fig. 7.5**). Pound the cap gradually until its height becomes flush with the rail top surface.
- You can reorder extra bolt hole caps. Refer to the dust resistance section of a model's technical description for details on bolt cap sizes and reference numbers.
- Caps made of metal also available upon request.

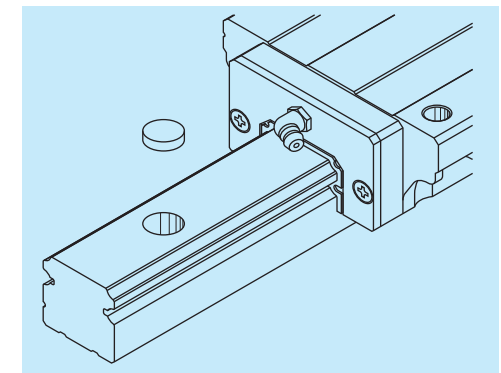


Fig. 7.4

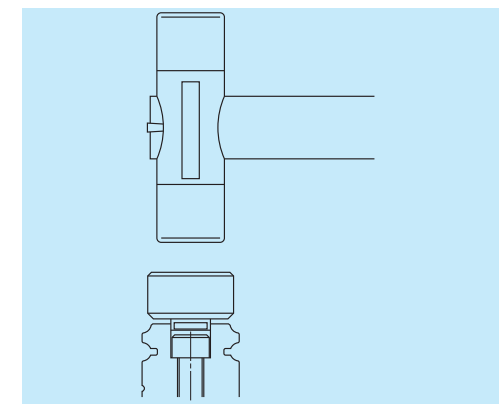


Fig. 7.5

(4) Inner seal

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

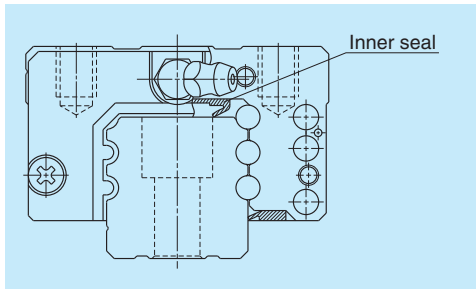


Fig. 7.6 Inner seal when installed

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

* Fixing to the ball slide (Fig. 7.7)

- Remove two machine screws (M_1) which secure the end seals to the end of the slide (**Fig. 7.7**). For NS15 and DS15, hold the end cap by hand. Otherwise, the end cap is detached from the ball slide, and the balls inside may spill out.
- Then insert a spacer to the hole for securing the end seal. Fasten the mounting plate at the end of the bellows to the slide with a slightly longer machine screw (provided with the bellows).

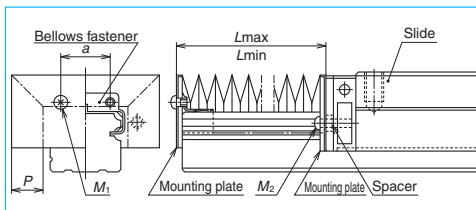


Fig. 7.7

(5) Bellows

- Bellows cover the entire linear guide. They are widely used for protection in environments where foreign matter is prevalent.
- NSK provides specialized bellows for the NH, NS, LW, DH, DS, RA, and LA models. We offer a middle bellows and end bellows for all these models. Bellows for the NH and DH model are further divided into high/low types based on the slide type.
- The high type is used with AN and BN slide shapes, while the low type is used with EM, GM, AL, and BL slide shapes. The top of the high type bellows is slightly lower than the top surface of the slide.
- When a high type bellows is installed to the slide with the height code L (such as AL), the top of the bellows becomes higher than the slide. However, it is advantageous for stroke because the pitch of the bellows becomes larger than the low type.
- Special bellows are required when installing the linear guide vertically, or hanging it from a ceiling. Please consult NSK in such a case.
- When a bellows is used, please be advised that we cannot put a grease fitting on the end of slide to which the bellows is attached. If you require a grease fitting, it will be put on the side of end cap or slide body. Consult NSK for details.
- Refer to the dust resistance section of a model's technical description for details on bellows dimensions.

* Fixing to the rail

- To install bellows for NH, NS, DH, and DS Models lightly knock a fastener exclusively for bellows to the end of the rail (**Fig. 7.7**). Then secure the mounting plate to the end of the bellows through the tap hole of the fastener.
 - As described above, bellows can be easily fixed to the end of the rail without adding a tap hole on the end of the rail.
 - Bellows fastener is available only for horizontal mounting positions. For other mounting positions, sliding plate is required (see **Fig. 7.10** on page A70.)
- For fixing to the rail, make tap holes on the rail end surface. Fix the bellows mounting plate on the rail end surface through these tap holes by using a machine screw. NSK processes a tap hole on the rail end face when ordered with a linear guide.

[2] LW and LA Models

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

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

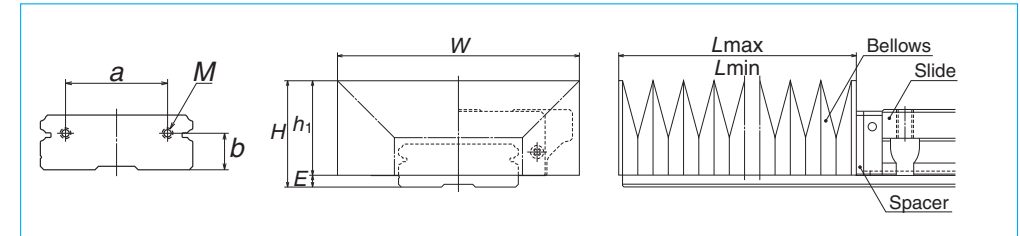


Fig. 7.8

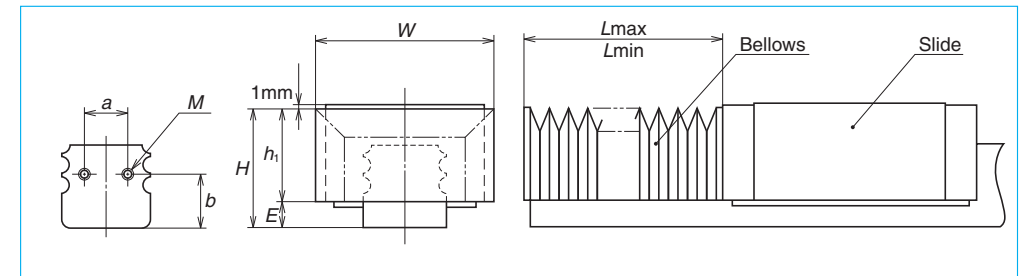


Fig. 7.9

[3] RA Model

- Please refer to page A260.

Calculating length of bellows

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

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

- Length when contracted to the minimum :

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

- Stroke : $St = L_{\max} - L_{\min}$
- The dimension of P and the number of BL are shown in the bellows dimension tables of each model.
- For the RA model, refer to page A314.

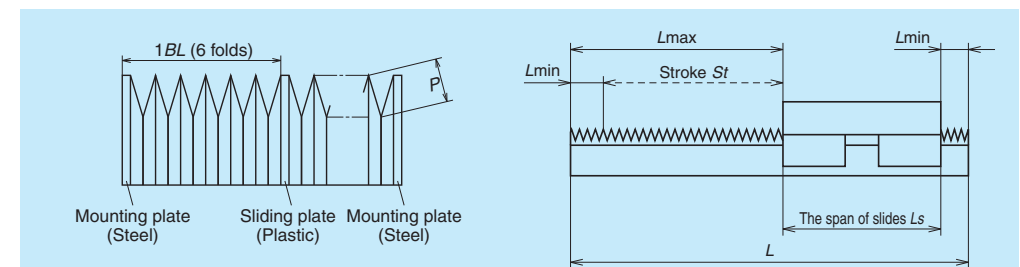


Fig. 7.10

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

1. Stainless steel

NSK linear guides are available in stainless steel.

○Stainless steel standard models

PU Model PE Model
LE Model Miniature LH Model LL Model

○Available in stainless steel

NH Model
NS Model
LU Model

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

2. Surface treatment

(1) Recommended surface treatment

We recommend "low temperature chrome plating" and "fluoride low temperature chrome plating" for rust prevention because of the result of the humidity chamber test for antirust characteristics and their cost-effectiveness.

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

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

Please consult NSK for other surface treatments.

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

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

○**Fluoride low temperature chrome plating**

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

(2) Rust prevention of fluoride low temperature chrome plating

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

● What is "Fluoride low temperature chrome plating?"

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

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

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

A-3-9 Special Environments

1. Heat-resistant specifications

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

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

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

Heat resistant linear guides

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

See page A76 for availability.

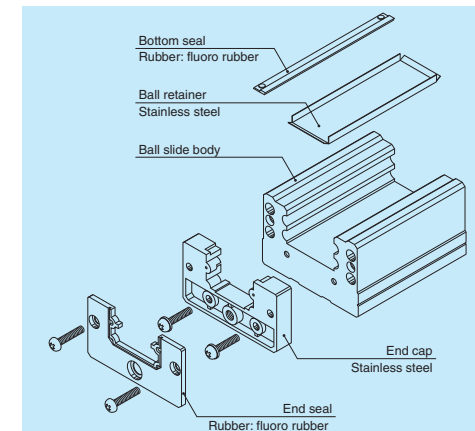


Fig. 9.1

2. Vacuum and cleanroom specifications

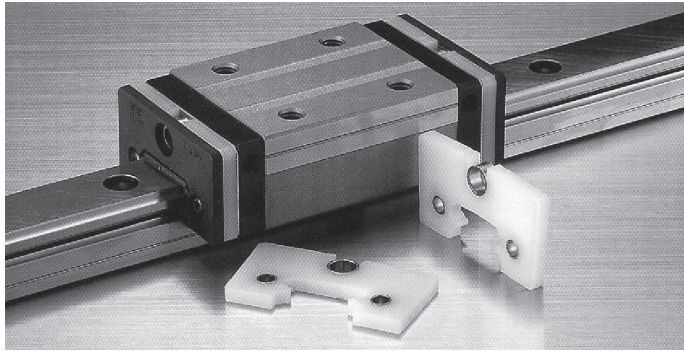
- Based on its abundant experience and technology, NSK manufactures linear guides that can be used in a vacuum or in cleanroom environment. Please consult NSK for more details.
- Linear guide specifications vary for environmental conditions. For example, "all stainless steel plus special grease", or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

3. Low dew point environment specifications for rechargeable battery production

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

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

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



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

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

(1) Features

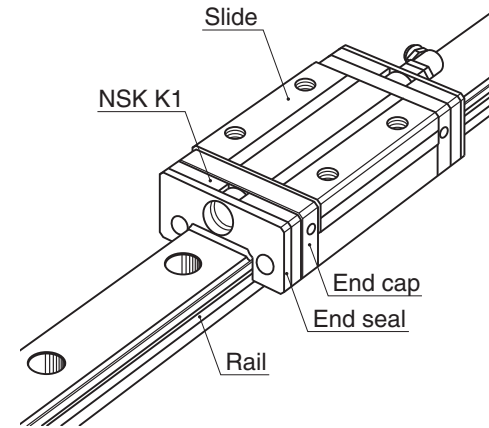
- 1) NSK linear guides for sanitary environments use NSF H1 food-grade grease.
 - *H1: Lubricants permitted for use where there is possibility of incidental food contact
- <Features of grease for food processing machines>
 - This grease is certified to the H1 food-grade standard (previously USDA H1) by NSF international.
 - *USDA: USDA (The United States Department of Agriculture)
 - Superb water resistance and antirust capabilities
 - Superb wear resistance
 - Applicable with centralized oiling systems
- 2) Appropriate volume of grease
 - A supply of the appropriate volume of grease reduces grease drain and scattering and maintains a clean environment.

(2) Available models

Table 9.2 shows available models.

Table 9.2

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



Handling Precautions

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

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

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

5. Specifications for special environments

Table 9.3 Linear guide specifications

Environment	Condition	NSK linear guide specifications				Technical Explanation Page No.
		Rail, slide	Steel balls/rollers	Ball recirculation component	Lubrication/surface treatment	
Cleanroom	Atmosphere, normal temperature	Standard material	Standard material	Standard material	LG2 Grease, LGU Grease	D8
					NSK K1-L/K1 lubrication unit	A58
	Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel	LG2 Grease, LGU Grease	D8	
				NSK K1-L/K1 lubrication unit	A58	
Atmosphere-Vacuum, normal temperature			Fluoride low temperature chrome plating	D5		
Atmosphere-Vacuum up to 200°C			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					
	High vacuum up to 500°C				Molybdenum disulfide	
					Special silver film	D7
Corrosion resistance	Vapor, steam	Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel		
	Acid, alkali	Standard material	Standard material	Standard material	Fluoride low temperature chrome plating	D5
	Acid, alkali, clean	Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel	Fluoride low temperature chrome plating	D5
					LG2 Grease, LGU Grease	D8
	Strong acid, strong alkali				Fluoride low temperature chrome plating	D5
Organic solvent				Fluoride grease		
High temperature	Atmosphere up to 150°C	Standard material	Standard material		ET-100K Grease	
	Atmosphere Up to 200°C	Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel	Fluoride grease	
	Atmosphere Up to 200°C, Corrosion resistant				Fluoride grease	
Low temperature	-273°C and higher	Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel	Solid lubricant	
Radiation resistance	Atmosphere	Standard material	Standard material	Standard material	Radiation resistant grease	
		Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel		
Foreign matters	Fine particles, wooden chips	Standard material	Standard material	Standard material	NSK K1-L/K1 lubrication unit	A58
			Martensitic stainless steel	Austenitic stainless steel		
	Water, under water	Martensitic stainless steel	Standard material	Standard material		
		Martensitic stainless steel	Austenitic stainless steel			

6. Responsiveness of NSK linear guides for special environments

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

*1) Applicable except for dust-resistant parts.
*2) Available with dust-resistant V1 seal.

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

7. Precautions for handling

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

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

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

A-3-10 Arrangement and Mounting of Linear Guides

1. Arrangement

- For NSK linear guides, the datum surfaces of the rail and slide are either marked with a "datum surface groove mark" or "arrow."
- If two or more linear guides are used together, one linear guide is designated as the reference side guide, and the others as adjusting side guides. The reference side linear guide has its reference number, serial number, and "KL" mark on the opposite side of the datum surface (Fig. 10.1).
- When the datum surfaces of the reference side rail and slides are pressed to their respective mounting datum surfaces, the variation of distance (mounting width W_2 or W_3) between the datum surfaces of the rails and that of the slides must be minimized as set by the accuracy standard. (Figs. 10.2 and 10.3)
- Indications of the datum surfaces for different models are shown in Table 10.1.

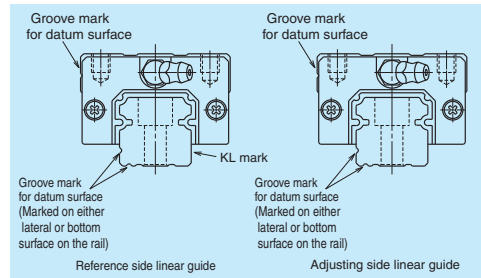


Fig. 10.1 Datum surface

Table 10.1 Marks on the rail datum surfaces in each model

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

Example arrangements

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

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

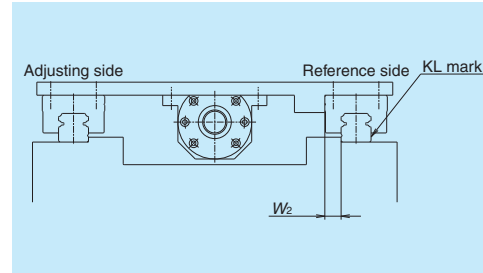


Fig. 10.2 Most common setting of the reference side rail

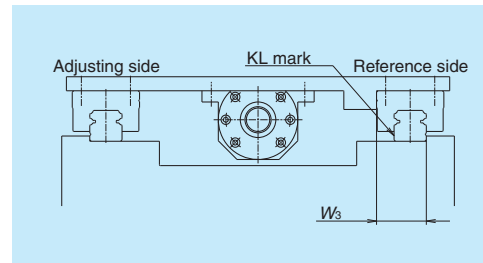


Fig. 10.3 Setting of the reference side rail in certain occasions

Table 10.2 Arrangement example

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

2. Mounting accuracy

(1) Accuracy of the mounting base of machine

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

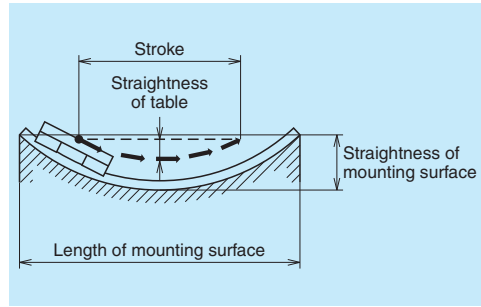


Fig. 10.4

(2) Installation error

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

Table 10.3 Influence of mounting error

Factor	Influence
Life	<ul style="list-style-type: none"> • Large mounting error generates a force which twists the slide and reduces its life. • It also distorts the contact point of the ball and the groove, and changes contact angle, thus lowering the table rigidity.
Friction	<ul style="list-style-type: none"> • NH and NS Models are affected very little by mounting error thanks to their small friction. (self aligning capability) • However, because of off-set Gothic arch grooves, their friction suddenly soars once the mounting error exceeds a certain level. • Mounting error severely affects friction of LA Models with heavy preload.
Accuracy	<ul style="list-style-type: none"> • When the rigidity of four slides is equal, the theoretical straightness becomes 1/2 of the installation error "e₁". • However, this value becomes slightly larger due to the deformation of the rail and the machine base.

(3) Permissible values of mounting error

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

For ball linear guides

- The permissible load per ball slide due to mounting error is 10% of the basic dynamic load rating C_{50} .
- The rated life is 5 000 km.
- The rigidity of the machine base is infinite.

For roller linear guide

- The permissible load per roller slide due to mounting error is 10% of the basic dynamic load rating C_{100} .
- The rated life is 10 000 km.
- The rigidity of the machine base is infinite.

C_{50} ; Basic dynamic load rating for 50 km rated fatigue life

C_{100} ; Basic dynamic load rating for 100 km rated fatigue life

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

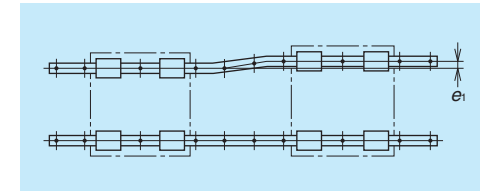


Fig. 10.5

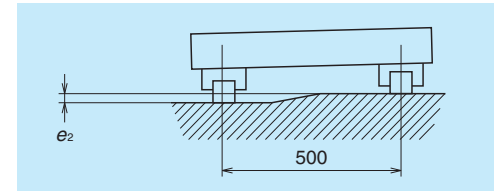


Fig. 10.6

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

When mounting on a machine base, the linear guide is affected by the flatness of the mounting surface. However, in the case of two-rail/four-side specification, which is most widely used, the straightness as a table unit is generally less than the straightness as a single component. This is due to the even-off effect generated by the shorter table stroke,

compared to the rail length, as well as by interaction between the rails and slides.

Fig. 10.9 shows an actually measured straightness of the table which uses NSK linear guides. In this case, the final straightness of the table is about 1/5 of the straightness of the mounting surface.

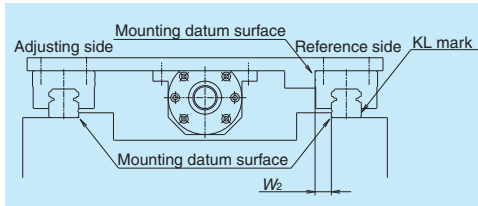


Fig. 10.7

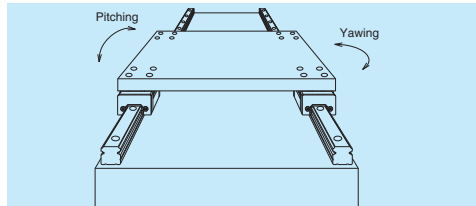


Fig. 10.8

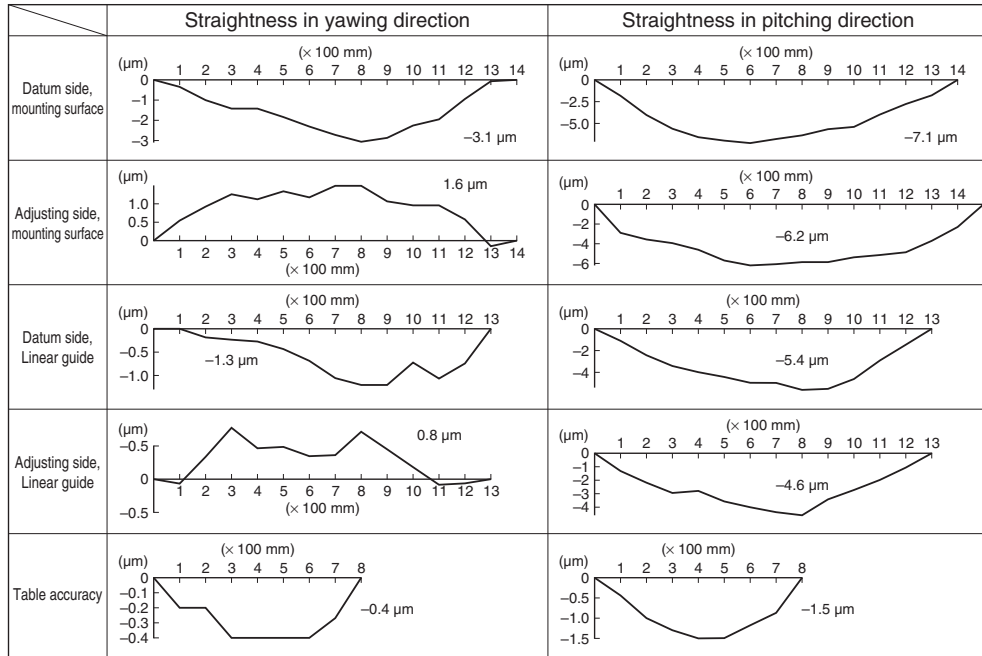


Fig. 10.9 Straightness of the table equipped with linear guide

3. Installation

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

Fig. 10.10 and 10.11, show shoulder height of the mounting surface of the machine base and the size of corner radius. These figures are relevant when the linear guide is pressed to the shoulder of the machine base or table (the raised section from where the mounting surface begins), and horizontally secured to it. Recommended sizes are shown in "Shoulder height and corner radius r" for each model.

The shoulder should be thick (wide) enough, so it is not deformed by the pressing force.

(2) Tightening torque of the bolt

Table 10.4 shows tightening torque of the bolt when the rail is secured to the fixture of race way grinding machine.

Apply same torque in this table when securing the rail to the machine base. Equal accuracy at the time of grinding can be obtained.

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

Unit: N·m			
Bolt size	Tightening torque	Bolt size	Tightening torque
M2	0.27	M8	22
M2.3	0.38	M10	43
M2.5	0.58	M12	76
M3	1.06	M14	122
M4	2.5	M16	196
M5	5.1	M18	265
M6	8.6	M22	520

(3) Installation procedures

There are two installation ways depending on the accuracy requirement.

- a. Installation with high accuracy
- b. Accuracy is not high, but easy to install

For both methods, wipe off the rust preventive oil applied to the linear guide. Remove burrs and small bumps on the machine base and table mounting surface with an oilstone (Fig. 10.12).

Apply machine oil or similar oil with low viscosity to the mounting surface to increase the rust preventive effect.

Linear guides are precision products. Handle them with care.

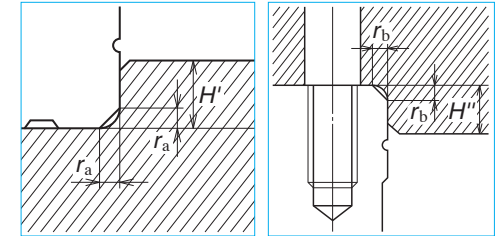


Fig. 10.10 Shoulder for the rail datum surface

Fig. 10.11 Shoulder for the slide datum surface

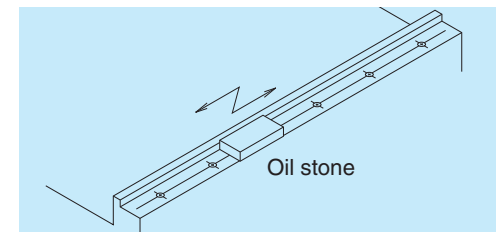


Fig. 10.12

1) Highly accurate installation

A) Rail installation procedures

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

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

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

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

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

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

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

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

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

The measuring table is more stable if secured to two slides, but one slides is sufficient. Parallelism between two rails can also be checked by the same method in **Fig. 10.15** when there is a shoulder on the surface where the adjusting side rail is installed.

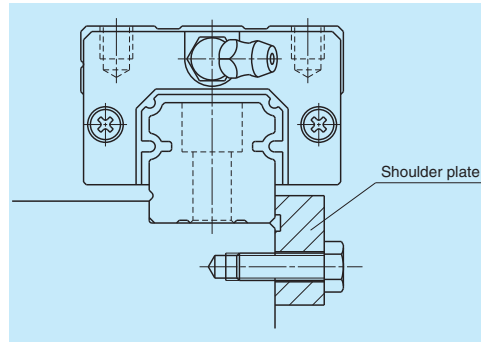


Fig. 10.13 Pressing the rail from sideways

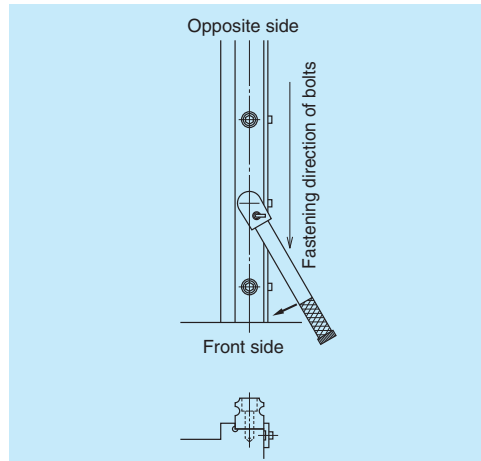


Fig. 10.14 Rail installation

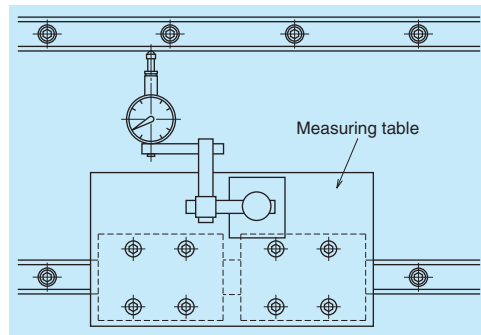


Fig. 10.15 Measuring parallelism

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

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

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

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

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

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

[4] Finally tighten all bolts with specified torque.

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

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

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

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

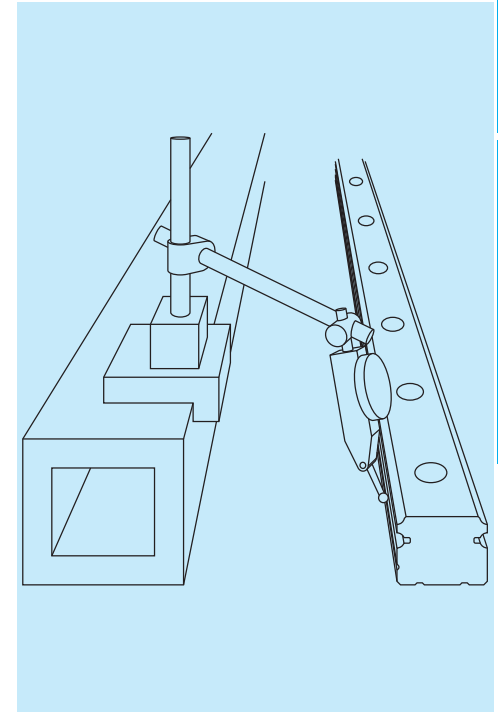


Fig. 10.16

B) Procedures for slide installation

a) When the table has a shoulder

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

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

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

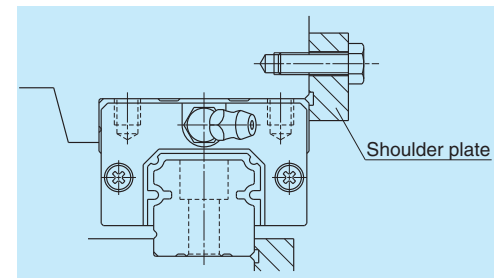


Fig. 10.17 Pressing slide from sideways

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

b) When table does not have a shoulder

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

2) Easy installation

- [1] Carefully place the reference side rail on the machine base. Then tighten the bolts to the specified torque.
- [2] Loosely tighten the bolts on the adjusting side rail.
- [3] Tighten the slides on the reference side rail and one slide on the adjustment side rail with the specified torque. Leave the rest of the slide on the adjusting side rail loosely tightened (**Fig. 10.18**).
- [4] While moving the table with each pitch of the bolt for rail: With the specified torque, tighten the rail mounting bolt which is located immediately adjacent to the slide on the adjusting side rail that had been firmly tightened.
Take this procedure from one end to the other.
- [5] Return the table to the original position once. Then, tighten the rest of the slides on the adjusting side to the specified torque. By the same procedure as in [4], tighten the rest of the rail mounting bolts to the specified torque. Move the table to check any abnormality such as large friction force.

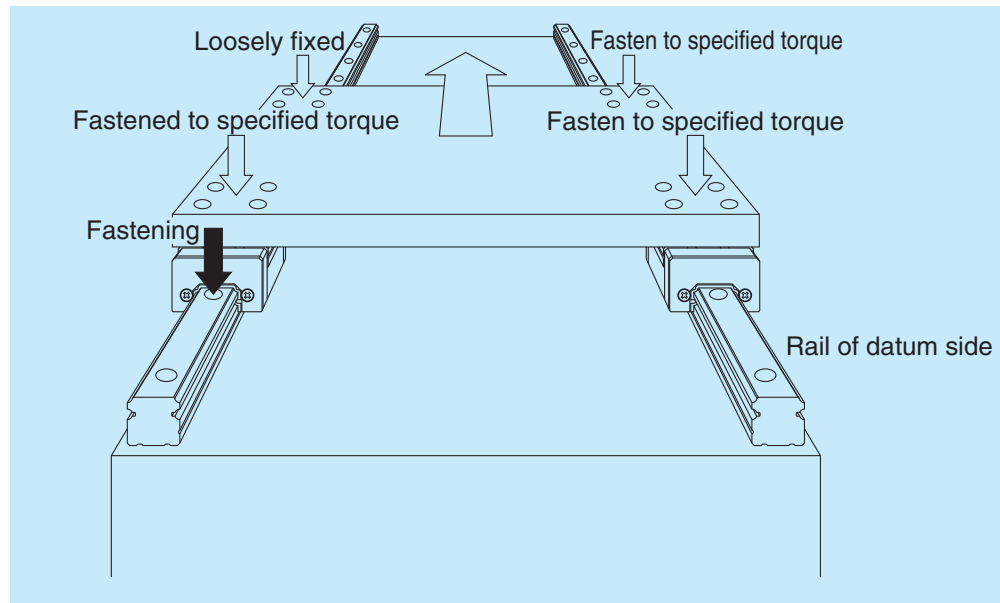


Fig. 10.18 Easy installation

(4) Various methods to press linear guide sideways

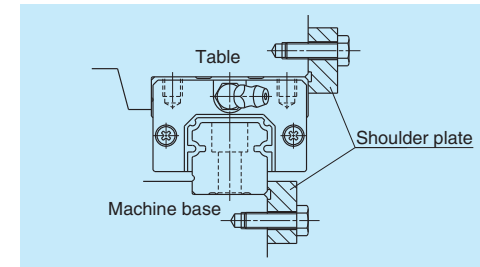


Fig. 10.19 Recommended method

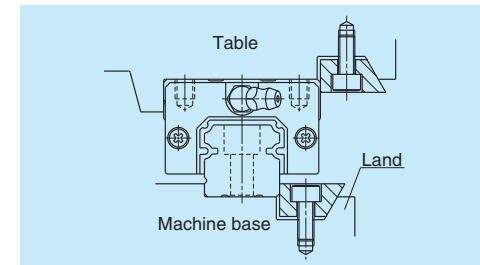


Fig. 10.20 Installation that requires caution

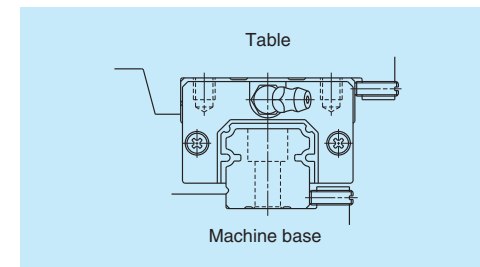


Fig. 10.21

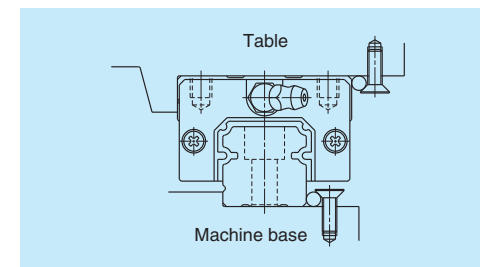


Fig. 10.22

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

- 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.

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

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

4. Interchangeable linear guides

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

Assembly procedures for an interchangeable linear guide

Follow steps as described below.

- (1) Wipe off the rust preventive oil from the rail and slide.
- (2) Please match groove mark for the datum surface of slide and rail to set desired assembling state W_2 or W_3 .
- (3) Align the provisional rail to the rail bottom and side surfaces. Press the provisional rail lightly against the rail, and move the slide onto the rail (Fig. 10.23).

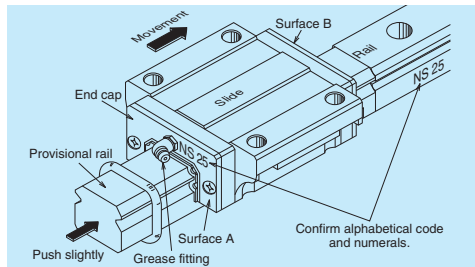


Fig. 10.23 Installing slide onto rail

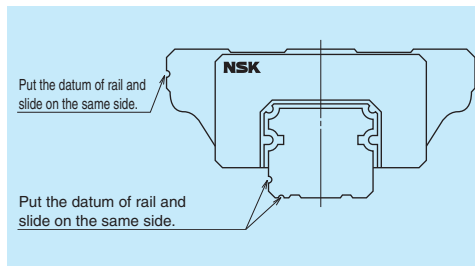


Fig. 10.24

5. Butting rail specification

- Rails may be butted to achieve a length longer than the maximum manufactured length.
- The rails with butting specification are marked with letters (A, B, C ...) and an arrow on the opposite side of the mounting datum surface. Use the letters and arrows for assembly order and direction of the rail (Fig. 10.25).

The interchangeable rails for butting specification are only marked with arrows.

- The pitch of the rail mounting hole on the butting section should be as F in Fig. 10.26. When two rails are used in parallel, the butted sections should not align. This is to avoid change in the running accuracy of the table at the butted sections.
- We recommend shifting the butting sections more than the length of a slide. If higher running accuracy is required, consider installing the slides into the table so that they do not simultaneously pass the butting sections.

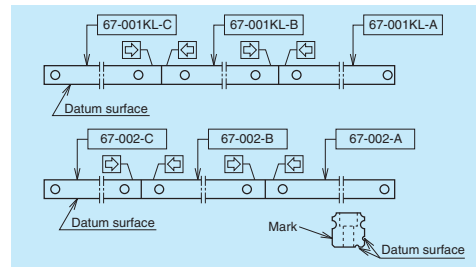


Fig. 10.25

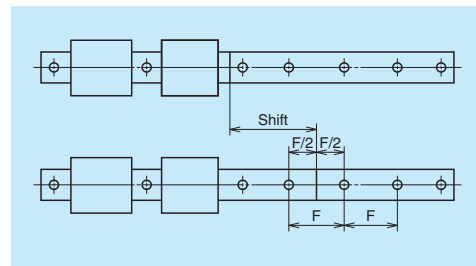


Fig. 10.26

6. Handling preloaded assembly

- When handling a preloaded assembly (not interchangeable type), do not remove slides from the rail as a general rule.
- If it is unavoidable to remove slides from the rail, make certain to use a provisional rail (a jig used to insert a slide to the rail) as shown in Fig. 10.27.
- Provisional rails are available for each model and size.
- Pay due attention to the assembly mark when returning the slide back to the rail. Follow the precautions described below.

Mark for assembling ball slide and rail

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

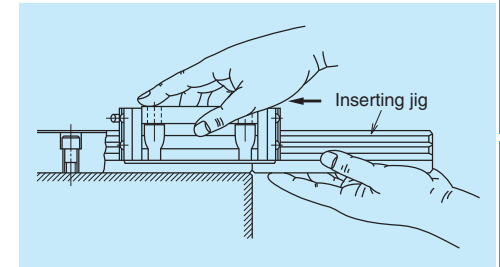


Fig. 10.27

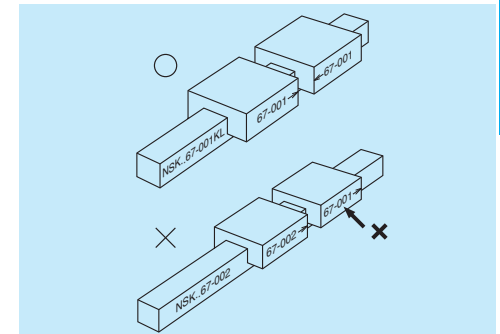


Fig. 10.28

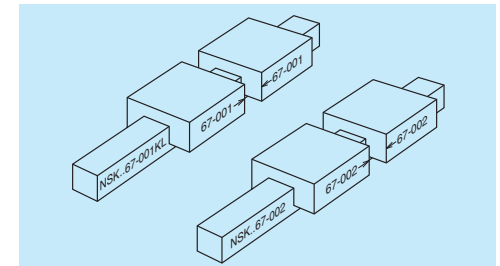


Fig. 10.29 When two rails have the same reference number

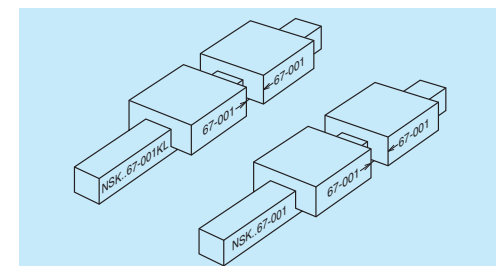


Fig. 10.30 When two rails have different reference numbers

A-3-11 Drills to Select Linear Guide

1. Single axis material handling system

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

Specification of the single axis material handling system

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

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

Load point coordinates from the table center (mm)

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

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

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

(1) Selection of linear guide model

Select a type of linear guide from "A-2-3 Linear Guide Models" Since this material handling system has two rails and four ball slides, **NH, NS, and PU Models** are suitable. Here, we'll temporarily select PU15 because of the dimensions of the mounting space.

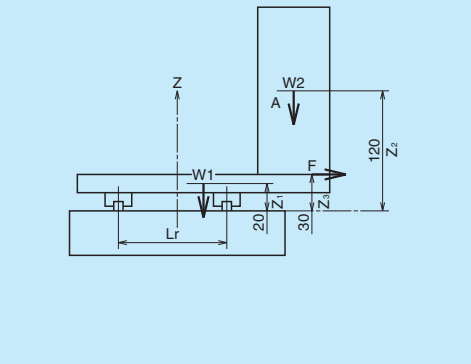
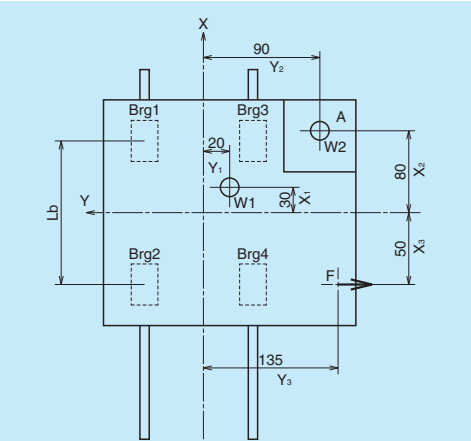


Fig. 11.1 Single axis material handling system

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

(2) Calculating life

Calculate life of the selected PU15AL based on "A-3-2 Rating Life and Basic Load Rating."

Linear guide PU15AL

Basic dynamic load rating C_{100} : 4 400 (N)
 Basic static load rating C_0 : 6 600 (N)

Load conditions of the linear guide

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

From the time to reach travel speed and the travel speed, the table acceleration is 0.8 m/sec². Therefore, it is not necessary to take into account inertial force brought about by the table mass.

Calculation of the load applied to ball slide

Calculate two occasions:

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

From **Pattern 4** on page A37 in **Table 2.2**

When a work is mounted on the table Vertical loads

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

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

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

$$= -27\ 000 \text{ (N}\cdot\text{mm)}$$

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

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

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

$$= 20\ 500 \text{ (N}\cdot\text{mm)}$$

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

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

$$= \frac{150 + 200}{4} + \frac{-27\ 000}{2 \times 90} + \frac{20\ 500}{2 \times 100}$$

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

Similarly

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

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

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

Lateral loads

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

$$= F \cdot X_3$$

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

$$= 10\ 000 \text{ (N}\cdot\text{mm)}$$

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

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

$$= \frac{-200}{4} + \frac{10\,000}{2 \times 100}$$

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

Lateral loads

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

$$= F \cdot X_3$$

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

$$= 10\,000 \text{ (N} \cdot \text{mm)}$$

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

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

$$= \frac{-200}{4} + \frac{10\,000}{2 \times 100}$$

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

Similarly

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

No work mounted on the table

Vertical load

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

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

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

$$= -9\,000 \text{ (N} \cdot \text{mm)}$$

Similarly

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

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

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

$$= W1 \cdot X_1$$

$$= 150 \times 30$$

$$= 4\,500 \text{ (N} \cdot \text{mm)}$$

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

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

$$= \frac{150}{4} + \frac{-9\,000}{2 \times 90} + \frac{4\,500}{2 \times 100}$$

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

Similarly

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

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

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

Calculation of dynamic equivalent load

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

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

In case of PU15AL,

Vertical direction dynamic equivalent load

$$F_r = F_r$$

Lateral direction dynamic equivalent load

$$F_{e0} = F_r \cdot \tan \alpha = F_r$$

Use the formula for full dynamic equivalent load (page A41) to calculate F_e .

Results are shown in the table below.

Unit: N

Work mounted	Slide1	Slide2	Slide3	Slide4
$F_r (F_{r1} - F_{r4})$	40	-165	340	135
$F_{s0} (F_{s1} - F_{s4})$	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
$F_{s0} (F_{s1} - F_{s4})$	0	-100	0	-100
F_e	10	118	110	133

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

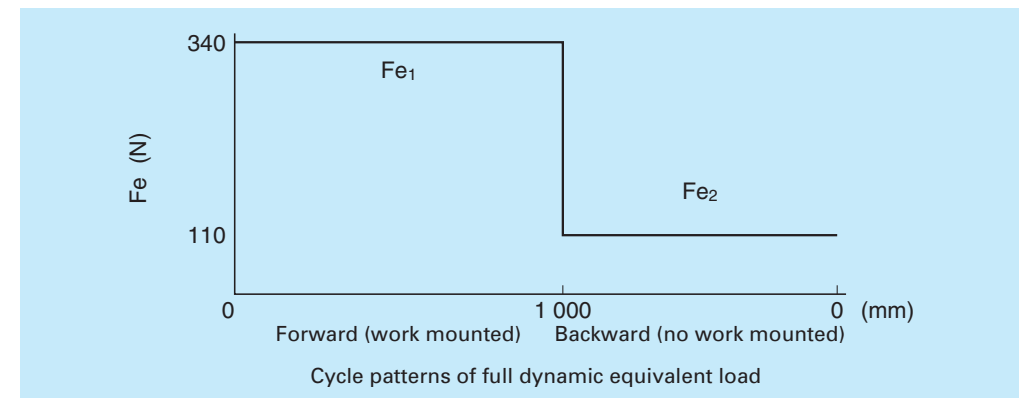
Calculation of mean effective load

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

Therefore;

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

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



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

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

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

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

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

Determine various coefficients

Determine applicable coefficients from "A-3-2.2

5. Various coefficients."

Load factors

Use conditions are: Travel speed, 12 m/min; Acceleration, 0.8 m/sec² (0.082 G). As the load factor f_w is in the range of 1.0 to 1.5, use common value $f_w = 1.2$.

Hardness coefficient

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

Calculate rating life

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

The basic dynamic load rating (C_{100}) of linear guide PU15AL : 4 400 (N)

Mean effective load F_m : 273 (N)

Load factor f_w : 1.2

Hardness coefficient f_H : 1

$$\text{Rating fatigue life } L = 100 \times \left(\frac{f_H \cdot C_{100}}{f_w \cdot F_m} \right)^3$$

$$= 100 \times \left(\frac{1 \times 4\,400}{1.2 \times 273} \right)^3$$

$$= \text{approximately } 242\,280 \text{ (km)}$$

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

Convert the above rating fatigue life into hours:

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

Examine static load

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

The basic static load rating (C_0) of linear guide PU15AL: 6 600 (N)

Ball slide No. 3 bears the largest load.

P_0 at this time:

$$P_0 = F_r + F_s = 340$$

Therefore, static permissible load coefficient f_s is:

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

There is no problem at this value.

(3) Selection of accuracy grade and preload

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

(4) Calculation of deformation

Calculate deformation by the weight of the mounted work W_2 . From "Rigidity of PU model," the rigidity of linear guide PU15AL with Z1 preload is:

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

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

From Pattern 4 in Table 2.2 (page A37)

Work mounted:

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

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

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

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

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

No work mounted:

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

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

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

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

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

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

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

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

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

2. Machining center

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

Operating conditions

Dimensions and load conditions are:

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

X axis stroke : 400 (mm)

Y axis stroke : 350 (mm)

Z axis stroke : 500 (mm)

Average rapid traverse speed : 15 (m/min)

[Max. 30 (m/min)]

Starting accelerating speed : 1 (G)

Milling speed : 2.5 (m/min)

Drilling speed : 0.8 (m/min)

Cutting load

Milling process $F_x = F_y = 1\,000 \text{ (N)}$

Drilling process $F_z = 3\,000 \text{ (N)}$

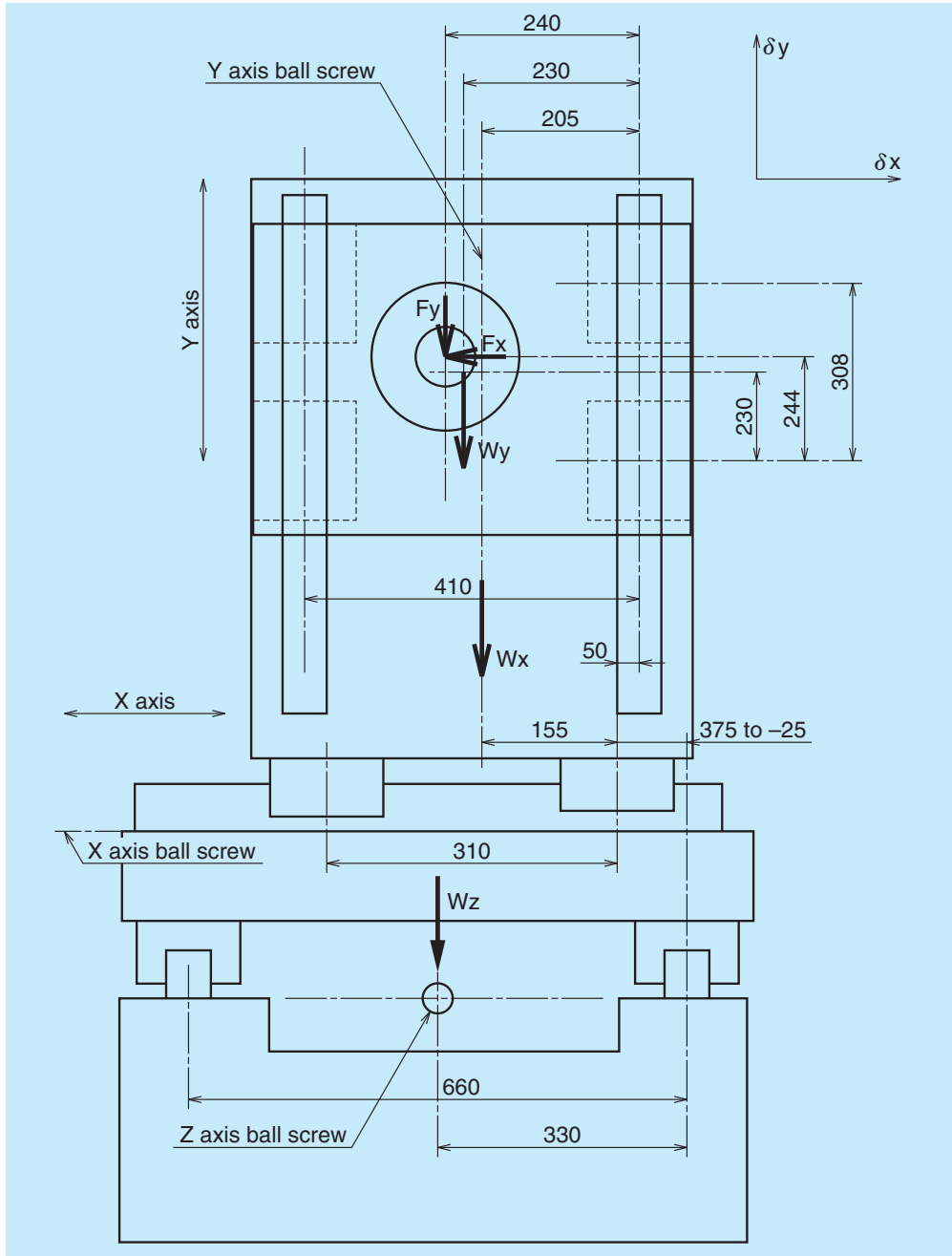


Fig. 11.2 Machining center (front view)

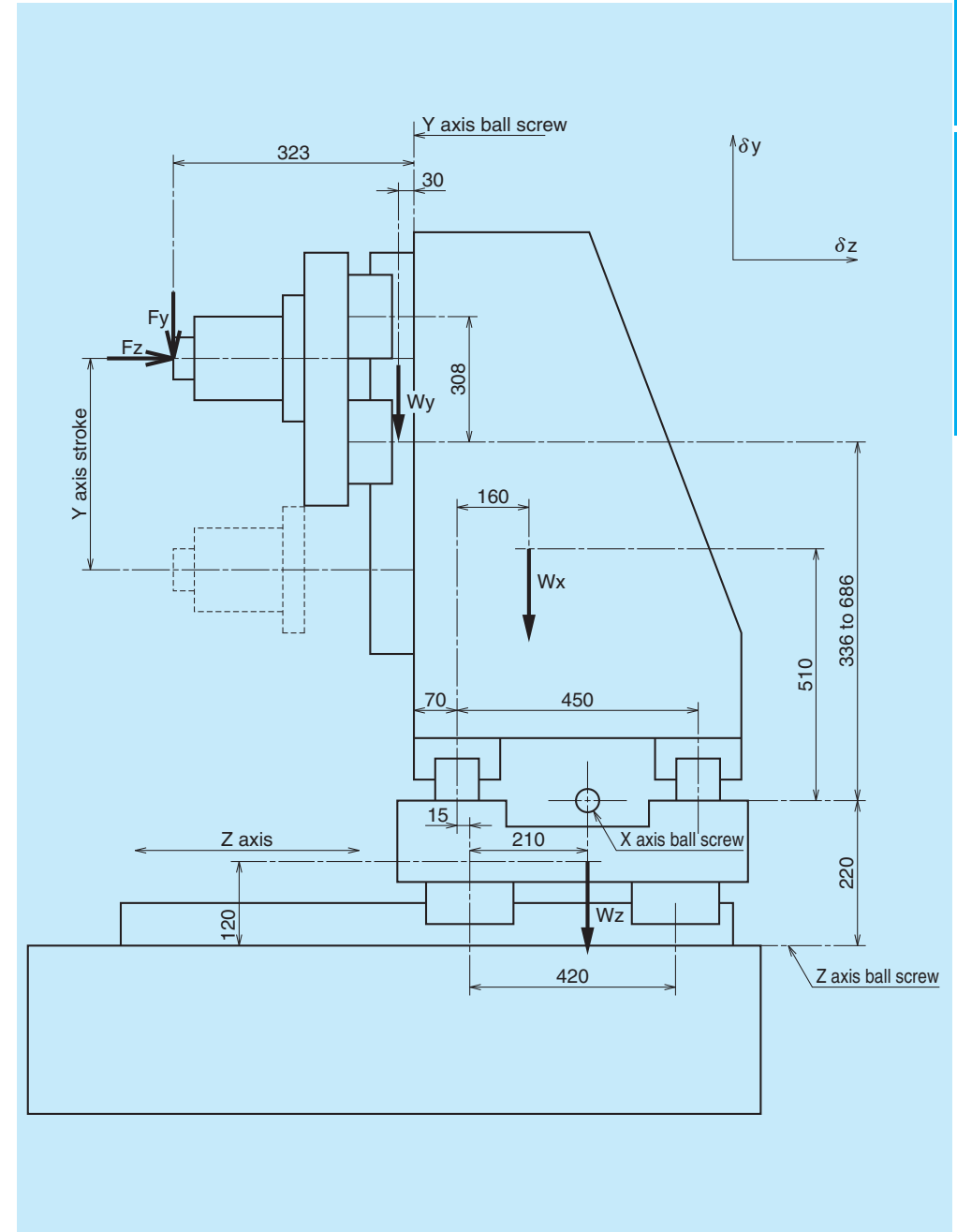


Fig. 11.3 Machining center (side view)

(1) Selection of linear guide model

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

Select below temporarily from shaft diameter of ball screw:

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

(2) Selection of accuracy grade and preload

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

Unit: N

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

In case of milling process: $F_x = F_y = 1\ 000\ (N)$

Similarly,
 X axis: Loads to be considered $W_x, W_y, F_x,$ and F_y
 Y axis: Loads to be considered $W_y, F_x,$ and F_y
 Z axis: Loads to be considered $W_x, W_y, W_z, F_x,$ and F_y

Unit: N

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

(3) Calculation of life expectancy

Examine three cases: no cutting load, milling process, and drilling process. Inertial force associated with the starting acceleration is not considered in this case. However, it must be calculated for more accurate figures.

Calculation of the loads that apply to the ball slide

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

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

X axis: Loads to be considered W_x and W_y
 Y axis: Loads to be considered W_y
 Z axis: Loads to be considered $W_x, W_y,$ and W_z

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

In case of drilling process: $F_z = 3\ 000\ (N)$

X axis: Loads to be considered $W_x, W_y,$ and F_z
 Y axis: Loads to be considered W_y and F_z
 Z axis: Loads to be considered $W_x, W_y, W_z,$ and F_z

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

Unit: N

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

Calculation of dynamic equivalent load

Next, find dynamic equivalent load under each cutting condition. From "Table 2.3" in "A-3-2.2 3. Calculation of dynamic equivalent load," the necessary loads, F_r and F_{se} are, as the linear guide model will be an LA Model, obtained as follows.

Vertical dynamic equivalent load

$F_r = F_r$

Lateral dynamic equivalent load

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

From the above, calculate F_e using formulas for full dynamic equivalent loads shown in page A41. From calculation, the largest full dynamic equivalent loads are as follows.

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

Calculation of full dynamic equivalent load taking account of preload

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

account".

Preload P (X axis linear guide LA55): 8 100 (N)

Preload P (Y axis linear guide LA35): 3 450 (N)

Preload P (Z axis linear guide LA65): 13 800 (N)

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

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

Calculation of mean effective load

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

Therefore,

X axis: $12\ 104 \times 0.7 = 8\ 473\ (N)$

Y axis: $4\ 171 \times 0.7 = 2\ 920\ (N)$

Z axis: $19\ 138 \times 0.7 = 13\ 397\ (N)$

Determine various coefficients

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

For this case the factors are :
 Load coefficient f_w : 1.5
 Hardness coefficient f_H : 1

Calculation of rating life

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

Basic dynamic load rating C_{100}
 (X axis linear guide LA55): 111 000 (N)
Basic dynamic load rating C_{100}
 (Y axis linear guide LA35): 49 000 (N)
Basic dynamic load rating C_{100}
 (Z axis linear guide LA65): 206 000 (N)

Load coefficient f_w : 1.5
Hardness coefficient f_H : 1

Rating fatigue life $L = 100 \times \left(\frac{f_H \cdot C_{100}}{f_w \cdot F_m} \right)^3$

From this,
In case of X axis $L_x = 66\ 617$ (km)
In case of Y axis $L_y = 140\ 012$ (km)
In case of Z axis $L_z = 107\ 722$ (km)

In case of roller linear guides, refer to "A-3-2.2 6.

Calculate using Pattern 4 in Table 2.2.

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

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

$\delta x = -17.9 - (-3.4) = -14.5$ (μm)
 $\delta y = -13.3 - (-9.1) = -4.2$ (μm)
 $\delta z = -14.2 - (-9.3) = -4.9$ (μm)

Deformation at processing points at time of drilling is:

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

Calculation of rating life" (page A43).

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

Basic static load rating C_0
 (X axis linear guide LA55): 215 000 (N)
Basic static load rating C_0
 (Y axis linear guide LA35): 98 000 (N)
Basic static load rating C_0
 (Z axis linear guide LA65): 420 000 (N)

Examine a high-load milling process with large load.

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

Similarly,

Y axis $f_s = 61.5$

Z axis $f_s = 42.0$

Therefore, there is no problem.

(4) Calculation of deformation

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

Rigidity of X axis linear guide LA55Z3: 1 400 (N/μm)
 Rigidity of Y axis linear guide LA35Z3: 825 (N/μm)
 Rigidity of Z axis linear guide LA65Z3: 1 730 (N/μm)

$\delta y = 5.0 - (-9.1) = 14.1$ (μm)
 $\delta z = 14.3 - (-9.3) = 23.6$ (μm)

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

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

A-3-12 Reference

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

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

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

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

Issue No.	Date of Publication	Articles related to linear guides ¹
No.11	October 2001	Development of the NSK S1 Series™ Ball Screws and Linear Guides High Load Capacity Mini LH Series of NSK Linear Guides
No.12	April 2002	NSK Linear Guides & Ball Screws Equipped with NSK K1™ Lubrication Unit
No.12	April 2002	NSK S1 Series™ NSK Linear Guides and Ball Screws
No.13	October 2002	Translide™ -New Rolling Element Linear Motion Bearing-
No.14	May 2003	New Generation of NSK Linear Guides Miniature PU Series
No.15	December 2003	Ultra-Precision NSK Linear Guides for Machine Tools-the HA Series
No.16	August 2004	Numerical Analysis Technology & NSK Linear Guides for Machine Tools
No.16	August 2004	NSK RA Series Roller Guide
No.18	August 2005	New Generation of NSK Linear Guides Miniature PU Series/PE Series
No.20	August 2007	V1 Series of Highly Dust-Resistant NSK Linear Guides
No.21	December 2009	Technological Trends of NSK Linear Guides for Industrial Machines Highly Accurate HS Series of Ultra-Precision NSK Linear Guides Linear Guides for Food Machine and Medical Devices
No.22	March 2011	Technological Trends of NSK Linear Guides for Industrial Machines High-Accuracy HS Series of Ultra-Precision NSK Linear Guides NSK Linear Guides for Food Processing Equipment and Medical Devices
No.23	June 2013	Technological Trends in Linear Motion Rolling Guides for Machine Tools
No.24	December 2014	Slight-Preload Type RA Series Roller Guides of NSK Linear Guides
No.25	September 2015	Precision-Grade, Medium-Preload, Random-Matching NSK Linear Guides Random-Matching, Miniature PU and PE Series of NSK Linear Guides
No.26	April 2016	NSK Roller Guides Equipped with V1 Seals Random-Matching, High-Precision-Grade RA Series Roller Guides
No.27	November 2016	NH Series and NS Series NSK Linear Guides: More than Twice the Life of Conventional NSK Linear Guides
No.30	June 2019	The Technical Trend of Machine Tool Components
No.31	June 2020	Improved Reliability of Roller Guides for Machine Tools NSK K1-L Lubrication Unit
No.33	June 2022	NSK Linear Guides™ Long-life Series: DH/DS Models
No.34	June 2023	Evaluation of Lubrication Performance in Ball Screws and Linear Guides by the Electrical Impedance Method

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

A-3-13 Guide to Technical Services

(1) CAD drawing data

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

<http://www.nsk.com>

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

CAD data offered

NSK linear guides

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

(2) Telephone consultation with NSK engineers

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

A-3-14 Linear Guides: Handling Precautions

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

(1) Lubrication



Confirm lubrication.

- If rust preventive oil has been applied, thoroughly wipe it and put lubricant inside slide before using. For seal lubrication, put lubricant on the rail.
- Do not mix greases of different brands.
- If your linear guide has rust prevention specifications, put lubricant inside slide before using.

(2) Handling



Handle with care.



Do not disassemble.



Do not drop.



Do not impact.

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

(3) Usage precautions



Avoid contamination.



Follow temperature limits.



Use care when hanging upside-down

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

(4) Storage



Store properly.

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

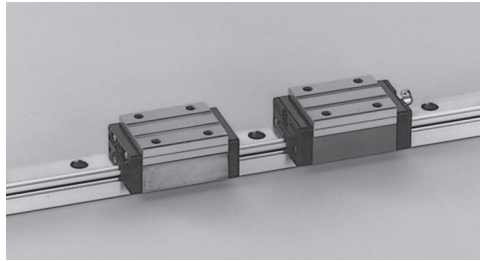
- A place where the indoor environment is hot and humid is not suitable because it significantly reduces the rust prevention effect. Store in a place with low humidity and little temperature change.
- Linear guides may bend if the rail is stored in an inappropriate position. Place it on a suitable surface, and store it in a flat position.

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

- | | |
|--------------------|-------------|
| 1. NH Model | A105 |
| 2. VH Model | A127 |
| 3. NS Model | A147 |
| 4. LW Model | A167 |

A-4-1 General Purpose Series

A-4-1.1 NH Model



1. Features

(1) Improves rating life dramatically

Based on the LH model characterized by reliability and performance, a significant increase in durability has been attained. A new ball groove geometry is introduced utilizing NSK's state-of-the-art tribological and analytical technologies. Rating life is dramatically increased due to the optimized distribution of contact surface pressures. Load rating capacity is 1.3 times higher than LH Model and life is doubled¹. These features enable you to design a machine with a longer life and downsize the machine. Thus, your design capability is greatly enhanced.

*1: Representative values for model.

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

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

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

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

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

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

This increases the capacity to absorb errors in installation.

(5) High vertical load carrying capacity

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

(6) High resistance against impact load

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

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

(7) High accuracy

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

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

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

(9) Abundant variations and sizes

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

(10) Fast delivery

A lineup of interchangeable rails and ball slides

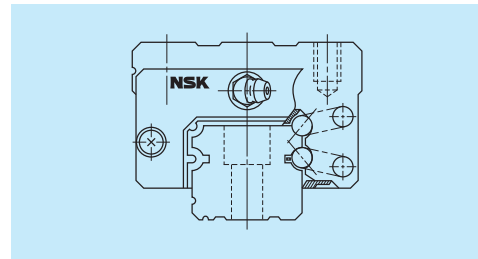


Fig. 1 NH Model

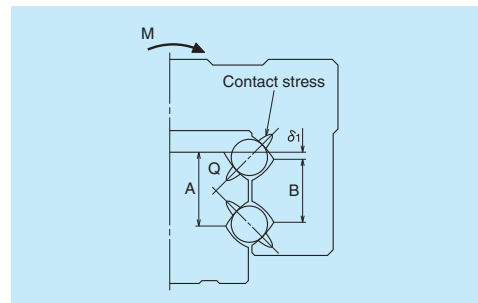


Fig. 2 Enlarged illustration of the offset Gothic arch groove

supports and facilitates fast delivery. Interchangeable precision grade and medium preload types are also available. (Special high-carbon steel products)

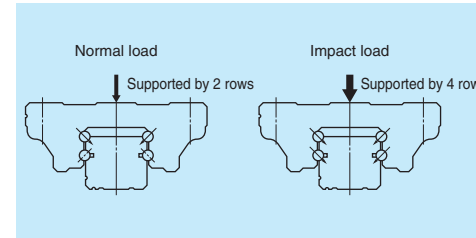


Fig. 3 When load is applied

(11) Option for smooth motion specification

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

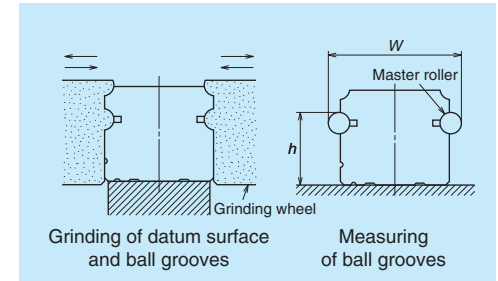


Fig. 4 Rail grinding and measuring

2. Ball slide shape

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

3. Accuracy and preload

(1) Running parallelism of ball slide

Table 1

Unit: μm

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

(2) Accuracy standard

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

• Tolerance of preloaded assembly

Table 2

Unit: μm

Characteristics	Accuracy grade	Ultra precision P3	Super precision P4	High precision P5	Precision grade P6	Normal grade PN
Mounting height H		± 8	± 10	± 20	± 40	± 80
Variation of H (All ball slides on a set of rails)		3	5	7	15	25
Mounting width W_2 or W_3		± 10	± 15	± 25	± 50	± 100
Variation of W_2 or W_3 (All ball slides on reference rail)		3	7	10	20	30
Running parallelism of surface C to surface A		Shown in Table 1, Fig. 5, and Fig. 6				
Running parallelism of surface D to surface B						

• Tolerance of interchangeable type

Table 3

Unit: μm

Accuracy grade	Model No.	High precision grade PH		Normal grade PC	
		NH15, 20, 25, 30, 35	NH45, 55, 65	NH15, 20, 25, 30, 35	NH45, 55, 65
Mounting height H		± 20	± 30	± 20	± 30
Variation of mounting height H		15① 30②	20① 35②	15① 30②	20① 35②
Mounting width W_2 or W_3		± 30	± 35	± 30	± 35
Variation of mounting width W_2 or W_3		20	20	25	30
Running parallelism of surface C to surface A		See Table 1, Fig. 5 and Fig. 6			
Running parallelism of surface D to surface B					

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

(3) Combinations of accuracy and preload

Table 4

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

(4) Assembled accuracy

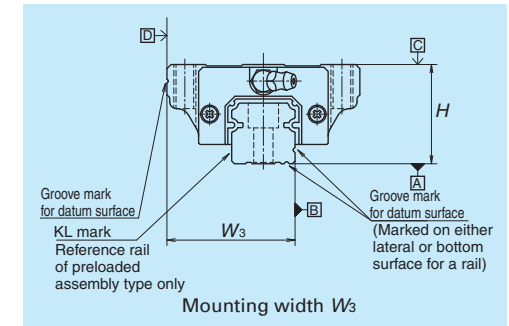
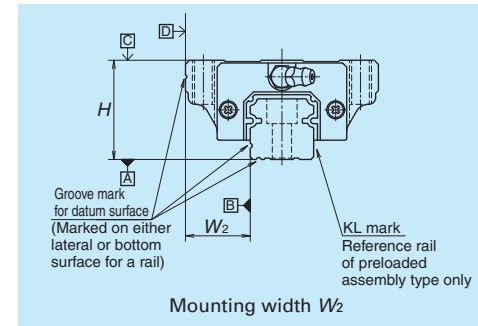


Fig. 5 Special high carbon steel

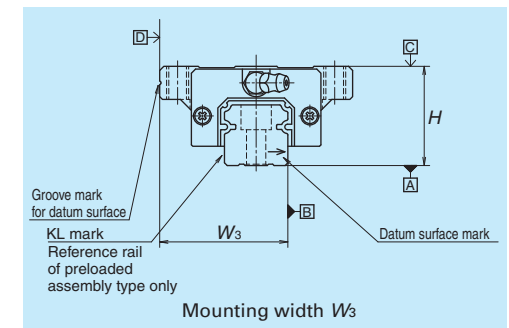
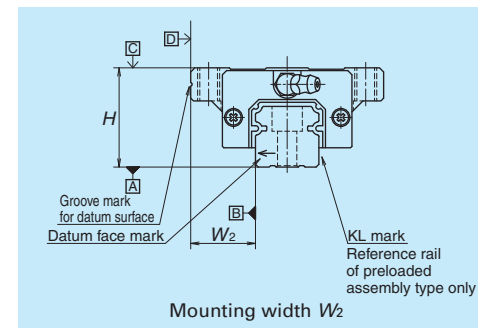


Fig. 6 Stainless steel

(5) Preload and rigidity

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

• Preload and rigidity of preloaded assembly

Table 5

Model No.	Preload (N)		Rigidity (N/μm)			
			Vertical direction		Lateral direction	
	Slight preload Z1	Medium preload Z3	Slight preload Z1	Medium preload Z3	Slight preload Z1	Medium preload Z3
NH15 AN, EM	78	490	137	226	98	186
NH20 AN, EM	147	835	186	335	137	245
NH25 AL, AN, EM	196	1 270	206	380	147	284
NH30 AL, AN	245	1 570	216	400	157	294
NH30 EM	294	1 770	265	480	186	355
NH35 AL, AN, EM	390	2 350	305	560	216	390
NH45 AL, AN, EM	635	3 900	400	745	284	540
NH55 AL, AN, EM	980	5 900	490	910	345	645
NH65 AN, EM	1 470	8 900	580	1 070	400	755
NH15 BN, GM	98	685	196	345	137	284
NH20 BN, GM	196	1 080	265	480	196	355
NH25 BL, BN, GM	245	1 570	294	560	216	400
NH30 BL, BN, GM	390	2 260	360	665	265	480
NH35 BL, BN, GM	490	2 940	430	795	305	570
NH45 BL, BN, GM	785	4 800	520	960	370	695
NH55 BL, BN, GM	1 180	7 050	635	1 170	440	835
NH65 BN, GM	1 860	11 300	805	1 480	550	1 040

Notes: 1) Clearance for Fine clearance Z0 is 0 to 3μm. Therefore, preload is zero.
However, Z0 of PN grade is 0 to 15μm.

2) In case of being applied option for smooth motion operation, preloads are shown in Table 11.

• Clearance and preload of interchangeable type

Table 6

Model No.	Unit: μm		
	Fine clearance ZT	Slight preload ZZ	Medium preload ZH
NH15	-4 to 15	-4 to 0	-7 to -3
NH20	-5 to 15	-5 to 0	-8 to -3
NH25		-5 to 0	-9 to -4
NH30		-7 to 0	-12 to -5
NH35		-7 to 0	-12 to -5
NH45		-7 to 0	-14 to -7
NH55		-9 to 0	-18 to -9
NH65		-9 to 0	-19 to -10

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

4. Maximum rail length

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

Table 7 Length limitations of rails

Model	Material	Unit: mm								
		15	20	25	30	35	45	55	65	
NH	Special high carbon steel	2 980	3 960	3 960	4 000	4 000	3 990	3 960	3 900	
	Stainless steel	1 800	3 500	3 500	3 500					

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

5. Installation

(1) Permissible values of mounting error

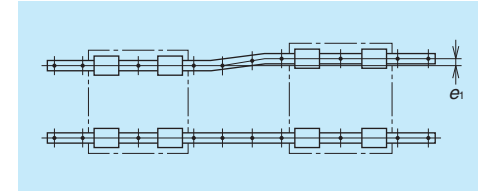


Fig. 7

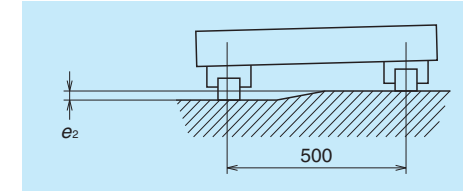


Fig. 8

Table 8

Unit: μm

Value	Preload	Model No.							
		NH15	NH20	NH25	NH30	NH35	NH45	NH55	NH65
Permissible values for parallelism error of two rails e ₁	Z0, ZT	22	30	40	45	55	65	80	110
	Z1, ZZ	18	20	25	30	35	45	55	70
	Z3, ZH	13	15	20	25	30	40	45	60
Permissible values for height error of two rails e ₂	Z0, ZT	375μm/500mm							
	Z1, ZZ, Z3, ZH	330μm/500mm							

Table 9

Unit: mm

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

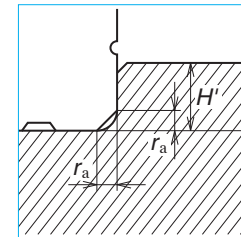


Fig. 9 Shoulder for the rail datum surface

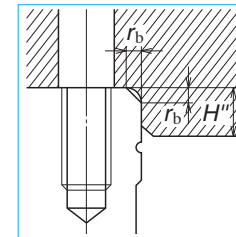


Fig. 10 Shoulder for the ball slide datum surface

Model No.	Corner radius (maximum)		Shoulder height	
	r _a	r _b	H'	H''
NH15	0.5	0.5	4	4
NH20	0.5	0.5	4.5	5
NH25	0.5	0.5	5	5
NH30	0.5	0.5	6	6
NH35	0.5	0.5	6	6
NH45	0.7	0.7	8	8
NH55	0.7	0.7	10	10
NH65	1	1	11	11

6. Maximum allowable speed

Table 10 indicates the maximum allowable speed for 10,000 km operation when using an NH model under normal conditions. However, the maximum allowable speed can be affected by accuracy of installation, operating temperature, external load, etc. If the operation is made exceeding the permissible distance and speed, please consult NSK.

Table 10 Maximum allowable speed

Unit: m/min

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

7. Option for smooth motion specification

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

(1) Mechanism for smooth motion

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

(2) Supported models

3 models supported: NH15, NH20, and NH25. Can be combined with various options,

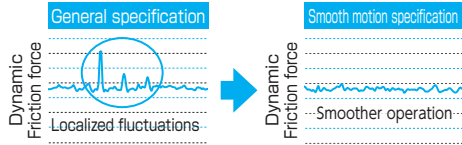


Fig. 11 Image of dynamic friction force of slide

including newly developed NSK K1-L lubrication units, stainless steel specifications, surface treatments, interchangeable types, etc.

- Mounting dimensions such as assembly height, assembly width, and screw diameter/pitch of mounting hole are identical to standard specifications.

(3) Handling precautions

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

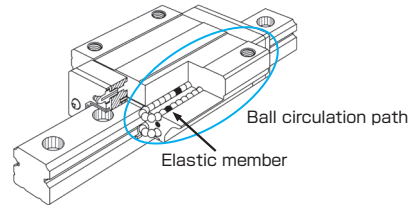


Fig. 12 Mechanism (structure)

Table 11

Model No.	Preload (N)		Rigidity (N/μm)			
			Vertical direction		Lateral direction	
	Slight preload (Z1)	Medium preload (Z3)	Slight preload (Z1)	Medium preload (Z3)	Slight preload (Z1)	Medium preload (Z3)
NH15 AN, EM	78	490	122	201	87	166
NH20 AN, EM	147	835	165	298	121	218
NH25 AL, AN, EM	196	1 270	181	334	130	251
NH15 BN, GM	98	685	182	318	127	262
NH20 BN, GM	196	1 080	244	442	181	328
NH25 BL, BN, GM	245	1 570	271	517	199	370

Table 12

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

8. Lubrication components

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

(1) Types of lubrication accessories

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

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

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

Please contact NSK if stainless lubrication accessories are required.

(2) Mounting position of lubrication accessories

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

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

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

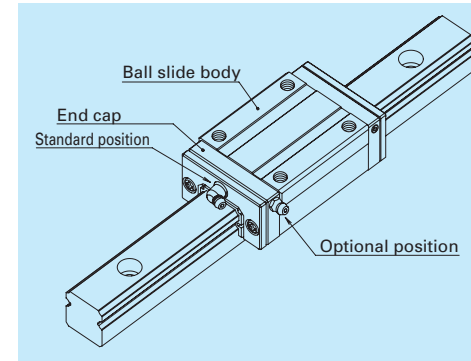


Fig. 14 Mounting position of lubrication accessories

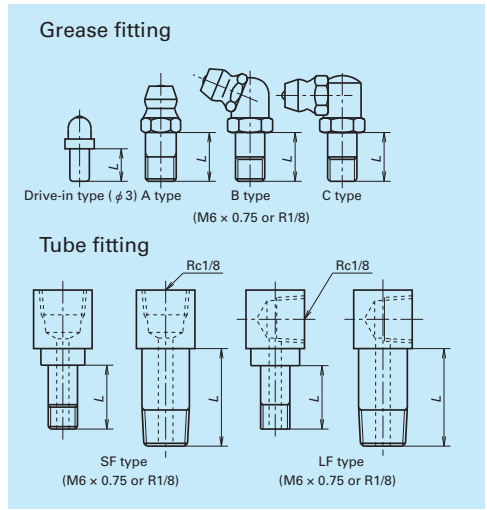


Fig. 13 Grease fitting and tube fitting

Table 13 Unit: mm

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

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

9. Dust-resistant components

(1) Standard specification

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

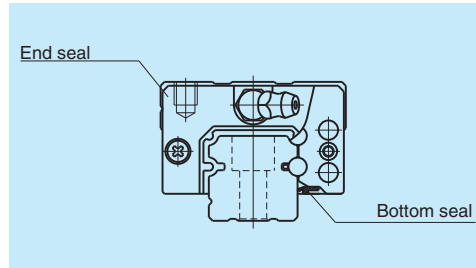


Fig. 15

Table 14 Seal friction per ball slide (maximum value)

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

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

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

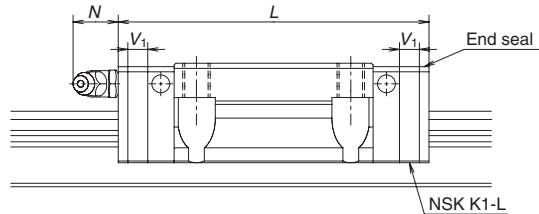


Table 15 Dimensions when equipped with NSK K1-L lubrication units

Model No.	Ball slide length	Ball slide shape code	Standard ball slide length	Ball slide length with two NSK K1-L units L	Unit: mm	
					Thickness of single NSK K1-L unit V ₁	Protrusion of grease fitting N
NH15	Standard	AN, EM	55	65.6	5.3	(5)
	Long	BN, GM	74	84.6		
NH20	Standard	AN, EM	69.8	80.4	5.3	(14)
	Long	BN, GM	91.8	102.4		
NH25	Standard	AL, AN, EM	79	90.6	5.8	(14)
	Long	BL, BN, GM	107	118.6		
NH30	Standard	AL, AN, EM	85.6	97.6	6	(14)
	Long	BL, BN, GM	124.6	136.6		
NH35	Standard	AL, AN, EM	109	122	6.5	(14)
	Long	BL, BN, GM	143	156		
NH45	Standard	AL, AN, EM	139	154	7.5	(15)
	Long	BL, BN, GM	171	186		
NH55	Standard	AL, AN, EM	163	178	7.5	(15)
	Long	BL, BN, GM	201	216		
NH65	Standard	AN, EM	193	211	9	(16)
	Long	BN, GM	253	271		

Notes: 1) When using NSK K1 for food processing machinery/medical equipment, refer to Table 16.
 2) Slide length when equipped with NSK K1-L = (standard ball slide length) + (V₁, thickness of single NSK K1-L unit) × (number of K1-L units).

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

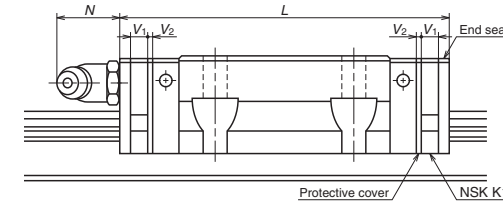


Table 16 Dimensions when equipped with NSK K1 for food processing machinery/medical equipment

Model No.	Ball slide length	Ball slide shape code	Standard ball slide length	Ball slide length with two NSK K1 installed L	Unit: mm		
					Thickness of single NSK K1 V ₁	Protective cover thickness V ₂	Protrusion of grease fitting N
NH15	Standard	AN, EM	55	65.6	4.5	0.8	(5)
	Long	BN, GM	74	84.6			
NH20	Standard	AN, EM	69.8	80.4	4.5	0.8	(14)
	Long	BN, GM	91.8	102.4			
NH25	Standard	AL, AN, EM	79.0	90.6	5.0	0.8	(14)
	Long	BL, BN, GM	107	118.6			
NH30	Standard	AL, AN, EM	85.6	97.6	5.0	1.0	(14)
	Long	BL, BN, GM	124.6	136.6			
NH35	Standard	AL, AN, EM	109	122	5.5	1.0	(14)
	Long	BL, BN, GM	143	156			

Note: Slide length when equipped with NSK K1 for food processing machinery/medical equipment = (standard ball slide length) + (V₁, thickness of single NSK K1 unit) × (number of K1 units) + (V₂, thickness of the protective cover) × 2.

(3) Double seal

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

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

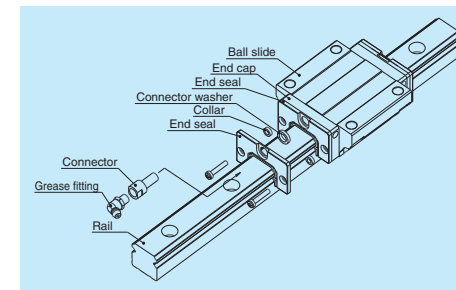


Fig. 16 Double seal

(4) Protector

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

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

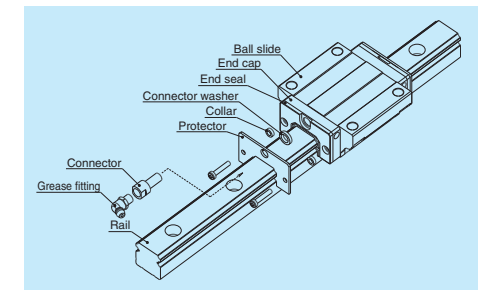


Fig. 17 Protector

Table 17 Double-seal set

Model No.	Reference No.		Increased thickness V_3 (mm)
	Without connector	With connector	
NH15	LH15WS-01	*	2.5
NH20	LH20WS-01	LH20WSC-01	2.5
NH25	LH25WS-01	LH25WSC-01	2.8
NH30	LH30WS-01	LH30WSC-01	3.6
NH35	LH35WS-01	LH35WSC-01	3.6
NH45	LH45WS-01	LH45WSC-01	4.3
NH55	LH55WS-01	LH55WSC-01	4.3
NH65	LH65WS-01	LH65WSC-01	4.9

Table 18 Protector set

Model No.	Reference No.		Increased thickness V_4 (mm)
	Without connector	With connector	
NH15	LH15PT-01	*	2.7
NH20	LH20PT-01	LH20PTC-01	2.9
NH25	LH25PT-01	LH25PTC-01	3.2
NH30	LH30PT-01	LH30PTC-01	4.2
NH35	LH35PT-01	LH35PTC-01	4.2
NH45	LH45PT-01	LH45PTC-01	4.9
NH55	LH55PT-01	LH55PTC-01	4.9
NH65	LH65PT-01	LH65PTC-01	5.5

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

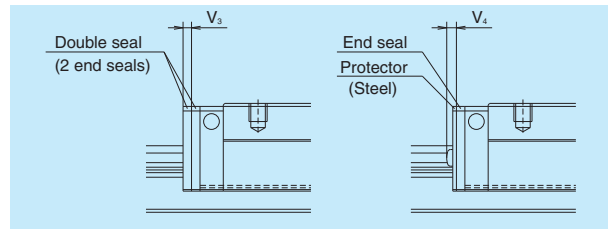


Fig. 18

(5) Caps to plug the rail mounting bolt hole

Table 19 Caps to plug rail bolt hole

Model No.	Bolt to secure rail	Cap reference No.	Quantity /case
NH15	M4	LG-CAP/M4	20
NH20	M5	LG-CAP/M5	20
NH25	M6	LG-CAP/M6	20
NH30, NH35	M8	LG-CAP/M8	20
NH45	M12	LG-CAP/M12	20
NH55	M14	LG-CAP/M14	20
NH65	M16	LG-CAP/M16	20

(6) Inner seal

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

Table 20

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

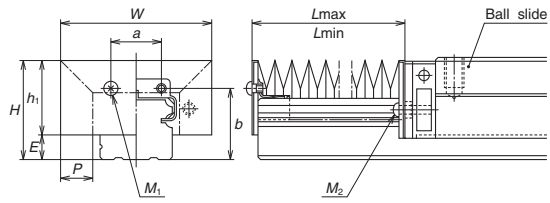
(7) Bellows

- A bellows fastener kit, which includes one bellows fastener, two M_1 set screws, two M_2 set screws, and two collars for M_2 set screws as shown in Fig. 7.7 on page A69, is supplied with bellows for the ends.
- Middle bellows are supplied with four set screws and four collars.
- Use a bellows fastener kit as shown in **Table 21**, when installing bellows to completed standard products.
- When NSK K1/K1-L units, NSK K1 for food and medical equipment, double seals, or protectors are used, the set screws of bellows fastener kits cannot be used. Please contact NSK for details.
- Bellows fasteners are available only for horizontal mounting positions; other mounting positions require a sliding plate (see **Fig. 7.10** on page A70). To fix the bellows to the rail, make tap holes on the rail end surface. Fix the bellows mounting plate to the rail end surface through these tap holes with a machine screw. NSK prepares tap holes on the rail end surface when bellows are ordered with a linear guide.

Table 21 Bellows fastner kit reference No.

Model No.	Kit reference No.
NH20	LH20FS-01
NH25	LH25FS-01
NH30	LH30FS-01
NH35	LH35FS-01
NH45	LH45FS-01
NH55	LH55FS-01
NH65	LH65FS-01

Dimension tables for bellows
NH Model



Bellows reference number

J A H 20 N 08

Bellows: J (Bellows for the ends), A (Middle bellows), H (Bellows for NH model)

Number of BL (fold number): 20

N: High type, L: Low type

Size number of linear guide: 08

Fig. 19 Dimensions of bellows

Table 22 Dimensions of bellows

Unit: mm

Model No.	H	h ₁	E	W	P	a	b	BL minimum length	M ₁ Tap x depth	M ₂ Tap x depth
JAH20N	29.5	24.5	5	48	10	13	22	17	M3 × 5	M2.5 × 16
JAH25L	35	28	7	51	10	16	26	17	M3 × 5	M3 × 18
JAH25N	39	32		61	15					
JAH30L	41	32	9	60	12	18	31	17	M4 × 6	M4 × 22
JAH30N	44	35		66	15					
JAH35L	47	37.5	9.5	72	15	24	34	17	M4 × 6	M4 × 23
JAH35N	54	44.5		82	20					
JAH45L	59	45	14	83	15	32	44.5	17	M5 × 8	M5 × 28
JAH45N	69	55		103	25					
JAH55L	69	54	15	101	20	40	50.5	17	M5 × 8	M5 × 30
JAH55N	79	64		121	30					
JAH65N	89	73	16	131	30	48	61	17	M6 × 8	M6 × 35

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

Unit: mm

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

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

NH Model

10. Reference number

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

(1) Reference number for preloaded assembly

NH 30 1200 ANC 2 - P5 3**

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

(2) Reference number for interchangeable type

NAH 30 ANSZ -L

Interchangeable ball slide model code									
NAH: NH Model interchangeable ball slide									
Size									
Ball slide shape code (See page A106.)									
							Option code		
							-L: Equipped with NSK K1-L		
							-F: Fluoride low temperature chrome plating+AS2 grease		
							-F50: Fluoride low temperature chrome plating+LG2 grease		
							Preload code		
							No code: Fine clearance, Z: Slight preload, H: Medium preload		
							Material code		
							No code: Special high carbon steel (NSK standard), S: Stainless steel		

Rail N1H30 1200 LCN - PC Z**

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

When interchangeable rails and slides are assembled, reference number coding is the same as that for preloaded assemblies. However, only preload codes T (fine clearance), Z (slight preload), and H (medium preload) may be used (Refer to Page A108.)

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

Table 24 Material/surface treatment code

Code	Description
C	Special high carbon steel (NSK standard)
K	Stainless steel (NH15 to NH30 only)
D	Special high carbon steel with surface treatment
H	Stainless steel with surface treatment
Z	Other, special

Note: High-precision grade and medium preload of interchangeable types are not available in stainless steel.

Table 25 Accuracy code

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

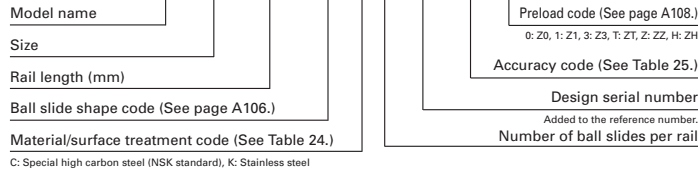
Notes: 1) Refer to page A58 for details on NSK K1-L lubrication units and to page A73 for details on NSK K1 lubrication units for food processing machinery/medical equipment.
2) Refer to page A111 for option for smooth motion operation.

11. Dimensions

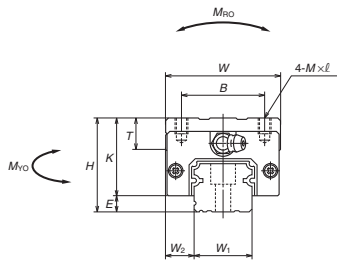
NH-AN (High-load / Standard)

NH-BN (Super-high-load / Long)

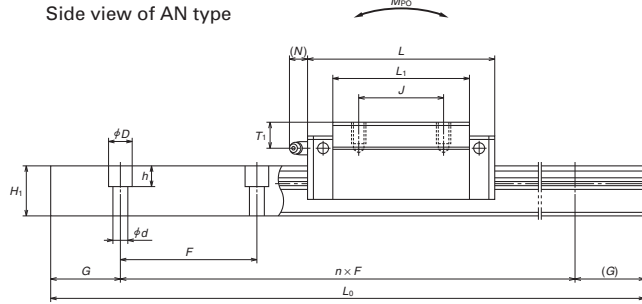
NH 30 1200 ANC 2 -** PC Z



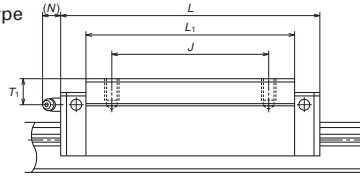
Front view of AN and BN types



Side view of AN type



Side view of BN type

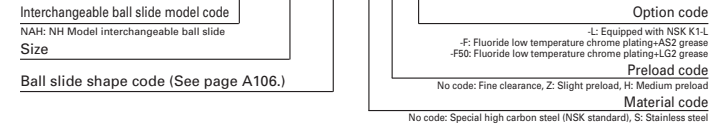


Model No.	Assembly			Ball slide										Width	Height	
	Height	Width	Length	Mounting hole						Grease fitting						
				B	J	M x pitch x l	L1	K	T	Hole size	T1	N	W1			H1
NH15AN	28	4.6	9.5	34	55	26	26	M4x0.7x6	39	23.4	8	phi 3	8.5	3.3	15	15
NH15BN					74				58							
NH20AN	30	5	12	44	69.8	32	36	M5x0.8x6	50	25	12	M6x0.75	5	11	20	18
NH20BN					91.8				72							
NH25AN	40	7	12.5	48	79	35	35	M6x1x9	58	33	12	M6x0.75	10	11	23	22
NH25BN					107				86							
NH30AN	45	9	16	60	85.6	40	40	M8x1.25x10	59	36	14	M6x0.75	10	11	28	26
NH30BN					124.6				98							
NH35AN	55	9.5	18	70	109	50	50	M8x1.25x12	80	45.5	15	M6x0.75	15	11	34	29
NH35BN					143				114							
NH45AN	70	14	20.5	86	139	60	60	M10x1.5x17	105	56	17	Rc1/8	20	13	45	38
NH45BN					171				137							
NH55AN	80	15	23.5	100	163	75	75	M12x1.75x18	126	65	18	Rc1/8	21	13	53	44
NH55BN					201				164							
NH65AN	90	16	31.5	126	193	76	70	M16x2x20	147	74	23	Rc1/8	19	13	63	53
NH65BN					253				207							

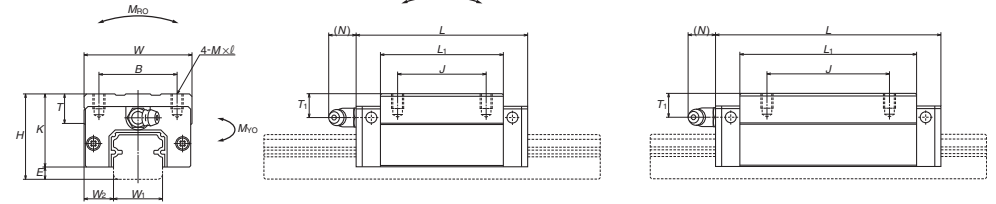
Notes: 1) The external appearance of stainless steel ball slides differs slightly from that of carbon steel ball slides.

Reference number for ball slide of interchangeable type

Ball slide NAH 30 AN SZ -L

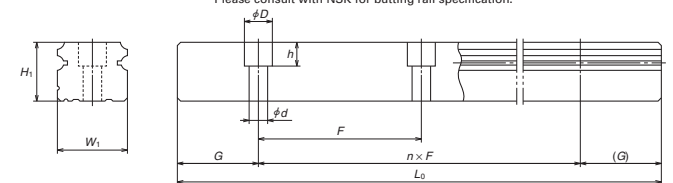
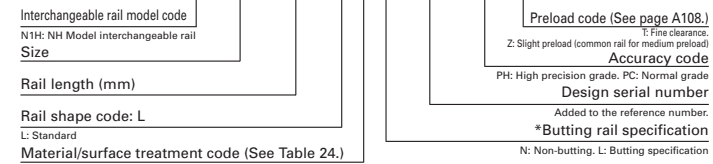


AN and BN types



Reference number for rail of interchangeable type

Rail N1H30 1200 LCN -** PC Z



Unit: mm

Rail		Basic load ratings								Weight			
Pitch	Mounting bolt hole	G	Max. length L _{max} () for stainless	Dynamic		C ₀ (N)	M _{ro}	Static moment (N-m)				Ball slide (kg)	Rail (kg/m)
				[50km] C ₅₀ (N)	[100km] C ₁₀₀ (N)			M _{FO}		M _{VO}			
				F	d x D x h			One slide	Two slides	One slide	Two slides		
60	4.5x7.5x5.3	20	2 980 (1 800)	14 200	11 300	20 700	108	94.5	575	79.5	480	0.18	1.6
60	6x9.5x8.5	20	3 960 (3 500)	18 100	14 400	32 000	166	216	1 150	181	965	0.26	2.6
60	7x11x9	20	3 960 (3 500)	23 700	18 800	32 500	219	185	1 140	155	955	0.33	3.6
80	9x14x12	20	4 000 (3 500)	30 000	24 000	50 500	340	420	2 230	355	1 870	0.48	5.2
80	9x14x12	20	4 000 (3 500)	33 500	26 800	46 000	360	320	1 840	267	1 540	0.55	7.2
80	9x14x12	20	4 000 (3 500)	41 000	32 500	51 500	490	350	2 290	292	1 920	0.77	
105	14x20x17	22.5	3 990	61 000	48 500	91 500	870	1 030	5 600	865	4 700	1.3	12.3
120	16x23x20	30	3 960	62 500	49 500	80 500	950	755	4 500	630	3 800	1.5	16.9
150	18x26x22	35	3 900	81 000	64 500	117 000	1 380	1 530	8 350	1 280	7 000	2.1	24.3

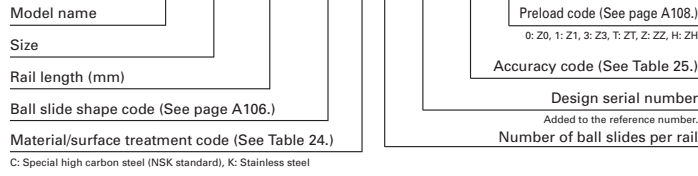
2) Basic load ratings comply with ISO standards (ISO 14728-1, 14728-2).

C₅₀; the basic dynamic load rating for 50 km rated fatigue life C₁₀₀; the basic dynamic load rating for 100 km rated fatigue life The basic static load rating shows static permissible load. In case of being applied option for smooth motion operation, basic load ratings are shown in Table 12.

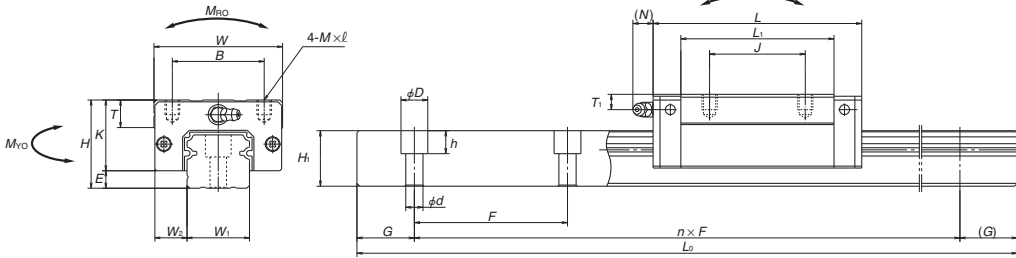
3) High-precision grade and medium preload interchangeable types are available for high-carbon steel products.

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

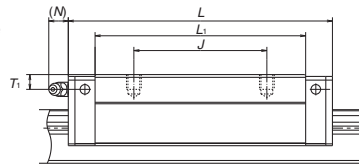
NH 30 1200 AL C 2 - PC Z**



Front view of AL and BL types Side view of AL type



Side view of BL type

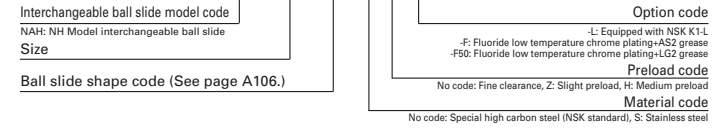


Model No.	Assembly			Ball slide											Width	Height
	Height	Width	Length	Mounting hole						Grease fitting			Width	Height		
				B	J	M x pitch x l	L ₁	K	T	Hole size	T ₁	N				
NH25AL NH25BL	36	7	12.5	48	79 107	35	35 50	M6x1x6	58 86	29	12	M6x0.75	6	11	23	22
NH30AL NH30BL	42	9	16	60	85.6 124.6	40	40 60	M8x1.25x8	59 98	33	14	M6x0.75	7	11	28	26
NH35AL NH35BL	48	9.5	18	70	109 143	50	50 72	M8x1.25x8	80 114	38.5	15	M6x0.75	8	11	34	29
NH45AL NH45BL	60	14	20.5	86	139 171	60	60 80	M10x1.5x10	105 137	46	17	Rc1/8	10	13	45	38
NH55AL NH55BL	70	15	23.5	100	163 201	75	75 95	M12x1.75x13	126 164	55	15	Rc1/8	11	13	53	44

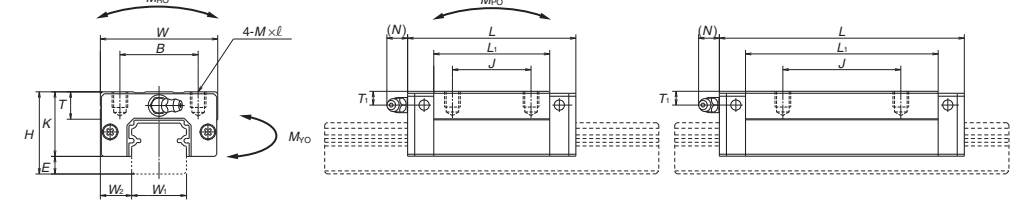
Notes: 1) The external appearance of stainless steel ball slides differs slightly from that of carbon steel ball slides.

Reference number for ball slide of interchangeable type

Ball slide NAH 30 AL SZ -L

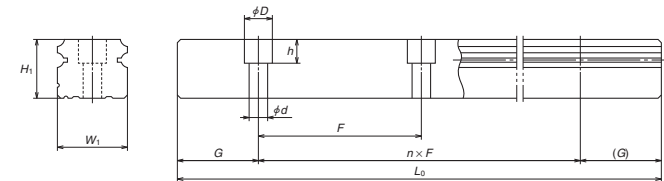
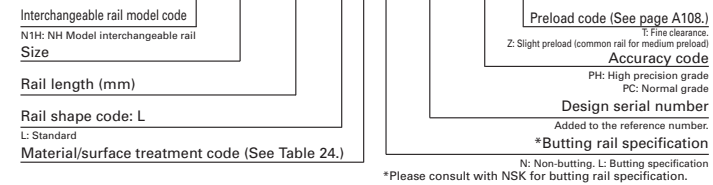


AL and BL types AL type BL type



Reference number for rail of interchangeable type

Rail N1H30 1200 LCN - PC Z**



Unit: mm

Rail	Pitch	Mounting bolt hole	G	Max. length L _{max} (mm) for stainless	Basic load ratings						Weight		
					² Dynamic		Static C ₀ (N)	M _{RO}	Static moment (N-m)		Ball slide (kg)	Rail (kg/m)	
					[50km] C ₅₀ (N)	[100km] C ₁₀₀ (N)			M _{PO} One slide	M _{PO} Two slides			M _{VO} One slide
60	7x11x9	20	3 960 (3 500)	33 500 45 500	26 800 36 500	46 000 71 000	360 555	320 725	1 840 3 700	267 610	1 540 3 100	0.46 0.69	3.6
80	9x14x12	20	4 000 (3 500)	41 000 61 000	32 500 48 500	51 500 91 500	490 870	350 1 030	2 290 5 600	292 865	1 920 4 700	0.69 1.16	5.2
80	9x14x12	20	4 000	62 500 81 000	49 500 64 500	80 500 117 000	950 1 380	755 1 530	4 500 8 350	630 1 280	3 800 7 000	1.2 1.7	7.2
105	14x20x17	22.5	3 990	107 000 131 000	84 500 104 000	140 000 187 000	2 140 2 860	1 740 3 000	9 750 15 600	1 460 2 520	8 150 13 100	2.2 2.9	12.3
120	16x23x20	30	3 960	158 000 193 000	125 000 153 000	198 000 264 000	3 600 4 850	3 000 5 150	16 300 26 300	2 510 4 350	13 700 22 100	3.7 4.7	16.9

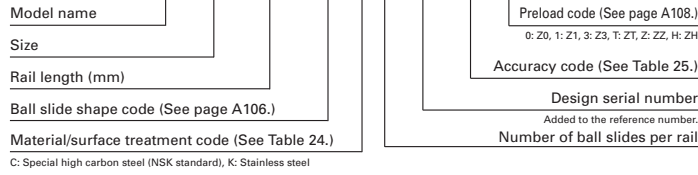
2) Basic load ratings comply with ISO standards (ISO 14728-1, 14728-2).

C₅₀: the basic dynamic load rating for 50 km rated fatigue life C₁₀₀: the basic dynamic load rating for 100 km rated fatigue life
The basic static load rating shows static permissible load. In case of being applied option for smooth motion operation, basic load ratings are shown in Table 12.

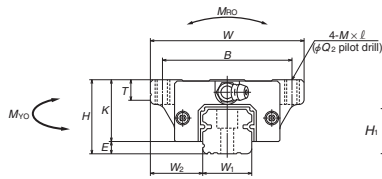
3) High-precision grade and medium preload interchangeable types are available for high-carbon steel products.

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

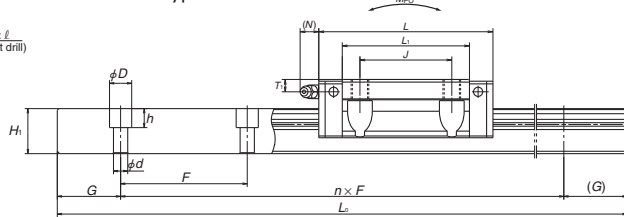
NH 30 1200 EM C 2 - PC Z**



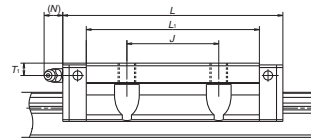
Front view of EM and GM types



Side view of EM type



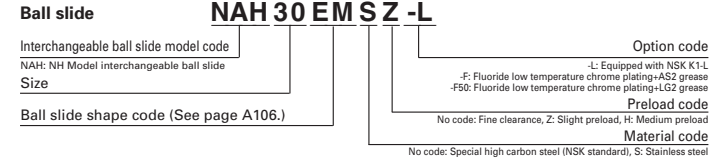
Side view of GM type



Model No.	Assembly			Ball slide											Width	Height			
	Height	E	W ₂	Width	Length	Mounting hole				L ₁	K	T	Grease fitting				W ₁	H ₁	
						B	J	M × pitch × ℓ	Q ₂				Hole size	T ₁					N
NH15EM	24	4.6	16	47	55	38	30	M5×0.8×7	4.4	39	19.4	8	φ 3	4.5	3.3	15	15		
NH15GM					74					58									
NH20EM	30	5	21.5	63	69.8	53	40	M6×1×9.5	5.3	50	25	10	M6×0.75	5	11	20	18		
NH20GM					91.8					72									
NH25EM	36	7	23.5	70	79	57	45	M8×1.25×10	6.8	58	29	11	M6×0.75	6	11	23	22		
NH25GM					107			(M8×1.25×11.5)		86		(12)							
NH30EM	42	9	31	90	98.6	72	52	M10×1.5×12	8.6	72	33	11	M6×0.75	7	11	28	26		
NH30GM					124.6			(M10×1.5×14.5)		98		(15)							
NH35EM	48	9.5	33	100	109	82	62	M10×1.5×13	8.6	80	38.5	12	M6×0.75	8	11	34	29		
NH35GM					143					114									
NH45EM	60	14	37.5	120	139	100	80	M12×1.75×15	10.5	105	46	13	Rc1/8	10	13	45	38		
NH45GM					171					137									
NH55EM	70	15	43.5	140	163	116	95	M14×2×18	12.5	126	55	15	Rc1/8	11	13	53	44		
NH55GM					201					164									
NH65EM	90	16	53.5	170	193	142	110	M16×2×24	14.6	147	74	23	Rc1/8	19	13	63	53		
NH65GM					253					207									

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

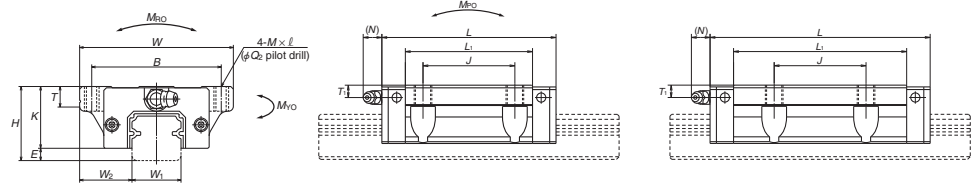
Reference number for ball slide of interchangeable type



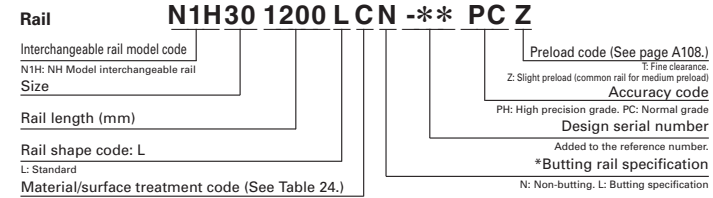
EM and GM types

EM type

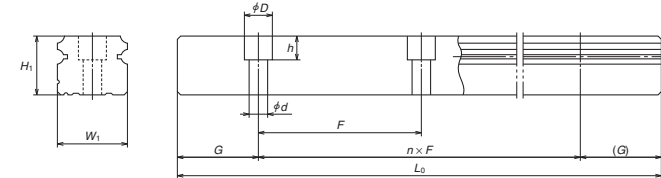
GM type



Reference number for rail of interchangeable type



*Please consult with NSK for butting rail specification.

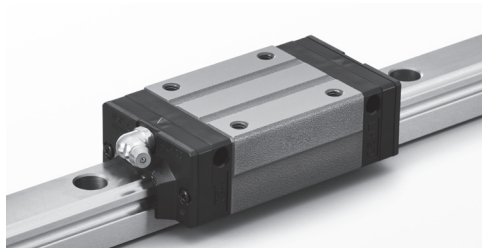


Unit: mm

Rail		Basic load ratings										Weight	
Pitch	Mounting bolt hole	G	Max. length L _{0max} () for stainless	Dynamic		Static	Static moment (N-m)				Ball slide (kg)	Rail (kg/m)	
				[50km]	[100km]		C ₀	M _{PO}		M _{VO}			
				C ₅₀ (N)	C ₁₀₀ (N)	(N)		One slide	Two slides	One slide	Two slides		
60	4.5×7.5×5.3	20	2 980 (1 800)	14 200	11 300	20 700	108	94.5	575	79.5	480	0.17	1.6
60	6×9.5×8.5	20	3 960 (3 500)	30 000	24 000	32 500	219	185	1 140	155	955	0.45	2.6
60	7×11×9	20	3 960 (3 500)	33 500	26 800	46 000	360	320	1 840	267	1 540	0.63	3.6
80	9×14×12	20	4 000 (3 500)	47 000	37 500	63 000	600	505	3 150	425	2 650	1.2	5.2
80	9×14×12	20	4 000	61 000	48 500	91 500	870	1 030	5 600	865	4 700	1.6	
80	9×14×12	20	4 000	62 500	49 500	80 500	950	755	4 500	630	3 800	1.7	7.2
105	14×20×17	22.5	3 990	107 000	84 500	140 000	2 140	1 740	9 750	1 460	8 150	3	12.3
120	16×23×20	30	3 960	131 000	104 000	187 000	2 860	3 000	15 600	2 520	13 100	3.9	
150	18×26×22	35	3 900	158 000	125 000	198 000	3 600	3 000	16 300	2 510	13 700	5	16.9
				193 000	153 000	264 000	4 850	5 150	26 300	4 350	22 100	6.5	
				239 000	190 000	281 000	6 150	4 950	27 900	4 150	23 400	10	24.3
				310 000	246 000	410 000	8 950	10 100	51 500	8 450	43 500	14.1	24.3

3) Basic load ratings comply with ISO standards (ISO 14728-1, 14728-2).
C₅₀: the basic dynamic load rating for 50 km rated fatigue life C₁₀₀: the basic dynamic load rating for 100 km rated fatigue life
The basic static load rating shows static permissible load. In case of being applied option for smooth motion operation, basic load ratings are shown in Table 12.
4) High-precision grade and medium preload interchangeable types are available for high-carbon steel products.

A-4-1.2 VH Model



1. Features

(1) High-performance end seals

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

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

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

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

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

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

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

(5) High vertical load carrying capacity

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

(6) High resistance against impact load

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

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

resistance to impact load.

(7) High accuracy

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

(8) Interchangeable

Interchangeable rails and ball slides are available.

(9) Improve rating life dramatically

A new ball groove geometry is introduced utilizing NSK's state-of-the-art tribological and

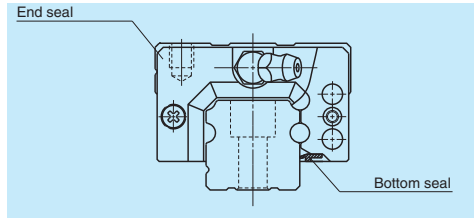


Fig. 1 VH Model

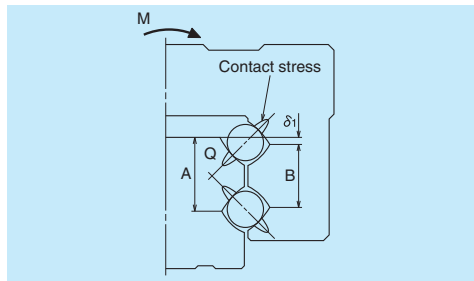


Fig. 2 Enlarged illustration of the offset Gothic arch groove

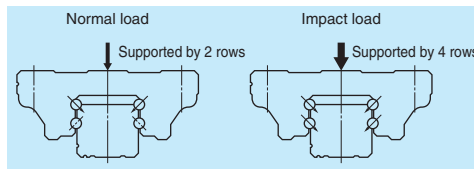


Fig. 3 When load is applied

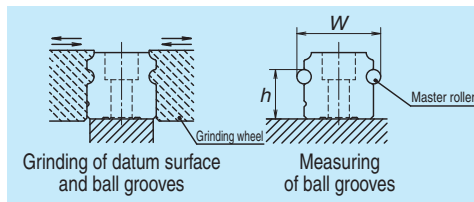


Fig. 4 Rail grinding and measuring

analytical technologies. Rating life is dramatically increased due to the optimized distribution of contact surface pressures.

Load rating capacity is 1.3 times higher than conventional products and life is doubled^{*1}.

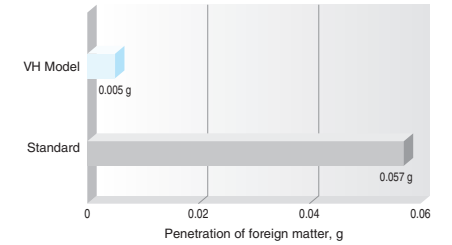
*1: Representative values for model.

● Comparison with NSK standard products

Level of fine contaminants reduced by 90% or more. Results of dust resistance tests reveal that the entry of fine contaminants is reduced to less than one-tenth that of existing standard models due to improvements in sealing.

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

(preload of 3 200 N)
 Rail orientation : Horizontal (wall mount)
 Speed : 400 mm/sec
 Lubrication : AS2 grease (prepacked AS2 only)
 Contaminant : Fine wood particles

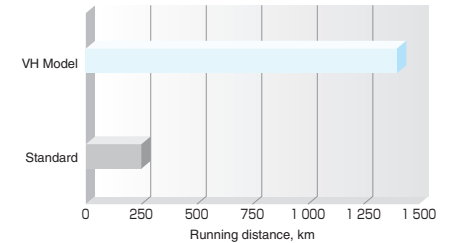


Operating life under contaminated environments is more than 5 times longer

Durability test with rubber fragments

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

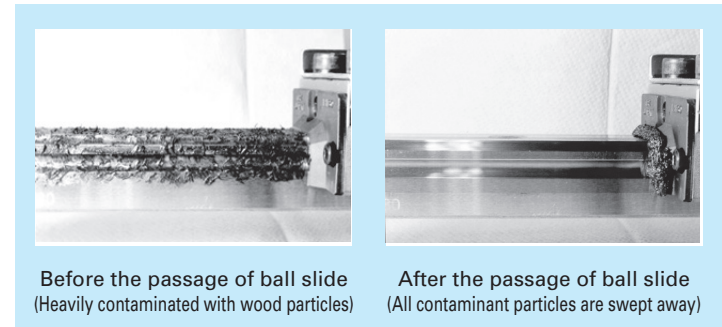
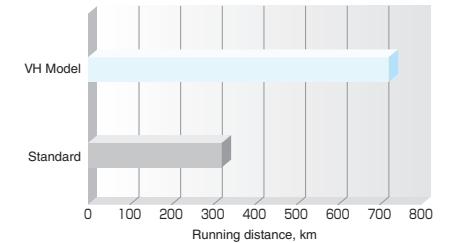
Test sample : VH30AN, preload code Z1 (preload of 245 N)
 Rail orientation : Horizontal (wall mount)
 Speed : 500 mm/sec
 Lubrication : AS2 grease (prepacked AS2 only)
 Contaminant : Rubber fragments



Durability test with fine wood particles

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

Test sample : VH30AN



Before the passage of ball slide (Heavily contaminated with wood particles)

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

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

2. Ball slide shape

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

3. Accuracy and preload

(1) Running parallelism of ball slide

Unit: μm

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

(2) Accuracy standard

The preloaded assembly has five accuracy grades: Ultra precision P3, Super precision P4, High precision P5, Precision P6, and Normal PN grades, while the interchangeable type has Normal PC grade only.

• Tolerance of preloaded assembly

Unit: μm

Characteristics	Accuracy grade	Ultra precision P3	Super precision P4	High precision P5	Precision grade P6	Normal grade PN
Mounting height H		± 8	± 10	± 20	± 40	± 80
Variation of H (All ball slides on a set of rails)		3	5	7	15	25
Mounting width W_2 or W_3		± 10	± 15	± 25	± 50	± 100
Variation of W_2 or W_3 (All ball slides on reference rail)		3	7	10	20	30
Running parallelism of surface C to surface A Running parallelism of surface D to surface B		Shown in Table 1, Fig. 5 and Fig. 6				

• Tolerance of interchangeable type: Normal grade PC

Unit: μm

Characteristics	Model No.	VH15, 20, 25, 30, 35	VH45, 55
Mounting height H		± 20	± 30
Variation of mounting height H		15 ^① 30 ^②	20 ^① 35 ^②
Mounting width W_2 or W_3		± 30	± 35
Variation of mounting width W_2 or W_3		25	30
Running parallelism of surface C to surface A Running parallelism of surface D to surface B		See Table 1, Fig. 5 and Fig. 6	

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

(3) Combinations of accuracy and preload

Table 4

	Accuracy grade						
	Ultra precision	Super precision	High Precision	Precision grade	Normal grade	Normal grade	
With NSK K1-L lubrication unit	L3	L4	L5	L6	LN	LC	
Preload	Fine clearance Z0	○	○	○	○	○	—
	Slight preload Z1	○	○	○	○	○	—
	Medium preload Z3	○	○	○	○	—	—
	Interchangeable type with fine clearance ZT	—	—	—	—	—	○
	Interchangeable type with slight preload ZZ	—	—	—	—	—	○

(4) Assembled accuracy

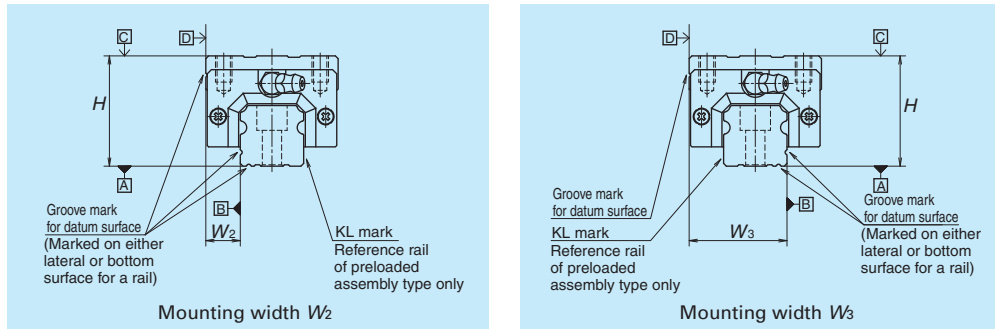


Fig. 5 Special high carbon steel

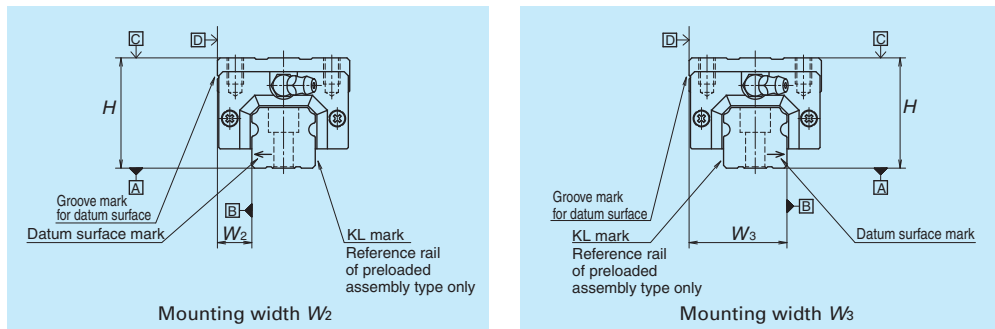


Fig. 6 Stainless steel

(5) Preload and rigidity

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

• Preload and rigidity of preloaded assembly

Table 5

Model No.	Preload (N)		Rigidity (N/μm)				
			Vertical direction		Lateral direction		
	Slight preload Z1	Medium preload Z3	Slight preload Z1	Medium preload Z3	Slight preload Z1	Medium preload Z3	
High-load	VH15 AN, EM	78	490	137	226	98	186
	VH20 AN, EM	147	835	186	335	137	245
	VH25 AN, AL, EM	196	1 270	206	380	147	284
	VH30 AN, AL	245	1 570	216	400	157	294
	VH30 EM	294	1 770	265	480	186	355
	VH35 AN, AL, EM	390	2 350	305	560	216	390
	VH45 AN, AL, EM	635	3 900	400	745	284	540
Super-high-load	VH55 AN, AL, EM	980	5 900	490	910	345	645
	VH15 BN, GM	98	685	196	345	137	284
	VH20 BN, GM	196	1 080	265	480	196	355
	VH25 BN, BL, GM	245	1 570	294	560	216	400
	VH30 BN, BL, GM	390	2 260	360	665	265	480
	VH35 BN, BL, GM	490	2 940	430	795	305	570
	VH45 BN, BL, GM	785	4 800	520	960	370	695
	VH55 BN, BL, GM	1 180	7 050	635	1 170	440	835

Note: Clearance for Fine clearance Z0 is 0 to 3 μm. Therefore, preload is zero.

However, Z0 of PN grade is 0 to 15 μm.

• Preload of interchangeable type

Table 6

Unit: μm

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

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

4. Maximum rail length

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

Table 7 Length limitations of rails

Unit: mm

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

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

5. Installation

(1) Permissible values of mounting error

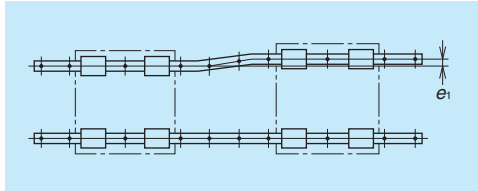


Fig. 7

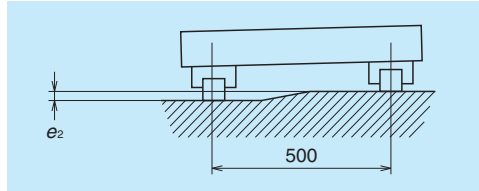


Fig. 8

Table 8

Unit: μm

Value	Preload	Model No.						
		VH15	VH20	VH25	VH30	VH35	VH45	VH55
Permissible values for parallelism error of two rails e_1	Z0, ZT	22	30	40	45	55	65	80
	Z1, ZZ	18	20	25	30	35	45	55
	Z3	13	15	20	25	30	40	45
Permissible values for height error of two rails e_2	Z0, ZT	375 μm /500 mm						
	Z1, ZZ, Z3	330 μm /500 mm						

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

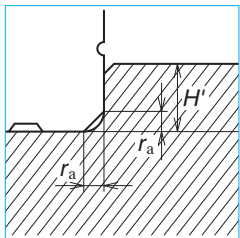


Fig. 9 Shoulder for the rail datum surface

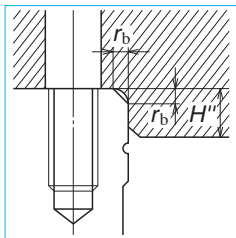


Fig. 10 Shoulder for the ball slide datum surface

Table 9

Unit: mm

Model No.	Corner radius (maximum)		Shoulder height	
	r_a	r_b	H'	H''
VH15	0.5	0.5	4	4
VH20	0.5	0.5	4.5	5
VH25	0.5	0.5	5	5
VH30	0.5	0.5	6	6
VH35	0.5	0.5	6	6
VH45	0.7	0.7	8	8
VH55	0.7	0.7	10	10

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

- Special high carbon steel is available for this specification.
- Applicable accuracy grades are precision grade (P6) and normal grades (PN and PC) only.
- The minimum rail length for production is 400 mm.
- The tapping pitch is the same as the pitch for regular mounting bolt holes. Please refer to the dimension table.

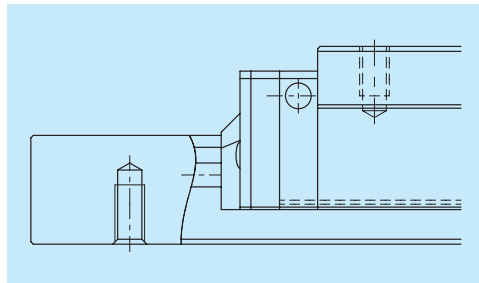


Fig. 11

6. Lubrication components

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

(1) Types of lubrication accessories

Fig. 12 and Table 10 show grease fittings and tube fittings.

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

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

Please contact NSK if stainless lubrication accessories are required.

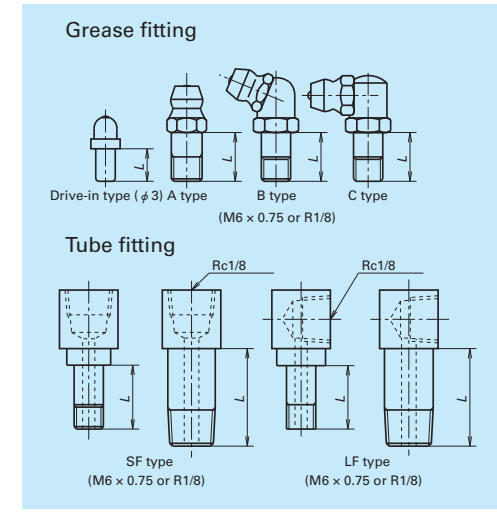


Fig. 12 Grease fitting and tube fitting

(2) Mounting position of lubrication accessories

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

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

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

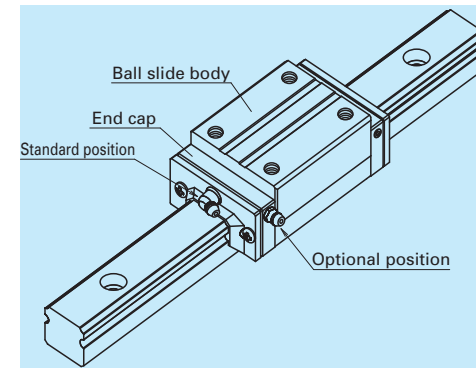


Fig. 13 Mounting position of lubrication accessories

Table 10

Unit: mm

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

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

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

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

7. Dust-resistant components

(1) Standard specification

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

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

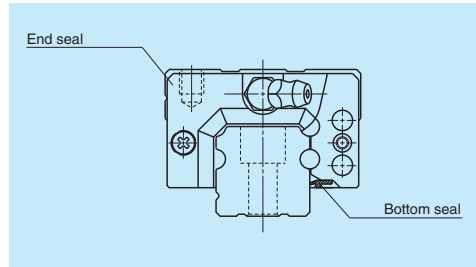


Fig. 14

Table 11 Seal friction per ball slide (maximum value)

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

(2) Double seal and protector

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

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

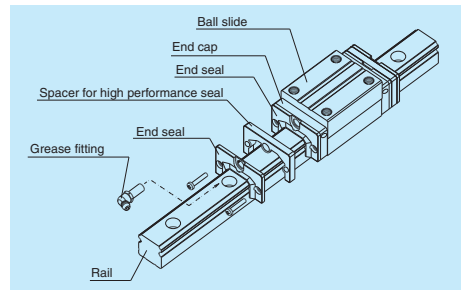


Fig. 15 Double seal

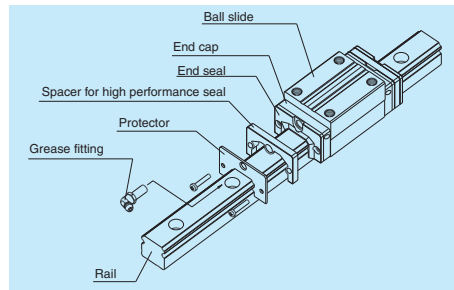


Fig. 16 Protector

Table 12 Dimensions with optional dust-resistant components installed

Unit: mm

Model No.	Ball slide length	Ball slide shape code	Ball slide length L		
			Standard	Double seal installation	Protector installation
VH15	Standard type	AN, EM	70.6	81.6	77
	Long type	BN, GM	89.6	100.6	96
VH20	Standard type	AN, EM	87.4	100.4	94.2
	Long type	BN, GM	109.4	122.4	116.2
VH25	Standard type	AN, AL, EM	97	110	104.4
	Long type	BN, BL, GM	125	138	132.4
VH30	Standard type	AN, AL, EM	104.4	120.4	114.8
	Long type	BN, BL, GM	143.4	159.4	153.8
VH35	Standard type	AN, AL, EM	128.8	144.8	139.2
	Long type	BN, BL, GM	162.8	178.8	173.2
VH45	Standard type	AN, AL, EM	161.4	180.4	174.2
	Long type	BN, BL, GM	193.4	212.4	206.2
VH55	Standard type	AN, AL, EM	185.4	204.4	198.2
	Long type	BN, BL, GM	223.4	242.4	236.2

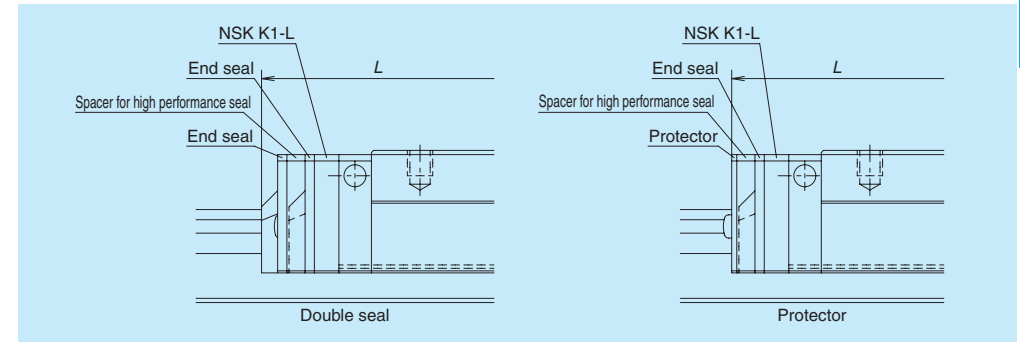


Fig. 17

(3) Caps to plug the rail mounting bolt hole

Table 13 Caps to plug rail bolt hole

Model No.	Bolt to secure rail	Cap reference No.	Quantity /case
VH15	M4	LG-CAP/M4	20
VH20	M5	LG-CAP/M5	20
VH25	M6	LG-CAP/M6	20
VH30, VH35	M8	LG-CAP/M8	20
VH45	M12	LG-CAP/M12	20
VH55	M14	LG-CAP/M14	20

(4) Inner seal

Inner seals are only available for the models shown below.

Table 14

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

8. Design Precautions

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

Dust-Resistant VH Model

9. Reference number

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

(1) Reference number for preloaded assembly

VH 30 1000 ANC 2 - L5 3**

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

(2) Reference number for interchangeable type

Ball slide **VAH 30 ANC -**LCZ**

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

Rail **V1H30 1000 LCN -** PC Z**

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

*Please consult with NSK for butting rail specification.

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

Table 15 Material/surface treatment code

Code	Description
C	Special high carbon steel (NSK standard) + counterbores on a rail top surface
K	Stainless steel + counterbores on a rail top surface
D	Special high carbon steel with surface treatment + counterbores on a rail top surface
H	Stainless steel with surface treatment + counterbores on a rail top surface
V	Special high carbon steel (NSK standard) + tapped holes on a rail bottom surface
W	Special high carbon steel with surface treatment + tapped holes on a rail bottom surface
Z	Other, special

Table 16 Accuracy code

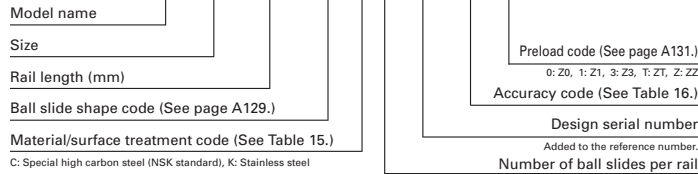
Accuracy	With NSK K1-L
Ultra precision grade	L3
Super precision grade	L4
High precision grade	L5
Precision grade	L6
Normal grade	LN
Normal grade (interchangeable type)	LC

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

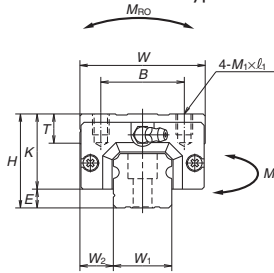
10. Dimensions

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

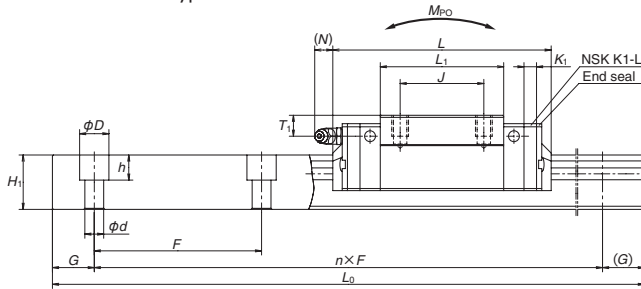
VH 30 1000 ANC 2 - LC Z**



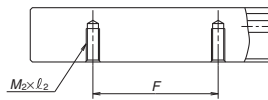
Front view of AN and BN type



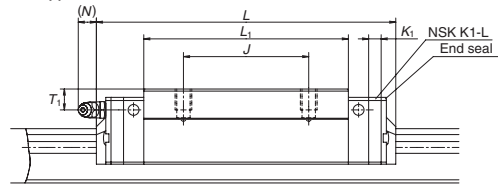
Side view of AN type



Specification for tapped holes on a rail bottom face

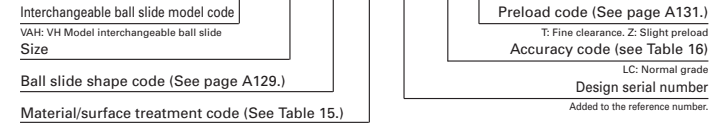


Side view of BN type

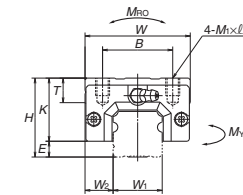


Reference number for ball slide of interchangeable type

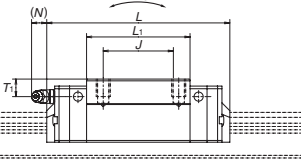
Ball slide **VAH 30 ANC -**LC Z**



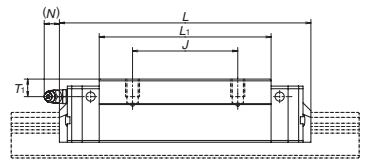
AN and BN types



AN type

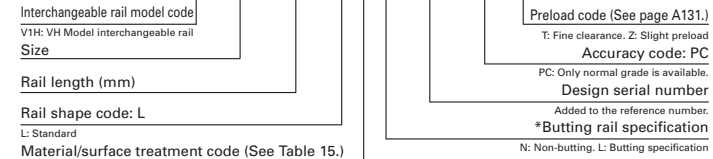


BN type

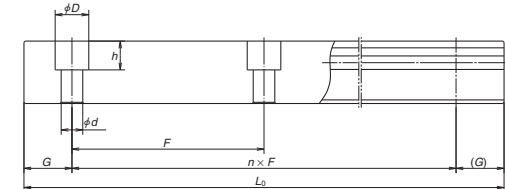
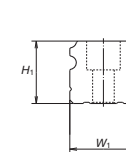


Reference number for rail of interchangeable type

Rail **V1H30 1000 LCN -** PC Z**



*Please consult with NSK for butting rail specification.



Unit: mm

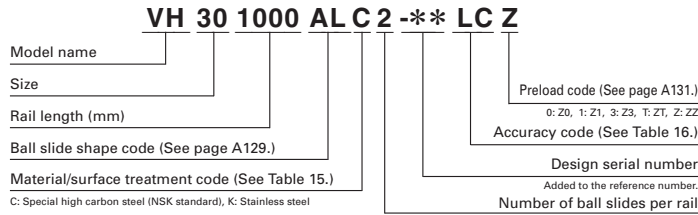
Model No.	Assembly		Ball slide											Width	Height			
	Height	E	Width	Length	Mounting hole			L ₁	K	T	K ₁	Grease fitting				W ₁	H ₁	
					H	E	W ₂					W	L					B
VH15AN	28	4.6	9.5	34	70.6 (77)	26	26	M4×0.7×6	39	23.4	8	5.3	φ 3	8.5	1 (8.2)	15	15	
VH15BN					89.6 (96)				58									
VH20AN	30	5	12	44	87.4 (94.2)	32	36	M5×0.8×6	50	25	12	5.3	M6×0.75	5	11.1 (12.3)	20	18	
VH20BN					109.4 (116.2)				72									
VH25AN	40	7	12.5	48	97 (104.4)	35	35	M6×1×9	58	33	12	5.8	M6×0.75	10	9.6 (12.9)	23	22	
VH25BN					125 (132.4)				86									
VH30AN	45	9	16	60	104.4 (114.8)	40	40	M8×1.25×10	59	36	14	6	M6×0.75	10	11.4 (14.2)	28	26	
VH30BN					143.4 (153.8)				98									
VH35AN	55	9.5	18	70	128.8 (139.2)	50	50	M8×1.25×12	80	45.5	15	6.5	M6×0.75	15	10.9 (13.7)	34	29	
VH35BN					162.8 (173.2)				114									
VH45AN	70	14	20.5	86	161.4 (174.2)	60	60	M10×1.5×17	105	56	17	7.5	Rc1/8	20	12.5 (14.1)	45	38	
VH45BN					193.4 (206.2)				137									
VH55AN	80	15	23.5	100	185.4 (198.2)	75	75	M12×1.75×18	126	65	18	7.5	Rc1/8	21	12.5 (14.1)	53	44	
VH55BN					223.4 (236.2)				164									

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

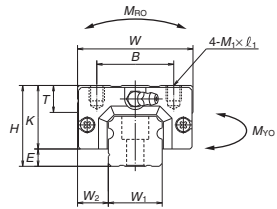
Pitch	Rail		G	Max. length L _{0max} () for stainless	Basic load ratings						Weight			
	Mounting bolt hole	Tapped hole			Dynamic		Static		Static moment (N-m)		Ball slide (kg)	Rail (kg/m)		
					[50km]	[100km]	C ₀	M _{Ro}	M _{Vo}					
					C ₅₀ (N)	C ₁₀₀ (N)	(N)	(N)	One slide	Two slides				
60	4.5×7.5×5.3	M5×0.8×8	20	2 000 [1 800]	14 200	11 300	20 700	108	94.5	575	79.5	480	0.18	1.6
60	6×9.5×8.5	M6×1×10	20	3 960 [3 500]	23 700	18 800	32 500	219	185	1 140	155	955	0.33	
60	7×11×9	M6×1×12	20	3 960 [3 500]	33 500	26 800	46 000	360	320	1 840	267	1 540	0.55	3.6
80	9×14×12	M8×1.25×15	20	4 000 [3 500]	41 000	32 500	51 500	490	350	2 290	292	1 920	0.77	
80	9×14×12	M8×1.25×17	20	4 000	61 000	48 500	91 500	870	1 030	5 600	865	4 700	1.3	5.2
80	9×14×12	M8×1.25×17	20	4 000	62 500	49 500	80 500	950	755	4 500	630	3 800	1.5	
105	14×20×17	M12×1.75×24	22.5	3 990	107 000	84 500	140 000	2 140	1 740	9 750	1 460	8 150	3.0	12.3
					131 000	104 000	187 000	2 860	3 000	15 600	2 520	13 100	3.9	
					158 000	125 000	198 000	3 600	3 000	16 300	2 510	13 700	4.7	
120	16×23×20	M14×2×24	30	3 960	193 000	153 000	264 000	4 850	5 150	26 300	4 350	22 100	6.1	16.9

- 4) Basic load ratings comply with ISO standards (ISO 14728-1, 14728-2).
- C₅₀: the basic dynamic load rating for 50 km rated fatigue life C₁₀₀: the basic dynamic load rating for 100 km rated fatigue life
- The basic static load rating shows static permissible load.

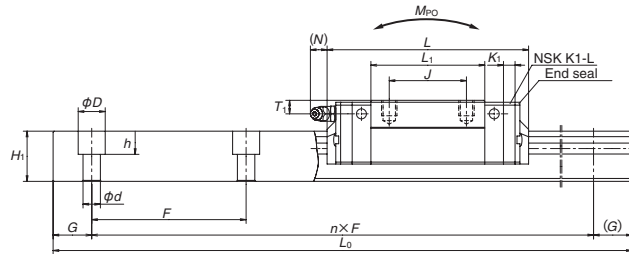
VH-AL (High-load / Standard)
VH-BL (Super-high-load / Long)



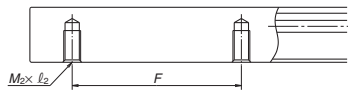
Front view of AL and BL type



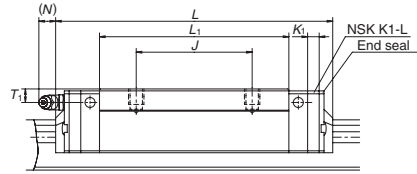
Side view of AL type



Specification for tapped holes on a rail bottom face



Side view of BL type



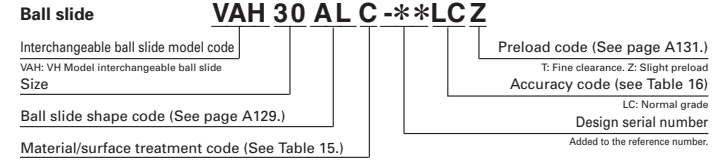
Model No.	Assembly		Ball slide											Width	Height		
	Height	E	W ₂	Width	Length	Mounting hole			L ₁	K	T	K ₁	Grease fitting				
						B	J	M × pitch × l					Hole size			T ₁	N
VH25AL VH25BL	36	7	12.5	48	97 (104.4) 125 (132.4)	35 50	M6×1×6	58 86	29	12	5.8	M6×0.75	6	9.6 (12.9)	23	22	
VH30AL VH30BL	42	9	16	60	104.4 (114.8) 143.4 (153.8)	40 60	M8×1.25×8	59 98	33	14	6	M6×0.75	7	11.4 (14.2)	28	26	
VH35AL VH35BL	48	9.5	18	70	128.8 (139.2) 162.8 (173.2)	50 72	M8×1.25×8	80 114	38.5	15	6.5	M6×0.75	8	10.9 (13.7)	34	29	
VH45AL VH45BL	60	14	20.5	86	161.4 (174.8) 193.4 (206.2)	60 80	M10×1.5×10	105 137	46	17	7.5	Rc1/8	10	12.5 (14.1)	45	38	
VH55AL VH55BL	70	15	23.5	100	185.4 (198.2) 223.4 (236.2)	75 95	M12×1.75×13	126 164	55	15	7.5	Rc1/8	11	12.5 (14.1)	53	44	

Notes: 1) Figures inside () apply when equipped with a protector.

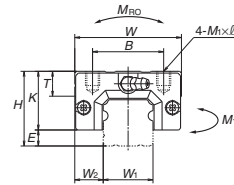
2) VH models do not have a ball retainer. Note that balls will fall out when the ball slide is removed from the rail.

3) The external appearance of stainless steel ball slides differs slightly from that of carbon steel ball slides.

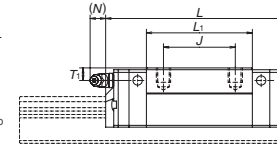
Reference number for ball slide of interchangeable type



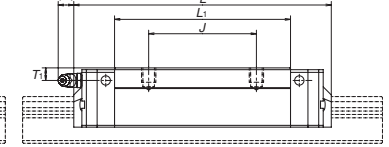
AL and BL types



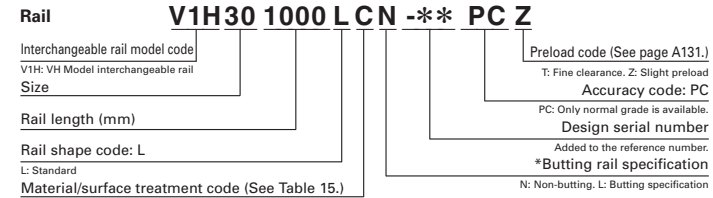
AL type



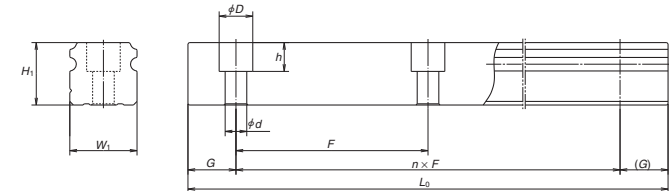
BL type



Reference number for rail of interchangeable type



*Please consult with NSK for butting rail specification.



Unit: mm

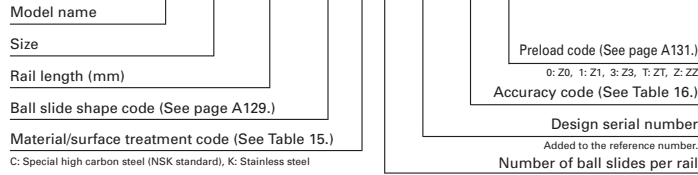
Rail			Basic load ratings						Weight					
Pitch	Mounting bolt hole	Tapped hole	G	Max. length L _{0max} (L) for stainless	Dynamic		Static		Static moment (N-m)		Ball slide (kg)	Rail (kg/m)		
					[50km]	[100km]	C ₀	M _{RO}	M _{VO}					
					C ₅₀ (N)	C ₁₀₀ (N)			One slide	Two slides			One slide	Two slides
60	7×11×9	M6×1×12	20	3 960 [3 500]	33 500 45 500	26 800 36 500	46 000 71 000	360 555	320 725	1 840 3 700	267 610	1 540 3 100	0.46 0.69	3.6
80	9×14×12	M8×1.25×15	20	4 000 [3 500]	41 000 61 000	32 500 48 500	51 500 91 500	490 870	350 1 030	2 290 5 600	292 865	1 920 4 700	0.69 1.16	
80	9×14×12	M8×1.25×17	20	4 000	62 500 81 000	49 500 64 500	80 500 117 000	950 1 380	755 1 530	4 500 8 350	630 1 280	3 800 7 000	1.2 1.7	7.2
105	14×20×17	M12×1.75×24	22.5	3 990	107 000 131 000	84 500 104 000	140 000 187 000	2 140 2 860	1 740 3 000	9 750 15 600	1 460 2 520	8 150 13 100	2.2 2.9	
120	16×23×20	M14×2×24	30	3 960	158 000 193 000	125 000 153 000	198 000 264 000	3 600 4 850	3 000 5 150	16 300 26 300	2 510 4 350	13 700 22 100	3.7 4.7	16.9

4) Basic load ratings comply with ISO standards (ISO 14728-1, 14728-2).

C₅₀: the basic dynamic load rating for 50 km rated fatigue life C₁₀₀: the basic dynamic load rating for 100 km rated fatigue life
 The basic static load rating shows static permissible load.

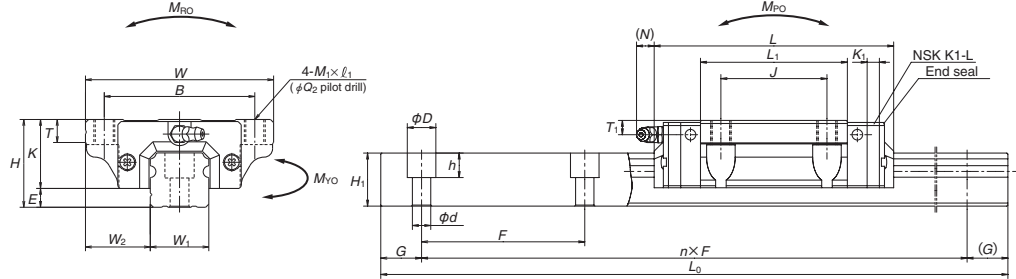
VH-EM (High-load / Standard)
VH-GM (Super-high-load / Long)

VH 30 1000 EM C 2 -** LC Z



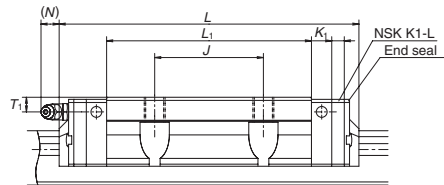
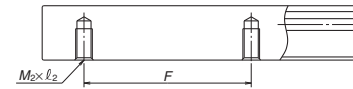
Front view of EM and GM type

Side view of EM type

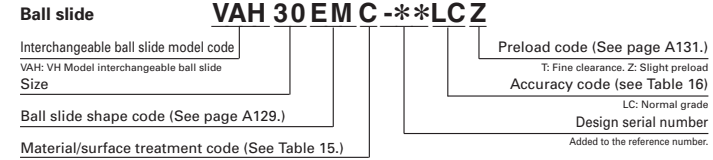


Specification for tapped holes on a rail bottom face

Side view of GM type



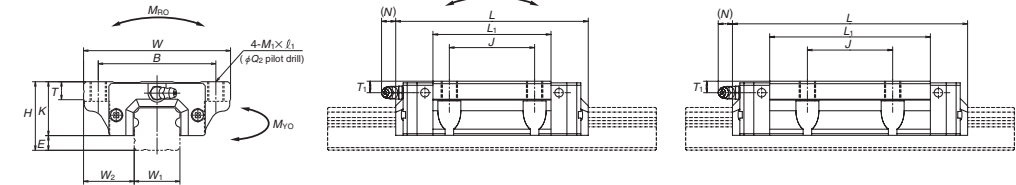
Reference number for ball slide of interchangeable type



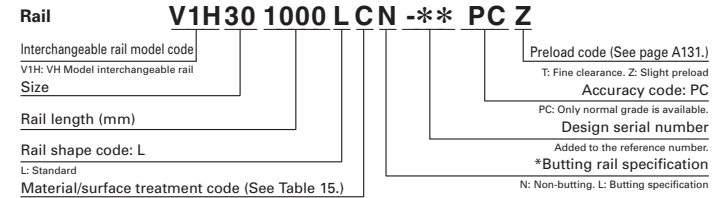
EM and GM types

EM type

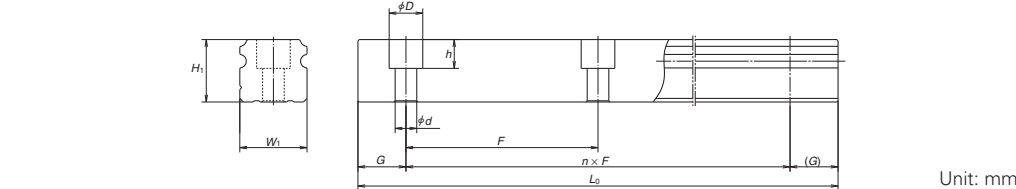
GM type



Reference number for rail of interchangeable type



*Please consult with NSK for butting rail specification.



Unit: mm

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

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

Pitch	Rail		G	Max. length L _{0max} () for stainless	Basic load ratings				Weight					
	Mounting bolt hole	Tapped hole			Dynamic		C ₀	M _{RO}	Static moment (N-m)		Ball slide (kg)	Rail (kg/m)		
					[50km]	[100km]			One slide	Two slides				
60	4.5×7.5×5.3	M5×0.8×8	20	2 000 [1 800]	14 200	11 300	20 700	108	94.5	575	79.5	480	0.17	1.6
					18 100	14 400	32 000	166	216	1 150	181	965	0.25	
60	6×9.5×8.5	M6×1×10	20	3 960 [3 500]	23 700	18 800	32 500	219	185	1 140	155	955	0.45	2.6
					30 000	24 000	50 500	340	420	2 230	355	1 870	0.65	
60	7×11×9	M6×1×12	20	3 960 [3 500]	33 500	26 800	46 000	360	320	1 840	267	1 540	0.63	3.6
					45 500	36 500	71 000	555	725	3 700	610	3 100	0.93	
80	9×14×12	M8×1.25×15	20	4 000 [3 500]	47 000	37 500	63 000	600	505	3 150	425	2 650	1.2	5.2
					61 000	48 500	91 500	870	1 030	5 600	865	4 700	1.6	
80	9×14×12	M8×1.25×17	20	4 000	62 500	49 500	80 500	950	755	4 500	630	3 800	1.7	7.2
					81 000	64 500	117 000	1 380	1 530	8 350	1 280	7 000	2.4	
105	14×20×17	M12×1.75×24	22.5	3 990	107 000	84 500	140 000	2 140	1 740	9 750	1 460	8 150	3.0	12.3
					131 000	104 000	187 000	2 860	3 000	15 600	2 520	13 100	3.9	
					158 000	125 000	198 000	3 600	3 000	16 300	2 510	13 700	5.0	
120	16×23×20	M14×2×24	30	3 960	193 000	153 000	264 000	4 850	5 150	26 300	4 350	22 100	6.5	16.9

- 5) Basic load ratings comply with ISO standards (ISO 14728-1, 14728-2).
C₅₀: the basic dynamic load rating for 50 km rated fatigue life C₁₀₀: the basic dynamic load rating for 100 km rated fatigue life
The basic static load rating shows static permissible load.

NSK Data Sheet for Linear Guides in Contaminated Environments

[Example] (Please copy) 1/1

Model: Graphite milling machine Location: Table axis

1. Operating Conditions

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

2. Linear Guide Environment (Accessories & Contamination)

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

3. Linear Guide Dimensions

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

Remarks

4. Durability Test

Durability test → Scheduled
→ Not scheduled (Reason:)

Linear Guide Use in Contaminated Environments

※Please read the below and tick the relevant boxes

- The results for evaluation tests carried out by NSK for dust-resistant seals represent an example under set testing conditions (foreign matter and operating conditions). Seals may be unable to completely prevent contamination under actual conditions and life may be affected by the environment, lubrication conditions, etc.
- Dust-resistant accessories (covers, lubrication, collectors, etc.)** are required in addition to the seals to improve wear life in contaminated environments.
- Linear guide wear life is greatly impacted by foreign matter entering the slide, offset load from misalignment, and lubricating conditions. The customer is responsible for evaluating and checking final durability in the actual machine.

Company Name:	Date:
Department:	Name:
Address:	Tel: Fax:

NSK Ltd. Sales Representative	NSK Ltd. Sales Manager
Sign	Sign

NSK Data Sheet for Linear Guides in Contaminated Environments

(Please copy) 1/1

Model: _____ Location: _____

1. Operating Conditions

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

2. Linear Guide Environment (Accessories & Contamination)

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

3. Linear Guide Dimensions

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

Remarks

4. Durability Test

Durability test → Scheduled
→ Not scheduled (Reason:)

Linear Guide Use in Contaminated Environments

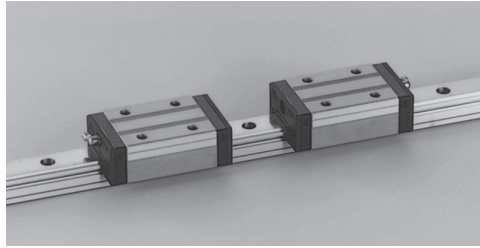
※Please read the below and tick the relevant boxes

- The results for evaluation tests carried out by NSK for dust-resistant seals represent an example under set testing conditions (foreign matter and operating conditions). Seals may be unable to completely prevent contamination under actual conditions and life may be affected by the environment, lubrication conditions, etc.
- Dust-resistant accessories (covers, lubrication, collectors, etc.)** are required in addition to the seals to improve wear life in contaminated environments.
- Linear guide wear life is greatly impacted by foreign matter entering the slide, offset load from misalignment, and lubricating conditions. The customer is responsible for evaluating and checking final durability in the actual machine.

Company Name:	Date:
Department:	Name:
Address:	Tel: Fax:

NSK Ltd. Sales Representative	NSK Ltd. Sales Manager
Sign	Sign

A-4-1.3 NS Model



1. Features

(1) Improves rating life dramatically

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

Load rating capacity is 1.3 times higher than LS Model and life is doubled^{*1}. These features enable you to design a machine with a longer life and downsize the machine. Thus, your design capability is greatly enhanced.

*1: Representative values of model.

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

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

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

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

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

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

This increases the capacity to absorb errors in installation.

(5) High vertical load carrying capacity

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

(6) High resistance against impact load

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

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

(7) High accuracy

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

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

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

(9) Abundant variations and sizes

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

(10) Fast delivery

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

(11) Option for smooth motion specification

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

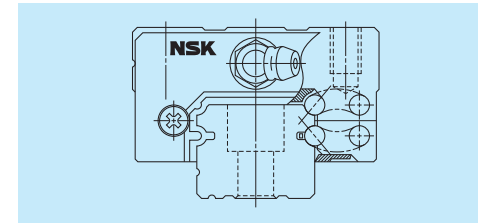


Fig. 1 NS Model

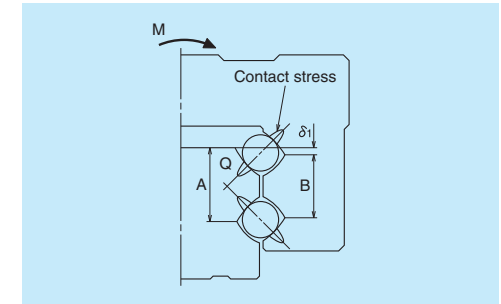


Fig. 2 Enlarged illustration of the offset Gothic arch groove

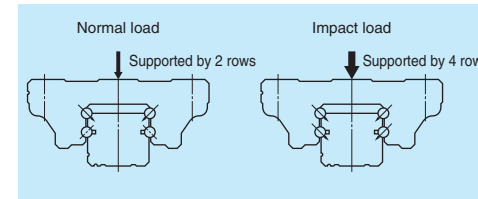


Fig. 3 When load is applied

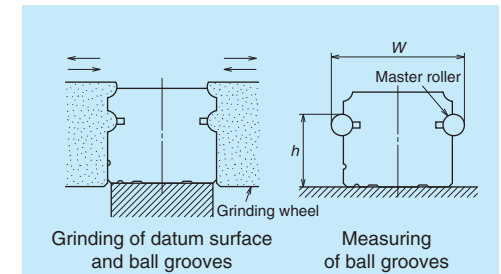


Fig. 4 Rail-grinding and measuring

2. Ball slide shape

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

3. Accuracy and preload

(1) Running parallelism of ball slide

Table 1

Unit: μm

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

(2) Accuracy standard

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

• Tolerance of preloaded assembly

Table 2

Unit: μm

Characteristics	Accuracy grade	Ultra precision P3	Super precision P4	High precision P5	Precision grade P6	Normal grade PN
Mounting height H		± 8	± 10	± 20	± 40	± 80
Variation of H (All ball slides on a set of rails)		3	5	7	15	25
Mounting width W_2 or W_3		± 10	± 15	± 25	± 50	± 100
Variation of W_2 or W_3 (All ball slides on reference rail)		3	7	10	20	30
Running parallelism of surface C to surface A Running parallelism of surface D to surface B		See Table 1, Fig. 5 and Fig. 6				

• Tolerance of interchangeable type

Table 3

Unit: μm

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

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

(3) Combinations of accuracy and preload

Table 4

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

(4) Assembled accuracy

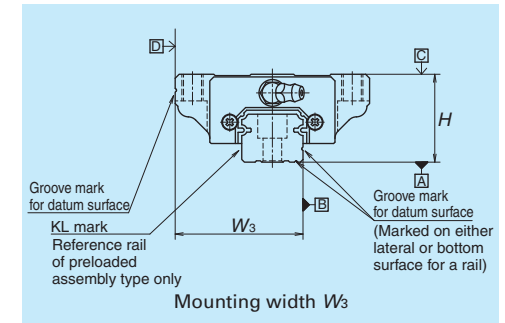
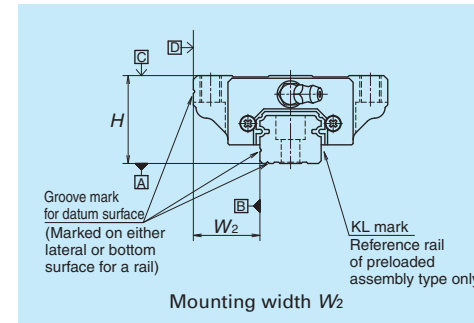


Fig. 5 Special high carbon steel

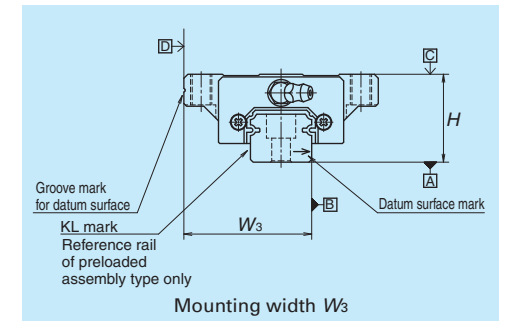
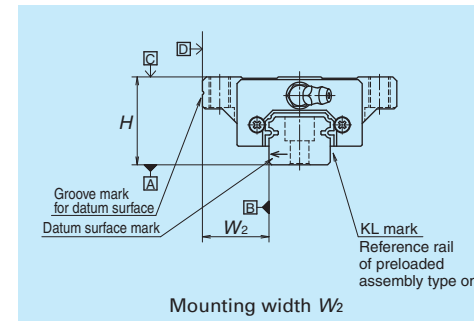


Fig. 6 Stainless steel

(5) Preload and rigidity

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

• **Preload and rigidity of preloaded assembly**

Table 5

Model No.	Preload (N)		Rigidity (N/μm)				
	Slight preload Z1	Medium preload Z3	Vertical direction		Lateral direction		
			Slight preload Z1	Medium preload Z3	Slight preload Z1	Medium preload Z3	
High-load	NS15 AL, EM	69	390	127	226	88	167
	NS20 AL, EM	88	540	147	284	108	206
	NS25 AL, EM	147	880	206	370	147	275
	NS30 AL, EM	245	1 370	255	460	186	345
	NS35 AL, EM	345	1 960	305	550	216	400
Medium-load	NS15 CL, JM	49	294	78	147	59	108
	NS20 CL, JM	69	390	108	186	78	137
	NS25 CL, JM	98	635	127	235	88	177
	NS30 CL, JM	147	980	147	275	108	206
	NS35 CL, JM	245	1 370	186	335	137	245

Notes:1) Clearance for Fine clearance Z0 is 0 to 3μm. Therefore, preload is zero.

However, Z0 of PN grade is 0 to 15μm.

2) In case of being applied option for smooth motion operation, preloads are shown in Table 11.

• **Clearance and preload of interchangeable type**

Table 6

Unit: μm

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

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

4. Maximum rail length

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

Table 7 Length limitations of rails

Unit: mm

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

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

5. Installation

(1) Permissible values of mounting error

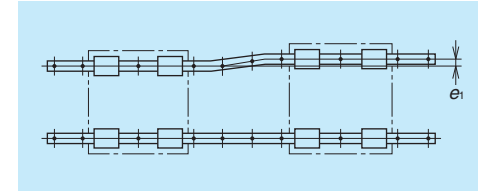


Fig. 7

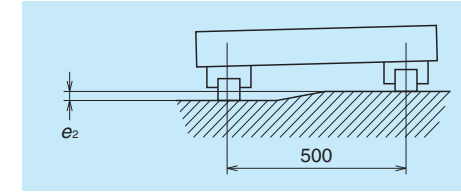


Fig. 8

Table 8

Unit: μm

Value	Preload	Model No.				
		NS15	NS20	NS25	NS30	NS35
Permissible values for parallelism error of two rails e ₁	Z0, ZT	20	22	30	35	40
	Z1, ZZ	15	17	20	25	30
	Z3, ZH	12	15	15	20	25
Permissible values for height error of two rails e ₂	Z0, ZT	375 μm/500 mm				
	Z1, ZZ, Z3, ZH	330 μm/500 mm				

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

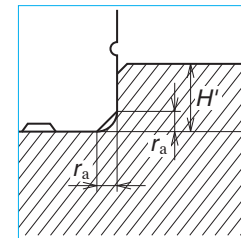


Fig. 9 Shoulder for the rail datum surface

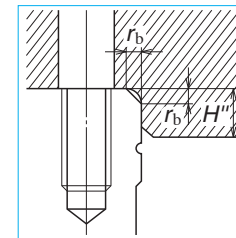


Fig. 10 Shoulder for the ball slide datum surface

Table 9

Unit: mm

Model No.	Corner radius (maximum)		Shoulder height	
	ra	rb	H'	H''
NS15	0.5	0.5	4	4
NS20	0.5	0.5	4.5	5
NS25	0.5	0.5	5	5
NS30	0.5	0.5	6	6
NS35	0.5	0.5	6	6

6. Maximum allowable speed

Table 10 indicates the maximum allowable speed for 10,000 km operation when using an NS model under normal conditions. However, the maximum allowable speed can be affected by accuracy of installation, operating temperature, external load, etc. If the operation is made exceeding the permissible distance and speed, please consult NSK.

Table 10 Maximum allowable speed

Unit: m/min

Model	Size	15	20	25	30	35
NS		300				

7. Option for smooth motion specification

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

(1) Mechanism for smooth motion

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

(2) Supported models

4 models supported: NS15, NS20, NS25,

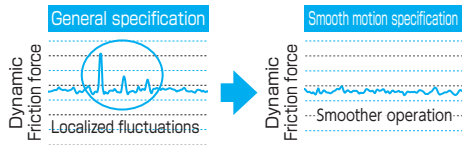


Fig. 11 Image of dynamic friction force of slide

and NS30. Can be combined with various options, including newly developed NSK K1-L lubrication units, stainless steel specifications, surface treatments, interchangeable types, etc.

- Mounting dimensions such as assembly height, assembly width, and screw diameter/pitch of mounting hole are identical to standard specifications.

(3) Handling precautions

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

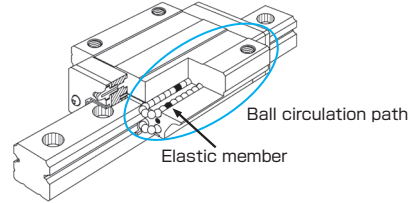


Fig. 12 Mechanism (structure)

Table 11

Model No.	Preload (N)		Rigidity (N/μm)			
	Slight preload (Z1)	Medium preload (Z3)	Vertical direction		Lateral direction	
			Slight preload (Z1)	Medium preload (Z3)	Slight preload (Z1)	Medium preload (Z3)
NS15 AL, EM	69	390	114	202	79	149
NS20 AL, EM	88	540	133	257	98	187
NS25 AL, EM	147	880	186	335	134	250
NS30 AL, EM	245	1 370	228	412	167	311
NS15 CL, JM	49	294	70	132	54	98
NS20 CL, JM	69	390	100	170	71	126
NS25 CL, JM	98	635	116	215	81	162
NS30 CL, JM	147	980	133	249	98	187

Table 12

Model No.	Basic load rating							
	Dynamic		Static	M_{Ro}	Static moment (N·m)			
	[50km]	[100km]			M_{Po}		M_{Lo}	
	$C_{50}(N)$	$C_{100}(N)$	C_0 (N)		One slide	Two slides	One slide	Two slides
NS15 AL, EM	10 600	8 850	15 600	78	66.5	445	55.5	370
NS20 AL, EM	14 900	12 400	21 800	149	115	710	96.5	595
NS25 AL, EM	24 800	20 700	33 500	266	224	1 380	188	1 160
NS30 AL, EM	36 000	30 000	50 500	480	375	2 480	315	2 080
NS15 CL, JM	6 550	5 750	7 800	39	18.6	175	15.6	147
NS20 CL, JM	9 700	8 400	11 800	80	36.5	300	30.5	252
NS25 CL, JM	16 200	14 000	18 200	143	71	590	59.5	495
NS30 CL, JM	22 300	19 600	25 400	241	105	960	88	805

8. Lubrication components

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

(1) Types of lubrication accessories

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

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

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

Please contact NSK if stainless lubrication accessories are required.

(2) Mounting position of lubrication accessories

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

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

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

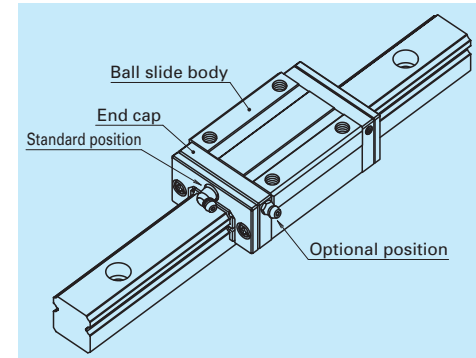


Fig. 14 Mounting position of lubrication accessories

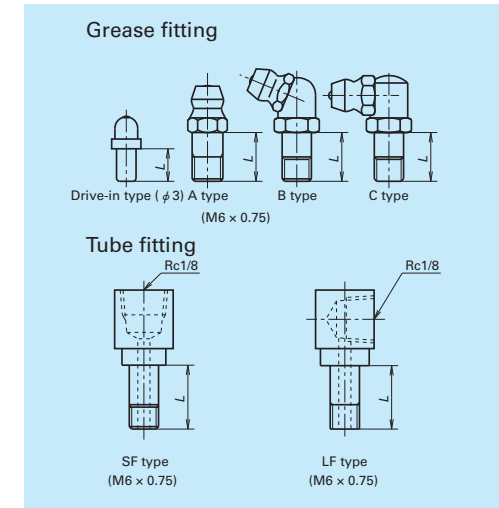


Fig. 13 Grease fitting and tube fitting

Table 13 Unit: mm

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

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

9. Dust-resistant components

(1) Standard specification

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

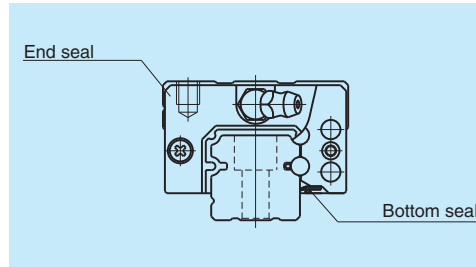


Fig. 15

Table 14 Seal friction per ball slide (maximum value)

		Unit: N				
Model	Size	15	20	25	30	35
NS		8	9	9	9	10

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

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

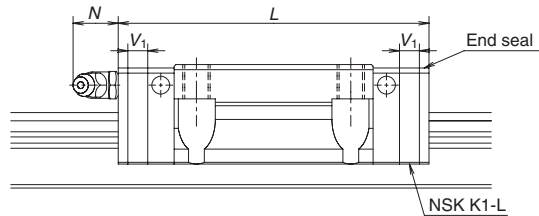


Table 15 Dimensions when equipped with NSK K1-L lubrication units

Unit: mm

Model No.	Ball slide length	Ball slide shape code	Standard ball slide length	Ball slide length with two NSK K1-L units L	Thickness of single NSK K1-L unit V ₁	Protrusion of grease fitting N
NS15	Standard	AL, EM	56.8	66.4	4.8	(5)
	Short	CL, JM	40.4	50		
NS20	Standard	AL, EM	65.2	75.8	5.3	(14)
	Short	CL, JM	47.2	57.8		
NS25	Standard	AL, EM	81.6	92.2	5.3	(14)
	Short	CL, JM	59.6	70.2		
NS30	Standard	AL, EM	96.4	108.4	6	(14)
	Short	CL, JM	67.4	79.4		
NS35	Standard	AL, EM	108	121	6.5	(14)
	Short	CL, JM	77	90		

Notes: 1) When using NSK K1 for food processing machinery/medical equipment, refer to Table 16.

2) Slide length when equipped with NSK K1-L = (standard ball slide length) + (V₁, thickness of single NSK K1-L unit) × (number of K1-L units).

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

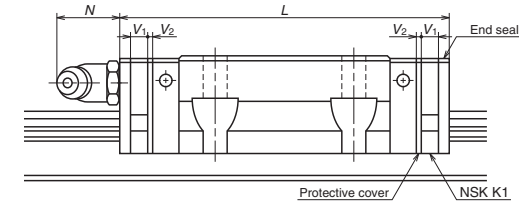


Table 16 Dimensions when equipped with NSK K1 for food processing machinery/medical equipment

Unit: mm

Model No.	Ball slide length	Ball slide shape code	Standard ball slide length	Ball slide length with two NSK K1 installed L	Thickness of single NSK K1 V ₁	Protective cover thickness V ₂	Protrusion of grease fitting N
NS15	Standard	AL, EM	56.8	66.4	4.0	0.8	(5)
	Short	CL, JM	40.4	50			
NS20	Standard	AL, EM	65.2	75.8	4.5	0.8	(14)
	Short	CL, JM	47.2	57.8			
NS25	Standard	AL, EM	81.6	92.2	4.5	0.8	(14)
	Short	CL, JM	59.6	70.2			
NS30	Standard	AL, EM	96.4	108.4	5.0	1.0	(14)
	Short	CL, JM	67.4	79.4			
NS35	Standard	AL, EM	108	121	5.5	1.0	(14)
	Short	CL, JM	77	90			

Note: Slide length when equipped with NSK K1 for food processing machinery/medical equipment = (standard ball slide length) + (V₁, thickness of single NSK K1 unit) × (number of K1 units) + (V₂, thickness of the protective cover) × 2.

(3) Double seal

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

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

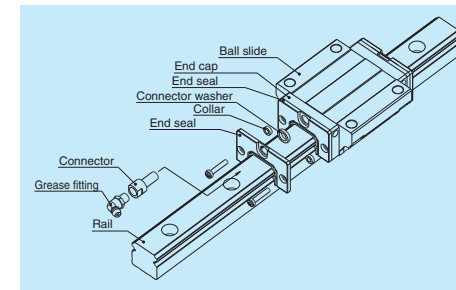


Fig. 16 Double seal

(4) Protector

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

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

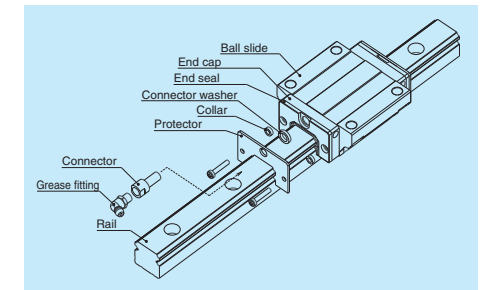


Fig. 17 Protector

Table 17 Double-seal set

Model No.	Reference No.		Increased thickness V_3 (mm)
	Without connector	With connector	
NS15	LS15WS-01	*	2.8
NS20	LS20WS-01	LS20WSC-01	2.5
NS25	LS25WS-01	LS25WSC-01	2.8
NS30	LS30WS-01	LS30WSC-01	3.6
NS35	LS35WS-01	LS35WSC-01	3.6

Table 18 Protector set

Model No.	Reference No.		Increased thickness V_4 (mm)
	Without connector	With connector	
NS15	LS15PT-01	*	3
NS20	LS20PT-01	LS20PTC-01	2.7
NS25	LS25PT-01	LS25PTC-01	3.2
NS30	LS30PT-01	LS30PTC-01	4.2
NS35	LS35PT-01	LS35PTC-01	4.2

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

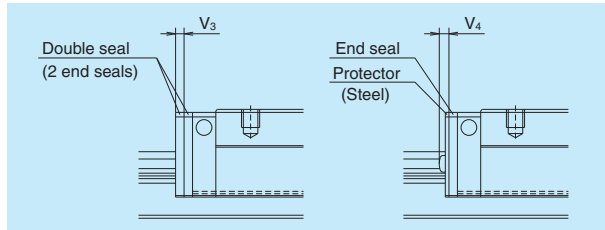


Fig. 18

(5) Caps to plug the rail mounting bolt hole

Table 19 Caps to plug rail bolt hole

Model No.	Bolt to secure rail	Cap reference No.	Quantity /case
NS15	M3	LG-CAP/M3	20
NS15	M4	LG-CAP/M4	20
NS20	M5	LG-CAP/M5	20
NS25, NS30	M6	LG-CAP/M6	20
NS35	M8	LG-CAP/M8	20

(6) Bellows

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

Table 20 Bellows fastner kit reference No.

Model No.	Kit reference No.
NS15	LS15FS-01
NS20	LS20FS-01
NS25	LS25FS-01
NS30	LS30FS-01
NS35	LS35FS-01

Dimension tables for bellows
NS Model

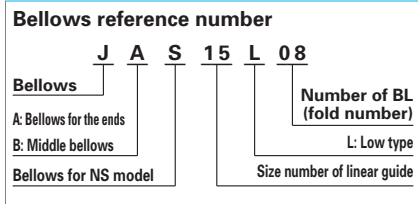
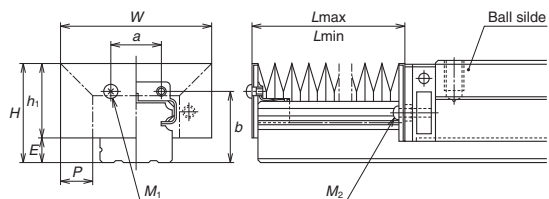


Fig. 19 Dimensions of bellows

Table 21 Dimensions of bellows

Unit: mm

Model No.	H	h ₁	E	W	P	a	b	BL minimum length	M ₁ Tap x depth	M ₂ Tap x depth
JAS15L	23.5	18.9	4.6	43	10	8	16.5	17	M3 × 5	M3 × 14
JAS20L	27	21	6	48	10	13	19.7	17	M3 × 5	M2.5 × 14
JAS25L	32	25	7	51	10	15	23.2	17	M3 × 5	M3 × 18
JAS30L	41	32	9	66	15	16	29	17	M4 × 6	M4 × 19
JAS35L	47	36.5	10.5	72	15	22	33.5	17	M4 × 6	M4 × 22

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

Unit: mm

Model No.	Number of BL	2	4	6	8	10	12	14	16	18	20
		L _{min}	34	68	102	136	170	204	238	272	306
JAS15L	Stroke	106	212	318	424	530	636	742	848	954	1 060
	L _{max}	140	280	420	560	700	840	980	1 120	1 260	1 400
JAS20L	Stroke	106	212	318	424	530	636	742	848	954	1 060
	L _{max}	140	280	420	560	700	840	980	1 120	1 260	1 400
JAS25L	Stroke	106	212	318	424	530	636	742	848	954	1 060
	L _{max}	140	280	420	560	700	840	980	1 120	1 260	1 400
JAS30L	Stroke	176	352	528	704	880	1 056	1 232	1 408	1 584	1 760
	L _{max}	210	420	630	840	1 050	1 260	1 470	1 680	1 890	2 100
JAS35L	Stroke	176	352	528	704	880	1 056	1 232	1 408	1 584	1 760
	L _{max}	210	420	630	840	1 050	1 260	1 470	1 680	1 890	2 100

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

10. Reference number

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

(1) Reference number for preloaded assembly

NS 30 1200 AL C 2 -** P5 3

Model name	Size	Rail length (mm)	Ball slide shape code (See page A148.)	Material/surface treatment code (See Table 23.) <small>C: Special high carbon steel (NSK standard), K: Stainless steel</small>	Preload code (See page A150.) <small>0: Z0, 1: Z1, 3: Z3</small>	Accuracy code (See Table 24.)	Design serial number <small>Added to the reference number.</small>	Number of ball slides per rail
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(2) Reference number for interchangeable type

NAS 30 AL SZ -L

Interchangeable ball slide model code <small>NAS: NS Model interchangeable ball slide</small>	Size	Ball slide shape code (See page A148.)	Option code <small>-L: Equipped with NSK K1-L -F: Fluoride low temperature chrome plating + AS2 grease -F50: Fluoride low temperature chrome plating + LG2 grease</small>	Preload code <small>No code: Fine clearance, Z: Slight preload, H: Medium preload</small>	Material code <small>No code: Special high carbon steel (NSK standard), S: Stainless steel</small>
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N1S30 1200 L CN -** PC Z

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

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

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

Table 23 Material/surface treatment code

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

Note: High-precision grade and medium preload of interchangeable types are not available in stainless steel.

Table 24 Accuracy code

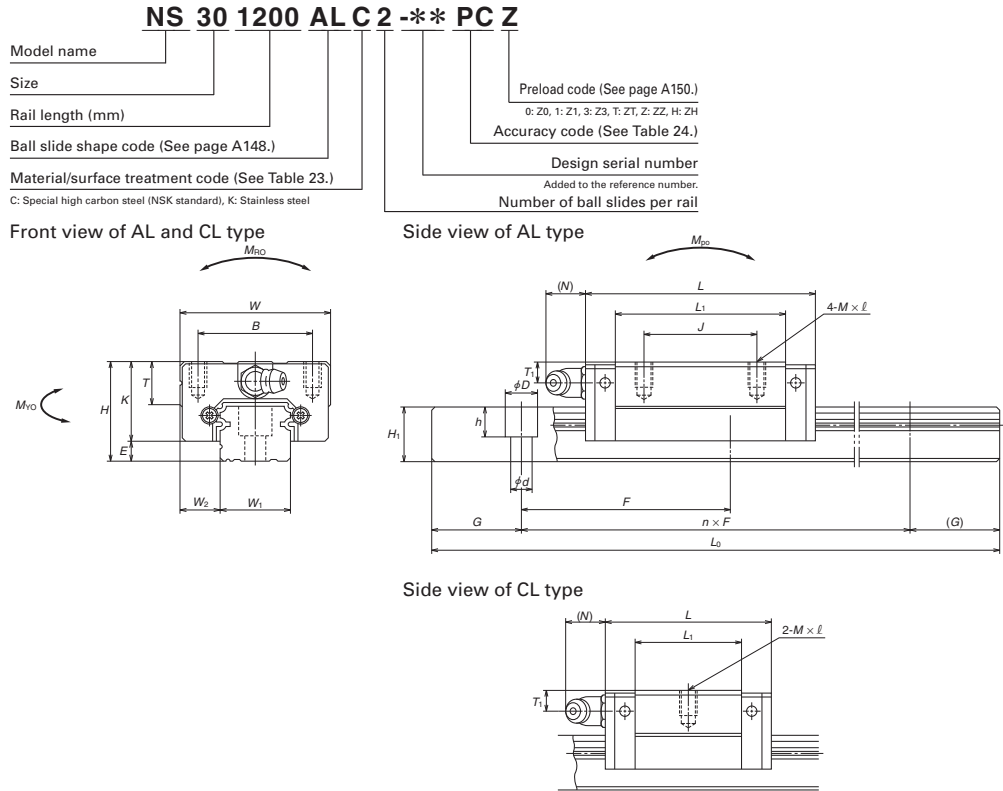
Accuracy	Standard (Without NSK K1-L)	With NSK K1-L	With NSK K1 for food and medical equipment	Standard (Without NSK K1-L)	With NSK K1-L
				With smooth motion specification	
Ultra precision grade	P3	L3	F3	S3	T3
Super precision grade	P4	L4	F4	S4	T4
High precision grade	P5	L5	F5	S5	T5
Precision grade	P6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

Notes:1) Refer to page A58 for details on NSK K1-L lubrication units and to page A73 for details on NSK K1 lubrication units for food processing machinery/medical equipment.
2) Refer to page A153 for option for smooth motion operation.

11. Dimensions

NS-CL (Medium-load / Short)

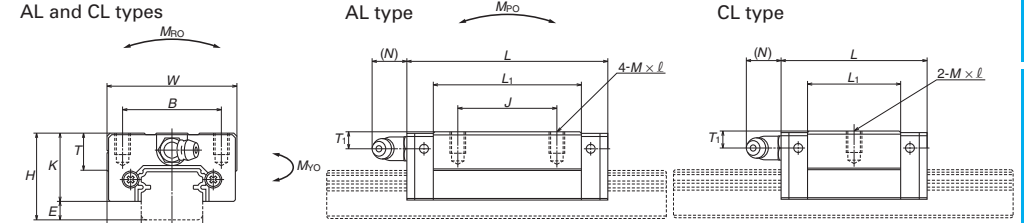
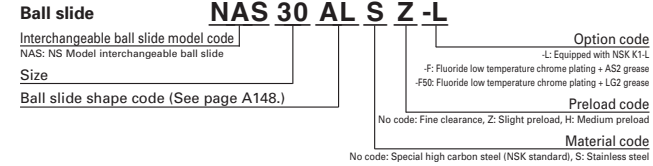
NS-AL (High-load / Standard)



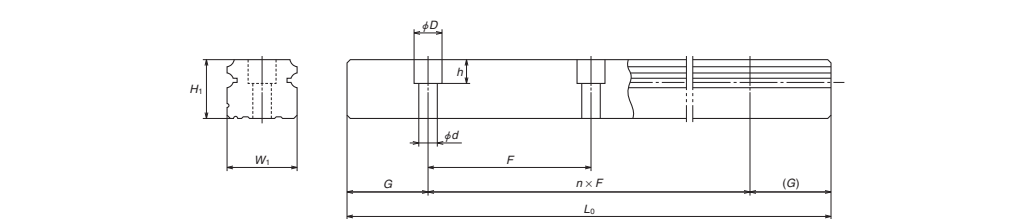
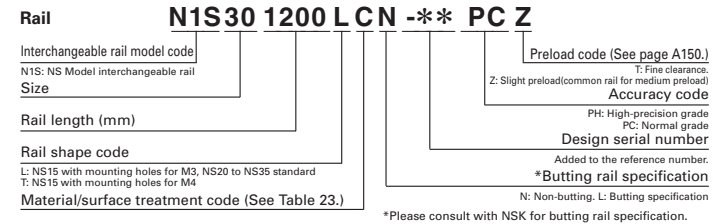
Model No.	Assembly			Ball slide										Width	Height		
	Height	E	W ₂	Width	Length	Mounting hole					Grease fitting					W ₁	H ₁
						B	J	M × pitch × ℓ	L ₁	K	T	Hole size	T ₁				
NS15CL	24	4.6	9.5	34	40.4	26	—	M4×0.7×6	23.6	19.4	10	φ3	6	3	15	12.5	
NS15AL					56.8		26		40								
NS20CL	28	6	11	42	47.2	32	—	M5×0.8×7	30	22	12	M6×0.75	5.5	11	20	15.5	
NS20AL					65.2		32		48								
NS25CL	33	7	12.5	48	59.6	35	—	M6×1×9	38	26	12	M6×0.75	7	11	23	18	
NS25AL					81.6		35		60								
NS30CL	42	9	16	60	67.4	40	—	M8×1.25×12	42	33	13	M6×0.75	8	11	28	23	
NS30AL					96.4		40		71								
NS35CL	48	10.5	18	70	77	50	—	M8×1.25×12	49	37.5	14	M6×0.75	8.5	11	34	27.5	
NS35AL					108		50		80								

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

Reference number for ball slide of interchangeable type



Reference number for rail of interchangeable type



Unit: mm

Rail				Basic load ratings						Weight			
Pitch	Mounting bolt hole	G	Max. length L _{dimax} () for stainless	² Dynamic		Static C ₀ (N)	M _{R0}	Static moment (N·m)				Ball slide (kg)	Rail (kg/m)
				[50km]	[100km]			M _{P0}		M _{Y0}			
				F	d × D × h	(reference)	() for stainless	C ₅₀ (N)	C ₁₀₀ (N)	(N)	M _{R0}	One slide	Two slides
60	*4.5×7.5×5.3 3.5×6×4.5	20	2 920 (1 800)	7 250	5 750	9 100	45.5	24.5	196	20.5	165	0.14	
60	6×9.5×8.5	20	3 960 (3 500)	10 600	8 400	16 900	84.5	77	470	64.5	395	0.20	1.4
60	7×11×9	20	3 960 (3 500)	17 700	14 000	20 800	91.5	46.5	330	39	279	0.19	2.3
80	7×11×9	20	4 000 (3 500)	26 100	19 600	29 600	164	91	655	76	550	0.34	3.1
80	9×14×12	20	4 000 (3 500)	34 500	27 300	40 000	282	139	1 080	116	905	0.58	4.8
80	9×14×12	20	4 000 (3 500)	34 500	27 300	40 000	465	220	1 670	185	1 400	0.86	7.0

2) Basic load ratings comply with ISO standards (ISO 14728-1, 14728-2).

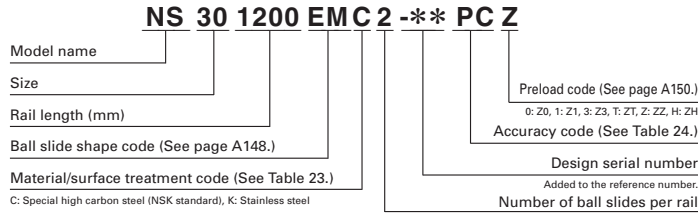
C₅₀: the basic dynamic load rating for 50 km rated fatigue life C₁₀₀: the basic dynamic load rating for 100 km rated fatigue life
The basic static load rating shows static permissible load. In case of being applied option for smooth motion operation, basic load ratings are shown in Table 12.

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

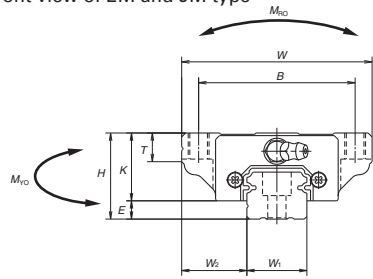
* Standard mounting hole of NS15 rail is for M4 bolts (Hole size: 4.5 × 7.5 × 5.3).

If you require mounting hole for M3 bolts (Hole size: 3.5 × 6 × 4.5), please specify when ordering.

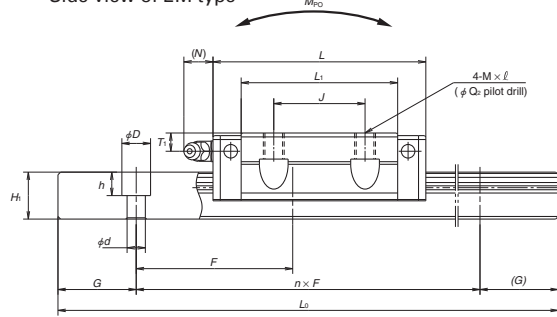
NS-JM (Medium-load / Short)
NS-EM (High-load / Standard)



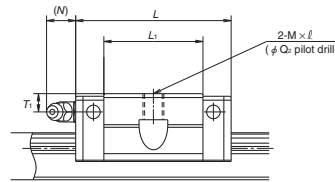
Front view of EM and JM type



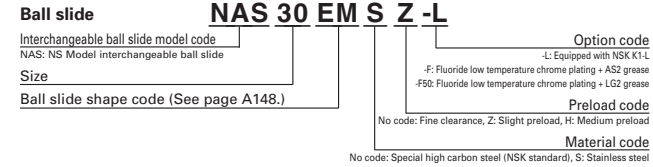
Side view of EM type



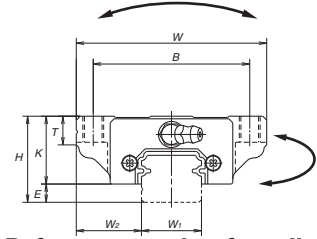
Side view of JM type



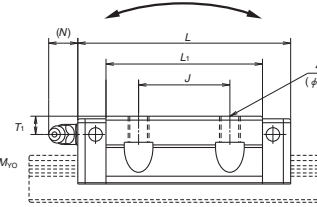
Reference number for ball slide of interchangeable type



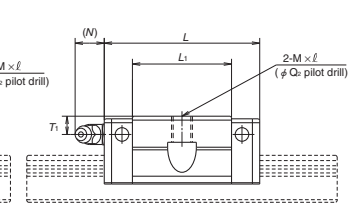
EM and JM types



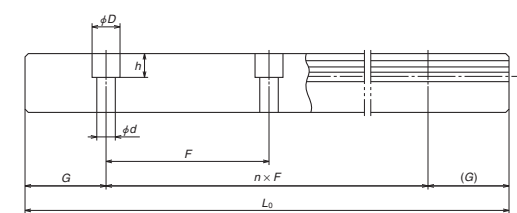
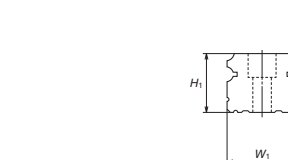
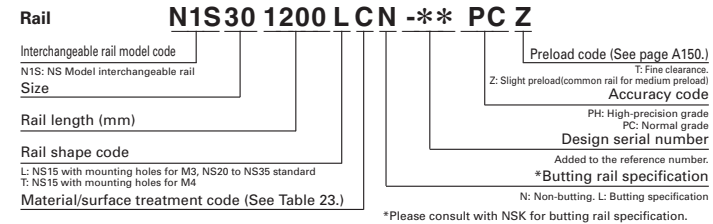
EM type



JM type



Reference number for rail of interchangeable type



Unit: mm

Model No.	Assembly			Ball slide											Width	Height	
	Height	E	Wz	W	L	Mounting hole				L1	K	T	Grease fitting				
						B	J	M x pitch x l	Q2				Hole size	T1			N
NS15JM NS15EM	24	4.6	18.5	52	40.4 56.8	41	—	M5x0.8x7	4.4	23.6 40	19.4	8	phi 3	6	3	15	12.5
NS20JM NS20EM	28	6	19.5	59	47.2 65.2	49	—	M6x1x9 (M6x1x9.5)	5.3	30 48	22	10	M6x0.75	5.5	11	20	15.5
NS25JM NS25EM	33	7	25	73	59.6 81.6	60	—	M8x1.25x10 (M8x1.25x11.5)	6.8	38 60	26	11 (12)	M6x0.75	7	11	23	18
NS30JM NS30EM	42	9	31	90	67.4 96.4	72	—	M10x1.5x12 (M10x1.5x14.5)	8.6	42 71	33	11 (15)	M6x0.75	8	11	28	23
NS35JM NS35EM	48	10.5	33	100	77 108	82	—	M10x1.5x13 (M10x1.5x14.5)	8.6	49 80	37.5	12 (15)	M6x0.75	8.5	11	34	27.5

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

Rail				Basic load ratings								Weight			
Pitch	Mounting bolt hole	G	Max. length Ldimax () for stainless	Dynamic				Static		Static moment (N-m)				Ball slide	Rail
				[50km]		[100km]		C0	MR0	MPO		MY0			
				C50(N)	C100(N)	One slide	Two slides			One slide	Two slides				
60	*4.5x7.5x5.3 3.5x6x4.5	20	2 920 (1 800)	7 250	5 750	16 900	8 850	9 100	45.5	24.5	196	20.5	165	0.17	1.4
60	6x9.5x8.5	20	3 960 (3 500)	10 600	8 400	23 500	160	91.5	46.5	330	39	279	0.24		
60	7x11x9	20	3 960 (3 500)	17 700	14 000	20 800	200	164	91	655	76	550	0.44	3.1	
80	7x11x9	20	4 000 (3 500)	26 100	20 700	36 500	286	258	1 470	217	1 230	630	0.66		
80	9x14x12	20	4 000 (3 500)	34 500	27 300	40 000	465	220	1 670	185	1 400	1.2	1.7	7	
80	9x14x12	20	4 000 (3 500)	52 500	42 000	74 500	865	695	4 000	580	3 350	1.7	1.7		

3) Basic load ratings comply with ISO standards (ISO 14728-1, 14728-2).
C50: the basic dynamic load rating for 50 km rated fatigue life C100: the basic dynamic load rating for 100 km rated fatigue life
The basic static load rating shows static permissible load. In case of being applied option for smooth motion operation, basic load ratings are shown in Table 12.

4) High-precision grade and medium preload interchangeable types are available for special high carbon steel products.
* Standard mounting hole of NS15 rail is for M4 bolts (Hole size: 4.5 x 7.5 x 5.3).
If you require mounting hole for M3 bolts (Hole size: 3.5 x 6 x 4.5), please specify when ordering.

A-4-1.4 LW Model

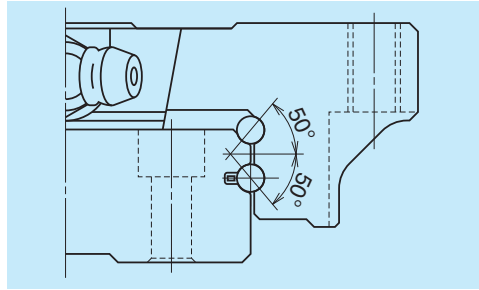
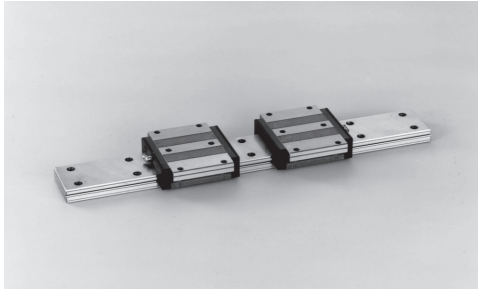


Fig. 1 Balls in contact

1. Features

(1) Ideal for use of single rail

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

(2) High vertical load carrying capacity

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

(3) High resistance against impact load

Same as NH and NS models the offset Gothic arch grooves support a large load, such as an impact, by four rows.

(4) High accuracy

Fixing master rollers to ball grooves is easy thanks to the Gothic arch groove. This makes for easy and accurate measuring of ball grooves.

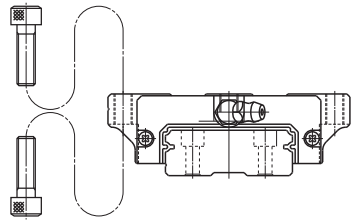
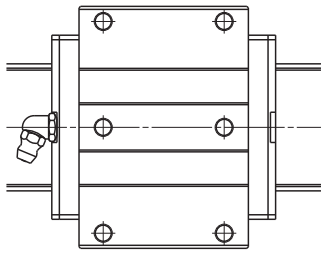
(5) Easy to handle, and designed with safety in mind.

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

(6) Fast delivery

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

2. Ball slide shape

Ball slide shape code	Shape / installation method	Type
EL		EL 

3. Accuracy and preload

(1) Running parallelism of ball slide

Table 1

Unit: μm

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

(2) Accuracy standard

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

• Tolerance of preloaded assembly type

Table 2

Unit: μm

Characteristics	Accuracy grade	High precision P5	Precision grade P6	Normal grade PN
Mounting height H		± 20	± 40	± 80
Variation of H (All ball slides on a set of rails)		7	15	25
Mounting width W_2 or W_3		± 25	± 50	± 100
Variation of W_2 or W_3 (All ball slides on reference rail)		10	20	30
Running parallelism of surface C to surface A	Shown in Table 1 and Fig. 2			
Running parallelism of surface D to surface B	Shown in Table 1 and Fig. 2			

• Tolerance of interchangeable type: Normal grade PC

Table 3

Unit: μm

Characteristics	Model No.	LW17, 21, 27, 35, 50
Mounting height H		± 20
Variation of mounting height H		15 ^①
		30 ^②
Mounting width W_2 or W_3		± 30
Variation of mounting width W_2 or W_3		25
Running parallelism of surface C to surface A	See Table 1 and Fig. 2	
Running parallelism of surface D to surface B	See Table 1 and Fig. 2	

Note: ① Variation on the same rail

② Variation on multiple rails

(3) Combination of accuracy and preload

Table 4

	Accuracy grade				
	High precision	Precision grade	Normal grade	Normal grade	
Without NSK K1 lubrication unit	P5	P6	PN	PC	
With NSK K1 lubrication unit	K5	K6	KN	KC	
With NSK K1 for food and medical equipment	F5	F6	FN	FC	
Preload	Fine clearance Z0	○	○	○	—
	Slight preload Z1	○	○	○	—
	Medium preload Z3	○	○	—	—
	Interchangeable type with fine clearance ZT	—	—	—	○
	Interchangeable type with slight preload ZZ	—	—	—	○

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

(4) Assembled accuracy

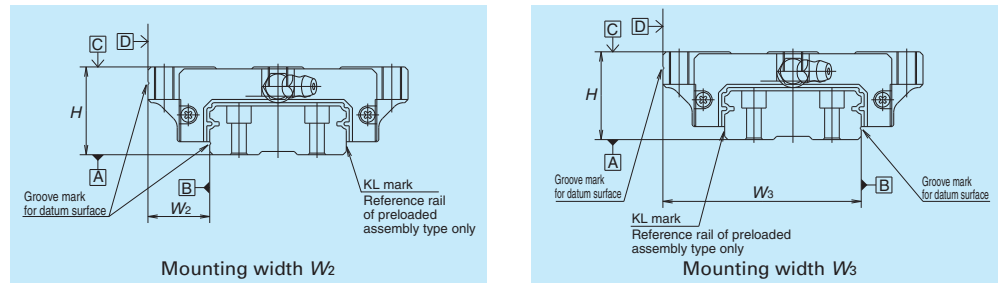


Fig. 2

(5) Preload and rigidity

We offer five levels of preload: Slight preload Z1, Medium preload Z3 and Fine clearance Z0, along with Interchangeable type Fine clearance ZT and Slight preload ZZ. Rigidities are for the median of the preload range.

• Preload and rigidity of preloaded assembly

Table 5

Model No.	Preload (N)		Rigidity (N/μm)			
			Vertical direction		Lateral direction	
	Slight preload Z1	Medium preload Z3	Slight preload Z1	Medium preload Z3	Slight preload Z1	Medium preload Z3
LW17 EL	0 – 245	—	156	—	112	—
LW21 EL	0 – 294	—	181	—	130	—
LW27 EL	0 – 390	—	226	—	167	—
LW35 EL	0 – 490	785	295	440	213	315
LW50 EL	0 – 590	1 470	345	600	246	425

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

• Clearance and preload of interchangeable type

Table 6

Unit: μm

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

Note: Minus sign denotes elastic deformation of balls representing.

5. Installation

(1) Permissible values of mounting error

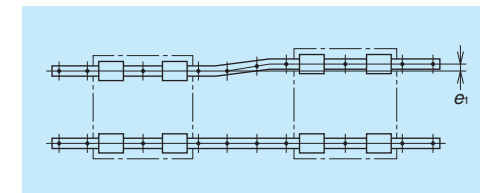


Fig. 3

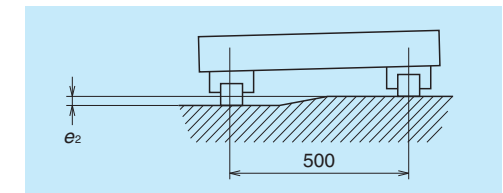


Fig. 4

Table 8

Unit: μm

Value	Preload	Model No.				
		LW17	LW21	LW27	LW35	LW50
Permissible values for parallelism error of two rails e ₁	Z0, ZT	20	20	25	38	50
	Z1, ZZ	9	9	13	23	34
Permissible values for height error of two rails e ₂	Z0, ZT	100 μm/500 mm				
	Z1, ZZ	45 μm/500 mm				

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

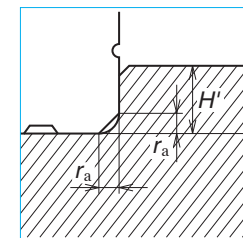


Fig. 5 Shoulder for the rail datum surface

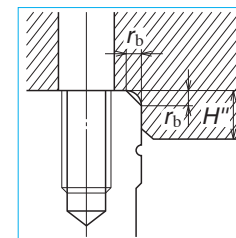


Fig. 6 Shoulder for the ball slide datum surface

Table 9

Unit: mm

Model No.	Corner radius (maximum)		Shoulder height	
	r _a	r _b	H'	H''
LW17	0.3	0.3	2.2	4
LW21	0.3	0.3	2.5	5
LW27	0.5	0.5	3.5	5
LW35	0.5	0.8	3.5	5
LW50	0.8	0.8	4	6

6. Lubrication components

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

(1) Types of lubrication accessories

Fig. 7 and Table 10 show grease fittings and tube fittings.

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

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

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

Please contact NSK if stainless lubrication accessories are required.

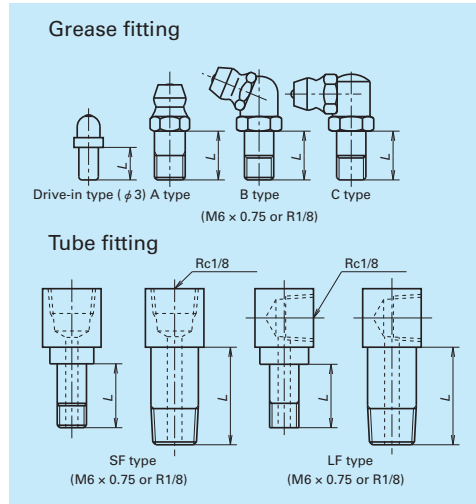


Fig. 7 Grease fitting and tube fitting

Table 10 Unit: mm

Model No.	Dust-resistant specification	Dimension L		
		Grease fitting / Drive-in type	SF type	LF type
LW17	Standard	5	-	-
	With NSK K1	10	-	-
	Double seal	*	-	-
	Protector	*	-	-
LW21	Standard	5	-	-
	With NSK K1	12	-	-
	Double seal	10	-	-
	Protector	10	-	-
LW27	Standard	5	5	5
	With NSK K1	12	12	12
	Double seal	10	9	9
	Protector	10	9	9
LW35	Standard	5	6	6
	With NSK K1	14	14	13
	Double seal	10	10	9
	Protector	10	10	9
LW50	Standard	8	13.5	17
	With NSK K1	18	18	19
	Double seal	14	16	17
	Protector	14	13.5	17

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

(2) Mounting position of lubrication accessories

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

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

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

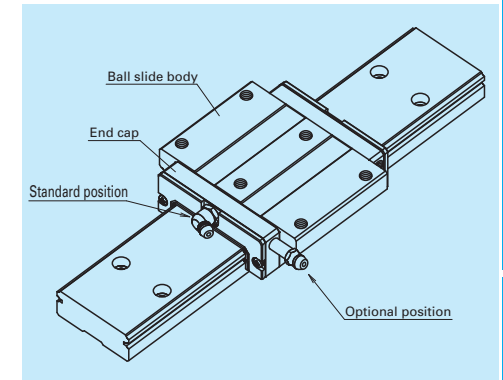


Fig. 8 Mounting position of lubrication accessories

7. Dust-resistant components

(1) Standard Specification

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

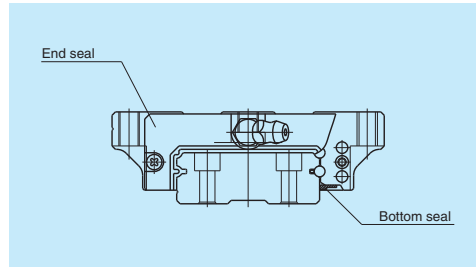


Fig. 9

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

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

(2) NSK K1™ lubrication unit

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

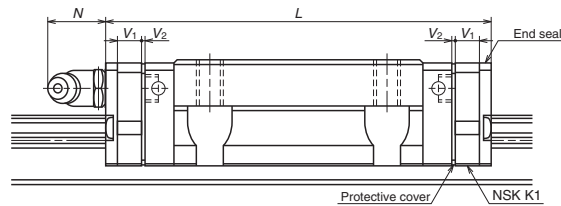


Table 12 Dimensions when equipped with NSK K1 lubrication units Unit: mm

Model No.	Ball slide length	Ball slide shape code	Standard ball slide length	Ball slide length installed with two NSK K1 L	Per NSK K1 thickness V ₁	Protective cover thickness V ₂	Protruding area of the grease fitting N
LW17	Standard	EL	51.4	61.6	4.5	0.6	(5)
LW21	Standard	EL	58.8	71.4	5.5	0.8	(13)
LW27	Standard	EL	74	86.6	5.5	0.8	(13)
LW35	Standard	EL	108	123	6.5	1.0	(13)
LW50	Standard	EL	140.6	155.6	6.5	1.0	(14)

Notes: 1) NSK K1 for food processing machinery/medical equipment are available for models LW17 to LW35.

2) Slide length when equipped with NSK K1 = (standard ball slide length) + (V₁ thickness of single K1 unit) × (number of K1 units) + (V₂ thickness of the protective cover) × 2.

(3) Double seal

Use a double seal set as shown in Table 13 when installing an extra seal to completed standard products. (Fig. 10)

When installing a grease fitting after the installation of double seals, a connector as shown in Fig.10 is required.

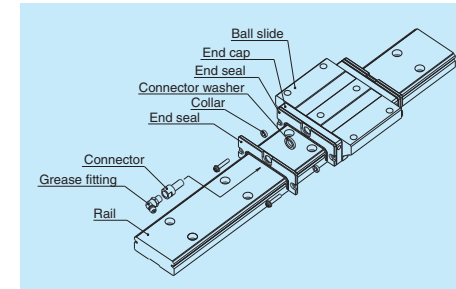


Fig. 10 Double seal

Table 13 Double-seal set

Model No.	Reference No.		Increased thickness V ₃ (mm)
	Without connector	With connector	
LW17	LW17WS-01	*	2.6
LW21	LW21WS-01	LW21WSC-01	2.8
LW27	LW27WS-01	LW27WSC-01	2.5
LW35	LW35WS-01	LW35WSC-01	3
LW50	LW50WS-01	LW50WSC-01	3.6

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

(4) Protector

Use a protector set as shown in Table 14 when installing a protector to completed standard products. (Fig.11)

When installing a grease fitting after the installation of protectors, a connector as shown in Fig.11 is required.

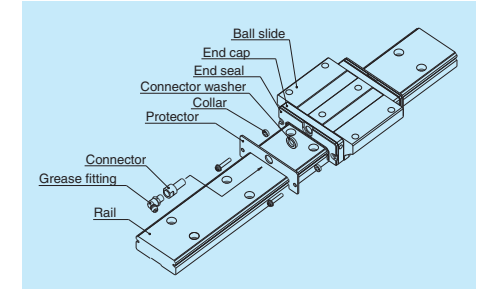


Fig. 11 Protector seal

Table 14 Protector set

Model No.	Reference No.		Increased thickness V ₄ (mm)
	Without connector	With connector	
LW17	LW17PT-01	*	3.2
LW21	LW21PT-01	LW21PTC-01	3.2
LW27	LW27PT-01	LW27PTC-01	2.9
LW35	LW35PT-01	LW35PTC-01	3.6
LW50	LW50PT-01	LW50PTC-01	4.2

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

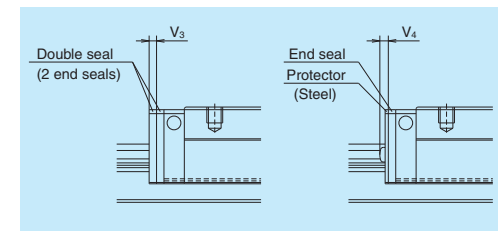


Fig. 12

(5) Caps to plug the rail mounting bolt hole

Table 15 Caps to plug rail bolt hole

Model No.	Bolt to secure rail	Cap reference No.	Quantity /case
LW17, LW21, LW27	M4	LG-CAP/M4	20
LW35	M6	LG-CAP/M6	20
LW50	M8	LG-CAP/M8	20

LW Model

(6) Bellows

- Make tap holes to the rail end face to fix the bellows mounting plate. NSK processes tap holes to the rail end face when ordered with a linear guide.

Dimension tables for bellows
LW model

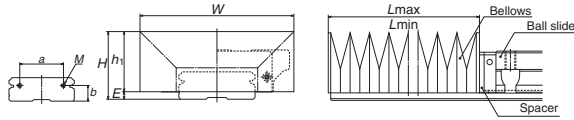


Fig. 13

Bellows reference number

J A W 21 L 08

Bellows

A: Bellows for the ends
B: Middle bellows

Number of BL (fold number)

N: High type L: Low type

Size number of linear guide

Bellows for LW model

Table 16 Dimensions of bellows

Unit: mm

Model No.	H	h ₁	E	W	P	a	b	BL minimum length	Tap (M) x depth
JAW17N	25.5	23	2.5	68	15	22	6	17	M3 × 6
JAW21N	29	26	3	75	17	26	7	17	M3 × 6
JAW27N	37	33	4	85	20	28	10	17	M3 × 6
JAW35L	34	30	4	100	14	48	12	17	M4 × 8
JAW35N	41	37		115	20				
JAW50L	46.5	42	4.5	135	20	70	14	17	M4 × 8
JAW50N	56.5	52		160	30				

Table 17 Numbers of folds (BL) and length of bellows

Unit: mm

Model No.	Number of BL	2	4	6	8	10	12	14	16	18	20
		L _{min}	34	68	102	136	170	204	238	272	306
JAW17N	Stroke	176	352	528	704	880	1 056	1 232	1 408	1 584	1 760
	L _{max}	210	420	630	840	1 050	1 260	1 470	1 680	1 890	2 100
JAW21N	Stroke	204	408	612	816	1 020	1 224	1 428	1 632	1 836	2 040
	L _{max}	238	476	714	952	1 190	1 428	1 666	1 904	2 142	2 380
JAW27N	Stroke	246	492	738	984	1 230	1 476	1 722	1 968	2 214	2 460
	L _{max}	280	560	840	1 120	1 400	1 680	1 960	2 240	2 520	2 800
JAW35L	Stroke	162	324	486	648	810	972	1 134	1 296	1 458	1 620
	L _{max}	196	392	588	784	980	1 176	1 372	1 568	1 764	1 960
JAW35N	Stroke	218	436	654	872	1 090	1 308	1 526	1 744	1 962	2 180
	L _{max}	252	504	756	1 008	1 260	1 512	1 764	2 016	2 268	2 520
JAW50L	Stroke	246	492	738	984	1 230	1 476	1 722	1 968	2 214	2 460
	L _{max}	280	560	840	1 120	1 400	1 680	1 960	2 240	2 520	2 800
JAW50N	Stroke	386	772	1 158	1 544	1 930	2 316	2 702	3 088	3 474	3 860
	L _{max}	420	840	1 260	1 680	2 100	2 520	2 940	3 360	3 780	4 200

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

LW Model

8. Reference number

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

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

(1) Reference number for preloaded assembly

LW 35 1000 EL C 2 - P6 1**

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

(2) Reference number for interchangeable type

Ball slide

LAW 35 EL Z -K

Interchangeable ball slide model code							Option code
LAW: LW Model interchangeable ball slide							-K: Equipped with NSK K1
Size							-F: Fluoride low temperature chrome plating + AS2 grease
Ball slide shape code (See page A167.)							-F50: Fluoride low temperature chrome plating + LG2 grease
							Preload code
							No code: Fine clearance, Z: Slight preload

Rail

L1W35 1000 L CN - PC Z**

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

*Please consult with NSK for butting rail specification.

When interchangeable rails and slides are assembled, reference number coding is the same as that for preloaded assemblies. However, only preload codes T (fine clearance) and Z (slight preload) may be used (Refer to Page A169.)

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

Table 18 Material/surface treatment code

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

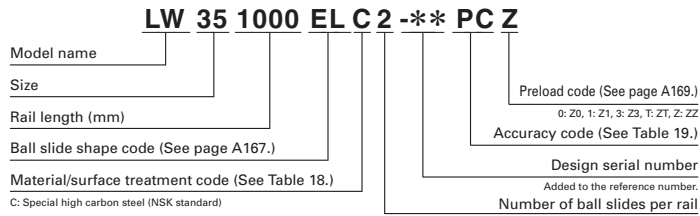
Table 19 Accuracy code

Accuracy	Standard (Without NSK K1)	With NSK K1	With NSK K1 for food and medical equipment
High precision grade	P5	K5	F5
Precision grade	P6	K6	F6
Normal grade	PN	KN	FN
Normal grade (interchangeable type)	PC	KC	FC

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

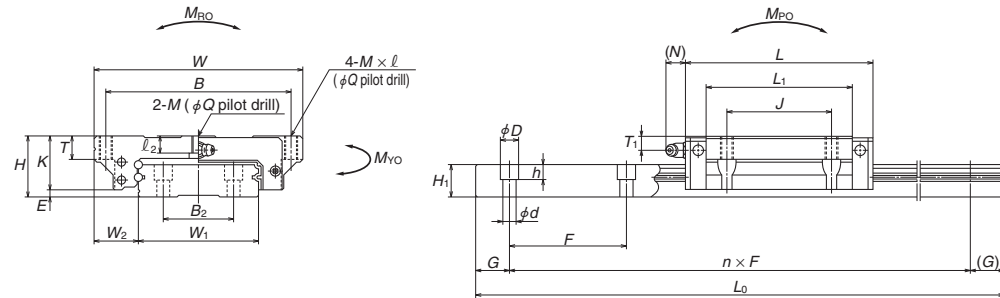
(9) Dimensions

LW-EL



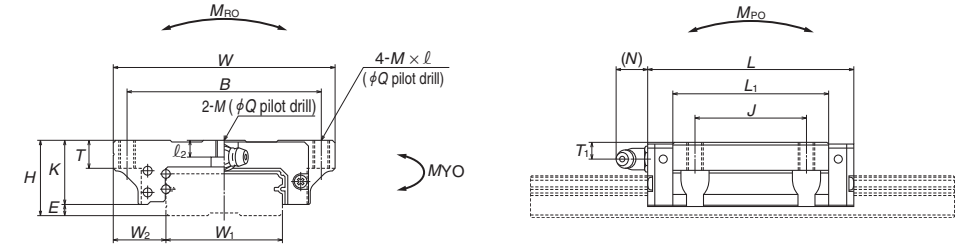
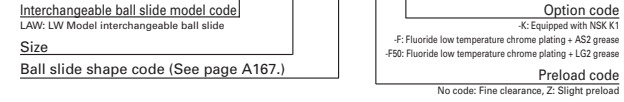
Front view

Side view



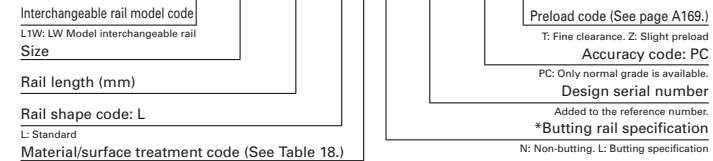
Reference number for ball slide of interchangeable type

LAW 35 EL Z -K

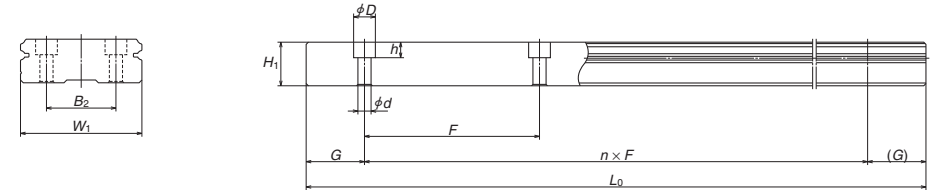


Reference number for rail of interchangeable type

Rail L1W35 1000 LCN - PC Z**



*Please consult with NSK for butting rail specification.



Model No.	Assembly			Ball slide											Width	Height		
	Height	E	W ₂	W	Length	Mounting hole					L ₁	K	T	Grease fitting				
						B	J	M × pitch × ℓ	ℓ ₂	Q				Hole size			T ₁	N
LW17EL	17	2.5	13.5	60	51.4	53	26	M4×0.7×6	3.2	3.3	35	14.5	6	φ3	4	3	33	8.7
LW21EL	21	3	15.5	68	58.8	60	29	M5×0.8×8	3.7	4.4	41	18	8	M6×0.75	4.5	11	37	10.5
LW27EL	27	4	19	80	74	70	40	M6×1×10	6	5.3	56	23	10	M6×0.75	6	11	42	15
LW35EL	35	4	25.5	120	108	107	60	M8×1.25×14	9	6.8	84	31	14	M6×0.75	8	11	69	19
LW50EL	50	4.5	36	162	140.6	144	80	M10×1.5×18	14	8.6	108	45.5	18	Rc1/8	14	14	90	24

Unit: mm

Rail				Basic load ratings								Weight		
B ₂	Pitch	Mounting bolt hole	G	Max. length L _{0max} () for stainless	Dynamic		Static	Static moment (N-m)				Ball slide (kg)	Rail (kg/m)	
					[50km]	[100km]		C ₀	M _{PO}		M _{YO}			
					C ₅₀ (N)	C ₁₀₀ (N)	(N)		One slide	Two slides	One slide	Two slides		
18	40	4.5×7.5×5.3	15	1 000	5 600	4 450	11 300	135	44	288	37	242	0.2	2.1
22	50	4.5×7.5×5.3	15	1 600	6 450	5 150	13 900	185	65.5	400	55	335	0.3	2.9
24	60	4.5×7.5×5.3	20	2 000	12 800	10 200	26 900	400	171	970	143	815	0.5	4.7
40	80	7×11×9	20	2 000	33 000	26 400	66 500	1 690	645	3 550	545	2 990	1.5	9.6
60	80	9×14×12	20	2 000	61 500	48 500	117 000	3 900	1 530	8 200	1 280	6 900	4.0	15.8

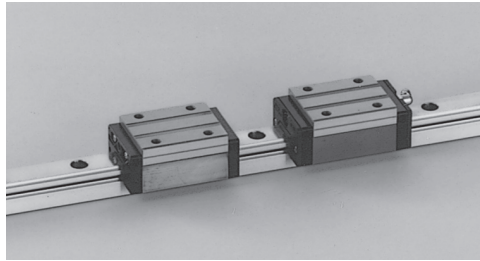
Note: Basic load ratings comply with ISO standards (ISO 14728-1, 14728-2).

C₅₀: the basic dynamic load rating for 50 km rated fatigue life C₁₀₀: the basic dynamic load rating for 100 km rated fatigue life

- | | |
|-------------|------|
| 1. DH Model | A183 |
| 2. DV Model | A203 |
| 3. DS Model | A221 |

A-4-2 Long-Life Series

A-4-2.1 DH Model



1. Features

(1) Double the life of standard linear guides

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

NSK's TF technology is an exclusive heat treatment developed and cultivated over years of experience with rolling bearings and materials. TF technology helps suppress surface flaking on the raceway. Load ratings are 1.25 times higher and service life is doubled compared to conventional NH model^{*1}. DH linear guide offers greatly improved life at the same size and equal or longer life to the next smallest conventional model, allowing for equipment downsizing.

*1: Representative values for model.

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

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

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

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

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

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

(5) High vertical load carrying capacity

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

(6) High resistance against impact load

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

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

(7) High accuracy

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

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

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

(9) Abundant variations and sizes

The DH model comes in several sizes and ball

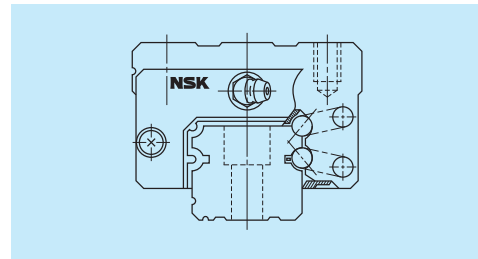


Fig. 1 DH Model

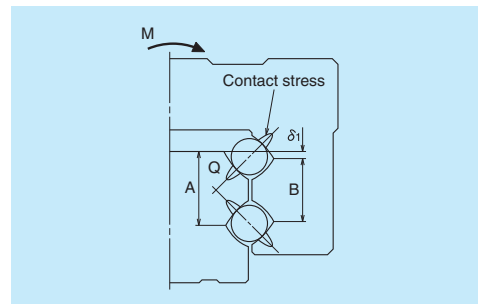


Fig. 2 Enlarged illustration of the offset Gothic arch groove

slide shapes, allowing for use in a variety of applications.

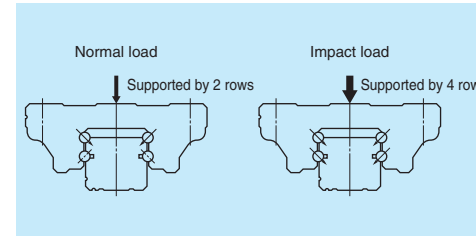


Fig. 3 When load is applied

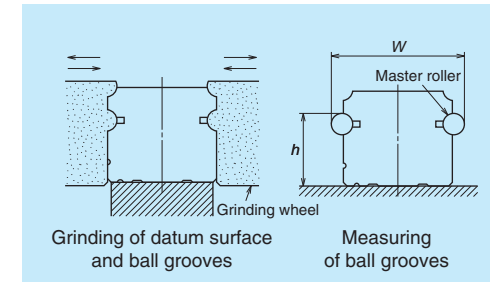


Fig. 4 Rail grinding and measuring

2. Ball slide shape

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

3. Accuracy and preload

(1) Running parallelism of ball slide

Table 1

Unit: μm

Rail length (mm)	Accuracy grade over or less	Preloaded assembly				
		Ultra precision P3	Super precision P4	High precision P5	Precision grade P6	Normal grade PN
– 50		2	2	2	4	5
50 – 80		2	2	3	4	5
80 – 125		2	2	3	4	5
125 – 200		2	2	3.5	5	6
200 – 250		2	2.5	4.5	6	7.5
250 – 315		2	2.5	5	6.5	8.5
315 – 400		2	3	5.5	7	9.5
400 – 500		2	3	6	7.5	11
500 – 630		2	3.5	6.5	8.5	12
630 – 800		2	4	7	9.5	13
800 – 1 000		2.5	4.5	7.5	10	15
1 000 – 1 250		3	5	8.5	12	16
1 250 – 1 600		3.5	5.5	9.5	13	17
1 600 – 2 000		4	6.5	11	14	19
2 000 – 2 500		4.5	7.5	12	16	21
2 500 – 3 150		5.5	8.5	13	18	23
3 150 – 4 000		6	9.5	14	19	25

(2) Accuracy standard

The preloaded assembly has five accuracy grades; Ultra precision P3, Super precision P4, High precision P5, Precision P6 and Normal PN grades

Table 2

Unit: μm

Characteristics	Ultra precision P3	Super precision P4	High precision P5	Precision grade P6	Normal grade PN
Mounting height H Variation of H (All ball slides on a set of rails)	± 8 3	± 10 5	± 20 7	± 40 15	± 80 25
Mounting width W_2 or W_3 Variation of W_2 or W_3 (All ball slides on reference rail)	± 10 3	± 15 7	± 25 10	± 50 20	± 100 30
Running parallelism of surface C to surface A Running parallelism of surface D to surface B	Shown in Table 1, Fig. 5				

(3) Combinations of accuracy and preload

Table 3

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

(4) Assembled accuracy

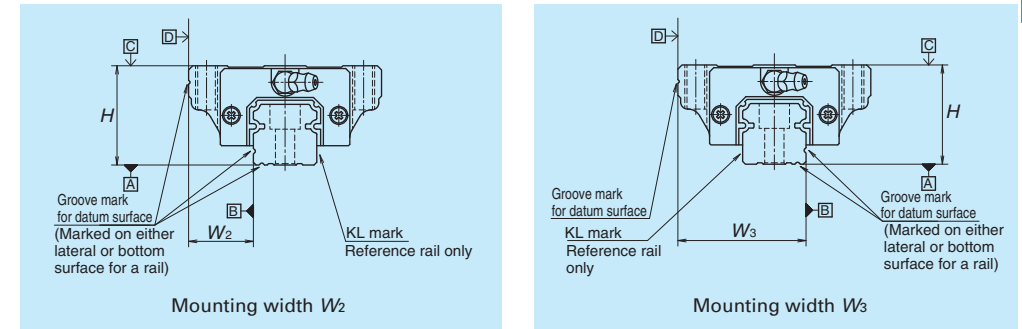


Fig. 5

(5) Preload and rigidity

We offer three levels of preload: Slight preload Z1, Medium preload Z3 and Fine clearance Z0.

• Preload and rigidity of preloaded assembly

Table 4

Model No.	Preload (N)		Rigidity (N/μm)				
	Slight preload Z1	Medium preload Z3	Vertical direction		Lateral direction		
			Slight preload Z1	Medium preload Z3	Slight preload Z1	Medium preload Z3	
High-load	DH15 AN, EM	78	490	137	226	98	186
	DH20 AN, EM	147	835	186	335	137	245
	DH25 AL, AN, EM	196	1 270	206	380	147	284
	DH30 AL, AN	245	1 570	216	400	157	294
	DH30 EM	294	1 770	265	480	186	355
	DH35 AL, AN, EM	390	2 350	305	560	216	390
	DH45 AL, AN, EM	635	3 900	400	745	284	540
	DH55 AL, AN, EM	980	5 900	490	910	345	645
	DH65 AN, EM	1 470	8 900	580	1 070	400	755
	Super-high-load	DH15 BN, GM	98	685	196	345	137
DH20 BN, GM		196	1 080	265	480	196	355
DH25 BL, BN, GM		245	1 570	294	560	216	400
DH30 BL, BN, GM		390	2 260	360	665	265	480
DH35 BL, BN, GM		490	2 940	430	795	305	570
DH45 BL, BN, GM		785	4 800	520	960	370	695
DH55 BL, BN, GM		1 180	7 050	635	1 170	440	835
DH65 BN, GM	1 860	11 300	805	1 480	550	1 040	

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

4. Maximum rail length

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

Table 5 Length limitations of rails

Unit: mm

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

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

5. Installation

(1) Permissible values of mounting error

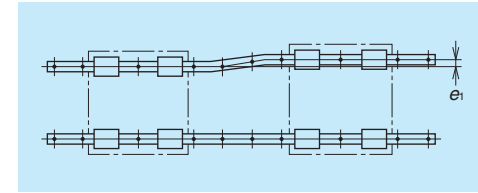


Fig. 6

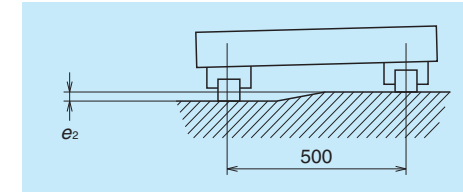


Fig. 7

Table 6

Unit: μm

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

Table 7

Unit: mm

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

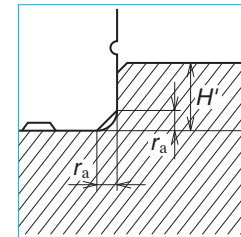


Fig. 8 Shoulder for the rail datum surface

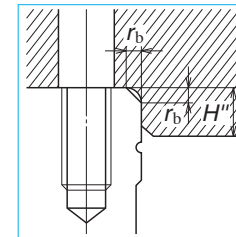


Fig. 9 Shoulder for the ball side datum surface

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

6. Maximum allowable speed

Table 8 indicates the maximum allowable speed for 10,000 km operation when using an DH model under normal conditions. However, the maximum allowable speed can be affected by accuracy of installation, operating temperature, external load, etc. If the operation is made exceeding the permissible distance and speed, please consult NSK.

Table 8 Maximum allowable speed

Unit: m/min

Model	Size	Maximum allowable speed (m/min)							
		15	20	25	30	35	45	55	65
DH		300				200			150

7. Lubrication components

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

(1) Types of lubrication accessories

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

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

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

Please contact NSK if stainless lubrication accessories are required.

(2) Mounting position of lubrication accessories

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

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

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

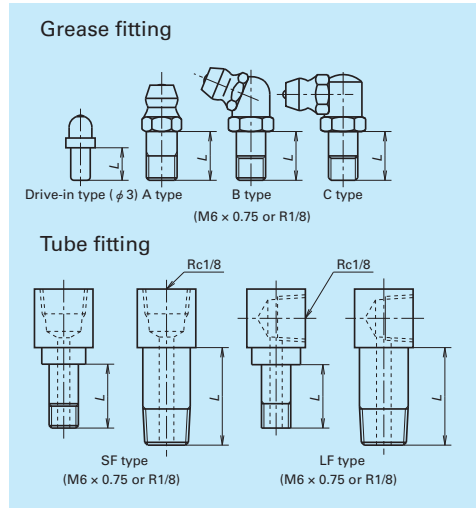


Fig. 10 Grease fitting and tube fitting

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

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

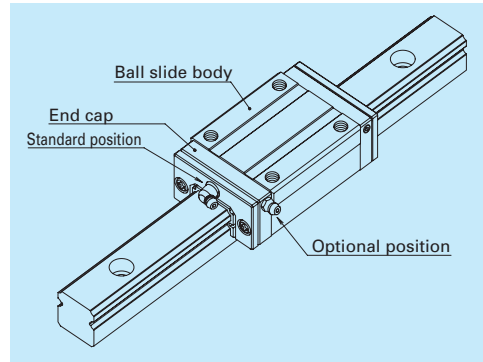


Fig. 11 Mounting position of lubrication accessories

8. Dust-resistant components

(1) Standard specification

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

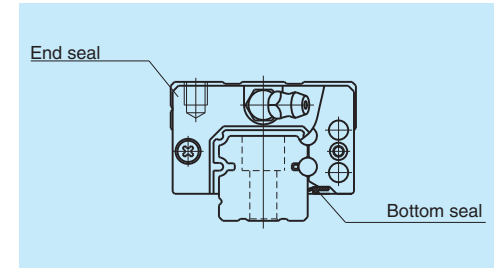


Fig. 12

Table 10 Seal friction per ball slide (maximum value)

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

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

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

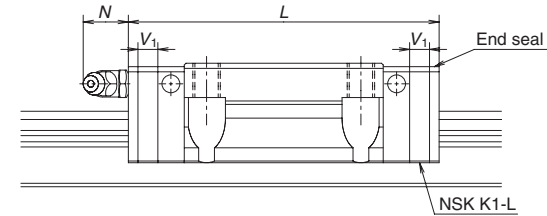


Table 11 Dimensions when equipped with NSK K1-L lubrication units

Model No.	Ball slide length	Ball slide shape code	Standard ball slide length	Ball slide length with two NSK K1-L units L	Unit: mm	
					Thickness of single NSK K1-L unit V ₁	Protrusion of grease fitting N
DH15	Standard	AN, EM	55	65.6	5.3	(5)
	Long	BN, GM	74	84.6		
DH20	Standard	AN, EM	69.8	80.4	5.3	(14)
	Long	BN, GM	91.8	102.4		
DH25	Standard	AL, AN, EM	79	90.6	5.8	(14)
	Long	BL, BN, GM	107	118.6		
DH30	Standard	AL, AN	85.6	97.6	6	(14)
		EM	98.6	110.6		
DH35	Standard	AL, AN, EM	109	122	6.5	(14)
		BL, BN, GM	143	156		
DH45	Standard	AL, AN, EM	139	154	7.5	(15)
		BL, BN, GM	171	186		
DH55	Standard	AL, AN, EM	163	178	7.5	(15)
		BL, BN, GM	201	216		
DH65	Standard	AN, EM	193	211	9	(16)
		BN, GM	253	271		

Notes: 1) When using NSK K1 for food processing machinery/medical equipment, refer to Table 12.

2) Slide length when equipped with NSK K1-L = (standard ball slide length) + (V₁, thickness of single NSK K1-L unit) × (number of K1-L units).

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

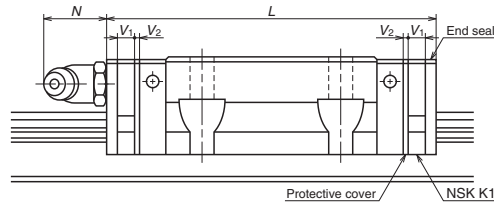


Table 12 Dimensions when equipped with NSK K1 for food processing machinery/medical equipment

Unit: mm

Model No.	Ball slide length	Ball slide shape code	Standard ball slide length	Ball slide length with two NSK K1 installed L	Thickness of single NSK K1 V ₁	Protective cover thickness V ₂	Protrusion of grease fitting N
DH15	Standard	AN, EM	55	65.6	4.5	0.8	(5)
	Long	BN, GM	74	84.6			
DH20	Standard	AN, EM	69.8	80.4	4.5	0.8	(14)
	Long	BN, GM	91.8	102.4			
DH25	Standard	AL, AN, EM	79.0	90.6	5.0	0.8	(14)
	Long	BL, BN, GM	107	118.6			
DH30	Standard	AL, AN	85.6	97.6	5.0	1.0	(14)
		EM	98.6	110.6			
DH35	Standard	AL, AN, EM	109	122	5.5	1.0	(14)
	Long	BL, BN, GM	143	156			

Note: Slide length when equipped with NSK K1 for food processing machinery/medical equipment = (standard ball slide length) + (V₁ thickness of single NSK K1 unit) × (number of K1 units) + (V₂ thickness of the protective cover) × 2.

Table 13 Double seal set

Model No.	Reference No.		Increased thickness V ₃ (mm)
	Without connector	With connector	
DH15	LH15WS-01	*	2.5
DH20	LH20WS-01	LH20WSC-01	2.5
DH25	LH25WS-01	LH25WSC-01	2.8
DH30	LH30WS-01	LH30WSC-01	3.6
DH35	LH35WS-01	LH35WSC-01	3.6
DH45	LH45WS-01	LH45WSC-01	4.3
DH55	LH55WS-01	LH55WSC-01	4.3
DH65	LH65WS-01	LH65WSC-01	4.9

Table 14 Protector set

Model No.	Reference No.		Increased thickness V ₄ (mm)
	Without connector	With connector	
DH15	LH15PT-01	*	2.7
DH20	LH20PT-01	LH20PTC-01	2.9
DH25	LH25PT-01	LH25PTC-01	3.2
DH30	LH30PT-01	LH30PTC-01	4.2
DH35	LH35PT-01	LH35PTC-01	4.2
DH45	LH45PT-01	LH45PTC-01	4.9
DH55	LH55PT-01	LH55PTC-01	4.9
DH65	LH65PT-01	LH65PTC-01	5.5

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

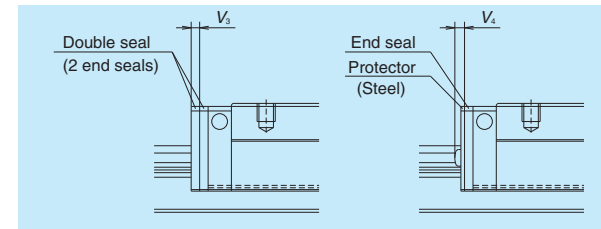


Fig. 15

(3) Double seal

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

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

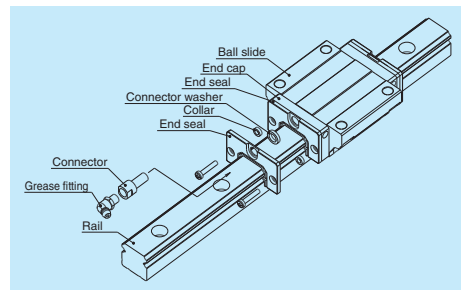


Fig. 13 Double seal

(4) Protector

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

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

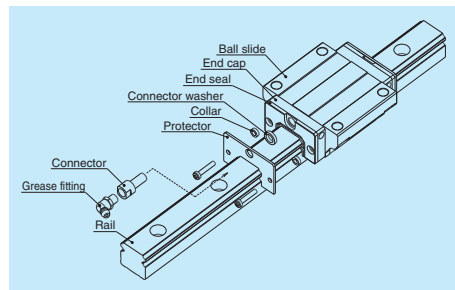


Fig. 14 Protector

(5) Caps to plug the rail mounting bolt hole

Table 15 Caps to plug rail bolt hole

Model No.	Bolt to secure rail	Cap reference No.	Quantity /case
DH15	M4	LG-CAP/M4	20
DH20	M5	LG-CAP/M5	20
DH25	M6	LG-CAP/M6	20
DH30, DH35	M8	LG-CAP/M8	20
DH45	M12	LG-CAP/M12	20
DH55	M14	LG-CAP/M14	20
DH65	M16	LG-CAP/M16	20

(6) Inner seal

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

Table 16

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

(7) Bellows

- A bellows fastener kit, which includes one bellows fastener, two M₁ set screws, two M₂ set screws, and two collars for M₂ set screws as shown in Fig. 7.7 on page A69, is supplied with bellows for the ends.
- Middle bellows are supplied with four set screws and four collars.
- Use a bellows fastener kit as shown in **Table 17**, when installing bellows to completed standard products.
- When NSK K1-L units, NSK K1 for food and medical equipment, double seals, or protectors are used, the set screws of bellows fastener kits cannot be used.

Table 17 Bellows fastener kit reference No.

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

Please contact NSK for details.

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

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

**Dimension tables for bellows
DH Model**

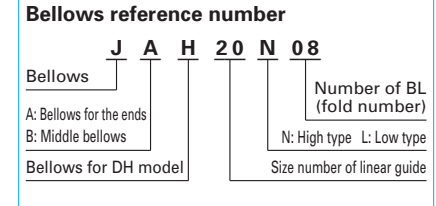
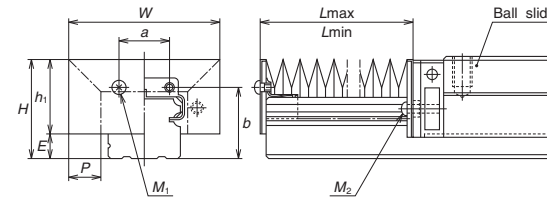


Fig. 16 Dimensions of bellows

Table 18 Dimensions of bellows

Unit: mm

Model No.	H	h ₁	E	W	P	a	b	BL minimum length	M ₁ Tap x depth	M ₂ Tap x depth
JAH20N	29.5	24.5	5	48	10	13	22	17	M3 × 5	M2.5 × 16
JAH25L	35	28	7	51	10	16	26	17	M3 × 5	M3 × 18
JAH25N	39	32		61	15					
JAH30L	41	32	9	60	12	18	31	17	M4 × 6	M4 × 22
JAH30N	44	35		66	15					
JAH35L	47	37.5	9.5	72	15	24	34	17	M4 × 6	M4 × 23
JAH35N	54	44.5		82	20					
JAH45L	59	45	14	83	15	32	44.5	17	M5 × 8	M5 × 28
JAH45N	69	55		103	25					
JAH55L	69	54	15	101	20	40	50.5	17	M5 × 8	M5 × 30
JAH55N	79	64		121	30					
JAH65N	89	73	16	131	30	48	61	17	M6 × 8	M6 × 35

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

Unit: mm

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

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

9. Reference number

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

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

DH 30 1200 ANC 2 - P5 3**

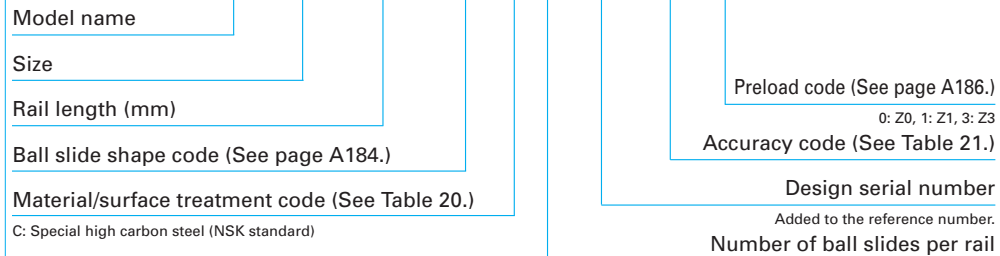


Table 20 Material/surface treatment code

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

Table 21 Accuracy code

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

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

10. Dimensions

DH-AN (High-load / Standard)

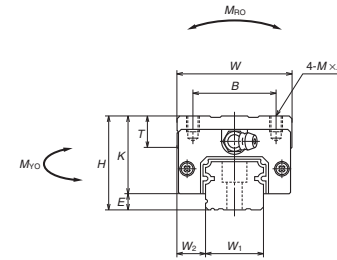
DH-BN (Super-high-load / Long)

DH 30 1200 ANC 2 - P5 3**

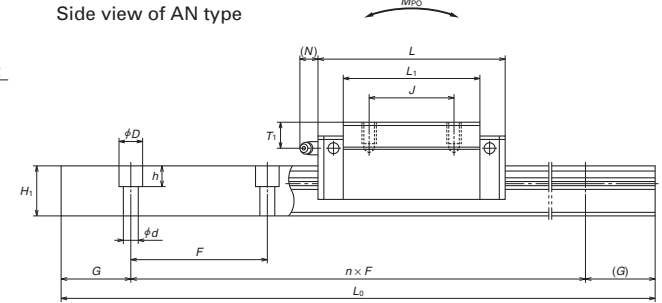
Model name	Preload code (See page A186.)
Size	0: Z0, 1: Z1, 3: Z3
Rail length (mm)	Accuracy code (See Table 21.)
Ball slide shape code (See page A184.)	Design serial number
Material/surface treatment code (See Table 20.)	Added to the reference number.
	Number of ball slides per rail

C: Special high carbon steel

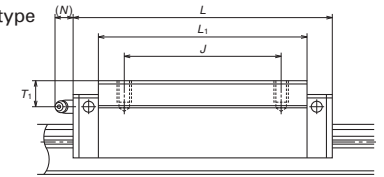
Front view of AN and BN types



Side view of AN type



Side view of BN type



Unit: mm

Model No.	Assembly			Ball slide										Width	Height	
	Height	Width	Length	Mounting hole						Grease fitting						
				B	J	M x pitch x l	L1	K	T	Hole size	T1	N				
DH15AN DH15BN	28	4.6	9.5	34	55 74	26	26	M4x0.7x6	39 58	23.4	8	phi 3	8.5	3.3	15	15
DH20AN DH20BN	30	5	12	44	69.8 91.8	32	36 50	M5x0.8x6	50 72	25	12	M6x0.75	5	11	20	18
DH25AN DH25BN	40	7	12.5	48	79 107	35	35 50	M6x1x9	58 86	33	12	M6x0.75	10	11	23	22
DH30AN DH30BN	45	9	16	60	85.6 124.6	40	40 60	M8x1.25x10	59 98	36	14	M6x0.75	10	11	28	26
DH35AN DH35BN	55	9.5	18	70	109 143	50	50 72	M8x1.25x12	80 114	45.5	15	M6x0.75	15	11	34	29
DH45AN DH45BN	70	14	20.5	86	139 171	60	60 80	M10x1.5x17	105 137	56	17	Rc1/8	20	13	45	38
DH55AN DH55BN	80	15	23.5	100	163 201	75	75 95	M12x1.75x18	126 164	65	18	Rc1/8	21	13	53	44
DH65AN DH65BN	90	16	31.5	126	193 253	76	70 120	M16x2x20	147 207	74	23	Rc1/8	19	13	63	53

Rail		Basic load ratings								Weight			
Pitch	Mounting bolt hole	G	Max. length	Dynamic		Static	Static moment (N-m)				Ball slide	Rail	
				[50km]	[100km]		MPO		MO				
				F	d x D x h	(reference)	Lmax	C50(N)	C100(N)	(N)	MPO	MO	(kg)
60	4.5x7.5x5.3	20	2 980	17 800	14 200	20 700	108	94.5	575	480	0.18	1.6	
				22 800	18 100	32 000	166	216	1 150	965	0.26		
60	6x9.5x8.5	20	3 960	29 800	23 700	32 500	219	185	1 140	155	955	0.33	2.6
				38 000	30 000	50 500	340	420	2 230	355	1 870	0.48	
60	7x11x9	20	3 960	42 500	33 500	46 000	360	320	1 840	267	1 540	0.55	3.6
				57 500	45 500	71 000	555	725	3 700	610	3 100	0.82	
80	9x14x12	20	4 000	51 500	41 000	51 500	490	350	2 290	292	1 920	0.77	5.2
				77 000	61 000	91 500	870	1 030	5 600	865	4 700	1.3	
80	9x14x12	20	4 000	78 500	62 500	80 500	950	755	4 500	630	3 800	1.5	7.2
				102 000	81 000	117 000	1 380	1 530	8 350	1 280	7 000	2.1	
105	14x20x17	22.5	3 990	135 000	107 000	140 000	2 140	1 740	9 750	1 460	8 150	3.0	12.3
				164 000	131 000	187 000	2 860	3 000	15 600	2 520	13 100	3.9	
120	16x23x20	30	3 960	199 000	158 000	198 000	3 600	3 000	16 300	2 510	13 700	4.7	16.9
				243 000	193 000	264 000	4 850	5 150	26 300	4 350	22 100	6.1	
150	18x26x22	35	3 900	300 000	239 000	281 000	6 150	4 950	27 900	4 150	23 400	7.7	24.3
				390 000	310 000	410 000	8 950	10 100	51 500	8 450	43 500	10.8	

Note : 1) The basic load ratings comply with the ISO standard. (ISO 14728-1, 14728-2) For long-life DH model, the rated load is multiplied by a coefficient that reflects the effect of life improvement technologies based on these ISO standards.
 C50, the basic dynamic load rating for 50 km rated fatigue life C100; the basic dynamic load rating for 100 km rated fatigue life
 The basic static load rating shows static permissible load.

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

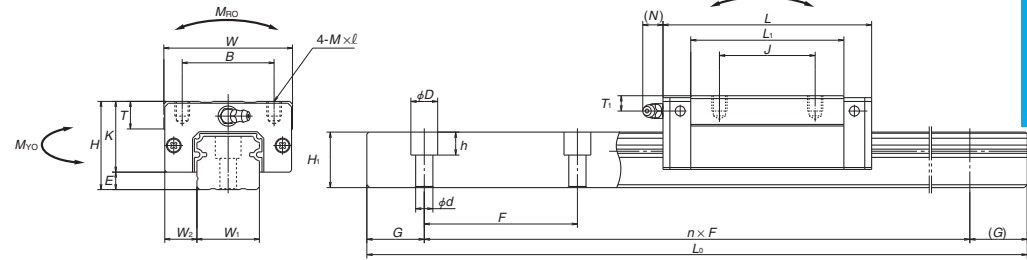
DH 30 1200 AL C 2 - P5 3**

Model name	Preload code (See page A186.)
Size	0: Z0, 1: Z1, 3: Z3
Rail length (mm)	Accuracy code (See Table 21.)
Ball slide shape code (See page A184.)	Design serial number
Material/surface treatment code (See Table 20.)	Added to the reference number.
	Number of ball slides per rail

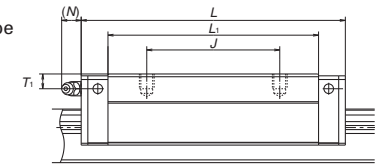
C: Special high carbon steel

Front view of AL and BL types

Side view of AL type



Side view of BL type



Unit: mm

Model No.	Assembly			Ball slide											Width	Height	
	Height	E	W ₂	Width	Length	Mounting hole					Grease fitting						
						B	J	M × pitch × l	L ₁	K	T	Hole size	T ₁	N			W ₁
DH25AL DH25BL	36	7	12.5	48	79 107	35	35 50	M6×1×6	58 86	29	12	M6×0.75	6	11	23	22	
DH30AL DH30BL	42	9	16	60	85.6 124.6	40	40 60	M8×1.25×8	59 98	33	14	M6×0.75	7	11	28	26	
DH35AL DH35BL	48	9.5	18	70	109 143	50	50 72	M8×1.25×8	80 114	38.5	15	M6×0.75	8	11	34	29	
DH45AL DH45BL	60	14	20.5	86	139 171	60	60 80	M10×1.5×10	105 137	46	17	Rc1/8	10	13	45	38	
DH55AL DH55BL	70	15	23.5	100	163 201	75	75 95	M12×1.75×13	126 164	55	15	Rc1/8	11	13	53	44	

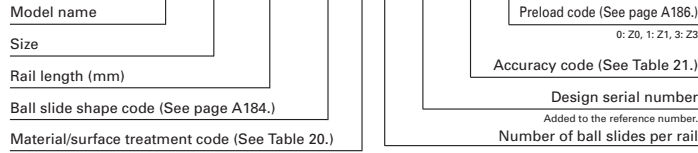
Rail		Basic load ratings								Weight			
Pitch	Mounting bolt hole	G	Max. length	¹⁾ Dynamic		Static	Static moment (N-m)				Ball slide	Rail	
				C ₅₀ (N)	C ₁₀₀ (N)		C ₀	M _{RO}		M _{VO}			
								One slide	Two slides	One slide			Two slides
60	7×11×9	20	3 960	42 500 57 500	33 500 45 500	46 000 71 000	360 555	320 725	1 840 3 700	267 610	1 540 3 100	0.46 0.69	3.6
80	9×14×12	20	4 000	51 500 77 000	41 000 61 000	51 500 91 500	490 870	350 1 030	2 290 5 600	292 865	1 920 4 700	0.69 1.16	5.2
80	9×14×12	20	4 000	78 500 102 000	62 500 81 000	80 500 117 000	950 1 380	755 1 530	4 500 8 350	630 1 280	3 800 7 000	1.2 1.7	7.2
105	14×20×17	22.5	3 990	135 000 164 000	107 000 131 000	140 000 187 000	2 140 2 860	1 740 3 000	9 750 15 600	1 460 2 520	8 150 13 100	2.2 2.9	12.3
120	16×23×20	30	3 960	199 000 243 000	158 000 193 000	198 000 264 000	3 600 4 850	3 000 5 150	16 300 26 300	2 510 4 350	13 700 22 100	3.7 4.7	16.9

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

C₅₀: the basic dynamic load rating for 50 km rated fatigue life C₁₀₀; the basic dynamic load rating for 100 km rated fatigue life
 The basic static load rating shows static permissible load.

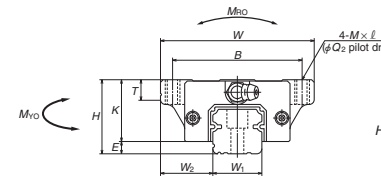
DH-EM (High-load / Standard)
DH-GM (Super-high-load / Long)

DH 30 1200 EMC 2 - P5 3**

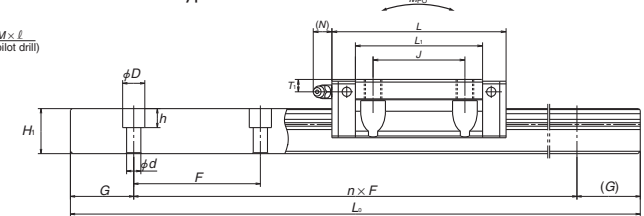


C: Special high carbon steel

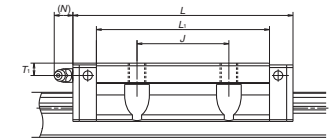
Front view of EM and GM types



Side view of EM type



Side view of GM type

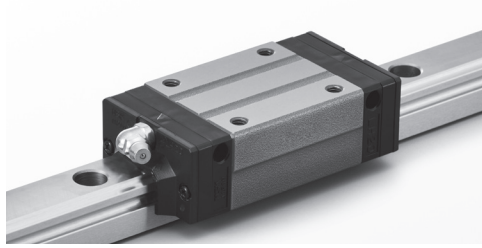


Model No.	Assembly			Ball slide										Width	Height			
	Height	Width		Length	Mounting hole				L ₁	K	T	Grease fitting				W ₁	H ₁	
		H	E		W ₂	W	B	J				M × pitch × l	Q ₂					Hole size
DH15EM DH15GM	24	4.6	16	47	55 74	38	30	M5×0.8×7	4.4	39 58	19.4	8	φ 3	4.5	3.3	15	15	
DH20EM DH20GM	30	5	21.5	63	69.8 91.8	53	40	M6×1×9.5	5.3	50 72	25	10	M6×0.75	5	11	20	18	
DH25EM DH25GM	36	7	23.5	70	79 107	57	45	M8×1.25×10	6.8	58 86	29	11	M6×0.75	6	11	23	22	
DH30EM DH30GM	42	9	31	90	98.6 124.6	72	52	M10×1.5×12	8.6	72 98	33	11	M6×0.75	7	11	28	26	
DH35EM DH35GM	48	9.5	33	100	109 143	82	62	M10×1.5×13	8.6	80 114	38.5	12	M6×0.75	8	11	34	29	
DH45EM DH45GM	60	14	37.5	120	139 171	100	80	M12×1.75×15	10.5	105 137	46	13	Rc1/8	10	13	45	38	
DH55EM DH55GM	70	15	43.5	140	163 201	116	95	M14×2×18	12.5	126 164	55	15	Rc1/8	11	13	53	44	
DH65EM DH65GM	90	16	53.5	170	193 253	142	110	M16×2×24	14.6	147 207	74	23	Rc1/8	19	13	63	53	

Rail				Basic load ratings								Weight	
Pitch	Mounting bolt hole	G	Max. length	Dynamic		C ₀	M _{Ro}	Static moment (N-m)				Ball slide	Rail
				[50km]	[100km]			M _{Ro}		M _{Vo}			
				F	d × D × h	(reference)	L _{0max}	C ₅₀ (N)	C ₁₀₀ (N)	(N)	One slide	Two slides	One slide
60	4.5×7.5×5.3	20	2 980	17 800 22 800	14 200 18 100	20 700 32 000	108 166	94.5 216	575 1 150	79.5 181	480 965	0.17 0.25	1.6
60	6×9.5×8.5	20	3 960	29 800 38 000	23 700 30 000	32 500 50 500	219 340	185 420	1 140 2 230	155 355	955 1 870	0.45 0.65	2.6
60	7×11×9	20	3 960	42 500 57 500	33 500 45 500	46 000 71 000	360 555	320 725	1 840 3 700	267 610	1 540 3 100	0.63 0.93	3.6
80	9×14×12	20	4 000	59 000 77 000	47 000 61 000	63 000 91 500	600 870	505 1 030	3 150 5 600	425 865	2 650 4 700	1.2 1.6	5.2
80	9×14×12	20	4 000	78 500 102 000	62 500 81 000	80 500 117 000	950 1 380	755 1 530	4 500 8 350	630 1 280	3 800 7 000	1.7 2.4	7.2
105	14×20×17	22.5	3 990	135 000 164 000	107 000 131 000	140 000 187 000	2 140 2 860	1 740 3 000	9 750 15 600	1 460 2 520	8 150 13 100	3 3.9	12.3
120	16×23×20	30	3 960	199 000 243 000	158 000 193 000	198 000 264 000	3 600 4 850	3 000 5 150	16 300 26 300	2 510 4 350	13 700 22 100	5 6.5	16.9
150	18×26×22	35	3 900	300 000 390 000	239 000 310 000	281 000 410 000	6 150 8 950	4 950 10 100	27 900 51 500	4 150 8 450	23 400 43 500	10 14.1	24.3

Note : 1) The basic load ratings comply with the ISO standard. (ISO 14728-1, 14728-2) For long-life DH model, the rated load is multiplied by a coefficient that reflects the effect of life improvement technologies based on these ISO standards.
 C₅₀; the basic dynamic load rating for 50 km rated fatigue life C₁₀₀; the basic dynamic load rating for 100 km rated fatigue life
 The basic static load rating shows static permissible load.

A-4-2.2 DV Model



1. Features

(1) High-performance end seals

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

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

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

(3) Double the life of standard linear guides

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

What is TF (Tough) Technology?

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

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

*1: Representative values for model.

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

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

(5) High vertical load carrying capacity

The contact angle is set at 50 degrees, thus increasing load carrying capacity as well as

rigidity in the vertical direction.

(6) High resistance against impact load

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

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

(7) High accuracy

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

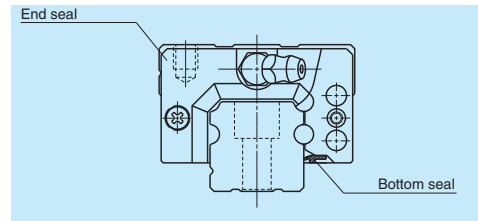


Fig. 1 DV Model

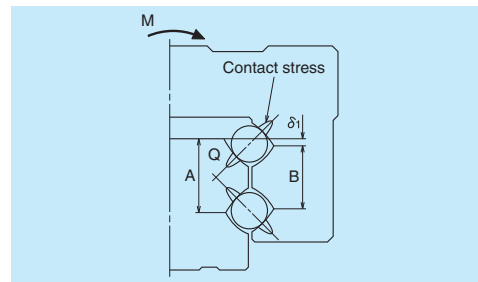


Fig. 2 Enlarged illustration of the offset Gothic arch groove

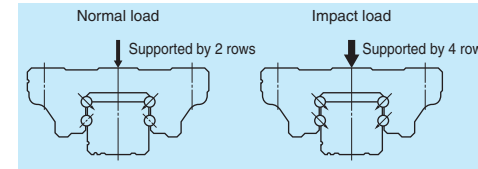


Fig. 3 When load is applied

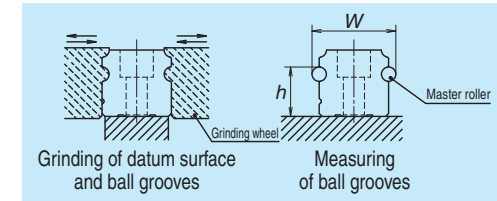
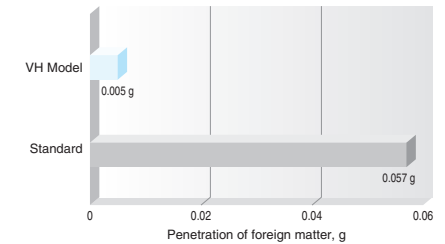


Fig. 4 Rail grinding and measuring

Comparison with NSK standard products

Level of fine contaminants reduced by 90% or more. Results of dust resistance tests reveal that the entry of fine contaminants is reduced to less than one-tenth that of existing standard models due to improvements in sealing.

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

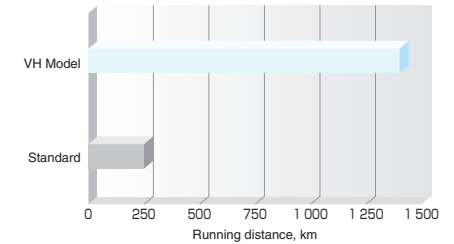


Operating life under contaminated environments is more than 5 times longer

Durability test with rubber fragments

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

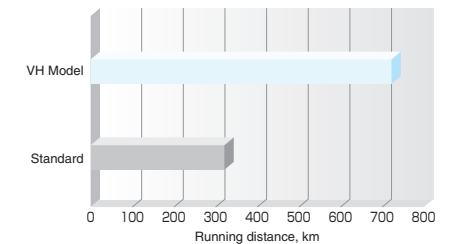
Test sample : VH30AN, preload code Z1 (preload of 245 N)
 Rail orientation : Horizontal (wall mount)
 Speed : 500 mm/sec
 Lubrication : AS2 grease (prepacked AS2 only)
 Contaminant : Rubber fragments



Durability test with fine wood particles

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

Test sample : VH30AN (preload of 3 200 N)
 Rail orientation : Horizontal (wall mount)
 Speed : 400 mm/sec
 Lubrication : AS2 grease (prepacked AS2 only)
 Contaminant : Fine wood particles



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

2. Ball slide shape

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

3. Accuracy and preload

(1) Running parallelism of ball slide

Table 1

Unit: μm

Rail length (mm)	Preloaded assembly				
	Ultra precision P3	Super precision P4	High precision P5	Precision grade P6	Normal grade PN
over					
or less					
– 50	2	2	2	4	5
50 – 80	2	2	3	4	5
80 – 125	2	2	3	4	5
125 – 200	2	2	3.5	5	6
200 – 250	2	2.5	4.5	6	7.5
250 – 315	2	2.5	5	6.5	8.5
315 – 400	2	3	5.5	7	9.5
400 – 500	2	3	6	7.5	11
500 – 630	2	3.5	6.5	8.5	12
630 – 800	2	4	7	9.5	13
800 – 1 000	2.5	4.5	7.5	10	15
1 000 – 1 250	3	5	8.5	12	16
1 250 – 1 600	3.5	5.5	9.5	13	17
1 600 – 2 000	4	6.5	11	14	19
2 000 – 2 500	4.5	7.5	12	16	21
2 500 – 3 150	5.5	8.5	13	18	23
3 150 – 4 000	6	9.5	14	19	25

(2) Accuracy standard

The preloaded assembly has five accuracy grades: Ultra precision P3, Super precision P4, High precision P5, Precision P6, and Normal PN grades.

• Tolerance of preloaded assembly

Table 2

Unit: μm

Characteristics	Accuracy grade	Ultra precision P3	Super precision P4	High precision P5	Precision grade P6	Normal grade PN
Mounting height H		± 8	± 10	± 20	± 40	± 80
Variation of H (All ball slides on a set of rails)		3	5	7	15	25
Mounting width W_2 or W_3		± 10	± 15	± 25	± 50	± 100
Variation of W_2 or W_3 (All ball slides on reference rail)		3	7	10	20	30
Running parallelism of surface C to surface A Running parallelism of surface D to surface B		Shown in Table 1, Fig. 5				

(3) Combinations of accuracy and preload

Table 3

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

(4) Assembled accuracy

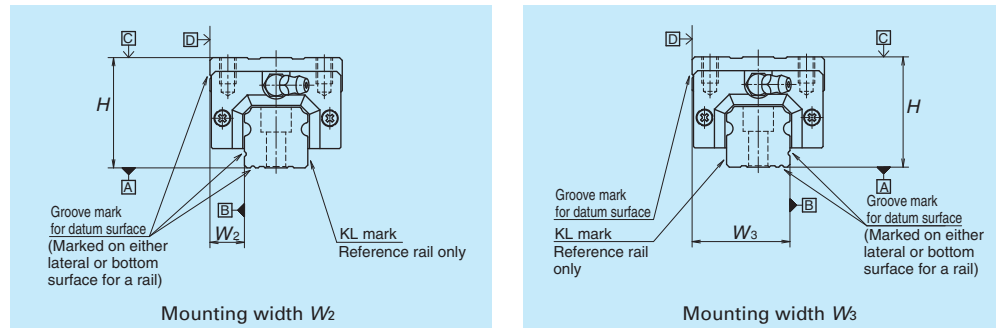


Fig. 5

(5) Preload and rigidity

We offer three levels of preload: Slight preload Z1, Medium preload Z3 and Fine clearance Z0.

• Preload and rigidity of preloaded assembly

Table 4

Model No.		Preload (N)		Rigidity (N/μm)			
		Slight preload Z1		Vertical direction		Lateral direction	
				Medium preload Z3	Slight preload Z1	Medium preload Z3	Slight preload Z1
High-load	DV15 AN, EM	78	490	137	226	98	186
	DV20 AN, EM	147	835	186	335	137	245
	DV25 AN, AL, EM	196	1 270	206	380	147	284
	DV30 AN, AL	245	1 570	216	400	157	294
	DV30 EM	294	1 770	265	480	186	355
	DV35 AN, AL, EM	390	2 350	305	560	216	390
Super-high-load	DV45 AN, AL, EM	635	3 900	400	745	284	540
	DV55 AN, AL, EM	980	5 900	490	910	345	645
	DV15 BN, GM	98	685	196	345	137	284
	DV20 BN, GM	196	1 080	265	480	196	355
	DV25 BN, BL, GM	245	1 570	294	560	216	400
	DV30 BN, BL, GM	390	2 260	360	665	265	480
	DV35 BN, BL, GM	490	2 940	430	795	305	570
	DV45 BN, BL, GM	785	4 800	520	960	370	695
	DV55 BN, BL, GM	1 180	7 050	635	1 170	440	835

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

4. Maximum rail length

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

Table 5 Length limitations of rails

Unit: mm

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

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

5. Installation

(1) Permissible values of mounting error

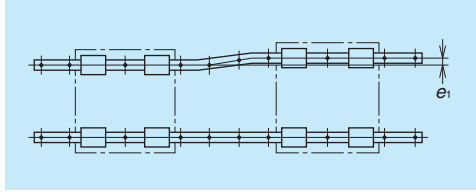


Fig. 6

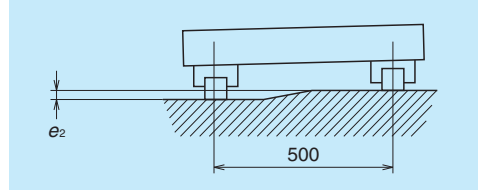


Fig. 7

Table 6

Unit: μm

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

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

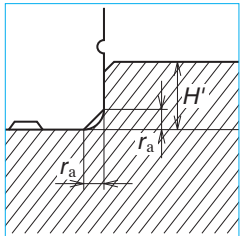


Fig. 8 Shoulder for the rail datum surface

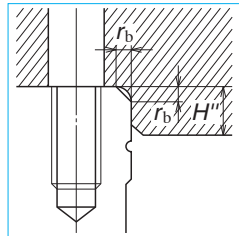


Fig. 9 Shoulder for the ball slide datum surface

Table 7

Unit: mm

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

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

- Applicable accuracy grades are precision grade (P6) and normal grades (PN) only.
- The minimum rail length for production is 400 mm.
- The tapping pitch is the same as the pitch for regular mounting bolt holes. Please refer to the dimension table.

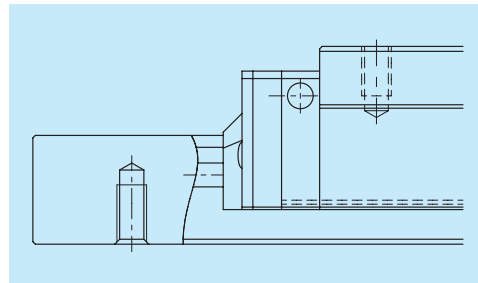


Fig. 10

6. Lubrication components

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

(1) Types of lubrication accessories

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

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

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

Please contact NSK if stainless lubrication accessories are required.

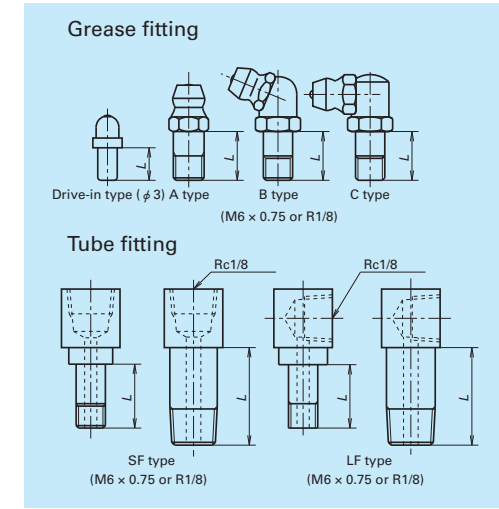


Fig. 11 Grease fitting and tube fitting

(2) Mounting position of lubrication accessories

The standard position for grease fittings is at the end face of the ball slide, but we can mount them on the side of the end cap as an option. (Fig. 12)

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

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

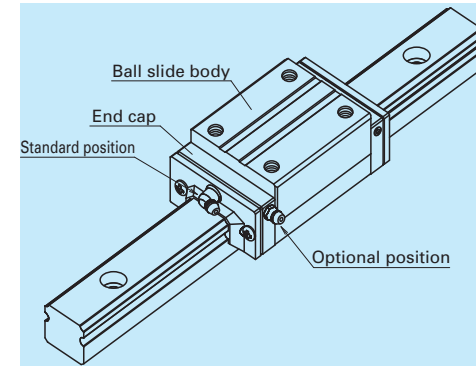


Fig. 12 Mounting position of lubrication accessories

Table 8

Unit: mm

Model No.	Dust-resistant specification	Dimension L		
		Grease fitting / Drive-in type	Tube fitting	
			SF type	LF type
DV15	Standard*	10	-	-
	Double seal	**	-	-
	Protector	**	-	-
DV20	Standard*	12	-	-
	Double seal	18	-	-
	Protector	18	-	-
DV25	Standard*	12	15	16
	Double seal	18	23	24.5***
	Protector	18	17	18
DV30	Standard*	14	18	17.5
	Double seal	22	25	24.5
	Protector	22	19.5	19
DV35	Standard*	14	15	15
	Double seal	22	25	24.5
	Protector	22	21.5	22
DV45	Standard*	18	22	21.5
	Double seal	22	32	32
	Protector	28	28	30
DV55	Standard*	18	20	20
	Double seal	22	32	32
	Protector	28	28	30

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

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

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

7. Dust-resistant components

(1) Standard specification

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

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

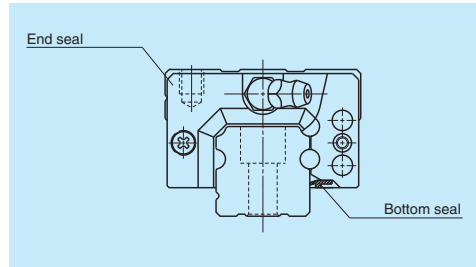


Fig. 13

Table 9 Seal friction per ball slide (maximum value)

Model	Size	Unit: N						
		15	20	25	30	35	45	55
DV		11	13	14	17	23	33	44

(2) Double seal and protector

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

Table 10 shows the ball slide length when a double seal set and a protector are installed.

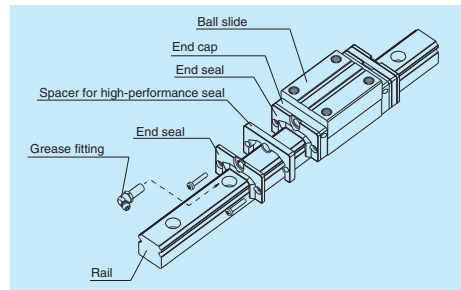


Fig. 14 Double seal

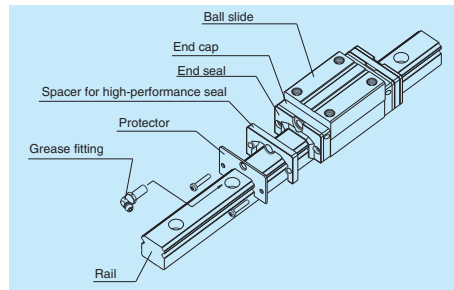


Fig. 15 Protector

Table 10 Dimensions with optional dust-resistant components installed

Unit: mm

Model No.	Ball slide length	Ball slide shape code	Ball slide length L		
			Standard	Double seal installation	Protector installation
DV15	Standard type	AN, EM	70.6	81.6	77
	Long type	BN, GM	89.6	100.6	96
DV20	Standard type	AN, EM	87.4	100.4	94.2
	Long type	BN, GM	109.4	122.4	116.2
DV25	Standard type	AN, AL, EM	97	110	104.4
	Long type	BN, BL, GM	125	138	132.4
DV30	Standard type	AN, AL, EM	104.4	120.4	114.8
	Long type	BN, BL, GM	143.4	159.4	153.8
DV35	Standard type	AN, AL, EM	128.8	144.8	139.2
	Long type	BN, BL, GM	162.8	178.8	173.2
DV45	Standard type	AN, AL, EM	161.4	180.4	174.2
	Long type	BN, BL, GM	193.4	212.4	206.2
DV55	Standard type	AN, AL, EM	185.4	204.4	198.2
	Long type	BN, BL, GM	223.4	242.4	236.2

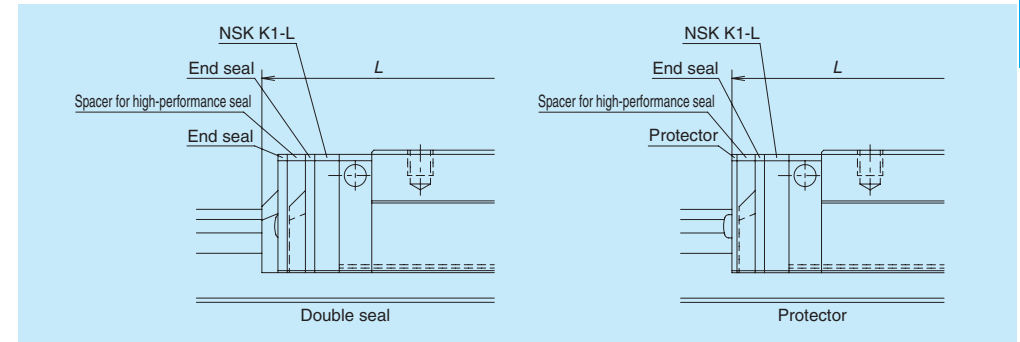


Fig. 16

(3) Caps to plug the rail mounting bolt hole

Table 11 Caps to plug rail bolt hole

Model No.	Bolt to secure rail	Cap reference No.	Quantity /case
DV15	M4	LG-CAP/M4	20
DV20	M5	LG-CAP/M5	20
DV25	M6	LG-CAP/M6	20
DV30, DV35	M8	LG-CAP/M8	20
DV45	M12	LG-CAP/M12	20
DV55	M14	LG-CAP/M14	20

(4) Inner seal

Inner seals are only available for the models shown below.

Table 12

Model	Model No.
DV	DV20, DV25, DV30, DV35, DV45, DV55

8. Design Precautions

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

9. Reference number

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

DV 30 1000 ANC 2 - L5 3**

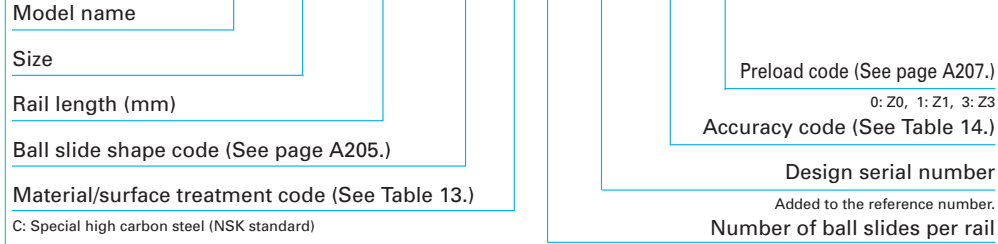


Table 13 Material/surface treatment code

Code	Description
C	Special high carbon steel + counterbores on a rail top surface
D	Special high carbon steel with surface treatment + counterbores on a rail top surface
V	Special high carbon steel + tapped holes on a rail bottom surface
W	Special high carbon steel with surface treatment + tapped holes on a rail bottom surface
Z	Other, special

Table 14 Accuracy code

Accuracy	With NSK K1-L
Ultra precision grade	L3
Super precision grade	L4
High precision grade	L5
Precision grade	L6
Normal grade	LN

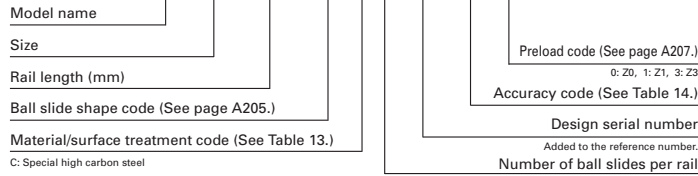
Note: Refer to page A58 for details on NSK K1-L lubrication units.

10. Dimensions

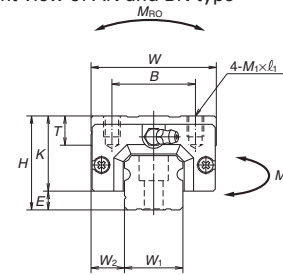
DV-AN (High-load / Standard)

DV-BN (Super-high-load / Long)

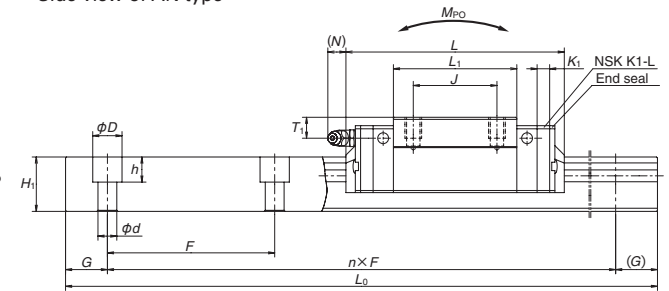
DV 30 1000 ANC 2 - L5 3**



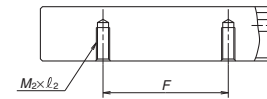
Front view of AN and BN type



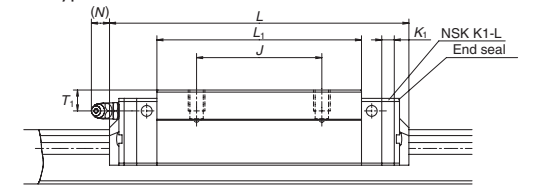
Side view of AN type



Specification for tapped holes on a rail bottom face



Side view of BN type



Unit: mm

Model No.	Assembly			Ball slide											Width	Height	
	Height	E	W ₂	Width	Length	Mounting hole					Grease fitting						
						B	J	M ₁ × pitch × l ₁	L ₁	K	T	K ₁	Hole size	T ₁			N
DV15AN DV15BN	28	4.6	9.5	34	70.6 (77) 89.6 (96)	26	26	M4×0.7×6	39 58	23.4	8	5.3	φ 3	8.5	1 (8.2)	15	15
DV20AN DV20BN	30	5	12	44	87.4 (94.2) 109.4 (116.2)	32	36 50	M5×0.8×6	50 72	25	12	5.3	M6×0.75	5	11.1 (12.3)	20	18
DV25AN DV25BN	40	7	12.5	48	97 (104.4) 125 (132.4)	35	35 50	M6×1×9	58 86	33	12	5.8	M6×0.75	10	9.6 (12.9)	23	22
DV30AN DV30BN	45	9	16	60	104.4 (114.8) 143.4 (153.8)	40	40 60	M8×1.25×10	59 98	36	14	6	M6×0.75	10	11.4 (14.2)	28	26
DV35AN DV35BN	55	9.5	18	70	128.8 (139.2) 162.8 (173.2)	50	50 72	M8×1.25×12	80 114	45.5	15	6.5	M6×0.75	15	10.9 (13.7)	34	29
DV45AN DV45BN	70	14	20.5	86	161.4 (174.2) 193.4 (206.2)	60	60 80	M10×1.5×17	105 137	56	17	7.5	Rc1/8	20	12.5 (14.1)	45	38
DV55AN DV55BN	80	15	23.5	100	185.4 (198.2) 223.4 (236.2)	75	75 95	M12×1.75×18	126 164	65	18	7.5	Rc1/8	21	12.5 (14.1)	53	44

Notes: 1) Figures inside () apply when equipped with a protector.

2) DV models do not have a ball retainer. Note that balls will fall out when the ball slide is removed from the rail.

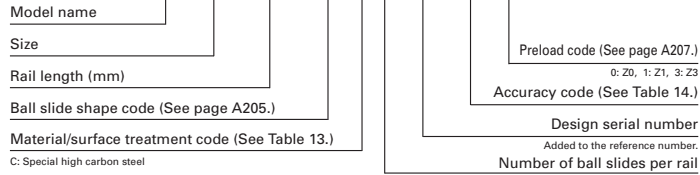
Rail		Basic load ratings							Weight					
Pitch	Mounting bolt hole	Tapped hole	G	Max. length	³⁾ Dynamic		Static	Static moment (N-m)				Ball slide	Rail	
					[50km]	[100km]		C ₀	M _{RO}	M _{PO}				M _{VO}
F	d × D × h	M ₂ × pitch × l ₂	(reference)	L _{0max}	C ₅₀ (N)	C ₁₀₀ (N)	(N)			One slide	Two slides	One slide	Two slides	(kg)
60	4.5×7.5×5.3	M5×0.8×8	20	2 000	17 800 22 800	14 200 18 100	20 700 32 000	108 166	94.5 216	575 1 150	79.5 181	480 965	0.18 0.26	1.6
60	6×9.5×8.5	M6×1×10	20	3 960	29 800 38 000	23 700 30 000	32 500 50 500	219 340	185 420	1 140 2 230	155 355	955 1 870	0.33 0.48	
60	7×11×9	M6×1×12	20	3 960	42 500 57 500	33 500 45 500	46 000 71 000	360 555	320 725	1 840 3 700	267 610	1 540 3 100	0.55 0.77	3.6
80	9×14×12	M8×1.25×15	20	4 000	51 500 77 000	41 000 61 000	51 500 91 500	490 870	350 1 030	2 290 5 600	292 865	1 920 4 700	0.72 1.3	
80	9×14×12	M8×1.25×17	20	4 000	78 500 102 000	62 500 81 000	80 500 117 000	950 1 380	755 1 530	4 500 8 350	630 1 280	3 800 7 000	1.5 2.1	7.2
105	14×20×17	M12×1.75×24	22.5	3 990	135 000 164 000	107 000 131 000	140 000 187 000	2 140 2 860	1 740 3 000	9 750 15 600	1 460 2 520	8 150 13 100	3.0 3.9	
120	16×23×20	M14×2×24	30	3 960	199 000 243 000	158 000 193 000	198 000 264 000	3 600 4 850	3 000 5 150	16 300 26 300	2 510 4 350	13 700 22 100	4.7 6.1	16.9

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

C₅₀: the basic dynamic load rating for 50 km rated fatigue life C₁₀₀: the basic dynamic load rating for 100 km rated fatigue life
The basic static load rating shows static permissible load.

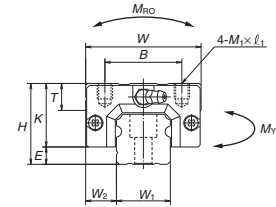
DV-AL (High-load / Standard)
DV-BL (Super-high-load / Long)

DV 30 1000 AL C 2 - L5 3**

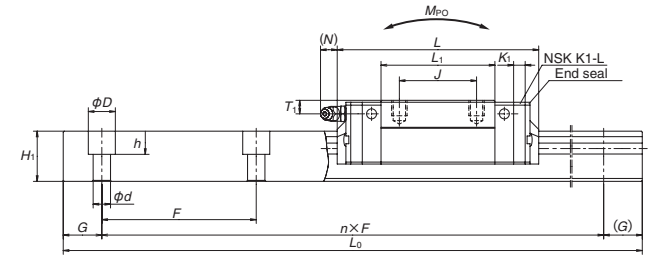


C: Special high carbon steel

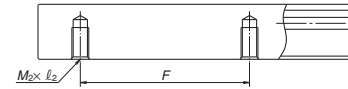
Front view of AL and BL type



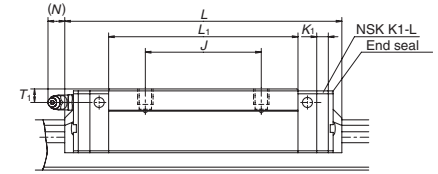
Side view of AL type



Specification for tapped holes on a rail bottom face



Side view of BL type



Unit: mm

Model No.	Assembly			Ball slide										Width	Height	
	Height	E	W ₂	Width	Length	Mounting hole					Grease fitting					
						B	J	M ₁ × pitch × l ₁	L ₁	K	T	K ₁	Hole size			T ₁
DV25AL DV25BL	36	7	12.5	48	97 (104.4) 125 (132.4)	35 50	M6×1×6	58 86	29	12	5.8	M6×0.75	6	9.6 (12.9)	23	22
DV30AL DV30BL	42	9	16	60	104.4 (114.8) 143.4 (153.8)	40 60	M8×1.25×8	59 98	33	14	6	M6×0.75	7	11.4 (14.2)	28	26
DV35AL DV35BL	48	9.5	18	70	128.8 (139.2) 162.8 (173.2)	50 72	M8×1.25×8	80 114	38.5	15	6.5	M6×0.75	8	10.9 (13.7)	34	29
DV45AL DV45BL	60	14	20.5	86	161.4 (174.2) 193.4 (206.2)	60 80	M10×1.5×10	105 137	46	17	7.5	Rc1/8	10	12.5 (14.1)	45	38
DV55AL DV55BL	70	15	23.5	100	185.4 (198.2) 223.4 (236.2)	75 95	M12×1.75×13	126 164	55	15	7.5	Rc1/8	11	12.5 (14.1)	53	44

Notes: 1) Figures inside () apply when equipped with a protector.

2) DV models do not have a ball retainer. Note that balls will fall out when the ball slide is removed from the rail.

Rail		Basic load ratings							Weight					
Pitch	Mounting bolt hole	Tapped hole	G	Max. length	³⁾ Dynamic		Static	Static moment (N-m)				Ball slide	Rail	
					[50km]	[100km]		C ₀	M _{RO}	M _{RO}				M _{VO}
					C ₅₀ (N)	C ₁₀₀ (N)	(N)			(N)	One slide	Two slides	One slide	Two slides
60	7×11×9	M6×1×12	20	3 960	42 500	33 500	46 000	360	320	1 840	267	1 540	0.46	3.6
					57 500	45 500	71 000	555	725	3 700	610	3 100	0.69	
80	9×14×12	M8×1.25×15	20	4 000	51 500	41 000	51 500	490	350	2 290	292	1 920	0.69	5.2
					77 000	61 000	91 500	870	1 030	5 600	865	4 700	1.16	
80	9×14×12	M8×1.25×17	20	4 000	78 500	62 500	80 500	950	755	4 500	630	3 800	1.2	7.2
					102 000	81 000	117 000	1 380	1 530	8 350	1 280	7 000	1.7	
105	14×20×17	M12×1.75×24	22.5	3 990	135 000	107 000	140 000	2 140	1 740	9 750	1 460	8 150	2.2	12.3
					164 000	131 000	187 000	2 860	3 000	15 600	2 520	13 100	2.9	
120	16×23×20	M14×2×24	30	3 960	199 000	158 000	198 000	3 600	3 000	16 300	2 510	13 700	3.7	16.9
					243 000	193 000	264 000	4 850	5 150	26 300	4 350	22 100	4.7	

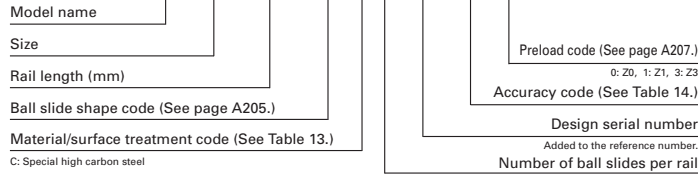
3) The basic load ratings comply with the ISO standard. (ISO 14728-1, 14728-2) For long-life DV model, the rated load is multiplied by a coefficient that reflects the effect of life improvement technologies based on these ISO standards.

C₅₀: the basic dynamic load rating for 50 km rated fatigue life C₁₀₀: the basic dynamic load rating for 100 km rated fatigue life
 The basic static load rating shows static permissible load.

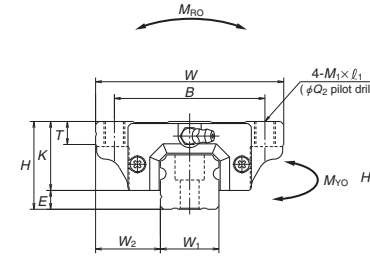
Dust-Resistant DV Model

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

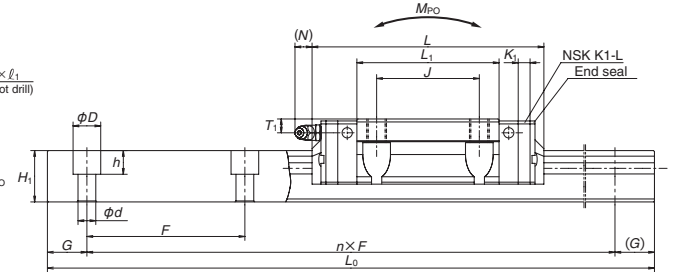
DV 30 1000 EMC 2 - L5 3**



Front view of EM and GM type



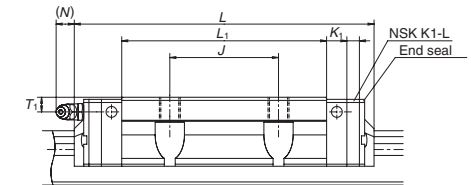
Side view of EM type



Specification for tapped holes on a rail bottom face



Side view of GM type



Unit: mm

Model No.	Assembly		Ball slide													Width	Height	
	Height	Width	Length	Mounting hole				Grease fitting					Width	Height				
				H	E	W ₂	W	L	B	J	M ₁ × pitch × l ₁	Q ₂			L ₁			K
DV15EM DV15GM	24	4.6	16	47	70.6 (77) 89.6 (96)	38	30	M5×0.8×7	4.4	39 58	19.4	8	5.3	φ3	4.5	1 (8.2)	15	15
DV20EM DV20GM	30	5	21.5	63	87.4 (94.2) 109.4 (116.2)	53	40	M6×1×9.5	5.3	50 72	25	10	5.3	M6×0.75	5	11.1 (12.3)	20	18
DV25EM DV25GM	36	7	23.5	70	97 (104.4) 125 (132.4)	57	45	M8×1.25×10	6.8	58 86	29	11	5.8	M6×0.75	6	9.6 (12.9)	23	22
DV30EM DV30GM	42	9	31	90	117.4 (127.8) 143.4 (153.8)	72	52	M10×1.5×12	8.6	72 98	33	11	6	M6×0.75	7	11.4 (14.2)	28	26
DV35EM DV35GM	48	9.5	33	100	128.8 (139.2) 162.8 (173.2)	82	62	M10×1.5×13	8.6	80 114	38.5	12	6.5	M6×0.75	8	10.9 (13.7)	34	29
DV45EM DV45GM	60	14	37.5	120	161.4 (174.2) 193.4 (206.2)	100	80	M12×1.75×15	10.5	105 137	46	13	7.5	Rc1/8	10	12.5 (14.1)	45	38
DV55EM DV55GM	70	15	43.5	140	185.4 (198.2) 223.4 (236.2)	116	95	M14×2×18	12.5	126 164	55	15	7.5	Rc1/8	11	12.5 (14.1)	53	44

Notes: 1) Figures inside () apply when equipped with a protector.

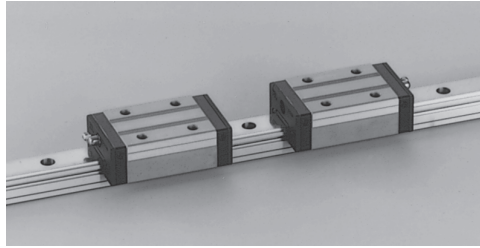
2) DV models do not have a ball retainer. Note that balls will fall out when the ball slide is removed from the rail.

Rail		Basic load ratings								Weight			
Pitch	Mounting bolt hole	Tapped hole	G	Max. length	Dynamic		Static	Static moment (N-m)				Ball slide	Rail
					[50km]	[100km]		C ₀	M _{RO}	M _{PO}			
F	d × D × h	M ₂ × pitch × l ₂	(reference)	L _{0max}	C ₅₀ (N)	C ₁₀₀ (N)	(N)			One slide	Two slides	One slide	Two slides
60	4.5×7.5×5.3	M5×0.8×8	20	2 000	17 800	14 200	20 700	108	94.5	575	79.5	480	0.17
60	6×9.5×8.5	M6×1×10	20	3 960	22 800	18 100	32 000	166	216	1 150	181	965	0.25
60	7×11×9	M6×1×12	20	3 960	29 800	23 700	32 500	219	185	1 140	155	955	0.45
60	9×14×12	M8×1.25×15	20	4 000	38 000	30 000	50 500	340	420	2 230	355	1 870	0.65
80	9×14×12	M8×1.25×15	20	4 000	42 500	33 500	46 000	360	320	1 840	267	1 540	0.63
80	9×14×12	M8×1.25×17	20	4 000	57 500	45 500	71 000	555	725	3 700	610	3 100	0.93
80	9×14×12	M8×1.25×17	20	4 000	59 000	47 000	63 000	600	505	3 150	425	2 650	1.2
105	14×20×17	M12×1.75×24	22.5	3 990	77 000	61 000	91 500	870	1 030	5 600	865	4 700	1.6
105	14×20×17	M12×1.75×24	22.5	3 990	78 500	62 500	80 500	950	755	4 500	630	3 800	1.7
120	16×23×20	M14×2×24	30	3 960	102 000	81 000	117 000	1 380	1 530	8 350	1 280	7 000	2.4
120	16×23×20	M14×2×24	30	3 960	135 000	107 000	140 000	2 140	1 740	9 750	1 460	8 150	3.0
120	16×23×20	M14×2×24	30	3 960	164 000	131 000	187 000	2 860	3 000	15 600	2 520	13 100	3.9
120	16×23×20	M14×2×24	30	3 960	199 000	158 000	198 000	3 600	3 000	16 300	2 510	13 700	5.0
120	16×23×20	M14×2×24	30	3 960	243 000	193 000	264 000	4 850	5 150	26 300	4 350	22 100	6.5

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

C₅₀: the basic dynamic load rating for 50 km rated fatigue life C₁₀₀: the basic dynamic load rating for 100 km rated fatigue life
 The basic static load rating shows static permissible load.

A-4-2.3 DS Model



1. Features

(1) Double the life of standard linear guides

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

What is TF (Tough) Technology?

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

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

*1: Representative values for model.

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

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

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

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

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

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

This increases the capacity to absorb errors in installation.

(5) High vertical load carrying capacity

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

(6) High resistance against impact load

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

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

(7) High accuracy

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

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

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

(9) Abundant variations and sizes

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

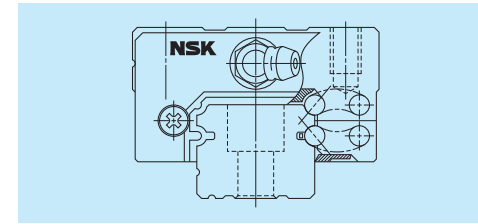


Fig. 1 DS Model

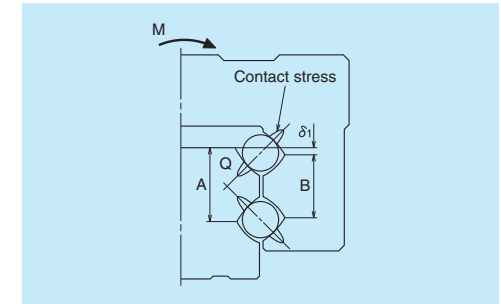


Fig. 2 Enlarged illustration of the offset Gothic arch groove

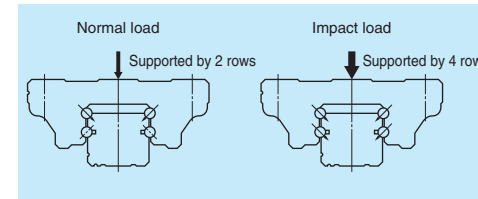


Fig. 3 When load is applied

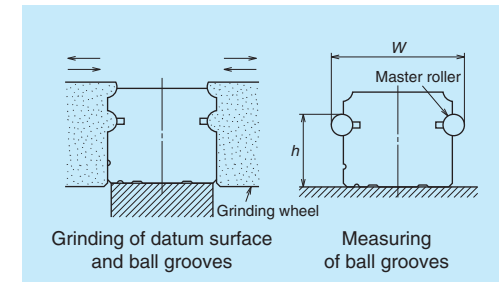


Fig. 4 Rail-grinding and measuring

2. Ball slide shape

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

3. Accuracy and preload

(1) Running parallelism of ball slide

Table 1

Unit: μm

Rail length (mm)	Accuracy grade	Preloaded assembly				
		Ultra precision P3	Super precision P4	High precision P5	Precision grade P6	Normal grade PN
over	or less					
- 50		2	2	2	4	5
50 - 80		2	2	3	4	5
80 - 125		2	2	3	4	5
125 - 200		2	2	3.5	5	6
200 - 250		2	2.5	4.5	6	7.5
250 - 315		2	2.5	5	6.5	8.5
315 - 400		2	3	5.5	7	9.5
400 - 500		2	3	6	7.5	11
500 - 630		2	3.5	6.5	8.5	12
630 - 800		2	4	7	9.5	13
800 - 1 000		2.5	4.5	7.5	10	15
1 000 - 1 250		3	5	8.5	12	16
1 250 - 1 600		3.5	5.5	9.5	13	17
1 600 - 2 000		4	6.5	11	14	19
2 000 - 2 500		4.5	7.5	12	16	21
2 500 - 3 150		5.5	8.5	13	18	23
3 150 - 4 000		6	9.5	14	19	25

(2) Accuracy standard

The preloaded assembly has five accuracy grades; Ultra precision P3, Super precision P4, High precision P5, Precision P6 and Normal PN grades.

• Tolerance of preloaded assembly

Table 2

Unit: μm

Characteristics	Accuracy grade	Ultra precision P3	Super precision P4	High precision P5	Precision grade P6	Normal grade PN
Mounting height H		± 8	± 10	± 20	± 40	± 80
Variation of H (All ball slides on a set of rails)		3	5	7	15	25
Mounting width W_2 or W_3		± 10	± 15	± 25	± 50	± 100
Variation of W_2 or W_3 (All ball slides on reference rail)		3	7	10	20	30
Running parallelism of surface C to surface A Running parallelism of surface D to surface B		See Table 1, Fig. 5				

(3) Combinations of accuracy and preload

Table 3

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

(4) Assembled accuracy

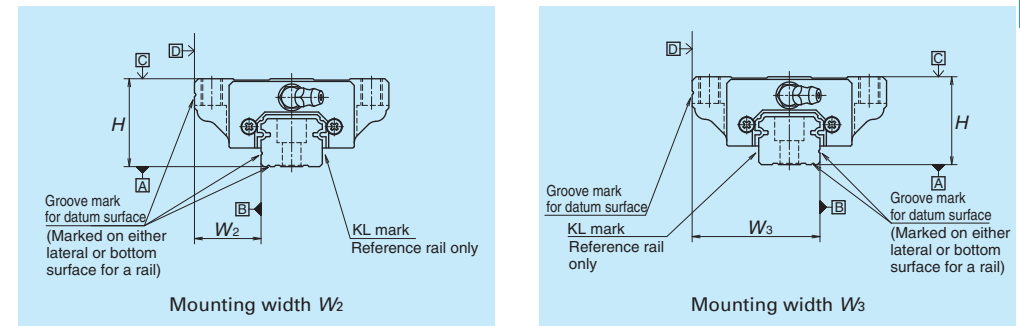


Fig. 5

(5) Preload and rigidity

We offer three levels of preload: Slight preload Z1, Medium preload Z3 and Fine clearance Z0.

• Preload and rigidity of preloaded assembly

Table 4

Model No.	Preload (N)		Rigidity (N/ μ m)				
	Slight preload Z1	Medium preload Z3	Vertical direction		Lateral direction		
			Slight preload Z1	Medium preload Z3	Slight preload Z1	Medium preload Z3	
High-load	DS15 AL, EM	69	390	127	226	88	167
	DS20 AL, EM	88	540	147	284	108	206
	DS25 AL, EM	147	880	206	370	147	275
	DS30 AL, EM	245	1 370	255	460	186	345
	DS35 AL, EM	345	1 960	305	550	216	400
Medium-load	DS15 CL, JM	49	294	78	147	59	108
	DS20 CL, JM	69	390	108	186	78	137
	DS25 CL, JM	98	635	127	235	88	177
	DS30 CL, JM	147	980	147	275	108	206
	DS35 CL, JM	245	1 370	186	335	137	245

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

4. Maximum rail length

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

Table 5 Length limitations of rails

Model	Size Material	Unit: mm				
		15	20	25	30	35
DS	Special high carbon steel	2 920	3 960	3 960	4 000	4 000

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

5. Installation

(1) Permissible values of mounting error

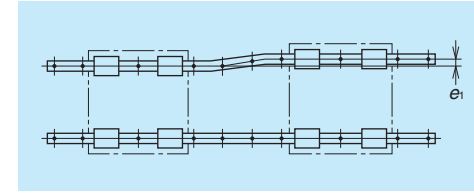


Fig. 6

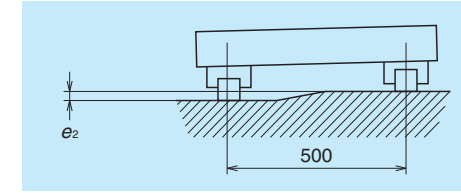


Fig. 7

Table 6

Unit: μ m

Value	Preload	Model No.				
		DS15	DS20	DS25	DS30	DS35
Permissible values for parallelism error of two rails e_1	Z0	20	22	30	35	40
	Z1	15	17	20	25	30
	Z3	12	15	15	20	25
Permissible values for height error of two rails e_2	Z0	375 μ m/500 mm				
	Z1, Z3	330 μ m/500 mm				

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

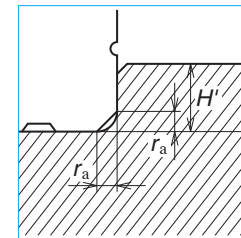


Fig. 8 Shoulder for the rail datum surface

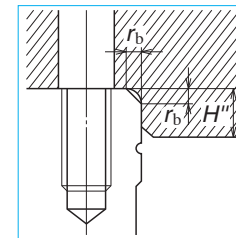


Fig. 9 Shoulder for the ball slide datum surface

Table 7

Unit: mm

Model No.	Corner radius (maximum)		Shoulder height	
	r_a	r_b	H'	H''
DS15	0.5	0.5	4	4
DS20	0.5	0.5	4.5	5
DS25	0.5	0.5	5	5
DS30	0.5	0.5	6	6
DS35	0.5	0.5	6	6

6. Maximum allowable speed

Table 8 indicates the maximum allowable speed for 10,000 km operation when using an DS model under normal conditions. However, the maximum allowable speed can be affected by accuracy of installation, operating temperature, external load, etc. If the operation is made exceeding the permissible distance and speed, please consult NSK.

Table 8 Maximum allowable speed Unit: m/min

Model	Size	15	20	25	30	35
DS		300				

7. Lubrication components

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

(1) Types of lubrication accessories

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

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

NSK can also provide extended length threads for ease of replenishment. Please contact NSK if stainless lubrication accessories are required.

(2) Mounting position of lubrication accessories

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

Please consult NSK for the installation of grease or tube fittings to the ball slide body. Using a piping unit with thread of M6 × 1, requires a connector to connect to a grease fitting mounting hole with M6 × 0.75. The connector is available from NSK.

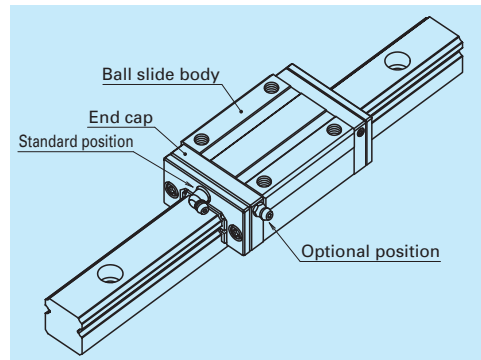


Fig. 11 Mounting position of lubrication accessories

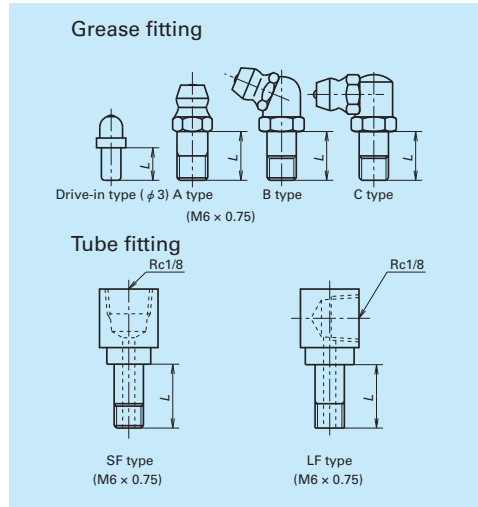


Fig. 10 Grease fitting and tube fitting

Model No.	Dust-resistant specification	Dimension L		
		Grease fitting / Drive-in type	SF type	LF type
DS15	Standard	5	-	-
	With NSK K1-L	10	-	-
	Double seal	*	-	-
	Protector	*	-	-
DS20	Standard	5	-	-
	With NSK K1-L	10	-	-
	Double seal	8	-	-
	Protector	8	-	-
DS25	Standard	5	6	6
	With NSK K1-L	12	11	11
	Double seal	10	9	9
	Protector	10	9	9
DS30	Standard	5	6	6
	With NSK K1-L	14	12	13
	Double seal	12	10	11
	Protector	12	10	11
DS35	Standard	5	6	6
	With NSK K1-L	14	12	13
	Double seal	12	10	11
	Protector	12	10	11

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

8. Dust-resistant components

(1) Standard specification

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

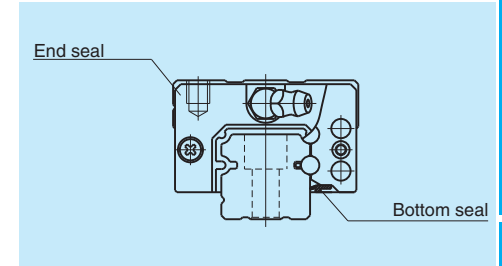


Fig. 12

Table 10 Seal friction per ball slide (maximum value)

Model	Size	Unit: N				
		15	20	25	30	35
DS		8	9	9	9	10

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

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

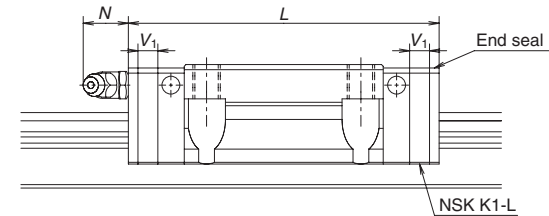


Table 11 Dimensions when equipped with NSK K1-L lubrication units Unit: mm

Model No.	Ball slide length	Ball slide shape code	Standard ball slide length	Ball slide length with two NSK K1-L units L	Thickness of single NSK K1-L unit V ₁	Protrusion of grease fitting N
DS15	Standard	AL, EM	56.8	66.4	4.8	(5)
	Short	CL, JM	40.4	50		
DS20	Standard	AL, EM	65.2	75.8	5.3	(14)
	Short	CL, JM	47.2	57.8		
DS25	Standard	AL, EM	81.6	92.2	5.3	(14)
	Short	CL, JM	59.6	70.2		
DS30	Standard	AL, EM	96.4	108.4	6	(14)
	Short	CL, JM	67.4	79.4		
DS35	Standard	AL, EM	108	121	6.5	(14)
	Short	CL, JM	77	90		

Notes: 1) When using NSK K1 for food processing machinery/medical equipment, refer to Table 12.

2) Slide length when equipped with NSK K1-L = (standard ball slide length) + (V₁, thickness of single NSK K1-L unit) × (number of K1-L units).

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

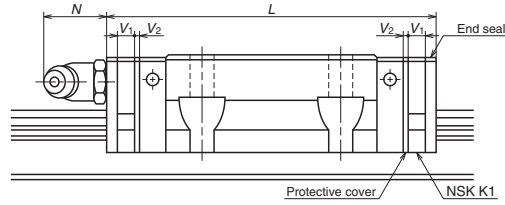


Table 12 Dimensions when equipped with NSK K1 for food processing machinery/medical equipment

Unit: mm

Model No.	Ball slide length	Ball slide shape code	Standard ball slide length	Ball slide length with two NSK K1 installed L	Thickness of single NSK K1 V ₁	Protective cover thickness V ₂	Protusion of grease fitting N
DS15	Standard	AL, EM	56.8	66.4	4.0	0.8	(5)
	Short	CL, JM	40.4	50			
DS20	Standard	AL, EM	65.2	75.8	4.5	0.8	(14)
	Short	CL, JM	47.2	57.8			
DS25	Standard	AL, EM	81.6	92.2	4.5	0.8	(14)
	Short	CL, JM	59.6	70.2			
DS30	Standard	AL, EM	96.4	108.4	5.0	1.0	(14)
	Short	CL, JM	67.4	79.4			
DS35	Standard	AL, EM	108	121	5.5	1.0	(14)
	Short	CL, JM	77	90			

Note: Slide length when equipped with NSK K1 for food processing machinery/medical equipment = (standard ball slide length) + (V₁ thickness of single NSK K1 unit) × (number of K1 units) + (V₂ thickness of the protective cover) × 2.

(3) Double seal

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

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

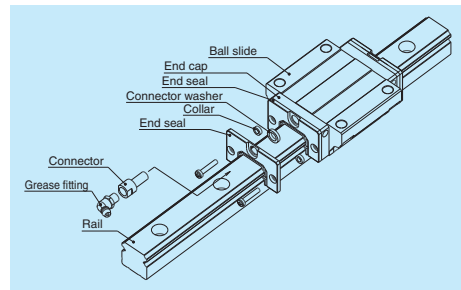


Fig. 13 Double seal

(4) Protector

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

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

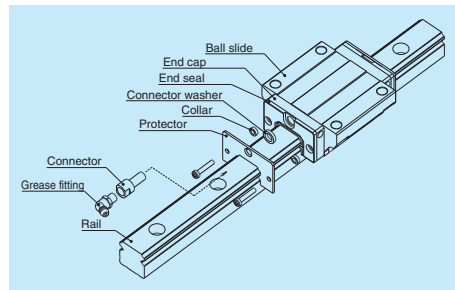


Fig. 14 Protector

Table 13 Double seal set

Model No.	Reference No.		Increased thickness V ₃ (mm)
	Without connector	With connector	
DS15	LS15WS-01	*	2.8
DS20	LS20WS-01	LS20WSC-01	2.5
DS25	LS25WS-01	LS25WSC-01	2.8
DS30	LS30WS-01	LS30WSC-01	3.6
DS35	LS35WS-01	LS35WSC-01	3.6

Table 14 Protector set

Model No.	Reference No.		Increased thickness V ₄ (mm)
	Without connector	With connector	
DS15	LS15PT-01	*	3
DS20	LS20PT-01	LS20PTC-01	2.7
DS25	LS25PT-01	LS25PTC-01	3.2
DS30	LS30PT-01	LS30PTC-01	4.2
DS35	LS35PT-01	LS35PTC-01	4.2

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

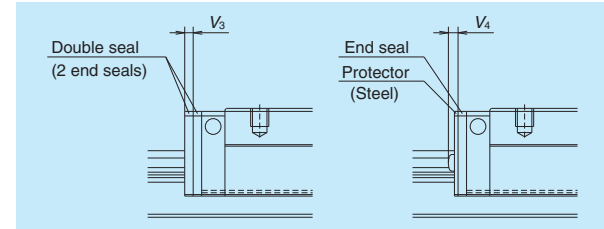


Fig. 15

(5) Caps to plug the rail mounting bolt hole

Table 15 Caps to plug rail bolt hole

Model No.	Bolt to secure rail	Cap reference No.	Quantity /case
DS15	M3	LG-CAP/M3	20
DS15	M4	LG-CAP/M4	20
DS20	M5	LG-CAP/M5	20
DS25, DS30	M6	LG-CAP/M6	20
DS35	M8	LG-CAP/M8	20

(6) Bellows

- A bellows fastener kit, which includes one bellows faster, two M_1 set screws, two M_2 set screws, and two collars for M_2 set screws as shown in Fig. 7.7 on page A69, is supplied with bellows for the ends.
- Middle bellows are supplied with four set screws and four collars.
- Use a bellows fastener kit as shown in **Table 16**, when installing bellows to completed standard products.
- When NSK K1-L units, NSK K1 for food and medical equipment, double seals, or protectors are used, the set screws of bellows fastener kits cannot be used.
Please contact NSK for details.
- Bellows fasteners are available only for horizontal mounting positions; other mounting positions require a sliding plate (see **Fig. 7.10** on page A70).

Table 16 Bellows fastener kit reference No.

Model No.	Kit reference No.
DS15	LS15FS-01
DS20	LS20FS-01
DS25	LS25FS-01
DS30	LS30FS-01
DS35	LS35FS-01

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

Dimension tables for bellows DS Model

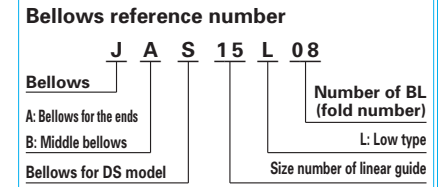
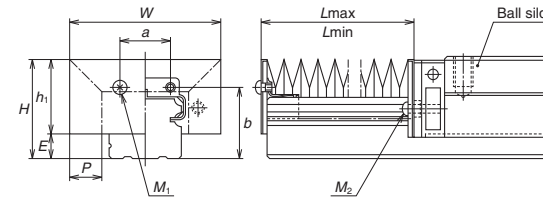


Fig. 16 Dimensions of bellows

Table 17 Dimensions of bellows

Unit: mm

Model No.	H	h_1	E	W	P	a	b	BL minimum length	M_1 Tap x depth	M_2 Tap x depth
JAS15L	23.5	18.9	4.6	43	10	8	16.5	17	M3 × 5	M3 × 14
JAS20L	27	21	6	48	10	13	19.7	17	M3 × 5	M2.5 × 14
JAS25L	32	25	7	51	10	15	23.2	17	M3 × 5	M3 × 18
JAS30L	41	32	9	66	15	16	29	17	M4 × 6	M4 × 19
JAS35L	47	36.5	10.5	72	15	22	33.5	17	M4 × 6	M4 × 22

Table 18 Numbers of folds (BL) and lengths of bellows

Unit: mm

Model No.	Number of BL	2	4	6	8	10	12	14	16	18	20
		L_{min}	34	68	102	136	170	204	238	272	306
JAS15L	Stroke	106	212	318	424	530	636	742	848	954	1 060
	L_{max}	140	280	420	560	700	840	980	1 120	1 260	1 400
JAS20L	Stroke	106	212	318	424	530	636	742	848	954	1 060
	L_{max}	140	280	420	560	700	840	980	1 120	1 260	1 400
JAS25L	Stroke	106	212	318	424	530	636	742	848	954	1 060
	L_{max}	140	280	420	560	700	840	980	1 120	1 260	1 400
JAS30L	Stroke	176	352	528	704	880	1 056	1 232	1 408	1 584	1 760
	L_{max}	210	420	630	840	1 050	1 260	1 470	1 680	1 890	2 100
JAS35L	Stroke	176	352	528	704	880	1 056	1 232	1 408	1 584	1 760
	L_{max}	210	420	630	840	1 050	1 260	1 470	1 680	1 890	2 100

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

9. Reference number

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

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

DS 30 1200 AL C 2 - P5 3**

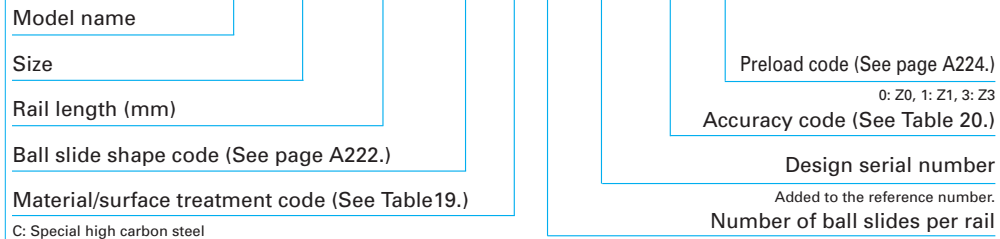


Table 19 Material/surface treatment code

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

Table 20 Accuracy code

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

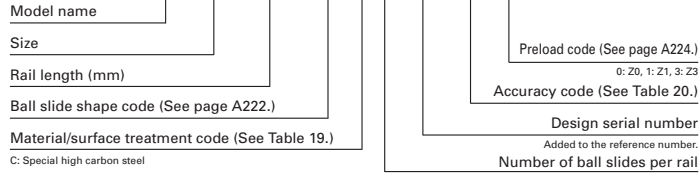
Note: Refer to page A58 for details on NSK K1-L lubrication units and to page A73 for details on NSK K1 lubrication units for food processing machinery/medical equipment.

10. Dimensions

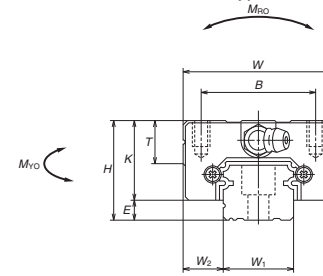
DS-CL (Medium-load / Short)

DS-AL (High-load / Standard)

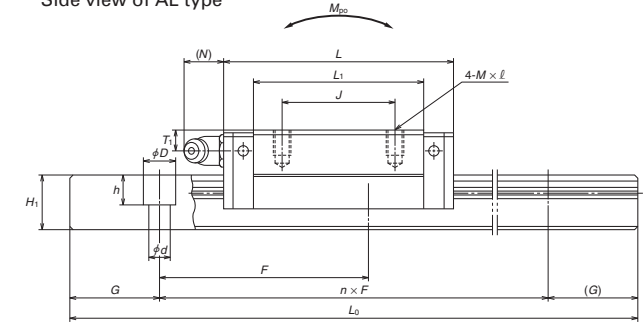
DS 30 1200 AL C 2 - P5 3**



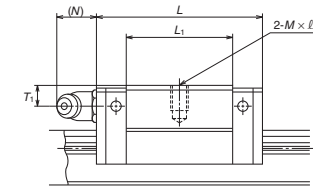
Front view of AL and CL type



Side view of AL type



Side view of CL type



Model No.	Assembly			Ball slide										Width	Height	
	Height	Width	Length	Mounting hole						Grease fitting						
				H	E	W ₂	W	L	B	J	M × pitch × l	L ₁	K			T
DS15CL DS15AL	24	4.6	9.5	34	40.4 56.8	26	— 26	M4×0.7×6	23.6 40	19.4	10	φ 3	6	3	15	12.5
DS20CL DS20AL	28	6	11	42	47.2 65.2	32	— 32	M5×0.8×7	30 48	22	12	M6×0.75	5.5	11	20	15.5
DS25CL DS25AL	33	7	12.5	48	59.6 81.6	35	— 35	M6×1×9	38 60	26	12	M6×0.75	7	11	23	18
DS30CL DS30AL	42	9	16	60	67.4 96.4	40	— 40	M8×1.25×12	42 71	33	13	M6×0.75	8	11	28	23
DS35CL DS35AL	48	10.5	18	70	77 108	50	— 50	M8×1.25×12	49 80	37.5	14	M6×0.75	8.5	11	34	27.5

Rail		Basic load ratings								Weight			
Pitch	Mounting bolt hole	G	Max. length	¹⁾ Dynamic		Static	Static moment (N·m)				Ball slide	Rail	
				[50km]	[100km]		C ₀	M _{P0}		M _{Y0}			
				C ₅₀ (N)	C ₁₀₀ (N)			(N)	One slide	Two slides			One slide
60	*4.5×7.5×5.3 3.5×6×4.5	20	2 920	9 150 14 100	7 250 11 200	9 100 16 900	45.5 84.5	24.5 77	196 470	20.5 64.5	165 395	0.14 0.20	1.4
60	6×9.5×8.5	20	3 960	13 400 19 700	10 600 15 600	13 400 23 500	91.5 160	46.5 133	330 755	39 111	279 630	0.19 0.28	2.3
60	7×11×9	20	3 960	22 300 33 000	17 700 26 100	20 800 36 500	164 286	91 258	655 1 470	76 217	550 1 230	0.34 0.51	3.1
80	7×11×9	20	4 000	31 000 48 000	24 700 38 000	29 600 55 000	282 520	139 435	1 080 2 650	116 365	905 2 220	0.58 0.85	4.8
80	9×14×12	20	4 000	43 000 66 500	34 500 52 500	40 000 74 500	465 865	220 695	1 670 4 000	185 580	1 400 3 350	0.86 1.3	7.0

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

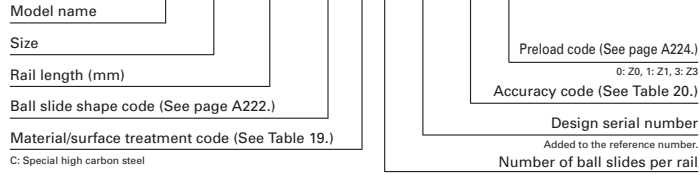
C₅₀: the basic dynamic load rating for 50 km rated fatigue life C₁₀₀: the basic dynamic load rating for 100 km rated fatigue life The basic static load rating shows static permissible load.

* Standard mounting hole of DS15 rail is for M4 bolts (Hole size: 4.5 × 7.5 × 5.3).

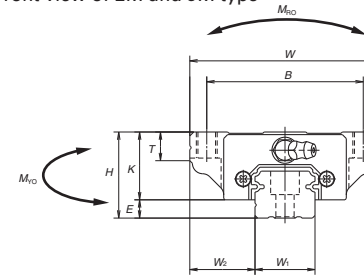
If you require mounting hole for M3 bolts (Hole size: 3.5 × 6 × 4.5), please specify when ordering.

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

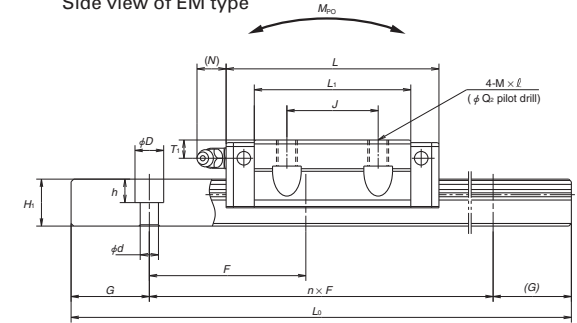
DS 30 1200 EMC 2 - P5 3**



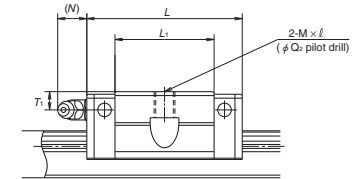
Front view of EM and JM type



Side view of EM type



Side view of JM type



Model No.	Assembly			Ball slide											Width	Height	
	Height	E	W ₂	Width	Length	Mounting hole					Grease fitting			W ₁			H ₁
						B	J	M × pitch × l	Q ₂	L ₁	K	T	Hole size				
DS15JM DS15EM	24	4.6	18.5	52	40.4 56.8	41	— 26	M5×0.8×7	4.4	23.6 40	19.4	8	φ 3	6	3	15	12.5
DS20JM DS20EM	28	6	19.5	59	47.2 65.2	49	— 32	M6×1×9	5.3	30 48	22	10	M6×0.75	5.5	11	20	15.5
DS25JM DS25EM	33	7	25	73	59.6 81.6	60	— 35	M8×1.25×10	6.8	38 60	26	11	M6×0.75	7	11	23	18
DS30JM DS30EM	42	9	31	90	67.4 96.4	72	— 40	M10×1.5×12	8.6	42 71	33	11	M6×0.75	8	11	28	23
DS35JM DS35EM	48	10.5	33	100	77 108	82	— 50	M10×1.5×13	8.6	49 80	37.5	12	M6×0.75	8.5	11	34	27.5

Rail		G	Max. length L _{0max}	Basic load ratings						Weight			
Pitch	Mounting bolt hole			¹ Dynamic		Static	Static moment (N·m)				Ball slide (kg)	Rail (kg/m)	
				[50km]	[100km]		C ₀	M _{R0}	M _{P0}				M _{Y0}
60	*4.5×7.5×5.3 3.5×6×4.5	20	2 920	9 150 14 100	7 250 11 200	9 100 16 900	45.5 84.5	24.5 77	196 470	20.5 64.5	165 395	0.17 0.26	1.4
60	6×9.5×8.5	20	3 960	13 400 19 700	10 600 15 600	13 400 23 500	91.5 160	46.5 133	330 755	39 111	279 630	0.24 0.35	2.3
60	7×11×9	20	3 960	22 300 33 000	17 700 26 100	20 800 36 500	164 286	91 258	655 1 470	76 217	550 1 230	0.44 0.66	3.1
80	7×11×9	20	4 000	31 000 48 000	24 700 38 000	29 600 55 000	282 520	139 435	1 080 2 650	116 365	905 2 220	0.76 1.2	4.8
80	9×14×12	20	4 000	43 000 66 500	34 500 52 500	40 000 74 500	465 865	220 695	1 670 4 000	185 580	1 400 3 350	1.2 1.7	7

Note: 1) The basic load ratings comply with the ISO standard. (ISO 14728-1, 14728-2) For long-life DS model, the rated load is multiplied by a coefficient that reflects the effect of life improvement technologies based on these ISO standards.
 C₅₀: the basic dynamic load rating for 50 km rated fatigue life C₁₀₀: the basic dynamic load rating for 100 km rated fatigue life
 The basic static load rating shows static permissible load.

* Standard mounting hole of DS15 rail is for M4 bolts (Hole size: 4.5 × 7.5 × 5.3).
 If you require mounting hole for M3 bolts (Hole size: 3.5 × 6 × 4.5), please specify when ordering.

- | | |
|--------------------------|------|
| 1. PU Model | A241 |
| 2. LU Model | A251 |
| 3. PE Model | A263 |
| 4. LE Model | A273 |
| 5. Miniature LH
Model | A287 |
| 6. LL Model | A297 |

A-4-3 Miniature Series

A-4-3.1 PU Model (Miniature type)

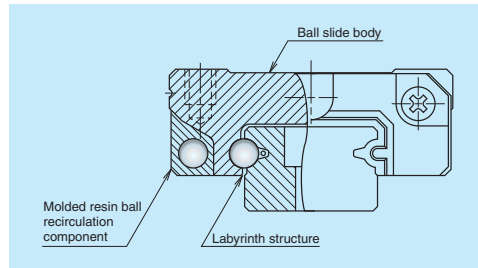
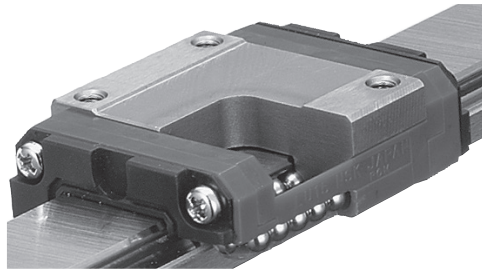


Fig. 1

1. Features

(1) Motion performance

A newly designed recirculation component facilitates smooth circulation of steel balls.

(2) Lightweight

The ball slide is approximately 20% lighter than the LU Model thanks to resin parts incorporated into its design.

(3) Reduced noise intensity

Resin parts used in ball recirculation components reduce collision noise between the steel balls and inner wall.

(4) Excellent dust resistance

PU model linear guides are designed to minimize the clearance between the rail sides and slide inner walls to help prevent foreign matter from entering.

(5) High corrosion resistance

Highly corrosion-resistant martensite stainless steel comes standard, providing excellent resistance to corrosion.

(6) Easy to handle

Designed for safety with a retainer that prevents steel balls from dropping out of the ball slide even when the slide is removed from the rail.

(7) Long-term, maintenance-free operation

PU model guides equipped with the NSK K1 lubrication units realize long term, maintenance-free operation.

(8) Fast delivery

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

2. Ball slide shape

Ball slide shape code	Shape/installation method	Type (Upper row, Rating: Lower row, Ball slide length)	
		Standard load Standard	High-load Long
AR TR AL UR BL		TR, AR, AL 	UR, BL

3. Accuracy and preload

(1) Running parallelism of ball slide

Table 1

Unit: μm

Rail length (mm)	Preloaded assembly type (not interchangeable)				Interchangeable type
	Super precision P4	High precision P5	Precision grade P6	Normal grade PN	Normal grade PC
over 50	2	2	4.5	6	6
50 – 80	2	3	5	6	6
80 – 125	2	3.5	5.5	6.5	6.5
125 – 200	2	4	6	7	7
200 – 250	2.5	5	7	8	8
250 – 315	2.5	5	8	9	9
315 – 400	3	6	9	11	11
400 – 500	3	6	10	12	12
500 – 630	3.5	7	12	14	14
630 – 800	4.5	8	14	16	16
800 – 1 000	5	9	16	18	18
1 000 – 1 250	6	10	17	20	20

(2) Accuracy standard

The preloaded assembly has four accuracy grades; Super precision P4, High precision P5, Precision grade P6, and normal grade PN, while the interchangeable type has Normal grade PC only.

Table 2 shows the accuracy standard for the preloaded assembly type while **Table 3** shows the accuracy standard for the interchangeable type.

• **Tolerance of preloaded assembly**

Characteristics	Accuracy grade	Super precision P4	High precision P5	Precision grade P6	Normal grade PN
Mounting height <i>H</i>		±10	±15	±20	±40
Variation of <i>H</i> (All ball slides on a set of rails)		5	7	15	25
Mounting width <i>W₂</i> or <i>W₃</i>		±15	±20	±30	±50
Variation of <i>W₂</i> or <i>W₃</i> (All ball slides on reference rail)		7	10	20	30
Running parallelism of surface C to surface A Running parallelism of surface D to surface B		Shown in Table 1 and Fig. 2			

• **Tolerance of interchangeable type: Normal grade PC**

Characteristics	Model No.	PU09, 12 and 15
Mounting height <i>H</i>		±20
Variation of mounting height <i>H</i>		15 ^① 30 ^②
Mounting width <i>W₂</i> or <i>W₃</i>		±20
Variation of mounting width <i>W₂</i> or <i>W₃</i>		20
Running parallelism of surface C to surface A Running parallelism of surface D to surface B		Shown in Table 1 and Fig. 2

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

(3) Assembled accuracy

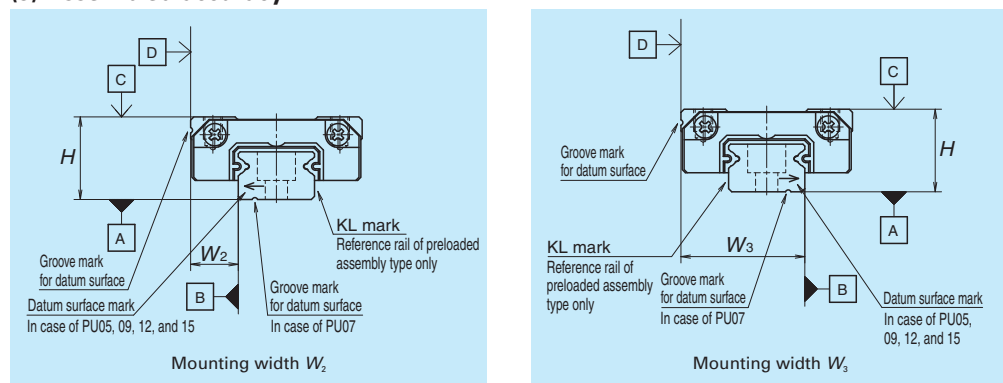


Fig. 2

Note: Please refer to page A77 for marks on the datum surfaces.

(4) Preload and rigidity

We offer three levels of preload: Slight preload Z1 and Fine clearance Z0 for preloaded assembly type, along with Fine clearance ZT for interchangeable type. Values for preload and rigidity of the preloaded assembly type are shown in **Table 4**. Rigidities are for the median of the preload range.

• **Preload and rigidity of preloaded assembly**

Model No.	Preload (N)	Rigidity (N/μm)
	Slight preload (Z1)	Slight preload (Z1)
Standard	PU09TR	0 – 10
	PU12TR	0 – 17
	PU15AL	0 – 33
High-load	PU09UR	0 – 14
	PU12UR	0 – 25
	PU15BL	0 – 51

Note: Clearance of Fine clearance Z0 is 0 to 3 μm. Therefore, preload is zero.

• **Clearance of interchangeable type**

Model No.	Fine clearance ZT	
Standard	PU09TR	3 or less
	PU12TR	
	PU15AL	
High-load	PU09UR	5 or less
	PU12UR	
	PU15BL	

4. Maximum rail length

Table 6 shows the limitations of rail length (maximum length). However, the limitations vary by accuracy grade.

Model	Material	Size		
		09	12	15
PU	Stainless steel	600	800	1 000

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

5. Installation

(1) Permissible values of mounting error

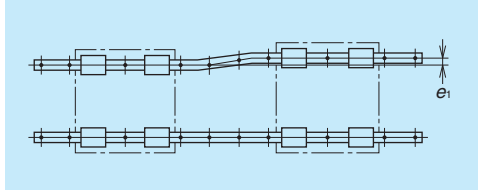


Fig. 3

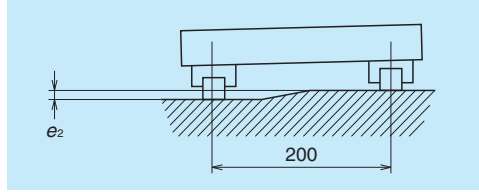


Fig. 4

Table 7 Unit: μm

Value	Preload	Model No.		
		PU09	PU12	PU15
Permissible values for parallelism error of two rails e_1	Z0, ZT	15	20	25
	Z1	13	15	21
Permissible values for height error of two rails e_2	Z0, ZT	150 μm /200 mm		
	Z1	90 μm /200 mm		

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

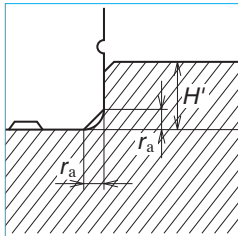


Fig. 5 Shoulder for the rail datum surface

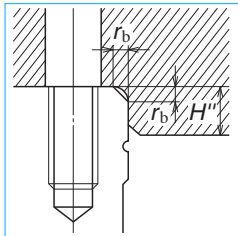


Fig. 6 Shoulder for the ball slide datum surface

Table 8 Unit: mm

Model No.	Corner radius (maximum)		Shoulder height	
	r_a	r_b	H'	H''^*
PU09	0.3	0.3	1.9	2.6
PU12	0.3	0.3	2.5	3.4
PU15	0.3	0.5	3.5	4.4

*) H'' is the minimum recommended value based on dimension T in the dimension tables.

6. Lubrication accessories

A drive-in grease fitting can be selected as an option for model PU15. For models PU09 to PU12, apply grease directly to the rail ball grooves using a point nozzle.



Drive-in type

7. Dust-resistant components

(1) Standard specification

An end seal is provided on both ends of the ball slide as a standard feature. Seal friction per standard ball slide is shown in Table 9.

Table 9 Seal friction per ball slide (maximum value)

		Unit: N		
Model	Size	09	12	15
PU		0.5	0.5	0.5

(2) NSK K1™ lubrication unit

Table 10 shows the dimensions of linear guides equipped with NSK K1 lubrication units.

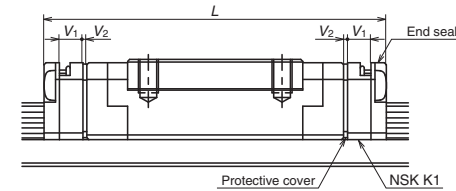


Table 10 Dimensions when equipped with NSK K1 lubrication units Unit: mm

Model No.	Ball slide length	Ball slide shape code	Standard ball slide length	Ball slide length with two NSK K1 installed L	Thickness of single NSK K1, V_1	Thickness of protective cover, V_2
PU09	Standard	TR	30	36.4	2.7	0.5
	Long	UR	41	47.4		
PU12	Standard	TR	35	42	3	0.5
	Long	UR	48.7	55.7		
PU15	Standard	AL	43	51.2	3.5	0.6
	Long	BL	61	69.2		

Note: Slide length when equipped with NSK K1 = (standard ball slide length) + (V_1 thickness of single NSK K1 unit) \times (number of K1 units) + (V_2 thickness of the protective cover) \times 2.

PU Model

8. Reference number

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

(1) Reference number for preloaded assembly

PU 15 0470 AL K 2 - P5 1**

Model name	PU	15	0470	AL	K	2	-**	P5	1
Size	15	0470							
Rail length (mm)	15	0470							
Ball slide shape code (See page A242.)				AL					
Material/surface treatment code (See Table 11.) K: Stainless steel					K				
						2			
							**		
								P5	
									1

Preload code (See page A244.)
0: Z0, 1: Z1

Accuracy code (See Table 12.)

Design serial number
Added to the reference number.

Number of ball slides per rail

(2) Reference number for interchangeable type

PAU 15 ALS -K

Interchangeable ball slide model code PAU: PU Model interchangeable ball slide	PAU	15	ALS	-K
Size	15			
Ball slide shape code (See page A242.)			ALS	
				-K

Option code
-K: Equipped with NSK K1

Material code
S: Stainless steel

Rail P1U15 0470 RKN - PC T**

Interchangeable rail model code P1U: PU Model interchangeable rail	P1U	15	0470	RKN	-**	PC	T
Size	15	0470					
Rail length (mm)	15	0470					
Rail shape code S: PU09, 12. R: PU15				R			
Material/surface treatment code (See Table 11.)						PC	
							T

Preload code (See page A244.)
T: Fine clearance

Accuracy code: PC
PC: Only normal grade is available.

Design serial number
Added to the reference number.

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

*Please consult with NSK for butting rail specification.

When interchangeable rails and slides are assembled, reference number coding is the same as that for preloaded assemblies. However, only preload code T (fine clearance) may be used (Refer to Page A244.)

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

Table 11 Material/surface treatment code

Code	Description
K	Stainless steel
H	Stainless steel with surface treatment
Z	Other, special

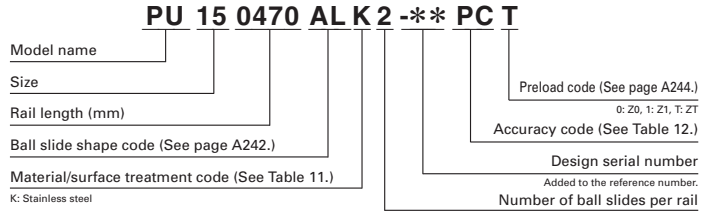
Table 12 Accuracy code

Accuracy	Standard (Without NSK K1)	With NSK K1	With NSK K1 for food and medical equipment
Super precision grade	P4	K4	F4
High precision grade	P5	K5	F5
Precision grade	P6	K6	F6
Normal grade	PN	KN	FN
Normal grade (interchangeable type)	PC	KC	FC

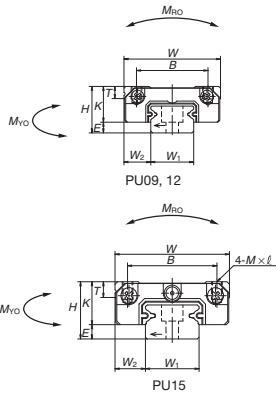
Note: Refer to pages A58 and A73 for details on NSK K1 lubrication units.

9. Dimensions

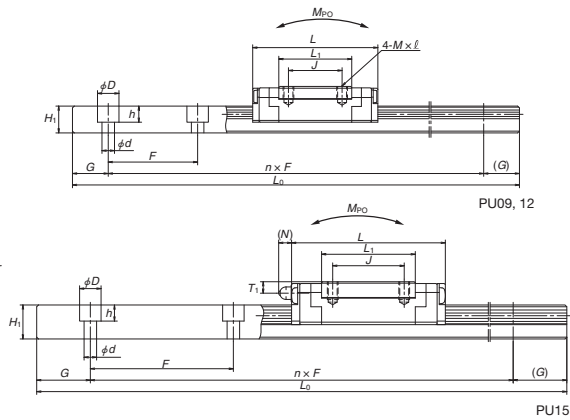
PU-TR, AL (Standard load / Standard)
 PU-UR, BL (High-load / Long)



Front view

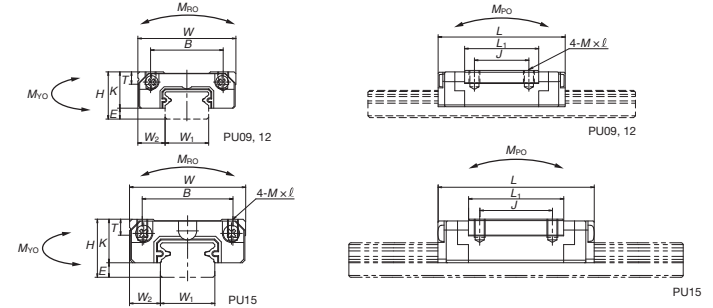
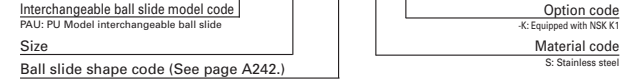


Side view



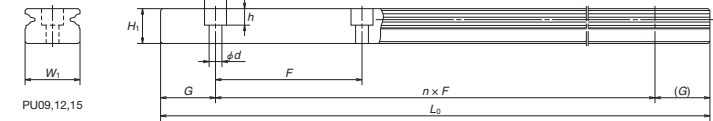
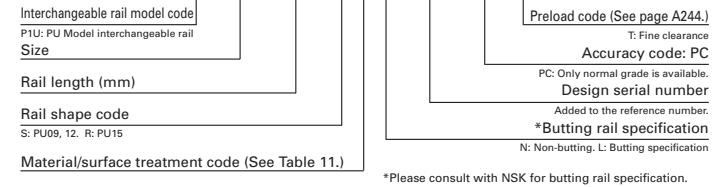
Reference number for ball slide of interchangeable type

PAU 15 AL S -K



Reference number for rail of interchangeable type

Rail P1U15 0470 RKN - PC T**



Model No.	Assembly			Ball slide											Width	Height
	Height	E	W ₂	W	Length	Mounting hole					Oil hole					
						B	J	M × pitch × l	L ₁	K	T	Hole size	T ₁	N		
PU09TR PU09UR	10	2.2	5.5	20	30 41	15	10 16	M3×0.5×3	19.6 30.6	7.8	2.6	—	—	—	9	5.5
PU12TR PU12UR	13	3	7.5	27	35 48.7	20	15 20	M3×0.5×3.5	20.4 34.1	10	3.4	—	—	—	12	7.5
PU15AL PU15BL	16	4	8.5	32	43 61	25	20 25	M3×0.5×5	26.2 44.2	12	4.4	φ 3	3.2 (3.6)	15	9.5	

Rail		Basic load ratings										Weight	
Pitch	Mounting bolt hole	G	Maximum length	Dynamic		Static	Static moment (N·m)				Ball slide	Rail	
				[50km]	[100km]		C ₀	M _{PO}		M _{YO}			
								One slide	Two slides	One slide			Two slides
20	3.5×6×4.5	7.5	600	1 490	1 180	2 150	9.90	6.10	41.0	6.10	41.0	16	35
				2 100	1 670								
25	3.5×6×4.5	10	800	2 830	2 250	3 500	21.1	11.4	73.5	11.4	73.5	32	65
				4 000	3 150								
40	3.5×6×4.5	15	1 000	5 550	4 400	6 600	49.5	25.6	190	25.6	190	59	105
				8 100	6 400								

Note: Basic load ratings comply with ISO standards (ISO 14728-1, 14728-2).
 C₅₀: the basic dynamic load rating for 50 km rated fatigue life C₁₀₀: the basic dynamic load rating for 100 km rated fatigue life

A-4-3.2 LU Model (Miniature type)

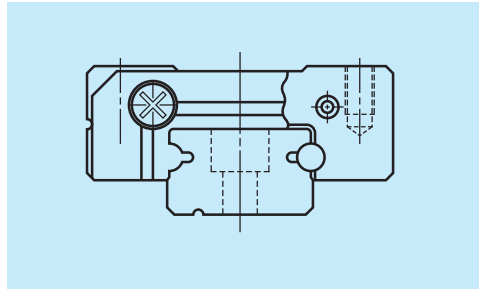
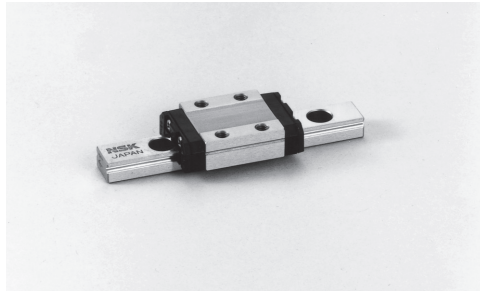


Fig. 1 LU Model

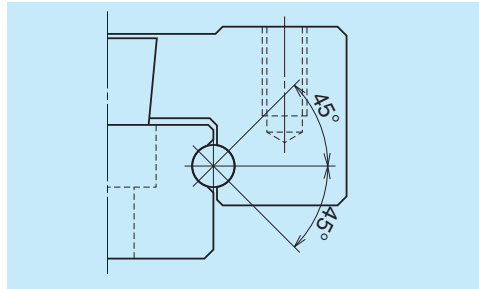


Fig. 2 Ball contact

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

The contact angle is set at 45 degrees, thus facilitating equal load carrying capacity in vertical and lateral directions. This also provides equal rigidity in both directions.

(3) Stainless steel also available as standard

Items made of martensitic stainless steel also available as standard.

(4) Models with ball retainers available

Ball retaining models (slide shape code AR and TR), including interchangeable types and LU15, come with a ball retainer to prevent balls from falling out when the slide is removed from the rail.

(5) Fast delivery

Interchangeable rails and ball slides are available. (LU09 to LU15)

2. Ball slide shape

Ball slide shape code	Shape/installation method	Type (Upper row, Rating: Lower row, Ball slide length)	
		Standard	High-load Long
AL TL AR TR BL UL		AL, TL, TR, AR 	BL, UL

Specification	Detail	Type	
		AL, AR	BL
Mounting hole	Normal	AL, AR	BL
	Large	TL, TR	UL
Ball retainer	Without	AL*, TL	BL*, UL
	With	AR, TR	-

*) LU15 is equipped with ball retainer

3. Accuracy and preload

(1) Running parallelism of ball slide

Table 1

Unit: μm

Rail length (mm)	Preloaded assembly type (not interchangeable)				Interchangeable type
	Super precision P4	High precision P5	Precision grade P6	Normal grade PN	Normal grade PC
over 50	2	2	4.5	6	6
50 - 80	2	3	5	6	6
80 - 125	2	3.5	5.5	6.5	6.5
125 - 200	2	4	6	7	7
200 - 250	2.5	5	7	8	8
250 - 315	2.5	5	8	9	9
315 - 400	3	6	9	11	11
400 - 500	3	6	10	12	12
500 - 630	3.5	7	12	14	14
630 - 800	4.5	8	14	16	16
800 - 1000	5	9	16	18	18
1000 - 1250	6	10	17	20	20

(2) Accuracy standard

The preloaded assembly type has four accuracy grades; Super precision P4, High precision P5, Precision P6, and Normal grade PN, while the interchangeable type has Normal grade PC only.

Table 2 shows the accuracy standard for the preloaded assembly type, while **Table 3** shows the accuracy standard for the interchangeable type.

• Tolerance of preloaded assembly

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

• Tolerance of interchangeable type: Normal grade PC

Characteristics	Accuracy grade	LU09, 12, 15
Mounting height H		± 20
Variation of mounting height H		40
Mounting width W_2 or W_3		± 20
Variation of mounting width W_2 or W_3		40
Running parallelism of surface C to surface A Running parallelism of surface D to surface B		Refer to Table 1 and Fig. 3

(3) Assembled accuracy

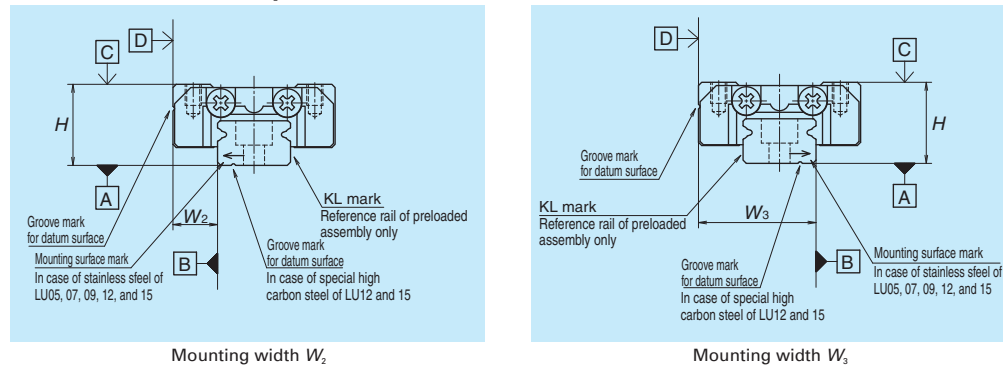


Fig. 3

Note: Please refer to page A77 for marks on the datum surfaces.

(4) Preload and rigidity

We offer three levels of preload: Slight preload Z1 and Fine clearance Z0 for the preloaded assembly type and Fine clearance ZT for the interchangeable type. Values for preload and rigidity of the preloaded assembly type are shown in **Table 4**. Rigidities are for the median of the preload range.

• Preload and rigidity of preloaded assembly

Model No.	Preload (N)	Rigidity (N/ μm)
	Slight preload (Z1)	Slight preload (Z1)
Standard type		
LU05 TL	0 – 3	15
LU07 AL	0 – 8	22
LU09 AL, TL	0 – 12	26
LU09 AR, TR	0 – 10	30
LU12 AL, TL	0 – 17	33
LU12 AR, TR	0 – 17	33
LU15 AL	0 – 33	45
High-load type		
LU09 BL, UL	0 – 17	43
LU12 BL, UL	0 – 25	52
LU15 BL	0 – 51	75

Note: Clearance of Fine clearance Z0 is 0 to 3 μm . Therefore, preload is zero. However, the clearance of the Z0 of PN grade is 3 to 10 μm .

• Clearance of interchangeable type

Model No.	Fine clearance ZT
LU09	0 – 15
LU12	
LU15	

4. Maximum rail length

Table 6 shows the limitations of rail length.

However, the limitations vary by accuracy grades.

Table 6 Length limitation of rails

Model	Size					
		Material	05	07	09	12
LU	Special high carbon steel	–	–	1 200	1 800	2 000
	Stainless steel	210	375	600	800	1 000

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

5. Installation

(1) Permissible values of mounting error

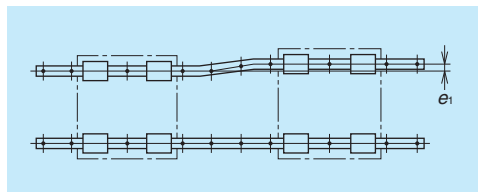


Fig. 4

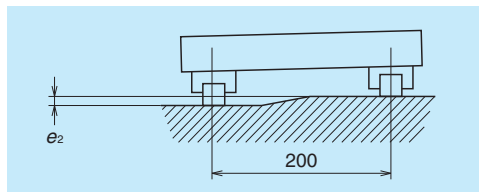


Fig. 5

Table 7

Unit: μm

Value	Preload	Model No.				
		LU05	LU07	LU09	LU12	LU15
Permissible values for parallelism error of two rails e_1	Z0, ZT	10	12	15	20	25
	Z1	7	10	13	15	21
Permissible values for height error of two rails e_2	Z0, ZT	150 $\mu\text{m}/200\text{ mm}$				
	Z1	90 $\mu\text{m}/200\text{ mm}$				

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

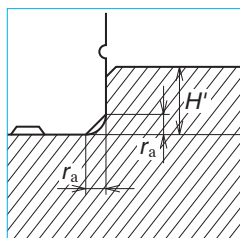


Fig. 6 Shoulder for the rail datum surface

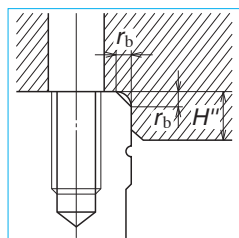


Fig. 7 Shoulder for the ball slide datum surface

Table 8

Unit: mm

Model No.	Corner radius (maximum)		Shoulder height	
	r_a	r_b	H'	H''
LU05	0.2	0.2	0.7	2
LU07	0.2	0.3	1.2	3
LU09	0.3	0.3	1.9	3
LU12	0.3	0.3	2.5	4
LU15	0.3	0.5	3.5	5

6. Lubrication accessories

There is no standard grease fitting for LU05 to LU15.

For the LU Model, apply grease directly to the rail ball grooves using a point nozzle.

7. Dust-resistant components

(1) Standard specification

An end seal is provided on both ends of the ball slide as a standard feature. LU05TL, LU07AL, LU09AL, and LU09TL can install the end seal as an option.

- Seal friction per standard ball slide is shown in Table 9.

Table 9 Seal friction per ball slide (maximum value)

Unit: N

Model	Size	05	07	09	12	15
		LU	0.3	0.3	0.5	0.5

(2) NSK K1™ lubrication unit

Table 10 shows dimensions when installed with NSK K1 lubrication units.

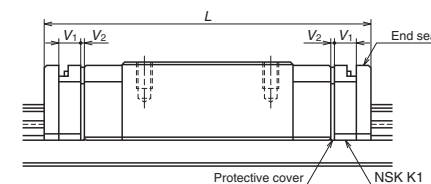


Table 10 Dimensions when equipped with NSK K1 lubrication units

Unit: mm

Model No.	Ball slide length	Ball slide shape code	Standard ball slide length	Ball slide length with two NSK K1 installed L	Thickness of single NSK K1 V_1	Protective cover thickness V_2
LU05	Standard	TL	18*	24.4	2.0	0.5
LU07	Standard	AL	20.4*	29.4	2.5	0.5
LU09	Standard	AR, TR	30	36.4	2.7	0.5
	Standard	AL, TL	26.8*	34.2		
LU12	Long	BL, UL	41	47.4	3.0	0.5
	Standard	AR, TR	35.2	42.2		
LU15	Standard	AL, TL	34	41	3.5	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 the thickness of the end seal (1.5 mm). However, it includes the height of the screw head for end cap installation (Included length – LU05, 0.8 mm; LU07, no projection; LU09, 1 mm)

Note: 1) Slide length when equipped with NSK K1 = (standard ball slide length) + (V_1 thickness of single NSK K1 unit) \times (number of K1 units) + (V_2 thickness of the protective cover) \times 2.

LU Model

8. Reference number

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

(1) Reference number for preloaded assembly

LU 12 0270 ARK 2 - P5 1**

Model name	Preload code (See page A254.)
Size	0: Z0, 1: Z1
Rail length (mm)	Accuracy code (See Table 12.)
Ball slide shape code (See page A252.)	Design serial number
Material/surface treatment code (See Table 11.) C: Special high carbon steel (NSK standard), K: Stainless steel	Added to the reference number.
	Number of ball slides per rail

(2) Reference number for interchangeable type

LAU 12 ARS -K

Interchangeable ball slide model code LAU: LU Model interchangeable ball slide	Option code -K: Equipped with NSK K1
Size	Material code No code: Special high carbon steel (NSK standard), S: Stainless steel
Ball slide shape code (See page A252.)	

L1U12 0270 RKN - PC T**

Interchangeable rail model code L1U: LU Model interchangeable rail	Preload code (See page A254.) T: Fine clearance
Size	Accuracy code: PC PC: Only normal grade is available.
Rail length (mm)	Design serial number
Rail shape code L: Standard. R: LU09 and LU12 standard, equipped with ball retainer. S: LU09 and LU12 with ball retainer and mounting holes for M3 T: LU09 and LU12 without ball retainer and mounting holes for M3	Added to the reference number.
Material/surface treatment code (See Table 11.)	*Butting rail specification N: Non-butting, L: Butting specification

*Please consult with NSK for butting rail specification.

When interchangeable rails and slides are assembled, reference number coding is the same as that for preloaded assemblies. However, only preload code T (fine clearance) may be used (Refer to Page A250.)

Table 11 Material/surface treatment code

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

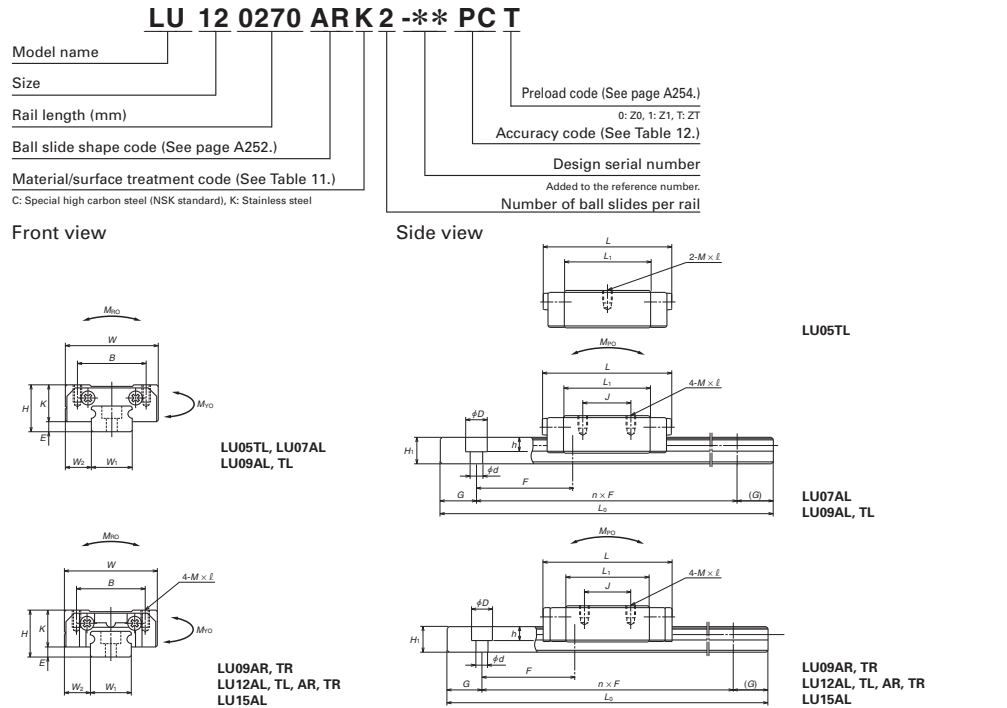
Table 12 Accuracy code

Accuracy	Standard (Without NSK K1)	With NSK K1
Super precision grade	P4	K4
High precision grade	P5	K5
Precision grade	P6	K6
Normal grade	PN	KN
Normal grade (interchangeable type)	PC	KC

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

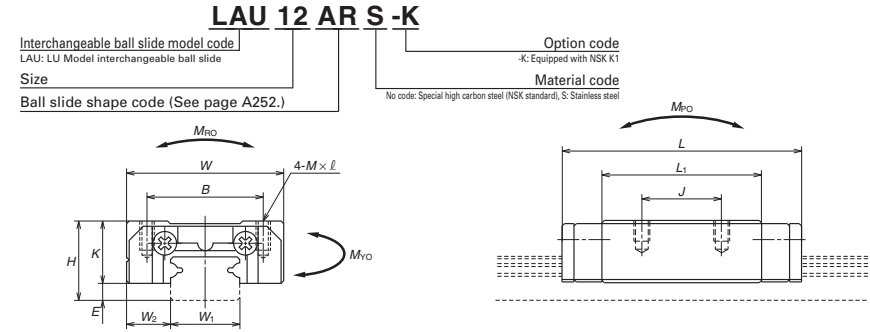
9. Dimensions

- LU-AL (Standard load, Standard, Only LU15 is equipped with ball retainer)
- LU-TL (Standard load, Standard, Large mounting hole)
- LU-AR (Standard load, Standard, With ball retainer)
- LU-TR (Standard load, Standard, Large mounting hole, with ball retainer)



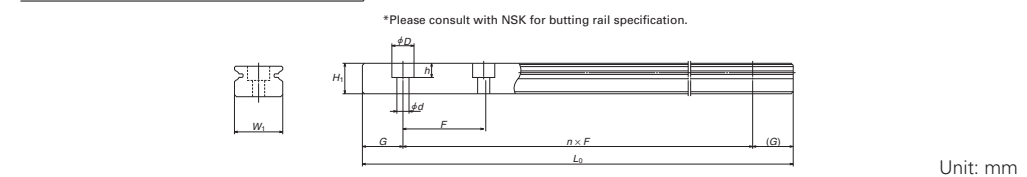
Reference number for ball slide of interchangeable type

- Interchangeable with retainer: LU09 - 12 are AR/TR, LU15 is AL.
- LAU-AR (With ball retainer)
- LAU-TR (Large mounting hole, with ball retainer)
- LAU-AL (LU15 is equipped with ball retainer)



Reference number for rail of interchangeable type

- L1U12 0270 RKN -** PC T**
- Interchangeable rail model code: L1U
 Preload code: PC
 Accuracy code: T
 Design serial number: 0270
 Material/surface treatment 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
 *Butting rail specification
 N: Non-butting, L: Butting specification



Model No.	Assembly			Ball slide							Width	Height	Pitch
	Height	E	W ₂	Width	Length	Mounting hole			L ₁	K			
						B	J	M × pitch × l					
LU05TL	6	1	3.5	12	18	8	—	M2×0.4×1.5	12	5	5	3.2	15
LU07AL	8	1.5	5	17	20.4	12	8	M2×0.4×2.4	13.6	6.5	7	4.7	15
LU09AL	10	2.2	5.5	20	26.8	15	13	M2×0.4×2.5	18	7.8	9	5.5	20
LU09AR	10	2.2	5.5	20	30	15	13	M2×0.4×2.5	20	7.8	9	5.5	20
LU09TR	10	2.2	5.5	20	30	15	10	M3×0.5×3	20	7.8	9	5.5	20
LU12AL	13	3	7.5	27	34	20	15	M2.5×0.45×3	21.8	10	12	7.5	25
LU12TL	13	3	7.5	27	34	20	15	M3×0.5×3.5	21.8	10	12	7.5	25
LU12AR	13	3	7.5	27	35.2	20	15	M2.5×0.45×3	21.8	10	12	7.5	25
LU12TR	13	3	7.5	27	35.2	20	15	M3×0.5×3.5	21.8	10	12	7.5	25
LU15AL	16	4	8.5	32	43.6	25	20	M3×0.5×4	27	12	15	9.5	40

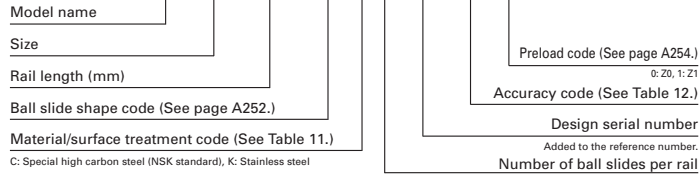
Notes 1) LU05TL, LU07AL, LU09TL, LU09AR, LU09TR, LU12AR and LU12TR come in stainless steel only.
 2) Ball slide of LU05TL has only two mounting tap holes in the center.
 3) End seals of LU05TL, LU07AL, LU09AL and LU09TL are available on request.

Rail	Basic load ratings										Weight		
	Mounting bolt hole	G	Max. length L _{0max} (mm) for stainless	Dynamic		Static C ₀ (N)	Static moment (N-m)				Ball slide (g)	Rail (g/100 mm)	
				[50km] C ₅₀ (N)	[100km] C ₁₀₀ (N)		M _{PO}	M _{YO}					
2.3×3.3×1.5	5	—	(210)	545	435	740	1.93	1.22	8.85	1.22	8.85	4	11
2.4×4.2×2.3	5	—	(375)	1 090	865	1 370	4.90	2.66	18.6	2.66	18.6	10	23
2.6×4.5×3	7.5	1 200	(600)	1 760	1 400	2 220	10.2	6.10	38.5	6.10	38.5	17	35
3.5×6×4.5	7.5	—	(600)	1 490	1 180	2 150	9.9	6.10	41.0	6.10	41.0	19	35
2.6×4.5×3	7.5	—	(600)	1 490	1 180	2 150	9.9	6.10	41.0	6.10	41.0	19	35
3.5×6×4.5	10	1 800	(800)	2 830	2 250	3 500	21.1	11.4	78.5	11.4	78.5	38	65
3×5.5×3.5	10	—	(800)	2 830	2 250	3 500	21.1	11.4	81.5	11.4	81.5	38	65
3.5×6×4.5	15	2 000	(1 000)	5 550	4 400	6 600	49.5	25.6	193	25.6	193	70	105

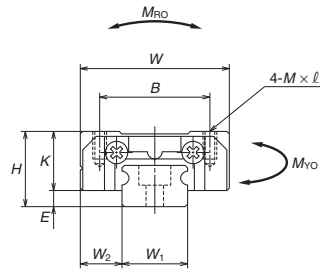
4) To fix rail of LU05TL, use M2 × 0.4 cross-recessed pan head machine screws for precision instruments. (JIS 10-70 No. 0 pan head machine screw No.1.) (JIS: Japanese Camera Industrial Standard.)
 5) Basic load ratings comply with ISO standards (ISO 14728-1, 14728-2).
 C₅₀: the basic dynamic load rating for 50 km rated fatigue life C₁₀₀: the basic dynamic load rating for 100 km rated fatigue life

LU-BL (High-load / Long)
LU-UL (High-load / Long, large mounting hole)

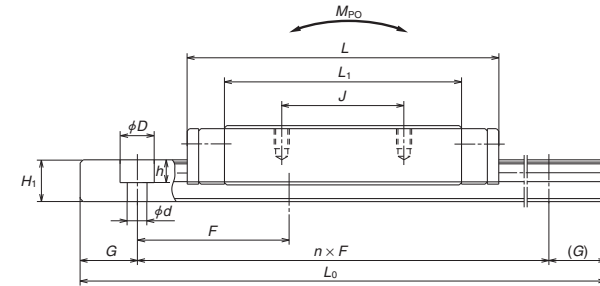
LU 12 0270 BL K 2 - P5 1**



Front view



Side view



Model No.	Assembly			Ball slide							Width	Height	Pitch			
	Height	E	W ₂	Width	Length	Mounting hole			L ₁	K				W ₁	H ₁	F
						B	J	M × pitch × l								
LU09BL	10	2.2	5.5	20	41	15	16	M2×0.4×2.5	31.2	7.8	9	5.5	20			
LU09UL								M3×0.5×3								
LU12BL	13	3	7.5	27	47.5	20	20	M2.5×0.45×3	35.3	10	12	7.5	25			
LU12UL								M3×0.5×3.5								
LU15BL	16	4	8.5	32	61	25	25	M3×0.5×4	44.4	12	15	9.5	40			

Notes 1) LU09UL is available only in stainless steel.
 2) LU15BL is equipped with ball retainer.

Unit: mm

Rail	Mounting bolt hole d × D × h	G (reference)	Max. length L _{0max} () for stainless	Basic load ratings						Weight			
				³ Dynamic		Static	Static moment (N-m)				Ball slide (g)	Rail (g/100 mm)	
				[50km]	[100km]		C ₀	M _{RO}	M _{PO}				M _{YO}
2.6×4.5×3				C ₅₀ (N)	C ₁₀₀ (N)	(N)		One slide	Two slides	One slide	Two slides		
3.5×6×4.5		7.5	1 200 (600)	2 600	2 070	3 900	17.9	17.2	98.0	17.2	98.0	29	35
3×5.5×3.5													
3.5×6×4.5		10	1 800 (800)	4 000	3 150	5 700	34.5	28.3	169	28.3	169	59	65
3.5×6×4.5		15	2 000 (1 000)	8 100	6 400	11 300	84.5	69.5	435	69.5	435	107	105

3) Basic load ratings comply with ISO standards (ISO 14728-1, 14728-2).
 C₅₀, the basic dynamic load rating for 50 km rated fatigue life C₁₀₀, the basic dynamic load rating for 100 km rated fatigue life

A-4-3.3 PE Model (Miniature wide type)

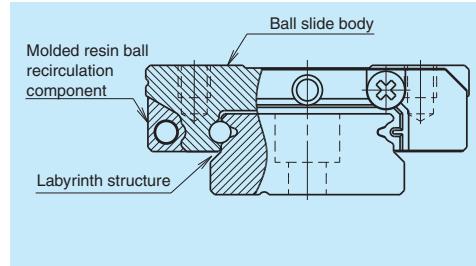
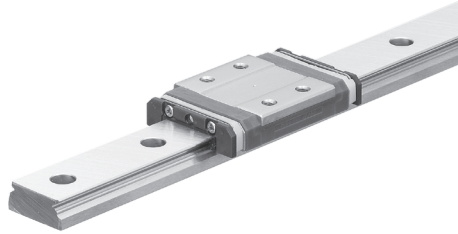


Fig. 1

1. Features

(1) Ideal for use of single rail

PE model miniature linear guides feature a wide rail, allowing for high load carrying capacity against moment loads in the rolling direction.

(2) Motion performance

A newly designed recirculation component facilitates smooth circulation of steel balls.

(3) Lightweight

The ball slide is approximately 20% lighter than the LE Model thanks to resin parts incorporated into its design.

(4) Reduced noise intensity

Resin parts used in ball recirculation components reduce collision noise between the steel balls and inner wall.

(5) Excellent dust resistance

PE model linear guides are designed to minimize the clearance between the rail sides and slide inner walls to help prevent foreign matter from entering.

(6) High corrosion resistance

Highly corrosion-resistant martensite stainless steel comes standard, providing excellent resistance to corrosion.

(7) Easy to handle

Designed for safety with a retainer that prevents steel balls from dropping out of the ball slide even when the slide is removed from the rail.

(8) Long-term, maintenance-free operation

PE model guides equipped with the NSK K1 lubrication units realize long-term, maintenance-free operation.

(9) Fast delivery

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

2. Ball slide shape

Ball slide shape code	Shape/installation method	Type (Upper row, Rating: Lower row, Ball slide length)	
		Standard type	High-load type
		Standard	Long
AR, TR UR, BR		AR, TR 	UR, BR

3. Accuracy and preload

(1) Running parallelism of ball slide

Table 1

Unit: μm

Rail length (mm)	Preloaded assembly type (not interchangeable)				Interchangeable type
	Super precision P4	High precision P5	Precision grade P6	Normal grade PN	Normal grade PC
over 50	2	2	4.5	6	6
50 – 80	2	3	5	6	6
80 – 125	2	3.5	5.5	6.5	6.5
125 – 200	2	4	6	7	7
200 – 250	2.5	5	7	8	8
250 – 315	2.5	5	8	9	9
315 – 400	3	6	9	11	11
400 – 500	3	6	10	12	12
500 – 630	3.5	7	12	14	14
630 – 800	4.5	8	14	16	16
800 – 1 000	5	9	16	18	18
1 000 – 1 250	6	10	17	20	20

(2) Accuracy standard

The preloaded assembly type has four accuracy grades; Super precision P4, High precision P5, Precision P6, and Normal PN grades, while the interchangeable type has Normal grade PC only.

Table 2 shows the accuracy standard for the preloaded assembly type while **Table 3** shows the accuracy standard for the interchangeable type.

• Tolerance of preloaded assembly

Characteristics	Accuracy grade	Super precision P4	High precision P5	Precision grade P6	Normal grade PN
Mounting height H Variation of H (All ball slides on a set of rails)		± 10 5	± 15 7	± 20 15	± 40 25
Mounting width W_2 or W_3 Variation of W_2 or W_3 (All ball slides on reference rail)		± 15 7	± 20 10	± 30 20	± 50 30
Running parallelism of surface C to surface A Running parallelism of surface D to surface B		Shown in Table 1 and Fig. 2			

• Tolerance of interchangeable type: Normal grade PC

Characteristics	Model No.	PE09, 12 and 15
Mounting height H		± 20
Variation of mounting height H		15 ^① 30 ^②
Mounting width W_2 or W_3		± 20
Variation of mounting width W_2 or W_3		20
Running parallelism of surface C to surface A Running parallelism of surface D to surface B		Shown in Table 1 and Fig. 2

Note: ① Variation on the same rail ② Variation on multiple rails

(3) Assembled accuracy

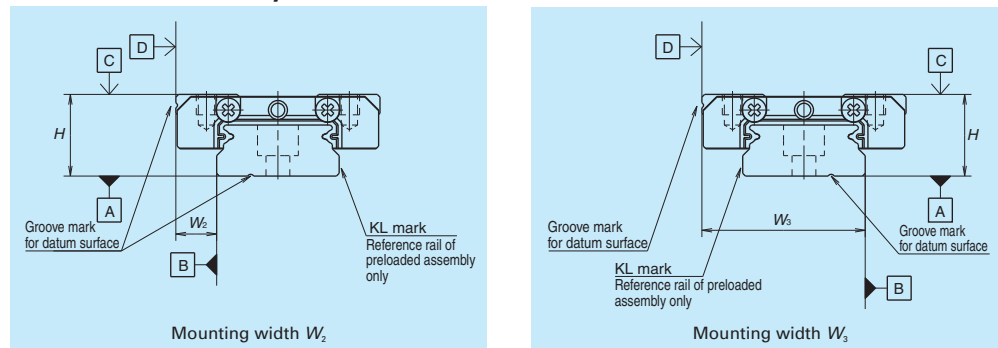


Fig. 2

(4) Preload and rigidity

We offer three levels of preload: Slight preload Z1 and Fine clearance Z0 and Fine clearance ZT for the interchangeable type. Values for preload and rigidity of the preloaded assembly types are shown in **Table 4**. Rigidities are for the median of the preload range.

• Preload and rigidity of preloaded assembly

Model No.	Preload (N)	Rigidity (N/ μm)
	Slight preload (Z1)	Slight preload (Z1)
Standard	PE09TR	0 – 37
	PE12AR	0 – 40
	PE15AR	0 – 49
High-load	PE09UR	0 – 54
	PE12BR	0 – 59
	PE15BR	0 – 75

Note: Clearance of Fine clearance Z0 is 0 to 3 μm . Therefore, preload is zero.

• Clearance of interchangeable type

Model No.	Fine clearance ZT	
Standard	PE09TR	3 or less
	PE12AR	
	PE15AR	
High-load	PE09UR	5 or less
	PE12BR	
	PE15BR	

4. Maximum rail length

Table 6 shows the limitations of rail length.

However, the limitations vary by accuracy grades.

Table 6 Length limitations of rails

Model	Material	Size		
		09	12	15
PE	Stainless steel	800	1 000	1 200

Note: Rails can be butted if user requirements exceed the rail length shown in the table. Please consult NSK.

5. Installation

(1) Permissible values of mounting error

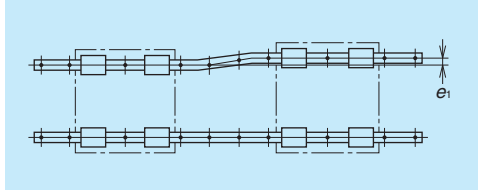


Fig. 3

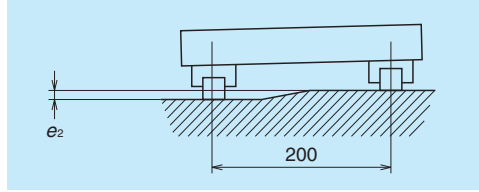


Fig. 4

Table 7 Unit: μm

Value	Preload	Model No.		
		PE09	PE12	PE15
Permissible values for parallelism error of two rails e_1	Z0, ZT	15	18	22
	Z1	10	13	17
Permissible values for height error of two rails e_2	Z0, ZT	50 $\mu\text{m}/200\text{ mm}$		
	Z1	35 $\mu\text{m}/200\text{ mm}$		

(2) Shoulder height of the mounting surface and corner radius r

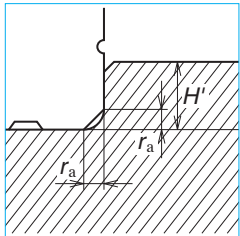


Fig. 5 Shoulder for the rail datum surface

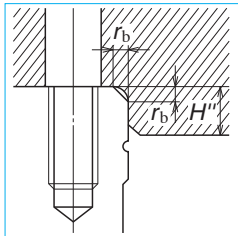


Fig. 6 Shoulder for the ball slide datum surface

Table 8 Unit: mm

Model No.	Corner radius (maximum)		Shoulder height	
	r_a	r_b	H'	H''^*
PE09	0.3	0.3	3.5	2.8
PE12	0.3	0.3	3.5	3.2
PE15	0.3	0.5	3.5	4.1

*) H'' is the minimum recommended value based on the dimension T in dimension table.

6. Lubrication accessories

A drive-in grease fitting can be selected as an option for model PE15.

For models PE09 to PE12, apply grease directly to the rail ball grooves using a point nozzle.



Drive-in type

7. Dust-resistant components

(1) Standard specification

An end seal is provided on both ends of the ball slide as a standard feature.

Seal friction per standard ball slide is shown in Table 9.

Table 9 Seal friction per ball slide (maximum value) Unit: N

Model	Size	09	12	15
		PE	0.8	1

(2) NSK K1™ lubrication unit

Table 10 shows the dimensions of linear guides equipped with NSK K1 lubrication units.

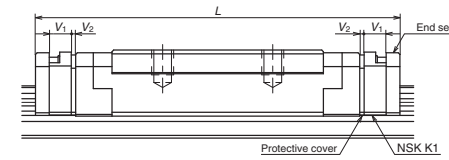


Table 10 Dimensions when equipped with NSK K1 lubrication units Unit: mm

Model No.	Ball slide length	Ball slide shape code	Standard ball slide length	Ball slide length with two NSK K1 installed L	Thickness of	
					single NSK K1 V_1	protective cover V_2
PE09	Standard	TR	39.8	46.8	3	0.5
	Long	UR	51.2	58.2		
PE12	Standard	AR	45	53	3.5	0.5
	Long	BR	60	68		
PE15	Standard	AR	56.6	66.2	4	0.8
	Long	BR	76	85.6		

Note: Slide length when equipped with NSK K1 = (standard ball slide length) + (V_1 thickness of single NSK K1 unit) \times (number of K1 units) + (V_2 thickness of the protective cover) \times 2.

PE Model

8. Reference number

A reference number (designation) is set and indicated on the specification drawing for an individual NSK linear guide when its specifications are finalized.
Please specify the reference number, except design serial number, to identify the product when ordering, requiring estimates, or inquiring about specifications from NSK.

(1) Reference number for preloaded assembly

PE 15 0470 ARK 2 - P5 1**

Model name	PE	Size	15	Rail length (mm)	0470	Ball slide shape code (See page A264.)	ARK	Preload code (See page A266.)	2	Accuracy code (See Table 12.)	-**	Design serial number	P5	Number of ball slides per rail	1
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0: Z0, 1: Z1

Added to the reference number.

(2) Reference number for interchangeable type

PAE 15 ARS -K

Ball slide	PAE	Interchangeable ball slide model code	15	Ball slide shape code (See page A264.)	ARS	Option code	-K	Material code	S
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PAE: PE Model interchangeable ball slide

-K: Equipped with NSK K1

S: Stainless steel

Rail P1E 15 0470 PKN - PC T**

Interchangeable rail model code	P1E	Size	15	Rail length (mm)	0470	Rail shape code	PKN	Preload code (See page A266.)	T	Accuracy code: PC	-**	Design serial number	PC	*Butting rail specification	T
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P1E: PE Model interchangeable rail

T: Fine clearance

PC: Only normal grade is available.

Added to the reference number.

N: Non-butting. L: Butting specification

*Please consult with NSK for butting rail specification.

When interchangeable rails and slides are assembled, reference number coding is the same as that for preloaded assemblies. However, only preload code T (fine clearance) may be used (Refer to Page A266.)

Click!Speedy™ NSK Linear Guide Quick Delivery System uses a new numbering system. For details, please refer to the Click!Speedy general catalog CAT. No. E3191.

Table 11 Material/surface treatment code

Code	Description
K	Stainless steel
H	Stainless steel with surface treatment
Z	Other, special

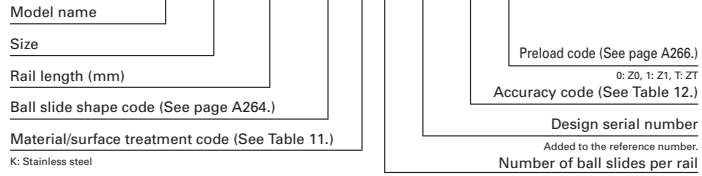
Table 12 Accuracy code

Accuracy	Standard (Without NSK K1)	With NSK K1	With NSK K1 for food and medical equipment
Super precision grade	P4	K4	F4
High precision grade	P5	K5	F5
Precision grade	P6	K6	F6
Normal grade	PN	KN	FN
Normal grade (interchangeable type)	PC	KC	FC

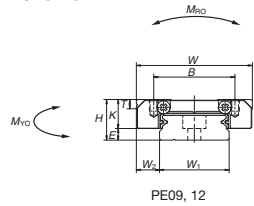
Note: Refer to pages A58 and A73 for details on NSK K1 lubrication units.

9. Dimensions
PE-AR, TR (Standard load / Standard)
PE-UR, BR (High-load / Long)

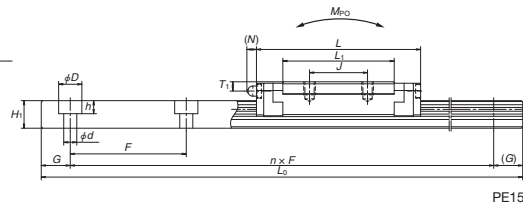
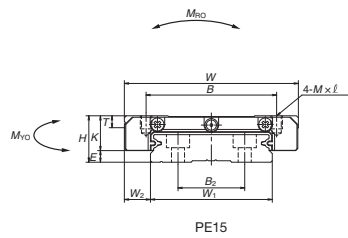
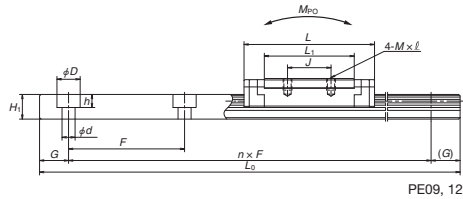
PE 15 0470 AR K 2 - PC T**



Front view



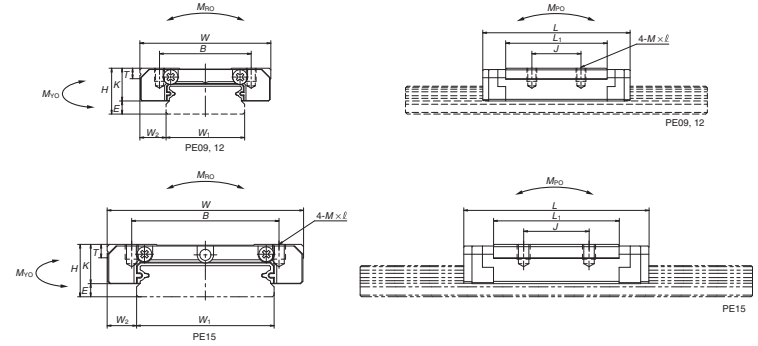
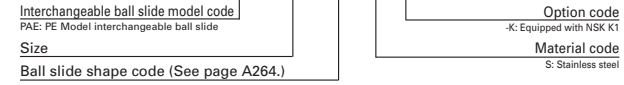
Side view



Model No.	Assembly			Ball slide										Width	Height	
	Height	Width	Length	Mounting hole						Oil hole						
				B	J	M x pitch x l	L ₁	K	T	Hole size	T ₁	N				
PE09TR PE09UR	12	4	6	30	39.8 51.2	21 23	12 24	M3x0.5x3	26.6 38	8	2.8	phi 2	2.3	—	18	7.5
PE12AR PE12BR	14	4	8	40	45 60	28	15 28	M3x0.5x4	31 46	10	3.2	phi 2.5	2.7	—	24	8.5
PE15AR PE15BR	16	4	9	60	56.6 76	45	20 35	M4x0.7x4.5	38.4 57.8	12	4.1	phi 3	3.2 (3.3)	—	42	9.5

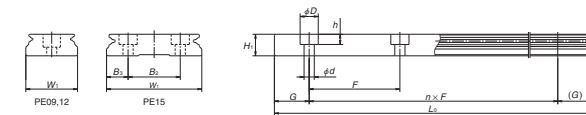
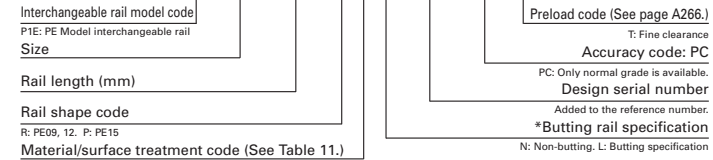
Reference number for ball slide of interchangeable type

PAE 15 AR S -K



Reference number for rail of interchangeable type

P1E15 0470 PKN - PC T**



Rail					Basic load ratings								Weight	
B ₂	Pitch	Mounting bolt hole	G	Maximum length	² Dynamic		C ₀	M _{RO}	Static moment (N-m)				Ball slide	Rail
					[50km]	[100km]			M _{PO}		M _{YO}			
									One slide	Two slides	One slide	Two slides		
—	30	3.5x6x4.5	10	800	3 000	2 390	4 500	36.5	17.3	113	17.3	113	35	95
					4 000	3 150	6 700	54.5	37.5	210	37.5	210		
—	40	4.5x8x4.5	15	1 000	4 350	3 450	6 350	70.5	29.3	180	29.3	180	66	140
					5 800	4 600	9 550	106	63.5	345	63.5	345		
23	40	4.5x8x4.5	15	1 200	7 600	6 050	10 400	207	59.0	370	59.0	370	140	275
					10 300	8 200	16 000	320	135	740	135	740		

Note: Basic load ratings comply with ISO standards (ISO 14728-1, 14728-2).
 C₅₀: the basic dynamic load rating for 50 km rated fatigue life
 C₁₀₀: the basic dynamic load rating for 100 km rated fatigue life

A-4-3.4 LE Model (Miniature wide type)

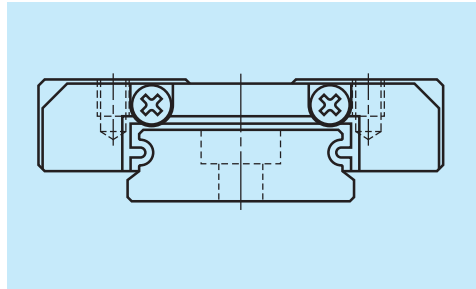
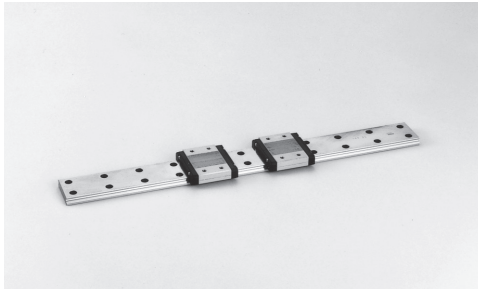


Fig. 1 LE Model

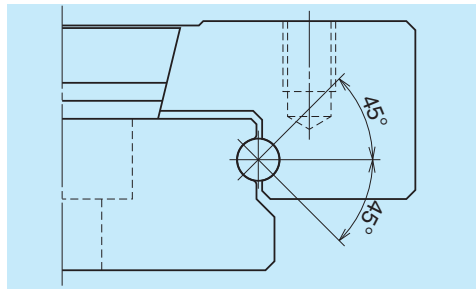


Fig. 2 Ball contact

1. Features

(1) Ideal for use of single rail

LE model miniature linear guides feature a wide rail, allowing for high load carrying capacity against moment loads in the rolling direction.

(2) Equal load carrying capacity in vertical and lateral directions

Contact angle is set at 45 degrees, equally dispersing the load from vertical and lateral directions. This also provides equal rigidity in the two directions.

(3) Super thin

Super-thin guides owe their design to the single ball groove on right and left sides (Gothic arch).

(4) High accuracy

Fixing the master rollers to the ball grooves is easy thanks to the Groove arch groove. This makes for easy and accurate measuring of ball grooves.

(5) Stainless steel standard

Rails and ball slides are made of martensitic stainless steel.

(6) Models with ball retainers available

Ball retaining models (slide shape code AR and TR), including interchangeable types, come with a ball retainer to prevent balls from falling out when the slide is removed from the rail.

(7) Fast delivery

Interchangeable rails and ball slides available. (LE09 to LE15)

2. Ball slide shape

Ball slide shape code	Shape/installation method	Type (Upper row, Rating: Lower row, Ball slide length)		
		Medium-load Short	Standard Standard	High-load Long
AL TL AR TR BL UL CL SL		CL, SL	AL, TL, AR, TR	BL, UL

Specification	Detail	Type		
Mounting hole	Normal	CL*	AL, AR	BL*
	Large	SL*	TL, TR	UL*
Ball retainer	Without	CL, SL	AL, TL	BL, UL
	With	—	AR, TR	—

* Only applicable to LE09

3. Accuracy and preload

(1) Running parallelism of ball slide

Table 1

Unit: μm

Rail length (mm)	Preloaded assembly type (not interchangeable)			Interchangeable type
	High precision P5	Precision grade P6	Normal grade PN	Normal grade PC
over				
or less				
– 50	2	4.5	6	6
50 – 80	3	5	6	6
80 – 125	3.5	5.5	6.5	6.5
125 – 200	4	6	7	7
200 – 250	5	7	8	8
250 – 315	5	8	9	9
315 – 400	6	9	11	11
400 – 500	6	10	12	12
500 – 630	7	12	14	14
630 – 800	8	14	16	16
800 – 1 000	9	16	18	18
1 000 – 1 250	10	17	20	20

(2) Accuracy standard

The preloaded assembly type has three accuracy grades; High precision P5, Precision P6, and Normal PN grades, while the interchangeable type has Normal grade PC only.

Table 2 shows the accuracy standard for the preloaded assembly type while **Table 3** shows the accuracy standard for the interchangeable type.

• Tolerance of preloaded assembly

Characteristics	Accuracy grade	High precision P5	Precision grade P6	Normal grade PN
Mounting height H		± 15	± 20	± 40
Variation of H (All ball slides on a set of rails)		7	15	25
Mounting width W_2 or W_3		± 20	± 30	± 50
Variation of W_2 or W_3 (All ball slides on reference rail)		10	20	30
Running parallelism of surface C to surface A Running parallelism of surface D to surface B		Refer to Table 1 and Fig. 3		

• Tolerance of interchangeable type: Normal grade PC

Characteristics	Accuracy grade
	LE09, 12, 15
Mounting height H	± 20
Variation of mounting height H	40
Mounting width W_2 or W_3	± 20
Variation of mounting width W_2 or W_3	40
Running parallelism of surface C to surface A Running parallelism of surface D to surface B	Refer to Table 1 and Fig. 3

(3) Assembled accuracy

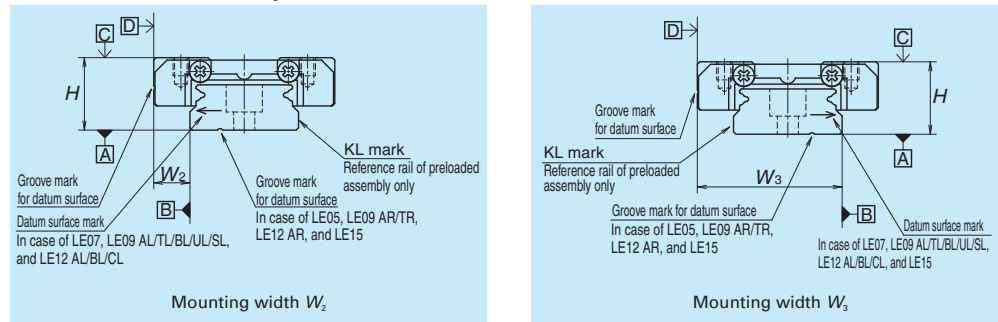


Fig. 3

(4) Preload and rigidity

We offer three levels of preload: Slight preload Z1 and Fine clearance Z0 for the preloaded assembly type, along with Fine clearance ZT for the interchangeable type. Values for preload and rigidity of the preloaded assembly type are shown in **Table 4**. Rigidities are for the median of the preload range.

• Preload and rigidity of preloaded assembly

Model No.	Preload (N)	Rigidity (N/ μm)
	Slight preload (Z1)	Slight preload (Z1)
Standard	LE05 AL	0 – 23
	LE07 TL	0 – 29
	LE09 AL, TL, AR, TR	0 – 37
	LE12 AL, AR	0 – 40
	LE15 AL, AR	0 – 49
Medium-load	LE05 CL	0 – 18
	LE07 SL	0 – 16
	LE09 CL, SL	0 – 21
	LE12 CL	0 – 23
High-load	LE15 CL	0 – 29
	LE07 UL	0 – 43
	LE09 BL, UL	0 – 54
	LE12 BL	0 – 59
LE15 BL	0 – 75	
LE15 BL	0 – 75	114

Note: The clearance of Fine clearance Z0 is 0 to 3 μm . Therefore, preload is zero. However, the clearance of the Z0 of PN grade is 3 to 10 μm .

• Clearance of interchangeable type

Model No.	Fine clearance ZT
LE09	0 – 15
LE12	
LE15	

4. Maximum rail length

Table 6 shows the limitations of rail length. The limitations vary by accuracy grades.

Model	Size	Material				
		05	07	09	12	15
LE	Stainless steel	150	600	800	1 000	1 200

Note: Rails can be butted if user requirements exceed the rail length shown in the table. Please consult NSK.

5. Installation

(1) Permissible values of mounting error

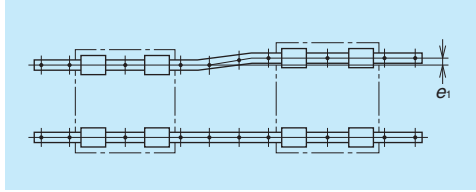


Fig. 4

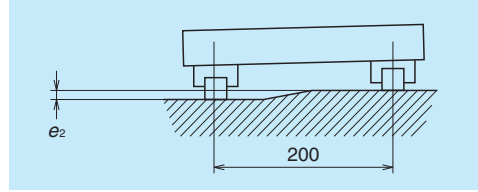


Fig. 5

Table 7

Unit: μm

Value	Preload	Model No.				
		LE05	LE07	LE09	LE12	LE15
Permissible values for parallelism error of two rails e_1	Z0, ZT	10	12	15	18	22
	Z1	5	7	10	13	17
Permissible values for height error of two rails e_2	Z0, ZT	50 $\mu\text{m}/200\text{ mm}$				
	Z1	35 $\mu\text{m}/200\text{ mm}$				

(2) Shoulder height of the mounting surface and corner radius r

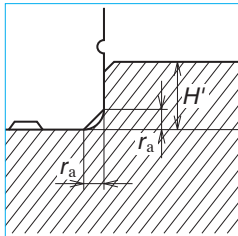


Fig. 6 Shoulder for the rail datum surface

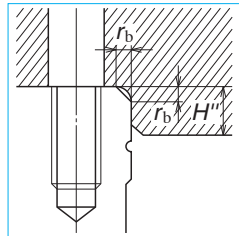


Fig. 7 Shoulder for the ball slide datum surface

Table 8

Unit: mm

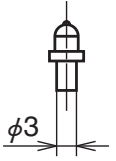
Model No.	Corner radius (maximum)		Shoulder height	
	r_a	r_b	H'	H''
LE05	0.2	0.2	1.1	2
LE07	0.2	0.3	1.7	3
LE09	0.3	0.3	3.5	3
LE12	0.3	0.3	3.5	4
LE15	0.3	0.5	3.5	5

6. Lubrication accessories

Model LE15AR can select drive-in grease fitting as option.

There is no standard grease fitting for LE05 to LE12.

For the models of LE05 to LE15 except for LE15AR, apply grease directly to the ball grooves of rail, using a point nozzle.



Drive-in type

7. Dust-resistant components

(1) Standard specification

An end seal is provided on both ends of the ball slide as a standard feature.

- Seal friction per standard ball slide is shown in Table 9.

Table 9 Seal friction per ball slide (maximum value)

Unit: N

Model	Size	05	07	09	12	15
LE		0.4	0.4	0.8	1.0	1.2

(2) NSK K1™ lubrication unit

The installed dimensions of NSK K1 lubrication units are shown in Table 10.

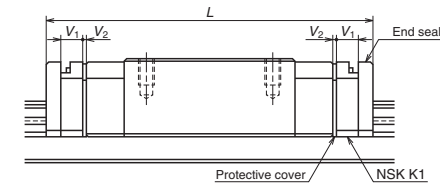


Table 10 Dimensions when equipped with NSK K1 lubrication units

Unit: mm

Model No.	Ball slide length	Ball slide model	Standard ball slide length	Ball slide length with two NSK K1 installed L	Thickness of single NSK K1 V_1	Protective cover thickness V_2
LE07	Standard	TL	31	37	2.5	0.5
	Long	UL	42	48		
	Short	SL	22.4	28.4		
LE09	Standard	AL, TL	39	46	3.0	0.5
	Standard	AR, TR	39.8	46.8		
	Long	BL, UL	50.4	57.4		
	Short	CL, SL	26.4	33.4		
LE12	Standard	AL	44	52	3.5	0.5
	Standard	AR	45	53		
	Long	BL	59	67		
	Short	CL	30.5	38.5		
LE15	Standard	AL	55.0	64.6	4.0	0.8
	Standard	AR	56.6	66.2		
	Long	BL	74.4	84		
	Short	CL	41.4	51		

Note: Slide length when equipped with NSK K1 = (standard ball slide length) + (V_1 thickness of single NSK K1 unit) \times (number of K1 units) + (V_2 thickness of the protective cover) \times 2.

LE Model

8. Reference number

A reference number (designation) is set and indicated on the specification drawing for an individual NSK linear guide when its specifications are finalized.
Please specify the reference number, except design serial number, to identify the product when ordering, requiring estimates, or inquiring about specifications from NSK.

(1) Reference number for preloaded assembly

LE 15 0310 ARK 2 - P5 1**

Model name									
Size									Preload code (See page A276.)
Rail length (mm)									0: Z0, 1: Z1
Ball slide shape code (See page A274.)									Accuracy code (See Table 12.)
Material/surface treatment code (See Table 11.)									Design serial number
K: Stainless steel									Added to the reference number.
									Number of ball slides per rail

(2) Reference number for interchangeable type

LAE 15 ARS -K

Interchangeable ball slide model code									Option code
LAE: LE Model interchangeable ball slide									-K: Equipped with NSK K1
Size									Material code
Ball slide shape code (See page A274.)									S: Stainless steel

Rail L1E 15 0310 RKN - PC T**

Interchangeable rail model code									Preload code (See page A276.)
L1E: LE Model interchangeable rail									T: Fine clearance
Size									Accuracy code: PC
Rail length (mm)									PC: Only normal grade is available.
Rail shape code									Design serial number
R: LE09 and LE12 standard, equipped with ball retainer									Added to the reference number.
Material/surface treatment code (See Table 11.)									*Butting rail specification
									N: Non-butting, L: Butting specification

*Please consult with NSK for butting rail specification.

When interchangeable rails and slides are assembled, reference number coding is the same as that for preloaded assemblies. However, only preload code T (fine clearance) may be used (Refer to Page A276.)

Table 11 Material/surface treatment code

Code	Description
K	Stainless steel
H	Stainless steel with surface treatment
Z	Other, special

Table 12 Accuracy code

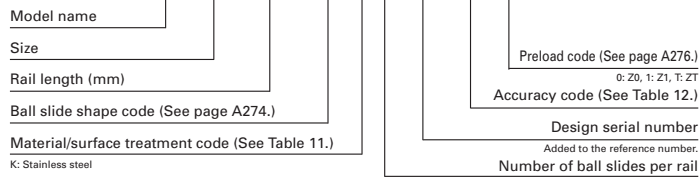
Accuracy	Standard (Without NSK K1)	With NSK K1
High precision grade	P5	K5
Precision grade	P6	K6
Normal grade	PN	KN
Normal grade (interchangeable type)	PC	KC

Note: Refer to page A58 for details on NSK K1 lubrication units.

9. Dimensions

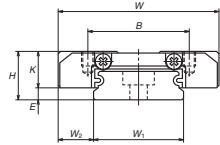
- LE-AL (Standard load / Standard)
- LE-TL (Standard load / Standard, large mounting hole)
- LE-AR (Standard load / Standard, with ball retainer)
- LE-TR (Standard load / Standard, large mounting hole, with ball retainer)

LE 15 0310 AR K 2 -** PC T

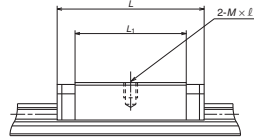


Front view

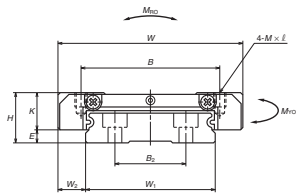
Side view



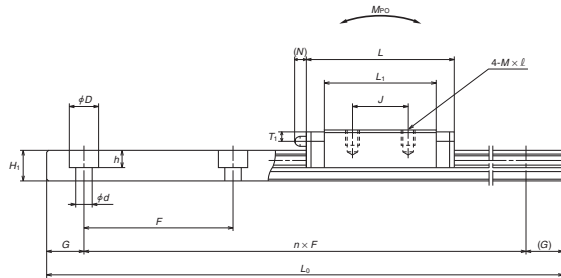
LE05, 07, 09, 12



LE05



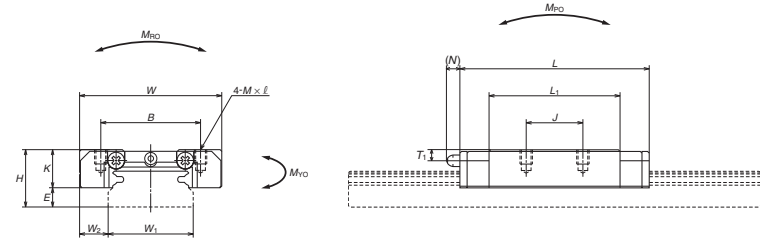
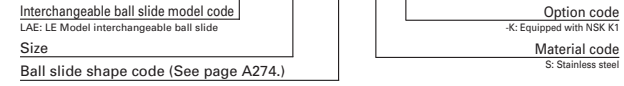
LE15



LE07, 09, 12, 15

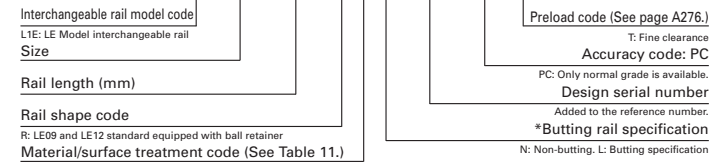
- Reference number for ball slide of interchangeable type
- Interchangeable with retainer: LAE09AR/TR, LAE12AR, LAE15AR
- LAE-AR (With ball retainer)
- LAE-TR (Large mounting hole with ball retainer)

LAE 15 AR S -K

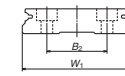


Reference number for rail of interchangeable type

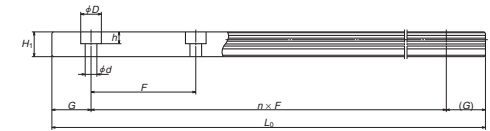
Rail L1E15 0310 RKN -** PC T



LE09, 12



LE15



Model No.	Assembly			Ball slide						Grease fitting				Pitch			
	Height	Width	Length	Mounting hole				Hole size	Width	Height	Pitch						
				B	J	M x pitch x l	L1										
LE05AL	6.5	1.4	3.5	17	24	13	—	M2.5x0.45x2	17	5.1	—	—	10	4	—	20	
LE07TL	9	2	5.5	25	31	19	10	M3x0.5x3	21.2	7	—	—	14	5.2	—	30	
LE09AL	12	4	6	30	39	21	12	M2.6x0.45x3	27.6	8	—	—	18	7.5	—	30	
LE09AR	12	4	6	30	39.8	21	12	M2.6x0.45x3	27.6	8	—	—	18	7.5	—	30	
LE09TR	12	4	6	30	39.8	21	12	M3x0.5x3	27.6	8	—	—	18	7.5	—	30	
LE12AL	14	4	8	40	44	28	15	M3x0.5x4	31	10	—	—	24	8.5	—	40	
LE12AR	14	4	8	40	45	28	15	M3x0.5x4	31	10	—	—	24	8.5	—	40	
LE15AL	16	4	9	60	55	45	20	M4x0.7x4.5	38.4	12	φ3	3.2	3	42	9.5	23	40
LE15AR	16	4	9	60	56.6	45	20	M4x0.7x4.5	38.4	12	φ3	3.2	3	42	9.5	23	40

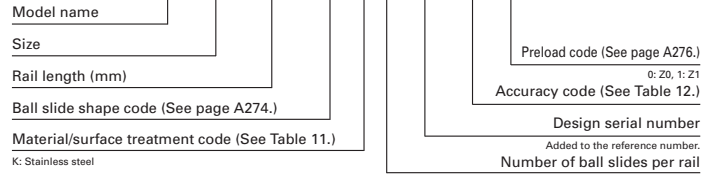
Notes: 1) Ball slide LE05 has only two mounting tap holes.

Rail	Mounting bolt hole	G	Max. length	Basic load ratings						Weight			
				Dynamic		Static	Static moment (N-m)				Ball slide	Rail	
				[50km]	[100km]		M _{PO}		M _{YO}				
3x5x1.6	(reference)	7.5	L _{0max}	C ₅₀ (N)	C ₁₀₀ (N)	C ₀ (N)	M _{RO}	One slide	Two slides	One slide	Two slides	(g)	(g/100 mm)
3.5x6x3.2	10	600	1 580	1 260	2 350	16.7	7.20	46.0	7.20	46.0	25	55	
3.5x6x4.5	10	800	3 000	2 400	4 500	36.5	17.3	110	17.3	110	40	95	
3.5x6x4.5	10	800	3 000	2 400	4 500	36.5	17.3	113	17.3	113	40	95	
4.5x8x4.5	15	1 000	4 350	3 450	6 350	70.5	29.3	175	29.3	175	75	140	
4.5x8x4.5	15	1 200	7 600	6 050	10 400	207	59.0	360	59.0	360	150	275	

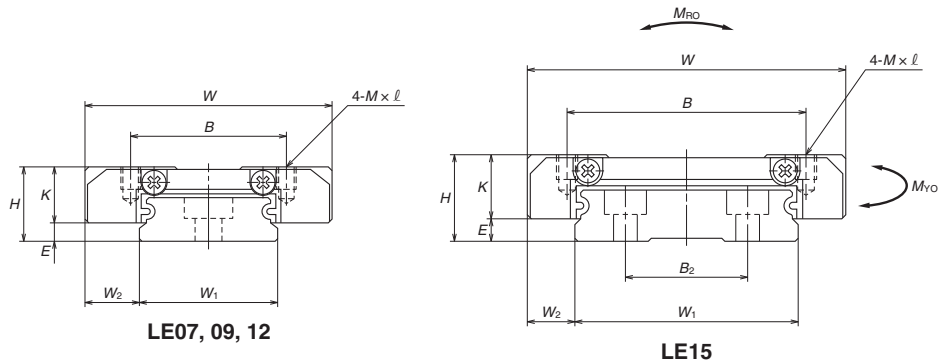
2) Basic load ratings comply with ISO standards (ISO 14728-1, 14728-2).
 C₅₀: the basic dynamic load rating for 50 km rated fatigue life C₁₀₀: the basic dynamic load rating for 100 km rated fatigue life
 3) For fixing a rail of LE05AL, use M2.5 x 0.45 cross-recessed pan head machine screw for precision instruments.
 (JCS 10-70: No.0 pan head machine screw No.3) (JCS: Japanese Camera Industrial Standard)

LE-BL (High-load / Long)
LE-UL (High-load / Long, large mounting hole)

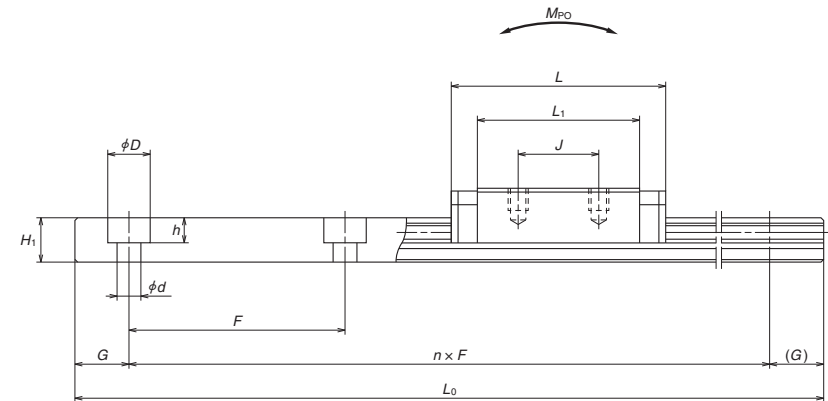
LE 15 0310 BL K 2 - P5 1**



Front view



Side view



Model No.	Assembly			Ball slide							Width	Height	Pitch		
	Height	E	W ₂	Width	Length	Mounting hole			L ₁	K				B ₂	F
						B	J	M × pitch × l							
LE07UL	9	2	5.5	25	42	19	19	M3×0.5×3	32.2	7	14	5.2	—	30	
LE09BL LE09UL	12	4	6	30	50.4	23	24	M2.6×0.45×3 M3×0.5×3	39	8	18	7.5	—	30	
LE12BL	14	4	8	40	59	28	28	M3×0.5×4	46	10	24	8.5	—	40	
LE15BL	16	4	9	60	74.4	45	35	M4×0.7×4.5	57.8	12	42	9.5	23	40	

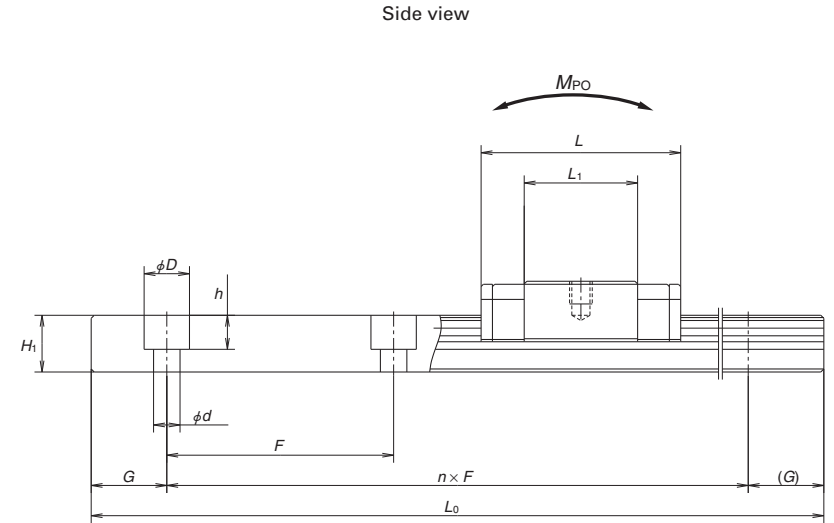
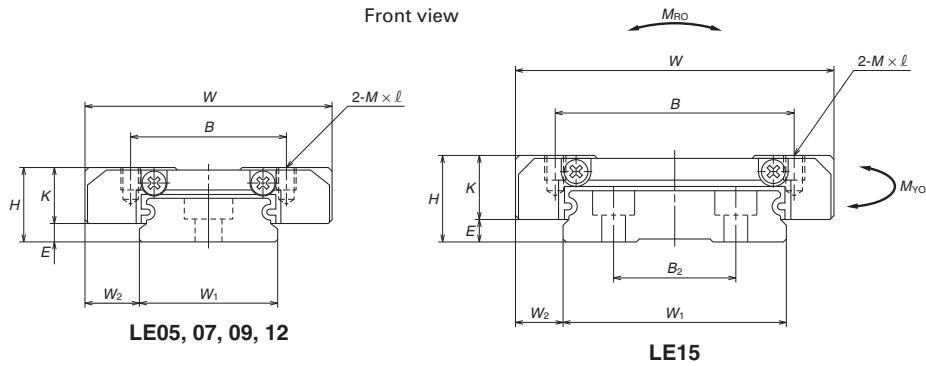
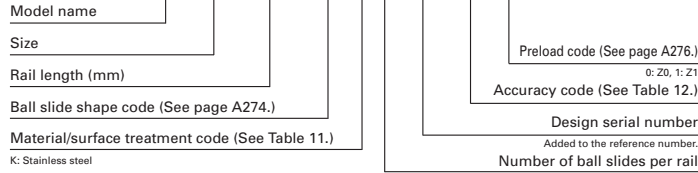
Unit: mm

Rail			Basic load ratings							Weight			
Mounting bolt hole	G	Max. length	¹⁾ Dynamic		Static	C ₀	Static moment (N·m)				Ball slide	Rail	
			[50km]	[100km]			M _{PO}		M _{YO}				
			d × D × h	(reference)	L _{0max}	C ₅₀ (N)	C ₁₀₀ (N)	(N)	M _{PO}	M _{YO}	One slide	Two slides	One slide
3.5×6×3.2	10	600	2 180	1 730	3 700	26.4	17.3	94.5	17.3	94.5	39	55	
3.5×6×4.5	10	800	4 000	3 150	6 700	54.5	37.5	206	37.5	206	58	95	
4.5×8×4.5	15	1 000	5 800	4 600	9 550	106	63.5	340	63.5	340	115	140	
4.5×8×4.5	15	1 200	10 300	8 200	16 000	320	135	725	135	725	235	275	

Note: 1) Basic load ratings comply with ISO standards (ISO 14728-1, 14728-2).
 C₅₀: the basic dynamic load rating for 50 km rated fatigue life
 C₁₀₀: the basic dynamic load rating for 100 km rated fatigue life

LE-CL (Medium-load / Short)
LE-SL (Medium-load / Short, large mounting hole)

LE 15 0310 CL K 2 - P5 1**



Model No.	Assembly			Ball slide										
	Height <i>H</i>	<i>E</i>	<i>W</i> ₂	Width <i>W</i>	Length <i>L</i>	Mounting hole					Width <i>W</i> ₁	Height <i>H</i> ₁	<i>B</i> ₂	Pitch <i>F</i>
						<i>B</i>	<i>J</i>	<i>M</i> × pitch × <i>l</i>	<i>L</i> ₁	<i>K</i>				
LE05CL	6.5	1.4	3.5	17	20	13	—	M2.5×0.45×2	13	5.1	10	4	—	20
LE07SL	9	2	5.5	25	22.4	19	—	M3×0.5×3	12.6	7	14	5.2	—	30
LE09CL LE09SL	12	4	6	30	26.4	21	—	M2.6×0.45×3 M3×0.5×3	15	8	18	7.5	—	30
LE12CL	14	4	8	40	30.5	28	—	M3×0.5×4	17.5	10	24	8.5	—	40
LE15CL	16	4	9	60	41.4	45	—	M4×0.7×4.5	24.8	12	42	9.5	23	40

Notes: 1) Ball slide CL and SL types have only two mounting tap holes in the center.

Rail		Mounting bolt hole <i>d</i> × <i>D</i> × <i>h</i>	<i>G</i> <small>(reference)</small>	Max. length <i>L</i> _{0max}	Basic load ratings								Weight	
[50km]	[100km]				Static <i>C</i> ₀ (N)	Static moment (N-m)				Ball slide (g)	Rail (g/100 mm)			
						<i>C</i> ₅₀ (N)	<i>C</i> ₁₀₀ (N)	<i>M</i> _{PO}	<i>M</i> _{VO}					
3×5×1.6	7.5	150	595	470	835	4.25	1.51	10.0	1.51	10.0	8	34		
3.5×6×3.2	10	600	980	775	1 170	8.35	2.01	18.5	2.01	18.5	17	55		
3.5×6×4.5	10	800	1 860	1 480	2 240	18.2	4.85	41.0	4.85	41.0	25	95		
4.5×8×4.5	15	1 000	2 700	2 140	3 150	35.0	8.15	67.0	8.15	67.0	50	140		
4.5×8×4.5	15	1 200	5 000	3 950	5 650	113	19.4	162	19.4	162	110	275		

2) Basic load ratings comply with ISO standards (ISO 14728-1, 14728-2).

*C*₅₀: the basic dynamic load rating for 50 km rated fatigue life *C*₁₀₀: the basic dynamic load rating for 100 km rated fatigue life

3) For fixing a rail of LE05CL, use cross-recessed pan head machine screw for precision instruments M2.5 × 0.45 (JCIS 10-70: Japan Camera Industry Association, No.0, class 3).

A-4-3.5 Miniature LH Model

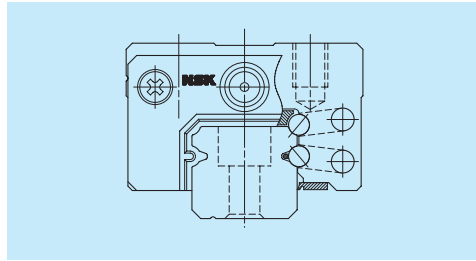
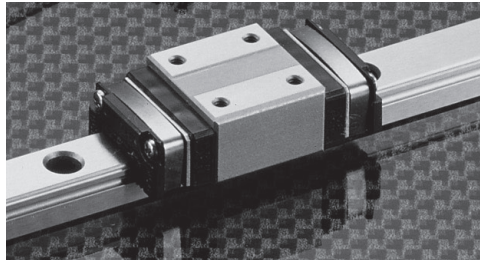


Fig. 1 LH Model

1. Features

(1) High self-aligning capability (rolling direction)

Similar to a DF arrangement of angular contact bearings, Miniature LH models offer large self-aligning capability with the internal intersection of the contact lines of the balls and grooves reducing moment rigidity. This increases the capacity to absorb errors in installation.

(2) High vertical load carrying capacity

The contact angle is set at 50 degrees, thus increasing load carrying capacity as well as rigidity in the vertical direction.

(3) High resistance against impact load

The bottom ball groove forms a Gothic arch and the center of the top and bottom grooves are offset as shown in Fig. 2.

Vertical load is generally carried by the top rows at two contact points, but with this design, the bottom rows also carry load when a large impact load is applied vertically as shown in Fig. 3. This assures high resistance to impact load.

(4) High accuracy

As shown in Fig. 4, fixing the master rollers to the ball grooves is easy thanks to the Gothic arch groove. This makes for easy and accurate measuring of ball grooves.

(5) High corrosion resistance

Highly corrosion-resistant martensite stainless steel is incorporated as a standard feature to provide excellent corrosion resistance.

(6) Easy to handle

Safe design includes a retainer that prevents steel balls from dropping out of the ball slide even when the slide is removed from the rail. (LH10-12)

(7) Long-term maintenance-free

Superb features of the NSK K1 lubrication unit realize long-term, maintenance-free operation.

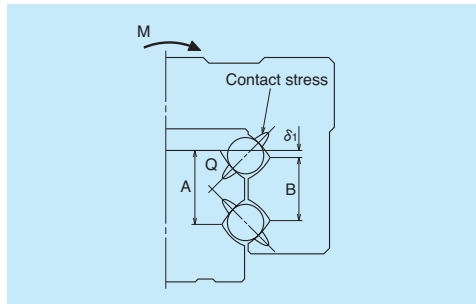


Fig. 2 Enlarged illustration of the offset Gothic arch groove

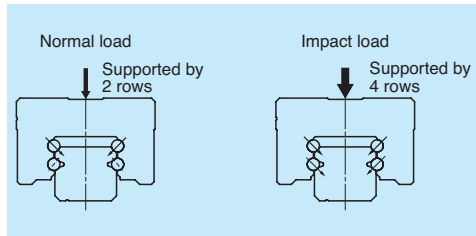


Fig. 3 When load is applied

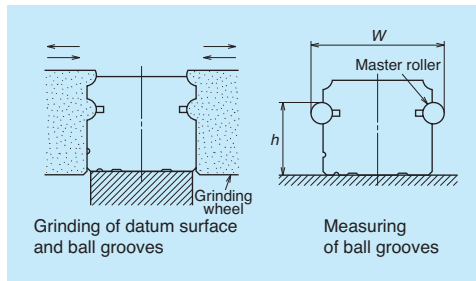


Fig. 4 Rail grinding and measuring

2. Ball slide shape

Ball slide shape code	Shape/installation method	Type
AN		AN

3. Accuracy and preload

(1) Running parallelism of ball slide

Unit: μm

Rail length (mm) over or less	Preloaded assembly			
	Super precision P4	High precision P5	Precision grade P6	Normal grade PN
- 50	2	2	4.5	6
50 - 80	2	3	5	6
80 - 125	2	3.5	5.5	6.5
125 - 200	2	4	6	7
200 - 250	2.5	5	7	8
250 - 315	2.5	5	8	9
315 - 400	3	6	9	11
400 - 500	3	6	10	12
500 - 630	3.5	7	12	14
630 - 800	4.5	8	14	16

(2) Accuracy standard

The preloaded assembly has four accuracy grades; Super precision P4, High precision P5, Precision P6 and Normal PN grades.

• Tolerance of preloaded assembly

Unit: μm

Characteristics	Super precision P4	High precision P5	Precision grade P6	Normal grade PN
Mounting height H Variation of H (All ball slides on a set of rails)	± 10 3	± 20 5	± 40 7	± 80 15
Mounting width W_2 or W_3 Variation of W_2 or W_3 (All ball slides on reference rail)	± 10 5	± 15 7	± 25 10	± 50 20
Running parallelism of surface C to surface A Running parallelism of surface D to surface B	Shown in Table 1, Fig. 5			

(3) Combinations of accuracy and preload

Table 3

		Accuracy grade			
		Super precision	High precision	Precision grade	Normal grade
Without NSK K1 lubrication unit		P4	P5	P6	PN
With NSK K1 lubrication unit		K4	K5	K6	KN
With NSK K1 for food and medical equipment		F4	F5	F6	FN
Preload	Fine clearance Z0	○	○	○	○
	Slight preload Z1	○	○	○	○

(4) Assembled accuracy

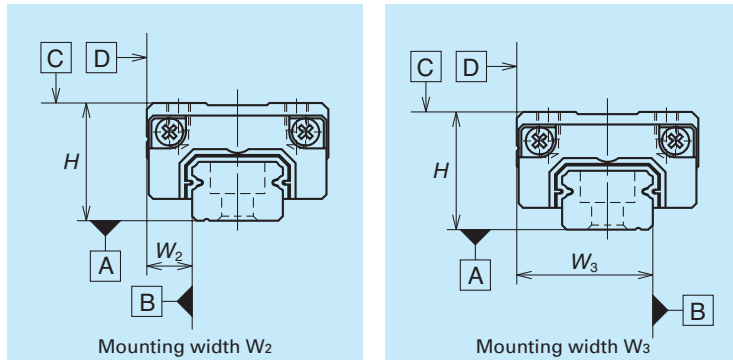


Fig. 5

(5) Preload and rigidity

We offer two levels of preload: Slight preload Z1 and Fine clearance Z0.

• Preload and rigidity of preloaded assembly

Table 4

Model No.	Preload (N)	Rigidity (N/μm)	
		Vertical direction	Lateral direction
	Slight preload Z1	Slight preload Z1	Slight preload Z1
LH08AN	5	33	23
LH10AN	9	44	31
LH12AN	22	68	47

Note: Clearance for Fine clearance Z0 is 0 to 3μm. Therefore, preload is zero. However, Z0 of PN grade is 0 to 5μm.

4. Maximum rail length

Table 5 shows the limitations of rail length (maximum length). However, the limitations vary by accuracy grades.

Table 5 Length limitations of rails

Unit: mm

Model	Material	Size		
		08	10	12
LH	Stainless steel	375	600	800

Note: Rails can be butted if user requirements exceed the rail length shown in the table. Please consult NSK.

5. Installation

(1) Permissible values of mounting error

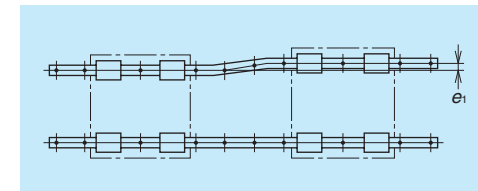


Fig. 6

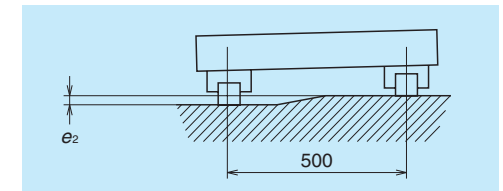


Fig. 7

Table 6

Unit: μm

Value	Preload	Model No.		
		LH08	LH10	LH12
Permissible values for parallelism error of two rails e_1	Z0	9	12	19
	Z1	8	11	18
Permissible values for height error of two rails e_2	Z0	375μm/500mm		
	Z1	330μm/500mm		

(2) Shoulder height of the mounting surface and corner radius r

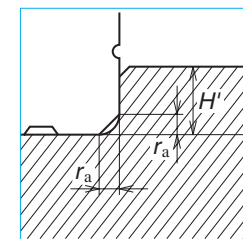


Fig. 8 Shoulder for the rail datum surface

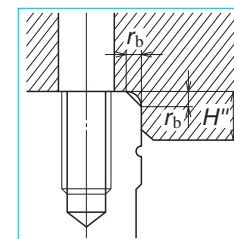


Fig. 9 Shoulder for the ball slide datum surface

Table 7

Unit: mm

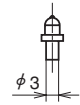
Model No.	Corner radius (maximum)		Shoulder height	
	r_a	r_b	H'	H''
LH08	0.3	0.5	1.8	3
LH10	0.3	0.5	2.1	4
LH12	0.5	0.5	2.7	4

6. Lubrication accessory

Model LH12 can use drive-in grease fittings as an option.

For models LH08 to LH10, apply grease directly to the ball grooves of rail using a point nozzle.

Grease fitting



Drive-in type

Fig. 10

7. Dust-resistant components

(1) Standard specification

Under normal applications, the LH model can be used without modification thanks to its dust resistance. As standard equipment, the ball slides have an end seal on both ends and bottom seals at the bottom.

However, bottom seals are not used with LH08 and 10.

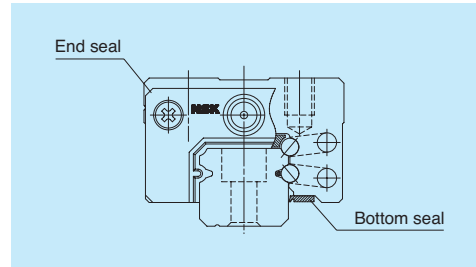


Fig. 11

Table 8 Seal friction per ball slide (maximum value)

Unit: N

Model	Size	08	10	12
LH		0.5	1	1.5

(2) NSK K1™ lubrication unit

Table 9 shows the dimensions of linear guides equipped with NSK K1 lubrication units.

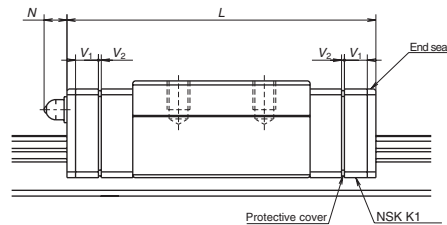


Table 9 Dimensions when equipped with NSK K1 lubrication units

Unit: mm

Model No.	Ball slide length	Ball slide shape code	Standard ball slide length	Ball slide length with two NSK K1 installed L	Thickness of single NSK K1 V ₁	Protective cover thickness V ₂	Protrusion of grease fitting N
LH08	Standard	AN	24	31	3	0.5	—
LH10	Standard	AN	31	40	4	0.5	—
LH12	Standard	AN	45	54	4	0.5	(4)

Notes: 1) NSK K1 for food processing machinery/medical equipment are available for LH12.

2) Slide length when equipped with NSK K1 = (standard ball slide length) + (V₁ thickness of single NSK K1 unit) × (number of K1 units) + (V₂ thickness of the protective cover) × 2.

(3) Caps to plug the rail mounting bolt hole

Table 10 Caps to plug rail bolt hole

Model No.	Bolt to secure rail	Cap reference No.	Quantity /case
LH12	M3	LG-CAP/M3	20

8. Reference number

A reference number (designation) is set and indicated on the specification drawing for an individual NSK linear guide when its specifications are finalized.

Please specify the reference number, except design serial number, to identify the product when ordering, requiring estimates, or inquiring about specifications from NSK.

(1) Reference number for preloaded assembly

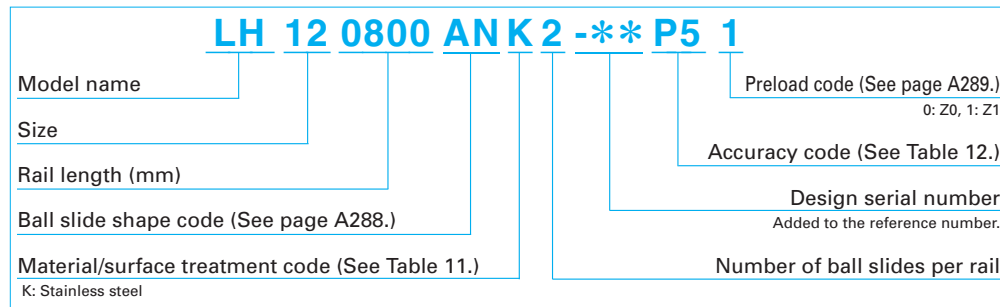


Table 11 Material/surface treatment code

Code	Description
K	Stainless steel
H	Stainless steel with surface treatment
Z	Other, special

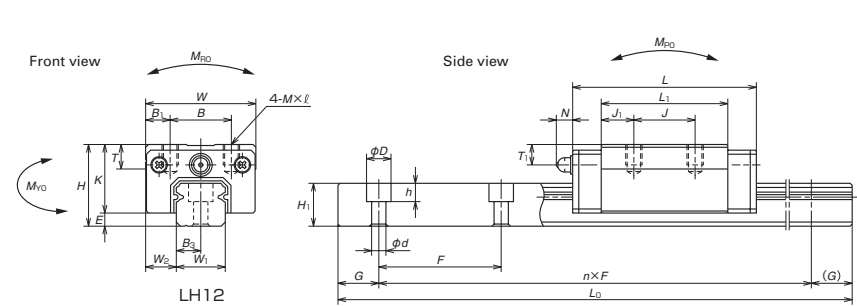
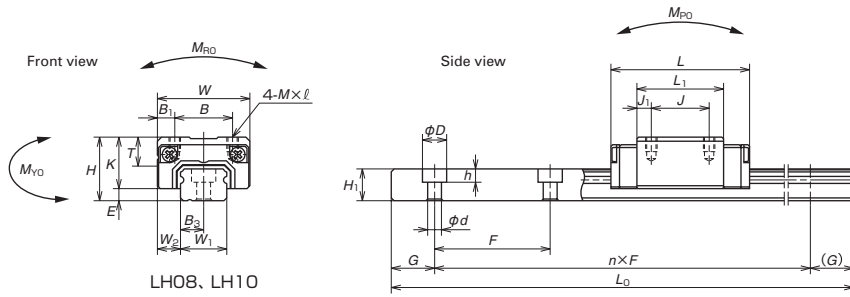
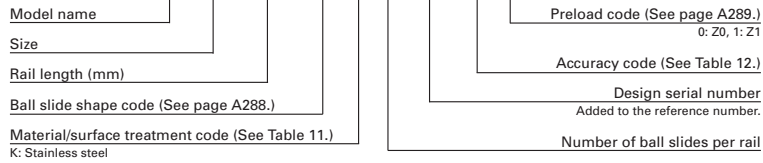
Table 12 Accuracy code

Accuracy	Standard (Without NSK K1)	With NSK K1	With NSK K1 for food and medical equipment
Super precision grade	P4	K4	F4
High precision grade	P5	K5	F5
Precision grade	P6	K6	F6
Normal grade	PN	KN	FN

Note: Refer to pages A58 and A73 for details on NSK K1 lubrication units.

9. Dimensions

LH 12 0800 AN K 2 - P5 1**



Model No.	Assembly			Ball slide										Width	Height	
	Height	E	W ₂	Width	Length	Mounting hole					Grease fitting					
						B	J	M × pitch × l	L ₁	K	T	Hole size	T ₁			N
LH08AN	11	2.1	4	16	24	10	10	M2×0.4×2.5	15	8.9	—	—	—	—	8	5.5
LH10AN	13	2.4	5	20	31	13	12	M2.6×0.45×3	20.2	10.6	6	—	—	—	10	6.5
LH12AN	20	3.2	7.5	27	45	15	15	M4×0.7×5	31	16.8	6	φ3	5	4	12	10.5

Notes: 1) LH08 does not have a ball retainer. Note that balls will fall out when the ball slide is removed from the rail.

Unit: mm

Rail		Basic load ratings										Weight	
Pitch	Mounting bolt hole	G	Max. length	² Dynamic		Static	Static moment (N·m)				Ball slide	Rail	
				[50km]	[100km]		C ₀	M _{R0}	M _{P0}				M _{V0}
F	d × D × h	(reference)	L _{0max}	C ₅₀ (N)	C ₁₀₀ (N)	(N)		One slide	Two slides	One slide	Two slides	(g)	(g/100 mm)
20	2.4×4.2×2.3	7.5	375	1 240	985	2 630	7.25	4.55	32.5	3.8	27.2	13	31
25	3.5×6×3.5	10	600	2 250	1 790	4 500	16.2	10.5	73.0	8.8	61.0	26	44
40	3.5×6×4.5	15	800	5 650	4 500	11 300	47.5	41.5	254	35	214	82	88

2) Basic load ratings comply with ISO standards (ISO 14728-1, 14728-2).

C₅₀: the basic dynamic load rating for 50 km rated fatigue life C₁₀₀: the basic dynamic load rating for 100 km rated fatigue life

A-4-3.6 LL Model

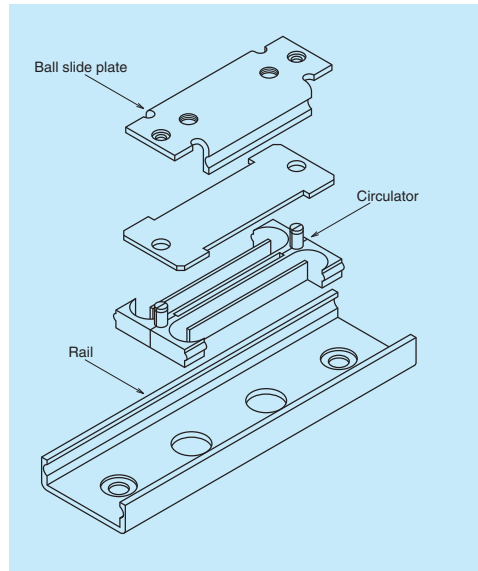
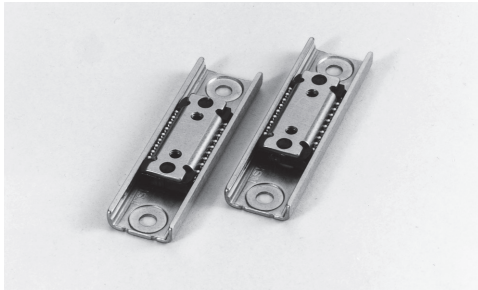


Fig. 1 LL Model structure

1. Features

(1) Super light-weight

This compact guide has a single ball groove on both right and left sides (Gothic arch). Rails and ball slides are made of stainless steel plate, therefore they are lightweight.

(2) Compact

The ball groove is made outside the ball slide to reduce overall size and obtain high speed.

(3) High corrosion resistance

Highly corrosion resistant martensitic stainless steel is used as standard material.

2. Ball slide shape

Ball slide shape code	Shape/installation method
PL	

3. Accuracy and preload

(1) Accuracy standard

The LL Model has a Normal grade PN as the accuracy grade.

Table 1 shows the tolerance.

Table 1 Tolerance of Normal grade (PN)

Characteristic	Model No.	Unit: μm
Mounting height	LL15	± 20
Running parallelism of surface C to surface A		20
Running parallelism of surface D to surface B		(See Fig. 2.)

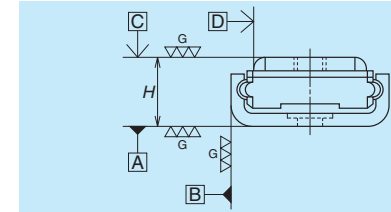


Fig. 2 Standard LL

(2) Preload

We offer clearance for the LL Model.

Table 2 shows the specification of clearance.

Table 2 Radial clearance

Model No.	Clearance	Unit: μm
LL15	0 - 10	

4. Maximum rail length

Table 3 Length limitation of rails

Model	Size	Material	Unit: mm				
			15				
LL	Stainless steel		40	60	75	90	120

5. Reference number

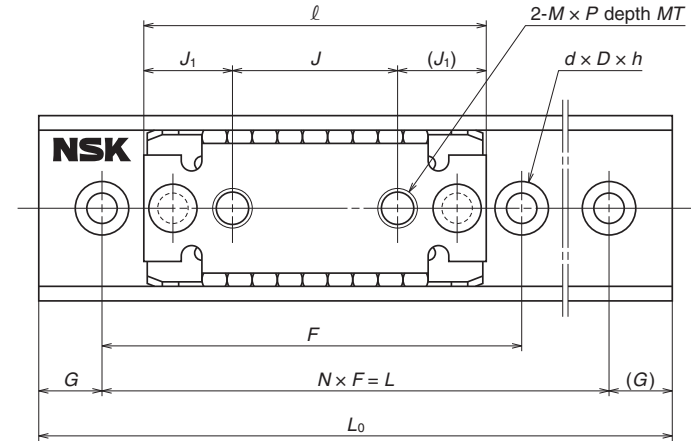
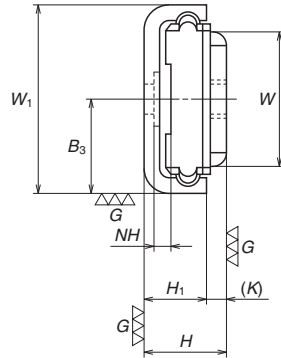
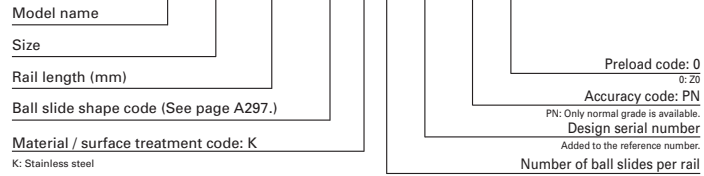
A reference number (designation) is set and indicated on the specification drawing for an individual NSK linear guide when its specifications are finalized.

Please specify the reference number, except design serial number, to identify the product when ordering, requiring estimates, or inquiring about specifications from NSK.

LL 15 0060 PL K 1 -** PN 0	
Model name	LL 15 0060 PL K 1 -** PN 0
Size	15
Rail length (mm)	0060
Ball slide shape code (See page A297.)	PL
Material / surface treatment code: K	K
	Preload code: 0
	0: Z0
	Accuracy code: PN
	PN: Only normal grade is available.
	Design serial number
	Added to the reference number.
	Number of ball slides per rail

6. Dimensions

LL 15 0060 PL K 1 - PN 0**



Model No.	Assembly		Ball slide							Height	Pitch	N
	Height	Width	Length	Mounting hole			J ₁	K				
				J	M × pitch	MT						
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

- Notes:
- 1) The LL model does not have a ball retainer. Note that balls will fall out when the ball slide is removed from the rail.
 - 2) Seals are not available. Please provide dust-prevention measures on the equipment.
 - 3) Do not use an installation screw on the ball slide which exceeds dimension MT (maximum screw-in depth) in the dimension table.
 - 4) To fix the rail, use M2 × 0.4 cross recessed machine screws for precision instruments.
(JCIS10-70 No.0 pan head machine screw No.1)
(JCIS: Japanese Camera Industrial Standard)

Unit: mm

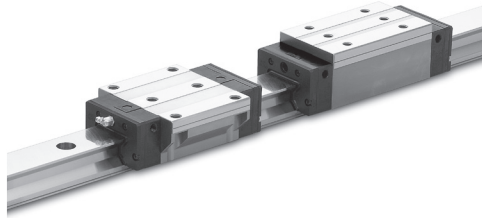
Rail		Basic load ratings								Ball dia.	Weight	
Mounting bolt hole	Length	⁵⁾ Dynamic		Static	Static moment			D _w	Ball slide	Rail		
		[50km]	[100km]		C ₀	M _{R0}	M _{P0}				M _{V0}	
d × D × h	L ₀	C ₅₀ (N)	C ₁₀₀ (N)	(N)	(N·m)	(N·m)	(N·m)		(g)	(g)		
2.4×5×0.4	40	880	700	785	7	3	3	2	6	9		
	60									11		
	75									13		
	90									16		
	120									21		

- 5) C₅₀: the basic dynamic load rating for 50 km rated fatigue life
C₁₀₀: the basic dynamic load rating for 100 km rated fatigue life

- | | |
|-------------|------|
| 1. RA Model | A303 |
| 2. RB Model | A325 |
| 3. LA Model | A341 |

A-4-4 High Rigidity Series

A-4-4.1 RA Model



1. Features

(1) Super-high load capacity

By installing rollers that are the largest possible diameter and length within the existing standard cross-section dimension in a rational layout based on our advanced analysis technology, we have realized extremely high load capacity. Super-long life is achieved and impact load can be sufficiently handled.

(2) Super-high rigidity

Using NSK's advanced analysis technology, we pursued a complete, optimal design, down to the detailed shape of roller slides and rails, thereby realizing super-high rigidity superior to that of competitor's roller guides.

(3) Super-high motion accuracy

NSK has developed its own unique method of simulating rolling element passage vibration and method of designing optimal roller slide specifications for damping roller passage vibration. These developments have dramatically enhanced roller slide motion accuracy for the RA model.

(4) Smooth motion

Installation of a retaining piece between rollers restrains roller skew peculiar to roller slides, thereby achieving smooth motion.

(5) Low friction

Using rollers for rolling elements helps minimize dynamic friction.

(6) Interchangeability

Interchangeable rails and roller slides are available. (RA25 to RA65)

(7) Specification with highly dust-resistant V1 seals

Specifications featuring highly dust-resistant V1 end seals with enhanced abrasion resistance are also available (RA 25–65).

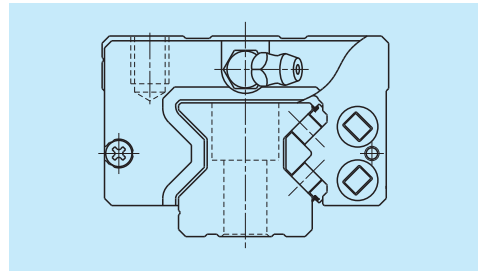


Fig. 1 RA Model

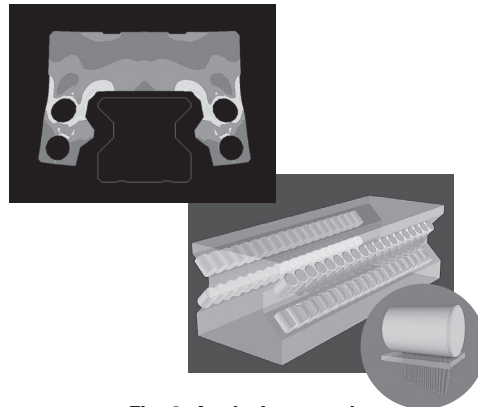


Fig. 2 Analysis example

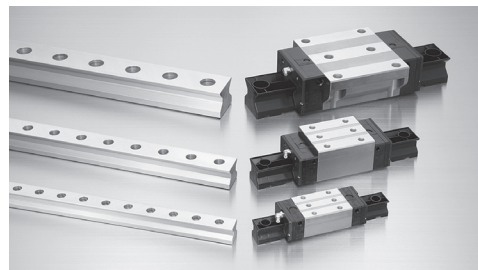


Fig. 3 Interchangeable type

2. Roller slide shape

Roller slide shape code	Shape/installation method	Type (Upper row, Rating: Lower row, Roller slide length)	
		High-load Standard	Super-high-load Long
AN BN		AN 	BN
AL BL		AL 	BL
EM GM		EM 	GM

3. Accuracy and preload

(1) Running parallelism of roller slide

Table 1

Unit: μm

Rail length (mm)	Accuracy grade	Preloaded assembly (not interchangeable)				Interchangeable type
		Ultra precision P3	Super precision P4	High precision P5	Precision grade P6	High precision PH
over	or less					
– 50	50	2	2	2	4	2
50 – 80	80	2	2	3	4	3
80 – 125	125	2	2	3	4	3
125 – 200	200	2	2	3.5	5	3.5
200 – 250	250	2	2.5	4.5	6	4.5
250 – 315	315	2	2.5	5	6.5	5
315 – 400	400	2	3	5.5	7	5.5
400 – 500	500	2	3	6	7.5	6
500 – 630	630	2	3.5	6.5	8.5	6.5
630 – 800	800	2	4	7	9.5	7
800 – 1 000	1 000	2.5	4.5	7.5	10	7.5
1 000 – 1 250	1 250	3	5	8.5	12	8.5
1 250 – 1 600	1 600	3.5	5.5	9.5	13	9.5
1 600 – 2 000	2 000	4	6.5	11	14	11
2 000 – 2 500	2 500	4.5	7.5	12	16	12
2 500 – 3 150	3 150	5.5	8.5	13	18	13
3 150 – 4 000	4 000	6	9.5	14	19	14

(2) Accuracy standard

The preloaded assembly has four accuracy grades; Ultra precision P3, Super precision P4, High precision P5, and Precision P6 grades, while the interchangeable type has High precision PH grade only.

• **Tolerance of preloaded assembly**

Table 2

Unit: μm

Characteristics	Accuracy grade			
	Ultra precision P3	Super precision P4	High precision P5	Precision grade P6
Mounting height H	± 8	± 10	± 20	± 40
Variation of H (All roller slides on a set of rails)	3	5	7	15
Mounting width W_2 or W_3	± 10	± 15	± 25	± 50
Variation of W_2 or W_3 (All roller slides on reference rail)	3	7	10	20
Running parallelism of surface C to surface A Running parallelism of surface D to surface B	Shown in Table 1 and Fig. 4			

• **Tolerance of interchangeable type**

Table 3

Unit: μm

Characteristics	Accuracy grade	
	Ultra precision P3	High precision PH
Mounting height H	± 20	
Variation of mounting height H	15 ^①	
	25 ^②	
Mounting width W_2 or W_3	± 25	
Variation of mounting width W_2 or W_3	20	
Running parallelism of surface C to surface A Running parallelism of surface D to surface B	See Table 1 and Fig. 4	

Note: ① Variation on the same rail ② Variation on multiple rails

(3) Combination of accuracy and preload

Table 4

	Accuracy grade					
	Ultra precision	Super precision	High precision	Precision grade	High precision	
Without NSK K1 lubrication unit	P3	P4	P5	P6	PH	
With NSK K1 lubrication unit	K3	K4	K5	K6	KH	
Preload	Slight preload Z1	○	○	○	○	—
	Medium preload Z3	○	○	○	○	—
	Interchangeable type with slight preload ZZ	—	—	—	—	○
	Interchangeable type with medium preload ZH	—	—	—	—	○

(4) Assembled accuracy

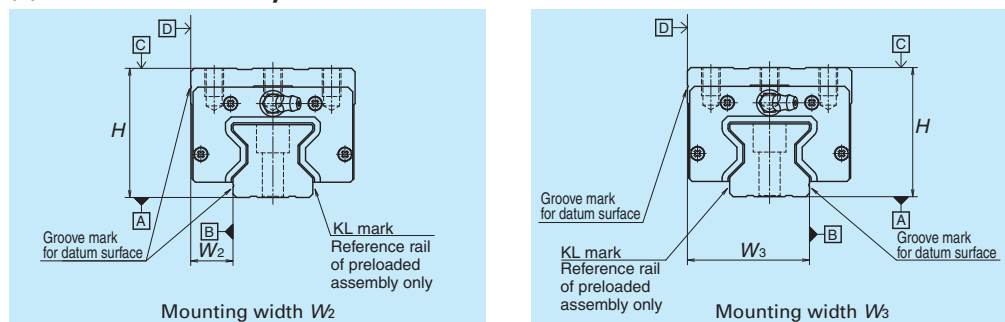


Fig. 4

(5) Preload and rigidity

Four types of preload are available: Medium preload Z3 and Slight preload Z1 for preloaded assembly, and Medium preload ZH and slight preload ZZ for Interchangeable types.

• **Preload of preloaded assembly**

Table 5

Model No.	Preload (N)		
	Slight preload (Z1)	Medium preload (Z3)	
High-load	RA15 AN, AL, EM	520	1 030
	RA20 AN, EM	960	1 920
	RA25 AN, AL, EM	880	2 920
	RA30 AN, AL, EM	1 170	3 890
	RA35 AN, AL, EM	1 600	5 330
	RA45 AN, AL, EM	2 780	9 280
Super-high-load	RA55 AN, AL, EM	3 800	12 900
	RA65 AN, EM	6 500	21 000
	RA15 BN, BL, GM	650	1 300
	RA20 BN, GM	1 200	2 400
	RA25 BN, BL, GM	1 060	3 540
	RA30 BN, BL, GM	1 430	4 760
RA35 BN, BL, GM	2 020	6 740	
RA45 BN, BL, GM	3 500	11 600	
RA55 BN, BL, GM	5 000	16 800	
RA65 BN, GM	8 500	28 800	

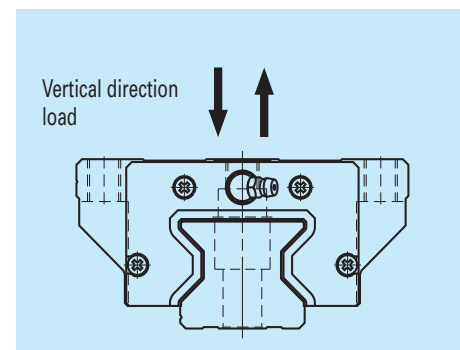


Fig. 5 Direction of load

• Rigidity of medium preload

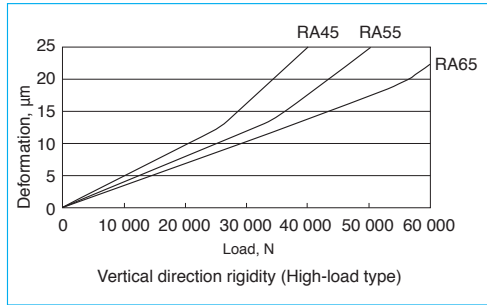
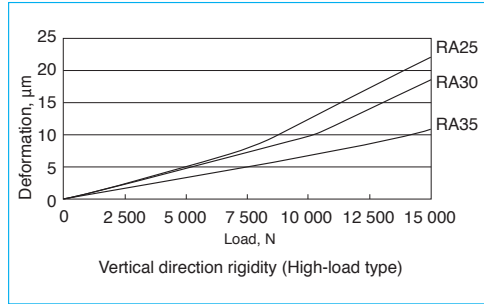
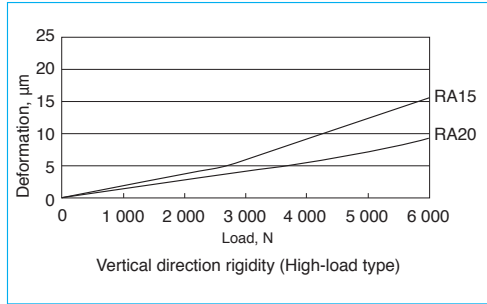


Fig. 6 Vertical direction theoretical rigidity line: High-load type (Roller slide shape: AN, AL, EM)

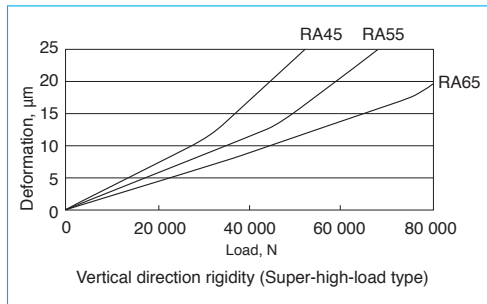
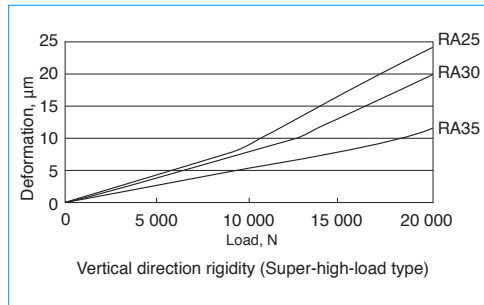
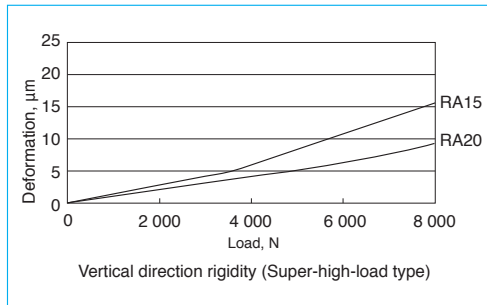


Fig. 7 Vertical direction theoretical rigidity line: Super-high-load type (Roller slide shape: BN, BL, GM)

4. Maximum rail length

Table 6 shows the limitations of rail length (maximum length). However, the limitations vary by accuracy grades.

Table 6 Length limitation of rails Unit: mm

Model	Size	15	20	25	30	35	45	55	65
RA		2 000	3 000	3 900	3 900	3 900	3 650	3 600	3 600

Note: Rails can be butted if user requirements exceed the rail length shown in the table. Please consult NSK.

5. Installation

(1) Permissible values of mounting error

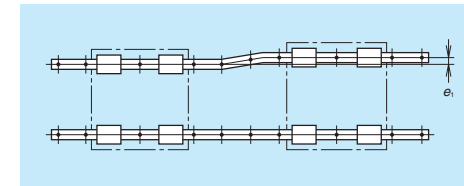


Fig. 8

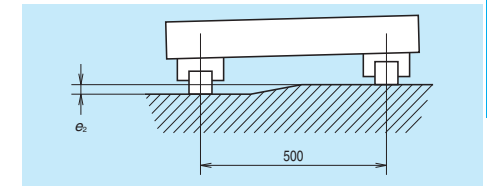


Fig. 9

Table 7 Unit: μm

Value	Preload	Model No.							
		RA15	RA20	RA25	RA30	RA35	RA45	RA55	RA65
Permissible values for parallelism error of two rails e_1	Z1, ZZ	7	10	14	18	21	27	31	49
	Z3, ZH	5	7	9	11	13	17	19	30
Permissible values for height error of two rails e_2	Z1, ZZ	290 μm / 500 mm							
	Z3, ZH	150 μm / 500 mm							

(2) Shoulder height of the mounting surface and corner radius

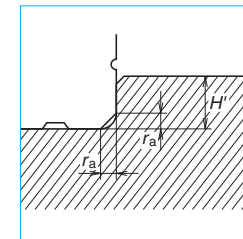


Fig. 10 Shoulder for the rail datum surface

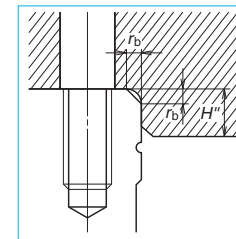


Fig. 11 Shoulder for the roller slide datum surface

Table 8 Unit: mm

Model No.	Corner radius (maximum)		Shoulder height	
	r_a	r_b	H'	H''
RA15	0.5	0.5	3	4
RA20	0.5	0.5	4	5
RA25	0.5	1	4	5
RA30	1	1	5	6
RA35	1	1	5	6
RA45	1.5	1	6	8
RA55	1.5	1.5	7	10
RA65	1.5	1.5	11	11

6. Lubrication components

Refer to pages A58 and D13 for the lubrication of linear guides.

(1) Types of lubrication accessories

Fig. 14 and Table 11 show grease fittings and tube fittings.

(2) Mounting position of lubrication accessories

The standard position for grease fittings is at the end face of the roller slide, but we can mount them on the side of the end cap for as an option. (Fig. 12) Please consult NSK for the installation of grease or tube fittings to the roller slide body.

A lubrication hole can also be provided on the top of the end cap. Fig.13, Table 9 and Table 10 show the mounting position O-ring, and spacer requirements. A spacer is required for some roller slides. The spacers are available from NSK.

Using a piping unit with thread of M6 × 1 requires a connector to connect it to a grease fitting mounting hole with M6 × 0.75. The connectors are available from NSK.

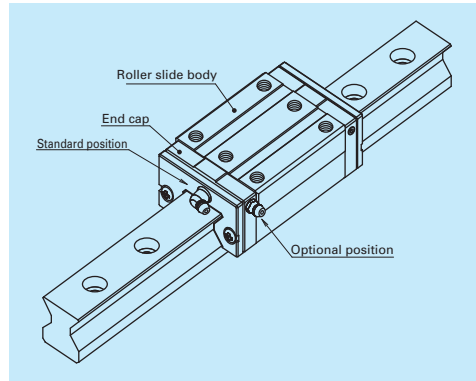


Fig. 12 Mounting position of lubrication accessories

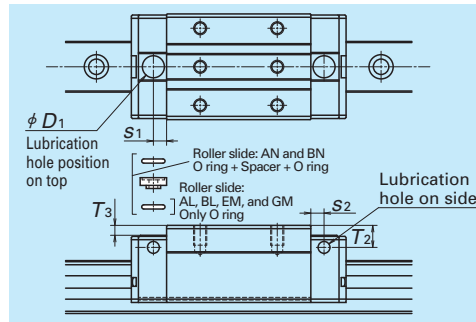


Fig.13 Top and side lubrication hole positions

Table 9 Top and side lubrication hole positions

Unit: mm

Model No.	Roller slide shape code	Grease fitting size	s_2	T_2	O ring (JIS)	Spacer	D_1	s_1	T_3
RA15	AN, BN	$\phi 3$	4	7	P5	Necessary	8.2	4.4	4.2
RA20		$\phi 3$	4	4	P6	—	9.2	5.4	0.2
RA25		M6×0.75	6	10	P7	Necessary	10	6	4.5
RA30		M6×0.75	5	10	P7+P5	Necessary	10.4	6	3.5
RA35		M6×0.75	5.5	15	P7+P5	Necessary	10.4	7	7.4
RA45		Rc 1/8	7.2	20	P7+P5	Necessary	10.4	7.2	10.4
RA55		Rc 1/8	7.2	21	P7+P5	Necessary	10.4	7.2	10.4
RA65		Rc 1/8	7.2	19	P7	—	10.4	7.2	0.4

Note: Grease fittings and tube fittings cannot be mounted on the top of the end cap.

Table 10 Top and side lubrication hole positions

Unit: mm

Model No.	Roller slide shape code	Grease fitting size	s_2	T_2	O ring (JIS)	D_1	s_1	T_3
RA15	AL, BL, EM, GM	$\phi 3$	4	3	P5	8.2	4.4	0.2
RA20	EM, GM	$\phi 3$	4	4	P6	9.2	5.4	0.2
RA25	AL, BL, EM, GM	M6×0.75	6	6	P7	10	6	0.5
RA30		M6×0.75	5	7	P7	10.4	6	0.5
RA35		M6×0.75	5.5	8	P7	10.4	7	0.4
RA45		Rc 1/8	7.2	10	P7	10.4	7.2	0.4
RA55		Rc 1/8	7.2	11	P7	10.4	7.2	0.4
RA65	EM, GM	Rc 1/8	7.2	19	P7	10.4	7.2	0.4

Note: Grease fittings and tube fittings cannot be mounted on the top of the end cap.

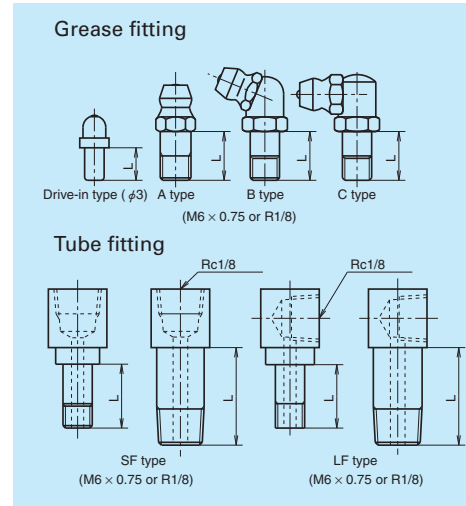


Fig. 14 Grease fitting and tube fitting

7. Dust-resistant components

(1) Standard specification

The RA model is equipped with end, inner* and bottom seals to prevent foreign matter from entering the inside of the roller slide. Under normal applications, the RA model can be used without modification.

For severe usage conditions, optional rail covers** are available. Contact NSK for information on how to mount the cover.

*) Inner seals for models RA15 and RA20 are available as options.

***) Rail covers are available for models RA25 to RA65.

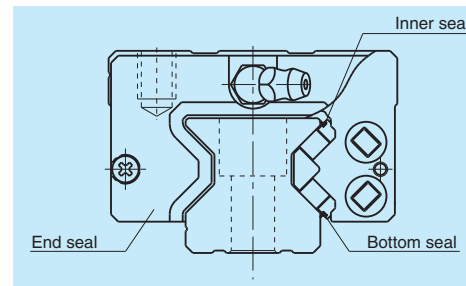


Fig. 15

Table 12 Seal friction per roller slide (maximum value)

Unit: N

Model	Size	15	20	25	30	35	45	55	65
RA		4	5.5	5	5	6	8	8	14

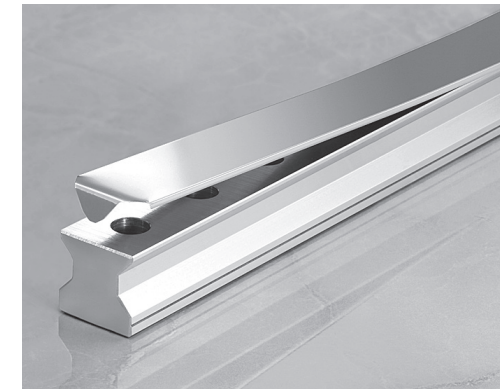


Fig. 16 Rail cover

Table 11 Unit: mm

Model No.	Dust-resistant specification	Dimension L		
		Grease fitting /Drive-in type	Tube fitting	
		SF type	LF type	LF type
RA15	Standard	5	—	—
	With NSK K1	10	—	—
	Double seal	8	—	—
RA20	Standard	5	—	—
	With NSK K1	10	—	—
	Double seal	8	—	—
RA25	Standard	5	5	5
	With NSK K1	12	12	12
	Double seal	10	9	9
RA30	Standard	5	6	6
	With NSK K1	14	14	15
	Double seal	12	12	11
RA35	Standard	5	6	6
	With NSK K1	14	14	15
	Double seal	12	12	11
RA45	Standard	8	13.5	17
	With NSK K1	18	20	21.5
	Double seal	14	16	17
RA55	Standard	8	13.5	17
	With NSK K1	18	20	21.5
	Double seal	14	16	17
RA65	Standard	8	13.5	17
	With NSK K1	20	20	20
	Double seal	14	18	17

(2) NSK K1™ lubrication unit

Table 13 shows the dimensions of linear guides equipped with NSK K1 lubrication units.

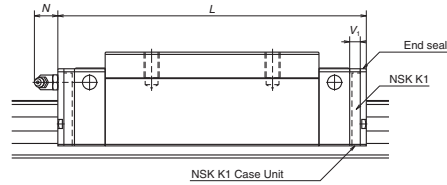


Table 13 Dimensions when equipped with NSK K1 lubrication units Unit: mm

Model No.	Roller slide length	Roller slide shape code	Standard roller slide length	Roller slide length with two NSK K1 installed L	Thickness of single NSK K1 V ₁	Protrusion of grease fitting N
RA15	Standard	AN, AL, EM	70	79	4.5	(3)
	Long	BN, BL, GM	85.4	94.4		
RA20	Standard	AN, EM	86.5	95.5	4.5	(3)
	Long	BN, GM	106.3	115.3		
RA25	Standard	AN, AL, EM	97.5	107.5	5	(11)
	Long	BN, BL, GM	115.5	125.5		
RA30	Standard	AN, AL, EM	110.8	122.8	6	(11)
	Long	BN, BL, GM	135.4	147.4		
RA35	Standard	AN, AL, EM	123.8	136.8	6.5	(11)
	Long	BN, BL, GM	152	165		
RA45	Standard	AN, AL, EM	154	168	7	(14)
	Long	BN, BL, GM	190	204		
RA55	Standard	AN, AL, EM	184	198	7	(14)
	Long	BN, BL, GM	234	248		
RA65	Standard	AN, EM	228.4	243.4	7.5	(14)
	Long	BN, GM	302.5	317.5		

Note: Slide length when equipped with NSK K1 = (standard roller slide length) + (V₁ thickness of single NSK K1 unit) × (number of K1 units) + (V₂ thickness of the protective cover) × 2.

(3) Double seal and protector

For the RA Model, double seals and protectors can be installed only before shipping from the factory.

Table 14 shows the increased thickness when end seals and protectors are installed.

Table 14 Unit: mm

Model No.	Thickness of end seal V ₃	Thickness of protector V ₄
RA15	3	2.7
RA20	3	3.3
RA25	3.2	3.3
RA30	3.4	3.6
RA35	3.4	3.6
RA45	4	4.2
RA55	4	4.2
RA65	5	5.5

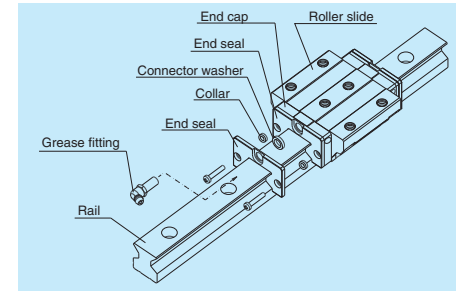


Fig. 17 Double seal

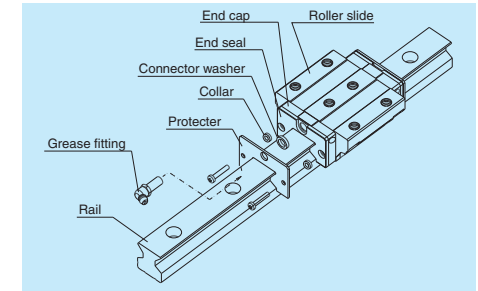


Fig. 18 Protector

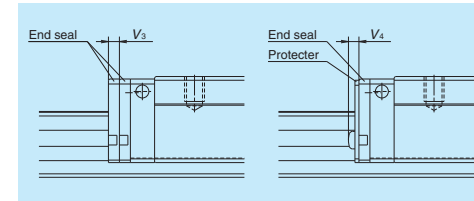


Fig. 19

(4) Rail cover

When the rail cover is used, use the cover bracket to secure the rail cover. Fig. 20 shows the dimensions for the cover bracket. The required room at the end of the rail is:

- Inside: 10.5 mm or less
 - Outside: 4 mm or less (Common to the models of RA25 to RA65)
- Please confirm the interference with your machine at the stroke end.
- Machine stroke
 - Room for the end of the rail

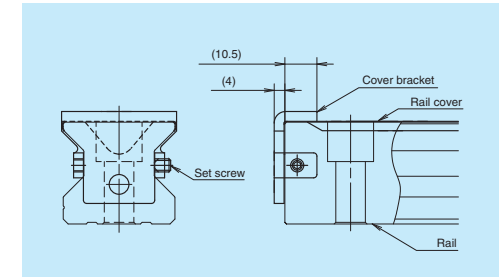


Fig. 20 End configuration of rail equipped with the rail cover

The height of the rail with the rail cover is shown in Table 15.

Table 15 Height of rails equipped with rail cover Unit: mm

Model No.	Standard height H _i	Cover installation
RA25	24	24.2
RA30	28	28.2
RA35	31	31.25
RA45	38	38.3
RA55	43.5	43.8
RA65	55	55.3

(5) Caps to plug the rail mounting bolt hole

Table 16 Caps to plug rail bolt hole

Model No.	Bolt to secure rail	Cap reference No.	Quantity /case
RA15	M4	LG-CAP/M4	20
RA20	M5	LG-CAP/M5	20
RA25	M6	LG-CAP/M6	20
RA30, RA35	M8	LG-CAP/M8	20
RA45	M12	LG-CAP/M12	20
RA55	M14	LG-CAP/M14	20
RA65	M16	LG-CAP/M16	20

(6) Specification with highly dust-resistant V1 seals and V1 bottom seals

RA25, RA30, RA35, RA45, RA55, and RA65 have specifications featuring dust-resistant V1 end seals with enhanced abrasion resistance.

Highly dust-resistant V1 seals feature new materials in a new shape for better abrasion resistance and prevent foreign matter getting into the roller slide for a long period.

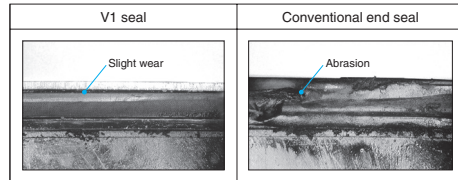
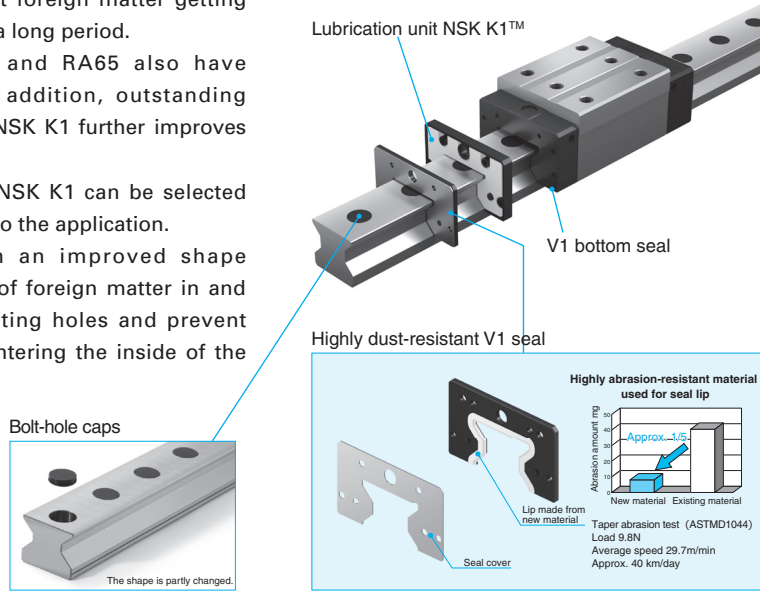
RA35, RA45, RA55, and RA65 also have V1 bottom seals. In addition, outstanding lubrication effects by NSK K1 further improves the durability.

V1 bottom seals and NSK K1 can be selected individually according to the application.

Bolt hole caps with an improved shape eliminate the buildup of foreign matter in and around the rail mounting holes and prevent foreign matter from entering the inside of the

slide. Additionally, a rail cover with higher dust resistance can be selected.

See A310 for the details of the rail cover.



●Durability test under extreme conditions - no lubrication

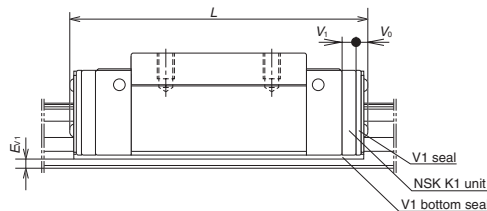
The durability of the seal lip has been greatly improved by adopting new materials and optimizing the seal lip shape.

Test sample: RA35

Lubrication: No lubrication (on the seal)

Travel speed: 30 m/min Travel distance: 40 km

Table 17 shows dimensions for roller slides with highly dust-resistant V1 seals.



Since the sealing property (resistance to foreign matter) is affected by usage or the lubrication environment, please conduct an evaluation test for your particular application.

Table 17

Unit: mm

Model No.	Roller slide length	Roller slide shape code	Standard roller slide length L	Roller slide length equipped with V1 seal and NSK K1 L	Slide bottom face height equipped with V1 bottom seal E'v1	Thickness of V1 seal V0	Thickness of K1 case unit V1
RA25	Standard	AN, AL, EM	97.5	111.3	—	5.1	5
	Long	BN, BL, GM	115.5	129.3			
RA30	Standard	AN, AL, EM	110.8	126.8	—	5.4	6
	Long	BN, BL, GM	135.4	151.4			
RA35	Standard	AN, AL, EM	123.8	140.8	min 3.7	5.4	6.5
	Long	BN, BL, GM	152	169			
RA45	Standard	AN, AL, EM	154	173.2	min 5.2	6.6	7
	Long	BN, BL, GM	190	209.2			
RA55	Standard	AN, AL, EM	184	203.2	min 6.2	6.6	7
	Long	BN, BL, GM	234	253.2			
RA65	Standard	AN, EM	228.4	251.2	min 10.2	8.9	7.5
	Long	BN, GM	302.5	325.3			

●Design Precautions

Because the product is used under severe operating conditions that require highly dust-resistant V1 seals, please inform NSK about your service conditions using the technical data sheet on page A146.

(7) Bellows

Installation of bellows

*** Fixing to the roller slide**

Remove two machine screws which secure the end seal. (For RA15, hold the end cap by hand. Otherwise, the end cap is detached from the slide, and the roller inside may spill over.)

Insert a spacer to the securing hole of the end seal, fasten the mounting plate at the end of the bellows using a slightly longer machine screw. (For RA15, insert a flat spacer between the end seal and the mounting plate at the end of the bellows.)

*** Fixing to the rail**

For fixing to the rail, make tap holes to the rail end surface. Fix the bellows mounting plate with machine screws to the rail end surface through these tap holes. NSK processes the tap holes to the rail end surface when ordered with a linear guide.

Calculating length of bellows

The formulas for calculating length of bellows for the end are as follows.

Stroke $St = L_{max} - L_{min}$

Length when stretched to the maximum length

$$L_{max} = f_b \cdot P \times \text{Number of folds}$$

Length when contracted to the minimum length

$$L_{min} = 2.5 \times \text{Number of folds} + 3$$

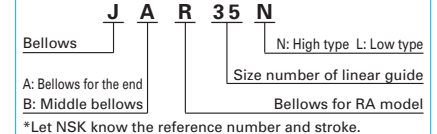
Values of f_b and P are shown in the bellows dimension table. Based on these above formulas, calculate the number of folds as follows.

$$\text{Number of folds} = \frac{St - 3}{f_b \cdot P - 2.5}$$

Round up the calculated value so that the number of folds will be $n + 0.5$ (n : the natural number).

For the length of a middle bellows, please ask NSK.

Bellow reference number



Dimension table of bellows
RA model

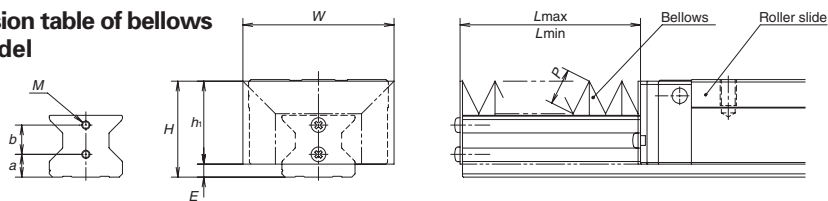


Fig. 21 Dimensions of bellows

Table 18 Dimensions of bellows

Unit: mm (excluding f_b)

Model No.	H	h_1	E	W	P	f_b	a	b	Tap (M) × depth
JAR15L	23.5	19.5	4	33	7	1.2	7	6.3	M3 × 5
JAR15N	27	23		39	10	1.3			
JAR20N	29	24	5	43	8	1.3	8.5	9	M3 × 5
JAR25L	35	30	5	51	10	1.3	8.5	12	M3 × 5
JAR25N	39	34		61	14	1.4			
JAR30L	41	34.5	6.5	60	12	1.3	11	12.5	M4 × 6
JAR30N	44	37.5		66	15	1.4			
JAR35L	47	40.5	6.5	72	15	1.4	11	15	M4 × 6
JAR35N	54	47.5		82	20	1.5			
JAR45L	59	51	8	93	20	1.5	14	18	M5 × 8
JAR45N	69	61		113	30	1.5			
JAR55L	69	60	9	101	20	1.5	15	22	M5 × 8
JAR55N	79	70		121	30	1.5			
JAR65N	89	76	13	131	30	1.5	21	26	M6 × 10

Note: f_b is a dimensionless number

Table 19 Dynamic friction force

Unit: N

Model. No.	Roller slide		Of standard products (when packed with AS2 grease)	Of V1 seals	Of V1 bottom seals	Of NSK K1 units
	Rating	Shape code				
RA15	High-load type	AN, AL, EM	21	3	—	3
	Super-high-load type	BN, BL, GM	24			
RA20	High-load type	AN, EM	22	3.5	—	3
	Super-high-load type	BN, GM	28			
RA25	High-load type	AN, AL, EM	27	5	6	4
	Super-high-load type	BN, BL, GM	34			
RA30	High-load type	AN, AL, EM	33	5	8	4
	Super-high-load type	BN, BL, GM	42			
RA35	High-load type	AN, AL, EM	42	6	10	5
	Super-high-load type	BN, BL, GM	53			
RA45	High-load type	AN, AL, EM	56	8	15	7
	Super-high-load type	BN, BL, GM	69			
RA55	High-load type	AN, AL, EM	80	8	20	8
	Super-high-load type	BN, BL, GM	95			
RA65	High-load type	AN, EM	120	14	25	8
	Super-high-load type	BN, GM	138			

Notes: 1) Values in the columns to the right of "For standard products" show the increase in dynamic friction force when two of the components listed are mounted on a slide.
2) These are indication values. Please use them as a reference.

8. Dynamic friction force

- Dynamic friction force indications per roller slide are shown in Table 19.
- In assuming actual usage conditions, the dynamic friction force of the standard product is the value when the dust-resistant specification of the slide is standard (with two end seals, inner seal and bottom seal) and standard grease (AS2 grease) is packed.
However, since the inner seal of RA15 and RA20 is optional, the inner seal is not attached to the standard dust-resistant specification.
- When using options, the dynamic friction force of each option (or, in the case of highly dust-resistant V1 seals, the difference from standard end seals) is added to that of the standard product.
- Dynamic friction force varies with grease.

9. Reference number

A reference number (designation) is set and indicated on the specification drawing for an individual NSK linear guide when its specifications are finalized.

Please specify the reference number, except design serial number, to identify the product when ordering, requiring estimates, or inquiring about specifications from NSK.

(1) Reference number for preloaded assembly

RA 35 1000 ANC 2 - P6 3**

Model name	Preload code (See page A305.) 1: Z1, 3: Z3
Size	Accuracy code (See Table 21.)
Rail length (mm)	Design serial number Added to the reference number.
Roller slide shape code (See page A304.)	Number of roller slides per rail
Material/surface treatment code (See Table 20.) C: Special high carbon steel (NSK standard)	

(2) Reference number for interchangeable type

Roller slide

RAA 35 AN PHH -F

Interchangeable roller slide model code RAA: RA Model interchangeable roller slide	Option code No code: No surface treatment -F: Fluoride low temperature chrome plating -C: No surface treatment + Rail cover compatible -CF: Fluoride low temperature chrome plating + Rail cover compatible
Size	Preload code: Z Z: Slight preload, H: Medium preload
Roller slide shape code (See page A304.)	Accuracy code PH, KH: High-precision grade interchangeable type (See Table 21.)

Rail

R1A35 1000 L CN - PH Z**

Interchangeable rail model code R1A: RA Model interchangeable rail	Preload code: Z Z: Common for slight and medium preload (See page A305.)
Size	Accuracy code PH: High-precision grade interchangeable type
Rail length (mm)	Design serial number Added to the reference number.
Rail shape code: L L: Standard	*Butting rail specification N: Non-butting, L: Butting specification
Material/surface treatment code (See Table 20.)	

*Please consult with NSK for butting rail specification.

When interchangeable rails and slides are assembled, reference number coding is the same as that for preloaded assemblies. However, only preload codes Z (slight preload) and H (medium preload) may be used (Refer to Page A305.)

Click!Speedy™ NSK Linear Guide Quick Delivery System uses a new numbering system. For details, please refer to the Click!Speedy general catalog CAT. No. E3191.

Table 20 Material/surface treatment code

Code	Description
C	Special high carbon steel (NSK standard)
D	Special high carbon steel with surface treatment
P	Special high carbon steel with V1 seal
R	Special high carbon steel with surface treatment and V1 seal
Z	Other, special

Note : P and R are not available for interchangeable slides and rails.

Table 21 Accuracy code

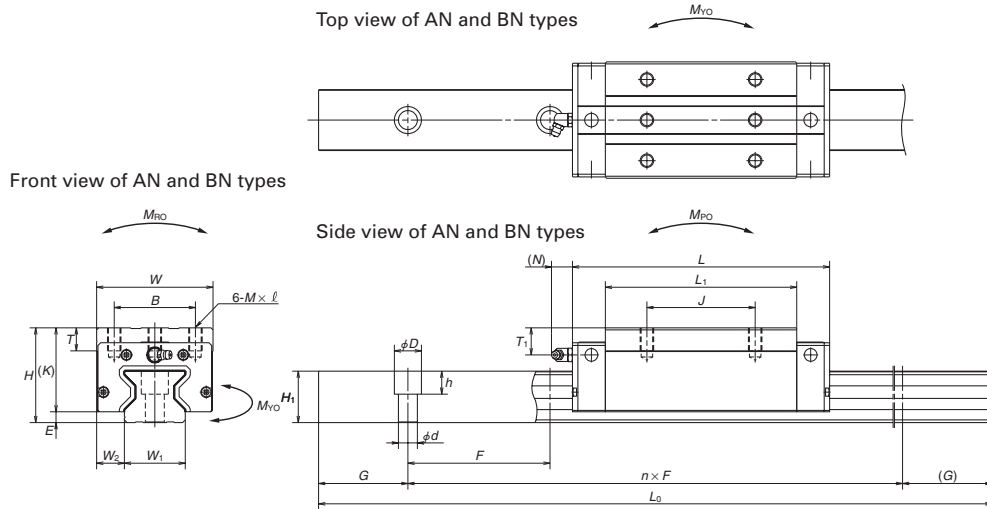
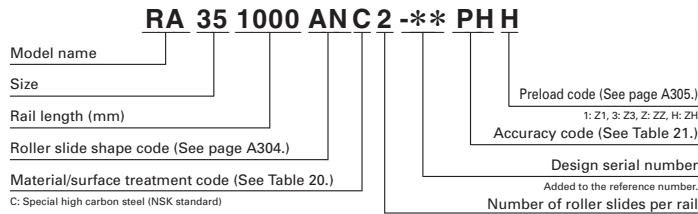
Accuracy	Standard (Without NSK K1)	With NSK K1
Ultra precision grade	P3	K3
Super precision grade	P4	K4
High precision grade	P5	K5
Precision grade	P6	K6
High precision grade (Interchangeable type)	PH	KH

Note: Refer to pages A58 for details on NSK K1 lubrication units.

10. Dimensions

RA-AN (High-load / Standard)

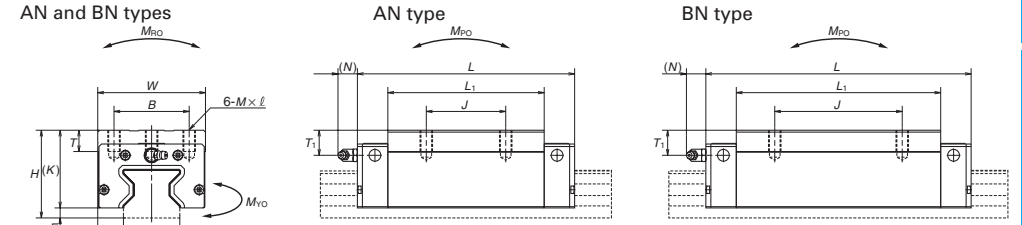
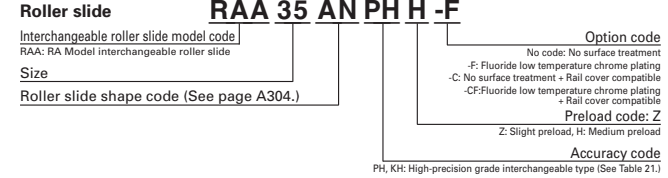
RA-BN (Super-high-load / Long)



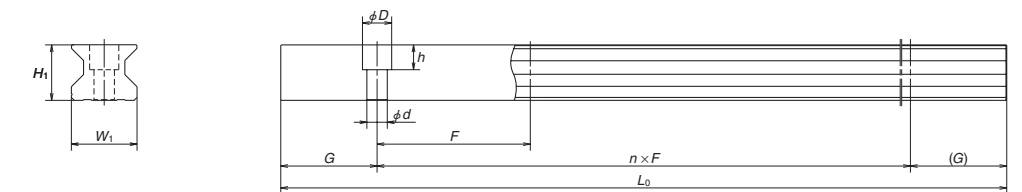
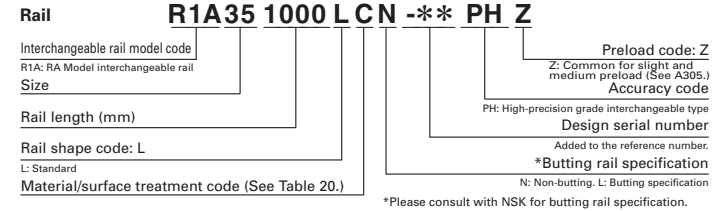
Model No.	Assembly			Roller slide										Width	Height			
	Height	E	W ₂	W	Length	Mounting hole			L ₁	K	T	Grease fitting				W ₁	H ₁	
						B	J	M × pitch × ℓ				Hole size	T ₁					N
RA15AN RA15BN	28	4	9.5	34	70 85.4	26	26	M4×0.7×6	44.8 60.2	24	8	φ3	8	3	15	16.3		
RA20AN RA20BN	30	5	12	44	86.5 106.3	32	36	M5×0.8×6	57.5 77.3	25	12	φ3	4	3	20	20.8		
RA25AN RA25BN	40	5	12.5	48	97.5 115.5	35	35	M6×1×9	65.5 83.5	35	12	M6×0.75	10	11	23	24		
RA30AN RA30BN	45	6.5	16	60	110.8 135.4	40	40	M8×1.25×11	74 98.6	38.5	14	M6×0.75	10	11	28	28		
RA35AN RA35BN	55	6.5	18	70	123.8 152	50	50	M8×1.25×12	83.2 111.4	48.5	15	M6×0.75	15	11	34	31		
RA45AN RA45BN	70	8	20.5	86	154 190	60	60	M10×1.5×17	105.4 141.4	62	17	Rc1/8	20	14	45	38		
RA55AN RA55BN	80	9	23.5	100	184 234	75	75	M12×1.75×18	128 178	71	18	Rc1/8	21	14	53	43.5		
RA65AN RA65BN	90	13	31.5	126	228.4 302.5	76	70	M16×2×20	155.4 229.5	77	22	Rc1/8	19	14	63	55		

Notes: 1) Select either the standard dimension for pitch *F* as shown without parentheses or the semi-standard dimension as shown inside parentheses. If not specified, the standard dimension for *F* will be applied.

Reference number for roller slide of interchangeable type



Reference number for rail of interchangeable type

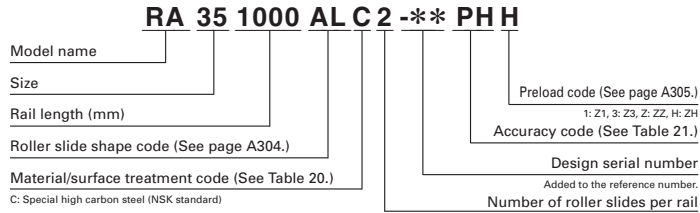


Unit: mm

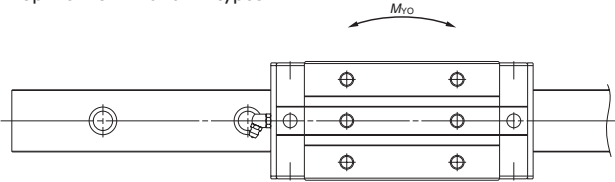
Rail		Basic load ratings										Weight	
Pitch	Mounting bolt hole	G	Maximum length	Dynamic		Static	Static moment (N-m)				Roller slide	Rail	
				[50km]	[100km]		M _{PO}		M _{YO}				
				C ₅₀ (N)	C ₁₀₀ (N)	One slide	Two slides	One slide	Two slides	(kg)			(kg/m)
60 (30)	4.5×7.5×5.3	20	2 000	12 600	10 300	27 500	260	210	1 320	210	1 320	0.21	1.6
60 (30)	6×9.5×8.5	20	3 000	16 000	13 000	37 000	350	375	2 130	375	2 130	0.30	
60 (30)	7×11×9	20	3 900	23 600	19 200	52 500	665	505	3 100	505	3 100	0.38	2.6
60 (30)	9×14×12	20	3 900	29 500	24 000	70 000	890	900	5 000	900	5 000	0.50	
30 (60)	7×11×9	20	3 900	36 000	29 200	72 700	970	760	4 850	760	4 850	0.60	3.4
40 (80)	9×14×12	20	3 900	43 500	35 400	92 900	1 240	1 240	7 200	1 240	7 200	0.91	
40 (80)	9×14×12	20	3 900	47 800	38 900	93 500	1 670	1 140	7 100	1 140	7 100	1.0	4.9
40 (80)	9×14×12	20	3 900	58 500	47 600	121 000	2 170	1 950	11 500	1 950	11 500	1.3	
40 (80)	9×14×12	20	3 900	65 500	53 300	129 000	2 810	1 800	11 000	1 800	11 000	1.6	6.8
40 (80)	9×14×12	20	3 900	82 900	67 400	175 000	3 810	3 250	17 800	3 250	17 800	2.1	
52.5 (105)	14×20×17	22.5	3 650	114 000	92 800	229 000	6 180	4 080	24 000	4 080	24 000	3.0	10.9
52.5 (105)	14×20×17	22.5	3 650	143 000	116 000	305 000	8 240	7 150	39 000	7 150	39 000	4.1	
60 (120)	16×23×20	30	3 600	159 000	129 000	330 000	10 200	7 060	41 000	7 060	41 000	4.9	14.6
60 (120)	16×23×20	30	3 600	207 000	168 000	462 000	14 300	13 600	72 000	13 600	72 000	6.7	
75 (150)	18×26×22	35	3 600	259 000	210 000	504 000	19 200	12 700	78 500	12 700	78 500	9.3	22.0
75 (150)	18×26×22	35	3 600	355 000	288 000	756 000	28 700	28 600	153 000	28 600	153 000	12.2	

2) The interchangeable type is available for models RA25 to RA65.
 3) Basic load ratings comply with ISO standards (ISO 14728-1, 14728-2).
 C₅₀: the basic dynamic load rating for 50 km rated fatigue life
 C₁₀₀: the basic dynamic load rating for 100 km rated fatigue life

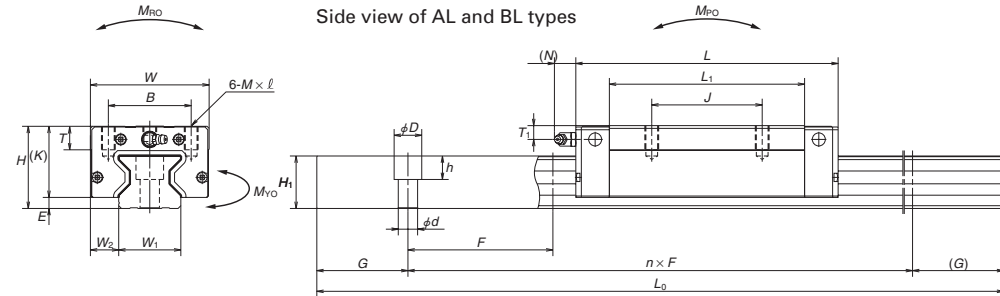
RA-AL (High-load / Standard)
RA-BL (Super-high-load / Long)



Top view of AL and BL types



Front view of AL and BL types

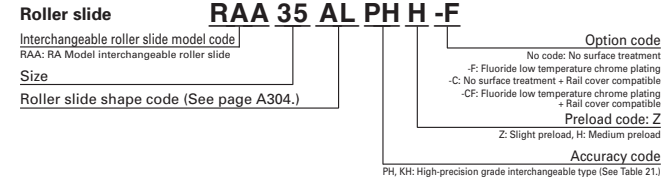


Side view of AL and BL types

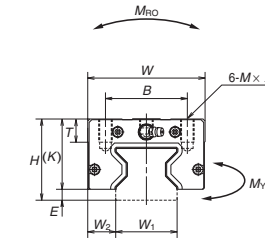
Model No.	Assembly			Roller slide										Width	Height			
	Height	E	W ₂	Width	Length	Mounting hole			L ₁	K	T	Grease fitting				W ₁	H ₁	
						B	J	M x pitch x l				Hole size	T ₁					N
RA15AL RA15BL	24	4	9.5	34	70 85.4	26	26	M4x0.7x5.5	44.8 60.2	20	8	phi 3	4	3	15	16.3		
RA25AL RA25BL	36	5	12.5	48	97.5 115.5	35	35	M6x1x8	65.5 83.5	31	12	M6x0.75	6	11	23	24		
RA30AL RA30BL	42	6.5	16	60	110.8 135.4	40	40	M8x1.25x11	74 98.6	35.5	14	M6x0.75	7	11	28	28		
RA35AL RA35BL	48	6.5	18	70	123.8 152	50	50	M8x1.25x12	83.2 111.4	41.5	15	M6x0.75	8	11	34	31		
RA45AL RA45BL	60	8	20.5	86	154 190	60	60	M10x1.5x16	105.4 141.4	52	17	Rc1/8	10	14	45	38		
RA55AL RA55BL	70	9	23.5	100	184 234	75	75	M12x1.75x18	128 178	61	18	Rc1/8	11	14	53	43.5		

Notes: 1) Select either the standard dimension for pitch *F* as shown without parentheses or the semi-standard dimension as shown inside parentheses. If not specified, the standard dimension for *F* will be applied.

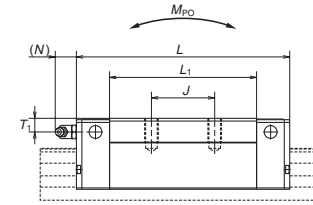
Reference number for roller slide of interchangeable type



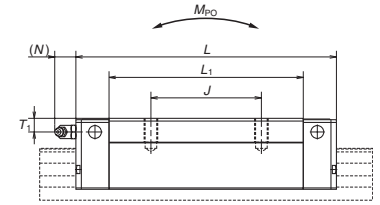
AL and BL types



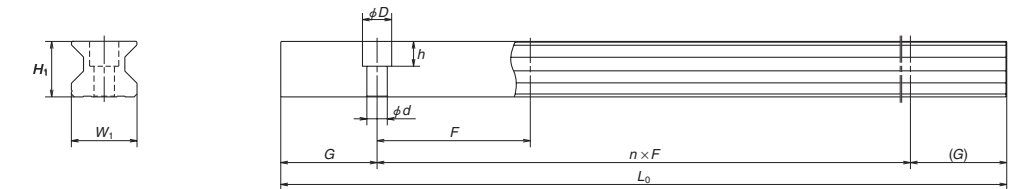
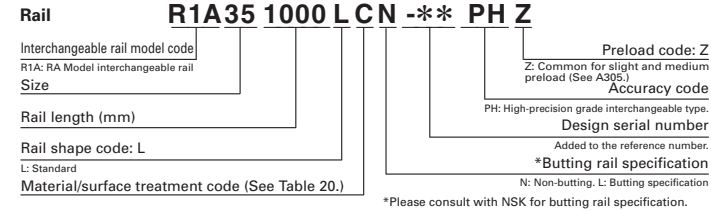
AL type



BL type



Reference number for rail of interchangeable type

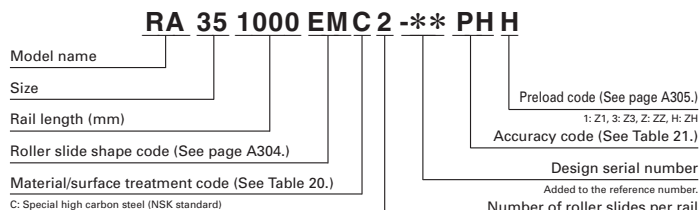


Unit: mm

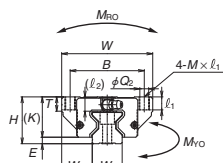
Pitch	Mounting bolt hole	G	Maximum length	Basic load ratings						Roller slide	Rail			
				reference	Dynamic		C ₀ (N)	M _{PO}	Static moment (N·m)			kg	kg/m	
					[50km]	[100km]			One slide					Two slides
					C ₅₀ (N)	C ₁₀₀ (N)								
60 (30)	4.5x7.5x5.3	20	2 000	12 600	10 300	27 500	260	210	1 320	210	1 320	0.17	1.6	
30 (60)	7x11x9	20	3 900	36 000	29 200	72 700	970	760	4 850	760	4 850	0.45	3.4	
40 (80)	9x14x12	20	3 900	43 500	35 400	92 900	1 240	1 240	7 200	1 240	7 200	0.80	4.9	
40 (80)	9x14x12	20	3 900	47 800	38 900	93 500	1 670	1 140	7 100	1 140	7 100	0.85	6.8	
52.5 (105)	14x20x17	22.5	3 650	58 500	47 600	121 000	2 170	1 950	11 500	1 950	11 500	1.1	10.9	
60 (120)	16x23x20	30	3 600	65 500	53 300	129 000	2 810	1 800	11 000	1 800	11 000	1.2	14.6	
				82 900	67 400	175 000	3 810	3 250	17 800	3 250	17 800	1.7		
				114 000	92 800	229 000	6 180	4 080	24 000	4 080	24 000	2.5		
				143 000	116 000	305 000	8 240	7 150	39 000	7 150	39 000	3.4		
				159 000	129 000	330 000	10 200	7 060	41 000	7 060	41 000	4.1		
				207 000	168 000	462 000	14 300	13 600	72 000	13 600	72 000	5.7		

2) The interchangeable type is available for models RA25 to RA55.
 3) Basic load ratings comply with ISO standards (ISO 14728-1, 14728-2).
 C₅₀: the basic dynamic load rating for 50 km rated fatigue life
 C₁₀₀: the basic dynamic load rating for 100 km rated fatigue life

RA-EM (High-load / Standard) RA-GM (Super-high-load / Long)

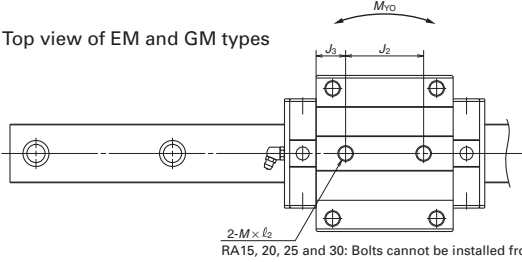


Front view of EM and GM types



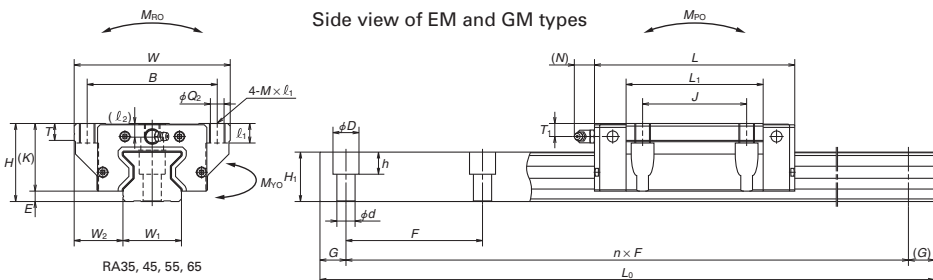
RA15, 20, 25, 30

Top view of EM and GM types



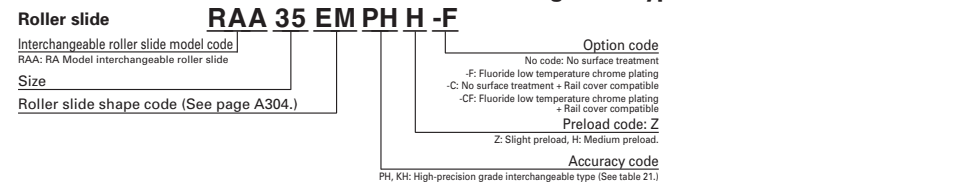
RA15, 20, 25 and 30: Bolts cannot be installed from the underside.

Side view of EM and GM types

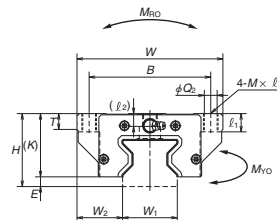


RA35, 45, 55, 65

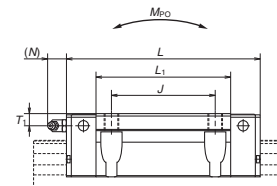
Reference number for roller slide of interchangeable type



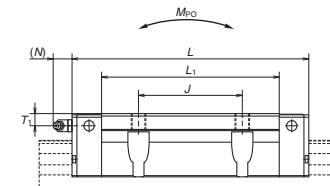
EM and GM types



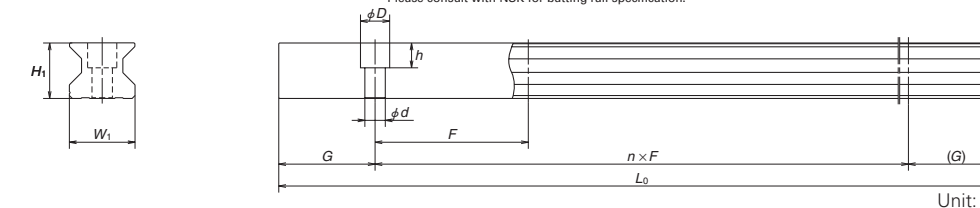
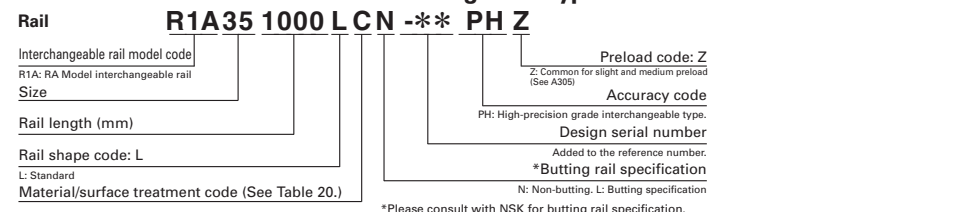
EM type



GM type



Reference number for rail of interchangeable type



Unit: mm

Model No.	Assembly			Roller slide										Grease fitting		
	Height	Width	Length	Mounting hole							L ₁	K	T	Hole size	T ₁	N
				H	E	W ₂	W	L	B	J						
RA15EM	24	4	16	47	70	38	30	26	M5x0.8x8.5 (6.5)	4.4	44.8	20	8	φ 3	4	3
RA15GM				85.4	86.5						60.2					
RA20EM	30	5	21.5	63	86.5	53	40	35	M6x1x9.5 (8)	5.3	57.5	25	10	φ 3	4	3
RA20GM				106.3	115.5						77.3					
RA25EM	36	5	23.5	70	97.5	57	45	40	M8x1.25x10 (11)	6.8	65.5	31	11	M6x0.75	6	11
RA25GM				115.5	135.4						83.5					
RA30EM	42	6.5	31	90	110.8	72	52	44	M10x1.5x12 (12.5)	8.6	74	35.5	11	M6x0.75	7	11
RA30GM				135.4	152						98.6					
RA35EM	48	6.5	33	100	123.8	82	62	52	M10x1.5x13 (7)	8.6	83.2	41.5	12	M6x0.75	8	11
RA35GM				152	171.4						111.4					
RA45EM	60	8	37.5	120	154	100	80	60	M12x1.75x15 (10.5)	10.5	105.4	52	13	Rc1/8	10	14
RA45GM				190	209.5						141.4					
RA55EM	70	9	43.5	140	184	116	95	70	M14x2x18 (13)	12.5	128	61	15	Rc1/8	11	14
RA55GM				234	253.5						178					
RA65EM	90	13	53.5	170	228.4	142	110	82	M16x2x24 (18.5)	14.6	155.4	77	22	Rc1/8	19	14
RA65GM				302.5	321.5						229.5					

Notes: 1) Select either the standard dimension for pitch F as shown without parentheses or the semi-standard dimension as shown inside parentheses. If not specified, the standard dimension for F will be applied.

Rail			Basic load ratings							Weight					
Width	Height	Pitch	Mounting bolt hole	G	Maximum length	³⁾ Dynamic		C ₀	M _{RO}	Static moment (N-m)		Roller slide	Rail		
						[50km]	[100km]			M _{PO}	M _{YO}				
W ₁	H ₁	F	d x D x h	reference	L _{0max}	C ₅₀ (N)	C ₁₀₀ (N)	(N)		One slide	Two slides	(kg)	(kg/m)		
15	16.3	60 (30)	4.5x7.5x5.3	20	2 000	12 600	10 300	27 500	260	210	1 320	210	1 320	0.21	1.6
						16 000	13 000	37 000	350	375	2 130	375	2 130	0.28	
20	20.8	60 (30)	6x9.5x8.5	20	3 000	23 600	19 200	52 500	665	505	3 100	505	3 100	0.45	2.6
						29 500	24 000	70 000	890	900	5 000	900	5 000	0.65	
23	24	30 (60)	7x11x9	20	3 900	36 000	29 200	72 700	970	760	4 850	760	4 850	0.80	3.4
						43 500	35 400	92 900	1 240	1 240	7 200	1 240	7 200	1.1	
28	28	40 (80)	9x14x12	20	3 900	47 800	38 900	93 500	1 670	1 140	7 100	1 140	7 100	1.3	4.9
						58 500	47 600	121 000	2 170	1 950	11 500	1 950	11 500	1.7	
34	31	40 (80)	9x14x12	20	3 900	65 500	53 300	129 000	2 810	1 800	11 000	1 800	11 000	1.7	6.8
						82 900	67 400	175 000	3 810	3 250	17 800	3 250	17 800	2.3	
45	38	52.5 (105)	14x20x17	22.5	3 650	114 000	92 800	229 000	6 180	4 080	24 000	4 080	24 000	3.2	10.9
						143 000	116 000	305 000	8 240	7 150	39 000	7 150	39 000	4.3	
53	43.5	60 (120)	16x23x20	30	3 600	159 000	129 000	330 000	10 200	7 060	41 000	7 060	41 000	5.4	14.6
						207 000	168 000	462 000	14 300	13 600	72 000	13 600	72 000	7.5	
63	55	75 (150)	18x26x22	35	3 600	259 000	210 000	504 000	19 200	12 700	78 500	12 700	78 500	12.2	22.0
						355 000	288 000	756 000	28 700	28 600	153 000	28 600	153 000	16.5	

2) The interchangeable type is available for models RA25 to RA65.
 3) Basic load ratings comply with ISO standards (ISO 14728-1, 14728-2).
 C₅₀: the basic dynamic load rating for 50 km rated fatigue life
 C₁₀₀: the basic dynamic load rating for 100 km rated fatigue life

A-4-4.2 RB Model

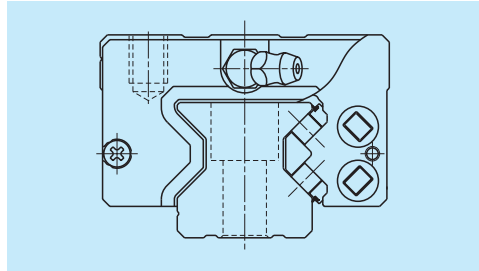
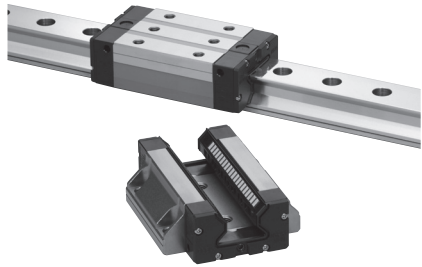


Fig. 1 RB Model

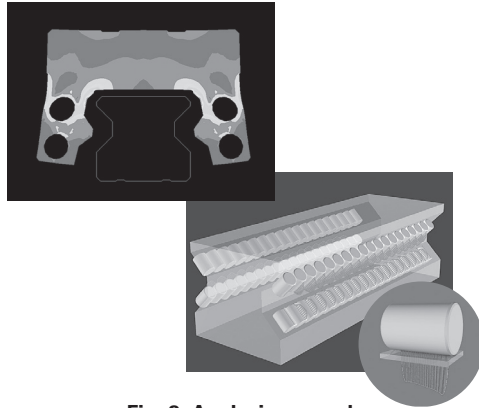


Fig. 2 Analysis example

1. Features

(1) Super-low type

With low mounting height, the RB model is effective for compact machine design.

(2) Super-high load capacity

The RB model can contribute to lower center of gravity of machines, while maintaining the load capacity of the RA model.

(3) Super-high rigidity

Using NSK's advanced analysis technology, we pursued a complete, optimal design, down to the detailed shape of roller slides and rails, thereby realizing super-high rigidity superior to that of competitor's roller guides.

(4) Super-high motion accuracy

NSK has developed its own unique method of simulating rolling element passage vibration and method of designing optimal roller slide specifications for damping roller passage vibration. These developments have dramatically enhanced roller slide motion accuracy for the RB model.

(5) Smooth motion

Installation of a retaining piece between rollers restrains roller skew peculiar to roller slides, thereby achieving smooth motion.

(6) Low friction

Using rollers for rolling elements helps minimize dynamic friction.

2. Roller slide shape

Roller slide shape code	Shape/installation method	Type (Upper row, Rating: Lower row, Roller slide length)	
		High-load Standard	Super-high-load Long
AL TL BL UL		AL · TL (excluding RB55AL)	BL (excluding RB55 and RB65)
		 RB55AL 	 UL RB55BL · RB65BL
EM GM		EM	GM

3. Accuracy and preload

(1) Running parallelism of roller slide

Table 1

Unit: μm

Accuracy grade	Preloaded assembly (not interchangeable)			
	Ultra precision P3	Super precision P4	High precision P5	Precision grade P6
Rail length(mm)				
over				
or less				
- 50	2	2	2	4
50 - 80	2	2	3	4
80 - 125	2	2	3	4
125 - 200	2	2	3.5	5
200 - 250	2	2.5	4.5	6
250 - 315	2	2.5	5	6.5
315 - 400	2	3	5.5	7
400 - 500	2	3	6	7.5
500 - 630	2	3.5	6.5	8.5
630 - 800	2	4	7	9.5
800 - 1 000	2.5	4.5	7.5	10
1 000 - 1 250	3	5	8.5	12
1 250 - 1 600	3.5	5.5	9.5	13
1 600 - 2 000	4	6.5	11	14
2 000 - 2 500	4.5	7.5	12	16
2 500 - 3 150	5.5	8.5	13	18
3 150 - 4 000	6	9.5	14	19

(2) Accuracy standard

The preloaded assembly has four accuracy grades; Ultra precision P3, Super precision P4, High precision P5, and Precision P6 grades.

• Tolerance of preloaded assembly

Characteristics	Accuracy grade	Ultra precision P3	Super precision P4	High precision P5	Precision grade P6
Mounting height H		± 8	± 10	± 20	± 40
Variation of H (All roller slides on a set of rails)		3	5	7	15
Mounting width W_2 or W_3		± 10	± 15	± 25	± 50
Variation of W_2 or W_3 (All roller slides on reference rail)		3	7	10	20
Running parallelism of surface C to surface A Running parallelism of surface D to surface B		Shown in Table 1 and Fig. 4			

(3) Assembled accuracy

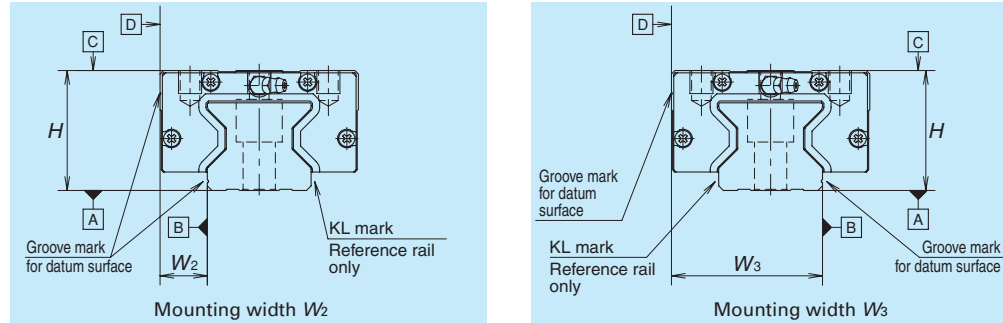


Fig. 3

(4) Preload and rigidity

One type of preload is available: Medium preload Z3 for preloaded assembly.

Model No.		Preload (N)
		Medium preload (Z3)
High-load	RB30 AL, EM	3 890
	RB35 AL, EM	5 330
	RB45 AL, EM	9 280
	RB55 AL, TL, EM	12 900
	RB65 AL, EM	21 000
Super-high-load	RB30 BL, GM	4 760
	RB35 BL, GM	6 740
	RB45 BL, GM	11 600
	RB55 BL, UL, GM	16 800
	RB65 BL, UL, GM	28 800

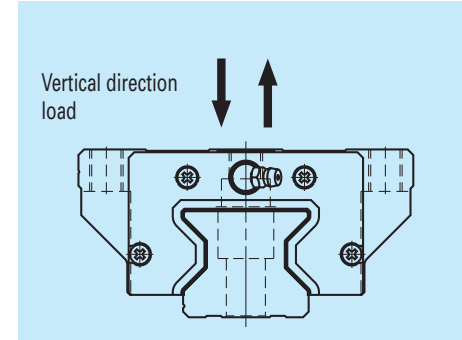


Fig. 4 Direction of load

• Rigidity of medium preload

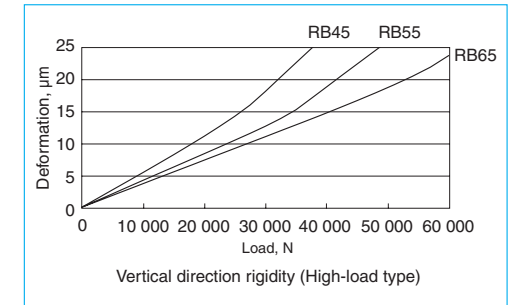
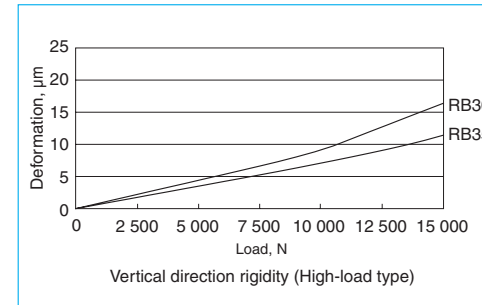


Fig. 5 Vertical direction theoretical rigidity line: High-load type (Roller slide shape: AL, TL, EM)

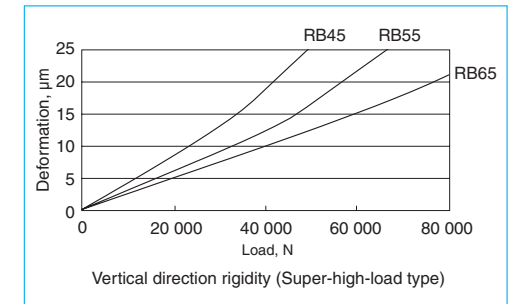
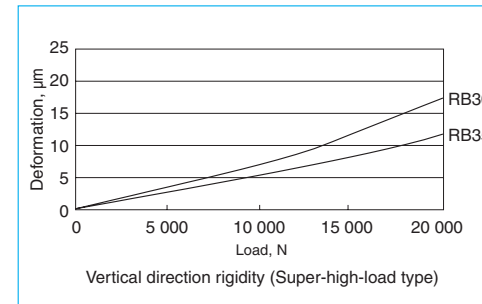


Fig. 6 Vertical direction theoretical rigidity line: Super-high-load type (Roller slide shape: BL, UL, GM)

4. Maximum rail length

Table 4 shows the limitations of rail length (maximum length). However, the limitations vary by accuracy grades.

Table 4 Length limitation of rails Unit: mm

Model	Size	30	35	45	55	65
RB		3 900	3 900	3 650	3 600	3 600

Note: Rails can be butted if user requirements exceed the rail length shown in the table. Please consult NSK.

5. Installation

(1) Permissible values of mounting error

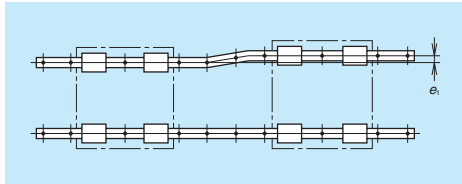


Fig. 7

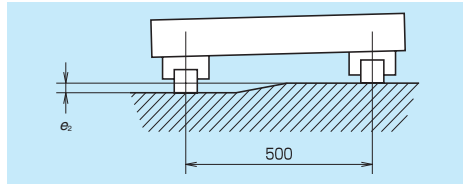


Fig. 8

Table 5 Unit: μm

Value	Model No.				
	RB30	RB35	RB45	RB55	RB65
Permissible values for parallelism error of two rails e_1	11	13	17	19	30
Permissible values for height error of two rails e_2	150 μm / 500 mm				

(2) Shoulder height of the mounting surface and corner radius r

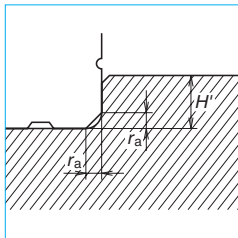


Fig. 9 Shoulder for the rail datum surface

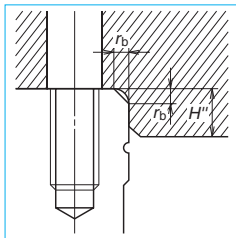


Fig. 10 Shoulder for the roller slide datum surface

Table 6 Unit: mm

Model No.	Corner radius (maximum)		Shoulder height	
	r_a	r_b	H'	H''
RB30	1	1	5	6
RB35	1	1	5	6
RB45	1.5	1	6	8
RB55	1.5	1.5	7	10
RB65	1.5	1.5	8	11

6. Lubrication components

Refer to pages A58 and D13 for the lubrication of linear guides.

(1) Types of lubrication accessories

Fig. 13 and Table 8 show grease fittings and tube fittings.

(2) Mounting position of lubrication accessories

- The standard position for grease fittings is at the end face of the roller slide, but we can mount them on the side of the end cap for as an option. (Fig. 11) Please consult NSK for the installation of grease or tube fittings to the roller slide body.
- A lubrication hole can also be provided on the top of the end cap. Fig.12 and Table 7 show the mounting position.
- Using a piping unit with thread of M6 \times 1 requires a connector to connect it to a grease fitting mounting hole with M6 \times 0.75. The connectors are available from NSK.

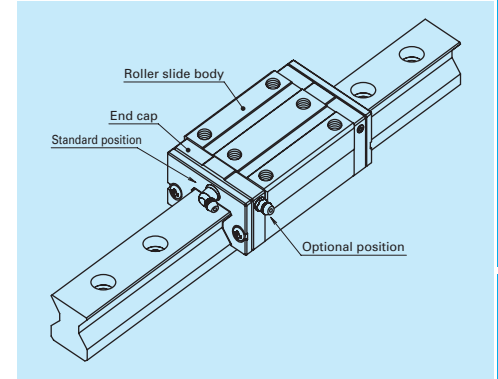


Fig. 11 Mounting position of lubrication accessories

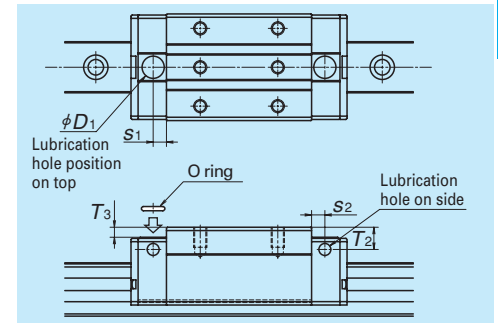


Fig.12 Top and side lubrication hole positions

Table 7 Top and side lubrication hole positions Unit: mm

Model No.	Grease fitting size	s_2	T_2	O ring (JIS)	D_1	s_1	T_3
RB30	M6 \times 0.75	5	6.5	P7	10.4	6	0.5
RB35	M6 \times 0.75	5.5	6.5	P7	10.4	7	0.4
RB45	M6 \times 0.75	7.2	6.5	P7	10.4	7.2	0.4
RB55	M6 \times 0.75	7.2	8	P7	10.4	7.2	0.4
RB65	M6 \times 0.75	7.2	10	P7	10.4	7.2	0.4

Note: Grease fittings and tube fittings cannot be mounted on the top of the end cap.

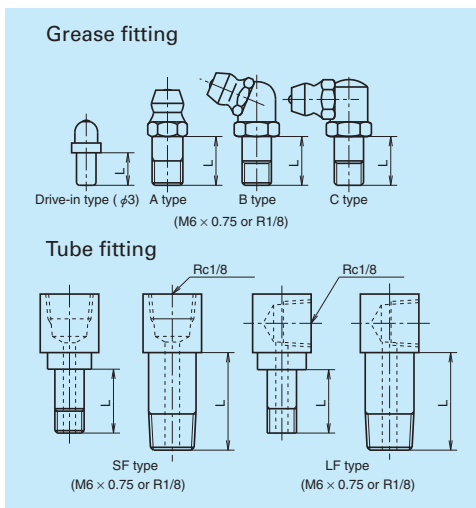


Fig. 13 Grease fitting and tube fitting

7. Dust-resistant components

(1) Standard specification

The RB model is equipped with end, inner and bottom seals to prevent foreign matter from entering the inside of the roller slide. Under normal applications, the RB model can be used without modification.

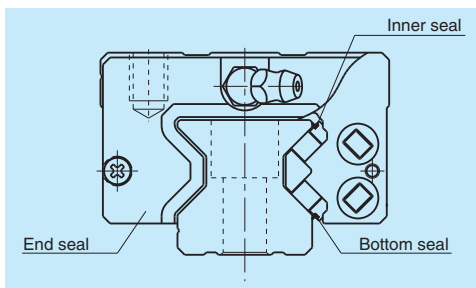


Fig. 14

Table 9 Seal friction per roller slide (maximum value)

		Unit: N				
Model	Size	30	35	45	55	65
RB		5	6	8	8	14

Table 8 Unit: mm

Model No.	Dust-resistant specification	Dimension L		
		Grease fitting / Drive-in type	SF type	LF type
RB30	Standard	5	-	-
	With NSK K1	10	-	-
	Double seal	8	-	-
RB35	Protector	8	-	-
	Standard	5	5	5
	With NSK K1	14	15	16
RB45	Double seal	12	12	12
	Protector	12	12	12
	Standard	5	5	5
RB55	With NSK K1	14	15	16
	Double seal	12	12	12
	Protector	12	12	12
RB65	Standard	8	13.5	17
	With NSK K1	18	20	21.5
	Double seal	14	16	17
RB65	Protector	14	16	17
	Standard	8	13.5	17
	With NSK K1	20	20	20
RB65	Double seal	14	18	17
	Protector	14	16	17

(2) NSK K1™ lubrication unit

Table 10 shows the dimensions of linear guides equipped with NSK K1 lubrication units.

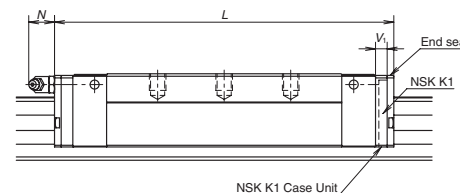


Table 10 Dimensions when equipped with NSK K1 lubrication units

Unit: mm						
Model No.	Roller slide length	Roller slide model	Standard roller slide length	Roller slide length with two NSK K1 installed L	Thickness of single NSK K1 V ₁	Protrusion of grease fitting N
RB30	Standard	AL, EM	110.8	122.8	6	(11)
	Long	BL, GM	135.4	147.4		
RB35	Standard	AL, EM	123.8	136.8	6.5	(11)
	Long	BL, GM	152	165		
RB45	Standard	AL, EM	154	168	7	(14)
	Long	BL, GM	190	204		
RB55	Standard	AL, TL, EM	184	198	7	(14)
	Long	BL, UL, GM	234	248		
RB65	Standard	AL, EM	228.4	243.4	7.5	(14)
	Long	BL, UL, GM	302.5	317.5		

Note: Slide length when equipped with NSK K1 = (standard roller slide length) + (V₁ thickness of single NSK K1 unit) × (number of K1 units) + (V₂ thickness of the protective cover) × 2.

(3) Double seal and protector

For the RB Model, double seals and protectors can be installed only before shipping from the factory.

Table 11 shows the increased thickness when end seals and protectors are installed.

Table 11 Unit: mm

Model No.	Thickness of end seal V ₃	Thickness of protector V ₄
RB30	3.4	3.6
RB35	3.4	3.6
RB45	4	4.2
RB55	4	4.2
RB65	5	5.5

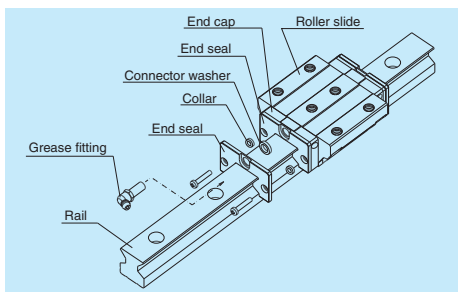


Fig. 15 Double seal

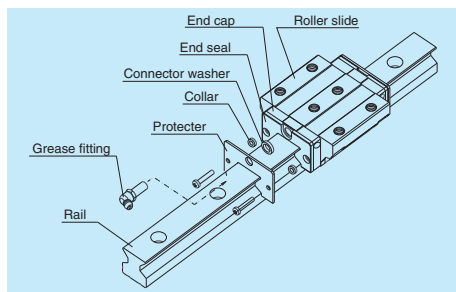


Fig. 16 Protector

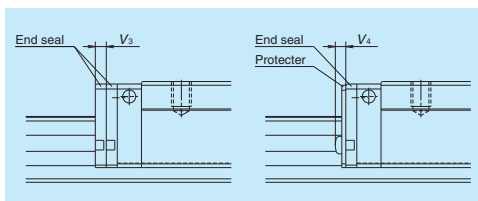


Fig. 17

(4) Caps to plug the rail mounting bolt hole

Table 12 Caps to plug rail bolt hole

Model No.	Bolt to secure rail	Cap reference No.	Quantity /case
RB30, RB35	M8	LG-CAP/M8	20
RB45	M12	LG-CAP/M12	20
RB55	M14	LG-CAP/M14	20
RB65	M16	LG-CAP/M16	20

(5) Bellows

Consult NSK when attaching bellows.

8. Dynamic friction force

- Dynamic friction force indications per roller slide are shown in **Table 13**.
- These values are assumed under actual conditions with standard specifications (two end seals, inner seal and bottom seal equipped) packed with standard grease (NSK Grease AS2)
- Dynamic friction force varies with grease.

Table 13 Dynamic friction force

Unit: N

Model No.	High-load type	Super-high-load type
RB30	33	42
RB35	42	53
RB45	56	69
RB55	80	95
RB65	120	138

Note: Values in Table 13 are indications.
Please refer to them.

9. Reference number

A reference number (designation) is set and indicated on the specification drawing for an individual NSK linear guide when its specifications are finalized.

Please specify the reference number, except design serial number, to identify the product when ordering, requiring estimates, or inquiring about specifications from NSK.

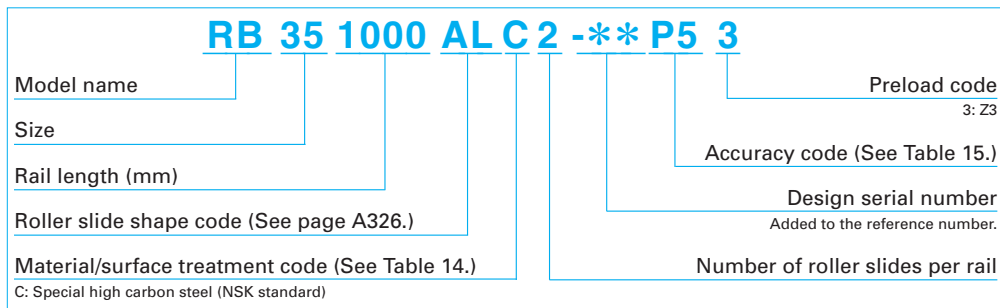


Table 14 Material/surface treatment code

Code	Description
C	Special high carbon steel (NSK standard)
D	Special high carbon steel with surface treatment
Z	Other, special

Table 15 Accuracy code

Accuracy	Standard (Without NSK K1)	With NSK K1
Ultra precision grade	P3	K3
Super precision grade	P4	K4
High precision grade	P5	K5
Precision grade	P6	K6

Note: Refer to pages A58 for details on NSK K1 lubrication units.

10. Dimensions

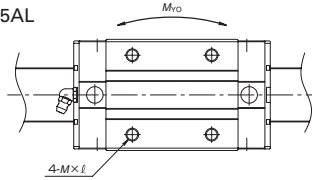
RB-AL-TL (High-load / Standard)

RB-BL-UL (Super-high-load / Long)

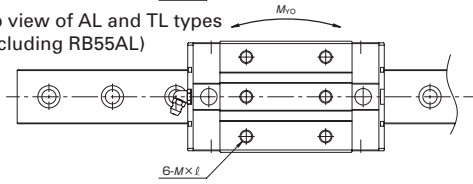
RB 35 1000 AL C 2 -** P5 3

Model name	Preload code
Size	3: 23
Rail length (mm)	Accuracy code (See Table 15.)
Roller slide shape code (See page A326.)	Design serial number
Material/surface treatment code (See Table 14.)	Added to the reference number.
C: Special high carbon steel (NSK standard)	Number of roller slides per rail

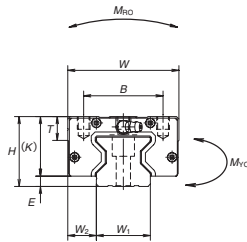
Top view of RB55AL



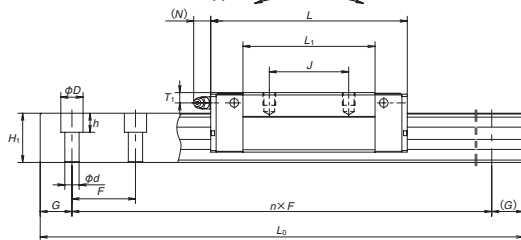
Top view of AL and TL types (excluding RB55AL)



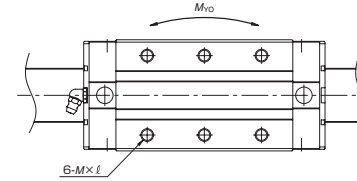
Front view



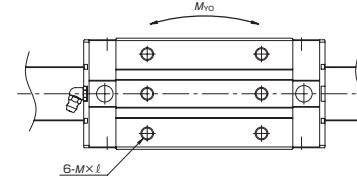
Side view of AL and TL types



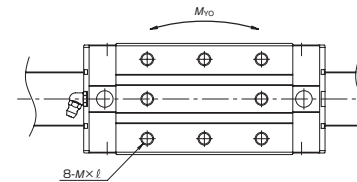
Top view of RB55BL and RB65BL



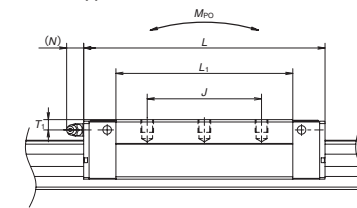
Top view of UL type



Top view of BL type (excluding RB55 and RB65)



Side view of BL type



Unit: mm

Model No.	Assembly			Roller slide												
	Height	Pitch	Mounting bolt hole	Width	Length	Mounting hole					Grease fitting			Width		
						B	J	Number of holes	M x pitch x L	L1	K	T	Hole size		T1	N
RB30AL RB30BL	38	6.5	16	60	110.8 135.4	40	40 60	6 8	M8 x 1.25 x 7	74 98.6	31.5	14	phi 3	5	2.6	28
RB35AL RB35BL	44	6.5	18	70	123.8 152	50	50 72	6 8	M8 x 1.25 x 8	83.2 111.4	37.5	15	M6 x 0.75	6.5	11	34
RB45AL RB45BL	52	8	20.5	86	154 190	60	60 80	6 8	M10 x 1.5 x 10	105.4 141.4	44	17	M6 x 0.75	6.5	14	45
RB55AL RB55TL RB55BL RB55UL	63	9	23.5	100	184	65 75 75	75	M12 x 1.75 x 12	128	54	18	Rc1/8	8.5	14	53	
234					6	178										
228.4					70	110										
302.5					76	120										
RB65AL RB65BL RB65UL	75	10	31.5	126	228.4 302.5	76	70 110 120	6	M16 x 2 x 16	155.4 229.5	65	22	Rc1/8	10	14	63

Notes: 1) Select either the standard dimension for pitch F as shown without parentheses or the semi-standard dimension as shown inside parentheses. If not specified, the standard dimension for F will be applied.

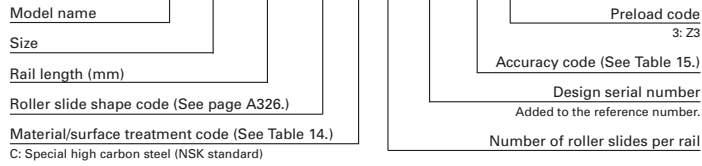
Height	Rail				Basic load ratings								Weight	
	Pitch	Mounting bolt hole	G	Maximum length	²⁾ Dynamic		Static	Static moment (N-m)				Roller slide	Rail	
					[50km]	[100km]		C0	MPO		MYO			
28	40 (80)	9 x 14 x 12	20	3 900	C50(N)	C100(N)	(N)	One slide		Two slides		(kg)	(kg/m)	
31	40 (80)	9 x 14 x 12	20	3 900	47 800	38 900	93 500	1 670	1 140	7 100	1 140	7 100	0.71	4.9
					58 500	47 600	121 000	2 170	1 950	11 500	1 950	11 500	0.91	
38	52.5 (105)	14 x 20 x 17	22.5	3 650	65 500	53 300	129 000	2 810	1 800	11 000	1 800	11 000	1.0	6.8
					82 900	67 400	175 000	3 810	3 250	17 800	3 250	17 800	1.5	
43.5	60 (120)	16 x 23 x 20	30	3 600	114 000	92 800	229 000	6 180	4 080	24 000	4 080	24 000	1.9	14.6
					143 000	116 000	305 000	8 240	7 150	39 000	7 150	39 000	2.6	
					159 000	129 000	330 000	10 200	7 060	41 000	7 060	41 000	3.4	
52	75 (150)	18 x 26 x 22	35	3 600	207 000	168 000	462 000	14 300	13 600	72 000	13 600	72 000	4.7	20.5
					259 000	210 000	504 000	19 200	12 700	78 500	12 700	78 500	7.2	
					355 000	288 000	756 000	28 700	28 600	153 000	28 600	153 000	9.5	

2) Basic load ratings comply with ISO standards (ISO 14728-1, 14728-2).

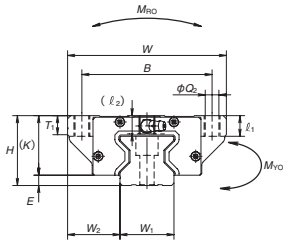
C₅₀: the basic dynamic load rating for 50 km rated fatigue life
C₁₀₀: the basic dynamic load rating for 100 km rated fatigue life

RB-EM (High-load / Standard)
RB-GM (Super-high-load / Long)

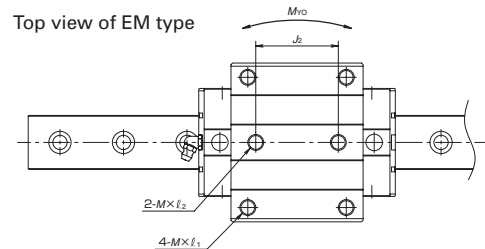
RB 35 1000EM C 2 - P5 3**



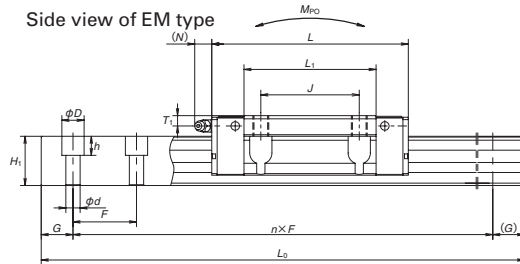
Front view of EM and GM types



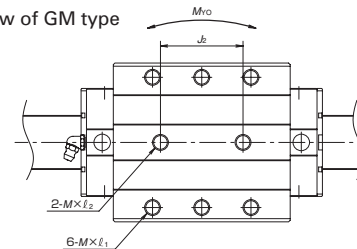
Top view of EM type



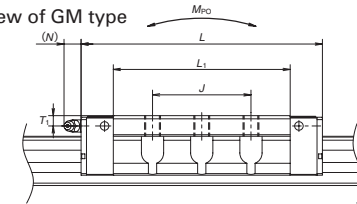
Side view of EM type



Top view of GM type



Side view of GM type



Model No.	Assembly			Roller slide														
	Height H	Pitch E	Mounting hole W ₂	Width W	Length L	Mounting hole						Grease fitting				Width W ₁		
						B	J	J ₂	Number of holes	M x pitch x L ₁ (L ₂)	Q	L ₁	K	T	Hole size		T ₁	N
RB30EM RB30GM	38	6.5	31	90	110.8 135.4	72	52	44	6 8	M10x1.5x12 (8.5)	8.6	74 98.6	31.5	11	φ 3	5	2.6	28
RB35EM RB35GM	44	6.5	33	100	123.8 152	82	62	52	6 8	M10x1.5x13 (11.5)	8.6	83.2 111.4	37.5	12	M6 x 0.75	6.5	11	34
RB45EM RB45GM	52	8	37.5	120	154 190	100	80	60	6 8	M12x1.75x15 (12.5)	10.5	105.4 141.4	44	13	M6 x 0.75	6.5	14	45
RB55EM RB55GM	63	9	43.5	140	184 234	116	95	70	6 8	M14x2x18 (18)	12.5	128 178	54	15	Rc1/8	8.5	14	53
RB65EM RB65GM	75	10	53.5	170	228.4 302.5	142	110	82	6 8	M16x2x24 (21)	14.6	155.4 229.5	65	15	Rc1/8	10	14	63

Notes: 1) Select either the standard dimension for pitch *F* as shown without parentheses or the semi-standard dimension as shown inside parentheses. If not specified, the standard dimension for *F* will be applied.

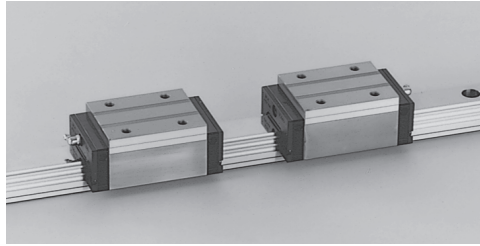
Unit: mm

Rail		Basic load ratings							Weight					
Height H ₁	Pitch F	Mounting bolt hole d x D x h	G (reference)	Maximum length L _{0max}	² Dynamic		Static C ₀ (N)	Static moment (N·m)				Roller slide (kg)	Rail (kg/m)	
					[50km] C ₅₀ (N)	[100km] C ₁₀₀ (N)		M _{P0}		M _{Y0}				
28	40 (80)	9 x 14 x 12	20	3900	47 800	38 900	93 500	1 670	1 140	7 100	1 140	7 100	1.1	4.9
					58 500	47 600	121 000	2 170	1 950	11 500	1 950	11 500	1.5	
31	40 (80)	9 x 14 x 12	20	3900	65 500	53 300	129 000	2 810	1 800	11 000	1 800	11 000	1.5	6.8
					82 900	67 400	175 000	3 810	3 250	17 800	3 250	17 800	2.0	
38	52.5 (105)	14 x 20 x 17	22.5	3650	114 000	92 800	229 000	6 180	4 080	24 000	4 080	24 000	2.5	10.9
					143 000	116 000	305 000	8 240	7 150	39 000	7 150	39 000	3.4	
43.5	60 (120)	16 x 23 x 20	30	3600	159 000	129 000	330 000	10 200	7 060	41 000	7 060	41 000	4.7	14.6
					207 000	168 000	462 000	14 300	13 600	72 000	13 600	72 000	6.6	
52	75 (150)	18 x 26 x 22	35	3600	259 000	210 000	504 000	19 200	12 700	78 500	12 700	78 500	9.7	20.5
					355 000	288 000	756 000	28 700	28 600	153 000	28 600	153 000	13.2	

2) Basic load ratings comply with ISO standards (ISO 14728-1, 14728-2).

C₅₀: the basic dynamic load rating for 50 km rated fatigue life
C₁₀₀: the basic dynamic load rating for 100 km rated fatigue life

A-4-4.3 LA Model



1. Features

(1) High rigidity and high load carrying capacity

A set of three ball grooves is made on both sides of ball slide and a rail. This contributes to increased rigidity and load carrying capacity. The top and bottom groove are formed in the circular arc with a closer radius of ball, which ensures great rigidity and load carrying capacity. With the Gothic arch center groove, rigidity and load carrying capacity are further increased.

(2) Moderate friction

A well-balanced combination of 2-point contacts at the top and bottom grooves and 4 points contact at the center groove provides moderate friction while ensuring rigidity by appropriate preload.

(3) Four-way equal load distribution

The contact angle of balls is set at 45 degrees in all grooves, thereby dispersing the load equally to four rows irrespective of load direction. This realizes equal rigidity and load carrying capacity in vertical and lateral directions and provides well-balanced design.

(4) Strong against shock load

Load from any direction, vertical and lateral, is received by four ball rows at all times. Since the LA model receives load on more ball rows than other linear guides, it is stronger against shock loads.

(5) High accuracy

As shown in Fig. 4, fixing the measuring rollers is easy thanks to the Gothic arch groove of the central ball groove. This allows accurate measuring of ball grooves for highly precise and stable manufacturing.

(6) Dust-resistant design

The rail's cross section is designed to be as simple as possible, thereby improving sealing efficiency combined with the enhanced sealing. In addition, optional inner seals are available.

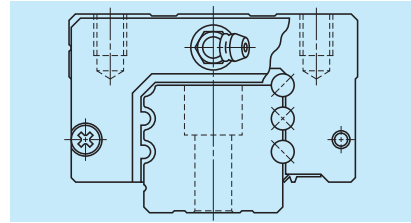


Fig. 1 LA Model

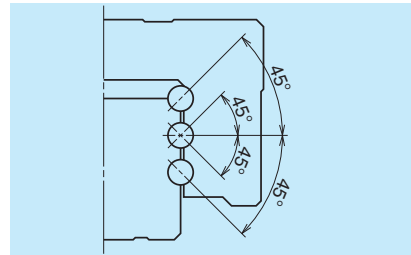


Fig. 2 Super rigidity design

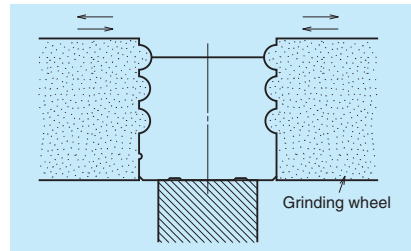


Fig. 3 Rail grinding

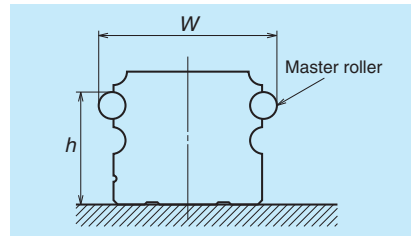


Fig. 4 Measuring groove accuracy

2. Ball slide shape

Ball slide shape code	Shape/installation method	Type (Upper row, Rating: Lower row, Ball slide length)	
		High-load Standard	Super-high-load Long
AN BN		AN 	BN
AL BL		AL 	BL
EL GL		EL 	GL
FL HL		FL 	HL

3. Accuracy and preload

(1) Running parallelism of ball slide

Table 1

Unit: μm

Accuracy grade		Preloaded assembly (not interchangeable)			
		Ultra precision P3	Super precision P4	High precision P5	Precision grade P6
Rail length(mm)	over				
	or less				
	– 50	2	2	2	4
	50 – 80	2	2	3	4
	80 – 125	2	2	3	4
	125 – 200	2	2	3.5	5
	200 – 250	2	2.5	4.5	6
	250 – 315	2	2.5	5	6.5
	315 – 400	2	3	5.5	7
	400 – 500	2	3	6	7.5
	500 – 630	2	3.5	6.5	8.5
	630 – 800	2	4	7	9.5
	800 – 1 000	2.5	4.5	7.5	10
	1 000 – 1 250	3	5	8.5	12
	1 250 – 1 600	3.5	5.5	9.5	13
	1 600 – 2 000	4	6.5	11	14
	2 000 – 2 500	4.5	7.5	12	16
	2 500 – 3 150	5.5	8.5	13	18
	3 150 – 4 000	6	9.5	14	19

(2) Accuracy standard

The LA Model has four accuracy grades: Ultra precision P3, Super precision P4, High precision P5, and Precision grade P6.

Table 2 Unit: μm

Accuracy grade	Ultra precision P3	Super precision P4	High precision P5	Precision grade P6
Mounting height H Variation of H (All ball slides on a set of rails)	± 8 3	± 10 5	± 20 7	± 40 15
Mounting width W_2 or W_3 Variation of W_2 or W_3 (All ball slides on reference rail)	± 10 3	± 15 7	± 25 10	± 50 20
Running parallelism of surface C to surface A Running parallelism of surface D to surface B	Shown in Table 1 and Fig. 5			

(3) Assembled accuracy

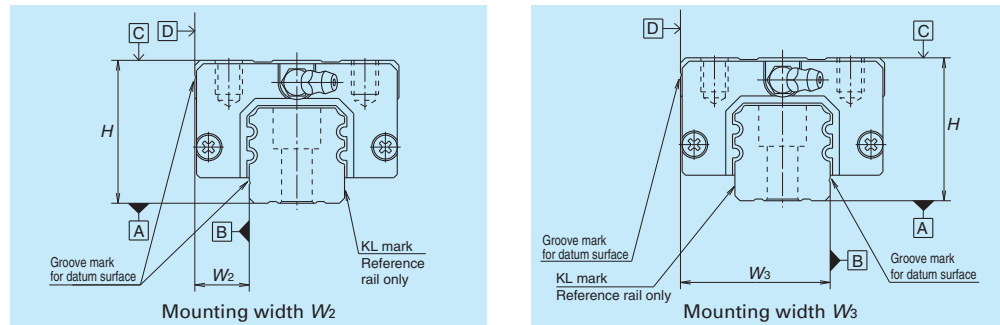


Fig. 5

4. Preload and rigidity

Table 3 shows preload and rigidity for the LA Model.

The LA Model has two types of preload specifications: Medium preload Z3 and Heavy preload Z4.

Table 3

	Model No.	Preload (N)		Rigidity (N/ μm)	
		Medium preload Z3	Heavy preload Z4	Medium preload Z3	Heavy preload Z4
High-load	LA25 AL, AN, EL, FL	1 670	2 110	475	550
	LA30 AL, AN, EL, FL	2 450	3 150	705	835
	LA35 AL, AN, EL, FL	3 450	4 300	825	970
	LA45 AL, AN, EL, FL	5 050	6 350	1 100	1 240
	LA55 AL, AN, EL, FL	8 100	10 200	1 400	1 540
Super-high-load	LA65 AN, EL, FL	13 800	18 800	1 730	2 030
	LA25 BL, BN, GL, HL	2 260	2 840	700	820
	LA30 BL, BN, GL, HL	3 250	4 050	1 000	1 180
	LA35 BL, BN, GL, HL	4 450	5 650	1 200	1 400
	LA45 BL, BN, GL, HL	6 150	7 750	1 450	1 640
	LA55 BL, BN, GL, HL	9 550	12 100	1 840	2 020
	LA65 BN, GL, HL	18 000	24 400	2 450	2 840

4. Maximum rail length

Table 4 shows the limitations of rail length. However, the limitations vary by accuracy grades.

Table 4 Length limitations of rails Unit: mm

Model	Size	25	30	35	45	55	65
LA		3 960	4 000	4 000	3 990	3 960	3 900

Note: Rails can be butted if user requirements exceed the rail length shown in the table. Please consult NSK.

5. Installation

(1) Permissible values of mounting error

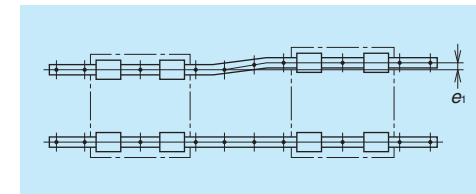


Fig. 6

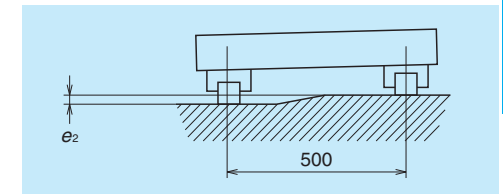


Fig. 7

Table 5 Unit: μm

Value	Preload	Model No.					
		LA25	LA30	LA35	LA45	LA55	LA65
Permissible values for parallelism error of two rails e_1	Z3	15	17	20	25	30	40
	Z4	13	15	17	20	25	30
Permissible values for height error of two rails e_2	Z3, Z4	185 $\mu\text{m}/500 \text{ mm}$					

(2) Shoulder height of the mounting surface and corner radius r

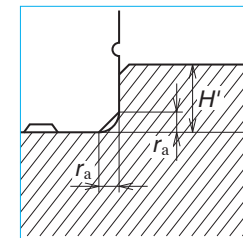


Fig. 8 Shoulder for the rail datum surface

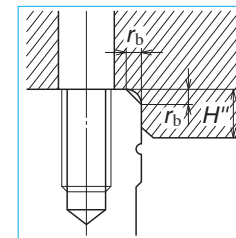


Fig. 9 Shoulder for the ball slide datum surface

Table 6 Unit: mm

Model No.	Corner radius (maximum)		Shoulder height	
	r_a	r_b	H'	H''
LA25	0.5	0.5	5	5
LA30	0.5	0.5	6	6
LA35	0.5	0.5	6	6
LA45	0.7	0.7	8	8
LA55	0.7	0.7	10	10
LA65	1	1	11	11

6. Lubrication components

Refer to pages A58 and D13 for the lubrication of linear guides.

(1) Types of lubrication accessories

Fig. 10 and Table 7 show grease fittings and tube fittings.

(2) Mounting position of lubrication accessories

- The standard position for grease fittings is at the end face of the ball slide, but we can mount them on the side of the end cap as an option. (Fig. 11)
- Please consult NSK for the installation of grease or tube fittings to the ball slide body.
- Using a piping unit with thread of M6 × 1 requires a connector to connect to a grease fitting mounting hole with M6 × 0.75. The connector is available from NSK.

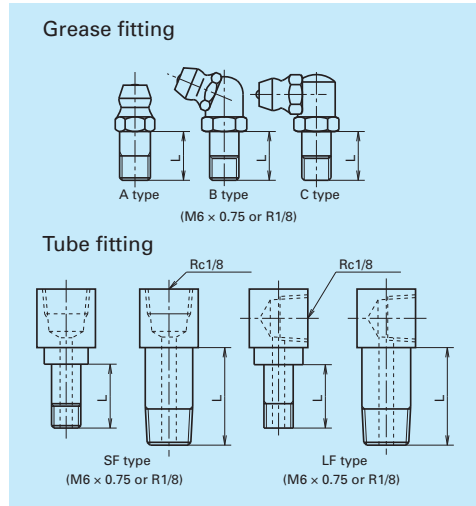


Fig. 10 Grease fitting and tube fitting

Table 7 Unit: mm

Model No.	Dust-resistant specification	Dimension L		
		Grease fitting	Tube fitting	
			SF type	LF type
LA25	Standard	5	5	5
	With NSK K1	14	12	12
	Double seal	10	9	9
LA30	Protector	10	9	9
	Standard	5	6	6
	With NSK K1	14	12	13
LA35	Double seal	12	10	11
	Protector	12	11	11
	Standard	5	6	6
LA45	With NSK K1	14	12	13
	Double seal	12	10	11
	Protector	12	11	11
LA55	Standard	8	13.5	17
	With NSK K1	18	22	21.5
	Double seal	14	18	17
LA65	Protector	14	16	17
	Standard	8	13.5	17
	With NSK K1	22	24	25.5
		16	20	19
		16	16	17

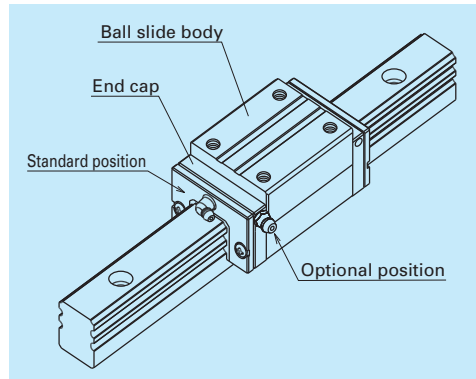


Fig. 11 Mounting position of lubrication accessories

7. Dust-resistant components

(1) Standard Specification

Under normal applications, the LA model can be used without modification thanks to its dust resistance. As standard equipment, the ball slides have an end seal on both ends, and bottom seals at the bottom.

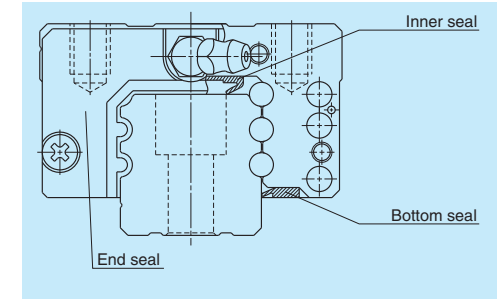


Fig. 12

Table 8 Seal friction per ball slide (maximum value)

Model	Size	Unit: N					
		25	30	35	45	55	65
LA		11	11	12	17	17	23

(2) NSK K1™ lubrication unit

Table 9 shows the dimensions of linear guides equipped with NSK K1 lubrication units.

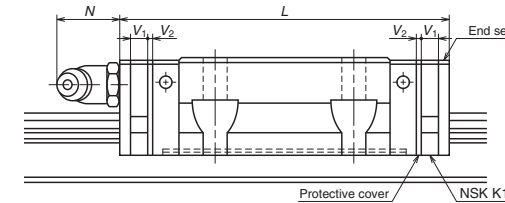


Table 9 Dimensions when equipped with NSK K1 lubrication units

Model No.	Ball slide length	Ball slide shape code	Standard ball slide length	Ball slide length with two NSK K1 installed L	Unit: mm		Protrusion of grease fitting N
					Thickness of single NSK K1 V ₁	Protective cover thickness V ₂	
LA25	Standard	AL, AN, EL, FL	79.8	91.8	5.0	1.0	(14)
	Long	BL, BN, GL, HL	107.8	119.8			
LA30	Standard	AL, AN, EL, FL	100.2	113.2	5.5	1.0	(14)
	Long	BL, BN, GL, HL	126.2	139.2			
LA35	Standard	AL, AN, EL, FL	110.6	123.6	5.5	1.0	(14)
	Long	BL, BN, GL, HL	144.6	157.6			
LA45	Standard	AL, AN, EL, FL	141.4	156.4	6.5	1.0	(15)
	Long	BL, BN, GL, HL	173.4	188.4			
LA55	Standard	AL, AN, EL, FL	165.4	180.4	6.5	1.0	(15)
	Long	BL, BN, GL, HL	203.4	218.4			
LA65	Standard	AN, EL, FL	196.2	214.2	8.0	1.0	(16)
	Long	BN, GL, HL	256.2	274.2			

Note: Slide length when equipped with NSK K1 = (standard ball slide length) + (V₁ thickness of single NSK K1 unit) × (number of K1 units) + (V₂ thickness of the protective cover) × 2.

(3) Double seal and protector

For the LA Model double seals and protectors can be installed only before shipping from the factory. Please consult with NSK when the double seal and the protectors are required.

Table 10 shows the increased thickness of V_3 and V_4 when end seals and protectors are installed (**Fig. 15**).

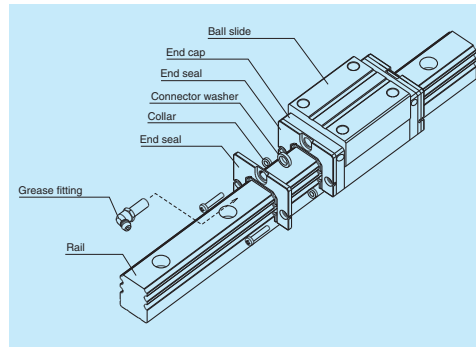


Fig. 13 Double seal

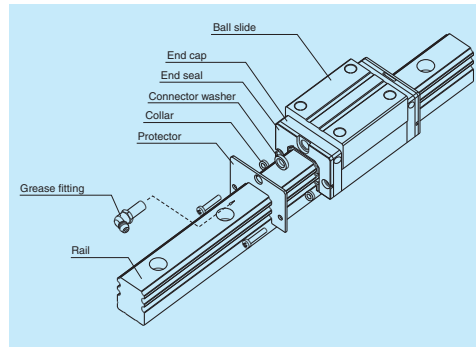


Fig. 14 Protector

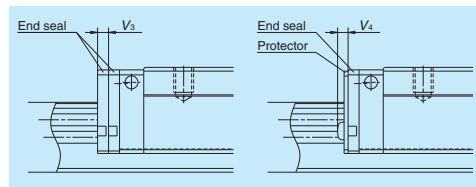


Fig. 15

Table 10

Unit: mm

Model No.	Thickness of end seal: V_3	Thickness of protector: V_4
LA25	3.2	3.6
LA30	4.4	4.2
LA35	4.4	4.2
LA45	5.5	4.9
LA55	5.5	4.9
LA65	6.5	5.5

(4) Caps to plug the rail mounting bolt hole

Table 11 Caps to plug rail bolt hole

Model No.	Bolt to secure rail	Cap reference No.	Quantity /case
LA25	M6	LG-CAP/M6	20
LA30, LA35	M8	LG-CAP/M8	20
LA45	M12	LG-CAP/M12	20
LA55	M14	LG-CAP/M14	20
LA65	M16	LG-CAP/M16	20

(5) Bellows

Make tap holes to the rail end face to fix the bellows mounting plate.

NSK processes tap holes to the rail end face when ordered with a linear guide.

Dimension tables for bellows LA Model

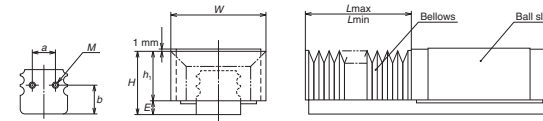


Fig. 16 Dimensions of bellows

Bellows reference number

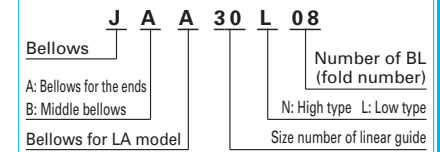


Table 12 Dimensions of bellows

Unit: mm

Model No.	H	h_1	E	W	P	a	b	Length of BL	Tap (M) × depth
JAA25L	35	29.5	5.5	55	12	12	13.8	17	M3 × 5
JAA25N	39	33.5	5.5	61	15	12	13.8	17	M3 × 5
JAA30L	41	33.5	7.5	60	12	14	17.5	17	M4 × 6
JAA30N	44	36.5	7.5	66	15	14	17.5	17	M4 × 6
JAA35L	47	39.5	7.5	72	15	15	18.8	17	M4 × 6
JAA35N	54	46.5	7.5	82	20	15	18.8	17	M4 × 6
JAA45L	59	49	10	93	20	25	22.5	17	M5 × 8
JAA45N	69	59	10	113	30	25	22.5	17	M5 × 8
JAA55L	69	57	12	101	20	35	27.1	17	M5 × 8
JAA55N	79	67	12	121	30	35	27.1	17	M5 × 8
JAA65N	89	75	14	131	30	40	33.3	17	M6 × 12

Table 13 Numbers of folds (BL) and length of bellows

Unit: mm

Type	Model No.	Length of BL	2	4	6	8	10	12	14	16	18	20
		L_{min}	34	68	102	136	170	204	238	272	306	340
Low type	JAA25L	Stroke	134	268	402	536	670	804	938	1 072	1 206	1 340
		L_{max}	168	336	504	672	840	1 008	1 176	1 344	1 512	1 680
High type	JAA25N	Stroke	176	352	528	704	880	1 056	1 232	1 408	1 584	1 760
		L_{max}	210	420	630	840	1 050	1 260	1 470	1 680	1 890	2 100
Low type	JAA30L	Stroke	134	268	402	536	670	804	938	1 072	1 206	1 340
		L_{max}	168	336	504	672	840	1 008	1 176	1 344	1 512	1 680
High type	JAA30N	Stroke	176	352	528	704	880	1 056	1 232	1 408	1 584	1 760
		L_{max}	210	420	630	840	1 050	1 260	1 470	1 680	1 890	2 100
Low type	JAA35L	Stroke	176	352	528	704	880	1 056	1 232	1 408	1 584	1 760
		L_{max}	210	420	630	840	1 050	1 260	1 470	1 680	1 890	2 100
High type	JAA35N	Stroke	246	492	738	984	1 230	1 476	1 722	1 968	2 214	2 460
		L_{max}	280	560	840	1 120	1 400	1 680	1 960	2 240	2 520	2 800
Low type	JAA45L	Stroke	246	492	738	984	1 230	1 476	1 722	1 968	2 214	2 460
		L_{max}	280	560	840	1 120	1 400	1 680	1 960	2 240	2 520	2 800
High type	JAA45N	Stroke	386	772	1 158	1 544	1 930	2 316	2 702	3 088	3 474	3 860
		L_{max}	420	840	1 260	1 680	2 100	2 520	2 940	3 360	3 780	4 200
Low type	JAA55L	Stroke	246	492	738	984	1 230	1 476	1 722	1 968	2 214	2 460
		L_{max}	280	560	840	1 120	1 400	1 680	1 960	2 240	2 520	2 800
High type	JAA55N	Stroke	386	772	1 158	1 544	1 930	2 316	2 702	3 088	3 474	3 860
		L_{max}	420	840	1 260	1 680	2 100	2 520	2 940	3 360	3 780	4 200
Low/high type	JAA65N*	Stroke	386	772	1 158	1 544	1 930	2 316	2 702	3 088	3 474	3 860
		L_{max}	420	840	1 260	1 680	2 100	2 520	2 940	3 360	3 780	4 200

* Bellows for LA65 is for both low and high types.

Note : The values of an odd number BL quantity (3, 5, 7, ...) can be obtained by adding two values of the even number BL on both sides, then by dividing the sum by 2.

8. Reference number

A reference number (designation) is set and indicated on the specification drawing for an individual NSK linear guide when its specifications are finalized.

Please specify the reference number, except design serial number, to identify the product when ordering, requiring estimates, or inquiring about specifications from NSK.

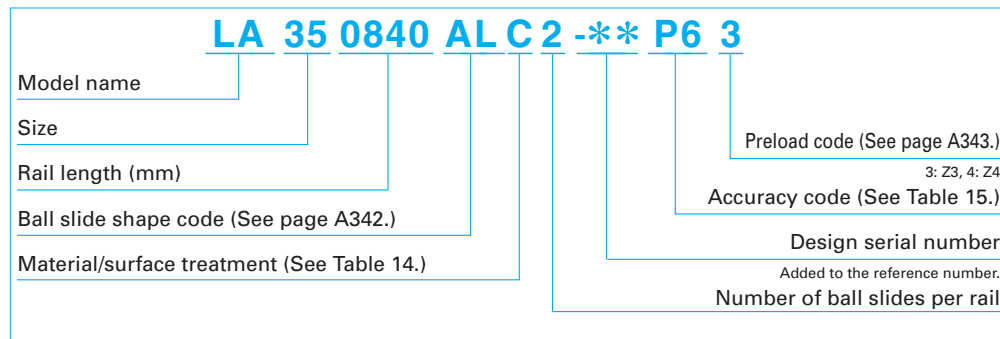


Table 14 Material/surface treatment code

Code	Description
C	Special high carbon steel (NSK standard)
D	Special high carbon steel with surface treatment
Z	Other, special

Table 15 Accuracy code

Accuracy	Standard (Without NSK K1)	With NSK K1
Ultra precision grade	P3	K3
Super precision grade	P4	K4
High precision grade	P5	K5
Precision grade	P6	K6

Note: Refer to pages A58 for details on NSK K1 lubrication units.

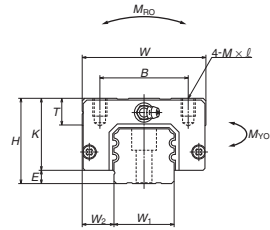
9. Dimensions

LA-AL (High-load / Standard)
LA-BL (Super-high-load / Long)

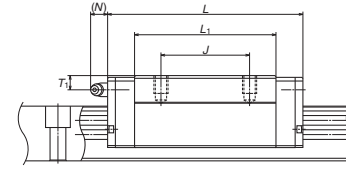
LA 35 0840 AL C 2 - P6 3**

Model name	Preload code (See page A343.)
Size	3: Z3, 4: Z4
Rail length (mm)	Accuracy code (See Table 15.)
Ball slide shape code (See page A342.)	Design serial number
Material/surface treatment (See Table 14.)	Added to the reference number.
	Number of ball slides per rail

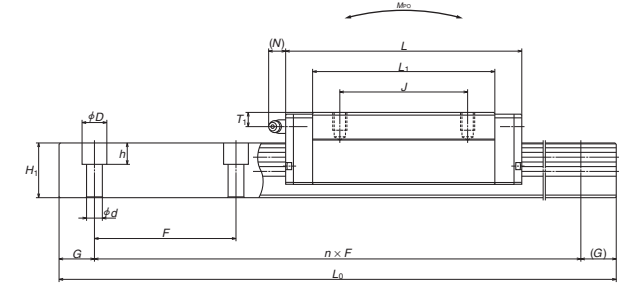
Front view of AL and BL types



Side view of AL type



Side view of BL type



Model No.	Assembly			Ball slide										Width	Height	
	Height	Width	Length	Mounting hole			L ₁	K	T	Grease fitting			W ₁			H ₁
				B	J	M × pitch × l				Hole size	T ₁	N				
LA25AL	36	5.5	12.5	48	79.8	35	M6×1×7	58	30.5	8	M6×0.75	6	11	23	22	
LA25BL					107.8	50		86								
LA30AL	42	7.5	16	60	100.2	40	M8×1.25×10	72	34.5	11	M6×0.75	6.5	11	28	28	
LA30BL					126.2	60		98								
LA35AL	48	7.5	18	70	110.6	50	M8×1.25×10	80	40.5	15	M6×0.75	8	11	34	30.8	
LA35BL					144.6	72		114								
LA45AL	60	10	20.5	86	141.4	60	M10×1.5×16	105	50	17	Rc1/8	10	13	45	36	
LA45BL					173.4	80		137								
LA55AL	70	12	23.5	100	165.4	75	M12×1.75×16	126	58	18	Rc1/8	11	13	53	43.2	
LA55BL					203.4	95		164								

Notes: 1) The LA model does not have a ball retainer. Note that balls will fall out when the ball slide is removed from the rail.

Unit: mm

Rail		Basic load ratings								Weight			
Pitch	Mounting bolt hole	G	Max. length	² Dynamic		Static	Static moment (N-m)				Ball slide	Rail	
				[50km]	[100km]		M _{RO}		M _{YO}				
F	d × D × h	(reference)	L _{max}	C ₅₀ (N)	C ₁₀₀ (N)	(N)	One slide	Two slides	One slide	Two slides	(kg)	(kg/m)	
60	7×11×9	20	3 960	30 000	23 900	50 000	290	410	2 490	410	2 490	0.5	3.7
				40 500	32 500	77 000	445	935	5 000	935	5 000	0.8	
80	9×14×12	20	4 000	47 000	37 000	77 500	535	820	4 800	820	4 800	0.8	5.8
				58 000	46 000	105 000	725	1 470	8 050	1 470	8 050	1.2	
80	9×14×12	20	4 000	61 500	49 000	98 000	845	1 130	6 750	1 130	6 750	1.3	7.7
				80 500	64 000	143 000	1 240	2 330	12 500	2 330	12 500	1.6	
105	14×20×17	22.5	3 990	91 000	72 000	148 000	1 840	2 210	12 900	2 210	12 900	2.5	12.0
				111 000	88 000	197 000	2 460	3 850	20 600	3 850	20 600	3.2	
120	16×23×20	30	3 960	139 000	111 000	215 000	3 150	3 800	22 000	3 800	22 000	3.9	17.2
				172 000	137 000	292 000	4 250	6 800	36 000	6 800	36 000	5.1	

2) Basic load ratings comply with ISO standards (ISO 14728-1, 14728-2).

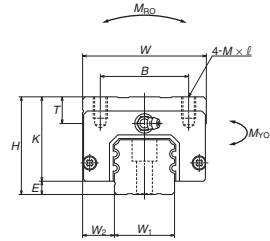
C₅₀: the basic dynamic load rating for 50 km rated fatigue life
C₁₀₀: the basic dynamic load rating for 100 km rated fatigue life

LA-AN (High-load / Standard)
LA-BN (Super-high-load / Long)

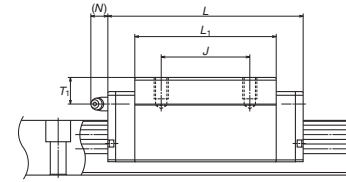
LA 35 0840 ANC 2 -** P6 3

Model name	Preload code (See page A343.)
Size	3: Z3, 4: Z4
Rail length (mm)	Accuracy code (See Table 15.)
Ball slide shape code (See page A342.)	Design serial number
Material/surface treatment (See Table 14.)	Added to the reference number.
	Number of ball slides per rail

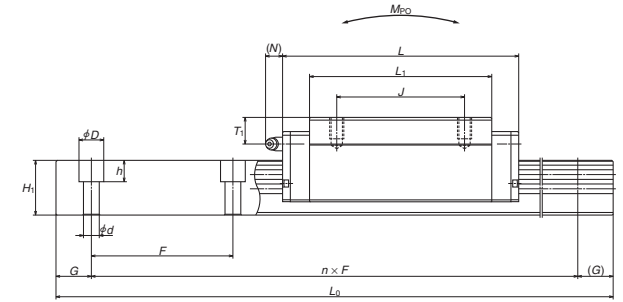
Front view of AN and BN types



Side view of AN type



Side view of BN type



Unit: mm

Model No.	Assembly			Ball slide										Width	Height	
	Height	Width	Length	Mounting hole						Grease fitting			Width			Height
				W_2	W	L	B	J	$M \times \text{pitch} \times \ell$	L_1	K	T				
LA25AN	40	5.5	12.5	48	79.8	35	35	M6×1×10	58	34.5	12	M6×0.75	10	11	23	22
LA25BN					107.8	50			86							
LA30AN	45	7.5	16	60	100.2	40	40	M8×1.25×11	72	37.5	14	M6×0.75	9.5	11	28	28
LA30BN					126.2	60			98							
LA35AN	55	7.5	18	70	110.6	50	50	M8×1.25×12	80	47.5	15	M6×0.75	15	11	34	30.8
LA35BN					144.6	72			114							
LA45AN	70	10	20.5	86	141.4	60	60	M10×1.5×16	105	60	17	Rc1/8	20	13	45	36
LA45BN					173.4	80			137							
LA55AN	80	12	23.5	100	165.4	75	75	M12×1.75×18	126	68	18	Rc1/8	21	13	53	43.2
LA55BN					203.4	95			164							
LA65AN	90	14	31.5	126	196.2	76	70	M16×2×19	147	76	22	Rc1/8	19	13	63	55
LA65BN					256.2	120			207							

Notes: 1) The LA model does not have a ball retainer. Note that balls will fall out when the ball slide is removed from the rail.

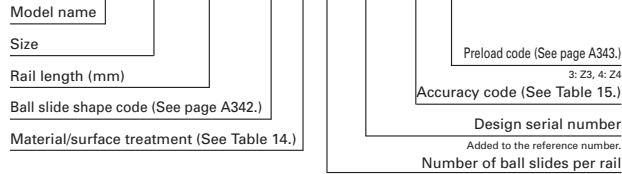
Rail				Basic load ratings								Weight	
Pitch	Mounting bolt hole	G	Max. length	²⁾ Dynamic		Static	Static moment (N·m)				Ball slide	Rail	
				[50km]	[100km]		C_0	M_{P0}		M_{V0}			
				C_{50} (N)	C_{100} (N)	(N)		One slide	Two slides	One slide	Two slides	(kg)	(kg/m)
60	7×11×9	20	3 960	30 000	23 900	50 000	290	410	2 490	410	2 490	0.6	3.7
				40 500	32 500	77 000	445	935	5 000	935	5 000	0.9	
80	9×14×12	20	4 000	47 000	37 000	77 500	535	820	4 800	820	4 800	0.9	5.8
				58 000	46 000	105 000	725	1 470	8 050	1 470	8 050	1.3	
80	9×14×12	20	4 000	61 500	49 000	98 000	845	1 130	6 750	1 130	6 750	1.5	7.7
				80 500	64 000	143 000	1 240	2 330	12 500	2 330	12 500	2.1	
105	14×20×17	22.5	3 990	91 000	72 000	148 000	1 840	2 210	12 900	2 210	12 900	3.0	12.0
				111 000	88 000	197 000	2 460	3 850	20 600	3 850	20 600	3.9	
120	16×23×20	30	3 960	139 000	111 000	215 000	3 150	3 800	22 000	3 800	22 000	4.7	17.2
				172 000	137 000	292 000	4 250	6 800	36 000	6 800	36 000	6.1	
150	18×26×22	35	3 900	260 000	206 000	420 000	7 300	9 050	51 000	9 050	51 000	7.7	25.9
				340 000	269 000	615 000	10 700	18 700	95 000	18 700	95 000	10.8	

2) Basic load ratings comply with ISO standards (ISO 14728-1, 14728-2).

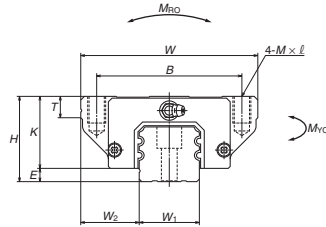
C_{50} : the basic dynamic load rating for 50 km rated fatigue life
 C_{100} : the basic dynamic load rating for 100 km rated fatigue life

LA-EL (High-load / Standard)
LA-GL (Super-high-load / Long)

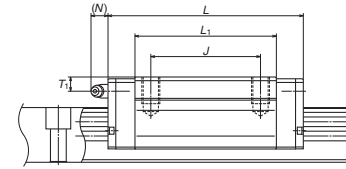
LA 35 0840 EL C 2 - P6 3**



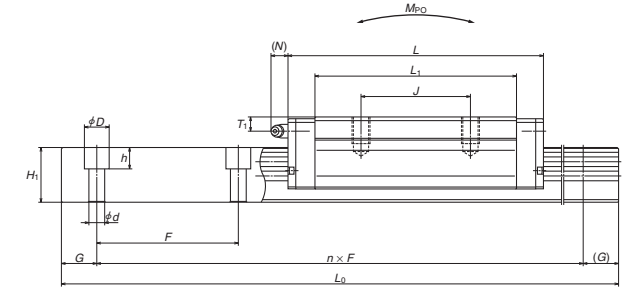
Front view of EL and GL types



Side view of EL type



Side view of GL type



Model No.	Assembly			Ball slide										Width	Height	
	Height	Width	Length	Mounting hole						Grease fitting						
				B	J	M × pitch × l	L ₁	K	T	Hole size	T ₁	N	W ₁			H ₁
H	E	W ₂	W	L	B	J	M × pitch × l	L ₁	K	T	Hole size	T ₁	N	W ₁	H ₁	
LA25EL	36	5.5	23.5	70	79.8	57	45	M8×1.25×12	58	30.5	11	M6×0.75	6	11	23	22
LA25GL					107.8				86							
LA30EL	42	7.5	31	90	100.2	72	52	M10×1.5×16	72	34.5	11	M6×0.75	6.5	11	28	28
LA30GL					126.2				98							
LA35EL	48	7.5	33	100	110.6	82	62	M10×1.5×15	80	40.5	12	M6×0.75	8	11	34	30.8
LA35GL					144.6				114							
LA45EL	60	10	37.5	120	141.4	100	80	M12×1.75×18	105	50	13	Rc1/8	10	13	45	36
LA45GL					173.4				137							
LA55EL	70	12	43.5	140	165.4	116	95	M14×2×21	126	58	15	Rc1/8	11	13	53	43.2
LA55GL					203.4				164							
LA65EL	90	14	53.5	170	196.2	142	110	M16×2×24	147	76	22	Rc1/8	19	13	63	55
LA65GL					256.2				207							

Notes: 1) The LA model does not have a ball retainer. Note that balls will fall out when the ball slide is removed from the rail.

Unit: mm

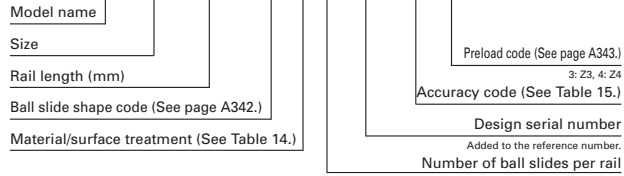
Rail				Basic load ratings								Weight	
Pitch	Mounting bolt hole	G	Max. length	²⁾ Dynamic		Static	Static moment (N·m)				Ball slide	Rail	
				[50km]	[100km]		C ₀	M _{P0}		M _{Y0}			
				F	d × D × h	(reference)		L _{0max}	C ₅₀ (N)	C ₁₀₀ (N)	(N)	One slide	Two slides
60	7×11×9	20	3 960	30 000	23 900	50 000	290	410	2 490	410	2 490	0.8	3.7
				40 500	32 500	77 000	445	935	5 000	935	5 000	1.1	
80	9×14×12	20	4 000	47 000	37 000	77 500	535	820	4 800	820	4 800	1.3	5.8
				58 000	46 000	105 000	725	1 470	8 050	1 470	8 050	1.8	
80	9×14×12	20	4 000	61 500	49 000	98 000	845	1 130	6 750	1 130	6 750	1.9	7.7
				80 500	64 000	143 000	1 240	2 330	12 500	2 330	12 500	2.6	
105	14×20×17	22.5	3 990	91 000	72 000	148 000	1 840	2 210	12 900	2 210	12 900	3.3	12.0
				111 000	88 000	197 000	2 460	3 850	20 600	3 850	20 600	4.3	
120	16×23×20	30	3 960	139 000	111 000	215 000	3 150	3 800	22 000	3 800	22 000	5.5	17.2
				172 000	137 000	292 000	4 250	6 800	36 000	6 800	36 000	7.2	
150	18×26×22	35	3 900	260 000	206 000	420 000	7 300	9 050	51 000	9 050	51 000	11.0	25.9
				340 000	269 000	615 000	10 700	18 700	95 000	18 700	95 000	15.5	

2) Basic load ratings comply with ISO standards (ISO 14728-1, 14728-2).

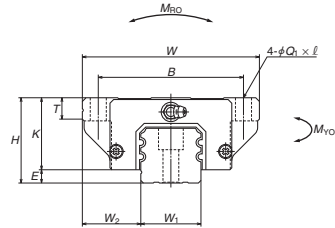
C₅₀: the basic dynamic load rating for 50 km rated fatigue life
 C₁₀₀: the basic dynamic load rating for 100 km rated fatigue life

LA-FL (High-load / Standard)
LA-HL (Super-high-load / Long)

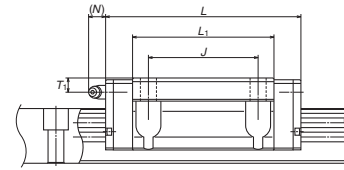
LA 35 0840 FL C 2 -** P6 3



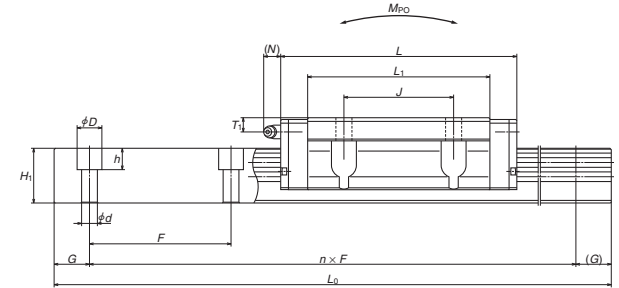
Front view of FL and HL types



Side view of FL type



Side view of HL type



Model No.	Assembly			Ball slide											Width	Height		
	Height	E	W ₂	Width	Length	Mounting hole			L ₁	K	T	Grease fitting					W ₁	H ₁
						B	J	M × pitch × l				Hole size	T ₁	N				
LA25FL	36	5.5	23.5	70	79.8	57	45	7×10	58	30.5	11	M6×0.75	6	11	23	22		
LA25HL					107.8				86									
LA30FL	42	7.5	31	90	100.2	72	52	9×12	72	34.5	11	M6×0.75	6.5	11	28	28		
LA30HL					126.2				98									
LA35FL	48	7.5	33	100	110.6	82	62	9×13	80	40.5	12	M6×0.75	8	11	34	30.8		
LA35HL					144.6				114									
LA45FL	60	10	37.5	120	141.4	100	80	11×15	105	50	13	Rc1/8	10	13	45	36		
LA45HL					173.4				137									
LA55FL	70	12	43.5	140	165.4	116	95	14×18	126	58	15	Rc1/8	11	13	53	43.2		
LA55HL					203.4				164									
LA65FL	90	14	53.5	170	196.2	142	110	16×23	147	76	22	Rc1/8	19	13	63	55		
LA65HL					256.2				207									

Notes: 1) The LA model does not have a ball retainer. Note that balls will fall out when the ball slide is removed from the rail.

Rail		Basic load ratings								Weight			
Pitch	Mounting bolt hole	G	Max. length	²⁾ Dynamic		Static	Static moment (N·m)				Ball slide	Rail	
				[50km]	[100km]		M _{P0}		M _{Y0}				
F	d × D × h	(reference)	L _{0max}	C ₅₀ (N)	C ₁₀₀ (N)	(N)	One slide	Two slides	One slide	Two slides	(kg)	(kg/m)	
60	7×11×9	20	3 960	30 000	23 900	50 000	290	410	2 490	410	2 490	0.8	3.7
				40 500	32 500	77 000	445	935	5 000	935	5 000	1.1	
80	9×14×12	20	4 000	47 000	37 000	77 500	535	820	4 800	820	4 800	1.3	5.8
				58 000	46 000	105 000	725	1 470	8 050	1 470	8 050	1.8	
80	9×14×12	20	4 000	61 500	49 000	98 000	845	1 130	6 750	1 130	6 750	1.9	7.7
				80 500	64 000	143 000	1 240	2 330	12 500	2 330	12 500	2.6	
105	14×20×17	22.5	3 990	91 000	72 000	148 000	1 840	2 210	12 900	2 210	12 900	3.3	12.0
				111 000	88 000	197 000	2 460	3 850	20 600	3 850	20 600	4.3	
120	16×23×20	30	3 960	139 000	111 000	215 000	3 150	3 800	22 000	3 800	22 000	5.5	17.2
				172 000	137 000	292 000	4 250	6 800	36 000	6 800	36 000	7.2	
150	18×26×22	35	3 900	260 000	206 000	420 000	7 300	9 050	51 000	9 050	51 000	11.0	25.9
				340 000	269 000	615 000	10 700	18 700	95 000	18 700	95 000	15.5	

2) Basic load ratings comply with ISO standards (ISO 14728-1, 14728-2).

C₅₀: the basic dynamic load rating for 50 km rated fatigue life
C₁₀₀: the basic dynamic load rating for 100 km rated fatigue life

1. HA Model**A361****2. HS Model****A375**

A-4-5 High-Accuracy Series

A-4-5.1 HA Model



1. Features

(1) High motion accuracy

High motion accuracy is achieved in both narrow and wide ranges by the adoption of ultra-long ball slides and the optimum design of the ball recirculation component.

(2) Ball passage vibration reduced to one-third of our conventional models

Our extensive performance tests show ball passage vibration has been reduced to one-third of our conventional models, dramatically improving straightness in table units.

(3) Installation of rail with greater accuracy

Increased counterbore depth of the rail mounting hole reduces rail deflection, which is caused by bolt tightening when fixing the rail to the mounting base to 50% or less. This feature restrains the pitching motion of ball slide whose frequency matches the mounting hole pitch.

In addition, the length of mounting hole pitch has been reduced by one-half of conventional models, so the rail can be more accurately installed in position.

(4) High rigidity and load capacity with lower friction

High rigidity, high load capacity and low friction are achieved by increasing the number of balls.

(5) Compact design

Reduced body size enables more compact machinery.

(6) Four-way equal load distribution

Contact angle is set at 45 degrees in all grooves, dispersing the load to four ball rows irrespective of load direction. This realizes equal rigidity and load carrying capacity in vertical and lateral directions and provides well-balanced design.

(7) Strong against shock load

Load from any direction, vertical and lateral,

is received by four ball rows at all times. Since the HA model receives load on more ball rows than other linear guides, it is stronger against shock loads.

(8) High accuracy at manufacturing

Fixing the measuring rollers to the ball grooves is easy thanks to the Gothic arch groove. Ball-groove measuring is accurate and simple. This allows for highly precise and stable manufacturing.

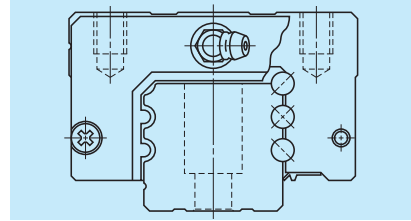


Fig. 1 HA Model

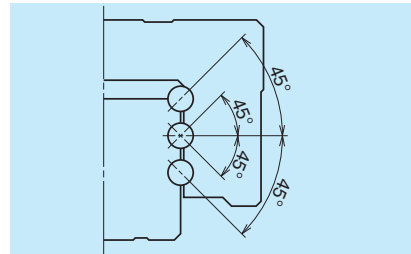


Fig. 2 Super rigidity design

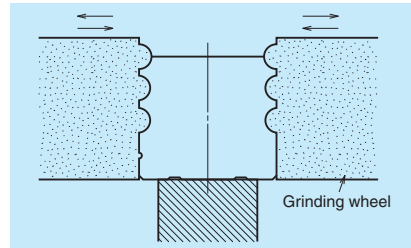


Fig. 3 Rail grinding

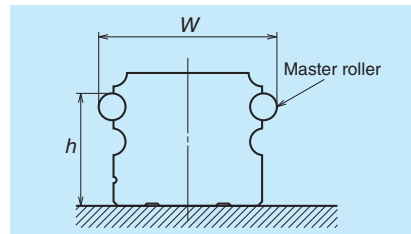


Fig. 4 Measuring groove accuracy

Measurement results of ball passage vibration

Ball passage vibration can translate into posture changes in the ball slide which result from ball passage (circulation). In the HA Model, this vibration has been substantially reduced to one-third of conventional models.

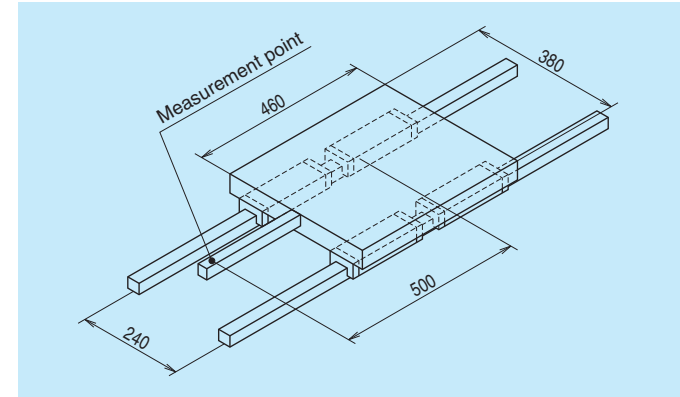
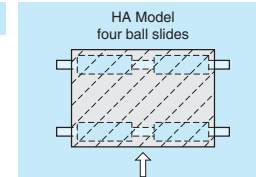


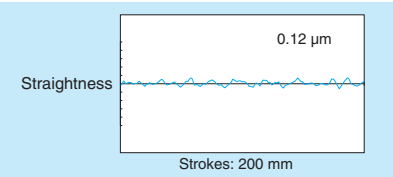
Fig. 5 Schematic view of measurement of ball passage vibration

HA Model

Model No.: HA30
Preload: Z3
Table dimensions: 460 mm x 380 mm



The same table is used.



Conventional Model

Model No.: LA30
Preload: Z3
Table dimensions: 460 mm x 380 mm

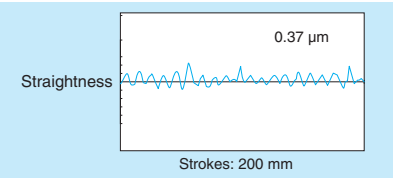
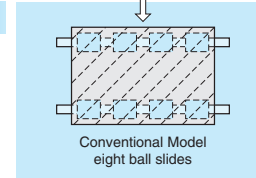


Fig. 6 Measurement results for the HA model vs. conventional model

2. Ball slide shape

Ball slide Shape code	Shape/installation method	Type
AN		
AL		
EM		

3. Accuracy and preload

(1) Running parallelism of ball slide

Table 1

Unit: μm

Accuracy grade	Preloaded assembly		
	Ultra precision P3	Super precision P4	High precision P5
Rail length(mm) over			
or less			
- 200	2	2	3.5
200 - 250	2	2.5	4.5
250 - 315	2	2.5	5
315 - 400	2	3	5.5
400 - 500	2	3	6
500 - 630	2	3.5	6.5
630 - 800	2	4	7
800 - 1 000	2.5	4.5	7.5
1 000 - 1 250	3	5	8.5
1 250 - 1 600	3.5	5.5	9.5
1 600 - 2 000	4	6.5	11
2 000 - 2 500	4.5	7.5	12
2 500 - 3 150	5.5	8.5	13
3 150 - 4 000	6	9.5	14

(2) Accuracy standard

Three accuracy grades are available: Ultra precision P3, Super precision P4 and High precision P5.

Table 2

Unit: μm

Characteristics	Ultra precision P3	Super precision P4	High precision P5
Mounting height H	± 8	± 10	± 20
Variation of H (All ball slides on a set of rails)	3	5	7
Mounting width W_2 or W_3 Variation of W_2 or W_3 (All ball slides on reference rail)	± 10	± 15	± 25
3	7	10	
Running parallelism of surface C to surface A Running parallelism of surface D to surface B	Refer to Table 1 and Fig. 7		

(3) Assembled accuracy

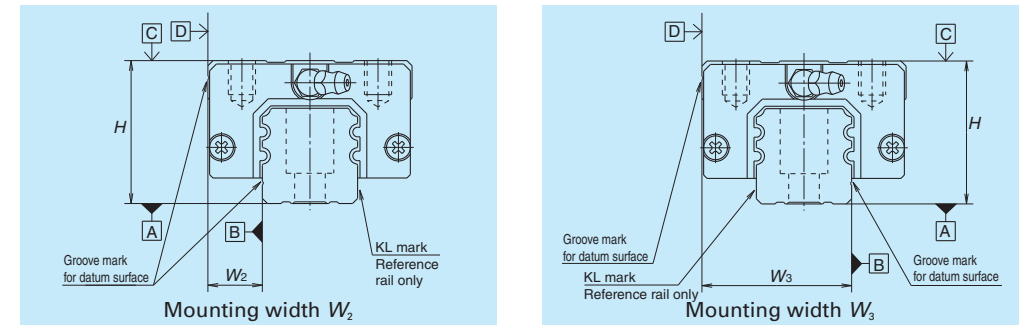


Fig. 7

(4) Preload and rigidity

Slight preload Z1 and Medium preload Z3 are available, which can be selected for specific applications.

Table 3

Model No.	Preload (N)		Rigidity (N/ μm)	
	Slight preload (Z1)	Medium preload (Z3)	Slight preload (Z1)	Medium preload (Z3)
HA25	735	2 990	635	1 030
HA30	1 030	4 400	880	1 270
HA35	1 470	6 100	1 030	1 620
HA45	1 960	8 150	1 230	2 060
HA55	3 150	13 100	1 520	2 450

4. Maximum rail length

Table 4 shows the limitations of rail length.

However, the limitations vary by accuracy grades.

Table 4 Length limitations of rails

Unit: mm

Model	Size	25	30	35	45	55
HA		3 960	4 000	4 000	3 990	3 960

Note: Rails can be butted if user requirements exceed the rail length shown in the table. Please consult NSK.

5. Installation

(1) Permissible values of mounting error

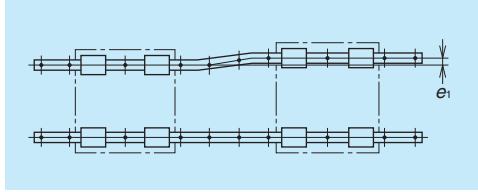


Fig. 8

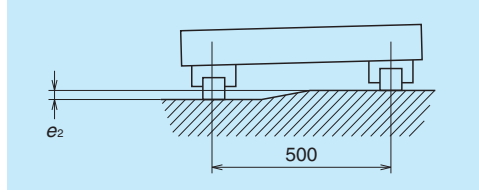


Fig. 9

Table 5

Unit: μm

Value	Preload	Model No.				
		HA25	HA30	HA35	HA45	HA55
Permissible values for parallelism error of two rails e_1	Z1	20	20	23	26	34
	Z3	15	14	17	19	25
Permissible values for height error of two rails e_2	Z1,Z3	250 μm /500 mm				

(2) Shoulder height of the mounting surface and corner radius

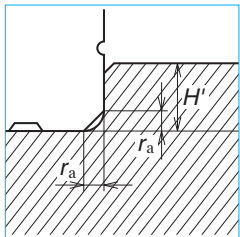


Fig. 10 Shoulder for the rail datum surface

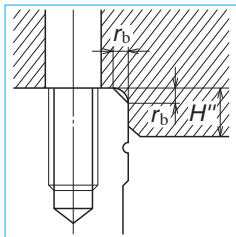


Fig. 11 Shoulder for the ball slide datum surface

Table 6

Unit: mm

Model No.	Corner radius (maximum)		Shoulder height	
	r_a	r_b	H'	H''
HA25	0.5	0.5	5	5
HA30	0.5	0.5	6	6
HA35	0.5	0.5	6	6
HA45	0.7	0.7	8	8
HA55	0.7	0.7	10	10

6. Lubrication components

Refer to pages A58 and D13 for linear guide lubrication.

(1) Types of lubrication accessories

Fig. 12 and Table 7 show grease fittings and tube fittings.

We provide lubrication accessories with an extended thread body length (L) for the addition of dust-resistant accessories such as NSK K1 lubrication units, double seals and protectors.

We provide suitable lubrication accessories for special dust-resistant requirements upon request.

NSK can also provide extended length threads for ease of replenishment.

Please contact NSK if stainless lubrication accessories are required.

(2) Mounting position of lubrication accessories

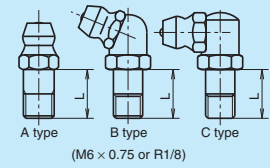
The standard position for grease fittings is at the end face of the ball slide, but we can mount them on the side of the end cap as an option.

(Fig. 13)

Please consult NSK for the installation of grease or tube fittings to the ball slide body.

Using a piping unit with thread of M6 \times 1, requires a connector to connect to a grease fitting mounting hole with M6 \times 0.75. The connector is available from NSK.

Grease fitting



Tube fitting

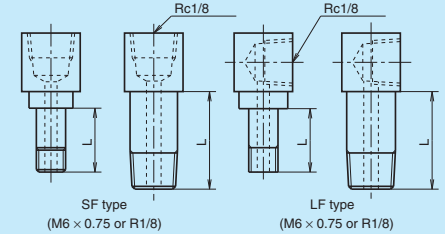


Fig. 12 Grease fitting and tube fitting

Table 7

Unit: mm

Model No.	Dust-resistant specification	Dimension L		
		Grease fitting	Tube fitting	
			SF type	LF type
HA25	Standard	5	5	5
	With NSK K1	14	12	12
	Double seal	10	9	9
HA30	Protector	10	9	9
	Standard	5	6	6
	With NSK K1	14	12	13
HA35	Double seal	12	10	11
	Protector	12	11	11
	Standard	5	6	6
HA45	With NSK K1	14	12	13
	Double seal	12	10	11
	Protector	12	11	11
HA55	Standard	8	13.5	17
	With NSK K1	18	22	21.5
	Double seal	14	18	17
HA55	Protector	14	16	17
	Standard	8	13.5	17
	With NSK K1	18	22	21.5
HA55	Double seal	14	18	17
	Protector	14	16	17

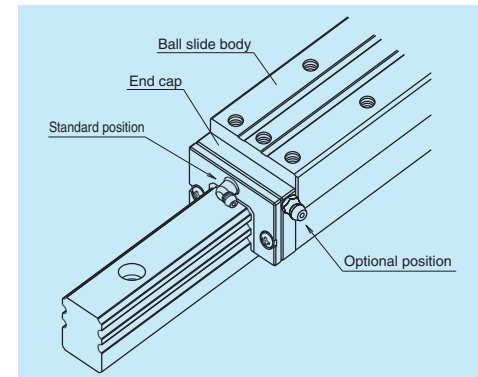


Fig. 13 Mounting position of lubrication accessories

7. Dust-resistant components

(1) Standard Specification

Under normal applications, the HA model can be used without modification thanks to its dust resistance. As standard equipment, the ball slides have an end seal on both ends, bottom seals at the bottom, and an inner seal in inside.

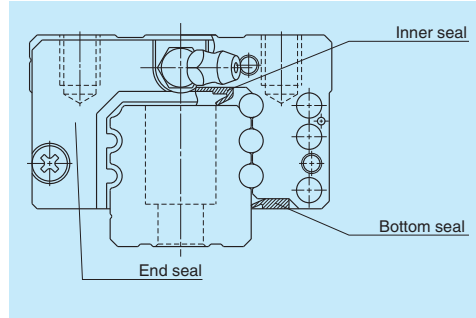


Fig. 14

Table 8 Seal friction per ball slide (maximum value)

		Unit: N				
Model	Size	25	30	35	45	55
HA		17	17	19	21	22

(2) NSK K1™ lubrication unit

Table 9 shows the dimensions of linear guides equipped with NSK K1 lubrication units.

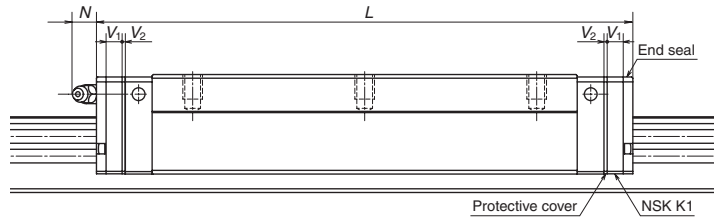


Table 9 Dimensions when equipped with NSK K1 lubrication units Unit: mm

Model No.	Ball slide shape code	Standard ball slide length	Ball slide length with two NSK K1 installed L	Thickness of single NSK K1 V ₁	Protective cover thickness V ₂	Protrusion of grease fitting N
HA25	AN, EM	147.8	159.8	5.0	1.0	(14)
HA30	AN, EM	177.2	190.2	5.5	1.0	(14)
HA35	AN, AL, EM	203.6	216.6	5.5	1.0	(14)
HA45	AN, AL, EM	233.4	248.4	6.5	1.0	(15)
HA55	AN,AL, EM	284.4	299.4	6.5	1.0	(15)

Note: Slide length when equipped with NSK K1 = (standard ball slide length) + (V₁ thickness of single NSK K1 unit) × (number of K1 units) + (V₂ thickness of the protective cover) × 2.

(3) Double seal and protector

For the HA Model, double seals and protectors can be installed only before shipping from the factory. Please consult with NSK when double seals or protectors are required.

Table 10 shows the increased thickness of V₃ and V₄ when the end seal and the protector are installed.

Table 10 Unit: mm

Model No.	Thickness of end seal: V ₃	Thickness of protector: V ₄
HA25	3.2	3.6
HA30	4.4	4.2
HA35	4.4	4.2
HA45	5.5	4.9
HA55	5.5	4.9

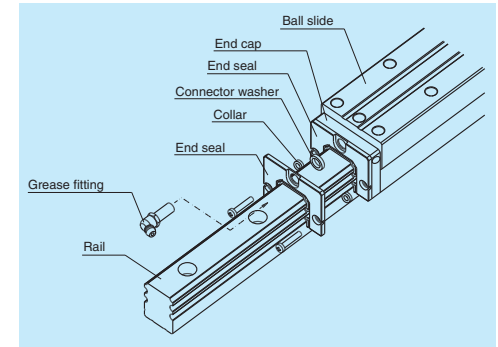


Fig. 15 Double seal

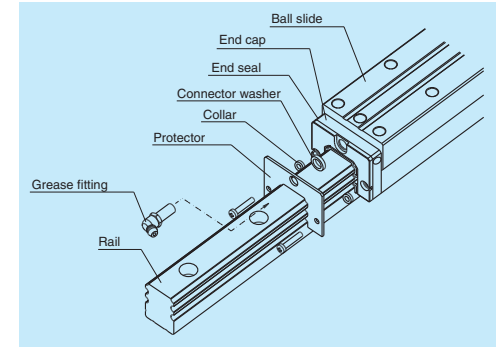


Fig. 16 Protector

(4) Caps to plug the rail mounting bolt hole

Table 11 Caps to plug rail bolt hole

Model No.	Bolt to secure rail	Cap reference No.	Quantity /case
HA25	M6	LG-CAP/M6	20
HA30, HA35	M8	LG-CAP/M8	20
HA45	M12	LG-CAP/M12	20
HA55	M14	LG-CAP/M14	20

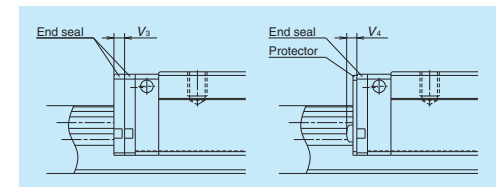


Fig. 17

8. Reference number

A reference number (designation) is set and indicated on the specification drawing for an individual NSK linear guide when its specifications are finalized.

Please specify the reference number, except design serial number, to identify the product when ordering, requiring estimates, or inquiring about specifications from NSK.

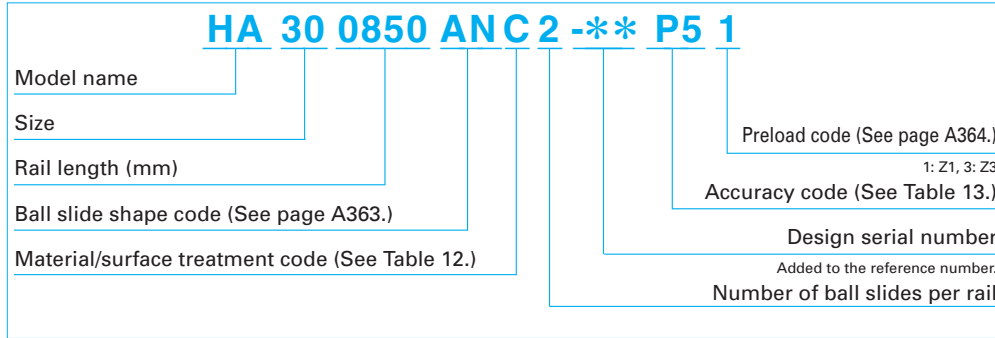


Table 12 Material/surface treatment code

Code	Description
C	Special high carbon steel (NSK standard)
D	Special high carbon steel with surface treatment
Z	Other, special

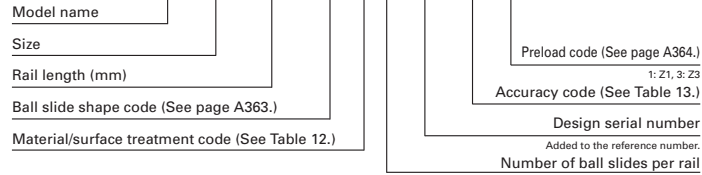
Table 13 Accuracy code

Accuracy	Standard (Without NSK K1)	With NSK K1
Ultra precision grade	P3	K3
Super precision grade	P4	K4
High precision grade	P5	K5

Note: Refer to page A58 for details on NSK K1 lubrication units.

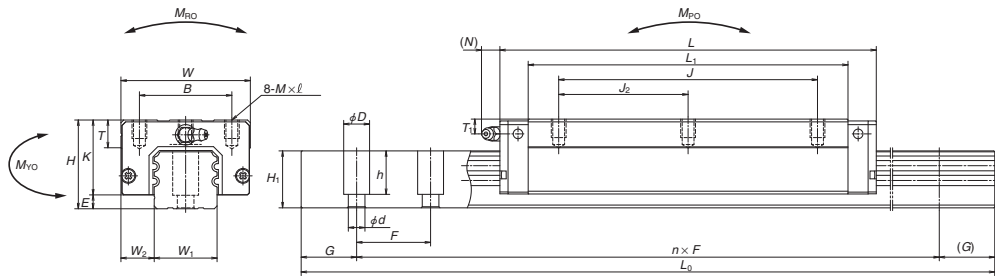
9. Dimensions
HA-AN
HA-AL

HA 30 0850 ANC 2 - P5 1**



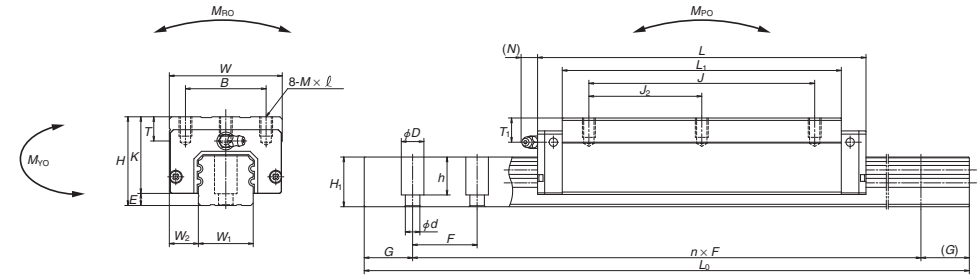
Front view of AL type

Side view of AL type



Front view of AN type

Side view of AN type



Model No.	Assembly			Ball slide										Rail			
	Height H	E	W ₂	Width W	Length L	Mounting hole					Grease fitting					Width W ₁	Height H ₁
						B	J	J ₂	M × pitch × l	L ₁	K	T	Hole size	T ₁	N		
HA25AN	40	5.5	12.5	48	147.8	35	100	50	M6×1.0×10	126	34.5	12	M6×0.75	10	11	23	22
HA30AN	45	7.5	16	60	177.2	40	120	60	M8×1.25×11	149	37.5	14	M6×0.75	9.5	11	28	28
HA35AN	55	7.5	18	70	203.6	50	140	70	M8×1.25×12 M8×1.25×10	173	47.5 40.5	15	M6×0.75	15 8	11	34	30.8
HA35AL																	
HA45AN	70	10	20.5	86	233.4	60	160	80	M10×1.5×16	197	60 50	17	Rc1/8	20 10	13	45	36
HA45AL																	
HA55AN	80	12	23.5	100	284.4	75	206	103	M12×1.75×18 M12×1.75×16	245	68 58	18	Rc1/8	21 11	13	53	43.2
HA55AL																	

Notes: 1) The HA model does not have a ball retainer. Note that balls will fall out when the ball slide is removed from the rail.

Unit: mm

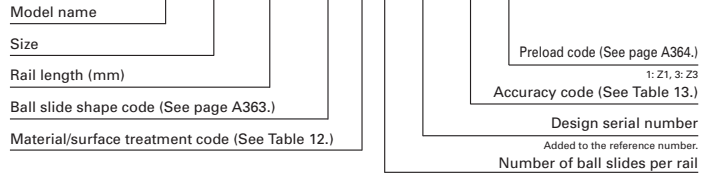
Rail				Basic load ratings								Weight	
Pitch F	Mounting bolt hole d × D × h	G (reference)	Maximum length L _{0max}	²⁾ Dynamic		Static C ₀ (N)	M _{RO}	Static moment (N·m)				Ball slide (kg)	Rail (kg/m)
				[50km] C ₅₀ (N)	[100km] C ₁₀₀ (N)			One slide		Two slides			
30	7×11×16.5	20	3 960	54 000	43 000	115 000	670	2 060	10 100	2 060	10 100	1.2	3.7
40	9×14×21	20	4 000	79 500	63 500	166 000	1 140	3 550	17 400	3 550	17 400	1.8	5.8
40	9×14×23.5	20	4 000	111 000	88 000	226 000	1 950	5 650	27 100	5 650	27 100	3.0 2.6	7.7
52.5	14×20×27	22.5	3 990	147 000	117 000	295 000	3 700	8 450	40 500	8 450	40 500	6.0 5.0	12.0
60	16×23×32.5	30	3 960	232 000	184 000	445 000	6 500	15 400	75 000	15 400	75 000	9.4 7.8	17.2

2) Basic load ratings comply with ISO standards (ISO 14728-1, 14728-2).

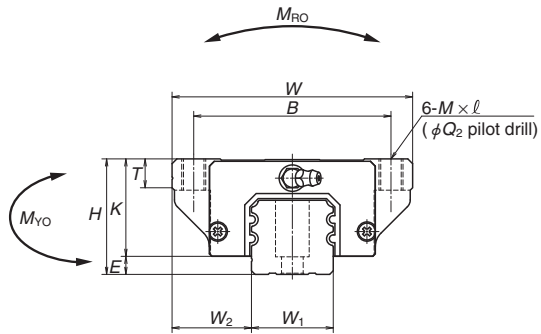
C₅₀: the basic dynamic load rating for 50 km rated fatigue life C₁₀₀: the basic dynamic load rating for 100 km rated fatigue life

HA-EM

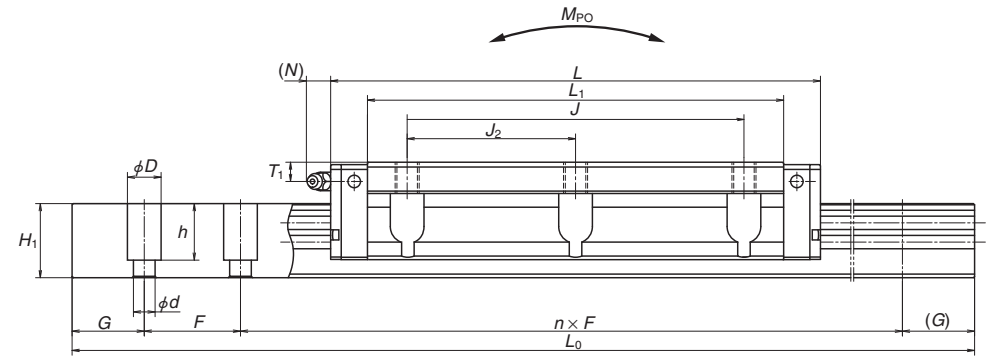
HA 30 0850 EMC 2 - P5 1**



Front view of EM type



Side view of EM type



Model No.	Assembly			Ball slide										Rail				
	Height H	E	W ₂	Width W	Length L	Mounting hole					L ₁	K	T	Grease fitting			Width W ₁	Height H ₁
						B	J	J ₂	M × pitch × l	Q ₂				Hole size	T ₁	N		
HA25EM	36	5.5	23.5	70	147.8	57	100	50	M8×1.25×10	6.8	126	30.5	11	M6×0.75	6	11	23	22
HA30EM	42	7.5	31	90	177.2	72	120	60	M10×1.5×12	8.6	149	34.5	11	M6×0.75	6.5	11	28	28
HA35EM	48	7.5	33	100	203.6	82	140	70	M10×1.5×13	8.6	173	40.5	12	M6×0.75	8	11	34	30.8
HA45EM	60	10	37.5	120	233.4	100	160	80	M12×1.75×15	10.5	197	50	13	Rc1/8	10	13	45	36
HA55EM	70	12	43.5	140	284.4	116	206	103	M14×2×18	12.5	245	58	15	Rc1/8	11	13	53	43.2

Notes: 1) The HA model does not have a ball retainer. Note that balls will fall out when the ball slide is removed from the rail.

Unit: mm

Pitch F	Mounting bolt hole d × D × h	G (reference)	Maximum length L _{0max}	Basic load ratings						Weight			
				²⁾ Dynamic		Static C ₀ (N)	Static moment (N·m)				Ball slide (kg)	Rail (kg/m)	
				[50km] C ₅₀ (N)	[100km] C ₁₀₀ (N)		M _{PO}		M _{YO}				
30	7×11×16.5	20	3 960	54 000	43 000	115 000	670	2 060	10 100	2 060	10 100	1.6	3.7
40	9×14×21	20	4 000	79 500	63 500	166 000	1 140	3 550	17 400	3 550	17 400	2.6	5.8
40	9×14×23.5	20	4 000	111 000	88 000	226 000	1 950	5 650	27 100	5 650	27 100	3.8	7.7
52.5	14×20×27	22.5	3 990	147 000	117 000	295 000	3 700	8 450	40 500	8 450	40 500	6.6	12.0
60	16×23×32.5	30	3 960	232 000	184 000	445 000	6 500	15 400	75 000	15 400	75 000	11	17.2

2) Basic load ratings comply with ISO standards (ISO 14728-1, 14728-2).

C₅₀: the basic dynamic load rating for 50 km rated fatigue life C₁₀₀: the basic dynamic load rating for 100 km rated fatigue life

A-4-5.2 HS Model



1. Features

(1) High motion accuracy

High motion accuracy is achieved in both narrow and wide ranges by adopting ultra-long ball slides and optimum design features for the ball recirculation component.

(2) Ball passage vibration reduced to one-third of our conventional models

Tests show ball passage vibration has been reduced to one-third of our conventional models, dramatically improving straightness in table units.

(3) Installation of rail with greater accuracy

Increased counterbore depth of the rail mounting hole reduces rail deflection, which is caused by bolt tightening when fixing the rail to the mounting base, to 50% or less. This feature restrains the pitching motion of ball slide whose frequency matches to the mounting hole pitch.

In addition, the mounting hole pitch has been reduced by one-half of the conventional models, so the rail can be more accurately installed in position.

(4) High rigidity and load capacity with lower friction

High rigidity, high load capacity and low friction are achieved by increasing the number of balls.

(5) Compact design

Reduced body size enables more compact machinery.

(6) High vertical load carrying capacity

The contact angle is set at 50 degrees, thus increasing load carrying capacity as well as rigidity in the vertical direction.

(7) High resistance against impact load

The bottom ball groove forms a Gothic arch and the center of the top and bottom grooves are offset as shown in Fig. 2.

Vertical load is generally carried by the top rows at two contact points, but with this design, the bottom rows also carry load when a large impact load is applied vertically as shown in Fig. 3. This assures high resistance to impact load.

(8) High accuracy at manufacturing

As showing in Fig. 4, fixing the measuring rollers to the ball groove is easy thanks to the Gothic arch groove. This makes for easy and accurate measuring of ball grooves.

(9) Improve rating life dramatically

A new ball groove geometry is introduced utilizing NSK's state-of-the-art tribological and analytical technologies. Rating life is dramatically increased due to the optimized distribution of contact surface pressures. Load rating capacity is 1.3 times higher than conventional products and life is doubled*1.

*1: Representative values.

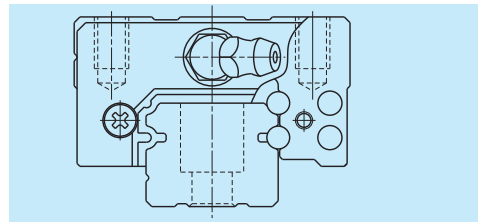


Fig. 1 HS Model

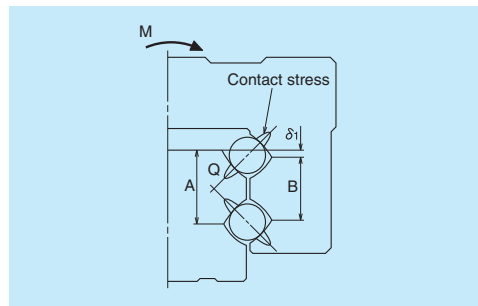


Fig. 2 Enlarged illustration: Offset Gothic arch

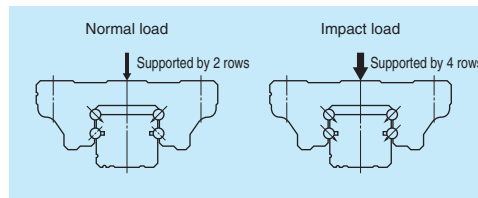


Fig. 3 When load is applied

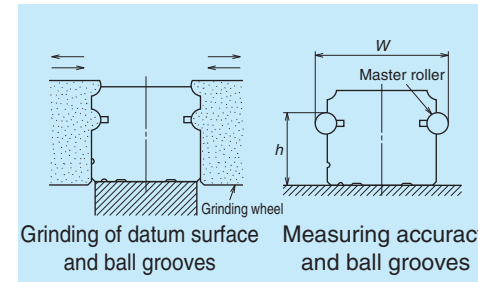


Fig. 4 Rail-grinding and measuring

Measurement results of ball passage vibration

Ball passage vibration can translate into posture changes in the ball slide which result from ball passage (circulation). In the HS Model, this vibration has been substantially reduced to one-third of conventional models.

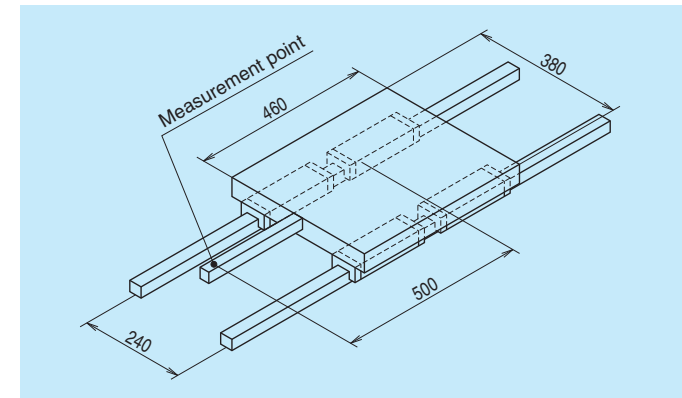


Fig. 5 Schematic view of measurement of ball passage vibration

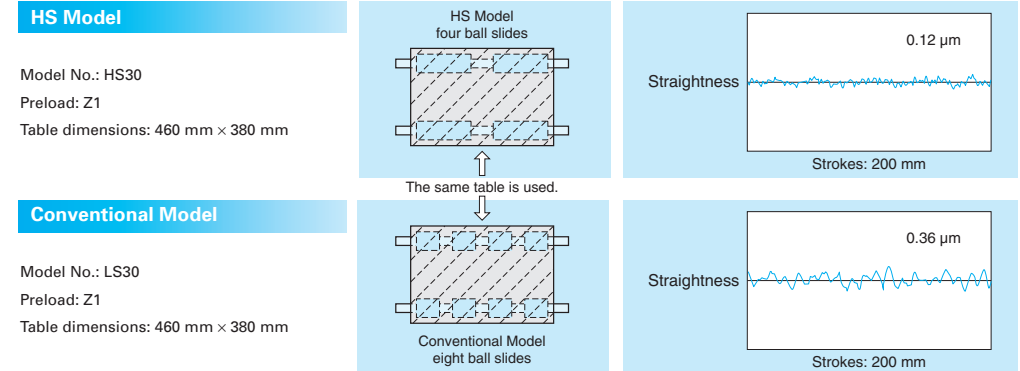


Fig. 6 Measurement results for the HS model vs. conventional model

2. Ball slide shape

Ball slide Shape code	Shape/installation method	Type
AL		
EM		

3. Accuracy and preload

(1) Running parallelism of ball slide

Table 1

Unit: μm

Accuracy grade	Preloaded assembly		
	Ultra precision P3	Super precision P4	High precision P5
Rail length(mm) over			
or less			
- 200	2	2	3.5
200 - 250	2	2.5	4.5
250 - 315	2	2.5	5
315 - 400	2	3	5.5
400 - 500	2	3	6
500 - 630	2	3.5	6.5
630 - 800	2	4	7
800 - 1 000	2.5	4.5	7.5
1 000 - 1 250	3	5	8.5
1 250 - 1 600	3.5	5.5	9.5
1 600 - 2 000	4	6.5	11
2 000 - 2 500	4.5	7.5	12
2 500 - 3 150	5.5	8.5	13
3 150 - 4 000	6	9.5	14

(2) Accuracy Standard

Three accuracy grades are available: Ultra precision P3, Super precision P4 and High precision P5.

Table 2

Unit: μm

Characteristics	Ultra precision P3	Super precision P4	High precision P5
Mounting height H	± 8	± 10	± 20
Variation of H (All ball slides on a set of rails)	3	5	7
Mounting width W_2 or W_3	± 10	± 15	± 25
Variation of W_2 or W_3 (All ball slides on reference rail)	3	7	10
Running parallelism of surface C to surface A	Refer to Table 1 and Fig. 7		
Running parallelism of surface D to surface B	Refer to Table 1 and Fig. 7		

(3) Assembled accuracy

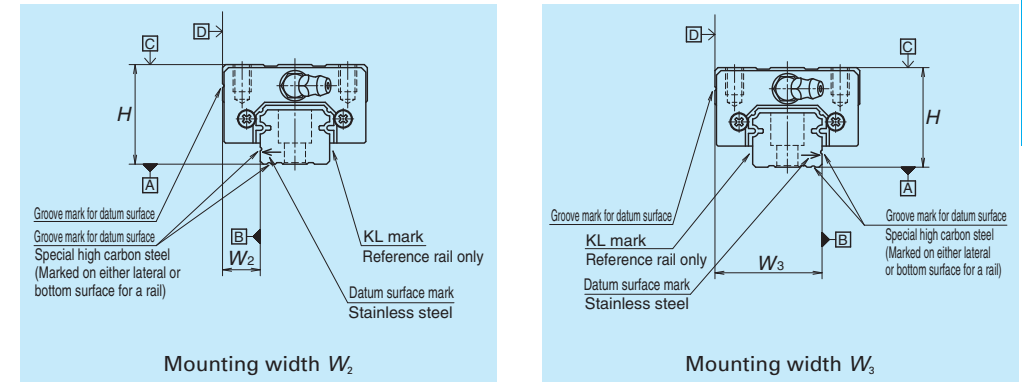


Fig. 7

(4) Preload and rigidity

Slight preload Z1 and Medium preload Z3 are available, which can be selected for specific applications.

Table 3

Model No.	Preload (N)		Rigidity (N/ μm)			
	Slight preload (Z1)	Medium preload (Z3)	Vertical direction		Lateral direction	
			Slight preload (Z1)	Medium preload (Z3)	Slight preload (Z1)	Medium preload (Z3)
HS15	98	785	260	530	173	355
HS20	147	1 030	305	600	212	415
HS25	245	1 620	385	735	263	505
HS30	390	2 550	505	965	345	665
HS35	590	3 550	610	1 140	415	780

4. Maximum rail length

Table 4 shows the limitation. The dimension in parenthesis is for stainless steel products. However, the limitations vary by accuracy grades.

Table 4 Length limitation of rails

Unit: mm

Model	Size	15	20	25	30	35
HS		2 000 (1 300)	3 960 (3 500)	3 960 (3 500)	4 000 (3 500)	4 000 (3 500)

Note: Rails can be butted if user requirements exceed the rail length shown in the table. Please consult NSK.

5. Installation

(1) Permissible values of mounting error

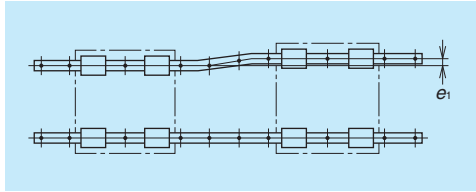


Fig. 8

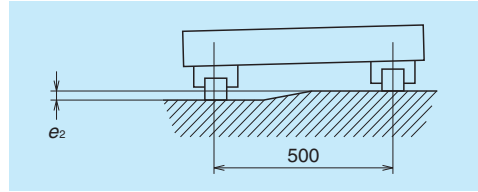


Fig. 9

Table 5

Unit: μm

Value	Preload	Model No.				
		HS15	HS20	HS25	HS30	HS35
Permissible values for parallelism error of two rails e_1	Z1	18	20	26	31	37
	Z3	12	14	18	22	26
Permissible values for height error of two rails e_2	Z1, Z3	330 μm /500 mm				

(2) Shoulder height of the mounting surface and corner radius r

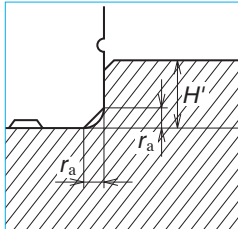


Fig. 10 Shoulder for the rail datum surface

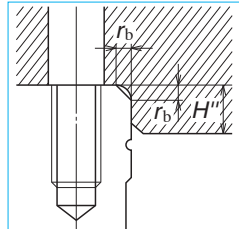


Fig. 11 Shoulder for the ball slide datum surface

Table 6

Unit: mm

Model No.	Corner radius (maximum)		Shoulder height	
	r_a	r_b	H'	H''
HS15	0.5	0.5	4	4
HS20	0.5	0.5	4.5	5
HS25	0.5	0.5	5	5
HS30	0.5	0.5	6	6
HS35	0.5	0.5	6	6

6. Lubrication components

Refer to pages A58 and D13 for linear guide lubrication.

(1) Types of lubrication accessories

Fig. 12 and Table 7 show grease fittings and tube fittings.

We provide lubrication accessories with an extended thread body length (L) for the addition of dust-resistant accessories such as NSK K1-L lubrication units, double seals and protectors. NSK can also provide extended length threads for ease of replenishment.

Please contact NSK if stainless lubrication accessories are required.

(2) Mounting position of lubrication accessories

The standard position for grease fittings is at the end face of the ball slide, but we can mount them on the side of the end cap as an option. (Fig. 13)

Please consult NSK for the installation of grease or tube fittings to the ball slide body.

Using a piping unit with thread of M6 \times 1 requires a connector to connect to a grease fitting mounting hole with M6 \times 0.75. The connector is available from NSK.

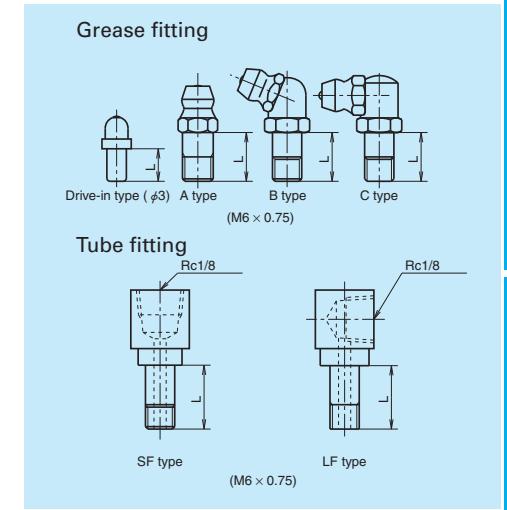


Fig. 12 Grease fitting and tube fitting

Table 7

Unit: mm

Model No.	Dust-resistant specification	Dimension L		
		Grease fitting /Drive-in type	Tube fitting	
			SF type	LF type
HS15	Standard	5	-	-
	With NSK K1-L	10	-	-
	Double seal	*	-	-
HS20	Standard	5	-	-
	With NSK K1-L	10	-	-
	Double seal	8	-	-
HS25	Standard	5	6	6
	With NSK K1-L	12	11	11
	Double seal	10	9	9
HS30	Standard	5	6	6
	With NSK K1-L	14	12	13
	Double seal	12	10	11
HS35	Standard	5	6	6
	With NSK K1-L	14	12	13
	Double seal	12	10	11

*) A connector is required for this model. Please contact NSK.

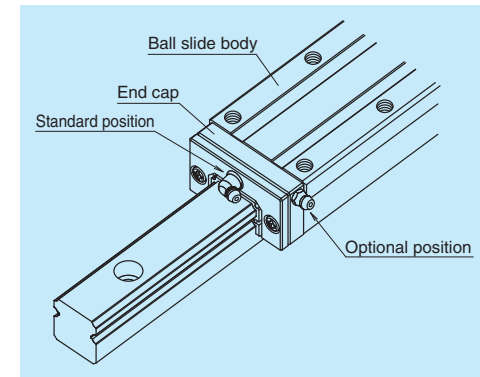


Fig. 13 Mounting position of lubrication accessories

7. Dust-resistant components

(1) Standard Specification

Under normal applications, the HS model can be used without modification thanks to its dust resistance. These ball slides come standard with an end seal on both ends.

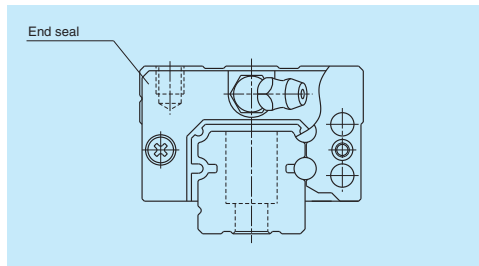


Fig. 14

Table 8 Seal friction per ball slide (maximum): end seal only

		Unit: N				
Model	Size	15	20	25	30	35
HS		3	3	3	3	4

(2) NSK K1-L™ lubrication unit

Refer to Table 9 for dimensions of linear guides equipped with NSK K1-L lubrication units.

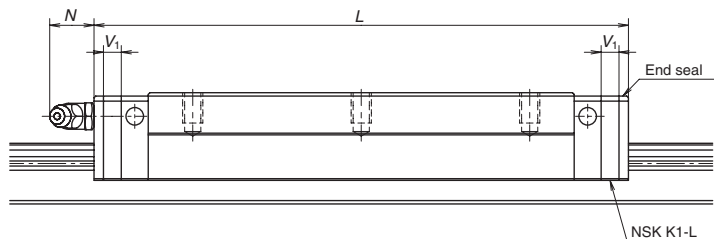


Table 9 Dimensions when equipped with NSK K1-L lubrication units

		Unit: mm			
Model No.	Ball slide shape code	Standard ball slide length	Ball slide length with two NSK K1-L units L	Thickness of single NSK K1-L unit V ₁	Protrusion of grease fitting N
HS15	AL, EM	106	115.6	4.8	(5)
HS20	AL, EM	119.7	130.3	5.3	(14)
HS25	AL, EM	148	158.6	5.3	(14)
HS30	AL, EM	176.1	188.1	6	(14)
HS35	AL, EM	203.6	216.6	6.5	(14)

Note: Slide length when equipped with NSK K1-L = (standard ball slide length) + (V₁ thickness of single NSK K1-L unit) × (number of K1-L units).

(3) Double seal and protector

For the HS Model, double seals and protectors can be installed only before shipping from the factory. Please consult with NSK when double seals or protectors are required.

Table 10 shows the increased thickness of V₃ and V₄ when the end seal and the protector are installed.

Table 10 Unit: mm

Model No.	Thickness of end seal: V ₃	Thickness of protector: V ₄
HS15	2.8	3
HS20	2.5	2.7
HS25	2.8	3.2
HS30	3.6	4.2
HS35	3.6	4.2

(4) Caps to plug the rail mounting bolt hole

Table 11 Caps to plug rail bolt hole

Model No.	Bolt to secure rail	Cap reference No.	Quantity /case
HS15	M3	LG-CAP/M3	20
HS15	M4	LG-CAP/M4	20
HS20	M5	LG-CAP/M5	20
HS25, HS30	M6	LG-CAP/M6	20
HS35	M8	LG-CAP/M8	20

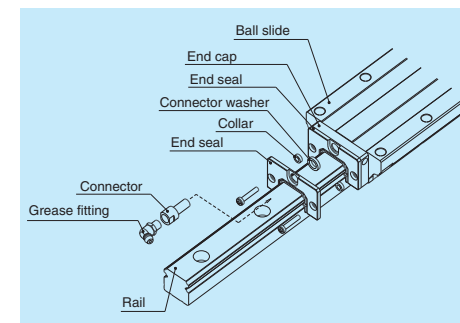


Fig. 15 Double seal

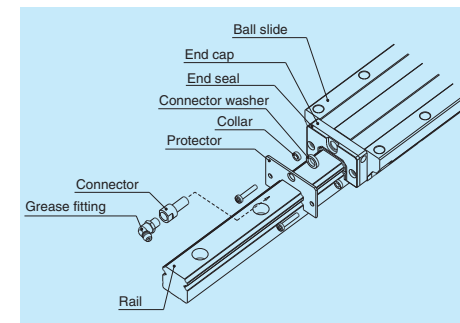


Fig. 16 Protector

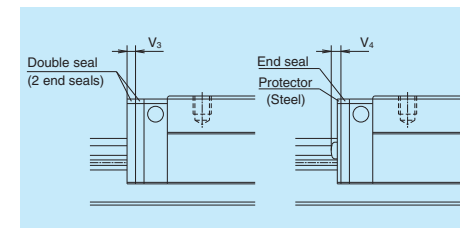


Fig. 17

8. Reference number

A reference number (designation) is set and indicated on the specification drawing for an individual NSK linear guide when its specifications are finalized.
Please specify the reference number, except design serial number, to identify the product when ordering, requiring estimates, or inquiring about specifications from NSK.

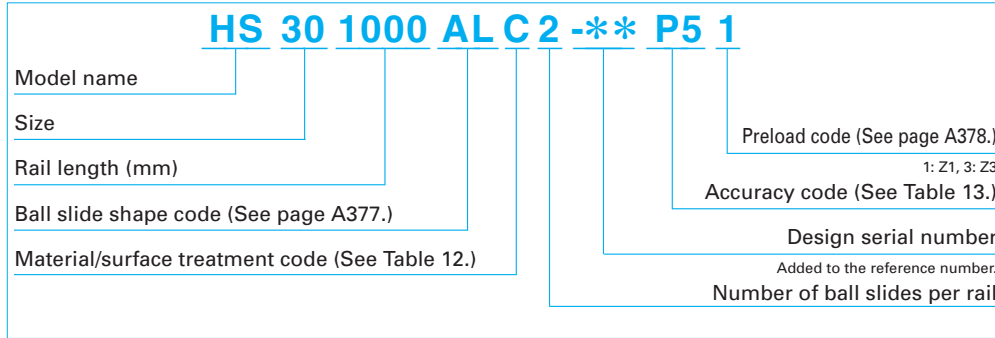


Table 12 Material/surface treatment code

Code	Description
C	Special high carbon steel (NSK standard)
K	Stainless steel
D	Special high carbon steel with surface treatment
H	Stainless steel with surface treatment
Z	Other, special

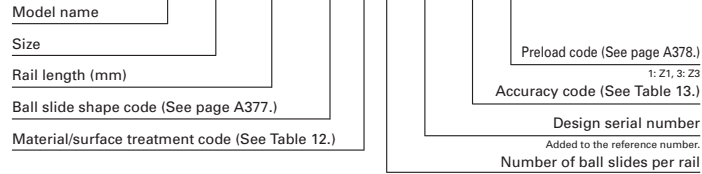
Table 13 Accuracy code

Accuracy	Standard (Without NSK K1-L)	With NSK K1-L
Ultra precision grade	P3	L3
Super precision grade	P4	L4
High precision grade	P5	L5

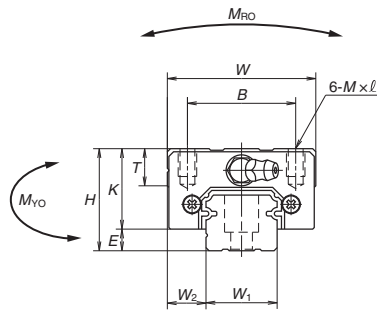
Note: Refer to page A58 for details on NSK K1-L lubrication units.

9. Dimensions
HS-AL

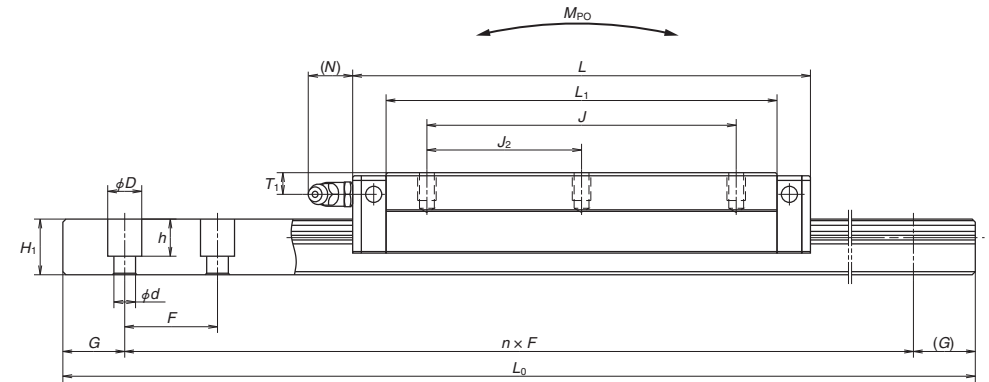
HS 30 1000 AL C 2 - P5 1**



Front view of AL types



Side view of AL type



Model No.	Assembly			Ball slide										Width	Height		
	Height	E	W ₂	Width	Length	Mounting hole					Grease fitting					Width	Height
						B	J	J ₂	M × pitch × l	L ₁	K	T	Hole size				
HS15AL	24	4.6	9.5	34	106	26	60	30	M4×0.7×6	89.2	19.4	10	φ 3	6	3	15	12.5
HS20AL	28	6	11	42	119.7	32	80	40	M5×0.8×7	102.5	22	12	M6×0.75	5.5	11	20	15.5
HS25AL	33	7	12.5	48	148	35	100	50	M6×1×9	126.4	26	12	M6×0.75	7	11	23	18
HS30AL	42	9	16	60	176.1	40	120	60	M8×1.25×12	150.7	33	13	M6×0.75	8	11	28	23
HS35AL	48	10.5	18	70	203.6	50	140	70	M8×1.25×12	175.6	37.5	14	M6×0.75	8.5	11	34	27.5

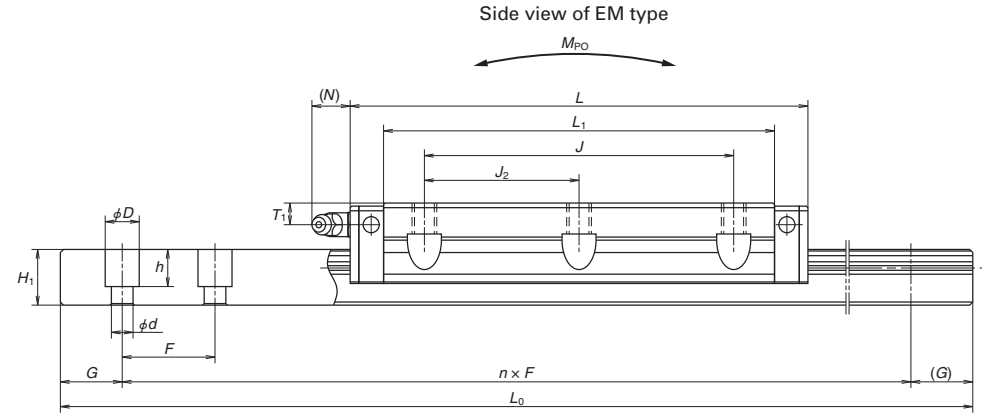
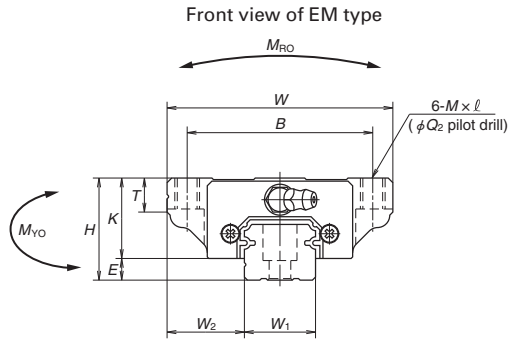
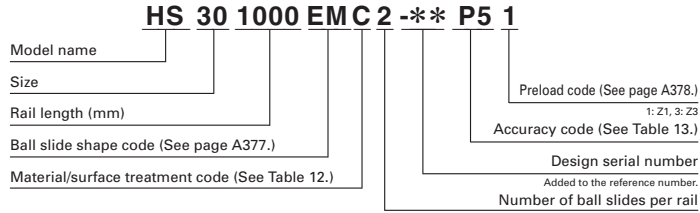
Notes: 1) The HS model does not have a ball retainer. Note that balls will fall out when the ball slide is removed from the rail.
2) The external appearance of stainless steel ball slides differs slightly from that of carbon steel ball slides.

Unit: mm

Rail		G	Max. length L _{max} () for stainless	Basic load ratings						Weight			
Pitch	Mounting bolt hole			Dynamic		Static	Static moment (N·m)				Ball slide (kg)	Rail (kg/m)	
				[50km]	[100km]		M _{RO}	M _{PO}		M _{YO}			
F	d × D × h	(reference)	() for stainless	C ₅₀ (N)	C ₁₀₀ (N)	C ₀ (N)		M _{PO}	M _{YO}	One slide	Two slides	One slide	Two slides
30	*4.5×7.5×8.5 3.5×6×8.5	20	2 000 (1 300)	20 500	16 300	40 000	199	395	1 990	335	1 670	0.34	1.4
30	6×9.5×10.5	20	3 960 (3 500)	27 300	21 600	52 000	350	590	2 930	495	2 460	0.52	2.3
30	7×11×12	20	3 960 (3 500)	44 500	35 000	78 000	605	1 090	5 450	910	4 600	0.85	3.1
40	7×11×16	20	4 000 (3 500)	68 000	54 000	127 000	1 190	2 120	10 600	1 780	8 850	1.7	4.8
40	9×14×20	20	4 000 (3 500)	94 500	75 000	172 000	1 980	3 350	16 600	2 820	13 900	2.5	7.0

3) Basic load ratings comply with ISO standards (ISO 14728-1, 14728-2).
C₅₀: the basic dynamic load rating for 50 km rated fatigue life C₁₀₀: the basic dynamic load rating for 100 km rated fatigue life
The basic static load rating shows static permissible load.
4) Parenthesized dimensions are applicable to stainless steel products.
*) Standard rail mounting bolt hole for HS15 is specified as hole for M4 (4.5 × 7.5 × 8.5). Please contact us to request a different hole for M3 (3.5 × 6 × 8.5).

HS-EM



Model No.	Assembly			Ball slide														
	Height	Width	Length	Mounting hole										Grease fitting		Width	Height	
				H	E	W_2	W	L	B	J	J_2	$M \times \text{pitch} \times l$	Q_2	L_1	K			T
HS15EM	24	4.6	18.5	52	106	41	60	30	M5×0.8×7	4.4	89.2	19.4	8	$\phi 3$	6	3	15	12.5
HS20EM	28	6	19.5	59	119.7	49	80	40	M6×1×9 (M6×1×9.5)	5.3	102.5	22	10	M6×0.75	5.5	11	20	15.5
HS25EM	33	7	25	73	148	60	100	50	M8×1.25×10 (M8×1.25×11.5)	6.8	126.4	26	11 (12)	M6×0.75	7	11	23	18
HS30EM	42	9	31	90	176.1	72	120	60	M10×1.5×12 (M10×1.5×14.5)	8.6	150.7	33	11 (15)	M6×0.75	8	11	28	23
HS35EM	48	10.5	33	100	203.6	82	140	70	M10×1.5×13 (M10×1.5×14.5)	8.6	175.6	37.5	12 (15)	M6×0.75	8.5	11	34	27.5

Notes: 1) The HS model does not have a ball retainer. Note that balls will fall out when the ball slide is removed from the rail.
2) The external appearance of stainless steel ball slides differs slightly from that of carbon steel ball slides.

Unit: mm

Rail		Basic load ratings									Weight		
Pitch	Mounting bolt hole	G	Max. length L_{max} () for stainless	Dynamic		Static C_0 (N)	M_{RO}	Static moment (N·m)				Ball slide (kg)	Rail (kg/m)
				[50km] C_{50} (N)	[100km] C_{100} (N)			M_{PO}		M_{YO}			
F	$d \times D \times h$	(reference)	() for stainless			(N)		One slide	Two slides	One slide	Two slides		
30	*4.5×7.5×8.5 3.5×6×8.5	20	2 000 (1 300)	20 500	16 300	40 000	199	395	1 990	335	1 670	0.45	1.4
30	6×9.5×10.5	20	3 960 (3 500)	27 300	21 600	52 000	350	590	2 930	495	2 460	0.67	2.3
30	7×11×12	20	3 960 (3 500)	44 500	35 000	78 000	605	1 090	5 450	910	4 600	1.3	3.1
40	7×11×16	20	4 000 (3 500)	68 000	54 000	127 000	1 190	2 120	10 600	1 780	8 850	2.4	4.8
40	9×14×20	20	4 000 (3 500)	94 500	75 000	172 000	1 980	3 350	16 600	2 820	13 900	3.4	7.0

3) Basic load ratings comply with ISO standards (ISO 14728-1, 14728-2).
 C_{50} : the basic dynamic load rating for 50 km rated fatigue life C_{100} : the basic dynamic load rating for 100 km rated fatigue life
The basic static load rating shows static permissible load.
4) Parenthesized dimensions are applicable to stainless steel products.
*) Standard rail mounting bolt hole for HS15 is specified as hole for M4 (4.5 × 7.5 × 8.5). Please contact us to request a different hole for M3 (3.5 × 6 × 8.5).

A-5 Other Linear Rolling Guide Products

A-5-1 Linear Rolling Bushing

1. Features

(1) Low friction

Low friction owes to its design: Balls come into point contacts with raceway surface: the balls smoothly re-circulate. There is very little stick slip.

(2) Low noise

Noise level is low due to the ball retainer which is made of a synthetic resin.

(3) High precision

Due to NSK's superb quality control, precision is guaranteed.

(4) Dust resistance

Models with seals are available. These seals feature low friction and high durability thanks to a highly effective double-lip system.

(5) Superb durability

The material of outer sleeve is vacuum degassed, highly pure, and is heat-treated with good expertise.

(2) LB-T model (adjustable clearance) (Fig. 2)

LB-T linear rolling bushings feature a cut on the outer sleeve in the axial direction. When used with a housing with an adjustable inner diameter, they allow for the clearance between the linear shaft and inscribed circle (an imaginary circle connecting the tops of the balls) to be adjusted in minute increments.



Fig. 2 LB-T model (adjustable clearance)

2. Models

There are two models

(1) LB model (standard) (Fig. 1)

This model is the most commonly used, and is the only model that comes with a seal and in super precision grade.



Fig. 1 LB model (standard)

3. Accuracy

(1) Accuracy grades

- LB model (standard).....High precision grade S and super precision grade SP are available.
- LB-T model (adjustable clearance).....High precision grade S is available.

(2) Tolerance of rolling linear bushing, linear shaft, and housing

Table 1 Tolerance for inscribed circle of the linear rolling bushing and shaft diameter

Unit: μm

Nominal dimension/ inscribed circle diameter /shaft diameter (mm)		Tolerance/inscribed circle diameter ^{*1}				Tolerance/width B		Tolerance/slot distance of retaining rings B _n		Recommended tolerance/ shaft diameter			
		High precision grade S		Super high precision grade SP		High precision grade S Super high precision grade SP	High precision grade S Super high precision grade SP	High precision grade S Super high precision grade SP	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}				Eccentricity ^{*2}	Tolerance/housing inside diameter			
		High precision grade S		Super high precision grade SP		Super high precision grade SP	High precision grade S	Super high precision grade SP		
over	or less	upper	lower	upper	lower	Maximum	upper	lower	upper	lower
2.5	6						+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

*1) For adjustable clearance types, figures indicate tolerances before the cut is made.

*2) Eccentricity means the run-out of offset between the centers of outer sleeve diameter and inscribed circle diameter.

4. Composition of Reference Number

Example	LB	35	N	Y	SP
Linear rolling bushing					
Nominal inscribed circle diameter (linear shaft nominal diameter)					
N.....With retaining ring groove No code.....Without retaining ring groove					
No code.....Standard LB T.....Adjustable clearance LB-T					
					Accuracy grade No code.....High precision grade SP.....Super precision grade
					No code.....No seal D.....Single-side seal DD.....Double-side seal
					Plastic retainer

5. Lubrication and Friction

(1) Grease lubrication

① Supply at initial stage

At time of delivery, the linear rolling bushing has a coat of rust preventive agent. Wipe it off with clean kerosene or organic solvent. Dry with an air blower, etc., then apply grease. Lithium soap based grease with consistency levels of 2 are generally used (e.g. NSK Grease LR3, PS2, and AS2).

② Replenishment

- Sealed linear rolling bushings are designed to be disposable. Therefore, replenishing grease is considered to be not required. However, if replenishment becomes necessary due to a dirty environment or wear of the seal, remove the linear bushing from the shaft and replenish lubricant in the same manner as the initial lubricating.
- For items without seals, wipe off old grease from the linear shaft, and apply new grease.
- Intervals of replenishment are every 100 km in a dirty environment, 500 km in a slightly dirty environment, 1 000 km or no replenishing for a normal environment.

(2) Oil lubrication

It is not necessary to wash off the rust preventive agent applied before delivery. Use an oil of ISO viscosity grade VG15-100. Drip the oil on the linear shaft by an oil supply system.

Temperature to use

- 30°C to 50°C Viscosity VG15 - 46
- 50°C to 80°C Viscosity VG46 - 100

Lubricant is removed by the seal if the linear ball bearing has a seal. Therefore, the drip method cannot be used except for single-seal types.

(3) Friction coefficient

The linear rolling bushing has a small dynamic friction coefficient. This contributes to low power loss and temperature rise.

According to Fig. 3, the dynamic friction coefficient is merely 0.001-0.004. Also, at the speed of under 60 m/min, there is no danger of the temperature rising. Friction force can be obtained by the following formula.

$$F = \mu \cdot P \dots \dots \dots (1)$$

In this formula:

- F: Friction force (N)
- P: Load (vertical load to the shaft center line) (N)
- μ: Friction coefficient (dynamic or static)

For a sealed type, a seal resistance of 0.3 to 2.40 N is added to the above.

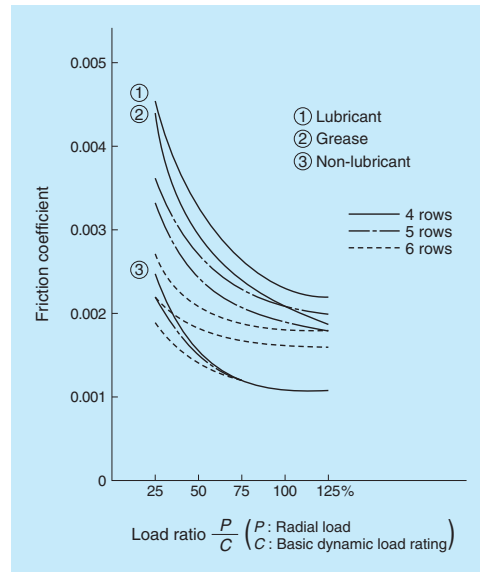


Fig. 3 Dynamic friction coefficient of linear rolling bushing

6. Range of Conditions to Use

Generally, use under the following conditions.

Please consult NSK when values exceed the ranges given below.

Temperature: - 30°C to 80°C

Speed: Up to 120 m/min

(excluding oscillation and short strokes)

7. Preload and Rigidity

The linear rolling bushing is normally used without applying preload. If high positioning accuracy is required, set the clearance between the linear rolling bush and the shaft at the range of 0 to 5 μm. Slight preload is a general rule (1% of basic dynamic load rating C -- see the dimension table).

The dimension table shows theoretical rigidity *K* when clearance with the shaft is zero, and a load of 0.1 C is applied to the summit of the ball.

Rigidity *K_N*, when load is not 0.1C, is obtained by the following formula.

$$K_N = K (P/0.1C)^{1/3} \dots \dots \dots (2)$$

In this formula:

- K: Rigidity value in the dimension table (N/μm)
- P: Radial load (N)

When the load is applied between the ball rows, the load becomes 1.122 times for 4 ball rows; 0.959 times for 5 ball rows; 0.98 times for 6 ball rows.

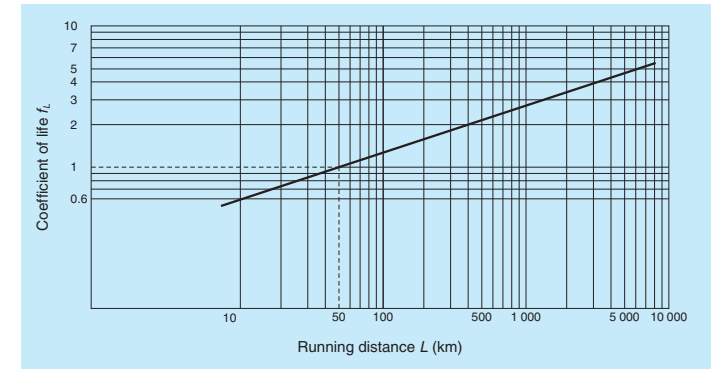


Fig. 4 Relationship between life factor and running distance

8. Basic Load Rating and Rated Life

(1) Basic dynamic load rating

Basic dynamic load rating C is a radial load which allows 90% of a group of linear rolling bush to run a distance of 50 km without suffering damage when they are moved individually.

There is a relationship as below between C and the life

$$L = 50 f_L^3 \dots \dots \dots (3)$$

$$f_L = C/P \dots \dots \dots (4)$$

In this formula:

- L: Rated life (km)
- P: Radial load (N)
- f_L: Life factor (Refer to Fig. 4)

This formula is used provided that the shaft hardness is HRC58 or higher. Rated life is shorter if the shaft is softer. In this case, find the hardness factor *f_H* from Fig. 5, and multiply the value.

$$f_L = C \cdot f_H/P \dots \dots \dots (5)$$

Or

$$C = P \cdot f_L/f_H \dots \dots \dots (6)$$

Life in time can be obtained by the following formula, substituting given stroke length, cycle numbers, and running distance:

$$L_h = (L/1.2 \cdot S \cdot n) \times 10^4 \dots \dots \dots (7)$$

In this formula:

- L_h: Life hours (h)
- L: Rated life (km)
- S: Stroke (mm)
- n: Cycles per minute (cpm)

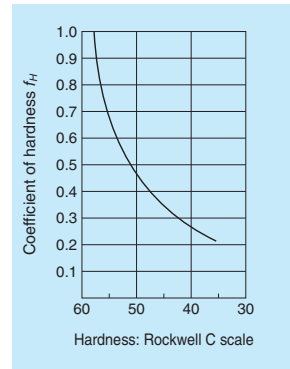


Fig. 5 Hardness factor

(2) Basic static load rating

It is a load that the total permanent deformation of outer sleeve, ball, and shaft at the contact point becomes 0.01% of the ball diameter when this load is applied to the rolling bushing. It is understood in general that this is the applicable load limit which causes this permanent deformation without hampering operation.

(3) Calculation example

What is the appropriate rolling bushing size if required life is 5 000 hours?

Conditions are:

- Three linear rolling bushings are installed in two parallel shafts, and support a reciprocating table.
- Load 450 N is equally distributed to the three bushings.
- The table is required to reciprocate on the shafts at 200 times per minute at a stroke of 70 mm.
- Hardness of the shaft: HRC 55

$$450/3 = 150 \text{ (N)}$$

• Load per linear rolling bushing is:

From Formula (7), the required life when indicated in distance is:

$$L = 5 \times 10^3 \times 1.2 \times 70 \times 200/10^4 = 8.4 \times 10^3 \text{ (km)}$$

From Fig. 4 and Fig. 5,

Life factor $f_L = 5.6$

Hardness factor $f_H = 0.65$

Therefore, from Formula (6),

$$C = P \times f_L / f_H = 150 \times 5.6 / 0.65 = 1\,292 \text{ (N)}$$

Based on the above, select linear rolling bushing LB30NY with shaft diameter of 30 mm, basic dynamic load rating of 1 400 N.

(4) Compensating load rating by ball row position

Load rating of the linear rolling bushing changes by the position of the ball circuit rows.

Permissible load is larger when it is applied to the middle of the ball circuit rows than when it is applied directly above the ball row (Fig. 6).

(Radial clearance set at zero in this case.)

Load ratings in the dimension tables are in case "A" when applied directly above the ball circuit row. If used as in case "B," the load rating becomes larger (refer to Fig. 6).

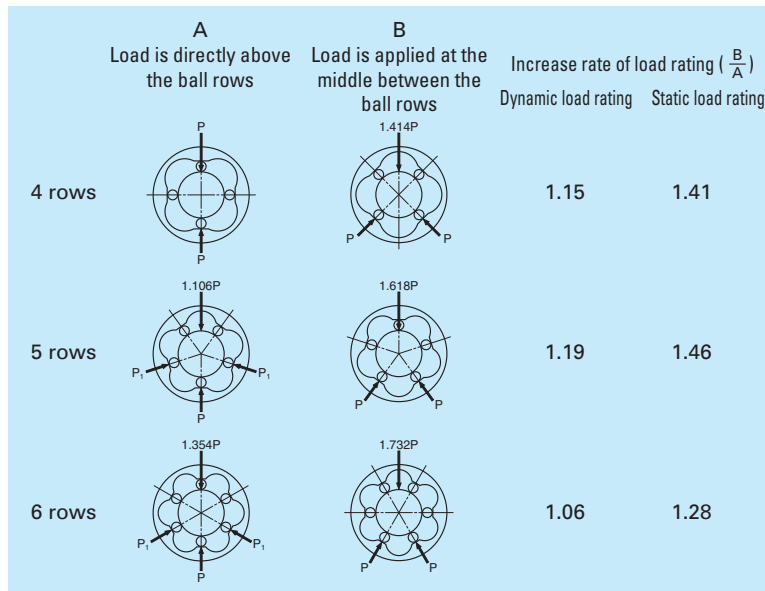


Fig. 6 Increasing rate of load rating by position of ball row (B/A)

9. Shaft Specifications

Harden the shaft surface where the balls run with heat treatment to provide the following values.

- Surface hardness: HRC58 or over
- Depth of core hardness at HRC50 or higher
 - Depth for LB3; 0.3 mm or deeper
 - Depth for LB50; 1.2 mm or deeper

Roughness of the surface should be:

- For SP grade, and "clearance for fit" with the ball bushing less than $5 \mu\text{m}$ - Less than 0.8 S
- For SP grade with "clearance" of more than $5 \mu\text{m}$, and for S grade - Less than 1.2 S

Bending should be:

- LB3 -- $15 \mu\text{m}/100 \text{ mm}$
- LB50 -- $100 \mu\text{m}/1\,000 \text{ mm}$

An appropriate clearance for normal use conditions can be obtained when the tolerance in shaft diameter remains within the recommended range (refer to Table 1 on page A390). For operations which require particular accuracy, select the shaft diameter which creates a clearance in the range of 0 to 0.005 (mm) for example, when assembled with the rolling bushing.

10. Dust resistance

Select a linear rolling bushing with seals to prevent moisture or foreign matter floating in the air from entering.

11. Installation

(1) Combination of shaft and linear rolling bushing

When the linear rolling bushing is installed in a linear motion table for its reciprocating movement, it is necessary to prevent the table from rotating. In general, for this reason, two shafts installed with two linear rolling bushings on each are used.

Fig. 7 is an installation example.

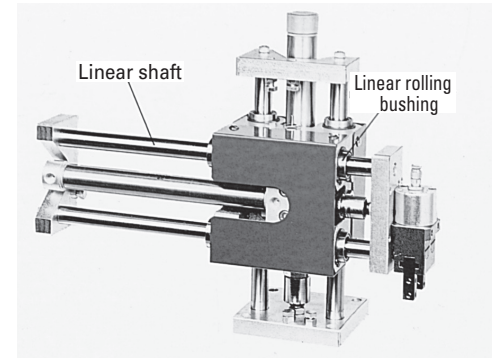


Fig. 7 Installation example

(2) Installation of linear rolling bushing

1) Installation of standard type

Fig. 8 shows a method using a retaining ring. Linear rolling bushings can also be secured to the housing using a stop plate and/or screw.

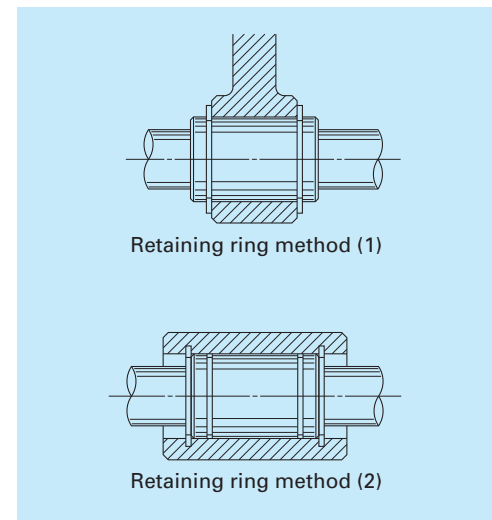


Fig. 8 Installation using retaining rings

a) Housing inside diameter should be of a recommended value (Table 2, page A390). The entire rolling bushing contracts and gives excessive preload if the inside diameter is small or the roundness or cylindricity is excessive. This may result in an unexpected failure.

b) To install linear rolling bushing, use a tool (Fig. 9) and squeeze it in, or use a holder and lightly pound it.

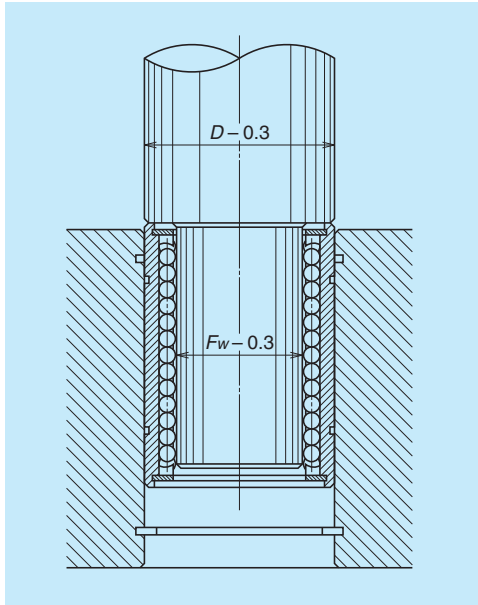


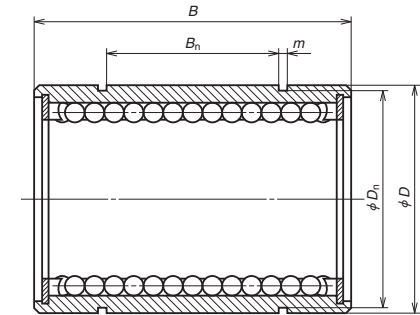
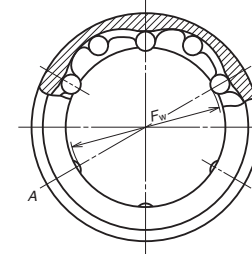
Fig. 9 Tool to install a linear rolling bushing

(3) Precautions for installing a shaft in the linear rolling bushing

- 1) To install two shafts parallel to each other, first install one shaft accurately. Use this as a reference, and install the other parallel to the first shaft. This makes installation easy.
- 2) Do not incline the shaft when inserting it into the linear rolling bushing. Do not force it to enter by twisting. This deforms the retainer, and causes the balls to fall out.
- 3) Do not use the shaft for rotating movement after inserting the shaft to the linear rolling bushing. The balls slip and damage the shaft.
- 4) Do not twist the shaft after it is inserted to the linear rolling bushing. The pressure scars the shaft.

12. Dimension tables

Model LB (standard), no seal



Section A-A

2) Installation of adjustable clearance type

Use a housing which can adjust the inside diameter of the rolling bushing. This way, the clearance between the rolling bushing and the linear shaft can be easily adjusted. Arrange the cut-open section of the rolling bushing at a 90-degree angle to the housing's cut-open section. This is the most effective way to evenly distribute deformation toward circumferential direction.

The tolerance of shaft diameter of the adjustable clearance type should be within the recommended range (refer to **Table 1** on page A390). As a general rule, set the preload at slight or light volume. (Do not provide excessive preload.) Use a dial gauge to measure and adjust clearance. However, here is an easy method to adjust .

First, loosen the housing until shaft turns freely. Then narrow the clearance gradually. Stop at the point when the shaft rotation becomes heavy. This creates a clearance zero or light preload.

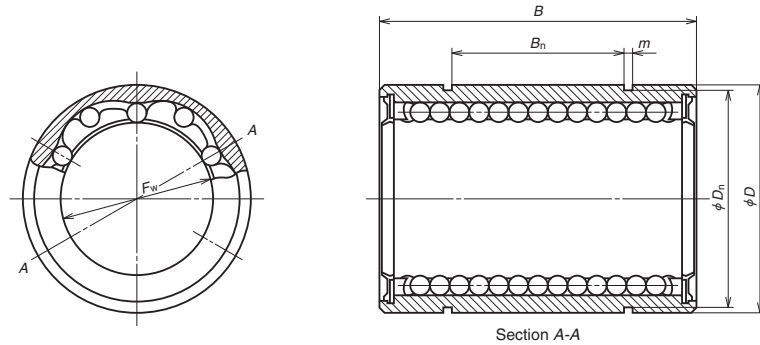
Unit: mm

Model No.	Inscribed circle diameter F_w	Outside diameter D	Length B	Retaining ring groove			Stiffness*1 (N/μm)	Number of ball circuits	Weight (kg) <small>(Reference only)</small>	Basic dynamic load rating C (N)	Basic static load rating C_0 (N)
				Distance B_n	Width m	Bottom diameter D_n					
LB3Y	3	7	10	—	—	—	3	4	0.0016	20	39
LB4Y	4	8	12	—	—	—	4.5	4	0.0022	29	59
LB6NY	6	12	19	11	1.15	11.5	7	4	0.0074	74	147
LB8ANY *2	8	15	17	9	1.15	14.3	5.5	4	0.0094	78	118
LB8NY	8	15	24	15	1.15	14.3	9.5	4	0.014	118	226
LB10NY	10	19	29	19	1.35	18	12	4	0.025	206	355
LB12NY	12	21	30	20	1.35	20	13	4	0.028	265	500
LB13NY	13	23	32	20	1.35	22	13	4	0.040	294	510
LB16NY	16	28	37	23	1.65	26.6	14	4	0.063	440	635
LB20NY	20	32	42	27	1.65	30.3	19	5	0.088	610	1 010
LB25NY	25	40	59	37	1.9	38	35	6	0.267	1 000	1 960
LB30NY	30	45	64	40	1.9	42.5	41	6	0.305	1 400	2 500
LB35NY	35	52	70	45	2.2	49	48	6	0.440	1 510	2 800
LB40NY	40	60	80	56	2.2	57	54	6	0.520	2 230	4 000
LB50NY	50	80	100	68	2.7	76.5	69	6	1.770	4 100	7 100

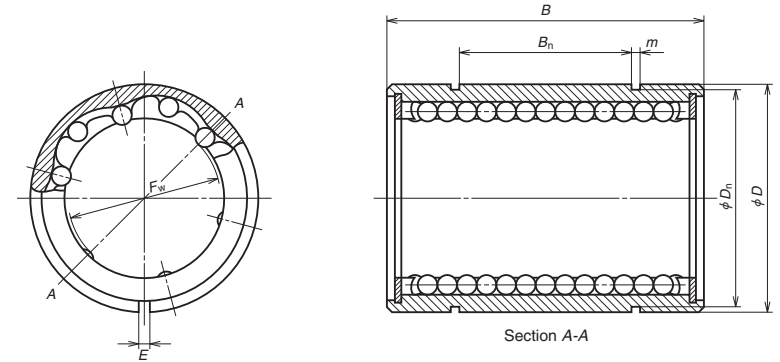
*1): Refer to Section (7).

*2): Semi-standard item of which length B is shorter than standard.

Model LB (standard), with seal



Model LB-T (Adjustable clearance)



Unit: mm

*Model No.	Inscribed circle diameter F_w	Outside diameter D	Length B	Retaining ring groove			Number of ball circuits	Weight (kg) (Reference only)	Basic dynamic load rating C (N)	Basic static load rating C_0 (N)
				Distance B_n	Width m	Bottom diameter D_n				
LB6NYDD	6	12	19	11	1.15	11.5	4	0.0074	74	147
LB8ANYDD	8	15	17	9	1.15	14.3	4	0.0094	78	118
LB8NYDD	8	15	24	15	1.15	14.3	4	0.014	118	226
LB10NYDD	10	19	29	19	1.35	18	4	0.025	206	355
LB12NYDD	12	21	30	20	1.35	20	4	0.028	265	500
LB13NYDD	13	23	32	20	1.35	22	4	0.040	294	510
LB16NYDD	16	28	37	23	1.65	26.6	4	0.063	440	635
LB20NYDD	20	32	42	27	1.65	30.3	5	0.088	610	1 010
LB25NYDD	25	40	59	37	1.9	38	6	0.267	1 000	1 960
LB30NYDD	30	45	64	40	1.9	42.5	6	0.305	1 400	2 500
LB35NYDD	35	52	70	45	2.2	49	6	0.440	1 510	2 800
LB40NYDD	40	60	80	56	2.2	57	6	0.520	2 230	4 000
LB50NYDD	50	80	100	68	2.7	76.5	6	1.770	4 100	7 100

Unit: mm

Model No.	Inscribed circle diameter F_w	Outside diameter D	Length B	Opening width E	Retaining ring groove			Number of ball circuits	Weight (kg) (Reference only)	Basic dynamic load rating C (N)	Basic static load rating C_0 (N)
					Distance B_n	Width m	Bottom diameter D_n				
LB6NTY	6	12	19	0.8	11	1.15	11.5	4	0.0073	74	147
LB8ANTY	8	15	17	1	9	1.15	14.3	4	0.0093	78	118
LB8NTY	8	15	24	1	15	1.15	14.3	4	0.014	118	226
LB10NTY	10	19	29	1.5	19	1.35	18	4	0.025	206	355
LB12NTY	12	21	30	1.5	20	1.35	20	4	0.028	265	500
LB13NTY	13	23	32	1.5	20	1.35	22	4	0.040	294	510
LB16NTY	16	28	37	1.5	23	1.65	26.6	4	0.062	440	635
LB20NTY	20	32	42	2	27	1.65	30.3	5	0.087	610	1 010
LB25NTY	25	40	59	2	37	1.9	38	6	0.265	1 000	1 960
LB30NTY	30	45	64	2	40	1.9	42.5	6	0.302	1 400	2 500
LB35NTY	35	52	70	3	45	2.2	49	6	0.44	1 510	2 800
LB40NTY	40	60	80	3	56	2.2	57	6	0.52	2 230	4 000
LB50NTY	50	80	100	3	68	2.7	76.5	6	1.75	4 100	7 100

*) Single-seal type is indicated as LB-D.

A-5-2 Roller Pack

1. Structure

A roller pack comprises a main body which supports load from the guide way block via two rows of rollers, an end cap which changes the direction of the re-circulation of rollers at the end of the main body, and a side plate which guides the rollers (Fig. 1). Roller packs are a type of linear rolling guide, where rollers are allowed to re-circulate infinitely.

There is a plate spring attached to a side of roller pack to prevent the roller pack from falling out when it is turned upside down after assembly.

Another component of the roller pack is the spring pin. A spring pin is on the top surface of the roller pack, and makes installation of the wedge block and fitting plate easier.

A wedge block is a unit to provide preload (Fig. 3) to roller pack; a fitting plate (Fig. 2), functioning like a pivot, adjusts misalignment of roller pack automatically. The wedge on the wedge block moves up and down to apply preload by turning the adjustment screw.



Photo 1 Roller pack

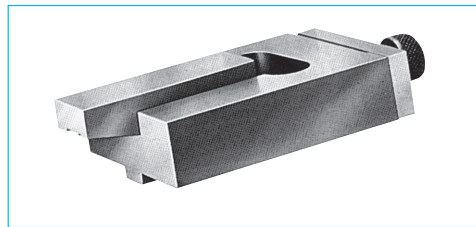


Photo 2 Wedge block

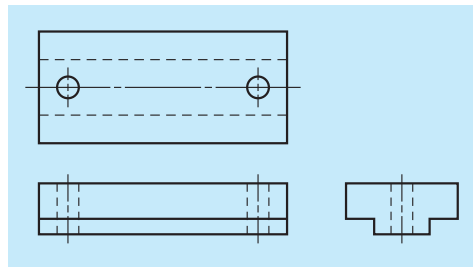


Fig. 2 Fitting plate

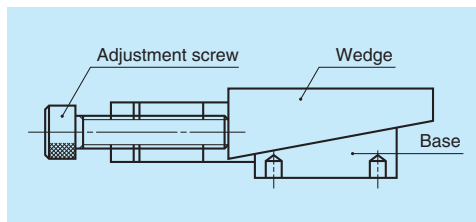


Fig. 3 Wedge block

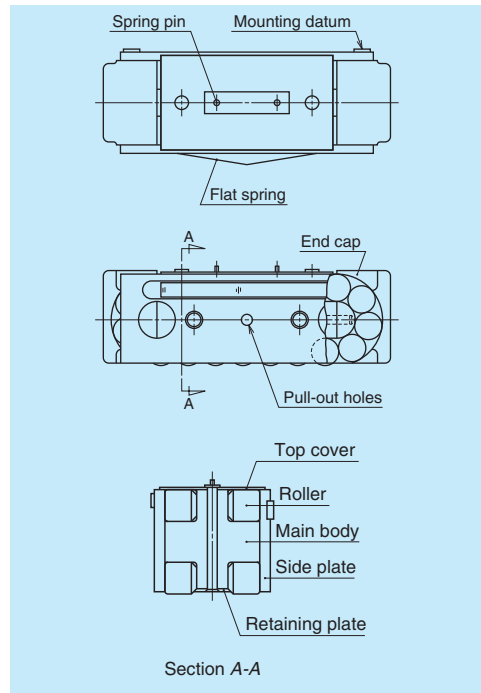


Fig. 1 Roller pack

2. Features

Roller packs have two remarkable characteristics other linear roller guide bearings do not have.

(1) No roller skewing

If the roller is long relative to its diameter, the roller inclines during operation. This phenomenon is called skewing. Skewing causes problems such as sudden rise in friction force. However, a short roller lacks large load carrying capacity. The roller introduced here solved the skewing problem, yet has a large load carrying capacity:

short rollers are combined into double rows.

(2) Load is applied equally.

This is due to a "fitting plate," a result of a "changed way of conceiving." Installation is quite easy: Merely place the fitting plate through the two holes to spring pins. The stop pins are inserted to holes on the top surface of the roller pack. The contact area between the fitting plate and the main body is made small. This way, self-alignment is automatically accomplished by elastic contact of both parts.

This distributes an equal load to the rollers, far extending the life, compared to conventional roller linear guides.

Roller packs also allow for easy application of preload by the wedge block, installation to vertical shafts, and reduced noise levels.

3. Accuracy

The height tolerance of roller pack is 10 μm. Roller packs are grouped into by size for every 2 μm (coded by A to E) before delivery (Table 1).

Table 1 Height Classification

Category		Code
over	or less	
+3	+5	A
+1	+3	B
-1	+1	C
-3	-1	D
-5	-3	E

4. Rigidity

Fig. 4 shows the relationship between load and deformation. This includes deformation caused by contact between: the rollers and main body; the rollers and guide way surface; the main body and fitting plate.

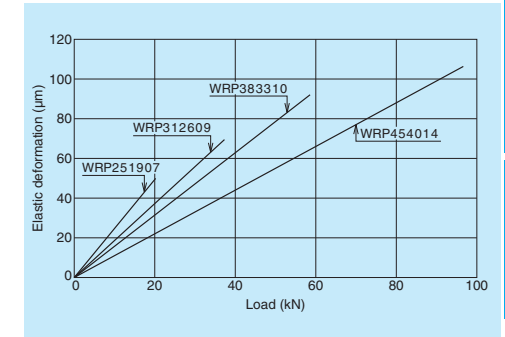


Fig. 4 Elastic deformation of the roller pack

5. Preload

Fig. 5 shows conversions of tightening torque of the wedge block adjustment screw into preload volume. Use a dial gauge for accurate measurement.

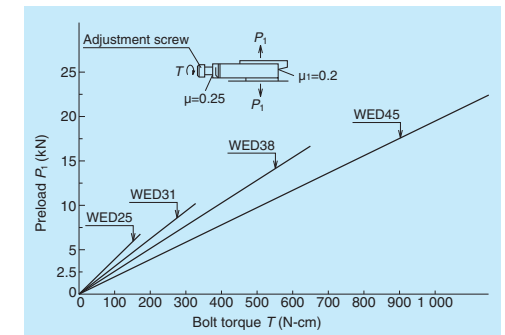


Fig. 5 Tightening torque of the adjustment screw, and preload volume

6. Friction and Lubrication

(1) Lubricants and volume

Mineral oils are commonly used. Since a roller pack is used under a relatively heavy load, the oil should, ideally, have high viscosity and provide a strong film. Select from JIS viscosity 32-150.

Criteria of oil supply per roller pack Q (cc/h) can be calculated by the following formula.

$$Q \geq S \times 1/4 \dots\dots\dots (1)$$

In this formula, S (stroke) is shown in meters. The oil volume, when the stroke is 1 m, per roller pack is more than 0.25 (cc/h). It is more desirable to supply a small amount of oil at short intervals than supplying a large amount at one time. In case of grease lubrication, use a grease of consistency 2. Albania EP2 is widely used.

(2) Friction coefficient

Starting friction coefficient is significantly small at under 0.005.

(3) Seal

It is necessary to install a wiper seal to the guide way surface to prevent foreign matter (swarf from cutting, and other dust) from entering the roller pack to enjoy the full benefit of the designed life. The material of the seal should have strong resistance to oil and wear. Felt and synthetic rubber (acrylonitril butadiene rubber) are some suitable materials. Fig. 6 shows a general method to install seals.

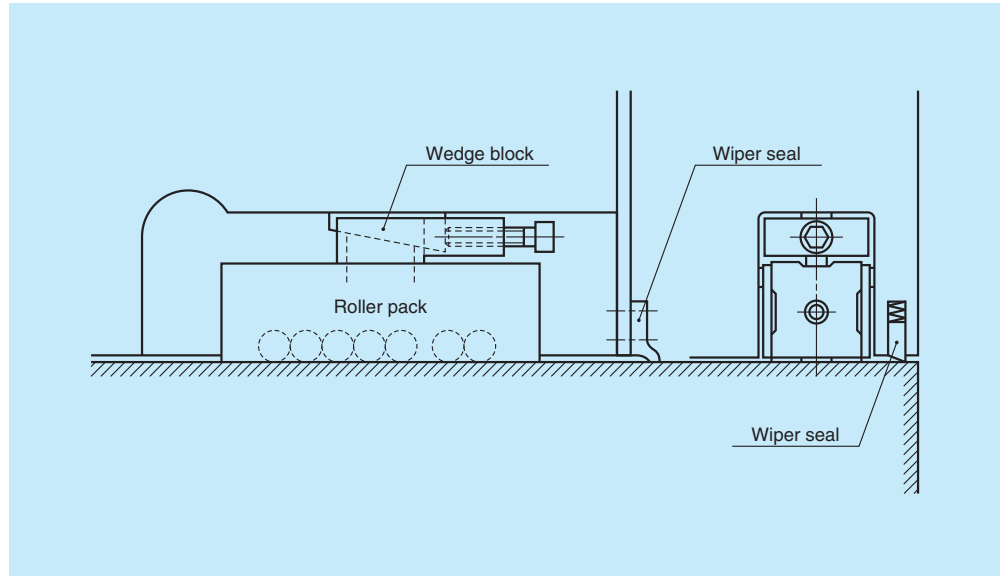


Fig. 6 Installation of seal

7. Installation

(1) Installation and applying preload

As shown in Fig. 7, a fitting plate is installed on the roller pack which receives load, and a wedge block is installed on the roller pack which receives no load, but is only used for preload. All components should be secured with a stop pin, facing toward the direction of movement. To cut costs for processing, it is recommended to divide the pocket (which contains roller pack) into some blocks and secure them with bolts (Fig. 7). Preload is provided by the wedge block. Estimate the actual load beforehand, so the preload shall not be lost when a load is applied. A load variation equivalent to up to two times of the preload volume can be absorbed in this case.

(Take into consideration the rated life in determining preload volume.)

(2) Accuracy of way block

The following is the ideal accuracy specification and installation accuracy of way block as a guide surface.

- Hardness by heat treatment : More than HRC58 hardened depth 2 mm or more
- Surface roughness : Less than 1.6 S
- Parallelism as a single unit: Less than 0.010 mm per meter
- Parallelism after installation : Less than 0.020 mm per meter

Please consult NSK when using cast iron or cast steel guide faces.

(3) Pocket accuracy

Accuracy of the pocket in which the roller pack is mounted should satisfy the following conditions.

- Pocket width : Roller pack width + 0.10 to 0.20 mm
- Parallelism of the pocket side faces to the guide way face : Less than 0.010 mm per 100 mm.
- Parallelism of the fitting plate (pocket bottom) mounting surface to the guide way face and parallelism of the wedge block mounting surface to the guide way surface : Less than 0.040 mm per 100 mm.

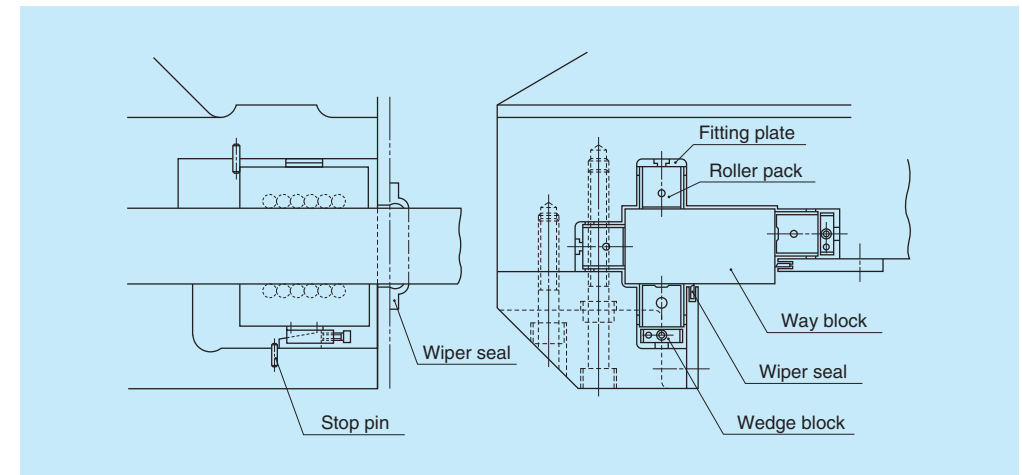


Fig. 7 Design of the roller pack pocket (example)

8. Rated life

Rated life L (km) is shown in the following formula.
In this formula:

$$L = 50 \left(\frac{C}{f_w \cdot F_c} \right)^{\frac{10}{3}} \dots\dots\dots (2)$$

- C: Basic dynamic load rating (N)
- f_w: Load factors. 1.0 to 1.2 at time of smooth operation
- F_c: Calculated load (N) applied to the roller pack

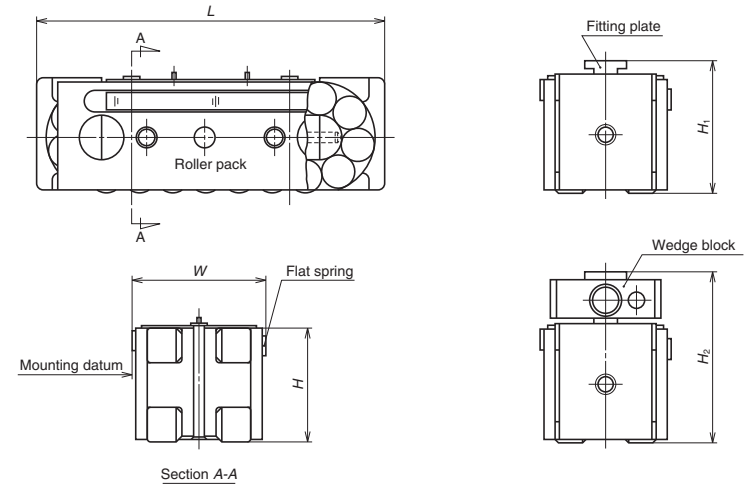
9. Disassembly

Remove the roller pack preloaded by the wedge block in the following manner.

- Loosen the adjust screw of the wedge block. Lightly tap the wedge. In case of light preload, the wedge loosens, and the roller pack can be pulled out.
- When pulling, put the bolt in the tap hole at the end of the end cap, and tug the bolt.
- In case of heavy load, the roller pack can not be pulled out by the above method. Hook a tool to the pull-out hole (Fig. 1) on the side plate of the roller pack, and pull out the roller pack.

10. Dimension Tables

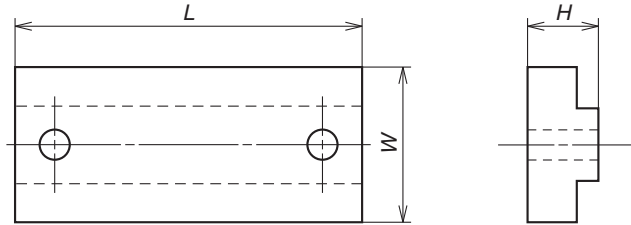
Roller pack: Model WRP



Unit: mm									
Model No.	Width W	Height ±0.005 H	Length L	Applicable fitting plate reference No.	Assembled height H ₁	Applicable wedge reference No.	Assembled height H ₂	Basic dynamic load rating C (N)	Basic static load rating C ₀ (N)
WRP 251907	25	19	65.5	WFT 25	24	WED 25	31 (30.4 – 31.6)	31 000	40 500
WRP 312609	31	26	85	WFT 31	31	WED 31	40 (39.4 – 40.6)	57 000	73 000
WRP 383310	38.1	33.31	104.4	WFT 38	38.91	WED 38	50.8 (50 – 51.5)	91 000	113 000
WRP 454014	45	40	138	WFT 45	45	WED 45	60 (59.2 – 60.8)	151 000	191 000

Note : Numbers in parentheses in column H₂ show the adjustable height range of the wedge block.

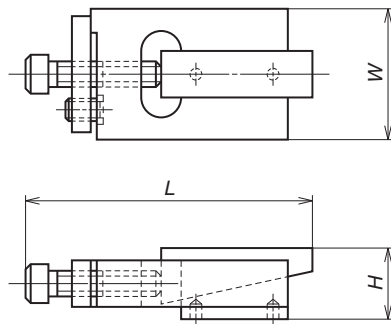
Fitting plate: Model WFT



Unit: mm

Model No.	Width W	Height (± 0.01) H	Length L	Applicable roller pack
WFT 25	10	5	20	WRP 251907
WFT 31	12	5	26	WRP 312609
WFT 38	12.8	5.6	29	WRP 383310
WFT 45	16	5	40	WRP 454014

Wedge block: Model WED



Unit: mm

Model No.	Width W	Height H	Length L	Applicable roller pack
WED 25	23	12 (11.5 – 12.5)	47	WRP 251907
WED 31	28	14 (13.5 – 14.5)	63	WRP 312609
WED 38	35	17.47 (16.9 – 18.1)	76	WRP 383310
WED 45	40	20 (19.2 – 20.8)	95	WRP 454014

Note : Numbers in parentheses in column H_2 show the adjustable height range of the wedge block.

B BLOCK Ball Screws

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B-1 Selection Guide for NSK Ball Screw

B-1-1 Features of NSK Ball Screws

(1) Quick delivery

Standard ball screws are for short lead times.

- Precision ball screws with finished shaft ends
Compact FA model, MA model, FA model, SA model, KA model
- Precision ball screws with blank shaft ends
MS model, FS model, SS model, HSS model
- Ball screws for transfer equipment with finished shaft ends
VFA model, RMA model
- Ball screws for transfer equipment with blank shaft ends
RMS model, R model

(2) Competitive prices

NSK reduces cost by well-planned mass production of standardized items. We rank the best in the world production of ordered items. We are able to offer our products at competitive prices by producing similar items in the same production group.

(3) Unparalleled accuracy

NSK utilizes its unique grinding technique and measuring equipment for top-notch precision.

(4) Superb durability

NSK uses thoroughly purified alloy steel for superb durability.

(5) No backlash, and unparalleled rigidity

NSK ball screws use Gothic arch grooves as shown in Fig. 1.1 to minimize the clearance between the balls and grooves. Further, an application of preload makes no backlash possible. As providing controlled preload is easy, appropriate rigidity is obtained.

As the Gothic arch also minimizes the clearance between the balls and the grooves, the backlash is minimized without applying preload.

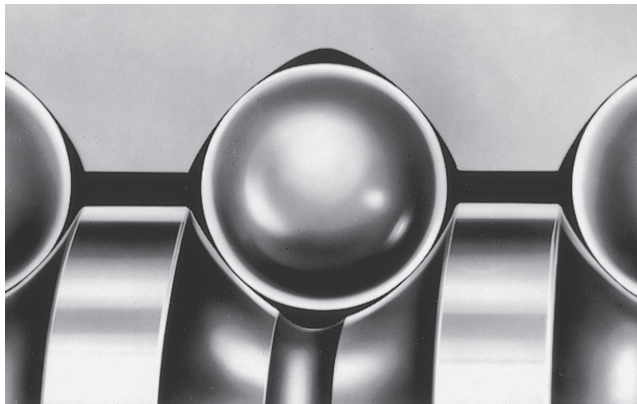


Fig. 1.1 Ball groove profile of NSK ball screw

(6) Smooth movement assures high efficiency

NSK uses a gothic-arch design for the ball grooves. This design prevents the balls from slightly wedging into the grooves of the ball nut and screw shaft and causing small vibrations. This phenomenon is common with the circular-arc design used by other manufacturers. The gothic arch, along with the low friction inherent in a ball screw, results in a smooth and highly efficient conversion of motion as shown in Fig. 1.2.

(7) Enhanced support units

Utilizing bearing technology, NSK produces high quality support units (for light load small equipment and heavy load machine tools) exclusively for ball screws. These units are standardized. NSK also offers quality-assured accessories such as lock nuts to tighten bearings, travel stoppers to prevent overrun, and sealing units to cool hollow shaft ball screws.

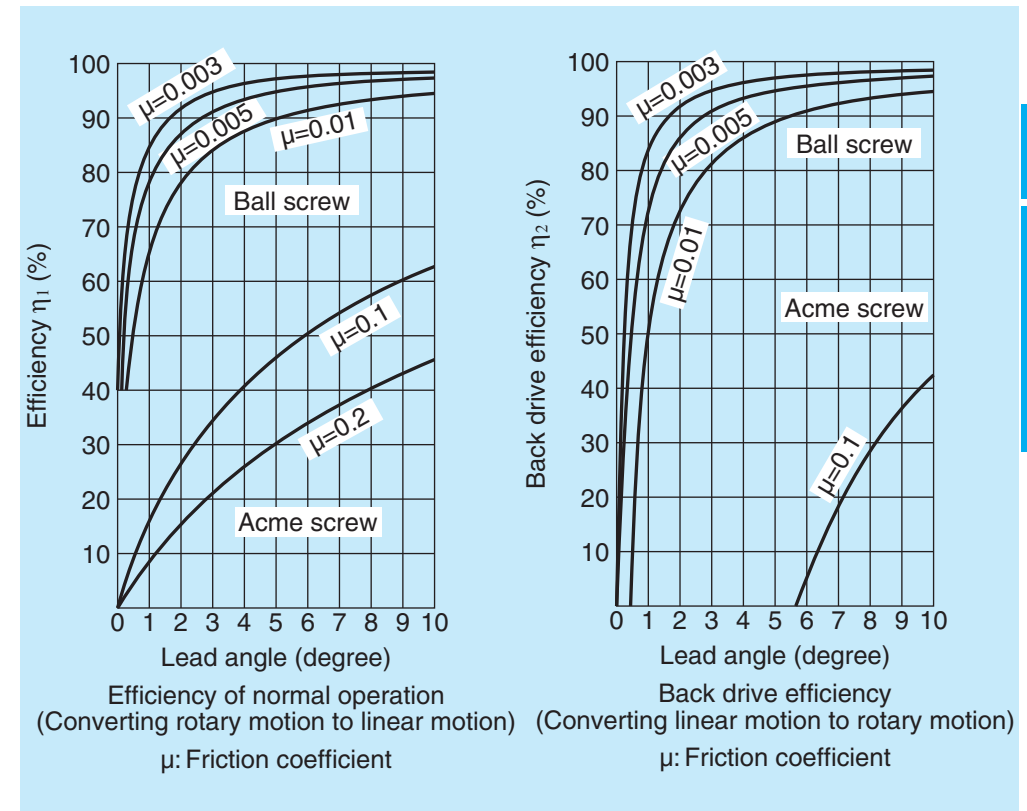


Fig. 1.2 Mechanical efficiency of ball screws

B-1-2 Structure of a Ball Screw

Balls are placed between the screw shaft and nut and roll. This system is called a "ball screw." To keep the balls recirculating continually, this system requires a screw shaft, a nut, balls, and recirculation components as basic items. A ball screw has the following functions.

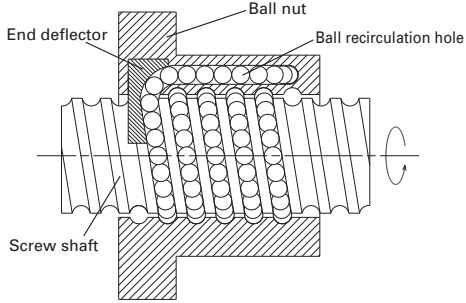
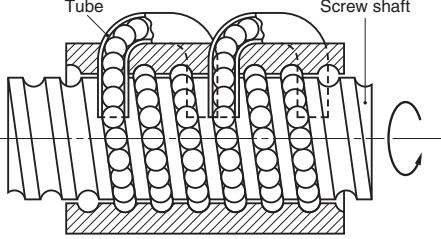
- (1) Converting motion: Changing rotary motion to linear motion (normal operation); Changing linear motion to rotary motion efficiently (back-drive operation).
- (2) Increasing power: A small torque is converted to a large thrust force.
- (3) Positioning: Sets accurate position in linear motion.

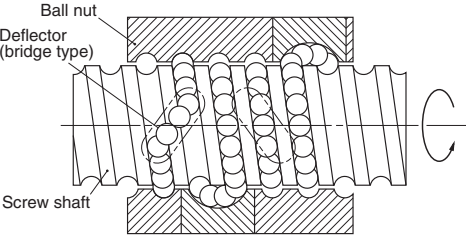
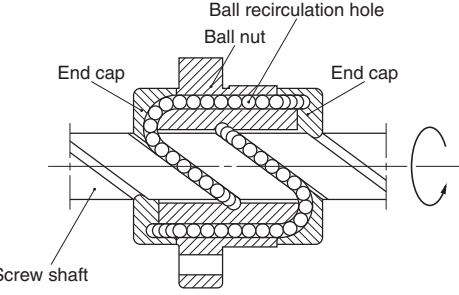
B-1-2.1 Ball Recirculation System

A ball screw's structure is typically classified by its recirculation system and preload.

As shown in **Table 2.1**, four types of ball recirculation system are used for NSK ball screws.

Table 2.1 Ball screw recirculation system

End deflector	Tube
	
<p>[Structure] Balls are smoothly picked up in the tangential direction at the end of the nut, and recirculated via a hole in the nut. This type is called a middle deflector when the balls are picked up at the middle of the nut.</p> <p>[Features] · Small nut outside diameter allows compact nut design. · Low noise, high speed.</p>	<p>[Structure] Balls are recirculated through a pipe (ball return tube) of optimized size, bridging the start and end of recirculation.</p> <p>[Features] · Adapts to various specifications (screw shaft diameter, lead).</p>

Deflector (bridge)	End cap
	
<p>[Structure] Balls are recirculated by a horseshoe shaped deflector bridging the adjacent ball thread grooves.</p> <p>[Features] · Suitable for fine lead ball screws. · Small nut outside diameter, allows compact nut design.</p>	<p>[Structure] Balls are picked up by an end cap placed at both ends of the nut, and recirculated via a hole through the nut.</p> <p>[Features] · Suitable for large lead ball screws. · Not universal due to complex recirculation structure.</p>

B-1-2.2 Preload system

There are four systems to apply preload to NSK ball screws, depending on the application.

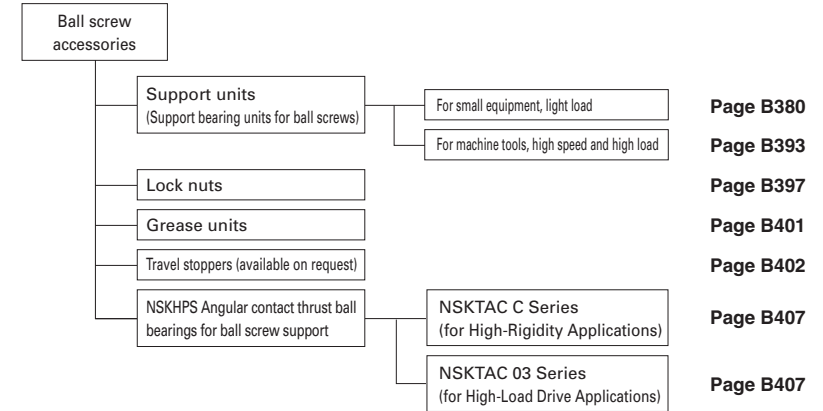
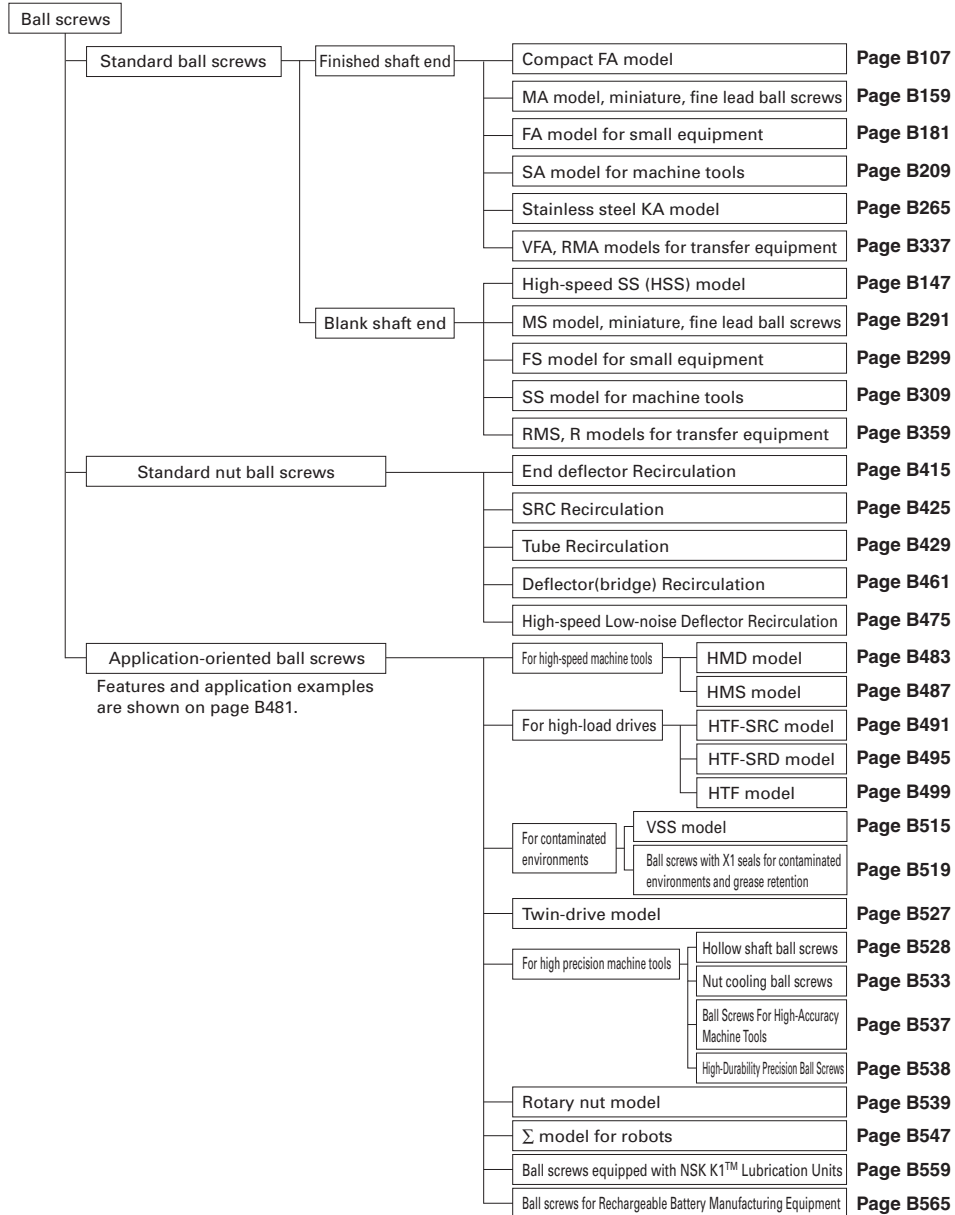
Table 2.2 Preload system for ball screws

Preload system	Double nut preload (D-Preload)	Offset preload (Z-Preload)
Structure		
Description	<p>Uses two nuts with a spacer between them to apply the preload. In general, a spacer is thicker (by the deformation equivalent to the preload) than the actual space between two nuts. However, a thin spacer is inserted in some cases.</p>	<p>To apply preload, the lead near the center of the nut is offset by the volume equivalent to preload (α). This method is similar to double nut preload (D-preload) by a single ball nut, thus enabling a compact nut design.</p>
Nut length	Long	Medium
Torque characteristics	○	○
Rigidity	◎	◎

Preload system	Oversize ball preload (P-Preload)	Spring preloaded double nut (J-Preload)
Structure		
Description	<p>Balls slightly larger than the ball groove space (oversize balls) are inserted to allow them to contact at four points. Provides better torque characteristics in the low torque range.</p>	<p>Similar to D-Preload except with a spring instead of a spacer. Must be used with care as rigidity will vary by load direction.</p>
Nut length	Short	Long
Torque characteristics	○	◎
Rigidity	○	△

B-1-3 Ball Screw Model

B-1-3.1 Ball Screw Classification



Lead classification

Classification	Lead ratio $K = \text{lead } l / \text{shaft diameter } d$
Fine	$K < 0.5$
Medium	$0.5 \leq K < 1$
High helix	$1 \leq K < 2$
Ultra high helix	$2 \leq K$

B-1-3.2 Product Externals

(1) Ball screws

● **Standard ball screws**

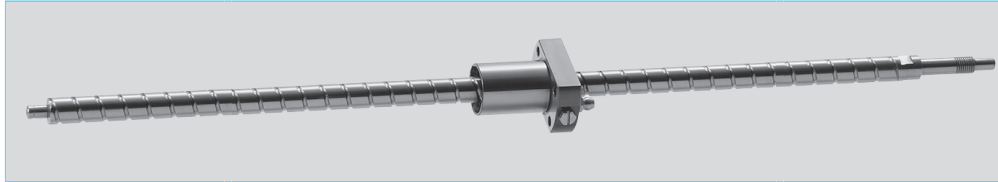


Fig. 3.1 Finished shaft end compact FA model

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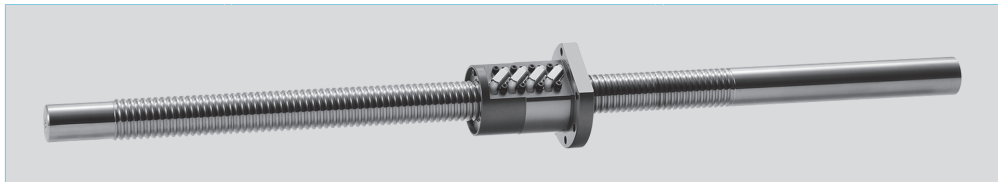


Fig. 3.2 Blank shaft end high-speed SS model

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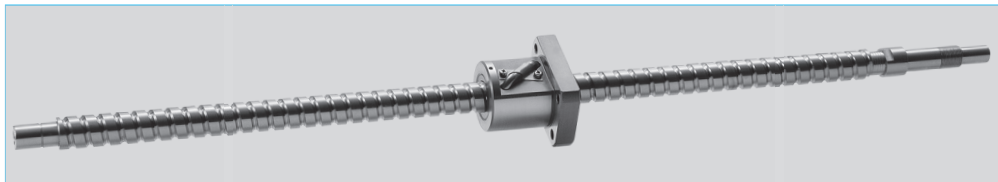


Fig. 3.3 Finished shaft end MA, FA, and SA models

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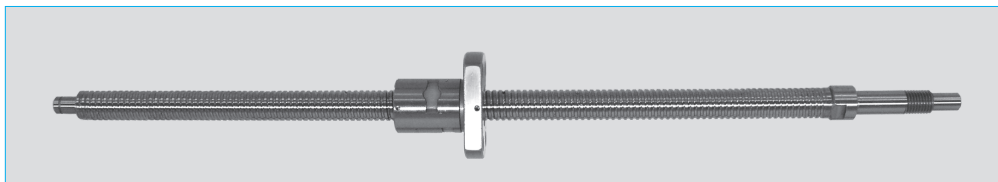


Fig. 3.4 Finished shaft end KA model

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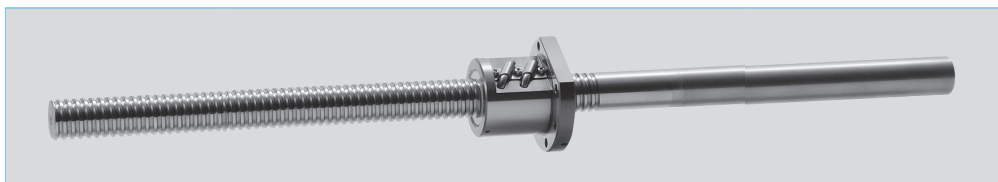


Fig. 3.5 Blank shaft end MS, FS, and SS models

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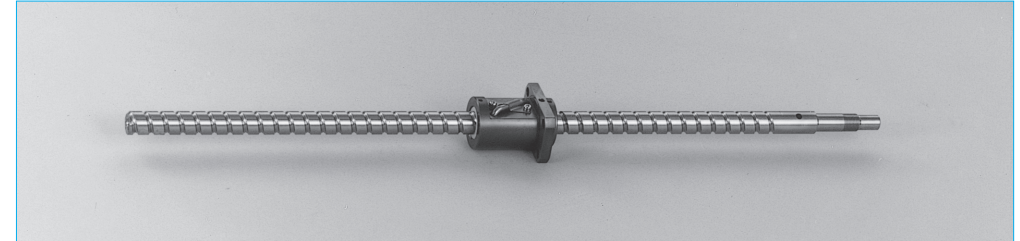


Fig. 3.6 Finished shaft end VFA model for transfer equipment

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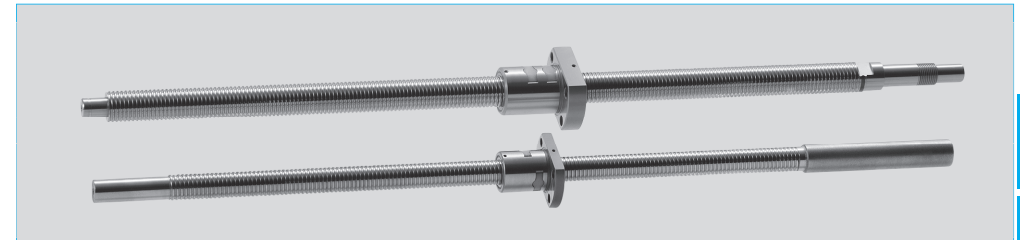


Fig. 3.7 Finished shaft end RMA model and blank shaft end RMS model for transfer equipment

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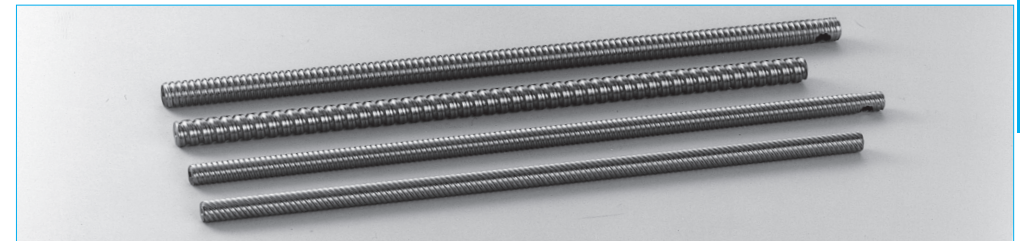


Fig. 3.8 Blank shaft end R model for transfer equipment

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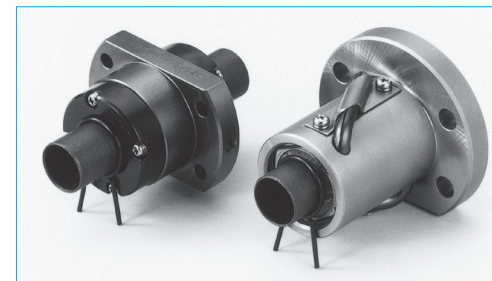


Fig. 3.9 R model nut assembly for transfer equipment

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●Standard nut ball screws

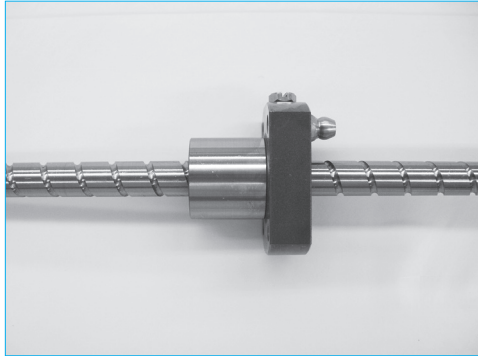


Fig. 3.10 End deflector recirculation Page B415

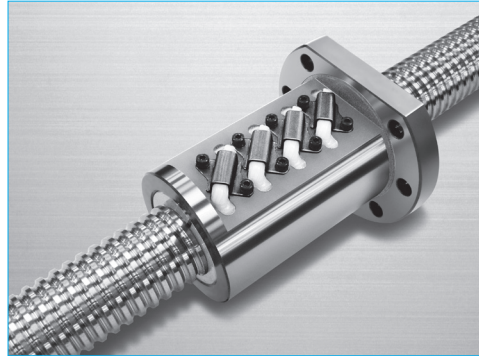


Fig. 3.11 SRC recirculation Page B425

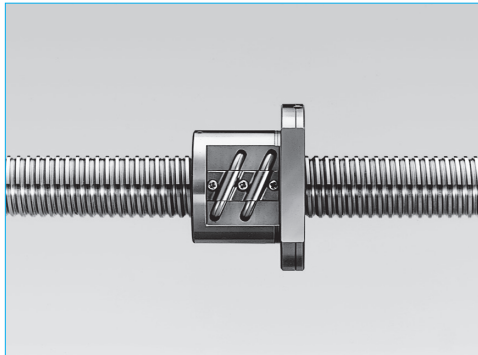


Fig. 3.12 Tube recirculation Page B429

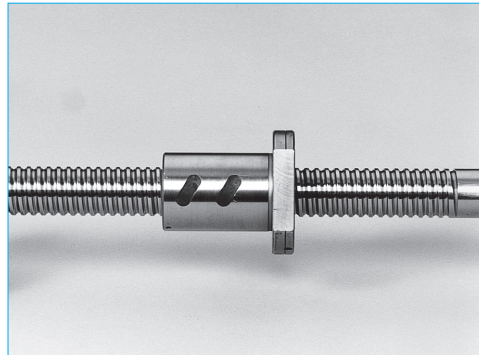


Fig. 3.13 Deflector (bridge) recirculation Page B461

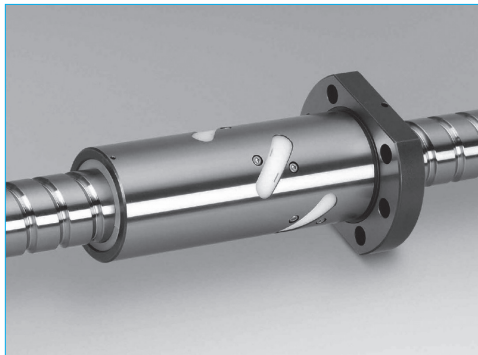


Fig. 3.14 High-speed low-noise deflector recirculation Page B475

●Application-oriented ball screws

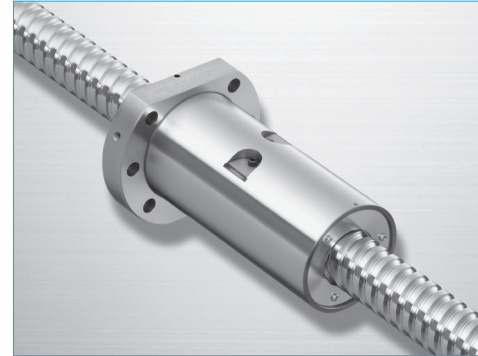


Fig. 3.16 HMD model for high-speed machine tools Page B483

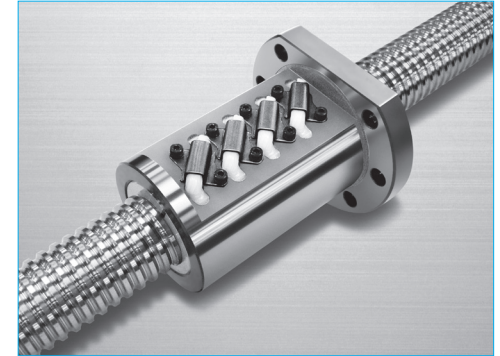


Fig. 3.17 HMS model for high-speed machine tools Page B487

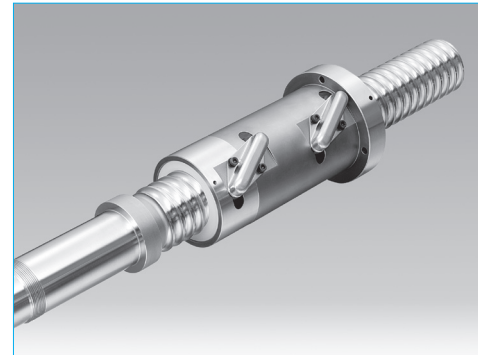


Fig. 3.20 HTF-SRC model for high-load drives Page B491

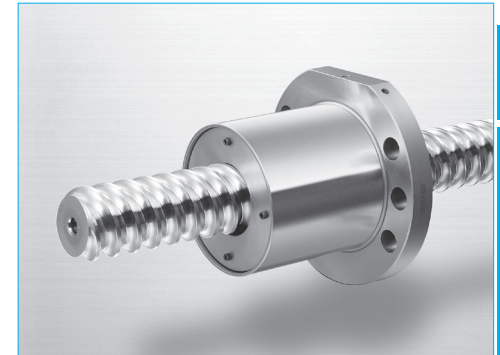


Fig. 3.21 HTF-SRD model for high-load drives Page B495

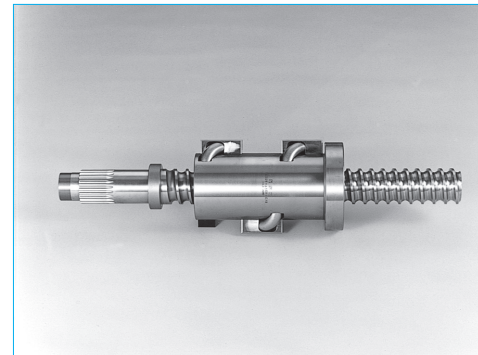


Fig. 3.22 HTF model for high-load drives Page B499

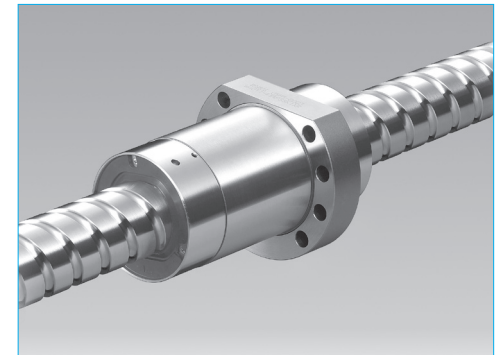


Fig. 3.23 VSS model for contaminated environments Page B515

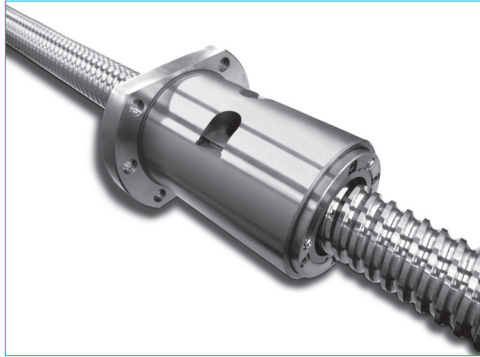


Fig. 3.24 Ball screws with X1 seals for contaminated environments and grease retention Page B519

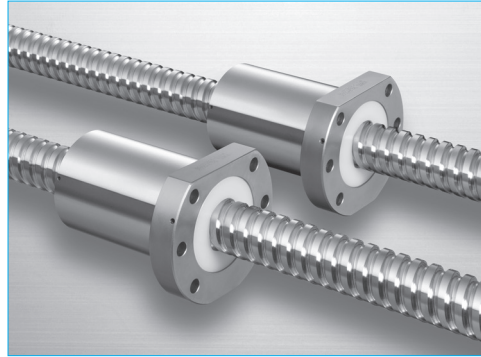


Fig. 3.25 Twin-drive model Page B527

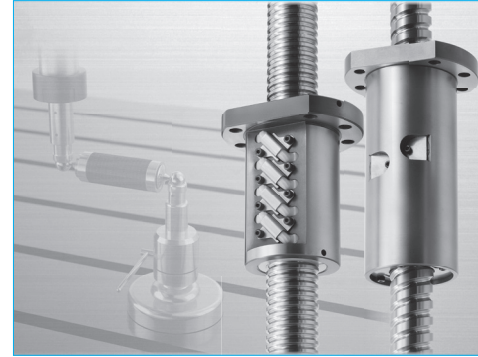


Fig. 3.28 Ball Screws for High-Accuracy Machine Tools Page B537



Fig.3.29 High-Durability Precision Ball Screws Page B538

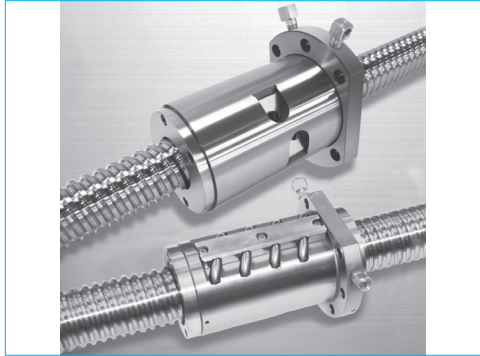


Fig. 3.26 Nut cooling ball screws for high precision machine tools Page B533

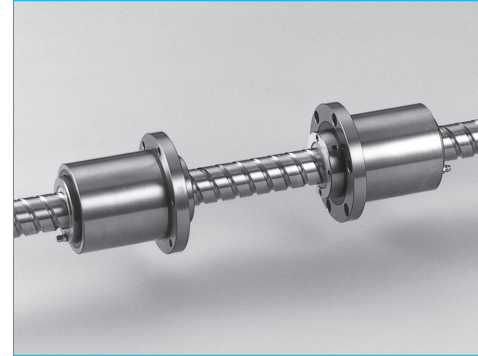


Fig. 3.30 Rotary nut model Page B539

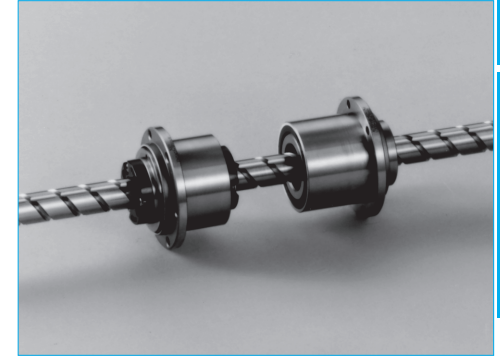


Fig. 3.31 Σ model for robots Page B547

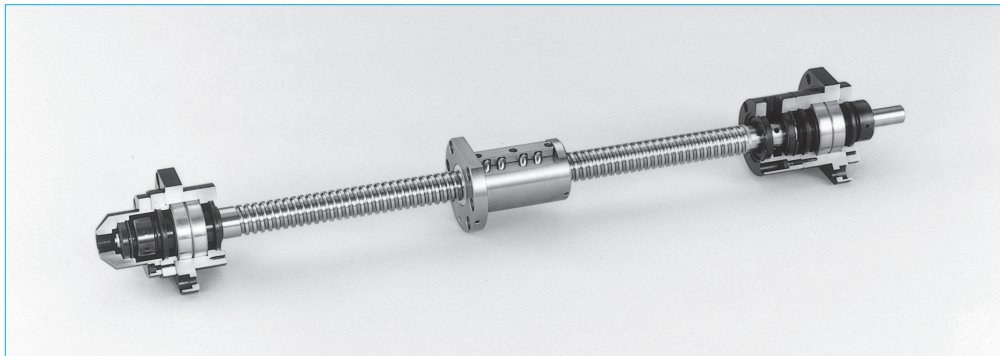


Fig. 3.27 Hollow shaft ball screws for high-precision machine tools Page B528

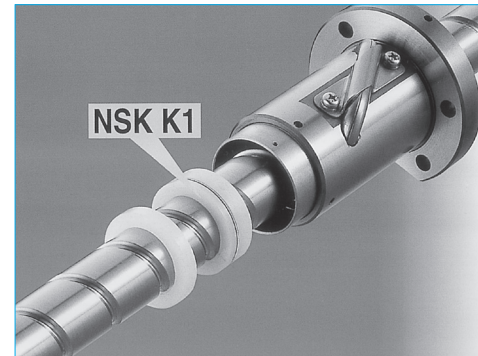


Fig. 3.32 Ball screws equipped with NSK K1™ lubrication units Page B559

(2) Standard accessories



Fig. 3.33 Support units Page B380
(for small equipment, light load)



Fig. 3.34 Support units Page B380
(for small equipment, light load, low-profile)



Fig. 3.39 Lock nuts for high load Page B398



Fig. 3.40 NSK hand grease pump unit Page D19



Fig. 3.35 Support kits for RMA and RMS models Page B389

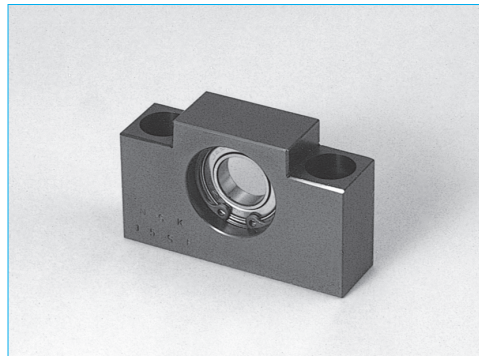


Fig. 3.36 Support unit for VFA model Page B387
(simple support side)



Fig. 3.41 NSK grease Page B401, D19

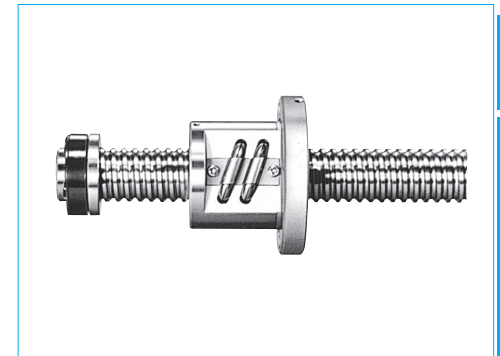


Fig. 3.42 Travel stoppers (by order) Page B402



Fig. 3.37 Support units Page B393
(for machine tools, high speed, heavy load)



Fig. 3.38 Lock nuts for light load Page B397



Fig. 3.43 Ball screw support bearings Page B407
NSKTAC C Series, NSKTAC 03 Series

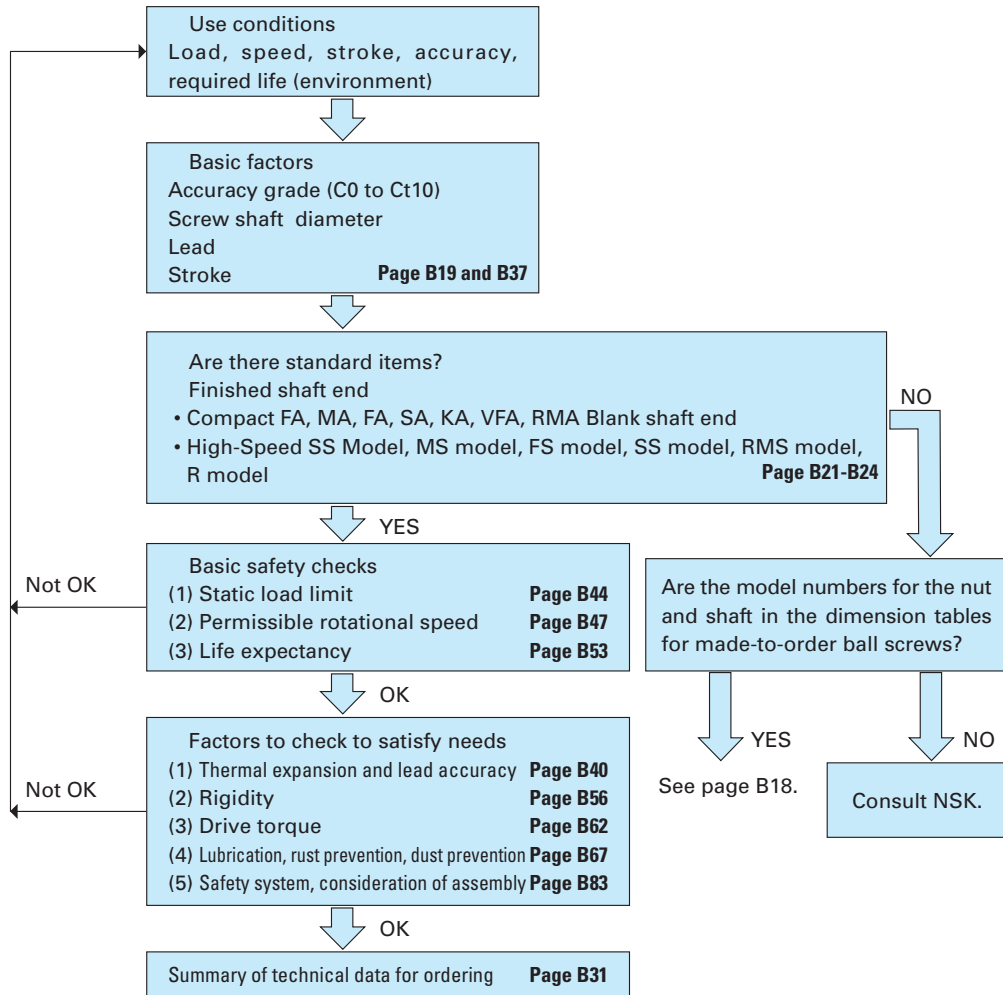
B-1-4 Procedures to Select Ball Screw

B-1-4.1 Flow Chart for Selection

Selecting a ball screw requires a review of use conditions and requirements such as applied load, stroke, positioning accuracy, required life, and the operating environment. These factors are often at odds, so we recommend a multifaceted approach to selection.

(1) Standard ball screw

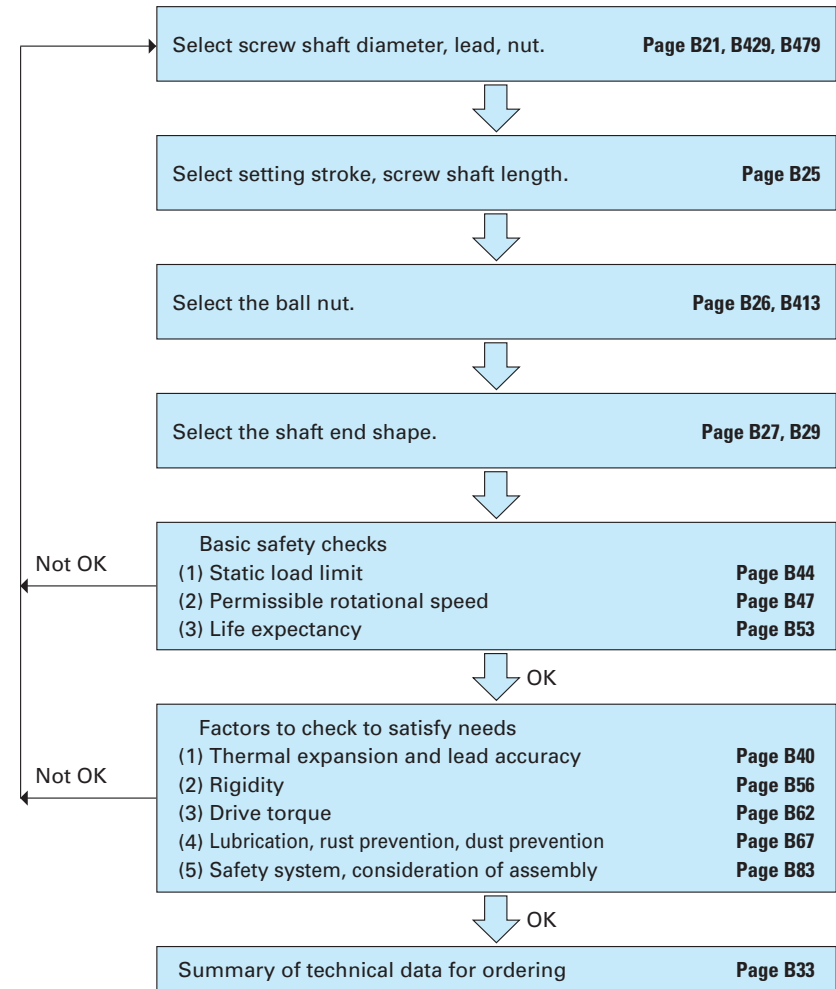
The chart below is one selection procedure. To take advantage of prompt delivery and reasonable prices, this procedure focuses on standardized ball screws. NSK offers a ball screw selection program and a service to select appropriate items using data compiled by our knowledge and experience.



(2) Made-to-order ball screws

Dimensions and specifications can be decided individually for application-oriented ball screws and standard nut ball screws. Procedures are as follows. Refer to the selection exercises on page B87.

Table 4.4 shows combinations of screw shaft diameter and leads for basic ball screws. Please consult NSK if you require types not listed in the table.



B-1-4.2 Accuracy Grades

Table 4.1 shows examples of how to select accuracy grade for a specific use. These practical cases are based on NSK's experience. The circles indicate the range of the accuracy grade in actual use. The double circles indicate accuracy grades most frequently used among the cases marked with the single circle. These

symbols help to select the accuracy grade of ball screws temporarily. To confirm whether a specific ball screw accuracy grade satisfies requirements in positioning accuracy in actual use, refer to "Technical Description" and "Mean travel deviation and travel variation." (page B38)

Table 4.1 Applications for ball screws by accuracy grade

Application		NC machine tools																					
		Lathes		Milling machines Boring machines		Machining centers		Drilling machines		Jig boring machines		Grinders		Electric discharge machines		Wire cuttings Electric discharge machines		Punch press		Laser cutting machines		Woodworking machines	
Axis	Accuracy grade	X	Z	XY	Z	XY	Z	XY	Z	XY	Z	XY	Z	XY	Z	XY	Z	XY	Z	XY	Z	XY	Z
			C0	○								○	○	○									
	C1	○		○		○				◎	◎	○	○	○		○	○						
	C2	○		○	○	○	○					◎	○	○	○	○	○						
	C3	◎	○	◎	○	○	○	○				◎	◎	◎	◎	◎	○	○	○	○	○	○	○
	C5	◎	◎	◎	◎	◎	◎	◎							◎		◎	◎	◎	◎	◎	◎	◎
	Ct7								○														◎
	Ct10																						○

Application		Semiconductor/associated industry						Industrial robots						Steel mills equipment		Plastic injection molding machines		Three-dimensional coordinate measuring machines		Office machines		Image processing equipment		Nuclear power	
		General industrial machines, Machines for specific use		Lithographic machines		Chemical processing equipment		Wire bonders		Probers		Electric component mounted devices		Printed circuit board drilling machines		Cartesian		Articulate		SCARA					
Axis	Accuracy grade	Assembly other purposes		Assembly other purposes		SCARA		Steel mills equipment		Plastic injection molding machines		Three-dimensional coordinate measuring machines		Office machines		Image processing equipment		Nuclear power		Aircraft					
			C0																						
	C1		◎		◎	◎		○									◎								
	C2				○	◎	○	○								○									
	C3	○		○			◎	○		○		○		○		○			○		○		○		○
	C5	◎		○			◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎
	Ct7	◎		◎			○	◎	◎	○	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎
	Ct10	○		○				○		○		○		○		○		○		○		○		○	○

B-1-4.3 Axial Play

Table 4.2 indicates the combinations of NSK ball screw accuracy grades and axial play. Select an axial play which satisfies the required accuracy in backlash, positioning, and repeatability. Ranges of available ball thread effective lengths in relation to accuracy grade and axial play are shown in **Table 4.3**. Please note that if the effective length exceeds the

range, the axial play may become partially negative (preloaded condition).

For the axial play of Ct10 grade (ball screws for transfer equipment), refer to R model dimension tables.

Table 4.2 Combinations of accuracy grades and axial play

Axial play	Z	T	S	N	L
	0 mm (Preload)	0.005 mm or less	0.020 mm or less	0.050 mm or less	0.3 mm or less
C0	C0Z	C0T	—	—	—
C1	C1Z	C1T	—	—	—
C2	C2Z	C2T	—	—	—
C3	C3Z	C3T	C3S	—	—
C5	C5Z	C5T	C5S	C5N	—
Ct7	—	—	C7S	C7N	—

Codes above are used in NSK reference numbers (designations).

Table 4.3 Maximum effective thread length in combination of accuracy grade and axial play

Unit: mm

Screw shaft diameter	Effective length of the screw thread (maximum)				
	Axial play T (0.005 mm or under)		Axial play S (0.020 mm or under)		
	C0 – C3	C5	C3	C5	Ct7
4 – 6	100	80	100	80	—
8 – 10	250	200	300	250	—
12 – 16	500	400	700	600	500
20 – 25	800	700	1 000	1 000	1 000
28 – 40	1 000	800	2 000	1 500	1 500
45 – 63	1 200	1 000	2 500	2 000	2 000
80 – 125	—	—	4 000	3 000	3 000

Note: Refer to **Table 4.8** (page B25) for the available length of screw shaft (maximum length). Also, axial play of code N does not become partially negative if it is within the available range of effective ball thread length.

B-1-4.4 Screw Shaft Diameter, Lead, and Stroke

Choose a screw shaft diameter and stroke based on the allowable space for ball screw installation. A lead should be set based on the required running speed, and should give some allowance to the maximum rotational speed of the motor.

(1) Standard ball screw

Tables 4.4 and 4.5 show the combinations of ball screw shaft diameter, leads, and range of stroke.

From these tables, select the closest values to the shaft diameter, lead, and stroke which had been selected previously. Confirm detailed specifications and sizes in "Dimension Tables for Standard Ball Screws" (page B105).

Table 4.4 Screw shaft diameter, lead and stroke of standard ball screws

Shaft dia.	Lead	Stroke														
		- 50	- 100	- 150	- 200	- 250	- 300	- 350	- 400	- 450	- 500	- 550	- 600	- 650		
4	1	○	○	○	○	○	○									
	2	○	○	○	○	○	○									
	4	○	○	○	○	○	○									
6	1	○	○	○	○	○	○									
	2	○	○	○	○	○	○									
	4	○	○	○	○	○	○									
8	1	○	○	○	○	○	○									
	1.5	○	○	○	○	○	○									
	2	○	○	○	○	○	○									
	10	○	○	○	○	○	○									
	15	○	○	○	○	○	○									
	2	○	○	○	○	○	○									
10	2.5	○	○	○	○	○	○									
	4	○	○	○	○	○	○									
	5	○	○	○	○	○	○									
12	10	○	○	○	○	○	○									
	2.5	○	○	○	○	○	○									
	5	○	○	○	○	○	○									
	10	○	○	○	○	○	○									
14	20	○	○	○	○	○	○									
	30	○	○	○	○	○	○									
	5	○	○	○	○	○	○									
15	8	○	○	○	○	○	○									
	10	○	○	○	○	○	○									
	20	○	○	○	○	○	○									
16	30	○	○	○	○	○	○									
	2	○	○	○	○	○	○									
	2.5	○	○	○	○	○	○									
20	4	○	○	○	○	○	○									
	5	○	○	○	○	○	○									
	10	○	○	○	○	○	○									
	20	○	○	○	○	○	○									
	30	○	○	○	○	○	○									
	40	○	○	○	○	○	○									
25	60	○	○	○	○	○	○									
	4	○	○	○	○	○	○									
	5	○	○	○	○	○	○									
	6	○	○	○	○	○	○									
	10	○	○	○	○	○	○									
	20	○	○	○	○	○	○									
28	25	○	○	○	○	○	○									
	30	○	○	○	○	○	○									
	50	○	○	○	○	○	○									
	6	○	○	○	○	○	○									
32	5	○	○	○	○	○	○									
	6	○	○	○	○	○	○									
	8	○	○	○	○	○	○									
36	10	○	○	○	○	○	○									
	5	○	○	○	○	○	○									
	8	○	○	○	○	○	○									
40	10	○	○	○	○	○	○									
	12	○	○	○	○	○	○									
	16	○	○	○	○	○	○									
	20	○	○	○	○	○	○									
45	10	○	○	○	○	○	○									
	12	○	○	○	○	○	○									
	12	○	○	○	○	○	○									

Note: See Table for stainless steel KA models.

Table 4.5 Screw shaft diameter, lead and stroke of stainless steel KA models

Unit: mm

Shaft dia.	Lead	Stroke								
		- 150	- 200	- 250	- 300	- 350	- 450	- 500	- 650	- 1 050
6	1	●								
	8		●							
10	2		●							
	4	●		●		●				
	2	●			●					
12	5			●				●		
	10				●			●		
	10						●	●		●
15	20						●	●		●
	20	●					●		●	●
16	2	●					●			
	20						●		●	●

Key:

●: PSS, USS, FSS models; ○: MA, FA, SA models; △: MS, FS, SS models;
 ▲: HSS model; ✓: VFA model; ■: RMA model; □: RMS model

Unit: mm

Shaft dia.	Lead	Stroke														
		- 700	- 750	- 800	- 850	- 900	- 950	- 1 100	- 1 200	- 1 300	- 1 400	- 1 500	- 1 700	- 2 100	- 3 000	
4	1	○														
	2	○														
	4	○														
6	1	○														
	2	○														
	4	○														
8	1	○														
	1.5	○														
	2	○														
	10	○														
	15	○														
	2	○														
10	2.5	○														
	4	○														
	5	○														
12	10	○														
	2.5	○														
	5	○														
	10	○														
14	20	○														
	30	○														
	5	○														
15	8	○														
	10	○														
	20	○														
16	30	○														
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	2.5	○														
20	4	○														
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25	60	○														
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	6	○														
	10	○														
	20	○														
28	25	○														
	30	○														
	50	○														
	6	○														
32	5	○														
	6	○														
	8	○														
36	10	○														
	5	○														
	8	○														
40	10	○														
	12	○														
	16	○														
	20	○														
45	10	○														
	12	○														
	12	○														

Table 4.6 Screw shaft diameter, lead and standard screw shaft length of R model Unit: mm

Screw shaft diameter	Lead	Standard screw shaft length									
		400	500	800	1 000	1 500	2 000	2 500	3 000	4 000	5 000
10	3	●		●							
	6	●		●							
12	8	●		●							
	12	●		●							
14	4		●		●						
	5		●		●						
15	20		●		●	●					
16	10		●		●	●					
	16		●		●	●					
	32		●		●	●					
18	8		●		●	●					
20	5		●		●		●				
	10		●		●		●				
	20		●		●		●				
	40		●		●	●	●				
25	5				●		●	●			
	10				●		●	●			
	25				●		●	●			
	50				●		●	●			
28	6				●		●	●			
32	10				●		●		●		
	32				●		●		●		
	64				●		●		●	●	
36	10				●		●		●		
40	10						●		●	●	
	40						●		●	●	
	80						●		●	●	●
45	12						●		●	●	
50	10						●		●	●	
	16						●		●	●	
	50						●		●	●	

B-1-4.5 Manufacturing Capability for Screw Shafts

Table 4.8 shows the manufacturing capability for the screw shaft overall length for each accuracy grade. The capability of large ball screws whose shaft diameter exceeds 100 mm is limited due to

weight (indicated by * asterisks in the table). Please consult NSK in such cases. Also consult NSK if the screw shaft size you desire exceeds the size listed in **Table 4.8**.

Table 4.8 Manufacturing capability for screw shafts

Unit: mm

Accuracy grade Screw shaft diameter	C0	C1	C2	C3	C5	Ct7	Ct10
4	90	110	120	140	140	140	—
6	150	180	200	250	250	250	—
8	240	280	340	340	340	340	—
10	350	400	500	500	500	550	800
12	450	500	650	700	750	800	800
14	600	650	750	800	1 000	1 000	1 000
15	600	700	800	900	1 250	1 250	1 500
16	600	750	900	1 000	1 500	1 500	1 500
18	—	—	—	—	—	—	1 500
20	850	1 000	1 200	1 400	1 900	1 900	2 000
25	1 100	1 400	1 600	1 900	2 500	2 500	2 500
28	1 100	1 400	1 600	1 900	2 500	2 500	2 500
32	1 500	1 750	2 250	2 500	3 200	3 200	3 000 (4 000)
36	1 500	1 750	2 250	2 500	3 200	3 500	3 000
40	2 000	2 400	3 000	3 400	3 800	4 300	4 000 (5 000)
45	2 000	2 400	3 000	3 400	4 000	4 500	4 000
50	2 000	3 200	4 000	4 500	5 000	5 750	4 000
55	2 000	4 000	5 000	5 800	6 000	6 000	—
63	2 000	4 000	5 000	6 000	6 800	7 700	—
80	—	4 000	6 300	8 200	9 200	10 000	—
100	—	4 000	6 300	10 000	12 500	13 500	—
*120	—	—	—	—	—	13 500	—
*125	—	—	—	10 000	13 500	13 500	—
*140	—	—	—	—	—	10 000	—
*160	—	—	—	—	—	8 000	—
*200	—	—	—	—	—	5 000	—

Notes: 1. Values in parentheses of Ct10 are applicable to the ultra high helix lead ($l/d \geq 2$). Refer to dimension tables on B373 and following pages for details.
2. Please note that small leads (3 mm or under) are also limited by screw length.

B-1-4.6 Outside Shapes of Ball Nuts

(1) Flange shape

Fig. 4.1 shows the available flange shapes. Select the appropriate shape according to the nut installation conditions. (**Fig. 4.2**)

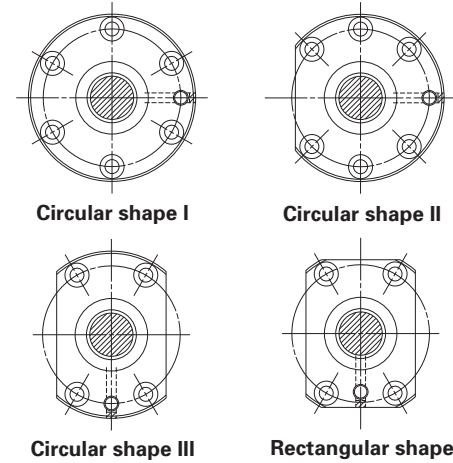


Fig. 4.1 Flange shape

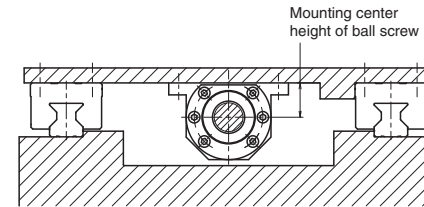


Fig. 4.2 Installation example

(2) Shapes of nut cross section

Cross-sections of nuts are shown in **Fig. 4.3**. For detailed dimensions, refer to dimension tables.

- ① **Circular (round)**
The ball recirculation components are contained inside the circumference of the nut. It can be inserted in a round hole.
- ② **Tube-projecting type**
This shape is unique to the tube recirculation type. The nut outside diameter is small. However some recess must be given for the housing because the ball recirculation tube protrudes from the circumference of the nut.

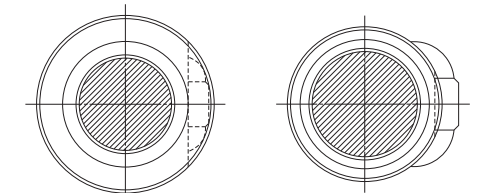


Fig. 4.3 Shape of the cross section of nut

B-1-4.7 Shaft End Configuration

(1) Standard shaft end dimensions

Tables 4.9 and 4.10 show shaft end types for NSK standard support units.

Refer to the dimension tables below when designing shaft ends of standard ball screws.

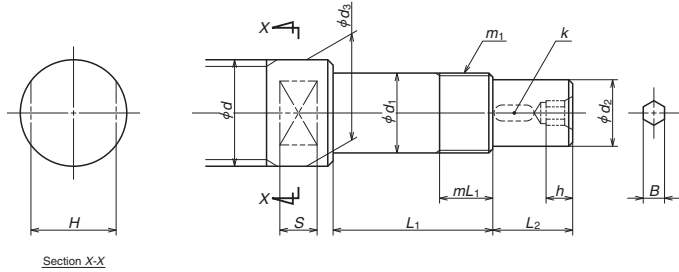


Fig. 4.4 Configuration of standard shaft end (drive side)

Table 4.9 Dimensions of shaft ends (drive side)

Unit: mm

Screw shaft diameter <i>d</i>	Bearing journal		Thread		Drive section			Seal section	Hexagon hole		Wrench flats		Support unit	
	Outside diameter	Length	Nominal spec.	Length	Outside diameter	Length	Key width	Outside diameter	Width across flats	Depth	Width across flats	Length	Reference No.	
	<i>d₁</i>	<i>L₁</i>	<i>m₁</i>	<i>mL₁</i>	<i>d₂</i>	<i>L₂</i>	<i>k</i>	<i>d₃</i>	<i>B</i>	<i>h</i>	<i>H</i>	<i>S</i>		
4	6	22.5	M6×0.75	7	4.5	7.5	—	9.5	—	—	8	4.5	WBK06-01A	WBK06-11
6	6	22.5	M6×0.75	7	4.5	7.5	—	9.5	—	—	8	4.5	WBK06-01A	WBK06-11
8	8	27	M8×1	9	6	10	—	11.5	—	—	10	5.5	WBK08-01A	WBK08-11
10	8	27	M8×1	9	6	10	—	11.5	—	—	10	5.5	WBK08-01A	WBK08-11
12	10	30	M10×1	10	8	15	—	14	—	—	12	6.5	WBK10-01A	WBK10-11
14	12	30	M12×1	10	10	15	3	15	4	6	12	6.5	WBK12-01A	WBK12-11
15	12	30	M12×1	10	10	15	3	15	4	6	12	6.5	WBK12-01A	WBK12-11
16	12	30	M12×1	10	10	15	3	15	4	6	12	6.5	WBK12-01A	WBK12-11
20	15	40	M15×1	15	12	20	4	19.5	5	7	17	8.5	WBK15-01A	WBK15-11
	17	81	M17×1	23	12	29	4	20	5	7	17	10	WBK17DF-31H	
25	20	53	M20×1	16	15	27	5	25	6	8	22	10	WBK20-01	WBK20-11
	20	81	M20×1	23	15	39	5	25	6	8	22	10	WBK20DF-31H	
28	20	53	M20×1	16	15	27	5	25	6	8	22	10	WBK20-01	WBK20-11
	20	81	M20×1	23	15	39	5	25	6	8	24	12	WBK20DF-31H	
32	25	62	M25×1.5	20	20	33	6	32	8	10	27	12	WBK25-01W	WBK25-11
	25	89	M25×1.5	26	20	51	6	32	8	10	27	12	WBK25DF-31H	
	25	104	M25×1.5	26	20	51	6	32	8	10	27	12	WBK25DFD-31H	
36	30	89	M30×1.5	26	25	61	8	36	10	12	30	13	WBK30DF-31H	
	30	104	M30×1.5	26	25	61	8	36	10	12	30	13	WBK30DFD-31H	
40	30	89	M30×1.5	26	25	61	8	40	10	12	—	—	WBK30DF-31H	
	30	104	M30×1.5	26	25	61	8	40	10	12	—	—	WBK30DFD-31H	
45	35	92	M35×1.5	30	30	63	8	45	12	14	—	—	WBK35DF-31H	
	35	107	M35×1.5	30	30	63	8	45	12	14	—	—	WBK35DFD-31H	
50	40	92	M40×1.5	30	35	78	10	50	14	18	—	—	WBK40DF-31H	
	40	107	M40×1.5	30	35	78	10	50	14	18	—	—	WBK40DFD-31H	

Note: Low-profile support units are available for the compact FA model.

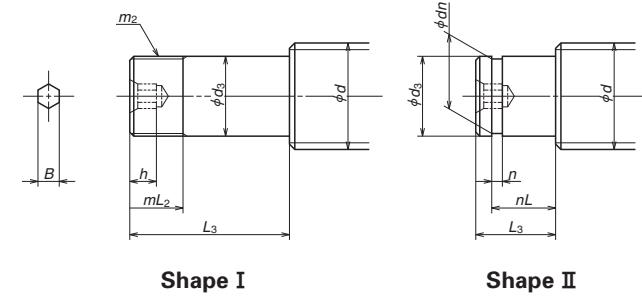


Fig. 4.5 Standard shaft end configuration (opposite the drive side)

Table 4.10 Dimensions of shaft ends (opposite the drive side)

Unit: mm

Screw shaft diameter <i>d</i>	Shape	Bearing journal		Thread for lock nut		Retainer ring groove		Hexagonal hole		Support unit		
		Outside diameter	Length	Nominal spec.	Length	Width	Groove diameter	Groove position	Width across flats	Depth	Reference No.	
		<i>d₁</i>	<i>L₁</i>	<i>m₂</i>	<i>mL₂</i>	<i>n</i>	<i>dn</i>	<i>nL</i>	<i>B</i>	<i>h</i>	Numbers in parentheses are bearing designations	
8	II	6	9	—	—	0.8	5.7	6.8	—	—	WBK08S-01	
10	II	6	9	—	—	0.8	5.7	6.8	—	—	WBK08S-01	
12	II	8	10	—	—	0.9	7.6	7.9	—	—	WBK10S-01	
14	II	10	22(12)	—	—	1.15	9.6	9.15	4	6	WBK12S-01	
15	II	10	22(12)	—	—	1.15	9.6	9.15	4	6	WBK12S-01	
16	II	10	22(12)	—	—	1.15	9.6	9.15	4	6	WBK12S-01	
20	II	15	25(13)	—	—	1.15	14.3	10.15	5	7	WBK15S-01	
	II	20	19	—	—	1.35	19	15.35	6	8	WBK20S-01	
25	I	20	53	M20×1	16	—	—	—	6	8	WBK20-01 WBK20-11	
	I	20	81	M20×1	23	—	—	—	6	8	WBK20DF-31H	
28	II	20	19	—	—	1.35	19	15.35	6	8	WBK20S-01	
	I	20	53	M20×1	16	—	—	—	6	8	WBK20-01 WBK20-11	
32	I	20	81	M20×1	23	—	—	—	6	8	WBK20DF-31H	
	II	25	20	—	—	1.35	23.9	16.35	8	10	WBK25S-01W	
36	I	25	62	M25×1.5	20	—	—	—	8	10	WBK25-01W WBK25-11	
	I	25	89	M25×1.5	26	—	—	—	8	10	WBK25DF-31H	
40	II	25	20	—	—	1.35	23.9	16.35	10	12	(6205)	
	I	25	89	M25×1.5	26	—	—	—	10	12	WBK25DF-31H	
45	II	30	22	—	—	1.75	28.6	17.75	10	12	(6206)	
	I	30	89	M30×1.5	26	—	—	—	10	12	WBK30DF-31H	
50	II	35	25	—	—	1.75	33	18.75	12	14	(6207)	
	I	35	92	M35×1.5	30	—	—	—	12	14	WBK35DF-31H	
50	II	40	25	—	—	1.95	38	19.95	14	18	(6208)	
	I	40	92	M40×1.5	30	—	—	—	14	18	WBK40DF-31H	

(2) Shaft end configuration of R model ball screws for transfer equipment

Tables 4.11 and 4.12 show shaft end types for the R model.

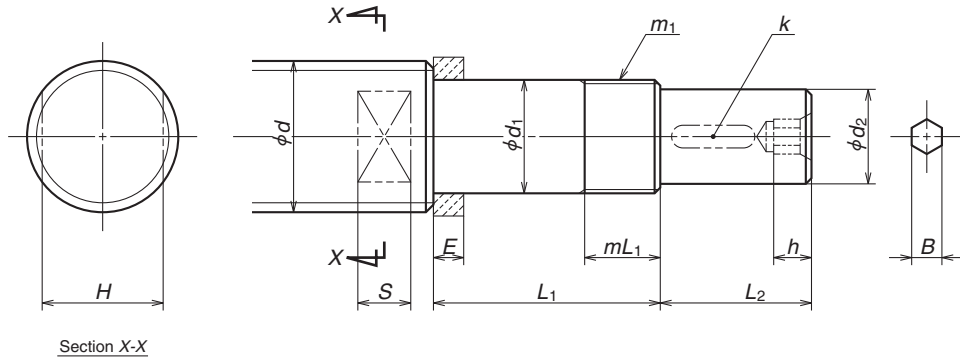


Fig. 4.6 R Model shaft end (drive side)

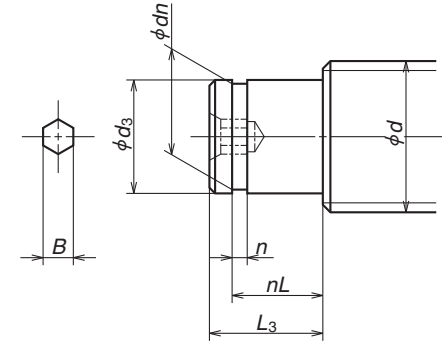


Fig. 4.7 Shaft end configuration of R model (opposite the drive side)

Table 4.11 Dimensions of R model shaft ends (drive side)

Unit: mm

Screw shaft diameter <i>d</i>	Bearing journal		Thread for lock nut		Spacer Width <i>E</i>	Drive section			Hexagonal hole		Wrench flat		Support unit	
	Outside diameter <i>d_i</i>	Length <i>L₁</i>	Nominal spec <i>m₁</i>	Length <i>mL₁</i>		Outside diameter <i>d₂</i>	Length <i>L₂</i>	Key width <i>k</i>	Width across flats <i>B</i>	Depth <i>h</i>	Width across flats <i>H</i>	Length <i>S</i>	Reference No.	
10	6	27	M6×0.75	7	5.0	4.5	7.5	—	—	—	8	4.5	WBK06-01A	WBK06-11
12	8	32	M8×1	9	5.5	6	10	—	—	—	10	5.5	WBK08-01A	WBK08-11
14	10	35	M10×1	10	5.5	8	15	—	—	—	12	6.5	WBK10-01A	WBK10-11
15	10	35	M10×1	10	5.5	8	15	—	—	—	12	6.5	WBK10-01A	WBK10-11
16	12	35	M12×1	10	5.6	10	15	3	4	6	12	6.5	WBK12-01A	WBK12-11
18	12	35	M12×1	10	5.6	10	15	3	4	6	12	6.5	WBK12-01A	WBK12-11
20	15	50	M15×1	15	10	12	20	4	5	7	17	8.5	WBK15-01A	WBK15-11
25	17	53	M17×1	17	7	15	27	5	6	8	22	10	WBK17-01A	—
	20	64	M20×1	16	11	15	27	5	6	8	22	10	WBK20-01	WBK20-11
28	20	64	M20×1	16	11	15	27	5	6	8	22	10	WBK20-01	WBK20-11
32	25	76	M25×1.5	20	14	20	33	6	8	10	27	12	WBK25-01W	WBK25-11
36	25	76	M25×1.5	20	14	20	33	6	8	10	27	12	WBK25-01W	WBK25-11
40	30	89	M30×1.5	26	—	25	61	8	10	12	—	—	WBK30DF-31H	—
45	35	92	M35×1.5	30	—	30	63	8	12	14	—	—	WBK35DF-31H	—
50	35	92	M35×1.5	30	—	30	63	8	12	14	—	—	WBK35DF-31H	—

Note: The dimension *d_i* must be smaller than the minor diameter of the ball screw thread to provide sufficient shoulder surface for the spacer.

Refer to "Precautions for Designing Ball Screws (page B83)".

Table 4.12 Dimensions of R model shaft ends (opposite the drive side)

Unit: mm

Screw shaft diameter <i>d</i>	Bearing journal		Retaining ring groove			Hexagonal hole		Support unit Numbers in parentheses are bearing designations.
	Outside diameter <i>d_s</i>	Length <i>L₃</i>	Width <i>n</i>	Groove diameter <i>dn</i>	Groove position <i>nL</i>	Width across flats <i>B</i>	Depth <i>h</i>	
10	6	9	0.8	5.7	6.8	—	—	WBK08S-01(606)
12	8	10	0.9	7.6	7.9	—	—	WBK10S-01(608)
14	10	12	1.15	9.6	9.15	4	6	WBK12S-01(6000)
15	10	12	1.15	9.6	9.15	4	6	WBK12S-01(6000)
16	10	12	1.15	9.6	9.15	4	6	WBK12S-01(6000)
18	10	12	1.15	9.6	9.15	4	6	WBK12S-01(6000)
20	15	13	1.15	14.3	10.15	5	7	WBK15S-01(6002)
25	17	16	1.15	16.2	13.15	6	8	WBK17S-01(6203)
	20	19	1.35	19	15.35	6	8	WBK20S-01(6204)
28	20	19	1.35	19	15.35	6	8	WBK20S-01(6204)
32	25	20	1.35	23.9	16.35	8	10	WBK25S-01W(6205)
36	25	20	1.35	23.9	16.35	8	10	WBK25S-01W(6205)
40	30	22	1.75	28.6	17.75	10	12	(6206)
45	35	23	1.75	33	18.75	12	14	(6207)
50	35	23	1.75	33	18.75	12	14	(6207)

B-1-5 When Placing Orders

To avoid confusion, please use "reference numbers" or provisional reference numbers when inquiring about desired ball screw specifications.

◇ Reference Number (Ref. No.)

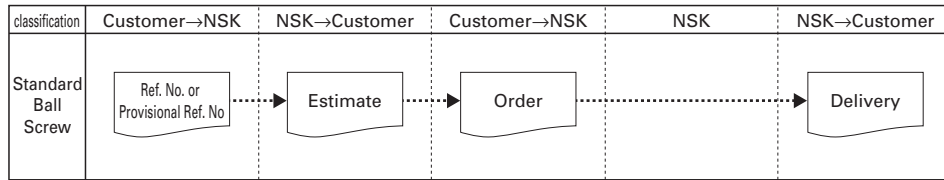
Alphanumeric codes are assigned to each ball screw. When placing orders, please use

this reference number.
 ◇ **Provisional Ref. No.:**
 Specification factors are identified by alpha-numeric codes. Codes allow for easy explanation of your requirements. (If you do not use these numbers, please itemize your requirements.)

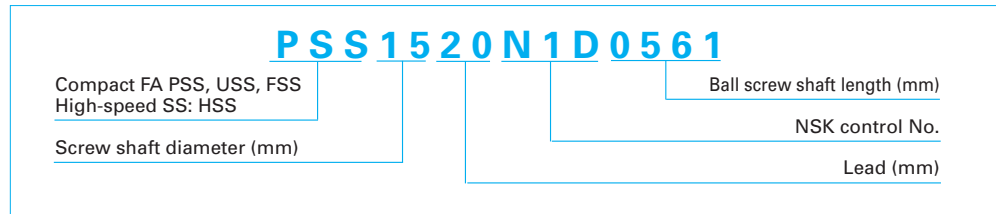
B-1-5.1 When Ordering Standard Ball Screws

Find the reference number from the dimension tables. Enter the reference number in the "Order Form" (page B34). Send this form to your local NSK agency (branch office, sales

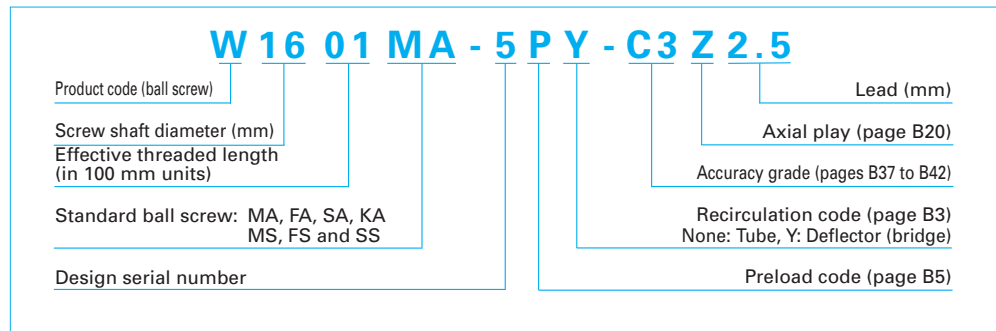
office, or your local representative.). The following shows a flowchart for ordering standard ball screws.



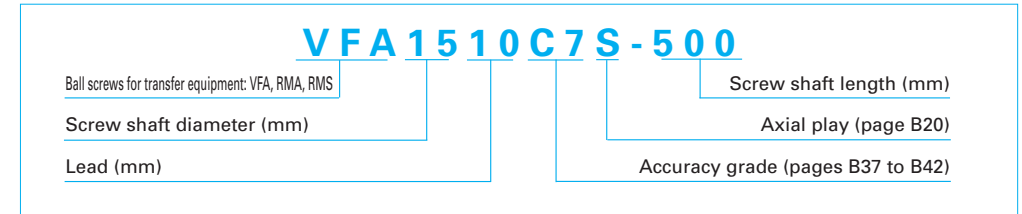
(1) Example reference number standard compact FA model and high-speed SS (HSS) model



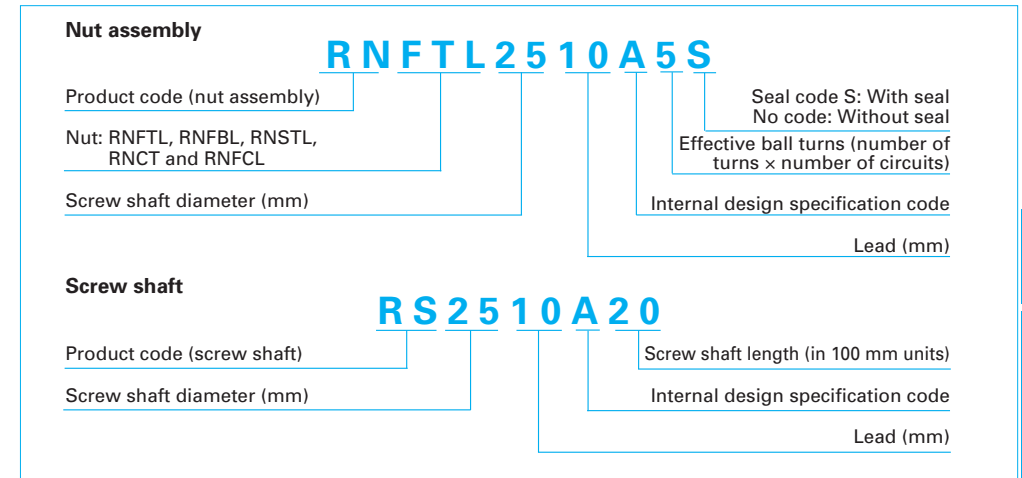
(2) Example reference number for standard ball screws



(3) Example reference number of ball screws for transfer equipment with finished shaft ends or blank shaft ends



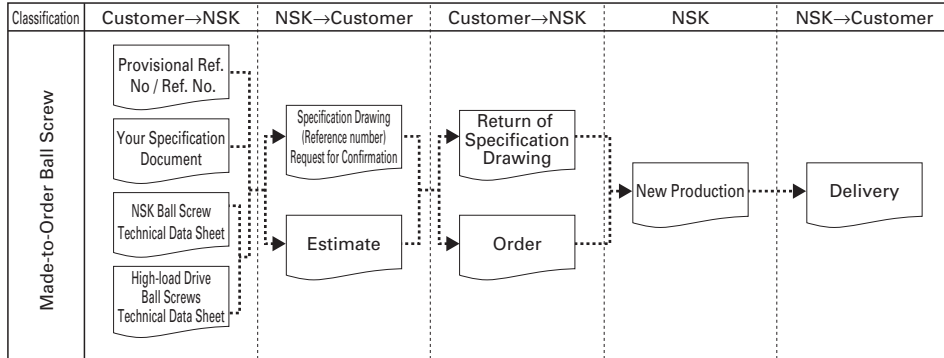
(4) Example reference number of R model ball screws for transfer equipment



B-1-5.2 When Ordering Made-to-Order Ball Screws

If you would like to discuss technical points regarding specifications, use the NSK ball screw technical data sheet as an aid (page B36). For high-load drive ball screws, use the technical

sheet on page B513 for NSK high-load drive ball screws. The following shows a flowchart for ordering made-to-order ball screws.



(1) Example of specification number of made-to-order ball screw

DFT 5010-5LC3Z-850/1230

Nut						Screw shaft length (mm)
Screw shaft diameter (mm)						Threaded length (mm)
Lead (mm)						Axial play (page B20)
Effective ball turns (number of turns x number of circuits)						Accuracy grade (page B37 to B42)
Direction of turn: No code, right; L, left						

(2) Example reference number of made-to-order ball screw

W5012-26LD-C1Z10

Product code (Ball Screw)						Lead (mm)
Screw shaft diameter (mm)						Axial play (page B20)
Effective threaded length (in 100 mm units)						Accuracy grade (page B37 to B42)
Design serial number						Ball screw specifications/appearance
Direction of turn: No code, right; L, left						

Order Form

(Make copies for future orders)

(1) Standard ball screw

Company name : _____

Date: Day Month Year

Address : _____

Telephone : _____

Name of Contact Person : _____

Section : _____

Product name	Provisional Ref. No / Ref. No.	Quantity	Desired delivery date
Precision ball screw			
R model ball screw Nut			
R model ball screw Screw shaft			
Support unit			
Lock nut			
Grease unit			

Describe the shaft end configuration if processing is required (blank shaft end ball screws) and specify which ball screw(s) must be processed.

Refer to pages B27 to B30 for shaft end configurations. These pages also show reference numbers for support units.

Drive side	
Opposite drive side	

NSK Ball Screw Technical Data Sheet (example)

(2) Made-to-order ball screw

Company name _____ Date: Day Month Year _____
 Address _____ Telephone _____
 Contact person _____ Section _____
 Machine Machining center Model MC- Application Table left/right movement (X axis)
 Drawing/rough sketch attached? Yes No

Use conditions

Maximum load	9 000 N	20 min ⁻¹	15 %	Operating conditions	Shaft rotation - Moving nut (Normal operation)
Load in normal use	4 000 N	360 min ⁻¹	60 %		Shaft rotation - Moving shaft Back drive operation
Minimum load	2 000 N	1 000 min ⁻¹	25 %		Nut rotation - Moving nut Nut rotation - Moving shaft Oscillation
				Degree of vibration shock	Normal
Maximum rotational speed	1 000 min ⁻¹			Required life	20 000 h
Lubricant	Grease/oil (Brand name: <u>NSK GRS AS2</u>) Maker: _____			Motor in use	Company A, Model 1
Seal	Yes _____ No _____			Control system	Company B, Model 2 (resolution: 1µm)
Support bearing	Drive side <u>35TAC62DF</u>		Opposite drive side <u>35TAC62DF</u>		
Guide way	Rolling (<u>RA451500GM2-P4Z3-I</u>)				
Environment	Temperature (Normal temperature in degrees Celsius)	Dust	Humidity	Gas	Liquid (where?) Cleanroom In vacuum
Schedule for prototype	Day	Month	Year (approx.)	Quantity used	Piece
Production start/quantity	/Month	/Year	/Lot	per machine	

Specifications

Screw shaft diameter	50 mm	Direction of turn	right	Accuracy grade	C2	Screw shaft length	880 mm	Preload	3000 N
Lead	10 mm	Effective ball turns		Axial play	0 mm	Overall shaft length	1 335 mm	Required torque	
Nut model	ZFT5010-10	Flange type	Circular I	Nut orientation	Same as shown in the dimension table		Opposite		

Supplemental explanation/requests

NSK Ball Screw Technical Data Sheet

(2) Made-to-order ball screw

Company name _____ Date: Day Month Year _____
 Address _____ Telephone _____
 Contact person _____ Section _____
 Machine _____ Application _____
 Drawing/rough sketch attached? Yes No

Use conditions

Maximum load	N	min ⁻¹	%	Operating conditions	Shaft rotation - Moving nut Normal operation
Load in normal use	N	min ⁻¹	%		Shaft rotation - Moving shaft Back drive operation
Minimum load	N	min ⁻¹	%		Nut rotation - Moving nut Nut rotation - Moving shaft Oscillation
				Degree of vibration shock	
Maximum rotational speed	min ⁻¹			Required life	
Lubricant	Grease/oil (Brand name: _____) Maker: _____			Motor in use	
Seal	Yes _____ No _____			Control system	(resolution: _____)
Support bearing	Drive side _____		Opposite drive side _____		
Guide way	Rolling Sliding (_____)				
Environment	Temperature (Normal temperature in degrees Celsius)	Dust	Humidity	Gas	Liquid (where?) Cleanroom In vacuum
Schedule for prototype	Day	Month	Year (approx.)	Quantity used	Piece
Production start/quantity	/Month	/Year	/Lot	per machine	

Specifications

Screw shaft diameter		Direction of turn		Accuracy grade		Screw shaft length		Preload	
Lead		Effective ball turns		Axial play		Overall shaft length		Required torque	
Nut model		Flange type		Nut orientation	Same as shown in the dimension table		Opposite		

Supplemental explanation/requests

B-2 Technical Description of Ball Screws

B-2-1 Accuracy

B-2-1.1 Lead Accuracy

The lead accuracy of NSK precision ball screws (C0 to C5 grades) conforms to the four characteristics specified in JIS Standards. These characteristics are expressed by ep , v_u , v_{300} , and $v_{2\pi}$.

Fig.1.1 explains the definition of each characteristic and shows allowable values of each. Leads are classified into two categories: the C system for positioning and

the Ct system for transportation. Tables 1.2, 1.3 and 1.4 show tolerance of each characteristic.

JIS B1192 sets C type and Cp type standards for positioning ball screws. NSK uses the specification of C type only. JIS B1192 specifies Ct1, 3, and 5 grade. NSK standards are integrated by C type only. Refer to Table 1.2 for C type standard tolerance.

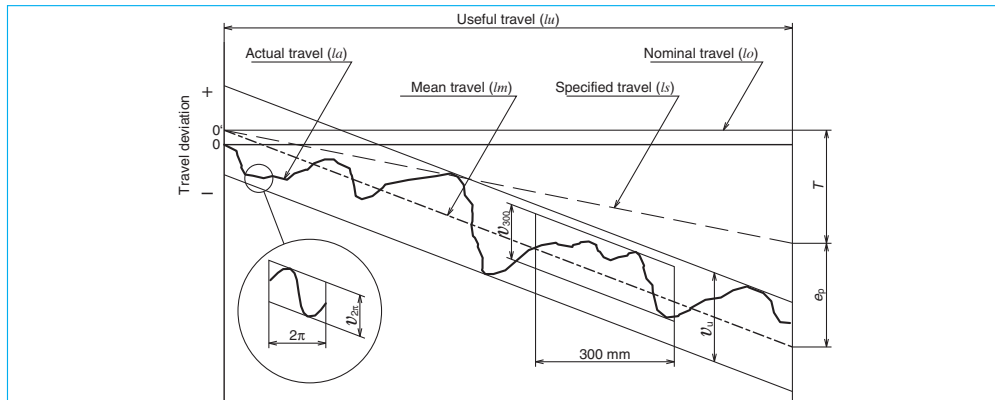


Fig. 1.1 Definition of lead accuracy

Table 1.1 Terminology in lead accuracy

Term	Code	Description	Tolerance
Specified travel	ls	The travel compensating the nominal travel for elongation caused by an increase of temperature or load.	
Travel compensation	T	Value obtained by subtracting the specified travel from the nominal travel based on the useful travel. The value is to compensate for errors caused by thermal deformation or deformation by load. This value is determined by tests and experience (see page B39).	
Actual travel	la	Actually measured travel	
Actual mean travel	lm	A straight line that demonstrates the direction of actual travel. This straight line is obtained from the curve that shows actual travel volume by the least-squares method or by approximation.	
Tolerance on specified travel	ep	Obtained by subtracting the specified travel from the actual mean travel.	Table 1.2
Travel variation	v_u v_{300} $v_{2\pi}$	Maximum range of the actual travel which is between the two straight lines drawn parallel to the actual mean travel. There are three categories as shown below. <ul style="list-style-type: none"> • 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 ($\pm ep$) and travel variation (v_u) of positioning (C type) ball screws

Unit: μm

Effective thread length, mm	Accuracy grade		C0		C1		C2		C3		C5	
	over	or less	$\pm ep$	v_u	$\pm ep$	v_u	$\pm ep$	v_u	$\pm ep$	v_u	$\pm ep$	v_u
	-	100	3	3	3.5	5	5	7	8	8	18	18
	100	200	3.5	3	4.5	5	7	7	10	8	20	18
	200	315	4	3.5	6	5	8	7	12	8	23	18
	315	400	5	3.5	7	5	9	7	13	10	25	20
	400	500	6	4	8	5	10	7	15	10	27	20
	500	630	6	4	9	6	11	8	16	12	30	23
	630	800	7	5	10	7	13	9	18	13	35	25
	800	1 000	8	6	11	8	15	10	21	15	40	27
	1 000	1 250	9	6	13	9	18	11	24	16	46	30
	1 250	1 600	11	7	15	10	21	13	29	18	54	35
	1 600	2 000			18	11	25	15	35	21	65	40
	2 000	2 500			22	13	30	18	41	24	77	46
	2 500	3 150			26	15	36	21	50	29	93	54
	3 150	4 000			30	18	44	25	60	35	115	65
	4 000	5 000					52	30	72	41	140	77
	5 000	6 300					65	36	90	50	170	93
	6 300	8 000							110	60	210	115
	8 000	10 000									260	140
	10 000	12 500									320	170

Table 1.3 Tolerance of travel variation relative to 300 mm (v_{300}) and one revolution ($v_{2\pi}$) of positioning (C type) ball screws

Unit: μm

Accuracy grade	C0	C1	C2	C3	C5
v_{300}	3.5	5	7	8	18
$v_{2\pi}$	2.5	4	5	6	8

Note: = JIS B1192 standards. Values in other areas are NSK standards.

Table 1.4 Travel variation (v_{300}) relative to 300 mm of transport (Ct type) ball screws

Unit: μm

Accuracy grade	Ct7	Ct10
v_{300}	52	210

Note: Tolerance on specified travel (ep) of transport (Ct type) ball screws is calculated as follows.

$$ep = \pm \frac{l_u}{300} \times v_{300}$$

l_u : Effective length of the screw thread

Example selection of lead accuracy

<Use Conditions>

Model No.: ZFT4010-10
 Stroke: 1 000 mm
 Positioning accuracy: ±0.035 mm/1 000 mm

<Calculation>

Obtain required lead accuracy of a ball screw under these conditions.

(1) Calculate the length of the thread

$$\begin{aligned} \text{Stroke} + \text{nut length} + \text{margin} &= 1\ 000 + 193 + 100 \\ &= 1\ 293 \text{ (mm)} \dots \rightarrow 1\ 300 \text{ mm} \end{aligned}$$

(2) Calculate lead accuracy

From **Table 1.2**, obtain the tolerance on specified travel relative to the length of thread (1 300 mm).

C5 ... ±0.054/1 250 – 1 600

C3 ... ±0.029/1 250 – 1 600

(3) Determine lead accuracy

Positioning accuracy is: ±ep < ±0.035/1 000 mm

Accuracy grade: C3 grade $\pm ep = 0.029/\text{length of thread (1 300 mm)}$
 $v_v = 0.018$

B-2-1.2 Thermal Expansion and Target Value of Specified Travel

(1) Thermal expansion

Thermal expansion of screw shaft induces the degradation of positioning accuracy of ball screws. Thermal expansion of a screw shaft is calculated as follows.

$$\Delta L_{\theta} = \rho \cdot \theta \cdot L \text{ (mm) } \dots\dots 1)$$

In this formula:

ΔL_{θ} : Thermal expansion (mm)

ρ : Thermal expansion coefficient ($12.0 \times 10^{-6} \text{ } ^\circ\text{C}^{-1}$)

θ : Average temperature rise of screw shaft (Celsius)

L : Length of screw shaft (mm)

The above formula indicates that when the temperature rises one degree Celsius, the screw shaft stretches 12 μm per meter. Ball screws generate more heat when used at high speed. This causes elongation of the screw shaft. Although the ball screw lead is ground high precision, an elongated screw shaft due to high temperature rise may not satisfy required highly accurate positioning.

(2) Countermeasures against temperature rise

Hollow shaft or nut-cooled ball screws are recommended for operation under high-speed and high-precision conditions. Take these countermeasures against temperature rise:

(a) Suppress heat generation.

- Do not apply excessive preload to the ball screw and support bearing.
- Select appropriate lubricant and use it properly.
- Use higher helix ball screw lead to lower rotational speed.

(b) Use forced cooling.

- Feed liquid coolant into the hollow shaft or nut-cooled ball screws. Refer to information on hollow shaft ball screws for high accuracy machine tools in the section for application-oriented ball screws (pages B528 to B536).
- Cool screw shaft surface with lubricant oil or air.

(c) Avoid effects of temperature rise on positioning.

- Warm up the machine at high speed until

the temperature rise of ball screw shaft saturates, then maintain it properly.

- Set pre-tension. (**Fig. 1.2**)
- Set the negative (minus) target value of specified travel.
- Employ a closed loop control system.

(3) How to determine specified travel

In general, the specified travel of a ball screw is the same as the nominal travel. However, the specified lead of ball screw is sometimes set to negative (minus) or positive (plus) to adjust expansion by temperature rise during operation, or the elongation/contraction of the screw shaft by external load. For such occasions, specify travel compensation (*T*) when ordering the ball screw.

As an example, **Table 1.5** shows the travel compensation (*T*) for typical NC machine tools.

Table 1.5 Travel compensation (*T*) of specified travel for typical NC machine tools

Unit: mm		
Type of machine	Axis	Travel compensation (per 1 m)
NC lathes	X	- 0.02 — - 0.05
	Z	- 0.02 — - 0.03
Machining centers	X, Y	- 0.03 — - 0.04
	Z	Differs by structure

(4) How to determine pre-tension force

In order to absorb thermal expansion, pre-tension can be provided to the screw shaft at the time of installation. In this case, the pre-tension is usually equivalent to the expansion brought about by a temperature rise of 2 to 3°C.

Fig. 1.2 shows the bearing support structure in such occasions.

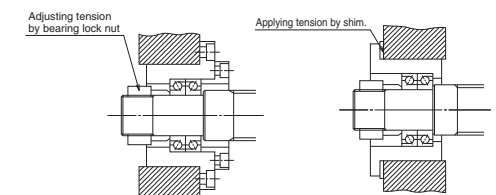


Fig. 1.2 Bearing structure to provide pre-tension

B-2-1.3 Mounting Accuracy and Tolerance of Ball Screws

The accuracy to mount the ball screws is specified by the following seven characteristics (Fig. 1.3).

Tolerances are indicated in the specification drawing.

Detailed tolerances are specified by JIS B1192. For reference, **Table 1.6** shows standard values of "(7) Total run-out of the screw shaft axis (straightness of the screw shaft)". NSK sets stricter tolerance standards than JIS standards. For accuracy of ball screw installation, refer to "Installation of Ball Screw (1) Centering of the units" (page B73).

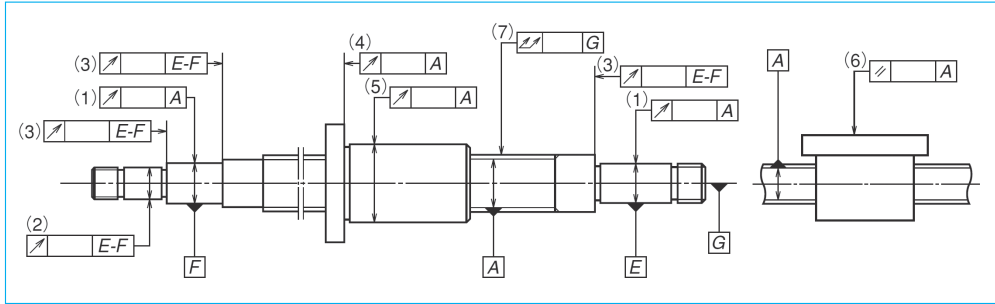


Fig. 1.3 Mounting accuracy of ball screw

- (1) Radial run-out of the support bearing seat relative to the axis of the ball thread of screw shaft.
- (2) Radial run-out of the other shaft ends section relative to the axis of the support bearing seat.
- (3) Radial run-out of the shoulder of support bearing seat relative to the axis of support bearing seat.
- (4) Radial run-out of the nut flange surface, or of the nut end datum surface, relative to the axis of screw shaft.
- (5) Radial run-out of the nut outside surface (cylindrical shape) to the axis of screw shaft.
- (6) Parallelism of the nut mounting surface to the screw shaft axis (in case of flat mounting surface).
- (7) Total run-out of the screw shaft axis.

Table 1.6 Total run-out of the screw shaft axis

Unit: μm

Accuracy grade		C0						C1								
Nominal diameter (mm)	over	–	8	12	20	32	50	–	8	12	20	32	50	80		
	or less	8	12	20	32	50	80	8	12	20	32	50	80	125		
Overall length of screw shaft (mm)	–	125	15	15	15				20	20	15					
	125	200	25	20	20	15			30	25	20					
	200	315	35	25	20	20			40	30	25	20				
	315	400		35	25	20	15		45	40	30	25	20			
	400	500		45	35	25	20			50	40	30	25			
	500	630		50	40	30	20	15		60	45	35	25	20		
	630	800			50	35	25	20			60	40	30	25		
	800	1 000			65	45	30	25			75	55	40	30	25	
	1 000	1 250			85	55	40	30			95	65	45	35	30	
	1 250	1 600			110	70	50	40			130	85	60	45	35	
	1 600	2 000				95	65	45				120	80	55	40	
	2 000	2 500											100	70	50	
	2 500	3 150													130	90
	3 150	4 000														120

Unit: μm

Accuracy grade		C3						C5								
Nominal diameter (mm)	over	–	8	12	20	32	50	80	–	8	12	20	32	50	80	
	or less	8	12	20	32	50	80	125	8	12	20	32	50	80	125	
Overall length of screw shaft (mm)	–	125	25	25	20					35	35	35				
	125	200	35	35	25	20				50	40	40	35			
	200	315	50	40	30	30				65	55	45	40			
	315	400	60	50	40	35	25			75	65	55	45	35		
	400	500		65	50	40	30				80	60	50	45		
	500	630		70	55	45	35	30			90	75	60	50	40	
	630	800			70	55	40	35				90	70	55	45	
	800	1 000			95	65	50	40	30			120	85	65	50	45
	1 000	1 250			120	85	60	45	35			150	100	75	60	50
	1 250	1 600			160	110	75	55	40			190	130	95	70	55
	1 600	2 000				140	95	70	50				170	120	85	65
	2 000	2 500					120	85	60					150	110	80
	2 500	3 150					160	110	75					200	140	95
	3 150	4 000						220	150	100				260	180	120
	4 000	5 000							200	130					240	160
5 000	6 300													310	210	
6 300	8 000														280	
8 000	10 000														370	

B-2-1.4 Automatic Lead Accuracy Measuring System of NSK

In response to the demand for high precision in production technology, NSK was the first to develop and use the "Lead Accuracy Measuring System (LAMS)." Lead accuracy is measured by a system that employs a laser interferometer measuring instrument and a personal computer.

Fig. 1.4 shows the lead accuracy measuring system. Inspection data for the ball screw is shown in Fig. 1.5. The laser interferometer measures either ball nut travel accuracy or lead accuracy of the ball thread. The data input into a computer are processed into four characteristic readings regarding lead accuracy. (See page B37.)

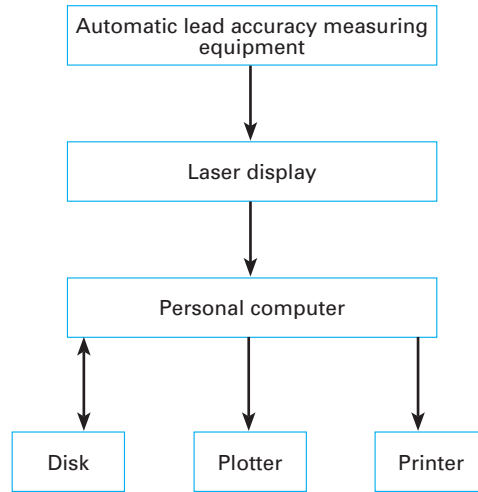


Fig. 1.4 Lead accuracy measuring system

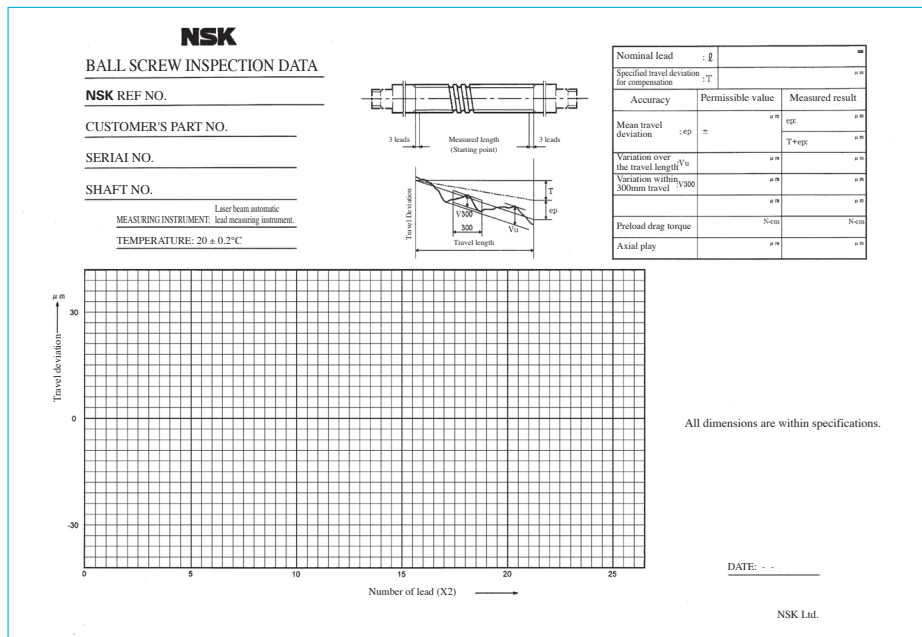


Fig. 1.5 Ball screw inspection data

B-2-2 Static Load Limits

Ball screws, based on their function, will generally receive axial load only. Ball screw shafts in general are long, so it is necessary to consider the 3 items below:

- Buckling load of the screw shaft
- Yielding of the screw shaft by tensional or compressive stress
- Permanent deformation at the ball contact points

B-2-2.1 Buckling Load

It is necessary to calculate whether the ball screw shaft is safe against buckling. Buckling load, i.e. permissible compressive load P to the axial direction, is calculated as follows.

$$P = \alpha \times \frac{N \cdot \pi^2 \cdot E \cdot I}{L^2} = m \frac{d_r^4}{L^2} \times 10^4 \text{ (N)} \dots\dots 2$$

In this formula:

- α : Safety factor ($\alpha = 0.5$)
- E : Elastic modulus ($E = 2.06 \times 10^5 \text{ MPa}$)
- I : Moment of inertia

$$I = \frac{\pi}{64} d_r^4 \text{ (mm}^4) \dots\dots 3$$

d_r : Screw shaft root diameter (mm) (See the dimension table.)

L : Distance between support positions (mm) (See Figs. 4.1 and 4.2 'Support configuration for screw shaft and nut' on page B51.)

m, N : Factors determined by the supporting condition of the ball screw shaft

Table 2.1 Factors of buckling load

Support condition	m	N
Fixed-Fixed	19.9	4
Fixed-Simple	10.0	2
Fixed-Free	1.2	0.25
Simple-Simple	5.0	1

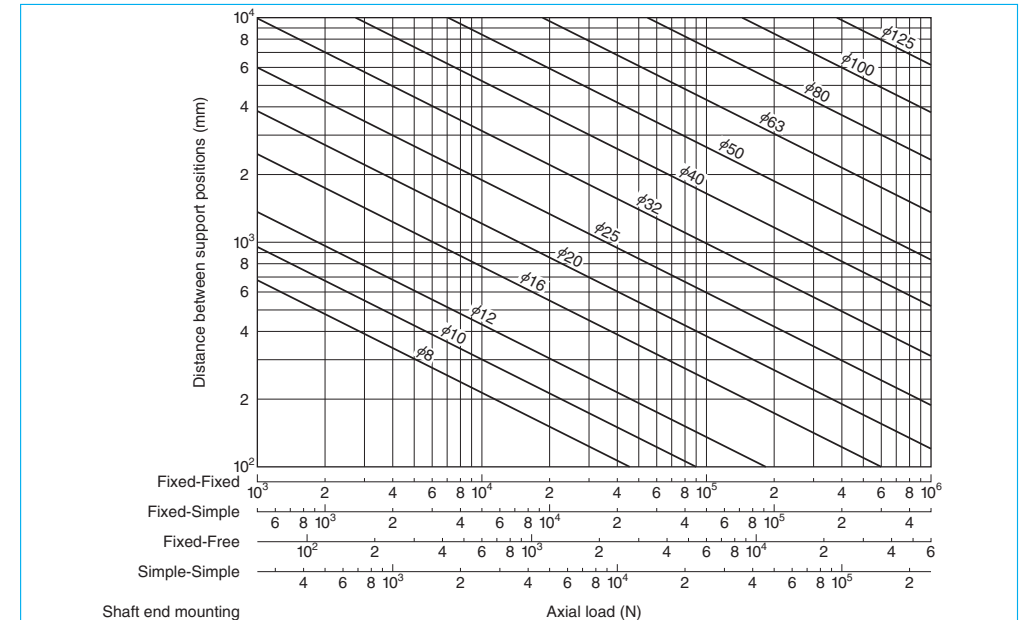


Fig. 2.1 Buckling load

<<Example calculation for buckling load>>

Calculate buckling load under the conditions in Fig. 2.2.

<Use conditions>

Model No.: ZFT4010-10

Support configuration is Fixed - Fixed (From (ii) in Fig. 4.1 "Support configuration of screw shaft and nut" on page B51.)

Distance between support positions $L = 2\,000$ mm

Screw shaft root diameter $d_r = 34.4$ mm (From the dimension table)

<Calculation>

Support configuration is Fixed - Fixed from Table 2.1 on page B44

$$N = 4$$

$$m = 19.9$$

By formula 2) on page B44

$$P = m \frac{d_r^4}{L^2} \cdot 10^4 = 19.9 \times \frac{34.4^4}{2\,000^2} \times 10^4 = 69\,667 \text{ (N)}$$

Therefore,

Permissible buckling load $P = 69\,600$ N

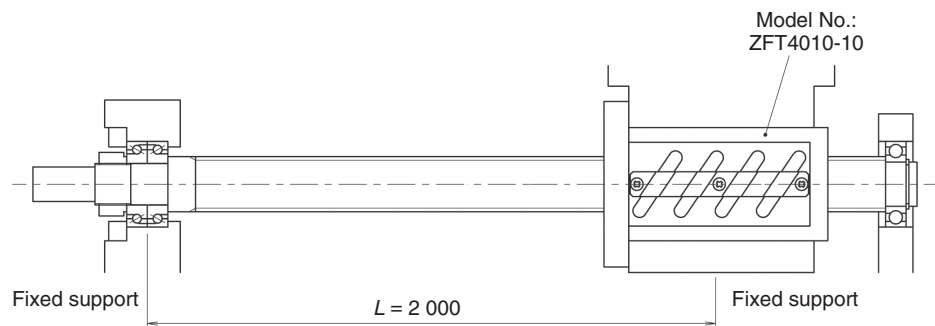


Fig. 2.2 Example calculation for buckling load

B-2-2.2 Yield by Tensional/Compressive Stress

It is necessary to consider permissible load in regards to the yield stress.

Permissible load P by tensional or compressive stress to screw shaft is

$$P = \sigma \cdot A = 1.15d_r^2 \times 10^2 \text{ (N)} \quad \dots 4)$$

In this formula:

σ : Allowable stress (= 147 MPa)

A : Cross section area of a screw shaft using root diameter (mm²)

$$A = \frac{\pi}{4} \cdot d_r^2 \text{ (mm}^2\text{)} \quad \dots 5)$$

d_r : Screw shaft root diameter (mm)

<<Example calculation for yield load>>

Obtain load in respect to the allowable stress under the conditions in Fig. 2.2.

<Use conditions>

Model No.: ZFT4010-10

Screw shaft root diameter $d_r = 34.4$ (mm)
(From the dimension table)

<Calculation>

By formula 4)

$$P = 1.15d_r^2 \times 10^2 = 1.15 \times 34.4^2 \times 10^2 = 136\,086 \text{ (N)}$$

Therefore,

Permissible load $P = 136\,000$ N

B-2-2.3 Permanent Deformation at the Ball Contact Point

Exposed to an excessively heavy load in axial direction, the balls are squashed, and the ball rolling surface is dented. The deformations on these points do not perfectly restore to original shape after the load is removed. They are permanently disfigured. It is necessary to determine the limit of this disfigurement to contain it within a certain range.

(1) Basic static load rating C_{0a}

Basic static load rating C_{0a} is a load in the axial direction that results in combined permanent deformation equal to 0.01% of the ball diameter at the contact points of ball and ball grooves of the screw shaft and nut.

(2) Calculation of permissible load by C_{0a}

P_0 (allowable axial load to limit permanent deformation) is calculated using C_{0a} .

$$P_0 = \frac{C_{0a}}{f_s} \text{ (N)} \quad \dots 6)$$

In this formula, f_s : Static permissible load factor

Table 2.2 Static permissible load factor

At time of normal operation	1 - 2
With vibration impact	1.5 - 3

<<Example calculation for maximum allowable load>>

Obtain the maximum allowable load to the ball groove section under conditions in Fig. 2.2.

<Use conditions>

Model No.: ZFT4010-10

Basic static load rating $C_{0a} = 137\,000$ (N)
(From the dimension table)

Static permissible load factor $f_s = 2$
(normal operation, no vibration impact)

<Calculation>

By formula 6), the maximum allowable load of the ball groove section

$$P_0 = \frac{C_{0a}}{f_s} = \frac{137\,000}{2} = 68\,500 \text{ (N)}$$

B-2-3 Permissible Rotational Speed

Permissible rotational speed is determined by the feeding speed and ball screw lead. When selecting a ball screw, it is important to know the permissible rotational speed.

It is necessary to calculate two items below, and take the smaller as the permissible rotational speed.

The lower of the following two factors, $d \cdot n$ and critical speed, will determine the overall permissible rotational speed of the ball screw.

- Critical speed, which is the resonance vibration of the shaft.

- $d \cdot n$ value, which is involved in damaging the ball recirculation components.

* Please consult NSK if the maximum rotational speed exceeds the criteria of maximum rotational speed on page B50, even if both the critical speed of screw shaft rotation and the $d \cdot n$ value are in range of the allowable limits.

B-2-3.1 Critical Speed of the Screw Shaft

Calculate the critical speed matching the ball screw rotational speed and the natural frequency of the screw shaft. 80% of the critical speed is defined as the permissible rotational speed.

Calculate the critical speed of the screw shaft whether you use shaft rotation or nut rotation. Critical speed varies by the nut traveling position. Please consult NSK for detailed calculations.

If using a ball screw exceeding the critical speed, it is necessary to increase the natural frequency by using an intermediate support, etc. If using nut rotation, it is possible to operate exceeding critical speed by installing a vibration energy absorbing system (optional, vibration control damper: patented by NSK) to the screw shaft. (Refer to "Rotary nut ball screws" on page B539.)

Calculate the permissible rotational speed based on critical speed n_c as follows, taking in account "B-2-4 Support Configuration for Calculation of Buckling Load and Critical Speed" on page B51.

Fig. 3.1 shows the permissible rotational speeds against critical speed for each shaft diameter.

$$n_c = \alpha \times \frac{60\lambda^2}{2\pi L^2} \sqrt{\frac{E \cdot I \cdot 10^9}{\rho \cdot A}} \quad \dots 7)$$

$$= f \frac{d_r}{L^2} \times 10^7 \text{ (min}^{-1}\text{)} \quad \dots 7)$$

In this formula:

α : Safety factor ($\alpha = 0.8$)

E : Elastic modulus ($E = 2.06 \times 10^5$ MPa)

I : Moment of inertia of area of screw shaft

$$I = \frac{\pi}{64} d_r^4 \text{ (mm}^4\text{)} \quad \dots 3)$$

d_r : Screw shaft root diameter (mm) (See the dimension table.)

ρ : Material density ($\rho = 7.86$ g/cm³)

A : Cross section area of the screw shaft root diameter (mm²)

$$A = \frac{\pi}{4} \times d_r^2 \text{ (mm}^2\text{)} \quad \dots 5)$$

L : Distance between support positions (mm) (See Figs. 4.1, and 4.2 "Support configuration of screw shaft and ball nut" on page B51)

f, λ : Factors determined by support conditions

Table 3.1 Coefficients of critical speed

Support condition	f	λ
Fixed-Fixed	15.1	3.927
Fixed-Simple	21.9	4.730
Fixed-Free	3.4	1.875
Simple-Simple	9.7	π

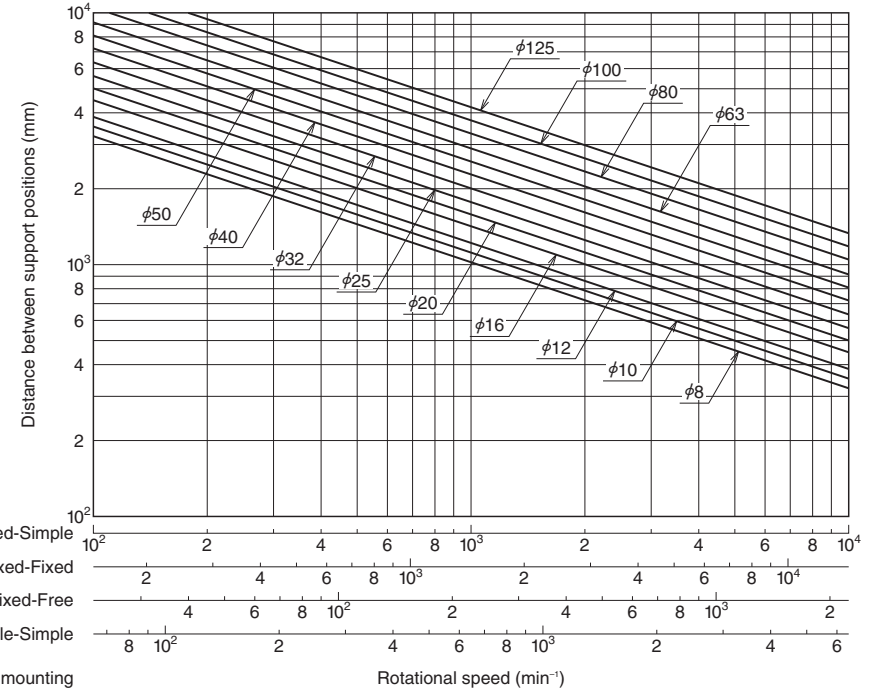


Fig. 3.1 Permissible rotational speeds vs. critical speeds

<<Example calculation of permissible rotational speed to critical speed>>
 Calculate the permissible rotational speed to the critical speed under conditions in **Fig. 3.2**.

<Use conditions>

Model No.: ZFT4010-10

The support configuration is Fixed-Simple (condition (ii) in **Fig 4.1**

Support configuration of screw shaft and ball nut on page B51.)

Distance between support positions $L = 2\,000$ mm

Screw shaft root diameter $d_i = 34.4$ mm (from the dimension table)

<Calculation>

The support configuration is Fixed-Simple, from **Table 3.1** on page B47

$$\lambda = 3.927$$

$$f = 15.1$$

By formula 7) on page B47, permissible rotational speed to critical speed is

$$n_c = f \frac{d_i}{L^2} \times 10^7 = 15.1 \times \frac{34.4}{2\,000^2} \times 10^7 = 1\,298.6 \text{ (min}^{-1}\text{)}$$

$$n_c = 1\,290 \text{ min}^{-1} \text{ or under}$$

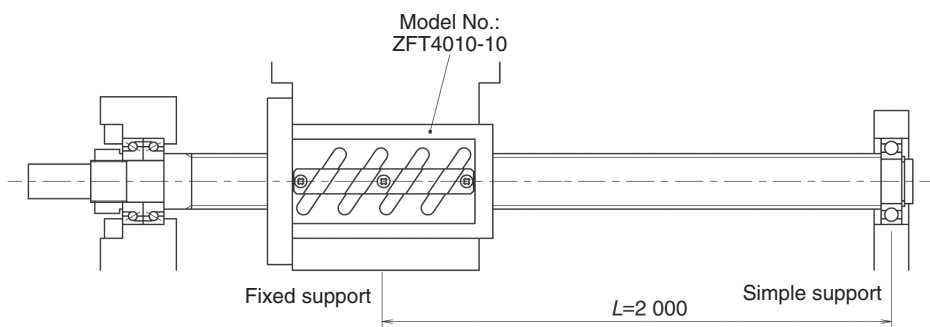


Fig.3.2 Example calculation of permissible rotational speed to critical speed

B-2-3.2 d·n Value

An increase of ball revolution speed increases the collision impacts of balls to ball recirculation parts, thus resulting in damage. For this reason, the permissible rotational speed is also limited by the *d·n* value (d, shaft diameter in millimeters; n, rotational speed per minutes). **Table 3.2** shows the allowable *d·n* value and the maximum rotational speed of ball screws.

- Notes: 1. Special measures must be taken for high-speed specification products. Please consult NSK.
 2. Please consult NSK if the maximum rotational speed or the *d·n* value exceed the values below, even if both the critical speed of screw shaft and the *d·n* value are in range of allowable limits.

Table 3.2 Criteria of allowable *d·n* value and maximum rotational speed

Ball screw recirculation system, model	Allowable <i>d·n</i> value		Criterion of permissible rotational speed [min ⁻¹]	
	Standard	High-speed		
Standard ball screw	R model ball screws for transfer equipment	50 000 or less	–	3 000
Standard nut ball screws	End-deflector recirculation	180 000 or less	–	5 000
	SRC recirculation	160 000 or less	–	5 000
	Tube recirculation	70 000 or less	100 000 or less	3 000
	Deflector (bridge) recirculation	84 000 or less	100 000 or less	3 000
	High-speed Low-noise Deflector Recirculation	160 000 or less, 150 000 or less ^{*1}	–	5 000
Application-oriented ball screws	HMD model for high-speed machine tools	160 000 or less	–	4 000
	HMS model for high-speed machine tools	160 000 or less	–	5 000
	HTF-SRC model for high-load drives	140 000 or less, 160 000 or less ^{*1}	–	3 225
	HTF-SRD model for high-load drives	120 000 or less	–	2 400
	HTF model for high-load drives	50 000 or less, 70 000 or less ^{*1}	100 000 or less	3 125
	VSS model for contaminated environments	150 000 or less	–	3 000
	Rotary nut ball screws	70 000 or less	100 000 or less	3 000
	Σ model for robots	70 000 or less	–	3 000

*1) Please refer to the relevant page when two allowable *d·n* values are listed:
 · High-speed Low-noise Deflector Recirculation: page B475
 · HTF-SRC model for high-load drives: page B491
 · HTF model for high-load drives: page B499

B-2-4 Support Configuration for Calculation of Buckling Load and Critical Speed

Figs. 4.1 and 4.2 are typical conditions in supporting ball screws. Use them to calculate buckling load and critical speed.

Please consult NSK to scrutinize calculations due to use conditions, or if boundary conditions are not clear due to a special installation.

[How to read the tables]

Example ii: A buckling load is generated between the nut and the left bearings, indicating that the critical speed appears between the nut and the right bearing. Therefore, set L at the maximum stroke for each side. Calculate by applying support bearing conditions.

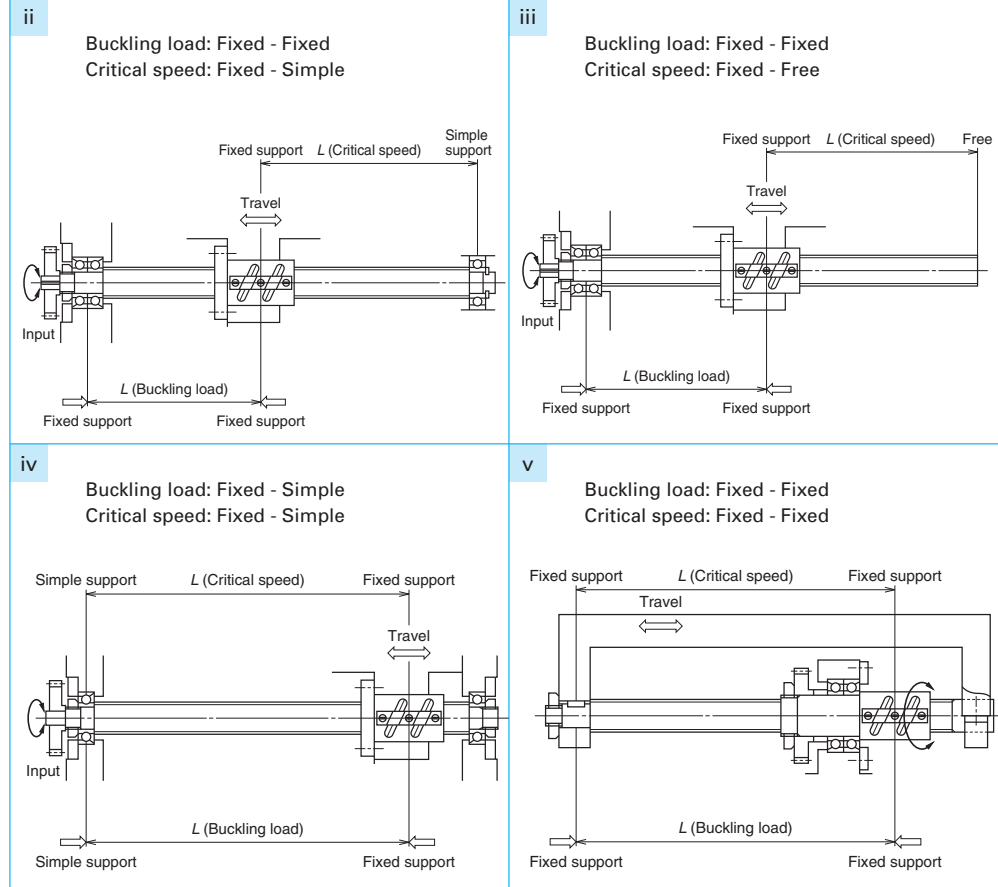


Fig. 4.1 Support configuration for screw shaft and ball nut

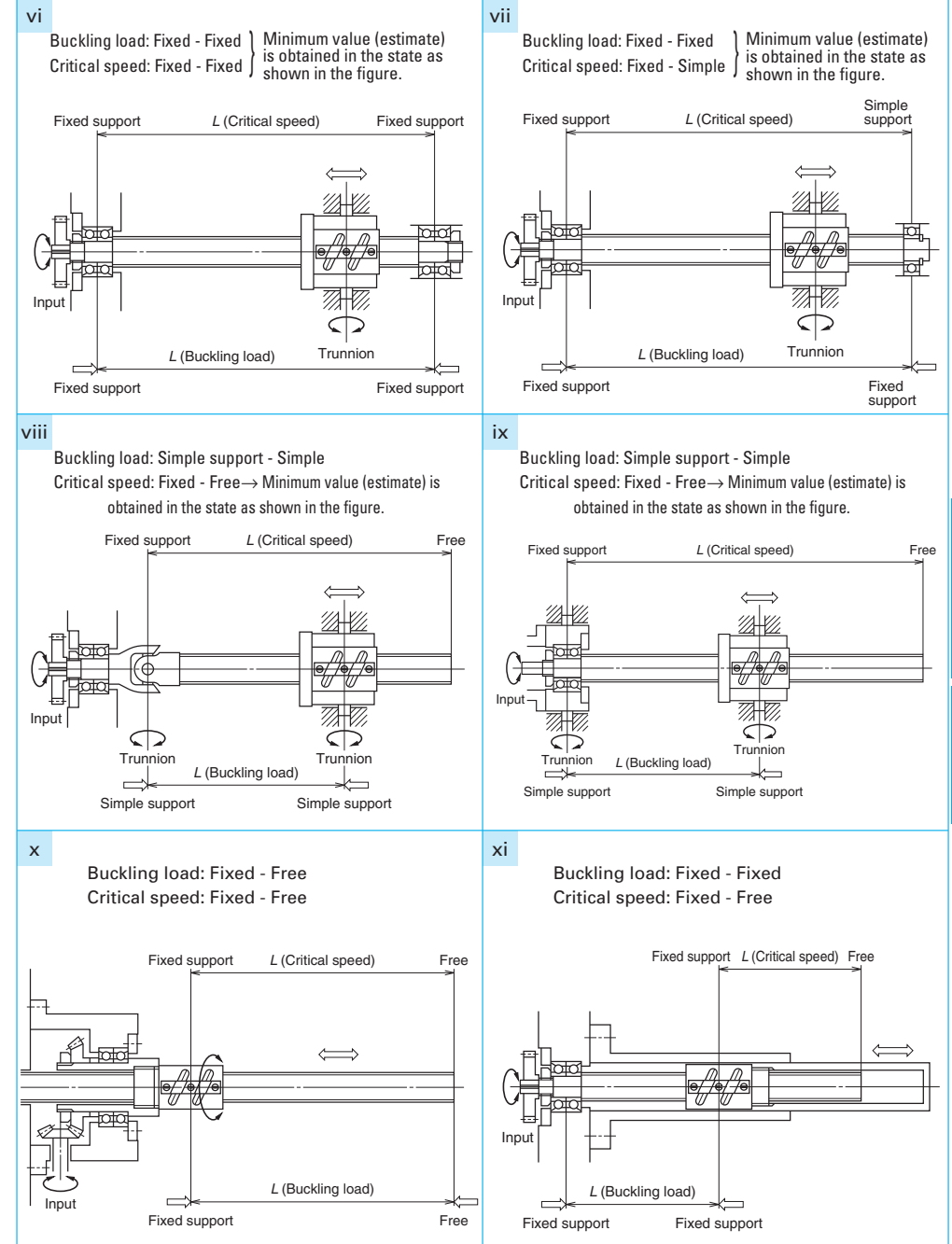


Fig. 4.2 Support configuration for screw shaft and ball nut

B-2-5 Life (Dynamic Load Limits)

B-2-5.1 Life of Ball Screws

Although used in appropriate conditions and ideally designed, the ball screw deteriorates after a certain operation period, and eventually becomes unusable. The period in this situation is the life of the ball screw. There are two life categories, "fatigue life" caused by flaking, and "accuracy life" caused by deterioration in precision because of wear.

B-2-5.2 Fatigue Life

Fatigue life of a ball screw can be estimated by the basic dynamic load rating (C_a) as for rolling bearings.

(1) Basic dynamic load rating C_a

The basic dynamic load rating is the axial load that allows 90% of the group of the same ball screws to rotate 1 million times (10^6 rev) under the same conditions without causing flaking by rolling contact fatigue.

(2) Fatigue life calculation

Fatigue life is defined in general as the total number of rotations. It is sometimes indicated by total rolling hours or total running distance. Fatigue life is obtained by the following formula.

$$L = \left(\frac{C_a}{F_a \cdot f_w} \right)^3 \cdot 10^6 \quad \dots 8)$$

$$L_t = \frac{L}{60n} \quad \dots 9)$$

$$L_s = \frac{L \cdot l}{10^6} \quad \dots 10)$$

In this formula:

- L : Rating fatigue life (rev)
- L_t : Life in hours (h)
- L_s : Life by running distance (km)
- C_a : Basic dynamic load rating (N)
- F_a : Axial load (N)
- n : Rotational speed (min^{-1})
- l : Lead (mm)
- f_w : Load factor (Coefficient by operating condition)

Load factor f_w for operating conditions is shown in **Table 5.1**.

Table 5.1 Load coefficient f_w

Smooth operation without impacts	1.0 – 1.2
Normal operation	1.2 – 1.5
Operation associated with impacts or vibrations	1.5 – 3.0

Setting fatigue life too long requires larger, more costly ball screws. Below are the general target values of operating life for machines.

Table 5.2 General target values of fatigue life

Machine tools	20 000 hours
Industrial machines	10 000 hours
Automatic control system	15 000 hours
Measuring equipment	15 000 hours

(3) Mean load

If the axial load often varies, calculate life by obtaining the mean load, which gives the equivalent fatigue life under varying load conditions.

(a) When the load and the rotational speed shift stepwise Obtain the mean load F_m by the formula below. Obtain mean rotational speed N_m by the formula below as **Table 5.3** and **Fig. 5.1**.

$$F_m = \left(\frac{F_1^3 \cdot n_1 \cdot t_1 + F_2^3 \cdot n_2 \cdot t_2 + \dots + F_n^3 \cdot n_n \cdot t_n}{n_1 \cdot t_1 + n_2 \cdot t_2 + \dots + n_n \cdot t_n} \right)^{\frac{1}{3}} \quad \dots 11)$$

$$N_m = \frac{n_1 \cdot t_1 + n_2 \cdot t_2 + \dots + n_n \cdot t_n}{t_1 + t_2 + \dots + t_n} \quad \dots 12)$$

Table 5.3 Stepwise operation conditions

Axial load (N)	Rotational speed (min^{-1})	Hours of use, or ratio of hours of use
F_1	n_1	t_1
F_2	n_2	t_2
:	:	:
F_n	n_n	t_n

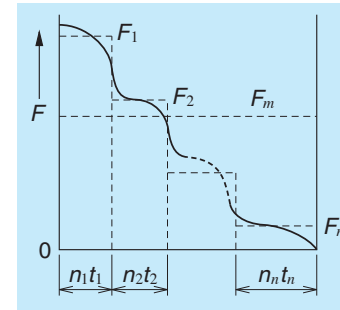


Fig. 5.1 Stepwise load variation

(b) When the rotational speed is constant, and the load changes linearly, obtain the approximate value of the mean load F_m by the formula below.

$$F_m = \frac{1}{3} (F_{min} + 2F_{max}) \quad \dots 13)$$

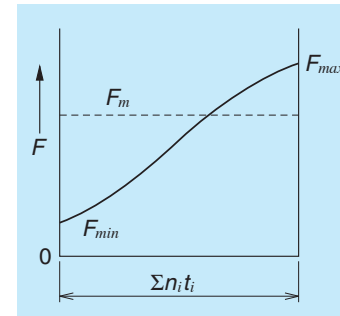


Fig. 5.2 Linear load change

(c) When the rotational speed is constant, and the load changes in a sinusoidal pattern, obtain the approximate value of the mean load F_m by the formula below.

When the sine curve is Fig. (a)

$$F_m \doteq 0.65 F_{max} \quad \dots 14)$$

When the sine curve is Fig. (b)

$$F_m \doteq 0.75 F_{max} \quad \dots 15)$$

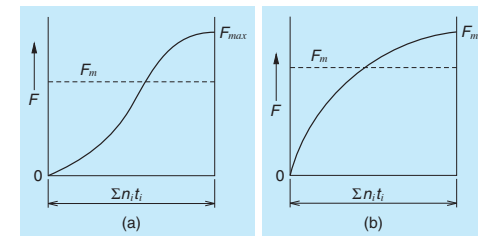


Fig. 5.3 Load changes in sinusoidal pattern

(4) Effects of mounting misalignment

Moment load or radial load applied to the ball screw adversely affects ball screw function and shortens life. Watch for eccentric load that induces moment or radial load.

Fig. 5.4 shows a calculation example of fatigue life when moment load is applied to the ball screw. In this figure, the value of the rigidity of mounting ball screw sections (screw shaft, support bearing, guide, etc.) is set at infinity. In actual use, deformation absorbs the moment load in various areas, and the moment load between the screw shaft and nut is abated.

In general, the following values are recommended as control values for precision grade.

- Misalignment in inclination : 1/2 000 or less (Target value : 1/5 000 or less)
- Eccentricity : 0.020mm or less

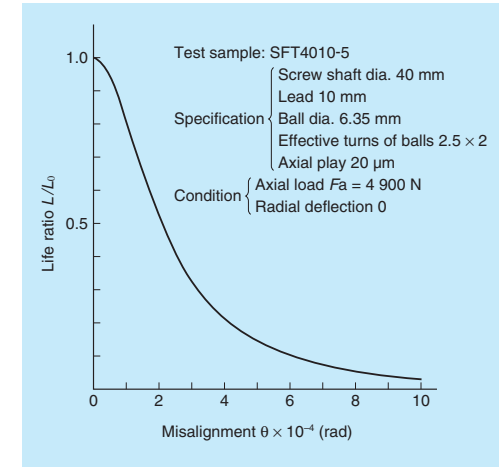


Fig. 5.4 Effects of misalignment

(5) Effects of heavy load and short stroke

If the ball screw is used under heavy load and short strokes, such as for the drive of plastic injection molding machines and press machines, the fatigue life may become significantly shorter than the rated fatigue life calculated in B-2-5.2.

This decreased life occurs because the heavy load generates large stress (surface pressure) in the contact points of balls and ball grooves of the screw shaft and the nut, adversely affecting life.

The axial load F_{amax} during operation and the size of strokes, which affect fatigue life, can be obtained by the following formula. In such cases, the life calculation should take into account the surface pressure as well as the size of the stroke. Please consult with NSK.

$$F_{\text{amax}} \geq 0.10C_{0a} \dots 16) \\ S \leq 4$$

In this formula:

F_{amax} : Maximum load in 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)

*1) Axial load: The load applied in the axial direction when the screw shaft and the nut of ball screw are rotating relative to each other. The rotational speed is irrelevant.

B-2-5.3 Ball Screw Hardness

Table 5.4 indicates the hardness of NSK standard ball screws.

Table 5.4 Ball screw materials and their hardness

Component	Heat treatment method	Hardness (HRC)
Screw shaft	Carburizing	58 or over
	Induction hardening	58 or over
Nut	Carburizing	58 or over

Note: NSK manufactures special material ball screws for special environments (stainless steel: SUS440C, SUS630). NSK also furnishes protective surface treatments (refer to page D5). Please consult NSK for such requests.

B-2-5.4 Wear Life

Wear of materials, as is the case for other mechanical components, is significantly affected by use conditions, lubrication conditions, and other factors. It is difficult to estimate its volume, and measuring requires various tests and field data.

NSK has wear data accumulated through abundant experience. Please contact NSK for inquiries pertaining to wear.

B-2-6 Preload and Rigidity

B-2-6.1 Elastic Deformation of Preloaded Ball Screw

(1) Position preload (D, Z, and P preload)

The concept of offset preload ball screw is shown in Fig. 6.1.

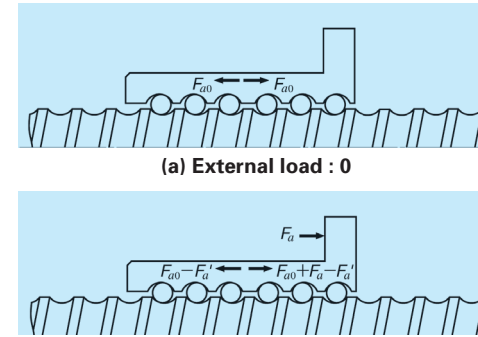


Fig. 6.1 Position preload

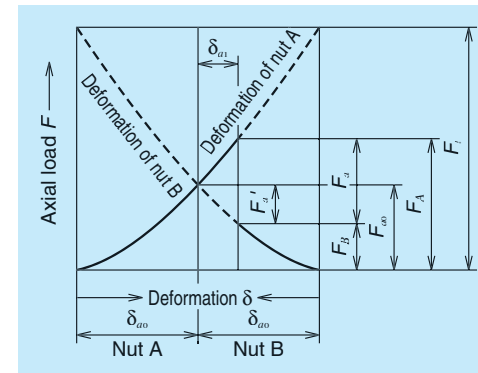


Fig. 6.2 Deformation of nuts A and B (position preload)

Elastic deformation of Nut A and B is already given at the time of assembly by the amount of δ_{a0} by preload F_{a0} . When the external load F_a is added to Nut A, the elastic deformation δ_a and δ_b of Nut A and B change as shown in Fig. 6.2,

$$\delta_a = \delta_{a0} + \delta_{a1} \quad \delta_b = \delta_{a0} - \delta_{a1}$$

At this time, the loads to Nut A and B are:

$$F_A = F_{a0} + F_a - F_a'$$

$$F_B = F_{a0} - F_a'$$

This shows that the load applied to Nut A is affected by Nut B and reduced by the amount

of F_a' . Thereby, the elastic deformation of Nut A becomes smaller. This effect continues until the elastic deformation from external load becomes δ_{a0} and the preload of Nut B disappears.

Assuming that the load when preload is absorbed is F_l , the relationship between the axial load and elastic deformation is as follows (refer to Fig. 6.2).

$$\delta_{a0} = K \cdot F_{a0}^{2/3} \quad 2\delta_{a0} = K \cdot F_l^{2/3} \\ (K: \text{Constant}) \\ \left[\frac{F_l}{F_{a0}} \right]^{2/3} = \frac{2\delta_{a0}}{\delta_{a0}} = 2 \\ F_l = 2^{3/2} \times F_{a0} \doteq 3F_{a0}$$

For this reason, the preload should be about 1/3 the maximum axial load. However, please note that if preload of about 1/3 the maximum axial load exceeds 8% of C_{0a} , which is the criterion of the maximum preload, the ball screw may adversely generate more heat and/or have shortened life.

Fig. 6.3 shows two types of elastic deformation curves: one is by a ball screw with preload, the other without preload. When an axial load which is about three times as large as the preload is applied, the deformation of the preloaded ball screw is 1/2 the deformation of the ball screw without preload.

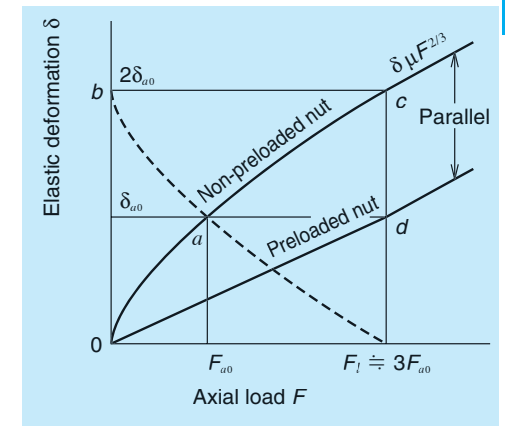


Fig. 6.3 Deformation of preloaded ball nut (position preload)

(2) Constant pressure preload (J preload: preloaded by spring)

Fig. 6.5 shows elastic deformation of a ball screw which is preloaded with "constant pressure." The rigidity of the preload spring is sufficiently smaller than the nut rigidity. Therefore, the deformation of the spring becomes nearly parallel to the abscissa axis. For this reason, elastic deformation by preload with constant pressure changes along the deformation curve by Nut A. In order to take advantage of the characteristics of preload with constant pressure, the major external load should be applied in the directions shown by arrows in Fig. 6.4.

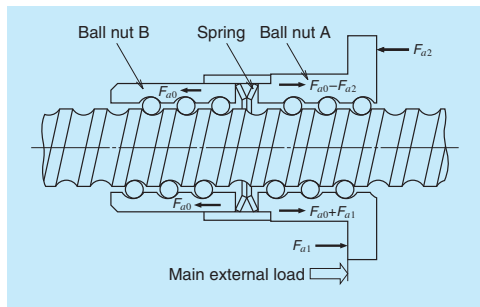


Fig. 6.4 Constant pressure preload (double nut)

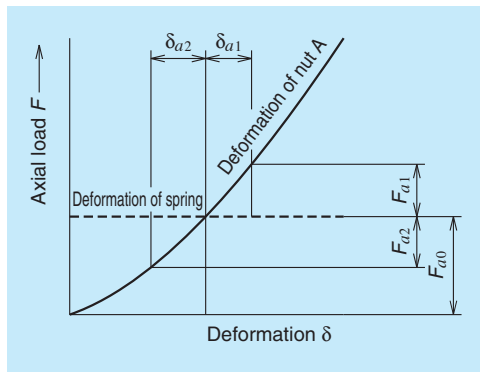


Fig. 6.5 Deformation curve of constant pressure preloaded nut

B-2-6.2 Rigidity of the Feed Screw System

A low rigidity around the feed screw mounting area causes lost motion. To improve the positioning accuracy of precision machines such as NC machine tools requires a good balance in axial rigidities of the parts composing the feed screw system. One should also examine the torsional rigidities of the feed screw system.

(1) Axial rigidity of the feed screw system K_T

Elastic deformation and rigidity of the feed screw system can be obtained by the following formula.

$$\delta = \frac{F_a}{K_T} \dots\dots\dots 17)$$

$$\frac{1}{K_T} = \frac{1}{K_S} + \frac{1}{K_N} + \frac{1}{K_B} + \frac{1}{K_H} \dots\dots\dots 18)$$

In this formula:

δ : Volume of axial elastic deformation of the feed screw system (μm)

F_a : Axial load on the feed screw system (N)

K_T : Axial rigidity of the feed system (N/ μm)

K_S : Axial rigidity of the screw shaft (N/ μm)

K_N : Axial rigidity of the nut (N/ μm)

K_B : Axial rigidity of the support bearing (N/ μm)

K_H : Axial rigidity of the nut and bearing mounting section (N/ μm)

(2) Axial rigidity of the screw shaft: K_S

(a) In case of: Fixed - Free (axial direction)

$$K_S = \frac{A \cdot E}{x} \times 10^{-3} \dots\dots\dots 19)$$

In this formula:

K_S : Axial rigidity of the screw shaft (N/ μm)

A : Cross section area of the screw shaft (mm^2)

$$A = \frac{\pi}{4} d_r^2$$

d_r : Screw shaft root diameter (mm)

E : Elastic modulus ($E = 2.06 \times 10^5$ MPa)

x : Distance between points of load application (mm)

(b) In case of: Fixed - Fixed support (axial direction)

$$K_S = \frac{A \cdot E \cdot L}{x(L-x)} \times 10^{-3} \dots\dots\dots 20)$$

In this formula:

K_S : Axial rigidity of the screw shaft (N/ μm)

L : Distance between support positions (mm)

x : Axial deformation is maximum at position $x = L/2$.

Axial rigidity of the screw shaft can be obtained by the following formula.

$$K_S = \frac{4A \cdot E}{L} \times 10^{-3} \dots\dots\dots 21)$$

<<Example calculation for axial rigidity (1)>>

Obtain axial rigidity of the screw shaft under the conditions in Fig. 6.6.

<Use conditions>

Model No.: ZFT 4010-10

From Fig. 6.6: Support configuration

Fixed-Free (axial direction)

Distance between points of load application

$$x = 1\,200 \text{ mm}$$

Screw shaft root diameter (from the dimension table)

$$d_r = 34.4 \text{ mm}$$

<Calculation>

By formula 19), axial rigidity K_S is :

$$A = \frac{\pi}{4} d_r^2 = \frac{3.14}{4} \times 34.4^2 = 929.4 \text{ (mm}^2\text{)}$$

$$K_S = \frac{A \cdot E}{x} \times 10^{-3} = \frac{929.4 \times 2.06 \times 10^5}{1\,200} \times 10^{-3} = 159 \text{ (N/}\mu\text{m)}$$

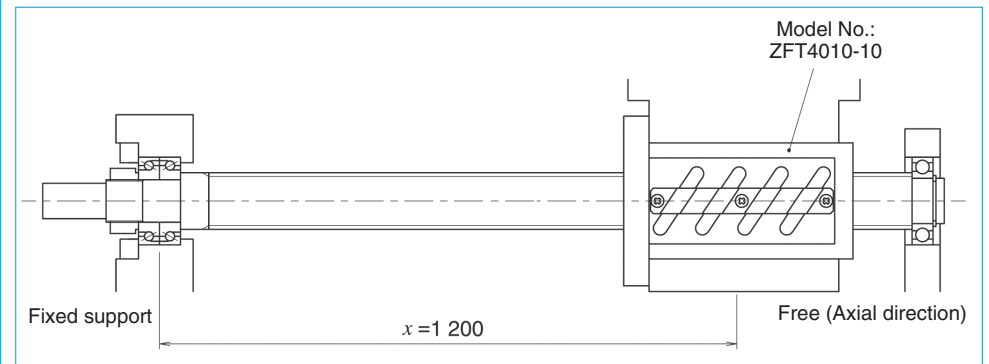


Fig. 6.6 Example calculation for axial rigidity of screw shaft (1)

<<Example calculation for axial rigidity (2)>>

Obtain axial rigidity of the screw shaft under the conditions in Fig. 6.7.

<Use conditions>

Model No.: ZFT 4010-10

From Fig. 6.7: Support configuration:

Fixed - Fixed support (axial direction)

$$L = 1\ 200\ \text{mm}$$

Distance between points of load application:

Screw shaft root diameter (from the dimension table)

$$dr = 34.4\ \text{mm}$$

<Calculation>

By formula 21), axial rigidity K_s is :

$$A = \frac{\pi}{4} dr^2 = \frac{3.14}{4} \times 34.4^2 = 929.4\ (\text{mm}^2)$$

$$K_s = \frac{4A \cdot E}{L} \times 10^{-3} = \frac{4 \times 929.4 \times 2.06 \times 10^5}{1\ 200} \times 10^{-3} = 638\ (\text{N}/\mu\text{m})$$

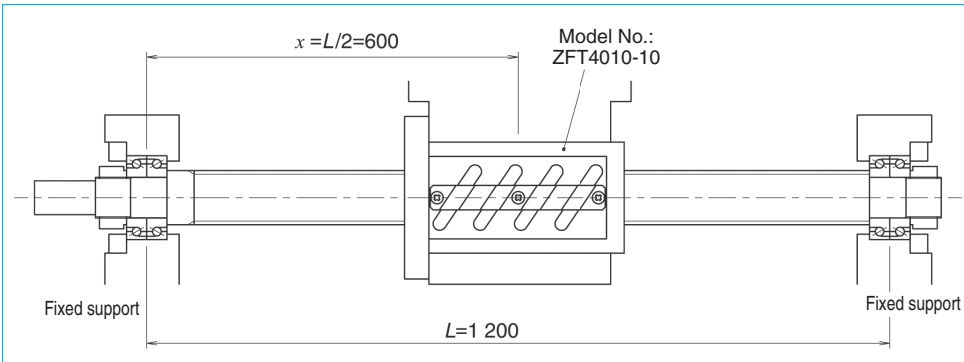


Fig. 6.7 Example calculation for axial rigidity of screw shaft (2)

(3) Axial rigidity of the ball nut : K_N

(a) Rigidity of the nut with axial play

Theoretical rigidity K is shown in the dimension tables. The value of K is obtained from the elastic deformation between screw grooves and balls when an axial load equivalent to 30% of the basic dynamic load rating C_a is applied. The criterion for the ball nut rigidity is 80% of the value listed in the table taking into consideration deformation of the ball nut, etc. The rigidity K_N is obtained by the following formula when the axial load F_a is not 30% of " C_a ."

$$K_N = 0.8 \times K \left(\frac{F_a}{0.3 \cdot C_a} \right)^{1/3} \quad (\text{N}/\mu\text{m}) \quad \dots 22$$

In this formula:

K : Rigidity in dimension tables (N/ μ m)

F_a : Axial load (N)

C_a : Basic dynamic load rating (N)

(b) Rigidity of preloaded ball nut

Theoretical rigidity K of a preloaded ball nut under an axial load is shown in each dimension table. K is obtained from the elastic deformation of the ball rolling surface and the balls when a preload equivalent to 10% of the basic dynamic load rating C_a (5% in case of the P-preload [single-nut oversize ball preload system]) is applied. The criterion for calculation of nut rigidity is 80% of the value listed in the table taking into consideration deformation of the ball nut, etc. Rigidity K_N is obtained by the following formula when preload F_{a0} is not 10% (or 5%) of C_a .

$$K_N = 0.8 \times K \left(\frac{F_{a0}}{\varepsilon \cdot C_a} \right)^{1/3} \quad (\text{N}/\mu\text{m}) \quad \dots 23$$

In this formula:

K : Rigidity in dimension tables (N/ μ m)

F_{a0} : Preload (N)

ε : Basic factor to calculate rigidity ($\varepsilon = 0.1$. For P-preload, use the percentage of the preload to the basic dynamic load rating e.g. 0.03 for BSS and 0.015 for VSS.)

<<Example calculation for axial rigidity (3)>>

Obtain axial rigidity of the nut under the following conditions.

<Use conditions>

Model No.: SFT 4010-5

Axial load: $F_a = 6\ 000\ \text{N}$

F_a = Rigidity at 0.3 C_a $K = 741\ \text{N}/\mu\text{m}$
(from the dimension table)

<Calculation>

By formula 22), axial rigidity K_N is :

$$\begin{aligned} K_N &= 0.8 \times K \left(\frac{F_a}{0.3 \cdot C_a} \right)^{1/3} \\ &= 0.8 \times 741 \times \left(\frac{6\ 000}{0.3 \times 61\ 200} \right)^{1/3} \\ &= 408\ (\text{N}/\mu\text{m}) \end{aligned}$$

<<Example calculation for axial rigidity of screw shaft (4)>>

Obtain axial rigidity of the nut under the following conditions.

<Use conditions>

Model No.: ZFT 4010-10

Preload : $F_{a0} = 4\ 000\ \text{N}$

Rigidity K when $F_{a0} = \varepsilon C_a$: $K = 1\ 454\ \text{N}/\mu\text{m}$
(from the dimension table on page B461)

Basic factor to calculate rigidity for D-Preload $\varepsilon = 0.1$

<Calculation>

By formula 23)

$$\begin{aligned} K_N &= 0.8 \times K \left(\frac{F_{a0}}{\varepsilon \cdot C_a} \right)^{1/3} \\ &= 0.8 \times 1\ 454 \times \left(\frac{4\ 000}{0.1 \times 61\ 200} \right)^{1/3} \\ &= 1\ 009\ (\text{N}/\mu\text{m}) \end{aligned}$$

Ball screw preload criteria

Nut rigidity increases with larger preload volume. But excessive preload shortens life and generates heat. Set the maximum preload to about 0.08 C_n (0.03 for P-Preload). **Table 6.1** shows the criteria for preload for different applications.

Table 6.1 Criteria of preload

Ball screw application	Preload (relative to dynamic load rating C_n)
Robots, material handling systems, etc.	Axial play or under 0.01 C_n
Semiconductor manufacturing systems, etc. That require highly accurate positioning	0.01 C_n – 0.03 C_n
Medium- high-speed machine tools for cutting	0.03 C_n – 0.05 C_n
Low to medium-speed systems that require especially high rigidity	0.05 C_n – 0.07 C_n

To minimize the thermal error for positioning accuracy:

- Suppress heat
- Use forced cooling
- Avoid temperature rise

Refer to "Measures against thermal expansion" on page B40.

(4) Axial rigidity of support bearing: K_b

The rigidity (K_b) of a bearing used for ball screw support is shown in the dimension tables. See Page B403 for NSKTAC C Series bearings.

(5) Axial rigidity of the ball nut and bearing mounting section: K_n

As the rigidity of the mounting section has a profound effect on positioning accuracy, we recommend incorporating high rigidity mounting sections for the ball nut and support bearings into the design the machine.

(a) Torsional rigidity of the feed screw system
Major torsion factors in the rotating system that bring about error in positioning accuracy are:

- Torsional deformation of the screw shaft
- Torsional deformation of the joint section
- Torsional deformation of the motor

The value of the effect of torsional strain to positioning accuracy is smaller than axial deformation. However, check the effect when designing equipment that requires high positioning accuracy.

(b) Suppress thermal error

B-2-7 Friction Torque and Drive Torque

Operations that use ball screw drives require a motor torque equivalent to the total of the following:

- Friction torque, i.e. the friction of the ball screw itself
- Drive torque which is required for operation

"breakaway torque." This torque is 2 to 2.5 times larger than the dynamic (friction) torque due to preload, which is described below. The starting friction torque quickly diminishes once the ball screw begins to move.

(2) Dynamic friction torque (dynamic friction torque due to preload)

When a ball screw is moving, two types of torque are generated: dynamic friction torque due to preload and friction torque associated with ball recirculation. JIS B1192 sets the standard of dynamic friction torque due to preload, which is the total of these two torque types. They are defined in **Fig. 7.2**.

Dynamic friction torque due to preload is calculated by the following formula. When the screw shaft is rotated as in **Fig. 7.1** in the following measuring conditions, measure the nut holding power F and then multiple the distance of action line L perpendicular to the direction of the power F .

$$T_p = F \cdot L \quad \dots 24)$$

- Measure at a rotational speed of 100 min⁻¹.
- Viscosity of lubrication is ISO VG 68 as prescribed in JIS K 2009.
- Remove Seals.

B-2-7.1 Friction Torque

(1) Starting friction torque (breakaway torque)

High torque is necessary to start a ball screw. This is called "starting friction torque" or

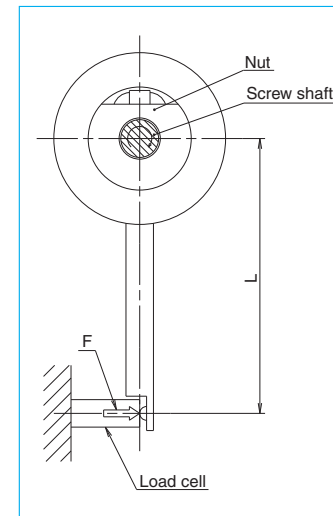


Fig. 7.1 Preload dynamic torque measuring method

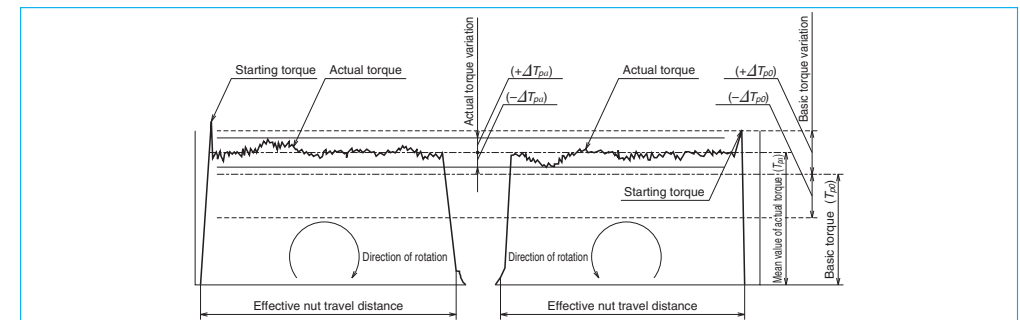


Fig. 7.2 Definitions of dynamic preloaded drag torque

(3) Calculation of basic torque

The basic torque of a preloaded ball screw T_{p0} can be obtained by the following formula.

$$T_{p0} = K \frac{F_{a0} \cdot l}{2\pi} \doteq 0.014 F_{a0} \sqrt{d_m \cdot l} \quad (\text{N} \cdot \text{cm}) \quad \dots 25)$$

In this formula:

F_{a0} : Preload (N)

l : Lead (cm)

K : Torque coefficient of ball screw

$$K = \frac{0.05}{\sqrt{\tan\beta}}$$

β : Lead angle (deg.)

d_m : Ball pitch circle diameter (cm)

Allowable values of torque variation relative to basic torque are specified as shown in **Table 7.1**.

B-2-7.2 Drive Torque

(1) Operating torque of a ball screw

(a) Normal drive

The torque when converting rotational motion to linear motion (normal operation) is obtained by the following formula.

$$T_a = \frac{F_a \cdot l}{2\pi \cdot \eta_1} \quad (\text{N} \cdot \text{cm}) \quad \dots 26)$$

In this formula:

T_a : Normal operation torque (N · cm)

F_a : Axial load (N)

l : Lead (cm)

η_1 : Normal efficiency ($\eta_1 = 0.9$ to 0.95)

(b) Back-drive operation

The torque when converting linear motion to rotational motion (back-drive operation) is obtained by the following formula.

$$T_b = \frac{F_a \cdot l \cdot \eta_2}{2\pi} \quad (\text{N} \cdot \text{cm}) \quad \dots 27)$$

In this formula:

T_b : Reverse operation torque (N · cm)

η_2 : Reverse efficiency ($\eta_2 = 0.9$ to 0.95)

(c) Dynamic drag torque of preloaded ball screws

The operation torque of preloaded ball screws can be obtained by Formula 25).

(2) Drive torque of the motor

(a) Drive torque at constant speed

The torque necessary to drive a ball screw at a constant speed resisting external loads can be obtained by the following formula.

$$T_1 = (T_a + T_{pmax} + T_u) \times \frac{N_1}{N_2} \quad \dots 28)$$

In this formula:

T_a : Drive torque at constant speed

$$T_a = \frac{F_a \cdot l}{2\pi \cdot \eta_1} \quad \dots 26)$$

F_a : Axial load (N)

The value of F_a in **Fig. 7.3** is:

$$F_a = F + \mu \cdot m \cdot g$$

F : Axial forces on screw shaft such as cutting force, etc. (N)

μ : Friction coefficient of the guide way

m : Volume of the traveling section (table mass plus work mass (kg)

g : Gravitational acceleration (9.80665 m/s^2)

T_{pmax} : Upper limit of the dynamic friction torque of ball screw (N · cm)

T_u : Friction torque of the support bearing (N · cm)

N_1 : Number of teeth in Gear 1

N_2 : Number of teeth in Gear 2

Generally, though it depends on the type of motor, T_1 is normally under 30% of the motor rating torque.

(b) Drive torque at acceleration

Accelerating a ball screw resisting axial load requires the maximum torque in an operation. Drive torque necessary for this occasion can be obtained by the following formula.

$$T_2 = T_1 + J \cdot \dot{\omega} \quad \dots 29)$$

$$J = J_M + J_{G1} \left(\frac{N_1}{N_2} \right)^2 \left[J_{G2} + J_S + m \left(\frac{l}{2\pi} \right)^2 \right] \quad (\text{kg} \cdot \text{m}^2) \quad \dots 30)$$

In this formula:

T_2 : Maximum drive torque at time of acceleration (N · m)

$\dot{\omega}$: Motor's angular acceleration (rad/s^2)

J : Moment of inertia applied to the motor ($\text{kg} \cdot \text{m}^2$)

J_M : Moment of inertia of the motor ($\text{kg} \cdot \text{m}^2$)

J_{G1} : Moment of inertia of Gear 1 ($\text{kg} \cdot \text{m}^2$)

J_{G2} : Moment of inertia of Gear 2 ($\text{kg} \cdot \text{m}^2$)

J_S : Moment of inertia of the screw shaft ($\text{kg} \cdot \text{m}^2$)

When selecting a motor, it is necessary to examine the maximum torque of the motor relative to the drive torque T_2 at the time of acceleration.

For the calculation of the moment of inertia of a cylindrical object (ball screw, gear, etc.), please refer to the formula below.

Table 7.1 Range of allowable values of torque variation rates (Source: JIS B 1192)

Basic torque (N · cm)		Effective length of the screw thread (mm)										
		4 000 or under					Over 4 000 and 10 000 or under					
		Slenderness ratio ⁽¹⁾ : 40 or less					Slenderness ratio ⁽¹⁾ : More than 40 and 60 or less					
		Accuracy grade				Accuracy grade				Accuracy grade		
Over	Incl.	C0	C1	C2, 3	C5	C0	C1	C2, 3	C5	C1	C2, 3	C5
20	40	±30%	±35%	±40%	±50%	±40%	±40%	±50%	±60%	—	—	—
40	60	±25%	±30%	±35%	±40%	±35%	±35%	±40%	±45%	—	—	—
60	100	±20%	±25%	±30%	±35%	±30%	±30%	±35%	±40%	—	±40%	±45%
100	250	±15%	±20%	±25%	±30%	±25%	±25%	±30%	±35%	—	±35%	±40%
250	630	±10%	±15%	±20%	±25%	±20%	±20%	±25%	±30%	—	±30%	±35%
630	1 000	—	±15%	±15%	±20%	—	—	±20%	±25%	—	±25%	±30%

Notes: 1. Slenderness ratio: The value obtained by dividing the length of the screw thread section of screw shaft (mm) by diameter of the screw shaft (mm).
2. NSK independently sets torque standards under 20 N · cm.

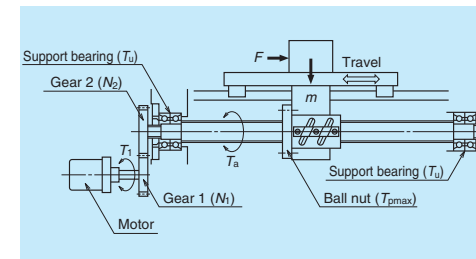


Fig. 7.3 Driving mechanism of ball screw

Formula for the moment of inertia of a cylindrical object

$$J = \frac{\pi \cdot \gamma}{32} D^4 \cdot L \quad (\text{kg} \cdot \text{cm}^2) \quad \dots 31)$$

In this formula:

γ : Material density (kg/cm^3)

D : Diameter of the cylindrical object (cm)

L : Length of the cylindrical object (cm)

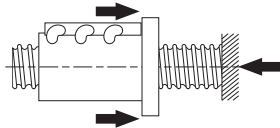
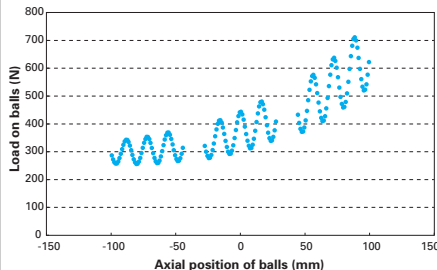
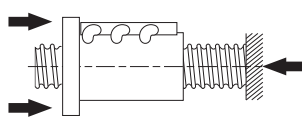
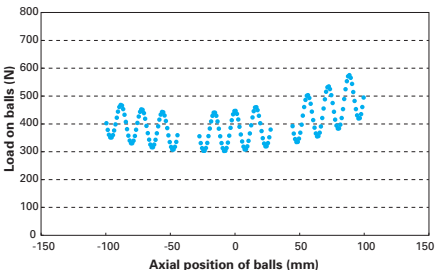
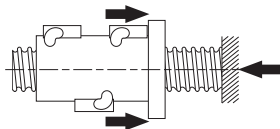
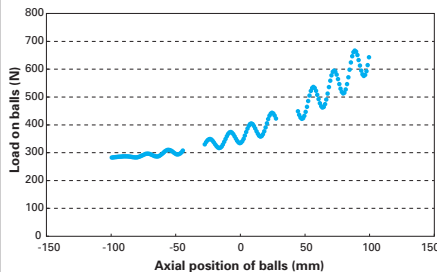
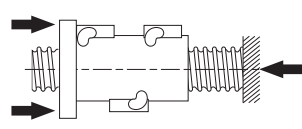
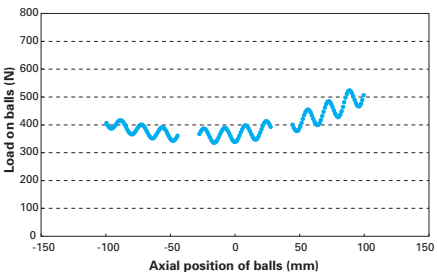
B-2-8 Even Load Distribution in Ball Nuts (Ball Screws for High-Load Drives)

Generally, the distribution of loaded balls in a ball nut is three-dimensionally asymmetric, thus resulting in uneven load distribution to the balls and ball nut. NSK has taken measures for even load distribution on the balls by an optimal arrangement of the position of ball recirculation circuits.

Additionally, a heavier load results in measurable axial deformation of the screw

shaft and the ball nut, thus further increasing the unevenness of load distribution. We have lessened the unevenness of load distribution to the balls by arranging the load acting point of the ball nut and the screw shaft opposite to each other. The relation between loading points and load distribution is shown in **Fig. 8.1**, while **Table. 8.1** shows the results of load distribution analysis.

Table. 8.1 Results of equalization of load distribution

	Conventional mounting direction	NSK recommended mounting direction
Conventional design	 	 
HTF design	 	 

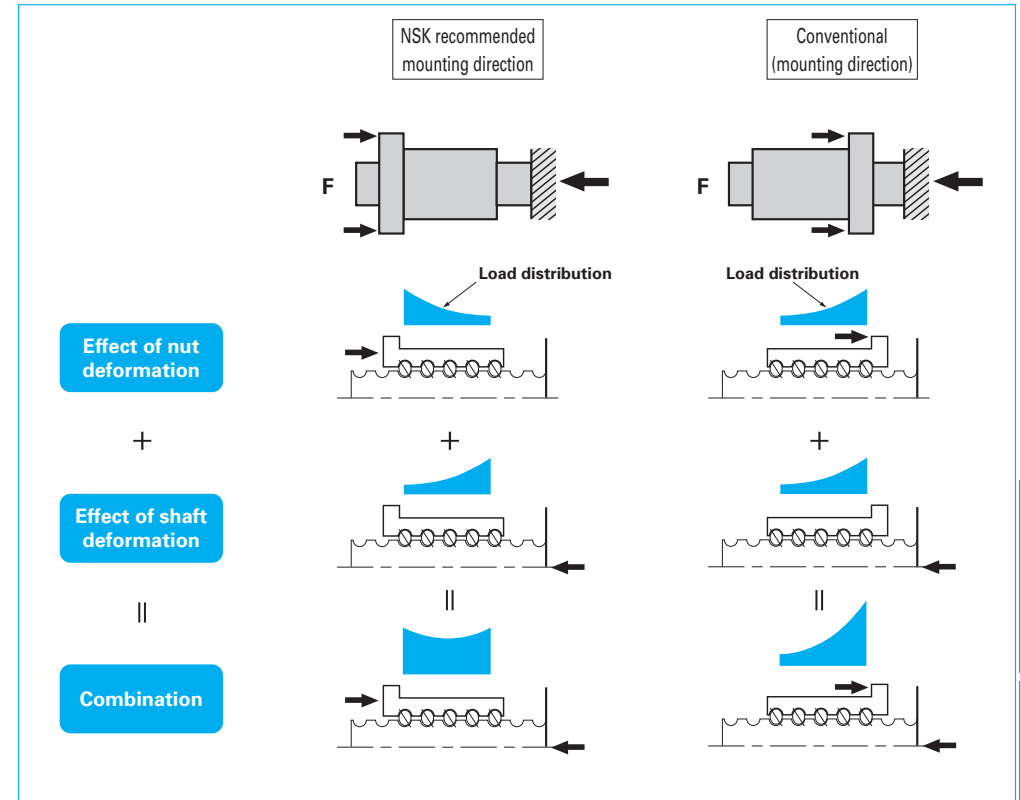


Fig. 8.1 Relationship between acting point of load and load distribution

B-2-9 Lubrication of Ball Screws

Lithium soap-based grease with base oil viscosity of 30 to 140 mm²/s (40°C) is recommended for grease lubrication and oil of ISO VG 32 to 100 for oil lubrication.

In general, a lubricant with low base oil viscosity is recommended where a ball screw is used for high-speed operation and thus requires reducing thermal elongation of the screw shaft. On the other hand, a lubricant with high base oil viscosity is recommended for low-speed, high-temperature operation or high-load, oscillating operation.

Please consult NSK about greases for high-load drives and high-temperature applications.

NSK offers "NSK Grease Units" as standard products for a variety of applications. NSK Grease Units for ball screw lubrication include:

- 1) Various types of grease in bellows tubes which can be easily attached to a grease pump
- 2) Hand grease pumps which are compact and easy to use
- 3) Nozzles

Table 9.1 shows NSK grease and names of other ball screw grease.

Table 9.2 explains check points in lubrication and standard intervals between replenishments. It is important to wipe off old grease from the screw shaft prior to applying new grease. Page D16 also explains in detail the replenishing methods.

Table 9.1 Grease for ball screw

Product name	Thickener	Base oil	Base oil viscosity mm ² /s (40°C)	Range of temperature for use (°C)	Application
NSK Grease AS2	Lithium	Mineral oil	130	-10 - 110	For general use at high load
NSK Grease PS2	Lithium	Synthetic oil combined with Synthetic hydrocarbon oil	15.9	-50 - 110	For light load
NSK Grease LR3	Lithium	Synthetic oil	30	-30 - 130	For high-speed medium load
NSK Grease LG2	Lithium	Mineral oil combined with Synthetic hydrocarbon oil	32	-20 - 70	For cleanroom environments
NSK Grease NF2	Urea composite	Synthetic hydrocarbon oil	26	-40 - 100	For fretting resistance

*Refer to page D13 for characteristics of NSK greases.

Table 9.2 Checking lubricant and intervals of replenishment

Lubricating method	Checking intervals	Check points	Replenishment/replacement interval
Intermittent automatic oil supply	Once a week	Remaining volume, contamination	Supply oil when checking (depending on the tank volume)
Grease	2 - 3 months after start of use	Clean, foreign matters	Generally once a year (replenish when necessary)
Oil bath	Every day, when starting work	Oil level	Specify according to oil consumption

B-2-10 Dust Prevention for Ball Screws

If foreign matter enters inside the ball nut, all screw grooves and balls wear rapidly, and the ball screw may malfunction due to damage of groove and/or ball recirculation system. Use bellows or telescopic pipes (**Fig. 10.1**) to keep foreign matter from entering into the feed screw

system. Install these items so as to exclude foreign matter completely from the ball screw.

It is even more effective to add seals on the ball nut as shown in **Figs. 10.2 to 10.7**. We provide the seals listed in **Table 10.1**.

Table 10.1 Seal

	Sealing capability	Torque	Heat	Grease retention	Application
Thin plastic seal	○	○	○	○	End deflector recirculation, HMS model, BSL model
Plastic seal	×	◎	◎	×	Tube recirculation, deflector (bridge) recirculation (seals are not used with leads 1 mm or smaller)
Wiper seal	○	×	×	○	
X1 seal	◎	○	○	◎	HMS model, HMD model
High performance seal	◎	○	○	○	VSS model
Brush-seal	△	○	○	△	R model (plastic seals are used for shaft diameters of 14 mm of less)

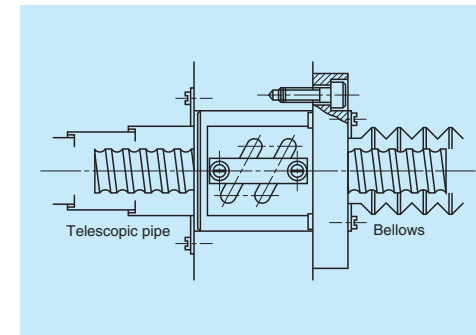


Fig. 10.1 Dust prevention by telescopic pipe and bellows

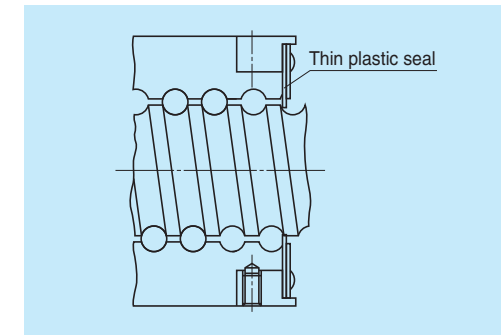


Fig. 10.2 Thin plastic seal

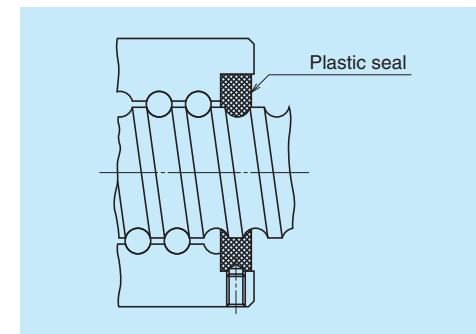


Fig. 10.3 Plastic seal

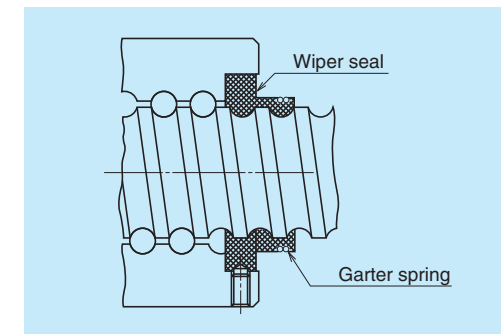


Fig. 10.4 Wiper seal

B-2-11 Rust Prevention and Surface Treatment of Ball Screws

(1) Stainless steel ball screw

KA model ball screws made of stainless steel are available. Please consult NSK for a custom made stainless steel ball screw.

(2) Types of surface treatment

The following are common types of treatment.

- Low temperature chrome plating
 - Used to prevent corrosion and light reflection, and for cosmetic purposes.
- Fluoride low temperature chrome plating
 - Fluoroplastic coating is provided following the low temperature chrome plating.
 - Resistance to corrosion is higher than the low temperature chrome plating.
- Hard chrome plating
 - Very hard coating provides high resistance to both wear and corrosion.
- Electroless nickel plating
 - Creates a film of consistent thickness on complex shaped items.
 - For corrosion prevention.

(3) Recommended surface treatment

Among the surface treatments mentioned above, we recommend "Low temperature chrome plating" and "fluoride low temperature chrome plating" for rust prevention because of humidity chamber test results.

However, never apply any organic solvent for degreasing because it will have an adverse effect on antirust characteristics.

Table 11.1 Surface treatment length

	Applicable length
Low temperature chrome plating	5 m or less
Fluoride low temperature chrome plating	4 m or less

Refer to "1.3 Rust Prevention and Surface Treatment" (page D5) for the results of humidity chamber tests.

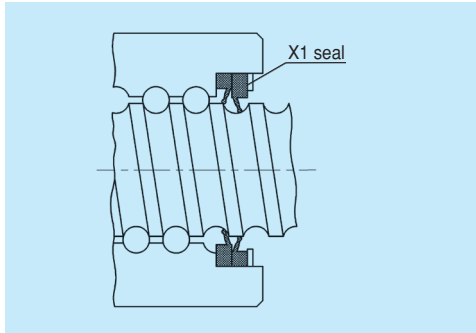


Fig. 10.5 X1 seal

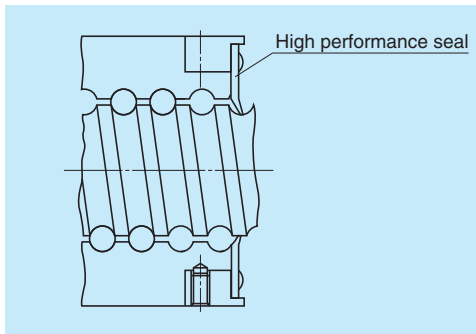


Fig. 10.6 High performance seal

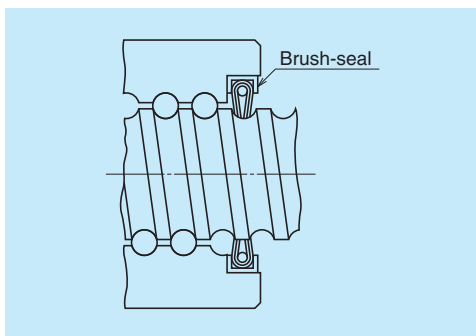


Fig. 10.7 Brush-seal for R Model

B-2-12 Ball Screw Specifications for Special Environments

B-2-12.1 Cleanroom Environments

NSK manufactures NSK Clean Grease "LG2" and "LGU" for NSK linear guides, ball screws, and Monocarriers used under normal temperature and pressure in cleanrooms.

LG2 and LGU grease have stable torque characteristics far superior to that of vacuum grease which has been used as a countermeasure against dust generation. LG2 and LGU also have sufficient durability and dust prevention capability.

Features of "LG2" and "LGU"

- (a) Generates less dust than prevailing vacuum grease and general greases. Cleanliness is enhanced by simply switching the grease to LG2 or LGU.
- (b) Extremely low and stable torque characteristics. LG2 and LGU are ideal for high-speed operation.
- (c) Unlike prevailing vacuum greases, LG2 and LGU have a nature similar to general grease. Their effect is long-lasting and sufficiently durable. They greatly contribute to minimize the frequency of maintenance.
- (d) They have an equal capability in rust prevention as general grease and are reliable.

When using NSK linear guides, ball screws, or Monocarriers in a cleanroom environment, request LG2 or LGU as a packed lubricant prior to delivery. NSK also makes bellows tubes which contain 80 grams of LG2 or LGU. The tube is easy to use and is ideal for maintenance (refer to pages B401 and D19). Wash to remove grease or oil substances prior to use.

Refer to page D8 for the functions and characteristics of LG2 and LGU.

B-2-12.2 Measures for Use Under Vacuum

NSK developed MoS₂ / WS₂ spattering and dry-filmed ball screws for equipment to be used in space. NSK also makes soft-metal film (gold and silver) ball screws to be used in a vacuum environment for semiconductor and flat panel display processing equipment.

Lubricants widely used for ball screws in a high vacuum are:

- Vacuum grease which uses a base oil of low vapor pressure.
- Solid lubricants such as MoS₂ and WS₂ used mainly for equipment in space.
- Solid lubricants with soft-metal such as gold, silver, or lead film.

When used for semiconductor and flat panel display manufacturing equipment, the oil of vacuum grease evaporates and causes environmental contamination. Also, it hinders creation of a super high vacuum. MoS₂ in the state of solid lubricant generates a large volume of dust, and Mo is unsuitable for semiconductors and reformed surfaces. Therefore, it is not suitable for processing machines for semiconductors and flat panel displays.

NSK recommends solid lubricant ball screws with a long life. These ball screws are treated with special silver film by NSK's unique processing technology and can be used in a super-high vacuum. However, solid lubricant may cause the film to peel off and stick to surface of ball grooves repeatedly, causing torque to rise momentarily on some occasions. The drive motor should be of large capacity to handle this drastic variation of torque.

Refer to page D7 for the test data of ball screws in vacuum.

For ball screw specifications for special environments, refer to page D2.

B-2-13 Noise and Vibration

B-2-13.1 Consideration of Noise

As the machine operates at higher speeds, noise levels tend to increase. Covering the nut section is insufficient to lower noise. NSK has abundant data (NSK Motion & Control Technical Journal No.4, etc.), and offers advice to users regarding selecting ball screws.

To lower noise level in general, the following points should be taken into consideration.

- (a) Use as a large lead as possible to reduce rotational speed.
- (b) Use a ball screw with the smallest outer diameter possible.
(Designs near limits often require special specifications. Please consult NSK.)

For reference, noise levels by ball screws alone are plotted below. The formula for calculation is also shown below.

(a) Average value at measuring distance of 400 mm

$$\text{dB (A)} = 25.2 \{ \log_{10} (D_w \cdot d_m \cdot n \times 10^{-5}) \} + 63.9$$
 ... 32)

(b) Upper limit at measuring distance of 400 mm
 Average value + 6 dB (A)
 D_w : Ball diameter (mm)
 d_m : Ball pitch circle dia. (mm)
 n : Rotational speed (min^{-1})

If measuring distance is 1 m, 8 dB (A) is subtracted from the 400 m average value to obtain the average noise level.

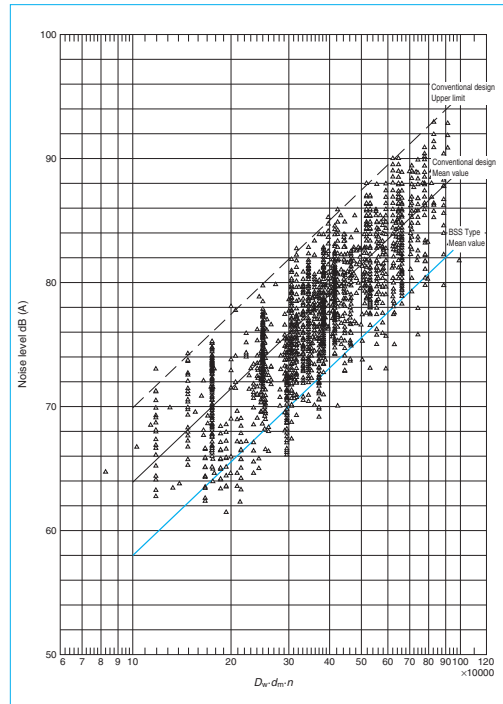


Fig. 13.1 Noise levels of ball screws

<<Calculation example for noise levels>>

<Use conditions>

Model No.: ZFT4010-10

From the dimension table: $D_w = 6.350$
 $d_m = 41$

Maximum rotational speed: $2\,000 \text{ min}^{-1}$

<Calculation>

By formula 34):

$$\begin{aligned} \text{dB (A)} &= 25.2 \{ \log_{10} (D_w \cdot d_m \cdot n \times 10^{-5}) \} + 63.9 \\ &= 25.2 \{ \log_{10} (6.350 \times 41 \times 2\,000 \times 10^{-5}) \} + 63.9 \\ &= 82 \text{ dB (A)} \end{aligned}$$

The average value of noise level by ball screws alone at maximum rotational speed (measuring distance 400 mm) is 82 dB (A). Upper limit is: 82 dB (A) + 6 dB (A) = 88 dB (A). If the measuring distance is 1 m, the average value of noise level is 74 dB (A), and upper limit is 80 dB (A).

When installed, the noise of ball screw becomes higher from the noise of the machine and the characteristics of machine vibration.

B-2-13.2 Consideration of Ball Screw Support System

A ball screw has low radial rigidity because its support span is long compared to its shaft diameter. It has only small damping capacity, requiring as much support rigidity as possible through design.

A simplified support bearing system to cut costs invites noise and vibration problems. Therefore, consideration to the ball screw support system of both shaft ends is increasingly becoming important as the speed of machines is ever-increasing.

If one shaft end must be left unfixed without a support bearing due to structural reasons, noise and vibration problems may occur. These problems are related to the natural vibration frequency of the screw shaft on the unsecured end. This problem can be averted by installing an impact damper to the shaft end (Fig. 13.2). Please consult NSK for details.

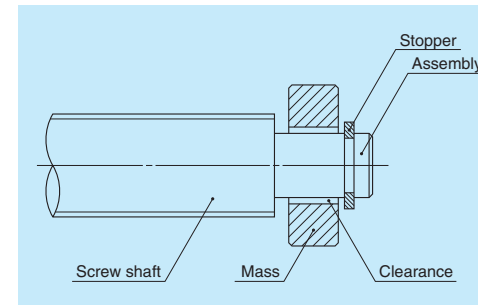
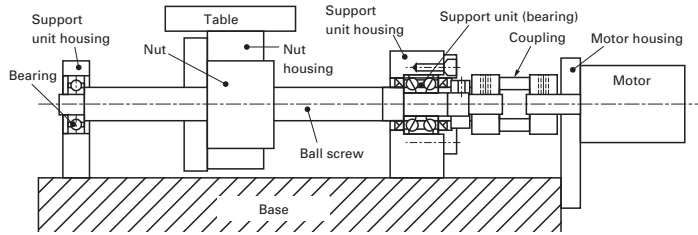


Fig. 13.2 Impact damper (Applied for patent)

B-2-14 Installation of Ball Screw

The following simplified component drawing shows a representative example of a single-axis table.



The screw shaft of the ball screw is supported by a nut and bearings, and it is driven by a motor. It is critically important to complete centering work to ensure the predetermined operation life, functionality, and accuracy of the ball screw. In general, the following accuracy is recommended for precision-class applications.

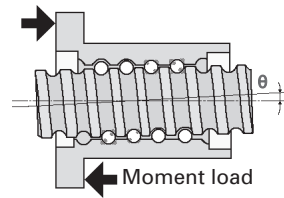
Inclination of center line: 1/2000 or less (Target: 1/5000 or less)

Eccentricity: 0.020 mm or less

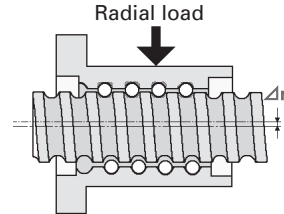
The following problems could occur if installation error negatively affected the ball screw:

- (1) Effects on durability:
 - Lowered flaking life or wearing life.
- (2) Effects on torque characteristics:
 - Increased friction torque or torque variations.
- (3) Effects on feed rate:
 - Decreased accuracy in motion.

<Inclination of center line>

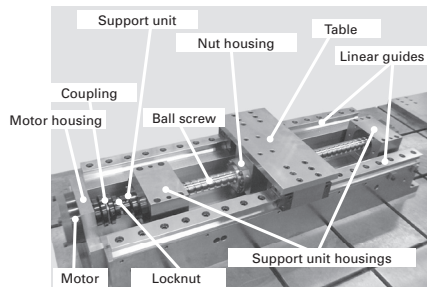


<Eccentricity>



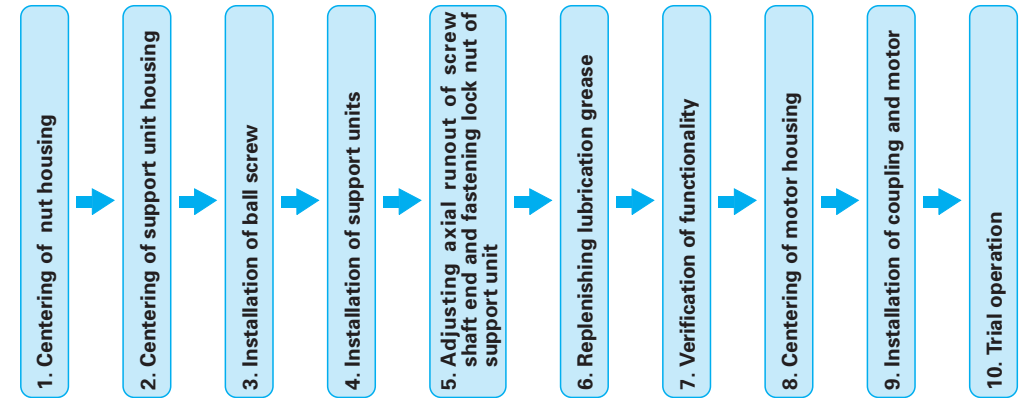
Overall View of Assembled Body

Explanations of the assembly procedure are given below, using a single-axis table as an example: In this explanation, two different installation procedures are provided: one for machine tools, where high installation accuracy is required, and another for general industrial machinery.



B-2-14.1 Installation Procedure for High Accuracy Applications (Machine Tools, etc.)

A single-axis table must be installed according to the following procedure:

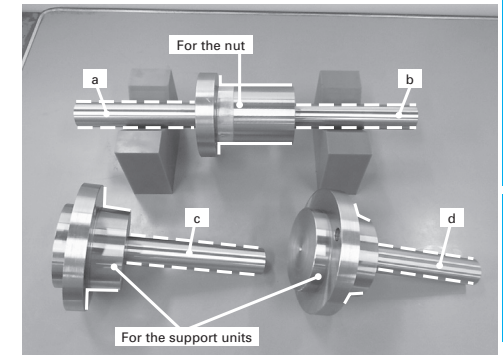


I. Jigs required for installation

Test bars:

(For the nut: one piece; for the support units: two pieces)

⇒ For centering and measurement of axial runout. The portions onto which the housing is installed (marked with the solid line) and the portions subject to measurement (a, b, c and d, marked with the broken line) must be finished to high precision.



II. Installation of assembled body

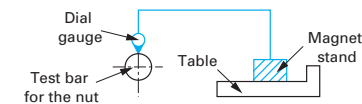
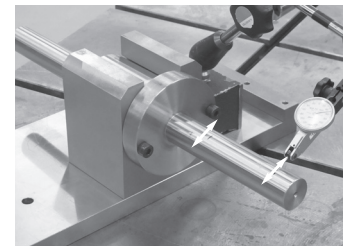
1. Centering of nut housing

1-1

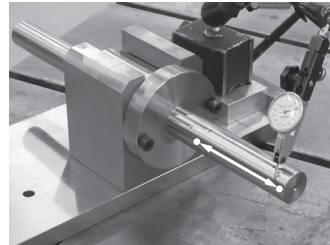
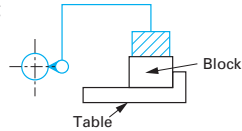
Turn the table over and mount the nut housing and test bar for the nut onto it.

Set up a magnet stand with a dial gauge attached, taking the rear side of the table as reference. Measure two spots at the top of the test bar for the nut by moving the magnetic stand around to check the inclination in the vertical direction.

If inclination of center line is observed, adjust the surfaces on which the nut housing is installed.

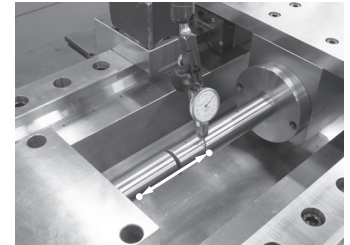
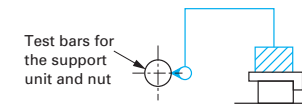


1-2
Fix the magnetic stand with the dial gauge attached onto a block. While pressing the block toward the reference surface of the table, move the magnet stand around. Measure the side surface of the test bar for the nut and check the inclination in the horizontal direction. If inclination of center line is observed, adjust the portion where the nut housing is installed onto the table.



2-4
Fix the magnet stand with the dial gauge attached onto a block. While pressing the block toward the top surface of the linear guide rail as reference and moving it, take measurements of the side surfaces of the test bars for the nut and support unit to check for eccentricity in the horizontal direction. If eccentricity is observed, adjust the mounting surface of the support unit housing.

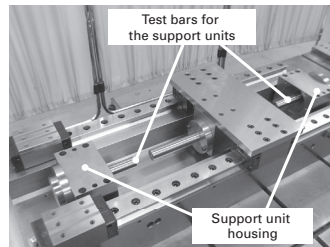
Follow the same procedure for the opposite side of the motor.



2. Centering of support unit housing

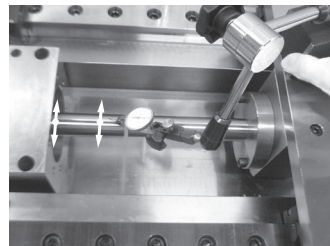
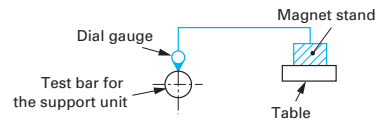
Install the linear guides onto the machine base, and then install the table, which has already been centered. (For installation of linear guides, please refer to A77 in CAT. No. 9008.)

2-1
Install the test bar for the support unit onto the support unit housing.



2-2
Install the magnet stand with the dial gauge attached using the table as reference. While moving the table, measure the two spots at the top of the test bar for the motor-side support unit to check the inclination in the vertical direction. If inclination of center line is observed, adjust the mounting surfaces of the support unit housing.

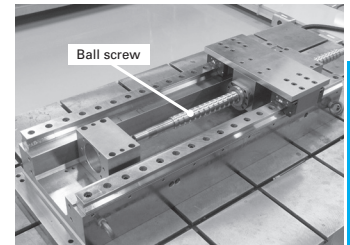
Follow the same procedure for the opposite side of the motor.



3. Installation of ball screw

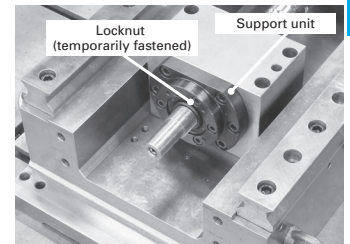
Remove all test bars from the housing. Clean the outside diameter surface of the nut and the inside diameter surface of the housing using a cloth, and install the ball screw.

Apply grease to spots with metal-to-metal contact to avoid any scratches or dents. While doing this, be careful not to drop the ball screw or hit it with anything which might cause malfunctions. If the housing must be removed in order to mount the ball screw, use a positioning pin so that the housing can be mounted back in its original position.



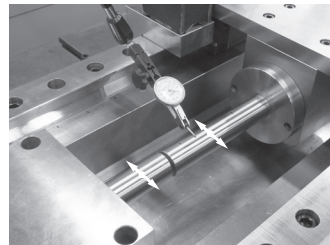
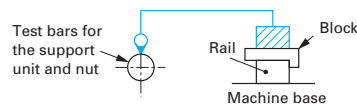
4. Installation of support units

Insert the screw shaft into the support unit housing and mount the support units on both shaft ends. Fix the motor-side support unit to the housing. Fasten the locknut temporarily. Follow the same procedure for the opposite side of the motor.



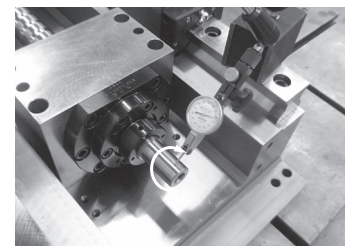
2-3
Fix the magnet stand with the dial gauge attached onto a block, and install the block onto the top surface of the linear guide rail. Measure the top points of the test bar for the nut and the support unit to check for eccentricity in the vertical direction. If eccentricity is observed, adjust the mounting surface of the support unit housing.

Follow the same procedure for the opposite side of the motor.



5. Adjusting axial runout of screw shaft end and fastening lock nut of support unit

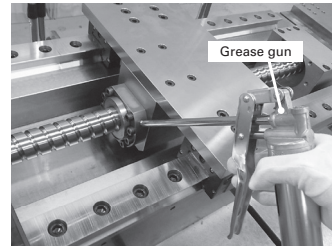
Bring the dial gauge into contact with the top of the shaft end. Then, while rotating the screw shaft, measure the runout of the shaft end. While adjusting the shaft end runout, fasten the locknut to attain the required fastening torque. Follow the same procedure for the opposite side of the motor.



6. Replenishing lubrication grease

Wipe away the antirust oil from the empty ball screw to which grease has not been applied, and supply grease through the grease hole to fill the inside. (Supply the grease while rotating the ball screw in the direction that moves grease toward the inside of the nut. This will lubricate the ball screw evenly.)

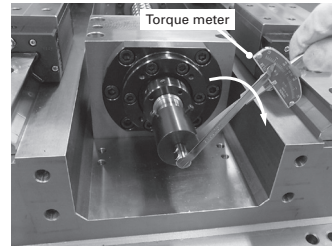
If you use a ball screw already filled with grease, it is not necessary to add more.



7. Verification of functionality

To check whether the ball screw has been installed accurately, verify its functionality. Measure the driving torque with a torque meter over the entire movable range of the screw.

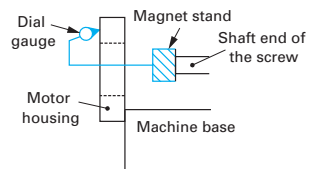
Confirm (including by touch) that there are no abnormalities.



8. Centering of motor housing

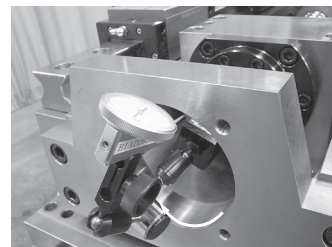
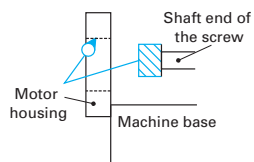
8-1

Install the motor housing, and mount the dial gauge onto the shaft end of the ball screw. Rotate the screw shaft to check the inclination of the motor housing with the stylus of the dial gauge in contact with the end face of the motor housing. If inclination of the end surface of the motor housing is observed, adjust the mounting surface of the motor housing.



8-2

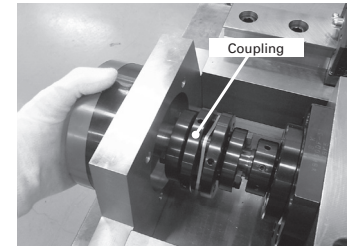
Set up the dial gauge onto the end face of the ball screw. Rotate the screw shaft to check eccentricity with the stylus touching the inside diameter surface of the motor housing. If eccentricity is observed, adjust it by installing the motor housing appropriately.



9. Installation of coupling and motor

Mount the coupling onto the shaft end of screw, and install the motor.

Fasten the bolts of the coupling to connect the shaft end with the motor shaft.



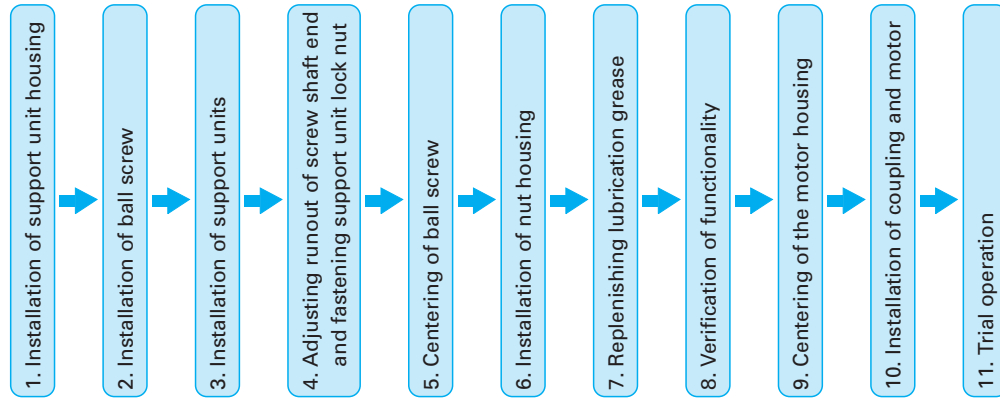
10. Trial operation

At the beginning, run the assembly at low speed to check for vibrations and noise. Then, run it at moderate speed, and finally at high speed and check for abnormalities. Then run it continuously for approximately two hours and carry out a running-in operation while checking for any abnormalities. During this running-in operation, the excess grease inside of the nut is pushed out of the nut. Wipe it away.

B-2-14.2 Installation Procedure for General Industrial Machinery

In this procedure, the ball screw is installed with the accuracy required for the linear guide. The centering of the nut and table are adjusted by installing the nut housing appropriately. Since no test bars are required and the inside diameter of the nut housing does not need to be fit with the nut, the ball screw can be installed relatively easily and cheaply.

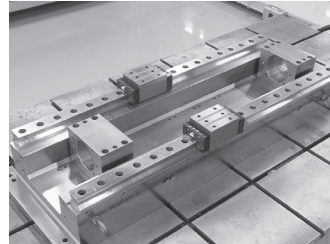
The installation procedure used for a single-axis table is shown below:



I. Installation of assembled body

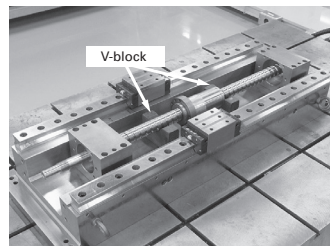
1. Installation of support unit housing

Install the linear guide onto the machine base.
(For installation procedurez for linear guidez, please refer to A77, CAT. No. 9908.)
Place the support unit housing at the predetermined position and fasten it temporarily.



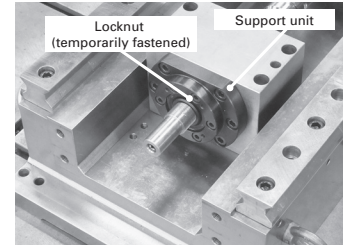
2. Installation of ball screw

Clean the outside diameter surface of the nut and the inside diameter surface of the housing using a cloth, and install the ball screw.
Apply grease to spots with metal-to-metal contact to avoid scratches and dents. While doing this, be careful not to drop the ball screw or hit it with anything which might cause malfunctionx.
Conduct this task using a V-block to prevent scratches and dents.



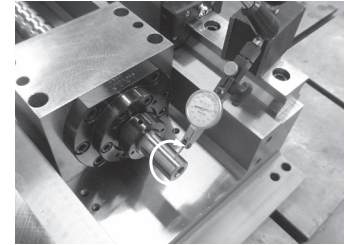
3. Installation of support units

Insert the screw shaft into the support unit housing and mount support units on both shaft ends. Fix the motor-side support unit to the housing. Fasten the locknut temporarily.
Follow the same procedure for the opposite side of the motor.



4. Adjusting runout of screw shaft end and fastening support unit locknut

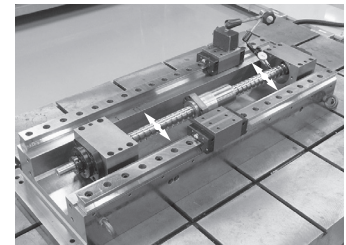
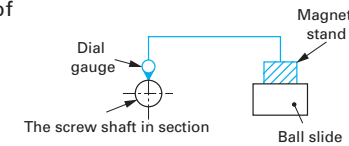
Bring the dial gauge into contact with the top of the shaft end. Then, while rotating the screw shaft, measure the runout of the shaft end. While adjusting the shaft end runout, fasten the locknut to attain the required fastening torque.
Follow the same procedure for the opposite side of the motor.



5. Centering of ball screw

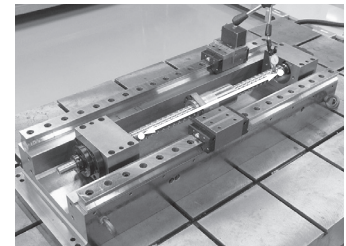
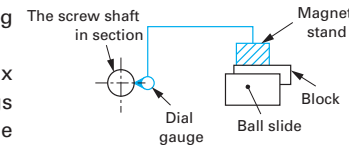
5-1

Set up a magnet stand with a dial gauge attached, using the ball slide of the linear guide as a reference. Measure the top of the screw shaft in the vicinity of the support unit housing both on the motor and opposite side to check the inclination in the vertical direction. If inclination of center line is observed, adjust the mounting surface of the support unit housing.



5-2

Fix the magnet stand with the dial gauge attached onto a block. While pressing the block toward the ball slide of the linear guide, move the block. Measure the side surface of the screw shaft in the vicinity of the support unit housing both on the motor and opposite side to check the inclination in the horizontal direction. If inclination of center line is observed, adjust by installing the support unit housing appropriately.
After the adjustment, fix the support unit housings of the motor side and the opposite side.

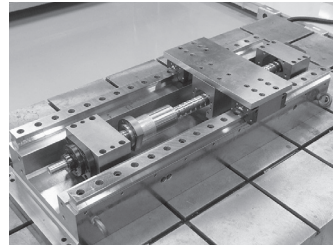


6. Installation of nut housing

6-1

Temporarily fasten the nut housing onto the table, and fasten the table, using the ball slide of the linear guide as reference surface.

To minimize bending of the screw shaft caused by the weight of the nut, move the nut toward the support unit housing at the shaft end.

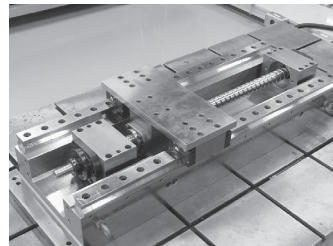


6-2

Move the table toward the nut, and fasten the nut to the nut housing.

Loosen the bolts that fasten the table to the nut housing, and re-fasten them.

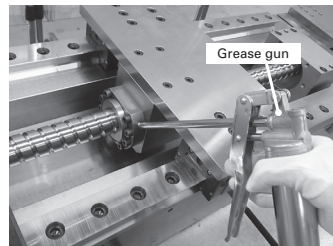
Loosen the bolts that fasten the nut housing and the nut, and re-fasten them.



7. Replenishing lubrication grease

Wipe away the antirust oil from the empty ball screw to which grease has not been applied and supply grease through the grease hole to fill the inside. (Supply grease while rotating the ball screw in the direction that moves grease toward the inside of the nut. This will lubricate the ball screw evenly.)

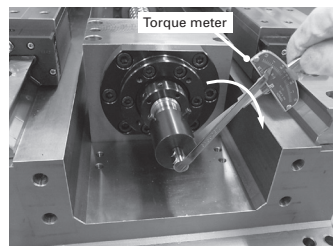
If you use a ball screw already filled with grease, it is not necessary to add more.



8. Verification of functionality

To check whether the ball screw has been installed accurately, verify its functionality. Measure the driving torque with a torque meter over the entire movable range of the screw.

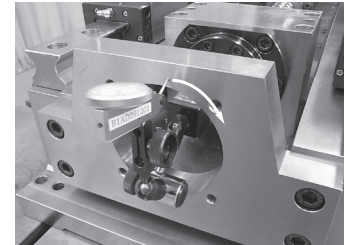
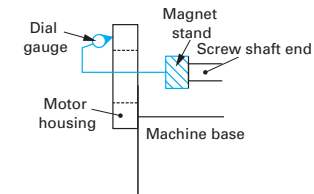
Confirm (including by touch) that there are no abnormalities.



9. Centering of motor housing

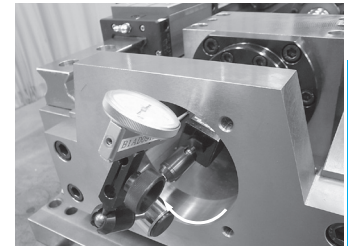
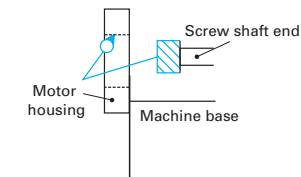
9-1

Install the motor housing, and mount the dial gauge onto the end face of the ball screw. Rotate the screw shaft to check the inclination of the motor housing with the stylus of the dial gauge in contact with the end face of the motor housing. If inclination of center line is observed, adjust the mounting surface of the motor housing.



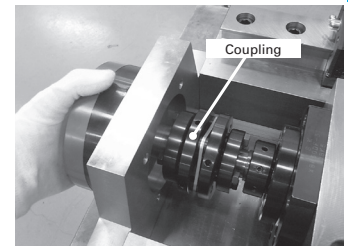
9-2

Set up the dial gauge onto the end face of the screw shaft. Rotate the screw shaft to check eccentricity with the stylus touching the inside-diameter surface of the motor housing. If eccentricity is observed, adjust it by installing the motor housing appropriately.



10. Installation of coupling and motor

Mount the coupling onto the shaft end, and install the motor. Fasten the bolts of the coupling to connect the shaft end with the motor shaft.



11. Trial operation

At the beginning, run the assembly at low speed to check for vibrations and noise. Then, run it at moderate speed, and finally at high speed and check for abnormalities. Then run it continuously for approximately two hours and carry out a running-in operation while checking for any abnormalities. During this running-in operation, the excessive grease inside of the nut is pushed out of the nut. Wipe it away.

B-2-15 Precautions for Designing Ball Screws

B-2-15.1 Safety System

As shown in the illustration on page B352, a stopper is installed in some cases to prevent the nut from overrunning due to malfunction of the safety system of the machine itself, or human error during operation.

The travel stopper should be installed at a place where it will not come into contact with the nut when the nut reaches the designed stroke end.

An impact absorbing travel stopper (NSK patent, refer to page B402) is available.

B-2-15.2 Design Considerations for Assembly

(1) Cutting through the thread screw to the end

Some recirculation systems, including deflector (bridge), end-cap, S1 (high-load drive), and some end-deflector specifications, require one end of the thread screw to be cut. This is necessary to assemble the ball nut to the screw shaft (Fig. 15.1). In this case, the shaft end diameter where this "cut-through thread" is made should be 0.2 mm or smaller than the ball groove root diameter " d_r ". (See the dimension tables.) A similar precaution is required when it is absolutely necessary to remove the nut from the screw shaft in order to install the ball screw to the machine. Also, if using the cut-through end as the shoulder of the support bearing, make certain that a sufficient amount of the effective flat surface is left from the root diameter. If it is insufficient, the bearing cannot be installed perpendicularly to the bearing seat. (Fig. 15.2)

(2) Designing the screw shaft end and the nut mounting area

When installing a ball screw to the machine, avoid a design which makes it necessary to separate the nut from the screw shaft as shown in Fig. 15.3. If separated, the balls may fall out. The separation may also deteriorate the ball screw accuracy or damage the ball screw. If separating them is unavoidable, please furnish NSK with the component which is to be installed between the nut and screw shaft. NSK will install the component prior to delivery.

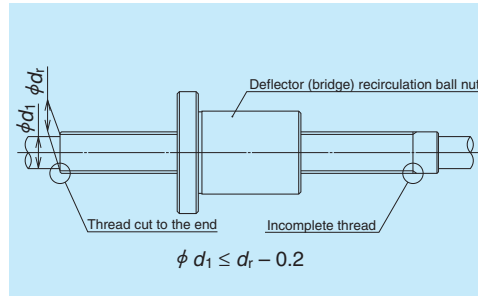


Fig. 15.1 Shaft end of a deflector (bridge) recirculation system ball screw

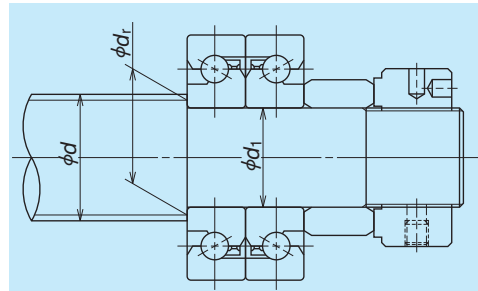


Fig. 15.2 Support bearing and end face (shoulder) for installation

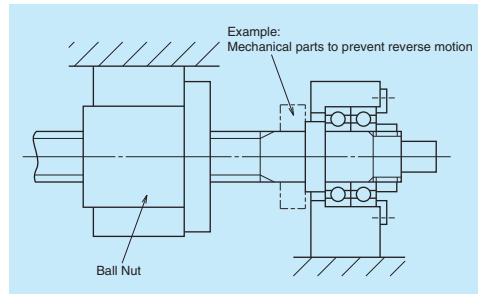


Fig. 15.3 Nut and ball screw are required to be separated when installing in this structure.

(3) Removing the nut from the screw shaft at the time of assembly

If it is unavoidable, use an arbor (Fig. 15.4) to keep the balls in the nut. In this case, the outside diameter of the arbor should be approximately 0.2 mm to 0.4 mm smaller than the ball groove root diameter " d_r ." However, Miniatures are excluded.

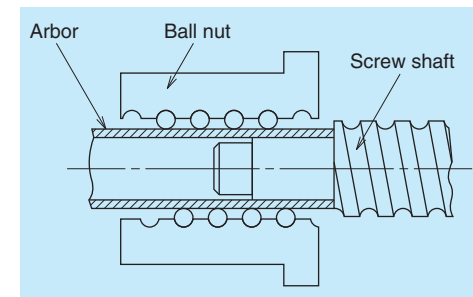


Fig. 15.4 Arbor to install and remove nut

(4) Centering of the ball nut when installing

When installing the nut as shown in Fig. 15.5, provide a space between the housing and the nut body diameter, allowing centering to be performed.

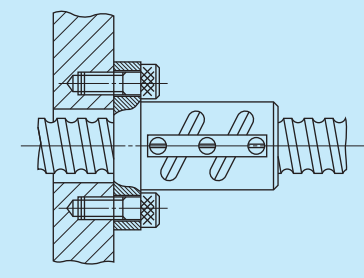
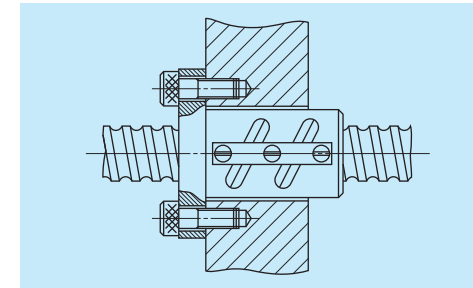


Fig. 15.5 Fixing a ball nut by flange

(5) Preventing the thread screw of nut from loosening

When installing and securing the nut to the housing at the thread screw section, as in the case for RNCT ball screws, apply an agent which prevents the nut from loosening.

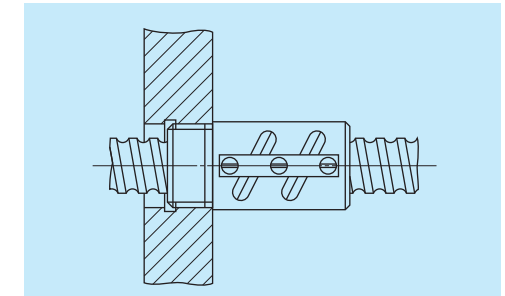


Fig. 15.6 Fixing a ball nut with thread screw

(6) Installation of brush-seal to the nut

If a brush-seal is installed at the thread screw side of the nut similar to the RNCT model which comes with a thread screw, the brush-seal should be secured as shown in Fig. 15.7.

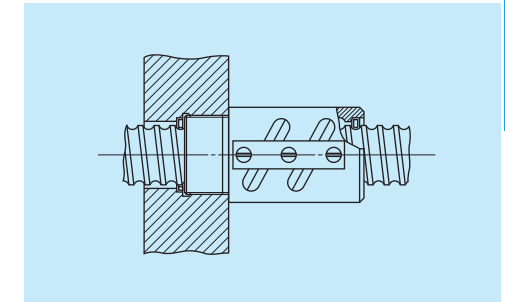


Fig. 15.7 Installation of brush-seal to a ball nut with thread screw

B-2-15.3 Effective Stroke of Ball Screws

When hardened by induction hardening, the hardness of a ball screw may be slightly low at both ends of the screw section. Consider this low hardness prior to determining the length of the effective stroke. Please consult NSK for details.

B-2-15.4 Machining after Delivery

When, after the delivery of a ball screw, you require a drill knock pin hole on the screw shaft end or at the nut mounting area please inform NSK on the position and size of the hole.

NSK will take measures and protect designated spots from heat treatment prior to delivery to make subsequent machining easy.

B-2-15.5 "NSK K1" Lubrication Unit

When using the NSK K1 lubrication unit, be aware of the operating temperature and chemicals that contact the unit to maintain the K1's best performance.

Temperature range for use:

Maximum temperature; 50°C

Momentary maximum temperature; 80°C

Chemicals to avoid contact with:

Do not leave the K1 unit in organic solvents, white kerosene such as hexane, thinners which remove oil, and rust preventive oil which contains white kerosene.

Water-based cutting oil, oil-based cutting oil, AS2 mineral grease, and PS2 ester grease can be used without damaging the K1 unit.

B-2-15.6 Intermediate support

The deflection of a long screw shaft due to its own weight may cause a radial load on the nut. There is also a risk that excessively large repeated load (rotational bending stress) will be applied to the shaft end during rotation. We therefore recommend intermediate support of the screw shaft at multiple points to minimize deflection.

B-2-15.7 Shaft End Strength

Take extra care to consider the strength of the shaft end shape and provide a design with a safety factor in mind when:

- *A pulley is mounted to the ball screw drive with a folded motor
- *Radial loads are applied due to the mounting structure
- *The ball screw is used under tension.

B-2-16 Shaft End Machining

You must machine the shaft ends of:

- *Precision ball screws with blank shaft ends
- *R model ball screws with blank shaft ends, and
- *Completed ball screws that require additional machining

The following summarizes the machining of these shaft ends. For details, please contact NSK.

(1) Machining of blank shaft ends of precision ball screws

(a) Cutting screw shaft

Use a cutting whetstone or the like to cut the shaft, leaving stock for turning. Keep the nut assembled to the screw shaft, and open only one side of the plastic wrapping bag exposing only the shaft end section to be machined, and then cut the screw shaft. This prevents foreign matter from entering the ball screw section. Do the same for other machining.

(b) Precautions in cutting shaft end

Outside of the screw shaft is ground with precision (excluding the R model). There are center holes in the ends. Use them for centering. Do not rotate the shaft quickly or stop it suddenly, or the nut might move along the shaft. We recommend securing the nut with tape. To machine a very long shaft, apply work rests to the screw shaft surface to suppress vibration (especially caused by critical speed).

(c) Turning by lathe

Cut to the length, turn shaft end steps, turn the thread screw, and provide the center hole. Refer to JIS B1192 for shaft end accuracy.

(d) Processing by grinding

Apply the same precautions used for cutting when centering and securing the nut and work rest. Grind sections where the bearings and "Spann ring" are installed.

e) Milling processing

Process keyways and tooth seats for lock washers.

(f) Deburring, washing, and rust prevention
Wash with clean white kerosene after processing. Apply lubricant for immediate use.

For later use, apply a rust preventive agent.
Note: Contact NSK if the nut is accidentally removed.

B-2-17 Ball Screw Selection Exercise

Drill 1: High-speed transporting system

1. Design conditions

Table mass :	$m_1 = 40 \text{ kg}$
Mass of the work :	$m_2 = 20 \text{ kg}$
Maximum stroke :	$S_{\text{max}} = 700 \text{ mm}$
Rapid traverse speed :	$V_{\text{max}} = 1\,000 \text{ mm/sec}$ (60 m/min)
Positioning accuracy :	$\pm 0.05/700 \text{ mm}$ (0.005 mm/pulse)
Repeatability :	$\pm 0.005 \text{ mm}$
Required life :	$L_r = 25\,000 \text{ h}$ (5 years)
Guide way (rolling) :	$\mu = 0.01$ (friction coefficient)
Drive motor :	AC servo motor ($N_{\text{max}} = 3\,000 \text{ min}^{-1}$)

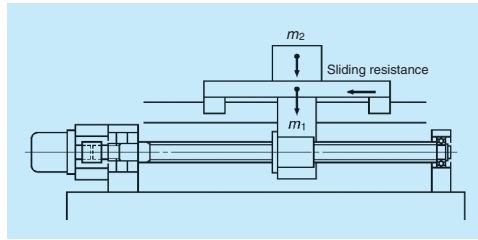


Fig. 17.1 System appearance

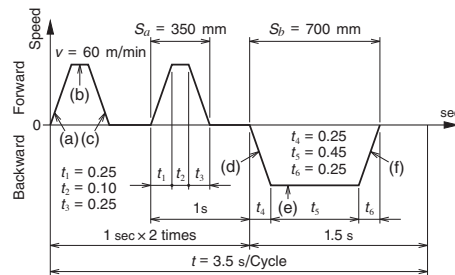


Fig. 17.2 Operating conditions

2. Selection of basic factors

(1) Selection of accuracy grade and axial play

According to **Table 4.1** "Applications for ball screws by accuracy grade" on page B19, the accuracy grade of ball screws for Cartesian industrial robots is C5 to Ct10. From the following conditions in design, the axial play should be 0.005 mm or less.

Repeatability : $\pm 0.005 \text{ (mm)}$

Resolution : 0.005 mm/pulse

According to **Table 4.2** "Combinations of accuracy grades and axial play" on page B20, you will require the accuracy grade C5 to satisfy the axial play of 0.005 mm or less. Therefore select accuracy grade C5 and the axial play of 0 mm (Z-preload).

(2) Selection of lead

Calculate the lead l based on the maximum speed of the AC servo motor and the rapid traverse speed V_{max} .

$$l \geq \frac{V_{\text{max}}}{N_{\text{max}}} = \frac{1\,000 \times 60}{3\,000} = 20 \text{ (mm)}$$

Select a lead l of 20 mm or larger.

(3) Selection of screw shaft diameter

According to **Table 4.4** "Shaft diameter, lead and stroke of standard ball screws" on page B21, the screw shaft diameter d which has a lead l larger than 20 mm should be in the range of 15 mm to 32 mm. Select the smallest: 15 mm.

(4) Selection of stroke

From **Table 4.4** "Screw shaft diameter, lead, and stroke of standard ball screws" on page B21, a ball screw with shaft diameter d of 15 mm and lead l of 20 mm meets maximum stroke of 700 mm, therefore it is possible to select from standard ball screws. The primary selection is as follows:

Primary selection:	
Shaft diameter :	15 (mm)
Lead :	20 (mm)
Stroke :	700 (mm)
Accuracy grade :	C5
Axial play :	Z

3. Confirmation of standard ball screw

In consideration of delivery time and price, select from standard ball screws with finished shaft ends.

Primary candidate: PSS1520N1D0879

4. Basic safety check

Let's examine the primary candidate.

(1) Allowable axial load

[1] Calculation of allowable axial load

From **Fig. 17.2**: Acceleration α_1 at accelerating / decelerating is:

$$\alpha_1 = \frac{V_{\text{max}}}{t_1} = \frac{1\,000}{0.25} = 4\,000 \text{ (mm/s}^2\text{)} = 4 \text{ (m/s}^2\text{)}$$

Axial load F_1 is:

(At the time of acceleration (a)(d))

$$F_1 = \mu (m_1 + m_2) \times g + (m_1 + m_2) \times \alpha_1 \\ = 0.01 \times (40 + 20) \times 9.80665 + (40 + 20) \times 4 \\ = 246 \text{ (N)}$$

(At the time of constant speed (b)(e))

$$F_2 = \mu (m_1 + m_2) \times g = 0.01 \times (40 + 20) \times 9.80665 \\ = 6 \text{ (N)}$$

(At the time of deceleration (c)(f))

$$F_3 = -\mu (m_1 + m_2) \times g + (m_1 + m_2) \times \alpha_1 \\ = -0.01 \times (40 + 20) \times 9.80665 + (40 + 20) \times 4 \\ = 234 \text{ (N)}$$

Thus, the maximum axial load P is 246 N.

[2] Buckling load

PSS1520N1D0879 has a support length of 804 mm (L_a as per the dimension table on page B193), and must support maximum axial load P of 246 (N). The support configuration of screw shaft is "Fixed - Simple", and the support configuration of ball nut is "Fixed". Due to the direction of the load, the whole ball screw support configuration is "Fixed - Fixed" (Factor $m = 19.9$).

From formula 2) on page B44:

$$d \geq \left[\frac{P \cdot L_a^2}{m} \times 10^{-4} \right]^{1/4} = \left[\frac{246 \times 804^2}{19.9} \times 10^{-4} \right]^{1/4} \\ = 5.3 \text{ (mm)}$$

PSS1520N1D0879 has the dimension d_i of 12.2 mm as per the dimension chart (page B193) and therefore meets the conditions.

Result: Acceptable

(2) Allowable rotational speed

The permissible rotational speed listed in the dimension table is $3\,150 \text{ min}^{-1}$. Since the motor maximum rotational speed is $3\,000 \text{ min}^{-1}$, the operation is in the range of permissible rotational speed.

Result: Acceptable

(3) Checking life expectation

[1] Mean load F_m and mean rotational speed N_m . From the calculation of axial load, rotational speed N_i and the operating time t_i are:

(At the time of acceleration (a)(d))

$$F_1 = 246 \text{ (N)}$$

$$N_1 = \frac{n}{2} = \frac{3\,000}{2} = 1\,500 \text{ (min}^{-1}\text{)}$$

$$t_a = 2 \times t_1 + t_4 = 0.75 \text{ (s)}$$

(At the time of constant speed (b)(e))

$$F_2 = 6 \text{ (N)}$$

$$N_2 = 3\,000 \text{ (min}^{-1}\text{)}$$

$$t_b = 2 \times t_2 + t_5 = 0.65 \text{ (s)}$$

(At the time of deceleration (c)(f))

$$F_3 = 234 \text{ (N)}$$

$$N_3 = 1\,500 \text{ (min}^{-1}\text{)}$$

$$t_c = 2 \times t_3 + t_6 = 0.75 \text{ (s)}$$

Calculation results are shown in **Table 17.1**

Table 17.1 Axial load and rotational speed

Operating conditions	Axial load (N)	Rotational speed (mean) (min ⁻¹)	Operating time (s)
(a) (d)	$F_1 = 246$	$N_1 = 1\,500$	$t_a = 0.75$
(b) (e)	$F_2 = 6$	$N_2 = 3\,000$	$t_b = 0.65$
(c) (f)	$F_3 = 234$	$N_3 = 1\,500$	$t_c = 0.75$

From formulas 11) and 12) on page B53:

$$F_m = \left(\frac{F_1^3 \cdot N_1 \cdot t_a + F_2^3 \cdot N_2 \cdot t_b + F_3^3 \cdot N_3 \cdot t_c}{N_1 \cdot t_a + N_2 \cdot t_b + N_3 \cdot t_c} \right)^{1/3} \\ = 195 \text{ (N)}$$

$$N_m = \frac{N_1 \cdot t_a + N_2 \cdot t_b + N_3 \cdot t_c}{t} \\ = 1\,200 \text{ (min}^{-1}\text{)}$$

[2] Calculation of life expectancy

As the basic dynamic load rating C_a of PSS1520N1D0879 (Clearance Z) is 5 660 N (as per the dimension table on page B193), from formulas 8) and 9) on page B53:

$$L_t = \left(\frac{C_a}{F_m \cdot f_w} \right)^3 \times \frac{1}{60 N_m} \times 10^6$$

$$= \left(\frac{5\,660}{195 \times 1.2} \right)^3 \times \frac{1}{60 \times 1\,200} \times 10^6$$

$$\doteq 196,500$$

The ball screw satisfies the required life.

Result: Acceptable

5. Check other requirements

(1) Accuracy and axial play

As per the dimension table on page B180 and **Table 1.2** for the permissible value of lead accuracy on page B38:

According to **Table 1.2**:

Accuracy grade: C5

$$e_p = \pm 0.035/800 \text{ (mm)}$$

$$v_u = 0.025 \text{ (mm)}$$

This grade satisfies the required positioning accuracy of $\pm 0.05/700$ mm.

The checking of axial play is omitted here since it is explained in "2. Selection of basic factors."

(2) Drive torque

Required specifications are as follows.

Motor rotational speed: 3 000 min⁻¹

Time to reach maximum speed: Less than 0.25 sec

[1] Load (converted to the motor axis)

Using formulas 30) and 31) on page B64, calculate the moment of inertia where γ is the material density of the ball screw.

(Screw shaft)

$$J_b = \frac{\pi \cdot \gamma \cdot D^4 \cdot L}{32} = \frac{\pi \times 7.8 \times 10^3}{32} \times 1.5^4 \times 88$$

$$= 0.34 \text{ (kg} \cdot \text{cm}^2)$$

(Moving part)

$$J_w = m \times \left(\frac{l}{2\pi} \right)^2 = 60 \times \left(\frac{2}{2\pi} \right)^2$$

$$= 6.1 \text{ (kg} \cdot \text{cm}^2)$$

(Coupling)

$$J_c = 0.25 \text{ (kg} \cdot \text{cm}^2) \cdots \text{Temporary}$$

(As a whole)

Moment of inertia of the ball screw J_L is:

$$J_L = J_b + J_w + J_c$$

$$= 0.34 + 6.1 + 0.25$$

$$= 6.7 \times 10^{-4} \text{ (kg} \cdot \text{m}^2)$$

[2] Driving torque

We assume that the WBK12-01B compact light load model is used as recommended for PSS1520N1D0879, and the moment of inertia of motor J_M is 3.1 (kg · cm²) (3.1 × 10⁻⁴ kg · m²).

(At the time of constant speed)

The torque which is necessary to drive the ball screw at a constant speed resisting external loads is per formula 28) on page B64:

$$T_1 = T_a + T_{pmax} + T_u$$

In this formula, T_a is the drive torque at constant speed, T_{pmax} is the upper limit of the dynamic friction torque of the ball screw, and T_u is the friction torque of the support bearings.

From the chart on pages B193 and B400, T_{pmax} is 13.8 (N · cm) and T_u is 2.1 (N · cm) respectively.

$$T_a = \frac{F_a \cdot l}{2\pi\eta_1}$$

Using formula 26) on page B63, the drive torque at a constant speed T_1 is:

$$T_1 = \frac{F_a \cdot l}{2\pi \cdot \eta_1} + T_{pmax} + T_u$$

$$= \frac{6 \times 2}{2\pi \times 0.9} + 13.8 + 2.1$$

$$= 18 \text{ (N} \cdot \text{cm)} = 0.18 \text{ (N} \cdot \text{m)}$$

(At the time of acceleration)

The drive torque necessary for accelerating the ball screw resisting axial load can be calculated by the formula 29) on page 64.

$$T_2 = T_1 + J \cdot \frac{2\pi \cdot n}{60t_1}$$

$$= T_1 + (J_L + J_M) \cdot \frac{2\pi \cdot n}{60t_1}$$

$$= 0.18 + (6.7 \times 10^{-4} + 3.1 \times 10^{-4}) \frac{2\pi \times 3\,000}{60 \times 0.25}$$

$$= 1.41 \text{ (N} \cdot \text{m)}$$

(At the time of deceleration)

Similarly, at the time of acceleration:

$$T_3 = T_1 - J \cdot \frac{2\pi \cdot n}{60t_3}$$

$$= T_1 - (J_L + J_M) \cdot \frac{2\pi \cdot n}{60t_3}$$

$$= 0.18 - (6.7 \times 10^{-4} + 3.1 \times 10^{-4}) \frac{2\pi \times 3\,000}{60 \times 0.25}$$

$$= -1.05 \text{ (N} \cdot \text{m)}$$

[3] Selection of motor

Selection conditions are as follows.

Maximum rotational speed: $N_M \geq 3\,000 \text{ (min}^{-1})$

Motor rating torque: $T_M \geq T_{rms} \text{ (N} \cdot \text{m)}$
(T_{rms} : Effective torque)

Moment of inertia of the motor: $J_M > J_L/3$ or more

From above: select an AC servo motor with the following specifications.

Motor specifications:
 Rating power output: $W_M = 300 \text{ (W)}$
 Maximum rotational speed:
 $N_M = 3\,000 \text{ (min}^{-1})$
 Rating torque: $T_M = 1 \text{ (N} \cdot \text{m)} = 1 \times 10^2 \text{ (N} \cdot \text{cm)}$
 Moment of inertia: $J_M = 3.1 \times 10^{-4} \text{ (kg} \cdot \text{m}^2)$
 $= 3.1 \text{ (kg} \cdot \text{cm}^2)$

[4] Check effective torque

Effective torque T_{rms} can be calculated as follows:

$$T_{rms} = \sqrt{\frac{T_2^2 \times t_a + T_1^2 \times t_b + T_3^2 \times t_c}{t}}$$

$$= \sqrt{\frac{1.41^2 \times 0.75 + 0.18^2 \times 0.65 + 1.05^2 \times 0.75}{3.5}}$$

$$= 0.82$$

Thus the condition of " $T_M \geq T_{rms}$ " is cleared.

[5] Check time to reach maximum speed

The time required to reach the rapid traverse speed can be calculated as follows. Where $T_M' = 2 \times T_M$:

$$t_a = \frac{(J_L + J_M) \times 2\pi \times n}{(T_M' - T_1)} \times 1.4$$

$$= \frac{(6.7 \times 10^{-4} + 3.1 \times 10^{-4}) \times 2\pi \times 3\,000}{(2 \times 1 - 0.18) \times 60} \times 1.4$$

$$= 0.24$$

Thus, the ball screw meets the requirement of "0.25 sec or less".

From the above, use PSS1520N1D0879

Drill 2: Processing table for special machines

1. Design conditions

- Table mass: $m_1 = 1\ 000\ \text{kg}$
- Mass of the work: $m_2 = 600\ \text{kg}$
- Maximum stroke: $S_{\text{max}} = 1\ 000\ \text{mm}$
- Maximum speed: $V_{\text{max}} = 15\ 000\ \text{mm/min}$
- Positioning accuracy: $\pm 0.035/1\ 000\ \text{mm}$ (no load)
- * Attitude accuracy of the table and thermal displacement are not included in the accuracy requirements of the ball screw.
- Repeatability: $\pm 0.005\ \text{mm}$ (no load)
- Lost motion: $0.020\ \text{mm}$ (no load)
- Required life expectancy: $L_i = 20\ 000\ \text{h}$
($16^{\text{h}} \times 250^{\text{days}} \times 10^{\text{years}} \times 0.5^{\text{rate of operation}}$)
- Guide way (sliding): $\mu = 0.15$
(friction coefficient)
- Processing: Milling and drilling
- Drive motor: AC servo motor
($N_{\text{max}} = 2\ 000\ \text{min}^{-1}$)

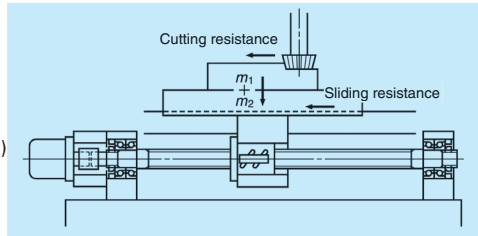


Fig. 17.3 System appearance

Table 17.2 Operating conditions

Operation	Axial load (N)		Feed speed (mm/min)	Use time ratio (%)
	Cutting resistance	Sliding resistance		
Rapid traverse	0	2 354	15 000	30
Light/medium cutting	4 000	2 354	500	50
Heavy cutting	8 000	2 354	100	20

- * Sliding resistance: $F_s = \mu (m_1 + m_2) g = 0.15 \times (1\ 000 + 600) \times 9.80665 = 2\ 354\ \text{(N)}$
- * Ignore the inertia force at the time of acceleration/deceleration because their time rate is negligibly short.

2. Selection of basic factors

(1) Selection of accuracy grade and axial play

The proper accuracy grade for machining centers should be in the range from C1 to C5 according to "Table 4.1 Applications for ball screws by accuracy grade" on page B19. Assuming the nut length is 200 mm and margin stroke is 100 mm, shaft length L_0 is obtained as follows:

$$L_0 = \text{Maximum stroke} + \text{nut length} + \text{margin}$$

$$= 1\ 000 = (200) + (100) = 1\ 300$$

From "Table 1.2 Tolerance on specified travel and travel variation of positioning ball screws" on page B38, the accuracy factors which satisfy the required functions are:

Accuracy C3 grade

$$e_p = \pm 0.029/1\ 600\ \text{(mm)}$$

$$v_u = 0.018\ \text{(mm)}$$

Considering the importance of lost motion, select Z code (axial play 0 mm and less) for the axial play.

(2) Selection of lead

From the maximum rotational speed of AC servo motor N_{max} and rapid traverse speed of table V_{max} , lead l is:

$$l \geq \frac{V_{\text{max}}}{N_{\text{max}}} = \frac{15\ 000}{2\ 000} = 7.5\ \text{(mm)}$$

A larger lead l would be beneficial for higher feed speed. But from the view of the control system (resolution), lead l is limited to 8 mm or 10 mm.

(3) Selection of screw shaft diameter

According to Table 4.4 "Screw shaft diameter, lead and stroke of standard ball screws" on page B21, screw shaft diameters with leads of 8 mm or 10 mm are in the range of 10 mm to 50 mm. Placing more importance on rigidity than volume of lost motion, select a relatively large size in the range of 32 mm to 50 mm.

(4) Selection of stroke

Select 1 000 mm, the maximum stroke as specified in the design conditions.

Primary selection:

- Standard ball screw
- Shaft diameter: 32, 36, 40, 45, 50 mm
- Lead: 8, 10 mm
- Stroke: 1 000 mm
- Grade: C3
- Axial play code: Z

3. Confirmation of standard ball screw

Giving consideration to delivery time and price, select a standard ball screw. C3 grade is not found in standard ball screws. Let us check application-oriented ball screws for a C3 grade.

4. Confirmation of made-to-order ball screw

Because standard ball screws do not meet the accuracy grade requirement, we will consider made-to-order ball screws which are based on standard ball screws but with accuracy grade of C3.

Second selection:

- Made-to-order ball screw
- Shaft diameter: 32, 36, 40, 45, 50 mm
- Lead: 8, 10 mm
- Stroke: 1 000 mm
- Accuracy grade: C3
- Axial play: Z

5. Selection of screw shaft diameter, lead, and nut

(1) Dynamic load rating

Obtain required load carrying capacity for each lead through load conditions. From Table 17.2 "Operating conditions" on page B91, calculate the rotation speed N_i as shown in Table 17.3.

$$N_i \geq \frac{V_i}{l}$$

Table 17.3 Load conditions

Operating condition	Axial load (N)	Rotations per minute (min^{-1})		Use time ratio (%)
		$l = 8$	$l = 10$	
Rapid traverse	$F_1 = 2\ 354$	$N_1 = 1\ 875$	$N_1 = 1\ 500$	$t_1 = 30$
Light/medium cutting	$F_2 = 6\ 354$	$N_2 = 62.5$	$N_2 = 50$	$t_2 = 50$
Heavy cutting	$F_3 = 10\ 354$	$N_3 = 12.5$	$N_3 = 10$	$t_3 = 20$

By using formulas 11) and 12) on page B53, calculate the mean load F_m and the mean rotational speed N_m as shown below.

$$F_m = \left(\frac{F_1^3 \cdot N_1 \cdot t_1 + F_2^3 \cdot N_2 \cdot t_2 + F_3^3 \cdot N_3 \cdot t_3}{N_1 \cdot t_1 + N_2 \cdot t_2 + N_3 \cdot t_3} \right)^{1/3}$$

$$N_m = \frac{N_1 \cdot t_1 + N_2 \cdot t_2 + N_3 \cdot t_3}{t}$$

Table 17.4 Mean load and mean rotational speed

Lead (mm)	8	10
Mean load F_m (N)	3 122	3 122
Mean rotational speed N_m (min^{-1})	596	477

Required dynamic load rating C_a is:

Using formulas 8) and 9) on page B53, calculate the required dynamic load rating.

$$C_a \geq (60 N_m \cdot L_t)^{1/3} \cdot F_m \cdot f_w \times 10^{-2} \text{ (N)}$$

Whereas required life expectancy $L_t = 20\ 000$ (h), load coefficient $f_w = 1.2$ (refer to page B53),

$$l = 8 \text{ (mm)} \dots\dots\dots C_a \geq 33\ 500 \text{ (N)}$$

$$l = 10 \text{ (mm)} \dots\dots\dots C_a \geq 31\ 100 \text{ (N)}$$

(2) Selection of the nut

Due to the requirement on lost motion, the nut will be selected as follows emphasizing the importance of system rigidity.

Table 17.5 shows the dynamic load rating of each specification.

- Standard nut ball screw, tube recirculation
- Model No.: ZFT (pages B431 to B460)
- Number of ball turns: Select from 2.5 turns 2 circuits or 2.5 turns 3 circuits

From **Table 17.5**, select an item that meets the required dynamic load rating C_a as follows:

Third selection: the range surrounded by dotted lines in **Table 17.5**

Table 17.5 Dynamic load rating of each specification

Screw shaft diameter (mm)	Dynamic load rating C_a : (N)			
	Lead 8 mm		Lead 10 mm	
	2.5 turns 2 circuits	2.5 turns 3 circuits	2.5 turns 2 circuits	2.5 turns 3 circuits
32	37 300	—	54 500	—
36	—	—	58 000	—
40	41 100	—	61 200	—
45	—	—	65 800	—
50	45 700	64 800	68 100	96 500

(3) Permissible rotational speed

[1] Critical speed

Check if the rapid traverse speed of 15 000 mm/min (V_{max}) clears the critical speed. Ball screw rotational speed at each lead N is:

$$l = 8 \text{ (mm)} \dots\dots\dots N = 1\ 875 \text{ (min}^{-1}\text{)}$$

$$l = 10 \text{ (mm)} \dots\dots\dots N = 1\ 500 \text{ (min}^{-1}\text{)}$$

From formula 7) on page B47, screw shaft root diameter to meet critical speed requirements is:

$$d \geq \frac{N \cdot L_a^2}{f} \times 10^{-7} \text{ (mm)}$$

In this formula, distance between support positions L_a is:

$$L_a = \text{Maximum stroke} + \text{nut length}/2 + \text{shaft end extra length} \\ = 1\ 000 + 100 + 200 = 1\ 300 \text{ (mm)}$$

The support configuration of the screw shaft is Fixed

- Fixed, and that of the ball nut is Fixed. Therefore, support configuration is Fixed - Fixed (Factor $f = 21.9$)

$$l = 8 \text{ (mm)} \dots\dots\dots d_t \geq 14.5 \text{ (mm)}$$

$$l = 10 \text{ (mm)} \dots\dots\dots d_t \geq 11.6 \text{ (mm)}$$

[2] $d \cdot n$ value

From **Table 3.2** on page B50, as the $d \cdot n$ is 70 000 or less, screw shaft diameters to meet $d \cdot n$ are:

$$d \leq \frac{70\ 000}{N} \text{ (mm)}$$

$$l = 8 \text{ (mm)} \dots\dots\dots d \leq 37.3 \text{ (mm)}$$

$$l = 10 \text{ (mm)} \dots\dots\dots d \leq 46.7 \text{ (mm)}$$

Based on nut specifications (pages B431 to B460) select an item that meets screw shaft root diameter d_t , and screw shaft diameter d .

* Please consult NSK if the $d \cdot n$ value exceeds 70 000.

Fourth selection: the range surrounded by solid lines in **Table 17.5**

(4) Rigidity of the ball screw system

Set the lost motion of the ball screw system (screw shaft, nut and support bearings) at 80% of the specified value. Then calculate the system rigidity. The criterion for lost motion is:

$$20 \text{ (}\mu\text{m)} \times 0.8 = 16 \text{ (}\mu\text{m)}$$

At this time, the one-way elastic deformation ΔL of the major factors of the ball screw system will be less than half the above criterion.

$$\Delta L \leq 8 \text{ (}\mu\text{m)}$$

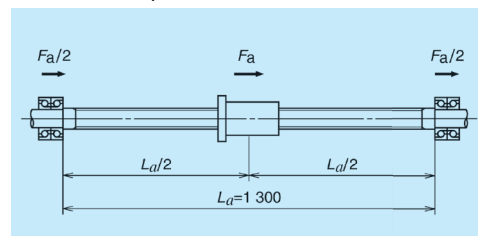


Fig. 17.4 Distance between support positions

[1] Rigidity of the screw shaft K_s

Calculate the rigidity at the center of screw shaft where the axial deformation becomes the largest. Because the support configuration of the screw shaft is Fixed - Fixed, the rigidity is per formula 21) on page B58:

$$K_s = \frac{\pi \cdot d_t^2 \cdot E}{L_a} \times 10^{-3} \text{ (N/mm)}$$

E is the elastic modulus. From formula 17) on page B57, the elastic deformation of the screw shaft ΔL_s is:

$$\Delta L_s = \frac{F_a}{K_s} = \frac{r F_a \cdot L_a}{\pi \cdot d_t^2 \cdot E} \times 10^3 \text{ (}\mu\text{m)}$$

The sliding resistance F_a is:

$$F_a = \mu (m_1 + m_2) = 0.15 \times (1\ 000 + 600) \\ = 2\ 354 \text{ (N)}$$

Table 17.7 shows the rigidity of screw shaft K_s and the elastic deformation ΔL_s .

[2] Rigidity of the ball nut K_n

Set about 1/3 the maximum axial load as preload value F_{a0} .

$$F_{a0} = \frac{F_{max}}{3} = \frac{10\ 354}{3} = 3\ 452 \rightarrow 3\ 500 \text{ (N)}$$

From formula 23) on page B60, the rigidity of the ball nut K_n is:

$$K_n = 0.8 \times K \left[\frac{F_{a0}}{\epsilon \cdot C_a} \right]^{1/3} = 0.8 \times K \left[\frac{3\ 500}{0.1 \cdot C_a} \right]^{1/3} \text{ (N/}\mu\text{m)}$$

K : Theoretical rigidity

From formula 17) on page B57, elastic deformation of the ball nut ΔL_n is:

$$\Delta L_n = \frac{F_a}{K_n} = \frac{2\ 354}{K_n}$$

Table 17.7 shows the rigidity of ball nut K_n and the elastic deformation ΔL_n .

[3] Rigidity of the support bearing K_b

NSKTAC C Series ball screw support bearings will be used. We specify designations for support units by shaft diameter as shown in **Table 17.6** (refer to page B403).

Table 17.6 Bearing No. (designation)

Screw shaft diameter (mm)	Bearing No. (designation)
32	25TAC62CDF
36	25TAC62CDF
40	30TAC62CDF
45	35TAC72CDF

Refer to page B410 for the rigidity K_b of each bearing unit (axial spring modulus). Elastic deformation of bearing ΔL_b is:

$$\Delta L_b = \frac{F_a}{2K_b}$$

Table 17.7 shows the rigidity of support bearing K_b and elastic deformation ΔL_b .

Table 17.7 Rigidity and elastic deformation

Model No.:	Screw shaft		Nut		Support bearing		Total ΔL
	K_s	ΔL_s	K_n	ΔL_n	K_b	ΔL_b	
ZFT3208-10	376	6.3	912	2.6	850	1.4	10.3
ZFT3210-10	347	6.8	843	2.8			11.0
ZFT3610-10	460	5.1	898	2.6			9.1
ZFT4010-10	589	4.0	966	2.4	890	1.3	7.7
ZFT4510-10	773	3.0	1 055	2.2	1 030	1.1	6.3

Choose the most economical ball screw system which meets the requirement of one-way deformation (ΔL) of 8 μm or less.

The selected ball screw:

Model No.: ZFT4010-10

Shaft diameter: 40 (mm)

Lead: 10 (mm)

Dynamic load rating: 61 200 (N)

6. Decision of screw shaft length

ZFT4010-10 ball nut has a length of 163 mm, and thus the distance between support positions of screw shaft L_a should be:

$$L_a = \text{Maximum stroke} + \text{nut length} + \text{margin} \\ = 1\ 000 + 163 + 100 = 1\ 263 \rightarrow 1\ 300 \text{ mm}$$

7. Checking basic safety

(1) Permissible axial load

Calculate the buckling load for conditions shown in Fig. 17.5 with P of 10 354 (N) and L_1 of 1 200 (mm).

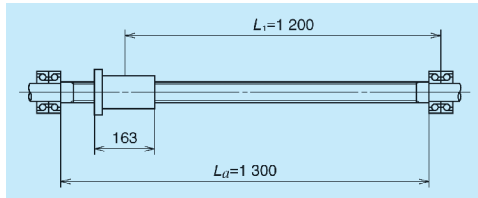


Fig. 17.5 Examination of buckling load

Support configuration is Fixed - Fixed, and from calculation formula 2) on page B44, the screw shaft diameter d , to prevent buckling is

$$d \geq \left(\frac{P \cdot L_1^2}{m} \times 10^{-4} \right)^{1/4}$$

$$= \left(\frac{10\,354 \times 1200^2}{19.9} \times 10^{-4} \right)^{1/4} = 16.5 \text{ (mm)}$$

From the specification of ZFT4010-10 ball nut (page B449), the root diameter of screw shaft d_r is 34.4 mm and thus meets the above conditions.

Result: Acceptable

(2) Permissible rotational speed

[1] Critical speed n

From the critical speed calculation formula 7) on page B47:

$$n = f \cdot \frac{d_r}{L_1^2} \times 10^7 = 21.9 \times \frac{34.4}{1\,200^2} \times 10^7$$

$$\doteq 5\,230$$

The maximum rotational speed (N_{max}) of 1 500 min^{-1} is less than the critical speed and thus meets requirements.

Result: Acceptable

[2] $d \cdot n$ value

The $d \cdot n$ value is:

$$d \cdot n = 40 \times 1\,500 = 60\,000$$

From Table 3.2 on page B50, the $d \cdot n$ of the tube recirculation ball nut is 70 000 or less and meets requirements.

Result: Acceptable

(3) Life L_t

The dynamic load rating C_a is 61 200 N (see dimension table on page B449), and from formulas 8) and 9) on page B53 the life expectancy is:

$$L_t = \left(\frac{C_a}{f_w \cdot F_m} \right)^3 \times 10^6 \times \frac{1}{60 \cdot N_m}$$

$$\doteq 152\,000$$

The above result satisfies the required life of 20 000 (h).

Result: Acceptable

8. Check whether factors satisfy requirements

(1) Checking accuracy

[1] Positioning accuracy

The positioning accuracy of $\pm 0.035/1\,000$ mm, from Table 1.2 "Tolerance of specified travel and travel variation" on page B38 meets the required positioning accuracy as follows:

Accuracy grade : C3

$$e_p = \pm 0.029/1\,600 \text{ (mm)}$$

$$v_u = 0.018 \text{ (mm)}$$

[2] Measures against thermal expansion

Provide pre-tension force equivalent to the elongation from 3°C temperature rise, taking in consideration the load carrying capacity of bearings. Also, adjust the travel compensation for the specified travel equivalent to 3°C temperature rise (refer to page B40).

(a) Thermal elongation : ΔL_0

From formula 1) on page B40:

$$\Delta L_0 = \rho \cdot \theta \cdot L_0 = 12.0 \times 10^{-6} \times 3 \times 1\,300$$

$$= 0.047 \text{ (mm)}$$

(b) Pre-tension force : F_0

$$F_0 = \Delta L_0 \cdot K_S = \frac{\Delta L_0 \cdot E \cdot \pi \cdot d_r^2}{4L_0}$$

$$= \frac{0.047 \times 2.06 \times 10^5 \times \pi \times 34.4^2}{4 \times 1\,300}$$

$$\doteq 6\,922 \rightarrow 6\,900 \text{ (N)}$$

Travel compensation : $-0.047/1\,300$ (mm)

Pre-tension force : 6 900 (N)

Tension (elongation) volume : 0.047 (mm)

[3] Selection of support bearing

Assuming that the ratio of basic dynamic load rating of support bearing (C_a) and pre-tension force (F_0) is ϵ , select a bearing which generally satisfies the following:

$$\epsilon = F_0 / C_a < 0.20$$

Design the bearing support configuration to which pre-tension force is applied in such way that the axial load is supported by a paired mounting or other multi-bearing arrangement. Please consult NSK when one bearing must sustain the pre-tension load.

Table 17.8 Comparison of dynamic load rating and pre-tension force

Bearing No. (designation)	C_a (N)	ϵ
30TAC62CDF	29 200	0.23
30TAC62CDFD	47 500	0.14

Selected support bearing: 30TAC62CDFD

(2) Checking drive torque of motor

⟨Required specifications⟩

• Motor rotational speed: 1 500 min^{-1}

• Time to reach maximum speed: 0.16 sec or less (At the time of rapid traverse)

[1] Load (converted to the motor load)

Calculate the moment of inertia of the ball screw. From formulas 30) and 31) on page B64, moment of inertia of ball screw parts J is calculated as follows, where γ is material density and ball screw shaft length L_s is 1 550 mm.

(Screw shaft)

$$J_B = \frac{\pi \cdot \gamma \cdot D^4 \cdot L_s}{32} = \frac{\pi \times 7.8 \times 10^3}{32} \times 4^4 \times 155$$

$$= 30 \text{ (kg} \cdot \text{cm}^2)$$

(Moving part)

$$J_w = m \times \left(\frac{l}{2\pi} \right)^2 = 1\,600 \times \left(\frac{1}{2\pi} \right)^2$$

$$= 40 \text{ (kg} \cdot \text{cm}^2)$$

(Coupling)

$$J_c = 10 \text{ (kg} \cdot \text{cm}^2) \dots \text{assumed}$$

(Total)

$$J_L = J_B + J_w + J_c = 30 + 40 + 10$$

$$= 80 \text{ (kg} \cdot \text{cm}^2) \rightarrow 80 \times 10^{-4} \text{ (kg} \cdot \text{m}^2)$$

[2] Driving torque

The required torque to drive a ball screw resisting external loads T_1 can be obtained by formula 28) on page B64:

$$T_1 = T_A + T_p + T_U$$

In this formula, T_A is drive torque at constant speed, T_p is dynamic friction torque, and T_U is friction torque of the support bearings. From formula 26) and 25) on page B63, T_A and T_p are:

$$T_A = \frac{F_a \cdot l}{2\pi \eta_1}$$

$$T_p = 0.014 F_{a0} \sqrt{d_m \cdot l}$$

$$\eta_1 = 0.9$$

Refer to the starting torque value in Table on page B410:

T_U is:

$$T_U = (16 \times 1.35) + (16 \times 1.35) = 43.2 \text{ (N} \cdot \text{cm)}$$

So, the required drive torques during rapid traverse T_{11} and heavy cutting T_{13} are:

(At the time of rapid traverse)

$$T_{11} = T_{A1} + T_{P1} + T_{U1}$$

$$= \frac{2\,354 \times 1}{2\pi \times 0.9} + 0.014 \times 3\,500 \sqrt{4.1 \times 1} + 43.2$$

$$= 559 \text{ (N} \cdot \text{cm)} \rightarrow 559 \times 10^{-2} \text{ (N} \cdot \text{m)}$$

(At the time of heavy cutting)

$$T_{12} = T_{A2} + T_{P2} + T_{U2}$$

$$= \frac{10\,354 \times 1}{2\pi \times 0.9} + 0.014 \times 3\,500 \sqrt{4.1 \times 1} + 43.2$$

$$= 1\,973 \text{ (N} \cdot \text{cm)} \rightarrow 1\,973 \times 10^{-2} \text{ (N} \cdot \text{m)}$$

[3] Selection of the motor

⟨Selection conditions⟩

Maximum rotational speed: $N_M \geq 1\,500$ (min^{-1})

Motor rating torque: $T_M > T_1$ (N · m)

Moment of inertia of the motor: $J_M > J_L/3$ (kg · m²)

Based on the above, select an AC servo motor as follows.

Motor specifications	
Rating power output:	$W_M = 1.8$ (kW)
Maximum rotational speed:	$N_M = 1\,500$ (min ⁻¹)
Rating torque:	$T_M = 22.5$ (N · m) $= 22.5 \times 10^2$ (N · cm)
Moment of inertia:	$J_M = 190 \times 10^{-4}$ (kg · m ²) $= 190$ (kg · cm ²)

[4] Checking the time to reach maximum speed:
Required time to reach rapid traverse speed can be calculated as follows (where $T_M' = 2 \times T_M$):

$$t_a = \frac{(J_L + J_M) \times 2\pi \times N}{(T_M' - T_L) \times 60} \times 1.4$$

$$= \frac{(80 \times 10^{-4} + 190 \times 10^{-4}) \times 2\pi \times 1\,500}{(2 \times 22.5 - 559 \times 10^{-2}) \times 60} \times 1.4$$

$$= 0.15 \text{ (sec)}$$

Thus, the time meets the requirement of 0.16 sec or less.

Drill 3: Cartesian robot Z axis (vertical axis)

1. Design conditions

Mass of the work :	$m = 300$ kg
Maximum travel :	$S_{\max} = 1\,500$ mm
Rapid traverse speed :	$V_{\max} = 10\,000$ mm/min
Repeatability :	0.3 mm
Required life :	$L_t = 24\,000$ h (16 ^{hours} × 300 ^{days} × 5 ^{years})

Screw shaft support configuration :

Fixed -- Simple

Nut:

Flanged single nut

Guide way (rolling) :

$\mu = 0.01$ (friction coefficient)

Drive motor :

AC servo motor ($N_{\max} = 1\,000$ min⁻¹)

Environment :

Slightly dusty

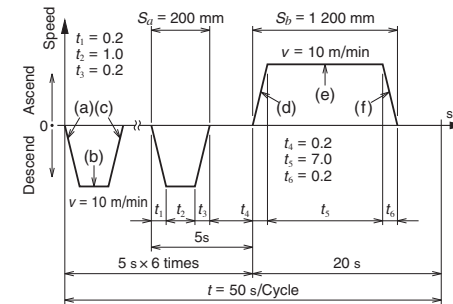


Fig. 17.7 Operating conditions

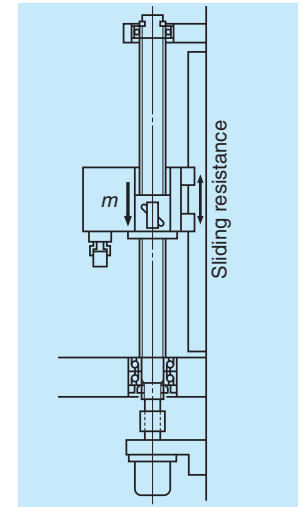


Fig. 17.6 System appearance

2. Selection of basic factors

(1) Selection of accuracy grade

Although this application is not listed in **Table 4.1** "Accuracy grades of ball screws and their applications" on page B19, it is possible to use an R model ball screw for transfer equipment because the required repeatability of 0.3 mm is not very high.

(2) Selection of lead

From the maximum rotational speed of the AC motor:

$$l \geq \frac{V_{\max}}{N_{\max}} = \frac{10\,000}{1\,000} = 10 \text{ (mm)}$$

Select a lead 10 mm or over.

(3) Selection of screw shaft diameter

According to **Table 4.6** "Shaft diameter, lead and standard screw length of R models" on page B23, the shaft diameters whose lead is 10 mm or over are in the range of 12 mm to 50 mm.

(4) Selection of stroke

From **Table 4.6** "Screw shaft diameter, lead and standard screw shaft length of R models" on page B23, it is possible to select from R models because the diameter d of 15 mm to 50 mm and lead l of 10 mm will meet the required maximum stroke of 1500 mm.

Primary selection : R model ball screw for transfer equipment
 Screw shaft diameter : 15 – 50 (mm)
 Lead : 10 (mm)
 Stroke : 1 500 (mm)

3. Confirmation of standard ball screw

Select from flanged single nuts of R model ball screws for transfer equipment.

Second selection : R model ball screw for transfer equipment
 Screw shaft diameter : 16, 20, 25, 32, 36
 40, 50 (mm)
 Lead : 10 (mm)
 Stroke : 1 500 (mm)

4. Decision of screw length

Screw length L_o is:

$$L_o = \text{Stroke} + \text{nut length} + \text{margin} + \text{shaft end length}$$

$$= 1\,500 + 100 + 100 + 200 = 1\,900 \text{ (mm)}$$

Normally, the overall screw shaft length L_o less than or equal to 70 times the screw shaft diameter d is recommended.

Therefore, screw shaft diameter d is:

$$d \geq \frac{L_o}{70} = \frac{1\,900}{70} = 27.1 \text{ (mm)}$$

Third selection : R model ball screw for transfer equipment
 Shaft diameter: 32, 36, 40, 45, 50 (mm)
 Lead: 10 (mm)
 Stroke: 1 500 (mm)

5. Checking basic safety

(1) Allowable axial load

[1] Calculation of allowable axial load
 Accelerating/decelerating time is:

$$\alpha = \frac{V}{60t} = \frac{10 \times 10^3}{60 \times 0.2} = 833 \text{ (mm/s}^2\text{)}$$

$$= 0.833 \text{ (m/s}^2\text{)}$$

$$t = t_1 = t_3 = t_4 = t_6$$

(a), (f) $\dots\dots F_1 = mg - m\alpha$
 $= 300 \times 9.80665 - 300 \times 0.833$
 $= 2\,690 \text{ (N)}$

(b), (e) $\dots\dots F_2 = mg = 2\,940 \text{ (N)}$

(c), (d) $\dots\dots F_3 = mg + m\alpha = 3\,190 \text{ (N)}$

[2] Buckling load

For conditions in Fig. 17.8, use values below.
 $P = 3\,190 \text{ N}$, $L_1 = 1\,600 \text{ mm}$

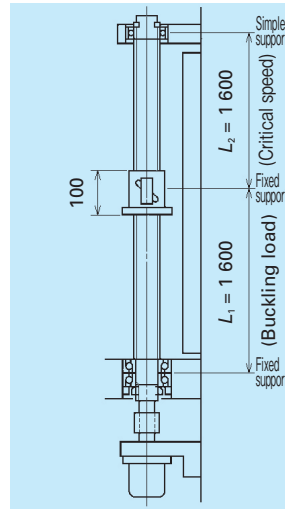


Fig. 17.8 Inspecting for buckling load and critical speed

From formula 2) on page B44:

$$d_i \geq \left(\frac{P \cdot L_1^2}{m} \times 10^{-4} \right)^{1/4}$$

$$= \left(\frac{3\,190 \times 1\,600^2}{19.9} \times 10^{-4} \right)^{1/4} = 14.2 \text{ (mm)}$$

(2) Checking permissible rotational speed

[1] Critical speed

Use values below.

$$n = 1\,000 \text{ (min}^{-1}\text{)}, L_2 = 1\,600 \text{ (mm)}$$

From formula 7) on page B47:

$$d_i \geq \frac{n \cdot L_2^2}{f} \times 10^{-7} = \frac{1\,000 \times 1\,600^2}{15.1} \times 10^{-7}$$

$$= 17 \text{ (mm)}$$

[2] $d \cdot n$ value

From Table 3.2 on page B50:

$$d \leq \frac{50\,000}{n} = \frac{50\,000}{1\,000}$$

$$= 50 \text{ (mm)}$$

* Please consult NSK when the $d \cdot n$ value exceeds 50 000.

(3) Checking life (dynamic load rating)

Determine the required load carrying capacity from the load conditions in Table 17.9.

Table 17.9 Load conditions

Operating condition	Axial load (N)	Rotational speed (mean) (min ⁻¹)	Use time (s)
(a) _{xe} (f)	$F_1 = 2\,690$	$N_1 = 500$	$t_a = 1.4$
(b) _{xe} (e)	$F_2 = 2\,940$	$N_2 = 1\,000$	$t_b = 13.0$
(c) _{xe} (d)	$F_3 = 3\,190$	$N_3 = 500$	$t_c = 1.4$

Calculate mean load F_m and mean rotational speed N_m from the formulas 11) and 12) on page B53:

Required load carrying capacity is:

$$F_m = \left(\frac{F_1^3 \cdot N_1 \cdot t_a + F_2^3 \cdot N_2 \cdot t_b + F_3^3 \cdot N_3 \cdot t_c}{N_1 \cdot t_a + N_2 \cdot t_b + N_3 \cdot t_c} \right)^{1/3}$$

$$= 2\,940 \text{ (N)}$$

$$N_m = \frac{N_1 \cdot t_a + N_2 \cdot t_b + N_3 \cdot t_c}{t}$$

$$= 288 \text{ (min}^{-1}\text{)}$$

From formulas 8) and 9) on page B53:

$$C_a \geq (60N_m \cdot L_1)^{1/3} \cdot F_m \cdot f_w \times 10^{-2} \text{ (N)}$$

$$= (60 \times 288 \times 24\,000)^{1/3} \times 2\,940 \times 1.2 \times 10^{-2}$$

$$= 26\,300 \text{ (N)}$$

(4) Checking static load rating

$$C_{0a} = F_{\max} \times f_s = 3\,190 \times 2$$

$$= 6\,380 \text{ (N)}$$

In consideration of expense, select a ball screw shaft as follows.

Fourth selection : R model ball screw for transfer equipment

Shaft diameter : 32 (mm)
 Lead : 10 (mm)
 Stroke :
 Ball turns and numbers of circuits : 2.5 × 2
 Screw length : 2 000 (mm)
 Basic dynamic load rating : 42 000 (N)

6. Selection of nut

Select a "standard nut with a flange and a built-in brush seals" based on the environment conditions.

Selected ball screw:

Nut assembly RNFTL3210A5S
 Screw shaft RS3210A20

B-2-18 References

"NSK Motion & Control (technical journal)" was compiled to introduce NSK products and technologies. You will find data summaries for selecting ball screws in this catalog. If you need detailed technical data, please refer to "NSK Motion & Control" technical journals.

For inquiries and orders, please contact NSK branch offices, sales offices, or representatives.

Table 18.1 NSK Motion & Control (technical journal) : Issues relating to ball screws (2002-)

Issue No.	Date of Publication	Articles Related to Ball Screws ¹
No.13	October 2002	Development of HTF Series Ball Screws for High Load Drive Applications
No.13	October 2002	High Lead Precision Rolled Ball Screws
No.14	May 2003	High Speed and Low Noise Ball Screws HMC-B02 Series
No.15	December 2003	Clean Support Units for Ball Screws
No.16	August 2004	Development of High Speed and Low Noise Ball Screws
No.18	August 2005	S3 Ball Screws: Super Low Noise Ball Screws for Automation Equipment
No.19	September 2006	High-Speed and Low-Noise Ball Screw for Standard Stock - Compact FA Series
No.21	December 2007	V1 Series Ball Screws for Contaminated Environments HTF-SRC Series Ball Screws for High-Speed and High-Load Applications
No.22	March 2011	Technological Trends of Ball Screws for Industrial Machinery BSL Series Ball Screws for Small Lathes HTF-SRD Series Long-Lead Ball Screws for High-Speed and Heavy-Load Applications
No.23	June 2013	TW Series Ball Screws for Twin-Drive Systems HMD Series Ball Screws for High-Speed Machine Tools
No.24	December 2014	Ball Screw for Motorcycle Brake Systems
No.25	September 2015	HMS Series Ball Screws for High-Speed Machine Tools Miniature Large-Lead Series of High-Speed, Low-Noise Ball Screws
No.26	April 2016	Development of a Nut Cooling Ball Screw Ball Screws with X1 Seals for Machine-Tool Applications HTF-SRE Large, High-Speed, High-Load Capacity Ball Screws
No.27	November 2016	Strategy for Frictional Behavior Control in Ball Screws Ball Screws with Minimal Grease-Splatter L1 Seals
No.28	June 2017	Ultra-Large Ball Screws
No.30	June 2019	The Technical Trend of Machine Tool Components
No.31	June 2020	Development of Long Life Ball Screw using Material with High Retained Austenite Amount γR for High-Load Drive
No.32	June 2021	High Load Endurance Test Unit for Electric Injection Molding Machine Ball Screws Ball Screw Units for Electric Hydraulic Brake Systems High Durability Precision Ball Screw
No.33	June 2022	Ball Screw Technologies to Control Machine Tool Quadrant Glitches
No.34	June 2023	Evaluation of Lubrication Performance in Ball Screws and Linear Guides by the Electrical Impedance Method
No.35	June 2024	NSK Ball Screw for High-Load Drives:Long-Life Specification

1. Titles reflect the original publication. Note that product names, expressions, etc. may have been changed/corrected since publication.

B-2-19 Guide to Technical Services

(1) CAD data

■ Web page

<http://www.jp.nsk.com/app01/en/ctr/g/>

(2) Telephone consultation with NSK engineers

This catalog contains technical explanations for each section. However, some descriptions and explanations may be insufficient due to page limitations, etc. To amend this shortcoming, NSK offers telephone assistance. NSK engineers are pleased to help you. Our local offices are listed in the last part of this catalog. Please do not hesitate to contact a NSK office or representative in your area.

(3) Additional machining (processing) of standard ball screws in stock

NSK processes standard ball screw blank shaft ends. NSK also cuts linear guide rails to required lengths. Service is available at NSK processing factories throughout the world. Requests are taken by branch offices and agencies.

B-2-20 Precautions When Handling Ball Screws

Ball screws are precision products. They require careful handling as described below.



Confirm lubrication

Lubrication

(1) Confirm the state of lubrication before use. Insufficient lubrication causes loss of ball screw functions in a short period.

(2) Do not apply any lubrication if grease is already applied to the ball screws. Remove dust or swarf if stuck to the greased surface during handling. Wipe the surface with clean white kerosene, and then apply the same type of new lubricant before use. Avoid using different types of grease at the same time.

Consult NSK for special oil lubricant if it is required for your application.

(3) Check the grease after two to three months of operation. Wipe off the old grease if it is excessively contaminated, and apply a sufficient volume of fresh grease. After the initial check, check and replenish the grease approximately every year. Check more often if the environment requires.

Note: Refer to pages B67 and D13 for lubrication.



Do not disassemble



Do not reassemble



Watch out for falling objects



Handle with care



Do not apply shock

Handling

(1) Never disassemble the ball screw. It invites dust to enter and lowers precision and may cause an accident.

(2) Once the ball screw is disassembled for some reason, the user should never reassemble the ball screw. Loss of ball screw function is apt to occur if a mistake is made. Please send the ball screw to NSK for repair or re-assembly. It will be reworked at a nominal fee.

(3) The ball screw shaft or nut may fall off due to its own weight. Watch out for such falling objects. If it falls, the ball groove or ball recirculation component may be damaged and their function might be lost. Make certain to return such items to NSK for checks. There will be a nominal fee for this service.

(4) If the recirculation component, the shaft outside, or the ball groove is scratched or damaged by impact, recirculation operation becomes deficient and may cause a loss of function.

Note: Refer to page B73 for assembling components.



Prevent dust



Follow speed limits



Do not overrun



Do not exceed temperature limits

Precautions in use

(1) Ball screws should be used in a clean environment. Use a dust cover to keep dust and swarf from entering into the system. Insufficient dust protection causes not only the ball screw function to deteriorate, but also brings about damage to the recirculation components if dust plugs the system. This may result in more serious accidents such as a fall of the table.

(2) For rotational speed in operation, refer to the applicable section in this catalog which describes permissible rotational speeds or to specification drawings furnished by NSK. Exceeding permissible rotational speed damages recirculation components and may cause the table to fall. A system such as a safety nut is recommended for vertical use of ball screws. Please consult NSK for safety systems.

(3) Overrunning ball nuts (removed from the ball thread) causes the balls to fall out, damages recirculation components, and dents ball grooves, resulting in insufficient operation. Continued use under such conditions may cause premature wear and damages recirculation components. For these reasons, avoid overrun by all means. If overrun occurs, please request NSK to check. There will be a nominal fee for this service.

(4) Ball screws are designed to be used at a temperature of less than 80°C. Do not operate at temperatures higher than this limit. Use at a higher temperature may damage recirculation and seal components. Please consult NSK if it is necessary to use at a temperature higher than the limit.

When using NSK K1 lubrication units, the operating temperature should be 50°C or less. (Momentary maximum temperature in use: 80°C)

Note: Please read page B83 before designing.



Store in the correct position

Storage

(1) Store in the original NSK packaging. Do not unpack or tear the inner wrapping unnecessarily. This allows dust and moisture to enter, potentially causing rusting and/or deterioration of product performance.

(2) Store indoors in a cool, dry environment with little temperature variation. High temperature and high humidity environments significantly decrease the effectiveness of rust-inhibiting compounds.

(3) The following position is recommended when storing ball screws.

- ① Keep in the NSK original package, and place it flat.
- ② Place flat on supports in a clean area.
- ③ Hang vertically in a clean place.

B-3 Ball Screw Dimension Tables

1. Compact FA Model	B107
2. High-Speed SS Model	B147
3. Finished Shaft End	B157
MA Model, Miniature, Fine Lead	B159
FA Model for Small Equipment	B181
SA Model for Machine Tools	B209
4. Finished Shaft End	
Stainless Steel KA Model	B265
5. Blank Shaft End	B289
MS Model, Miniature, Fine Lead	B291
FS Model for Small Equipment	B299
SS Model for Machine Tools	B309
6. Ball Screws for Transfer Equipment	B337
7. Accessories	B377

B-3-1 Dimension Tables and Reference Numbers for Standard Ball Screws

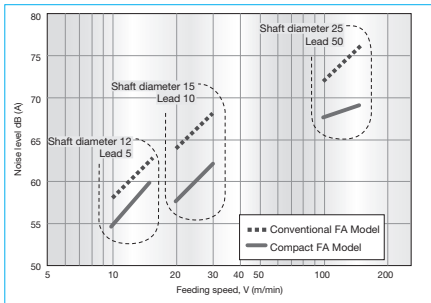
B-3-1.1 Compact FA-PSS, FA-USS, and FA-FSS Models

1. Features

NSK offers the compact FA model featuring end-deflector recirculation systems for high-speed and low-nose operation in a compact design. These exceptionally high performance ball screws are ready for use in a variety of fields such as semiconductor manufacturing equipment, flat panel display manufacturing equipment, chip mounting equipment, measuring apparatus, food and medical equipment, and automotive manufacturing equipment.

●Quieter sound

The operating noise level of ball screws has been reduced by 6 dB(A), about half of what is sensed by the ear.



(Microphone was positioned at a distance of 400 mm for all noise levels)

Fig. 1 Comparison of noise level

●Compact

The outside diameter of the ball nut is as much as 30% smaller than existing NSK products. This contributes to more compact designs of all sorts of equipment and devices such as low-profile positioning stages.

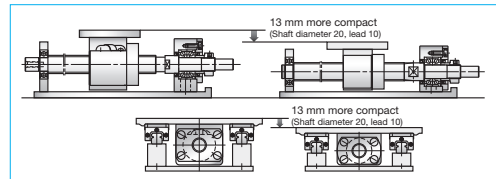


Fig. 2 Comparison of FA and compact FA-PSS models

●High speed

The permissible rotational speed up to 5 000 min⁻¹. This capability dramatically expands the range of service conditions. Please refer to the dimension tables for details of the permissible rotational speed.

●A grease fitting is provided as a standard equipment
The new ball screw is equipped with a grease fitting (M5 × 0.8) as standard equipment. Two lubrication ports are provided to facilitate easy maintenance.

●Storage seal

Compact, thin plastic seals are available. Nut outside diameter is compact compared with the tube recirculation system.

●Low-profile design

Low-profile support units especially compatible with the compact FA model are available for a superb space-saving design.

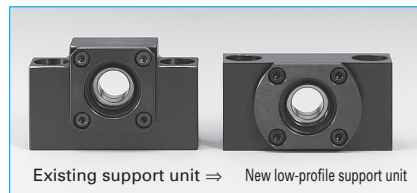


Fig. 3 Comparison of support units

●Low dust generation LG2 grease FA-USS model

The dust count is approximately 1/100 that of the existing FA model. It is suitable for applications in clean environments.

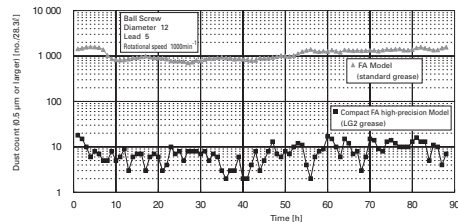
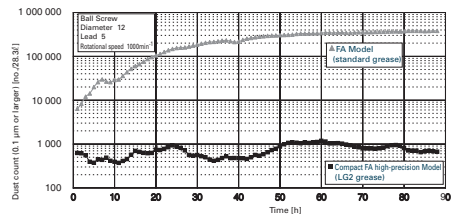


Fig. 4 Comparison of dust count

●Easy stroke setting FA-FSS model

Flexible stroke setting with fixed-simple support by mounting a support unit (simple support side) directly onto ball screw thread outside diameter. Proprietary support units (simple support side) are available from NSK.

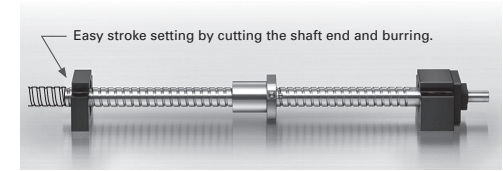


Fig. 5 Flexible stroke setting

2. Order of the dimension tables

Dimension tables are arranged by model in order of increasing shaft diameter.

3. Dimension tables

Dimension tables show shapes/sizes as well as specification factors for each shaft diameter/lead combination. Tables also contain data as follows:

●Stroke

Nominal stroke: A reference for your use.
Maximum stroke: The limit stroke that the nut can move. The value is obtained by subtracting the nut length from the effective threaded length (L₁).

●Lead accuracy

FA-PSS model: C5 grade; FA-USS model: C3 grade; FA-FSS model: Ct7 grade

- T: Travel compensation
- e_p: Tolerance on specified travel
- v_u: Travel variation

See "Technical Description: Lead Accuracy" (page B37) for the details of the codes.

●Permissible rotational speed

d · n: Limited by the relative peripheral speed between the screw shaft and the nut.

Critical speed: Limited by the natural frequency of the ball screw shaft. Critical speed depends on the support condition of the screw shaft.

The lower of the two criteria, the *d · n* and critical speed, will determine the overall permissible rotational speed of the ball screw. For details, see "Technical Description: Permissible Rotational Speed" (page B47).

4. Other

The seal of the ball screw and end deflector are made of synthetic resin. Consult NSK when using our ball screws under extreme environments, in special environments, or if using special lubricant or oil.

The NSK K1 cannot be mounted to the compact FA model.

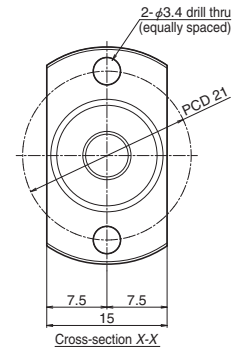
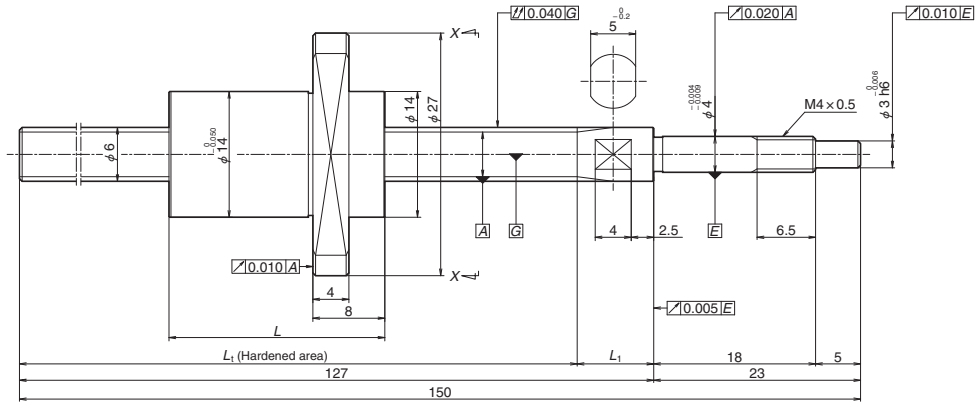
For special environments, see pages B70 and D2. For lubrication, see pages B67 and D13.

Note: For details on standard stock products, contact NSK.

Table 1 Combinations of screw shaft diameter and lead

Screw shaft diameter \ Lead	Lead											
	5	8	10	12	15	20	25	30	40	50	60	
6		B109		B109								
8			B111		B111							
10	B113 B133		B113									
12	B115 B135		B115 B139			B115		B115				
15	B117 B137		B117 B141			B119 B141		B119				
20	B121		B121 B143			B123 B143		B123	B125		B125	
25	B127		B127 B145			B129 B145	B129 B145	B131		B131		

Compact FA-PSS Model



NSK

Screw shaft $\phi 6$

Lead 8, 12

Unit: mm

Ball screw specifications

Ball diameter/screw shaft root diameter	1.2 / 4.9
Ball circle dia.	6.2
Accuracy grade/axial play	C5 / 0.005 or less
Factory-packed grease	NSK grease PS2

Recommended support unit

For drive side (Fixed)

WBK04-01M (square)

WBK04-11M (round)

Reference No.	Screw shaft diameter d	Lead l	Effective ball turns	Basic load ratings (N)		Maximum stroke	Nut length L	Screw shaft dimensions	
				Dynamic C_a	Static C_{0a}			L_1	L_1
PSS0608NAD0150	6	8	2	690	805	102.5	16	118.5	8.5
PSS0608NBD0150			4	1 480	1 940	94.5	24	118.5	8.5
PSS0612NAD0150		12	2	665	800	97.0	20	117	10
PSS0612NBD0150			4	1 430	1 970	85.0	32	117	10

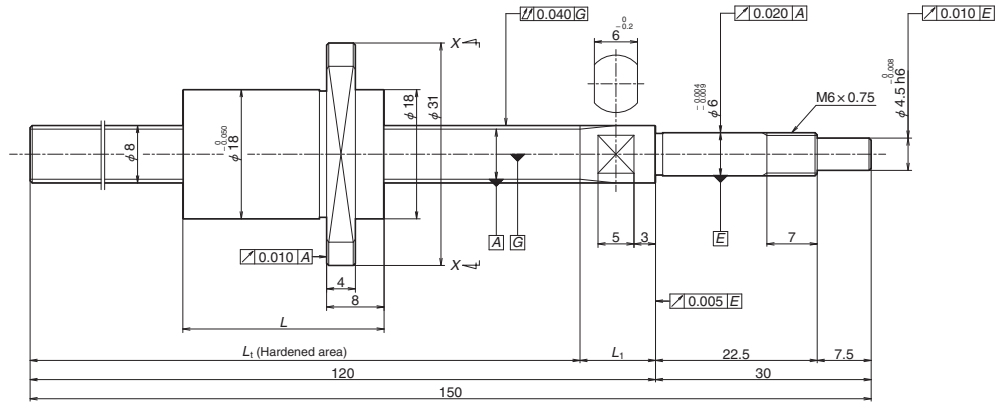
Notes: *1. Contact NSK if permissible rotational speed will be exceeded.

Lead accuracy			Dynamic preload torque (N-cm)	Mass (kg)	Permissible rotational speed (min^{-1}) *1	Nut internal space (cm^3)	Standard grease replenishment (cm^3)
Target value T	Error e_p	Variation v_u					
0	0.020	0.018	~0.5	0.06	5 000	0.2	0.1
				0.06		0.3	0.2
				0.06		0.2	0.1
				0.07		0.3	0.2

2. These ball screws are suitable for operating temperatures from 0 to 80 °C.

3. We recommend using NSK support units. Refer to Page B377 for details.

Compact FA-PSS Model

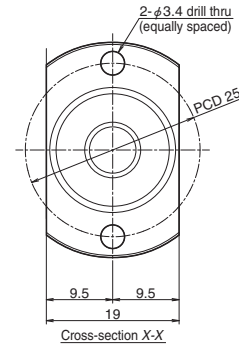


NSK

Screw shaft $\phi 8$

Lead 10, 15

Unit: mm



Ball screw specifications	
Ball diameter/screw shaft root diameter	1.588 / 6.6
Ball circle dia.	8.3
Accuracy grade/axial play	C5 / 0.005 or less
Factory-packed grease	NSK grease PS2

Recommended support unit

For drive side (Fixed)	
WBK06-01M (square)	
WBK06-11M (round)	

Reference No.	Screw shaft diameter d	Lead l	Effective ball turns	Basic load ratings (N)		Maximum stroke	Nut length L	Screw shaft dimensions	
				Dynamic C_d	Static C_{0a}			L_1	L_1
				PSS0810NAD0150	8			10	2
PSS0810NBD0150	8	10	4	2 470	3 430	81.5	28	109.5	10.5
PSS0815NAD0150	8	15	2	1 130	1 430	85.0	22	107	13
PSS0815NBD0150	8	15	4	2 410	3 520	70.0	37	107	13

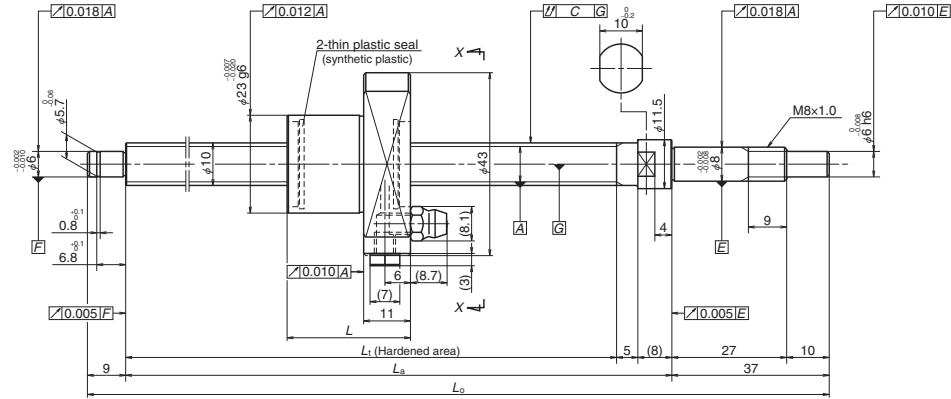
Notes: *1. Contact NSK if permissible rotational speed will be exceeded.

Lead accuracy			Dynamic preload torque (N·cm)	Mass (kg)	Permissible rotational speed (min ⁻¹) *1	Nut internal space (cm ³)	Standard grease replenishment (cm ³)
Target value T	Error e_p	Variation v_u					
0	0.020	0.018	~0.5	0.09	5 000	0.4	0.2
				0.11		0.5	0.3
				0.1		0.4	0.2
				0.12		0.6	0.3

- These ball screws are suitable for operating temperatures from 0 to 80 °C.
- We recommend using NSK support units. Refer to Page B377 for details.

Compact FA-PSS Model

(Medium, High helix lead)



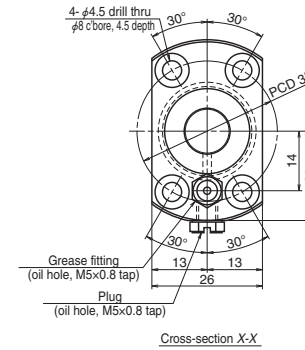
Nut: BSS

NSK

Screw shaft $\phi 10$

Lead 5, 10

Unit: mm



Ball screw specifications	
Preload	Oversize ball preload (P-preload)
Ball diameter/screw shaft root diameter	2.000 / 8.2
Ball circle dia.	10.3
Accuracy grade/axial play	C5 / 0
Factory-packed grease	NSK grease PS2

Recommended support unit	
For drive side (Fixed)	For non-drive side (Simple)
WBK08-01B (low-profile, square)	WBK08S-01B (low-profile, square)
WBK08-11 (round)	
WBK08-11B (round, high load)	

Reference No.	Screw shaft diameter d	Lead l	Basic load ratings (N)		Stroke		Nut length L	Screw shaft dimensions		
			Dynamic C_a	Static C_{0a}	Nominal	Max.		L_t	L_a	L_o
PSS1005N1D0171	10	5	3 420	4 840	50	78	29	112	125	171
PSS1005N1D0221					100	128		162	175	221
PSS1005N1D0321					200	228		262	275	321
PSS1005N1D0421					300	328		362	375	421
PSS1005N1D0521					400	428		462	475	521
PSS1010N1D0221		10	2 290	2 980	100	125	32	162	175	221
PSS1010N1D0321					200	225		262	275	321
PSS1010N1D0421					300	325		362	375	421
PSS1010N1D0521					400	425		462	475	521

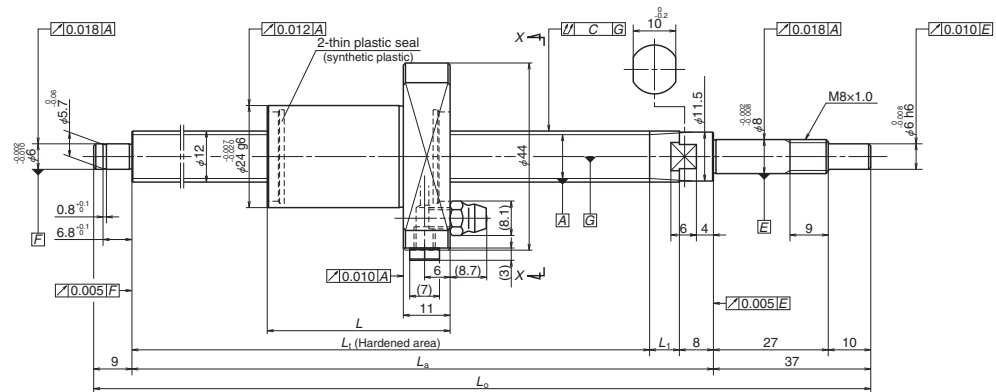
Notes: *1. Ball screw preload control values are shown. Approximately 2.0 N-cm of torque will be added due to thin plastic seals.
 *2. Contact NSK if permissible rotational speed will be exceeded.
 3. These ball screws are suitable for operating temperatures from 0 to 80 °C.

Lead accuracy			Shaft run-out C	Dynamic preload torque (N-cm) *1	Mass (kg)	Permissible rotational speed (min ⁻¹) *2	Nut internal space (cm ³)	Standard grease replenishment (cm ³)	
Target value T	Error e_p	Variation v_u							
0	0.020	0.018	0.030	0.7 - 3.3	0.3	5 000	0.8	0.4	
			0.045	0.7 - 3.3	0.3				
			0.060	0.6 - 4.3	0.3				
			0.070	0.6 - 4.3	0.4				
			0.085	0.4 - 4.9	0.5				
	0.023	0.020	0.020	0.045	0.7 - 3.3	0.3	5 000	0.7	0.4
				0.060	0.6 - 4.3	0.4			
				0.070	0.6 - 4.3	0.4			
				0.085	0.4 - 4.9	0.5			

4. We recommend using NSK support units. Refer to Page B377 for details.
 5. We recommend filling about 50% of the nut's internal space with grease. See Page D16 for details.

Compact FA-PSS Model

(Fine, Medium, High helix lead)



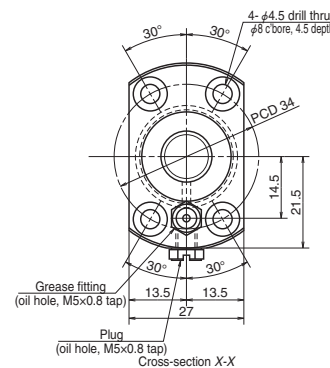
Nut: BSS

NSK

Screw shaft $\phi 12$

Lead 5, 10, 20, 30

Unit: mm



Ball screw specifications

Preload	Oversize ball preload (P-preload)
Ball diameter/screw shaft root diameter	2.000 / 10.2
Ball circle dia.	12.3
Accuracy grade/axial play	C5 / 0
Factory-packed grease	NSK grease PS2

Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK08-01B (low-profile, square)	WBK08S-01B (low-profile, square)
WBK08-11 (round)	
WBK08-11B (round, high load)	

Unit: mm

Reference No.	Screw shaft diameter <i>d</i>	Lead <i>l</i>	Basic load ratings (N)		Stroke		Nut length <i>L</i>	Screw shaft dimensions			
			Dynamic <i>C_a</i>	Static <i>C_{0a}</i>	Nominal	Max.		<i>L₁</i>	<i>L_a</i>	<i>L₀</i>	
PSS1205N1D0171	12	5	3 750	5 810	50	75	30	110	125	171	7
PSS1205N1D0221					100	125		160	175	221	
PSS1205N1D0321					200	225		260	275	321	
PSS1205N1D0421					300	325		360	375	421	
PSS1205N1D0521					400	425		460	475	521	
PSS1205N1D0621					500	525		560	575	621	
PSS1210N1D0221		10	3 760	5 780	100	112	43	160	175	221	7
PSS1210N1D0321					200	212		260	275	321	
PSS1210N1D0421					300	312		360	375	421	
PSS1210N1D0521					400	412		460	475	521	
PSS1210N1D0621					500	512		560	575	621	
PSS1220N1D0271					20	2 330		3 600	100	153	
PSS1220N1D0371		200	253	308			325		371		
PSS1220N1D0471		300	353	408			425		471		
PSS1220N1D0571		400	453	508			525		571		
PSS1220N1D0671	500	553	608	625	671						
PSS1230N1D0271	30	2 190	3 650	100	128	70	203	225	271	14	
PSS1230N1D0371				200	228		303	325	371		
PSS1230N1D0471				300	328		403	425	471		
PSS1230N1D0571				400	428		503	525	571		
PSS1230N1D0671				500	528		603	625	671		

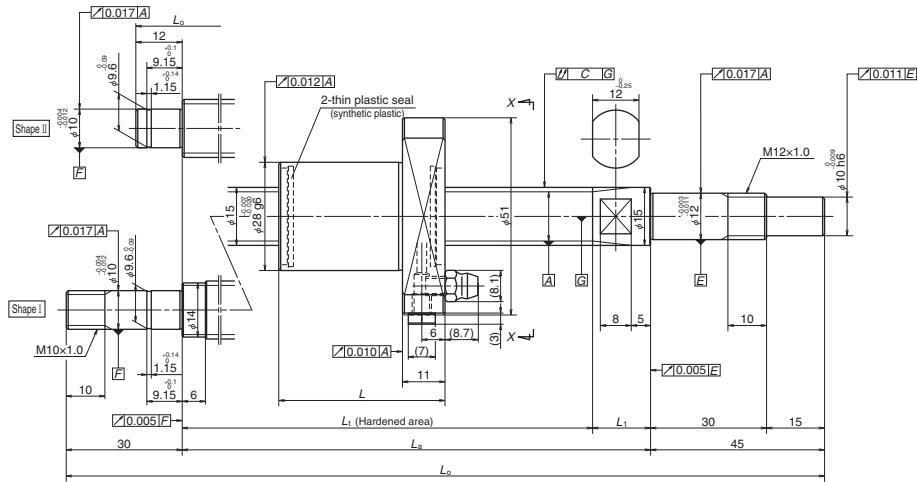
Notes: *1. Ball screw preload control values are shown. Approximately 2.0 N-cm of torque will be added due to thin plastic seals.
*2. Contact NSK if permissible rotational speed will be exceeded.
3. These ball screws are suitable for operating temperatures from 0 to 80 °C.

Target value <i>T</i>	Lead accuracy		Shaft run-out <i>C</i>	Dynamic preload torque (N-cm) *1	Mass (kg)	Permissible rotational speed (min ⁻¹) *2	Nut internal space (cm ³)	Standard grease replenishment (cm ³)
	Error <i>e_p</i>	Variation <i>v_u</i>						
0	0.020	0.018	0.030	0.7 - 3.3	0.3	5 000	1.0	0.5
		0.018	0.045	0.7 - 3.3	0.3			
		0.018	0.060	0.6 - 4.3	0.4			
		0.020	0.070	0.6 - 4.3	0.5			
		0.020	0.085	0.6 - 4.3	0.6			
		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
		0.018	0.060	0.6 - 4.3	0.5			
		0.020	0.070	0.6 - 4.3	0.5			
		0.020	0.085	0.6 - 4.3	0.6			
		0.020	0.085	0.4 - 4.9	0.7			
		0.023	0.085	1.4 - 4.5	0.4			
	0.020	0.018	0.045	1.4 - 4.5	0.4	5 000	1.2	0.6
		0.018	0.060	0.9 - 4.9	0.5			
		0.020	0.070	0.9 - 4.9	0.6			
0.020		0.085	0.6 - 5.9	0.7				
0.020		0.085	0.6 - 5.9	0.8				
0.023		0.085	1.4 - 4.5	0.5				
0.020	0.018	0.045	1.4 - 4.5	0.5	5 000	1.5	0.8	
	0.018	0.060	0.9 - 4.9	0.6				
	0.020	0.070	0.9 - 4.9	0.7				
	0.020	0.085	0.6 - 5.9	0.7				
	0.020	0.085	0.6 - 5.9	0.8				
	0.023	0.085	1.4 - 4.5	0.5				

4. We recommend using NSK support units. Refer to Page B377 for details.
5. We recommend filling about 50% of the nut's internal space with grease. See Page D16 for details.

Compact FA-PSS Model

(Fine, Medium lead)



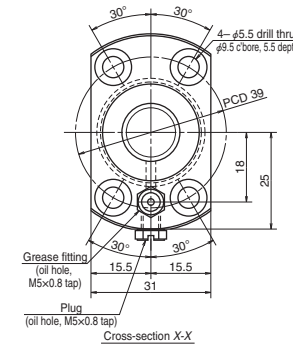
Nut: BSS

NSK

Screw shaft $\phi 15$

Lead 5, 10

Unit: mm



Ball screw specifications

Preload	Oversize ball preload (P-preload)
Ball diameter/screw shaft root diameter	2.778 / 12.6
Ball circle dia.	15.5
Accuracy grade/axial play	C5 / 0
Factory-packed grease	NSK grease LR3

Recommended support unit

For drive side (Fixed)	For non-drive side	
	(Fixed)	(Simple)
WBK12-01B (low-profile, square)	WBK10-01B (low-profile, square)	WBK12S-01B (low-profile, square)
WBK12-11 (round)	WBK10-11 (round)	

Unit: mm

Reference No.	Screw shaft diameter d	Lead l	Basic load ratings (N)		Stroke		Nut length L	Screw shaft dimensions						
			Dynamic C_a	Static C_{0a}	Nominal	Max.		L_1	L_2	L_3	L_4			
PSS1505N1D0211	15	5	6 410	10 100	50	103	30	139	154	211	15			
PSS1505N1D0261					100	153								
PSS1505N1D0361					200	253								
PSS1505N1D0461					300	353								
PSS1505N1D0561					400	453								
PSS1505N1D0661					500	553								
PSS1505N1D0761					600	653								
PSS1510N1D0261	15	10	6 530	10 200	100	140	43	189	204	261	15			
PSS1510N1D0361					200	240								
PSS1510N1D0461					300	340								
PSS1510N1D0561					400	440								
PSS1510N1D0661					500	540								
PSS1510N1D0761					600	640								
PSS1510N1D0879					700	740								
PSS1510N1D0979					800	840								
PSS1510N1D1179					1 000	1 040						1 089	1 104	1 179

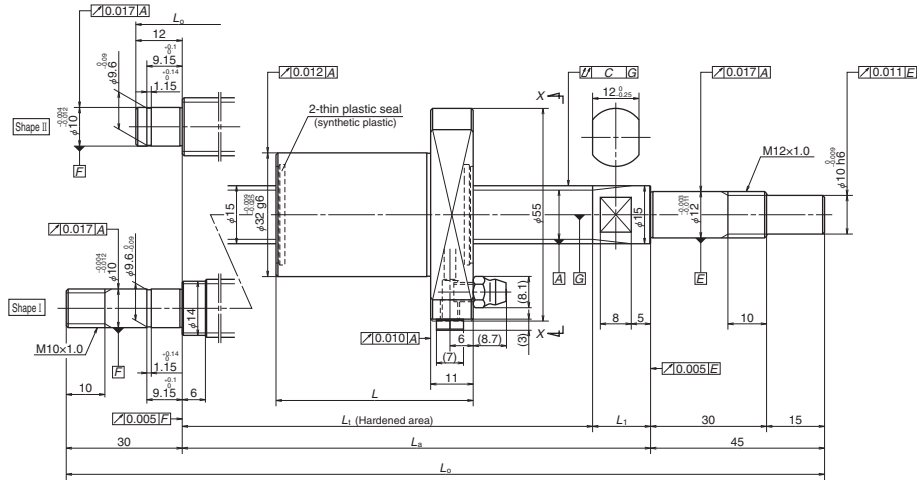
- Notes: *1. Ball screw preload control values are shown. Approximately 2.0 N-cm of torque will be added due to thin plastic seals.
 *2. Contact NSK if permissible rotational speed will be exceeded.
 3. These ball screws are suitable for operating temperatures from 0 to 80 °C.

Left shaft end shape (non-drive side)	Lead accuracy			Shaft run-out C	Dynamic preload torque (N-cm) *1	Mass (kg)	Permissible rotational speed (min) ⁻¹ *2		Nut internal space (cm ³)	Standard grease replenishment (cm ³)
	Target value T	Error e_p	Variation v_u				Fixed-Simple	Fixed-Fixed		
II	0	0.020	0.018	0.035	0.2 - 6.9	0.5	5 000	2.0	1.0	
		0.020	0.018	0.035	0.2 - 6.9	0.5	5 000			
		0.023	0.018	0.045	0.2 - 6.9	0.6	5 000			
		0.025	0.020	0.050	0.4 - 9.8	0.8	5 000			
		0.027	0.020	0.060	0.4 - 9.8	0.9	5 000			
		0.030	0.023	0.075	0.4 - 9.8	1.0	5 000			
		0.035	0.025	0.075	0.4 - 11.8	1.1	4 130			
II	0	0.020	0.018	0.035	0.6 - 7.4	0.6	5 000	2.0	1.0	
II		0.023	0.018	0.045	0.6 - 7.4	0.7	5 000			
II		0.025	0.020	0.050	0.4 - 9.8	0.8	5 000			
II		0.027	0.020	0.060	0.4 - 9.8	1.0	5 000			
II		0.030	0.023	0.075	0.4 - 9.8	1.1	5 000			
II		0.035	0.025	0.075	0.4 - 11.8	1.2	4 210			
I		0.035	0.025	0.095	0.4 - 11.8	1.4	3 190			4 410
I	0.040	0.027	0.095	0.4 - 11.8	1.5	2 500	3 470			
I	0.046	0.030	0.120	0.4 - 11.8	1.7	1 650	2 320			

4. We recommend using NSK support units. Refer to Page B377 for details.
 5. We recommend filling about 50% of the nut's internal space with grease. See Page D16 for details.

Compact FA-PSS Model

(Medium, High helix lead)



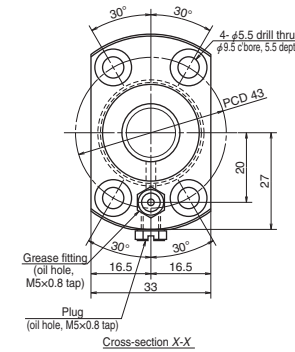
Nut: BSS



Screw shaft $\phi 15$

Lead 20, 30

Unit: mm



Ball screw specifications

Preload	Oversize ball preload (P-preload)
Ball diameter/screw shaft root diameter	3.175 / 12.2
Ball circle dia.	15.5
Accuracy grade/axial play	C5 / 0
Factory-packed grease	NSK grease LR3

Recommended support unit

For drive side (Fixed)	For non-drive side	
	(Fixed)	(Simple)
WBK12-01B (low-profile, square)	WBK10-01B (low-profile, square)	WBK12S-01B (low-profile, square)
WBK12-11 (round)	WBK10-11 (round)	

Unit: mm

Reference No.	Screw shaft diameter <i>d</i>	Lead <i>l</i>	Basic load ratings (N)		Stroke		Nut length <i>L</i>	Screw shaft dimensions								
			Dynamic <i>C_a</i>	Static <i>C_{0a}</i>	Nominal	Max.		<i>L₁</i>	<i>L₂</i>	<i>L₃</i>	<i>L₄</i>					
PSS1520N1D0261	15	20	5 660	8 700	100	129	51	186	204	261	18					
PSS1520N1D0361					200	229		286	304	361						
PSS1520N1D0461					300	329		386	404	461						
PSS1520N1D0561					400	429		486	504	561						
PSS1520N1D0661					500	529		586	604	661						
PSS1520N1D0761					600	629		686	704	761						
PSS1520N1D0879					700	729		786	804	879						
PSS1520N1D0979					800	829		886	904	979						
PSS1520N1D1179					1 000	1 029		1 086	1 104	1 179						
PSS1530N1D0311					30	5 500		8 580	100	153		71	230	254	311	24
PSS1530N1D0411									200	253			330	354	411	
PSS1530N1D0511									300	353			430	454	511	
PSS1530N1D0611									400	453			530	554	611	
PSS1530N1D0711									500	553			630	654	711	
PSS1530N1D0811									600	653			730	754	811	
PSS1530N1D0929	700	753	830	854			929									
PSS1530N1D1029	800	853	930	954			1 029									
PSS1530N1D1229	1 000	1 053	1 130	1 154			1 229									

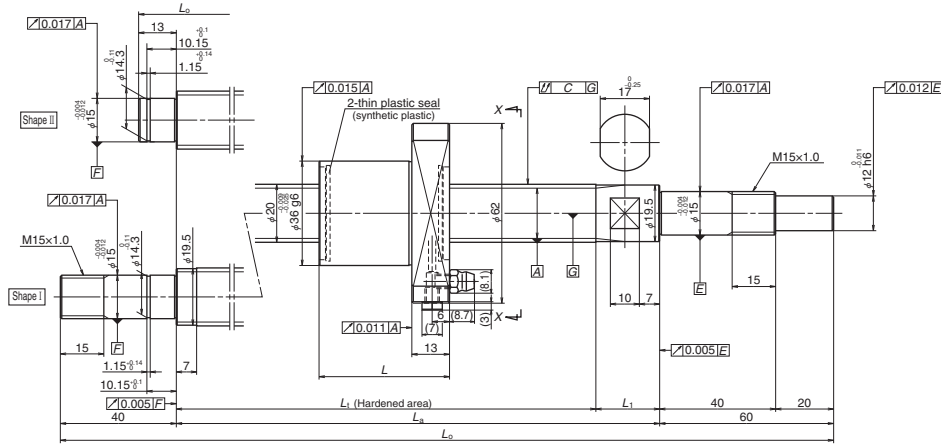
Notes: *1. Ball screw preload control values are shown. Approximately 2.0 N-cm of torque will be added due to thin plastic seals.
*2. Contact NSK if permissible rotational speed will be exceeded.
3. These ball screws are suitable for operating temperatures from 0 to 80 °C.

Left shaft end shape (non-drive side)	Lead accuracy			Shaft run-out <i>C</i>	Dynamic preload torque (N-cm) *1	Mass (kg)	Permissible rotational speed (min ⁻¹) *2		Nut internal space (cm ³)	Standard grease replenishment (cm ³)
	Target value <i>T</i>	Error <i>e_p</i>	Variation <i>v_u</i>				Fixed-Simple	Fixed-Fixed		
II	0	0.020	0.018	0.035	0.8 - 8.8	0.7	5 000	—	2.8	1.4
II		0.023	0.018	0.045	0.8 - 8.8	0.8	5 000	—		
II		0.025	0.020	0.050	0.8 - 10.8	0.9	5 000	—		
II		0.027	0.020	0.060	0.8 - 10.8	1.1	5 000	—		
II		0.030	0.023	0.075	0.8 - 10.8	1.2	5 000	—		
II		0.035	0.025	0.075	0.8 - 13.8	1.3	4 170	—		
I		0.035	0.025	0.095	0.8 - 13.8	1.5	3 150	4 310		
I		0.040	0.027	0.095	0.8 - 13.8	1.6	2 460	3 390		
I		0.046	0.030	0.120	0.8 - 13.8	1.9	1 620	2 260		
II		0.023	0.018	0.035	1.2 - 9.3	0.8	5 000	—	3.4	1.7
II		0.025	0.020	0.050	0.8 - 10.8	1.0	5 000	—		
II		0.027	0.020	0.060	0.8 - 10.8	1.1	5 000	—		
II		0.030	0.023	0.060	0.8 - 10.8	1.2	5 000	—		
II		0.030	0.023	0.075	0.8 - 13.8	1.4	5 000	—		
II		0.035	0.025	0.095	0.8 - 13.8	1.5	3 770	—		
I	0.040	0.027	0.095	0.8 - 13.8	1.6	2 880	3 910			
I	0.040	0.027	0.120	0.8 - 13.8	1.8	2 310	3 110			
I	0.046	0.030	0.120	0.8 - 13.8	2.0	1 540	2 100			

4. We recommend using NSK support units. Refer to Page B377 for details.
5. We recommend filling about 50% of the nut's internal space with grease. See Page D16 for details.

Compact FA-PSS Model

(Fine, Medium lead)



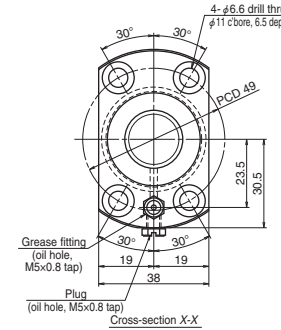
Nut: BSS

NSK

Screw shaft $\phi 20$

Lead 5, 10

Unit: mm



Ball screw specifications

Preload	Oversize ball preload (P-preload)
Ball diameter/screw shaft root diameter	3.175 / 17.2
Ball circle dia.	20.5
Accuracy grade/axial play	C5 / 0
Factory-packed grease	NSK grease LR3

Recommended support unit

For drive side (Fixed)	For non-drive side	
	(Fixed)	(Simple)
WBK15-01B (low-profile, square)	WBK15-01B (low-profile, square)	WBK15S-01B (low-profile, square)
WBK15-11 (round)	WBK15-11 (round)	

Unit: mm

Reference No.	Screw shaft diameter d	Lead l	Basic load ratings (N)		Stroke		Nut length L	Screw shaft dimensions								
			Dynamic C_d	Static C_{0s}	Nominal	Max.		L_1	L_2	L_3	L_4					
PSS2005N1D0323	20	5	10 400	18 500	150	191	31	228	250	323	22					
PSS2005N1D0373					200	241		278	300	373						
PSS2005N1D0473					300	341		378	400	473						
PSS2005N1D0573					400	441		478	500	573						
PSS2005N1D0673					500	541		578	600	673						
PSS2005N1D0773					600	641		678	700	773						
PSS2005N1D0873					700	741		778	800	873						
PSS2005N1D1000					800	839		878	900	1 000						
PSS2010N1D0387					10	10 200		18 600	200	241		45	292	314	387	22
PSS2010N1D0487									300	341			392	414	487	
PSS2010N1D0587	400	441	492	514			587									
PSS2010N1D0687	500	541	592	614			687									
PSS2010N1D0787	600	641	692	714			787									
PSS2010N1D0887	700	741	792	814			887									
PSS2010N1D1014	800	839	892	914			1 014									
PSS2010N1D1214	1 000	1 039	1 092	1 114			1 214									
PSS2010N1D1414	1 200	1 239	1 292	1 314			1 414									

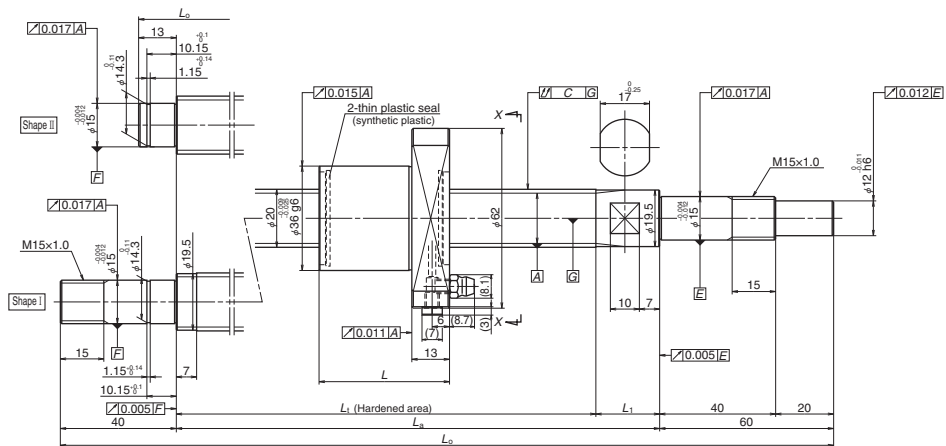
Notes: *1. Ball screw preload control values are shown. Approximately 2.0 N-cm of torque will be added due to thin plastic seals.
*2. Contact NSK if permissible rotational speed will be exceeded.
3. These ball screws are suitable for operating temperatures from 0 to 80 °C.

Left shaft end shape (non-drive side)	Lead accuracy			Shaft run-out C	Dynamic preload torque (N-cm) *1	Mass (kg)	Permissible rotational speed (min ⁻¹) *2		Nut internal space (cm ³)	Standard grease replenishment (cm ³)		
	Target value T	Error e_p	Variation v_u				Fixed-Simple	Fixed-Fixed				
II	0	0.023	0.018	0.045	0.6 - 7.4	1.0	5 000	—	3.4	1.7		
II		0.023	0.018	0.045	0.6 - 7.4	1.1	5 000	—				
II		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	5 000	—				
II		0.030	0.023	0.075	0.4 - 9.8	1.7	5 000	—				
II		0.035	0.025	0.075	0.4 - 9.8	1.9	5 000	—				
II		0.035	0.025	0.095	0.4 - 9.8	2.2	4 410	—				
I		0.040	0.027	0.095	0.4 - 11.8	2.4	3 450	4 710				
II		0.023	0.018	0.045	1.2 - 9.3	1.2	5 000	—			3.2	1.6
II		0.025	0.020	0.050	1.2 - 9.3	1.4	5 000	—				
II	0.027	0.020	0.060	0.8 - 10.8	1.7	5 000	—					
II	0.030	0.023	0.075	0.8 - 10.8	1.9	5 000	—					
II	0.035	0.025	0.075	0.8 - 10.8	2.1	5 000	—					
II	0.035	0.025	0.095	0.8 - 10.8	2.4	4 330	—					
I	0.040	0.027	0.120	0.8 - 13.8	2.6	3 400	4 640					
I	0.046	0.030	0.120	0.8 - 13.8	3.1	2 250	3 110					
I	0.054	0.035	0.160	0.8 - 13.8	3.6	1 600	2 220					

4. We recommend using NSK support units. Refer to Page B377 for details.
5. We recommend filling about 50% of the nut's internal space with grease. See Page D16 for details.

Compact FA-PSS Model

(High helix lead)



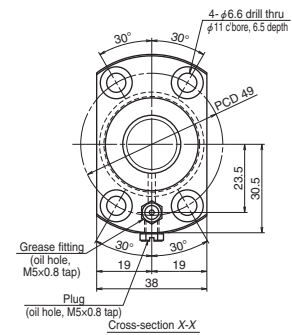
Nut: BSS



Screw shaft $\phi 20$

Lead 20, 30

Unit: mm



Ball screw specifications	
Preload	Oversize ball preload (P-preload)
Ball diameter/screw shaft root diameter	3.175 / 17.2
Ball circle dia.	20.5
Accuracy grade/axial play	C5 / 0
Factory-packed grease	NSK grease LR3

Recommended support unit		
For drive side (Fixed)	For non-drive side (Fixed) (Simple)	
WBK15-01B (low-profile, square)	WBK15-01B (low-profile, square)	WBK15S-01B (low-profile, square)
WBK15-11 (round)	WBK15-11 (round)	

Reference No.	Screw shaft diameter d	Lead l	Basic load ratings (N)		Stroke		Nut length L	Screw shaft dimensions			
			Dynamic C_a	Static C_{0a}	Nominal	Max.		L_1	L_a	L_b	L_c
PSS2020N1D0508	20	20	6 790	11 800	300	353	54	413	435	508	22
PSS2020N1D0608					400	453		513	535	608	
PSS2020N1D0708					500	553		613	635	708	
PSS2020N1D0808					600	653		713	735	808	
PSS2020N1D0908					700	753		813	835	908	
PSS2020N1D1035					800	851		913	935	1 035	
PSS2020N1D1235					1 000	1 051		1 113	1 135	1 235	
PSS2020N1D1435					1 200	1 251		1 313	1 335	1 435	
PSS2020N1D1835		1 600	1 651	1 713	1 735	1 835					
PSS2030N1D0408		30	6 550	11 800	200	228	74	308	335	408	27
PSS2030N1D0508					300	328		408	435	508	
PSS2030N1D0608					400	428		508	535	608	
PSS2030N1D0708					500	528		608	635	708	
PSS2030N1D0808					600	628		708	735	808	
PSS2030N1D0908					700	728		808	835	908	
PSS2030N1D1035					800	826		908	935	1 035	
PSS2030N1D1235	1 000				1 026	1 108		1 135	1 235		
PSS2030N1D1435	1 200	1 226	1 308	1 335	1 435						

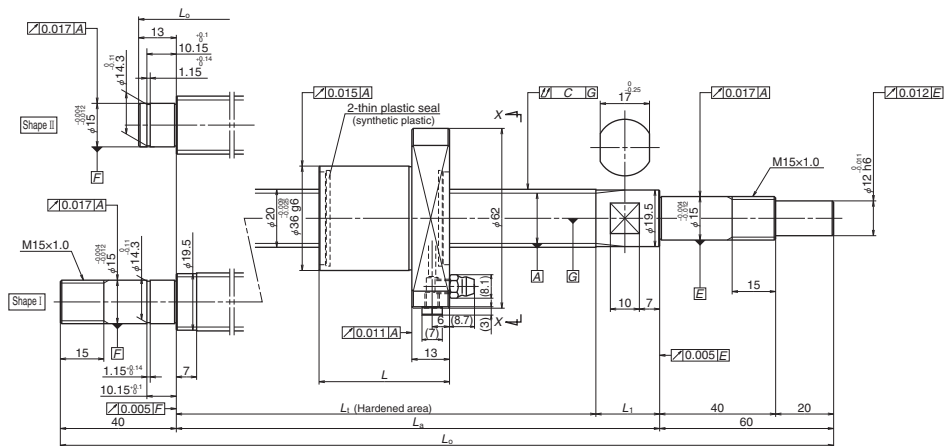
Notes: *1. Ball screw preload control values are shown. Approximately 2.0 N-cm of torque will be added due to thin plastic seals.
 *2. Contact NSK if permissible rotational speed will be exceeded.
 3. These ball screws are suitable for operating temperatures from 0 to 80 °C.

Left shaft end shape (non-drive side)	Lead accuracy			Shaft run-out C	Dynamic preload torque (N-cm) *1	Mass (kg)	Permissible rotational speed (min ⁻¹) *2		Nut internal space (cm ³)	Standard grease replenishment (cm ³)
	Target value T	Error e_p	Variation v_u				Fixed-Simple	Fixed-Fixed		
II	0	0.027	0.020	0.060	1.4 - 11.8	1.6	5 000	—	3.2	1.6
II		0.030	0.023	0.060	1.4 - 11.8	1.8	5 000	—		
II		0.030	0.023	0.075	1.4 - 11.8	2.0	5 000	—		
II		0.035	0.025	0.095	1.4 - 11.8	2.3	5 000	—		
II		0.040	0.027	0.095	0.8 - 13.8	2.5	4 150	—		
I		0.040	0.027	0.120	0.8 - 13.8	2.8	3 270	4 470		
I		0.046	0.030	0.120	0.8 - 13.8	3.3	2 180	3 010		
I		0.054	0.035	0.160	0.8 - 13.8	3.8	1 550	2 170		
I		0.065	0.040	0.200	0.8 - 13.8	4.7	900	1 270		
II		0.023	0.018	0.050	1.6 - 9.8	1.4	5 000	—	4.6	2.3
II		0.027	0.020	0.060	1.4 - 11.8	1.7	5 000	—		
II		0.030	0.023	0.060	1.4 - 11.8	1.9	5 000	—		
II		0.030	0.023	0.075	1.4 - 11.8	2.1	5 000	—		
II		0.035	0.025	0.095	1.4 - 11.8	2.4	5 000	—		
II		0.040	0.027	0.095	0.8 - 13.8	2.6	4 310	—		
I		0.040	0.027	0.120	0.8 - 13.8	2.9	3 380	4 570		
I	0.046	0.030	0.120	0.8 - 13.8	3.4	2 240	3 070			
I	0.054	0.035	0.160	0.8 - 13.8	3.9	1 590	2 200			

4. We recommend using NSK support units. Refer to Page B377 for details.
 5. We recommend filling about 50% of the nut's internal space with grease. See Page D16 for details.

Compact FA-PSS Model

(Ultra high helix lead)



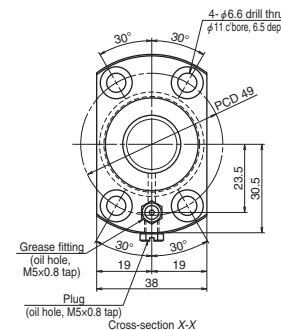
Nut: BSS

NSK

Screw shaft $\phi 20$

Lead 40, 60

Unit: mm



Ball screw specifications

Preload	Oversize ball preload (P-preload)
Ball diameter/screw shaft root diameter	3.175 / 17.2
Ball circle dia.	20.5
Accuracy grade/axial play	C5 / 0
Factory-packed grease	NSK grease LR3

Recommended support unit

For drive side (Fixed)	For non-drive side	
	(Fixed)	(Simple)
WBK15-01B (low-profile, square)	WBK15-01B (low-profile, square)	WBK15S-01B (low-profile, square)
WBK15-11 (round)	WBK15-11 (round)	

Unit: mm

Reference No.	Screw shaft diameter d	Lead l	Basic load ratings (N)		Stroke		Nut length L	Screw shaft dimensions								
			Dynamic C_d	Static C_{0s}	Nominal	Max.		L_1	L_2	L_3	L_4					
PSS2040N1D0658	20	40	6 380	11 600	400	455	92	553	585	658	32					
PSS2040N1D0758					500	555		653	685	758						
PSS2040N1D0858					600	655		753	785	858						
PSS2040N1D0958					700	755		853	885	958						
PSS2040N1D1085					800	853		953	985	1 085						
PSS2040N1D1285					1 000	1 053		1 153	1 185	1 285						
PSS2040N1D1485					1 200	1 253		1 353	1 385	1 485						
PSS2040N1D1885					1 600	1 653		1 753	1 785	1 885						
PSS2040N1D2285					2 000	2 053		2 153	2 185	2 285						
PSS2060N1D0708					60	5 680		11 800	400	458		129	593	635	708	42
PSS2060N1D0808									500	558			693	735	808	
PSS2060N1D0908									600	658			793	835	908	
PSS2060N1D1008									700	758			893	935	1 008	
PSS2060N1D1135									800	856			993	1 035	1 135	
PSS2060N1D1335	1 000	1 056	1 193	1 235			1 335									
PSS2060N1D1535	1 200	1 256	1 393	1 435			1 535									
PSS2060N1D1935	1 600	1 656	1 793	1 835			1 935									
PSS2060N1D2335	2 000	2 056	2 193	2 235			2 335									

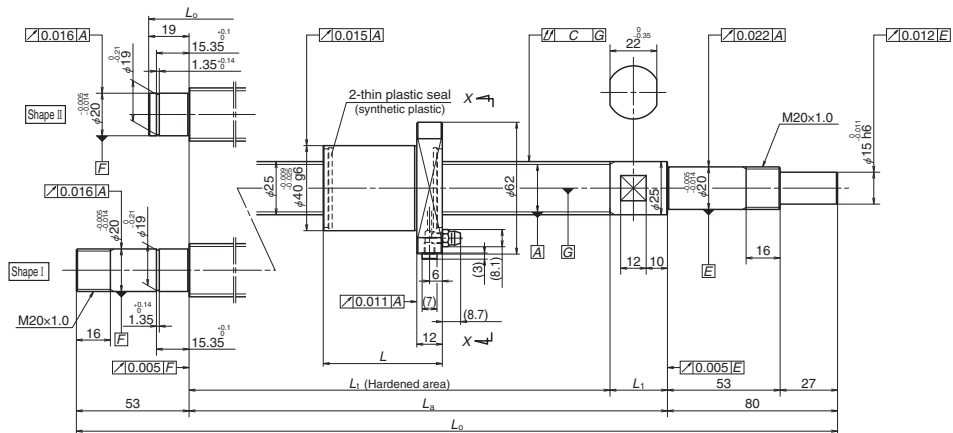
Notes: *1. Ball screw preload control values are shown. Approximately 2.0 N-cm of torque will be added due to thin plastic seals.
*2. Contact NSK if permissible rotational speed will be exceeded.
3. These ball screws are suitable for operating temperatures from 0 to 80 °C.

Left shaft end shape (non-drive side)	Lead accuracy			Shaft run-out C	Dynamic preload torque (N-cm) *1	Mass (kg)	Permissible rotational speed (min ⁻¹) *2		Nut internal space (cm ³)	Standard grease replenishment (cm ³)
	Target value T	Error e_p	Variation v_u				Fixed-Simple	Fixed-Fixed		
II	0	0.030	0.023	0.075	2.2 - 12.8	2.1	5 000	—	5.3	2.7
		0.035	0.025	0.075	2.2 - 12.8	2.4	5 000	—		
		0.035	0.025	0.095	2.2 - 12.8	2.6	5 000	—		
		0.040	0.027	0.095	1.8 - 14.8	2.8	3 940	—		
		0.040	0.027	0.120	1.8 - 14.8	3.1	3 120	4 190		
		0.046	0.030	0.160	1.8 - 14.8	3.6	2 100	2 850		
		0.054	0.035	0.160	1.8 - 14.8	4.1	1 500	2 070		
		0.065	0.040	0.200	1.8 - 14.8	5.1	880	1 230		
		0.077	0.046	0.240	1.8 - 14.8	6.0	580	810		
		0.030	0.023	0.075	2.7 - 13.8	2.4	5 000	—		
		0.035	0.025	0.095	2.7 - 13.8	2.6	5 000	—		
		0.035	0.025	0.095	2.7 - 13.8	2.9	4 830	—		
		0.040	0.027	0.120	1.8 - 14.8	3.1	3 740	—		
		0.040	0.027	0.120	1.8 - 14.8	3.4	2 980	3 920		
0.046	0.030	0.160	1.8 - 14.8	3.9	2 020	2 700				
0.054	0.035	0.160	1.8 - 14.8	4.4	1 460	1 970				
0.065	0.040	0.200	1.8 - 14.8	5.4	860	1 180				
0.077	0.046	0.240	1.8 - 14.8	6.3	570	790				

4. We recommend using NSK support units. Refer to Page B377 for details.
5. We recommend filling about 50% of the nut's internal space with grease. See Page D16 for details.

Compact FA-PSS Model

(Fine lead)



Nut: BSS

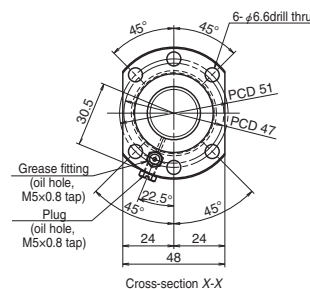
NSK

Screw shaft $\phi 25$

Lead 5, 10

Unit: mm

Ball screw specifications	
Preload	Oversize ball preload (P-preload)
Ball diameter/screw shaft root diameter	3.175 / 22.2
Ball circle dia.	25.5
Accuracy grade/axial play	C5 / 0
Factory-packed grease	NSK grease LR3



Recommended support unit

For drive side (Fixed)	For non-drive side	
	(Fixed)	(Simple)
WBK20-01 (square)	WBK20-01 (square)	WBK20S-01 (square)
WBK20-11 (round)	WBK20-11 (round)	

Reference No.	Screw shaft diameter d	Lead l	Basic load ratings (N)		Stroke		Nut length L	Screw shaft dimensions			
			Dynamic C_a	Static C_{0a}	Nominal	Max.		L_1	L_a	L_b	L_c
PSS2505N1D0349	25	5	11 500	23 500	150	185	32	223	250	349	27
PSS2505N1D0399					200	235		273	300	399	
PSS2505N1D0499					300	335		373	400	499	
PSS2505N1D0599					400	435		473	500	599	
PSS2505N1D0699					500	535		573	600	699	
PSS2505N1D0899					700	735		773	800	899	
PSS2505N1D0999					800	835		873	900	999	
PSS2505N1D1233		1 000	1 027	1 073	1 100	1 233					
PSS2510N1D0549		10	15 000	32 400	300	361	56	423	450	549	27
PSS2510N1D0649					400	461		523	550	649	
PSS2510N1D0749					500	561		623	650	749	
PSS2510N1D0849					600	661		723	750	849	
PSS2510N1D0949					700	761		823	850	949	
PSS2510N1D1049					800	861		923	950	1 049	
PSS2510N1D1283	1 000				1 053	1 123		1 150	1 283		
PSS2510N1D1883	1 600	1 653	1 723	1 750	1 883						

Notes: *1. Ball screw preload control values are shown. Approximately 2.0 N-cm of torque will be added due to thin plastic seals.
*2. Contact NSK if permissible rotational speed will be exceeded.
3. These ball screws are suitable for operating temperatures from 0 to 80 °C.

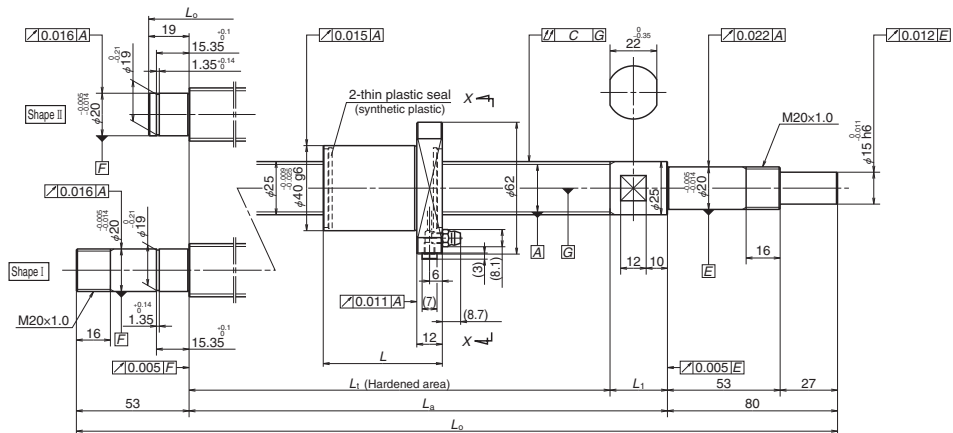
Unit: mm

Left shaft end shape (non-drive side)	Lead accuracy			Shaft run-out C	Dynamic preload torque (N-cm) *1	Mass (kg)	Permissible rotational speed (min ⁻¹) *2		Nut internal space (cm ³)	Standard grease replenishment (cm ³)
	Target value T	Error e_p	Variation v_u				Fixed-Simple	Fixed-Fixed		
II	0	0.023	0.018	0.035	1.2 - 9.3	1.5	5 000	—	4.4	2.2
II		0.023	0.018	0.035	1.2 - 9.3	1.6	5 000	—		
II		0.025	0.020	0.040	1.2 - 9.3	2.0	5 000	—		
II		0.027	0.020	0.045	1.2 - 9.3	2.3	5 000	—		
II		0.030	0.023	0.055	0.8 - 10.8	2.7	5 000	—		
II		0.035	0.025	0.065	0.8 - 10.8	3.4	5 000	—		
II		0.040	0.027	0.065	0.8 - 10.8	3.7	4 490	—		
I		0.046	0.030	0.080	0.8 - 13.8	4.5	2 960	4 060	4.7	2.4
II		0.027	0.020	0.045	3.1 - 11.8	2.4	5 000	—		
II		0.030	0.023	0.055	2.2 - 12.8	2.7	5 000	—		
II		0.030	0.023	0.055	2.2 - 12.8	3.1	5 000	—		
II		0.035	0.025	0.065	2.2 - 12.8	3.5	5 000	—		
II		0.040	0.027	0.065	2.2 - 12.8	3.8	5 000	—		
I		0.046	0.030	0.100	1.8 - 14.8	5.0	2 760	3 790		
I	0.065	0.040	0.130	1.8 - 14.8	7.2	1 150	1 620			

4. We recommend using NSK support units. Refer to Page B377 for details.
5. We recommend filling about 50% of the nut's internal space with grease. See Page D16 for details.

Compact FA-PSS Model

(Medium, High helix lead)



Nut: BSS

NSK

Screw shaft $\phi 25$

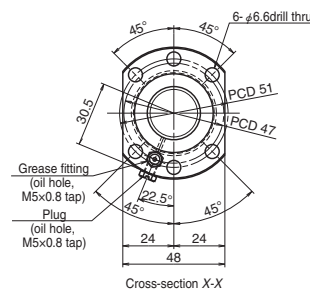
Lead 20, 25

Unit: mm

Ball screw specifications	
Preload	Oversize ball preload (P-preload)
Ball diameter/screw shaft root diameter	3.175 / 22.2
Ball circle dia.	25.5
Accuracy grade/axial play	C5 / 0
Factory-packed grease	NSK grease LR3

Recommended support unit

For drive side (Fixed)	For non-drive side	
	(Fixed)	(Simple)
WBK20-01 (square)	WBK20-01 (square)	WBK20S-01 (square)
WBK20-11 (round)	WBK20-11 (round)	



Reference No.	Screw shaft diameter d	Lead l	Basic load ratings (N)		Stroke		Nut length L	Screw shaft dimensions			
			Dynamic C_a	Static C_{0a}	Nominal	Max.		L_1	L_a	L_b	L_1
PSS2520N1D0729	25	20	7 650	14 800	500	544	54	604	630	729	26
PSS2520N1D0829					600	644		704	730	829	
PSS2520N1D0929					700	744		804	830	929	
PSS2520N1D1029					800	844		904	930	1 029	
PSS2520N1D1263					1 000	1 036		1 104	1 130	1 263	
PSS2520N1D1463					1 200	1 236		1 304	1 330	1 463	
PSS2520N1D1863					1 600	1 636		1 704	1 730	1 863	
PSS2520N1D2263		2 000	2 036	2 104	2 130	2 263					
PSS2525N1D0779		25	7 490	14 600	500	581	63	650	680	779	30
PSS2525N1D0879					600	681		750	780	879	
PSS2525N1D0979					700	781		850	880	979	
PSS2525N1D1079					800	881		950	980	1 079	
PSS2525N1D1313					1 000	1 073		1 150	1 180	1 313	
PSS2525N1D1513					1 200	1 273		1 350	1 380	1 513	
PSS2525N1D1913	1 600				1 673	1 750		1 780	1 913		
PSS2525N1D2313	2 000	2 073	2 150	2 180	2 313						

Notes: *1. Ball screw preload control values are shown. Approximately 2.0 N-cm of torque will be added due to thin plastic seals.
*2. Contact NSK if permissible rotational speed will be exceeded.
3. These ball screws are suitable for operating temperatures from 0 to 80 °C.

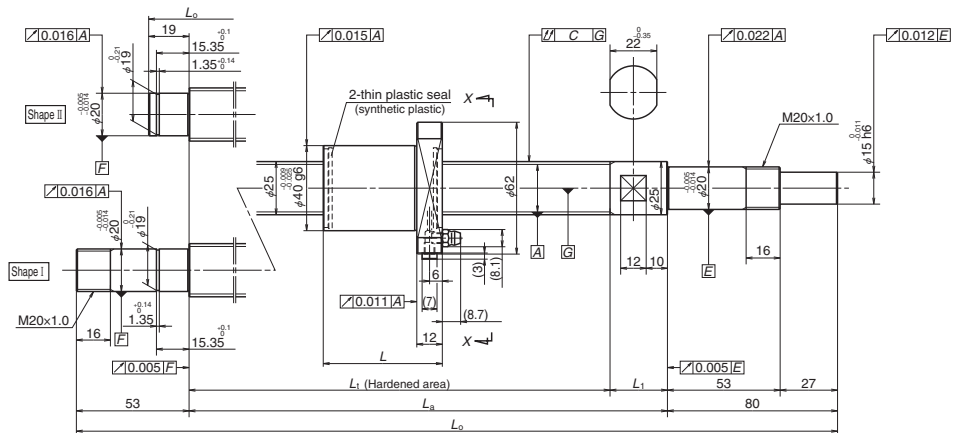
Unit: mm

Left shaft end shape (non-drive side)	Lead accuracy			Shaft run-out C	Dynamic preload torque (N-cm) *1	Mass (kg)	Permissible rotational speed (min) ⁻¹ *2		Nut internal space (cm ³)	Standard grease replenishment (cm ³)
	Target value T	Error e_p	Variation v_u				Fixed-Simple	Fixed-Fixed		
II	0	0.030	0.023	0.055	2.2 - 12.8	3.1	5 000	—	3.9	2.0
II		0.035	0.025	0.065	2.2 - 12.8	3.4	5 000	—		
II		0.040	0.027	0.065	2.2 - 12.8	3.8	5 000	—		
II		0.040	0.027	0.080	2.2 - 12.8	4.2	4 280	—		
I		0.046	0.030	0.100	1.8 - 14.8	5.0	2 850	3 920		
I		0.054	0.035	0.100	1.8 - 14.8	5.8	2 030	2 820		
I		0.065	0.040	0.130	1.8 - 14.8	7.3	1 180	1 650		
I		0.077	0.046	0.170	1.8 - 14.8	8.8	770	1 080		
II		0.035	0.025	0.055	2.7 - 13.8	3.3	5 000	—	4.3	2.2
II		0.035	0.025	0.065	2.7 - 13.8	3.7	5 000	—		
II		0.040	0.027	0.065	2.7 - 13.8	4.1	4 910	—		
II		0.040	0.027	0.080	2.7 - 13.8	4.4	3 910	—		
I		0.046	0.030	0.100	1.8 - 14.8	5.3	2 640	3 620		
I		0.054	0.035	0.100	1.8 - 14.8	6.0	1 900	2 630		
I	0.065	0.040	0.130	1.8 - 14.8	7.5	1 120	1 570			
I	0.077	0.046	0.170	1.8 - 14.8	9.1	740	1 040			

4. We recommend using NSK support units. Refer to Page B377 for details.
5. We recommend filling about 50% of the nut's internal space with grease. See Page D16 for details.

Compact FA-PSS Model

(High helix, Ultra high helix lead)



Nut: BSS

NSK

Screw shaft $\phi 25$

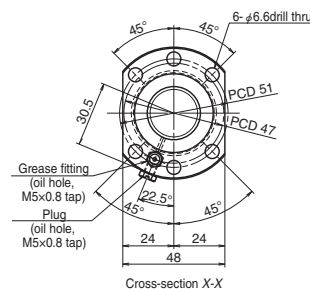
Lead 30, 50

Unit: mm

Ball screw specifications	
Preload	Oversize ball preload (P-preload)
Ball diameter/screw shaft root diameter	3.175 / 22.2
Ball circle dia.	25.5
Accuracy grade/axial play	C5 / 0
Factory-packed grease	NSK grease LR3

Recommended support unit

For drive side (Fixed)	For non-drive side	
	(Fixed)	(Simple)
WBK20-01 (square)	WBK20-01 (square)	WBK20S-01 (square)
WBK20-11 (round)	WBK20-11 (round)	



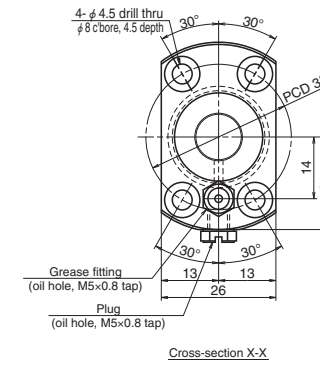
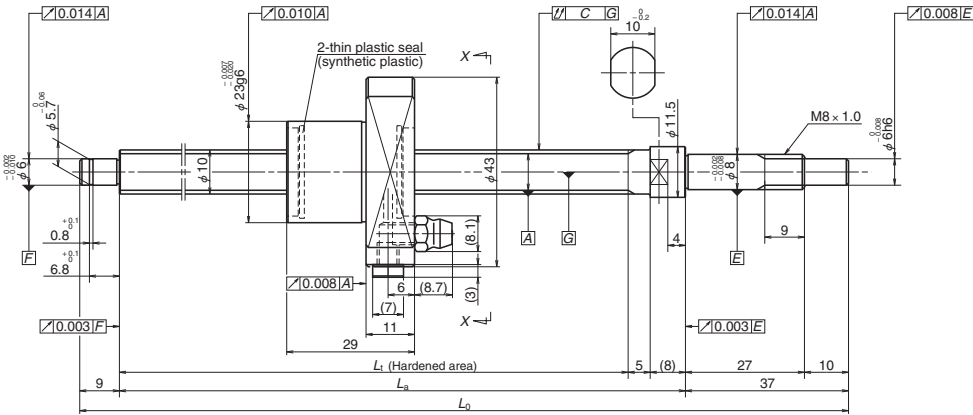
Reference No.	Screw shaft diameter d	Lead l	Basic load ratings (N)		Stroke		Nut length L	Screw shaft dimensions			
			Dynamic C_a	Static C_{0a}	Nominal	Max.		L_1	L_a	L_b	L_c
PSS2530N1D0779	25	30	7 490	14 600	500	570	74	650	680	779	30
PSS2530N1D0879					600	670		750	780	879	
PSS2530N1D0979					700	770		850	880	979	
PSS2530N1D1079					800	870		950	980	1 079	
PSS2530N1D1313					1 000	1 062		1 150	1 180	1 313	
PSS2530N1D1513					1 200	1 262		1 350	1 380	1 513	
PSS2530N1D1913					1 600	1 662		1 750	1 780	1 913	
PSS2530N1D2313		2 000	2 062	2 150	2 180	2 313					
PSS2550N1D0829		50	6 910	14 700	500	570	114	690	730	829	40
PSS2550N1D0929					600	670		790	830	929	
PSS2550N1D1029					700	770		890	930	1 029	
PSS2550N1D1129					800	870		990	1 030	1 129	
PSS2550N1D1363					1 000	1 062		1 190	1 230	1 363	
PSS2550N1D1563					1 200	1 262		1 390	1 430	1 563	
PSS2550N1D1963	1 600				1 662	1 790		1 830	1 963		
PSS2550N1D2363	2 000	2 062	2 190	2 230	2 363						

Notes: *1. Ball screw preload control values are shown. Approximately 2.0 N-cm of torque will be added due to thin plastic seals.
*2. Contact NSK if permissible rotational speed will be exceeded.
3. These ball screws are suitable for operating temperatures from 0 to 80 °C.

Unit: mm

Left shaft end shape (non-drive side)	Lead accuracy			Shaft run-out C	Dynamic preload torque (N-cm) *1	Mass (kg)	Permissible rotational speed (min ⁻¹) *2		Nut internal space (cm ³)	Standard grease replenishment (cm ³)
	Target value T	Error e_p	Variation v_u				Fixed-Simple	Fixed-Fixed		
II	0	0.035	0.025	0.055	2.7 - 13.8	3.4	5 000	—	5.5	2.8
II		0.035	0.025	0.065	2.7 - 13.8	3.7	5 000	—		
II		0.040	0.027	0.065	2.7 - 13.8	4.1	4 980	—		
II		0.040	0.027	0.080	2.7 - 13.8	4.5	3 960	—		
I		0.046	0.030	0.100	1.8 - 14.8	5.3	2 670	3 650		
I		0.054	0.035	0.100	1.8 - 14.8	6.1	1 920	2 650		
I		0.065	0.040	0.130	1.8 - 14.8	7.6	1 130	1 580		
I		0.077	0.046	0.170	1.8 - 14.8	9.1	740	1 040		
II		0.035	0.025	0.065	5.4 - 17.6	3.8	5 000	—	7.7	3.9
II		0.035	0.025	0.065	5.4 - 17.6	4.1	5 000	—		
II		0.040	0.027	0.080	5.4 - 17.6	4.5	4 750	—		
II		0.040	0.027	0.080	5.4 - 17.6	4.9	3 790	—		
I		0.046	0.030	0.100	4.1 - 19.6	5.8	2 570	3 470		
I		0.054	0.035	0.100	4.1 - 19.6	6.5	1 860	2 540		
I	0.065	0.040	0.130	4.1 - 19.6	8.0	1 100	1 520			
I	0.077	0.046	0.170	4.1 - 19.6	9.6	730	1 020			

4. We recommend using NSK support units. Refer to Page B377 for details.
5. We recommend filling about 50% of the nut's internal space with grease. See Page D16 for details.



Ball screw specifications

Preload	Oversize ball preload (P-preload)
Ball diameter/screw shaft root diameter	2.000 / 8.2
Ball circle dia.	10.3
Accuracy grade/axial play	C3 / 0
Factory-packed grease	NSK grease LG2

Recommended support unit

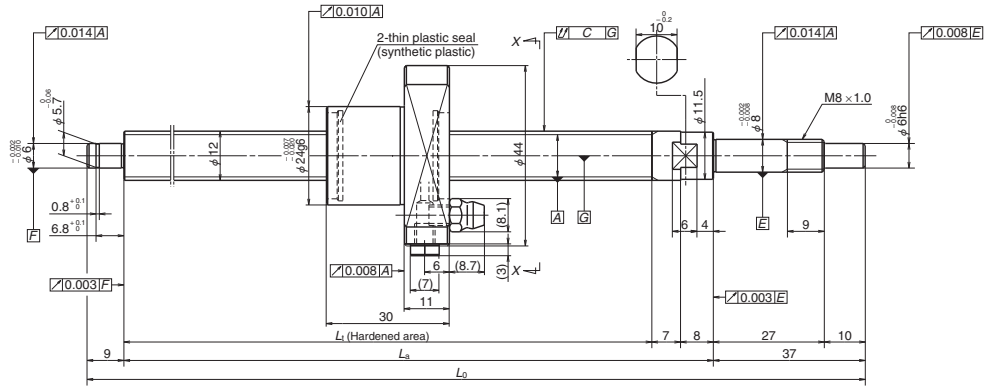
For drive side (Fixed)	For non-drive side (Simple)
WBK08-01C (square, clean)	WBK08S-01C (square, clean)
WBK08-11C (round, clean)	WBK08S-01B (low-profile, square)
WBK08-01B (low-profile, square)	
WBK08-11 (round)	

Reference No.	Screw shaft diameter <i>d</i>	Lead <i>l</i>	Basic load ratings (N)		Stroke		Screw shaft dimensions		
			Dynamic <i>C_d</i>	Static <i>C_{0a}</i>	Nominal	Max.	<i>L₁</i>	<i>L_a</i>	<i>L₀</i>
USS1005N1D0221	10	5	3 420	4 840	100	133	162	175	221
USS1005N1D0321					200	233	262	275	321
USS1005N1D0521					400	433	462	475	521

Notes: *1. Ball screw preload control values are shown. Approximately 0.5 N-cm of torque will be added due to thin plastic seals.
 *2. Contact NSK if permissible rotational speed will be exceeded.
 3. These ball screws are suitable for operating temperatures from 0 to 80 °C.

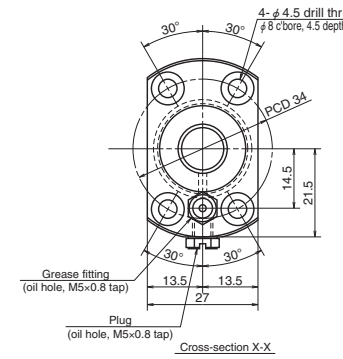
Target value <i>T</i>	Lead accuracy		Shaft run-out <i>C</i>	Dynamic preload torque (N-cm) *1	Mass (kg)	Permissible rotational speed (min ⁻¹) *2	Nut internal space (cm ³)	Standard grease replenishment (cm ³)
	Error <i>e_p</i>	Variation <i>V₀</i>						
0	0.010	0.008	0.035	0.2-1.8	0.3	5 000	0.8	0.4
	0.012	0.008	0.045	0.2-2.0	0.3			
	0.015	0.010	0.070	0.2-3.0	0.5			

4. We recommend using NSK support units. Refer to Page B377 for details.



Reference No.	Screw shaft diameter <i>d</i>	Lead <i>l</i>	Basic load ratings (N)		Stroke		Screw shaft dimensions		
			Dynamic <i>C_d</i>	Static <i>C_{0a}</i>	Nominal	Max.	<i>L₁</i>	<i>L_a</i>	<i>L₀</i>
USS1205N1D0221	12	5	3 750	5 810	100	130	160	175	221
USS1205N1D0321					200	230	260	275	321
USS1205N1D0621					500	530	560	575	621

Notes: *1. Ball screw preload control values are shown. Approximately 0.5 N-cm of torque will be added due to thin plastic seals.
 *2. Contact NSK if permissible rotational speed will be exceeded.
 3. These ball screws are suitable for operating temperatures from 0 to 80 °C.



Ball screw specifications	
Preload	Oversize ball preload (P-preload)
Ball diameter/screw shaft root diameter	2.000 / 10.2
Ball circle dia.	12.3
Accuracy grade/axial play	C3 / 0
Factory-packed grease	NSK grease LG2

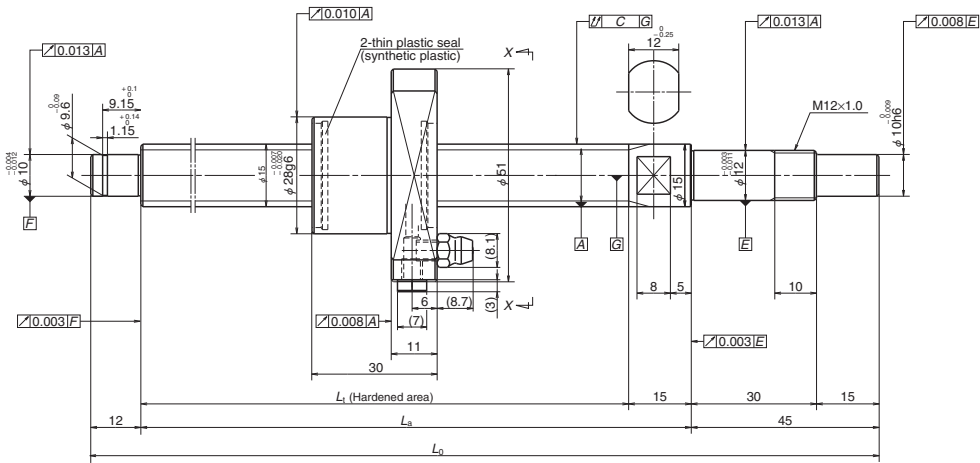
Recommended support unit	
For drive side (Fixed)	For non-drive side (Simple)
WBK08-01C (square, clean)	WBK08S-01C (square, clean)
WBK08-11C (round, clean)	WBK08S-01B (low-profile, square)
WBK08-01B (low-profile, square)	
WBK08-11 (round)	

Target value <i>T</i>	Lead accuracy		Shaft run-out <i>C</i>	Dynamic preload torque (N-cm) *1	Mass (kg)	Permissible rotational speed (min ⁻¹) *2	Nut internal space (cm ³)	Standard grease replenishment (cm ³)
	Error <i>e_p</i>	Variation <i>V_v</i>						
0	0.010	0.008	0.035	0.2-1.8	0.3	5 000	1.0	0.5
	0.012	0.008	0.045	0.2-2.0	0.3			
	0.016	0.012	0.070	0.2-3.0	0.7			

4. We recommend using NSK support units. Refer to Page B377 for details.

Compact FA-USS Model

(Fine lead)



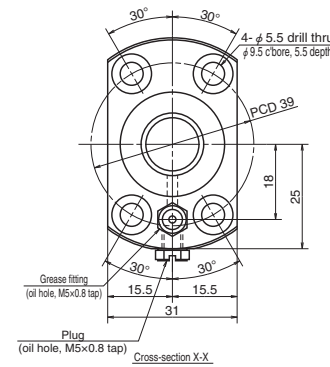
Nut: BSS

NSK

Screw shaft $\phi 15$

Lead 5

Unit: mm



Ball screw specifications

Preload	Oversize ball preload (P-preload)
Ball diameter/screw shaft root diameter	2.778 / 12.6
Ball circle dia.	15.5
Accuracy grade/axial play	C3 / 0
Factory-packed grease	NSK grease LG2

Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK12-01C (square, clean)	WBK12S-01C (square, clean)
WBK12-11C (round, clean)	WBK12-01B (low-profile, square)
WBK12S-01B (low-profile, square)	
WBK12-11 (round)	

Reference No.	Screw shaft diameter d	Lead l	Basic load ratings (N)		Stroke		Screw shaft dimensions		
			Dynamic C_d	Static C_{0a}	Nominal	Max.	L_1	L_2	L_3
USS1505N1D0261	15	5	6 410	10 100	100	159	189	204	261
USS1505N1D0361					200	259	289	304	361
USS1505N1D0561					400	459	489	504	561
USS1505N1D0761					600	653	689	704	761

Notes: *1. Ball screw preload control values are shown. Approximately 0.5 N-cm of torque will be added due to thin plastic seals.
*2. Contact NSK if permissible rotational speed will be exceeded.
3. These ball screws are suitable for operating temperatures from 0 to 80 °C.

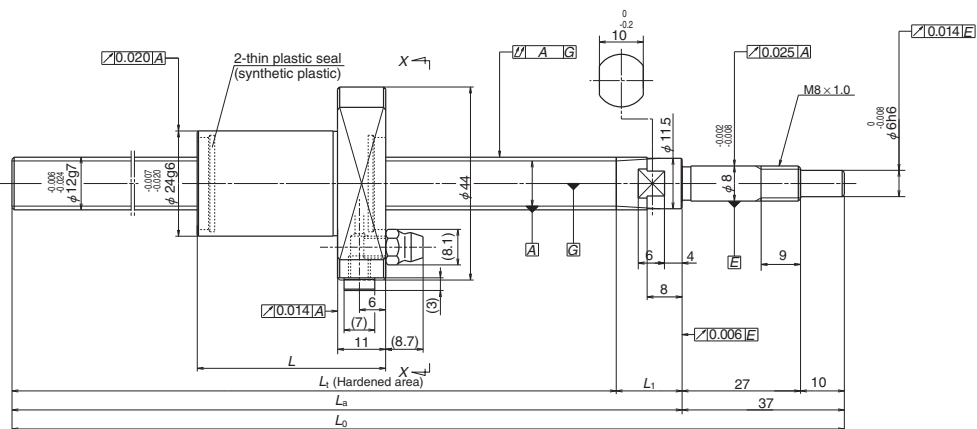
Unit: mm

Target value T	Lead accuracy		Shaft run-out C	Dynamic preload torque (N-cm) *1	Mass (kg)	Permissible rotational speed (min ⁻¹) *2	Nut internal space (cm ³)	Standard grease replenishment (cm ³)
	Error e_p	Variation V_v						
0	0.010	0.008	0.025	0.2-5.0	0.5	5 000	2.0	1.0
	0.012	0.008	0.035	0.2-5.0	0.6	5 000		
	0.015	0.010	0.045	0.2-6.0	0.9	5 000		
	0.018	0.013	0.060	0.2-8.0	1.1	4 130		

4. We recommend using NSK support units. Refer to Page B377 for details.

Compact FA-FSS Model

(Medium lead)



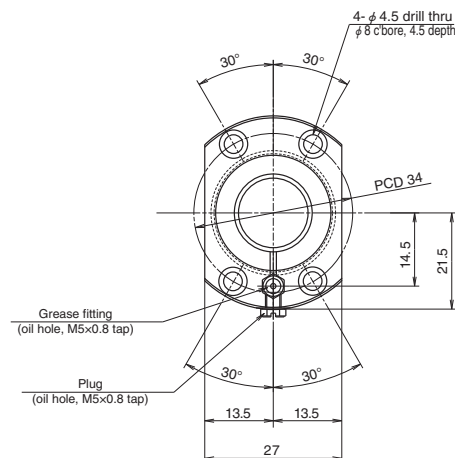
Nut: BSS

NSK

Screw shaft $\phi 12$

Lead 10

Unit: mm



Ball screw specifications

Ball diameter/screw shaft root diameter	2.000 / 10.2
Accuracy grade/axial play	Ct7 / 0.010 or less
Factory-packed grease	NSK grease LR3

Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK08-01B (low-profile, square)	WBK12SF-01B (low-profile, square)

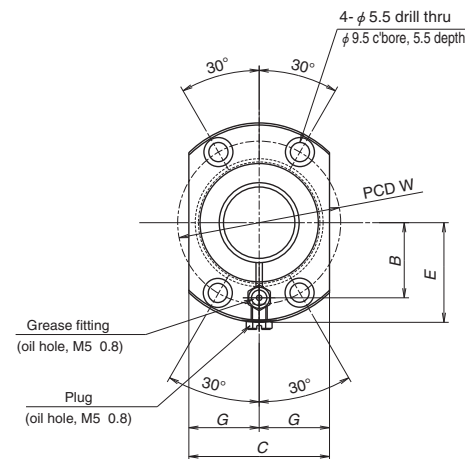
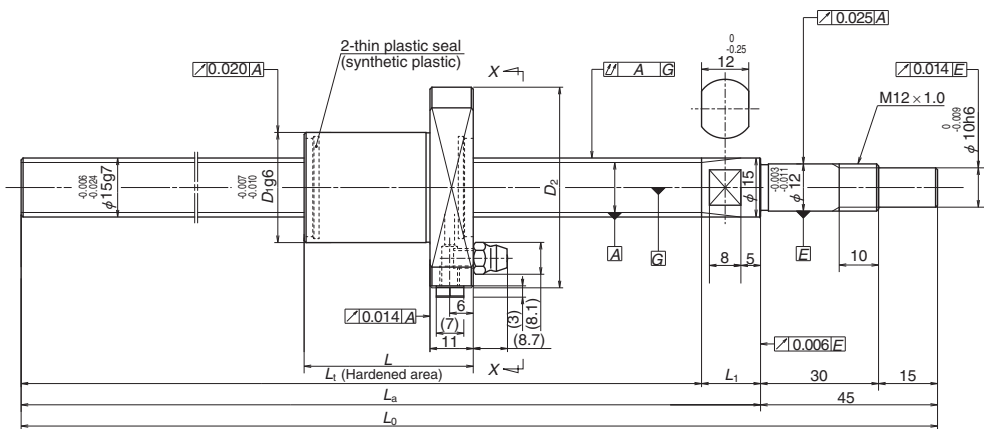
Reference No.	Screw shaft diameter d	Lead l	Basic load ratings (N)		Stroke		Nut length L	Screw shaft dimensions			
			Dynamic C_d	Static C_{0a}	Nominal	Max.		L_1	L_2	L_3	L_4
FSS1210N1D0400					250	287		348	363	400	
FSS1210N1D0600	12	10	3 760	5 780	450	487	43	548	563	600	15
FSS1210N1D0900					750	787		848	863	900	

- Notes: 1. Ball screw preload control values are shown. Approximately 2.0 N-cm of torque will be added due to thin plastic seals.
2. These ball screws are suitable for operating temperatures from 0 to 80 °C.
3. We recommend using NSK support units. Refer to Page B377 for details.

Unit: mm

Lead accuracy			Shaft run-out C	Dynamic preload torque (N-cm)	Mass (kg)	Permissible rotational speed (min ⁻¹) ^{*5}	Nut internal space (cm ³)	Standard grease replenishment (cm ³)
Target value T	Error e_p	Variation V_{300}						
	0.120		0.080		0.5	5 000		
0	0.195	0.052	0.120	–	0.7	5 000	1.0	0.5
	0.310		0.180		1.0	2 300		

4. Stroke and permissible rotational speeds shown apply when using support units recommended by NSK in a Fixed-Simple configuration.
*5. Permissible rotational speed changes when using cut screw shafts. In these cases, use the smaller of the following two values as the permissible rotational speed:
-Critical speed where shaft resonance is generated (see Page B47)
-5 000 min⁻¹ (maximum rotational speed)



Ball screw specifications		
Lead	10	20
Ball diameter/screw shaft root diameter	2.778 / 12.6	3.175 / 12.2
Accuracy grade/axial play	Ct7 / 0.010 or less	
Factory-packed grease	NSK grease LR3	

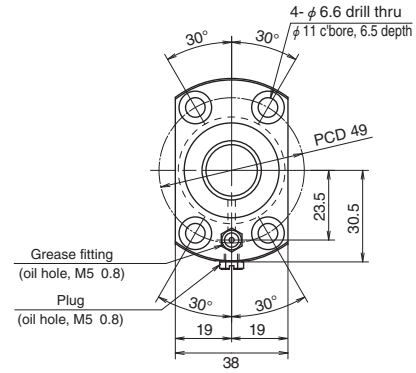
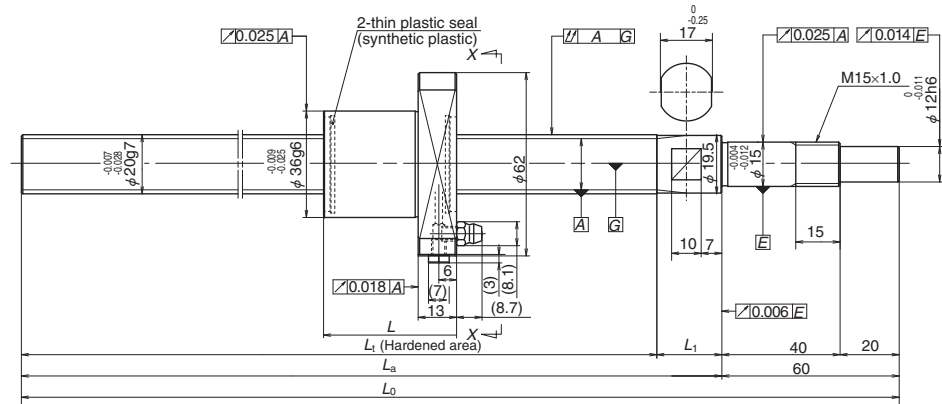
Recommended support unit		
For drive side (Fixed)	For non-drive side (Simple)	
WBK12-01B (low-profile, square)	WBK15SF-01B (low-profile, square)	

Reference No.	Screw shaft diameter <i>d</i>	Lead <i>l</i>	Basic load ratings (N)		Stroke		Screw shaft dimensions				Lead accuracy			
			Dynamic <i>C_d</i>	Static <i>C_{0a}</i>	Nominal	Max.	<i>L₁</i>	<i>L_a</i>	<i>L₀</i>	<i>L₁</i>	Target value <i>T</i>	Error <i>e_p</i>	Variation <i>V₃₀₀</i>	
FSS1510N1D0500	15	10	6 530	10 200	350	379	440	455	500	15	0	0.155	0.052	
FSS1510N1D1000					850	879	940	955	1 000					0.310
FSS1510N1D1450					1 300	1 329	1 390	1 405	1 450					0.490
FSS1520N1D0500		20	5 660	8 700	350	368	437	455	500	18	0	0.155	0.052	
FSS1520N1D1000					850	868	937	955	1 000					0.310
FSS1520N1D1450					1 300	1 318	1 387	1 405	1 450					0.490

- Notes: 1. Ball screw preload control values are shown. Approximately 2.0 N-cm of torque will be added due to thin plastic seals.
 2. These ball screws are suitable for operating temperatures from 0 to 80 °C.
 3. We recommend using NSK support units. Refer to Page B377 for details.

Nut dimensions								Shaft run-out <i>C</i>	Dynamic preload torque (N-cm)	Mass (kg)	Permissible rotational speed (min ⁻¹) ^{*5}		Nut internal space (cm ³)	Standard grease replenishment (cm ³)
<i>L</i>	<i>D₁</i>	<i>D₂</i>	<i>W</i>	<i>B</i>	<i>C</i>	<i>E</i>	<i>G</i>				Fixed	Simple		
43	28	51	39	18	31	25	15.5	0.070	-	0.9	5 000	2.0	1.0	
								0.125		1.7	2 300			
								0.200		2.3	1 020			
51	32	55	43	20	33	27	16.5	0.070	-	1.0	5 000	2.8	1.4	
								0.125		1.7	2 260			
								0.200		2.3	1 000			

4. Stroke and permissible rotational speeds shown apply when using support units recommended by NSK in a Fixed-Simple configuration.
 *5. Permissible rotational speed changes when using cut screw shafts. In these cases, use the smaller of the following two values as the permissible rotational speed:
 -Critical speed where shaft resonance is generated (see Page B47)
 -5 000 min⁻¹ (maximum rotational speed)



Ball screw specifications	
Ball diameter/screw shaft root diameter	3.175 / 17.2
Accuracy grade/axial play	Ct7 / 0.010 or less
Factory-packed grease	NSK grease LR3

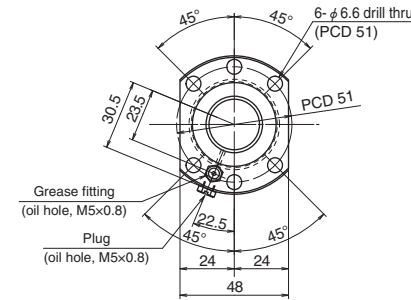
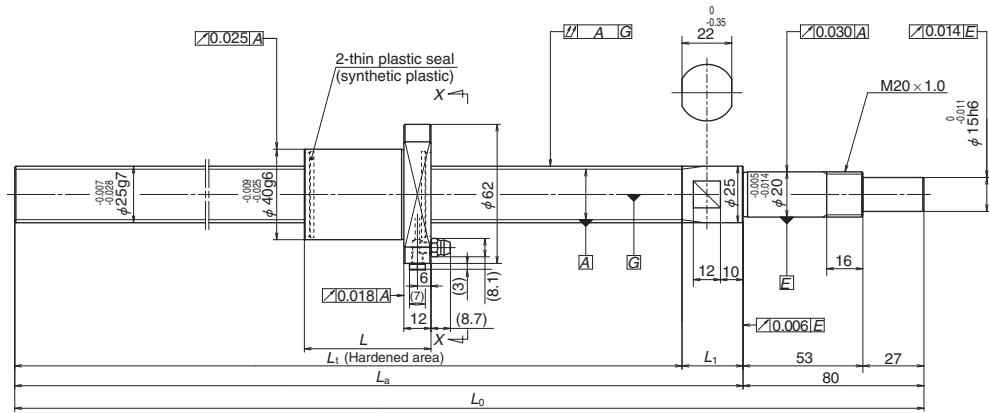
Recommended support unit	
For drive side (Fixed)	For non-drive side (Simple)
WBK15-01B (low-profile, square)	WBK20SF-01B (low-profile, square)

Reference No.	Screw shaft diameter <i>d</i>	Lead <i>l</i>	Basic load ratings (N)		Stroke		Nut length <i>L</i>	Screw shaft dimensions			
			Dynamic <i>C_d</i>	Static <i>C_{0a}</i>	Nominal	Max.		<i>L₁</i>	<i>L_a</i>	<i>L_b</i>	<i>L_c</i>
FSS2010N1D0600	20	10	10 200	18 600	400	451	45	518	540	600	22
FSS2010N1D1000					800	851		918	940	1 000	
FSS2010N1D1450					1 250	1 301		1 368	1 390	1 450	
FSS2020N1D0600					400	442		518	540	600	
FSS2020N1D1000		6 790	11 800	800	842	54	918	940	1 000		
FSS2020N1D1450				1 250	1 292		1 368	1 390	1 450		

Notes: 1. Ball screw preload control values are shown. Approximately 2.0 N-cm of torque will be added due to thin plastic seals.
 2. These ball screws are suitable for operating temperatures from 0 to 80 °C.
 3. We recommend using NSK support units. Refer to Page B377 for details.

Lead accuracy			Shaft run-out <i>C</i>	Dynamic preload torque (N-cm)	Mass (kg)	Permissible rotational speed (min ⁻¹) ^{*5} Fixed-Simple	Nut internal space (cm ³)	Standard grease replenishment (cm ³)
Target value <i>T</i>	Error <i>e_p</i>	Variation <i>V₃₀₀</i>						
0	0.195	0.052	0.085	-	1.7	5 000	3.2	1.6
	0.310		0.125		2.6	3 310		
	0.490		0.200		3.6	1 450		
	0.195		0.085		1.8	5 000		
	0.310		0.125		2.7	3 350		
	0.490		0.200		3.8	1 460		

4. Stroke and permissible rotational speeds shown apply when using support units recommended by NSK in a Fixed-Simple configuration.
 *5. Permissible rotational speed changes when using cut screw shafts. In these cases, use the smaller of the following two values as the permissible rotational speed:
 -Critical speed where shaft resonance is generated (see Page B47)
 -5 000 min⁻¹ (maximum rotational speed)



Ball screw specifications

Ball diameter/screw shaft root diameter	3.175 / 22.2
Accuracy grade/axial play	Ct7 / 0.010 or less
Factory-packed grease	NSK grease LR3

Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK20-01 (square)	WBK25SF-01 (square)

Reference No.	Screw shaft diameter <i>d</i>	Lead <i>l</i>	Basic load ratings (N)		Stroke		Nut length <i>L</i>	Screw shaft dimensions			
			Dynamic <i>C_d</i>	Static <i>C_{0a}</i>	Nominal	Max.		<i>L₁</i>	<i>L_a</i>	<i>L₀</i>	<i>L₁</i>
FSS2510N1D0600	25	10	15 000	32 400	400	415	56	493	520	600	27
FSS2510N1D1000					800	815		893	920	1 000	
FSS2510N1D1450					1 250	1 265		1 343	1 370	1 450	
FSS2520N1D0600	25	20	7 650	14 800	400	418	54	494	520	600	26
FSS2520N1D1000					800	818		894	920	1 000	
FSS2520N1D1450					1 250	1 268		1 344	1 370	1 450	
FSS2525N1D0600	25	25	7 490	14 600	400	405	63	490	520	600	30
FSS2525N1D1000					800	805		890	920	1 000	
FSS2525N1D1450					1 250	1 255		1 340	1 370	1 450	

- Notes: 1. Ball screw preload control values are shown. Approximately 2.0 N-cm of torque will be added due to thin plastic seals.
 2. These ball screws are suitable for operating temperatures from 0 to 80 °C.
 3. We recommend using NSK support units. Refer to Page B377 for details.

Lead accuracy			Shaft run-out <i>C</i>	Dynamic preload torque (N-cm)	Mass (kg)	Permissible rotational speed (min ⁻¹) ^{*5}	Nut internal space (cm ³)	Standard grease replenishment (cm ³)		
Target value <i>T</i>	Error <i>e_p</i>	Variation <i>V₃₀₀</i>								
0	0.155	0.052	0.065	-	2.6	5 000	4.7	2.4		
			0.090						4.0	4 590
			0.130						5.8	1 970
	0.310	0.052	0.065		2.6	5 000	3.9	2.0		
			0.090		4.0	4 570				
			0.130		5.8	1 960				
	0.490	0.052	0.065		2.6	5 000	4.3	2.2		
			0.090		4.1	4 660				
			0.130		5.8	1 990				

4. Stroke and permissible rotational speeds shown apply when using support units recommended by NSK in a Fixed-Simple configuration.
 *5. Permissible rotational speed changes when using cut screw shafts. In these cases, use the smaller of the following two values as the permissible rotational speed:
 -Critical speed where shaft resonance is generated (see Page B47)
 -5 000 min⁻¹ (maximum rotational speed)

B-3-1.2 High-Speed SS (HSS) Model

◆ **Features**

The HMS and HMD models, originally developed for machine tools, are an addition to NSK's lineup of standard ball screws. They have a wide range of applications, from general machines to high performance machines such as those requiring high speed and precision.

● **High speed**

A new recirculation system that utilizes NSK's high speed and low noise technology more than doubles the $d \cdot n$ value from 70 000 to 160 000.

To extend the range of the lead to 20 mm, high speed operation of over 60m/min. is possible.

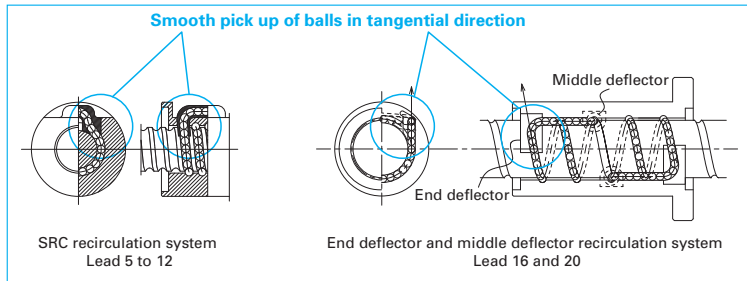


Fig 1 Ball recirculation system

Table 1 Allowable feed speed of combinations of shaft diameter and lead

shaft diameter [mm]	Lead [mm]	5	10	12	16	20
32		25m/min	50m/min			
40			40m/min	48m/min	64m/min	80m/min
45			35m/min			
50			32m/min	38m/min		

* Allowable speed needs to be calculated. See the permissible rotational speed in the dimensions table.

● **Low noise and vibrations**

Compared to our conventional products, the average noise level has been reduced by more than 6 dB(A), reducing the number of colliding balls and recirculation parts thanks to high speed, low noise technology.

The vibration level of the nut has also been reduced drastically.

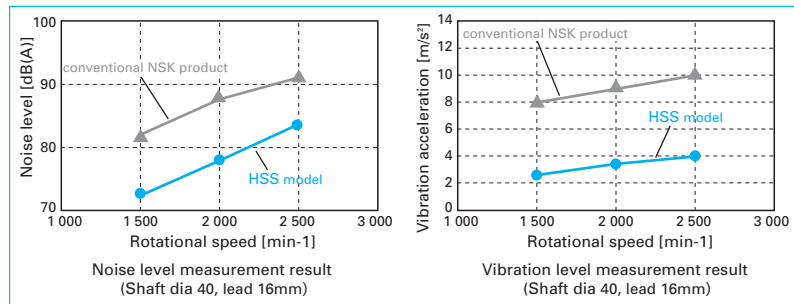


Table 2

● **Installation**

Installation dimensions are the same as those of a conventional SS model.

● **Compact**

Achieved high-level stiffness and high load capacity equivalent to that of double nut preload by changing the double nut preload to the offset preload of a single nut, and compact sized nut. Adopted thin seals axially and shorten nut length.

● **Blank shaft ends**

The blank shaft ends can be customized according to customers' requests. See page B27 in NSK's recommended design when drawing up plans for a shaft end. The support units available on page B377 in the case of NSK's recommended design. See "Technical Description: Shaft End Processing" (page B86) for procedures of shaft end processing and precautions.

● **Oil supply**

2 oil holes, M6x1.0, are provided in the nut flange periphery at the end of the nut flange. A plug is standardly screwed into the periphery of the nut flange.

◆ **Specifications**

● **Accuracy grade and axial play**

The available standard accuracy grade and axial play are shown in Table 2.

Table 2 Accuracy grade and axial play

Accuracy grade	C5
Axial play	0 mm (preloaded)

● **Dimension tables**

Dimensions, shapes, and specifications are listed by shaft diameter/lead combinations. See Table 3 for the relevant pages to reference.

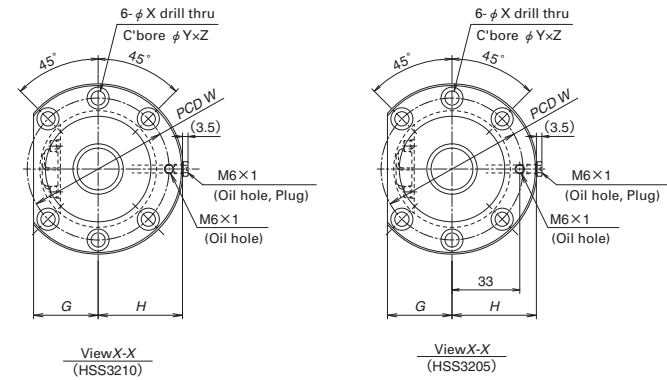
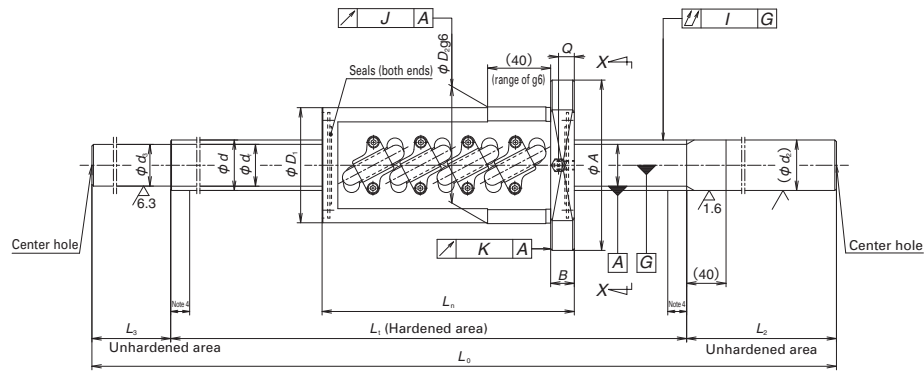
◆ **Other**

The seal of the ball screw and recirculation parts are made of synthetic resin. Consult NSK when using the ball screws under extreme environments or special environments, or using special lubricants or oil.

For special environments, see pages B70 and D2. See pages B67 and D13 for lubricants.

Table 3 Combinations of screw shaft diameter and lead

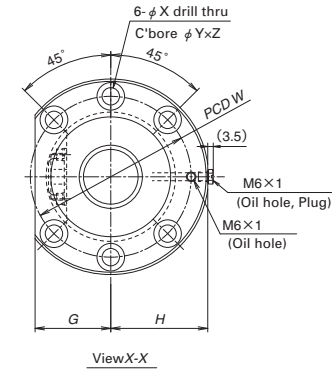
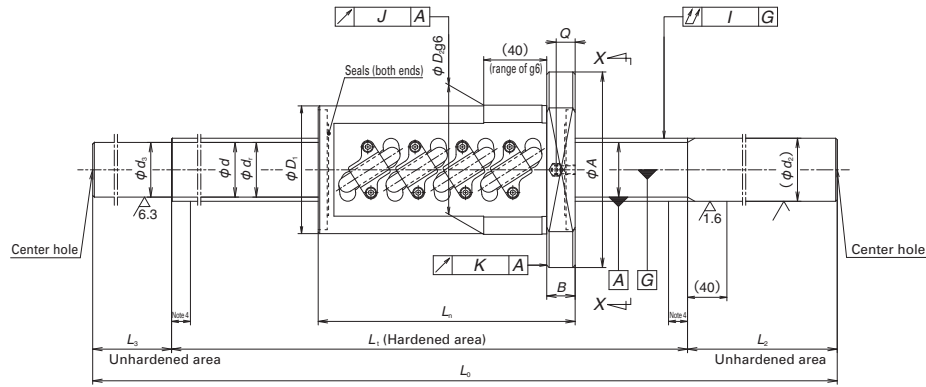
Screw shaft diameter [mm]	Lead [mm]	5	10	12	16	20
32		B149	B149			
40			B151	B151	B153	B153
45			B155			
50			B155	B155		



Reference No.	Screw shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D_w</i>	Ball circle dia. <i>d_m</i>	Root dia. <i>d_r</i>	Effective ball turns Turns x Circuits	Basic load ratings(N)			Dynamic friction torque, standard (N·cm)	Ball nut dimensions							
							Dynamic <i>C_d</i>	Static <i>C_{0a}</i>	Preload (N)		Diameter		Flange			Overall length <i>L_n</i>	<i>W</i>	
											<i>D₁</i>	<i>D₂</i>	<i>A</i>	<i>G</i>	<i>H</i>			<i>B</i>
HSS3205N1D0650	32	5	3.175	32.5	29.2	2.5X2	21 800	56 000	920	17.0	57	58	85	32	42	13	89	71
HSS3205N1D0950																		
HSS3205N1D1250																		
HSS3205N1D1550																		
HSS3205N1D1850																		
HSS3210N1D0850	32	10	6.350	33.0	26.4	2.5X2	54 500	110 000	2 310	59.5	73	74	108	41	53.5	15	160	90
HSS3210N1D1050																		
HSS3210N1D1450																		
HSS3210N1D1850																		
HSS3210N1D2250																		

- Notes: 1. These ball screws are suitable for operating temperatures from 0 to 60 °C.
 2. We recommend using NSK support units. Refer to Page B377 for details.
 3. Only a rust preventive is applied before delivery. Apply lubricant (oil or grease) before use. See Page D13 for details.
 4. Note that hardening imperfections occur at both screw ends of one lead. Keep this in mind when setting the stroke.
 5. Permissible rotational speeds consider critical speeds for threaded lengths in the tables and NSK recommended shaft end designs (See Page B27).
 For details on critical speeds, see Page B47.

Bolt hole <i>X</i>	<i>Y</i>	<i>Z</i>	Oil hole <i>Q</i>	Screw shaft dimensions						Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed (min ⁻¹)		Nut internal space (cm ³)	Standard grease replenishment (cm ³)
				Threaded length <i>L₁</i>	Shaft end, right		Shaft end, left		Overall length <i>L₀</i>	Travel compensation <i>T</i>	Deviation <i>e_p</i>	Variation <i>V_u</i>	Shaft straightness <i>I</i>	Radial run-out			Configuration			
					<i>d₂</i>	<i>L₂</i>	<i>d₃</i>	<i>L₃</i>						<i>J</i>	<i>K</i>			Fixed-Simple		
6.6	11	6.5	8	400	200	50	650	-0.010	0.025	0.020	0.055	0.019	0.013	5.2	5 000	5 000	10	5		
				600	250	100	950	-0.014	0.030	0.023	0.065			7.0	5 000	5 000				
				900	320	250	1 250	-0.022	0.040	0.027	0.080			8.7	5 000	5 000				
				1 150	300	100	1 550	-0.028	0.046	0.030	0.100			10.5	3 500	4 700				
				1 450	300	100	1 850	-0.035	0.054	0.035	0.130			12.2	2 200	2 900				
9	14	8.5	10	500	250	100	850	-0.012	0.027	0.020	0.065	0.019	0.013	8.9	5 000	5 000	43	22		
				700	250	100	1 050	-0.017	0.035	0.025	0.080			10.0	5 000	5 000				
				1 050	320	26.4	1 450	-0.025	0.046	0.030	0.100			12.2	4 100	5 000				
				1 450	300	100	1 850	-0.035	0.054	0.035	0.130			14.3	2 100	2 800				
				1 850	300	100	2 250	-0.045	0.065	0.040	0.170			16.5	1 200	1 700				

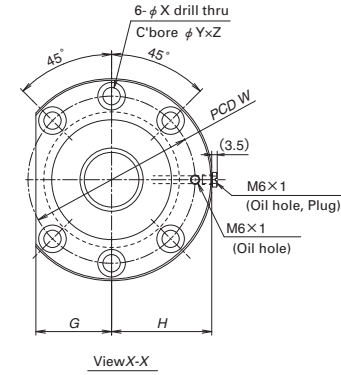
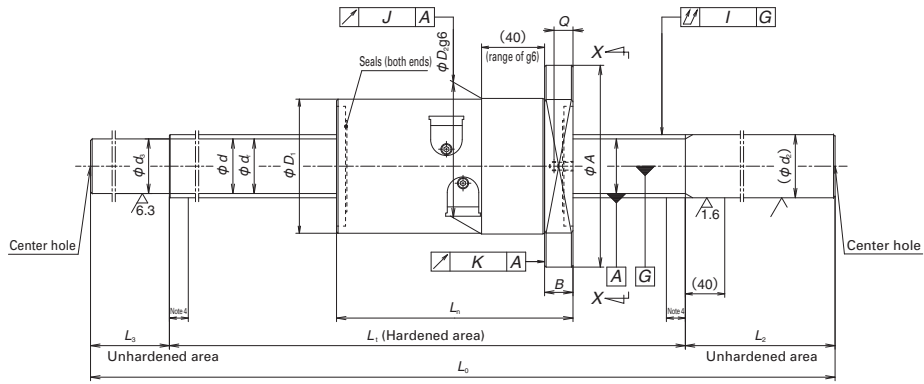


Unit : mm

Reference No.	Screw shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D_w</i>	Ball circle dia. <i>d_m</i>	Root dia. <i>d_r</i>	Effective ball turns Turns × Circuits	Basic load ratings(N)			Dynamic friction torque, standard (N·cm)	Ball nut dimensions							
							Dynamic <i>C_d</i>	Static <i>C_{0a}</i>	Preload (N)		Diameter		Flange			Overall length <i>L_n</i>	<i>W</i>	
											<i>D₁</i>	<i>D₂</i>	<i>A</i>	<i>G</i>	<i>H</i>			<i>B</i>
HSS4010N1D0950	40	10	6.350	41.0	34.4	2.5X2	61 200	137 000	2 600	74.5	81	82	124	47	61.5	18	163	102
HSS4010N1D1450																		
HSS4010N1D2100																		
HSS4010N1D2900																		
HSS4012N1D1450	40	12	7.144	41.5	34.1	2.5X2	71 700	154 000	3 050	96.0	85	86	128	48	63.5	18	187	106
HSS4012N1D2100																		
HSS4012N1D2900																		

- Notes: 1. These ball screws are suitable for operating temperatures from 0 to 60 °C.
 2. We recommend using NSK support units. Refer to Page B377 for details.
 3. Only a rust preventive is applied before delivery. Apply lubricant (oil or grease) before use. See Page D13 for details.
 4. Note that hardening imperfections occur at both screw ends of one lead. Keep this in mind when setting the stroke.
 5. Permissible rotational speeds consider critical speeds for threaded lengths in the tables and NSK recommended shaft end designs (See Page B27).
 For details on critical speeds, see Page B47.

Bolt hole			Oil hole			Screw shaft dimensions					Lead accuracy			Run-out		Mass (kg)	Permissible rotational speed (min ⁻¹)		Nut internal space (cm ³)	Standard grease replenishment (cm ³)	
						Threaded length	Shaft end, right		Shaft end, left		Overall length	Travel compensation	Deviation	Variation	Shaft straightness		Radial run-out				Configuration
							<i>L₁</i>	<i>d₂</i>	<i>L₂</i>	<i>d₃</i>							<i>L₃</i>	<i>L₀</i>			
11	17.5	11	12	Q	L ₁	600	250	100	950	-0.014	0.030	0.023	0.050	0.025	0.015	13.5	4 000	4 000	52	26	
						1 050	300	100	1 450	-0.025	0.046	0.030	0.070				17.9	4 000			4 000
						1 600	350	150	2 100	-0.039	0.054	0.035	0.110				23.5	2 200			3 000
						2 400	350	150	2 900	-0.058	0.077	0.046	0.140				30.5	900			1 300
11	17.5	11	12	Q	L ₁	1 050	300	100	1 450	-0.025	0.046	0.030	0.070	0.025	0.015	19.1	4 000	4 000	67	34	
						1 600	350	150	2 100	-0.039	0.054	0.035	0.110				24.8	2 200			3 000
						2 400	350	150	2 900	-0.058	0.077	0.046	0.140				31.8	900			1 300



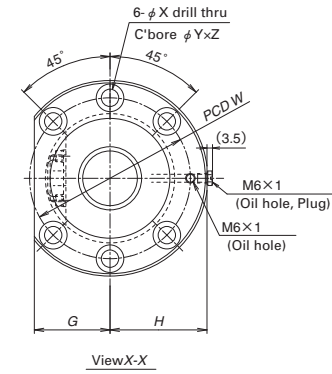
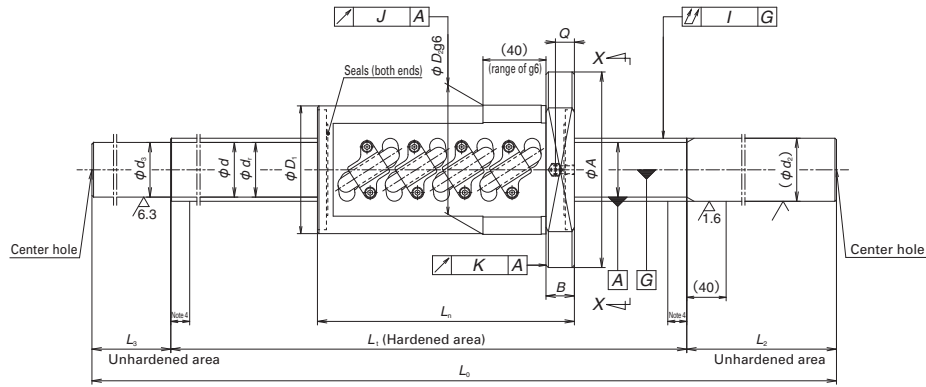
Reference No.	Screw shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D_w</i>	Ball circle dia. <i>d_m</i>	Root dia. <i>d_r</i>	Effective ball turns Turns × Circuits	Basic load ratings(N)			Dynamic friction torque, standard (N·cm)	Ball nut dimensions							
							Dynamic <i>C_d</i>	Static <i>C_{0a}</i>	Preload (N)		Diameter		Flange			Overall length <i>L_n</i>	<i>W</i>	
											<i>D₁</i>	<i>D₂</i>	<i>A</i>	<i>G</i>	<i>H</i>			<i>B</i>
HSS4016N1D1450	40	16	7.144	41.5	34.1	3.7X1	66 900	131 000	2 850	104.0	85	86	128	48	63.5	18	160	106
HSS4016N1D2100																		
HSS4016N1D2900																		
HSS4020N1D1450	40	20	7.144	41.5	34.1	3.7X1	66 500	131 000	2 850	116.5	85	86	128	48	63.5	18	192	106
HSS4020N1D2100																		
HSS4020N1D2900																		

- Notes: 1. These ball screws are suitable for operating temperatures from 0 to 60 °C.
 2. We recommend using NSK support units. Refer to Page B377 for details.
 3. Only a rust preventive is applied before delivery. Apply lubricant (oil or grease) before use. See Page D13 for details.
 4. Note that hardening imperfections occur at both screw ends of one lead. Keep this in mind when setting the stroke.
 5. Permissible rotational speeds consider critical speeds for threaded lengths in the tables and NSK recommended shaft end designs (See Page B27).
 For details on critical speeds, see Page B47.

Bolt hole	Oil hole	Screw shaft dimensions							Lead accuracy			Run-out		Mass (kg)	Permissible rotational speed (min ⁻¹)		Nut internal space (cm ³)	Standard grease replenishment (cm ³)			
		Threaded length	Shaft end, right	Shaft end, left	Overall length	Travel compensation	Deviation	Variation	Shaft straightness	Radial run-out		Configuration									
										<i>J</i>	<i>K</i>		Fixed-Simple		Fixed-Fixed						
11	17.5	11	11	1 050	300	100	1 450	-0.025	0.046	0.030	0.070	0.025	0.015	19.2	4 000	4 000	40	20			
				1 600	40	350	34.1	150	2 100	-0.039	0.054				0.035	0.110			25.0	2 200	3 000
				2 400	350	150	2 900	-0.058	0.077	0.046	0.140				32.2	900			1 300		
11	17.5	11	11	1 050	300	100	1 450	-0.025	0.046	0.030	0.070	0.025	0.015	20.3	4 000	4 000	47	24			
				1 600	40	350	34.4	150	2 100	-0.039	0.054				0.035	0.110			26.2	2 200	3 000
				2 400	350	150	2 900	-0.058	0.077	0.046	0.140				33.5	900			1 300		

Unit : mm

SSH



Reference No.	Screw shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D_w</i>	Ball circle dia. <i>d_m</i>	Root dia. <i>d_r</i>	Effective ball turns Turns x Circuits	Basic load ratings(N)			Dynamic friction torque, standard (N·cm)	Ball nut dimensions							
							Dynamic <i>C_a</i>	Static <i>C_{0a}</i>	Preload (N)		Diameter		Flange			Overall length <i>L_n</i>	<i>W</i>	
											<i>D₁</i>	<i>D₂</i>	<i>A</i>	<i>G</i>	<i>H</i>			<i>B</i>
HSS4510N1D1450	45	10	6.350	46.0	39.4	2.5X2	65 800	157 000	2 710	82.0	87	88	132	50	65.5	18	163	110
HSS4510N1D2100																		
HSS4510N1D2900																		
HSS5010N1D1450	50	10	6.350	51.0	44.4	2.5X2	68 100	174 000	2 880	92.0	92	93	135	51	67	18	163	113
HSS5010N1D1850																		
HSS5010N1D2350																		
HSS5010N1D2900																		
HSS5012N1D1450	50	12	7.938	51.5	43.2	2.5X2	91 500	218 000	3 880	136.5	99	100	146	55	72.5	22	193	122
HSS5012N1D2100																		
HSS5012N1D2900																		

- Notes: 1. These ball screws are suitable for operating temperatures from 0 to 60 °C.
 2. We recommend using NSK support units. Refer to Page B377 for details.
 3. Only a rust preventive is applied before delivery. Apply lubricant (oil or grease) before use. See Page D13 for details.
 4. Note that hardening imperfections occur at both screw ends of one lead. Keep this in mind when setting the stroke.
 5. Permissible rotational speeds consider critical speeds for threaded lengths in the tables and NSK recommended shaft end designs (See Page B27).
 For details on critical speeds, see Page B47.

Bolt hole <i>X</i>	<i>Y</i>	<i>Z</i>	Oil hole <i>Q</i>	Screw shaft dimensions					Lead accuracy			Run-out		Mass (kg)	Permissible rotational speed (min ⁻¹)		Nut internal space (cm ³)	Standard grease replenishment (cm ³)		
				Threaded length <i>L₁</i>	Shaft end, right <i>d₂</i>	Shaft end, left <i>L₂</i>	Overall length <i>d₃</i>	<i>L₃</i>	<i>L₀</i>	Travel compensation <i>T</i>	Deviation <i>e_p</i>	Variation <i>V_u</i>	Shaft straightness <i>I</i>		Radial run-out				Fixed-Simple	Fixed-Fixed
															<i>J</i>	<i>K</i>				
11	17.5	11	12	1 050	300	100	1 450	-0.025	0.046	0.030	0.070	0.025	0.015	22.0	3 500	3 500	58	29		
				1 600	350	39.4	150	2 100	-0.039	0.054	0.035			0.110	29.2	2 500			3 400	
				2 400	350	150	2 900	-0.058	0.077	0.046	0.140			38.2	1 100	1 500				
11	17.5	11	12	1 050	300	100	1 450	-0.025	0.046	0.030	0.070	0.025	0.015	26.3	3 200	3 200	64	32		
				1 450	300	100	1 850	-0.035	0.054	0.035	0.090			31.9	3 200	3 200				
				1 850	350	44.4	150	2 350	-0.045	0.065	0.040			0.110	38.8	2 100			2 900	
				2 400	350	150	2 900	-0.058	0.077	0.046	0.140			46.5	1 200	1 700				
14	20	13	12	1 050	300	100	1 450	-0.025	0.046	0.030	0.070	0.025	0.015	28.5	3 200	3 200	99	50		
				1 600	350	43.2	150	2 100	-0.039	0.054	0.035			0.110	37.3	2 800			3 200	
				2 400	350	150	2 900	-0.058	0.077	0.046	0.140			48.2	1 200	1 600				

B-3-1.3 Finished Shaft End MA, FA, and SA Models

1. Order of the dimension tables

Tables are arranged by model in order of increasing shaft diameter. If ball screws have the same shaft diameter, those with smaller leads appear first. Page numbers for shaft diameter and lead combinations are shown in Table 1.

2. Dimension tables

Dimensions, shapes, and specifications are listed by shaft diameter/lead combinations. The following tables also contain data regarding:

● **Stroke**

Nominal stroke: A reference for use.
 Maximum stroke: The limit stroke that the nut can move. The value is obtained by subtracting the nut length from effective threaded length.

● **Lead accuracy**

Lead accuracy is either C3 or C5 grade.
T : Travel compensation
e_p : Tolerance on specified travel
v_u : Travel variation
 See "Technical Description: Lead Accuracy" (page B37) for details of the codes.

● **Permissible rotational speed**

d · n: Limited by the relative peripheral speed between the screw shaft and nut.

Critical speed: Limited by the natural frequency of the ball screw shaft. Critical speed depends on the support configuration of the screw shaft.

The lower of the two criteria, *d · n* and critical speed, will determine the overall permissible rotational speed of the ball screw. For details, see "Technical Description: Permissible Rotational Speed" (page B47).

3. Other

The seal of the ball screw, ball recirculating deflector, and end cap are made of synthetic resin. Consult NSK when using our ball screws under extreme environments, in special environments, or if using special lubricants or oil.

For special environments, see pages B70 and D2. For lubricants, see pages B67 and D13.

Note: For details about standard stock products, contact NSK.

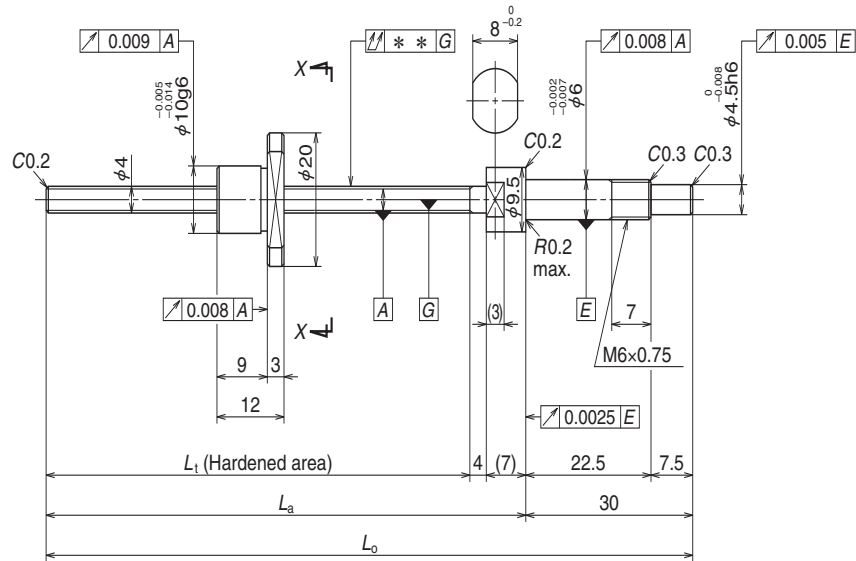
Table 1 Combinations of screw shaft diameter and lead

Lead (mm) \ Screw shaft diameter (mm)	1	1.5	2	2.5	4	5	6
4	B159						
6	B161						
8	B163	B165	B167				
10			B169	B171	B181		
12			B173	B175		B183	
14						B187	
15							
16			B177	B179		B193	
20					B209	B211	
25					B213	B215	B217
28						B221	B225
						B223	B227
32						B229	B233
						B231	B235
36							
40						B247	
45							
50							

8	10	12	16	20	25	32	40	50
	B185							
B189								
	B191							
			B195					
				B199				
	B197			B201	B203			
	B219							
B237	B239				B205	B207		
	B241							
	B243							
	B245							
B249	B251	B255						
	B253	B257						
	B259							
	B261							
	B263							

Finished Shaft End MA Model

(Fine lead)



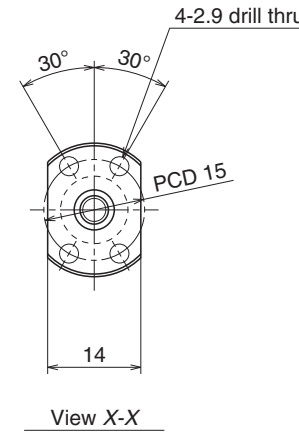
Nut: MPFD, MSFD

NSK

Screw shaft ø4

Lead 1

Unit: mm



Ball screw specifications		
Product classification	Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn	4 × 1 / Right	
Preload / Ball recirculation	P-preload / Deflector (bridge)	
Ball dia. / Ball circle dia.	0.800 / 4.2	
Screw shaft root diameter	3.2	
Effective ball turns	1 × 2	
Accuracy grade / Preload / Axial play	C3 / Z	C3 / T
Basic load ratings (N)	Dynamic C_a	370
	Static C_{0a}	370
Axial play	0	0.005 or less
Preload (N)	19.6	—
Dynamic friction torque (N-cm)	1.0 or less	0.3 or less
Spacer ball	None	
Factory-packed grease	NSK grease PS2	

Recommended support unit

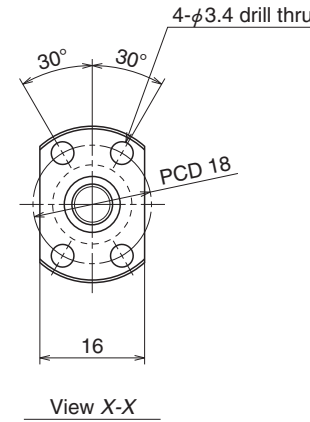
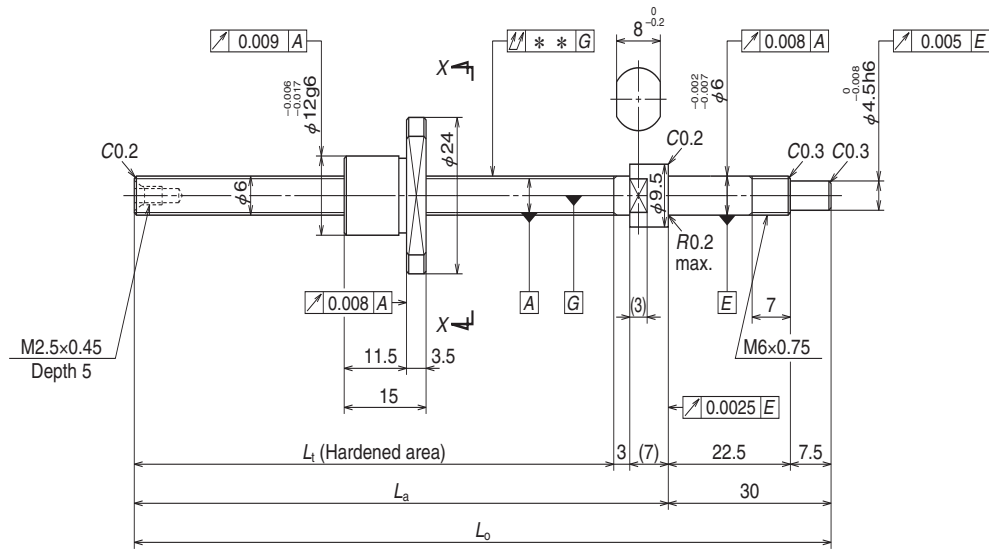
For drive side (Fixed)	
WBK06-01A (square)	
WBK06-11 (round)	

Unit: mm

Reference No.		Stroke	
		Nominal	Maximum
Preloaded (MPFD)	Precise clearance (MSFD)		
W0400MA-1PY-C3Z1	W0400MA-2Y-C3T1	20	32
W0400MA-3PY-C3Z1	W0400MA-4Y-C3T1	40	52
W0401MA-1PY-C3Z1	W0401MA-2Y-C3T1	70	82

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min ⁻¹)
L_t	L_a	L_o	T	e_p	v_u			Configuration
44	55	85	0	0.008	0.008	0.015	0.024	3 000
64	75	105	0	0.008	0.008	0.020	0.026	3 000
94	105	135	0	0.008	0.008	0.025	0.028	3 000

- Notes:
1. We recommend using NSK support units. See Page B377 for details.
 2. We recommend using NSK Grease PS2. Apply the grease to the screw shaft surface during replenishment. See Page D16 for details.
 3. These ball nuts do not have seals.
 4. Contact NSK if permissible rotational speed N will be exceeded.



Ball screw specifications		
Product classification	Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn	6 × 1 / Right	
Preload / Ball recirculation	P-preload / Deflector (bridge)	
Ball dia. / Ball circle dia.	0.800 / 6.2	
Screw shaft root diameter	5.2	
Effective ball turns	1 × 3	
Accuracy grade / Preload / Axial play	C3 / Z	C3 / T
Basic load ratings (N)	Dynamic C_a	680
	Static C_{0a}	920
Axial play	0	0.005 or less
Preload (N)	24.5	—
Dynamic friction torque (N-cm)	1.3 or less	0.3 or less
Spacer ball	None	
Factory-packed grease	NSK grease PS2	

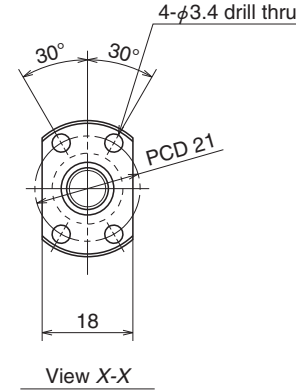
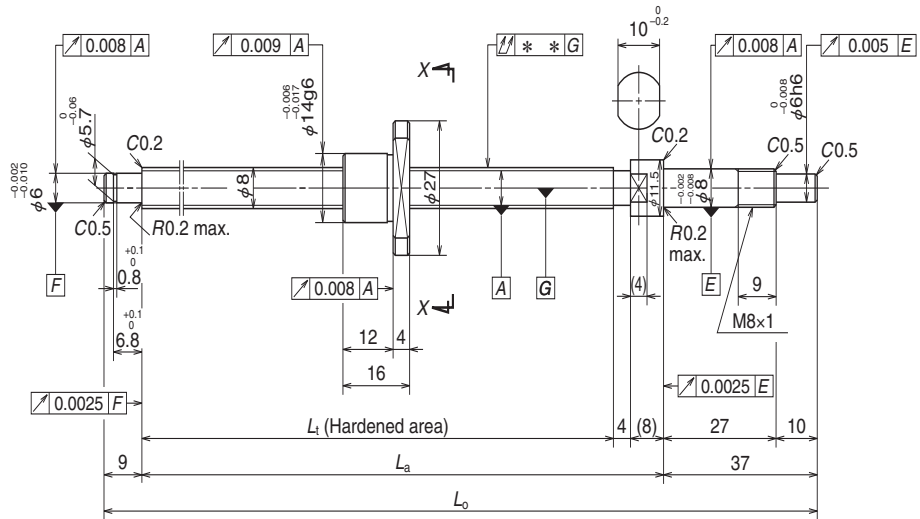
Recommended support unit

For drive side (Fixed)	
WBK06-01A (square)	
WBK06-11 (round)	

Reference No.		Stroke	
		Nominal	Maximum
Preloaded (MPFD)	Precise clearance (MSFD)		
W0600MA-1PY-C3Z1	W0600MA-2Y-C3T1	40	50
W0601MA-1PY-C3Z1	W0601MA-2Y-C3T1	70	80
W0601MA-3PY-C3Z1	W0601MA-4Y-C3T1	100	110

- Notes: 1. We recommend using NSK support units. See Page B377 for details.
 2. We recommend using NSK Grease PS2. Apply the grease to the screw shaft surface during replenishment. See Page D16 for details.
 3. These ball nuts do not have seals.
 4. Contact NSK if permissible rotational speed N will be exceeded.

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min ⁻¹)
L_t	L_a	L_o	T	e_p	v_u			
								Fixed - Free
65	75	105	0	0.008	0.008	0.015	0.039	3 000
95	105	135	0	0.008	0.008	0.020	0.045	3 000
125	135	165	0	0.010	0.008	0.025	0.051	3 000



Ball screw specifications		
Product classification	Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn	8 x 1 / Right	
Preload / Ball recirculation	P-preload / Deflector (bridge)	
Ball dia. / Ball circle dia.	0.800 / 8.2	
Screw shaft root diameter	7.2	
Effective ball turns	1 x 3	
Accuracy grade / Preload / Axial play	C3 / Z	C3 / T
Basic load ratings (N)	Dynamic C_d	790
	Static C_0	1 290
Axial play	0	0.005 or less
Preload (N)	29.4	—
Dynamic friction torque (N-cm)	1.8 or less	0.5 or less
Spacer ball	None	
Factory-packed grease	NSK grease PS2	

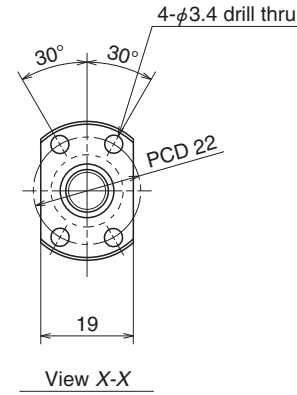
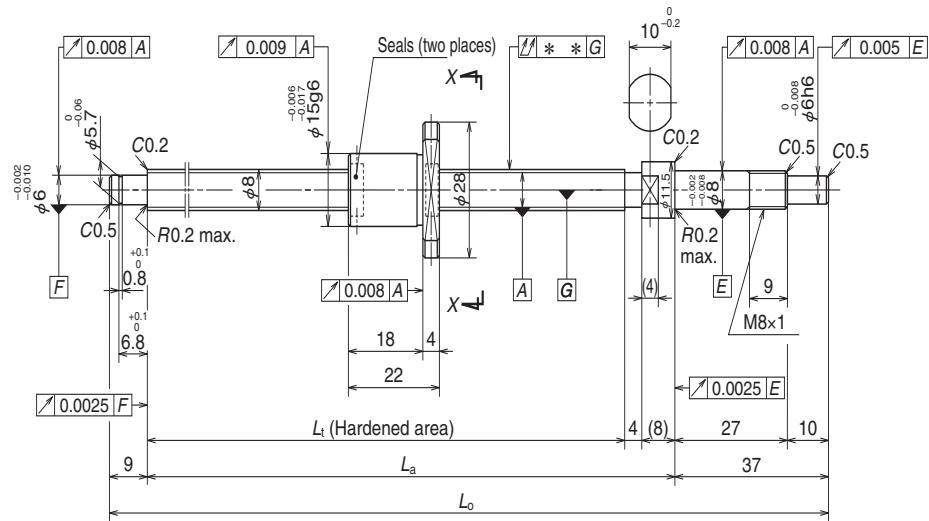
Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK08-01A (square)	WBK08S-01 (square)
WBK08-11 (round)	

Reference No.		Stroke	
		Nominal	Maximum
Preloaded (MPFD)	Precise clearance (MSFD)		
W0800MA-1PY-C3Z1	W0800MA-2Y-C3T1	40	59
W0801MA-1PY-C3Z1	W0801MA-2Y-C3T1	70	89
W0801MA-3PY-C3Z1	W0801MA-4Y-C3T1	100	119
W0802MA-1PY-C3Z1	W0802MA-2Y-C3T1	150	169

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min ⁻¹)
L_t	L_a	L_o	T	e_p	v_u			Configuration
80	92	138	0	0.008	0.008	0.025	0.073	3 000
110	122	168	0	0.010	0.008	0.030	0.084	3 000
140	152	198	0	0.010	0.008	0.030	0.095	3 000
190	202	248	0	0.010	0.008	0.035	0.11	3 000

- Notes:
1. We recommend using NSK support units. See Page B377 for details.
 2. We recommend using NSK Grease PS2. Apply the grease to the screw shaft surface during replenishment. See Page D16 for details.
 3. These ball nuts do not have seals.
 4. Contact NSK if permissible rotational speed N will be exceeded.



Ball screw specifications		
Product classification	Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn	8 x 1.5 / Right	
Preload / Ball recirculation	P-preload / Deflector (bridge)	
Ball dia. / Ball circle dia.	1.000 / 8.3	
Screw shaft root diameter	7.0	
Effective ball turns	1 x 3	
Accuracy grade / Preload / Axial play	C3 / Z	C3 / T
Basic load ratings (N)	Dynamic C _a	1 270
	Static C _{0a}	1 970
Axial play	0	0.005 or less
Preload (N)	49.0	—
Dynamic friction torque, (N-cm)	2.0 or less	0.5 or less
Spacer ball	None	
Factory-packed grease	NSK grease PS2	

Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK08-01A (square)	WBK08S-01 (square)
WBK08-11 (round)	

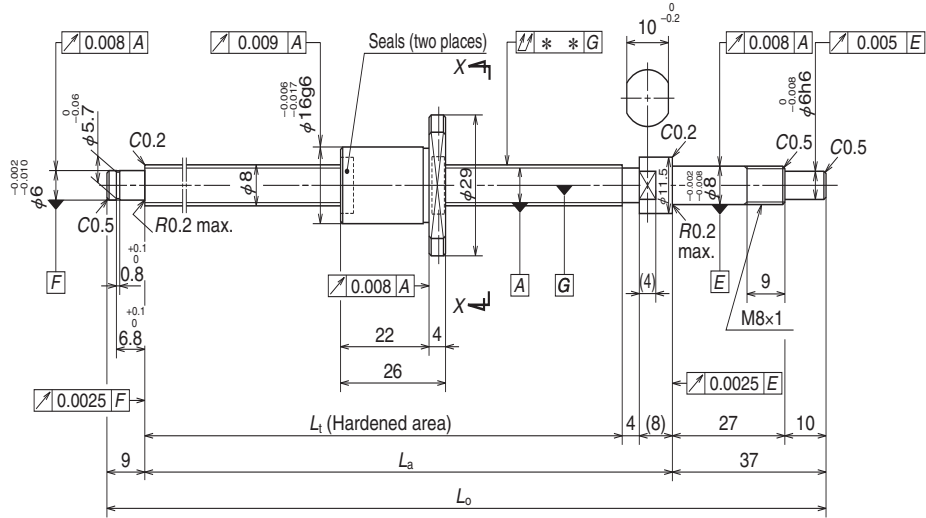
Reference No.		Stroke	
		Nominal	Maximum
Preloaded (MPFD)	Precise clearance (MSFD)		
W0800MA-3PY-C3Z1.5	W0800MA-4Y-C3T1.5	40	53
W0801MA-5PY-C3Z1.5	W0801MA-6Y-C3T1.5	70	83
W0801MA-7PY-C3Z1.5	W0801MA-8Y-C3T1.5	100	113
W0802MA-3PY-C3Z1.5	W0802MA-4Y-C3T1.5	150	163

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min ⁻¹)
L _t	L _a	L _o	T	e _p	v _u			Configuration
80	92	138	0	0.008	0.008	0.025	0.082	3 000
110	122	168	0	0.010	0.008	0.030	0.093	3 000
140	152	198	0	0.010	0.008	0.030	0.10	3 000
190	202	248	0	0.010	0.008	0.035	0.12	3 000

- Notes: 1. We recommend using NSK support units. See Page B377 for details.
 2. We recommend using NSK Grease PS2. Apply the grease to the screw shaft surface during replenishment. See Page D16 for details.
 3. Contact NSK if permissible rotational speed N will be exceeded.

Finished Shaft End MA Model

(Fine lead)



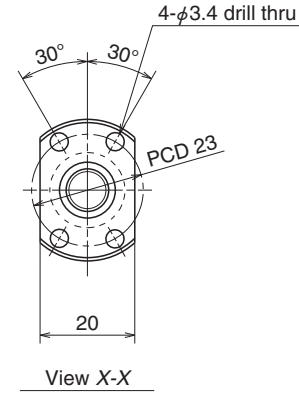
Nut: MPFD, MSFD

NSK

Screw shaft $\phi 8$

Lead 2

Unit: mm



Ball screw specifications			
Product classification	Preloaded	Precise clearance	
Shaft dia. x Lead / Direction of turn	8 x 2 / Right		
Preload / Ball recirculation	P-preload / Deflector (bridge)		
Ball dia. / Ball circle dia.	1.200 / 8.3		
Screw shaft root diameter	6.9		
Effective ball turns	1 x 3		
Accuracy grade / Preload / Axial play	C3 / Z	C3 / T	
Basic load ratings (N)	Dynamic C_a	1 560	
	Static C_{0a}	2 200	
Axial play	0	0.005 or less	
Preload (N)	49.0	—	
Dynamic friction torque, (N-cm)	2.0 or less	0.5 or less	
Spacer ball	None		
Factory-packed grease	NSK grease PS2		

Recommended support unit

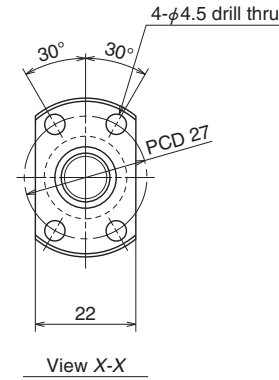
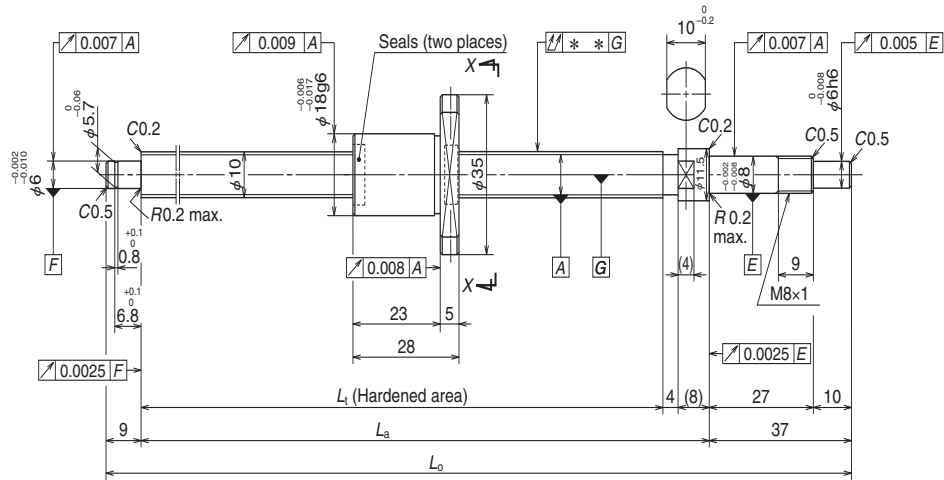
For drive side (Fixed)	For non-drive side (Simple)
WBK08-01A (square)	WBK08S-01 (square)
WBK08-11 (round)	

Unit: mm

Reference No.		Stroke	
Preloaded (MPFD)	Precise clearance (MSFD)	Nominal	Maximum
W0800MA-5PY-C3Z2	W0800MA-6Y-C3T2	40	49
W0801MA-9PY-C3Z2	W0801MA-10Y-C3T2	70	79
W0801MA-11PY-C3Z2	W0801MA-12Y-C3T2	100	109
W0802MA-5PY-C3Z2	W0802MA-6Y-C3T2	150	159

- Notes: 1. We recommend using NSK support units. See Page B377 for details.
 2. We recommend using NSK Grease PS2. Apply the grease to the screw shaft surface during replenishment. See Page D16 for details.
 3. Contact NSK if permissible rotational speed N will be exceeded.

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min ⁻¹)
L_t	L_a	L_0	T	e_p	v_u			Configuration
80	92	138	0	0.008	0.008	0.025	0.09	3 000
110	122	168	0	0.010	0.008	0.030	0.10	3 000
140	152	198	0	0.010	0.008	0.030	0.11	3 000
190	202	248	0	0.010	0.008	0.035	0.13	3 000



Ball screw specifications		
Product classification	Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn	10 x 2 / Right	
Preload / Ball recirculation	P-preload / Deflector (bridge)	
Ball dia. / Ball circle dia.	1.200 / 10.3	
Screw shaft root diameter	8.9	
Effective ball turns	1 x 3	
Accuracy grade / Preload / Axial play	C3 / Z	C3 / T
Basic load ratings (N)	Dynamic C_a	1 800
	Static C_{0a}	2 970
Axial play	0	0.005 or less
Preload (N)	58.8	—
Dynamic friction torque, (N-cm)	0.1 - 2.4	0.5 or less
Spacer ball	None	
Factory-packed grease	NSK grease PS2	

Recommended support unit

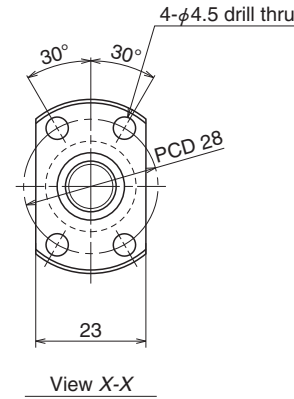
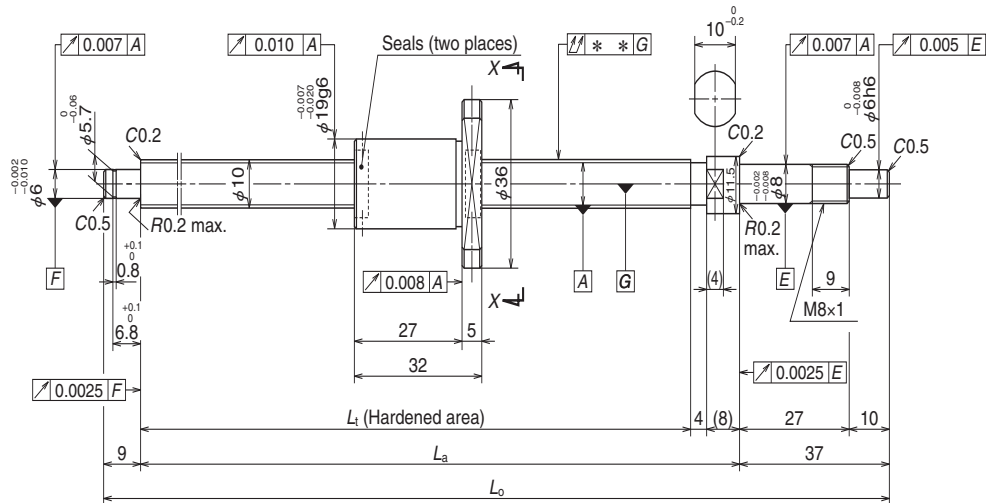
For drive side (Fixed)	For non-drive side (Simple)
WBK08-01A (square)	WBK08S-01 (square)
WBK08-11 (round)	

Unit: mm

Reference No.		Stroke	
		Nominal	Maximum
Preloaded (MPFD)	Precise clearance (MSFD)		
W1001MA-1PY-C3Z2	W1001MA-2Y-C3T2	50	67
W1001MA-3PY-C3Z2	W1001MA-4Y-C3T2	100	117
W1002MA-1PY-C3Z2	W1002MA-2Y-C3T2	150	167
W1002MA-3PY-C3Z2	W1002MA-4Y-C3T2	200	217

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min ⁻¹)
L_t	L_a	L_o	T	e_p	v_u			Configuration
								Fixed - Simple
100	112	158	0	0.008	0.008	0.020	0.13	3 000
150	162	208	0	0.010	0.008	0.030	0.16	3 000
200	212	258	0	0.010	0.008	0.030	0.19	3 000
250	262	308	0	0.012	0.008	0.030	0.22	3 000

- Notes: 1. We recommend using NSK support units. See Page B377 for details.
 2. We recommend using NSK Grease PS2. Apply the grease to the screw shaft surface during replenishment. See Page D16 for details.
 3. Contact NSK if permissible rotational speed N will be exceeded.



Ball screw specifications		
Product classification	Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn	10 x 2.5 / Right	
Preload / Ball recirculation	P-preload / Deflector (bridge)	
Ball dia. / Ball circle dia.	1.588 / 10.4	
Screw shaft root diameter	8.6	
Effective ball turns	1 x 3	
Accuracy grade / Preload / Axial play	C3 / Z	C3 / T
Basic load ratings (N)	Dynamic C_d	2 500
	Static C_0	3 630
Axial play	0	0.005 or less
Preload (N)	98.1	—
Dynamic friction torque, (N-cm)	0.2 - 2.9	0.5 or less
Spacer ball	None	
Factory-packed grease	NSK grease PS2	

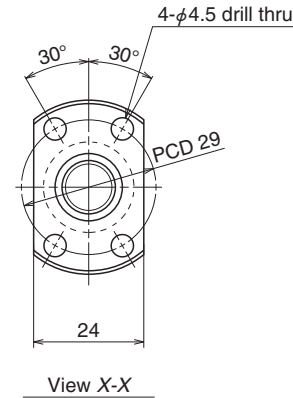
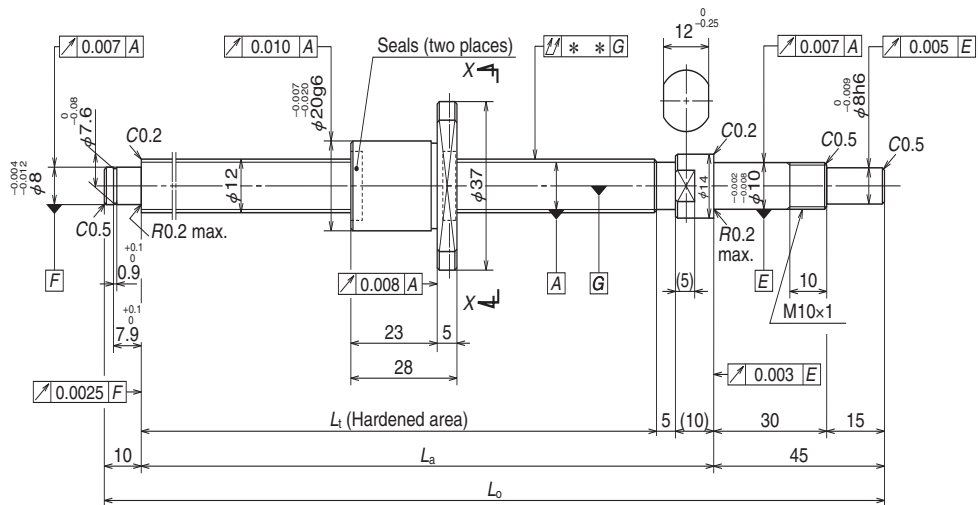
Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK08-01A (square)	WBK08S-01 (square)
WBK08-11 (round)	

Reference No.		Stroke	
		Nominal	Maximum
Preloaded (MPFD)	Precise clearance (MSFD)		
W1001MA-5PY-C3Z2.5	W1001MA-6Y-C3T2.5	50	63
W1001MA-7PY-C3Z2.5	W1001MA-8Y-C3T2.5	100	113
W1002MA-5PY-C3Z2.5	W1002MA-6Y-C3T2.5	150	163
W1002MA-7PY-C3Z2.5	W1002MA-8Y-C3T2.5	200	213

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min ⁻¹)
L_t	L_a	L_o	T	e_p	v_u			Configuration
								Fixed - Simple
100	112	158	0	0.008	0.008	0.020	0.14	3 000
150	162	208	0	0.010	0.008	0.030	0.17	3 000
200	212	258	0	0.010	0.008	0.030	0.20	3 000
250	262	308	0	0.012	0.008	0.030	0.23	3 000

- Notes: 1. We recommend using NSK support units. See Page B377 for details.
 2. We recommend using NSK Grease PS2. Apply the grease to the screw shaft surface during replenishment. See Page D16 for details.
 3. Contact NSK if permissible rotational speed N will be exceeded.



Ball screw specifications		
Product classification	Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn	12 x 2 / Right	
Preload / Ball recirculation	P-preload / Deflector (bridge)	
Ball dia. / Ball circle dia.	1.200 / 12.3	
Screw shaft root diameter	10.9	
Effective ball turns	1 x 3	
Accuracy grade / Preload / Axial play	C3 / Z	C3 / T
Basic load ratings (N)	Dynamic C_d	1 960
	Static C_0	3 620
Axial play	0	0.005 or less
Preload (N)	98.1	—
Dynamic friction torque, (N-cm)	0.4 - 3.4	1.0 or less
Spacer ball	None	
Factory-packed grease	NSK grease PS2	

Recommended support unit

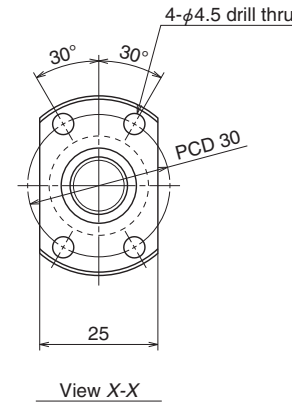
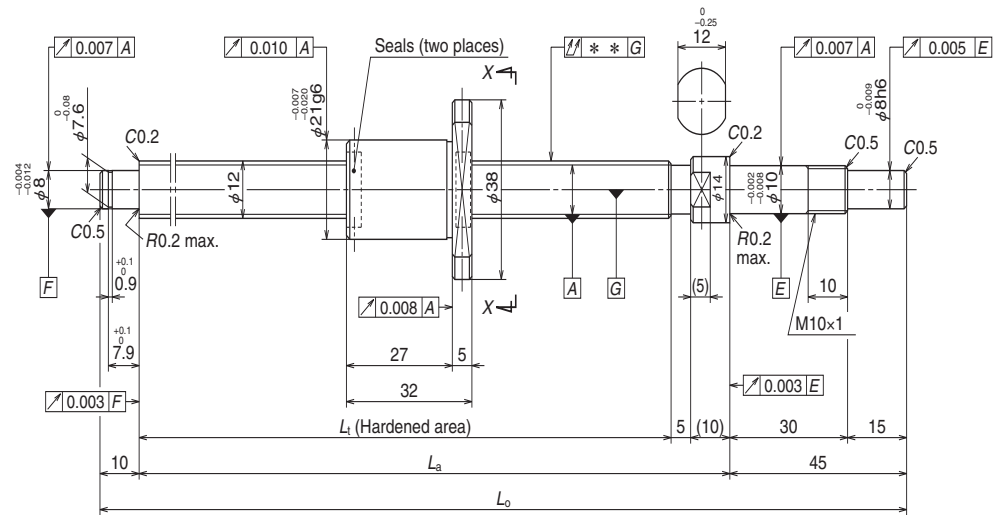
For drive side (Fixed)	For non-drive side (Simple)
WBK10-01A (square)	WBK10S-01 (square)
WBK10-11 (round)	

Unit: mm

Reference No.		Stroke	
		Nominal	Maximum
Preloaded (MPFD)	Precise clearance (MSFD)		
W1201MA-1PY-C3Z2	W1201MA-2Y-C3T2	50	75
W1201MA-3PY-C3Z2	W1201MA-4Y-C3T2	100	125
W1202MA-1PY-C3Z2	W1202MA-2Y-C3T2	150	175
W1202MA-3PY-C3Z2	W1202MA-4Y-C3T2	200	225
W1203MA-1PY-C3Z2	W1203MA-2Y-C3T2	250	275

- Notes: 1. We recommend using NSK support units. See Page B377 for details.
 2. We recommend using NSK Grease PS2. Apply the grease to the screw shaft surface during replenishment. See Page D16 for details.
 3. Contact NSK if permissible rotational speed N will be exceeded.

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min ⁻¹)
L_t	L_a	L_o	T	e_p	v_u			Configuration
110	125	180	0	0.010	0.008	0.020	0.20	3 000
160	175	230	0	0.010	0.008	0.030	0.24	3 000
210	225	280	0	0.012	0.008	0.030	0.28	3 000
260	275	330	0	0.012	0.008	0.040	0.32	3 000
310	325	380	0	0.012	0.008	0.040	0.36	3 000



Ball screw specifications		
Product classification	Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn	12 x 2.5 / Right	
Preload / Ball recirculation	P-preload / Deflector (bridge)	
Ball dia. / Ball circle dia.	1.588 / 12.4	
Screw shaft root diameter	10.6	
Effective ball turns	1 x 3	
Accuracy grade / Preload / Axial play	C3 / Z	C3 / T
Basic load ratings (N)	Dynamic C_d	2 790
	Static C_0	4 530
Axial play	0	0.005 or less
Preload (N)	98.1	—
Dynamic friction torque, (N-cm)	0.4 - 3.4	1.0 or less
Spacer ball	None	
Factory-packed grease	NSK grease PS2	

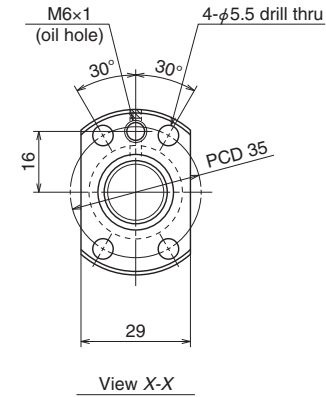
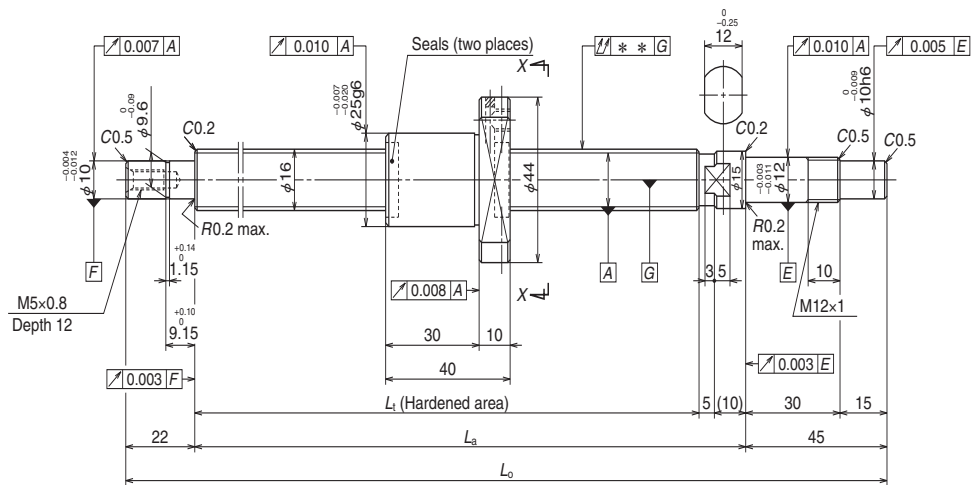
Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK10-01A (square)	WBK10S-01 (square)
WBK10-11 (round)	

Reference No.		Stroke	
		Nominal	Maximum
Preloaded (MPFD)	Precise clearance (MSFD)		
W1201MA-5PY-C3Z2.5	W1201MA-6Y-C3T2.5	50	71
W1201MA-7PY-C3Z2.5	W1201MA-8Y-C3T2.5	100	121
W1202MA-5PY-C3Z2.5	W1202MA-6Y-C3T2.5	150	171
W1202MA-7PY-C3Z2.5	W1202MA-8Y-C3T2.5	200	221
W1203MA-3PY-C3Z2.5	W1203MA-4Y-C3T2.5	250	271

- Notes: 1. We recommend using NSK support units. See Page B377 for details.
 2. We recommend using NSK Grease PS2. Apply the grease to the screw shaft surface during replenishment. See Page D16 for details.
 3. Contact NSK if permissible rotational speed N will be exceeded.

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min ⁻¹)
L_t	L_a	L_o	T	e_p	v_u			Configuration
110	125	180	0	0.010	0.008	0.020	0.21	3 000
160	175	230	0	0.010	0.008	0.030	0.25	3 000
210	225	280	0	0.012	0.008	0.030	0.29	3 000
260	275	330	0	0.012	0.008	0.040	0.33	3 000
310	325	380	0	0.012	0.008	0.040	0.37	3 000



Ball screw specifications		
Product classification	Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn	16 x 2 / Right	
Preload / Ball recirculation	P-preload / Deflector (bridge)	
Ball dia. / Ball circle dia.	1.588 / 16.4	
Screw shaft root diameter	14.6	
Effective ball turns	1 x 4	
Accuracy grade / Preload / Axial play	C3 / Z	C3 / T
Basic load ratings (N)	Dynamic C_a	4 150
	Static C_{0a}	8 450
Axial play	0	0.005 or less
Preload (N)	147	—
Dynamic friction torque (N-cm)	0.5 - 4.9	1.5 or less
Spacer ball	None	
Factory-packed grease	NSK grease PS2	
Nut internal space (cm ³)	1.6	
Standard grease replenishment (cm ³)	0.8	

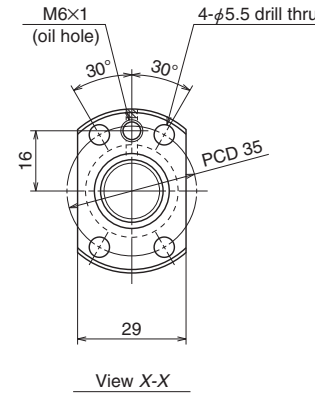
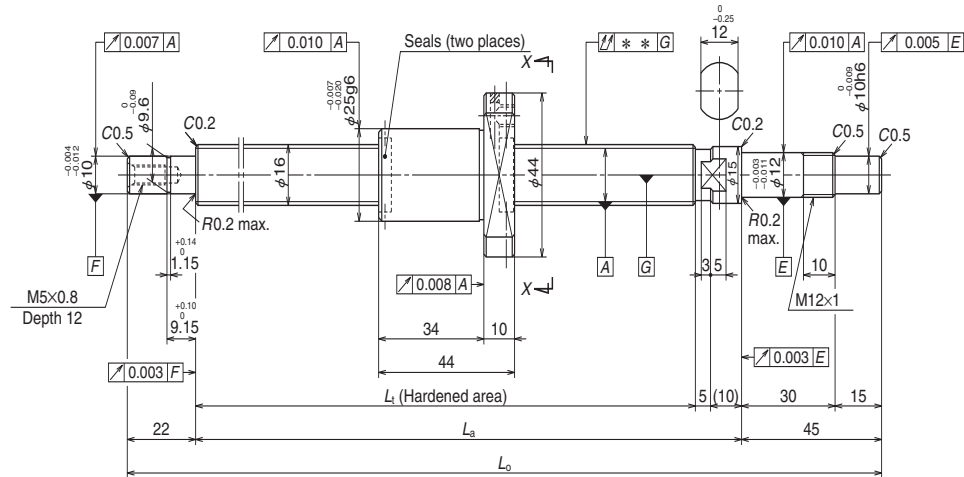
Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK12-01A (square)	WBK12S-01 (square)
WBK12-11 (round)	

Reference No.		Stroke	
		Nominal	Maximum
Preloaded (MPFD)	Precise clearance (MSFD)		
W1601MA-1PY-C3Z2	W1601MA-2Y-C3T2	50	93
W1601MA-3PY-C3Z2	W1601MA-4Y-C3T2	100	143
W1602MA-1PY-C3Z2	W1602MA-2Y-C3T2	150	193
W1602MA-3PY-C3Z2	W1602MA-4Y-C3T2	200	243
W1603MA-1PY-C3Z2	W1603MA-2Y-C3T2	300	343

- Notes: 1. We recommend using NSK support units. See Page B377 for details.
 2. We recommend using NSK Grease PS2. The standard quantity for replenishment is about 50% of the nut's internal space. See Page D16 for details.
 3. Contact NSK if permissible rotational speed N will be exceeded.
 4. The user must design the support bearing structure if the non-drive side is fixed.
 5. See Pages B51 and B52 for details on support configurations (Fixed-Simple, Fixed-Fixed, etc.)

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min ⁻¹)	
L_t	L_a	L_o	T	e_p	v_u			Configuration	
								Fixed - Simple	Fixed - Fixed
139	154	221	0	0.010	0.008	0.020	0.41	3 000	3 000
189	204	271	0	0.010	0.008	0.020	0.48	3 000	3 000
239	254	321	0	0.012	0.008	0.030	0.55	3 000	3 000
289	304	371	0	0.012	0.008	0.030	0.62	3 000	3 000
389	404	471	0	0.013	0.010	0.035	0.77	3 000	3 000



Ball screw specifications		
Product classification	Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn	16 x 2.5 / Right	
Preload / Ball recirculation	P-preload / Deflector (bridge)	
Ball dia. / Ball circle dia.	1.588 / 16.4	
Screw shaft root diameter	14.6	
Effective ball turns	1 x 4	
Accuracy grade / Preload / Axial play	C3 / Z	C3 / T
Basic load ratings (N)	Dynamic C_a	4 150
	Static C_{0a}	8 440
Axial play	0	0.005 or less
Preload (N)	147	—
Dynamic friction torque (N-cm)	0.5 – 4.9	1.5 or less
Spacer ball	None	
Factory-packed grease	NSK grease PS2	
Nut internal space (cm ³)	1.6	
Standard grease replenishment (cm ³)	0.8	

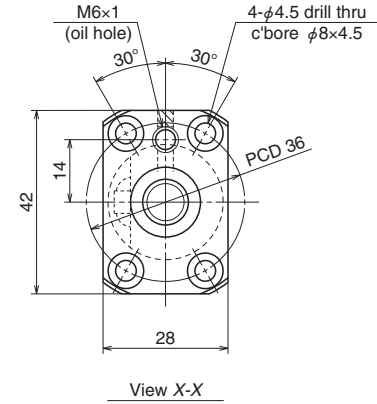
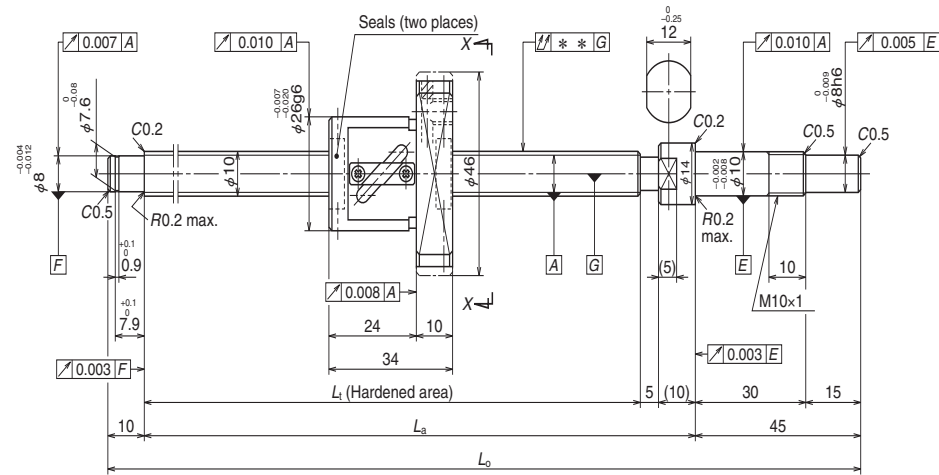
Recommended support unit

For drive side (Fixed)	non-drive side (Simple)
WBK12-01A (square)	WBK12S-01 (square)
WBK12-11 (round)	

Reference No.		Stroke	
		Nominal	Maximum
Preloaded (MPFD)	Precise clearance (MSFD)		
W1601MA-5PY-C3Z2.5	W1601MA-6Y-C3T2.5	50	89
W1601MA-7PY-C3Z2.5	W1601MA-8Y-C3T2.5	100	139
W1602MA-5PY-C3Z2.5	W1602MA-6Y-C3T2.5	150	189
W1602MA-7PY-C3Z2.5	W1602MA-8Y-C3T2.5	200	239
W1603MA-3PY-C3Z2.5	W1603MA-4Y-C3T2.5	300	339

- Notes:
1. We recommend using NSK support units. See Page B377 for details.
 2. We recommend using NSK Grease PS2. The standard quantity for replenishment is about 50% of the nut's internal space. See Page D16 for details.
 3. Contact NSK if permissible rotational speed N will be exceeded.
 4. The user must design the support bearing structure if the non-drive side is fixed.
 5. See Pages B51 and B52 for details on support configurations (Fixed-Simple, Fixed-Fixed, etc.)

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min ⁻¹)	
								Configuration	
L_t	L_a	L_o	T	e_p	v_u		Fixed - Simple	Fixed - Fixed	
139	154	221	0	0.010	0.008	0.020	0.42	3 000	3 000
189	204	271	0	0.010	0.008	0.020	0.49	3 000	3 000
239	254	321	0	0.012	0.008	0.030	0.57	3 000	3 000
289	304	371	0	0.012	0.008	0.030	0.64	3 000	3 000
389	404	471	0	0.013	0.010	0.035	0.79	3 000	3 000



Ball screw specifications

Product classification	Preloaded	Precise clearance	
Shaft dia. x Lead / Direction of turn	10 x 4 / Right		
Preload / Ball recirculation	P-preload / Tube		
Ball dia. / Ball circle dia.	2.000 / 10.3		
Screw shaft root diameter	8.2		
Effective ball turns	2.5 x 1		
Accuracy grade / Preload / Axial play	C3 / Z	C3 / T	
Basic load ratings (N)	Dynamic C_a	2 020	3 210
	Static C_{0a}	2 210	4 420
Axial play	0	0.005 or less	
Preload (N)	98.1	—	
Dynamic friction torque (N-cm)	0.5 - 3.9	1.0 or less	
Spacer ball	Yes	None	
Factory-packed grease	NSK grease PS2		
Nut internal space (cm ³)	0.8		
Standard grease replenishment (cm ³)	0.4		

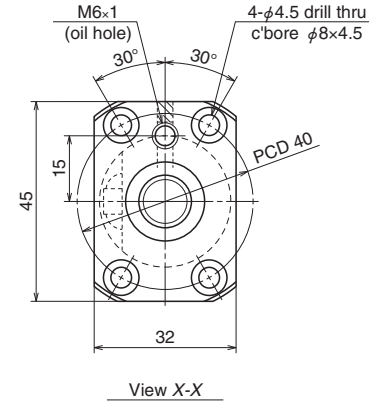
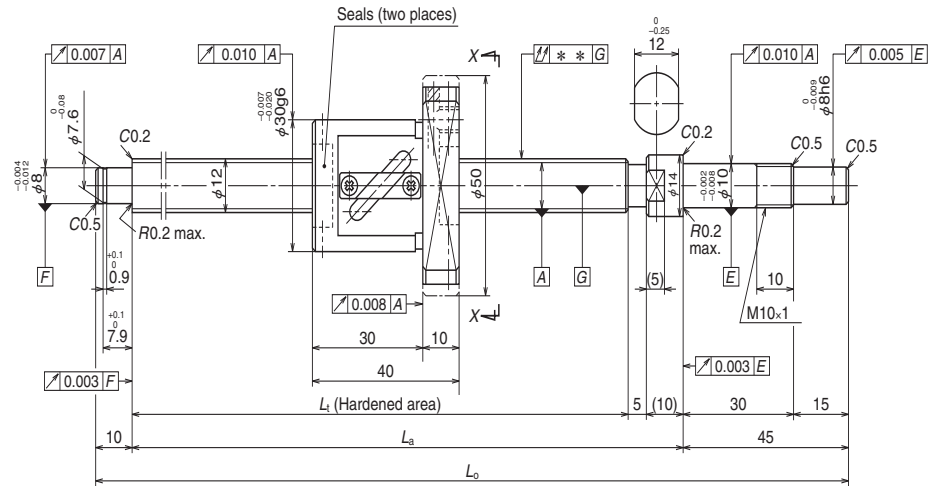
Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK10-01A (square)	WBK10S-01 (square)
WBK10-11 (round)	

Reference No.		Stroke	
		Nominal	Maximum
Preloaded (PFT)	Precise clearance (SFT)		
W1001FA-1P-C3Z4	W1001FA-2-C3T4	50	69
W1001FA-3P-C3Z4	W1001FA-4-C3T4	100	119
W1002FA-1P-C3Z4	W1002FA-2-C3T4	150	169
W1002FA-3P-C3Z4	W1002FA-4-C3T4	200	219
W1003FA-1P-C3Z4	W1003FA-2-C3T4	250	269
W1003FA-3P-C3Z4	W1003FA-4-C3T4	300	319

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min ⁻¹)	
								Configuration	Fixed - Simple
L_t	L_a	L_o	T	e_p	v_u				
110	125	180	0	0.010	0.008	0.020	0.26	3 000	
160	175	230	0	0.010	0.008	0.030	0.28	3 000	
210	225	280	0	0.012	0.008	0.030	0.31	3 000	
260	275	330	0	0.012	0.008	0.040	0.34	3 000	
310	325	380	0	0.012	0.008	0.040	0.37	3 000	
360	375	430	0	0.013	0.010	0.050	0.39	3 000	

- Notes: 1. We recommend using NSK support units. See Page B377 for details.
 2. We recommend using NSK Grease PS2. The standard quantity for replenishment is about 50% of the nut's internal space. See Page D16 for details.
 3. Contact NSK if permissible rotational speed N will be exceeded.



Ball screw specifications

Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		12 x 5 / Right	
Preload / Ball recirculation		P-preload / Tube	
Ball dia. / Ball circle dia.		2.381 / 12.3	
Screw shaft root diameter		9.8	
Effective ball turns		2.5 x 1	
Accuracy grade / Preload / Axial play		C3 / Z	C3 / T
Basic load ratings (N)	Dynamic C_a	2 770	4 390
	Static C_{0a}	3 130	6 260
Axial play		0	0.005 or less
Preload (N)		98.1	—
Dynamic friction torque (N-cm)		1.0 - 4.4	1.0 or less
Spacer ball		Yes	None
Factory-packed grease		NSK grease PS2	
Nut internal space (cm ³)		1.2	
Standard grease replenishment (cm ³)		0.6	

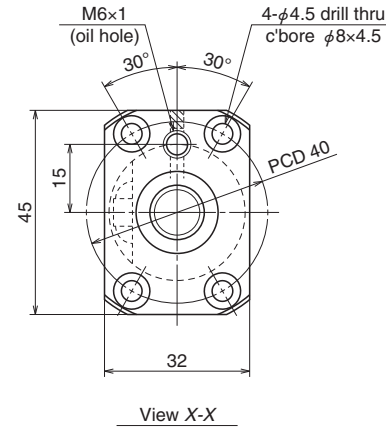
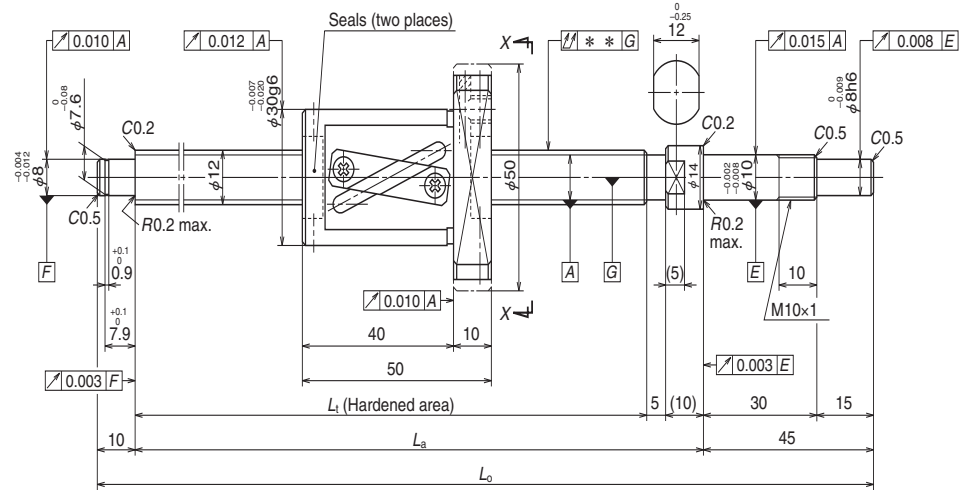
Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK10-01A (square)	WBK10S-01 (square)
WBK10-11 (round)	

Reference No.		Stroke	
		Nominal	Maximum
Preloaded (PFT)	Precise clearance (SFT)		
W1201FA-1P-C3Z5	W1201FA-2-C3T5	50	63
W1201FA-3P-C3Z5	W1201FA-4-C3T5	100	113
W1202FA-1P-C3Z5	W1202FA-2-C3T5	150	163
W1202FA-3P-C3Z5	W1202FA-4-C3T5	200	213
W1203FA-1P-C3Z5	W1203FA-2-C3T5	250	263
W1204FA-1P-C3Z5	W1204FA-2-C3T5	350	363
W1205FA-1P-C3Z5	W1205FA-2-C3T5	450	463

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min ⁻¹)	
L_t	L_a	L_o	T	e_p	v_u			Configuration	Fixed - Simple
110	125	180	0	0.010	0.008	0.020	0.35	3 000	
160	175	230	0	0.010	0.008	0.030	0.38	3 000	
210	225	280	0	0.012	0.008	0.030	0.42	3 000	
260	275	330	0	0.012	0.008	0.040	0.46	3 000	
310	325	380	0	0.012	0.008	0.040	0.50	3 000	
410	425	480	0	0.015	0.010	0.050	0.58	3 000	
510	525	580	0	0.016	0.012	0.065	0.66	3 000	

- Notes: 1. We recommend using NSK support units. See Page B377 for details.
 2. We recommend using NSK Grease PS2. The standard quantity for replenishment is about 50% of the nut's internal space. See Page D16 for details.
 3. Contact NSK if permissible rotational speed N will be exceeded.



Ball screw specifications			
Product classification	Preloaded	Precise clearance	
Shaft dia. x Lead / Direction of turn	12 x 10 / Right		
Preload / Ball recirculation	P-preload / Tube		
Ball dia. / Ball circle dia.	2.381 / 12.5		
Screw shaft root diameter	10.0		
Effective ball turns	2.5 x 1		
Accuracy grade / Preload / Axial play	C5 / Z	C5 / T	
Basic load ratings (N)	Dynamic C _a	2 790	4 430
	Static C _{0a}	3 220	6 430
Axial play	0	0.005 or less	
Preload (N)	98.1	—	
Dynamic friction torque (N-cm)	1.0 - 4.9	1.5 or less	
Spacer ball	Yes	None	
Factory-packed grease	NSK grease LR3		
Nut internal space (cm ³)	1.4		
Standard grease replenishment (cm ³)	0.7		

Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK10-01A (square)	WBK10S-01 (square)
WBK10-11 (round)	

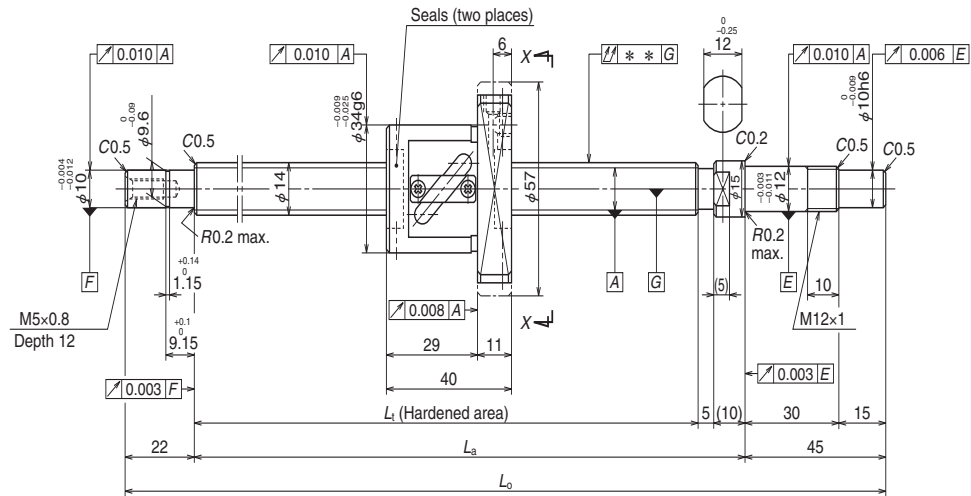
Reference No.		Stroke	
		Nominal	Maximum
Preloaded (LPFT)	Precise clearance (LSFT)		
W1201FA-5P-C5Z10	W1201FA-6-C5T10	100	103
W1202FA-5P-C5Z10	W1202FA-6-C5T10	150	153
W1203FA-3P-C5Z10	W1203FA-4-C5T10	250	253
W1204FA-3P-C5Z10	W1204FA-4-C5T10	350	353
W1205FA-3P-C5Z10	W1205FA-4-C5T10	450	453

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min ⁻¹)	
L _t	L _a	L _o	T	e _p	v _u			Configuration	Fixed - Simple
160	175	230	0	0.020	0.018	0.035	0.43	3 000	
210	225	280	0	0.023	0.018	0.035	0.47	3 000	
310	325	380	0	0.023	0.018	0.050	0.56	3 000	
410	425	480	0	0.027	0.020	0.060	0.64	3 000	
510	525	580	0	0.030	0.023	0.075	0.72	3 000	

- Notes: 1. We recommend using NSK support units. See Page B377 for details.
 2. We recommend using NSK Grease LR3. The standard quantity for replenishment is about 50% of the nut's internal space. See Page D16 for details.
 3. Contact NSK if permissible rotational speed N will be exceeded.

Finished Shaft End FA Model

(Fine lead)



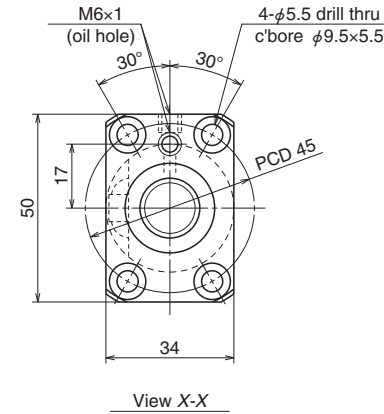
Nut: PFT, SFT

NSK

Screw shaft $\phi 14$

Lead 5

Unit: mm



Ball screw specifications			
Product classification	Preloaded	Precise clearance	
Shaft dia. x Lead / Direction of turn	14 x 5 / Right		
Preload / Ball recirculation	P-preload / Tube		
Ball dia. / Ball circle dia.	3.175 / 14.5		
Screw shaft root diameter	11.2		
Effective ball turns	2.5 x 1		
Accuracy grade / Preload / Axial play	C3 / Z	C3 / T	
Basic load ratings (N)	Dynamic C_a	5 020	7 970
	Static C_{0a}	5 970	11 900
Axial play	0	0.005 or less	
Preload (N)	147	—	
Dynamic friction torque (N-cm)	1.5 - 6.9	2.0 or less	
Spacer ball	Yes	None	
Factory-packed grease	NSK grease LR3		
Nut internal space (cm ³)	2.2		
Standard grease replenishment (cm ³)	1.1		

Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK12-01A (square)	WBK12S-01 (square)
WBK12-11 (round)	

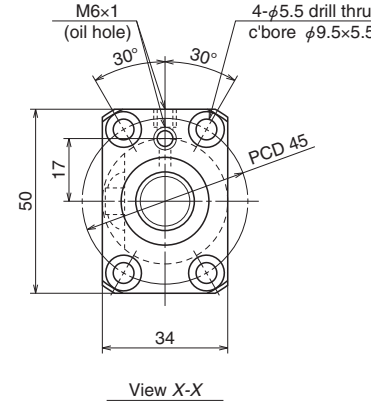
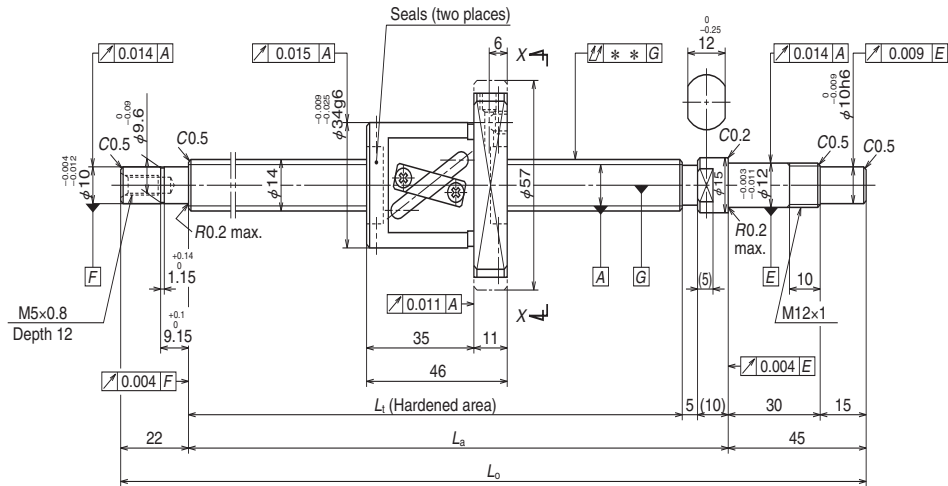
Unit: mm

Reference No.		Stroke	
		Nominal	Maximum
Preloaded (PFT)	Precise clearance (SFT)		
W1401FA-1P-C3Z5	W1401FA-2-C3T5	100	143
W1402FA-1P-C3Z5	W1402FA-2-C3T5	150	193
W1403FA-1P-C3Z5	W1403FA-2-C3T5	250	293
W1404FA-1P-C3Z5	W1404FA-2-C3T5	350	393
W1405FA-1P-C3Z5	W1405FA-2-C3T5	450	493
W1406FA-1P-C3Z5	W1406FA-2-C3T5	600	643

- Notes: 1. We recommend using NSK support units. See Page B377 for details.
 2. We recommend using NSK Grease LR3. The standard quantity for replenishment is about 50% of the nut's internal space. See Page D16 for details.
 3. Contact NSK if permissible rotational speed N will be exceeded.

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min ⁻¹)	
L_t	L_a	L_o	T	e_p	v_a			Configuration	
								Fixed - Simple	Fixed - Fixed
189	204	271	0	0.010	0.008	0.020	0.52	3 000	3 000
239	254	321	0	0.012	0.008	0.030	0.57	3 000	3 000
339	354	421	0	0.013	0.010	0.035	0.67	3 000	3 000
439	454	521	0	0.015	0.010	0.045	0.77	3 000	3 000
539	554	621	0	0.016	0.012	0.045	0.87	3 000	3 000
689	704	771	0	0.018	0.013	0.055	1.0	3 000	3 000

- Notes: 4. The user must design the support bearing structure if the non-drive side is fixed.
 5. See Pages B51 and B52 for details on support configurations (Fixed-Simple, Fixed-Fixed, etc.)



Ball screw specifications		
Product classification	Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn	14 × 8 / Right	
Preload / Ball recirculation	P-preload / Tube	
Ball dia. / Ball circle dia.	3.175 / 14.5	
Screw shaft root diameter	11.2	
Effective ball turns	2.5 × 1	
Accuracy grade / Preload / Axial play	C5 / Z	C5 / T
Basic load ratings (N)	Dynamic C _a	4 960
	Static C _{0a}	5 920
Dynamic C _{0a}	7 880	11 800
Axial play	0	0.005 or less
Preload (N)	147	—
Dynamic friction torque (N·cm)	1.5 – 7.8	2.4 or less
Spacer ball	Yes	None
Factory-packed grease	NSK grease LR3	
Nut internal space (cm ³)	2.1	
Standard grease replenishment (cm ³)	1.1	

Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK12-01A (square)	WBK12S-01 (square)
WBK12-11 (round)	

Unit: mm

Reference No.		Stroke	
		Nominal	Maximum
Preloaded (LPFT)	Precise clearance (LSFT)		
W1401FA-3P-C5Z8	W1401FA-4-C5T8	100	137
W1402FA-3P-C5Z8	W1402FA-4-C5T8	150	187
W1402FA-5P-C5Z8	W1402FA-6-C5T8	200	237
W1403FA-3P-C5Z8	W1403FA-4-C5T8	250	287
W1403FA-5P-C5Z8	W1403FA-6-C5T8	300	337
W1404FA-3P-C5Z8	W1404FA-4-C5T8	350	387
W1404FA-5P-C5Z8	W1404FA-6-C5T8	400	437
W1405FA-3P-C5Z8	W1405FA-4-C5T8	450	487
W1405FA-5P-C5Z8	W1405FA-6-C5T8	500	537
W1406FA-3P-C5Z8	W1406FA-4-C5T8	550	587
W1406FA-5P-C5Z8	W1406FA-6-C5T8	600	637
W1407FA-1P-C5Z8	W1407FA-2-C5T8	700	737

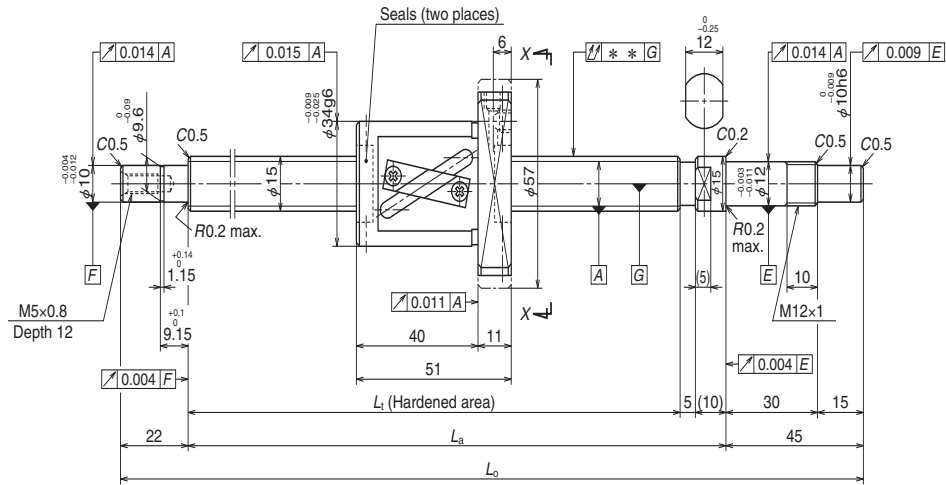
- Notes: 1. We recommend using NSK support units. See Page B377 for details.
- 2. We recommend using NSK Grease LR3. The standard quantity for replenishment is about 50% of the nut's internal space. See Page D16 for details.
- 3. Contact NSK if permissible rotational speed *N* will be exceeded.

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed <i>N</i> (min ⁻¹)	
								Configuration	
<i>L_t</i>	<i>L_a</i>	<i>L_o</i>	<i>T</i>	<i>e_p</i>	<i>v_a</i>		Fixed - Simple	Fixed - Fixed	
189	204	271	0	0.020	0.018	0.025	0.56	3 000	3 000
239	254	321	0	0.023	0.018	0.035	0.61	3 000	3 000
289	304	371	0	0.023	0.018	0.035	0.67	3 000	3 000
339	354	421	0	0.025	0.020	0.040	0.72	3 000	3 000
389	404	471	0	0.025	0.020	0.040	0.78	3 000	3 000
439	454	521	0	0.027	0.020	0.050	0.83	3 000	3 000
489	504	571	0	0.027	0.020	0.050	0.88	3 000	3 000
539	554	621	0	0.030	0.023	0.050	0.94	3 000	3 000
589	604	671	0	0.030	0.023	0.065	0.99	3 000	3 000
639	654	721	0	0.035	0.025	0.065	1.0	3 000	3 000
689	704	771	0	0.035	0.025	0.065	1.1	3 000	3 000
789	804	871	0	0.035	0.025	0.085	1.2	2 830	3 000

- Notes: 4. The user must design the support bearing structure if the non-drive side is fixed.
- 5. See Pages B51 and B52 for details on support configurations (Fixed-Simple, Fixed-Fixed, etc.)

Finished Shaft End FA Model

(Medium lead)

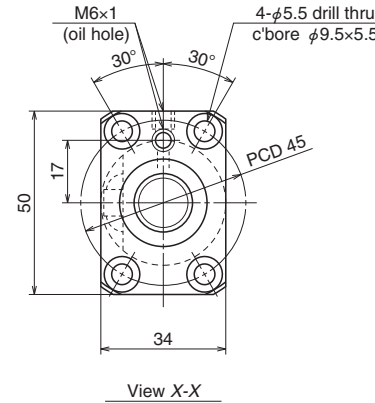


Nut: LPFT, LSFT

NSK

Screw shaft ø15

Unit: mm Lead 10



Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK12-01A (square)	WBK12S-01 (square)
WBK12-11 (round)	

Ball screw specifications		
Product classification	Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn	15 × 10 / Right	
Preload / Ball recirculation	P-preload / Tube	
Ball dia. / Ball circle dia.	3.175 / 15.5	
Screw shaft root diameter	12.2	
Effective ball turns	2.5 × 1	
Accuracy grade / Preload / Axial play	C5 / Z	C5 / T
Basic load ratings (N)	Dynamic C _a	5 130 8 140
	Static C _{0a}	6 420 12 800
Axial play	0	0.005 or less
Preload (N)	147	—
Dynamic friction torque (N·cm)	1.5 – 7.8	2.4 or less
Spacer ball	Yes	None
Factory-packed grease	NSK grease LR3	
Nut internal space (cm ³)	2.3	
Standard grease replenishment (cm ³)	1.2	

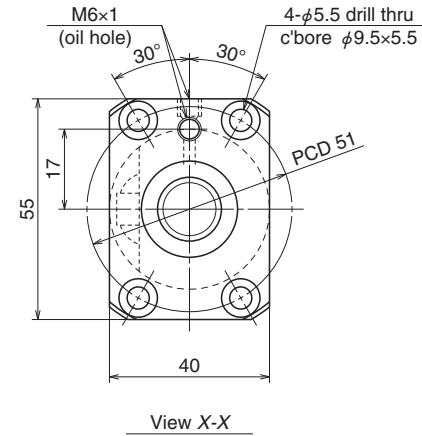
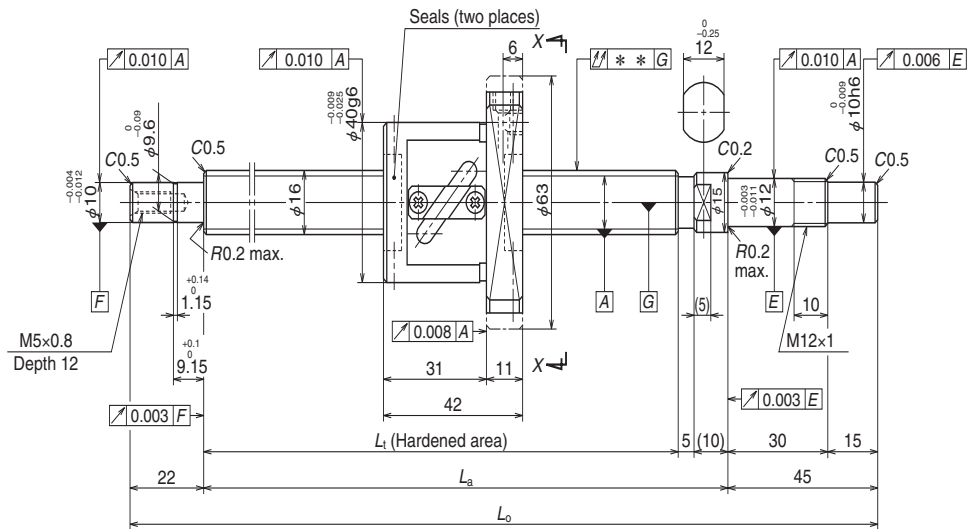
Unit: mm

Reference No.		Stroke	
		Nominal	Maximum
Preloaded (LPFT)	Precise clearance (LSFT)		
W1501FA-1P-C5Z10	W1501FA-2-C5T10	100	132
W1502FA-1P-C5Z10	W1502FA-2-C5T10	150	182
W1502FA-3P-C5Z10	W1502FA-4-C5T10	200	232
W1503FA-1P-C5Z10	W1503FA-2-C5T10	250	282
W1503FA-3P-C5Z10	W1503FA-4-C5T10	300	332
W1504FA-1P-C5Z10	W1504FA-2-C5T10	350	382
W1504FA-3P-C5Z10	W1504FA-4-C5T10	400	432
W1505FA-1P-C5Z10	W1505FA-2-C5T10	450	482
W1505FA-3P-C5Z10	W1505FA-4-C5T10	500	532
W1506FA-1P-C5Z10	W1506FA-2-C5T10	550	582
W1506FA-3P-C5Z10	W1506FA-4-C5T10	600	632
W1507FA-1P-C5Z10	W1507FA-2-C5T10	700	732
W1508FA-1P-C5Z10	W1508FA-2-C5T10	800	832
W1510FA-1P-C5Z10	W1510FA-2-C5T10	1 000	1 032

1. We recommend using NSK support units. See Page B377 for details.
2. We recommend using NSK Grease LR3. The standard quantity for replenishment is about 50% of the nut's internal space. See Page D16 for details.
3. Contact NSK if permissible rotational speed *N* will be exceeded.

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed <i>N</i> (min ⁻¹)	
								Configuration	
<i>L_t</i>	<i>L_a</i>	<i>L_o</i>	<i>T</i>	<i>e_p</i>	<i>v_s</i>			Fixed - Simple	Fixed - Fixed
189	204	271	0	0.020	0.018	0.025	0.61	3 000	3 000
239	254	321	0	0.023	0.018	0.035	0.67	3 000	3 000
289	304	371	0	0.023	0.018	0.035	0.74	3 000	3 000
339	354	421	0	0.025	0.020	0.040	0.80	3 000	3 000
389	404	471	0	0.025	0.020	0.040	0.86	3 000	3 000
439	454	521	0	0.027	0.020	0.050	0.93	3 000	3 000
489	504	571	0	0.027	0.020	0.050	1.0	3 000	3 000
539	554	621	0	0.030	0.023	0.050	1.1	3 000	3 000
589	604	671	0	0.030	0.023	0.065	1.1	3 000	3 000
639	654	721	0	0.035	0.025	0.065	1.2	3 000	3 000
689	704	771	0	0.035	0.025	0.065	1.2	3 000	3 000
789	804	871	0	0.035	0.025	0.085	1.4	3 000	3 000
889	904	971	0	0.040	0.027	0.085	1.5	2 430	3 000
1 089	1 104	1 171	0	0.046	0.030	0.110	1.8	1 600	2 250

4. The user must design the support bearing structure if the non-drive side is fixed.
5. See Pages B51 and B52 for details on support configurations (Fixed-Simple, Fixed-Fixed, etc.)



Ball screw specifications			
Product classification	Preloaded	Precise clearance	
Shaft dia. x Lead / Direction of turn	16 × 5 / Right		
Preload / Ball recirculation	P-preload / Tube		
Ball dia. / Ball circle dia.	3.175 / 16.5		
Screw shaft root diameter	13.2		
Effective ball turns	2.5 × 1		
Accuracy grade / Preload / Axial play	C3 / Z	C3 / T	
Basic load ratings (N)	Dynamic C_a	5 430	8 620
	Static C_{0a}	6 890	13 800
Axial play	0	0.005 or less	
Preload (N)	147	—	
Dynamic friction torque (N-cm)	1.5 – 7.8	2.0 or less	
Spacer ball	Yes	None	
Factory-packed grease	NSK grease LR3		
Nut internal space (cm ³)	2.6		
Standard grease replenishment (cm ³)	1.3		

Recommended support unit

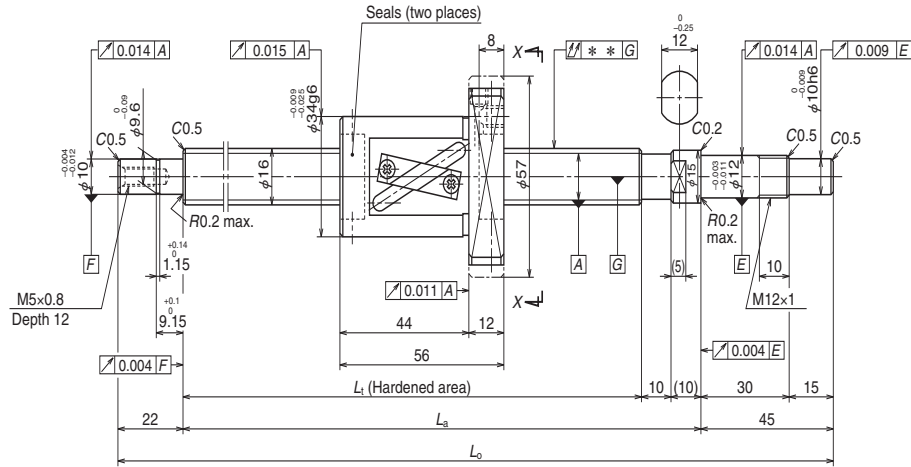
For drive side (Fixed)	For non-drive side (Simple)
WBK12-01A (square)	WBK12S-01 (square)
WBK12-11 (round)	

Reference No.		Stroke	
		Nominal	Maximum
Preloaded (PFT)	Precise clearance (SFT)		
W1601FA-1P-C3Z5	W1601FA-2-C3T5	100	141
W1602FA-1P-C3Z5	W1602FA-2-C3T5	200	241
W1603FA-1P-C3Z5	W1603FA-2-C3T5	300	341
W1604FA-1P-C3Z5	W1604FA-2-C3T5	400	441
W1606FA-1P-C3Z5	W1606FA-2-C3T5	600	641
W1608FA-1P-C3Z5	W1608FA-2-C3T5	800	841

- Notes: 1. We recommend using NSK support units. See Page B377 for details.
 2. We recommend using NSK Grease LR3. The standard quantity for replenishment is about 50% of the nut's internal space. See Page D16 for details.
 3. Contact NSK if permissible rotational speed N will be exceeded.

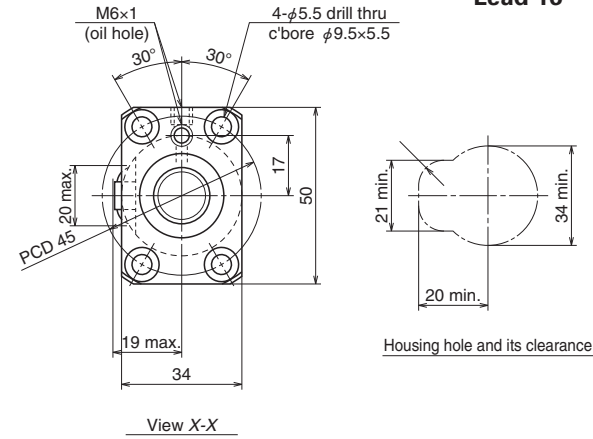
Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min ⁻¹)	
L_t	L_a	L_o	T	e_p	v_a			Configuration	
								Fixed - Simple	Fixed - Fixed
189	204	271	0	0.010	0.008	0.020	0.70	3 000	3 000
289	304	371	0	0.012	0.008	0.030	0.83	3 000	3 000
389	404	471	0	0.013	0.010	0.035	0.97	3 000	3 000
489	504	571	0	0.015	0.010	0.045	1.1	3 000	3 000
689	704	771	0	0.018	0.013	0.055	1.4	3 000	3 000
889	904	971	0	0.021	0.015	0.075	1.6	2 570	3 000

- Notes: 4. The user must design the support bearing structure if the non-drive side is fixed.
 5. See Pages B51 and B52 for details on support configurations (Fixed-Simple, Fixed-Fixed, etc.)



Screw shaft ø16

Lead 16



Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK12-01A (square)	WBK12S-01 (square)
WBK12-11 (round)	

Ball screw specifications		
Product classification	Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn	16 x 16 / Right	
Preload / Ball recirculation	P-preload / Tube	
Ball dia. / Ball circle dia.	3.175 / 16.75	
Screw shaft root diameter	13.4	
Effective ball turns	1.5 x 1	
Accuracy grade / Preload / Axial play	C5 / Z	C5 / T
Basic load ratings (N)	Dynamic C _a	4 180
	Static C _{0a}	5 390
Axial play	0	0.005 or less
Preload (N)	147	—
Dynamic friction torque (N-cm)	1.5 - 7.8	2.4 or less
Spacer ball	Yes	None
Factory-packed grease	NSK grease LR3	
Nut internal space (cm ³)	2.1	
Standard grease replenishment (cm ³)	1.1	

Reference No.		Stroke	
Preloaded (LPFT)	Precise clearance (LSFT)	Nominal	Maximum
W1601FA-3P-C5Z16	W1601FA-4-C5T16	100	122
W1602FA-3P-C5Z16	W1602FA-4-C5T16	150	172
W1602FA-5P-C5Z16	W1602FA-6-C5T16	200	222
W1603FA-3P-C5Z16	W1603FA-4-C5T16	250	272
W1603FA-5P-C5Z16	W1603FA-6-C5T16	300	322
W1604FA-3P-C5Z16	W1604FA-4-C5T16	350	372
W1604FA-5P-C5Z16	W1604FA-6-C5T16	400	422
W1605FA-1P-C5Z16	W1605FA-2-C5T16	450	472
W1605FA-3P-C5Z16	W1605FA-4-C5T16	500	522
W1606FA-3P-C5Z16	W1606FA-4-C5T16	550	572
W1606FA-5P-C5Z16	W1606FA-6-C5T16	600	622
W1607FA-1P-C5Z16	W1607FA-2-C5T16	700	722
W1608FA-3P-C5Z16	W1608FA-4-C5T16	800	822
W1610FA-1P-C5Z16	W1610FA-2-C5T16	1 000	1 022

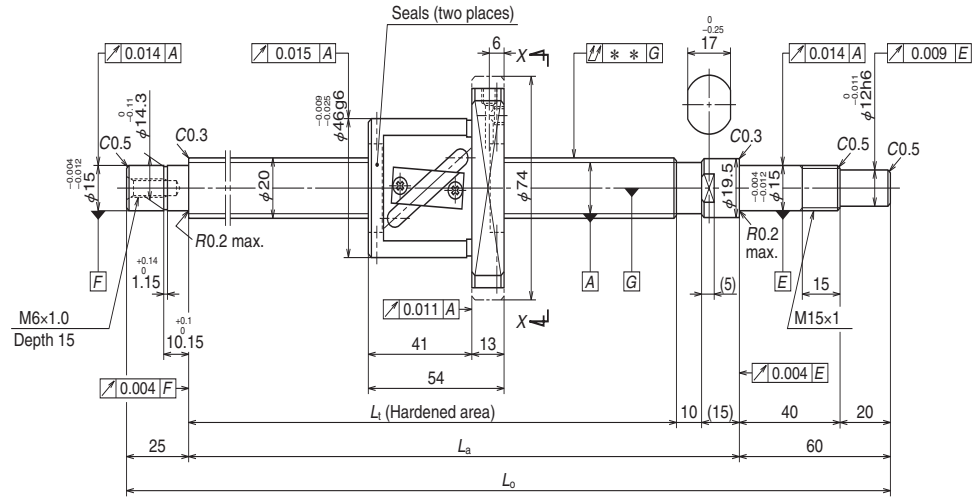
- Notes:
1. We recommend using NSK support units. See Page B377 for details.
 2. We recommend using NSK Grease LR3. The standard quantity for replenishment is about 50% of the nut's internal space. See Page D16 for details.
 3. Contact NSK if permissible rotational speed *N* will be exceeded.

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed <i>N</i> (min ⁻¹)	
<i>L_t</i>	<i>L_a</i>	<i>L_o</i>	<i>T</i>	<i>e_p</i>	<i>v_a</i>			Configuration	
								Fixed - Simple	Fixed - Fixed
184	204	271	0	0.020	0.018	0.025	0.69	3 000	3 000
234	254	321	0	0.023	0.018	0.035	0.77	3 000	3 000
284	304	371	0	0.023	0.018	0.035	0.84	3 000	3 000
334	354	421	0	0.025	0.020	0.040	0.92	3 000	3 000
384	404	471	0	0.025	0.020	0.040	0.99	3 000	3 000
434	454	521	0	0.027	0.020	0.050	1.1	3 000	3 000
484	504	571	0	0.027	0.020	0.050	1.1	3 000	3 000
534	554	621	0	0.030	0.023	0.050	1.2	3 000	3 000
584	604	671	0	0.030	0.023	0.065	1.3	3 000	3 000
634	654	721	0	0.035	0.025	0.065	1.4	3 000	3 000
684	704	771	0	0.035	0.025	0.065	1.4	3 000	3 000
784	804	871	0	0.035	0.025	0.085	1.6	3 000	3 000
884	904	971	0	0.040	0.027	0.085	1.7	2 720	3 000
1 084	1 104	1 171	0	0.046	0.030	0.110	2.0	1 790	2 480

- Notes:
4. The user must design the support bearing structure if the non-drive side is fixed.
 5. See Pages B51 and B52 for details on support configurations (Fixed-Simple, Fixed-Fixed, etc.)

Finished Shaft End FA Model

(Medium lead)



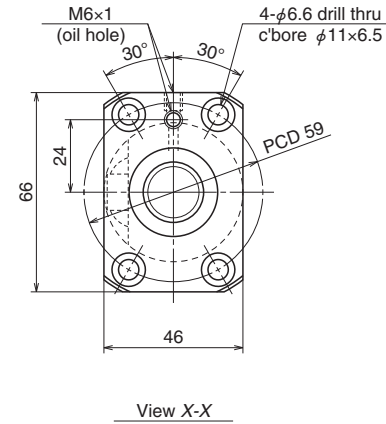
Nut: LPFT, LSFT

NSK

Screw shaft ø20

Lead 10

Unit: mm



Ball screw specifications			
Product classification	Preloaded	Precise clearance	
Shaft dia. x Lead / Direction of turn	20 x 10 / Right		
Preload / Ball recirculation	P-preload / Tube		
Ball dia. / Ball circle dia.	3.969 / 21		
Screw shaft root diameter	16.9		
Effective ball turns	2.5 x 1		
Accuracy grade / Preload / Axial play	C5 / Z	C5 / T	
Basic load ratings (N)	Dynamic C _a	8 350	13 300
	Static C _{0a}	11 000	21 900
Axial play	0	0.005 or less	
Preload (N)	196	—	
Dynamic friction torque (N-cm)	2.0 - 11.8	2.9 or less	
Spacer ball	Yes	None	
Factory-packed grease	NSK grease LR3		
Nut internal space (cm ³)	4.7		
Standard grease replenishment (cm ³)	2.4		

Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK15-01A (square)	WBK15S-01 (square)
WBK15-11 (round)	

Unit: mm

Reference No.		Stroke	
		Nominal	Maximum
Preloaded (LPFT)	Precise clearance (LSFT)		
W2002FA-1P-C5Z10	W2002FA-2-C5T10	200	229
W2003FA-1P-C5Z10	W2003FA-2-C5T10	300	329
W2004FA-1P-C5Z10	W2004FA-2-C5T10	400	429
W2005FA-1P-C5Z10	W2005FA-2-C5T10	500	529
W2006FA-1P-C5Z10	W2006FA-2-C5T10	600	629
W2007FA-1P-C5Z10	W2007FA-2-C5T10	700	729
W2008FA-1P-C5Z10	W2008FA-2-C5T10	800	829
W2009FA-1P-C5Z10	W2009FA-2-C5T10	900	929
W2010FA-1P-C5Z10	W2010FA-2-C5T10	1 000	1 029
W2011FA-1P-C5Z10	W2011FA-2-C5T10	1 100	1 129
W2012FA-1P-C5Z10	W2012FA-2-C5T10	1 200	1 229

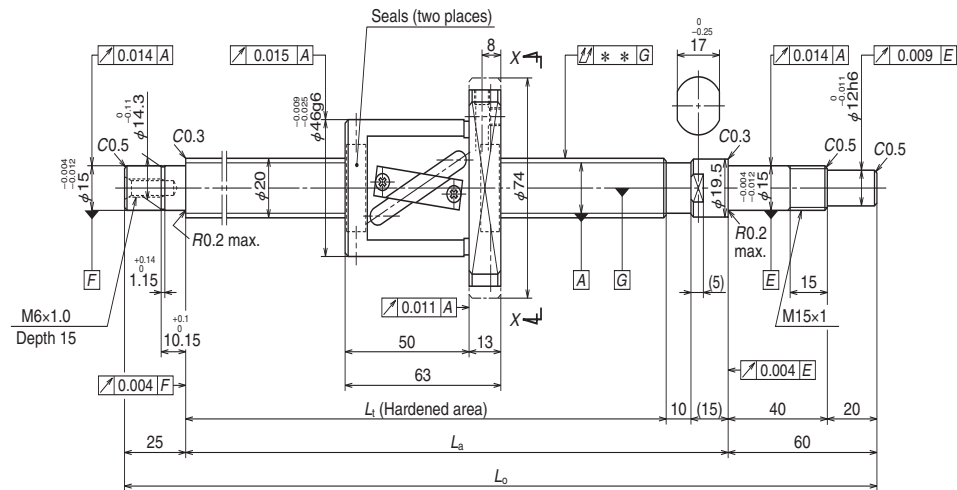
- Notes: 1. We recommend using NSK support units. See Page B377 for details.
 2. We recommend using NSK Grease LR3. The standard quantity for replenishment is about 50% of the nut's internal space. See Page D16 for details.
 3. Contact NSK if permissible rotational speed *N* will be exceeded.

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed <i>N</i> (min ⁻¹)	
								Configuration	
<i>L</i> ₁	<i>L</i> ₂	<i>L</i> ₀	<i>T</i>	<i>e</i> _p	<i>v</i> _s		Fixed - Simple	Fixed - Fixed	
289	314	399	0	0.023	0.018	0.035	1.4	3 000	3 000
389	414	499	0	0.025	0.020	0.040	1.6	3 000	3 000
489	514	599	0	0.027	0.020	0.050	1.9	3 000	3 000
589	614	699	0	0.030	0.023	0.065	2.1	3 000	3 000
689	714	799	0	0.035	0.025	0.065	2.3	3 000	3 000
789	814	899	0	0.035	0.025	0.085	2.5	3 000	3 000
889	914	999	0	0.040	0.027	0.085	2.8	3 000	3 000
989	1 014	1 099	0	0.040	0.027	0.110	3.0	2 710	3 000
1 089	1 114	1 199	0	0.046	0.030	0.110	3.2	2 220	3 000
1 189	1 214	1 299	0	0.046	0.030	0.150	3.4	1 860	2 570
1 289	1 314	1 399	0	0.054	0.035	0.150	3.7	1 580	2 190

- Notes: 4. The user must design the support bearing structure if the non-drive side is fixed.
 5. See Pages B51 and B52 for details on support configurations (Fixed-Simple, Fixed-Fixed, etc.)

Finished Shaft End FA Model

(High helix lead)



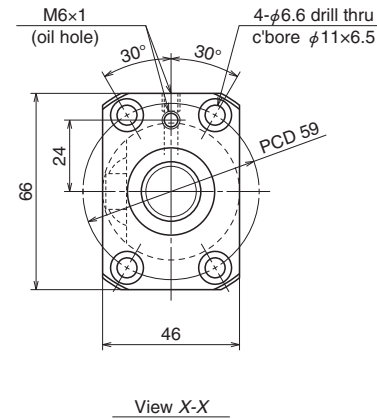
Nut: LPFT, LSFT

NSK

Screw shaft ø20

Lead 20

Unit: mm



Ball screw specifications			
Product classification	Preloaded	Precise clearance	
Shaft dia. x Lead / Direction of turn	20 x 20 / Right		
Preload / Ball recirculation	P-preload / Tube		
Ball dia. / Ball circle dia.	3.969 / 21		
Screw shaft root diameter	16.9		
Effective ball turns	1.5 x 1		
Accuracy grade / Preload / Axial play	C5 / Z	C5 / T	
Basic load ratings (N)	Dynamic C_a	6 250	8 190
	Static C_0	8 760	13 100
Axial play	0	0.005 or less	
Preload (N)	196	—	
Dynamic friction torque (N-cm)	2.0 - 11.8	2.9 or less	
Spacer ball	Yes	None	
Factory-packed grease	NSK grease LR3		
Nut internal space (cm ³)	4.2		
Standard grease replenishment (cm ³)	2.1		

Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK15-01A (square)	WBK15S-01 (square)
WBK15-11 (round)	

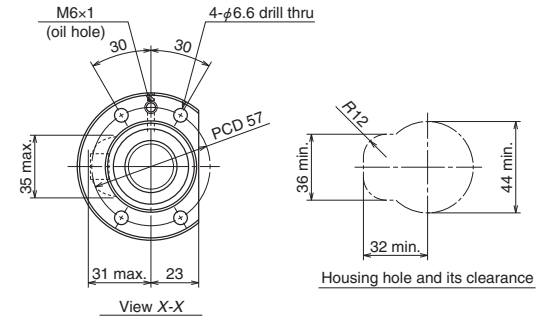
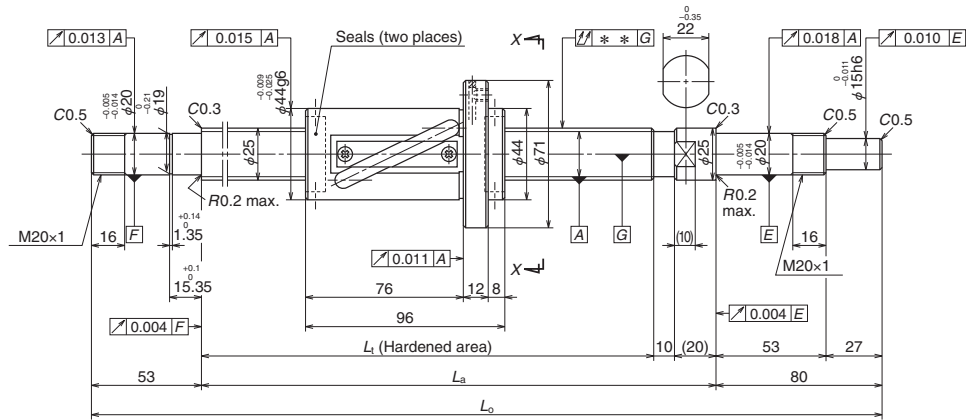
Unit: mm

Reference No.		Stroke	
		Nominal	Maximum
Preloaded (LPFT)	Precise clearance (LSFT)		
W2003FA-3P-C5Z20	W2003FA-4-C5T20	200	241
W2004FA-3P-C5Z20	W2004FA-4-C5T20	300	341
W2005FA-3P-C5Z20	W2005FA-4-C5T20	400	441
W2006FA-3P-C5Z20	W2006FA-4-C5T20	500	541
W2007FA-3P-C5Z20	W2007FA-4-C5T20	600	641
W2008FA-3P-C5Z20	W2008FA-4-C5T20	700	741
W2009FA-3P-C5Z20	W2009FA-4-C5T20	800	841
W2010FA-3P-C5Z20	W2010FA-4-C5T20	900	941
W2011FA-3P-C5Z20	W2011FA-4-C5T20	1 000	1 041
W2012FA-3P-C5Z20	W2012FA-4-C5T20	1 100	1 141
W2015FA-1P-C5Z20	W2015FA-2-C5T20	1 400	1 441

- Notes: 1. We recommend using NSK support units. See Page B377 for details.
 2. We recommend using NSK Grease LR3. The standard quantity for replenishment is about 50% of the nut's internal space. See Page D16 for details.
 3. Contact NSK if permissible rotational speed N will be exceeded.

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min ⁻¹)	
L_t	L_a	L_o	T	e_p	v_u			Configuration	
								Fixed - Simple	Fixed - Fixed
310	335	420	0	0.023	0.018	0.040	1.6	3 000	3 000
410	435	520	0	0.027	0.020	0.050	1.8	3 000	3 000
510	535	620	0	0.030	0.023	0.050	2.0	3 000	3 000
610	635	720	0	0.030	0.023	0.065	2.3	3 000	3 000
710	735	820	0	0.035	0.025	0.085	2.5	3 000	3 000
810	835	920	0	0.040	0.027	0.085	2.7	3 000	3 000
910	935	1 020	0	0.040	0.027	0.110	3.0	3 000	3 000
1 010	1 035	1 120	0	0.046	0.030	0.110	3.2	2 630	3 000
1 110	1 135	1 220	0	0.046	0.030	0.110	3.4	2 160	2 970
1 210	1 235	1 320	0	0.046	0.030	0.150	3.7	1 810	2 500
1 510	1 535	1 620	0	0.054	0.035	0.180	4.4	1 150	1 610

- Notes: 4. The user must design the support bearing structure if the non-drive side is fixed.
 5. See Pages B51 and B52 for details on support configurations (Fixed-Simple, Fixed-Fixed, etc.)



Ball screw specifications			
Product classification	Preloaded	Precise clearance	
Shaft dia. x Lead / Direction of turn	25 x 20 / Right		
Preload / Ball recirculation	P-preload / Tube		
Ball dia. / Ball circle dia.	4.762 / 26.25		
Screw shaft root diameter	21.3		
Effective ball turns	2.5 x 1		
Accuracy grade / Preload / Axial play	C5 / Z	C5 / T	
Basic load ratings (N)	Dynamic C_d	11 700	18 600
	Static C_0	16 300	32 600
Axial play	0	0.005 or less	
Preload (N)	343	—	
Dynamic friction torque (N-cm)	3.9 - 24.5	4.9 or less	
Spacer ball	Yes	None	
Factory-packed grease	NSK grease LR3		
Nut internal space (cm ³)	12		
Standard grease replenishment (cm ³)	6		

Recommended support unit

For drive side (Fixed)	For non-drive side	
	(Fixed)	(Simple)
WBK20-01 (square)	WBK20-01 (square)	WBK20S-01 (square)
WBK20-11 (round)	WBK20-11 (round)	

Unit: mm

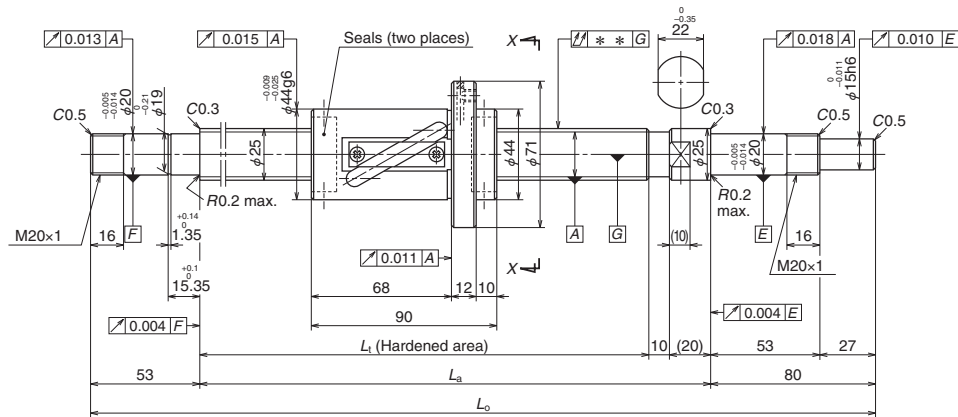
Reference No.		Stroke	
		Nominal	Maximum
Preloaded (LPFT)	Precise clearance (LSFT)		
W2507FA-1P-C5Z20	W2507FA-2-C5T20	600	640
W2509FA-1P-C5Z20	W2509FA-2-C5T20	800	840
W2511FA-1P-C5Z20	W2511FA-2-C5T20	1 000	1 040
W2513FA-1P-C5Z20	W2513FA-2-C5T20	1 200	1 240
W2515FA-1P-C5Z20	W2515FA-2-C5T20	1 400	1 440
W2517FA-1P-C5Z20	W2517FA-2-C5T20	1 600	1 640
W2521FA-1P-C5Z20	W2521FA-2-C5T20	2 000	2 040

- Notes: 1. We recommend using NSK support units. See Page B377 for details.
 2. We recommend using NSK Grease LR3. The standard quantity for replenishment is about 50% of the nut's internal space. See Page D16 for details.
 3. Contact NSK if permissible rotational speed N will be exceeded.

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min ⁻¹)	
L_1	L_a	L_2	T	e_p	v_u			Configuration	
								Fixed - Simple	Fixed - Fixed
750	780	913	0	0.035	0.025	0.055	4.0	2 800	2 800
950	980	1 113	0	0.040	0.027	0.070	4.7	2 800	2 800
1 150	1 180	1 313	0	0.046	0.030	0.090	5.4	2 590	2 800
1 350	1 380	1 513	0	0.054	0.035	0.090	6.2	1 860	2 550
1 550	1 580	1 713	0	0.054	0.035	0.120	6.9	1 400	1 940
1 750	1 780	1 913	0	0.065	0.040	0.120	7.6	1 090	1 520
2 150	2 180	2 313	0	0.077	0.046	0.160	9.1	720	1 000

Finished Shaft End FA Model

(High helix lead)



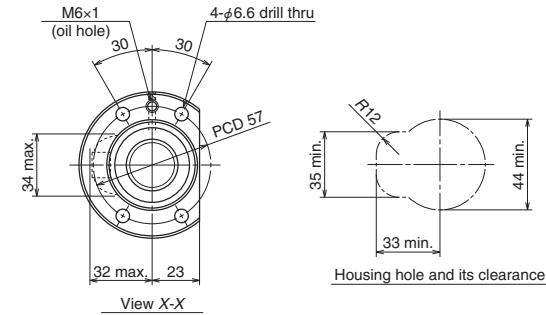
Nut: LPFT, LSFT

NSK

Screw shaft ø25

Lead 25

Unit: mm



Ball screw specifications		
Product classification	Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn	25 x 25 / Right	
Preload / Ball recirculation	P-preload / Tube	
Ball dia. / Ball circle dia.	4.762 / 26.25	
Screw shaft root diameter	21.3	
Effective ball turns	1.5 x 1	
Accuracy grade / Preload / Axial play	C5 / Z	C5 / T
Basic load ratings (N)	Dynamic C_d	8 970
	Static C_0	13 100
		11 700
		19 700
Axial play	0	0.005 or less
Preload (N)	294	—
Dynamic friction torque (N-cm)	3.9 - 24.5	4.9
Spacer ball	Yes	None
Factory-packed grease	NSK grease LR3	
Nut internal space (cm ³)	7.5	
Standard grease replenishment (cm ³)	3.8	

Recommended support unit

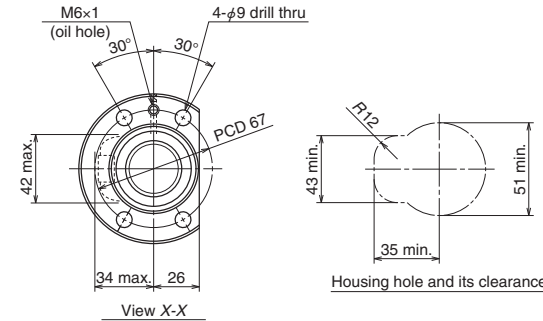
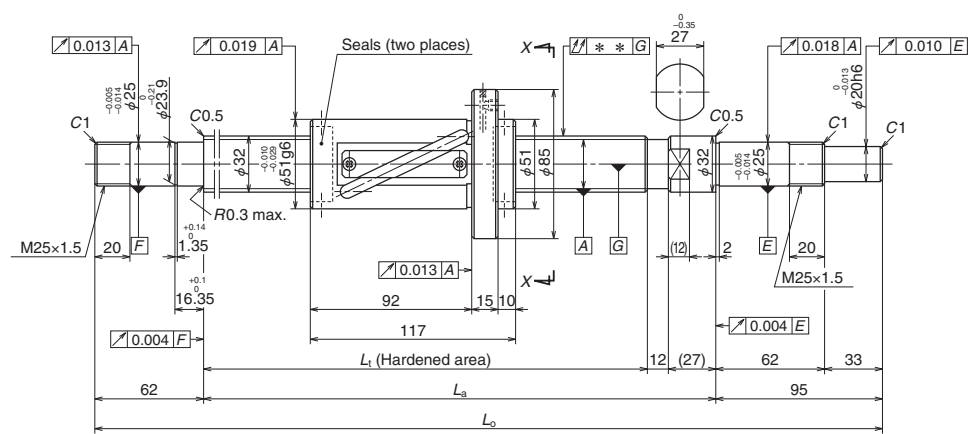
For drive side (Fixed)	For non-drive side	
	(Fixed)	(Simple)
WBK20-01 (square)	WBK20-01 (square)	WBK20S-01 (square)
WBK20-11 (round)	WBK20-11 (round)	

Unit: mm

Reference No.		Stroke	
		Nominal	Maximum
Preloaded (LPFT)	Precise clearance (LSFT)		
W2507FA-3P-C5Z25	W2507FA-4-C5T25	600	646
W2509FA-3P-C5Z25	W2509FA-4-C5T25	800	846
W2511FA-3P-C5Z25	W2511FA-4-C5T25	1 000	1 046
W2513FA-3P-C5Z25	W2513FA-4-C5T25	1 200	1 246
W2515FA-3P-C5Z25	W2515FA-4-C5T25	1 400	1 446
W2517FA-3P-C5Z25	W2517FA-4-C5T25	1 600	1 646
W2521FA-3P-C5Z25	W2521FA-4-C5T25	2 000	2 046

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min ⁻¹)	
L_1	L_a	L_o	T	e_p	v_u			Configuration	
							Fixed - Simple	Fixed - Fixed	
750	780	913	0	0.035	0.025	0.055	4.0	2 800	2 800
950	980	1 113	0	0.040	0.027	0.070	4.7	2 800	2 800
1 150	1 180	1 313	0	0.046	0.030	0.090	5.4	2 580	2 800
1 350	1 380	1 513	0	0.054	0.035	0.090	6.2	1 850	2 550
1 550	1 580	1 713	0	0.054	0.035	0.120	7.0	1 400	1 930
1 750	1 780	1 913	0	0.065	0.040	0.120	7.7	1 090	1 510
2 150	2 180	2 313	0	0.077	0.046	0.160	9.1	710	1 000

- Notes:
1. We recommend using NSK support units. See Page B377 for details.
 2. We recommend using NSK Grease LR3. The standard quantity for replenishment is about 50% of the nut's internal space. See Page D16 for details.
 3. Contact NSK if permissible rotational speed N will be exceeded.



Ball screw specifications		
Product classification	Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn	32 x 25 / Right	
Preload / Ball recirculation	P-preload / Tube	
Ball dia. / Ball circle dia.	4.762 / 33.25	
Screw shaft root diameter	28.3	
Effective ball turns	2.5 x 1	
Accuracy grade / Preload / Axial play	C5 / Z	C5 / T
Basic load ratings (N)	Dynamic C_d	12 900
	Static C_0	21 100
		20 400
		42 200
Axial play	0	0.005 or less
Preload (N)	441	—
Dynamic friction torque (N-cm)	6.8 - 31.5	7.8 or less
Spacer ball	Yes	None
Factory-packed grease	NSK grease LR3	
Nut internal space (cm ³)	17.5	
Standard grease replenishment (cm ³)	8.8	

Recommended support unit

For drive side (Fixed)	For non-drive side	
	(Fixed)	(Simple)
WBK25-01W (square)	WBK25-01W (square)	WBK25S-01W (square)
WBK25-11 (round)	WBK25-11 (round)	

Unit: mm

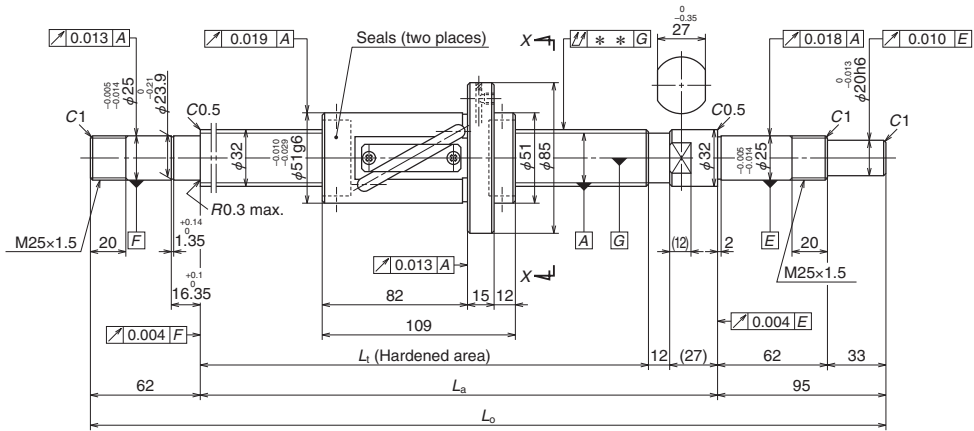
Reference No.		Stroke	
		Nominal	Maximum
Preloaded (LPFT)	Precise clearance (LSFT)		
W3211FA-1P-C5Z25	W3211FA-2-C5T25	1 000	1 046
W3216FA-1P-C5Z25	W3216FA-2-C5T25	1 500	1 546
W3221FA-1P-C5Z25	W3221FA-2-C5T25	2 000	2 046
W3227FA-1P-C5Z25	W3227FA-2-C5T25	2 600	2 646

- Notes: 1. We recommend using NSK support units. See Page B377 for details.
 2. We recommend using NSK Grease LR3. The standard quantity for replenishment is about 50% of the nut's internal space. See Page D16 for details.
 3. Contact NSK if permissible rotational speed N will be exceeded.

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min ⁻¹)	
								Configuration	
L_t	L_a	L_o	T	e_p	v_u		Fixed - Simple	Fixed - Fixed	
1 180	1 219	1 376	0	0.046	0.030	0.090	9.3	2 180	2 180
1 680	1 719	1 876	0	0.065	0.040	0.120	12.3	1 600	2 180
2 180	2 219	2 376	0	0.077	0.046	0.160	15.4	930	1 300
2 780	2 819	2 976	0	0.093	0.054	0.200	19.1	570	800

Finished Shaft End FA Model

(High helix lead)



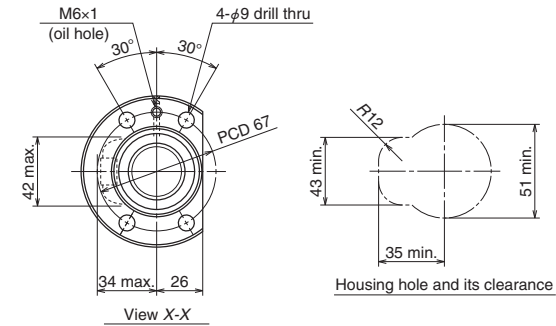
Nut: LPFT, LSFT

NSK

Screw shaft $\phi 32$

Lead 32

Unit: mm



Ball screw specifications

Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		32 x 32 / Right	
Preload / Ball recirculation		P-preload / Tube	
Ball dia. / Ball circle dia.		4.762 / 33.25	
Screw shaft root diameter		28.3	
Effective ball turns		1.5 x 1	
Accuracy grade / Preload / Axial play		C5 / Z	C5 / T
Basic load ratings (N)	Dynamic C_d	10 100	13 300
	Static C_0	16 800	25 200
Axial play		0	0.005 or less
Preload (N)		392	—
Dynamic friction torque (N-cm)		6.9 - 31.5	7.8 or less
Spacer ball		Yes	None
Factory-packed grease		NSK grease LR3	
Nut internal space (cm ³)		14	
Standard grease replenishment (cm ³)		7	

Recommended support unit

For drive side (Fixed)	For non-drive side	
	(Fixed)	(Simple)
WBK25-01W (square)	WBK25-01W (square)	WBK25S-01W (square)
WBK25-11 (round)	WBK25-11 (round)	

Unit: mm

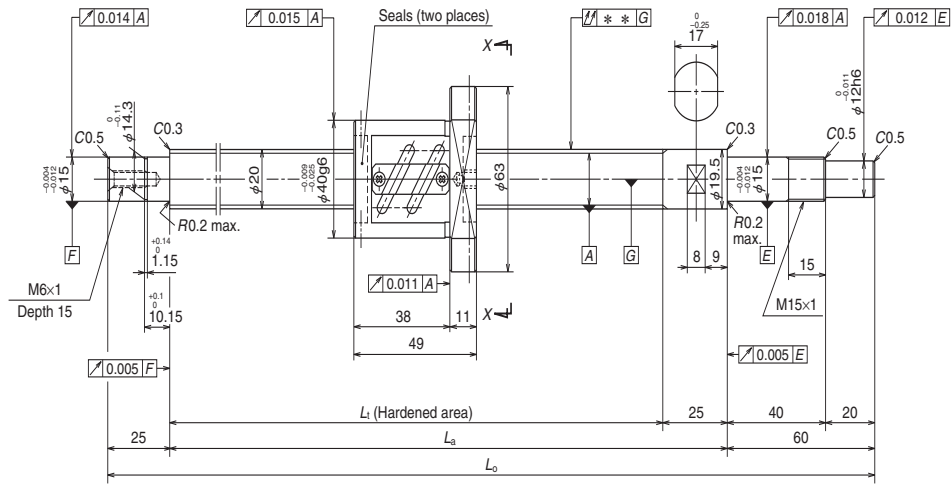
Reference No.		Stroke	
		Nominal	Maximum
Preloaded (LPFT)	Precise clearance (LSFT)		
W3211FA-3P-C5Z32	W3211FA-4-C5T32	1 000	1 054
W3216FA-3P-C5Z32	W3216FA-4-C5T32	1 500	1 554
W3221FA-3P-C5Z32	W3221FA-4-C5T32	2 000	2 054
W3227FA-3P-C5Z32	W3227FA-4-C5T32	2 600	2 654

- Notes: 1. We recommend using NSK support units. See Page B377 for details.
 2. We recommend using NSK Grease LR3. The standard quantity for replenishment is about 50% of the nut's internal space. See Page D16 for details.
 3. Contact NSK if permissible rotational speed N will be exceeded.

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min ⁻¹)	
L_t	L_a	L_o	T	e_p	v_u			Configuration	
								Fixed - Simple	Fixed - Fixed
1 180	1 219	1 376	0	0.046	0.030	0.090	9.3	2 180	2 180
1 680	1 719	1 876	0	0.065	0.040	0.120	12.3	1 590	2 180
2 180	2 219	2 376	0	0.077	0.046	0.160	15.4	930	1 290
2 780	2 819	2 976	0	0.093	0.054	0.200	19.1	570	790

Finished Shaft End SA Model

(Fine lead)



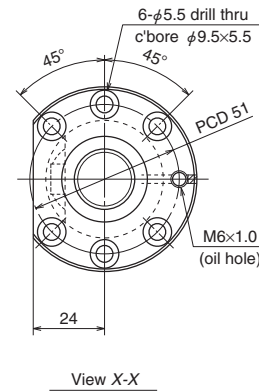
Nut: PFT

NSK

Screw shaft ø20

Lead 4

Unit: mm



Ball screw specifications		
Shaft dia. x Lead / Direction of turn	20 × 4 / Right	
Preload / Ball recirculation	P-preload / Tube	
Ball dia. / Ball circle dia.	2.381 / 20.3	
Effective ball turns	2.5 × 2	
Screw shaft root diameter	17.8	
Accuracy grade / Preload	C5 / Z	
Basic load ratings (N)	Dynamic C_a	6 550
	Static C_{0a}	10 900
Preload (N)	294	
Standard dynamic friction torque (N·cm)	3.9	
Spacer ball	Yes	
Factory-packed grease	Refer to Note 2.	
Nut internal space (cm ³)	2.7	
Standard grease replenishment (cm ³)	1.4	

Recommended support unit

	For drive side (Fixed)	For non-drive side (Simple)
	WBK15-01A (square)	WBK15S-01 (square)
	WBK15-11 (round)	

Unit: mm

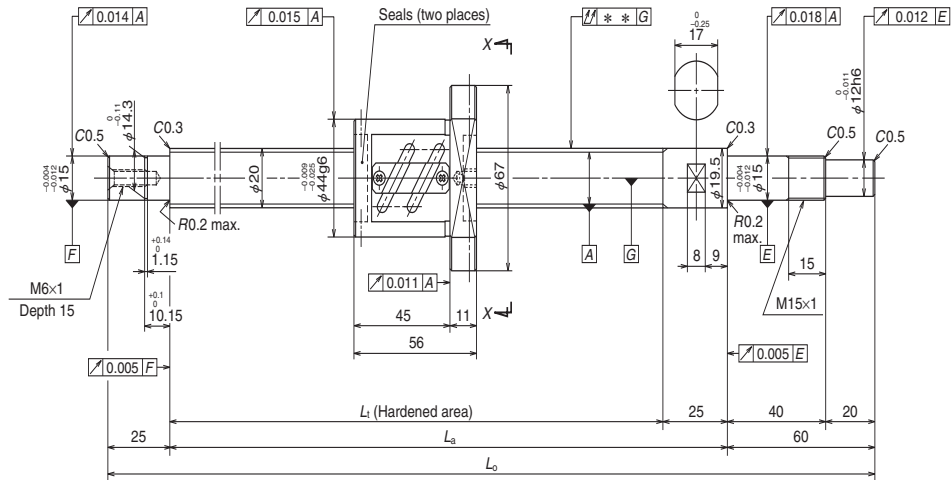
Reference No.	Stroke		Screw shaft length		
	Nominal	Maximum	L_1	L_a	L_o
W2002SA-1P-C5Z4	150	170	225	250	335
W2002SA-2P-C5Z4	200	220	275	300	385
W2003SA-1P-C5Z4	300	320	375	400	485
W2004SA-1P-C5Z4	400	420	475	500	585
W2005SA-1P-C5Z4	500	520	575	600	685
W2006SA-1P-C5Z4	600	620	675	700	785

Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min ⁻¹)	
T	e_p	v_u			Configuration	
					Fixed - Simple	Fixed - Fixed
-0.005	0.023	0.018	0.045	1.1	3 000	3 000
-0.007	0.023	0.018	0.045	1.2	3 000	3 000
-0.009	0.025	0.020	0.055	1.5	3 000	3 000
-0.011	0.027	0.020	0.070	1.7	3 000	3 000
-0.014	0.030	0.023	0.085	1.9	3 000	3 000
-0.016	0.035	0.025	0.085	2.1	3 000	3 000

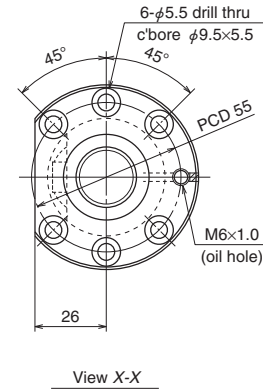
- Notes:
1. We recommend use of the NSK support unit. See Page B377 for details.
 2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
 3. Contact NSK if permissible rotational speed N will be exceeded.
 4. If the non-drive side is fixed, the user must design the configuration of the support bearing area.
 5. See Pages B51 and B52 for details on support configurations (Fixed-Simple, Fixed-Fixed, etc.)

Finished Shaft End SA Model

(Fine lead)



Nut: PFT



NSK

Screw shaft ø20

Lead 5

Unit: mm

Ball screw specifications

Shaft dia. x Lead / Direction of turn	20 x 5 / Right	
Preload / Ball recirculation	P-preload / Tube	
Ball dia. / Ball circle dia.	3.175 / 20.5	
Screw shaft root diameter	17.2	
Effective ball turns	2.5 x 2	
Accuracy grade / Preload	C5 / Z	
Basic load ratings (N)	Dynamic C_a	11 100
	Static C_{0a}	17 100
Preload (N)	490	
Standard dynamic friction torque (N·cm)	7.8	
Spacer ball	Yes	
Factory-packed grease	Refer to Note 2.	
Nut internal space (cm ³)	4.3	
Standard grease replenishment (cm ³)	2.2	

Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK15-01A (square)	WBK15S-01 (square)
WBK15-11 (round)	

Unit: mm

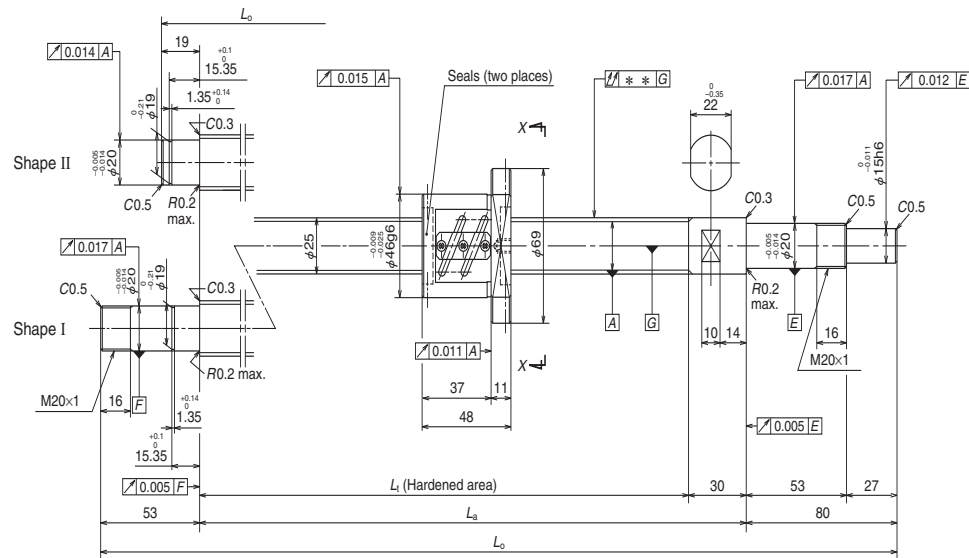
Reference No.	Stroke		Screw shaft length		
	Nominal	Maximum	L_t	L_a	L_o
W2002SA-3P-C5Z5	150	163	225	250	335
W2002SA-4P-C5Z5	200	213	275	300	385
W2003SA-2P-C5Z5	300	313	375	400	485
W2004SA-2P-C5Z5	400	413	475	500	585
W2005SA-2P-C5Z5	500	513	575	600	685
W2007SA-1P-C5Z5	700	713	775	800	885

Lead accuracy			Shaft run-out ** μ	Mass (kg)	Permissible rotational speed N (min ⁻¹)	
T	e_p	v_u			Configuration	
					Fixed - Simple	Fixed - Fixed
-0.005	0.023	0.018	0.045	1.3	3 000	3 000
-0.007	0.023	0.018	0.045	1.4	3 000	3 000
-0.009	0.025	0.020	0.055	1.6	3 000	3 000
-0.011	0.027	0.020	0.070	1.8	3 000	3 000
-0.014	0.030	0.023	0.085	2.0	3 000	3 000
-0.019	0.035	0.025	0.110	2.5	3 000	3 000

- Notes: 1. We recommend use of the NSK support unit. See Page B377 for details.
 2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
 3. Contact NSK if permissible rotational speed N will be exceeded.
 4. If the non-drive side is fixed, the user must design the configuration of the support bearing area.
 5. See Pages B51 and B52 for details on support configurations (Fixed-Simple, Fixed-Fixed, etc.)

Finished Shaft End SA Model

(Fine lead)



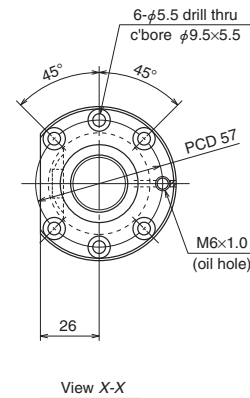
Nut: PFT

NSK

Screw shaft ø25

Lead 4

Unit: mm



Ball screw specifications

Shaft dia. x Lead / Direction of turn	25 x 4 / Right	
Preload / Ball recirculation	P-preload / Tube	
Ball dia. / Ball circle dia.	2.381 / 25.3	
Screw shaft root diameter	22.8	
Effective ball turns	2.5 x 2	
Accuracy grade / Preload	C5 / Z	
Basic load ratings (N)	Dynamic C_a	7 110
	Static C_{0a}	13 600
Preload (N)	290	
Standard dynamic friction torque (N·cm)	4.9	
Spacer ball	Yes	
Factory-packed grease	Refer to Note 2.	
Nut internal space (cm ³)	3.2	
Standard grease replenishment (cm ³)	1.6	

Recommended support unit

For drive side (Fixed)	For non-drive side	
	(Fixed)	(Simple)
WBK20-01 (square)	WBK20-01 (square)	WBK20S-01 (square)
WBK20-11 (round)	WBK20-11 (round)	

Unit: mm

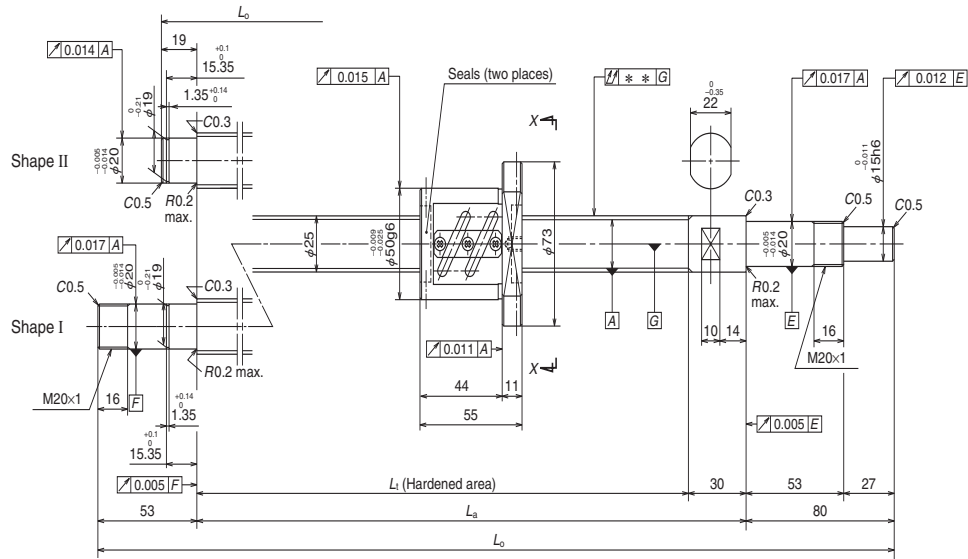
Reference No.	Stroke		Screw shaft length		
	Nominal	Maximum	L_t	L_a	L_o
W2502SA-1P-C5Z4	150	166	220	250	349
W2502SA-2P-C5Z4	200	216	270	300	399
W2503SA-1P-C5Z4	300	316	370	400	499
W2504SA-1P-C5Z4	400	416	470	500	599
W2505SA-1P-C5Z4	500	516	570	600	733
W2507SA-1P-C5Z4	700	716	770	800	933

Left shaft end shape	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min ⁻¹)	
	T	e_o	v_u			Configuration	
						Fixed - Simple	Fixed - Fixed
II	-0.005	0.023	0.018	0.035	1.6	2 800	—
II	-0.006	0.023	0.018	0.035	1.8	2 800	—
II	-0.009	0.025	0.020	0.040	2.2	2 800	—
II	-0.011	0.027	0.020	0.050	2.5	2 800	—
I	-0.014	0.030	0.023	0.060	3.0	2 800	2 800
I	-0.018	0.035	0.025	0.075	3.7	2 800	2 800

- Notes:
1. We recommend use of the NSK support unit. See Page B377 for details.
 2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
 3. Contact NSK if permissible rotational speed N will be exceeded.
 4. The maximum stroke is -8 mm when a Fixed-Fixed configuration is used with left shaft end shape I.

Finished Shaft End SA Model

(Fine lead)



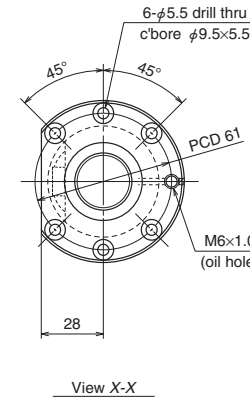
Nut: PFT

NSK

Screw shaft $\phi 25$

Lead 5

Unit: mm



Ball screw specifications		
Shaft dia. x Lead / Direction of turn	25 x 5 / Right	
Preload / Ball recirculation	P-preload / Tube	
Ball dia. / Ball circle dia.	3.175 / 25.5	
Screw shaft root diameter	22.2	
Effective ball turns	2.5 x 2	
Accuracy grade / Preload	C5 / Z	
Basic load ratings (N)	Dynamic C_s	12 300
	Static C_{0a}	21 800
Preload (N)	540	
Standard dynamic friction torque (N-cm)	8.8	
Spacer ball	Yes	
Factory-packed grease	Refer to NOTE 2.	
Nut internal space (cm ³)	5.0	
Standard grease replenishment (cm ³)	2.5	

Recommended support unit

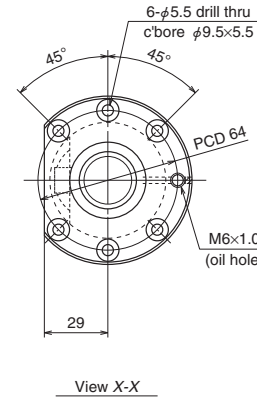
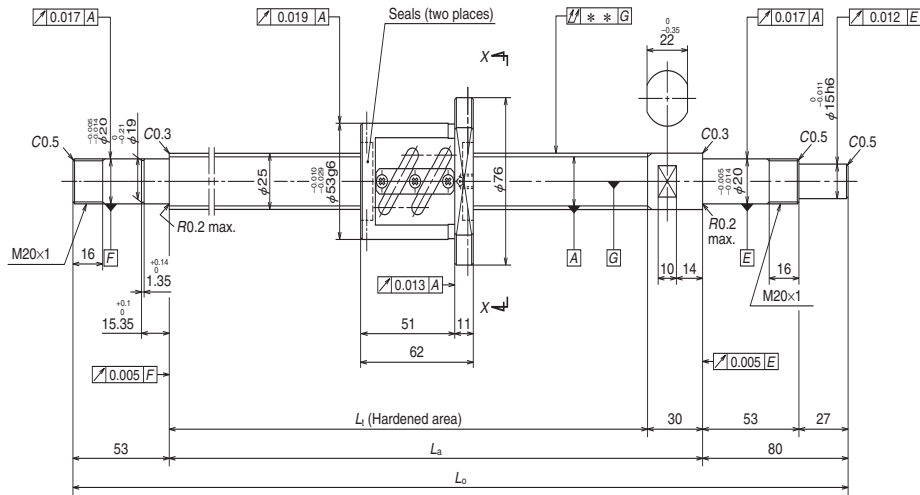
For drive side (Fixed)	For non-drive side	
	(Fixed)	(Simple)
WBK20-01 (square)	WBK20-01 (square)	WBK20S-01 (square)
WBK20-11 (round)	WBK20-11 (round)	

Unit: mm

Reference No.	Stroke		Screw shaft length		
	Nominal	Maximum	L_t	L_a	L_o
W2502SA-3P-C5Z5	150	159	220	250	349
W2502SA-4P-C5Z5	200	209	270	300	399
W2503SA-2P-C5Z5	300	309	370	400	499
W2504SA-2P-C5Z5	400	409	470	500	599
W2505SA-2P-C5Z5	500	509	570	600	733
W2506SA-1P-C5Z5	600	609	670	700	833
W2507SA-2P-C5Z5	700	709	770	800	933
W2509SA-1P-C5Z5	900	909	970	1 000	1 133
W2511SA-1P-C5Z5	1 100	1 109	1 170	1 200	1 333

Left shaft end shape	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min ⁻¹)	
	T	e_o	v_u			Configuration	
						Fixed - Simple	Fixed - Fixed
II	-0.005	0.023	0.018	0.035	1.8	2 800	—
II	-0.006	0.023	0.018	0.035	2.0	2 800	—
II	-0.009	0.025	0.020	0.040	2.3	2 800	—
II	-0.011	0.027	0.020	0.050	2.7	2 800	—
I	-0.014	0.030	0.023	0.060	3.1	2 800	2 800
I	-0.016	0.035	0.025	0.075	3.4	2 800	2 800
I	-0.018	0.035	0.025	0.075	3.8	2 800	2 800
I	-0.023	0.040	0.027	0.090	4.5	2 800	2 800
I	-0.028	0.046	0.030	0.120	5.2	2 520	2 800

- Notes:
1. We recommend use of the NSK support unit. See Page B377 for details.
 2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
 3. Contact NSK if permissible rotational speed N will be exceeded.
 4. The maximum stroke is -8 mm when a Fixed-Fixed configuration is used with left shaft end shape I.



Ball screw specifications

Shaft dia. x Lead / Direction of turn	25 × 6 / Right	
Preload / Ball recirculation	P-preload / Tube	
Ball dia. / Ball circle dia.	3.969 / 25.5	
Screw shaft root diameter	21.4	
Effective ball turns	2.5 × 2	
Accuracy grade / Preload	C5 / Z	
Basic load ratings (N)	Dynamic C_s	16 600
	Static C_{0a}	26 700
Preload (N)	685	
Standard dynamic friction torque (N·cm)	13.8	
Spacer ball	Yes	
Factory-packed grease	Refer to Note 2.	
Nut internal space (cm ³)	7.0	
Standard grease replenishment (cm ³)	3.5	

Recommended support unit

For drive side (Fixed)	For non-drive side	
	(Fixed)	(Simple)
WBK20-01 (square)	WBK20-01 (square)	WBK20S-01 (square)
WBK20-11 (round)	WBK20-11 (round)	

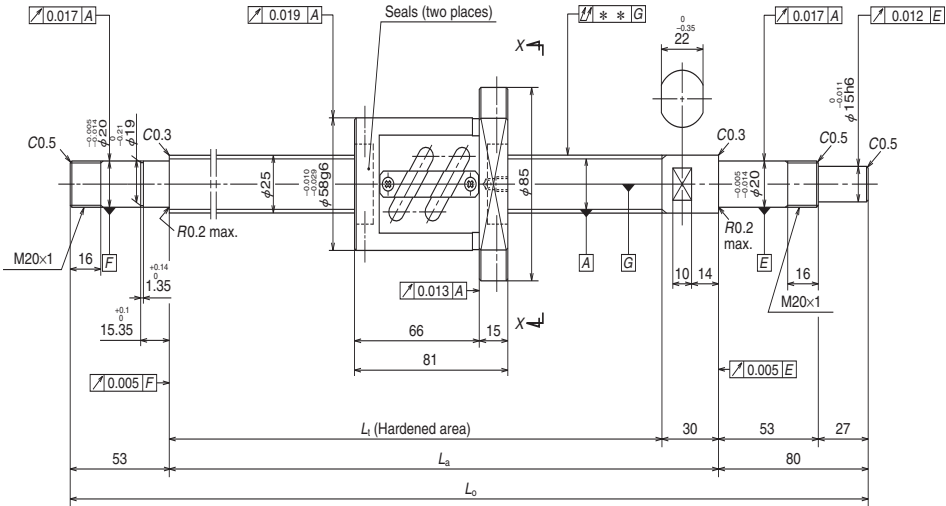
Reference No.	Stroke		Screw shaft length		
	Nominal	Maximum	L_t	L_a	L_o
W2503SA-3P-C5Z6	250	302	370	400	533
W2505SA-3P-C5Z6	450	502	570	600	733
W2507SA-3P-C5Z6	650	702	770	800	933
W2511SA-2P-C5Z6	1 050	1 102	1 170	1 200	1 333

Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min ⁻¹)	
T	e_p	v_u			Configuration	
			Fixed - Simple	Fixed - Fixed		
-0.009	0.025	0.020	0.050	2.5	2 800	2 800
-0.014	0.030	0.023	0.060	3.2	2 800	2 800
-0.018	0.035	0.025	0.075	3.9	2 800	2 800
-0.028	0.046	0.030	0.120	5.2	2 450	2 800

- Notes: 1. We recommend use of the NSK support unit. See Page B377 for details.
 2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
 3. Contact NSK if permissible rotational speed N will be exceeded.
 4. The maximum stroke is -8 mm when a Fixed-Fixed configuration is used with left shaft end shape I.

Finished Shaft End SA Model

(Fine lead)



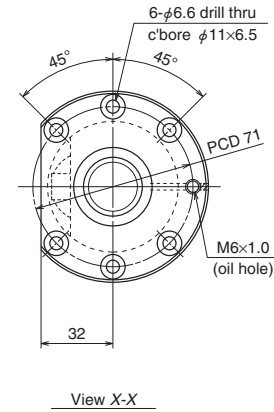
Nut: PFT

NSK

Screw shaft $\phi 25$

Lead 10

Unit: mm



Ball screw specifications		
Shaft dia. x Lead / Direction of turn	25 x 10 / Right	
Preload / Ball recirculation	P-preload / Tube	
Ball dia. / Ball circle dia.	4.762 / 25.5	
Screw shaft root diameter	20.5	
Effective ball turns	1.5 x 2	
Accuracy grade / Preload	C5 / Z	
Basic load ratings (N)	Dynamic C_s	13 600
	Static C_{0a}	18 900
Preload (N)	585	
Standard dynamic friction torque (N·cm)	13.8	
Spacer ball	Yes	
Factory-packed grease	Refer to Note 2.	
Nut internal space (cm ³)	9.5	
Standard grease replenishment (cm ³)	4.8	

Recommended support unit

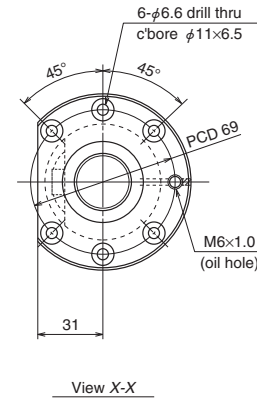
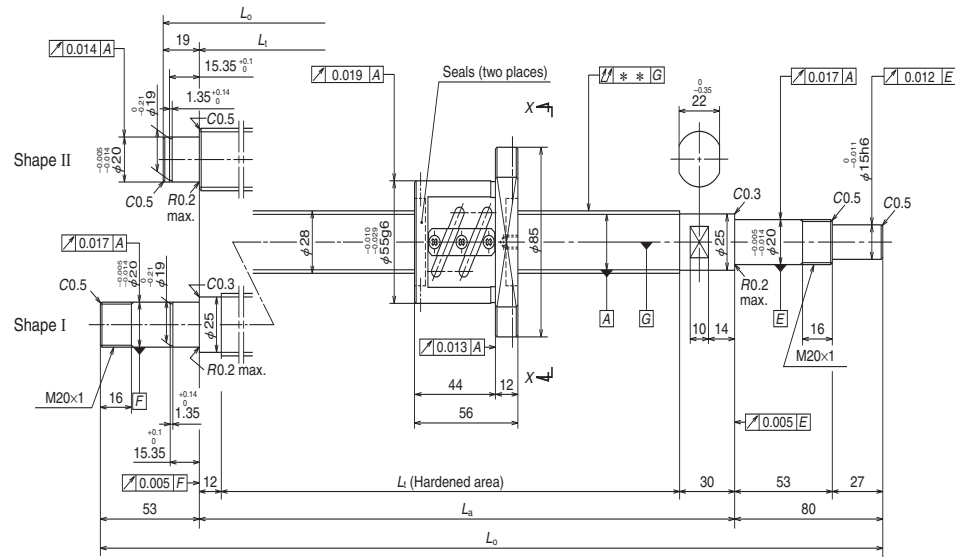
For drive side (Fixed)	For non-drive side	
	(Fixed)	(Simple)
WBK20-01 (square)	WBK20-01 (square)	WBK20S-01 (square)
WBK20-11 (round)	WBK20-11 (round)	

Unit: mm

Reference No.	Stroke		Screw shaft length		
	Nominal	Maximum	L_t	L_a	L_0
W2503SA-4P-C5Z10	250	283	370	400	533
W2505SA-4P-C5Z10	450	483	570	600	733
W2507SA-4P-C5Z10	650	683	770	800	933
W2509SA-2P-C5Z10	850	883	970	1 000	1 133
W2511SA-3P-C5Z10	1 050	1 083	1 170	1 200	1 333
W2514SA-1P-C5Z10	1 350	1 383	1 470	1 500	1 633

Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min ⁻¹)	
T	e_p	v_u			Configuration	
					Fixed - Simple	Fixed - Fixed
-0.009	0.025	0.020	0.050	3.2	2 800	2 800
-0.014	0.030	0.023	0.060	3.8	2 800	2 800
-0.018	0.035	0.025	0.075	4.5	2 800	2 800
-0.023	0.040	0.027	0.090	5.2	2 800	2 800
-0.028	0.046	0.030	0.120	5.9	2 390	2 800
-0.035	0.054	0.035	0.150	6.9	1 490	2 060

- Notes: 1. We recommend use of the NSK support unit. See Page B377 for details.
 2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
 3. Contact NSK if permissible rotational speed N will be exceeded.
 4. The maximum stroke is -8 mm when a Fixed-Fixed configuration is used with left shaft end shape I.



Ball screw specifications

Shaft dia. x Lead / Direction of turn	28 x 5 / Right	
Preload / Ball recirculation	P-preload / Tube	
Ball dia. / Ball circle dia.	3.175 / 28.5	
Screw shaft root diameter	25.2	
Effective ball turns	2.5 x 2	
Accuracy grade / Preload	C5 / Z	
Basic load ratings (N)	Dynamic C_s	13 000
	Static C_{0a}	24 400
Preload (N)	540	
Standard dynamic friction torque (N-cm)	9.8	
Spacer ball	Yes	
Factory-packed grease	Refer to Note 2.	
Nut internal space (cm ³)	6.0	
Standard grease replenishment (cm ³)	3.0	

Recommended support unit

For drive side (Fixed)	For non-drive side	
	(Fixed)	(Simple)
WBK20-01 (square)	WBK20-01 (square)	WBK20S-01 (square)
WBK20-11 (round)	WBK20-11 (round)	

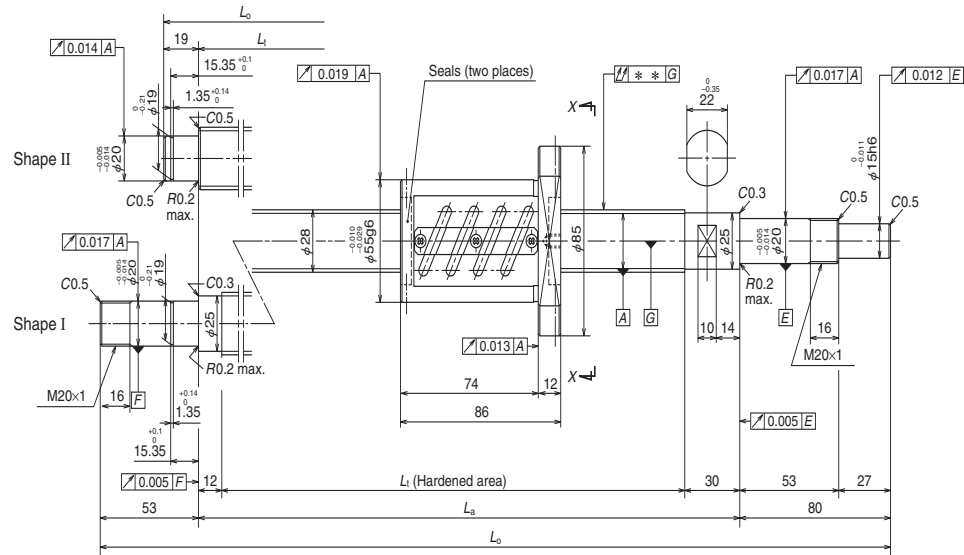
Reference No.	Stroke		Screw shaft length		
	Nominal	Maximum	L_t	L_a	L_0
W2802SA-1P-C5Z5	200	208	270	300	399
W2803SA-1P-C5Z5	300	308	370	400	499
W2804SA-1P-C5Z5	400	408	470	500	599
W2805SA-1P-C5Z5	450	502	558	600	733
W2807SA-1P-C5Z5	650	702	758	800	933
W2809SA-1P-C5Z5	850	902	958	1 000	1 133
W2811SA-1P-C5Z5	1 050	1 102	1 158	1 200	1 333

Left shaft end shape	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min ⁻¹)	
	T	e_0	v_u			Configuration	
						Fixed - Simple	Fixed - Fixed
II	-0.006	0.023	0.018	0.035	2.5	2 500	—
II	-0.009	0.025	0.020	0.040	2.9	2 500	—
II	-0.011	0.027	0.020	0.050	3.3	2 500	—
I	-0.014	0.030	0.023	0.060	3.8	2 500	2 500
I	-0.018	0.035	0.025	0.075	4.7	2 500	2 500
I	-0.024	0.040	0.027	0.090	5.6	2 500	2 500
I	-0.028	0.046	0.030	0.120	6.5	2 500	2 500

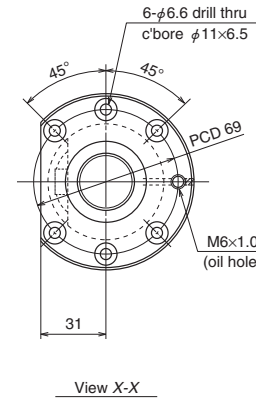
- Notes:
1. We recommend use of the NSK support unit. See Page B377 for details.
 2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
 3. Contact NSK if permissible rotational speed N will be exceeded.
 4. The maximum stroke is -2 mm when a Fixed-Fixed configuration is used with left shaft end shape I.

Finished Shaft End SA Model

(Fine lead)



Nut: ZFT



NSK

Screw shaft ø28

Lead 5

Unit: mm

Ball screw specifications

Shaft dia. x Lead / Direction of turn	28 × 5 / Right	
Preload / Ball recirculation	Z-preload / Tube	
Ball dia. / Ball circle dia.	3.175 / 28.5	
Screw shaft root diameter	25.2	
Effective ball turns	2.5 × 2	
Accuracy grade / Preload	C5 / Z	
Basic load ratings (N)	Dynamic C_s	20 600
	Static C_{0a}	48 700
Preload (N)	1 220	
Standard dynamic friction torque (N·cm)	21.5	
Spacer ball	None	
Factory-packed grease	Refer to Note 2.	
Nut internal space (cm ³)	9.0	
Standard grease replenishment (cm ³)	4.5	

Recommended support unit

For drive side (Fixed)	For non-drive side	
	(Fixed)	(Simple)
WBK20-01 (square)	WBK20-01 (square)	WBK20S-01 (square)
WBK20-11 (round)	WBK20-11 (round)	

Unit: mm

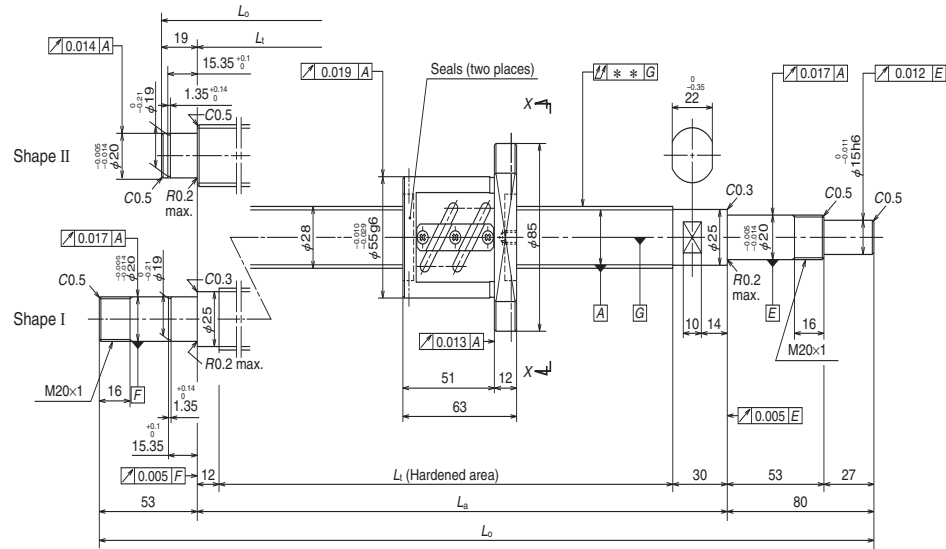
Reference No.	Stroke		Screw shaft length		
	Nominal	Maximum	L_t	L_a	L_o
W2802SA-2Z-C5Z5	150	178	270	300	399
W2803SA-2Z-C5Z5	250	278	370	400	499
W2804SA-2Z-C5Z5	350	378	470	500	599
W2805SA-2Z-C5Z5	450	472	558	600	733
W2807SA-2Z-C5Z5	650	672	758	800	933
W2809SA-2Z-C5Z5	850	872	958	1 000	1 133
W2811SA-2Z-C5Z5	1 050	1 072	1 158	1 200	1 333

- Notes: 1. We recommend use of the NSK support unit. See Page B377 for details.
 2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
 3. Contact NSK if permissible rotational speed N will be exceeded.
 4. The maximum stroke is -2 mm when a Fixed-Fixed configuration is used with left shaft end shape I.

Left shaft end shape	Lead accuracy			Shaft run-out ** $\uparrow \downarrow$	Mass (kg)	Permissible rotational speed N (min ⁻¹)	
	T	e_o	v_u			Configuration	
						Fixed - Simple	Fixed - Fixed
II	-0.006	0.023	0.018	0.035	2.8	2 500	—
II	-0.009	0.025	0.020	0.040	3.2	2 500	—
II	-0.011	0.027	0.020	0.050	3.7	2 500	—
I	-0.013	0.030	0.023	0.060	4.2	2 500	2 500
I	-0.018	0.035	0.025	0.075	5.1	2 500	2 500
I	-0.023	0.040	0.027	0.090	5.9	2 500	2 500
I	-0.028	0.046	0.030	0.120	6.8	2 500	2 500

Finished Shaft End SA Model

(Fine lead)



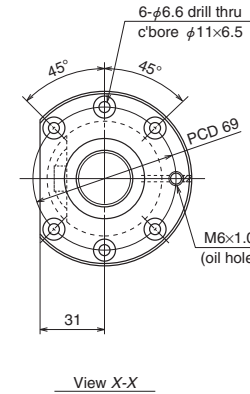
Nut: PFT

NSK

Screw shaft ø28

Lead 6

Unit: mm



Ball screw specifications		
Shaft dia. x Lead / Direction of turn	28 × 6 / Right	
Preload / Ball recirculation	P-preload / Tube	
Ball dia. / Ball circle dia.	3.175 / 28.5	
Screw shaft root diameter	25.2	
Effective ball turns	2.5 × 2	
Accuracy grade / Preload	C5 / Z	
Basic load ratings (N)	Dynamic C _s	12 900
	Static C _{0a}	24 300
Preload (N)	540	
Standard dynamic friction torque (N·cm)	11.8	
Spacer ball	Yes	
Factory-packed grease	Refer to Note 2.	
Nut internal space (cm ³)	6.0	
Standard grease replenishment (cm ³)	3.0	

Recommended support unit

For drive side (Fixed)	For non-drive side	
	(Fixed)	(Simple)
WBK20-01 (square)	WBK20-01 (square)	WBK20S-01 (square)
WBK20-11 (round)	WBK20-11 (round)	

Unit: mm

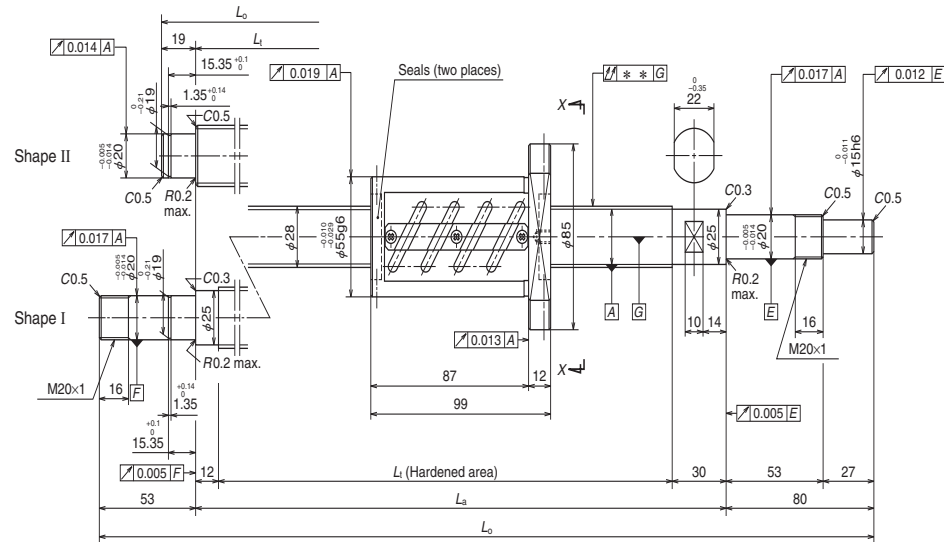
Reference No.	Stroke		Screw shaft length		
	Nominal	Maximum	L _t	L _a	L _o
W2803SA-3P-C5Z6	250	301	370	400	499
W2805SA-3P-C5Z6	450	501	570	600	699
W2807SA-3P-C5Z6	650	695	758	800	933
W2809SA-3P-C5Z6	850	895	958	1 000	1 133
W2811SA-3P-C5Z6	1 050	1 095	1 158	1 200	1 333

- Notes:
- We recommend use of the NSK support unit. See Page B377 for details.
 - Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
 - Contact NSK if permissible rotational speed *N* will be exceeded.
 - The maximum stroke is -2 mm when a Fixed-Fixed configuration is used with left shaft end shape I.

Left shaft end shape	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed <i>N</i> (min ⁻¹)	
	T	e _p	v _u			Configuration	
						Fixed - Simple	Fixed - Fixed
II	-0.009	0.025	0.020	0.040	3.0	2 500	—
II	-0.014	0.030	0.023	0.060	3.9	2 500	—
I	-0.018	0.035	0.025	0.075	4.9	2 500	2 500
I	-0.023	0.040	0.027	0.090	5.8	2 500	2 500
I	-0.028	0.046	0.030	0.120	6.6	2 500	2 500

Finished Shaft End SA Model

(Fine lead)



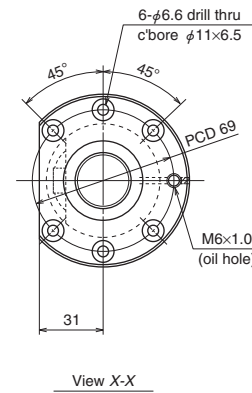
Nut: ZFT

NSK

Screw shaft $\phi 28$

Lead 6

Unit: mm



Ball screw specifications

Shaft dia. x Lead / Direction of turn	28 x 6 / Right	
Preload / Ball recirculation	Z-preload / Tube	
Ball dia. / Ball circle dia.	3.175 / 28.5	
Screw shaft root diameter	25.2	
Effective ball turns	2.5 x 2	
Accuracy grade / Preload	C5 / Z	
Basic load ratings (N)	Dynamic C_a	20 600
	Static C_{0a}	48 700
Preload (N)	1 220	
Standard dynamic friction torque (N-cm)	23.5	
Spacer ball	None	
Factory-packed grease	Refer to NOTE 2.	
Nut internal space (cm ³)	9.5	
Standard grease replenishment (cm ³)	4.8	

Recommended support unit

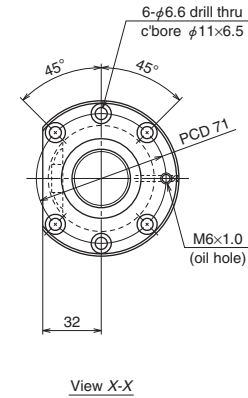
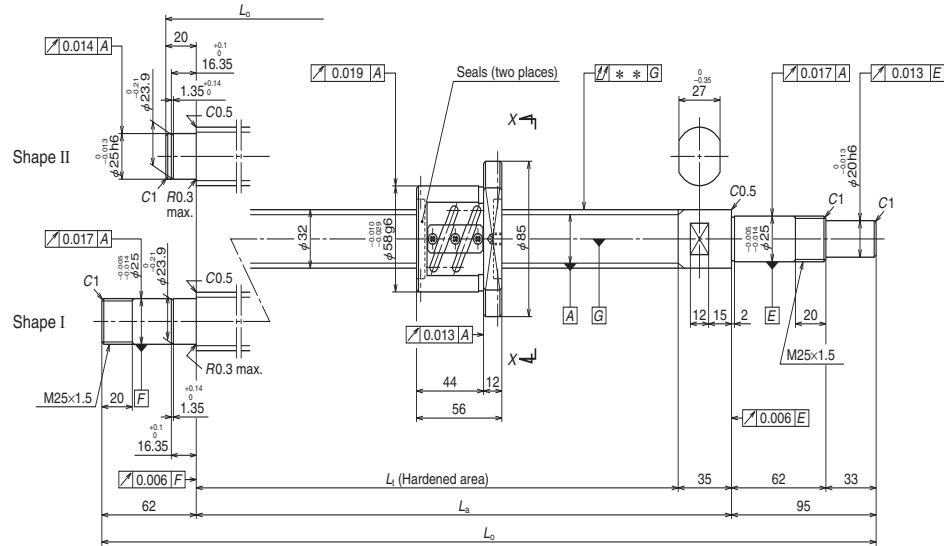
For drive side (Fixed)	For non-drive side	
	(Fixed)	(Simple)
WBK20-01 (square)	WBK20-01 (square)	WBK20S-01 (square)
WBK20-11 (round)	WBK20-11 (round)	

Unit: mm

Reference No.	Stroke		Screw shaft length		
	Nominal	Maximum	L_t	L_a	L_o
W2803SA-4Z-C5Z6	250	265	370	400	499
W2805SA-4Z-C5Z6	450	465	570	600	699
W2807SA-4Z-C5Z6	650	659	758	800	933
W2809SA-4Z-C5Z6	850	859	958	1 000	1 133
W2811SA-4Z-C5Z6	1 050	1 059	1 158	1 200	1 333

- Notes:
- We recommend use of the NSK support unit. See Page B377 for details.
 - Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use. See Page D13 for details.
 - Contact NSK if permissible rotational speed N will be exceeded.
 - The maximum stroke is -2 mm when a Fixed-Fixed configuration is used with left shaft end shape I.

Left shaft end shape	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min ⁻¹)	
	T	e_p	v_u			Configuration	
						Fixed - Simple	Fixed - Fixed
II	-0.009	0.025	0.020	0.040	3.4	2 500	—
II	-0.014	0.030	0.023	0.060	4.3	2 500	—
I	-0.018	0.035	0.025	0.075	5.3	2 500	2 500
I	-0.023	0.040	0.027	0.090	6.2	2 500	2 500
I	-0.028	0.046	0.030	0.120	7.1	2 500	2 500



Ball screw specifications		
Shaft dia. x Lead / Direction of turn	32 x 5 / Right	
Preload / Ball recirculation	P-preload / Tube	
Ball dia. / Ball circle dia.	3.175 / 32.5	
Screw shaft root diameter	29.2	
Effective ball turns	2.5 x 2	
Accuracy grade / Preload	C5 / Z	
Basic load ratings (N)	Dynamic C_a	13 700
	Static C_{0a}	28 000
Preload (N)	590	
Standard dynamic friction torque (N-cm)	11.8	
Spacer ball	Yes	
Factory-packed grease	Refer to Note 2.	
Nut internal space (cm ³)	7.0	
Standard grease replenishment (cm ³)	3.5	

Recommended support unit

For drive side (Fixed)	For non-drive side	
	(Fixed)	(Simple)
WBK25-01W (square)	WBK25-01W (square)	WBK25S-01W (square)
WBK25-11 (round)	WBK25-11 (round)	

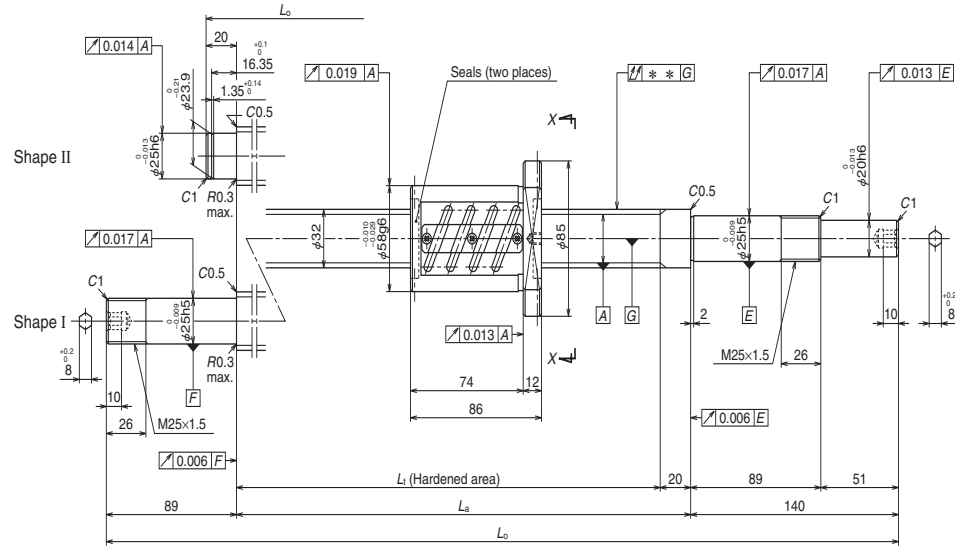
Reference No.	Stroke		Screw shaft length		
	Nominal	Maximum	L_t	L_a	L_0
W3202SA-1P-C5Z5	150	201	265	300	415
W3203SA-1P-C5Z5	250	301	365	400	515
W3204SA-1P-C5Z5	350	401	465	500	615
W3205SA-1P-C5Z5	450	501	565	600	715
W3206SA-1P-C5Z5	550	601	665	700	857
W3207SA-1P-C5Z5	650	701	765	800	957
W3209SA-1P-C5Z5	850	901	965	1 000	1 157
W3211SA-1P-C5Z5	1 050	1 101	1 165	1 200	1 357
W3214SA-1P-C5Z5	1 350	1 401	1 465	1 500	1 657

Left shaft end shape	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min ⁻¹)	
	T	e_p	v_u			Configuration	
						Fixed - Simple	Fixed - Fixed
II	-0.006	0.023	0.018	0.040	3.1	2 180	—
II	-0.009	0.025	0.020	0.050	3.7	2 180	—
II	-0.011	0.027	0.020	0.050	4.2	2 180	—
II	-0.014	0.030	0.023	0.060	4.8	2 180	—
I	-0.016	0.035	0.025	0.075	5.6	2 180	2 180
I	-0.018	0.035	0.025	0.075	6.1	2 180	2 180
I	-0.023	0.040	0.027	0.090	7.3	2 180	2 180
I	-0.028	0.046	0.030	0.120	8.5	2 180	2 180
I	-0.035	0.054	0.035	0.150	10.2	2 100	2 180

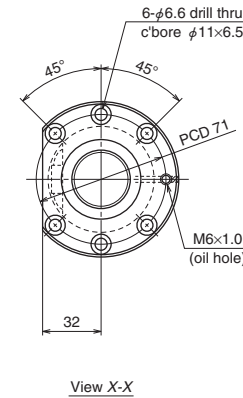
- Notes:
1. We recommend use of the NSK support unit. See Page B377 for details.
 2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
 3. Contact NSK if permissible rotational speed N will be exceeded.
 4. The maximum stroke is -9 mm when a Fixed-Fixed configuration is used with left shaft end shape I.

Finished Shaft End SA Model

(Fine lead)



Nut: ZFT



NSK

Screw shaft ø32

Lead 5

Unit: mm

Ball screw specifications		
Shaft dia. x Lead / Direction of turn	32 x 5 / Right	
Preload / Ball recirculation	Z-preload / Tube	
Ball dia. / Ball circle dia.	3.175 / 32.5	
Screw shaft root diameter	29.2	
Effective ball turns	2.5 x 2	
Accuracy grade / Preload	C5 / Z	
Basic load ratings (N)	Dynamic C_a	21 800
	Static C_{0a}	56 000
Preload (N)	1 270	
Standard dynamic friction torque (N·cm)	23.5	
Spacer ball	None	
Factory-packed grease	Refer to Note 2.	
Nut internal space (cm ³)	10	
Standard grease replenishment (cm ³)	5	

Recommended support unit

For drive side, for non-drive side (Fixed)	
WBK25DF-31H (round)	

Unit: mm

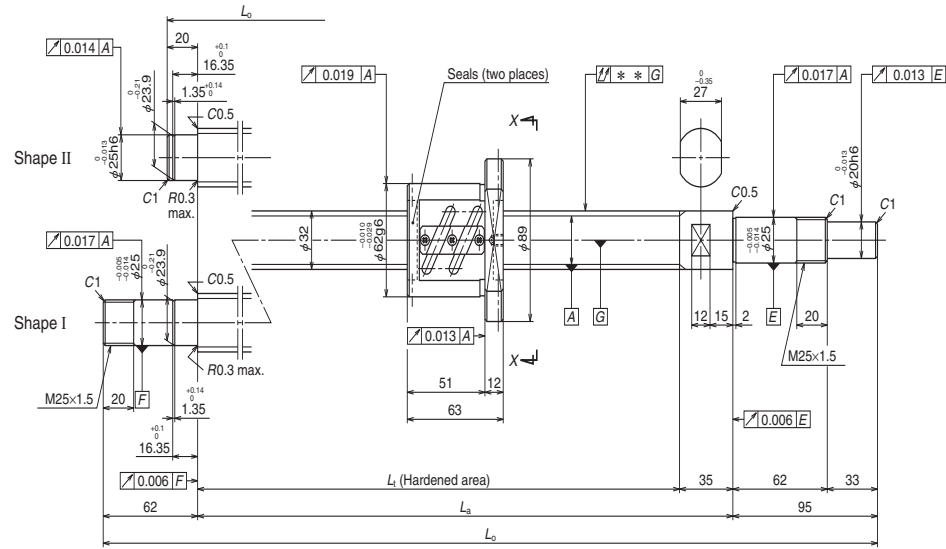
Reference No.	Stroke		Screw shaft length		
	Nominal	Maximum	L_t	L_a	L_o
W3202SA-2Z-C5Z5	150	186	280	300	460
W3203SA-2Z-C5Z5	250	286	380	400	560
W3204SA-2Z-C5Z5	350	386	480	500	660
W3205SA-2Z-C5Z5	450	486	580	600	760
W3206SA-2Z-C5Z5	550	586	680	700	929
W3207SA-2Z-C5Z5	650	686	780	800	1 029
W3209SA-2Z-C5Z5	850	886	980	1 000	1 229
W3211SA-2Z-C5Z5	1 050	1 086	1 180	1 200	1 429
W3214SA-2Z-C5Z5	1 350	1 386	1 480	1 500	1 729

Left shaft end shape	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min ⁻¹)	
	T	e_p	v_u			Configuration	
						Fixed - Simple	Fixed - Fixed
II	-0.007	0.023	0.018	0.040	3.5	2 180	—
II	-0.009	0.025	0.020	0.050	4.1	2 180	—
II	-0.012	0.027	0.020	0.060	4.7	2 180	—
II	-0.014	0.030	0.023	0.060	5.3	2 180	—
I	-0.016	0.035	0.025	0.075	6.1	2 180	2 180
I	-0.019	0.035	0.025	0.090	6.7	2 180	2 180
I	-0.024	0.040	0.027	0.090	7.9	2 180	2 180
I	-0.028	0.046	0.030	0.120	9.0	2 180	2 180
I	-0.036	0.054	0.035	0.150	10.8	2 100	2 180

- Notes:
1. We recommend use of the NSK support unit. See Page B377 for details.
 2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
 3. Contact NSK if permissible rotational speed N will be exceeded.
 4. The maximum stroke is -9 mm when a Fixed-Fixed configuration is used with left shaft end shape I.

Finished Shaft End SA Model

(Fine lead)



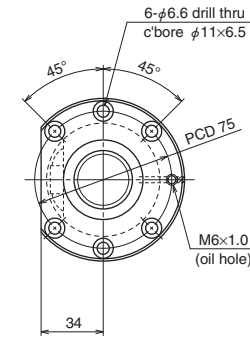
Nut: PFT

NSK

Screw shaft ø32

Lead 6

Unit: mm



View X-X

Ball screw specifications

Shaft dia. x Lead / Direction of turn	32 × 6 / Right	
Preload / Ball recirculation	P-preload / Tube	
Ball dia. / Ball circle dia.	3.969 / 32.5	
Screw shaft root diameter	28.4	
Effective ball turns	2.5 × 2	
Accuracy grade / Preload	C5 / Z	
Basic load ratings (N)	Dynamic C_a	18 300
	Static C_{0a}	34 700
Preload (N)	780	
Standard dynamic friction torque (N·cm)	15.7	
Spacer ball	Yes	
Factory-packed grease	Refer to Note 2.	
Nut internal space (cm ³)	9.5	
Standard grease replenishment (cm ³)	4.8	

Recommended support unit

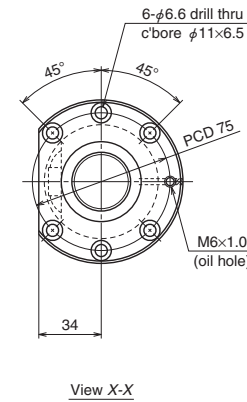
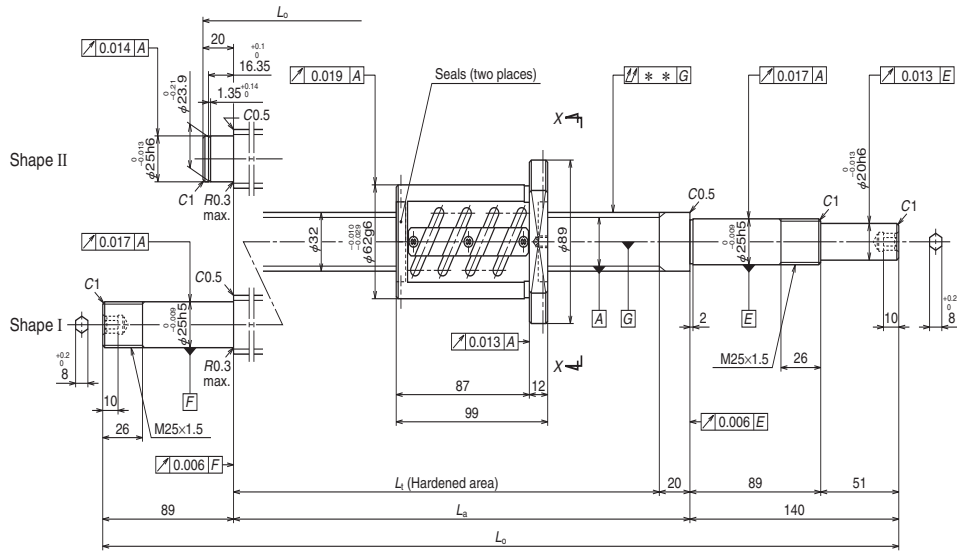
For drive side (Fixed)	For non-drive side	
	(Fixed)	(Simple)
WBK25-01W (square)	WBK25-01W (square)	WBK25S-01W (square)
WBK25-11 (round)	WBK25-11 (round)	

Unit: mm

Reference No.	Stroke		Screw shaft length		
	Nominal	Maximum	L_t	L_a	L_o
W3203SA-3P-C5Z6	250	294	365	400	515
W3205SA-3P-C5Z6	450	494	565	600	715
W3207SA-3P-C5Z6	650	694	765	800	957
W3209SA-3P-C5Z6	850	894	965	1 000	1 157
W3211SA-3P-C5Z6	1 050	1 094	1 165	1 200	1 357
W3214SA-3P-C5Z6	1 350	1 394	1 465	1 500	1 657

Left shaft end shape	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min ⁻¹)	
	T	e_p	v_u			Configuration	
						Fixed - Simple	Fixed - Fixed
II	-0.009	0.025	0.020	0.050	3.8	2 180	—
II	-0.014	0.030	0.023	0.060	5.0	2 180	—
I	-0.018	0.035	0.025	0.075	6.3	2 180	2 180
I	-0.023	0.040	0.027	0.090	7.4	2 180	2 180
I	-0.028	0.046	0.030	0.120	8.5	2 180	2 180
I	-0.035	0.054	0.035	0.150	10.2	2 050	2 180

- Notes: 1. We recommend use of the NSK support unit. See Page B377 for details.
 2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
 3. Contact NSK if permissible rotational speed N will be exceeded.
 4. The maximum stroke is -9 mm when a Fixed-Fixed configuration is used with left shaft end shape I.



Ball screw specifications		
Shaft dia. x Lead / Direction of turn	32 × 6 / Right	
Preload / Ball recirculation	Z-preload / Tube	
Ball dia. / Ball circle dia.	3.969 / 32.5	
Screw shaft root diameter	28.4	
Effective ball turns	2.5 × 2	
Accuracy grade / Preload	C5 / Z	
Basic load ratings (N)	Dynamic C_s	29 100
	Static C_{0a}	69 300
Preload (N)	1 710	
Standard dynamic friction torque (N·cm)	35.0	
Spacer ball	None	
Factory-packed grease	Refer to Note 2.	
Nut internal space (cm ³)	14	
Standard grease replenishment (cm ³)	7	

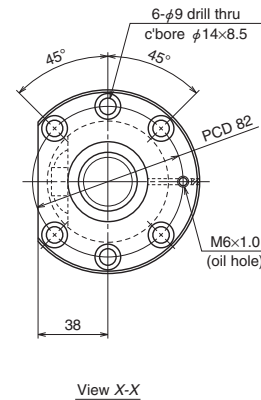
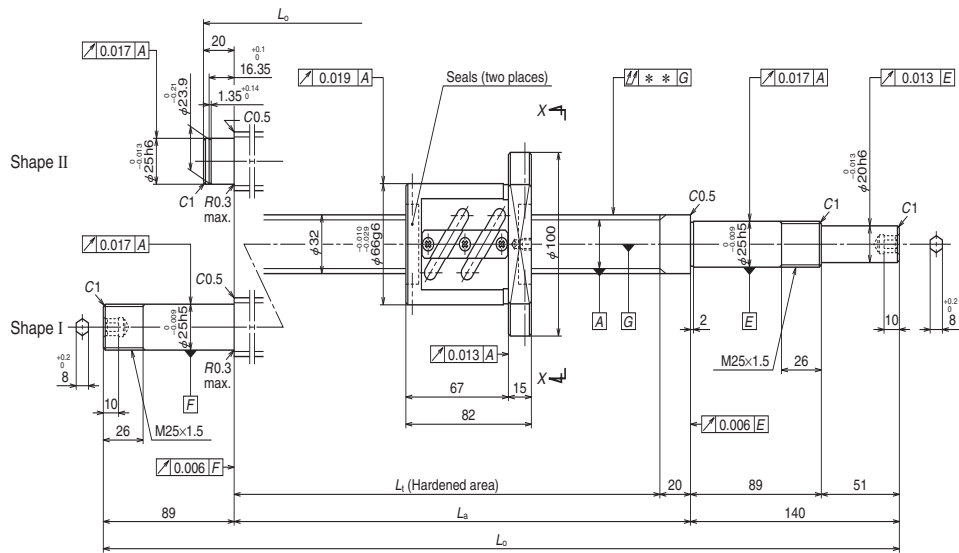
Recommended support unit

For drive side, for non-drive side (Fixed)	
WBK25DF-31H (round)	

Reference No.	Stroke		Screw shaft length		
	Nominal	Maximum	L_t	L_a	L_o
W3203SA-4Z-C5Z6	250	273	380	400	560
W3205SA-4Z-C5Z6	450	473	580	600	760
W3207SA-4Z-C5Z6	650	673	780	800	1 029
W3209SA-4Z-C5Z6	850	873	980	1 000	1 229
W3211SA-4Z-C5Z6	1 050	1 073	1 180	1 200	1 429
W3214SA-4Z-C5Z6	1 350	1 373	1 480	1 500	1 729

Left shaft end shape	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min ⁻¹)	
	T	e_p	v_u			Configuration	
						Fixed - Simple	Fixed - Fixed
II	-0.009	0.025	0.020	0.050	4.5	2 180	—
II	-0.014	0.030	0.023	0.060	5.6	2 180	—
I	-0.019	0.035	0.025	0.090	7.0	2 180	2 180
I	-0.024	0.040	0.027	0.090	8.1	2 180	2 180
I	-0.028	0.046	0.030	0.120	9.3	2 180	2 180
I	-0.036	0.054	0.035	0.150	11.0	2 060	2 180

- Notes: 1. We recommend use of the NSK support unit. See Page B377 for details.
 2. Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use. See Page D13 for details.
 3. Contact NSK if permissible rotational speed N will be exceeded.



Ball screw specifications

Shaft dia. x Lead / Direction of turn	32 × 8 / Right	
Preload / Ball recirculation	Z-preload / Tube	
Ball dia. / Ball circle dia.	4.762 / 32.5	
Screw shaft root diameter	27.5	
Effective ball turns	2.5 × 1	
Accuracy grade / Preload	C5 / Z	
Basic load ratings (N)	Dynamic C_a	20 600
	Static C_{0a}	40 900
Preload (N)	1 320	
Standard dynamic friction torque (N·cm)	31.0	
Spacer ball	None	
Factory-packed grease	Refer to Note 2.	
Nut internal space (cm ³)	13	
Standard grease replenishment (cm ³)	6.5	

Recommended support unit

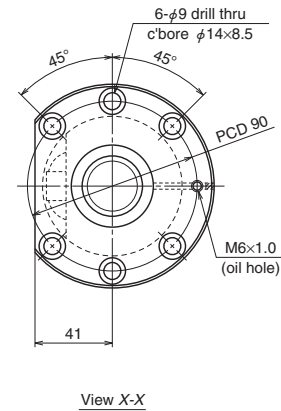
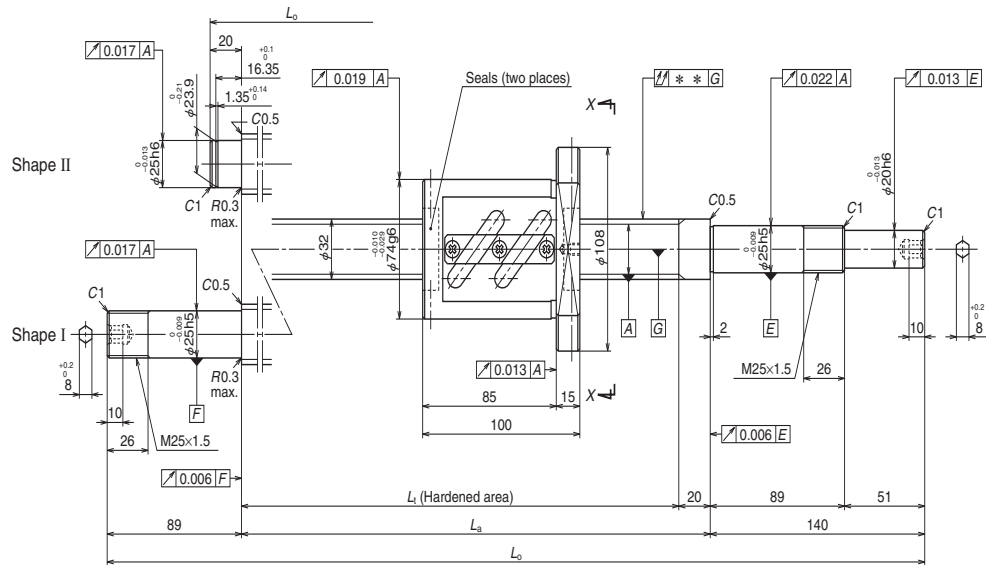
For drive side, for non-drive side (Fixed)

WBK25DF-31H (round)

Reference No.	Stroke		Screw shaft length		
	Nominal	Maximum	L_t	L_s	L_o
W3203SA-5Z-C5Z8	250	290	380	400	560
W3205SA-5Z-C5Z8	450	490	580	600	760
W3207SA-5Z-C5Z8	650	690	780	800	1 029
W3209SA-5Z-C5Z8	850	890	980	1 000	1 229
W3214SA-5Z-C5Z8	1 350	1 390	1 480	1 500	1 729

- Notes: 1. We recommend use of the NSK support unit. See Page B377 for details.
 2. Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use. See Page D13 for details.
 3. Contact NSK if permissible rotational speed N will be exceeded.

Left shaft end shape	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min ⁻¹)	
	T	e_p	v_u			Configuration	
						Fixed - Simple	Fixed - Fixed
II	-0.009	0.025	0.020	0.050	4.7	2 180	—
II	-0.014	0.030	0.023	0.060	5.8	2 180	—
I	-0.019	0.035	0.025	0.090	7.2	2 180	2 180
I	-0.024	0.040	0.027	0.090	8.3	2 180	2 180
I	-0.036	0.054	0.035	0.150	11.1	1 960	2 180



Ball screw specifications		
Shaft dia. x Lead / Direction of turn	32 x 10 / Right	
Preload / Ball recirculation	Z-preload / Tube	
Ball dia. / Ball circle dia.	6.35 / 33	
Screw shaft root diameter	26.4	
Effective ball turns	2.5 x 1	
Accuracy grade / Preload	C5 / Z	
Basic load ratings (N)	Dynamic C_a	30 000
	Static C_{0a}	55 100
Preload (N)	1 960	
Standard dynamic friction torque (N-cm)	54.0	
Spacer ball	None	
Factory-packed grease	Refer to Note 2.	
Nut internal space (cm ³)	22	
Standard grease replenishment (cm ³)	11	

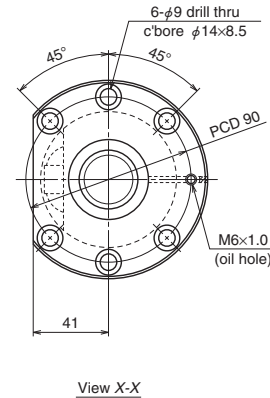
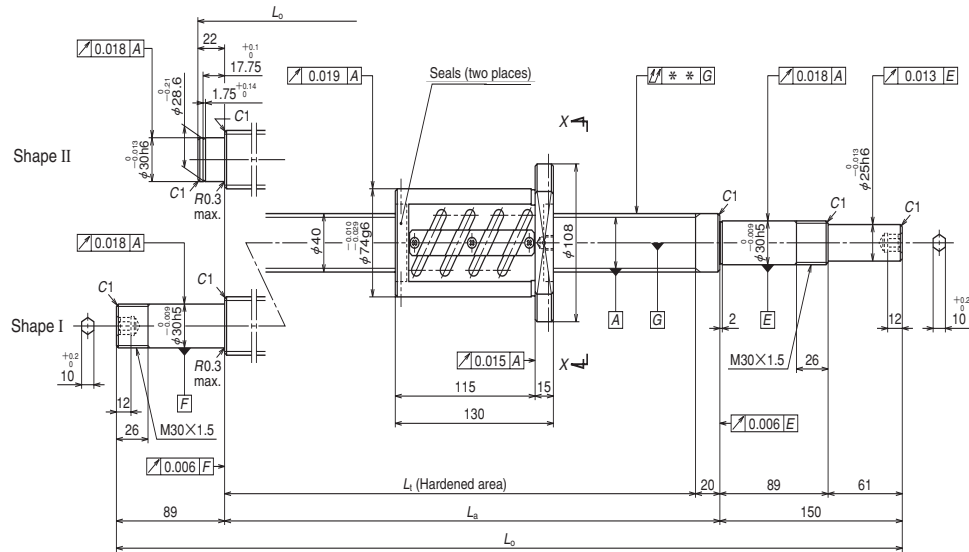
Recommended support unit

For drive side, for non-drive side (Fixed)
WBK25DF-31H (round)

Reference No.	Stroke		Screw shaft length		
	Nominal	Maximum	L_t	L_a	L_0
W3203SA-6Z-C5Z10	250	272	380	400	560
W3204SA-3Z-C5Z10	350	372	480	500	660
W3205SA-6Z-C5Z10	450	472	580	600	760
W3206SA-3Z-C5Z10	550	572	680	700	929
W3207SA-6Z-C5Z10	650	672	780	800	1 029
W3209SA-6Z-C5Z10	850	872	980	1 000	1 229
W3211SA-5Z-C5Z10	1 050	1 072	1 180	1 200	1 429
W3214SA-6Z-C5Z10	1 350	1 372	1 480	1 500	1 729
W3217SA-1Z-C5Z10	1 650	1 672	1 780	1 800	2 029

- Notes: 1. We recommend use of the NSK support unit. See Page B377 for details.
 2. Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use. See Page D13 for details.
 3. Contact NSK if permissible rotational speed N will be exceeded.

Left shaft end shape	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min ⁻¹)	
	T	e_p	v_u			Configuration	
						Fixed - Simple	Fixed - Fixed
II	-0.009	0.025	0.020	0.050	5.5	2 180	—
II	-0.012	0.027	0.020	0.060	6.0	2 180	—
II	-0.014	0.030	0.023	0.060	6.6	2 180	—
I	-0.016	0.035	0.025	0.075	7.4	2 180	2 180
I	-0.019	0.035	0.025	0.090	7.9	2 180	2 180
I	-0.024	0.040	0.027	0.090	9.0	2 180	2 180
I	-0.028	0.046	0.030	0.120	10.1	2 180	2 180
I	-0.036	0.054	0.035	0.150	11.7	1 920	2 180
I	-0.043	0.065	0.040	0.200	13.3	1 310	1 810



Ball screw specifications		
Shaft dia. x Lead / Direction of turn	32 × 10 / Right	
Preload / Ball recirculation	Z-preload / Tube	
Ball dia. / Ball circle dia.	6.35 / 33	
Screw shaft root diameter	26.4	
Effective ball turns	2.5 × 2	
Accuracy grade / Preload	C5 / Z	
Basic load ratings (N)	Dynamic C_s	54 500
	Static C_{0a}	110 000
Preload (N)	2 320	
Standard dynamic friction torque (N·cm)	59.0	
Spacer ball	None	
Factory-packed grease	Refer to Note 2.	
Nut internal space (cm ³)	44	
Standard grease replenishment (cm ³)	22	

Recommended support unit

For drive side, for non-drive side (Fixed)	
WBK25DFD-31H (round)	

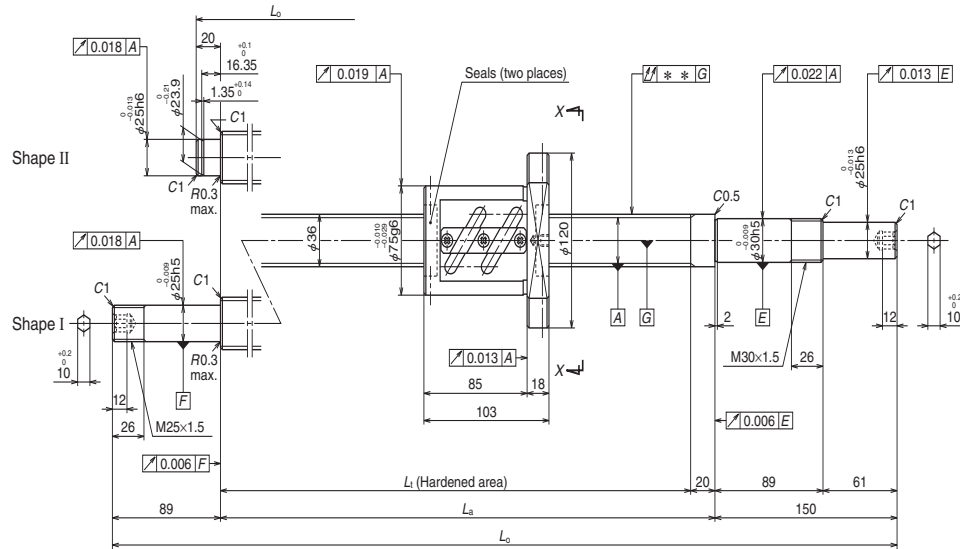
Reference No.	Stroke		Screw shaft length		
	Nominal	Maximum	L_t	L_a	L_o
W3203SA-8Z-C5Z10	150	182	380	400	575
W3204SA-5Z-C5Z10	250	282	480	500	675
W3205SA-8Z-C5Z10	350	382	580	600	775
W3206SA-5Z-C5Z10	450	482	680	700	959
W3207SA-8Z-C5Z10	550	582	780	800	1 059
W3209SA-8Z-C5Z10	750	782	980	1 000	1 259
W3211SA-7Z-C5Z10	950	982	1 180	1 200	1 459
W3214SA-8Z-C5Z10	1 250	1 282	1 480	1 500	1 759
W3217SA-3Z-C5Z10	1 550	1 582	1 780	1 800	2 059

Left shaft end shape	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min ⁻¹)	
	T	e_p	v_u			Configuration	
						Fixed - Simple	Fixed - Fixed
II	-0.009	0.025	0.020	0.050	7.5	2 180	—
II	-0.012	0.027	0.020	0.060	8.1	2 180	—
II	-0.014	0.030	0.023	0.060	8.6	2 180	—
I	-0.016	0.035	0.025	0.075	9.5	2 180	2 180
I	-0.019	0.035	0.025	0.090	10.0	2 180	2 180
I	-0.024	0.040	0.027	0.120	11.1	2 180	2 180
I	-0.028	0.046	0.030	0.120	12.2	2 180	2 180
I	-0.036	0.054	0.035	0.150	13.8	2 050	2 180
I	-0.043	0.065	0.040	0.200	15.4	1 380	1 910

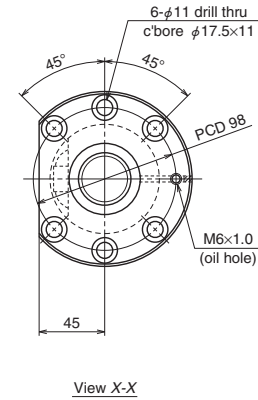
- Notes: 1. We recommend use of the NSK support unit. See Page B377 for details.
 2. Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use. See Page D13 for details.
 3. Contact NSK if permissible rotational speed N will be exceeded.

Finished Shaft End SA Model

(Fine lead)



Nut: ZFT



NSK

Screw shaft $\phi 36$

Lead 10

Unit: mm

Ball screw specifications

Shaft dia. x Lead / Direction of turn	36 x 10 / Right	
Preload / Ball recirculation	Z-preload / Tube	
Ball dia. / Ball circle dia.	6.35 / 37	
Screw shaft root diameter	30.4	
Effective ball turns	2.5 x 1	
Accuracy grade / Preload	C5 / Z	
Basic load ratings (N)	Dynamic C_s	32 000
	Static C_{0a}	61 100
Preload (N)	2 060	
Standard dynamic friction torque (N·cm)	59.0	
Spacer ball	None	
Factory-packed grease	Refer to Note 2.	
Nut internal space (cm ³)	27	
Standard grease replenishment (cm ³)	16	

Recommended support unit

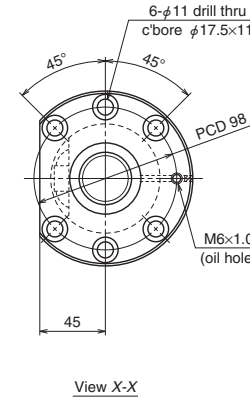
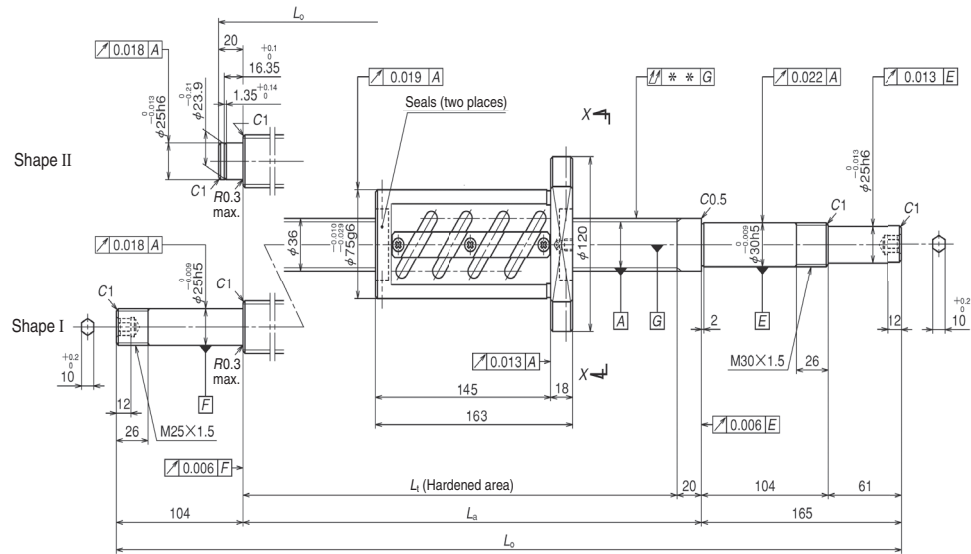
For drive side (Fixed)	For non-drive side (Simple)
WBK30DF-31H (round)	WBK25DF-31H (round)

Unit: mm

Reference No.	Stroke		Screw shaft length		
	Nominal	Maximum	L_t	L_a	L_o
W3604SA-1Z-C5Z10	350	370	480	500	670
W3606SA-1Z-C5Z10	550	570	680	700	870
W3609SA-1Z-C5Z10	850	870	980	1 000	1 239
W3613SA-1Z-C5Z10	1 250	1 270	1 380	1 400	1 639
W3617SA-1Z-C5Z10	1 650	1 670	1 780	1 800	2 039

- Notes: 1. We recommend use of the NSK support unit. See Page B377 for details.
 2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
 3. Contact NSK if permissible rotational speed N will be exceeded.

Left shaft end shape	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min ⁻¹)	
	T	e_p	v_u			Configuration	
					Fixed - Simple	Fixed - Fixed	
II	-0.012	0.027	0.020	0.040	7.4	1 940	—
II	-0.016	0.035	0.025	0.050	8.8	1 940	—
I	-0.024	0.040	0.027	0.065	11.1	1 940	1 940
I	-0.033	0.054	0.035	0.100	13.9	1 940	1 940
I	-0.043	0.065	0.040	0.130	16.6	1 510	1 940



Ball screw specifications		
Shaft dia. x Lead / Direction of turn	36 x 10 / Right	
Preload / Ball recirculation	Z-preload / Tube	
Ball dia. / Ball circle dia.	6.35 / 37	
Screw shaft root diameter	30.4	
Effective ball turns	2.5 x 2	
Accuracy grade / Preload	C5 / Z	
Basic load ratings (N)	Dynamic C_a	58 000
	Static C_{0a}	122 000
Preload (N)	2 470	
Standard dynamic friction torque (N-cm)	67.0	
Spacer ball	None	
Factory-packed grease	Refer to Note 2.	
Nut internal space (cm ³)	64	
Standard grease replenishment (cm ³)	27	

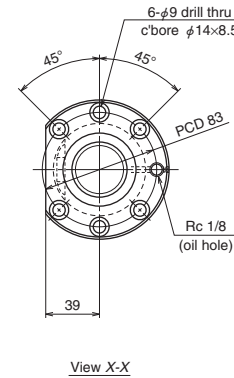
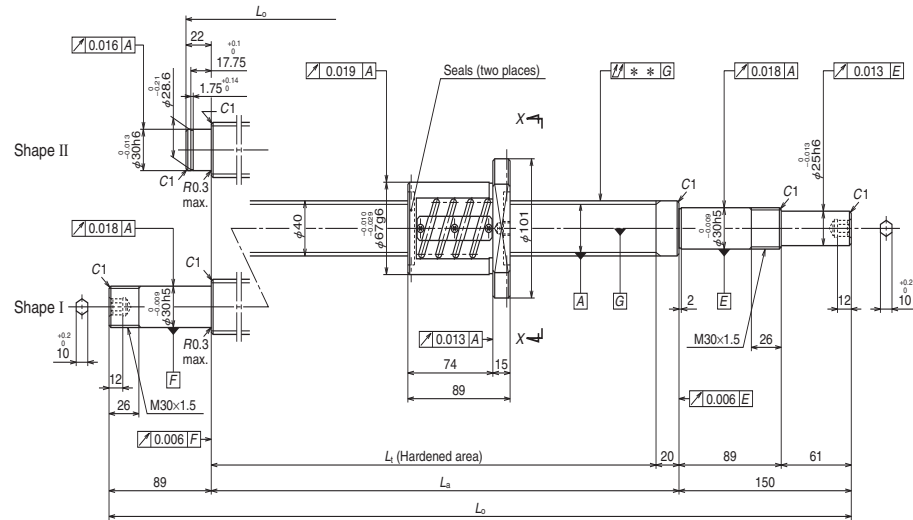
Recommended support unit

For drive side (Fixed)	For non-drive side (Fixed)
WBK30DFD-31H (round)	WBK25DFD-31H (round)

Reference No.	Stroke		Screw shaft length		
	Nominal	Maximum	L_t	L_a	L_o
W3604SA-3Z-C5Z10	250	280	480	500	685
W3606SA-3Z-C5Z10	450	480	680	700	885
W3609SA-3Z-C5Z10	750	780	980	1 000	1 269
W3613SA-3Z-C5Z10	1 150	1 180	1 380	1 400	1 669
W3617SA-3Z-C5Z10	1 550	1 580	1 780	1 800	2 069

- Notes: 1. We recommend use of the NSK support unit. See Page B377 for details.
 2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
 3. Contact NSK if permissible rotational speed N will be exceeded.

Left shaft end shape	Lead accuracy			Shaft run-out ** $\uparrow \downarrow$	Mass (kg)	Permissible rotational speed N (min ⁻¹)	
	T	e_o	v_u			Configuration	
						Fixed - Simple	Fixed - Fixed
II	-0.012	0.027	0.020	0.040	9.3	1 940	—
II	-0.016	0.035	0.025	0.050	10.7	1 940	—
I	-0.024	0.040	0.027	0.080	13.1	1 940	1 940
I	-0.033	0.054	0.035	0.100	15.9	1 940	1 940
I	-0.043	0.065	0.040	0.130	18.6	1 600	1 940



Ball screw specifications		
Shaft dia. x Lead / Direction of turn	40 x 5 / Right	
Preload / Ball recirculation	Z-preload / Tube	
Ball dia. / Ball circle dia.	3.175 / 40.5	
Screw shaft root diameter	37.2	
Effective ball turns	2.5 x 2	
Accuracy grade / Preload	C5 / Z	
Basic load ratings (N)	Dynamic C _s	23 900
	Static C _{0a}	70 500
Preload (N)	1 420	
Standard dynamic friction torque (N·cm)	29.5	
Spacer ball	None	
Factory-packed grease	Refer to Note 2.	
Nut internal space (cm ³)	14	
Standard grease replenishment (cm ³)	7	

Recommended support unit

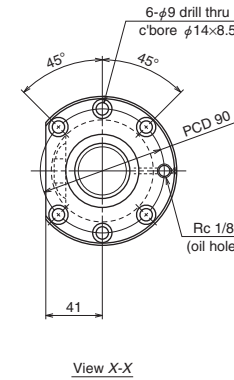
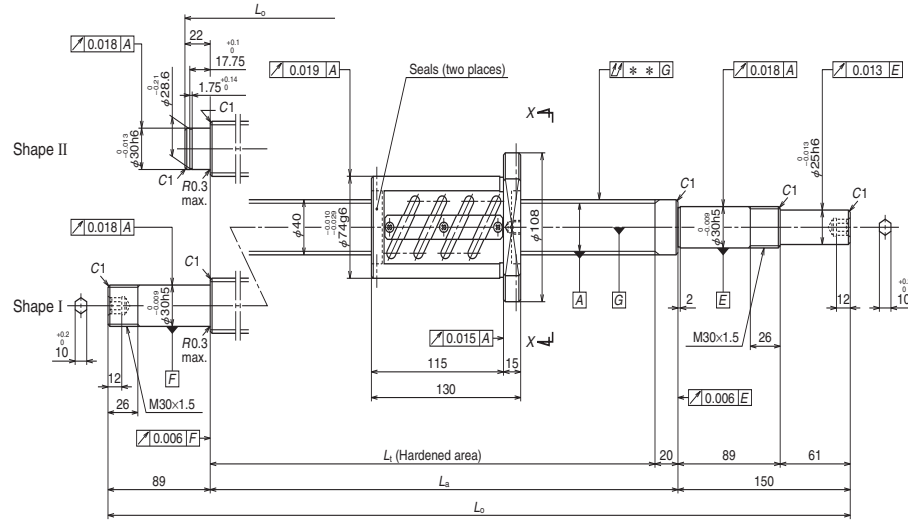
For drive side, for non-drive side (Fixed)	
WBK30DF-31H (round)	

Unit: mm

Reference No.	Stroke		Screw shaft length		
	Nominal	Maximum	L _t	L _a	L _o
W4003SA-1Z-C5Z5	250	284	380	400	572
W4005SA-1Z-C5Z5	450	484	580	600	772
W4007SA-1Z-C5Z5	650	684	780	800	1 039
W4009SA-1Z-C5Z5	850	884	980	1 000	1 239
W4011SA-1Z-C5Z5	1 050	1 084	1 180	1 200	1 439
W4015SA-1Z-C5Z5	1 450	1 484	1 580	1 600	1 839

- Notes: 1. We recommend use of the NSK support unit. See Page B377 for details.
 2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
 3. Contact NSK if permissible rotational speed *N* will be exceeded.

Left shaft end shape	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed <i>N</i> (min ⁻¹)	
	<i>T</i>	<i>e_p</i>	<i>v_u</i>			Configuration	
						Fixed - Simple	Fixed - Fixed
II	-0.009	0.025	0.020	0.035	6.3	1 750	—
II	-0.014	0.030	0.023	0.040	8.1	1 750	—
I	-0.019	0.035	0.025	0.065	10.3	1 750	1 750
I	-0.024	0.040	0.027	0.065	12.2	1 750	1 750
I	-0.028	0.046	0.030	0.080	14.0	1 750	1 750
I	-0.038	0.054	0.035	0.100	17.7	1 750	1 750



Ball screw specifications		
Shaft dia. x Lead / Direction of turn	40 × 8 / Right	
Preload / Ball recirculation	Z-preload / Tube	
Ball dia. / Ball circle dia.	4.762 / 40.5	
Screw shaft root diameter	35.5	
Effective ball turns	2.5 × 2	
Accuracy grade / Preload	C5 / Z	
Basic load ratings (N)	Dynamic C _s	41 100
	Static C _{0a}	103 000
Preload (N)	2 450	
Standard dynamic friction torque (N·cm)	64.0	
Spacer ball	None	
Factory-packed grease	Refer to Note 2.	
Nut internal space (cm ³)	27	
Standard grease replenishment (cm ³)	14	

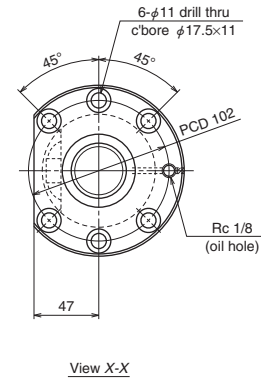
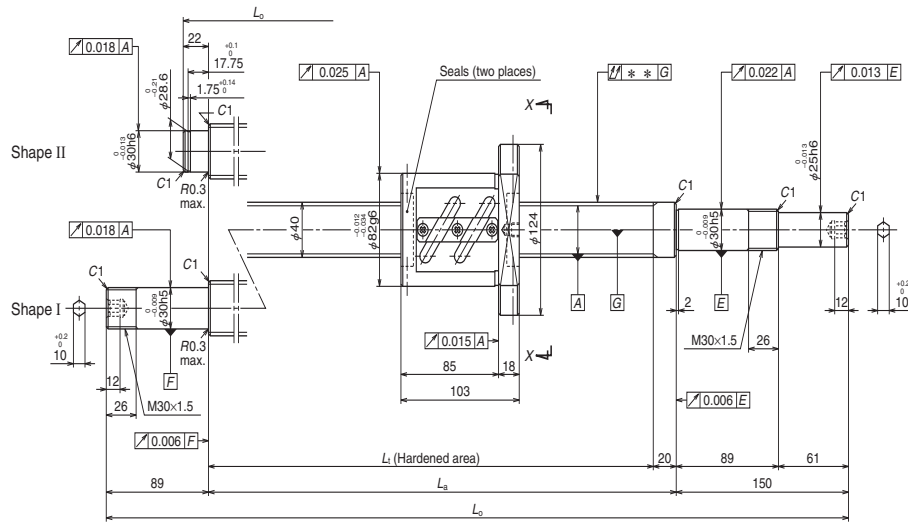
Recommended support unit

For drive side, for non-drive side (Fixed)	
WBK30DF-31H (round)	

Reference No.	Stroke		Screw shaft length		
	Nominal	Maximum	L _t	L _a	L _o
W4003SA-2Z-C5Z8	200	243	380	400	572
W4005SA-2Z-C5Z8	400	443	580	600	772
W4007SA-2Z-C5Z8	600	643	780	800	1 039
W4009SA-2Z-C5Z8	800	843	980	1 000	1 239
W4011SA-2Z-C5Z8	1 000	1 043	1 180	1 200	1 439
W4015SA-2Z-C5Z8	1 400	1 443	1 580	1 600	1 839

Left shaft end shape	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min ⁻¹)	
	T	e _p	v _u			Configuration	
						Fixed - Simple	Fixed - Fixed
II	-0.009	0.025	0.020	0.035	7.4	1 750	—
II	-0.014	0.030	0.023	0.040	9.2	1 750	—
I	-0.019	0.035	0.025	0.065	11.3	1 750	1 750
I	-0.024	0.040	0.027	0.065	13.1	1 750	1 750
I	-0.028	0.046	0.030	0.080	14.9	1 750	1 750
I	-0.038	0.054	0.035	0.100	18.5	1 750	1 750

- Notes: 1. We recommend use of the NSK support unit. See Page B377 for details.
 2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
 3. Contact NSK if permissible rotational speed N will be exceeded.



Ball screw specifications		
Shaft dia. x Lead / Direction of turn	40 × 10 / Right	
Preload / Ball recirculation	Z-preload / Tube	
Ball dia. / Ball circle dia.	6.35 / 41	
Screw shaft root diameter	34.4	
Effective ball turns	2.5 × 1	
Accuracy grade / Preload	C5 / Z	
Basic load ratings (N)	Dynamic C _s	33 700
	Static C _{0a}	68 300
Preload (N)	2 160	
Standard dynamic friction torque (N·cm)	64.0	
Spacer ball	None	
Factory-packed grease	Refer to Note 2.	
Nut internal space (cm ³)	30	
Standard grease replenishment (cm ³)	15	

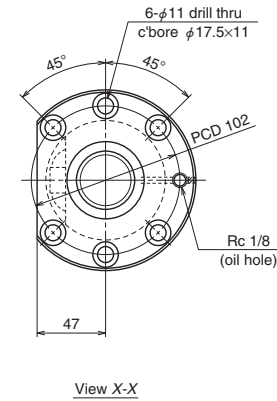
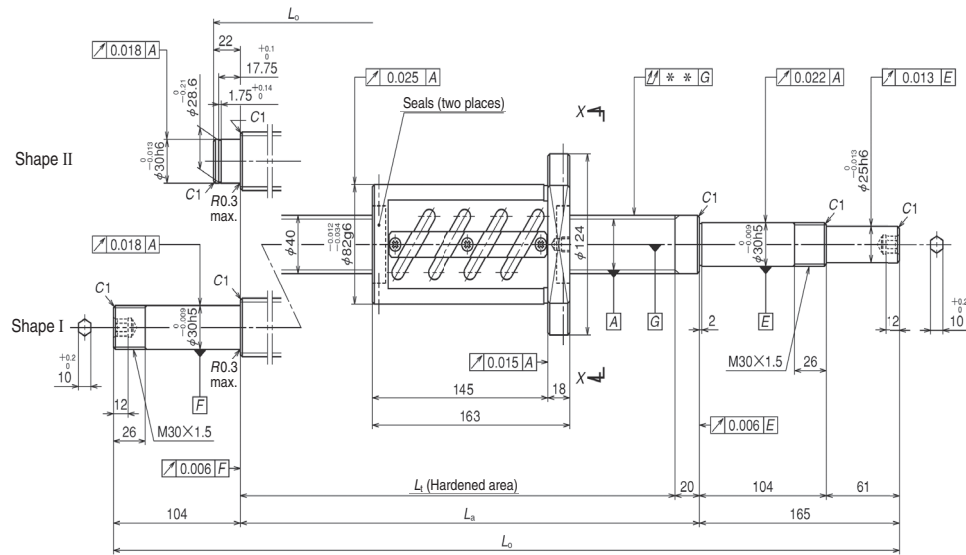
Recommended support unit

For drive side, for non-drive side (Fixed)	
WBK30DF-31H (round)	

Reference No.	Stroke		Screw shaft length		
	Nominal	Maximum	L _t	L _a	L _o
			W4004SA-1Z-C5Z10	350	370
W4005SA-3Z-C5Z10	450	470	580	600	772
W4006SA-1Z-C5Z10	550	570	680	700	872
W4007SA-3Z-C5Z10	650	670	780	800	1 039
W4009SA-3Z-C5Z10	850	870	980	1 000	1 239
W4011SA-3Z-C5Z10	1 050	1 070	1 180	1 200	1 439
W4013SA-1Z-C5Z10	1 250	1 270	1 380	1 400	1 639
W4015SA-3Z-C5Z10	1 450	1 470	1 580	1 600	1 839
W4017SA-1Z-C5Z10	1 650	1 670	1 780	1 800	2 039
W4023SA-1Z-C5Z10	2 250	2 270	2 380	2 400	2 639

Left shaft end shape	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min ⁻¹)	
	T	e _p	v _u			Configuration	
						Fixed - Simple	Fixed - Fixed
II	-0.012	0.027	0.020	0.040	8.7	1 750	—
II	-0.014	0.030	0.023	0.040	9.6	1 750	—
II	-0.016	0.035	0.025	0.050	10.4	1 750	—
I	-0.019	0.035	0.025	0.065	11.7	1 750	1 750
I	-0.024	0.040	0.027	0.065	13.4	1 750	1 750
I	-0.028	0.046	0.030	0.080	15.1	1 750	1 750
I	-0.033	0.054	0.035	0.100	16.9	1 750	1 750
I	-0.038	0.054	0.035	0.100	18.6	1 750	1 750
I	-0.043	0.065	0.040	0.130	20.3	1 710	1 750
I	-0.057	0.077	0.046	0.170	25.5	940	1 320

- Notes: 1. We recommend use of the NSK support unit. See Page B377 for details.
 2. Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use. See Page D13 for details.
 3. Contact NSK if permissible rotational speed N will be exceeded.



Ball screw specifications		
Shaft dia. x Lead / Direction of turn	40 x 10 / Right	
Preload / Ball recirculation	Z-preload / Tube	
Ball dia. / Ball circle dia.	6.35 / 41	
Screw shaft root diameter	34.4	
Effective ball turns	2.5 x 2	
Accuracy grade / Preload	C5 / Z	
Basic load ratings (N)	Dynamic C_s	61 200
	Static C_{0a}	137 000
Preload (N)	2 600	
Standard dynamic friction torque (N·cm)	74.0	
Spacer ball	None	
Factory-packed grease	Refer to Note 2.	
Nut internal space (cm ³)	59	
Standard grease replenishment (cm ³)	30	

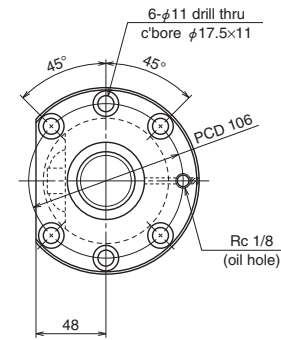
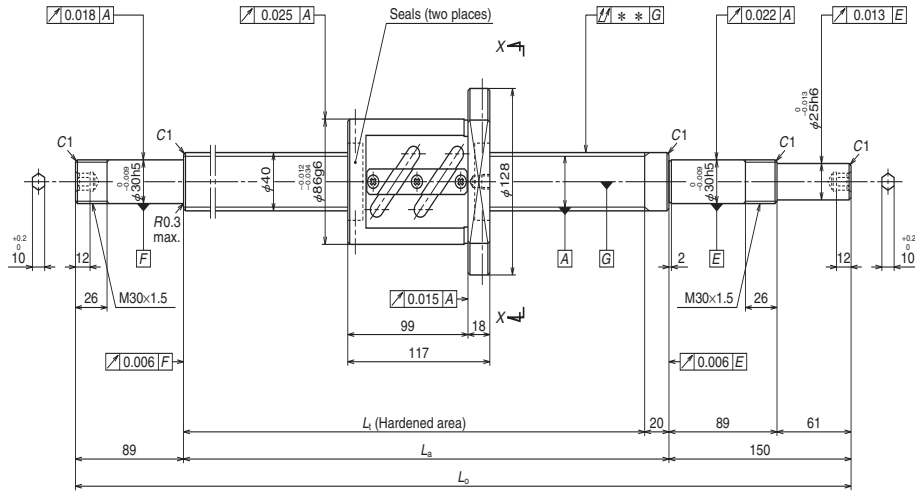
Recommended support unit

For drive side, for non-drive side (Fixed)	
WBK30DFD-31H (round)	

Reference No.	Stroke		Screw shaft length		
	Nominal	Maximum	L_t	L_a	L_o
W4004SA-3Z-C5Z10	250	280	480	500	687
W4005SA-5Z-C5Z10	350	380	580	600	787
W4006SA-5Z-C5Z10	450	480	680	700	887
W4007SA-5Z-C5Z10	550	580	780	800	1 069
W4009SA-7Z-C5Z10	750	780	980	1 000	1 269
W4011SA-5Z-C5Z10	950	980	1 180	1 200	1 469
W4013SA-5Z-C5Z10	1 150	1 180	1 380	1 400	1 669
W4015SA-5Z-C5Z10	1 350	1 380	1 580	1 600	1 869
W4017SA-5Z-C5Z10	1 550	1 580	1 780	1 800	2 069
W4023SA-3Z-C5Z10	2 150	2 180	2 380	2 400	2 669

Left shaft end shape	Lead accuracy			Shaft run-out ** $\sqrt{\quad}$	Mass (kg)	Permissible rotational speed N (min ⁻¹)	
	T	e_p	v_u			Configuration	
						Fixed - Simple	Fixed - Fixed
II	-0.012	0.027	0.020	0.040	11.0	1 750	—
II	-0.014	0.030	0.023	0.040	11.9	1 750	—
II	-0.016	0.035	0.025	0.050	12.7	1 750	—
I	-0.019	0.035	0.025	0.065	14.1	1 750	1 750
I	-0.024	0.040	0.027	0.080	15.8	1 750	1 750
I	-0.028	0.046	0.030	0.080	17.5	1 750	1 750
I	-0.033	0.054	0.035	0.100	19.3	1 750	1 750
I	-0.038	0.054	0.035	0.100	21.0	1 750	1 750
I	-0.043	0.065	0.040	0.130	22.7	1 750	1 750
I	-0.057	0.077	0.046	0.170	27.9	980	1 370

- Notes: 1. We recommend use of the NSK support unit. See Page B377 for details.
 2. Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use. See Page D13 for details.
 3. Contact NSK if permissible rotational speed N will be exceeded.



View X-X

Ball screw specifications

Shaft dia. x Lead / Direction of turn	40 × 12 / Right	
Preload / Ball recirculation	Z-preload / Tube	
Ball dia. / Ball circle dia.	7.144 / 41.5	
Screw shaft root diameter	34.1	
Effective ball turns	2.5 × 1	
Accuracy grade / Preload	C5 / Z	
Basic load ratings (N)	Dynamic C_s	39 500
	Static C_{0a}	77 200
Preload (N)	2 550	
Standard dynamic friction torque (N·cm)	83.0	
Spacer ball	None	
Factory-packed grease	Refer to Note 2.	
Nut internal space (cm ³)	33	
Standard grease replenishment (cm ³)	17	

Recommended support unit

For drive side, for non-drive side (Fixed)

WBK30DF-31H (round)

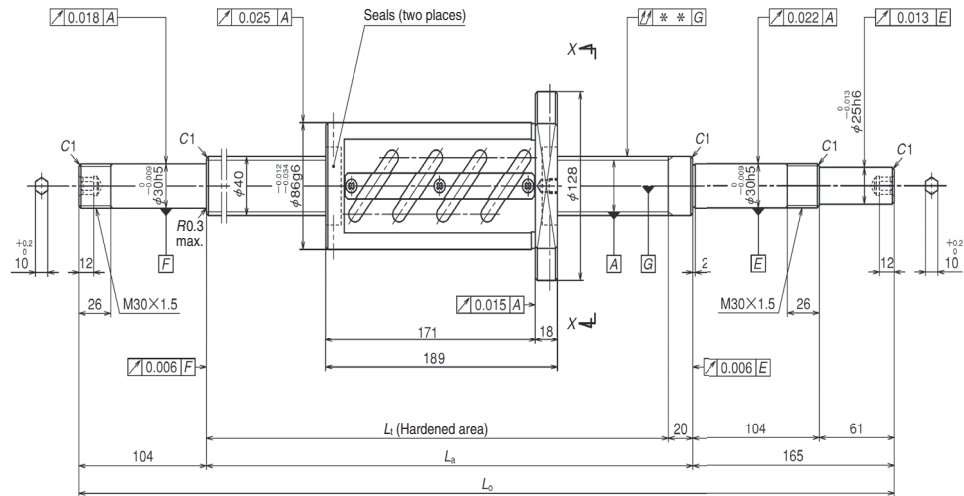
Reference No.	Stroke		Screw shaft length		
	Nominal	Maximum	L_t	L_a	L_o
W4006SA-3Z-C5Z12	500	556	680	700	939
W4009SA-5Z-C5Z12	800	856	980	1 000	1 239
W4013SA-3Z-C5Z12	1 200	1 256	1 380	1 400	1 639
W4017SA-3Z-C5Z12	1 600	1 656	1 780	1 800	2 039
W4024SA-1Z-C5Z12	2 300	2 356	2 480	2 500	2 739

Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min ⁻¹)	
T	e_p	v_u			Configuration	
					Fixed - Simple	Fixed - Fixed
-0.016	0.035	0.025	0.050	11.6	1 750	1 750
-0.024	0.040	0.027	0.065	14.2	1 750	1 750
-0.033	0.054	0.035	0.100	17.7	1 750	1 750
-0.043	0.065	0.040	0.130	21.2	1 710	1 750
-0.060	0.077	0.046	0.170	27.2	870	1 210

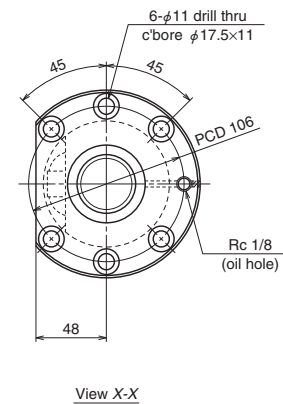
- Notes: 1. We recommend use of the NSK support unit. See Page B377 for details.
 2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
 3. Contact NSK if permissible rotational speed N will be exceeded.

Finished Shaft End SA Model

(Fine lead)



Nut: ZFT



NSK

Screw shaft $\phi 40$

Lead 12

Unit: mm

Ball screw specifications

Shaft dia. x Lead / Direction of turn	40 × 12 / Right	
Preload / Ball recirculation	Z-preload / Tube	
Ball dia. / Ball circle dia.	7.144 / 41.5	
Screw shaft root diameter	34.1	
Effective ball turns	2.5 × 2	
Accuracy grade / Preload	C5 / Z	
Basic load ratings (N)	Dynamic C_s	71 700
	Static C_{0a}	154 000
Preload (N)	3 050	
Standard dynamic friction torque (N·cm)	96.0	
Spacer ball	None	
Factory-packed grease	Refer to Note 2.	
Nut internal space (cm ³)	76	
Standard grease replenishment (cm ³)	38	

Recommended support unit

For drive side, for non-drive side (Fixed)

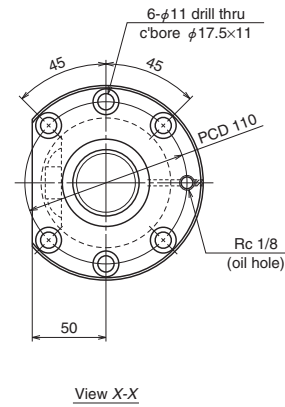
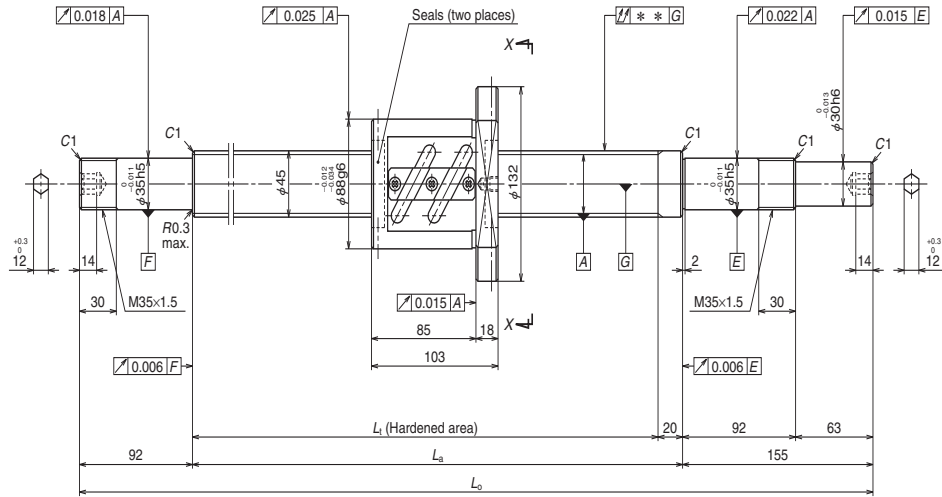
WBK30DFD-31H (round)

Unit: mm

Reference No.	Stroke		Screw shaft length		
	Nominal	Maximum	L_t	L_a	L_o
W4006SA-6Z-C5Z12	400	448	680	700	969
W4009SA-8Z-C5Z12	700	748	980	1 000	1 269
W4013SA-6Z-C5Z12	1 100	1 148	1 380	1 400	1 669
W4017SA-6Z-C5Z12	1 500	1 548	1 780	1 800	2 069
W4024SA-3Z-C5Z12	2 200	2 248	2 480	2 500	2 769

Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min ⁻¹)	
T	e_p	v_u			Configuration	
					Fixed - Simple	Fixed - Fixed
-0.016	0.035	0.025	0.050	14.8	1 750	1 750
-0.024	0.040	0.027	0.080	17.4	1 750	1 750
-0.033	0.054	0.035	0.100	20.9	1 750	1 750
-0.043	0.065	0.040	0.130	24.3	1 750	1 750
-0.060	0.077	0.046	0.170	30.4	910	1 270

- Notes: 1. We recommend use of the NSK support unit. See Page B377 for details.
 2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
 3. Contact NSK if permissible rotational speed N will be exceeded.



Ball screw specifications		
Shaft dia. x Lead / Direction of turn	45 × 10 / Right	
Preload / Ball recirculation	Z-preload / Tube	
Ball dia. / Ball circle dia.	6.35 / 46	
Screw shaft root diameter	39.4	
Effective ball turns	2.5 × 1	
Accuracy grade / Preload	C5 / Z	
Basic load ratings (N)	Dynamic C_a	36 300
	Static C_{0a}	78 500
Preload (N)	2 260	
Standard dynamic friction torque (N·cm)	69.0	
Spacer ball	None	
Factory-packed grease	Refer to Note 2.	
Nut internal space (cm ³)	33	
Standard grease replenishment (cm ³)	17	

Recommended support unit

For drive side, for non-drive side (Fixed)	
WBK35DF-31H (round)	

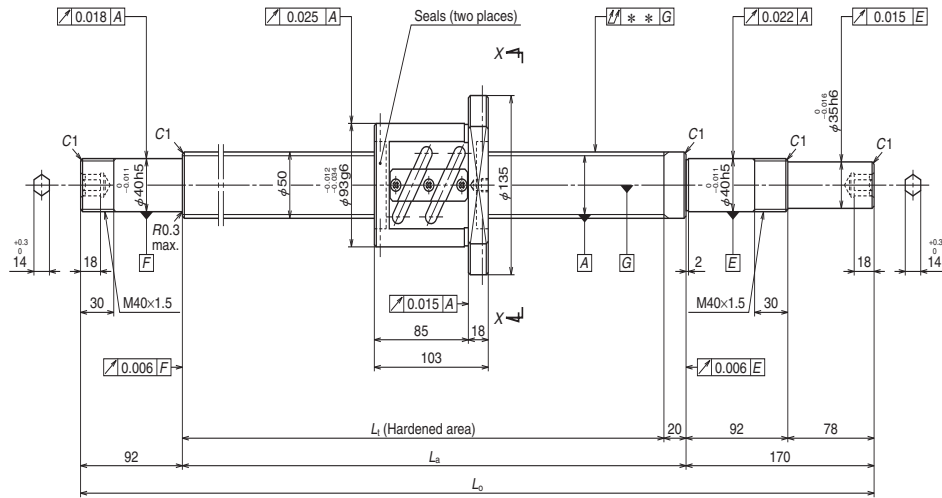
Reference No.	Stroke		Screw shaft length		
	Nominal	Maximum	L_t	L_a	L_o
W4506SA-1Z-C5Z10	550	568	680	700	947
W4509SA-1Z-C5Z10	850	868	980	1 000	1 247
W4513SA-1Z-C5Z10	1 250	1 268	1 380	1 400	1 647
W4517SA-1Z-C5Z10	1 650	1 668	1 780	1 800	2 047
W4524SA-1Z-C5Z10	2 350	2 368	2 480	2 500	2 747

Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min ⁻¹)	
T	e_p	v_u			Configuration	
					Fixed - Simple	Fixed - Fixed
-0.016	0.035	0.025	0.050	13.4	1 550	1 550
-0.024	0.040	0.027	0.065	16.7	1 550	1 550
-0.033	0.054	0.035	0.100	21.2	1 550	1 550
-0.043	0.065	0.040	0.130	25.6	1 550	1 550
-0.060	0.077	0.046	0.170	33.4	990	1 390

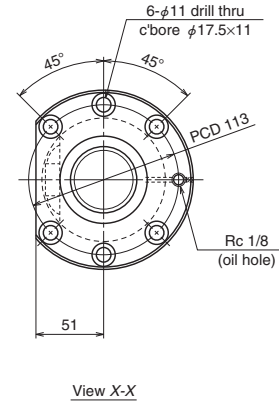
- Notes: 1. We recommend use of the NSK support unit. See Page B377 for details.
 2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
 3. Contact NSK if permissible rotational speed N will be exceeded.

Finished Shaft End SA Model

(Fine lead)



Nut: ZFT



NSK

Screw shaft ø50

Lead 10

Unit: mm

Ball screw specifications		
Shaft dia. x Lead / Direction of turn	50 x 10 / Right	
Preload / Ball recirculation	Z-preload / Tube	
Ball dia. / Ball circle dia.	6.35 / 51	
Screw shaft root diameter	44.4	
Effective ball turns	2.5 x 1	
Accuracy grade / Preload	C5 / Z	
Basic load ratings (N)	Dynamic C_a	37 500
	Static C_{0a}	87 200
Preload (N)	2 450	
Standard dynamic friction torque (N·cm)	79.0	
Spacer ball	None	
Factory-packed grease	Refer to Note 2.	
Nut internal space (cm ³)	37	
Standard grease replenishment (cm ³)	19	

Recommended support unit

For drive side, for non-drive side (Fixed)	
WBK40DF-31H (round)	

Unit: mm

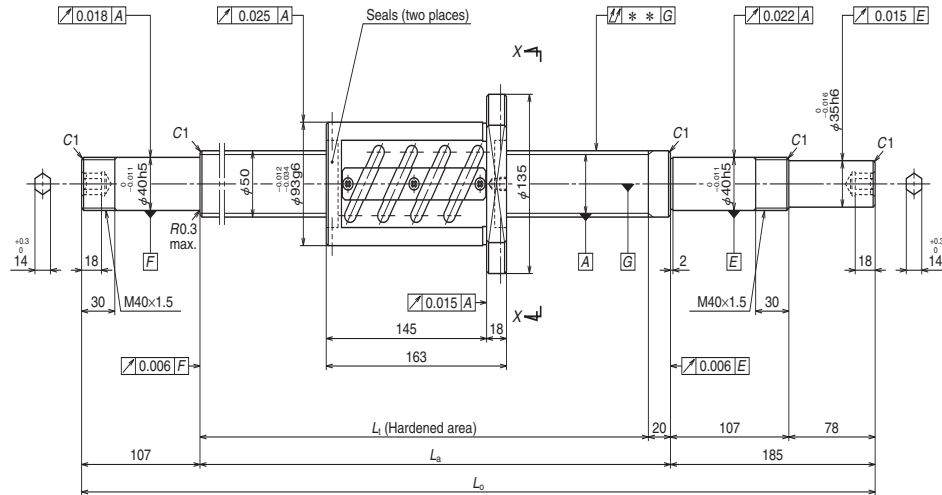
Reference No.	Stroke		Screw shaft length		
	Nominal	Maximum	L_t	L_a	L_o
W5005SA-1Z-C5Z10	450	468	580	600	862
W5007SA-1Z-C5Z10	650	668	780	800	1 062
W5009SA-1Z-C5Z10	850	868	980	1 000	1 262
W5011SA-1Z-C5Z10	1 050	1 068	1 180	1 200	1 462
W5014SA-1Z-C5Z10	1 350	1 368	1 480	1 500	1 762
W5019SA-1Z-C5Z10	1 850	1 868	1 980	2 000	2 262
W5025SA-1Z-C5Z10	2 450	2 468	2 580	2 600	2 862

Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min ⁻¹)	
T	e_p	v_u			Configuration	
			\uparrow			
				Fixed - Simple	Fixed - Fixed	
-0.014	0.030	0.023	0.050	14.8	1 400	1 400
-0.019	0.035	0.025	0.065	17.6	1 400	1 400
-0.024	0.040	0.027	0.080	20.3	1 400	1 400
-0.028	0.046	0.030	0.080	23.1	1 400	1 400
-0.036	0.054	0.035	0.100	27.3	1 400	1 400
-0.048	0.065	0.040	0.130	34.2	1 400	1 400
-0.062	0.093	0.054	0.170	42.5	1 030	1 400

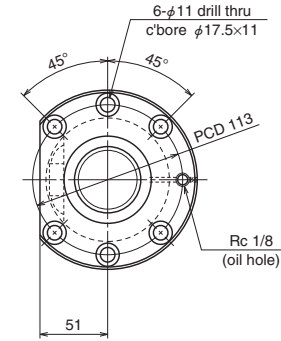
- Notes: 1. We recommend use of the NSK support unit. See Page B377 for details.
 2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
 3. Contact NSK if permissible rotational speed N will be exceeded.

Finished Shaft End SA Model

(Fine lead)



Nut: ZFT



View X-X

NSK

Screw shaft ø50

Lead 10

Unit: mm

Ball screw specifications		
Shaft dia. x Lead / Direction of turn	50 × 10 / Right	
Preload / Ball recirculation	Z-preload / Tube	
Ball dia. / Ball circle dia.	6.35 / 51	
Screw shaft root diameter	44.4	
Effective ball turns	2.5 × 2	
Accuracy grade / Preload	C5 / Z	
Basic load ratings (N)	Dynamic C _s	68 100
	Static C _{0a}	174 000
Preload (N)	4 020	
Standard dynamic friction torque (N·cm)	137	
Spacer ball	None	
Factory-packed grease	Refer to Note 2.	
Nut internal space (cm ³)	59	
Standard grease replenishment (cm ³)	30	

Recommended support unit

For drive side, for non-drive side (Fixed)
WBK40DFD-31H (round)

Unit: mm

Reference No.	Stroke		Screw shaft length		
	Nominal	Maximum	L _t	L _a	L _o
W5005SA-2Z-C5Z10	350	408	580	600	892
W5007SA-2Z-C5Z10	550	608	780	800	1 092
W5009SA-2Z-C5Z10	750	808	980	1 000	1 292
W5011SA-2Z-C5Z10	950	1 008	1 180	1 200	1 492
W5014SA-2Z-C5Z10	1 250	1 308	1 480	1 500	1 792
W5019SA-2Z-C5Z10	1 750	1 808	1 980	2 000	2 292
W5025SA-2Z-C5Z10	2 350	2 408	2 580	2 600	2 892

- Notes: 1. We recommend use of the NSK support unit. See Page B377 for details.
 2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
 3. Contact NSK if permissible rotational speed *N* will be exceeded.

Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed <i>N</i> (min ⁻¹)	
<i>T</i>	<i>e_p</i>	<i>v_u</i>			Configuration	
					Fixed - Simple	Fixed - Fixed
-0.014	0.030	0.023	0.050	16.8	1 400	1 400
-0.019	0.035	0.025	0.065	19.6	1 400	1 400
-0.024	0.040	0.027	0.080	22.3	1 400	1 400
-0.028	0.046	0.030	0.080	25.1	1 400	1 400
-0.036	0.054	0.035	0.100	29.3	1 400	1 400
-0.048	0.065	0.040	0.130	36.2	1 400	1 400
-0.062	0.093	0.054	0.170	44.6	1 060	1 400

B-3-1.4 Finished Shaft End Stainless Steel KA Model

1. Order of the dimension tables

Tables are arranged by model in order of increasing shaft diameter. If ball screws have the same shaft diameter, those with smaller leads appear first. Page numbers for shaft diameter and lead combinations are shown in **Table 1**.

2. Dimension tables

Dimensions, shapes, and specifications are listed by shaft diameter/lead combinations. The following tables also contain data regarding:

●Stroke

Nominal stroke : A reference for your use.
Maximum stroke: The stroke limit that the nut can move.

●Lead accuracy

Lead accuracy is C3 and C5 grades.

- T : Travel compensation
- e_p : Tolerance on specified travel
- v_v : Travel variation

See "Technical Description: Lead Accuracy" (page B37) for details.

●Permissible rotational speed

$d \cdot n$: Limited by the relative peripheral speed between screw shaft and nut.

Critical speed: Limited by the natural frequency of the ball screw shaft. Critical speed depends on the support configuration of screw shaft.

The lower of the two criteria, $d \cdot n$ and critical speed, will determine the overall permissible rotational speed of the ball screw. For details, see "Technical Description: Permissible Rotational Speed" (page B47).

3. Material

A martensitic stainless steel is used. A special heat treatment technology provides the ball groove section with sufficient hardness which produces high load carrying capacity and durability.

4. Other

The seal of the ball screw, ball recirculating deflector, and end cap are made of synthetic resin. Consult NSK when using ball screws under extreme environments, special environments, or if using special lubricant or oil. For special environments, see pages B70 and D2. See pages B67 and D13 for lubricants.

Note: For details about standard stock products, contact NSK.

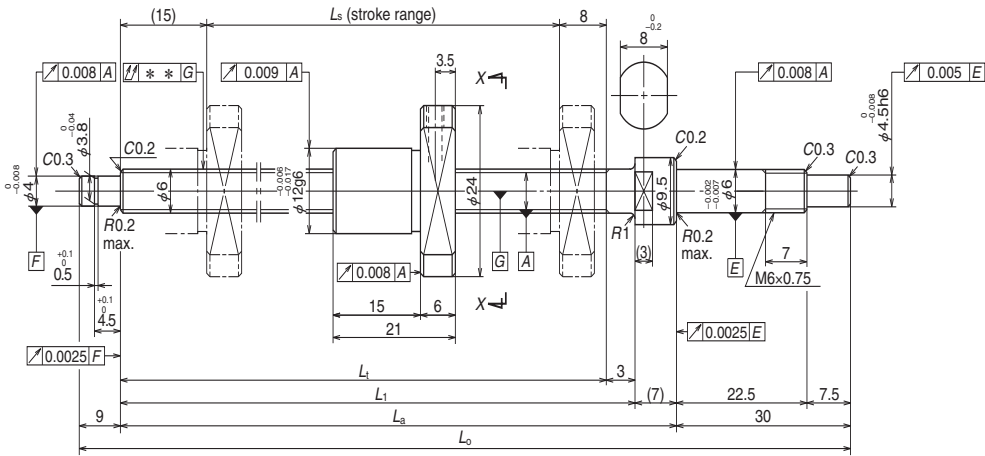
Table 1 Combinations of screw shaft diameter and lead

Screw shaft diameter (mm) \ Lead (mm)	Lead (mm)	
	1	2
6	B267	
8	B269	B271
10		B273
12		B277
15		
16		B285
20		

4	5	10	20
B275			
	B279	B281	
		B283	
			B287

Finished Shaft End Stainless Steel KA Model

(Fine lead)



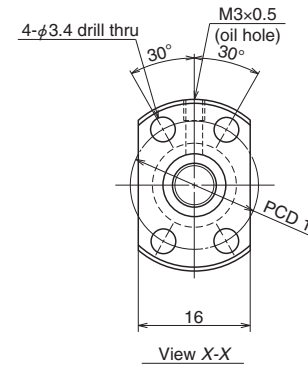
Nut: MPFD

NSK

Screw shaft $\phi 6$

Lead 1

Unit: mm



Ball screw specifications

Shaft dia. x Lead / Direction of turn	6 × 1 / Right	
Preload / Ball recirculation	P-preload / Deflector (bridge)	
Ball dia. / Ball circle dia.	0.800 / 6.2	
Screw shaft root diameter	5.2	
Effective ball turns	1 × 3	
Accuracy grade / Preload	C3 / Z	
Basic load ratings (N)	Dynamic C_a	555
	Static C_{0a}	680
Axial play	0	
Preload (N)	24.5	
Dynamic friction torque (N-cm)	1.3 or less	
Spacer ball	None	
Factory-packed grease	Refer to Note 1.	

Unit: mm

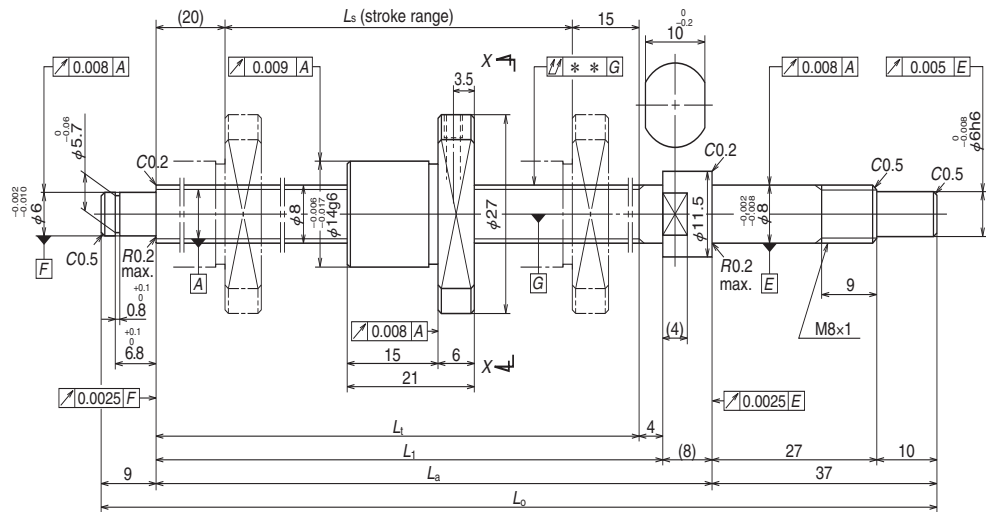
Reference No.	Stroke L_s		Thread length			
	Nominal	Maximum	L_1	L_1	L_a	L_o
W0601KA-3PY-C3Z1	100	102	125	128	135	174

- Notes:
1. Only a rust preventive is applied before delivery. Apply lubricant (oil or grease) before use. See Page D13 for details. We recommend using NSK Grease LG2 (Cleanroom).
 2. These ball nuts do not have seals.
 3. Contact NSK if permissible rotational speed N will be exceeded.

Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min ⁻¹)
T	e_p	v_u			Configuration
0	0.010	0.008	0.025	0.06	Fixed - Simple 3 000

Finished Shaft End Stainless Steel KA Model

(Fine lead)



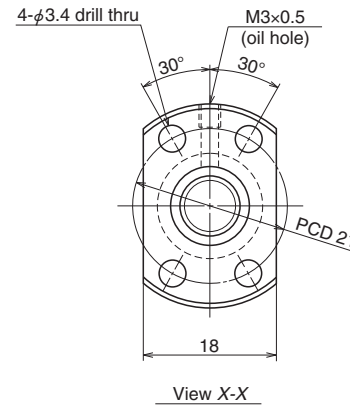
Nut: MPFD

NSK

Screw shaft $\phi 8$

Lead 1

Unit: mm



Ball screw specifications		
Shaft dia. x Lead / Direction of turn	8 x 1 / Right	
Preload / Ball recirculation	P-preload / Deflector (bridge)	
Ball dia. / Ball circle dia.	0.800 / 8.2	
Screw shaft root diameter	7.2	
Effective ball turns	1 x 3	
Accuracy grade / Preload	C3 / Z	
Basic load ratings (N)	Dynamic C_a	645
	Static C_{0a}	955
Axial play	0	
Preload (N)	29.4	
Dynamic friction torque (N-cm)	1.8 or less	
Spacer ball	None	
Factory-packed grease	Refer to Note 1.	

Recommended support unit

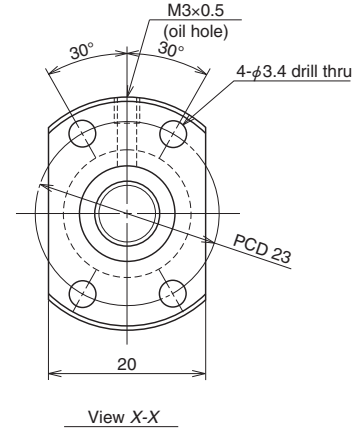
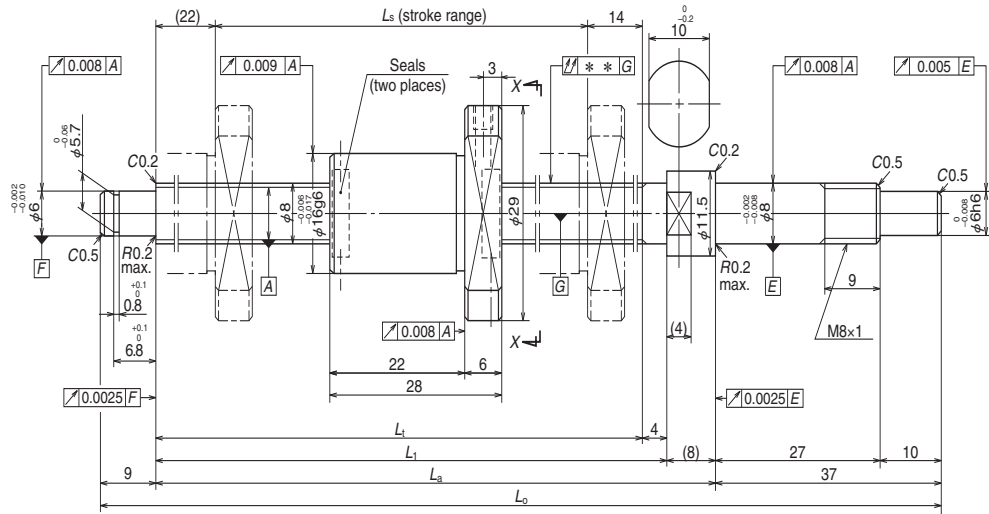
For drive side (Fixed)	For non-drive side (Simple)
WBK08-01C (square, clean)	WBK08S-01C (square, clean)
WBK08-11C (round, clean)	

Unit: mm

Reference No.	Stroke L_s		Thread length			
	Nominal	Maximum	L_t	L_1	L_a	L_o
W0802KA-1PY-C3Z1	150	155	190	194	202	248

- Notes:
1. Only a rust preventive is applied before delivery. Apply lubricant (oil or grease) before use. See Page D13 for details. We recommend using NSK Grease LG2 (Cleanroom).
 2. These ball nuts do not have seals.
 3. Contact NSK if permissible rotational speed N will be exceeded.

Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min ⁻¹)
T	e_p	v_u			Configuration
0	0.010	0.008	0.035	0.12	Fixed - Simple 3 000



Ball screw specifications		
Shaft dia. x Lead / Direction of turn	8 × 2 / Right	
Preload / Ball recirculation	P-preload / Deflector (bridge)	
Ball dia. / Ball circle dia.	1.200 / 8.3	
Screw shaft root diameter	6.9	
Effective ball turns	1 × 3	
Accuracy grade / Preload	C3 / Z	
Basic load ratings (N)	Dynamic C_a	1 270
	Static C_{0a}	1 630
Axial play	0	
Preload (N)	49.0	
Dynamic friction torque (N-cm)	2.0 or less	
Spacer ball	None	
Factory-packed grease	Refer to NOTE 1.	
Nut internal space (cm ³)	0.34	
Standard grease replenishment (cm ³)	0.17	

Recommended support unit

	For drive side (Fixed)	For non-drive side (Simple)
	WBK08-01C (square, clean)	WBK08S-01C (square, clean)
	WBK08-11C (round, clean)	

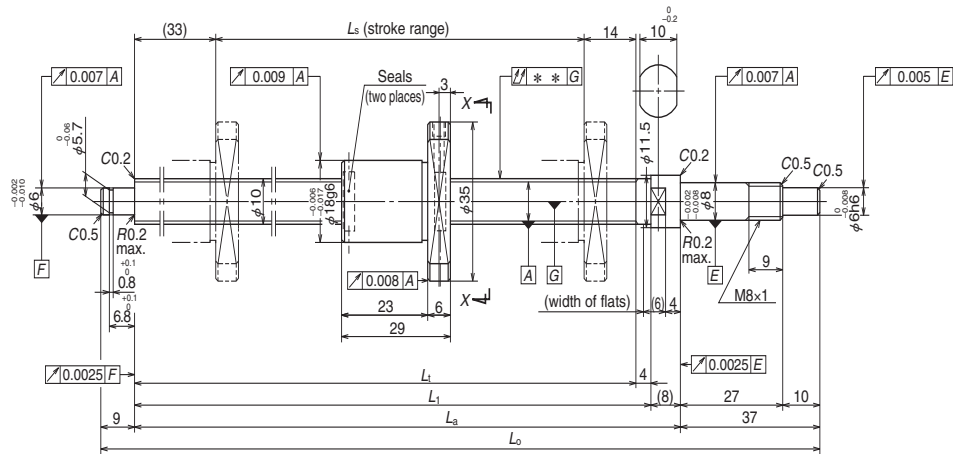
Reference No.	Stroke L_s		Thread length			
	Nominal	Maximum	L_1	L_1	L_a	L_o
W0802KA-5PY-C3Z2	150	154	190	194	202	248

Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min ⁻¹)
T	e_p	v_u			Configuration
					Fixed - Simple
0	0.010	0.008	0.035	0.13	3 000

- Notes: 1. Only a rust preventive is applied before delivery. Apply lubricant (oil or grease) before use. See Page D13 for details. We recommend using NSK Grease LG2 (Cleanroom).
 2. Contact NSK if permissible rotational speed N will be exceeded.

Finished Shaft End Stainless Steel KA Model

(Fine lead)



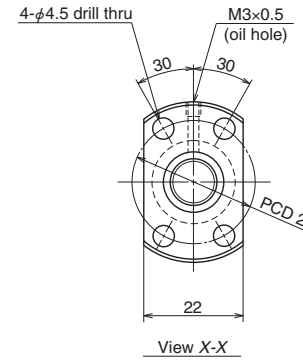
Nut: MPFD

NSK

Screw shaft ø10

Lead 2

Unit: mm



Ball screw specifications

Shaft dia. x Lead / Direction of turn	10 × 2 / Right	
Preload / Ball recirculation	P-preload / Deflector (bridge)	
Ball dia. / Ball circle dia.	1.200 / 10.3	
Screw shaft root diameter	8.9	
Effective ball turns	1 × 3	
Accuracy grade / Preload	C3 / Z	
Basic load ratings (N)	Dynamic C_a	1 470
	Static C_{0a}	2 190
Axial play	0	
Preload (N)	58.8	
Dynamic friction torque (N-cm)	0.10 – 2.5	
Spacer ball	None	
Factory-packed grease	Refer to Note 1.	
Nut internal space (cm ³)	0.44	
Standard grease replenishment (cm ³)	0.22	

Recommended support unit

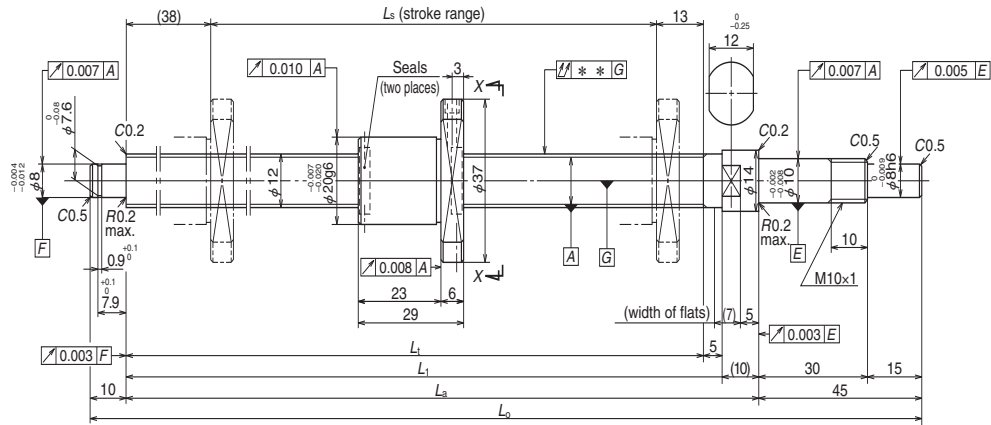
	For drive side (Fixed)	For non-drive side (Simple)
	WBK08-01C (square, clean)	WBK08S-01C (square, clean)
	WBK08-11C (round, clean)	

Unit: mm

Reference No.	Stroke L_s		Thread length			
	Nominal	Maximum	L_1	L_1	L_a	L_o
W1002KA-3PY-C3Z2	200	203	250	254	262	308

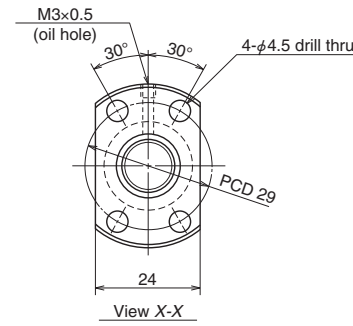
Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min ⁻¹)
T	e_p	v_u			Configuration
0	0.012	0.008	0.030	0.22	Fixed - Simple 3 000

- Notes:
1. Only a rust preventive is applied before delivery. Apply lubricant (oil or grease) before use. See Page D13 for details. We recommend using NSK Grease LG2 (Cleanroom).
 2. Contact NSK if permissible rotational speed N will be exceeded.



Reference No.	Stroke L_s		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

- Notes:
1. Only a rust preventive is applied before delivery. Apply lubricant (oil or grease) before use. See Page D13 for details. We recommend using NSK Grease LG2 (Cleanroom).
 2. Contact NSK if permissible rotational speed N will be exceeded.



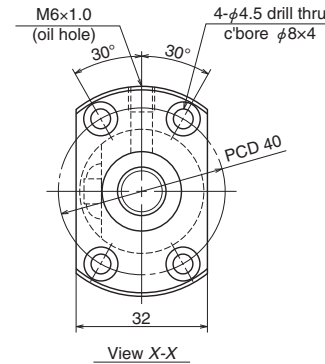
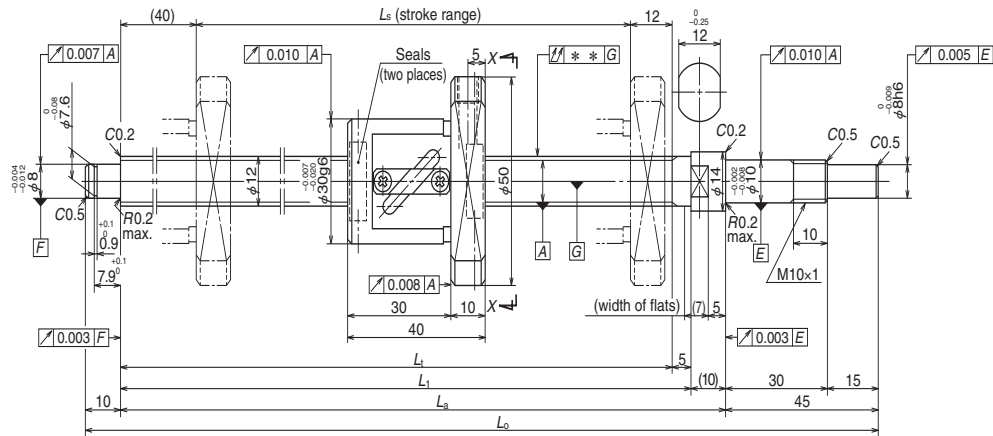
Ball screw specifications		
Shaft dia. x Lead / Direction of turn	12 x 2 / Right	
Preload / Ball recirculation	P-preload / Deflector (bridge)	
Ball dia. / Ball circle dia.	1.200 / 12.3	
Screw shaft root diameter	10.9	
Effective ball turns	1 x 3	
Accuracy grade / Preload	C3 / Z	
Basic load ratings (N)	Dynamic C_a	1 600
	Static C_{0a}	2 670
Axial play	0	
Preload (N)	98.1	
Dynamic friction torque (N-cm)	0.4 - 3.4	
Spacer ball	None	
Factory-packed grease	Refer to Note 1.	
Nut internal space (cm ³)	0.53	
Standard grease replenishment (cm ³)	0.27	

Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK10-01C (square, clean)	WBK10S-01C (square, clean)
WBK10-11C (round, clean)	

Unit: mm

Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min ⁻¹)
T	e_p	v_u			Configuration
0	0.010	0.008	0.030	0.24	Fixed - Simple 3 000
0	0.012	0.008	0.040	0.36	3 000



Ball screw specifications		
Shaft dia. x Lead / Direction of turn	12 x 5 / Right	
Preload / Ball recirculation	P-preload / Tube	
Ball dia. / Ball circle dia.	2.381 / 12.3	
Screw shaft root diameter	9.8	
Effective ball turns	2.5 x 1	
Accuracy grade / Preload	C3 / Z	
Basic load ratings (N)	Dynamic C _s	3 590
	Static C _{0s}	4 630
Axial play	0	
Preload (N)	98.1	
Dynamic friction torque (N-cm)	1.0 – 4.4	
Spacer ball	None	
Factory-packed grease	Refer to Note 1.	
Nut internal space (cm ³)	1.2	
Standard grease replenishment (cm ³)	0.6	

Recommended support unit

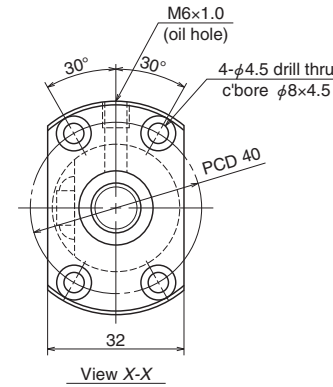
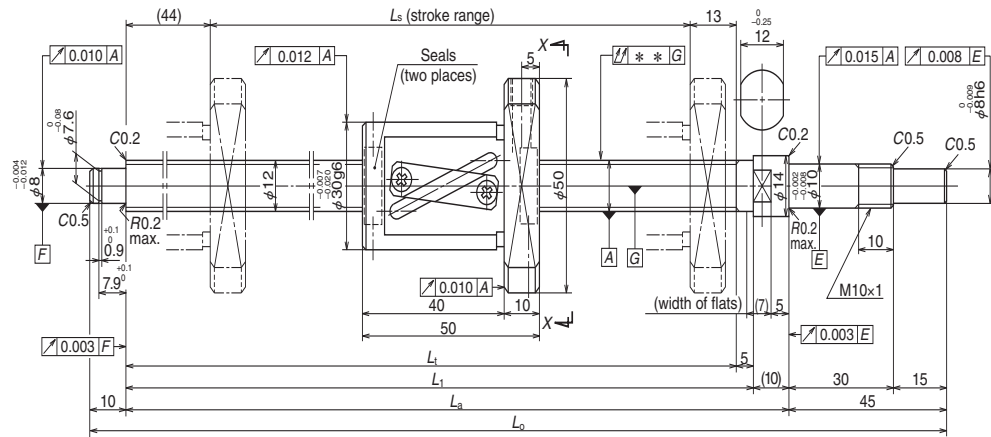
For drive side (Fixed)	For non-drive side (Simple)
WBK10-01C (square, clean)	WBK10S-01C (square, clean)
WBK10-11C (round, clean)	

Unit: mm

Reference No.	Stroke L _s		Thread length			
	Nominal	Maximum	L ₁	L _i	L _a	L _o
			W1202KA-3P-C3Z5	200	208	260
W1205KA-1P-C3Z5	450	458	510	515	525	580

Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min ⁻¹)
T	e _p	v _u			Configuration
0	0.012	0.008	0.040	0.47	Fixed - Simple 3 000
0	0.016	0.012	0.065	0.66	3 000

- Notes:
1. Only a rust preventive is applied before delivery. Apply lubricant (oil or grease) before use. See Page D13 for details. We recommend using NSK Grease LG2 (Cleanroom).
 2. Contact NSK if permissible rotational speed N will be exceeded.



Ball screw specifications		
Shaft dia. x Lead / Direction of turn	12 × 10 / Right	
Preload / Ball recirculation	P-preload / Tube	
Ball dia. / Ball circle dia.	2.381 / 12.5	
Screw shaft root diameter	10.0	
Effective ball turns	2.5 × 1	
Accuracy grade / Preload	C5 / Z	
Basic load ratings (N)	Dynamic C_a	3 620
	Static C_{0a}	4 750
Axial play	0	
Preload (N)	98.1	
Dynamic friction torque (N-cm)	1.0 – 4.9	
Spacer ball	None	
Factory-packed grease	Refer to Note 1.	
Nut internal space (cm ³)	1.4	
Standard grease replenishment (cm ³)	0.7	

Recommended support unit

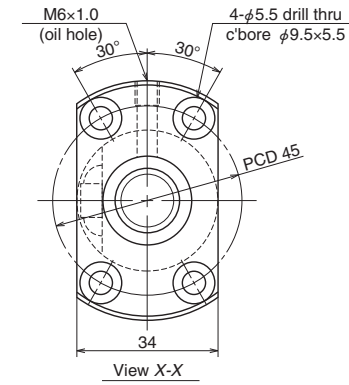
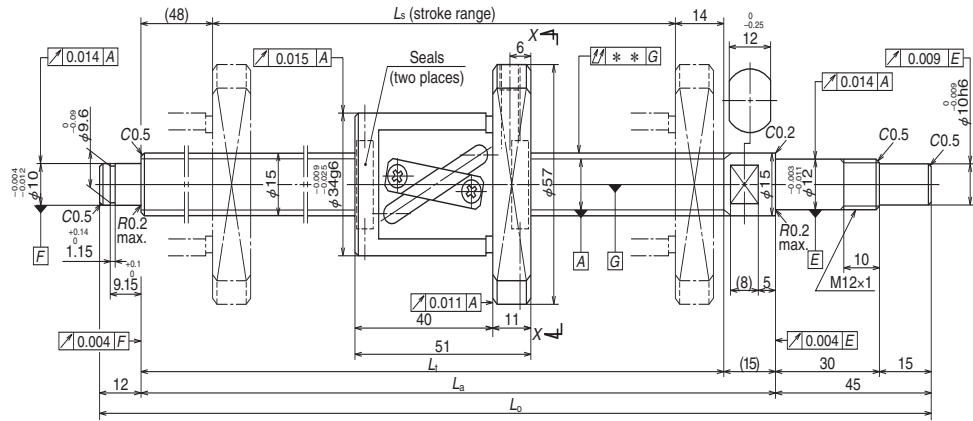
	For drive side (Fixed)	For non-drive side (Simple)
	WBK10-01C (square, clean)	WBK10S-01C (square, clean)
	WBK10-11C (round, clean)	

Unit: mm

Reference No.	Stroke L_s		Thread length			
	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

Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min ⁻¹)
T	e_p	v_u			Configuration
0	0.023	0.018	0.050	0.56	Fixed - Simple 3 000
0	0.030	0.023	0.075	0.72	3 000

- Notes:
1. Only a rust preventive is applied before delivery. Apply lubricant (oil or grease) before use. See Page D13 for details. We recommend using NSK Grease LG2 (Cleanroom).
 2. Contact NSK if permissible rotational speed N will be exceeded.



Ball screw specifications		
Shaft dia. x Lead / Direction of turn	15 × 10 / Right	
Preload / Ball recirculation	P-preload / Tube	
Ball dia. / Ball circle dia.	3.175 / 15.5	
Screw shaft root diameter	12.2	
Effective ball turns	2.5 × 1	
Accuracy grade / Preload	C5 / Z	
Basic load ratings (N)	Dynamic C_a	6 660
	Static C_{0a}	9 480
Axial play	0	
Preload (N)	147	
Dynamic friction torque (N-cm)	1.5 – 7.9	
Spacer ball	None	
Factory-packed grease	Refer to Note 1.	
Nut internal space (cm ³)	2.3	
Standard grease replenishment (cm ³)	1.4	

Recommended support unit

	For drive side (Fixed)	For non-drive side (Simple)
	WBK12-01C (square, clean)	WBK12S-01C (square, clean)
	WBK12-11C (round, clean)	

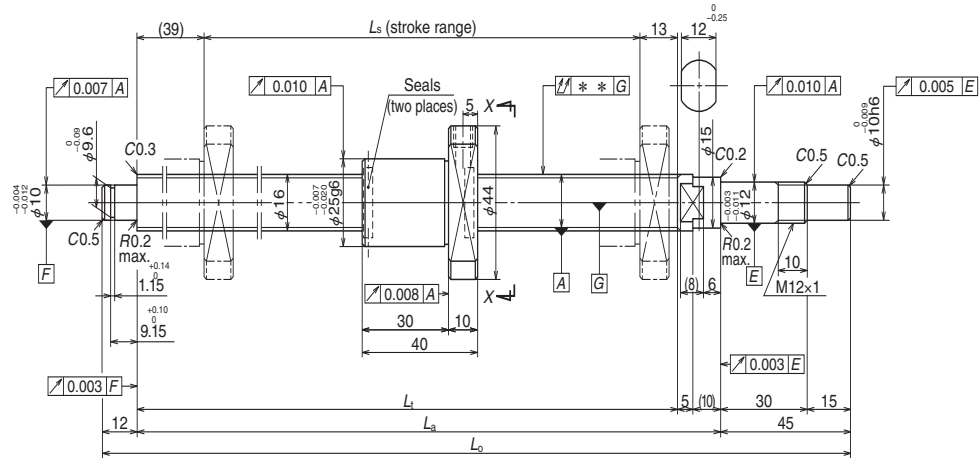
Reference No.	Stroke L_s		Thread length		
	Nominal	Maximum	L_t	L_a	L_o
W1504KA-3P-C5Z10	400	427	489	504	561
W1506KA-3P-C5Z10	600	627	689	704	761
W1510KA-1P-C5Z10	1 000	1 027	1 089	1 104	1 161

Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min ⁻¹)
T	e_p	v_u			Configuration
0	0.027	0.020	0.050	0.99	3 000
0	0.035	0.025	0.065	1.2	3 000
0	0.046	0.030	0.110	1.7	1 610

- Notes:
1. Only a rust preventive is applied before delivery. Apply lubricant (oil or grease) before use. See Page D13 for details. We recommend using NSK Grease LG2 (Cleanroom).
 2. Contact NSK if permissible rotational speed N will be exceeded.

Finished Shaft End Stainless Steel KA Model

(Fine lead)



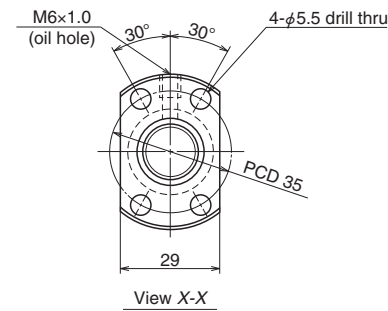
Nut: MPFD

NSK

Screw shaft $\phi 16$

Lead 2

Unit: mm



Ball screw specifications

Shaft dia. x Lead / Direction of turn	16 × 2 / Right	
Preload / Ball recirculation	P-preload / Deflector (bridge)	
Ball dia. / Ball circle dia.	1.588 / 16.4	
Screw shaft root diameter	14.6	
Effective ball turns	1 × 4	
Accuracy grade / Preload	C3 / Z	
Basic load ratings (N)	Dynamic C_a	3 400
	Static C_{0a}	6 240
Axial play	0	
Preload (N)	147	
Dynamic friction torque (N-cm)	0.5 – 4.9	
Spacer ball	None	
Factory-packed grease	Refer to Note 1.	
Nut internal space (cm ³)	1.6	
Standard grease replenishment (cm ³)	0.8	

Recommended support unit

	For drive side (Fixed)	For non-drive side (Simple)
WBK12-01C (square, clean)		WBK12S-01C (square, clean)
WBK12-11C (round, clean)		

Unit: mm

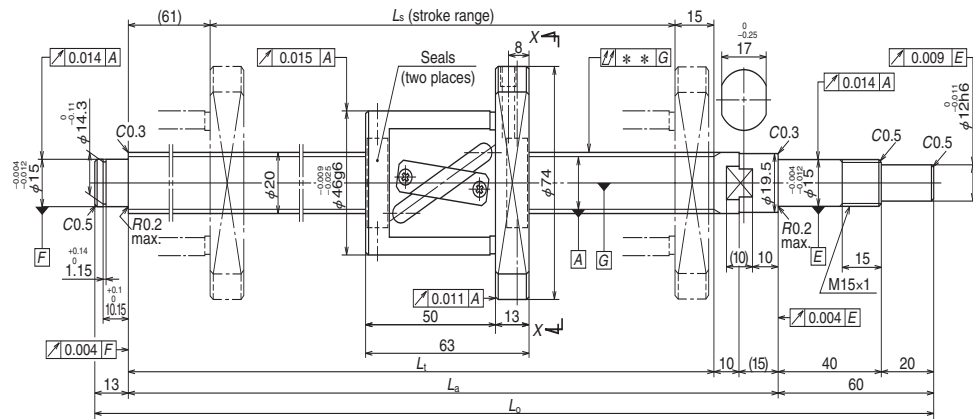
Reference No.	Stroke L_s		Thread length		
	Nominal	Maximum	L_1	L_a	L_o
W1601KA-3PY-C3Z2	100	137	189	204	261
W1603KA-1PY-C3Z2	300	337	389	404	461

Lead accuracy			Shaft run-out ** $\uparrow \downarrow$	Mass (kg)	Permissible rotational speed N (min ⁻¹)
T	e_p	v_u			Configuration
					Fixed - Simple
0	0.010	0.008	0.020	0.46	3 000
0	0.013	0.010	0.035	0.75	3 000

- Notes:
1. Only a rust preventive is applied before delivery. Apply lubricant (oil or grease) before use. See Page D13 for details. We recommend using NSK Grease LG2 (Cleanroom).
 2. Contact NSK if permissible rotational speed N will be exceeded.

Finished Shaft End Stainless Steel KA Model

(High helix lead)



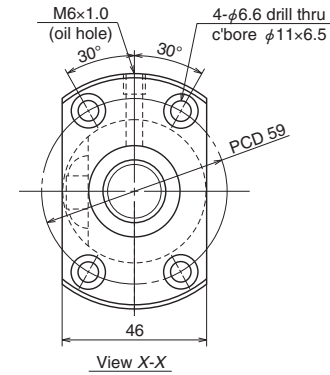
Nut: LPFT

NSK

Screw shaft ø20

Lead 20

Unit: mm



Ball screw specifications

Shaft dia. x Lead / Direction of turn	20 × 20 / Right	
Preload / Ball recirculation	P-preload / Tube	
Ball dia. / Ball circle dia.	3.969 / 21	
Screw shaft root diameter	16.9	
Effective ball turns	1.5 × 1	
Accuracy grade / Preload	C5 / Z	
Basic load ratings (N)	Dynamic C_a	6 700
	Static C_{0a}	9 710
Axial play	0	
Preload (N)	196	
Dynamic friction torque (N-cm)	2.0 – 11.8	
Spacer ball	None	
Factory-packed grease	Refer to Note 1.	
Nut internal space (cm ³)	4.2	
Standard grease replenishment (cm ³)	2.1	

Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK15-01C (square, clean)	WBK15S-01C (square, clean)
WBK15-11C (round, clean)	

Unit: mm

Reference No.	Stroke L_s		Thread length		
	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	1 000	1 034	1 110	1 135	1 208

Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min ⁻¹)
T	e_p	v_u			Configuration
0	0.030	0.023	0.050	2.0	Fixed - Simple 3 000
0	0.035	0.025	0.085	2.5	3 000
0	0.046	0.030	0.110	3.4	2 160

- Notes:
1. Only a rust preventive is applied before delivery. Apply lubricant (oil or grease) before use. See Page D13 for details. We recommend using NSK Grease LG2 (Cleanroom).
 2. Contact NSK if permissible rotational speed N will be exceeded.

B-3-1.5 Blank Shaft End MS, FS, and SS Models

1. Order of the dimension tables

Tables are arranged by model in order of increasing shaft diameter. If ball screws have the same shaft diameter, those with smaller leads appear first. Page numbers for shaft diameter and lead combinations are shown in the **Table 1**.

2. Dimension tables

Dimensions, shapes, and specifications are listed by shaft diameter/lead combinations. The following tables also contain data regarding:

● **Lead accuracy**

Lead accuracy is either C3 or C5 grade.

T : Travel compensation

e_p : Tolerance of specified travel

v_u : Travel variation

See "Technical Description: Lead Accuracy" (page B37) for details.

● **Permissible rotational speed**

$d \cdot n$: Limited by the relative peripheral speed between the screw shaft and the nut.

Critical speed : Limited by the natural frequency of the ball screw shaft. Critical speed depends on the support configuration of screw shaft.

Criterion of maximum rotational speed

: 3 000 min⁻¹

The lower of the two criteria, $d \cdot n$ and critical speed, will determine the overall permissible rotational speed of the ball screw. For details, see "Technical Description: Permissible Rotational Speed" (page B47).

3. Shaft end processing

MS, FS, and SS models require shaft end processing. Specialized support units (page B377) can be used for the design of shaft end support sections. See "Configuration of shaft end" (page B27 and following pages) when using a support unit. See "Technical

Description: Shaft End Processing" (page B86) for procedures and precautions.

4. Other

The seals of the ball screw, ball recirculating deflectors, and end caps are made of synthetic resin. Consult NSK when using the ball screws under extreme environments, special environments, or if using special lubricant or oil. For special environments, see pages B70 and D2. See pages B67 and D13 for lubricants. Shaft end appearance, including thread ends, may vary depending on manufacturing. Note: For details on standard stock products, contact NSK.

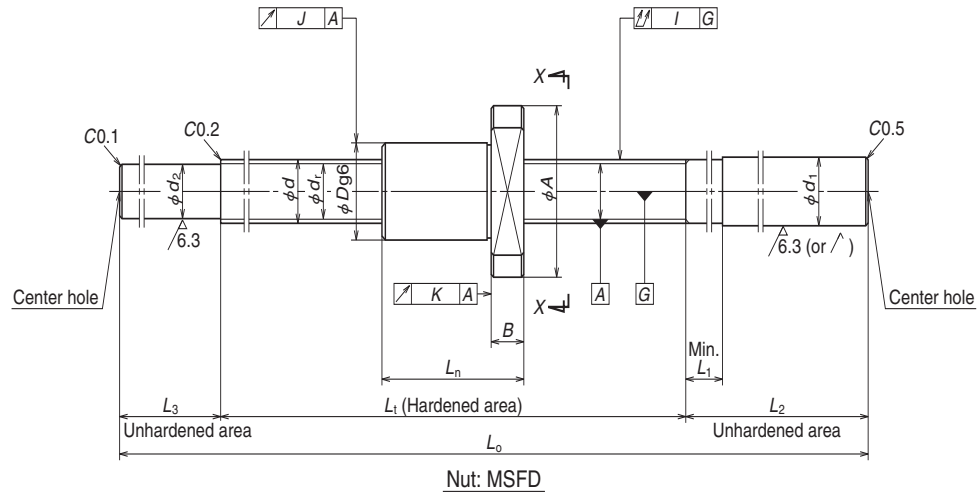
Table 1 Combinations of screw shaft diameter and lead

Screw shaft diameter(mm) \ Lead(mm)	1	1.5	2	2.5	4	5	6
4	B291						
6	B291						
8	B291	B293	B293				
10			B293	B295	B299		
12			B295	B295		B299	
14						B301	
15							
16			B297	B297		B303	
20					B309	B309	
25					B311	B311 B313	B311
28						B315 B317	B315 B317
32						B319 B321 B323	B319 B321
36							
40						B325	
45							
50							

	8	10	12	16	20	25	32	40	50
		B299							
B301		B301							
				B303					
		B303			B303				
		B313 B315			B305	B305			
B321		B323 B325 B327				B307	B307		
		B325 B327							
B329		B329 B331 B333	B329 B331						
		B325							
		B333 B335							

Blank Shaft End MS Model

(Fine lead: Deflector (bridge) Recirculation)



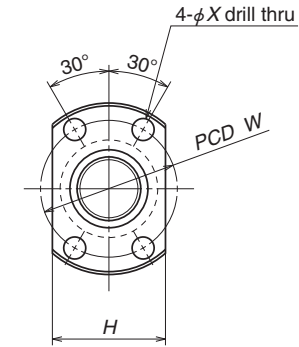
Nut: MSFD

Nut: MSFD



Screw shaft ø4, ø6, ø8,

Lead 1



View X-X

Model No.	Stroke Max. L_r-L_n	Screw shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns	Basic load ratings (N)		Axial play Max.	Nut			
								Dynamic C_a	Static C_{0a}		Flange			
											Outside dia. D	A	H	B
W0400MS-1Y-C3T1	68	4	1	0.8	4.2	3.2	2	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	1 290	0.005	14	27	18	4
W0802MS-1Y-C3T1	174													

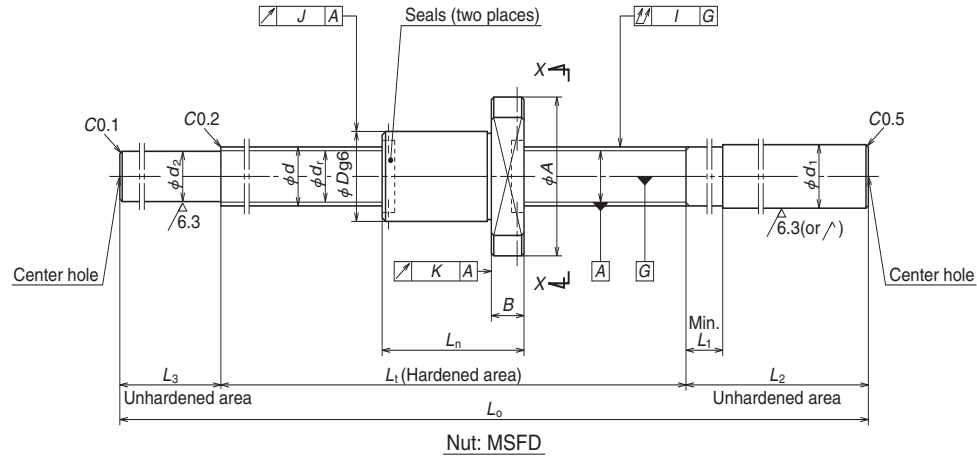
- Notes:
1. We recommend using NSK support units. See Page B377 for details.
 2. Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use. See Page D13 for details.
 3. These ball nuts do not have seals.
 4. The permissible rotational speed is determined by the $d-n$ value, critical speed, and maximum rotational speed. See Page B47 and B289 for details. The values shown for permissible rotational speed apply when the mounting configuration is Fixed-Fixed.

Unit: mm

dimensions			Screw shaft dimensions							Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed N (min^{-1})
Overall length L_n	Bolt hole		Threaded length L_1	Shaft end, right		Shaft end, left		Overall length L_0	T	Deviation e_p	Variation v_u	Shaft straightness I	Radial run-out				
	W	X		d_1	L_1	L_2	d_2						L_3	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	3 000
15	18	3.4	125	8.0	4	50	5.3	15	190	0	0.010	0.008	0.030	0.009	0.008	0.063	3 000
16	21	3.4	110	10.2	4	60	7.3	25	195	0	0.010	0.008	0.030	0.009	0.008	0.11	3 000
			190						0.050				0.14				

Blank Shaft End MS Model

(Fine lead: Deflector (bridge) Recirculation)



Nut: MSFD

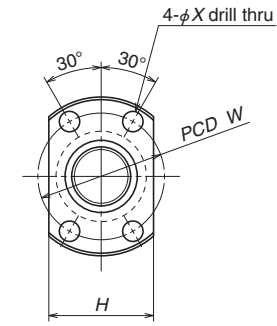
NSK

Screw shaft ø8

Lead 1.5, 2

Screw shaft ø10

Lead 2



View X-X

Model No.	Stroke Max. L_1-L_n	Screw shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns	Basic load ratings (N)		Axial play Max.	Nut			
								Dynamic C_a	Static C_{0a}		Flange			
											Outside dia. D	A	H	B
W0801MS-2Y-C3T1.5	88	8	1.5	1.0	8.3	7.0	3	1 270	1 970	0.005	15	28	19	4
W0802MS-2Y-C3T1.5	168													
W0801MS-3Y-C3T2	84	8	2	1.2	8.3	6.9	3	1 560	2 200	0.005	16	29	20	4
W0802MS-3Y-C3T2	164													
W1001MS-1Y-C3T2	122	10	2	1.2	10.3	8.9	3	1 800	2 970	0.005	18	35	22	5
W1002MS-1Y-C3T2	222													

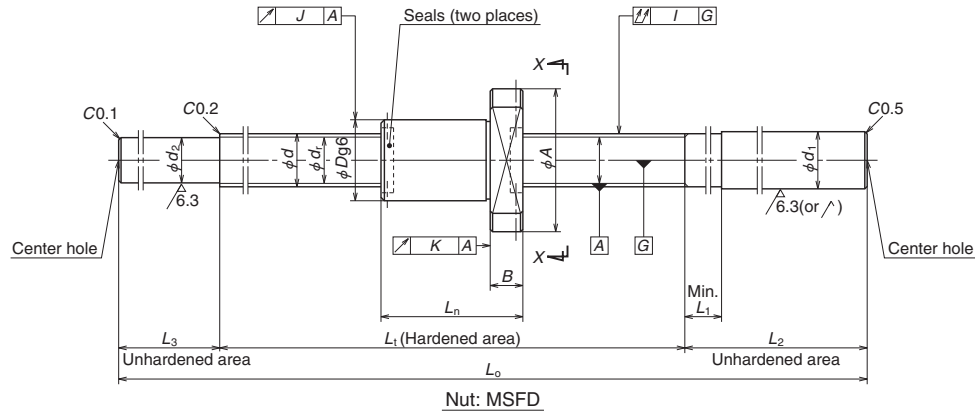
- Notes:
1. We recommend using NSK support units. See Page B377 for details.
 2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
 3. The permissible rotational speed is determined by the $d-n$ value, critical speed, and maximum rotational speed. See Pages B47 and B289 for details. The values shown for permissible rotational speed apply when the mounting configuration is Fixed-Fixed.

Unit: mm

dimensions			Screw shaft dimensions						Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed N (min^{-1})	
Overall length L_n	Bolt hole		Threaded length L_1	Shaft end, right		Shaft end, left		Overall length L_0	T	Deviation e_p	Variation v_u	Shaft straightness I	Radial run-out				
	W	X		d_1	L_1	L_2	d_2						L_3	J			K
22	22	3.4	110	10.2	4	60	7.2	25	195	0	0.010	0.008	0.030	0.009	0.008	0.12	3 000
			190						275				0.050			0.15	
26	23	3.4	110	10.2	4	60	7.0	25	195	0	0.010	0.008	0.030	0.009	0.008	0.12	3 000
			190						275				0.050			0.15	
28	27	4.5	150	12.2	4	70	9.0	30	250	0	0.010	0.008	0.035	0.009	0.008	0.22	3 000
			250						350		0.012		0.17				

Blank Shaft End MS Model

(Fine lead: Deflector (bridge) Recirculation)



Nut: MSFD

Nut: MSFD

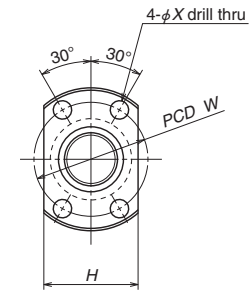
NSK

Screw shaft ø10

Lead 2.5

Screw shaft ø12

Lead 2, 2.5



View X-X

Model No.	Stroke Max. L_r-L_n	Screw shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns	Basic load ratings (N)		Axial play Max.	Nut			
								Dynamic C_a	Static C_{0a}		Flange			
											Outside dia. D	A	H	B
W1001MS-2Y-C3T2.5	118	10	2.5	1.588	10.4	8.6	3	2 500	3 630	0.005	19	36	23	5
W1002MS-2Y-C3T2.5	218													
W1202MS-1Y-C3T2	182	12	2	1.200	12.3	10.9	3	1 960	3 620	0.005	20	37	24	5
W1203MS-1Y-C3T2	282													
W1202MS-2Y-C3T2.5	178	12	2.5	1.588	12.4	10.6	3	2 790	4 530	0.005	21	38	25	5
W1203MS-2Y-C3T2.5	278													

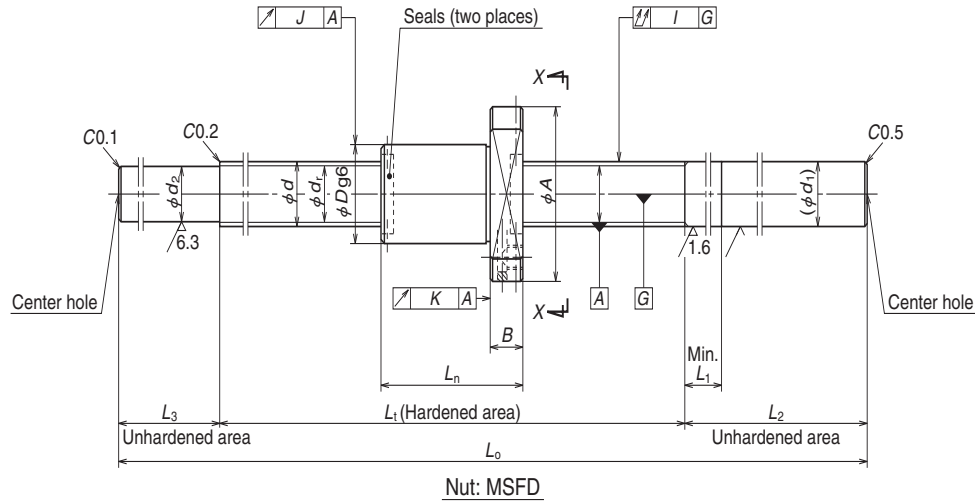
- Notes:
1. We recommend using NSK support units. See Page B377 for details.
 2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
 3. The permissible rotational speed is determined by the $d-n$ value, critical speed, and maximum rotational speed. See Pages B47 and B289 for details. The values shown for permissible rotational speed apply when the mounting configuration is Fixed-Fixed.

Unit: mm

dimensions			Screw shaft dimensions						Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed N (min ⁻¹)	
Overall length L_n	Bolt hole W X		Threaded length L_1	Shaft end, right d_1 L_1 L_2		Shaft end, left d_2 L_3		Overall length L_0	T	Deviation e_p	Variation v_u	Shaft straightness I	Radial run-out 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	3 000
			250						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	3 000
			310						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	3 000
			310						0.060				0.45				

Blank Shaft End MS Model

(Fine lead: Deflector (bridge) Recirculation)

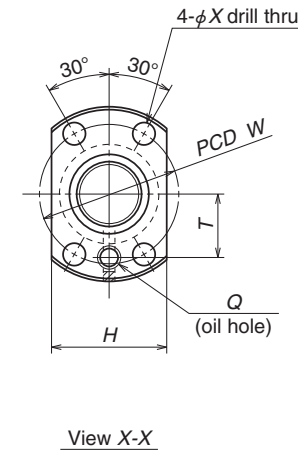


Nut: MSFD

NSK

Screw shaft ø16

Lead 2, 2.5



Model No.	Stroke Max. L_1-L_n	Screw shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns	Basic load ratings (N)		Axial play Max.	Nut						
								Dynamic C_a	Static C_{0a}		Outside dia. D	Flange			Overall length L_n	Bolt hole	
												A	H	B		W	X
W1602MS-1Y-C3T2	210	16	2	1.588	16.4	14.6	4	4 150	8 450	0.005	25	44	29	10	40	35	5.5
W1604MS-1Y-C3T2	360																
W1602MS-2Y-C3T2.5	206	16	2.5	1.588	16.4	14.6	4	4 150	8 440	0.005	25	44	29	10	44	35	5.5
W1604MS-2Y-C3T2.5	356																

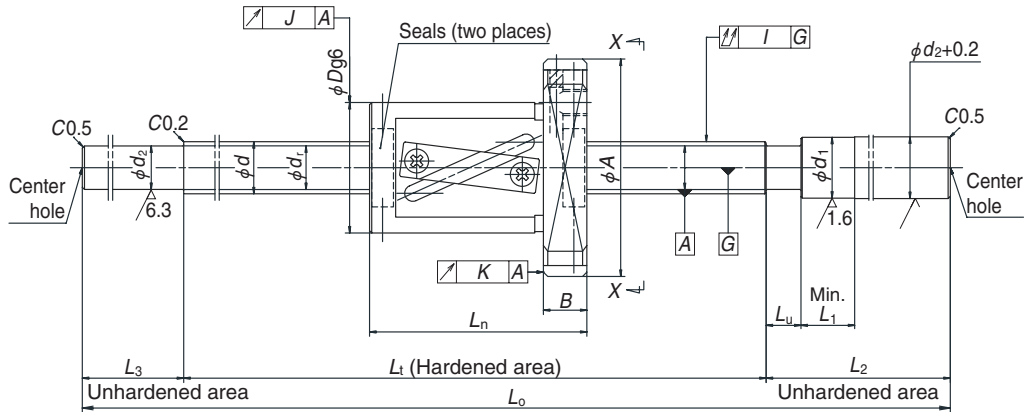
Unit: mm

dimensions	Screw shaft dimensions							Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed (min ⁻¹)	Nut internal space (cm ³)	Standard grease replenishment (cm ³)	
	Oil hole		Shaft end, right		Shaft end, left		Overall length L_o	Deviation e_p	Variation v_{li}	Shaft straightness I	Radial run-out							
	Q	T	d_1	L_1	L_2	d_2					L_3	J	K					
M6x1	16	250	16	30	100	14.7	40	390	0	0.012	0.008	0.035	0.010	0.008	0.71	3 000	1.5	0.8
		400						540										
M6x1	16	250	16	30	100	14.7	40	390	0	0.012	0.008	0.035	0.010	0.008	0.73	3 000	1.5	0.8
		400						540										

- Notes:
1. We recommend using NSK support units. See Page B377 for details.
 2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
 3. The permissible rotational speed is determined by the $d-n$ value, critical speed, and maximum rotational speed. See Pages B47 and B289 for details. The values shown for permissible rotational speed apply when the mounting configuration is Fixed-Fixed.

Blank Shaft End FS Model

(Fine, Medium lead: Tube Recirculation)



Nut: SFT, LSFT

Nut: SFT, LSFT

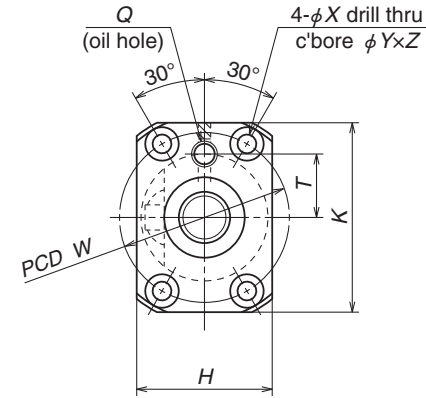


Screw shaft $\phi 10$

Lead 4

Screw shaft $\phi 12$

Lead 5, 10



View X-X

Model No.	Stroke Max. L_t-L_n	Screw shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns Turns x Circuits	Basic load ratings (N)		Axial play Max.	Nut																
								Dynamic C_a	Static C_{oa}		Flange				Overall length L_n	Bolt hole											
											Outside dia. D	A	H	K		B	W	X	Y	Z							
W1001FS-1-C3T4	126																										
W1002FS-1-C3T4	226	10	4	2.000	10.3	8.2	2.5x1	3	210	4	420	0.005	26	46	28	42	10	34	36	4.5	8	4.5					
W1003FS-1-C3T4	326																										
W1201FS-1-C3T5	110																										
W1202FS-1-C3T5	210	12	5	2.381	12.3	9.8	2.5x1	4	390	6	260	0.005	30	50	32	45	10	40	40	4.5	8	4.5					
W1204FS-1-C3T5	410																										
W1202FS-2-C5T10	200	12	10	2.381	12.5	10.0	2.5x1	4	430	6	430	0.005	30	50	32	45	10	50	40	4.5	8	4.5					
W1204FS-2-C5T10	400																										

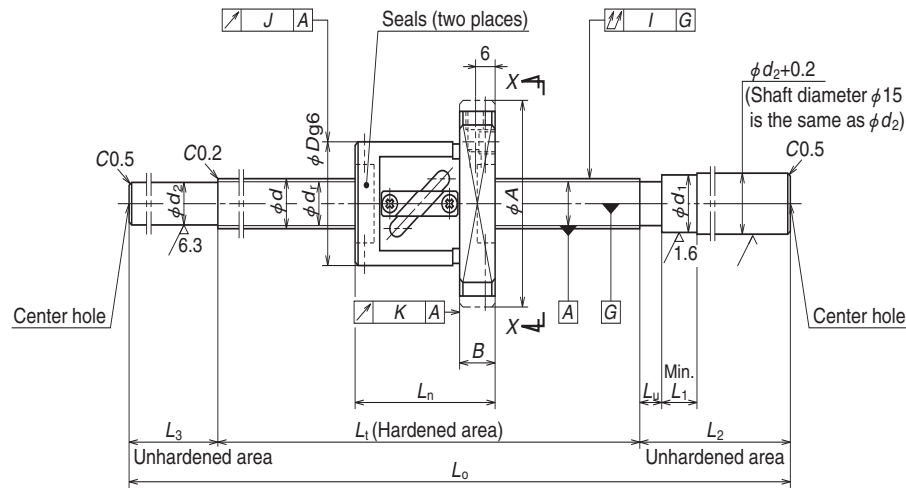
- Notes:
1. We recommend using NSK support units. See Page B377 for details.
 2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
 3. The permissible rotational speed is determined by the $d \cdot n$ value, critical speed, and maximum rotational speed. See Pages B47 and B289 for details. The values shown for permissible rotational speed apply when the mounting configuration is Fixed-Fixed.

dimensions	Screw shaft dimensions										Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed N (min ⁻¹)	Nut internal space (cm ³)	Standard grease replenishment (cm ³)
	Oil hole		Threaded length L_t	Shaft end, right		Shaft end, left		Overall length L_o	T	Deviation e_p	Variation v_u	Shaft straightness I	Radial run-out							
	Q	T		d_1	L_u	L_1	L_2						d_2	L_3	J	K				
M6x1 14	160		14	5	40	70	8.2	35	265	0	0.010	0.008	0.030	0.010	0.008	0.34	3 000	0.86	0.43	
	260								365		0.012	0.008	0.040							0.39
	360								465		0.013	0.010	0.050							
M6x1 15	150		14	5	40	70	9.8	35	255	0	0.010	0.008	0.030	0.010	0.008	0.44	3 000	1.2	0.6	
	250								355		0.012	0.008	0.040							0.52
	450								555		0.015	0.010	0.065							
M6x1 15	250		14	8	40	70	10.0	35	355	0	0.023	0.018	0.050	0.012	0.010	0.57	3 000	1.4	0.7	
	450								555		0.027	0.020	0.075							0.74

Unit: mm

Blank Shaft End FS Model

(Fine, Medium lead: Tube Recirculation)



Nut: SFT, LSFT

Nut: SFT, LSFT

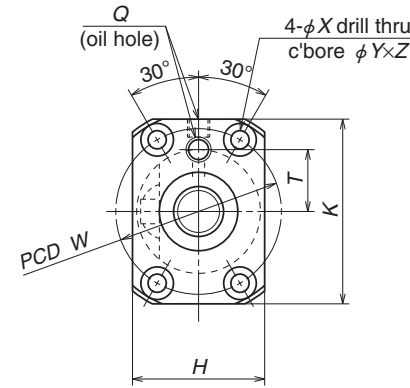
NSK

Screw shaft ø14

Lead 5, 8

Screw shaft ø15

Lead 10



View X-X

Model No.	Stroke Max. L_t-L_n	Screw shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns Turns x Circuits	Basic load ratings (N)		Axial play Max.	Nut											
								Dynamic C_a	Static C_{0a}		Outside dia.				Overall length L_n	Bolt hole						
											D	A	H	K		B	W	X	Y	Z		
W1403FS-1-C3T5	310	14	5	3.175	14.5	11.2	2.5x1	7 970	11 900	0.005	34	57	34	50	11	40	45	5.5	9.5	5.5		
W1406FS-1-C3T5	560										34	57	34	50	11	40	45	5.5	9.5	5.5		
W1405FS-1-C5T8	454	14	8	3.175	14.5	11.2	2.5x1	7 880	11 800	0.005	34	57	34	50	11	46	45	5.5	9.5	5.5		
W1408FS-1-C5T8	754										34	57	34	50	11	46	45	5.5	9.5	5.5		
W1504FS-1-C5T10	349	15	10	3.175	15.5	12.2	2.5x1	8 140	12 800	0.005	34	57	34	50	11	51	45	5.5	9.5	5.5		
W1506FS-1-C5T10	549										34	57	34	50	11	51	45	5.5	9.5	5.5		
W1509FS-1-C5T10	849										34	57	34	50	11	51	45	5.5	9.5	5.5		
W1511FS-1-C5T10	1 049										34	57	34	50	11	51	45	5.5	9.5	5.5		

Notes: 1. We recommend using NSK support units. See Page B377 for details.

2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.

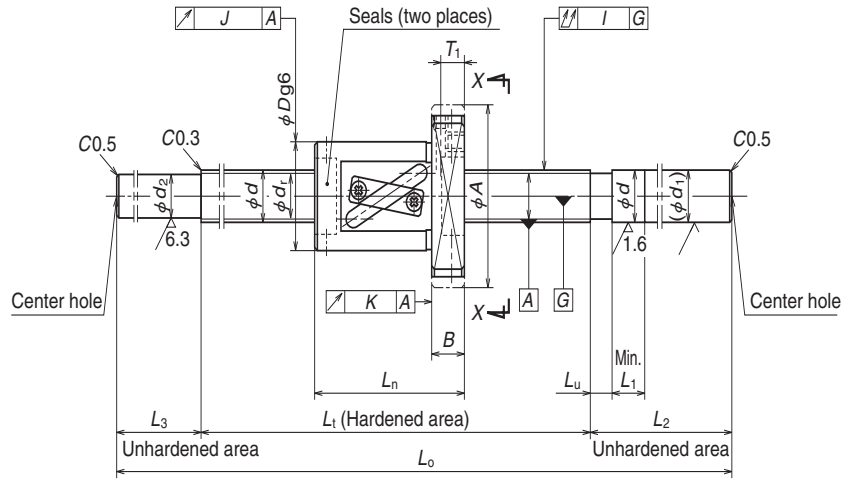
3. The permissible rotational speed is determined by the $d \cdot n$ value, critical speed, and maximum rotational speed. See Pages B47 and B289 for details. The values shown for permissible rotational speed apply when the mounting configuration is Fixed-Fixed.

dimensions	Screw shaft dimensions										Lead accuracy			Run-out		Mass (kg)	Permissible rotational speed N (min ⁻¹)	Nut internal space (cm ³)	Standard grease replenishment (cm ³)
	Oil hole		Threaded length L_t	Shaft end, right		Shaft end, left		Overall length L_o	T	Deviation e_p	Variation v_u	Shaft straightness I	Radial run-out						
	Q	T		d_1	L_u	L_1	L_2						d_2	L_3	J				
M6x1	17	350	15	5	40	100	11.2	40	490	0	0.013	0.010	0.035	0.012	0.008	0.78	3 000	2.0	1.0
		600							740		0.016	0.012	0.055			1.0			
M6x1	17	500	15	8	40	100	11.2	40	640	0	0.027	0.020	0.065	0.015	0.011	1.0	3 000	2.0	1.0
		800							940		0.035	0.025	0.085			1.3			
M6x1	17	400	15	8	40	120	12.2	50	570	0	0.025	0.020	0.050	0.015	0.011	1.0	3 000	2.3	1.2
		600							0.030		0.023	0.065	1.3						
		900							0.040		0.027	0.110	1.7						
		1 100							0.046		0.030	0.150	1.9						

Unit: mm

Blank Shaft End FS Model

(Fine, Medium, High helix lead: Tube Recirculation)



Nut: SFT, LSFT

Nut: SFT, LSFT

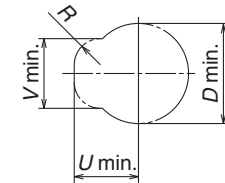
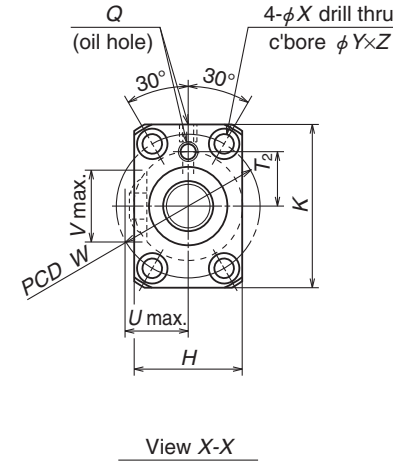


Screw shaft $\phi 16$

Lead 5, 16

Screw shaft $\phi 20$

Lead 10, 20



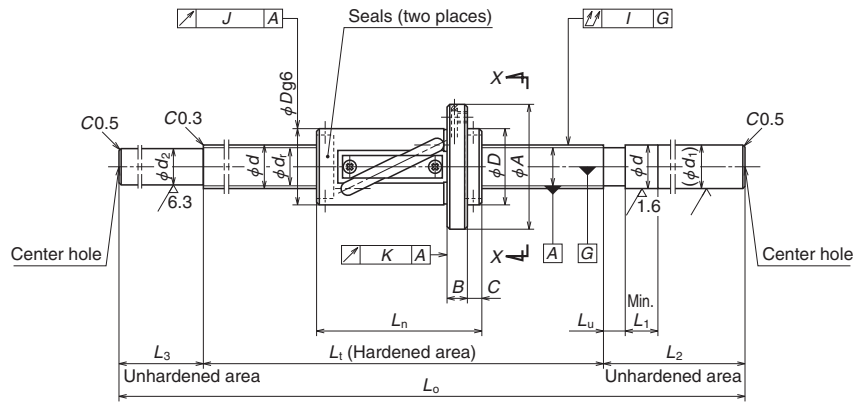
Housing hole and its clearance
(only applicable to shaft dia. $\phi 16$, lead 16)

Model No.	Stroke Max. L_t-L_n	Screw shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns Turns \times Circuits	Basic load ratings (N)		Axial play Max.	Nut										
								Dynamic C_o	Static C_{0a}		Outside dia. D	Flange				Overall length L_n	Bolt hole				
												D	A	H	K		B	L_n	W	X	Y
W1605FS-1-C3T5	458	16	5	3.175	16.5	13.2	2.5x1	8 620	13 800	0.005	40	63	40	55	11	42	51	5.5	9.5	5.5	
W1609FS-1-C3T5	858	16	16	3.175	16.5	13.2	2.5x1	8 620	13 800	0.005	40	63	40	55	11	42	51	5.5	9.5	5.5	
W1606FS-1-C5T16	544	16	16	3.175	16.75	13.4	1.5x1	5 480	8 080	0.005	34	57	34	50	12	56	45	5.5	9.5	5.5	
W1611FS-1-C5T16	1 044	16	16	3.175	16.75	13.4	1.5x1	5 480	8 080	0.005	34	57	34	50	12	56	45	5.5	9.5	5.5	
W2009FS-1-C5T10	846	20	10	3.969	21	16.9	2.5x1	13 300	21 900	0.005	46	74	46	66	13	54	59	6.6	11	6.5	
W2013FS-1-C5T10	1 246	20	10	3.969	21	16.9	2.5x1	13 300	21 900	0.005	46	74	46	66	13	54	59	6.6	11	6.5	
W2010FS-1-C5T20	937	20	20	3.969	21	16.9	1.5x1	8 190	13 100	0.005	46	74	46	66	13	63	59	6.6	11	6.5	
W2015FS-1-C5T20	1 437	20	20	3.969	21	16.9	1.5x1	8 190	13 100	0.005	46	74	46	66	13	63	59	6.6	11	6.5	

- Notes: 1. We recommend using NSK support units. See Page B377 for details.
 2. Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use. See Page D13 for details.
 3. The permissible rotational speed is determined by the $d \cdot n$ value, critical speed, and maximum rotational speed. See Pages B47 and B289 for details. The values shown for permissible rotational speed apply when the mounting configuration is Fixed-Fixed.

Unit: mm

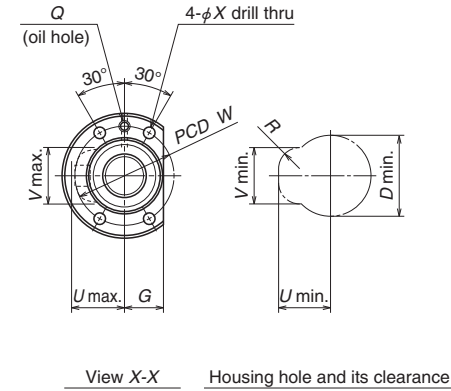
dimensions			Screw shaft dimensions										Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed N (min ⁻¹)	Nut internal space (cm ³)	Standard grease replenishment (cm ³)	
Projecting tube U V R	Oil hole		Threaded length L_t	Shaft end, right				Shaft end, left		Overall length L_o	Deviation T e_p	Variation v_u	Shaft straightness I	Radial run-out									
	Q	T_1		T_2	d_t	L_u	L_1	L_2	d_2					L_3	J	K							
—	—	—	M6x1	6	17	500	16	5	40	150	13.2	60	710	0	0.015	0.010	0.055	0.012	0.008	1.4	3 000	2.6	1.3
—	—	—	M6x1	8	17	900	16	10	40	150	13.4	60	1 110	0	0.021	0.015	0.095	0.015	0.011	1.9	3 000	2.1	1.1
19	20	8	M6x1	8	17	600	16	10	40	150	13.4	60	810	0	0.030	0.023	0.085	0.015	0.011	1.5	3 000	2.1	1.1
—	—	—	M6x1	8	24	1 100	20	10	60	150	16.9	80	1 310	0	0.046	0.030	0.150	0.015	0.011	2.3	2 480	4.7	2.4
—	—	—	M6x1	6	24	900	20	10	60	150	16.9	80	1 130	0	0.040	0.027	0.110	0.015	0.011	3.2	3 000	4.7	2.4
—	—	—	M6x1	8	24	1 300	20	10	60	150	16.9	80	1 530	0	0.054	0.035	0.150	0.015	0.011	4.1	2 190	4.2	2.1
—	—	—	M6x1	8	24	1 000	20	13	60	150	16.9	80	1 230	0	0.040	0.027	0.110	0.015	0.011	3.6	3 000	4.2	2.1
—	—	—	M6x1	8	24	1 500	20	13	60	150	16.9	80	1 730	0	0.054	0.035	0.200	0.015	0.011	4.8	1 610	4.2	2.1



Nut: LSFT

Model No.	Stroke Max. L _t -L _n	Screw shaft dia. d	Lead l	Ball dia. D _w	Ball circle dia. d _m	Root dia. d _r	Effective ball turns x Circuits	Basic load ratings (N)		Axial play Max.	Nut										
								Dynamic C _{0a}	Static C _{0a}		Nut	Flange						Overall length L _n	Bolt hole W X		
												D	A	G	H	K	B			C	
W2513FS-1-C5T20	1 254	25	20	4.762	26.25	21.3	2.5x1	18 600	32 600	0.005	LSFT	44	71	23	—	—	12	8	96	57	6.6
W2521FS-1-C5T20	2 054											44	71	23	—	—	12	8	96	57	6.6
W2513FS-2-C5T25	1 260	25	25	4.762	26.25	21.3	1.5x1	11 700	19 700	0.005	LSFT	44	71	23	—	—	12	10	90	57	6.6
W2521FS-2-C5T25	2 060											44	71	23	—	—	12	10	90	57	6.6

Notes: 1. We recommend using NSK support units. See Page B389 for details.
 2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
 3. The permissible rotational speed is determined by the *d-n* value, critical speed, and maximum rotational speed. See Pages B47 and B299 for details. The values shown for permissible rotational speed apply when the mounting configuration is Fixed-Fixed.

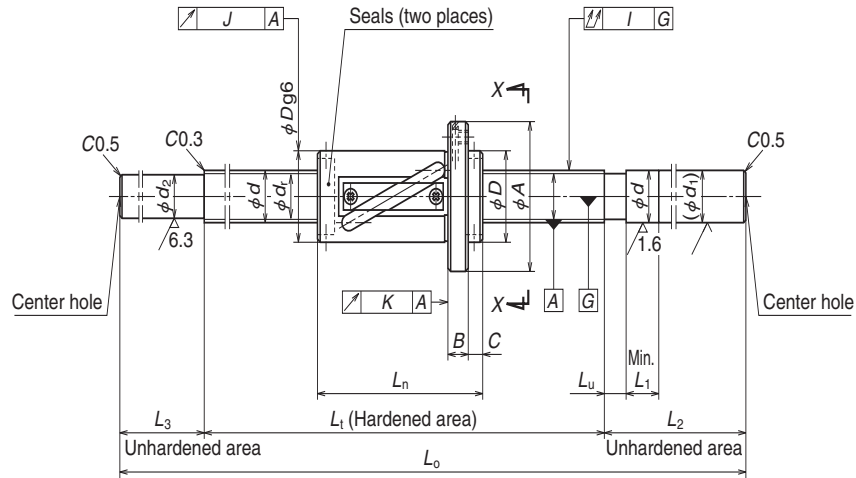


Unit: mm

dimensions			Screw shaft dimensions					Lead accuracy		Run-out			Mass (kg)	Permissible rotational speed N (min ⁻¹)	Nut internal space (cm ³)	Standard grease replenishment (cm ³)						
Projecting tube	Oil hole		Threaded length	Shaft end, right		Shaft end, left		Overall length	Deviation	Variation	Shaft straightness	Radial run-out										
U	V	R	Q	T	L _t	d _i	L _u	L ₁	L ₂	d ₂	L ₃	L ₀	T	e _p	v _u	I	J	K				
31	35	12	M6x1	—	1 350	25	13	70	200	21.3	100	1 650	0	0.054	0.035	0.120	0.015	0.011	6.8	2 550	12	6.0
					2 150							2 450		0.077	0.046	0.160			9.8	1 000		
32	34	12	M6x1	—	1 350	25	15	70	200	21.3	100	1 650	0	0.054	0.035	0.120	0.015	0.011	6.8	2 540	10	5.0
					2 150							2 450		0.077	0.046	0.160			9.8	1 000		

Blank Shaft End FS Model

(Medium, High helix lead: Tube Recirculation)



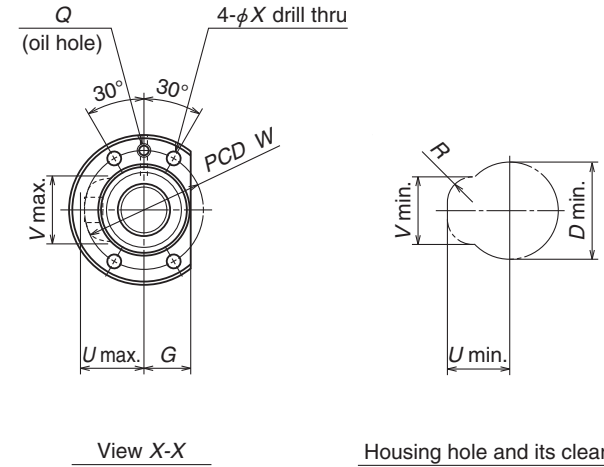
Nut: LSFT

Nut: LSFT



Screw shaft ø32

Lead 25, 32



View X-X

Housing hole and its clearance

Model No.	Stroke Max. L_t-L_n	Screw shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns Turns x Circuits	Basic load ratings (N)		Axial play Max.	Nut							
								Dynamic C_a	Static C_{0a}		Outside dia. D	Flange			Overall length L_n	Bolt hole W	X	
												A	G	B				C
W3217FS-1-C5T25	1 583	32	25	4.762	33.25	28.3	2.5x1	20 400	42 200	0.005	51	85	26	15	10	117	67	9
W3227FS-1-C5T25	2 583																	
W3217FS-2-C5T32	1 591	32	32	4.762	33.25	28.3	1.5x1	13 300	25 200	0.005	51	85	26	15	12	109	67	9
W3227FS-2-C5T32	2 591																	

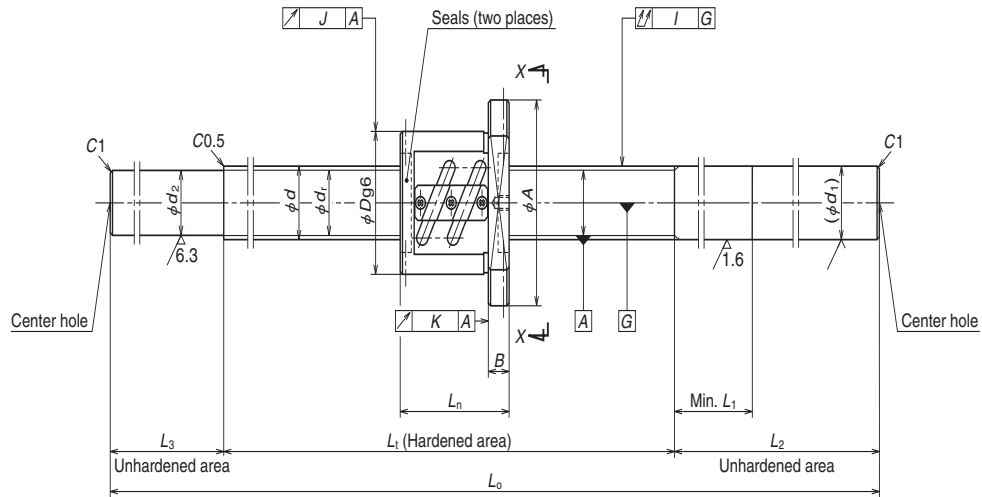
- Notes: 1. We recommend using NSK support units. See Page B377 for details.
 2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
 3. The permissible rotational speed is determined by the $d \cdot n$ value, critical speed, and maximum rotational speed. See Pages B47 and B289 for details. The values shown for permissible rotational speed apply when the mounting configuration is Fixed-Fixed.

Unit: mm

dimensions			Screw shaft dimensions					Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed (N (min ⁻¹))	Nut internal space (cm ³)	Standard grease replenishment (cm ³)				
Projecting tube U	Oil hole V	R	Threaded length Q	Shaft end, right L_t	Shaft end, left d_1	Shaft end, left L_u	Shaft end, left L_1	Shaft end, left L_2	Shaft end, left d_2	Shaft end, left L_3	Overall length L_0	Tread compression T	Deviation e_p					Variation v_u	Shaft straightness I	Radial run-out J	Radial run-out K
34	42	12	M6x1	1 700	32	15	70	250	28.3	120	2 070	0	0.065	0.040	0.160	0.019	0.013	13.8	2 180	17	8.5
				2 700							3 070		0.093	0.054	0.210			20.0	800		
34	42	12	M6x1	1 700	32	19	70	250	28.3	120	2 070	0	0.065	0.040	0.160	0.019	0.013	13.9	2 180	15	7.5
				2 700							3 070		0.093	0.054	0.210			20.0	790		

Blank Shaft End SS Model

(Fine lead: Tube Recirculation)



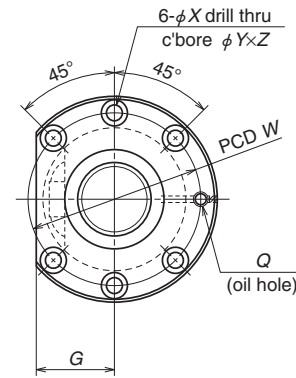
Nut: PFT

Nut: PFT

NSK

Screw shaft ø20

Lead 4, 5



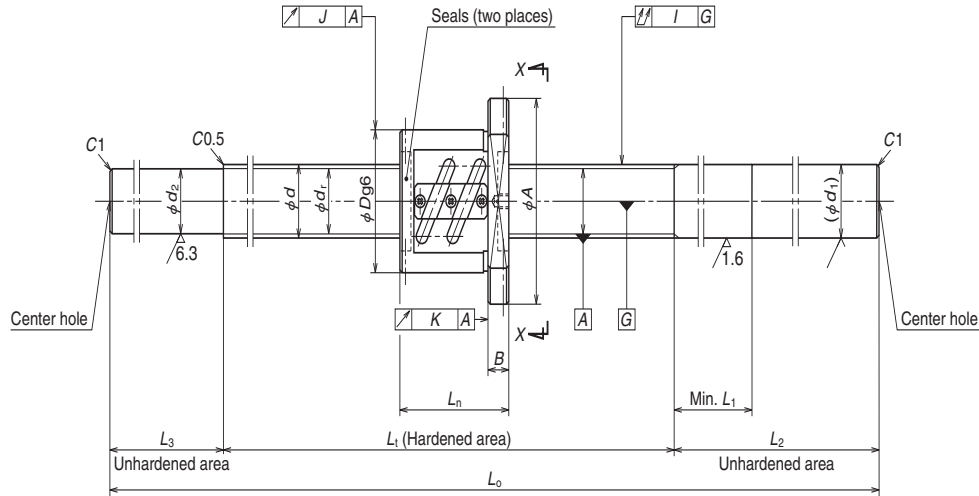
View X-X

Model No.	Stroke Max. L_r-L_n	Screw shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns x Circuits	Basic load ratings (N)		Preload (N)	Dynamic friction torque, median (N·cm)	Nut						
								Dynamic C_a	Static C_{0a}			Outside dia. D	Flange		Overall length L_n	Bolt hole		
													A	G		B	W	X
W2003SS-1P-C5Z4	251	20	4	2.381	20.3	17.8	2.5×2	6 550	10 900	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	11 100	17 100	490	7.8	44	67	26	11	56	55	5.5
W2005SS-2P-C5Z5	444																	
W2007SS-1P-C5Z5	644																	
W2010SS-1P-C5Z5	944																	

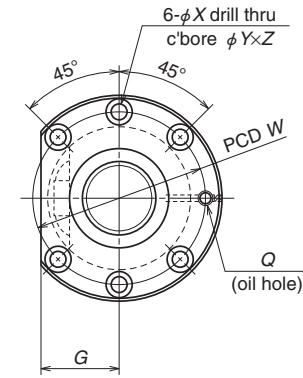
- Notes: 1. We recommend using NSK support units. See Page B377 for details.
 2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
 3. The permissible rotational speed is determined by the $d-n$ value, critical speed, and maximum rotational speed. See Pages B47 and B289 for details. The values shown for permissible rotational speed apply when the mounting configuration is Fixed-Fixed.

Unit: mm

dimensions		Screw shaft dimensions							Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed N (min ⁻¹)	Nut internal space (cm ³)	Standard grease replenishment (cm ³)	
Bolt hole Y	Oil hole Z	Threaded length L_t	Shaft end, right		Shaft end, left		Overall length L_o	Travel compensation T	Deviation e_p	Variation v_u	Radial run-out								
			d_1	L_1	L_2	d_2					L_3	Shaft straightness I	J	K					
9.5	5.5	M6×1	300	20	40	150	17.8	50	700	-0.012	0.027	0.020	0.085	0.015	0.011	1.5	3 000	2.7	1.4
			500													2.0			
			800													2.9			
9.5	5.5	M6×1	300	20	40	150	17.2	50	700	-0.012	0.027	0.020	0.085	0.015	0.011	1.6	3 000	4.3	2.2
			500													2.2			
			700													2.8			
			1 000													3.5			



Nut: PFT



View X-X

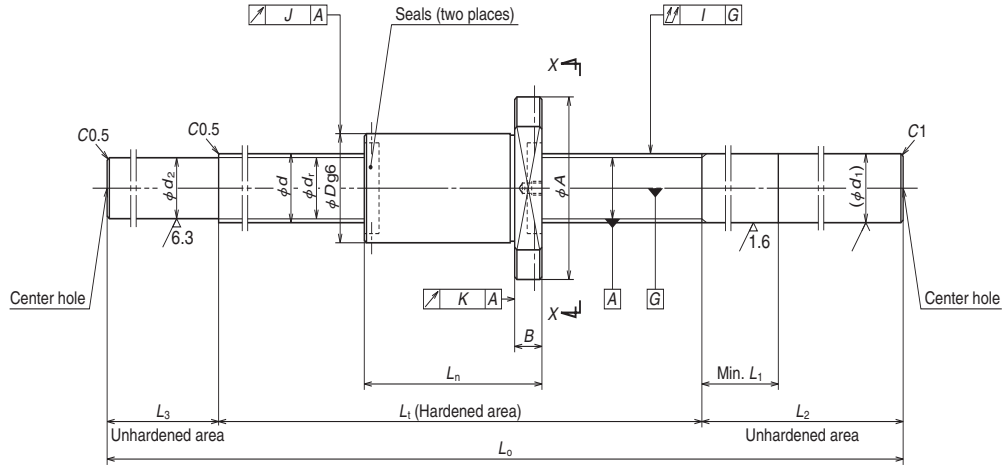
Model No.	Stroke Max. L_r-L_n	Screw shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns x Circuits	Basic load ratings (N)		Preload (N)	Dynamic friction torque, median (N·cm)	Nut						
								Dynamic C_a	Static C_{0a}			Outside dia. D	Flange		Overall length L_n	Bolt hole X		
													A	G			B	
W2503SS-1P-C5Z4	252							7 110	13 600	290	4.9	46	69	26	11	48	57	5.5
W2506SS-1P-C5Z4	552	25	4	2.381	25.3	22.8	2.5x2	7 110	13 600	290	4.9	46	69	26	11	48	57	5.5
W2510SS-1P-C5Z4	952																	
W2503SS-2P-C5Z5	245																	
W2505SS-1P-C5Z5	445	25	5	3.175	25.5	22.2	2.5x2	12 300	21 800	540	8.8	50	73	28	11	55	61	5.5
W2508SS-1P-C5Z5	745																	
W2512SS-1P-C5Z5	1 145																	
W2504SS-1P-C5Z6	338																	
W2508SS-2P-C5Z6	738	25	6	3.969	25.5	21.4	2.5x2	16 600	26 700	690	13.8	53	76	29	11	62	64	5.5
W2512SS-2P-C5Z6	1 138																	

- Notes: 1. We recommend using NSK support units. See Page B377 for details.
 2. Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use. See Page D13 for details.
 3. The permissible rotational speed is determined by the $d-n$ value, critical speed, and maximum rotational speed. See Pages B47 and B289 for details. The values shown for permissible rotational speed apply when the mounting configuration is Fixed-Fixed.

dimensions		Screw shaft dimensions						Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed N (min ⁻¹)	Nut internal space (cm ³)	Standard grease replenishment (cm ³)				
Bolt hole Y	Oil hole Z	Threaded length L_t	Shaft end, right d_1	Shaft end, left d_2	Overall length L_o	Travel compensation T	Deviation e_p	Variation v_u	Shaft straightness I	Radial run-out											
	Q		L_1	L_2	L_3					J	K										
9.5	5.5	M6x1	300	25	40	150	—	450	-0.007	0.023	0.018	0.040	0.015	0.011	2.2	2 800	3.2	1.6			
			600	200	22.8	100	900	-0.014	0.030	0.023	0.075	3.8									
			1 000	200	100	1 300	-0.024	0.040	0.027	0.120	5.2										
9.5	5.5	M6x1	300	25	40	200	22.2	50	750	-0.012	0.027	0.020	0.015	0.011	2.5	2 800	5.2	2.6			
			500					100	1 150	-0.019	0.035	0.025							0.090	3.4	
			800					250	100	1 600	-0.029	0.046							0.030	0.120	4.8
			1 200					300	100	1 600	-0.029	0.046							0.030	0.120	6.3
9.5	5.5	M6x1	400	25	40	250	21.4	60	600	-0.010	0.025	0.020	0.019	0.013	3.0	2 800	7.0	3.5			
			800					100	1 150	-0.019	0.035	0.025							0.090	4.8	
			1 200					100	1 600	-0.029	0.046	0.030							0.120	6.3	

Blank Shaft End SS Model

(Fine lead: Deflector (bridge) Recirculation)



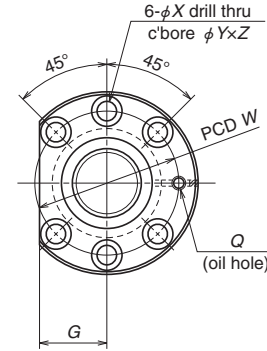
Nut: ZFD

Nut: ZFD

NSK

Screw shaft ø25

Lead 5, 10



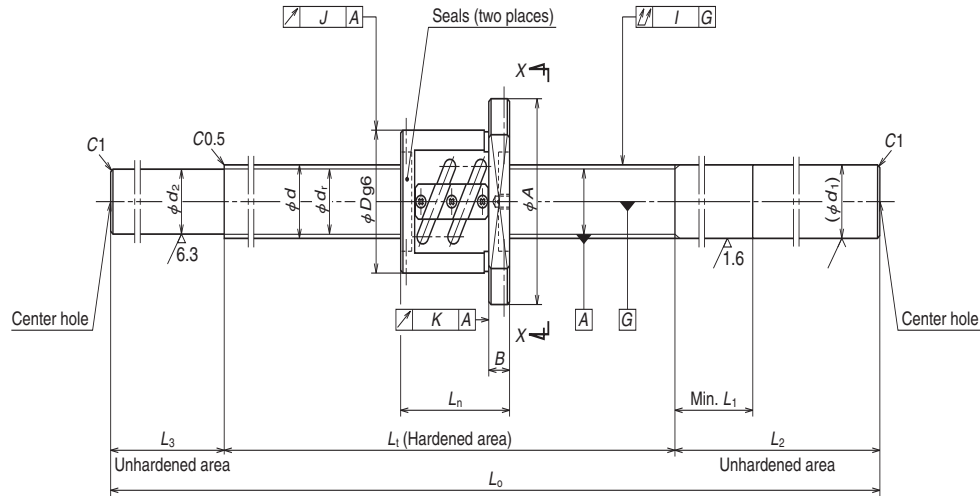
View X-X

Model No.	Stroke Max. L_1-L_n	Screw shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns x Circuits	Basic load ratings (N)		Preload (N)	Dynamic friction torque, median (N·cm)	Nut						
								Dynamic C_a	Static C_{0a}			Outside dia. D	Flange		Overall length L_n	Bolt hole		
													A	G		B	W	X
W2502SS-1ZY-C5Z5	184	25	5	3.175	25.75	22.4	1x3	11 600	22 900	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	1 134																	
W2504SS-4ZY-C5Z10	312	25	10	4.762	26.25	21.3	1x2	13 300	21 200	880	21.5	42	69	26	15	88	55	6.6
W2506SS-3ZY-C5Z10	512																	
W2508SS-3ZY-C5Z10	712																	
W2511SS-1ZY-C5Z10	1 012																	
W2515SS-2ZY-C5Z10	1 412																	

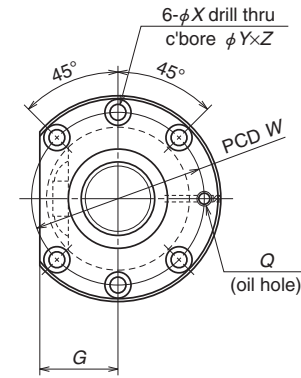
- Notes: 1. We recommend using NSK support units. See Page B377 for details.
 2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
 3. The permissible rotational speed is determined by the $d-n$ value, critical speed, and maximum rotational speed. See Pages B47 and B289 for details. The values shown for permissible rotational speed apply when the mounting configuration is Fixed-Fixed.

Unit: mm

dimensions		Screw shaft dimensions						Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed N (min ⁻¹)	Nut internal space (cm ³)	Standard grease replenishment (cm ³)			
Bolt hole Y	Oil hole Z	Threaded length L_t	Shaft end, right d_1 L_1 L_2		Shaft end, left d_2 L_3		Overall length L_o	Travel compensation T	Deviation e_p	Variation v_u	Shaft straightness I	Radial run-out J K								
9.5	5.5	M6x1	250	25	40	200	22.4	—	450	-0.005	0.023	0.018	0.040	0.015	0.011	2.1	2 800	5.4	2.7	
			400			200		50	650	-0.009	0.025	0.020	0.060							2.8
			600			250		100	1 250	-0.021	0.040	0.027	0.090							3.9
			900			250		100	1 600	-0.028	0.046	0.030	0.120							4.9
			1 200			300		100	1 600	-0.028	0.046	0.030	0.120							6.2
11	6.5	M6x1	400	25	60	200	21.3	50	650	-0.008	0.025	0.020	0.060	0.015	0.011	3.0	2 800	9.0	4.5	
			600			250		100	950	-0.012	0.030	0.023	0.075							4.1
			800			250		100	1 150	-0.017	0.035	0.025	0.090							4.8
			1 100			300		100	1 500	-0.024	0.046	0.030	0.120							6.0
			1 500			300		100	1 900	-0.034	0.054	0.035	0.150							7.4



Nut: PFT



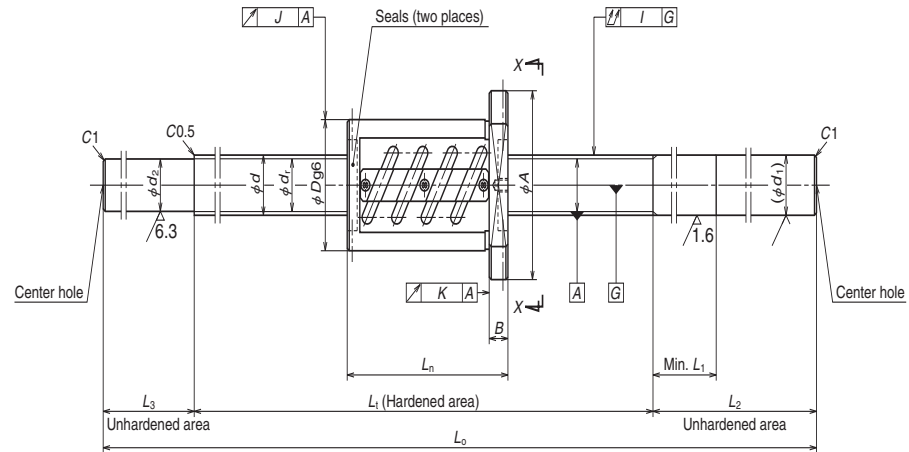
View X-X

Model No.	Stroke Max. L_r-L_n	Screw shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns x Circuits	Basic load ratings (N)		Preload (N)	Dynamic friction torque, median (N·cm)	Nut						
								Dynamic C_a	Static C_{0a}			Outside dia. D	Flange		Overall length L_n	Bolt hole		
													A	G		B	W	X
W2504SS-2P-C5Z10	319	25	10	4.762	25.5	20.5	1.5x2	13 600	18 900	590	13.8	58	85	32	15	81	71	6.6
W2507SS-1P-C5Z10	619																	
W2510SS-2P-C5Z10	919																	
W2515SS-1P-C5Z10	1 419																	
W2804SS-1P-C5Z5	344	28	5	3.175	28.5	25.2	2.5x2	13 000	24 400	540	9.8	55	85	31	12	56	69	6.6
W2806SS-1P-C5Z5	544																	
W2808SS-1P-C5Z5	744																	
W2812SS-1P-C5Z5	1 144																	
W2804SS-3P-C5Z6	337	28	6	3.175	28.5	25.2	2.5x2	12 900	24 300	540	10.8	55	85	31	12	63	69	6.6
W2806SS-3P-C5Z6	537																	
W2808SS-3P-C5Z6	737																	
W2812SS-3P-C5Z6	1 137																	

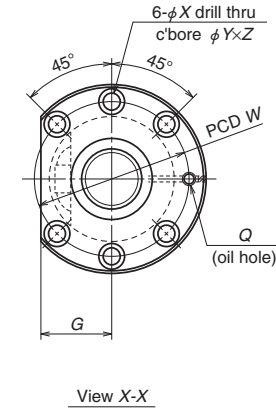
- Notes: 1. We recommend using NSK support units. See Page B377 for details.
 2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
 3. The permissible rotational speed is determined by the $d-n$ value, critical speed, and maximum rotational speed. See Pages B47 and B289 for details. The values shown for permissible rotational speed apply when the mounting configuration is Fixed-Fixed.

Unit: mm

dimensions		Screw shaft dimensions						Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed N (min ⁻¹)	Nut internal space (cm ³)	Standard grease replenishment (cm ³)		
Bolt hole Y	Oil hole Z	Threaded length L_t	Shaft end, right		Shaft end, left		Overall length L_o	Travel compensation T	Deviation e_p	Variation v_u	Shaft straightness		Radial run-out						
			d_1	L_1	L_2	d_2					L_3	I						J	K
11	6.5	M6x1	400	25	60	200	20.5	50	650	-0.010	0.025	0.020	0.060	0.019	0.013	3.8	2 800	9.7	4.9
			700			250		100	1 050	-0.017	0.035	0.025	0.090			5.1			
			1 000			250		100	1 350	-0.024	0.040	0.027	0.120			6.1			
			1 500			300		100	1 900	-0.036	0.054	0.035	0.150			8.0			
11	6.5	M6x1	400	28	40	200	25.2	—	600	-0.010	0.025	0.020	0.050	0.019	0.013	3.7	2 500	6.1	3.1
			600			250		100	950	-0.014	0.030	0.023	0.075			5.2			
			800			250		100	1 150	-0.019	0.035	0.025	0.090			6.1			
			1 200			300		100	1 600	-0.029	0.046	0.030	0.120			8.1			
11	6.5	M6x1	400	28	40	200	25.2	—	600	-0.010	0.025	0.020	0.050	0.019	0.013	3.8	2 500	6.1	3.1
			600			250		100	950	-0.014	0.030	0.023	0.075			5.3			
			800			250		100	1 150	-0.019	0.035	0.025	0.090			6.2			
			1 200			300		100	1 600	-0.029	0.046	0.030	0.120			8.2			



Nut: ZFT



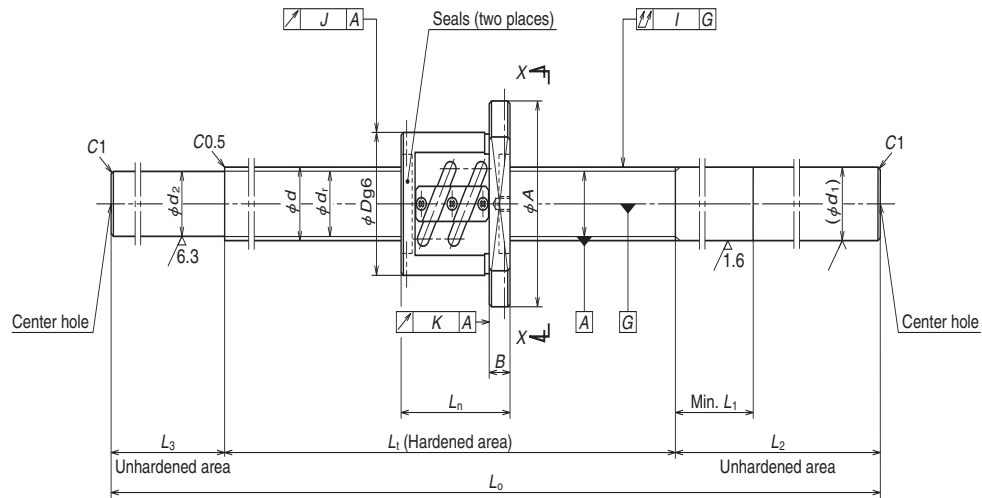
View X-X

Model No.	Stroke Max. L_1-L_n	Screw shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns Turns x Circuits	Basic load ratings (N)		Preload (N)	Dynamic friction torque, median (N·cm)	Nut						
								Dynamic C_0	Static C_{0a}			Outside dia. D	Flange			Overall length L_1	Bolt hole	
													A	G	B		W	X
W2804SS-2Z-C5Z5	314	28	5	3.175	28.5	25.2	2.5x2	20 600	48 700	1 225	21.5	55	85	31	12	86	69	6.6
W2806SS-2Z-C5Z5	514																	
W2808SS-2Z-C5Z5	714																	
W2812SS-2Z-C5Z5	1 114																	
W2804SS-4Z-C5Z6	301	28	6	3.175	28.5	25.2	2.5x2	20 600	48 700	1 225	22.5	55	85	31	12	99	69	6.6
W2806SS-4Z-C5Z6	501																	
W2808SS-4Z-C5Z6	701																	
W2812SS-4Z-C5Z6	1 101																	

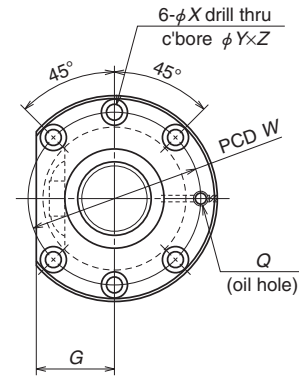
- Notes: 1. We recommend using NSK support units. See Page B377 for details.
 2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
 3. The permissible rotational speed is determined by the $d-n$ value, critical speed, and maximum rotational speed. See Pages B47 and B289 for details. The values shown for permissible rotational speed apply when the mounting configuration is Fixed-Fixed.

Unit: mm

dimensions		Screw shaft dimensions							Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed N(min ⁻¹)	Nut internal space (cm ³)	Standard grease replenishment (cm ³)
Bolt hole Y	Oil hole Z	Threaded length L_t	Shaft end, right		Shaft end, left		Overall length L_o	Travel compensation T	Deviation e_p	Variation v_u	Shaft straightness		Radial run-out J	K				
			d_1	L_1	L_2	d_2					L_3	I						
11	6.5	M6x1	400	28	40	25.2	—	600	-0.010	0.025	0.020	0.050	0.019	0.013	4.7	2 500	9.2	4.6
			600				100	950	-0.014	0.030	0.023	0.075			5.5			
			800				100	1 150	-0.019	0.035	0.025	0.090			6.4			
			1 200				100	1 600	-0.029	0.046	0.030	0.120			8.4			
11	6.5	M6x1	400	28	40	25.2	—	600	-0.010	0.025	0.020	0.050	0.019	0.013	4.2	2 500	9.5	4.8
			600				100	950	-0.014	0.030	0.023	0.075			5.7			
			800				100	1 150	-0.019	0.035	0.025	0.090			6.6			
			1 200				100	1 600	-0.029	0.046	0.030	0.120			8.6			



Nut: PFT



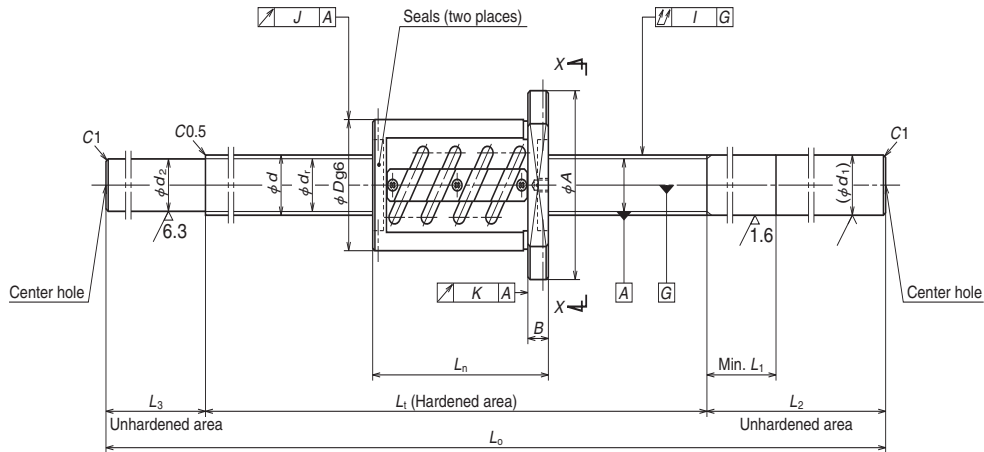
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Reference No.	Stroke Max. L_r-L_n	Screw shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns \times Circuits	Basic load ratings (N)		Preload (N)	Dynamic friction torque, median (N-cm)	Nut				
								Dynamic C_a	Static C_{oa}			Outside dia. D	Flange			Overall length L_n
													A	G	B	
W3204SS-1P-C5Z5	344	32	5	3.175	32.5	29.2	2.5×2	13 700	28 000	590	10.8	58	85	32	12	56
W3206SS-1P-C5Z5	544															
W3208SS-1P-C5Z5	744															
W3212SS-1P-C5Z5	1 144															
W3215SS-1P-C5Z5	1 444															
W3206SS-3P-C5Z6	537	32	6	3.969	32.5	28.4	2.5×2	18 300	34 700	780	15.6	62	89	34	12	63
W3210SS-1P-C5Z6	937															
W3215SS-3P-C5Z6	1 437															

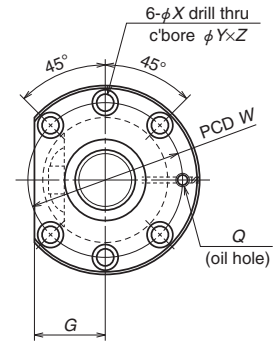
- Notes: 1. We recommend using NSK support units. See Page B377 for details.
 2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
 3. The permissible rotational speed is determined by the $d \cdot n$ value, critical speed, and maximum rotational speed. See Pages B47 and B289 for details. The values shown for permissible rotational speed apply when the mounting configuration is Fixed-Fixed.

Unit: mm

dimensions				Screw shaft dimensions					Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed N (min ⁻¹)	Nut internal space (cm ³)	Standard grease replenishment (cm ³)	
Bolt hole		Oil hole		Threaded length L_t	Shaft end, right		Shaft end, left		Overall length L_o	Travel compensation T	Deviation e_p	Variation v_u	Shaft straightness I	Radial run-out					
W	X	Y	Z		Q	L_1	L_2	d_2						L_3					J
71	6.6	11	6.5	M6×1	400	32	40	200	50	650	-0.010	0.025	0.020	0.060	0.019	0.013	4.8		
					600			250	100	950	-0.014	0.030	0.023	0.075			6.5		
					800			250	100	1 150	-0.019	0.035	0.025	0.090			7.7		
					1 200			300	100	1 600	-0.029	0.046	0.030	0.120			10.3		
					1 500			300	100	1 900	-0.036	0.054	0.035	0.150			12.1		
75	6.6	11	6.5	M6×1	600	32	40	250	950	-0.014	0.030	0.023	0.075	0.019	0.013	6.7			
					1 000			300	28.4	100	1 400	-0.024	0.040			0.027	0.120	9.2	
					1 500			300	1 900	-0.036	0.054	0.035	0.150			12.1			



Nut: ZFT

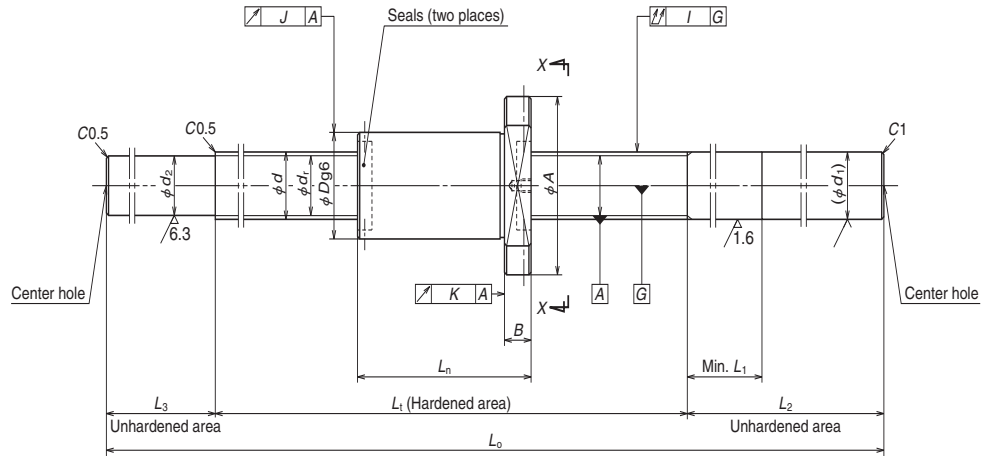


View X-X

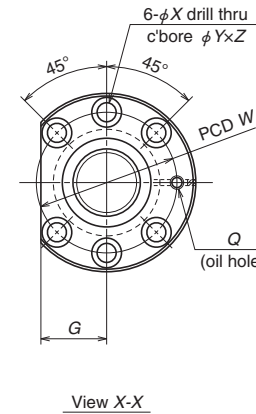
Reference No.	Stroke Max. L _r -L _n	Screw shaft dia. d	Lead l	Ball dia. D _w	Ball circle dia. d _m	Root dia. d _r	Effective ball turns × Circuits	Basic load ratings (N)			Dynamic friction torque, median (N·cm)	Nut				
								Dynamic C _a	Static C _{oa}	Preload (N)		Flange				Overall length L _n
												Outside dia. D	A	G	B	
W3204SS-2Z-C5Z5	314	32	5	3.175	32.5	29.2	2.5x2	21 800	56 000	1 270	22.5	58	85	32	12	86
W3206SS-2Z-C5Z5	514															
W3208SS-2Z-C5Z5	714															
W3212SS-2Z-C5Z5	1 114															
W3215SS-2Z-C5Z5	1 414															
W3206SS-4Z-C5Z6	501	32	6	3.969	32.5	28.4	2.5x2	29 100	69 300	1 720	34.5	62	89	34	12	99
W3210SS-2Z-C5Z6	901															
W3215SS-4Z-C5Z6	1 401															
W3206SS-5Z-C5Z8	518	32	8	4.762	32.5	27.5	2.5x1	20 600	40 900	1 320	30.5	66	100	38	15	82
W3210SS-3Z-C5Z8	918															
W3215SS-5Z-C5Z8	1 418															

- Notes:
1. We recommend using NSK support units. See Page B377 for details.
 2. Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use. See Page D13 for details.
 3. The permissible rotational speed is determined by the *d-n* value, critical speed, and maximum rotational speed. See Pages B47 and B289 for details. The values shown for permissible rotational speed apply when the mounting configuration is Fixed-Fixed.

dimensions				Screw shaft dimensions					Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed N (min ⁻¹)	Nut internal space (cm ³)	Standard grease replenishment (cm ³)	
Bolt hole		Oil hole		Threaded length	Shaft end, right		Shaft end, left		Overall length	Travel compensation	Deviation	Variation	Shaft straightness	Radial run-out					
W	X	Y	Z	Q	L _r	d ₁	L ₁	L ₂	d ₂	L ₃	L _o	T	e _p	v _u					I
71	6.6	11	6.5	M6x1	400	32	40	250	29.2	50	650	-0.010	0.025	0.020	0.060	0.019	0.013	5.1	
					600					100	950	-0.014	0.030	0.023	0.075			6.9	
					800					100	1 150	-0.019	0.035	0.025	0.090			8.0	
					1 200					100	1 600	-0.029	0.046	0.030	0.120			10.1	
					1 500					100	1 900	-0.036	0.054	0.035	0.150			12.4	
75	6.6	11	6.5	M6x1	600	32	40	300	28.4	100	950	-0.014	0.030	0.023	0.075	0.019	0.013	7.1	
					1 000					100	1 400	-0.024	0.040	0.027	0.120			9.7	
					1 500					100	1 900	-0.036	0.054	0.035	0.150			12.6	
82	9	14	8.5	M6x1	600	32	50	300	27.5	100	950	-0.014	0.030	0.023	0.075	0.019	0.013	7.3	
					1 000					100	1 400	-0.024	0.040	0.027	0.120			9.8	
					1 500					100	1 900	-0.036	0.054	0.035	0.150			12.6	



Nut: ZFD



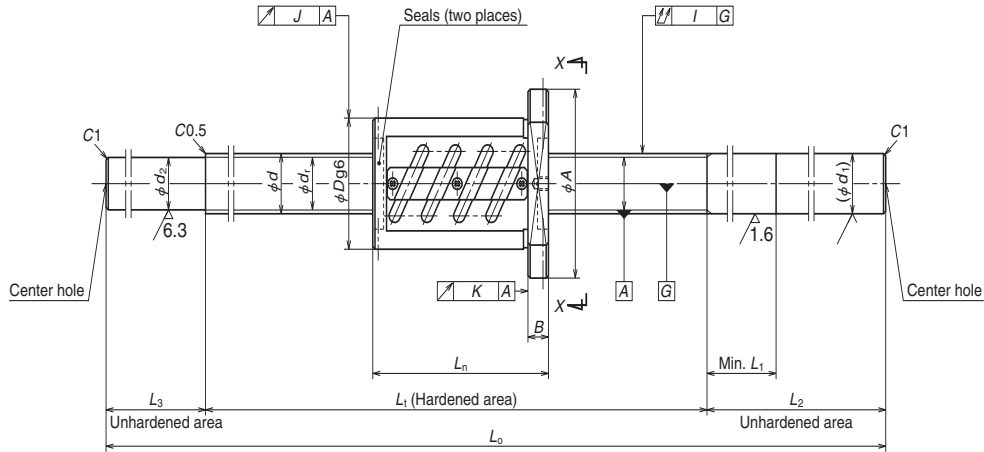
Reference No.	Stroke Max. L_r-L_n	Screw shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns \times Circuits	Basic load ratings (N)			Dynamic friction torque, median (N-cm)	Nut								
								Dynamic C_a	Static C_{0a}	Preload (N)		Flange				Overall length L_n				
												Outside dia. D	A	G	B					
W3204SS-3ZY-C5Z5	323																			
W3206SS-6ZY-C5Z5	523																			
W3209SS-1ZY-C5Z5	823	32	5	3.175	32.75	29.4	4	16 800	40 600	1 080	19.6	48	75	29	12	77				
W3212SS-3ZY-C5Z5	1 123																			
W3216SS-1ZY-C5Z5	1 523																			
W3205SS-3ZY-C5Z10	380																			
W3207SS-3ZY-C5Z10	580																			
W3210SS-6ZY-C5Z10	880	32	10	6.35	33.75	27.1	3	30 500	52 500	1 860	49.0	54	88	34	15	120				
W3214SS-3ZY-C5Z10	1 280																			
W3218SS-3ZY-C5Z10	1 680																			

- Notes: 1. We recommend using NSK support units. See Page B377 for details.
 2. Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use. See Page D13 for details.
 3. The permissible rotational speed is determined by the $d \cdot n$ value, critical speed, and maximum rotational speed. See Pages B47 and B289 for details. The values shown for permissible rotational speed apply when the mounting configuration is Fixed-Fixed.

dimensions				Screw shaft dimensions					Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed (min ⁻¹)	Nut internal space (cm ³)	Standard grease replenishment (cm ³)		
Bolt hole		Oil hole		Threaded length	Shaft end, right		Shaft end, left		Overall length	Travel compensation	Deviation	Variation	Shaft straightness						Radial run-out	
W	X	Y	Z	Q	L_1	d_1	L_1	L_2	d_2	L_3	L_0	T	e_p	v_u						I
61	6.6	11	6.5	M6x1	400	32	40	200	50	650	-0.009	0.025	0.020	0.060	0.015	0.011	4.6	2 180	22	11
					600			250	100	950	-0.013	0.030	0.023	0.075			6.4			
					900			250	100	1 250	-0.021	0.040	0.027	0.090			8.1			
					1 200			300	100	1 600	-0.028	0.046	0.030	0.120			10.2			
					1 600			300	100	2 000	-0.037	0.054	0.035	0.150			12.6			
70	9	14	8.5	M6x1	500	32	60	250	100	850	-0.010	0.027	0.020	0.075	0.019	0.013	6.2	2 180	23	12
					700			250	100	1 050	-0.015	0.035	0.025	0.090			7.3			
					1 000			300	100	1 400	-0.022	0.040	0.027	0.120			9.3			
					1 400			350	120	1 870	-0.032	0.054	0.035	0.150			11.9			
					1 800			350	120	2 270	-0.041	0.065	0.040	0.200			14.1			

Blank Shaft End SS Model

(Fine lead: Tube Recirculation)



Nut: ZFT

Nut: ZFT

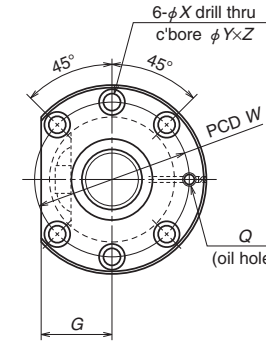
NSK

Screw shaft $\phi 32, \phi 36$

Lead 10

Screw shaft $\phi 40$

Lead 5



View X-X

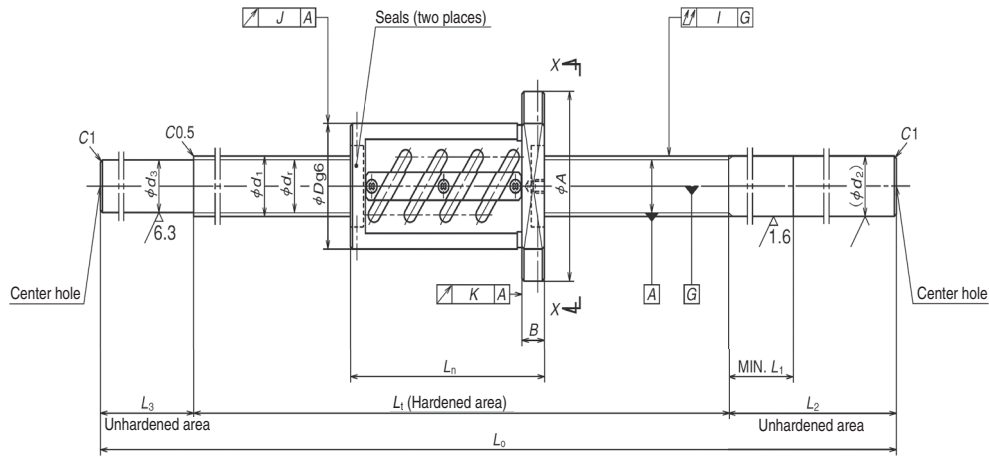
Reference No.	Stroke Max. L_r-L_n	Screw shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns \times Circuits	Basic load ratings (N)			Dynamic friction torque, median (N-cm)	Nut										
								Dynamic C_a	Static C_{0a}	Preload (N)		Flange				Overall length						
												Outside dia. D	A	G	B		L_n					
W3205SS-1Z-C5Z10	400																					
W3207SS-1Z-C5Z10	600																					
W3210SS-4Z-C5Z10	900	32	10	6.350	33	26.4	2.5×1	30 000	55 100	1 960	50	74	108	41	15	100						
W3214SS-1Z-C5Z10	1 300																					
W3218SS-1Z-C5Z10	1 700																					
W3607SS-1Z-C5Z10	597																					
W3612SS-1Z-C5Z10	1 097	36	10	6.350	37	30.4	2.5×1	32 000	61 100	2 060	56	75	120	45	18	103						
W3620SS-1Z-C5Z10	1 897																					
W4006SS-1Z-C5Z5	511																					
W4010SS-1Z-C5Z5	911	40	5	3.175	40.5	37.2	2.5×2	23 900	70 500	1 420	28.5	67	101	39	15	89						
W4016SS-1Z-C5Z5	1 511																					

- Notes: 1. We recommend using NSK support units. See Page B377 for details.
 2. Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use. See Page D13 for details.
 3. The permissible rotational speed is determined by the $d \cdot n$ value, critical speed, and maximum rotational speed. See Pages B47 and B289 for details. The values shown for permissible rotational speed apply when the mounting configuration is Fixed-Fixed.

dimensions				Screw shaft dimensions					Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed (min ⁻¹)	Nut internal space (cm ³)	Standard grease replenishment (cm ³)							
Bolt hole				Oil hole	Threaded length	Shaft end, right		Shaft end, left		Overall length	Travel compensation	Deviation	Variation	Shaft straightness					Radial run-out						
W	X	Y	Z			L_1	d_1	L_1	L_2										d_2	L_3	L_0	T	e_p	v_u	I
90	9	14	8.5	M6×1	500	32	60	250	26.4	100	850	-0.012	0.027	0.020	0.075	0.019	0.013	7.5	2 180	22	11				
					700			250		100		1 050						-0.017				0.035	0.025	0.090	8.5
					1 000			300		120		1 400						-0.024				0.040	0.027	0.120	10.5
					1 400			350		120		1 870						-0.034				0.054	0.035	0.150	13.1
					1 800			350		120		2 270						-0.043				0.065	0.040	0.200	15.2
98	11	17.5	11	M6×1	700	36	60	300	30.4	100	1 100	-0.017	0.035	0.025	0.065	0.019	0.013	10.9	1 940	27	14				
					1 200			350		120		1 670						-0.029				0.046	0.030	0.100	14.9
					2 000			350		120		2 470						-0.048				0.065	0.040	0.130	20.4
83	9	14	8.5	Rc1/8	600	40	50	300	37.2	100	1 000	-0.014	0.030	0.023	0.050	0.019	0.013	11.1	1 750	14	7.0				
					1 000			300		140		1 400						-0.024				0.040	0.027	0.080	14.8
					1 600			350		205		2 050						-0.038				0.054	0.035	0.130	20.8

Blank Shaft End SS Model

(Fine lead: Tube Recirculation)



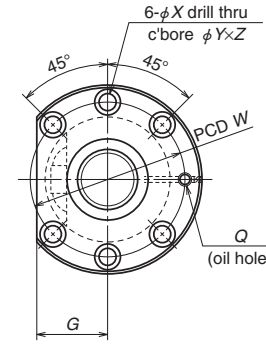
Nut: ZFT

Nut: ZFT

NSK

Screw shaft ø32, ø36

Lead 10

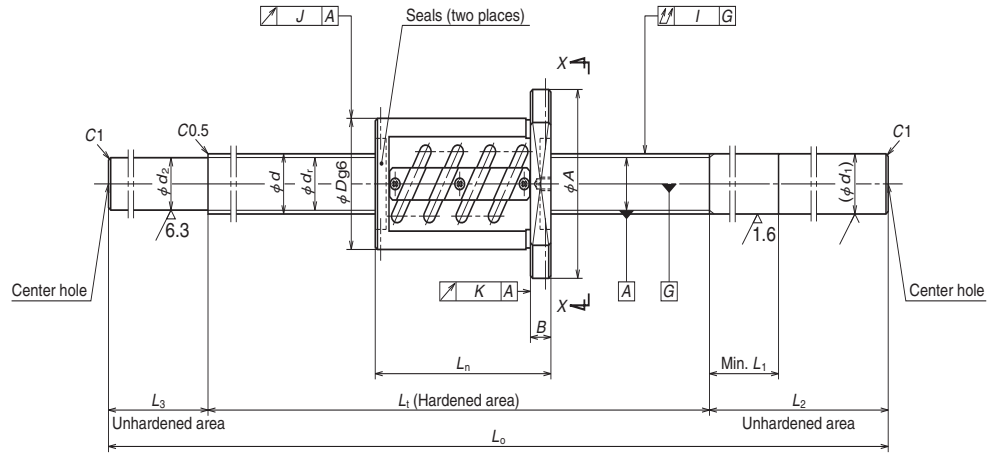


View X-X

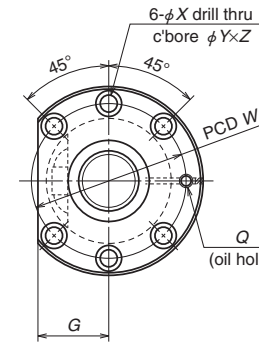
Reference No.	Stroke Max. L_t-L_n	Screw shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns \times Circuits	Basic load ratings (N)		Preload (N)	Dynamic friction torque, median (N·cm)	Nut																											
								Dynamic C_a	Static C_{0a}			Flange				Overall length L_n																							
												Outside dia. D	A	G	B																								
W3205SS-4Z-C5Z10	310																																						
W3207SS-4Z-C5Z10	510																																						
W3210SS-7Z-C5Z10	810	32	10	6.350	33	26.4	2.5x2	54 500	110 000	2 320	59	74	108	41	15	160																							
W3214SS-4Z-C5Z10	1 210																																						
W3218SS-4Z-C5Z10	1 610																																						
W3607SS-3Z-C5Z10	507																																						
W3612SS-3Z-C5Z10	1 007	36	10	6.350	37	30.4	2.5x2	58 000	122 000	2 470	67	75	120	45	18	163																							
W3620SS-3Z-C5Z10	1 807																																						

- Notes:
1. We recommend using NSK support units. See Page B389 for details.
 2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
 3. The permissible rotational speed is determined by the $d \cdot n$ value, critical speed, and maximum rotational speed. See Pages B47 and B299 for details. The values shown for permissible rotational speed apply when the mounting configuration is Fixed-Fixed.

dimensions		Screw shaft dimensions					Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed (min ⁻¹)	Nut internal space (cm ³)	Standard grease replenishment (cm ³)					
Bolt hole		Oil hole	Threaded length	Shaft end, right		Shaft end, left		Travel compensation	Deviation	Variation	Shaft straightness	Radial run-out									
W	X			Y	Z	Q	L_t					d_1					L_1	L_2	d_2	L_3	L_0
90	9	14	8.5	M6x1	500	32	60	300	26.4	100	850	-0.012	0.027	0.020	0.075	0.019	0.013	9.5	2 180	57	29
					700					100	1 050	-0.017	0.035	0.025	0.090			10.6			
					1 000					100	1 400	-0.024	0.040	0.027	0.120			12.5			
					1 400					120	1 870	-0.034	0.054	0.035	0.150			15.1			
					1 800					120	2 270	-0.043	0.065	0.040	0.200			17.2			
98	11	17.5	11	M6x1	700	36	60	350	30.4	100	1 100	-0.017	0.035	0.025	0.065	0.019	0.013	12.8	1 940	67	34
					1 200					120	1 670	-0.029	0.046	0.030	0.100			16.8			
					2 000					120	2 470	-0.048	0.065	0.040	0.130			22.3			



Nut: ZFT



View X-X

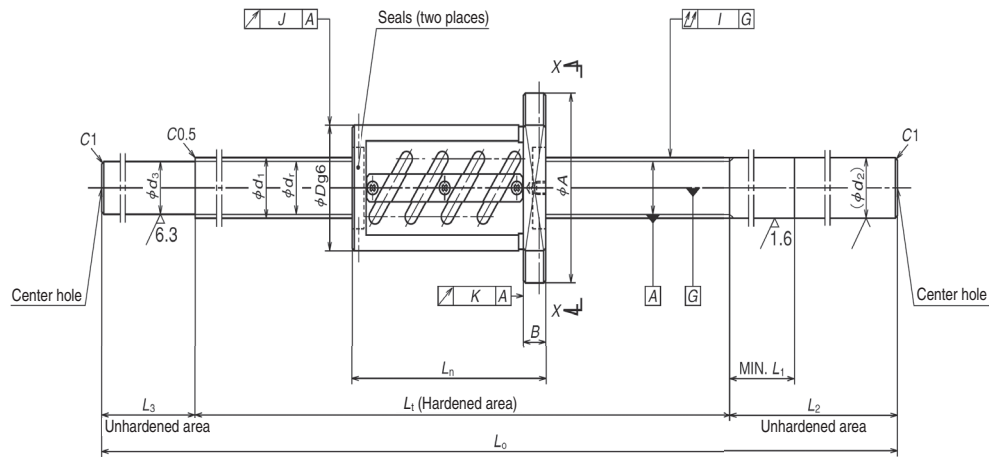
Reference No.	Stroke Max. L_3-L_n	Screw shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns \times Circuits	Basic load ratings (N)			Dynamic friction torque, median (N-cm)	Nut				
								Dynamic C_a	Static C_{oa}	Preload (N)		Flange				Overall length L_n
												Outside dia. D	A	G	B	
W4007SS-1Z-C5Z8	570	40	8	4.762	40.5	35.5	2.5x2	41 100	103 000	2 450	64	74	108	41	15	130
W4012SS-1Z-C5Z8	1 070															
W4018SS-1Z-C5Z8	1 670															
W4007SS-2Z-C5Z10	597	40	10	6.350	41	34.4	2.5x1	33 700	68 300	2 160	64	82	124	47	18	103
W4010SS-2Z-C5Z10	897															
W4014SS-1Z-C5Z10	1 297															
W4018SS-2Z-C5Z10	1 697	40	12	7.144	41.5	34.1	2.5x1	39 500	77 200	2 550	83	86	128	48	18	117
W4024SS-1Z-C5Z10	2 297															
W4010SS-4Z-C5Z12	883															
W4016SS-2Z-C5Z12	1 483	40	12	7.144	41.5	34.1	2.5x1	39 500	77 200	2 550	83	86	128	48	18	117
W4025SS-1Z-C5Z12	2 383															

- Notes: 1. We recommend using NSK support units. See Page B377 for details.
 2. Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use. See Page D13 for details.
 3. The permissible rotational speed is determined by the $d-n$ value, critical speed, and maximum rotational speed. See Pages B47 and B289 for details. The values shown for permissible rotational speed apply when the mounting configuration is Fixed-Fixed.

dimensions				Screw shaft dimensions					Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed (min ⁻¹)	Nut internal space (cm ³)	Standard grease replenishment (cm ³)			
Bolt hole		Oil hole		Threaded length	Shaft end, right		Shaft end, left		Overall length	Travel compensation	Deviation	Variation	Shaft straightness	Radial run-out							
W	X	Y	Z	Q	L_1	d_1	L_1	L_2	d_2	L_3	L_o	T	e_p	v_u					I	J	K
90	9	14	8.5	Rc1/8	700	40	50	350	35.5	100	1 100	-0.017	0.035	0.025	0.065	0.019	0.013	13.0	1 750	27	14
					1 200						1 650	-0.029	0.046	0.030	0.100			18.0			
					1 800						2 270	-0.043	0.065	0.040	0.130			23.5			
102	11	17.5	11	Rc1/8	700	40	60	350	34.4	120	1 100	-0.017	0.035	0.025	0.065	0.025	0.015	13.3	1 750	30	15
					1 000						1 400	-0.024	0.040	0.027	0.080			15.9			
					1 400						1 870	-0.034	0.054	0.035	0.100			20.0			
					1 800						2 270	-0.043	0.065	0.040	0.130			23.4			
					2 400						2 950	-0.058	0.077	0.046	0.170			29.4			
106	11	17.5	11	Rc1/8	1 000	40	70	350	34.1	150	1 400	-0.024	0.040	0.027	0.080	0.025	0.015	16.7	1 750	35	18
					1 600						2 100	-0.038	0.054	0.035	0.130			22.9			
					2 500						3 050	-0.060	0.077	0.046	0.170			31.1			

Blank Shaft End SS Model

(Fine lead: Tube Recirculation)



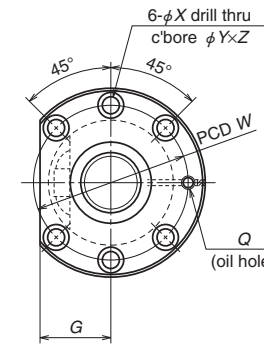
Nut: ZFT

Nut: ZFT

NSK

Screw shaft ø40

Lead 10, 12



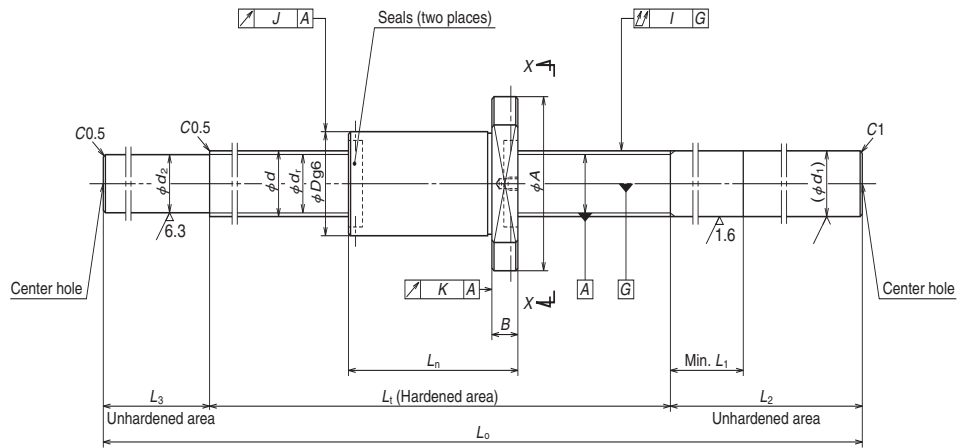
View X-X

Reference No.	Stroke Max. L_t-L_n	Screw shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns × Circuits	Basic load ratings (N)			Dynamic friction torque, median (N·cm)	Nut				
								Dynamic C_a	Static C_{0a}	Preload (N)		Flange				Overall length L_n
												Outside dia. D	A	G	B	
W4007SS-5Z-C5Z10	507	40	10	6.350	41	34.4	2.5×2	61 200	137 000	2 600	74	82	124	47	18	163
W4010SS-7Z-C5Z10	807															
W4014SS-4Z-C5Z10	1 207															
W4018SS-5Z-C5Z10	1 607															
W4024SS-4Z-C5Z10	2 207															
W4010SS-8Z-C5Z12	775	40	12	7.144	41.5	34.1	2.5×2	71 700	154 000	3 050	96	86	128	48	18	189
W4016SS-4Z-C5Z12	1 375															
W4025SS-3Z-C5Z12	2 275															

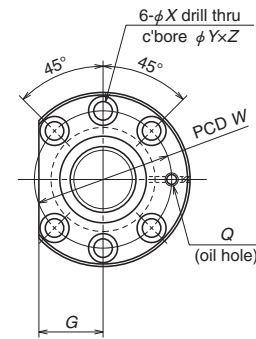
- Notes: 1. We recommend using NSK support units. See Page B389 for details.
 2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
 3. The permissible rotational speed is determined by the $d \cdot n$ value, critical speed, and maximum rotational speed. See Pages B47 and B299 for details. The values shown for permissible rotational speed apply when the mounting configuration is Fixed-Fixed.

Unit: mm

dimensions				Screw shaft dimensions					Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed (min ⁻¹)	Nut internal space (cm ³)	Standard grease replenishment (cm ³)					
Bolt hole				Threaded length L_t	Shaft end, right		Shaft end, left		Overall length L_o	Travel compensation T	Deviation e_p	Variation v_u	Shaft straightness I	Radial run-out									
W	X	Y	Z		L_1	L_2	d_2	L_3						J					K				
102	11	17.5	11	Rc1/8	700	40	60	300	34.4	100	1 100	-0.017	0.035	0.025	0.065	0.025	0.015	15.5	1 750	74	37		
					1 000			300		100	1 400	-0.024	0.040	0.027	0.080							18.1	
					1 400			350		120	1 870	-0.034	0.054	0.035	0.100							22.2	
					1 800			350		120	2 270	-0.043	0.065	0.040	0.130							25.6	
					2 400			400		150	2 950	-0.058	0.077	0.046	0.170							31.6	
106	11	17.5	11	Rc1/8	1 000	40	70	300	34.1	100	1 400	-0.024	0.040	0.027	0.080	0.025	0.015	19.7	1 750	93	47		
					1 600			350		150	2 100	-0.038	0.054	0.035	0.130							25.8	
					2 500			400		150	3 050	-0.060	0.077	0.046	0.170							34.0	1 260



Nut: ZFD

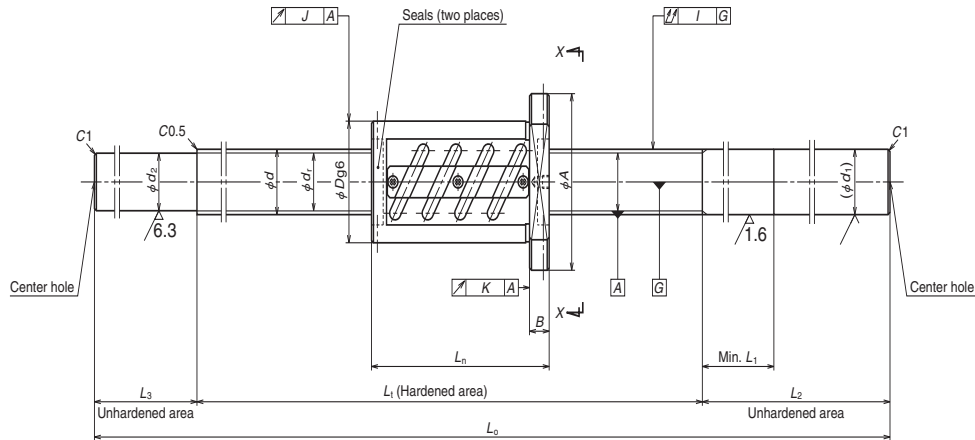


View X-X

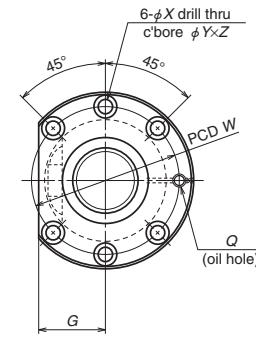
Reference No.	Stroke Max. L_r-L_n	Screw shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns	Basic load ratings (N)			Dynamic friction torque, median (N·cm)	Nut								
								Dynamic C_a	Static C_{0a}	Preload (N)		Flange			Overall length L_n					
												Outside dia. D	A	G		B	L_n			
W4007SS-4ZY-C5Z10	557																			
W4010SS-6ZY-C5Z10	857																			
W4014SS-3ZY-C5Z10	1 257	40	10	6.350	41.75	35.1	4	45 200	93 100	2 840	83	62	104	40	18	143				
W4018SS-4ZY-C5Z10	1 657																			
W4024SS-3ZY-C5Z10	2 257																			
W5007SS-1ZY-C5Z10	557																			
W5010SS-3ZY-C5Z10	857																			
W5015SS-3ZY-C5Z10	1 357	50	10	6.350	51.75	45.1	4	51 500	122 000	3 240	108	72	114	44	18	143				
W5020SS-3ZY-C5Z10	1 857																			
W5026SS-3ZY-C5Z10	2 457																			

- Notes: 1. We recommend using NSK support units. See Page B377 for details.
 2. Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use. See Page D13 for details.
 3. The permissible rotational speed is determined by the $d-n$ value, critical speed, and maximum rotational speed. See Pages B47 and B289 for details. The values shown for permissible rotational speed apply when the mounting configuration is Fixed-Fixed.

dimensions		Screw shaft dimensions					Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed (min ⁻¹)	Nut internal space (cm ³)	Standard grease replenishment (cm ³)					
Bolt hole		Oil hole	Threaded length	Shaft end, right		Shaft end, left		Travel compensation	Deviation e_p	Variation v_u	Shaft straightness I	Radial run-out									
W	X			Y	Z	Q	L_t					d_1					L_1	L_2	d_2	L_3	L_o
82	11	17.5	11	Rc1/8	700			300	100	1 100	-0.015	0.035	0.025	0.065	0.019	0.013	12.1	1 750	32	16	
					1 000			300	100	1 400	-0.022	0.040	0.027	0.080			14.7				
					1 400	40	60	350	35.1	120	1 870	-0.032	0.054	0.035			0.100				18.9
					1 800			350	120	2 270	-0.041	0.065	0.040	0.130			22.5				
92	11	17.5	11	Rc1/8	2 400			400	150	2 950	-0.056	0.077	0.046	0.170	0.019	0.013	28.5	1 320	39	20	
					700			300	100	1 100	-0.015	0.035	0.025	0.065			18.3				
					1 000			300	100	1 400	-0.022	0.040	0.027	0.080			22.5				
					1 500	50	60	400	45.1	150	2 050	-0.034	0.054	0.035			0.130				31.8
92	11	17.5	11	Rc1/8	2 000			400	150	2 550	-0.046	0.065	0.040	0.170	0.019	0.013	38.9	1 400	39	20	
					2 600			500	200	3 300	-0.060	0.093	0.054	0.220			49.5				



Nut: ZFT



View X-X

Reference No.	Stroke Max. $L-L_n$	Screw shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns \times Circuits	Basic load ratings (N)			Dynamic friction torque, median (N-cm)	Nut				
								Dynamic C_a	Static C_{oa}	Preload (N)		Flange				Overall length L_n
												Outside dia. D	A	G	B	
W4510SS-1Z-C5Z10	897	45	10	6.350	46	39.4	2.5x1	36 300	78 500	2 260	69	88	132	50	18	103
W4516SS-1Z-C5Z10	1 497															
W4525SS-1Z-C5Z10	2 397															
W5010SS-1Z-C5Z10	897	50	10	6.350	51	44.4	2.5x1	37 500	87 200	2 450	78	93	135	51	18	103
W5015SS-1Z-C5Z10	1 397															
W5020SS-1Z-C5Z10	1 897															
W5026SS-1Z-C5Z10	2 497															
W5010SS-2Z-C5Z10	837															
W5015SS-2Z-C5Z10	1 337	50	10	6.350	51	44.4	2.5x2	68 100	174 000	4 020	138	93	135	51	18	163
W5020SS-2Z-C5Z10	1 837															
W5026SS-2Z-C5Z10	2 437															

- Notes: 1. We recommend using NSK support units. See Page B377 for details.
 2. Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use. See Page D13 for details.
 3. The permissible rotational speed is determined by the $d \cdot n$ value, critical speed, and maximum rotational speed. See Pages B47 and B289 for details. The values shown for permissible rotational speed apply when the mounting configuration is Fixed-Fixed.

dimensions					Screw shaft dimensions					Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed (min ⁻¹)	Nut internal space (cm ³)	Standard grease replenishment (cm ³)		
Bolt hole				Oil hole	Threaded length	Shaft end, right		Shaft end, left		Overall length	Travel compensation	Deviation	Variation	Shaft straightness	Radial run-out						
W	X	Y	Z	Q	L_t	d_1	L_1	L_2	d_2	L_3	L_o	T	e_p	v_u	I					J	K
110	11	17.5	11	Rc1/8	1 000	45	60	300	39.4	100	1 400	-0.024	0.040	0.027	0.080	0.025	0.015	19.7	1 550	34	17
					1 600			150		2 150	-0.038	0.054	0.035	0.130	28.1						
					2 500			150		3 100	-0.060	0.077	0.046	0.170	38.8						
113	11	17.5	11	Rc1/8	1 000	50	60	300	44.4	100	1 400	-0.024	0.040	0.027	0.080	0.025	0.015	23.8	1 400	37	19
					1 500			150		2 050	-0.036	0.054	0.035	0.130	32.9						
					2 000			150		2 550	-0.048	0.065	0.040	0.170	39.8						
					2 600			150		3 200	-0.062	0.093	0.054	0.220	48.9						
113	11	17.5	11	Rc1/8	1 000	50	60	300	44.4	100	1 400	-0.024	0.040	0.027	0.080	0.025	0.015	25.5	1 400	59	30
					1 500			150		2 050	-0.036	0.054	0.035	0.130	34.6						
					2 000			150		2 550	-0.048	0.065	0.040	0.170	41.5						
					2 600			150		3 200	-0.062	0.093	0.054	0.220	50.7						

Unit: mm

B-3-1.6 Ball Screws for Transfer Equipment

1. Features

● Transporting mechanism

Models with accuracy grades of Ct7 and Ct10 demonstrate high performance for transport mechanisms in Cartesian robots and single-axis actuators.

We offer a variety of models of ball screws for transfer equipment. VFA and RMA models have finished shaft ends, while RMS and R models with RNFTL, RNFBL, RNCT, RNFLC, and RNSTL ball nuts have blank shaft ends.

Table 1 Classifications of ball screws for transfer equipment

Finished shaft end	VFA model, RMA model
	RMS model
Blank shaft end	R Model
	Nut Assemblies: RNFTL, RNFBL, RNCTL, RNFLC, RNSTL

● Interchangeable screw shaft and ball nut

Screw shaft and nut assembly components are sold separately. The maximum axial play after assembly is shown in the dimension tables.

2. Specifications

(1) Ball recirculation system

Figs. 1, 2, and 3 show the structures of tube, deflector (bridge), and end cap ball recirculation systems.

Deflector (bridge) recirculation systems feature compact nut outside diameters for small leads. End cap recirculation systems suit screws with high helix leads and multiple start threads. Since the leads are up to 3 times larger than the screw shaft diameter, they are well-suited for high speeds.

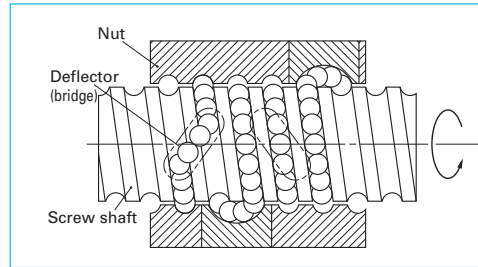


Fig. 2 Structure of deflector (bridge) recirculation system

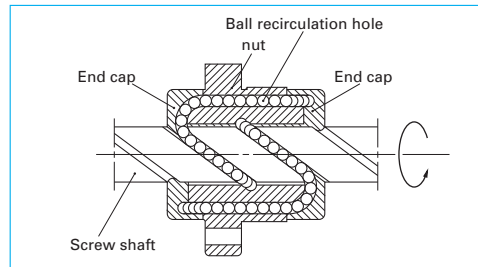


Fig. 3 Structure of end cap recirculation system

(2) Accuracy grade and axial play

Standard lead accuracy and axial play are shown on Table 2. Axial play varies with internal specification. Refer to the dimension tables.

Table 2 Accuracy grade and axial play

Accuracy grade	VFA model, RMA model, RMS model: Ct7 R Model: Ct10
Axial play	See dimension tables

(3) Allowable *d·n* value and the criterion of maximum rotational speed

The allowable *d·n* value and criterion of maximum rotational speed are shown below. Please consult NSK if the rotational speed exceeds the permissible range below.

Table 3 Allowable *d·n* value and the criterion of maximum rotational speed

Allowable <i>d·n</i> value	50 000 or less
Criterion of maximum rotational speed	3 000 min ⁻¹

d·n value: shaft dia. *d* [mm] × rotational speed *n* [min⁻¹]

Note: Please also review the critical speed. See "Technical Description: Permissible Rotational Speed" (page B47) for details.

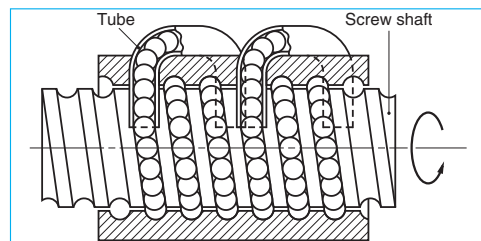


Fig. 1 Structure of tube recirculation system

3. Lineup

Ball screws for transfer equipment are available in the following models:

Table 4 Lineup of ball screws for transfer equipment

Nut	Shape	Flange shape	Recirculation system	Preload	Page
VFA		Flanged rectangular	Tube	No preload Slight axial play	B341 - B346
RMA RMS		Flanged Circular III	Deflector (bridge)	No preload Slight axial play	B347 - B360
RNFTL		Flanged Circular I Projecting tube type	Tube	No preload Slight axial play	B361 - B366
RNFBL		Flanged Circular II	Tube	No preload Slight axial play	B367 - B368
RNCT		V-thread (no flange) Projecting tube type	Tube	No preload Slight axial play	B369 - B370
RNFLC		Flanged Circular III	End cap	No preload Slight axial play	B371 - B374
RNSTL		Square type	Tube	No preload Slight axial play	B375 - B376

4. Structure of reference number

Ball screws for transfer equipment have the following reference number structures:

◇Reference number for VFA, RMA, and RMS models

VFA 15 10 - C7 S - 500

Ball screw for transfer equipment:
VFA, RMA, RMS

Screw shaft diameter (mm)

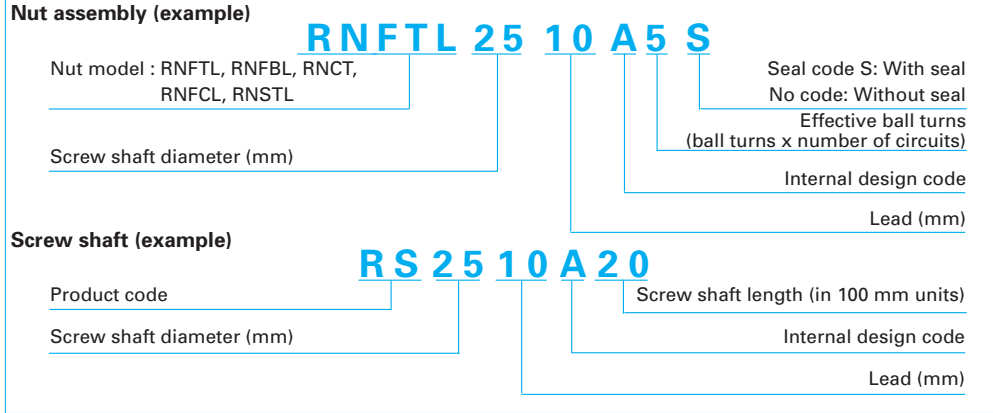
Lead (mm)

Screw shaft length (mm)

Axial play

Accuracy grade code

◇ Reference number for R model



5. Combinations of shaft diameter and lead

Combinations of shaft diameter and lead are shown below.
For details on standard stock products, contact NSK.

Table 5 Combinations of shaft diameter and lead for VFA, RMA, and RMS models

Lead	1	1.5	2	10	20
Screw shaft diameter					
6	B347, 359				
8	B349, 359	B351, 359	B353, 359		
10			B355, 359		
12			B357, 359	B341	
15				B343	B345

Table 6 Combinations of shaft diameter and lead for R model

Screw shaft diameter (mm)	Lead (mm)														
	3	4	5	6	8	10	12	16	20	25	32	40	50	64	80
10	○B361 △B369			○B361 ●B367											
12					○B361 ●B367		○B365 ○B371								
14	○B361 ●B367 △B369 □B375	○B361 ●B367 △B369 □B375													
15									○B371						
16						○B361		○B365 ○B371		○B373					
18					○B361 ●B367 △B369 □B375										
20			○B361 ●B367 △B369 □B375			○B361 ●B367 △B369 □B375			○B365 ○B371		○B373				
25			○B361 ●B367 △B369 □B375			○B361 ●B367 △B369 □B375			○B365 ○B371			○B373			
28				○B363 ●B367 △B369 □B375											
32						○B363 ●B367 △B369 □B375				○B365 ○B371		○B373			
36						○B363 ●B367 △B369 □B375									
40						○B363 ●B367 △B369 □B375						○B365 ○B371			○B373
45															
50								○B363 △B369	○B363 △B369						○B371

○: RNFTL ●: RNFB △: RNCT ◎: RNFL □: RNSTL

6. Precautions for design

Please reference the general precautions on Pages B83 and B103.

(1) Nut assembly

The nut assemblies and screw shafts of R models are separate when delivered. The nut assembly comes on an arbor and must be moved onto the screw shaft during mounting.

(a) Consideration to end configuration of screw shaft

The balls may fall out from the nut when moving the assembly from the arbor to the screw shaft if dimensions or shapes are not appropriate. If the end of the ball groove can touch the end of the arbor, connect both ends and move the assembled nut from the arbor to the screw shaft (Fig. 4). If not, wrap tape around the outside of the ball screw shaft so that tape's thickness matches the outside diameter of the arbor (Fig. 5). If there are gaps or nicks along the groove, fill these before moving the nut.

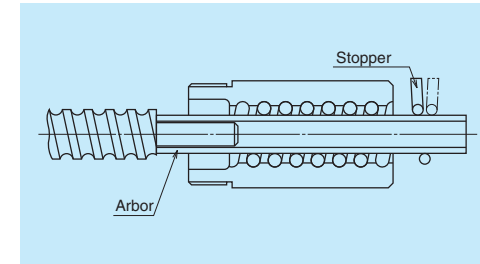


Fig. 4 Inserting nut into screwshaft

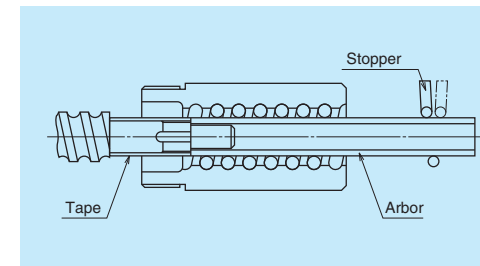


Fig. 5 Arbor and shaft end configuration

(b) Installation of arbor

Confirm the correct nut orientation for installation. Remove the stop ring on the side from where the assembled nut is to be removed. Align the centers of the screw shaft and the arbor while pressing the

screw shaft end firmly against the arbor.

(c) Moving the nut

Slide the nut until it lightly touches the ball groove shoulder. With the arbor pressed against the shaft, turn the nut counter to the thread so that it moves onto the screw. Do not separate the arbor from the screw shaft until the ball groove end is completely visible.

(2) Shaft end processing

RMS and R models have blank shaft ends that must be machined. See page B27 for details on shaft end configurations for NSK support units.

(a) Cutting screw shafts

Carry out the same process as that used for machining blank shaft ends for precision ball screws.

(b) Shaft end annealing

Heat the shaft end with an acetylene torch or similar and gradually cool it at room temperature. Note that non-machined areas will lose hardness if heated, which could impact the life of the ball screw. Use water cooling or other means to prevent heat conduction in these areas.

(c) Turning by lathe

Cut to length, process steps, perform triangular threading, and provide the center hole. Refer to JIS B 1192 which specifies shape accuracies.

(d) Processing by grinding

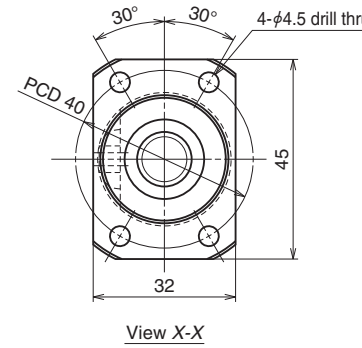
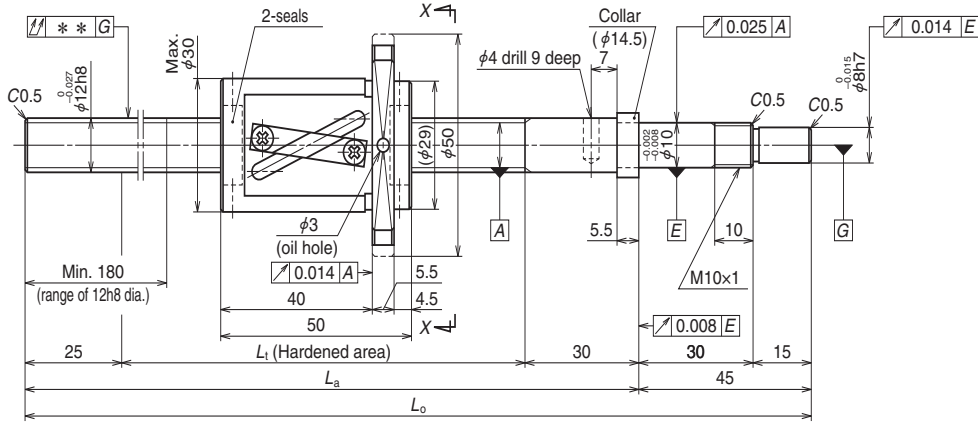
The precautions for centering, securing the nut, and providing a steady rest, etc. are the same as those for cutting. Grind the sections where bearings or Spann rings will be installed.

(e) Milling processing

Process keyways and tooth seats for lock washers.

(f) Deburring, washing, and rust prevention

Wash with clean white kerosene after processing is finished. Apply lubricant if the screw will be used immediately; otherwise apply a rust preventive agent. Contact NSK if the nut is accidentally removed from the shaft.



Ball screw specifications		
Shaft dia. x Lead / Direction of turn	12 x 10 / Right	
Ball recirculation	Tube	
Ball dia. / Ball circle dia.	2.381 / 12.5	
Screw shaft root dia.	10.0	
Effective ball turns	2.5 x 1	
Accuracy grade / Axial play code	Ct7 / S	
Basic load ratings (N)	Dynamic C_a	4 430
	Static C_{0a}	6 430
Axial play	0.010 or less	
Dynamic friction torque (N-cm)	1.5 or less	
Spacer ball	None	
Factory-packed grease	NSK grease LR3	
Nut internal space (cm ³)	1.4	
Reference standard grease replenishment	0.7	

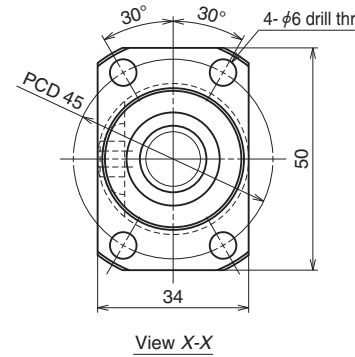
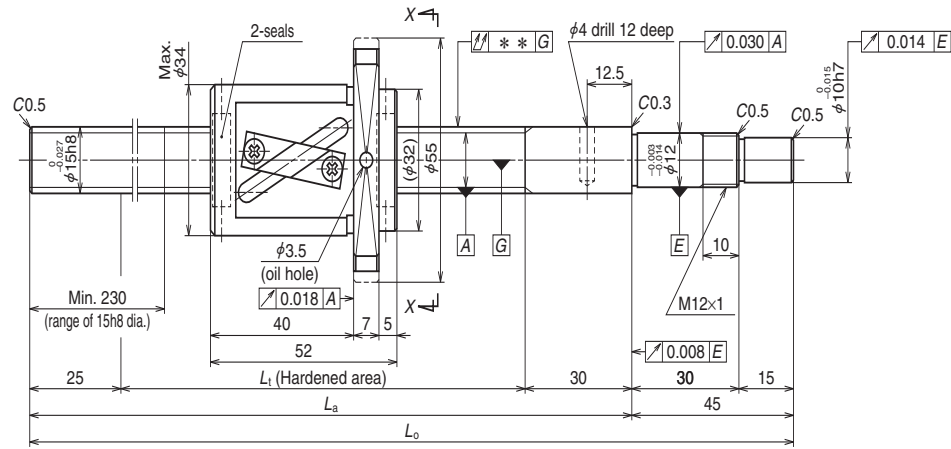
Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK10-01A (square)	WBK12SF-01 (square)
WBK10-11 (round)	

Reference 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

Lead accuracy			Shaft run-out**	Mass (kg)	Permissible rotational speed N (min ⁻¹)	
T	e_p	v_{300}			Configuration	
					Fixed - Simple	Fixed - Free
0	0.085	0.052	0.100	0.56	3 000	3 000
0	0.155	0.052	0.160	0.73	3 000	1 300

- Notes: 1. We recommend using NSK support units. See Page B377 for details. WBK12SF-01 units (on the simple support side) support the ball screw directly on the shaft outside diameter.
 2. We recommend using NSK Grease LR3 filled to about 50% of the ball nut's internal space. See Page D16 for details.
 3. Permissible rotational speed is determined by the $d \cdot n$ value and critical speed. See Pages B47 and B337 for details.



Ball screw specifications		
Shaft dia.xLead / Direction of turn	15 × 10 / Right	
Ball recirculation	Tube	
Ball dia. / Ball circle dia.	3.175 / 15.5	
Screw shaft root dia.	12.2	
Effective ball turns	2.5 × 1	
Accuracy grade / Axial play code	Ct7 / S	
Basic load ratings (N)	Dynamic C_a	8 140
	Static C_{0a}	12 800
Axial play	0.010 or less	
Dynamic friction torque (N-cm)	2.5 or less	
Spacer ball	None	
Factory-packed grease	NSK grease LR3	
Nut internal space (cm ³)	2.3	
Reference standard grease replenishment	1.2	

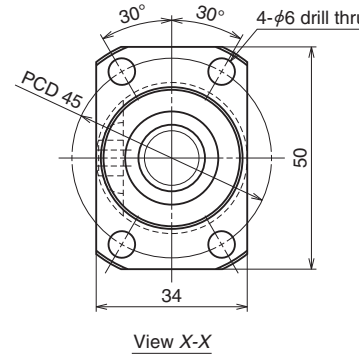
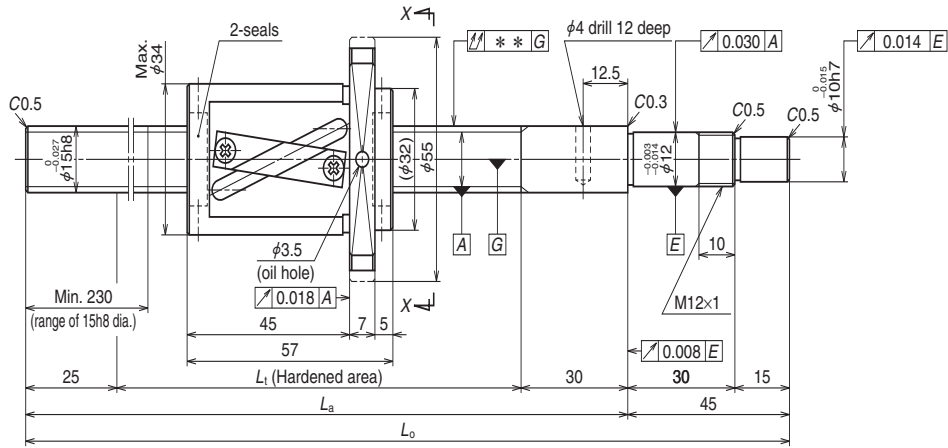
Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK12-01A (square)	WBK15SF-01 (square)
WBK12-11 (round)	

Reference No.	Stroke		Screw shaft length		
	Nominal	Maximum (L_r -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	1 000

- Notes: 1. We recommend using NSK support units. See Page B377 for details. WBK12SF-01 units (on the simple support side) support the ball screw directly on the shaft outside diameter.
 2. We recommend using NSK Grease LR3 filled to about 50% of the ball nut's internal space. See Page D16 for details.
 3. Permissible rotational speed is determined by the $d \cdot n$ value and critical speed. See Pages B47 and B337 for details.

Lead accuracy			Shaft run-out**	Mass (kg)	Permissible rotational speed N (min ⁻¹)	
T	e_p	v_{300}			Configuration	
					Fixed - Simple	Fixed - Free
0	0.120	0.052	0.075	0.89	3 000	2 600
0	0.195	0.052	0.110	1.1	3 000	1 150
0	0.310	0.052	0.180	1.5	2 340	510



Ball screw specifications		
Shaft dia. x Lead / Direction of turn	15 × 20 / Right	
Ball recirculation	Tube	
Ball dia. / Ball circle dia.	3.175 / 15.5	
Screw shaft root dia.	12.2	
Effective ball turns	1.5 × 1	
Accuracy grade / Axial play code	Ct7 / S	
Basic load ratings (N)	Dynamic C_a	5 080
	Static C_{0a}	7 460
Axial play	0.010 or less	
Dynamic friction torque (N-cm)	2.5 or less	
Spacer ball	None	
Factory-packed grease	NSK grease LR3	
Nut internal space (cm ³)	2.3	
Reference standard grease replenishment	1.4	

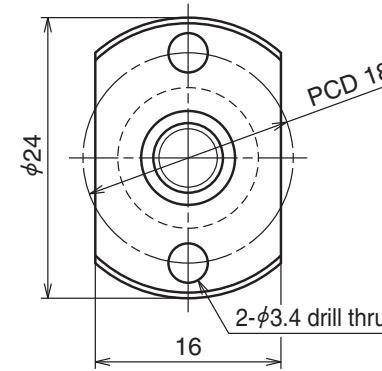
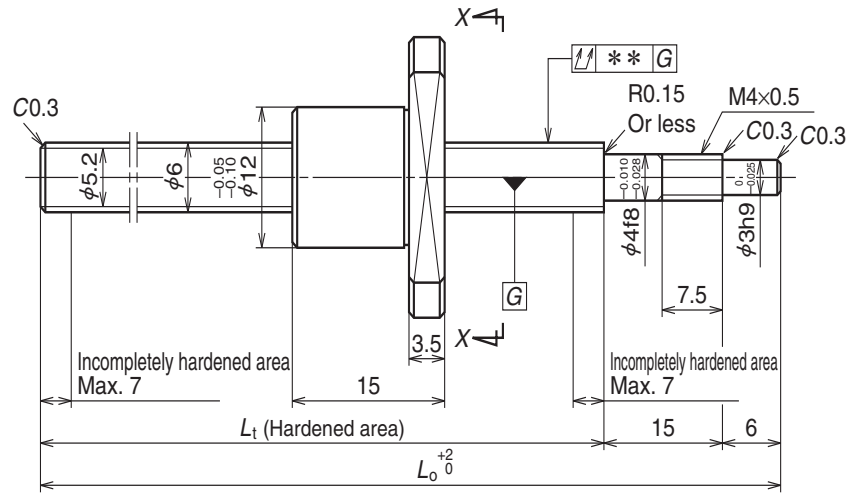
Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK12-01A (square)	WBK15SF-01 (square)
WBK12-11 (round)	

Reference No.	Stroke		Screw shaft length		
	Nominal	Maximum (L_r -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	1 000

- Notes: 1. We recommend using NSK support units. See Page B377 for details. WBK12SF-01 units (on the simple support side) support the ball screw directly on the shaft outside diameter.
 2. We recommend using NSK Grease LR3 filled to about 50% of the ball nut's internal space. See Page D16 for details.
 3. Permissible rotational speed is determined by the $d \cdot n$ value and critical speed. See Pages B47 and B337 for details.

Lead accuracy			Shaft run-out**	Mass (kg)	Permissible rotational speed N (min ⁻¹)	
T	e_p	v_{300}			Configuration	
					Fixed - Simple	Fixed - Free
0	0.120	0.052	0.075	0.94	3 000	2 630
0	0.195	0.052	0.110	1.2	3 000	1 160
0	0.310	0.052	0.180	1.6	2 350	510



View X-X

Ball screw specifications

Shaft dia.xLead / Direction of turn	6 × 1 / Right	
Ball recirculation	Deflector (bridge)	
Ball dia. / Ball circle dia.	0.800 / 6.2	
Screw shaft root dia.	5.2	
Effective ball turns	1 × 3	
Accuracy grade / Axial play code	Ct7 / S	
Basic load ratings (N)	Dynamic C_a	610
	Static C_{0a}	920
Axial play	0.020 or less	
Dynamic friction torque (N-cm)	1.0 or less	
Spacer ball	None	
Factory-packed grease	See Note 2.	

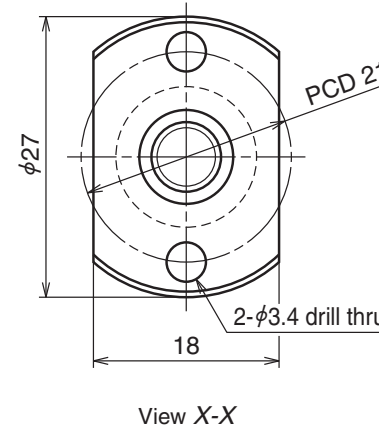
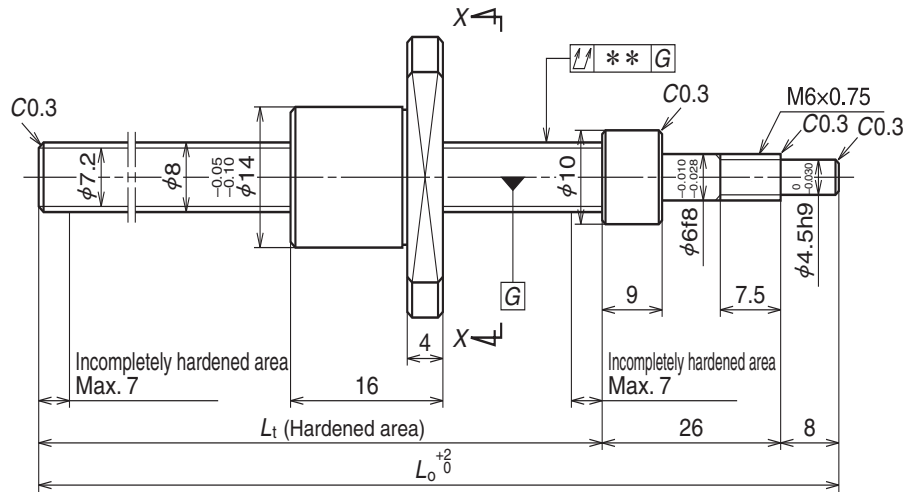
Recommended support unit

For drive side (Fixed)	
WBK04R-11 (round)	

Reference No.	Stroke		Screw shaft length	
	Nominal	Maximum (L_t -Nut length)	L_t	L_o
RMA0601C7S-160	100	124	139	160
RMA0601C7S-260	200	224	239	260

Lead accuracy			Shaft run-out**	Mass (kg)	Permissible rotational speed N (min^{-1})
Target compensation T	Deviation e_p	Variation v_{300}			
0	0.052	0.052	0.060	0.045	3 000
0	0.085	0.052	0.090	0.065	3 000

- Notes: 1. We recommend using NSK support kits. See Page B389 for details.
 2. Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use. See Page D13 for details.
 3. The permissible rotational speed is determined by the $d \cdot n$ value and critical speed. See Pages B47 and B337 for details.



Ball screw specifications		
Shaft dia.xLead / Direction of turn	8 × 1 / Right	
Ball recirculation	Deflector (bridge)	
Ball dia. / Ball circle dia.	0.800 / 8.2	
Screw shaft root dia.	7.2	
Effective ball turns	1 × 3	
Accuracy grade / Axial play code	Ct7 / S	
Basic load ratings (N)	Dynamic C_a	710
	Static C_{0a}	1 290
Axial play	0.020 or less	
Dynamic friction torque (N-cm)	1.0 or less	
Spacer ball	None	
Factory-packed grease	See Note 2.	

Recommended support unit

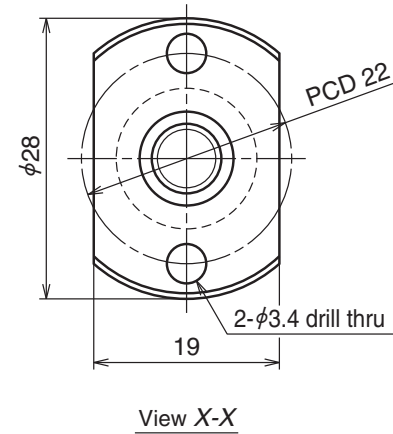
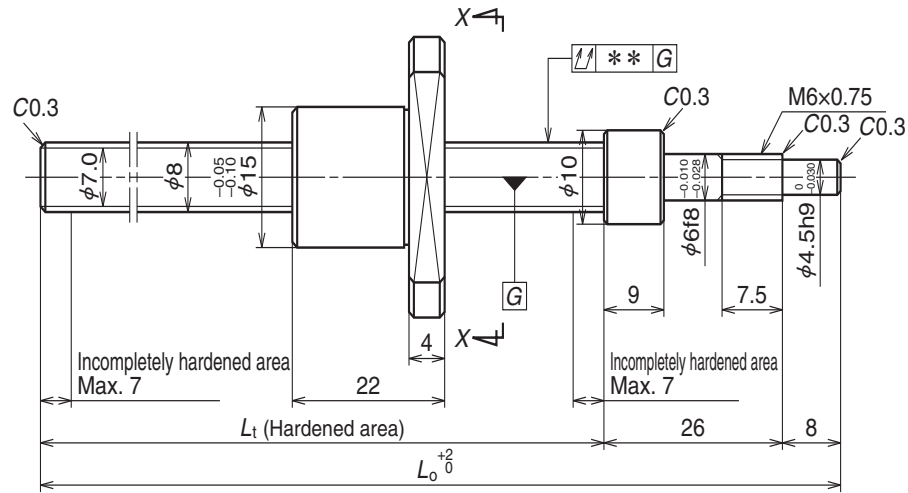
For drive side (Fixed)	
WBK06R-11 (round)	

Reference 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

Unit: mm

Lead accuracy			Shaft run-out**	Mass (kg)	Permissible rotational speed N (min ⁻¹)
Target compensation T	Deviation e_p	Variation v_{300}			
0	0.052	0.052	0.060	0.085	3 000
0	0.085	0.052	0.090	0.12	3 000

- Notes: 1. We recommend using NSK support kits. See Page B389 for details.
 2. Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use. See Page D13 for details.
 3. The permissible rotational speed is determined by the $d \cdot n$ value and critical speed. See Pages B47 and B337 for details.



Ball screw specifications		
Shaft dia.xLead / Direction of turn	8 × 1.5 / Right	
Ball recirculation	Deflector (bridge)	
Ball dia. / Ball circle dia.	1.000 / 8.3	
Screw shaft root dia.	7.0	
Effective ball turns	1 × 3	
Accuracy grade / Axial play code	Ct7 / S	
Basic load ratings (N)	Dynamic C_a	955
	Static C_{0a}	1 580
Axial play	0.020 or less	
Dynamic friction torque (N-cm)	1.0 or less	
Spacer ball	None	
Factory-packed grease	See Note 2.	

Recommended support unit

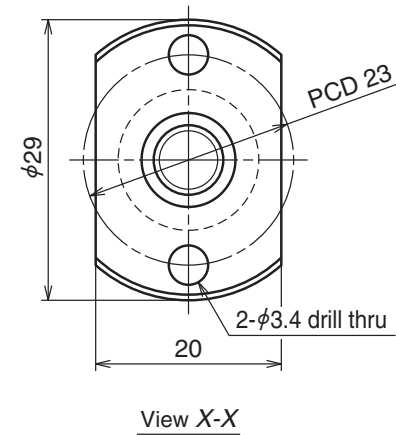
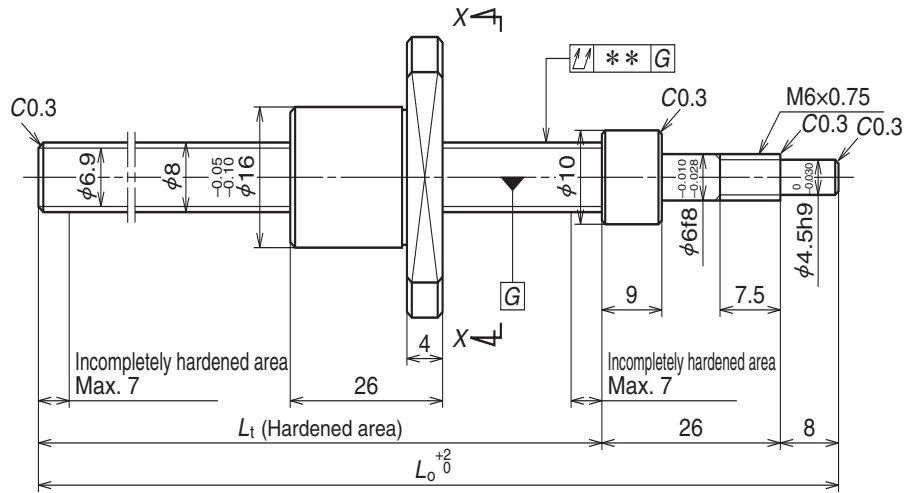
For drive side (Fixed)	
WBK06R-11 (round)	

Reference 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

Unit: mm

Lead accuracy			Shaft run-out**	Mass (kg)	Permissible rotational speed N (min^{-1})
Target compensation T	Deviation e_p	Variation v_{300}			
0	0.052	0.052	0.060	0.093	3 000
0	0.085	0.052	0.090	0.13	3 000

- Notes: 1. We recommend using NSK support kits. See Page B389 for details.
 2. Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use. See Page D13 for details.
 3. The permissible rotational speed is determined by the $d \cdot n$ value and critical speed. See Pages B47 and B337 for details.



Ball screw specifications		
Shaft dia. x Lead / Direction of turn	8 x 2 / Right	
Ball recirculation	Deflector (bridge)	
Ball dia. / Ball circle dia.	1.200 / 8.3	
Screw shaft root dia.	6.9	
Effective ball turns	1 x 3	
Accuracy grade / Axial play code	Ct7 / S	
Basic load ratings (N)	Dynamic C_a	1 260
	Static C_{0a}	1 940
Axial play	0.020 or less	
Dynamic friction torque (N-cm)	1.0 or less	
Spacer ball	None	
Factory-packed grease	See Note 2.	

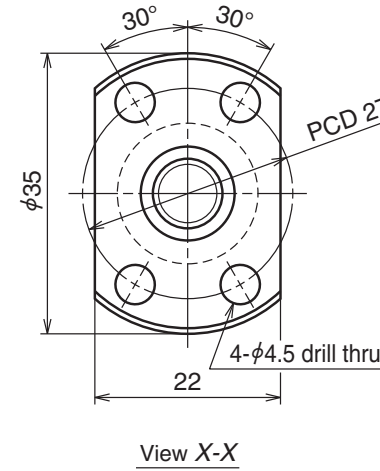
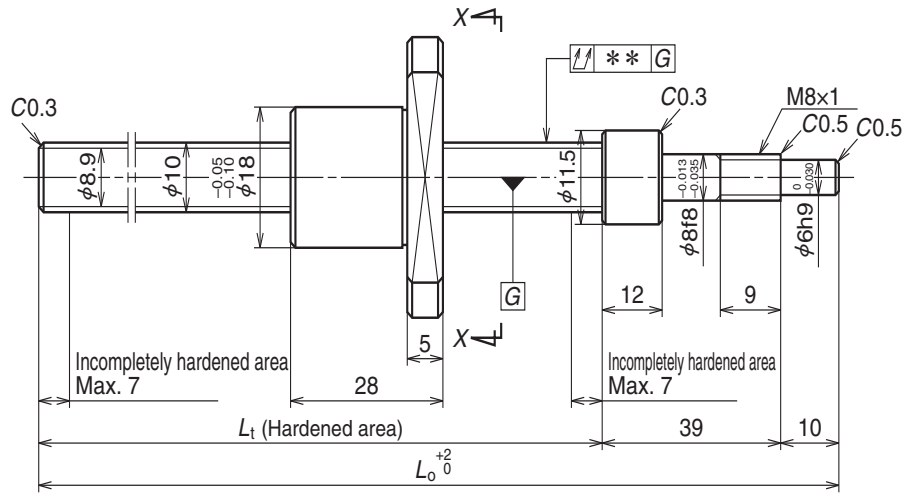
Recommended support unit

For drive side (Fixed)	
WBK06R-11 (round)	

Reference No.	Stroke		Screw shaft length	
	Nominal	Maximum (L_t -Nut length)	L_t	L_o
RMA0802C7S-180	100	120	146	180
RMA0802C7S-280	200	220	246	280

Lead accuracy			Shaft run-out**	Mass (kg)	Permissible rotational speed N (min^{-1})
Target compensation T	Deviation e_p	Variation v_{300}			
0	0.052	0.052	0.060	0.10	3 000
0	0.085	0.052	0.090	0.14	3 000

- Notes: 1. We recommend using NSK support kits. See Page B389 for details.
 2. Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use. See Page D13 for details.
 3. The permissible rotational speed is determined by the $d \cdot n$ value and critical speed. See Pages B47 and B337 for details.



Ball screw specifications		
Shaft dia.xLead / Direction of turn	10 × 2 / Right	
Ball recirculation	Deflector (bridge)	
Ball dia. / Ball circle dia.	1.200 / 10.3	
Screw shaft root dia.	8.9	
Effective ball turns	1 × 3	
Accuracy grade / Axial play code	Ct7 / S	
Basic load ratings (N)	Dynamic C_a	1 460
	Static C_{0a}	2 620
Axial play	0.020 or less	
Dynamic friction torque (N-cm)	1.0 or less	
Spacer ball	None	
Factory-packed grease	See Note 2.	

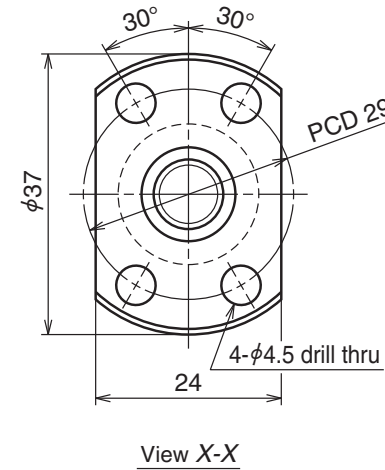
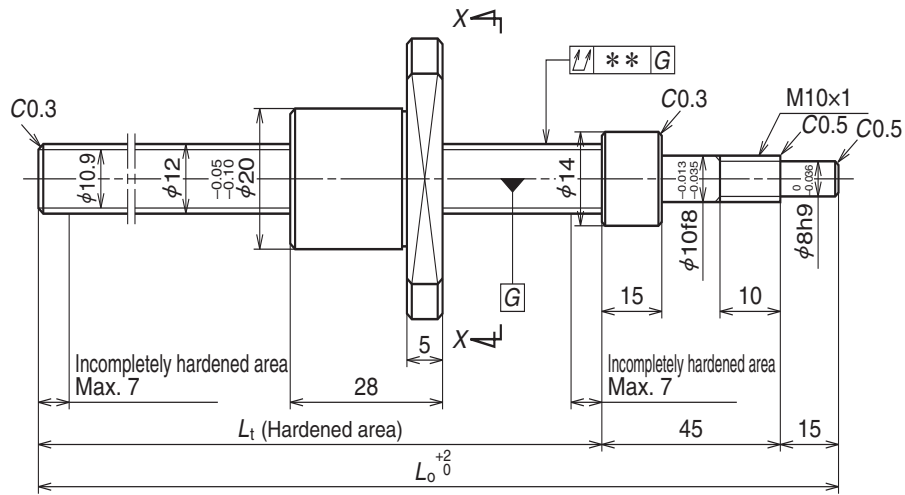
Recommended support unit

For drive side (Fixed)	
WBK08-01A (square)	
WBK08-11 (round)	

Reference 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

Lead accuracy			Shaft run-out**	Mass (kg)	Permissible rotational speed N (min ⁻¹)
Target compensation T	Deviation e_p	Variation v_{300}			
0	0.085	0.052	0.070	0.19	3 000
0	0.085	0.052	0.100	0.25	3 000

- Notes: 1. We recommend using NSK support units. See Page B377 for details.
 2. Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use. See Page D13 for details.
 3. The permissible rotational speed is determined by the $d \cdot n$ value and critical speed. See Pages B47 and B337 for details.



Ball screw specifications		
Shaft dia.xLead / Direction of turn	12 × 2 / Right	
Ball recirculation	Deflector (bridge)	
Ball dia. / Ball circle dia.	1.200 / 12.3	
Screw shaft root dia.	10.9	
Effective ball turns	1 × 3	
Accuracy grade / Axial play code	Ct7 / S	
Basic load ratings (N)	Dynamic C_a	1 590
	Static C_{0a}	3 190
Axial play	0.020 or less	
Dynamic friction torque (N-cm)	1.0 or less	
Spacer ball	None	
Factory-packed grease	See Note 2.	

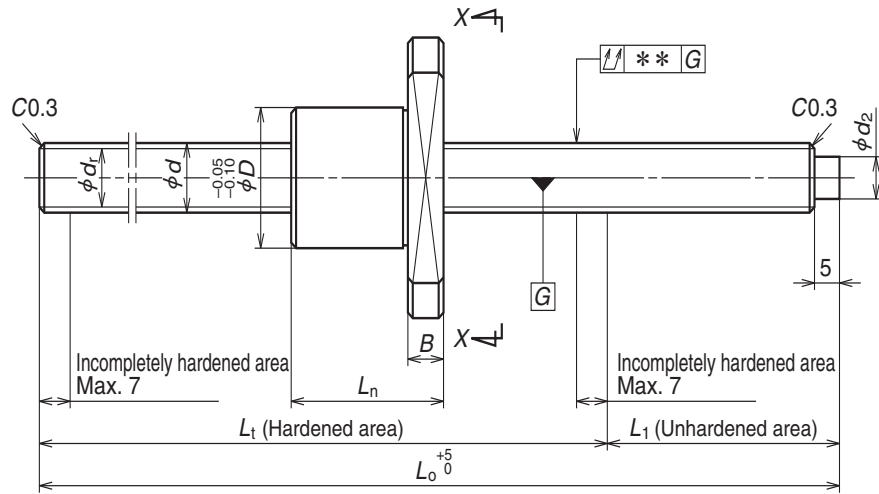
Recommended support unit

For drive side (Fixed)	
WBK10-01A (square)	
WBK10-11 (round)	

Reference 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

Lead accuracy			Shaft run-out**	Mass (kg)	Permissible rotational speed N (min^{-1})
Target compensation T	Deviation e_p	Variation v_{300}			
0	0.060	0.052	0.070	0.26	3 000
0	0.085	0.052	0.100	0.34	3 000

- Notes: 1. We recommend using NSK support units. See Page B377 for details.
 2. Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use. See Page D13 for details.
 3. The permissible rotational speed is determined by the $d \cdot n$ value and critical speed. See Pages B47 and B337 for details.



Screw shaft ø6

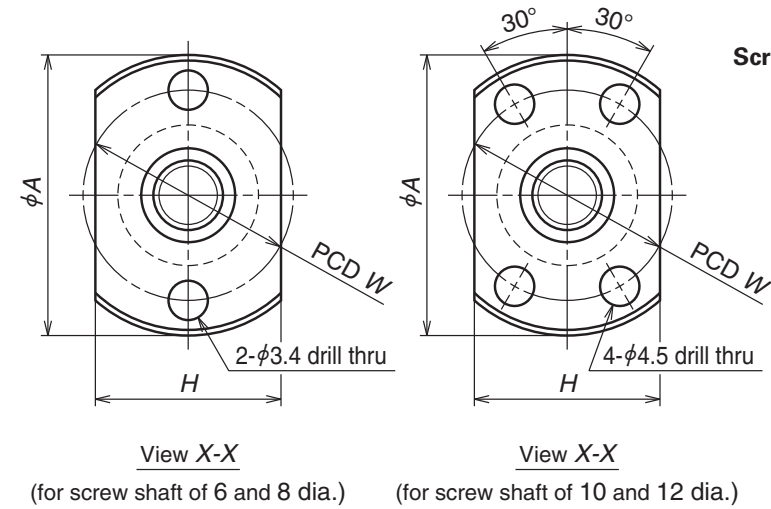
Lead 1

Screw shaft ø8

Lead 1, 1.5, 2

Screw shaft ø10, ø12

Lead 2

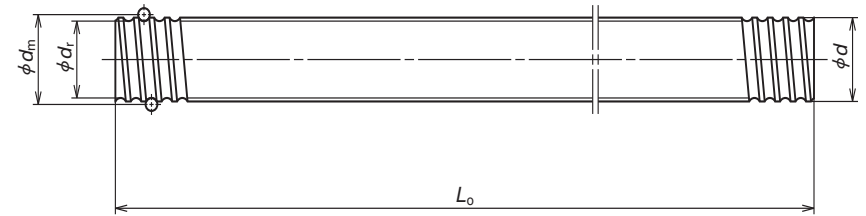
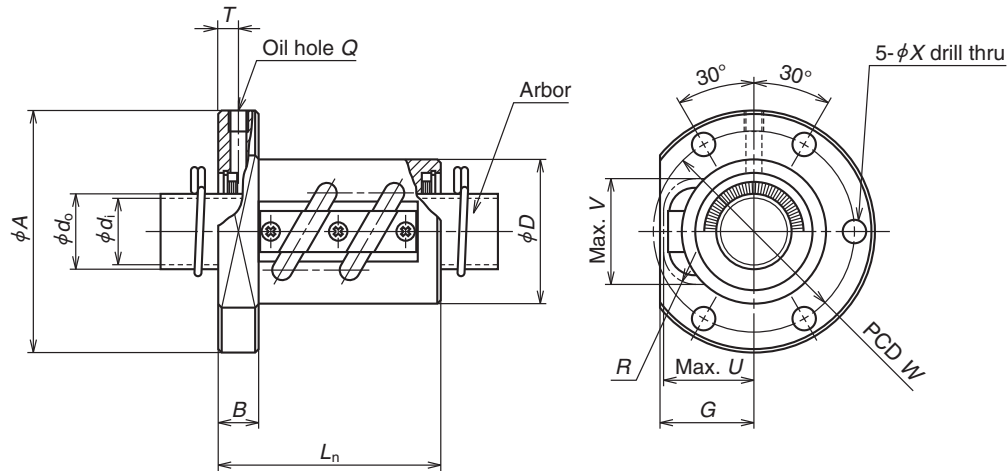


Unit: mm

Reference No.	Stroke Max. L_t-L_n	Shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ratings	Basic load ratings (N)		Axial play Max.
								Dynamic C_a	Static C_{0a}	
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	1 290	0.02
RMS0801.5C7S-300	228		1.5	1.000	8.3	7.2		955	1 580	
RMS0802C7S-300	224		2	1.200	8.3	7.0		1 260	1 940	
RMS1002C7S-350	262	10	2	1.200	10.3	9.0	3	1 460	2 620	0.02
RMS1202C7S-350	262	12	2	1.200	12.3	11.0	3	1 590	3 190	0.02

Nut dimensions						Screw shaft dimensions				Lead accuracy			Shaft run-out**	Mass (Kg)	Permissible rotational speed N (min ⁻¹)
D	A	H	B	L_n	W	Effective thread length L_t	Shaft end L_1	d_2	Overall length L_o	Target compensation T	Deviation e_p	Variation v_{300}			
12	24	16	3.5	15	18	250	50	4	300	0	0.085	0.052	0.09	0.075	3 000
14	27	18	4	16	21	250	50	6	300	0	0.085	0.052	0.09	0.13	
15	28	19		22	22									0.14	
16	29	20		26	23									0.15	
18	35	22	5	28	27	290	60	8	350	0	0.085	0.052	0.10	0.25	
20	37	24	5	28	29	290	60	10	350	0	0.085	0.052	0.10	0.35	

- Notes: 1. We recommend using NSK support units (Page B377) or support kits (Page B389).
 2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
 3. Seals are not installed.
 4. The permissible rotational speed is determined by the $d \cdot n$ value and critical speed. See Pages B47 and B337 for details.



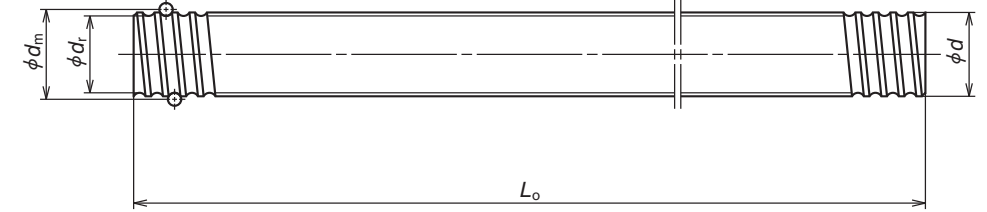
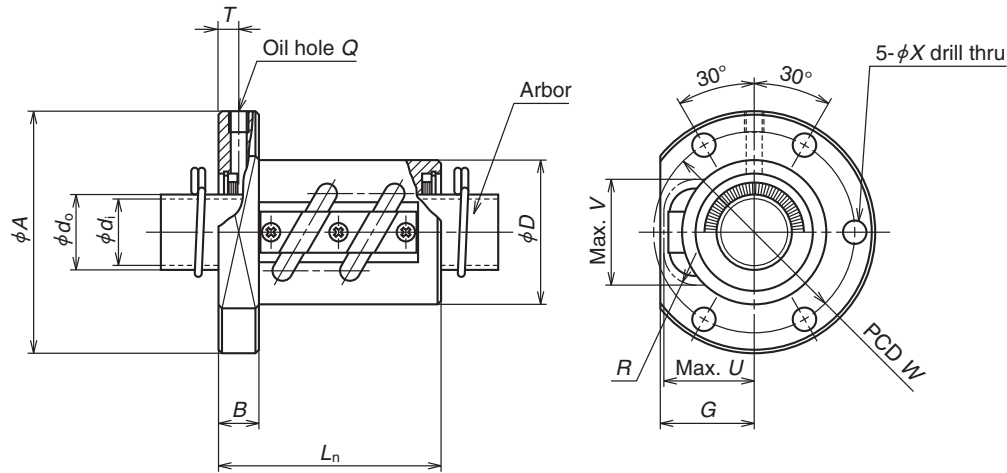
Nut Ref. No.	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D_b</i>	Ball circle dia. <i>d_m</i>	Root dia. <i>d_t</i>	Effective ball turns × Circuits	Basic load ratings (N)		Axial play Max.	Ball nut dimensions Outside dia. <i>D</i>
							Dynamic <i>C_a</i>	Static <i>C_{0a}</i>		
RNFTL 1003A3.5	10	3	2.381	10.65	8.1	3.5×1	4 440	6 700	0.10	20
RNFTL 1006A2.5S	10	6	2.381	10.65	8.1	2.5×1	3 280	4 730	0.10	20
RNFTL 1208A2.5S	12	8	2.778	12.65	9.6	2.5×1	4 290	6 610	0.10	25
RNFTL 1404A3.5S	14	4	2.778	14.5	11.5	3.5×1	6 310	10 800	0.10	25
RNFTL 1405A2.5S	14	5	3.175	14.5	11.0	2.5×1	6 170	9 940	0.10	30
RNFTL 1610A2.5	16	10	3.175	16.75	13.3	2.5×1	6 810	11 600	0.10	30
RNFTL 1610A2.5S	16	10	3.175	16.75	13.3	2.5×1	6 810	11 600	0.10	30
RNFTL 1808A3.5	18	8	4.762	18.5	13.6	3.5×1	15 500	26 200	0.15	34
RNFTL 1808A3.5S	18	8	4.762	18.5	13.6	3.5×1	15 500	26 200	0.15	34
RNFTL 2005A2.5	20	5	3.175	20.5	17.0	2.5×1	7 500	14 200	0.10	40
RNFTL 2005A2.5S	20	5	3.175	20.5	17.0	2.5×1	7 500	14 200	0.10	40
RNFTL 2010A2.5	20	10	4.762	21.25	16.2	2.5×1	12 700	21 600	0.15	40
RNFTL 2010A2.5S	20	10	4.762	21.25	16.2	2.5×1	12 700	21 600	0.15	40
RNFTL 2505A5	25	5	3.175	25.5	22.0	2.5×2	15 100	36 300	0.10	42
RNFTL 2505A5S	25	5	3.175	25.5	22.0	2.5×2	15 100	36 300	0.10	42
RNFTL 2510A2.5	25	10	6.35	26	19.0	2.5×1	20 500	34 900	0.20	44
RNFTL 2510A2.5S						2.5×1	20 500	34 900		44
RNFTL 2510A5						2.5×2	37 300	69 800		44
RNFTL 2510A5S						2.5×2	37 300	69 800		44

Unit: mm

Ball nut dimensions											Nut mass (kg)	Arbor		Screw shaft				Shaft mass per meter (kg)	Nut internal space (cm ³)	Standard grease replenishment (cm ³)
Flange		Length		Bolt hole		Oil hole		Projecting tube				Outside dia.	Bore	Standard length		Shaft Ref. No.				
A	G	B	L _n	W	X	Q	T	U	V	R		d _o	d	L _o	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	1 000	—	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	1 000	—	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	1 000	1 500	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	1 000	1 500	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	1 000	2 000	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	1 000	2 000	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	1 000	2 000	2 500	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	1 000	2 000	2 500	RS2510A··	13	6.5	
80	34	15	92	62	9	M6×1	7.5	34	37	17								18	9.0	

- Notes: 1. The protrusion of the tube will not cause interference if the mating section of the nut body has dimensions greater than U and V.
 2. Actual screw shaft length may become slightly longer than nominal length L₀ due to manufacturing tolerances.
 3. A Nut Ref. No. ending in "S" has seals. The external dimensions of these are identical to those without seals. The figure shows a seal above the center line and no seal below. Synthetic resin seals are used for shaft diameters of 14 mm or less and brush seals for shaft diameters of 16 mm or more.

4. The nut assembly is separate from the screw shaft and comes delivered on an arbor.
 5. The last digits (***) in the Shaft Ref. No. will show the value for screw shaft length in 100 mm units.
 6. Standard inventory products have not undergone surface treatments.
 7. Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.
 8. Values for nut internal space and standard grease replenishment are for ball screws with seals. The standard quantity for replenishment is about 50% of the nut's internal space. For ball screws without seals, apply grease to the screw shaft surface or move the nut by hand while filling to ensure that grease reaches all areas inside. See Page D16 for details.

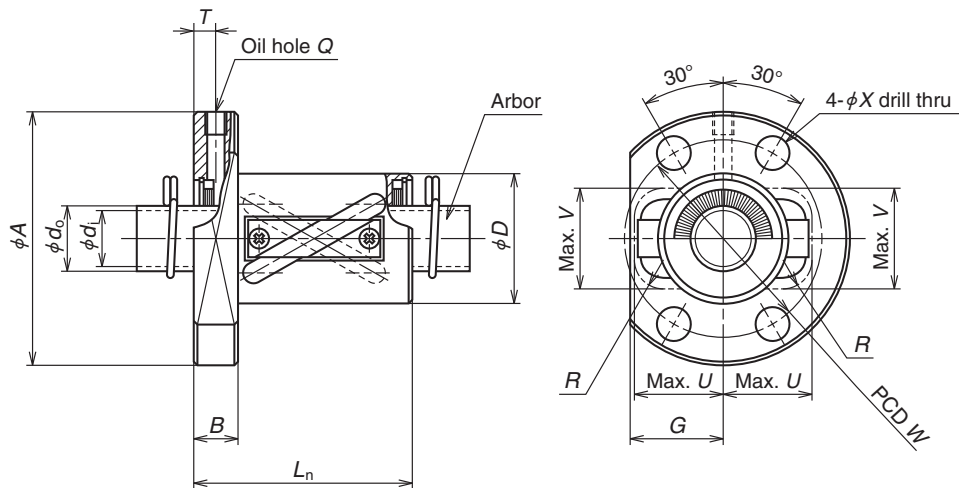


Nut Ref. No.	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D_b</i>	Ball circle dia. <i>d_m</i>	Root dia. <i>d_t</i>	Effective ball turns Turns × Circuits	Basic load ratings (N)		Axial play Max.	Ball nut dimensions Outside dia. <i>D</i>
							Dynamic <i>C_d</i>	Static <i>C_s</i>		
RNFTL 2806A2.5 RNFTL 2806A2.5S	28	6	3.175	28.5	25.0	2.5×1	8 760	20 200	0.10	50
RNFTL 2806A5 RNFTL 2806A5S										
RNFTL 3210A5 RNFTL 3210A5S	32	10	6.35	33.75	27.0	2.5×2	42 000	91 800	0.20	55
RNFTL 3610A2.5 RNFTL 3610A2.5S	36	10	6.35	37	30.0	2.5×1	24 700	50 800	0.20	60
RNFTL 3610A5 RNFTL 3610A5S										
RNFTL 4010A7 RNFTL 4010A7S	40	10	6.35	41.75	35.0	3.5×2	63 100	164 000	0.20	65
RNFTL 4512A5 RNFTL 4512A5S	45	12	7.144	46.5	39.0	2.5×2	58 500	147 000	0.23	70
RNFTL 5010A7 RNFTL 5010A7S	50	10	6.35	51.75	45.0	3.5×2	70 100	205 000	0.20	80
RNFTL 5016A5 RNFTL 5016A5S	50	16	9.525	52	42.0	2.5×2	117 000	299 000	0.23	85

- Notes: 1. The protrusion of the tube will not cause interference if the mating section of the nut body has dimensions greater than *U* and *V*.
 2. Actual screw shaft length may become slightly longer than nominal length *L₀* due to manufacturing tolerances.
 3. A Nut Ref. No. ending in "S" has seals. The external dimensions of these are identical to those without seals. The figure shows a seal above the center line and no seal below. Synthetic resin seals are used for shaft diameters of 14 mm or less and brush seals for shaft diameters of 16 mm or more.

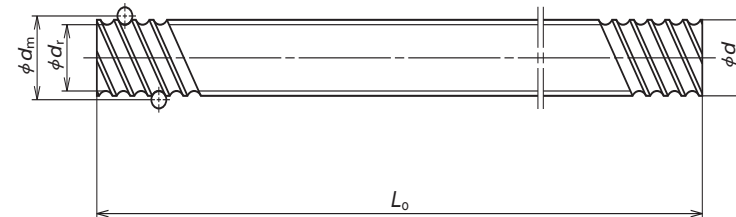
Ball nut dimensions											Nut mass (kg)	Arbor		Screw shaft			Shaft mass per meter (kg)	Nut internal space (cm ³)	Standard grease replenishment (cm ³)	
Flange		Length		Bolt hole		Oil hole		Projecting tube				Outside dia.	Bore	Standard length						Shaft Ref. No.
<i>A</i>	<i>G</i>	<i>B</i>	<i>L_n</i>	<i>W</i>	<i>X</i>	<i>Q</i>	<i>T</i>	<i>U</i>	<i>V</i>	<i>R</i>	<i>d₀</i>	<i>d</i>	<i>L₀</i>							
79	33	15	55	65	6.6	M6×1	7.5	33	34	10	0.85	25.0	22.6	1 000	2 000	2 500	RS2806A··	4.47	5.9	3.0
79	33	15	79	65	6.6	M6×1	7.5	33	34	10	1.07			8.4	4.2					
97	39	18	97	75	11	M6×1	9.0	39	42	17	1.55	27.0	24.6	1 000	2 000	3 000	RS3210A··	5.53	29	15
102	42	18	68	80	11	M6×1	9.0	42	46	17	1.47	30.0	27.6	1 000	2 000	3 000	RS3610A··	6.91	21	11
102	42	18	98	80	11	M6×1	9.0	42	46	17	1.80			33	17					
114	44	20	120	90	14	M6×1	10.0	44	50	20	2.49	35.0	31.8	2 000	3 000	4 000	RS4010A··	8.87	42	21
130	47	22	116	100	18	M6×1	11.0	47	55	20	3.07	39.0	35.8	2 000	3 000	4 000	RS4512A··	11.16	49	25
140	52	22	122	110	18	M6×1	11.0	52	59	20	4.06	45.0	41.8	2 000	3 000	4 000	RS5010A··	14.15	53	27
163	57	28	146	125	22	M6×1	14.0	57	63	25	6.42	42.0	38.8	2 000	3 000	4 000	RS5016A··	13.48	94	47

4. The nut assembly is separate from the screw shaft and comes delivered on an arbor.
 5. The last digits (***) in the Shaft Ref. No. will show the value for screw shaft length in 100 mm units.
 6. Standard inventory products have not undergone surface treatments.
 7. Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.
 8. Values for nut internal space and standard grease replenishment are for ball screws with seals. The standard quantity for replenishment is about 50% of the nut's internal space. For ball screws without seals, apply grease to the screw shaft surface or move the nut by hand while filling to ensure that grease reaches all areas inside. See Page D16 for details.



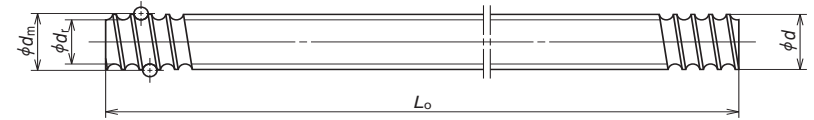
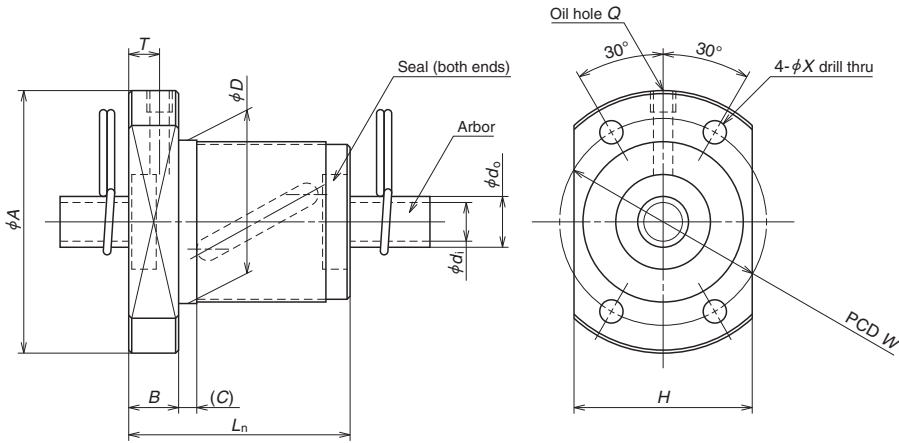
Nut Ref. No.	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D_w</i>	Ball circle dia. <i>d_m</i>	Root dia. <i>d_r</i>	Effective ball turns × Circuits	Basic load ratings (N)		Axial play Max.	Ball nut dimensions Outside dia. <i>D</i>
							Dynamic <i>C_a</i>	Static <i>C_{0a}</i>		
							RNFTL 1212A3	12		
RNFTL 1616A3 RNFTL 1616A3S	16	16	2.778	16.65	13.6	1.5 × 2	5 440	9 550	0.10	30
RNFTL 2020A3 RNFTL 2020A3S	20	20	3.175	20.75	17.3	1.5 × 2	8 080	15 700	0.10	35
RNFTL 2525A3 RNFTL 2525A3S	25	25	3.969	26	22.0	1.5 × 2	12 100	24 500	0.12	45
RNFTL 3232A3 RNFTL 3232A3S	32	32	4.762	33.25	28.0	1.5 × 2	17 600	37 700	0.15	55
RNFTL 4040A3 RNFTL 4040A3S	40	40	6.35	41.75	35.0	1.5 × 2	28 100	62 900	0.20	70

Notes: 1. The protrusion of the tube will not cause interference if the mating section of the nut body has dimensions greater than *U* and *V*.
 2. Actual screw shaft length may become slightly longer than nominal length *L₀* due to manufacturing tolerances.
 3. A Nut Ref. No. ending in "S" has seals. The external dimensions of these are identical to those without seals. The figure shows a seal above the center line and no seal below. Synthetic resin seals are used for shaft diameters of 14 mm or less and brush seals for shaft diameters of 16 mm or more.



Ball nut dimensions													Nut mass (kg)	Arbor		Screw shaft			Shaft mass per meter (kg)	Nut internal space (cm ³)	Standard grease replenishment (cm ³)
Flange		Length	Bolt hole	Oil hole	Projecting tube			Outside dia. <i>d₀</i>	Bore <i>d_i</i>	Standard length				Shaft Ref. No.							
<i>A</i>	<i>G</i>	<i>B</i>	<i>L_n</i>	<i>W</i>	<i>X</i>	<i>Q</i>	<i>T</i>			<i>U</i>	<i>V</i>	<i>R</i>			<i>L₀</i>						
44	17	8	44	34	4.5	M3×0.5	4.0	17	16	5	0.16	10.1	8.1	400	800	-	RS1212A	0.74	1.7	0.9	
55	22	10	50	43	6.6	M6×1	5.0	22	22	7	0.29	13.6	11.6	500	1 000	1 500	RS1616A	1.37	2.8	1.4	
68	25	12	59	52	9	M6×1	6.0	25	27	8	0.49	17.3	14.9	500	1 000	2 000	RS2020A	2.19	4.9	2.5	
80	31	12	69	63	9	M6×1	6.0	31	32	10	0.80	22.0	19.6	1 000	2 000	2 500	RS2525A	3.43	9.1	4.6	
100	37	15	84	80	11	M6×1	7.5	37	40	12	1.46	28.0	25.6	1 000	2 000	3 000	RS3232A	5.71	19	9.5	
120	46	18	103	95	14	M6×1	9.0	46	49	15	2.69	35.0	31.8	2 000	3 000	4 000	RS4040A	8.82	39	20	

4. The nut assembly is separate from the screw shaft and comes delivered on an arbor.
 5. The last digits (***) in the Shaft Ref. No. will show the value for screw shaft length in 100 mm units.
 6. Standard inventory products have not undergone surface treatments.
 7. Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.
 8. Values for nut internal space and standard grease replenishment are for ball screws with seals. The standard quantity for replenishment is about 50% of the nut's internal space. For ball screws without seals, apply grease to the screw shaft surface or move the nut by hand while filling to ensure that grease reaches all areas inside. See Page D16 for details.

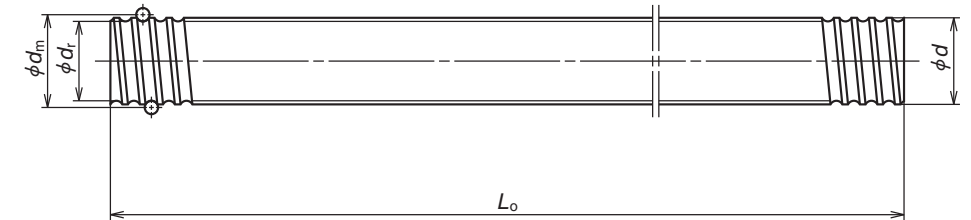
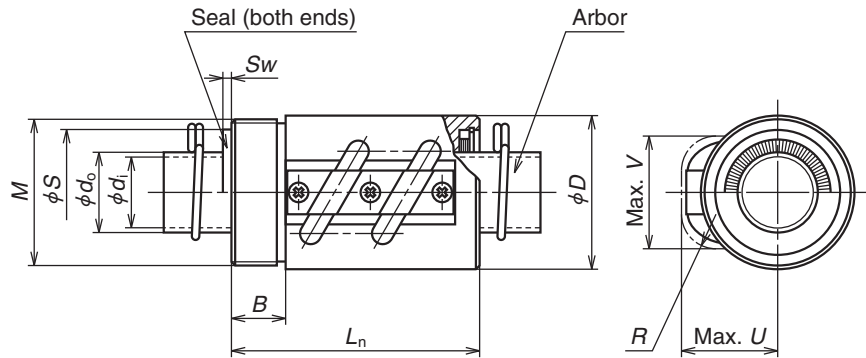


Nut Ref. No.	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D_w</i>	Ball circle dia. <i>d_m</i>	Root dia. <i>d_r</i>	Effective ball turns × Circuits	Basic load ratings (N)		Axial play Max.	Ball nut dimensions Outside dia. <i>D</i>
							Dynamic <i>C_a</i>	Static <i>C_{0b}</i>		
RNFBL 1006A2.5S	10	6	2.381	10.65	8.1	2.5×1	3 280	4 730	0.10	26
RNFBL 1208A2.5S	12	8	2.778	12.65	9.6	2.5×1	4 290	6 610	0.10	29
RNFBL 1404A3.5S	14	4	2.778	14.5	11.5	3.5×1	6 310	10 800	0.10	31
RNFBL 1405A2.5S	14	5	3.175	14.5	11.0	2.5×1	6 170	9 940	0.10	32
RNFBL 1808A3.5S	18	8	4.762	18.5	13.6	3.5×1	15 500	26 200	0.15	50
RNFBL 2005A2.5S	20	5	3.175	20.5	17.0	2.5×1	7 500	14 200	0.10	40
RNFBL 2010A2.5S	20	10	4.762	21.25	16.2	2.5×1	12 700	21 600	0.15	52
RNFBL 2505A2.5S	25	5	3.175	25.5	22.0	2.5×1	8 340	18 100	0.10	43
RNFBL 2505A5S						2.5×2	15 100	36 300		
RNFBL 2510A2.5S	25	10	6.35	26	19.0	2.5×1	20 500	34 900	0.20	60
RNFBL 2510A5S						2.5×2	37 300	69 800		
RNFBL 2806A2.5S	28	6	3.175	28.5	25.0	2.5×1	8 760	20 200	0.10	50
RNFBL 2806A5S						2.5×2	15 900	40 500		
RNFBL 3210A2.5S	32	10	6.35	33.75	27.0	2.5×1	23 100	45 900	0.20	67
RNFBL 3210A5S						2.5×2	42 000	91 800		
RNFBL 3610A2.5S	36	10	6.35	37	30.0	2.5×1	24 700	50 800	0.20	70
RNFBL 3610A5S						2.5×2	44 900	102 000		
RNFBL 4010A5S	40	10	6.35	41.75	35.0	2.5×2	47 200	116 000	0.20	76

- Notes: 1. Actual screw shaft length may become slightly longer than nominal length *L_o* due to manufacturing tolerances.
 2. The nut assembly is separate from the screw shaft and comes delivered on an arbor.
 3. The last digits (**) in the Shaft Ref. No. will show the value for screw shaft length in 100 mm units.

Ball nut dimensions										Arbor		Screw shaft				Shaft mass per meter (kg)	Nut internal space (cm ³)	Standard grease replenishment (cm ³)
Flange		Length		Bolt hole		Oil hole		Nut mass (kg)	Outside dia. <i>d_o</i>	Bore <i>d_i</i>	Standard length			Shaft Ref. No.				
<i>A</i>	<i>H</i>	<i>B</i>	Overall length <i>L_n</i>	<i>C</i>	<i>W</i>	<i>X</i>	<i>Q</i>				<i>T</i>	<i>L_o</i>						
42	29	8	36	3	34	4.5	M3×0.5	5.0	0.16	8.1	6.1	400	800	—	RS1006A··	0.56	1.1	0.6
45	32	8	44	3	37	4.5	M3×0.5	5.5	0.21	9.6	7.6	400	800	—	RS1208A··	0.81	1.6	0.8
50	37	10	40	4	40	4.5	M6×1	5.0	0.25	11.5	9.5	500	1 000	—	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	1 000	—	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	1 000	1 500	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	1 000	2 000	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	1 000	2 000	RS2010A··	2.18	7.6	3.8
67	50	10	40	4	55	5.5	M6×1	5.0	0.40	22.0	19.6	1 000	2 000	2 500	RS2505A··	3.47	3.5	1.8
			55	4	55	5.5	M6×1	5.0	0.50								4.7	2.4
96	72	15	66	5	78	9.0	M6×1	7.5	1.52	19.0	16.6	1 000	2 000	2 500	RS2510A··	3.13	14	7.0
			96	5	78	9.0	M6×1	7.5	1.99								19	9.5
80	60	12	47	5	65	6.6	M6×1	6.0	0.70	25.0	22.6	1 000	2 000	2 500	RS2806A··	4.47	4.5	2.3
			65	5	65	6.6	M6×1	6.0	0.87								7.6	3.8
103	78	15	67	5	85	9.0	M6×1	7.5	1.72	27.0	24.6	1 000	2 000	3 000	RS3210A··	5.53	20	10
			97	5	85	9.0	M6×1	7.5	2.25								28	14
110	82	17	69	5	90	11.0	M6×1	8.5	1.97	30.0	27.6	1 000	2 000	3 000	RS3610A··	6.91	21	11
			99	5	90	11.0	M6×1	8.5	2.53								29	15
116	88	17	99	5	96	11.0	M6×1	8.5	2.86	35.0	31.8	2 000	3 000	4 000	RS4010A··	8.87	36	18

4. Products in standard inventory have not had surface treatments.
 5. Synthetic resin seals are used for shaft diameters of 14 mm or less and brush seals for shaft diameters of 16 mm or more.
 6. Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.
 7. The standard quantity for grease replenishment is about 50% of the nut's internal space. See Page D16 for details.



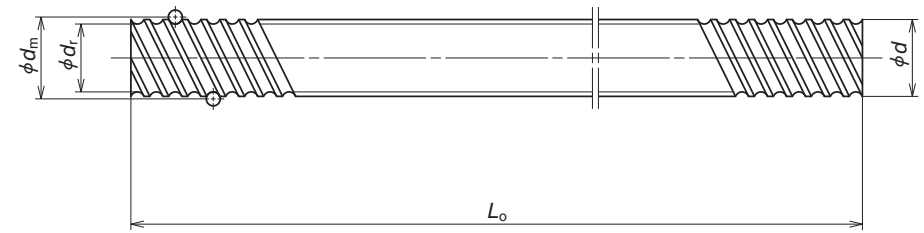
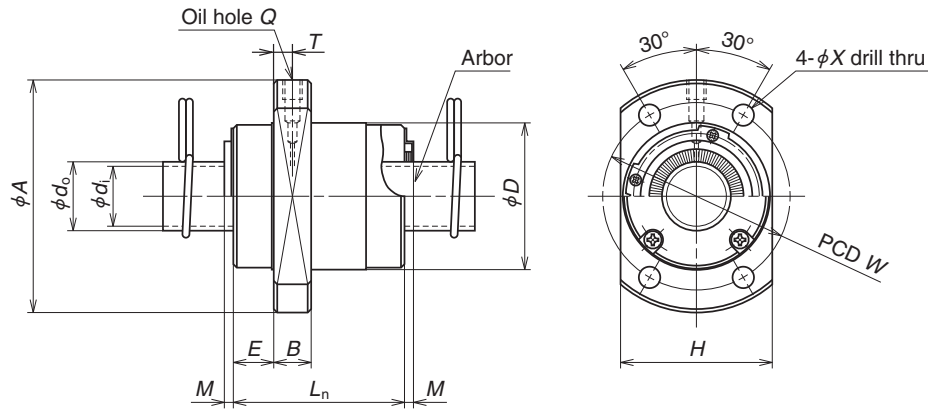
Unit: mm

Nut Ref. No.	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D_w</i>	Ball circle dia. <i>d_m</i>	Root dia. <i>d_r</i>	Effective ball turns × Circuits	Basic load ratings (N)		Axial play Max.	Ball nut dimensions	
							Dynamic <i>C_d</i>	Static <i>C_{sa}</i>		Outside dia. <i>D</i>	
RNCT 1003A3.5	10	3	2.381	10.65	8.1	3.5 × 1	4 440	6 700	0.10	20	
RNCT 1404A3.5S	14	4	2.778	14.5	11.5	3.5 × 1	6 310	10 800	0.10	25	
RNCT 1405A2.5S	14	5	3.175	14.5	11.0	2.5 × 1	6 170	9 940	0.10	30	
RNCT 1808A3.5	18	8	4.762	18.5	13.6	3.5 × 1	15 500	26 200	0.15	34	
RNCT 1808A3.5S											
RNCT 2005A2.5	20	5	3.175	20.5	17.0	2.5 × 1	7 500	14 200	0.10	40	
RNCT 2005A2.5S											
RNCT 2505A5	25	5	3.175	25.5	22.0	2.5 × 2	15 100	36 300	0.10	42	
RNCT 2505A5S											
RNCT 2510A5	25	10	6.35	26	19.0	2.5 × 2	37 300	69 800	0.20	44	
RNCT 2510A5S											
RNCT 2806A5	28	6	3.175	28.5	25.0	2.5 × 2	15 900	40 500	0.10	50	
RNCT 2806A5S											
RNCT 3210A5	32	10	6.35	33.75	27.0	2.5 × 2	42 000	91 800	0.20	55	
RNCT 3210A5S											
RNCT 3610A5	36	10	6.35	37	30.0	2.5 × 2	44 900	102 000	0.20	60	
RNCT 3610A5S											
RNCT 4010A7	40	10	6.35	41.75	35.0	3.5 × 2	63 100	164 000	0.20	65	
RNCT 4010A7S											
RNCT 4512A5	45	12	7.144	46.5	39.0	2.5 × 2	58 500	147 000	0.23	70	
RNCT 4512A5S											
RNCT 5010A7	50	10	6.35	51.75	45.0	3.5 × 2	70 100	205 000	0.20	80	
RNCT 5010A7S											
RNCT 5016A5	50	16	9.525	52	42.0	2.5 × 2	117 000	299 000	0.23	85	
RNCT 5016A5S											

- Notes: 1. The protrusion of the tube will not cause interference if the mating section of the nut body has dimensions greater than *U* and *V*.
 2. Actual screw shaft length may become slightly longer than nominal length *L_n* due to manufacturing tolerances.
 3. A Nut Ref. No. ending in "S" has seals. The external dimensions of these are identical to those without seals. The figure shows a seal above the center line and no seal below. Synthetic resin seals are used for shaft diameters of 14 mm or less and brush seals for shaft diameters of 16 mm or more.

Ball nut dimensions						Nut mass (kg)	Seal dimensions		Arbor		Screw shaft			Shaft mass per meter (kg)	Nut internal space (cm ³)	Standard grease replenishment (cm ³)	
V-thread		Length	Projecting tube				Diameter	Thickness	Outside dia.	Bore	Standard length						Shaft Ref. No.
<i>M</i>	<i>B</i>		<i>L_n</i>	<i>U</i>	<i>V</i>						<i>R</i>	<i>L₀</i>					
M18 × 1	10	38	15	15	7	0.049	—	—	8.1	6.1	400	800	—	RS1003A··	0.50	—	—
M24 × 1	10	43	19	20	7	0.083	—	—	11.5	9.5	500	1 000	—	RS1404A··	1.02	2.7	1.4
M26 × 1.5	10	45	22	21	8	0.15	—	—	11.0	9.0	500	1 000	—	RS1405A··	1.00	3.1	1.6
M32 × 1.5	12	58	27	27	8	0.21	28.5	2.5	13.6	11.6	500	1 000	1 500	RS1808A··	1.60	6.6	3.3
M36 × 1.5	12	48	28	27	10	0.28	29.5	2.5	17.0	14.6	500	1 000	2 000	RS2005A··	2.17	4.8	2.4
M40 × 1.5	15	69	28	31	10	0.38	34.5	2.5	22.0	19.6	1 000	2 000	2 500	RS2505A··	3.47	8.4	4.2
M42 × 1.5	15	92	34	37	17	0.49	38.5	2.5	19.0	16.6	1 000	2 000	2 500	RS2510A··	3.13	21	1
M45 × 1.5	15	79	33	34	10	0.68	37.5	2.5	25.0	22.6	1 000	2 000	2 500	RS2806A··	4.47	9.7	4.9
M50 × 1.5	18	97	39	42	17	0.79	45.5	2.5	27.0	24.6	1 000	2 000	3 000	RS3210A··	5.53	32	16
M55 × 2	18	98	42	46	17	0.97	50.5	3.0	30.0	27.6	1 000	2 000	3 000	RS3610A··	6.91	32	16
M60 × 2	25	125	44	50	20	1.37	54.5	3.0	35.0	31.8	2 000	3 000	4 000	RS4010A··	8.87	51	26
M65 × 2	30	124	47	55	20	1.42	60.5	3.0	39.0	35.8	2 000	3 000	4 000	RS4512A··	11.16	60	30
M75 × 2	40	140	52	59	20	2.41	64.5	3.0	45.0	41.8	2 000	3 000	4 000	RS5010A··	14.15	76	38
M80 × 2	40	158	57	63	25	3.14	68.5	3.0	42.0	38.8	2 000	3 000	4 000	RS5016A··	13.48	114	57

4. The nut assembly is separate from the screw shaft and comes delivered on an arbor.
 5. The last digits (**) in the Shaft Ref. No. will show the value for screw shaft length in 100 mm units.
 6. Standard inventory products have not undergone surface treatments.
 7. Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.
 8. Values for nut internal space and standard grease replenishment are for ball screws with seals. The standard quantity for replenishment is about 50% of the nut's internal space. For ball screws without seals, apply grease to the screw shaft surface or move the nut by hand while filling to ensure that grease reaches all areas inside. See Page D16 for details.

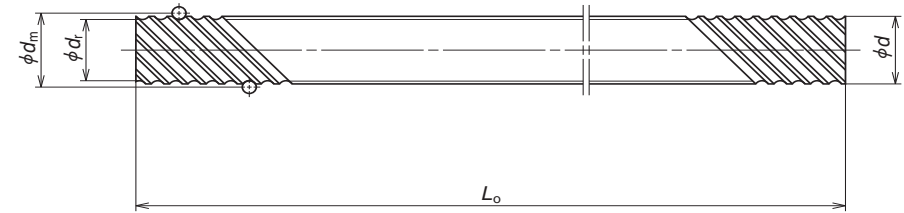
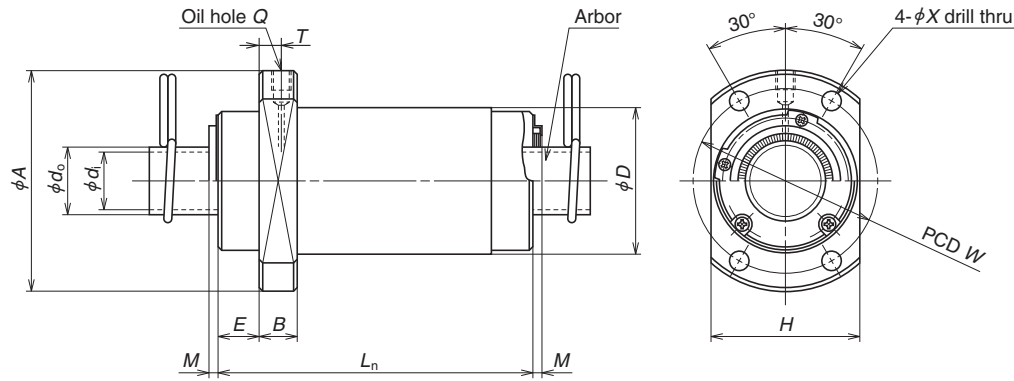


Nut Ref. No.	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D_w</i>	Ball circle dia. <i>d_m</i>	Root dia. <i>d_r</i>	Effective ball turns × Circuits	Basic load ratings (N)		Axial play Max.	Ball nut dimensions Outside dia. <i>D</i>
							Dynamic <i>C_n</i>	Static <i>C₀</i>		
RNFCL 1212A3 RNFCL 1212A6	12	12	2.381	12.65	10.1	1.7 × 2 1.7 × 4	4 350 7 890	6 580 13 200	0.10	26
RNFCL 1520A3 RNFCL 1520A6S	15	20	3.175	15.5	12.2	1.7 × 2	7 510	12 300	0.10	33
RNFCL 1616A3 RNFCL 1616A3S RNFCL 1616A6 RNFCL 1616A6S	16	16	2.778	16.65	13.5	1.7 × 2 1.7 × 4	6 060 11 000	10 300 20 500	0.10	32
RNFCL 2020A3 RNFCL 2020A3S RNFCL 2020A6 RNFCL 2020A6S	20	20	3.175	20.75	17.3	1.7 × 2 1.7 × 4	9 000 16 300	16 700 33 400	0.10	39
RNFCL 2525A3 RNFCL 2525A3S RNFCL 2525A6 RNFCL 2525A6S	25	25	3.969	26	22.0	1.7 × 2 1.7 × 4	13 400 24 400	26 100 52 200	0.12	47
RNFCL 3232A3 RNFCL 3232A3S RNFCL 3232A6 RNFCL 3232A6S	32	32	4.762	33.25	28.0	1.7 × 2 1.7 × 4	19 600 35 600	39 800 79 600	0.15	58
RNFCL 4040A3 RNFCL 4040A3S RNFCL 4040A6 RNFCL 4040A6S	40	40	6.35	41.75	35.0	1.7 × 2 1.7 × 4	31 300 56 900	66 800 134 000	0.20	73
RNFCL 5050A3 RNFCL 5050A3S RNFCL 5050A6 RNFCL 5050A6S	50	50	7.938	52.25	44.0	1.7 × 2 1.7 × 4	46 800 85 000	104 000 209 000	0.25	90

Ball nut dimensions										Nut mass (kg)	Arbor		Screw shaft			Shaft mass per meter (kg)	Nut internal space (cm ³)	Standard grease replenishment (cm ²)	
Flange		Length			Bolt hole		Oil hole		Outside dia. <i>d₀</i>		Bore <i>d_i</i>	Standard length <i>L₀</i>			Shaft Ref. No.				
<i>A</i>	<i>H</i>	<i>B</i>	<i>E</i>	<i>L_m</i>	<i>M</i>	<i>W</i>	<i>X</i>	<i>Q</i>		<i>T</i>		<i>d₀</i>	<i>d_i</i>						
44	28	6	9	30	-	35	4.5	M3 × 0.5	3.0	0.12	10.1	8.1	400	800	-	RS1212A··	0.74	-	-
51	35	10	11	45	3	42	4.5	M6 × 1	5.0	0.28	12.2	10.2	500	1 000	1 500	RS1520A··	1.15	3.3	1.7
53	34	10	10	38	3	42	4.5	M6 × 1	5.0	0.23	13.5	11.5	500	1 000	1 500	RS1616A··	1.37	2.6	1.3
62	41	10	11.5	46	3	50	5.5	M6 × 1	5.0	0.37	17.3	14.9	500	1 000	2 000	RS2020A··	2.19	4.4	2.2
74	49	12	13	55	3	60	6.6	M6 × 1	6.0	0.62	22.0	19.6	1 000	2 000	2 500	RS2525A··	3.43	8.2	4.1
92	60	12	16	70	3	74	9	M6 × 1	5.5	1.10	28.0	25.6	1 000	2 000	3 000	RS3232A··	5.71	16	8.0
114	75	15	19.5	85	3.5	93	11	M6 × 1	6.5	2.09	35.0	31.8	2 000	3 000	4 000	RS4040A··	8.82	32	16
135	92	20	21.5	107	3.5	112	14	M6 × 1	7.0	3.90	44.0	40.8	2 000	3 000	4 000	RS5050A··	13.81	64	32

Notes: 1. Actual screw shaft length may become slightly longer than nominal length *L₀* due to manufacturing tolerances.
 2. The nut assembly is separate from the screw shaft and comes delivered on an arbor.
 3. The last digits (**) in the Shaft Ref. No. will show the value for screw shaft length in 100 mm units.
 4. Products in standard inventory have not had surface treatments.
 5. A Nut Ref. No. ending in "S" has seals. These are brush seals, and the nut total length becomes longer (by 2 × *M*) when seals are equipped.

6. Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.
 7. Values for nut internal space and standard grease replenishment are for ball screws with seals. The standard quantity for replenishment is about 50% of the nut's internal space. For ball screws without seals, apply grease to the screw shaft surface or move the nut by hand while filling to ensure that grease reaches all areas inside. See Page D16 for details.

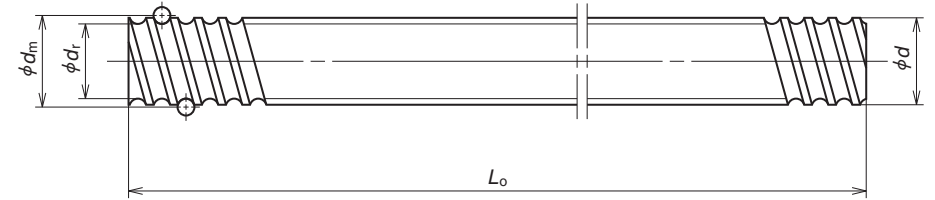
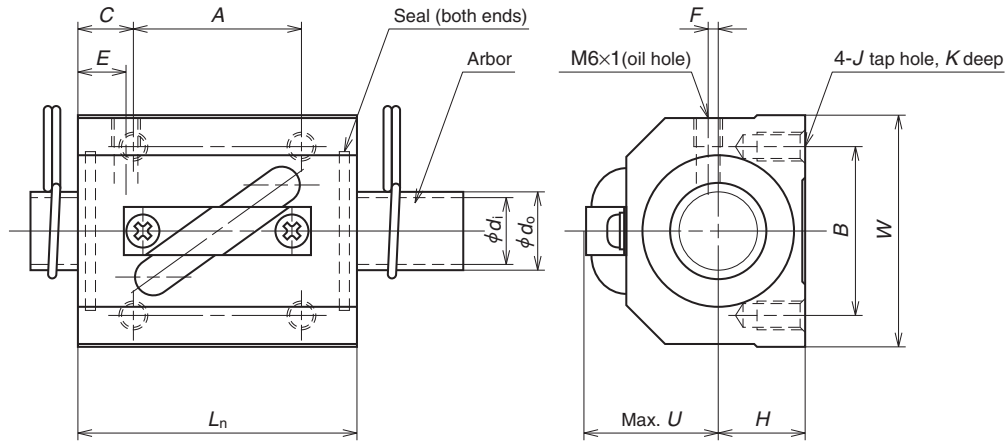


Nut Ref. No.	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D_w</i>	Ball circle dia. <i>d_m</i>	Root dia. <i>d_r</i>	Effective ball turns × Circuits	Basic load ratings (N)		Axial play Max.	Ball nut dimensions	
							Dynamic <i>C_{0a}</i>	Static <i>C_{0s}</i>		Outside dia. <i>D</i>	
RFNCL 1632A2 RFNCL 1632A2S	16	32	2.778	16.65	13.5	0.7 × 4	4 880	8 330	0.10	32	
RFNCL 1632A3 RFNCL 1632A3S						1.7 × 2	5 760	10 300			
RFNCL 1632A6 RFNCL 1632A6S						1.7 × 4	10 500	20 500			
RFNCL 2040A2 RFNCL 2040A2S	20	40	3.175	20.75	17.3	0.7 × 4	7 170	13 200	0.10	38	
RFNCL 2040A3 RFNCL 2040A3S						1.7 × 2	8 480	16 500			
RFNCL 2040A6 RFNCL 2040A6S						1.7 × 4	15 400	33 100			
RFNCL 2550A2 RFNCL 2550A2S	25	50	3.969	26	22.0	0.7 × 4	10 700	20 700	0.12	46	
RFNCL 2550A3 RFNCL 2550A3S						1.7 × 2	12 700	26 500			
RFNCL 2550A6 RFNCL 2550A6S						1.7 × 4	23 000	53 000			
RFNCL 3264A3 RFNCL 3264A3S	32	64	4.762	33.25	28.0	1.7 × 2	17 900	40 200	0.15	58	
RFNCL 3264A6 RFNCL 3264A6S						1.7 × 4	32 400	80 300			
RFNCL 4080A3 RFNCL 4080A3S						1.7 × 2	29 500	67 900			
RFNCL 4080A6 RFNCL 4080A6S	1.7 × 4	53 600	136 000	0.20	73						

Ball nut dimensions											Nut mass (kg)	Arbor		Screw shaft				Shaft mass per meter (kg)	Nut internal space (cm ³)	Standard grease replenishment (cm ²)
Flange		Length			Bolt hole		Oil hole		Outside dia. <i>d_o</i>	Bore <i>d_i</i>		Standard length				Shaft Ref. No.				
<i>A</i>	<i>H</i>	<i>B</i>	<i>E</i>	<i>L_n</i>	<i>M</i>	<i>W</i>	<i>X</i>	<i>Q</i>			<i>T</i>	<i>L_o</i>								
50	34	10	10	34	—	41	4.5	M6 × 1	5.5	0.21	13.5	11.5	500	1 000	1 500	—	RS1632A··	1.34	2.4	1.2
				66	—					0.33									3.9	2.0
				66	—					0.33									4.1	2.1
58	40	10	11	41	—	48	5.5	M6 × 1	5.5	0.31	17.3	14.9	500	1 000	1 500	2 000	RS2040A··	2.15	4.1	2.1
				81	—					0.53									6.3	3.2
				81	—					0.53									7.0	3.5
70	48	12	13	50	—	58	6.6	M6 × 1	7.0	0.53	22.0	19.6	1 000	2 000	2 500	—	RS2550A··	3.37	8.4	4.2
				100	—					0.91									14	7.0
				100	—					0.91									15	7.5
92	60	12	15.5	126	—	74	9	M6 × 1	7.5	1.76	28.0	25.6	1 000	2 000	3 000	4 000	RS3264A··	5.63	24	12
				—	—					—									26	13
				—	—					—									—	—
114	75	15	19	158	—	93	11	M6 × 1	10.0	3.44	35.0	31.8	2 000	3 000	4 000	5 000	RS4080A··	8.69	52	26
				—	—					—									55	28
				—	—					—									—	—

Notes: 1. Actual screw shaft length may become slightly longer than nominal length *L_o* due to manufacturing tolerances.
 2. The nut assembly is separate from the screw shaft and comes delivered on an arbor.
 3. The last digits (***) in the Shaft Ref. No. will show the value for screw shaft length in 100 mm units.
 4. Products in standard inventory have not had surface treatments.
 5. A Nut Ref. No. ending in 'S' has seals. These are brush seals, and the nut total length becomes longer (by 2 × *M*) when seals are equipped.

6. Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.
 7. Values for nut internal space and standard grease replenishment are for ball screws with seals. The standard quantity for replenishment is about 50% of the nut's internal space. For ball screws without seals, apply grease to the screw shaft surface or move the nut by hand while filling to ensure that grease reaches all areas inside. See Page D16 for details.



Nut Ref. No.	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D_w</i>	Ball circle dia. <i>d_m</i>	Root dia. <i>d_r</i>	Effective ball turns × Circuits	Basic load ratings (N)		Axial play Max.	Ball nut dimensions Length <i>L_n</i>
							Dynamic <i>C_d</i>	Static <i>C_{st}</i>		
							RNSTL 1404A3.5S	14		
RNSTL 1405A2.5S	14	5	3.175	14.5	11.0	2.5 × 1	6 170	9 940	0.10	38
RNSTL 1808A3.5S	18	8	4.762	18.5	13.6	3.5 × 1	15 500	26 200	0.15	56
RNSTL 2005A2.5S	20	5	3.175	20.5	17.0	2.5 × 1	7 500	14 200	0.10	38
RNSTL 2010A2.5S	20	10	4.762	21.25	16.2	2.5 × 1	12 700	21 600	0.15	58
RNSTL 2505A2.5S	25	5	3.175	25.5	22.0	2.5 × 1	8 340	18 100	0.10	35
RNSTL 2510A5S	25	10	6.35	26	19.0	2.5 × 2	37 300	69 800	0.20	94
RNSTL 2806A2.5S	28	6	3.175	28.5	25.0	2.5 × 1	8 760	20 200	0.10	42
RNSTL 2806A5S						2.5 × 2	15 900	40 500		67
RNSTL 3210A2.5S	32	10	6.35	33.75	27.0	2.5 × 1	23 100	45 900	0.20	64
RNSTL 3210A5S						2.5 × 2	42 000	91 800		94
RNSTL 3610A2.5S	36	10	6.35	37	30.0	2.5 × 1	24 700	50 800	0.20	64
RNSTL 3610A5S						2.5 × 2	44 900	102 000		96
RNSTL 4512A5S	45	12	7.144	46.5	39.0	2.5 × 2	58 500	147 000	0.23	115

Unit: mm

Ball nut dimensions										Nut mass (kg)	Arbor		Screw shaft				Shaft mass per meter (kg)	Nut internal space (cm ³)	Standard grease replenishment (cm ³)
Width <i>W</i>	Center height <i>H</i>	Bolt hole					Oil hole				Outside dia. <i>d_o</i>	Bore <i>d_i</i>	Standard length		Shaft Ref. No.				
		<i>A</i>	<i>B</i>	<i>C</i>	<i>J</i>	<i>K</i>	<i>E</i>	<i>F</i>	<i>U</i>				<i>L_s</i>						
34	13	22	26	8	M4	7	7	3	20	0.20	11.5	9.5	500	1 000	-	RS1404A··	1.02	1.6	0.8
34	13	22	26	8	M4	7	7	3	21	0.20	11.0	9.0	500	1 000	-	RS1405A··	1.00	1.8	0.9
48	17	35	35	10.5	M6	10	8	3	26	0.31	13.6	11.6	500	1 000	1 500	RS1808A··	1.60	3.4	1.7
48	17	22	35	8	M6	9	6	2	27	0.24	17.0	14.6	500	1 000	2 000	RS2005A··	2.17	2.5	1.3
48	18	35	35	11.5	M6	10	10	2	28	0.35	16.2	13.8	500	1 000	2 000	RS2010A··	2.18	6.3	3.2
60	20	22	40	6.5	M8	10	6	0	27	0.31	22.0	19.6	1 000	2 000	2 500	RS2505A··	3.47	2.6	1.3
60	23	60	40	17	M8	12	10	0	32	1.32	19.0	16.6	1 000	2 000	2 500	RS2510A··	3.13	18	9.0
60	22	18	40	12	M8	12	8	0	32	0.65	25.0	22.6	1 000	2 000	2 500	RS2806A··	4.47	7.0	3.5
60	22	40	40	13.5						1.04									
70	26	45	50	9.5	M8	12	10	0	38	1.12	27.0	24.6	1 000	2 000	3 000	RS3210A··	5.53	18	9.0
70	26	60	50	17						1.75									
86	29	45	60	9.5	M10	16	11	0	41	1.76	30.0	27.6	1 000	2 000	3 000	RS3610A··	6.91	18	9.0
86	29	60	60	18						2.64									
100	36	75	75	20	M12	20	13	0	46	1.22	39.0	35.8	2 000	3 000	4 000	RS4512A··	11.16	47	24

Notes: 1. Actual screw shaft length may become slightly longer than nominal length *L_s* due to manufacturing tolerances.
 2. The nut assembly is separate from the screw shaft and comes delivered on an arbor.
 3. The last digits (**) in the Shaft Ref. No. will show the value for screw shaft length in 100 mm units.

4. Products in standard inventory have not had surface treatments.
 5. Synthetic resin seals are used for shaft diameters of 14 mm or less and brush seals for shaft diameters of 16 mm or more.
 6. Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.
 7. The standard quantity for grease replenishment is about 50% of the nut's internal space. See Page D16 for details.

B-3-1.7 Accessories

Accessories to use with NSK ball screws are available.

Table 1 Support unit lineup

Application	Shape	Support side	Bearing in use	Bearing bore, Bearing seat diameter	Page
Small equipment, light load	Square	Fixed support side	Angular contact ball bearing	$\phi 4 - \phi 25$	B383 -
			Deep groove ball bearing	$\phi 6 - \phi 25$	B387 -
		Simple support side	Deep groove ball bearing	$\phi 12, \phi 15$ <small>(exclusively for VFA model)</small>	B387

1. Classification

Ball screw support units are classified by their shape (Table 1). Select the type that best suits your particular needs.

2. Features

●Bearings and seals

On the fixed support side, an angular contact ball bearing is used. It has great rigidity and low friction torque, which match the rigidity of the ball screw. A thrust angular contact ball bearing with high precision and great rigidity is another choice for the fixed support side. The dynamic load ratings of the bearing were revised in 2024.

The target is a part of Support Units with locating bearing the fixing side bearings (High-Precision Angular Contact Ball Bearing)

and supporting bearings (Deep Groove Ball Bearing).

This revision is due to the introduction of NSK's original material evaluation technology (Micro-UT™).

(For more information on Micro-UT™ technology, please refer to our catalog "CAT.No 1103e Rolling Bearings").

An oil seal is installed to the fixed support side with an angular contact ball bearing. Fine clearance may occur with this seal.

A deep-groove ball bearing with a shield on both sides is used on the simple support side.

●Lock nut provided

A lock nut with fine grade finish is provided to fix the bearing with high precision.

The lock nuts are designed to be difficult to loosen, but they can still loosen if subjected to

Application	Shape	Support side	Bearing in use	Bearing bore, Bearing seat diameter	Page
Small equipment, light load	Round	Fixed support side	WBK**R-11 (Support kit)	$\phi 4, \phi 6$ <small>(exclusively for RMA and RMS models)</small>	B389
			WBK**-11*	Angular contact ball bearing	$\phi 4 - \phi 25$
Machine tools, high speed, heavy load	Round	Fixed support side	Thrust angular contact ball bearing	$\phi 17 - \phi 40$	B395 -

strong mechanical vibration. If necessary, this should be prevented by applying threadlocking adhesive or similar precautions.

3. Reference number coding

(For light load)

Example: **WBK 08 S - 01 A**

Product code for support unit

Nominal size code*

Mounting code

No code: Fixed side

S: Simple side

SF: Simple side (for FSS and VFA)

R: Fixed side (support kit for miniature ball screws)

No code or A: For general use

B: Low-profile type (only for square type)

C: For cleanroom use

M: Miniature general-purpose use

W: Lost-wax product

01: Square type

11: Round type

*) Nominal size codes of 12 or less for support units mounted on the simple side do not strictly represent internal bore of bearing in millimeters. Please refer to the dimensional tables for details.

(For high speed and heavy load)

Example: **WBK 25 DF - 31H**

Product code for support unit

Nominal size code (internal bore of bearing)

H: High speed type

Bearing combination code

DF: Face to face two-row arrangement (paired mounting)

DFD: Face to face three-row arrangement

DFF: Face to face four-row arrangement

(1) Support Units for Light Loads and Small Equipment

Support units for light load and small equipment provide both fixed and support side bearing assemblies to support screw shafts. They provide all required parts such as bearing locknuts so that you can mount them directly to standard NSK machined ball screws.

Please refer to the dimensions listed on the dimension tables for the configuration of standard screw shaft ends for NSK standard ball screws with blank shaft ends. Ball screws for transfer equipment require spacers (sold separately) to use support units.

(a) Features

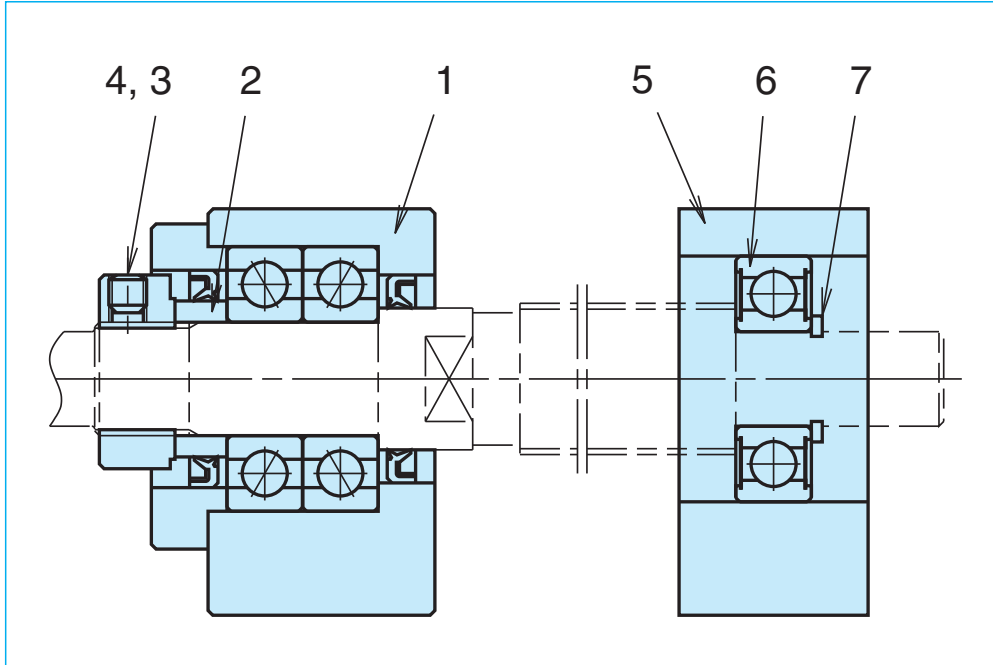
- Prompt delivery
Support units are standard products.
- Best selection of bearings for your application
General use support units for fixed support are equipped with highly rigid angular contact ball bearings that have been assembled with proper preload and packed with the appropriate volume of grease. On the other hand, clean support units for fixed support low dust emission grease and low torque special bearings. Sealed deep groove ball bearings are used for simple support side units for both general and cleanroom use.

Accessories

● **Accessories**

Support units provide everything necessary for mounting ball screws to machines. (Please refer to the table below.)

* Do not disassemble fixed-side support units as they are equipped with bearings and oil seals.



● **Antirust treatment**

The table on the right shows details on parts, the surface treatment, and materials.

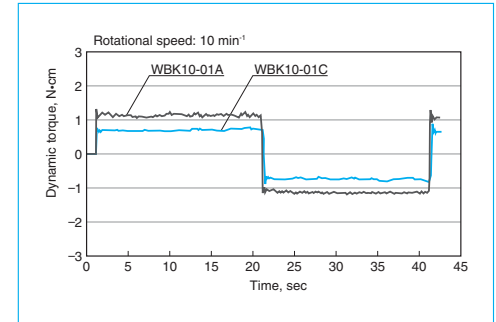
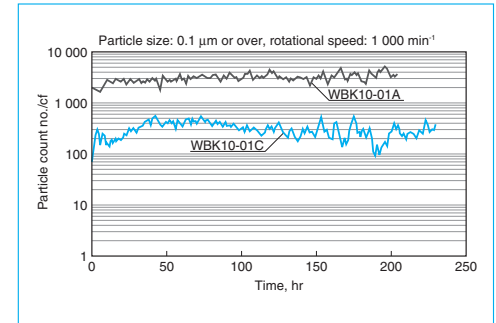
Fixed side		Simple side	
Part No.	Name of part	Part No.	Name of part
1	Bearing housing	5	Bearing housing
2	Spacer	6	Bearing
3	Locknut	7	Snap ring
4	Set screw with brass pad		

Details for General Support Units	
Bearings and grease	Angular contact ball bearings, PS2
Surface treatment	Black oxide
Screws and snap rings	Standard material

(b) Features of Clean Support Units

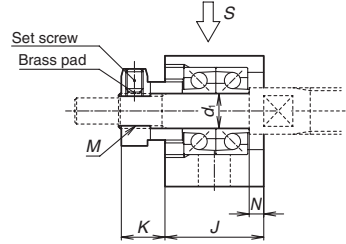
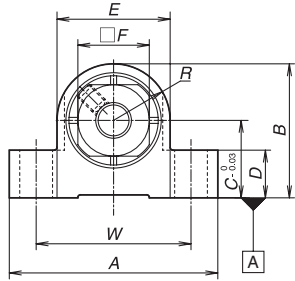
- **Outstanding low dust emissions**
Clean support units use NSK Cleanroom Grease LG2 with proven low dust emissions. These units reduce dust emissions to 1/10th that of general support units.
- **Low torque**
Specialized bearings provide significantly lower torque than standard units (50% lower than general support units.)
- **High antirust specifications**
Low temperature chrome plating is applied to bearing housings, retaining plates, locknuts and spacers to improve antirust properties. Moreover, bolts and snap rings are made of stainless steel. The table below shows details on parts, the surface treatment, and materials.

Details for Cleanroom Support Units	
Bearings and grease	Specialized angular contact ball bearings LG2
Surface treatment	Low temperature chrome plating
Set screw and snap ring material	Stainless steel

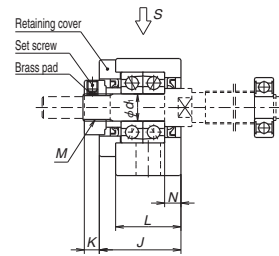
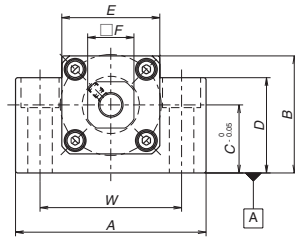


Support Units for Light Load and Small Equipment

WBK**-01M



WBK**-01*

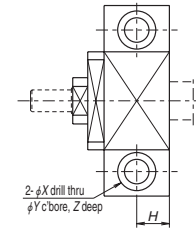
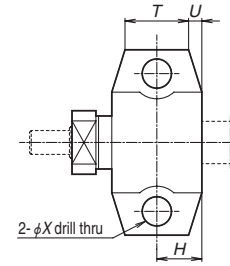


Fixed-side support units (square type)

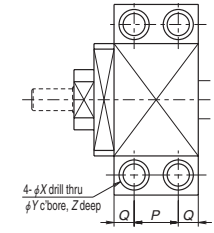
Reference No.	Use	d_i	A	B	C	D	E	F	L	J	K	R
WBK04-01M	General	4	27	17	10	6	14	10	—	14	5.5	7
WBK06-01M	General	6	35	22.5	13	8	19	12	—	17	7.5	9.5
WBK06-01A*1	General	6	42	25	13	20	18	12	20	20	5.5	—
WBK08-01A*1	General	8	52	32	17	26	25	14	23	23	7	—
WBK08-01B	Low type		62	31	15.5	31	—		21.5	25.5	4.5	
WBK08-01C*1	Cleanroom		52	32	17	26	25		23	23	7	
WBK10-01A	General	10	70	43	25	35	36	17	24	30	5.5	—
WBK10-01B	Low type			38	20	38	—					
WBK10-01C	Cleanroom			43	25	35	36					
WBK12-01A	General	12	70	43	25	35	36	19	24	30	5.5	—
WBK12-01B	Low type			38	20	38	—					
WBK12-01C	Cleanroom			43	25	35	36					
WBK15-01A	General	15	80	50	30	40	41	22	25	31	12	—
WBK15-01B	Low type			42	22	42	—					
WBK15-01C	Cleanroom			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	—
WBK25-01W	General	25	105	68	35	25	66	36	48	61	13	—

- Notes:
1. Use datum surface A for mounting to the machine base.
 2. After the locknut has been adjusted and tightened, insert the provided brass pad and set screw, then tighten the set screw.
 3. Insert the provided set piece (brass pad) before tightening the set screw.
 4. Single-row deep groove ball bearings and C-shaped snap rings are provided (excluding WBK04-01M, WBK06-01M, and WBK06-01A).

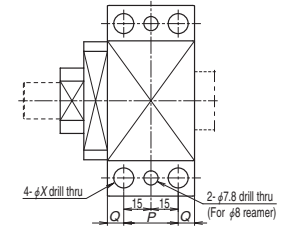
Reference No.	Tightening torque (reference) [N·cm]	
	Locknut	Set screw
WBK04-**	100	69 (M3)
WBK06-**	190	69 (M3)
WBK08-**	230	69 (M3)
WBK10-**	280	147 (M4)
WBK12-**	630	147 (M4)
WBK15-**	790	147 (M4)
WBK17-**	910	147 (M4)
WBK20-**	1670	147 (M4)
WBK25-**	2060	490 (M6)



View S (WBK06 – 15)



View S (WBK17 – 20)

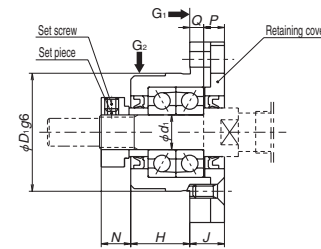
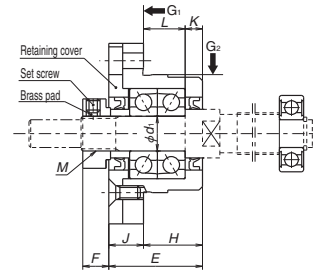
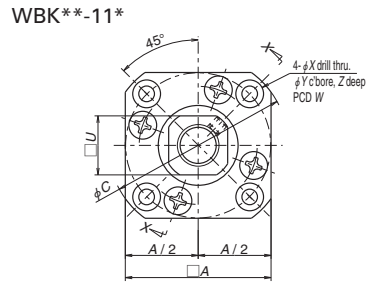
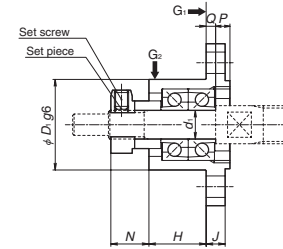
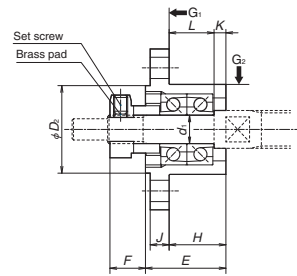
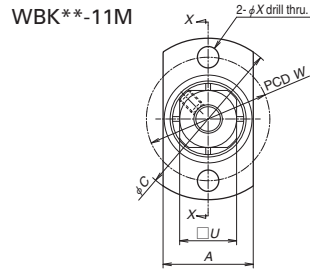


View S (WBK25)

Units: mm

T	U	N	Counterbore dimensions							Mass (kg)	Locknut screw M	Attached bearing for support side					
			H	P	Q	W	X	Y	Z								
9	2.5	2	7	—	—	21	3.5	—	—	0.03	M4×0.5	—					
12	2.5	2.5	8.5	—	—	26	5.5	—	—	0.05	M6×0.75	—					
—	—	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	x11	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					

5. Bearings for WBK04-01M and WBK06-01M have non-contact metal shields on both sides.
- *1. WBK06-01A, WBK08-01A, and WBK08-01C do not have seals on the retaining cover side.
6. Contact NSK if the rotational speed will be 50 min⁻¹ or less.



View X-X (example 1)

(example 2)

Reference No.	Tightening torque (reference) [N·cm]	
	Locknut	Set screw
WBK04-**	100	69 (M3)
WBK06-**	190	69 (M3)
WBK08-**	230	69 (M3)
WBK10-**	280	147 (M4)
WBK12-**	630	147 (M4)
WBK15-**	790	147 (M4)
WBK17-**	910	147 (M4)
WBK20-**	1670	147 (M4)
WBK25-**	2060	490 (M6)

Fixed-side support units (round type)

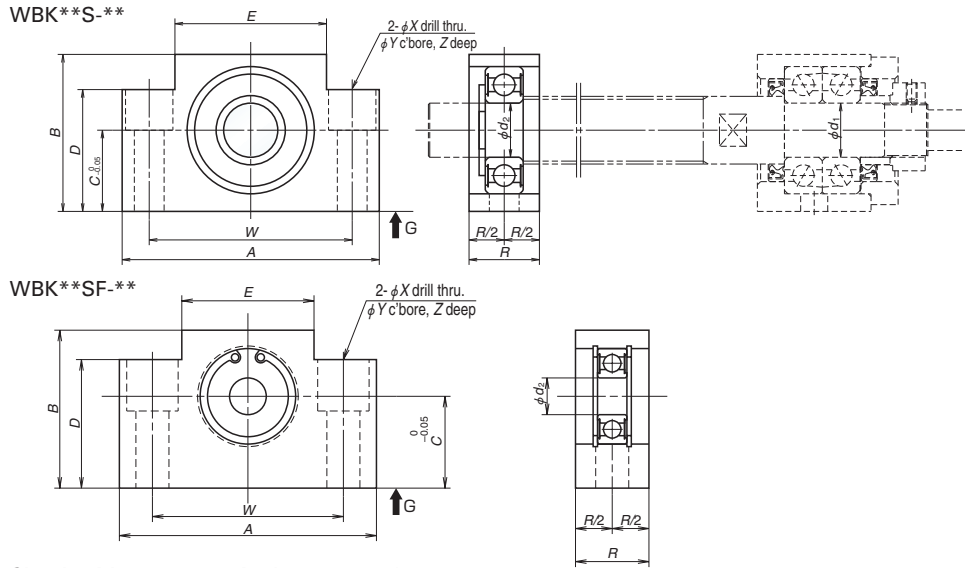
Units: mm

Reference No.	Use	d_1	A	C	D_1	D_2	E	H	L	K	F	N
WBK04-11M	General	4	14	26	14	14	13.5	8.5	7	1.5	5.5	6.6
WBK06-11M	General	6	19	34	19	18.5	17	12	9.5	2.5	7.5	8
WBK06-11*	General	6	28	35	22	—	20	13	9.5	3.5	5.5	6.5
WBK08-11B	High-load type	8	42	52	34	—	25.5	15.5	12	3.5	4.5	7
WBK08-11*	General		35	43	28	—	23	14	10	4	7	8
WBK08-11C*	Cleanroom		—	—	—	—	—	—	—	—	—	—
WBK10-11	General	10	42	52	34	—	27	17	12	5	7.5	8.5
WBK10-11C	Cleanroom		—	—	—	—	—	—	—	—	—	—
WBK12-11	General	12	44	54	36	—	27	17	12	5	7.5	8.5
WBK12-11C	Cleanroom		—	—	—	—	—	—	—	—	—	—
WBK15-11	General	15	52	63	40	—	32	17	11	6	12	14
WBK15-11C	Cleanroom		—	—	—	—	—	—	—	—	—	—
WBK20-11	General	20	68	85	57	—	52	30	20	10	10	14
WBK25-11	General	25	79	98	63	—	57	30	20	10	13	20

U	P	Q	Counterbore dimensions					Mass (kg)	Locknut screw M	Attached bearing for support side
			J	W	X	Y	Z			
10	2.6	2.4	3	20	3.5	—	—	0.02	M4x0.5	—
12	3	2	4	26	4.5	—	—	0.04	M6x0.75	—
12	4.5	2.5	7	28	2.9	5.5	3.5	0.1	M6x0.75	—
14	6	4	10	42	4.5	8	4	0.2	M8x1	606ZZ
	5		9	35	3.4	6.5		0.15		606ZZ 606VV
17	6	4	10	42	4.5	8	4	0.2	M10x1	608ZZ 608VV
19	6	4	10	44	4.5	8	4	0.25	M12x1	6000ZZ 6000VV
22	8	7	15	50	5.5	9.5	6	0.4	M15x1	6002ZZ 6002VV
30	14	8	22	70	6.6	11	10	1.1	M20x1	6204ZZ
36	17	10	27	80	9	15	13	1.5	M25x1.5	6205ZZ

- Notes:
1. Tighten the set screw after the locknut has been adjusted and tightened.
 2. Insert the provided set piece (brass pad) before tightening the set screw.
 3. Single-row deep groove ball bearings and C-shaped snap rings are provided (excluding WBK04-11M, WBK06-11M, and WBK06-11).

4. Bearings for WBK04-11M and WBK06-11M have non-contact metal shields on both sides.
- *1. WBK06-11, WBK08-11, and WBK08-11C do not have seals on the retaining cover side.
5. Contact NSK if the rotational speed will be 50 min⁻¹ or less.
6. Use datum surface G₁ and G₂ for mounting to the machine base.



Simple-side support units (square type)

Units: mm

Reference No.	Use	d ₂	A	B	C	D	E	R	Counterbore dimensions				Mass (kg)
									W	X	Y	Z	
WBK08S-01	General	6	52	32	17	26	25	15	38	6.6	11	12	0.15
WBK08S-01B	Low type		62	31	15.5	31	—	16	46	9	14	18	0.2
WBK08S-01C	Cleanroom		52	32	17	26	25	15	38	6.6	11	12	0.15
WBK10S-01	General	8	70	43	25	35	36	20	52	9	14	11	0.4
WBK10S-01C	Cleanroom		70	43	25	35	36	20	52	9	14	11	0.4
WBK12S-01	General	10	70	43	25	35	36	20	52	9	14	11	0.35
WBK12S-01B	Low type			38	20	38	—					19	0.4
WBK12S-01C	Cleanroom			43	25	35	36					11	0.35
WBK12SF-01^{*2}	General	12	62	31	15.5	31	—	18	46	9	14	11	0.3
WBK12SF-01B^{*1}	Low type											18	0.2
WBK15S-01	General	15	80	50	30	40	41	20	60	9	14	11	0.45
WBK15S-01B	Low type			42	22	42	—					23	0.4
WBK15S-01C	Cleanroom			50	30	40	41					11	0.45
WBK15SF-01^{*2}	General			43	25	35	36					19	0.3
WBK15SF-01B^{*1}	Low type	70	38	20	38	—	18	52	11	17	15	0.8	
WBK17S-01	General	17	86	64	39	55	50	23	68	9	14	11	0.8
WBK20S-01	General	20	95	58	30	45	56	26	75	11	17	15	0.8
WBK20SF-01B	Low type		80	42	22	42	—	22	60			23	0.4
WBK25S-01W	General	25	105	68	35	25	66	30	85	11	—	—	0.9
WBK25SF-01^{*1}			95	58	30	45	56	22	75	11	17	15	0.55

- Notes:**
1. Use datum surface G for mounting to the machine base.
 2. Note that the inner dimensions of the bearing differ for products with nominal size codes of 12 or less.
 3. WBK**SF supports the ball screw outside diameter.
 4. See page B400 for bearing designations and basic dynamic load ratings in the radial direction.
- *1 Exclusively for FSS models.
*2 Exclusively for VFA models.

Specifications of support units

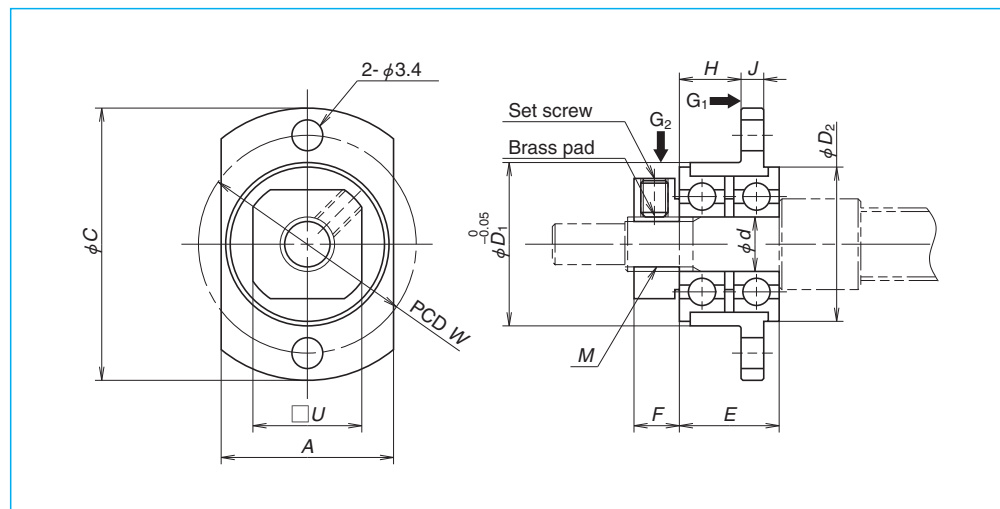
Reference No.	Use	Fixed-side support units			Maximum starting torque [N·cm]	Simple-side support units		
		Basic dynamic load rating Ca [N]	Allowable load [N]	Rigidity [N/μm]		Reference No.	Bearing reference No.	Radial direction Basic dynamic load rating C [N]
WBK04-01M	General	1 470	320	39	0.2	—	—	—
WBK04-11M	General	1 470	320	39	0.2	—	—	—
WBK06-01A	General	3 350	725	28	0.49	—	—	—
WBK06-01M	General	2 760	595	60	0.35	—	—	—
WBK06-11	General	3 350	725	28	0.49	—	—	—
WBK06-11M	General	2 760	595	60	0.35	—	—	—
WBK08-01A	General	5 550	1 020	49	0.88	WBK08S-01	606ZZ	2 490
WBK08-01B	Low type	8 300	1 890	94	1.9	WBK08S-01B	606ZZ	2 490
						WBK12SF-01B^{*1}	6801ZZ	2 110
WBK08-01C	Cleanroom	3 900	770	36	0.52	WBK08S-01C	606VV	2 490
WBK08-11	General	5 550	1 020	49	0.88	WBK08S-01	606ZZ	2 490
WBK08-11B	High load	8 300	1 890	94	1.9	—	606ZZ	2 490
WBK08-11C	Cleanroom	3 900	770	36	0.52	WBK08S-01C	606VV	2 490
WBK10-01A	General	8 300	1 910	94	1.9	WBK10S-01	608ZZ	3 650
						WBK12SF-01^{*2}	6001ZZ	5 600
WBK10-01B	Low type	8 300	1 910	94	1.9	—	608ZZ	3 650
WBK10-01C	Cleanroom	5 400	950	50	1.1	WBK10S-01C	608VV	3 650
WBK10-11	General	8 300	1 910	94	1.9	WBK10S-01	608ZZ	3 650
WBK10-11C	Cleanroom	5 400	950	50	1.1	WBK10S-01C	608VV	3 650
WBK12-01A	General	9 000	2 130	104	2.1	WBK12S-01	6000ZZ	5 050
						WBK15SF-01^{*2}	6902ZZ	4 750
WBK12-01B	Low type	9 000	2 130	104	2.1	WBK12S-01B	6000ZZ	5 050
						WBK15SF-01B^{*1}	6902ZZ	4 750
WBK12-01C	Cleanroom	5 950	1 710	57	1.2	WBK12S-01C	6000VV	5 050
WBK12-11	General	9 000	2 130	104	2.1	WBK12S-01	6000ZZ	5 050
WBK12-11C	Cleanroom	5 950	1 710	57	1.2	WBK12S-01C	6000VV	5 050
WBK15-01A	General	9 600	2 360	113	2.4	WBK15S-01	6002ZZ	6 150
WBK15-01B	Low type	9 600	2 360	113	2.4	WBK15S-01B	6002ZZ	6 150
						WBK20SF-01B^{*1}	6804ZZ	4 400
WBK15-01C	Cleanroom	6 450	1 925	63	1.3	WBK15S-01C	6002VV	6 150
WBK15-11	General	9 600	2 360	113	2.4	WBK15S-01	6002ZZ	6 150
WBK15-11C	Cleanroom	6 450	1 925	63	1.3	WBK15S-01C	6002VV	6 150
WBK17-01A	General	16 800	4 050	120	3.5	WBK17S-01	6203ZZ	10 500
WBK20-01	General	22 500	5 750	155	6.2	WBK20S-01	6204ZZ	14 100
						WBK25SF-01^{*1}	6005ZZ	11 100
WBK20-11	General	22 500	5 750	155	6.2	WBK20S-01	6204ZZ	14 100
WBK25-01W	General	25 500	6 950	192	7.2	WBK25S-01W	6205ZZ	15 400
WBK25-11	General	25 500	6 950	192	7.2	WBK25S-01W	6205ZZ	15 400
WBK04R-11	General	615	340	6.5	0.59	—	—	—
WBK06R-11	General	1 280	650	9	0.59	—	—	—

- Notes:** *1 Exclusively for FSS models.
*2 Exclusively for VFA models.

Support kits for ball screws for transfer equipment

Support kits are for RMA model ball screws.

In case of RMA1002 or larger rolled ball screws, please use support units for general use.



Units: mm

Reference No.	A	C	d	D ₁	D ₂	E	F	J	H	W	U	M	Mass (kg)
WBK04R-11	14	25	4	13	12.5	9	5	2.5	5	19	10	M4×0.5	0.13
WBK06R-11	19	30	6	18	17	11	5	2.5	6.8	24	12	M6×0.75	0.23

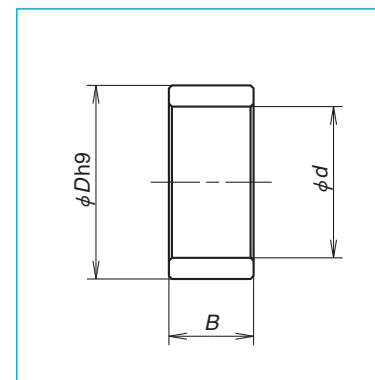
Reference No.	Applicable ball screw	Locknut tightening torque (reference) [N·cm]	Set screw tightening torque (reference) [N·cm]
WBK04R-11	RMA0601	100	38 (M2.5)
WBK06R-11	RMA0801 RMA0801.5 RMA0802	190	69 (M3)

Notes:

- When mounting, adjust the bearing and and locknut phase to minimize the runout of the flange mounting surface. Use datum surface G₁ and G₂ for mounting to the machine base.
- Support kits are delivered on a temporary shaft (bolt).
- Insert the provided set piece (brass pad) before tightening the set screw.

Spacers

When using a fixed-side support unit, a spacer may be required to have an effective shoulder surface when the ball thread is threaded to the end of the shoulder, as common in R models for transfer equipment.



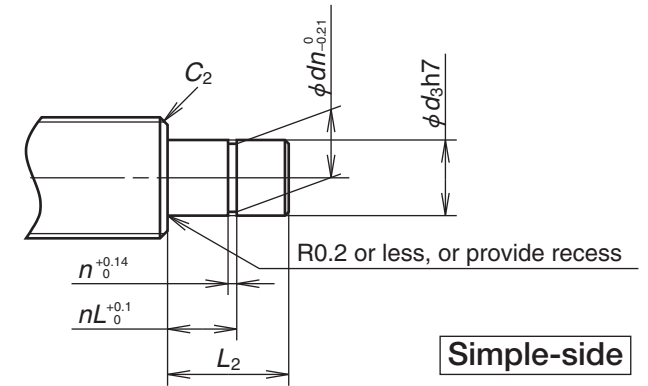
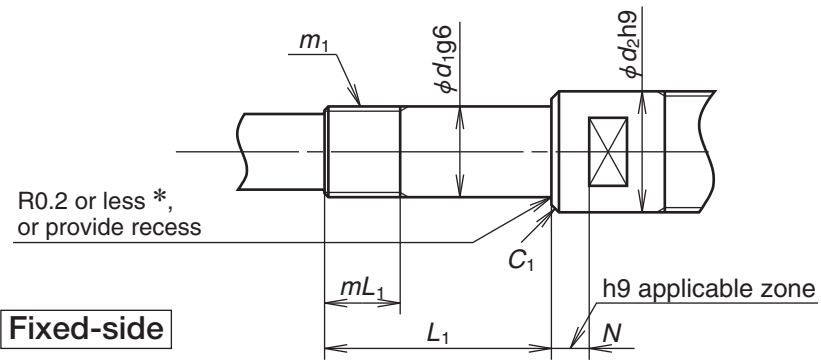
Units: mm

Reference No.	Internal diameter, d	Outside diameter, D	Width B	Mass (g)	Applicable support unit
WBK06K	6	9.5	5.0	2	WBK06- **
WBK08K	8	11.5	5.5	2	WBK08- **
WBK10K	10	14.5	5.5	4	WBK10- **
WBK12K	12	15.0	5.6	3	WBK12- **
WBK15K	15	19.5	10.0	10	WBK15- **
WBK17K	17	24.4	7.0	13	WBK17- **
WBK20K	20	25.5	11.0	17	WBK20- **
WBK25K	25	32.0	14.0	34	WBK25- **

Screw shaft end configuration

Dimensions of shaft end configurations for light load and small equipment support units are shown in the table below. When using a spacer

with a ball screw for transfer equipment, add the width of the spacer (B from spacer dimensions on page B402) to the L_1 dimension below.



Radius marked with * above is 0.15 or less for WBK04R-11 and WBK06R-11.

Units: mm

Fixed-side support units

Reference No.	Bearing journal		Locknut thread		Sealing part		Chamfer
	d_1	L_1	m_1	mL_1	d_2	N	C_1
WBK06- **	6	22.5	M6x0.75	7	9.5	3.5	0.2
WBK08- **	8	27	M8x1	9	11.5	4	0.2
WBK10- **	10	30	M10x1	10	14	6	0.2
WBK12- **	12	30	M12x1	10	15	6	0.2
WBK15- **	15	40	M15x1	15	19.5	5	0.3
WBK17- **	17	46	M17x1	17	24	7	0.3
WBK20- **	20	53	M20x1	16	25	10	0.3
WBK25- **	25	62	M25x1.5	20	32	14	0.5
WBK04R-11	4	15	M4x0.5	7.5	—	—	0.3
WBK06R-11	6	17	M6x0.75	7.5	—	—	0.3

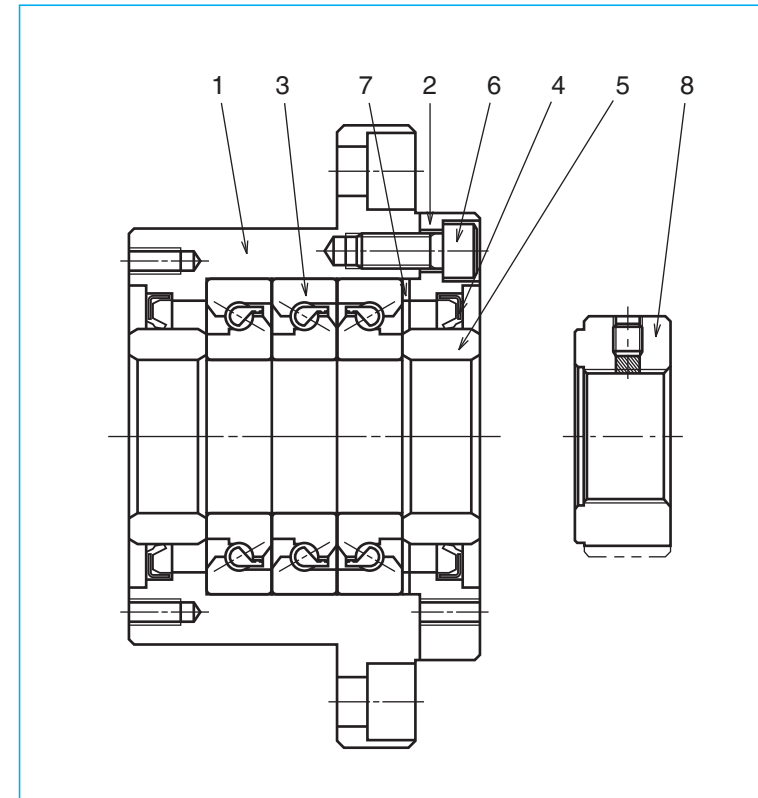
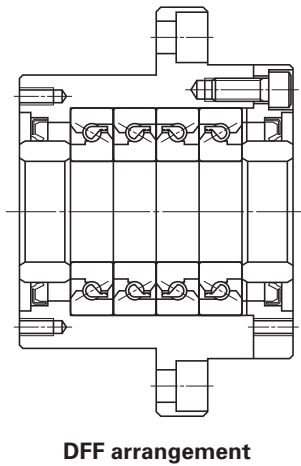
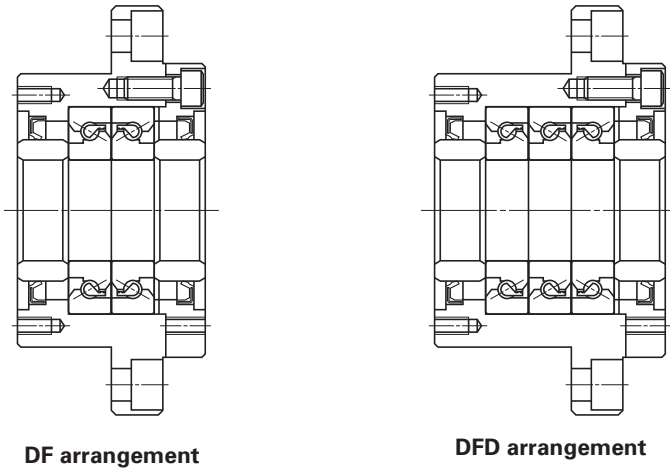
Units: mm

Simple-side support units

Reference No.	Bearing journal		Snap ring groove			Chamfer
	d_3	L_2	n	dn	nL	C_2
—	—	—	—	—	—	—
WBK08S- **	6	9	0.8	5.7	6.8	0.2
WBK10S- **	8	10	0.9	7.6	7.9	0.2
WBK12S- **	10	22	1.15	9.6	9.15	0.5
WBK15S- **	15	25	1.15	14.3	10.15	0.5
WBK17S- **	17	16	1.15	16.2	13.15	0.5
WBK20S- **	20	19	1.35	19	15.35	0.5
WBK25S- **	25	20	1.35	23.9	16.35	0.5

(2) Support units for ball screws for high-speed and heavy-load machine tools

Support units for high-speed and heavy-load machine tools use NSKHPS™ BSBD Series ball screw support bearings with an optimal structure and functions. Possible bearing combinations are shown below:

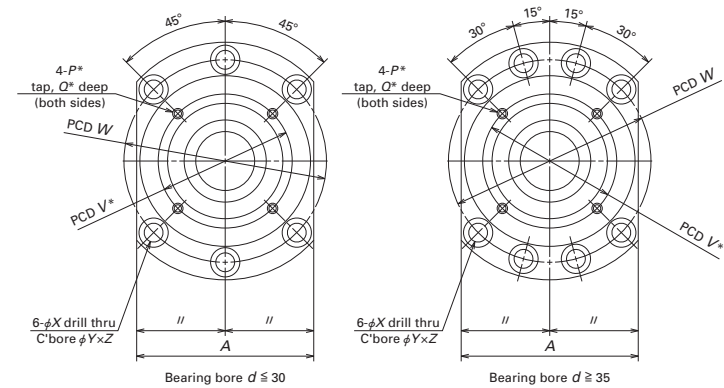
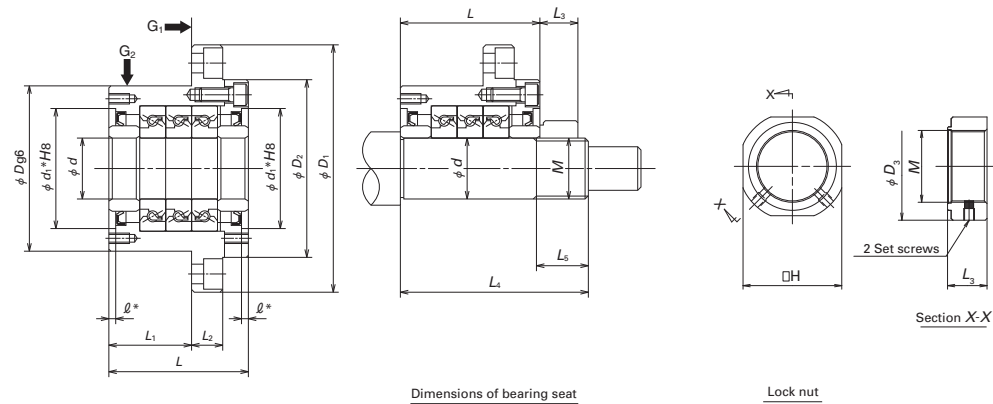


Parts list

Part No.	Part name	Quantity
1	Housing	1
2	Retaining cover	1
3	High accuracy thrust angular contact ball bearing	One set
4	Dust seal	2
5	Collar	2
6	Preload bolt	6 or 8
7	Shim	One set
8	Lock nut	1

Notes:

1. NSK support units are precisely preloaded and adjusted. Parts 1–7 come as a unit and should not be disassembled.
2. Grease is pre-packed in the bearings.
3. The lock nut (Part 8) is specialized for ball screws and has an end surface that is strictly controlled to be precisely perpendicular to the V thread. Secure the lock nut using a set screw. Lock nuts are also available separately (see page B397).
4. See page B403 for details on NSK TAC C Series angular contact thrust ball bearings for ball screw support.



Support Unit Reference No.	Support unit															Basic dynamic load rating C_0 [N]	Limiting static axial load [N]		
	d	D	D_1	D_2	L	L_1	L_2	A	W	X	Y	Z	d_1^*	ϕ^*	V^*			P^*	Q^*
WBK17DF-31H	17	70	106	72	60	32	15	80	88	9	14	8.5	45	3	58	M5	10	27 600	26 600
WBK20DF-31H	20	70	106	72	60	32	15	80	88	9	14	8.5	45	3	58	M5	10	27 600	26 600
WBK25DF-31H	25	85	130	90	66	33	18	100	110	11	17.5	11	57	4	70	M6	12	36 000	40 500
WBK25DFD-31H					81	48												58 500 (36 000)	81 500 (40 500)
WBK30DF-31H	30	85	130	90	66	33	18	100	110	11	17.5	11	57	4	70	M6	12	37 000	43 000
WBK30DFD-31H					81	48												59 500 (37 000)	86 000 (43 000)
WBK35DF-31H	35	95	142	102	66	33	18	106	121	11	17.5	11	69	4	80	M6	12	39 000	50 000
WBK35DFD-31H					81	48												63 500 (39 000)	100 000 (50 000)
WBK35DFF-31H					96	48												63 500	100 000
WBK40DF-31H	40	95	142	102	66	33	18	106	121	11	17.5	11	69	4	80	M6	12	40 000	52 000
WBK40DFD-31H					81	48												65 000 (40 000)	104 000 (52 000)
WBK40DFF-31H					96	48												65 000	104 000

- Notes:
1. Rigidity values in the table are theoretical values obtained from the elastic deformation between the ball groove and the balls.
 2. Starting torque values indicate torque from bearing preload. Seal torque is not included.
 3. We recommend h5 class tolerance for the shaft outside diameter of the bearing seats.
 4. Values in parentheses for basic dynamic load ratings and permissible axial loads reflect values when axial load is applied in a line.

Unit: mm

Preload C_0 [N]	Axial rigidity [N/ μ m]	Starting torque [N · cm]	Lock nut					Screwing torque (reference) [N · cm]	Bearing seat for unit			Permissible rotational speed [min^{-1}]	Mass [kg]
			Dimension				L_3		d	L_4	L_5		
M	H	D_3	L_1	L_2	L_3	d		L_4				L_5	
1 450	630	14	M17×1.0	32	37	18	4 100	17	81	23	6 900	1.9	
1 450	630	14	M20×1.0	36	40	18	4 500	20	81	23	6 900	1.9	
2 280	850	21	M25×1.5	41	45	20	8 500	25	89	26	5 200	3.1	
3 100	1 250	28							104			3.4	
2 400	890	23	M30×1.5	46	50	20	10 100	30	89	26	4 900	3.0	
3 260	1 310	30							104			3.3	
2 750	1 030	27	M35×1.5	50	55	22	13 800	35	92	30	4 100	3.4	
3 740	1 500	34							107			4.3	
5 490	2 060	43							122			5.0	
2 860	1 080	28	M40×1.5	55	60	22	15 500	40	92	30	4 100	3.6	
3 900	1 590	36							107			4.2	
5 730	2 150	46							122			4.7	

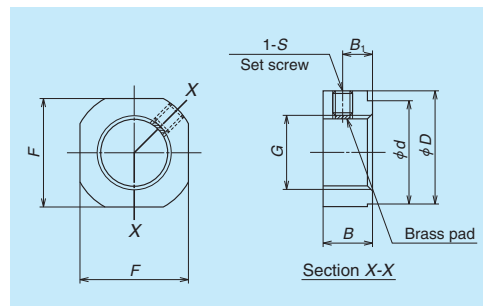
5. Dimensions marked with an asterisk (*) are used to install seal units for NSK hollow shaft ball screws; however, these can also be used to install dust covers and dampers.
6. Grease comes pre-packed in the bearing, allowing bearings to be used as is.
7. Permissible axial load is 0.7 times the limiting static axial load.
8. Contact NSK if the rotational speed will be 50 min^{-1} or less.
9. Use datum surface G_1 and G_2 for mounting to the machine base.

In addition to support units, NSK has other components for ball screws as shown below.

(3) Lock nuts

Ball screw support bearings must be installed

with minimum inclination against the ball screw center. NSK lock nuts for ball screw support bearings help to reduce this inclination.



Light load Shapes and dimensions

Light load lock nuts

Light load lock nuts

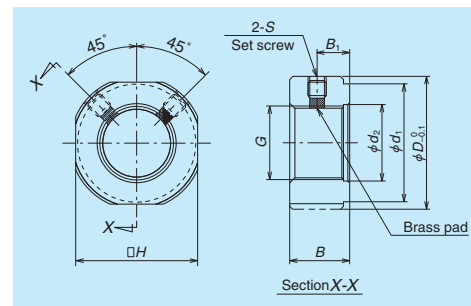
Lock nut Reference No.	G	D	F	B	d
WBK04L-01	M4x0.5	11.5	10	5	6
WBK06L-01	M6x0.75	14.5	12	5	10
WBK08L-01	M8x1	17	14	6.5	13
WBK10L-01	M10x1	20	17	8	16
WBK12L-01	M12x1	22	19	8	17
WBK15L-01	M15x1	25	22	10	21
WBK17L-01	M17x1	29	24	13	24
WBK20L-01	M20x1	35	30	13	26
WBK25L-01	M25x1.5	42	36	16	34

- Notes:** 1. Insert brass pad and then tighten securing set screw.
2. The tightening torque is a reference value when support bearings are used in a face-to-face arrangement.

High speed and heavy load lock nuts

Lock nut Reference No.	G	D _{3.1}	B	d ₁	d ₂
WBK17L-31H	M17x1	37	18	30	18
WBK20L-31H	M20x1	40	18	30	21
WBK25L-31H	M25x1.5	45	20	40	26
WBK30L-31H	M30x1.5	50	20	40	31
WBK35L-31H	M35x1.5	55	22	49	36
WBK40L-31H	M40x1.5	60	22	49	41

Note: The tightening torque is a reference value when support bearings are used in a face-to-face arrangement.



High speed and heavy load Shapes and dimensions

High speed and heavy load lock nuts

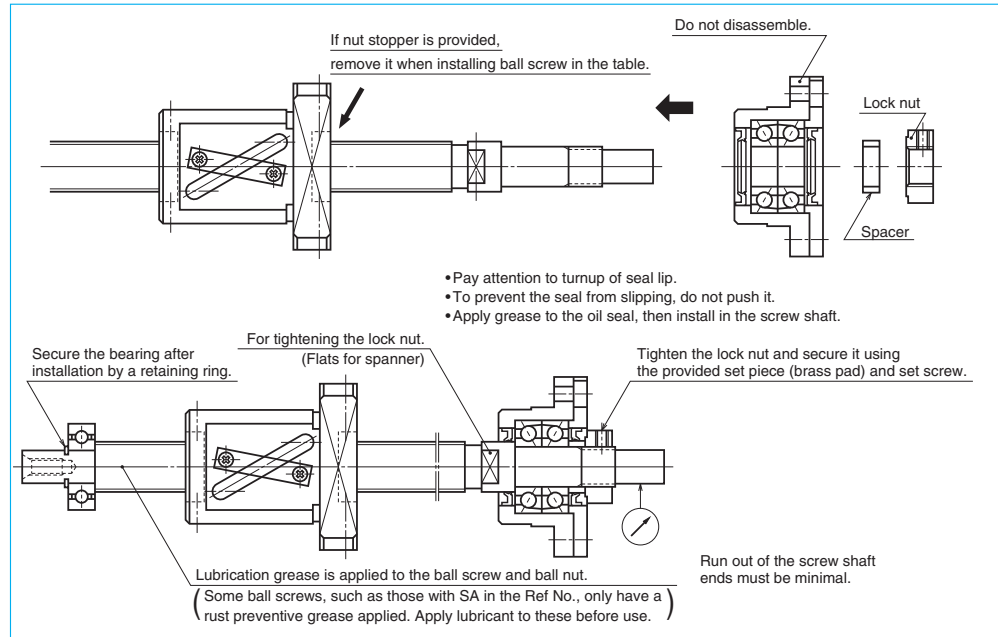
B ₁	S	Tightening torque (reference) [N · cm]	Set screw tightening torque (reference) [N · cm]	Mass (g)	Unit: mm
2.75	M3, with a brass pad	100	69 (M2.5)	3.0	
2.75	M3, with a brass pad	190	69 (M3)	3.8	
4	M3, with a brass pad	230	69 (M3)	6.4	
5	M4, with a brass pad	280	147 (M4)	11.2	
5	M4, with a brass pad	630	147 (M4)	12.8	
6	M4, with a brass pad	790	147 (M4)	20.0	
8	M4, with a brass pad	910	147 (M4)	33.1	
8	M4, with a brass pad	1 670	147 (M4)	50.0	
10	M6, with a brass pad	2 060	490 (M6)	87.0	

B ₁	H	S	Tightening torque (reference) [N · cm]	Set screw tightening torque (reference) [N · cm]	Mass (g)	Unit: mm
10	32	M6	4 100	490 (M6)	100.9	
10	36	M6	4 500	490 (M6)	117.3	
11	41	M6	8 500	490 (M6)	163.8	
11	46	M6	10 100	490 (M6)	186.7	
12	50	M6	13 800	490 (M6)	233.4	
12	55	M6	15 500	490 (M6)	258.8	

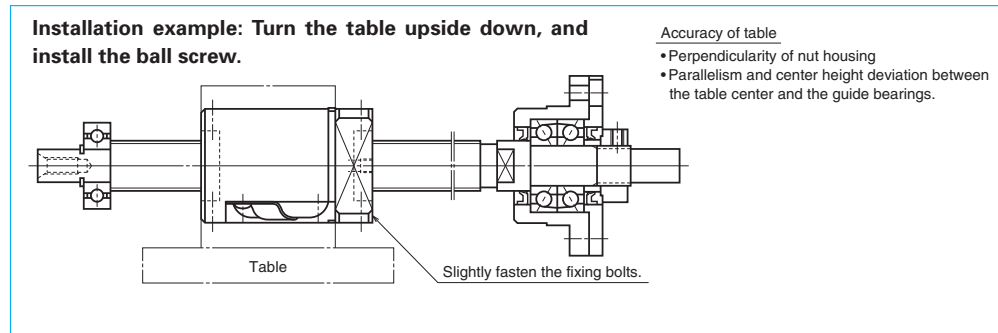
Installation of Ball Screw and Support Unit

The illustrations below show typical installation procedures for a standard ball screw and a support unit.

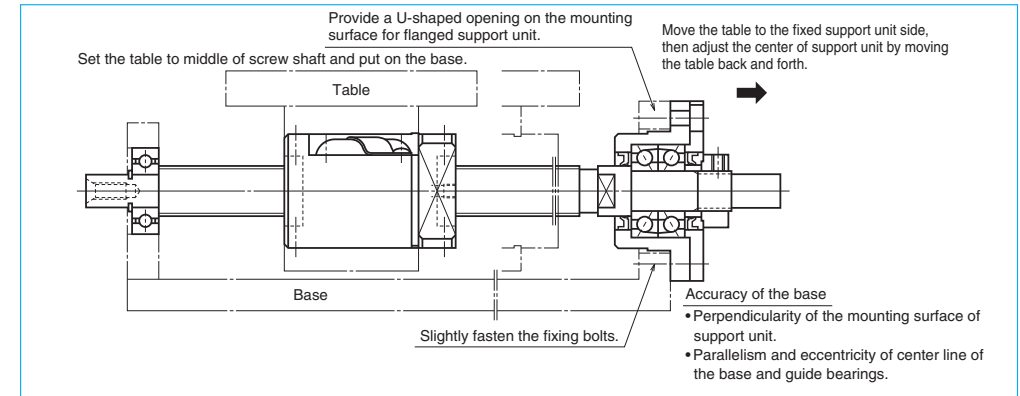
1) Assembly of support unit



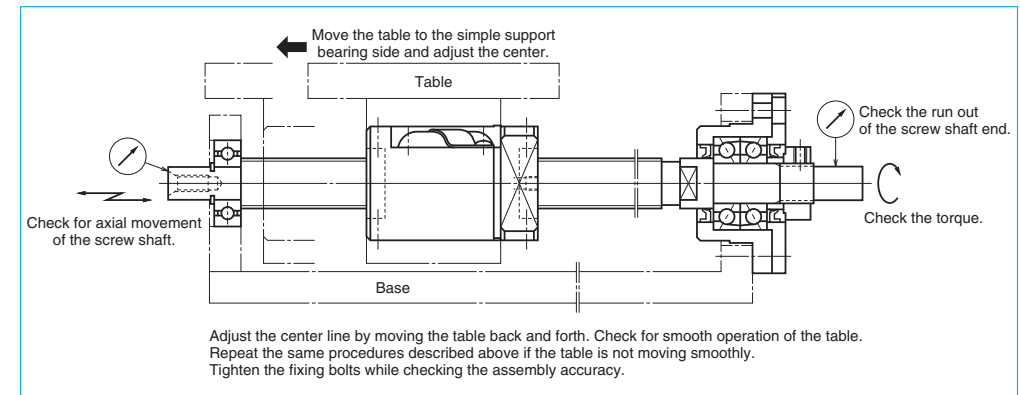
2) Installation of ball nut to the table



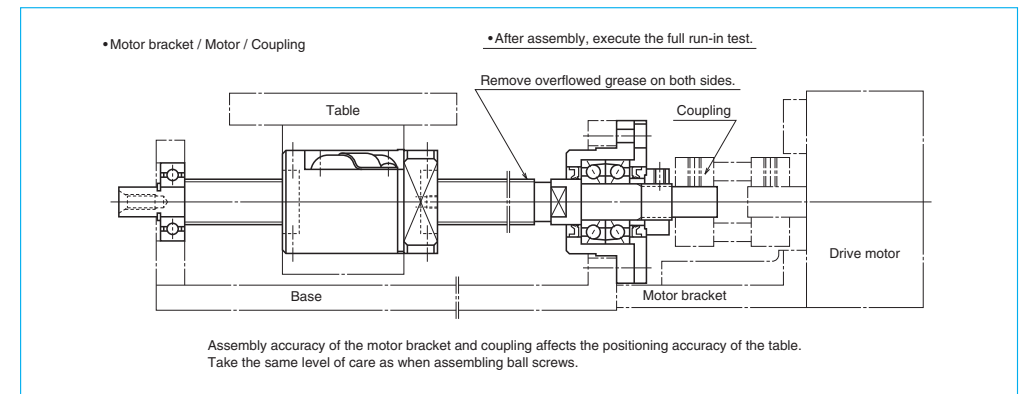
3) Base and the support unit installation on the fixed support side



4) Base and bearing installation on simple support side, and confirming assembling accuracy.



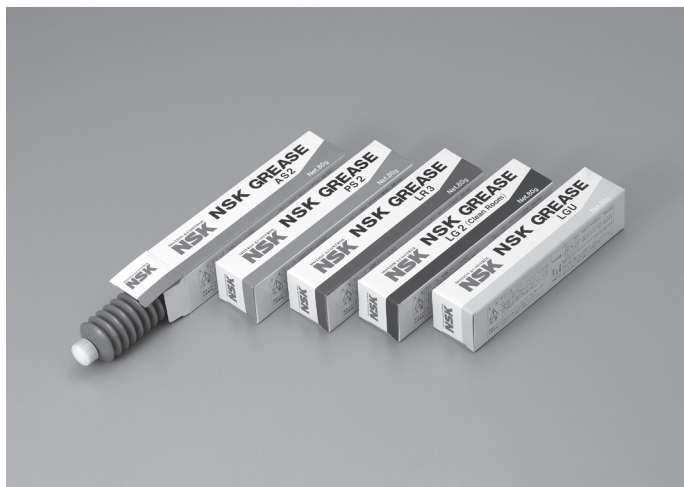
5) Assembly completed.



(4) Grease units

NSK has numerous grease types exclusive for ball screw lubrication. They come in bellows-shaped tubes, which can be attached to a hand

grease pump quickly. For details of grease types, see page D13 and for a hand grease pump and nozzles, see page D19.



NSK grease

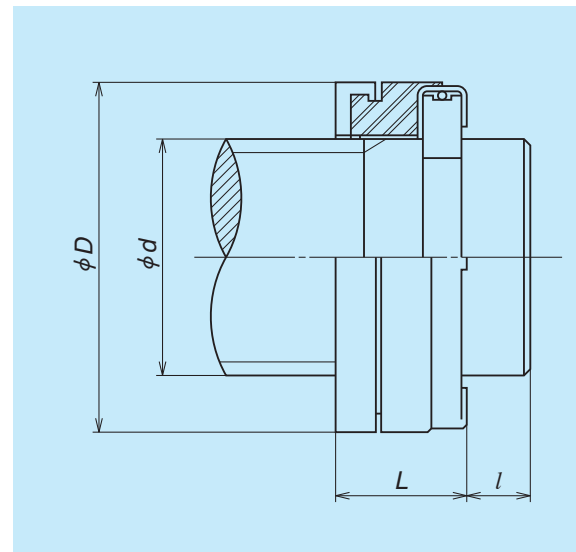
Lubricant greases

Name	Use	Base oil viscosity 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

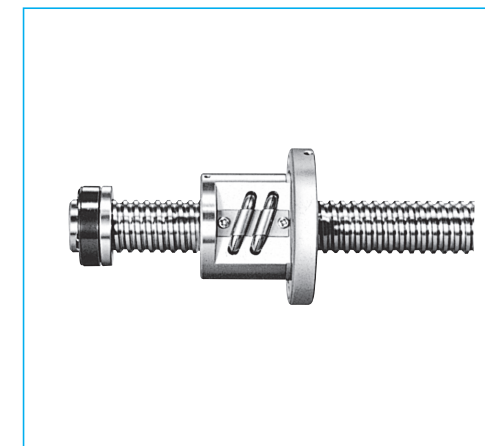
(5) Travel stoppers (made-to-order)

A travel stopper is installed in some cases to prevent the ball nut from overrunning to the end of ball thread due to a malfunction of the safety system or by human error. NSK has several series of shock-absorbing travel stoppers. The travel stopper is not sold as a standalone item since it is not for general

use. Also, a travel stopper cannot be used for ball screws with end cap ball recirculation systems because the stopper would come directly into contact with components for ball recirculation. Please request NSK for the installation of travel stoppers when ordering a ball screw.



Stopper Ref. No.	Applicable shaft dia. <i>d</i>	Outer dia. <i>D</i>	Length <i>L</i>	Unit: mm
				Shaft end width (Min.) <i>l</i>
BSR 20	20	32	16	5
BSR 25	25	38	16	5
BSR 32	32	46	20	6
BSR 40	40	60	22	6
BSR 50	50	72	24	7
BSR 63	63	85	25	7



Shock-absorbing travel stopper

(6) NSKHPS angular contact thrust ball bearings for ball screw support

1. Features

This is highly rigid and accurate ball screw support bearing often used for the machine tool driving mechanism.

Reliability has been improved by focusing on material cleanliness, which has the biggest impact on bearing life, by employing NSK's proprietary material evaluation technology. The dynamic load rating has been improved by 5% compared with that of conventional bearings.

The NSKTAC C Series features high axial rigidity and is suitable for machine tool feeding mechanisms, while the NSKTAC 03 Series with its high axial load capacity is well suited for the support of large ball screws in high-load drive applications such as electric injection molding machines. With these series, users can achieve much lower torque and higher accuracy than with roller bearings.

(a) High axial rigidity

The axial rigidity is high because of a higher contact angle of 60°

(b) Low starting torque

Compared with tapered roller bearings or cylindrical roller bearings, this type has lower starting torque; so smoother rotation is possible with driving force.

(c) Easy Installation

The clearance in each individual bearing in an arrangement is adjusted to obtain the optimum preload. With universal arrangement bearings (arrangement code SU), a specific preload is obtained when used with others having the same bearing designation in any combination (DB, DF, and others).

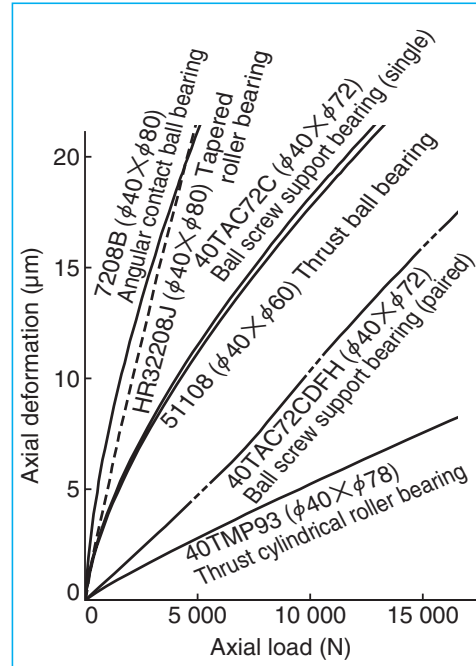


Fig. 1 Axial rigidity of various bearings

(d) Structural simplicity

Since this type can sustain both axial and radial loads, the surrounding structure is simpler and more compact than when using a combination of radial and thrust bearings.

(e) Easy handling

Since the Inner and outer rings are inseparable, handling is easy.

Table 2 Comparison with other types of bearings

Bearing type	Bearing rigidity (See Fig. 1)	Starting torque	Preload adjustment	Installation structure
Ball screw support bearings	High	Low	Not required	Simple
Combined angular contact ball bearing	Low	Low	Not required	Simple
Tapered roller bearing	Low	High	Complicated	Simple
Thrust ball bearing and radial bearing	High	Low	Complicated	Complicated
Thrust cylindrical roller bearing and radial bearing	Extremely high	Extremely high	Complicated	Complicated

Note: Consult NSK if bearings will be used for an application besides ball screw support.

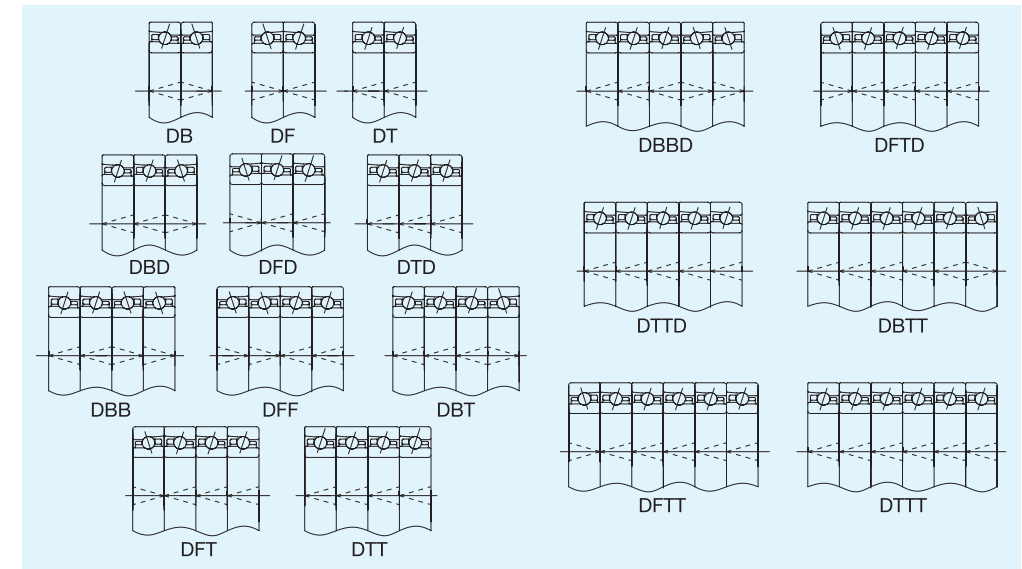
2. Bearing arrangements

Angular contact thrust ball bearings for ball screw support are generally used in two or more rows with preload applied.

Universal Arrangement Bearings

NSK manufactures universal arrangement bearings which have been controlled to have the same amount of stand-out (offset) on their front and back faces. That way, for bearings with the same bearing designation, users will achieve the specified amount for each standard preload, regardless of which combination they chose. Each universal arrangement bearing comes with a V-shaped mark on the surface of the outer ring to simplify identification of the correct direction when mounting and to ensure that the correct combination is achieved. The V-shaped mark points to the direction of the axial load that the inner ring supports (contact angle).

Arrangement Mark and Matching Method for Universal Arrangement Bearings



3. Permissible Axial Load for Angular Contact Ball Bearings

NSK has defined the limiting static axial load as the smaller of the two values listed below:

(1) Limiting axial load that produces shoulder override
The limiting load at which the contact ellipse generated between the ball and the raceway overrides the shoulder of the raceway groove (Fig. 2)

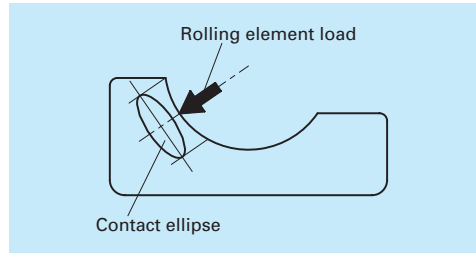


Fig. 2 Ride-over limit axial load

(2) Limiting axial load in terms of surface pressure
The limiting load at which the contact stress at the center of the contact area between the ball and the raceway groove reaches a level that leaves an indentation as defined in the basic static load rating (Fig. 3)

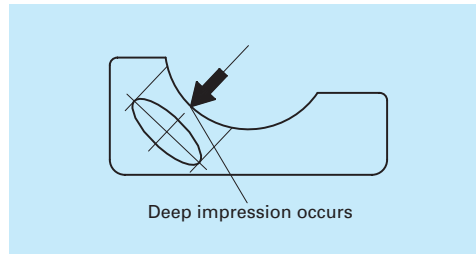


Fig. 3 Contact pressure limit axial load

To maintain optimal bearing performance, NSK has defined permissible static axial load values by applying a safety factor to the limiting axial load based on many years of experience. The formula for calculating the basic static axial load rating C_{0a} does not take the shoulder height of the raceway groove into account. Therefore, in some cases the C_{0a} value may exceed the limiting axial load that produces shoulder override.

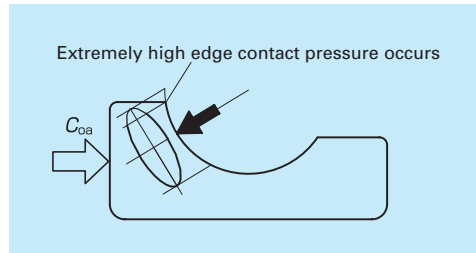


Fig. 4 C_{0a} and limit axial load

In such cases, the maximum load that the bearing can sustain is lower than the C_{0a} value, making the C_{0a} value unsuitable (Fig. 4). Therefore, instead of C_{0a} values, we have listed limiting axial load values in the bearing tables where necessary, particularly for angular contact thrust ball bearings as they are usually used to support heavy axial loads.

4. Rolling contact fatigue life

The relationship between basic load rating, bearing load, and basic rating life for the rolling bearing is presented in the following formula.

$$L_h = \frac{10^6}{60n} \left(\frac{C_0}{P} \right)^3$$

Where, L_h : Basic rating life (h)

C_0 : Basic dynamic load rating (N)

P : Dynamic equivalent load (N)

n : Rotational speed (min^{-1})

See the table on the right for dynamic equivalent load by arrangement.

Dynamic equivalent load $P_a = XF_r + YF_a$

Bearing configuration Combination code Number of load-carrying rows	Two-row		Three-row		Four-row				
	DF	DT	DFD	DTD	DFT	DFE	DFT		
$e = 2.17$	One	Two	One	Two	Three	One	Two	Three	
$F_a/F_r \leq e$	X	1.9	-	1.43	2.33	-	1.17	1.9	2.53
	Y	0.55	-	0.77	0.35	-	0.89	0.55	0.26
$F_a/F_r > e$	X	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
	Y	1	1	1	1	1	1	1	1

5. Fits

Recommended interference values for standard operating conditions of ball screws are listed in Table 3. When using angular contact thrust ball bearings for high-load drive ball screw support, in cases where a single end is supported and moment loads are high, it is advisable to increase shaft interference, for example by choosing k5 etc. as required.

Table 3 Tolerances for Shaft and Housing Bore Diameters Unit: μm

Shaft Outer Diameter, Housing Bore Diameter (mm)	Tolerance of shaft outer diameter						Tolerance of housing bore diameter		
	Angular contact thrust ball bearings for high-rigidity applications		Angular contact thrust ball bearings for high-load drive applications		Angular contact thrust ball bearings for high-load drive applications		Tolerance of housing bore diameter		
	Over	Incl.	Min.	Max.	Min.	Max.	Min.	Max.	
10	18	-	-	-8	0	-4	4	-	-
18	30	-	-	-9	0	-4.5	4.5	-	-
30	50	-	-	-10	0	-5.5	5.5	0	16
50	80	-	-	-13	0	-6.5	6.5	0	19
80	120	-	-	-	-	-7.5	7.5	0	22
120	180	-	-	-	-	-9.0	9.0	0	25
180	250	-	-	-	-	-	-	0	29
250	315	-	-	-	-	-	-	0	32
315	400	-	-	-	-	-	-	0	36

6. Bearing Accuracy

Table 4 to 6 shows accuracy for angular contact thrust ball bearings for ball screw support.

Table 4 Tolerances for angular contact thrust ball bearings NSKTAC C for high-rigidity ball screw support (Class PN7C⁽¹⁾) Unit: μm

Nominal Bore (Outside) Diameter $d(D)$ (mm)	Single Plane Mean Bore Diameter Deviation Δ_{dmp}		Deviation of Single Bore Diameter Δ_{ds}		Single Plane Mean Outside Diameter Deviation Δ_{Dmp}		Deviation of Single Outside Diameter Δ_{Ds}		Deviation of Single Inner Ring Width Δ_{bs}		Axial Runout of Inner (Outer) Ring of Assembled Bearing $S_a (S_{oa})$	
	Over	Incl.	High	Low	High	Low	High	Low	High	Low	Max.	
10	18	0	-4	0	-4	-	-	-	0	-120	2.5	
18	30	0	-5	0	-5	-	-	-	0	-120	2.5	
30	50	0	-6	0	-6	0	-6	0	-6	0	-120	2.5
50	80	0	-7	0	-7	0	-7	0	-7	0	-150	2.5
80	120	-	-	-	-	0	-8	0	-8	-	-	2.5

Note: 1. NSK specification

Table 5 Tolerances for angular contact thrust ball bearings NSKTAC 03 for high-load drive applications ball screw support (Class PN5D⁽²⁾) Unit: μm

Nominal Bore (Outside) Diameter $d(D)$ (mm)	Single Plane Mean Bore Diameter Deviation Δ_{dmp}		Single Plane Mean Outside Diameter Deviation Δ_{Dmp}		Deviation of Single Inner Ring Width Δ_{bs}		Axial Runout of Inner (Outer) Ring of Assembled Bearing $S_a (S_{oa})$	
	Over	Incl.	High	Low	High	Low	Max.	
10	18	0	-5	-	-	0	-80	5
18	30	0	-6	-	-	0	-120	5
30	50	0	-8	0	-7	0	-120	5
50	80	0	-9	0	-9	0	-150	8
80	120	0	-10	0	-10	0	-200	8
120	150	0	-13	0	-11	0	-250	10
150	180	0	-13	0	-13	0	-250	10
180	250	-	-	0	-15	-	-	10
250	315	-	-	0	-18	-	-	11
315	400	-	-	0	-20	-	-	13

Note: 2. NSK specification

Table 6 Tolerances for BSBD Series double-row bearings (Class P2B⁽³⁾ BSF and BSN series) Unit: μm

Nominal Bore (Outside) Diameter $d(D)$ (mm)	Single Plane Mean Bore Diameter Deviation Δ_{dmp}		Single Plane Mean Outside Diameter Deviation Δ_{Dmp}		Axial Runout of Inner Ring of Assembled Bearing S_a	Radial Runout of Assembled Big. Inner Ring K_a	Width Tolerance		
	Over	Incl.	High	Low	Max.	Max.	High	Low	
10	18	0	-5	0	-10	1.5	1.5	0	-250
18	30	0	-5	0	-10	2.5	2.5	0	-250
30	50	0	-5	0	-10	2.5	2.5	0	-250
50	80	0	-8	0	-15	2.5	2.5	0	-250

Note: 3. NSK specification

NSKTAC C Angular Contact Thrust Ball Bearings for Ball Screw Support in High-Rigidity Applications

A larger number of balls and a 60° contact angle provide high axial rigidity and make these bearings ideally suited for machine tool feeding mechanisms.

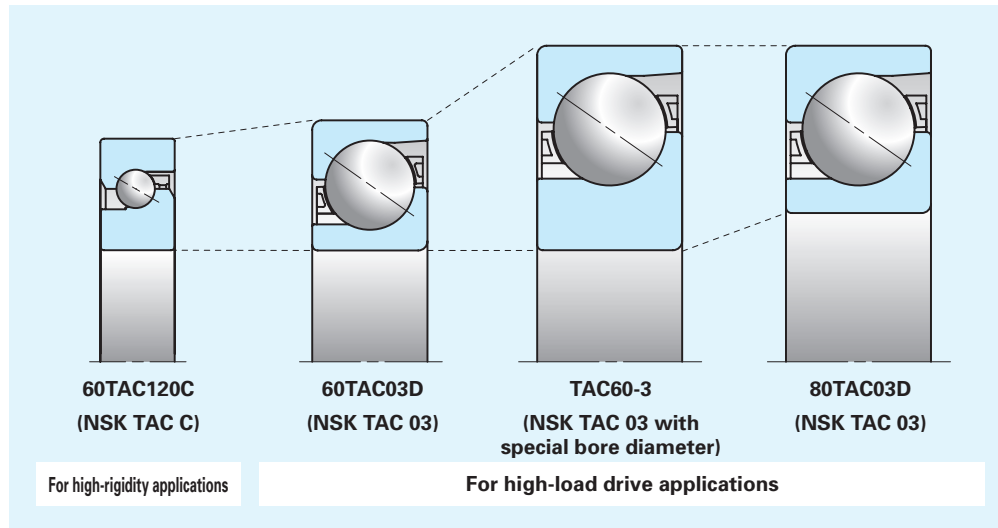
The “DDG” seals used for the sealed bearings of this series are light-contact seals for high-speed capability; a strong sealing effect is achieved by a labyrinth between the seal lip and the seal groove of the inner ring. This ensures that no foreign particles can get into the bearing and no grease can leak out, thus helping to keep the surrounding area clean. Some bearings from this series are also available as non-contact sealed bearings for even lower torque and lower heat generation.

For ease of handling and increased efficiency, NSKTAC C bearings come prepacked with “WPH” grease that resists high temperatures and is less likely to soften and leak.

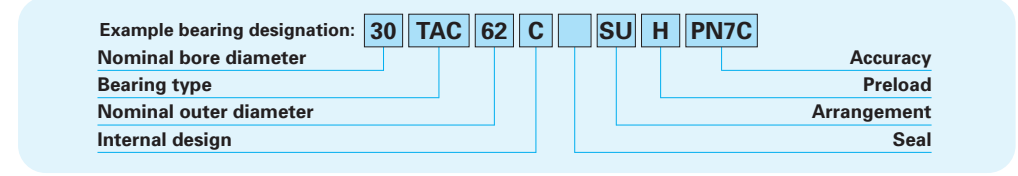
NSKTAC 03 Angular Contact Thrust Ball Bearings for Ball Screw Support in High-Load Drive Applications

An optimized internal design has led to a higher limiting axial load. The number of rows may be reduced, contributing to smaller sized equipment. We also offer bearings with special bore diameters. That way, bearings with higher load capacity may be employed without any need to modify the shaft diameter, allowing for more compact screw shaft ends.

To confirm the suitability of this series for other applications, please ask NSK.

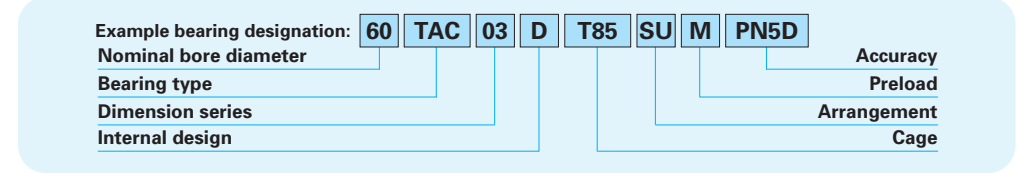


Designations of NSKTAC C Angular Contact Thrust Ball Bearings for Ball Screw Support in High-Rigidity Applications



30	Nominal bore diameter	Bore diameter (mm)
TAC	Bearing type	Angular contact thrust ball bearing
62	Nominal outer diameter	Outer diameter (mm)
C	Internal design	Contact angle 60°
	Seal	No symbol: Open type DDG: Contact rubber seal V1V: Non-contact rubber seal
SU	Arrangement	SU: Universal arrangement (single-row)
H	Preload	H: Heavy preload (standard in the HPS Models)
PN7C	Accuracy	PN7C: NES Class 7C (axial runout equivalent to P2)

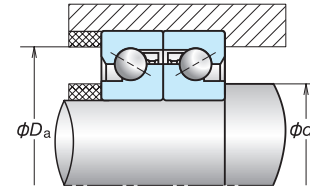
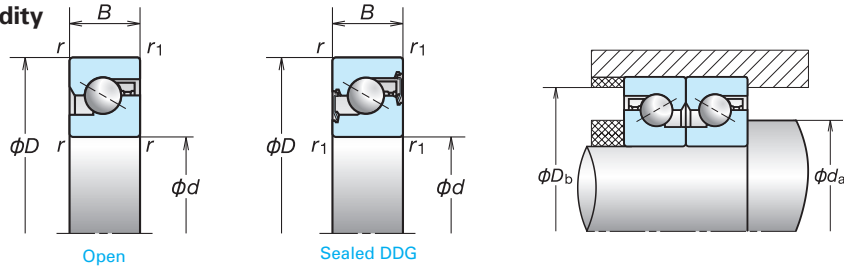
Designations of NSKTAC 03 Angular Contact Thrust Ball Bearings for Ball Screw Support in High-Load Drive Applications



60	Nominal bore diameter	Bore diameter (mm)
TAC	Bearing type	Angular contact thrust ball bearing
03	Dimension series	02: 02 Series 03: 03 Series
D	Internal design	Contact angle 55°
T85	Cage	T85: Polyamide cage M: Brass Cage
SU	Arrangement	SU: Universal arrangement (single-row)
M	Preload	M: Medium preload EL: Extra light preload
PN5D	Accuracy	PN5D: Standard accuracy (equivalent to ISO Class 5)

NSKHPS is not applicable for TAC160-3 and 180TAC03D.

for High-Rigidity



Calculation of preload, axial rigidity and starting torque for bearing arrangements
Multiply by factors in table B.

Table B	DFD	DF	DFT
	DBD	DBB	DBT
Preload factor	1.36	2.00	1.57
Axial rigidity	1.49	2.00	1.89
Starting torque	1.35	2.00	1.55

(Open)

Bearing Designation	Boundary Dimensions (mm)				Abutment and Fillet Dimensions (mm)				Recommended Grease Quantity (cc)	Contact Angle (°)	Limiting Speeds ⁽²⁾ (min ⁻¹)		Mass (kg) (approx.)	
	d	D	B	r (Min.)	r ₁ (Min.)	D _b (Max.)	d _i (Min.)	D _a (Max.)			d _b (Min.)	Grease		Oil
17TAC47C	17	47	15	1	0.6	42	23	41	23	2.2	60	6 900	9 200	0.140
20TAC47C	20	47	15	1	0.6	42	25	41	25	2.2	60	6 900	9 200	0.135
25TAC62C	25	62	15	1	0.6	57	31	56	31	3.0	60	5 200	6 900	0.252
30TAC62C	30	62	15	1	0.6	57	36	56	36	3.2	60	4 900	6 400	0.224
35TAC72C	35	72	15	1	0.6	67	42	66	42	3.8	60	4 100	5 800	0.310
40TAC72C	40	72	15	1	0.6	67	47	66	47	3.9	60	4 100	5 500	0.275
40TAC90C	40	90	20	1	0.6	85	48	84	48	8.8	60	3 500	4 600	0.674
45TAC75C	45	75	15	1	0.6	68	54	67	54	4.2	60	3 700	4 900	0.270
45TAC100C	45	100	20	1	0.6	93	55	92	55	9.7	60	3 000	4 100	0.842
50TAC100C	50	100	20	1	0.6	92	60	91	60	10.2	60	3 000	3 900	0.778
55TAC100C	55	100	20	1	0.6	92	63	91	63	10.2	60	3 000	3 900	0.714
55TAC120C	55	120	20	1	0.6	112	63	111	63	12	60	2 500	3 500	1.23
60TAC120C	60	120	20	1	0.6	112	70	111	70	12	60	2 500	3 500	1.16

(Sealed)

Bearing Designation ⁽¹⁾	Boundary Dimensions (mm)				Abutment and Fillet Dimensions (mm)				Contact Angle (°)	Limiting Speeds (min ⁻¹)		Mass (kg) (approx.)
	d	D	B	r (Min.)	r ₁ (Min.)	D _b (Max.)	d _i (Min.)	D _a (Max.)		d _b (Min.)	Grease	
* 17TAC47CDDG	17	47	15	1	0.6	42	22	41	22	60	6 900	0.140
* 20TAC47CDDG	20	47	15	1	0.6	42	25	41	25	60	6 900	0.135
* 25TAC62CDDG	25	62	15	1	0.6	57	30	56	30	60	5 200	0.252
30TAC62CDDG	30	62	15	1	0.6	57	36	56	36	60	4 900	0.224
35TAC72CDDG	35	72	15	1	0.6	67	41	66	41	60	4 100	0.310
40TAC72CDDG	40	72	15	1	0.6	67	46	66	46	60	4 100	0.275
40TAC90CDDG	40	90	20	1	0.6	85	47	84	47	60	3 500	0.674
45TAC100CDDG	45	100	20	1	0.6	93	54	92	54	60	3 000	0.842
50TAC100CDDG	50	100	20	1	0.6	92	59	91	59	60	3 000	0.778
55TAC100CDDG	55	100	20	1	0.6	92	63	91	63	60	3 000	0.714

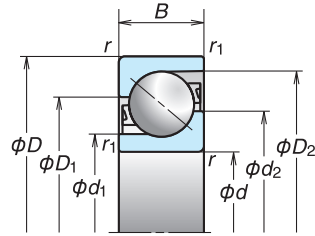
- Note: 1. An asterisk (*) indicates bearings that are also available as non-contact sealed bearings.
 2. Limiting speeds are based on high preload (H). The values shown are valid for all types of bearing arrangements.
 3. To calculate permissible axial load, multiply limiting axial load by 0.7.

Preload (DB and DF Arrangements) (N)	Axial Rigidity (DB and DF Arrangements) (N/μm)	Starting Torque (DB and DF Arrangements) ⁽⁴⁾ (N-m)(reference)	Basic Dynamic Load Rating C _r by Number of Rows Sustaining F _r			Limiting Axial Load by Number of Rows Sustaining F _a ⁽⁵⁾		
			1 row (kN)	2 rows (kN)	3 rows (kN)	1 row (kN)	2 rows (kN)	3 rows (kN)
H	H	H	1 row (kN)	2 rows (kN)	3 rows (kN)	1 row (kN)	2 rows (kN)	3 rows (kN)
1 450	630	0.09	27.6	45.0	59.5	26.6	53.0	79.5
1 450	630	0.09	27.6	45.0	59.5	26.6	53.0	79.5
1 450	630	0.09	27.6	45.0	59.5	26.6	53.0	79.5
2 280	850	0.15	36.0	58.5	77.5	40.5	81.5	122
2 400	890	0.16	37.0	59.5	79.5	43.0	86.0	129
2 750	1 030	0.18	39.0	63.5	84.5	50.0	100	150
2 860	1 080	0.19	40.0	65.0	86.5	52.0	104	157
3 450	1 150	0.29	74.5	121	160	89.5	179	269
3 100	1 170	0.20	41.5	67.0	89.5	57.0	114	170
4 440	1 340	0.40	77.5	126	167	99.0	198	298
4 650	1 410	0.42	79.0	129	171	104	208	310
4 650	1 410	0.42	79.0	129	171	104	208	310
5 450	1 660	0.49	85.0	138	183	123	246	370
5 450	1 660	0.49	85.0	138	183	123	246	370

Preload (DB and DF Arrangements) (N)	Axial Rigidity (DB and DF Arrangements) (N/μm)	Starting Torque (DB and DF Arrangements) ⁽⁴⁾ (N-m)(reference)	Basic Dynamic Load Rating C _r by Number of Rows Sustaining F _r			Limiting Axial Load by Number of Rows Sustaining F _a ⁽⁵⁾		
			1 row (kN)	2 rows (kN)	3 rows (kN)	1 row (kN)	2 rows (kN)	3 rows (kN)
H	H	H	1 row (kN)	2 rows (kN)	3 rows (kN)	1 row (kN)	2 rows (kN)	3 rows (kN)
1 450	630	0.09	27.6	45.0	59.5	26.6	53.0	79.5
1 450	630	0.09	27.6	45.0	59.5	26.6	53.0	79.5
1 450	630	0.09	27.6	45.0	59.5	26.6	53.0	79.5
2 280	850	0.15	36.0	58.5	77.5	40.5	81.5	122
2 400	890	0.16	37.0	59.5	79.5	43.0	86.0	129
2 750	1 030	0.18	39.0	63.5	84.5	50.0	100	150
2 860	1 080	0.19	40.0	65.0	86.5	52.0	104	157
3 450	1 150	0.29	74.5	121	160	89.5	179	269
4 440	1 340	0.40	77.5	126	167	99.0	198	298
4 650	1 410	0.42	79.0	129	171	104	208	310
4 650	1 410	0.42	79.0	129	171	104	208	310

4. The starting torque values in the table apply to grease lubricated bearings. Contact seal torque is not included. For oil lubricated bearings, multiply by 1.4.
 5. Abutment and fillet dimensions are recommended values for standard machine tool applications. For heavy load applications, please contact NSK.

for High-Load Drive Applications



Multi-row arrangement calculations

Calculation of preload, axial rigidity and starting torque for bearing arrangements
Multiply by factors in Table B.

Table B

Number of load-sustaining rows	2 rows		3 rows			4 rows		5 rows
	DFD ⊗⊗	DFD ⊗⊗⊗	DFT ⊗⊗⊗	DFFD ⊗⊗⊗⊗	DFFF ⊗⊗⊗⊗⊗	DFTD ⊗⊗⊗⊗	DFFT ⊗⊗⊗⊗⊗	DFTT ⊗⊗⊗⊗⊗⊗
Preload factor	1.36	2.00	1.57	2.42	3.00	1.72	2.72	1.83
Axial rigidity	1.49	2.00	1.89	2.51	3.00	2.24	2.97	2.57
Starting torque	1.35	2.00	1.55	2.41	3.00	1.68	2.71	1.77

Bearing Designation ⁽¹⁾	Boundary Dimensions (mm)					Reference Dimensions (mm)				Recommended Grease Quantity (cc/row)	Contact Angle (°)	Limiting Speeds ⁽²⁾ (min ⁻¹)		Mass (kg) (approx.)
	d	D	B	r (Min.)	r ₁ (Min.)	d ₁	d ₂	D ₁	D ₂			Grease	Oil	
	15TAC02D	15	35	11	0.6	0.3	19.1	24.5	26	31.9	1	55	12 000	14 800
20TAC03D	20	52	15	1.1	0.6	27.2	35.3	37.5	46.1	2.7	55	8 300	10 300	0.155
25TAC02D	25	52	15	1	0.6	30.8	38.1	39.6	47.3	3	55	7 700	9 700	0.137
TAC35-3	35	90	23	1.5	1	50.4	64.2	67.1	81.7	14	55	4 600	6 000	0.712
40TAC03D	40	90	23	1.5	1	50.4	64.2	67.1	81.7	14	55	4 600	5 700	0.659
TAC40-3	40	110	27	2	1	62	79.1	82.4	100.6	25	55	3 700	5 000	1.28
45TAC03D	45	100	25	1.5	1	56.5	71.7	74.7	90.8	18	55	4 100	5 200	0.877
TAC45-3	45	110	27	2	1	62	79.1	82.4	100.6	25	55	3 700	4 800	1.21
50TAC03D	50	110	27	2	1	62	79.1	82.4	100.6	25	55	3 700	4 700	1.14
TAC50-3	50	130	31	2.1	1.1	73.9	93.8	98	119	40	55	3 100	4 200	2.00
55TAC03D	55	120	29	2	1	68	86.4	90.2	109.7	32	55	3 400	4 300	1.44
60TAC03D	60	130	31	2.1	1.1	73.9	93.8	98	119	40	55	3 100	3 900	1.80
TAC60-3	60	170	39	2.1	1.1	98.5	123.6	128.7	157.5	85	55	2 400	3 300	4.47
70TAC03D	70	150	35	2.1	1.1	86.3	108.6	113.4	137.8	59	55	2 700	3 400	2.67
75TAC03D	75	160	37	2.1	1.1	92.4	116.2	121	146.2	67	55	2 500	3 200	3.20
80TAC03D	80	170	39	2.1	1.1	98.5	123.6	128.7	157.5	85	55	2 400	3 000	3.80
TAC80-3	80	215	47	3	1.1	124	154.9	160.4	194.5	156	55	1 900	2 600	8.66
100TAC03D	100	215	47	3	1.1	124	154.9	160.4	194.5	156	55	1 900	2 400	7.54
TAC100-3	100	260	55	3	1.1	150.5	186.9	193.4	231.7	254	55	1 500	2 100	14.8
120TAC03D	120	260	55	3	1.1	150.5	186.9	193.4	231.7	254	55	1 500	2 000	13.3
* TAC120-3M	120	300	62	4	1.5	170.8	215.3	224.1	265.7	336	55	1 300	1 800	24.5
* 140TAC03DM	140	300	62	4	1.5	170.8	215.3	224.1	265.7	336	55	1 300	1 700	22.5
* TAC140-3M	140	340	68	4	1.5	197.5	246.2	254.3	298.8	442	55	1 200	1 600	34.5
* 160TAC03DM	160	340	68	4	1.5	197.5	246.2	254.3	298.8	442	55	1 200	1 500	32.0
* TAC160-3M	160	380	75	4	1.5	221.1	275.6	284.9	334.9	624	55	1 000	1 400	46.8
* 180TAC03DM	180	380	75	4	1.5	221.1	275.6	284.9	334.9	624	55	1 000	1 400	43.7

Preload ⁽³⁾ (DB and DF Arrangements) (N)	Axial Rigidity ⁽³⁾ (DB and DF Arrangements) (N/μm)	Starting Torque ⁽⁴⁾ (DB and DF Arrangements) (N-m)	Basic Dynamic Load Rating C _r by Number of Rows Sustaining F _r					Limiting static axial load by Number of Rows Sustaining F _s ⁽⁵⁾				
			1 row (kN)	2 rows (kN)	3 rows (kN)	4 rows (kN)	5 rows (kN)	1 row (kN)	2 rows (kN)	3 rows (kN)	4 rows (kN)	5 rows (kN)
			400	290	0.017	25.1	41.0	54.0	66.5	77.5	18.6	37.5
830	430	0.026	51.0	83.0	110	135	158	38.5	77.0	116	154	193
690	430	0.036	44.5	72.0	95.5	117	137	36.0	72.5	109	145	181
2 500	780	0.26	136	221	293	360	420	118	235	355	470	590
2 500	780	0.26	136	221	293	360	420	118	235	355	470	590
3 900	970	0.50	200	325	430	525	615	181	360	540	720	905
2 800	830	0.31	160	259	345	420	495	142	283	425	565	710
3 900	970	0.50	200	325	430	525	615	181	360	540	720	905
3 900	970	0.50	200	325	430	525	615	181	360	540	720	905
5 200	1 120	0.78	261	425	565	690	805	242	485	725	965	1 210
4 280	1 060	0.68	228	370	490	600	705	210	420	630	840	1 050
5 200	1 120	0.78	261	425	565	690	805	242	485	725	965	1 210
8 050	1 400	1.5	365	595	790	965	1 130	390	775	1 170	1 550	1 940
6 400	1 250	1.1	315	510	680	830	970	305	615	920	1 230	1 530
7 230	1 330	1.3	340	550	735	895	1 050	345	690	1 040	1 380	1 730
8 050	1 400	1.5	365	595	790	965	1 130	390	775	1 170	1 550	1 940
1 240	880	0.15	505	820	1 090	1 330	1 560	510	1 020	1 530	2 040	2 550
1 240	880	0.15	505	820	1 090	1 330	1 560	510	1 020	1 530	2 040	2 550
1 620	1 050	0.21	625	1 020	1 350	1 650	1 930	680	1 360	2 040	2 720	3 400
1 620	1 050	0.21	625	1 020	1 350	1 650	1 930	680	1 360	2 040	2 720	3 400
1 710	1 130	0.24	765	1 240	1 650	2 020	2 360	794	1 590	2 380	3 200	3 950
1 710	1 130	0.24	765	1 240	1 650	2 020	2 360	794	1 590	2 380	3 200	3 950
1 850	1 240	0.27	870	1 420	1 880	2 300	2 690	1 040	2 080	3 100	4 150	5 200
1 850	1 240	0.27	870	1 420	1 880	2 300	2 690	1 040	2 080	3 100	4 150	5 200
1 940	1 310	0.30	1 030	1 670	2 220	2 710	3 150	1 360	2 720	4 100	5 450	6 800
1 940	1 310	0.30	1 030	1 670	2 220	2 710	3 150	1 360	2 720	4 100	5 450	6 800

- Note: 1. An asterisk (*) indicates bearings that are also available equipped with screw holes for mounting bolts.
- 2. Limiting speeds are based on the standard preload of each bearing. The values shown are valid for all types of bearing arrangements.
- 3. Preload values for bearings with a bore diameter of 100 mm or more as well as for TAC80-3 are based on EL preload.

- 4. The starting torque values in the table apply to grease lubrication.
- 5. To calculate permissible axial load, multiply limiting static axial load by 0.7.

1. End Deflector Recirculation **B415**
2. SRC Recirculation **B425**
3. Tube Recirculation **B429**
4. Deflector (Bridge) Recirculation **B461**
5. High-speed Low-noise
Deflector Recirculation **B475**

B-3-2 Dimension Tables and Reference Numbers for Ball Screws With Standard Nuts

B-3-2.1 End Deflector Recirculation Ball Screws

1. Features

●Quiet operation

The average noise level is reduced by more than 6 dB(A) compared with our existing products. At low-speed rotation, the ball screws are nearly silent, while their noise is unprecedentedly low at high-speed rotation.

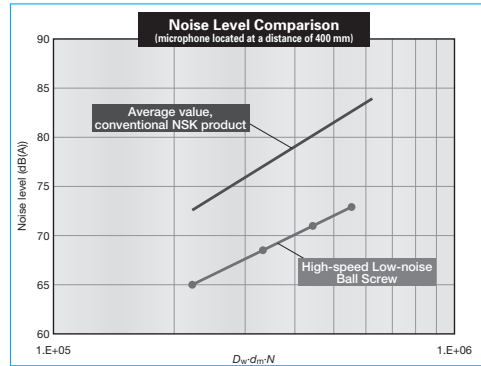


Fig. 1 Comparison of noise level

●High-speed operation

Realizes a $d \cdot n$ value of 180 000, outstanding for ball screws and far surpassing the 100 000 $d \cdot n$ performance of existing tube recirculation products. For high-lead ball screws, high-speed operation at over 200 m/min is also possible.

●Compact

The external diameter of the ball nut is 30% smaller than our existing models. Compact configurations are possible for low-profile XY tables as well as for other devices and equipment.

●Grease fitting provided as standard equipment

Ball screws with shaft diameters equal to or less than $\phi 25$ are equipped with a grease fitting (M5 \times 0.8) as a standard. Lubrication ports are provided in 2 places for ease of maintenance. The ball screws can be easily connected to an integrated lubrication system.

2. Specifications

(1) Ball recirculation system

Fig. 2 shows the structure of a end-deflector recirculation system.

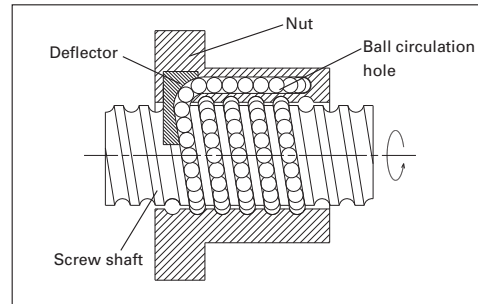


Fig. 2 Structure of end-deflector recirculation system

(2) Accuracy grade and axial play

The available standard accuracy grades and axial play are as follows. Please consult NSK for other grades.

Table 1 Accuracy grade and axial play

Accuracy grade	C0, C1, C2, C3, C5, Ct7
Axial play	Z, 0 mm (preloaded); T, 0.005 mm or less; S, 0.020 mm or less; N, 0.050 mm or less

(3) Allowable $d \cdot n$ value and the criterion of maximum rotational speed

The allowable $d \cdot n$ value and criterion of maximum rotational speed are shown below. Please consult NSK if the rotational speed exceeds the permissible range below.

Allowable $d \cdot n$ value : 180 000 or less
Standard of rotational speed: 5 000 min⁻¹

Note: Please also review the critical speed. See "Technical Description: Permissible Rotational Speed" (page B47) for details.

(4) Seal

A compact and thin plastic seal is used. Nut outside diameter is compact compared with tube recirculation systems.

(5) Options

An optional NSK K1 lubrication unit, molded from resin and saturated with lubrication oil, supplies fresh oil onto ball rolling surfaces, ensuring long-term, maintenance-free operation. Please contact NSK when using NSK K1.

3. Design precaution

When designing the shaft end of a ball screw with a diameter is 25 mm or less or 32 mm or over and the lead is the same as its shaft diameter, one end of the screw must meet one of the following conditions. If not, we cannot

install the ball nut on the screw shaft.

- Cut the ball groove through to the shaft end.
- The diameters of bearing journals and the gear or pulley seat must be less than the root diameter of ball groove d_r specified on the dimension table.

For general precautions regarding ball screws, refer to "Design Precautions"(page B83) and "Handling Precautions"(page B103).

4. Lineup

End deflector ball screws are available in the following varieties:

Table 2 End-deflector ball screw lineup

Nut	Shape	Flange shape	Nut shape	Preload
BSS		Circular II, III	Circular	No preload, Slight axial play
				P-preload (light preload)

5. Structure of model number and reference number

The following explains the codes used in model numbers and ball screw reference numbers.

◇Model number

BSS 10 10 - 2E

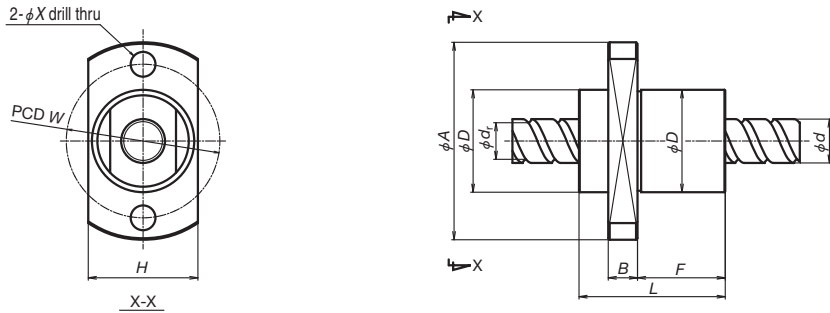
Nut: BSS Screw shaft diameter (mm) Effective ball turns Lead (mm)

◇Reference number for ball screws

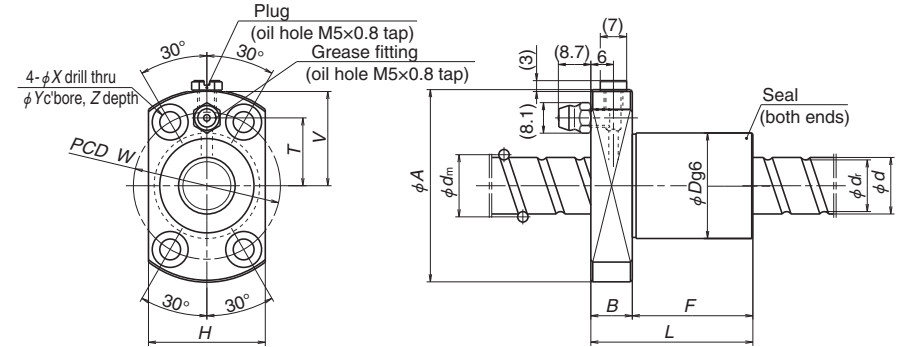
W 10 01 - ** P SS - C5 Z 10

Product code Screw shaft diameter (mm) Effective threaded length (in 100 mm units) NSK design serial number Preload code: No code, no preload; P, P-preload (page B5)

Lead (mm) Axial play code: Z, T, S, N (page B20) Accuracy grade: C0, C1, C2, C3, C5, C7 (Ct7) (page B37 to B42) End-deflector recirculation system



Shape I



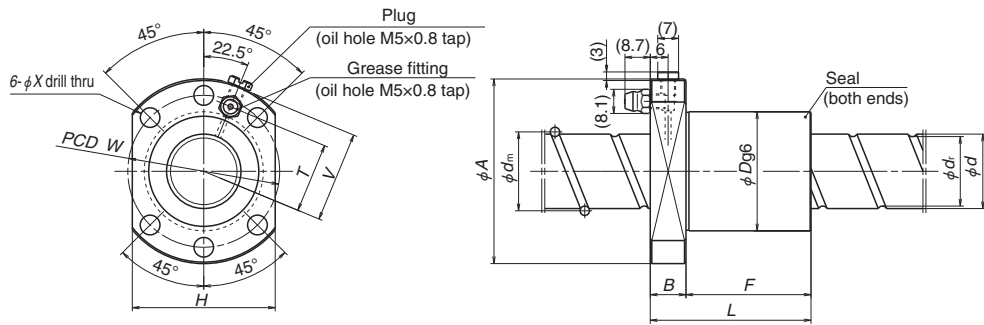
Shape II

Model No.	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D_w</i>	Ball circle dia. <i>d_m</i>	Root dia. <i>d_r</i>	Effective ball turns	Basic load ratings (N)		Axial rigidity <i>K</i> (N/μm)	Shape
							Dynamic <i>C_d</i>	Static <i>C_{st}</i>		
BSS0608-2E	6	8	1.2	6.2	4.9	2	690	805	32	I
BSS0608-4E		8	1.2	6.2	4.9	4	1 480	1 940	75	I
BSS0612-2E		12	1.2	6.2	4.9	2	665	800	29	I
BSS0612-4E		12	1.2	6.2	4.9	4	1 430	1 790	69	I
BSS0810-2E	8	10	1.588	8.3	6.6	2	1 150	1 420	43	I
BSS0810-4E		10	1.588	8.3	6.6	4	2 470	3 430	99	I
BSS0815-2E		15	1.588	8.3	6.6	2	1 130	1 430	40	I
BSS0815-4E		15	1.588	8.3	6.6	4	2 410	3 520	93	I
BSS1005-3E	10	5	2.000	10.3	8.2	3	3 420	4 840	133	II
BSS1010-2E		10	2.000	10.3	8.2	2	2 290	2 980	81	II
BSS1205-3E	12	5	2.000	12.3	10.2	3	3 750	5 810	154	II
BSS1210-3E		10	2.000	12.3	10.2	3	3 760	5 780	150	II
BSS1215-2EG		15	2.381	12.3	9.8	2	3 030	4 270	93	II
BSS1220-2E		20	2.000	12.3	10.2	2	2 330	3 600	86	II
BSS1220-2EG		20	2.381	12.3	9.8	2	2 960	4 340	89	II
BSS1230-2E		30	2.000	12.3	10.2	2	2 190	3 650	75	II
BSS1505-3E	15	5	2.778	15.5	12.6	3	6 410	10 100	193	II
BSS1510-3E		10	2.778	15.5	12.6	3	6 530	10 200	192	II
BSS1510-3EG		10	3.175	15.5	12.2	3	8 700	13 800	219	II
BSS1520-2ES		20	2.778	15.5	12.6	2	4 220	6 400	115	II
BSS1520-2E		20	3.175	15.5	12.2	2	5 660	8 700	132	II
BSS1530-2E		30	3.175	15.5	12.2	2	5 500	8 580	119	II
BSS2005-3E	20	5	3.175	20.5	17.2	3	10 400	18 500	284	II
BSS2006-3E		6	3.175	20.5	17.2	3	10 300	18 800	286	II
BSS2008-3E		8	3.175	20.5	17.2	3	10 300	18 700	284	II
BSS2010-3E		10	3.175	20.5	17.2	3	10 200	18 600	281	II
BSS2010-3EG		10	3.969	21	16.9	3	14 200	23 500	296	II
BSS2012-3E		12	3.175	20.5	17.2	3	10 200	18 500	279	II
BSS2020-2E		20	3.175	20.5	17.2	2	6 790	11 800	175	II
BSS2020-2EG		20	3.969	20.5	16.4	2	9 120	14 100	176	II
BSS2030-2E		30	3.175	20.5	17.2	2	6 550	11 800	164	II
BSS2040-2E		40	3.175	20.5	17.2	2	6 380	11 600	151	II
BSS2060-2E		60	3.175	20.5	17.2	2	5 680	11 800	126	II

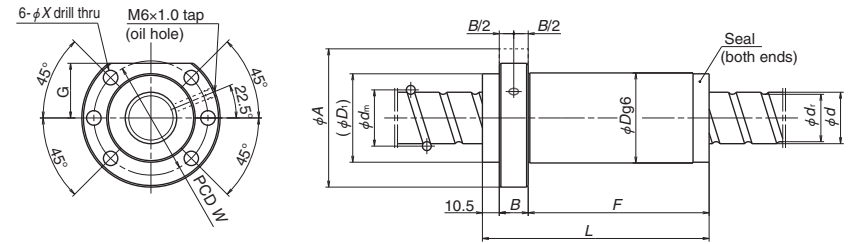
Note: 1) The axial rigidity *K* in the table above is a theoretical value derived from elastic deformation between screw grooves and balls when axial load is applied to a ball nut for which preload is set at 3% of the basic dynamic load rating (*C_d*).
2) The standard Compact FA PSS model is available for ball screws with shaft diameters less than ø25.

Nut total length <i>L</i>	Nut diameter		Flange diameter <i>A</i>	Flange width <i>B</i>	Nut length <i>F</i>	Flange notch <i>G</i>	Flange dimensions		Bolt hole PCD <i>W</i>	Bolt hole dimensions			Oil hole distance <i>T</i>
	<i>D</i>	<i>D_i</i>					<i>H</i>	<i>V</i>		<i>X</i>	<i>Y</i>	<i>Z</i>	
16	14	-	27	4	8	-	15 (10)	-	21	3.4	-	-	-
24	14	-	27	4	16	-	15 (10)	-	21	3.4	-	-	-
20	14	-	27	4	12	-	15 (10)	-	21	3.4	-	-	-
32	14	-	27	4	24	-	15 (10)	-	21	3.4	-	-	-
18	18	-	31	4	10	-	19 (13)	-	25	3.4	-	-	-
28	18	-	31	4	20	-	19 (13)	-	25	3.4	-	-	-
22	18	-	31	4	14	-	19 (13)	-	25	3.4	-	-	-
37	18	-	31	4	29	-	19 (13)	-	25	3.4	-	-	-
29	23	-	43	11	18	-	26	21	33	4.5	8	4.5	14
32	23	-	43	11	21	-	26	21	33	4.5	8	4.5	14
30	24	-	44	11	19	-	27	21.5	34	4.5	8	4.5	14.5
43	24	-	44	11	32	-	27	21.5	34	4.5	8	4.5	14.5
40	26	-	46	11	29	-	29	22.5	36	4.5	8	4.5	15.5
50	24	-	44	11	39	-	27	21.5	34	4.5	8	4.5	14.5
48	26	-	44	11	37	-	29	22.5	36	4.5	8	4.5	15.5
70	24	-	44	11	59	-	27	21.5	34	4.5	8	4.5	14.5
30	28	-	51	11	19	-	31	25	39	5.5	9.5	5.5	18
43	28	-	51	11	32	-	31	25	39	5.5	9.5	5.5	18
45	32	-	55	11	34	-	33	27	43	5.5	9.5	5.5	20
51	28	-	51	11	51	-	31	25	39	5.5	9.5	5.5	18
51	32	-	55	11	40	-	33	27	43	5.5	9.5	5.5	20
71	32	-	55	11	60	-	33	27	43	5.5	9.5	5.5	20
31	36	-	62	13	18	-	38	30.5	49	6.6	11	6.5	23.5
33	40	-	66	13	20	-	42	32.5	53	6.6	11	6.5	25.5
40	40	-	66	13	27	-	42	32.5	53	6.6	11	6.5	25.5
45	36	-	62	13	32	-	38	30.5	49	6.6	11	6.5	23.5
65	40	-	66	13	52	-	42	32.5	53	6.6	11	6.5	25.5
51	36	-	62	13	38	-	38	30.5	49	6.6	11	6.5	23.5
54	36	-	62	13	41	-	38	30.5	49	6.6	11	6.5	23.5
53	40	-	66	13	40	-	42	32.5	53	6.6	11	6.5	25.5
74	36	-	62	13	61	-	38	30.5	49	6.6	11	6.5	23.5
92	36	-	62	13	79	-	38	30.5	49	6.6	11	6.5	23.5
129	36	-	62	13	116	-	38	30.5	49	6.6	11	6.5	23.5

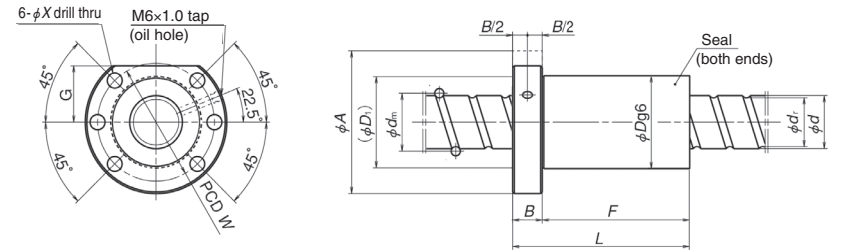
3) Axial play for shaft diameters of 6 mm and 8 mm is only for *T* equal to or less than 0.005 mm.
4) Dimensions in parentheses are for flat nut configurations.



Shape III



Shape IV



Shape IVa

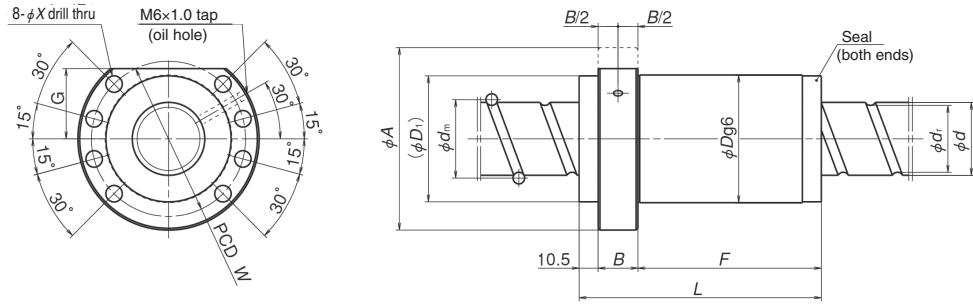
Unit: mm

Model No.	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D_w</i>	Ball circle dia. <i>d_m</i>	Root dia. <i>d</i>	Effective ball turns	Basic load ratings (N)		Axial rigidity <i>K</i> (N/μm)	Shape
							Dynamic <i>C_d</i>	Static <i>C_{st}</i>		
BSS2505-3E	25	5	3.175	25.5	22.2	3	11 500	23 500	343	III
BSS2506-4E		6	3.969	25.5	21.4	4	20 300	39 500	471	III
BSS2508-4EG		8	4.762	25.5	20.5	4	26 000	47 000	482	III
BSS2510-4E		10	3.175	25.5	22.2	4	15 000	32 400	460	III
BSS2510-4EG		10	4.762	25.5	20.5	4	25 900	46 800	479	III
BSS2512-4E		12	3.175	25.5	22.2	4	14 900	32 200	457	III
BSS2512-4EG		12	4.762	25.5	20.5	4	25 800	46 700	475	III
BSS2516-4E		16	3.969	25.5	21.4	4	19 900	39 900	464	III
BSS2520-2E		20	3.175	25.5	22.2	2	7 650	14 800	214	III
BSS2525-2E		25	3.175	25.5	22.2	2	7 490	14 600	206	III
BSS2530-2E		30	3.175	25.5	22.2	2	7 490	14 600	203	III
BSS2550-2E		50	3.175	25.5	22.2	2	6 910	14 700	180	III
BSS2812-4E	28	12	4.762	28.5	23.5	4	27 400	53 200	528	III
BSS2816-4E		16	4.762	28.5	23.5	4	27 100	52 900	520	III
BSS3205-4E	32	5	3.175	32.5	29.2	4	16 800	41 700	566	IV
BSS3208-4E		8	4.762	32.5	27.5	4	28 800	60 900	588	IV
BSS3210-4ES		10	3.969	32.5	28.4	4	23 000	51 300	579	IVa
BSS3210-6E		10	5.556	33	27.2	6	50 900	110 000	907	IV
BSS3210-6EG		10	6.35	33	26.4	6	60 900	125 000	923	IVa
BSS3212-5E		12	5.556	33	27.2	5	43 000	91 300	755	IV
BSS3212-5EG		12	6.35	33	26.4	5	51 500	103 000	767	IVa
BSS3216-5E		16	5.556	33	27.2	5	44 300	90 800	756	IV
BSS3220-4ES		20	3.969	32.5	28.4	4	22 600	51 100	566	IVa
BSS3220-5E		20	5.556	33	27.2	5	43 900	91 200	752	IV
BSS3232-2ES		32	3.966	32.5	28.4	2	11 400	23 300	259	IVa
BSS3232-2E		32	5.556	33	27.2	2	17 700	32 900	274	IV
BSS3232-2EG		32	7.144	33.5	26.1	2	24 500	42 200	284	IV
BSS3264-2E		64	5.556	33	27.2	2	16 800	32 900	240	IV

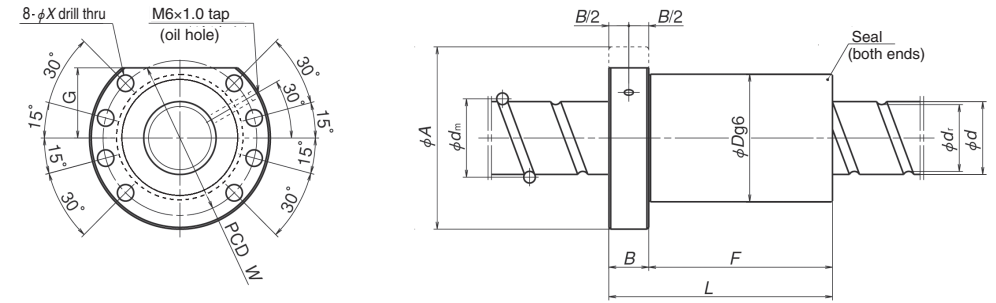
Note: 1) The axial rigidity *K* in the table above is a theoretical value derived from elastic deformation between screw grooves and balls when axial load is applied to a ball nut for which preload is set at 3% of the basic dynamic load rating (*C_d*).

2) The standard Compact FA PSS model is available for ball screws with shaft diameters less than ø25.

Nut total length <i>L</i>	Nut diameter		Flange diameter <i>A</i>	Flange width <i>B</i>	Nut length <i>F</i>	Flange notch <i>G</i>	Flange dimensions		Bolt hole PCD <i>W</i>	Bolt hole dimensions			Oil hole distance <i>T</i>
	<i>D</i>	<i>D_i</i>					<i>H</i>	<i>V</i>		<i>X</i>	<i>Y</i>	<i>Z</i>	
32	40	-	62	12	20	-	48	30.5	51	6.6	-	-	23.5
38	43	-	65	12	26	-	51	32	54	6.6	-	-	25
47	46	-	68	12	35	-	54	33.5	57	6.6	-	-	26.5
56	40	-	62	12	44	-	48	30.5	51	6.6	-	-	23.5
55	46	-	68	12	43	-	54	35.5	58	6.6	-	-	29
63	40	-	62	12	51	-	48	30.5	51	6.6	-	-	23.5
63	46	-	68	12	51	-	54	33.5	57	6.6	-	-	26.5
80	44	-	66	12	68	-	52	32.5	55	6.6	-	-	25.5
54	40	-	62	12	42	-	48	30.5	51	6.6	-	-	23.5
63	40	-	62	12	51	-	48	30.5	51	6.6	-	-	23.5
74	40	-	62	12	62	-	48	30.5	51	6.6	-	-	23.5
114	40	-	62	12	102	-	48	30.5	51	6.6	-	-	23.5
70	60	-	88	18	52	-	66	-	74	6.5	11	6.5	35
85	60	-	88	18	67	-	66	-	74	6.5	11	6.5	35
55	56	(55)	86	12	32.5	34	-	-	71	9	-	-	-
78	57	(55)	86	18	49.5	34	-	-	71	9	-	-	-
59	50	-	80	12	47	31	-	-	65	9	-	-	-
104	56	(55)	86	18	75.5	34	-	-	71	9	-	-	-
78	61	-	93	18	60	34	-	-	76	9	-	-	-
103	56	(55)	86	18	74.5	34	-	-	71	9	-	-	-
77	61	-	90	18	59	34	-	-	76	9	-	-	-
122	56	(55)	86	18	93.5	34	-	-	71	9	-	-	-
98	50	-	80	12	86	31	-	-	65	9	-	-	-
141	56	(55)	86	18	112.5	34	-	-	71	9	-	-	-
79	50	-	80	12	67	31	-	-	65	9	-	-	-
94	56	(55)	86	18	65.5	34	-	-	71	9	-	-	-
98	62	(55)	97	18	69.5	37	-	-	82	9	-	-	-
153	56	(55)	86	18	124.5	34	-	-	71	9	-	-	-



Shape V



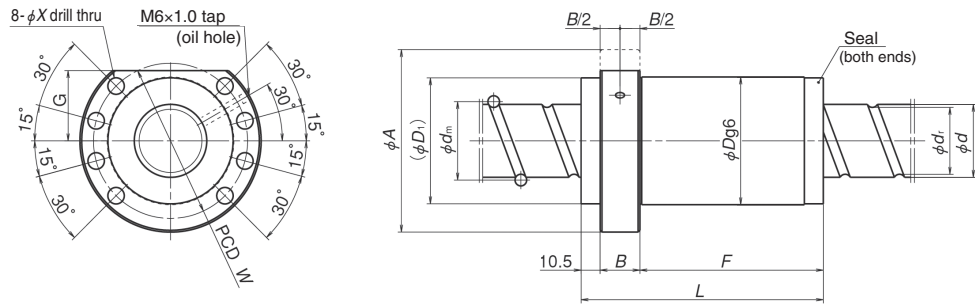
Shape Va

Model No.	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D_w</i>	Ball circle dia. <i>d_m</i>	Root dia. <i>d</i>	Effective ball turns	Basic load ratings (N)		Axial rigidity <i>K</i> (N/μm)	Shape
							Dynamic	Static		
							<i>C_a</i>	<i>C_{0a}</i>		
BSS3605-3E	36	5	3.175	36.5	33.2	3	13 500	34 100	459	V
BSS3608-4E		8	4.762	36.5	31.5	4	30 800	69 100	651	V
BSS3610-6E		10	6.35	37	30.4	6	65 000	141 000	1 018	V
BSS3612-6E		12	6.35	37	30.4	6	64 800	141 000	1 014	V
BSS3616-6E		16	6.35	37	30.4	6	64 500	142 000	1 012	V
BSS3620-6E		20	6.35	37	30.4	6	64 000	141 000	1 001	V
BSS4010-5ES	40	10	5.556	41	35.2	5	48 800	115 000	914	V _a
BSS4010-5E		10	6.35	41	34.4	5	58 100	130 000	924	V
BSS4012-5E		12	6.35	41	34.4	5	58 000	130 000	922	V
BSS4016-4ES		16	5.556	41	35.2	4	39 500	90 300	722	V
BSS4016-5E		16	6.35	41	34.4	5	57 700	131 000	921	V
BSS4016-5EG		16	7.144	41.5	34.1	5	67 700	147 000	939	V _a
BSS4020-4ES		20	5.556	41	35.2	4	39 300	89 900	716	V
BSS4020-5E		20	6.35	41	34.4	5	57 400	130 000	913	V
BSS4020-5EG		20	7.144	41.5	34.1	5	67 400	146 000	932	V _a
BSS4025-4ES		25	5.556	41	35.2	4	39 000	90 300	711	V
BSS4025-4E		25	6.35	41	34.4	4	46 300	102 000	720	V
BSS4025-4EG		25	7.144	41.5	34.1	4	54 400	115 000	734	V _a
BSS4030-3ES		30	5.556	41	35.2	3	30 300	65 900	526	V
BSS4030-3E		30	6.35	41	34.4	3	36 100	74 800	533	V
BSS4030-3EG		30	7.144	41.5	34.1	3	41 100	84 000	538	V _a
BSS4040-2ES		40	5.556	41	35.2	2	19 800	41 400	328	V _a
BSS4040-2E		40	6.35	41	34.4	2	23 700	47 100	334	V
BSS4080-2E		80	6.35	41	34.4	2	22 200	46 600	289	V

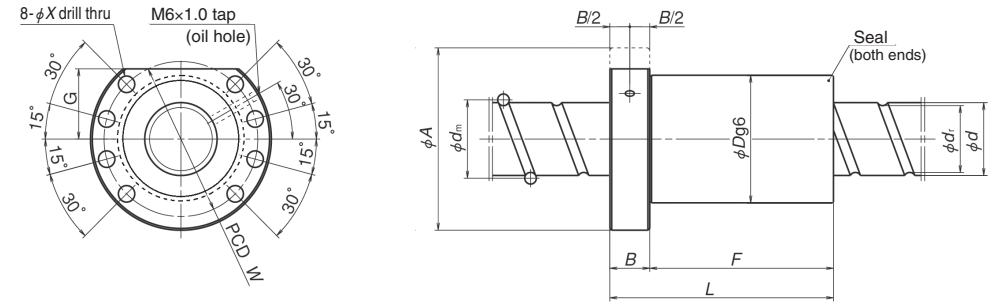
Note: The axial rigidity *K* in the table above is a theoretical value derived from elastic deformation between screw grooves and balls when axial load is applied to a ball nut for which preload is set at 3% of the basic dynamic load rating (*C_a*).

Unit: mm

Nut total length <i>L</i>	Nut diameter		Flange diameter <i>A</i>	Flange width <i>B</i>	Nut length <i>F</i>	Flange notch <i>G</i>	Flange dimensions		Bolt hole PCD <i>W</i>	Bolt hole dimensions			Oil hole distance <i>T</i>
	<i>D</i>	<i>D₁</i>					<i>H</i>	<i>V</i>		<i>X</i>	<i>Y</i>	<i>Z</i>	
	<i>L</i>	<i>D</i>	<i>D₁</i>	<i>A</i>	<i>B</i>	<i>F</i>	<i>G</i>	<i>H</i>	<i>V</i>	<i>W</i>	<i>X</i>	<i>Y</i>	<i>Z</i>
50	65	(64)	95	12	27.5	36	-	-	80	9	-	-	-
73	65	(64)	95	15	47.5	36	-	-	80	9	-	-	-
109	65	(64)	95	22	76.5	36	-	-	80	9	-	-	-
120	65	(64)	95	22	87.5	36	-	-	80	9	-	-	-
143	65	(64)	95	22	110.5	36	-	-	80	9	-	-	-
166	65	(64)	95	22	133.5	36	-	-	80	9	-	-	-
70	63	-	93	22	48	35	-	-	78	9	-	-	-
99	70	(69)	100	22	66.5	38.5	-	-	85	9	-	-	-
108	70	(69)	100	22	75.5	38.5	-	-	85	9	-	-	-
87	63	(62)	93	22	60	35	-	-	78	9	-	-	-
127	70	(69)	100	22	94.5	38.5	-	-	85	9	-	-	-
109	80	-	110	22	87	43.5	-	-	95	9	-	-	-
102	63	(62)	93	22	75	35	-	-	78	9	-	-	-
146	70	(69)	100	22	113.5	38.5	-	-	85	9	-	-	-
128	80	-	110	22	106	43.5	-	-	95	9	-	-	-
122	63	(62)	93	22	95	35	-	-	95	9	-	-	-
145	70	(69)	100	22	112.5	38.5	-	-	85	9	-	-	-
127	80	-	110	22	105	43.5	-	-	95	9	-	-	-
111	63	(62)	93	22	84	35	-	-	95	9	-	-	-
134	70	(69)	100	22	101.5	38.5	-	-	85	9	-	-	-
117	80	-	110	22	95	43.5	-	-	95	9	-	-	-
94	63	-	93	22	72	35	-	-	78	9	-	-	-
110	70	(69)	100	22	77.5	38.5	-	-	85	9	-	-	-
184	70	(69)	100	22	151.5	38.5	-	-	85	9	-	-	-



Shape V



Shape Va

Model No.	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D_w</i>	Ball circle dia. <i>d_m</i>	Root dia. <i>d_r</i>	Effective ball turns	Basic load ratings (N)		Axial rigidity <i>K</i> (N/μm)	Shape	
							Dynamic	Static			
							<i>C_a</i>	<i>C_{sa}</i>			
BSS4510-5E	45	10	6.35	46	39.4	5	62 400	147 000	1 026	V	
BSS4512-5E		12	6.35	46	39.4	5	62 300	147 000	1 023	V	
BSS4516-5E		16	6.35	46	39.4	5	62 100	147 000	1 018	V	
BSS4516-5EG		16	7.144	46.5	39.1	5	71 400	166 000	1 032	Va	
BSS4520-5E		20	6.35	46	39.4	5	61 800	146 000	1 011	V	
BSS4525-5E		25	6.35	46	39.4	5	61 400	147 000	1 006	V	
BSS4525-5EG		25	7.144	46.5	39.1	5	70 600	166 000	1 021	Va	
BSS4530-4E		30	6.35	46	39.4	4	49 600	115 000	790	V	
BSS4530-4EG		30	7.144	46.5	39.1	4	58 900	131 000	815	V	
BSS5010-4E		50	10	6.35	51	44.4	4	52 600	129 000	883	V
BSS5012-4E	12		6.35	51	44.4	4	52 500	129 000	881	V	
BSS5016-4E	16		6.35	51	44.4	4	52 400	128 000	878	V	
BSS5016-4EG	16		7.144	51.5	44.1	4	60 800	146 000	896	Va	
BSS5020-4E	20		6.35	51	44.4	4	52 200	129 000	879	V	
BSS5025-4E	25		6.35	51	44.4	4	51 900	129 000	871	V	
BSS5025-4EG	25		7.144	51.5	44.1	4	62 100	145 000	892	Va	
BSS5030-4E	30		6.35	51	44.4	4	51 500	128 000	861	V	
BSS5030-4EG	30		7.144	51.5	44.1	4	61 700	146 000	890	Va	
BSS5036-4EG	36		7.938	51.5	43.2	4	70 900	161 000	893	V	
BSS5040-3E	40		6.35	51	44.4	3	39 700	94 200	635	V	
BSS5040-3EG	40		7.144	51.5	44.1	3	46 300	105 000	642	V	
BSS5050-2E	50		6.35	51	44.4	2	26 100	58 300	394	V	
BSS5050-2EG	50		7.938	51.5	43.2	2	35 300	73 700	411	V	
BSS50100-2E	100		6.35	51	44.4	2	24 100	58 900	343	V	
BSS50100-2EG	100		7.938	52.25	44	2	33 300	75 100	365	V	
BSS5510-3E	55		10	6.35	56	49.4	3	41 300	103 000	700	V
BSS5520-3E			20	6.35	56	49.4	3	42 100	104 000	705	Va
BSS5525-3E			25	6.35	56	49.4	3	41 900	103 000	700	V
BSS6316-4E	63		16	9.525	65	55.2	4	131 000	338 000	1 430	Va
BSS6340-3E		40	7.144	64.5	57.1	3	52 100	135 000	792	Va	

Note: The axial rigidity *K* in the table above is a theoretical value derived from elastic deformation between screw grooves and balls when axial load is applied to a ball nut for which preload is set at 3% of the basic dynamic load rating (*C_a*).

Nut total length <i>L</i>	Nut diameter		Flange diameter <i>A</i>	Flange width <i>B</i>	Nut length <i>F</i>	Flange notch <i>G</i>	Flange dimensions		Bolt hole PCD <i>W</i>	Bolt hole dimensions			Oil hole distance <i>T</i>
	<i>D</i>	<i>D_i</i>					<i>H</i>	<i>V</i>		<i>X</i>	<i>Y</i>	<i>Z</i>	
	<i>L</i>	<i>D</i>	<i>D_i</i>	<i>A</i>	<i>B</i>	<i>F</i>	<i>G</i>	<i>H</i>	<i>V</i>	<i>W</i>	<i>X</i>	<i>Y</i>	<i>Z</i>
99	75	(74)	110	22	66.5	43	-	-	93	11	-	-	-
108	75	(74)	110	22	75.5	43	-	-	93	11	-	-	-
127	75	(74)	110	22	94.5	43	-	-	93	11	-	-	-
109	87	-	122	22	87	49	-	-	105	11	-	-	-
146	75	(74)	110	22	113.5	43	-	-	93	11	-	-	-
170	75	(74)	110	22	137.5	43	-	-	93	11	-	-	-
152	87	-	122	22	130	49	-	-	105	11	-	-	-
164	75	(74)	110	22	131.5	43	-	-	93	11	-	-	-
164	83	(82)	118	22	135.5	47	-	-	101	11	-	-	-
89	82	(81)	118	22	56.5	46	-	-	100	11	-	-	-
96	82	(81)	118	22	63.5	46	-	-	100	11	-	-	-
111	82	(81)	118	22	78.5	46	-	-	100	11	-	-	-
93	94	-	130	22	71	52	-	-	112	11	-	-	-
126	82	(81)	118	22	93.5	46	-	-	100	11	-	-	-
145	82	(81)	118	22	112.5	46	-	-	100	11	-	-	-
127	94	-	130	22	105	52	-	-	112	11	-	-	-
164	82	(81)	118	22	131.5	46	-	-	100	11	-	-	-
146	94	-	130	22	124	52	-	-	112	11	-	-	-
189	90	(86)	126	22	156.5	50	-	-	108	11	-	-	-
163	82	(81)	118	22	130.5	46	-	-	100	11	-	-	-
146	85	-	121	22	124	47.5	-	-	103	11	-	-	-
130	82	(81)	118	22	97.5	46	-	-	100	11	-	-	-
118	90	-	149	20	98	54	-	-	126	11	-	-	-
224	82	(81)	118	22	191.5	46	-	-	100	11	-	-	-
220	90	-	126	22	198	50	-	-	108	11	-	-	-
79	90	(89)	126	22	46.5	50	-	-	108	11	-	-	-
88	94	-	130	22	66	52	-	-	112	11	-	-	-
116	90	(89)	126	22	83.5	50	-	-	108	11	-	-	-
102	122	-	183	28	74	70	-	-	150	18	-	-	-
145	100	-	140	28	117	65	-	-	128	18	-	-	-

Unit: mm

B-3-2.2 SRC Recirculation Ball Screws

1. Features

SRC Recirculation is a new generation standard method for ball recirculation in ball screws. Quiet operation is possible in all speed ranges.

2. Specifications

(1) Ball recirculation system

The structure of a SRC Recirculation system is shown below.

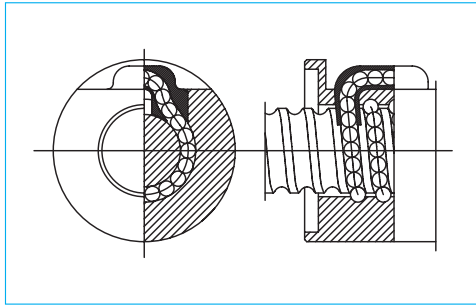


Fig.1 Structure of SRC recirculation system

Table 1 Accuracy grade and axial play

Accuracy grade	C0, C1, C2, C3, C5, Ct7
Axial play	Z, 0 mm (preloaded); T, 0.005 mm or less; S, 0.020 mm or less

(2) Accuracy grade and axial play

The available standard accuracy grade and axial play are shown in **Table 1**. Please consult NSK for other grades.

(3) Allowable *d·n* value and the criterion of maximum rotational speed

The allowable *d·n* value and criterion of maximum rotational speed are shown below. Please consult NSK if the rotational speed exceeds the permissible range below.

Allowable *d·n* value: 160 000 or less

Criterion of maximum rotational speed

: 5 000 min⁻¹

Note: Please also review the critical speed.

See "Technical Description: Permissible Rotational Speed" (page B47) for details.

(4) Options

A type equipped with the NSK K1 lubrication unit is also available.

3. Lineup

There are three different preloads available (Table2).

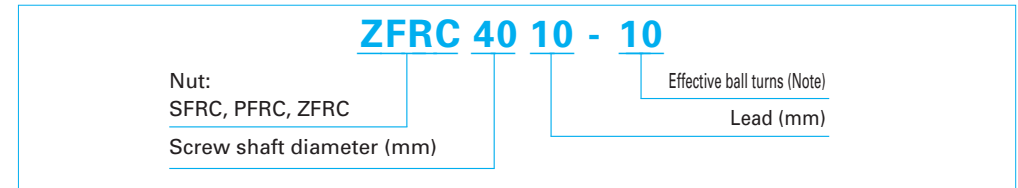
Table 2 SRC recirculation ball screws lineup

Nut	Shape	Flange shape	Nut shape	Preload
SFRC		Flanged Circular II	Circular	No preload Slight axial play
PFRC		Flanged Circular II	Circular	P-preload (light preload) Spacer ball 1:1
ZFRC		Flanged Circular II	Circular	Z-preload (medium preload)

4. Structure of model number and reference number

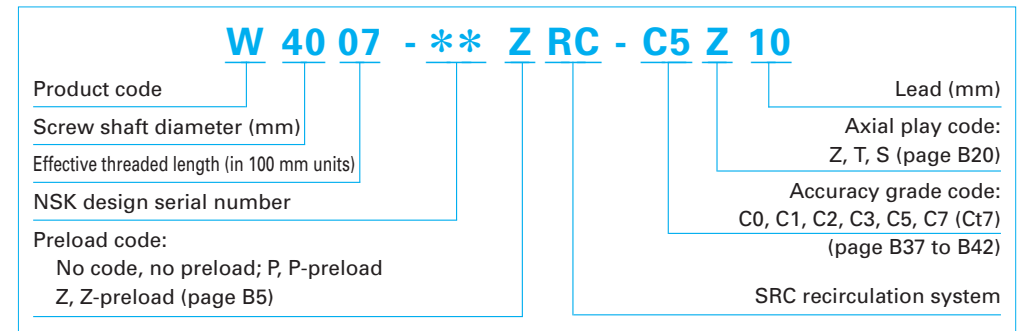
The following explains the codes used in model numbers and ball screw reference numbers.

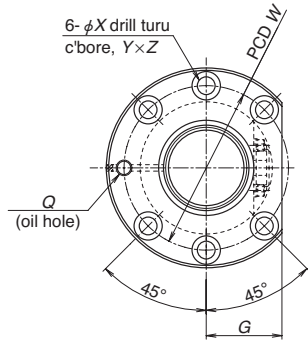
◇ Model number



Note: In Z-preload, the number here is twice the effective ball turns.

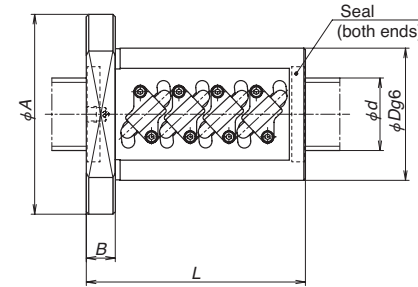
◇ Reference number for ball screw





Model No.	Preload	Shaft dia. <i>d</i>	Lead <i>l</i>	Root dia. <i>d_r</i>	Effective ball turns Turns × Circuits	Basic load ratings (N)		Axial rigidity <i>K</i> (N/μm)
						Dynamic <i>C₀</i>	Static <i>C_{0s}</i>	
ZFRC 2812-7	Z	28	12	23.5	3.5×1	26100	50200	592
PFRC 2812-3.5	P				3.5×1	16400	25100	270
SFRC 2812-3.5	Clearance				3.5×1	26100	50200	381
ZFRC 2816-5	Z	28	16	22.4	2.5×1	27400	47400	437
PFRC 2816-2.5	P				2.5×1	17300	23700	199
SFRC 2816-2.5	Clearance				2.5×1	27400	47400	281
ZFRC 3205-10	Z	32	5	29.2	2.5×2	21800	56000	891
PFRC 3205-5	P				2.5×2	13700	28000	406
SFRC 3205-5	Clearance				2.5×2	21800	56000	573
ZFRC 3210-10	Z	32	10	26.4	2.5×2	54500	110000	970
PFRC 3210-5	P				2.5×2	34300	55100	434
SFRC 3210-5	Clearance				2.5×2	54500	110000	623
ZFRC 4005-10	Z	40	5	37.2	2.5×2	23900	70500	1067
PFRC 4005-5	P				2.5×2	15100	35300	486
SFRC 4005-5	Clearance				2.5×2	23900	70500	685
ZFRC 4010-10	Z	40	10	34.4	2.5×2	61200	137000	1154
PFRC 4010-5	P				2.5×2	38600	68300	526
SFRC 4010-5	Clearance				2.5×2	61200	137000	740
ZFRC 4012-10	Z	40	12	34.1	2.5×2	71700	154000	1177
PFRC 4012-5	P				2.5×2	45200	77200	528
SFRC 4012-5	Clearance				2.5×2	71700	154000	756
ZFRC 4508-10	Z	45	8	40.5	2.5×2	44000	118000	1234
PFRC 4508-5	P				2.5×2	27700	58900	557
SFRC 4508-5	Clearance				2.5×2	44000	118000	792
ZFRC 4510-10	Z	45	10	39.4	2.5×2	65800	157000	1291
PFRC 4510-5	P				2.5×2	41500	78500	582
SFRC 4510-5	Clearance				2.5×2	65800	157000	830
ZFRC 4512-10	Z	45	12	39.1	2.5×2	75600	176000	1304
PFRC 4512-5	P				2.5×2	47600	88200	586
SFRC 4512-5	Clearance				2.5×2	75600	176000	838
ZFRC 5010-10	Z	50	10	44.4	2.5×2	68100	174000	1397
PFRC 5010-5	P				2.5×2	42900	87200	630
SFRC 5010-5	Clearance				2.5×2	68100	174000	898
ZFRC 5012-10	Z	50	12	43.2	2.5×2	91500	218000	1441
PFRC 5012-5	P				2.5×2	57600	109000	647
SFRC 5012-5	Clearance				2.5×2	91500	218000	926
ZFRC 5508-10	Z	55	8	50.5	2.5×2	47300	144000	1439
PFRC 5508-5	P				2.5×2	29800	72000	651
SFRC 5508-5	Clearance				2.5×2	47300	144000	923
ZFRC 6312-14	Z	63	12	56.2	3.5×2	136000	385000	2388
PFRC 6312-7	P				3.5×2	85400	193000	1078
SFRC 6312-7	Clearance				3.5×2	136000	385000	1539

Notes: 1. Values for axial rigidity *K* above are theoretical values elastic deformation between the screw groove and ball when axial load is applied to a ball nut for which preload is set at 3% for PFRC (P-preload), and 5% for ZFRC (Z-preload) of the basic dynamic load rating (*C₀*).



The number of circuits (number of circulating parts) may differ from the diagram

Unit: mm

Nut total length <i>L</i>	Ball nut dimensions					Bolt hole dimensions			Bolt hole PCD <i>W</i>	Oil hole <i>Q</i>	Max. feed speed (m/min)
	Nut diameter <i>D</i>	Flange diameter <i>A</i>	Flange width <i>B</i>	Flange notch <i>G</i>	Bolt hole dimensions						
					<i>X</i>	<i>Y</i>	<i>Z</i>				
128	60	88	15	33	6.6	11	6.5	73	M6×1	60	
80											
80											
131	73	101	15	38	6.6	11	6.5	86	M6×1	80	
83											
83											
89	58	85	12	32	6.6	11	6.5	71	M6×1	25	
59											
59											
163	74	108	15	41	9	14	8.5	90	M6×1	50	
103											
103											
92	67	101	15	39	9	14	8.5	83	M6×1	25	
62											
62											
166	82	124	18	47	11	17.5	11	102	Rc1/8	40	
106											
106											
192	86	128	18	48	11	17.5	11	106	Rc1/8	48	
120											
120											
136	82	124	18	47	11	17.5	11	102	Rc1/8	28	
88											
88											
166	88	132	18	50	11	17.5	11	110	Rc1/8	35	
106											
106											
192	90	132	18	50	11	17.5	11	110	Rc1/8	42	
120											
120											
166	93	135	18	51	11	17.5	11	113	Rc1/8	32	
106											
106											
198	100	146	22	55	14	20	13	122	Rc1/8	38	
126											
126											
133	94	136	18	52	11	17.5	11	114	Rc1/8	23	
85											
85											
244	115	161	22	61	14	20	13	137	Rc1/8	30	
148											
148											

2. Spacer balls are installed in PFRC.

B-3-2.3 Tube Recirculation Ball Screws

1. Features

Tube recirculation is a standard method for ball recirculation in ball screws. Various combinations of shaft diameter and lead are available.

2. Specifications

(1) Ball recirculation system

The structure of a tube recirculation system is shown below.

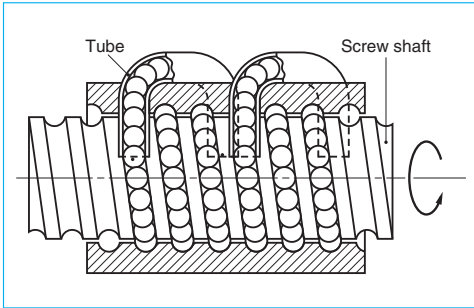


Fig.1 Structure of tube recirculation system

Table 1 Accuracy grade and axial play

Accuracy grade	SFT, PFT, ZFT, DFT: C0, C1, C2, C3, C5, Ct7 LSFT, LPFT, LDFT: C1, C2, C3, C5, Ct7 (Ct7 is not included in DFT, LDFT)
Axial play	Z, 0 mm (preloaded); T, 0.005 mm or less; S, 0.020 mm or less; N, 0.050 mm or less

(2) Accuracy grade and axial play

The available standard accuracy grade and axial play are shown in **Table 1**. Please consult NSK for other grades.

(3) Allowable *d·n* value and the criterion of maximum rotational speed

The allowable *d·n* value and criterion of maximum rotational speed are shown below. Please consult NSK if the rotational speed exceeds the permissible range below. Basic measures must be taken for high-speed ball screws.

Allowable *d·n* value :

Standard specification ; 70 000 or less

High-speed specification; 100 000 or less

Standard of rotational speed : 3 000 min⁻¹

Note: Please also review the critical speed. Refer to "Technical Description: Permissible Rotational Speed" (page B47) for details.

(4) Options

A type equipped with the NSK K1 lubrication unit is also available.

(5) Other specifications

Please consult NSK for specifications not listed in the dimension tables.

3. Lineup

There are four different preloads available with several models. Since the leads range from 1/2 to the same length of the shaft diameter

Table 2 Tube recirculation ball screws lineup

Nut	Shape	Flange shape	Nut shape	Preload
SFT		Flanged d=16mm or under	Circle dia.	No preload, Slight axial play
PFT		Rectangle d=20mm or over Circular I, II		P-preload (light preload) Spacer ball 1:1
ZFT		Flanged Circular I, II	Circle dia.	Z-preload (medium preload)

Nut	Shape	Flange shape	Nut shape	Preload
DFT		Flanged Circular I, II	Circular	D-preload (medium preload) (heavy preload)
LSFT		Flanged d=20mm or under Rectangle d=25mm or over Circular II	d=20mm or under Circular	No preload, Slight axial play
LPFT			d=25mm or over Tube- projecting type	P-preload (light preload) Spacer ball 1:1
LDFT		Flanged Circular II	Circular	D-preload (medium preload) (heavy preload)

(medium-high helix lead), LSFT, LPFT, and LDFT nut ball screws are suitable for high-speed operation.

4. Structure of model number and reference number

The following explains the codes used in model numbers and ball screw reference numbers.

◇ Model number

SFT 14 05 - 2.5

Nut:
SFT, PFT, ZFT, DFT
LSFT, LPFT, LDFT

Screw shaft diameter (mm)

Effective ball turns (Note)

Lead (mm)

Note: In Z-preload, the number here is twice the effective ball turns.

◇ Reference number for ball screw

W 14 01 - ** P - C3 Z 5

Product code

Screw shaft diameter (mm)

Effective threaded length (in 100 mm units)

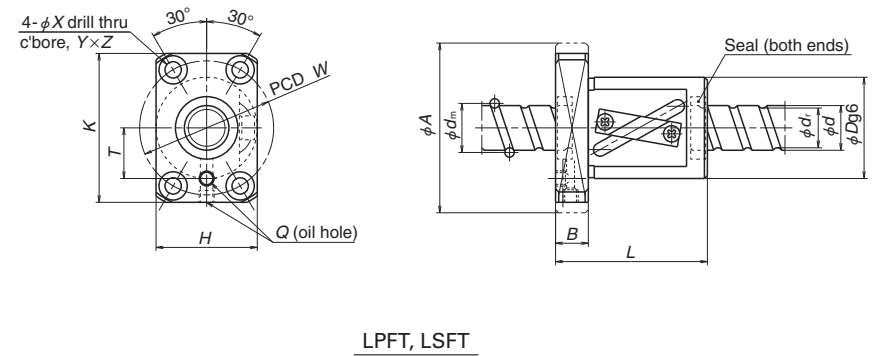
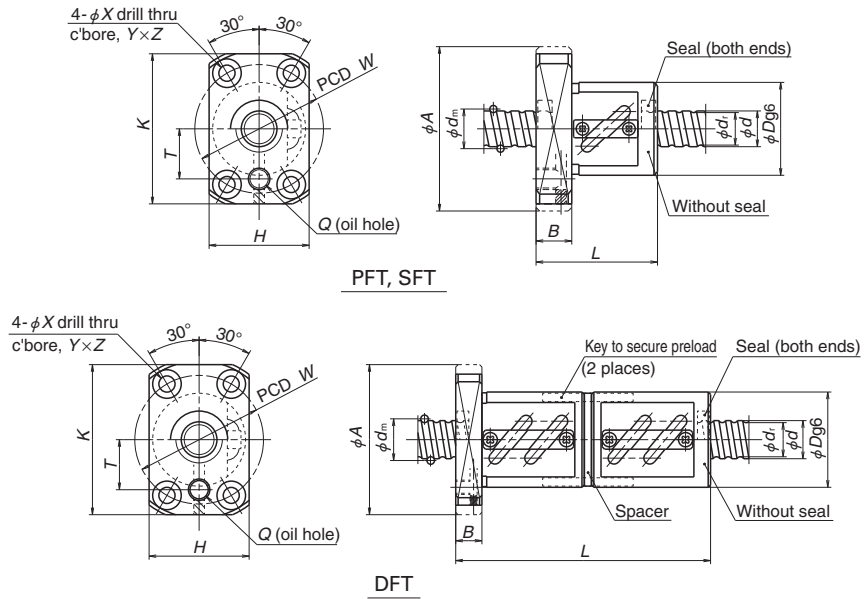
NSK design serial number

Preload code:
No code, no preload; P, P-preload
Z, Z-preload; D, D-preload (page B5)

Lead (mm)

Axial play code:
Z, T, S, N (page B20)

Accuracy grade code:
C0, C1, C2, C3, C5, C7 (Ct7)
(page B37 to B42)

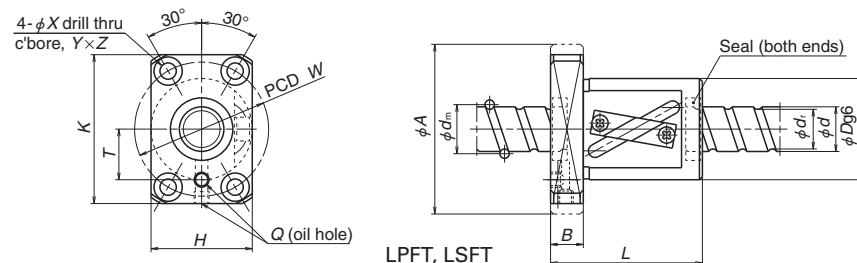
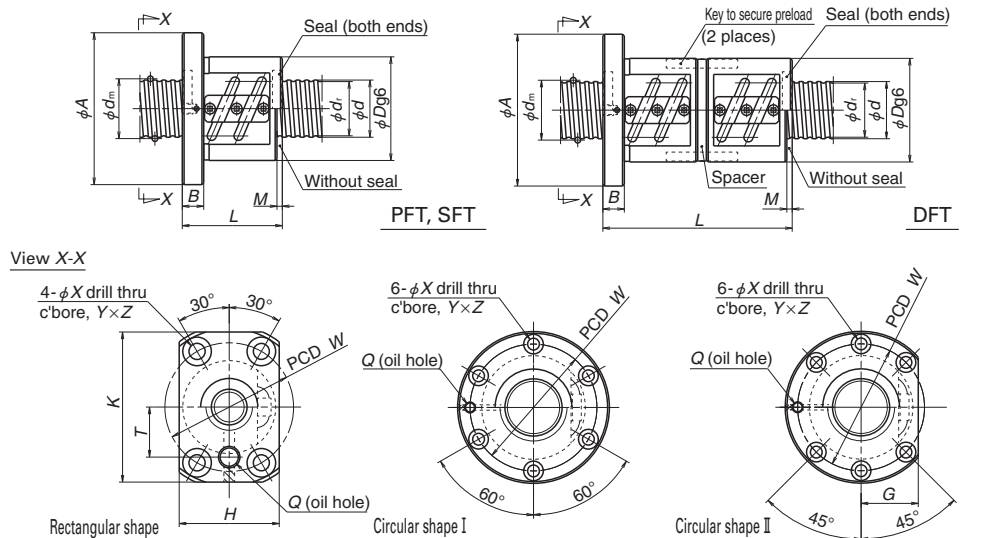


Model No.	Preload	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D_w</i>	Ball circle dia. <i>d_m</i>	Root dia. <i>d_r</i>	Effective ball turns Turns × Circuits	Basic load ratings (N)		Axial rigidity <i>K</i> (N/μm)	
								Dynamic <i>C_s</i>	Static <i>C_{sa}</i>		
* PFT 1004-2.5 SFT 1004-2.5	P Clearance	10	4	2.000	10.3	8.2	2.5×1	2 020	2 210	79	
								3 210	4 420	94	
PFT 1204-3 SFT 1204-2.5 SFT 1204-3	P Clearance Clearance	12	4	2.381	12.3	9.8	2.5×1	2 780	3 140	93	
								1.5×2	3 250	3 770	111
								2.5×1	4 410	6 280	111
								1.5×2	5 160	7 540	132
* PFT 1205-2.5 PFT 1205-3 SFT 1205-2.5 SFT 1205-3	P Clearance Clearance	12	5	2.381	12.3	9.8	2.5×1	2 770	3 130	92	
								1.5×2	3 240	3 760	110
								2.5×1	4 390	6 260	110
								1.5×2	5 140	7 510	131
* LPFT 1210-2.5 LSFT 1210-2.5	P Clearance	12	10	2.381	12.5	10.0	2.5×1	2 790	3 220	92	
								4 430	6 430	110	
* PFT 1405-2.5 SFT 1405-2.5 PFT 1405-5 SFT 1405-5	P Clearance Clearance	14	5	3.175	14.5	11.2	2.5×1	5 020	5 970	126	
								2.5×1	7 970	11 900	150
								2.5×2	9 110	11 900	244
								2.5×2	14 500	23 900	291
* LPFT 1408-2.5 LSFT 1408-2.5	P Clearance	14	8	3.175	14.5	11.2	2.5×1	4 960	5 920	124	
								7 880	11 800	147	
* LPFT 1510-2.5 LSFT 1510-2.5	P Clearance	15	10	3.175	15.5	12.2	2.5×1	5 130	6 420	129	
								8 140	12 800	156	
PFT 1604-3 SFT 1604-2.5 ZFT 1604-5 PFT 1604-5 SFT 1604-3 DFT 1604-3	P Clearance Z P Clearance D	16	4	2.381	16.3	13.8	1.5×2	3 740	5 130	141	
								2.5×1	5 070	8 500	140
								2.5×1	5 070	8 500	275
								2.5×2	5 800	8 500	226
								1.5×2	5 930	10 300	168
								1.5×2	5 930	10 300	329

Notes: 1. Rectangular flanges are used for shaft diameters of 16 mm or less.
 2. Seals are equipped as standard for LSFT and LPFT nuts when shaft diameter is 20 mm or less. The outside dimensions are the same as those without seals.
 3. Right-turn screws are standard. "L" is added to the end of the Model No. for left turn screws.

Ball nut dimensions											
Nut total length <i>L</i>	Nut diameter <i>D</i>	Flange diameter <i>A</i>	Flange width <i>B</i>	Rectangle flange dimensions			Bolt hole dimensions			Oil hole distance <i>T</i>	Oil hole <i>Q</i>
				<i>H</i>	<i>K</i>	<i>X</i>	<i>Y</i>	<i>Z</i>	Bolt hole PCD <i>W</i>		
34	26	46	10	28	42	4.5	8	4.5	36	14	M6×1
38	30	50	10	32	45	4.5	8	4.5	40	15	M6×1
44											
38											
44											
40	30	50	10	32	45	4.5	8	4.5	40	15	M6×1
48											
40											
48											
50	30	50	10	32	45	4.5	8	4.5	40	15	M6×1
40	34	57	11	34	50	5.5	9.5	5.5	45	17	M6×1
40											
55											
55											
46	34	57	11	34	50	5.5	9.5	5.5	45	17	M6×1
51	34	57	11	34	50	5.5	9.5	5.5	45	17	M6×1
45	34	57	11	34	50	5.5	9.5	5.5	45	17	M6×1
38	34										
50	36										
50	34										
45	34										
85	36			36							

4. Values for axial rigidity *K* above are theoretical values obtained from the elastic deformation between the screw groove and ball when axial load is 30% of the basic dynamic load rating *C_s* for clearance (no preload), 10% for D-preload, and 5% for P-preload. Refer to the "Technical Description" on page B56 if axial load and preload differ from the conditions above or if deformation of the ball nut body must be considered.
 5. The basic load ratings with PFT and LPFT nuts are different due to the installed spacer balls.
 6. Finished shaft end FA models are available for those models marked with an asterisk (*).
 7. P-preload refers to oversize ball preload and D-preload to double-nut preload. For details, see page B5.

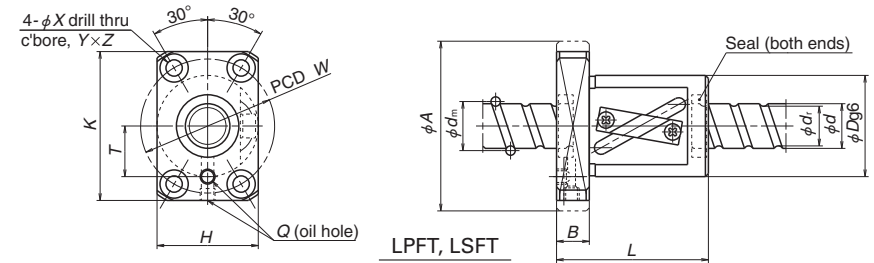
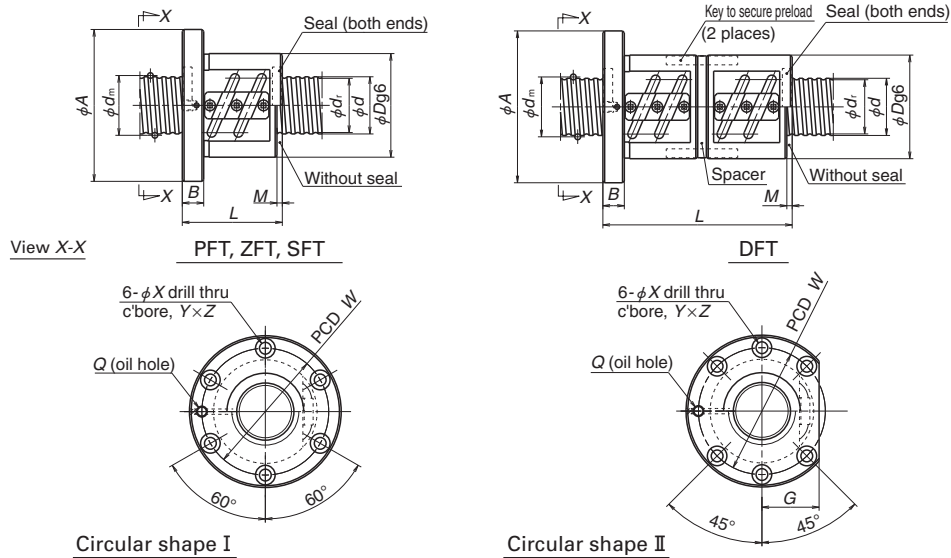


Model No.	Preload	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D_w</i>	Ball circle dia. <i>d_m</i>	Root dia. <i>d_r</i>	Effective ball turns Turns × Circuits	Basic load ratings (N)		Axial rigidity <i>K</i> (N/μm)	
								Dynamic <i>C_e</i>	Static <i>C_{0a}</i>		
PFT 1605-3	P	16	5	3.175	16.5	13.2	1.5×2	6 350	8 070	166	
SFT 1605-2.5	Clearance						2.5×1	8 620	13 800	168	
ZFT 1605-5	Z						2.5×1	8 620	13 800	330	
PFT 1605-5	P						2.5×2	9 850	13 800	270	
SFT 1605-3	Clearance						1.5×2	10 100	16 100	197	
DFT 1605-3	D						1.5×2	10 100	16 100	387	
SFT 1605-5	Clearance		2.5×2	15 600	27 600	326					
DFT 1605-5	D		2.5×2	15 600	27 600	639					
PFT 1606-2.5	P		6	3.175	16.5	13.2	13.2	2.5×1	5 410	6 880	139
SFT 1606-2.5	Clearance							2.5×1	8 590	13 800	168
DFT 1606-2.5	D							2.5×1	8 590	13 800	329
SFT 1606-3	Clearance							1.5×2	10 100	16 100	197
DFT 1606-3	D	1.5×2						10 100	16 100	386	
LPFT 1616-1.5	P	16						3.175	16.75	13.4	13.4
LSFT 1616-1.5	Clearance		5 480	8 080	98						
SFT 2004-2.5	Clearance	20	4	2.381	20.3	17.8	2.5×1	5 730	10 900	171	
ZFT 2004-5	Z						2.5×1	5 730	10 900	336	
PFT 2004-5	P						2.5×2	6 550	10 900	276	
SFT 2004-5	Clearance						2.5×2	10 400	21 800	332	
ZFT 2004-10	Z						2.5×2	10 400	21 800	651	
PFT 2005-3	P						5	3.175	20.5	17.2	17.2
SFT 2005-2.5	Clearance	2.5×1	9 690	17 100	201						
ZFT 2005-5	Z	2.5×1	9 690	17 100	393						
PFT 2005-5	P	2.5×2	11 100	17 100	327						
SFT 2005-3	Clearance	1.5×2	11 300	20 500	238						
ZFT 2005-6	Z	1.5×2	11 300	20 500	467						
SFT 2005-5	Clearance	2.5×2	17 600	34 200	388						
ZFT 2005-10	Z	2.5×2	17 600	34 200	762						

Notes: 1. Rectangular flanges are used for shaft diameters of 16 mm or less. Circular shape I and II flanges are used for shaft diameters of 20 mm or more. Select a flange suitable for the space available for nut installation.
 2. If no seal is used with nuts PFT, SFT, or DFT, the nut length will be shortened by the amount of dimension *M*.
 3. Seals are equipped as standard for LSFT and LPFT nuts when shaft diameter is 20 mm or less. The outside dimensions are the same as those without seals.
 4. Right-turn screws are standard. "L" is added to the end of the Model No. for left turn screws.

Ball nut dimensions													
Nut total length <i>L</i>	Nut diameter <i>D</i>	Flange diameter <i>A</i>	Flange width <i>B</i>	Flange notch <i>G</i>	Rectangle flange dimensions		Seal dimension <i>M</i>	Bolt hole dimensions			Bolt hole PCD <i>W</i>	Oil hole distance <i>T</i>	Oil hole <i>Q</i>
					<i>H</i>	<i>K</i>		<i>X</i>	<i>Y</i>	<i>Z</i>			
52	40	63	11	—	40	55	—	5.5	9.5	5.5	51	20	M6×1
42													
57													
57													
52													
97													
57													
107													
44													
44													
86													
56													
110													
56	40	63	12	—	40	55	—	5.5	9.5	5.5	51	17	M6×1
37													
49													
49													
49													
73													
52	44	67	11	26	—	—	3	5.5	9.5	5.5	55	—	M6×1
41													
56													
56													
52													
77													
56													
86													

5. Values for axial rigidity *K* above are theoretical values obtained from the elastic deformation between the screw groove and ball when axial load is 30% of the basic dynamic load rating *C_e* for clearance (no preload), 10% for D-preload, and 5% for P-preload. Refer to the "Technical Description" on page B56 if axial load and preload differ from the conditions above or if deformation of the ball nut body must be considered.
 6. The basic load ratings with PFT and LPFT nuts are different due to the installed spacer balls.
 7. Finished shaft end FA models are available for those models marked with an asterisk (*).
 8. P-preload refers to oversize ball preload and D-preload to double-nut preload. For details, see page B5.



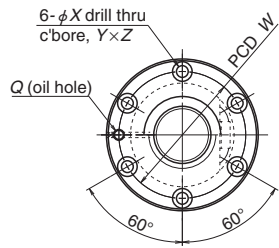
Model No.	Preload	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D_w</i>	Ball circle dia. <i>d_m</i>	Root dia. <i>d_t</i>	Effective ball turns × Circuits	Basic load ratings (N)		Axial rigidity <i>K</i> (N/μm)										
								Dynamic <i>C₀</i>	Static <i>C_{0s}</i>											
PFT 2006-2.5	P	20	6	3.969	20.5	16.4	2.5×1	8 120	10 500	172										
PFT 2006-3	P						1.5×2	9 500	12 600	204										
SFT 2006-2.5	Clearance						2.5×1	12 900	21 000	204										
ZFT 2006-5	Z						2.5×1	12 900	21 000	401										
SFT 2006-3	Clearance						1.5×2	15 100	25 200	243										
DFT 2006-3	D						1.5×2	15 100	25 200	477										
PFT 2008-2.5	P		8	3.969	20.5	16.4	16.4	2.5×1	8 080	10 500	170									
SFT 2008-2.5	P							2.5×1	12 800	20 900	203									
DFT 2008-2.5	D							2.5×1	12 800	20 900	397									
SFT 2008-3	Clearance							1.5×2	15 000	25 100	241									
DFT 2008-3	D							1.5×2	15 000	25 100	473									
* LPFT 2010-2.5	P							10	3.969	21.0	16.9	16.9	2.5×1	8 350	11 000	177				
LSFT 2010-2.5	Clearance	13 300	21 900	211																
LPFT 2016-2.5	P	16	3.969	21.0	16.9	16.9	2.5×1						8 170	10 800	171					
LSFT 2016-2.5	Clearance						13 000						21 600	203						
* LPFT 2020-1.5	P						20						3.969	21.0	16.9	16.9	1.5×1	6 250	8 760	132
LSFT 2020-1.5	Clearance																8 190	13 100	123	
SFT 2504-2.5	Clearance							4	2.381	25.3	22.8	22.8					2.5×1	6 220	13 600	203
ZFT 2504-5	Z																2.5×1	6 220	13 600	399
* PFT 2504-5	P	2.5×2	7 110	13 600	328															
SFT 2504-5	Clearance	2.5×2	11 300	27 200	394															
ZFT 2504-10	Z	2.5×2	11 300	27 200	773															
PFT 2505-3	P	5	3.175	25.5	22.2	22.2	1.5×2						7 940	12 800	235					
SFT 2505-2.5	Clearance						2.5×1		10 800	21 800	243									
ZFT 2505-5	Z						2.5×1		10 800	21 800	477									
* PFT 2505-5	P						2.5×2		12 300	21 800	391									
SFT 2505-3	Clearance						1.5×2		12 600	25 600	285									
DFT 2505-3	D						1.5×2		12 600	25 600	558									
PFT 2505-7.5	P		2.5×3	17 500	32 700	576														
SFT 2505-5	Clearance		2.5×2	19 600	43 600	470														
ZFT 2505-10	Z		2.5×2	19 600	43 600	923														
SFT 2505-7.5	Clearance		2.5×3	27 700	65 400	692														

Notes: 1. Rectangular flanges are used for shaft diameters of 16 mm or less. Circular shape I and II flanges are used for shaft diameters of 20 mm or more. Select a flange suitable for the space available for nut installation.
 2. If no seal is used with nuts PFT, SFT, or DFT, the nut length will be shortened by the amount of dimension M.
 3. Seals are equipped as standard for LSFT and LPFT nuts when shaft diameter is 20 mm or less. The outside dimensions are the same as those without seals.
 4. Right-turn screws are standard. "L" is added to the end of the Model No. for left turn screws.

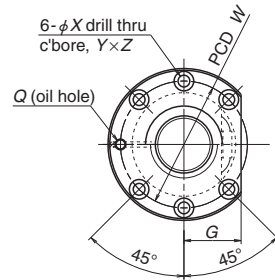
Ball nut dimensions														
Nut total length <i>L</i>	Nut diameter <i>D</i>	Flange diameter <i>A</i>	Flange width <i>B</i>	Flange notch <i>G</i>	Rectangle flange dimensions		Seal dimension <i>M</i>	Bolt hole dimensions			Bolt hole PCD <i>W</i>	Oil hole distance <i>T</i>	Oil hole <i>Q</i>	
					<i>H</i>	<i>K</i>		<i>X</i>	<i>Y</i>	<i>Z</i>				
44	48	71	11	27	—	—	3	5.5	9.5	5.5	59	—	M6×1	
56														
44														
62														
56														
110														
54	48	75	13	28	—	—	5	6.6	11	6.5	61	—	M6×1	
54														
102														
64														
120														
54														
54	46	74	13	—	46	66	—	6.6	11	6.5	59	24	M6×1	
72														
63														
36														
48														
48														
48														
48	46	69	11	26	—	—	3	5.5	9.5	5.5	57	—	M6×1	
72														
52														
40														
55														
55														
52	50	73	11	28	—	—	3	5.5	9.5	5.5	61	—	M6×1	
102														
70														
55														
85														
70														

5. Values for axial rigidity *K* above are theoretical values obtained from the elastic deformation between the screw groove and ball when axial load is 30% of the basic dynamic load rating *C*, for clearance (no preload), 10% for D-preload, and 5% for P-preload. Refer to the "Technical Description" on page B56 if axial load and preload differ from the conditions above or if deformation of the ball nut body must be considered.
 6. The basic load ratings with PFT and LPFT nuts are different due to the installed spacer balls.
 7. Finished shaft end FA models are available for those models marked with an asterisk (*).
 8. P-preload refers to oversize ball preload and D-preload to double-nut preload. For details, see page B5.

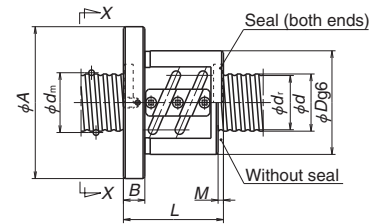
View X-X



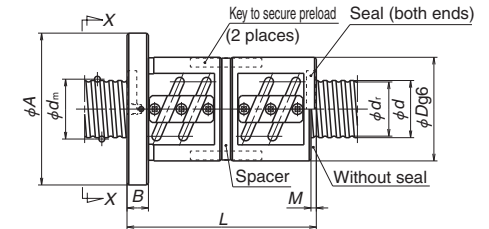
Circular shape I



Circular shape II



PFT, ZFT, SFT



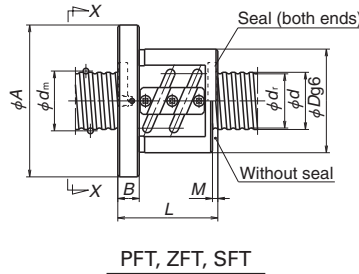
DFT

Model No.	Preload	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D_w</i>	Ball circle dia. <i>d_m</i>	Root dia. <i>d_r</i>	Effective ball turns × Circuits	Basic load ratings (N)		Axial rigidity <i>K</i> (N/μm)					
								Dynamic <i>C_a</i>	Static <i>C_{0a}</i>						
PFT 2506-3	P	25	6	3.969	25.5	21.4	1.5×2	10 700	16 000	247					
SFT 2506-2.5	Clearance						2.5×1	14 500	26 700	247					
ZFT 2506-5	Z						2.5×1	14 500	26 700	485					
* PFT 2506-5	P						2.5×2	16 600	26 700	402					
SFT 2506-3	Clearance						1.5×2	17 000	32 000	294					
ZFT 2506-6	Z						1.5×2	17 000	32 000	577					
SFT 2506-5	Clearance						2.5×2	26 300	53 400	478					
ZFT 2506-10	Z						2.5×2	26 300	53 400	938					
PFT 2508-2.5	P						25	8	4.762	25.5	20.5	2.5×1	11 700	15 900	213
PFT 2508-3	P											1.5×2	13 700	18 900	245
SFT 2508-2.5	Clearance	2.5×1	18 500	31 800	253										
ZFT 2508-5	Z	2.5×1	18 500	31 800	495										
SFT 2508-3	Clearance	1.5×2	21 700	37 900	299										
DFT 2508-3	D	1.5×2	21 700	37 900	587										
PFT 2510-2.5	P	25	10	4.762	25.5	20.5						2.5×1	11 600	15 900	211
ZFT 2510-3	Z											1.5×1	11 900	18 900	301
PFT 2510-3	P											1.5×2	13 600	18 900	243
SFT 2510-2.5	Clearance											2.5×1	18 500	31 700	251
DFT 2510-2.5	D						2.5×1	18 500	31 700	493					
SFT 2510-3	Clearance						1.5×2	21 600	37 800	297					
DFT 2510-3	D						1.5×2	21 600	37 800	583					
SFT 2510-3.5	Clearance						3.5×1	24 700	44 600	347					
DFT 2510-3.5	D						3.5×1	24 700	44 600	681					

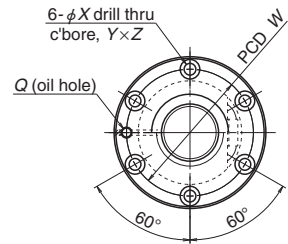
- Notes: 1. Circular shape I and Circular shape II flanges are used for shaft diameters of 20 mm or more. Select a flange suitable for the space available for nut installation.
 2. If no seal is used with nuts PFT, SFT, ZFT, or DFT, the nut length will be shortened by the amount of dimension *M*.
 3. Right-turn screws are standard. "L" is added to the end of the Model No. for left turn screws.

Ball nut dimensions																				
Nut total length <i>L</i>	Nut diameter <i>D</i>	Flange diameter <i>A</i>	Flange width <i>B</i>	Flange notch <i>G</i>	Seal dimension <i>M</i>	Bolt hole dimensions			Oil hole distance <i>W</i>	Oil hole <i>Q</i>										
						<i>X</i>	<i>Y</i>	<i>Z</i>												
56	53	76	11	29	3	5.5	9.5	5.5	64	M6×1										
44																				
62																				
62																				
56																				
92																				
62																				
98																				
56											58	85	13	32	5	6.6	11	6.5	71	M6×1
69																				
56																				
80																				
69																				
133																				
67	58	85	15	32	8	6.6	11	6.5	71	M6×1										
81																				
81																				
67																				
127																				
81																				
151																				
77																				
147																				

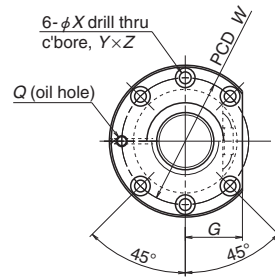
4. Values for axial rigidity *K* above are theoretical values obtained from the elastic deformation between the screw groove and ball when axial load is 30% of the basic dynamic load rating *C_a* for clearance (no preload), 10% for D-preload, and 5% for P-preload. Refer to the "Technical Description" on page B56 if axial load and preload differ from the conditions above or if deformation of the ball nut body must be considered.
 5. The basic load ratings with PFT nuts are different due to the installed spacer balls.
 6. Finished shaft end FA models are available for those models marked with an asterisk (*).
 7. P-preload refers to oversize ball preload and D-preload to double-nut preload. For details, see page B5.



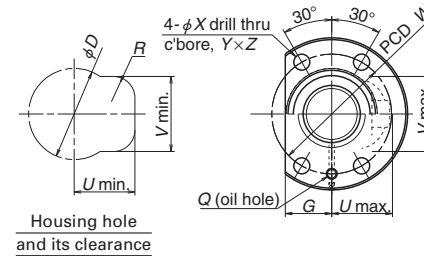
View X-X



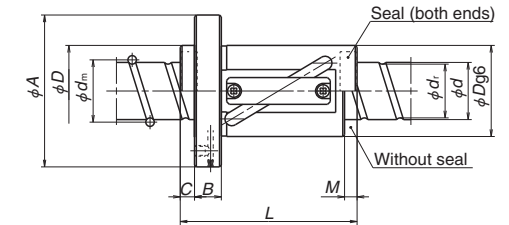
Circular shape I



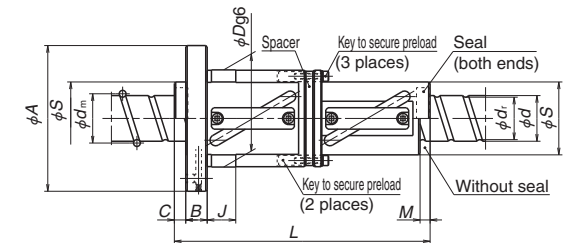
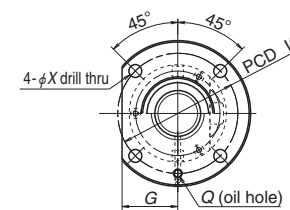
Circular shape II



Housing hole and its clearance



LPFT, LSFT



LDFT

Unit: mm

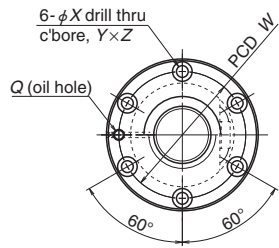
Model No.	Preload	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D_w</i>	Ball circle dia. <i>d_m</i>	Root dia. <i>d_r</i>	Effective ball turns Turns × Circuits	Basic load ratings (N)		Axial rigidity <i>K</i> (N/μm)	Nut total length <i>L</i>
								Dynamic <i>C₀</i>	Static <i>C_{0s}</i>		
LPFT 2516-2.5	P	25	16	4.762	26.25	21.3	2.5×1	11 400	16 500	213	84
LPFT 2516-3	P						1.5×2	13 400	19 500	251	100
LSFT 2516-2.5	Clearance						2.5×1	18 100	33 000	253	84
LDFT 2516-2.5	D						2.5×1	18 100	33 000	496	152
LSFT 2516-3	Clearance						1.5×2	21 200	39 000	298	100
LDFT 2516-3	D						1.5×2	21 200	39 000	584	181
* LPFT 2520-2.5	P	25	20	4.762	26.25	21.3	2.5×1	11 700	16 300	211	96
LPFT 2520-3	P						1.5×2	13 700	19 300	248	116
LSFT 2520-2.5	Clearance						2.5×1	18 600	32 600	251	96
LDFT 2520-2.5	D						2.5×1	18 600	32 600	492	177
LSFT 2520-3	Clearance						1.5×2	21 800	38 600	296	116
LDFT 2520-3	D						1.5×2	21 800	38 600	580	217
* LPFT 2525-1.5	P	28	5	3.175	28.5	25.2	8.970	13 100	165	90	
LDFT 2525-1.5	D						11 700	19 700	297	166	
LSFT 2525-1.5	Clearance						11 700	19 700	151	90	
SFT 2805-2.5	Clearance						11 300	24 400	265	41	
ZFT 2805-5	Z						2.5×1	11 300	24 400	519	56
* PFT 2805-5	P						2.5×2	13 000	24 400	432	56
SFT 2805-5	Clearance	2.5×2	20 600	48 700	514	56					
* ZFT 2805-10	Z	2.5×2	20 600	48 700	1 007	86					

- Notes: 1. Circular shape I and Circular shape II flanges are used for shaft diameters of 20 mm or more. Select a flange suitable for the space available for nut installation.
 2. If no seal is used with nuts PFT, ZFT, or SFT, the nut length will be shortened by the amount of dimension *M*.
 3. If no seal is used with nuts LSFT or LDFT, the nut length will be shortened by the amount of dimension *M* and *C*.
 4. Right-turn screws are standard. "L" is added to the end of the Model No. for left turn screws.

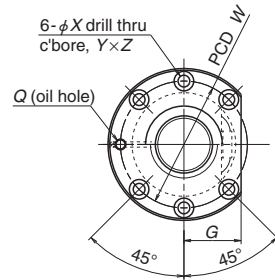
Nut diameter		Ball nut dimensions																						
<i>D</i>	<i>S</i>	Flange diameter <i>A</i>	Flange width <i>B</i>	Flange notch <i>G</i>	Projecting tube dimensions			Seal dimensions		Diameter g6 <i>J</i>	Bolt hole dimensions			Bolt hole PCD <i>W</i>	Oil hole <i>Q</i>									
					<i>U</i>	<i>V</i>	<i>R</i>	<i>M</i>	<i>C</i>		<i>X</i>	<i>Y</i>	<i>Z</i>											
44	—	71	12	23	31	35	12	6	8	—	6.6	—	—	57	M6×1									
44	—	71		23	31	35	12																	
44	—	71		23	31	35	12																	
62	44	89		34	—	—	—																	
44	—	71		23	31	35	12																	
62	44	89		34	—	—	—																	
44	—	71	12	23	31	35	12	7	8	—	6.6	—	—	57	M6×1									
44	—	71		23	31	35	12																	
44	—	71		23	31	35	12																	
62	44	89		34	—	—	—																	
44	—	71		23	31	35	12																	
62	44	89		34	—	—	—																	
44	—	71	12	23	32	34	12	10	10	—	6.6	—	—	57	M6×1									
62	44	89		34	—	—	—																	
44	—	71		23	32	34	12																	
44	—	71		23	32	34	12																	
55	—	85		12	31	—	—									—	3	—	—	6.6	11	6.5	69	M6×1

5. Values for axial rigidity *K* above are theoretical values obtained from the elastic deformation between the screw groove and ball when axial load is 30% of the basic dynamic load rating *C₀* for clearance (no preload), 10% for D-preload, and 5% for P-preload. Refer to the "Technical Description" on page B56 if axial load and preload differ from the conditions above or if deformation of the ball nut body must be considered.
 6. The basic load ratings with PFT and LPFT nuts are different due to the installed spacer balls.
 7. Finished shaft end FA models and standard SA models are available for those models marked with an asterisk (*).
 8. P-preload refers to oversize ball preload and D-preload to double-nut preload. For details, see page B5.

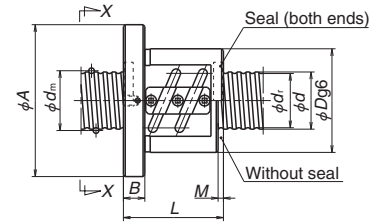
View X-X



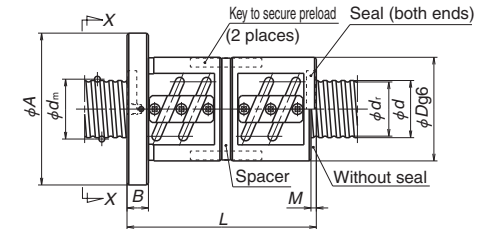
Circular shape I



Circular shape II



PFT, ZFT, SFT



DFT

Model No.	Preload	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D_w</i>	Ball circle dia. <i>d_m</i>	Root dia. <i>d_r</i>	Effective ball turns × Circuits	Basic load ratings (N)		Axial rigidity <i>K</i> (N/μm)
								Dynamic <i>C_d</i>	Static <i>C_{0a}</i>	
PFT 2806-3	P	28	6	3.175	28.5	25.2	1.5×2	8 350	14 600	265
SFT 2806-2.5	Clearance						2.5×1	11 300	24 300	265
ZFT 2806-5	Z						2.5×1	11 300	24 300	519
* PFT 2806-5	P						2.5×2	12 900	24 300	430
SFT 2806-3	Clearance						1.5×2	13 200	29 200	315
ZFT 2806-6	Z						1.5×2	13 200	29 200	617
SFT 2806-5	Clearance		2.5×2	20 600	48 700	513				
* ZFT 2806-10	Z		2.5×2	20 600	48 700	1 006				
PFT 2810-2.5	P		10	4.762	28.5	23.5	2.5×1	12 300	17 900	229
ZFT 2810-3	Z						1.5×1	12 600	21 400	332
PFT 2810-3	P						1.5×2	14 400	21 400	275
SFT 2810-2.5	Clearance						2.5×1	19 600	35 800	277
ZFT 2810-5	Z	2.5×1					19 600	35 800	543	
SFT 2810-3	Clearance	1.5×2					22 900	42 700	328	
ZFT 2810-6	Z	1.5×2	22 900	42 700	643					
SFT 3204-2.5	Clearance	4	2.381	32.3	29.8	2.5×1	6 850	17 500	247	
ZFT 3204-5	Z					2.5×1	6 850	17 500	485	
PFT 3204-5	P					2.5×2	7 840	17 500	403	
SFT 3204-5	Clearance					2.5×2	12 400	35 000	479	
ZFT 3204-10	Z					2.5×2	12 400	35 000	939	
PFT 3205-3	P					32	5	3.175	29.2	1.5×2
SFT 3205-2.5	Clearance	2.5×1	12 000	28 000	296					
ZFT 3205-5	Z	2.5×1	12 000	28 000	580					
** PFT 3205-5	P	2.5×2	13 700	28 000	481					
SFT 3205-3	Clearance	1.5×2	14 000	33 600	351					
ZFT 3205-6	Z	1.5×2	14 000	33 600	689					
PFT 3205-7.5	P	2.5×3	19 500	42 000	709					
# SFT 3205-5	Clearance	2.5×2	21 800	56 000	572					
** ZFT 3205-10	Z	2.5×2	21 800	56 000	1 123					
SFT 3205-7.5	Clearance	2.5×3	30 900	84 000	843					
ZFT 3205-15	Z	2.5×3	30 900	84 000	1 652					

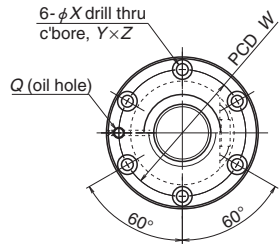
- Notes: 1. Circular shape I and Circular shape II flanges are used for shaft diameters of 20 mm or more. Select a flange suitable for the space available for nut installation.
 2. If no seal is used with nuts PFT, SFT, ZFT, or DFT, the nut length will be shortened by the amount of dimension *M*.
 3. Right-turn screws are standard. **L* is added to the end of the Model No. for left turn screws.

Unit: mm

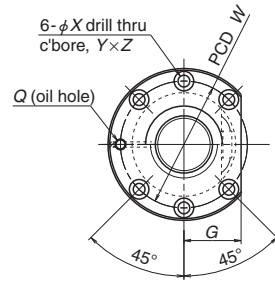
Ball nut dimensions										
Nut total length <i>L</i>	Nut diameter <i>D</i>	Flange diameter <i>A</i>	Flange width <i>B</i>	Flange notch <i>G</i>	Seal dimension <i>M</i>	Bolt hole dimensions			Bolt hole PCD <i>W</i>	Oil hole <i>Q</i>
						<i>X</i>	<i>Y</i>	<i>Z</i>		
57	55	85	12	31	3	6.6	11	6.5	69	M6×1
45										
63										
63										
57										
87										
63										
99	60	94	15	36	7	9	14	8.5	76	M6×1
68										
82										
82										
68										
98										
82										
132	54	81	12	31	3	6.6	11	6.5	67	M6×1
37										
49										
49										
49										
73										
53	58	85	12	32	3	6.6	11	6.5	71	M6×1
41										
56										
56										
53										
78										
71										
56										
86										
71										
116										

4. Values for axial rigidity *K* above are theoretical values obtained from the elastic deformation between the screw groove and ball when axial load is 30% of the basic dynamic load rating *C*, for clearance (no preload), 10% for D-preload, and 5% for P-preload. Refer to the "Technical Description" on page B56 if axial load and preload differ from the conditions above or if deformation of the ball nut body must be considered.
 5. The basic load ratings with PFT nuts are different due to the installed spacer balls.
 6. Finished shaft end FA models are available for those models marked with an asterisk (*).
 7. P-preload refers to oversize ball preload and D-preload to double-nut preload. For details, see page B5.
 8. SRC type is recommended for markings (#).

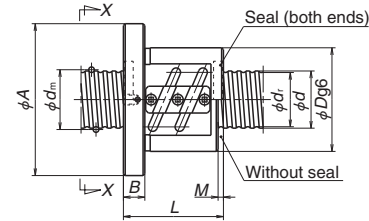
View X-X



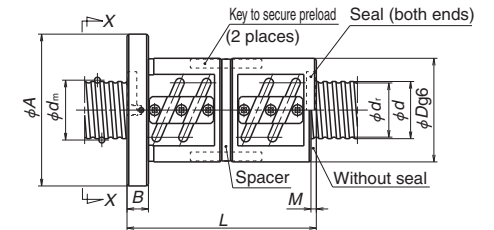
Circular shape I



Circular shape II



PFT, ZFT, SFT



DFT

Unit: mm

Model No.	Preload	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D_w</i>	Ball circle dia. <i>d_m</i>	Root dia. <i>d_r</i>	Effective ball turns Turns × Circuits	Basic load ratings (N)		Axial rigidity <i>K</i> (N/μm)				
								Dynamic <i>C_d</i>	Static <i>C_{0a}</i>					
PFT 3206-3	P	32	6	3.969	32.5	28.4	1.5×2	11 800	20 600	300				
SFT 3206-2.5	Clearance						2.5×1	16 000	34 700	302				
ZFT 3206-5	Z						2.5×1	16 000	34 700	592				
PFT 3206-5	P						2.5×2	18 300	34 700	491				
SFT 3206-3	Clearance						1.5×2	18 800	41 200	357				
ZFT 3206-6	Z						1.5×2	18 800	41 200	700				
SFT 3206-5	Clearance						2.5×2	29 100	69 300	585				
ZFT 3206-10	Z						2.5×2	29 100	69 300	1 146				
PFT 3208-3	P						8	4.762	32.5	27.5	1.5×2	15 100	24 700	308
SFT 3208-2.5	Clearance										2.5×1	20 600	40 900	307
ZFT 3208-5	Z	2.5×1	20 600	40 900	602									
PFT 3208-5	P	2.5×2	23 500	40 900	493									
SFT 3208-3	Clearance	1.5×2	24 000	49 400	366									
ZFT 3208-6	Z	1.5×2	24 000	49 400	718									
SFT 3208-5	Clearance	2.5×2	37 300	81 800	594									
ZFT 3208-10	Z	2.5×2	37 300	81 800	1 164									
PFT 3210-2.5	P	10	6.35	33.0	26.4	2.5×1					18 900	27 600	266	
ZFT 3210-3	Z					1.5×1					19 300	32 300	381	
PFT 3210-3	P					1.5×2	22 100	32 300	316					
SFT 3210-2.5	Clearance					2.5×1	30 000	55 100	322					
ZFT 3210-5	Z					2.5×1	30 000	55 100	631					
PFT 3210-5	P					2.5×2	34 300	55 100	515					
SFT 3210-3	Clearance					1.5×2	35 100	64 500	376					
ZFT 3210-6	Z					1.5×2	35 100	64 500	738					
SFT 3210-3.5	Clearance					3.5×1	40 100	76 600	441					
ZFT 3210-7	Z					3.5×1	40 100	76 600	865					
SFT 3210-5	Clearance	2.5×2	54 500	110 000	623									
ZFT 3210-10	Z	2.5×2	54 500	110 000	1 222									
PFT 3212-2.5	P	12	6.35	33.0	26.4	2.5×1	18 800	27 500	265					
ZFT 3212-3	Z					1.5×1	19 300	32 200	380					
PFT 3212-3	P					1.5×2	22 000	32 200	315					
SFT 3212-2.5	Clearance					2.5×1	29 900	55 000	320					
ZFT 3212-5	Z					2.5×1	29 900	55 000	628					
SFT 3212-3	Clearance					1.5×2	35 000	64 400	375					
ZFT 3212-6	Z					1.5×2	35 000	64 400	735					

Notes: 1. Circular shape I and Circular shape II flanges are used for shaft diameters of 20 mm or more. Select a flange suitable for the space available for nut installation.

2. If no seal is used with nuts PFT, SFT, ZFT, or DFT, the nut length will be shortened by the amount of dimension *M*.

3. Right-turn screws are standard. "L" is added to the end of the Model No. for left turn screws.

Ball nut dimensions

Nut total length <i>L</i>	Nut diameter <i>D</i>	Flange diameter <i>A</i>	Flange width <i>B</i>	Flange notch <i>G</i>	Seal dimension <i>M</i>	Bolt hole dimensions			Bolt hole PCD <i>W</i>	Oil hole <i>Q</i>
						<i>X</i>	<i>Y</i>	<i>Z</i>		
57	62	89	12	34	3	6.6	11	6.5	75	M6×1
45										
63										
63										
57										
87										
63										
99										
71										
58										
82										
82										
71										
111										
82										
130										
70										
87										
87										
70										
100										
100										
87										
137										
80										
120										
100										
160										
81										
97										
97										
81										
117										
97										
157										

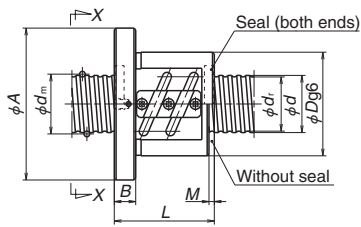
4. Values for axial rigidity *K* above are theoretical values obtained from the elastic deformation between the screw groove and ball when axial load is 30% of the basic dynamic load rating *C_d* for clearance (no preload), 10% for D-preload, and 5% for P-preload. Refer to the "Technical Description" on page B56 if axial load and preload differ from the conditions above or if deformation of the ball nut body must be considered.

5. The basic load ratings with PFT nuts are different due to the installed spacer balls.

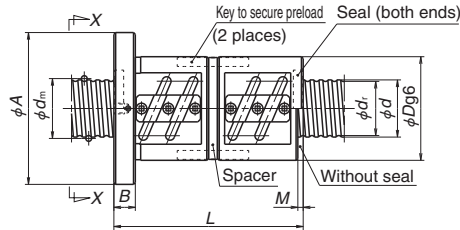
6. Finished shaft end FA models are available for those models marked with an asterisk (*).

7. P-preload refers to oversize ball preload and D-preload to double-nut preload. For details, see page B5.

8. SRC type is recommended for markings (#).

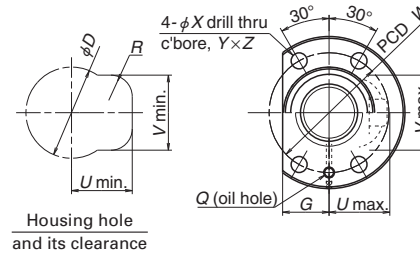


PFT, ZFT, SFT

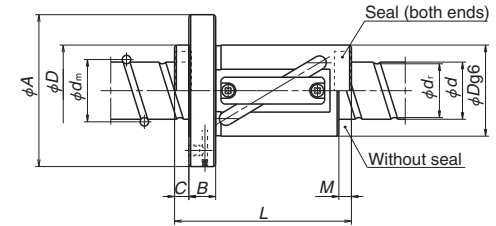


DFT

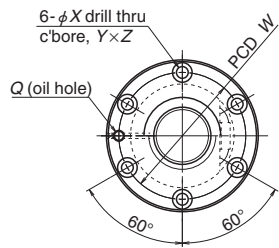
View X-X



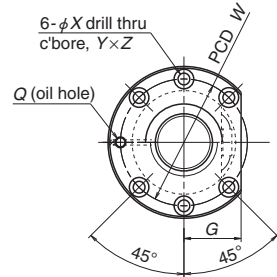
Housing hole and its clearance



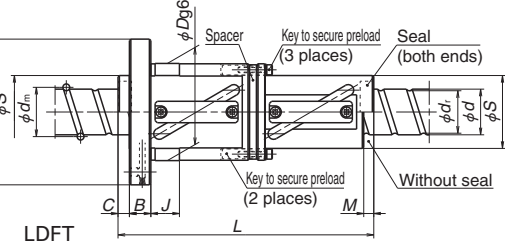
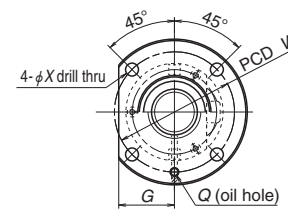
LPFT, LSFT



Circular shape I



Circular shape II



LDFT

Unit: mm

Model No.	Preload	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D_w</i>	Ball circle dia. <i>d_m</i>	Root dia. <i>d_r</i>	Effective ball turns × Circuits	Basic load ratings (N)		Axial rigidity <i>K</i> (N/μm)	Nut total length <i>L</i>
								Dynamic <i>C_d</i>	Static <i>C_s</i>		
LPFT 3220-2.5	P	32	20	4.762	33.25	28.3	2.5×1	13 000	20 900	255	99
LPFT 3220-3	P						1.5×2	15 300	25 100	301	119
LSFT 3220-2.5	Clearance D						2.5×1	20 700	41 900	307	99
LDFT 3220-2.5	Clearance D						2.5×1	20 700	41 900	603	179
LSFT 3220-3	Clearance D						1.5×2	24 200	50 200	366	119
LDFT 3220-3	Clearance D						1.5×2	24 200	50 200	717	219
* LPFT 3225-2.5	P	25	25	4.762	33.25	28.3	2.5×1	12 900	21 100	256	117
LPFT 3225-3	P						1.5×2	15 100	24 900	295	142
LSFT 3225-2.5	Clearance D						2.5×1	20 400	42 200	304	117
LDFT 3225-2.5	Clearance D						2.5×1	20 400	42 200	597	218
LSFT 3225-3	Clearance D						1.5×2	23 900	49 700	358	142
LDFT 3225-3	Clearance D						1.5×2	23 900	49 700	702	268
* LPFT 3232-1.5	P	32	32	4.762	33.25	28.3	1.5×1	10 100	16 800	195	109
LSFT 3232-1.5	Clearance D						1.3 300	25 200	184	109	
LDFT 3232-1.5	Clearance D						13 300	25 200	361	205	
ZFT 3605-5	Z	36	5	3.175	36.5	33.2	2.5×1	12 600	31 600	637	59
PFT 3605-5	P						2.5×2	14 400	31 600	529	59
PFT 3605-7.5	P						2.5×3	20 400	47 500	779	74
SFT 3605-5	Clearance Z						2.5×2	22 900	63 300	630	59
ZFT 3605-10	Z						2.5×2	22 900	63 300	1 235	89
SFT 3605-7.5	Clearance Z						2.5×3	32 400	94 900	926	74
ZFT 3605-15	Z						2.5×3	32 400	94 900	1 817	119

Notes: 1. Circular shape I and Circular shape II flanges are used for shaft diameters of 20 mm or more. Select a flange suitable for the space available for nut installation.

2. If no seal is used with nuts PFT, ZFT, or SFT, the nut length will be shortened by the amount of dimension *M*.

3. If no seal is used with nuts LSFT or LDFT, the nut length will be shortened by the amount of dimension *M* and *C*.

4. Right-turn screws are standard. "L" is added to the end of the Model No. for left turn screws.

Ball nut dimensions															
Nut diameter		Flange diameter <i>A</i>	Flange width <i>B</i>	Flange notch <i>G</i>	Projecting tube dimensions			Seal dimensions		Diameter g6	Bolt hole dimensions			Bolt hole PCD <i>W</i>	Oil hole <i>Q</i>
<i>D</i>	<i>S</i>				<i>U</i>	<i>V</i>	<i>R</i>	<i>M</i>	<i>C</i>		<i>X</i>	<i>Y</i>	<i>Z</i>		
51	—	85	15	26	34	42	12	7	8	20	9	—	—	67	M6×1
51	—	85		26	34	42	12								
51	—	85		26	34	42	12								
68	51	102		39	—	—	—								
51	—	85		26	34	42	12								
68	51	102		39	—	—	—								
51	—	85	15	26	34	42	12	10	10	20	9	—	—	67	M6×1
51	—	85		26	34	42	12								
51	—	85		26	34	42	12								
68	51	102		39	—	—	—								
51	—	85		26	34	42	12								
68	51	102		39	—	—	—								
51	—	85	15	26	34	42	12	13	12	20	9	—	—	67	M6×1
51	—	85		26	34	42	12								
68	51	102		39	—	—	—								
65	—	100	15	38	—	—	—	3	—	—	9	14	8.5	82	M6×1

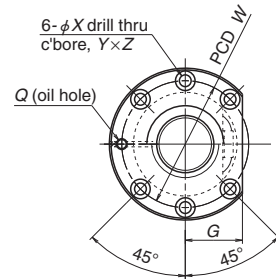
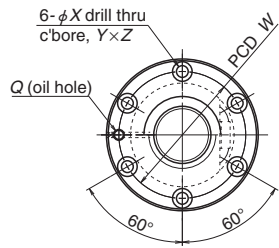
5. Values for axial rigidity *K* above are theoretical values obtained from the elastic deformation between the screw groove and ball when axial load is 30% of the basic dynamic load rating *C_d* for clearance (no preload), 10% for D-preload, and 5% for P-preload. Refer to the "Technical Description" on page B56 if axial load and preload differ from the conditions above or if deformation of the ball nut body must be considered.

6. The basic load ratings with PFT and LPFT nuts are different due to the installed spacer balls.

7. Finished shaft end FA models and standard SA models are available for those models marked with an asterisk (*).

8. P-preload refers to oversize ball preload and D-preload to double-nut preload. For details, see page B5.

View X-X

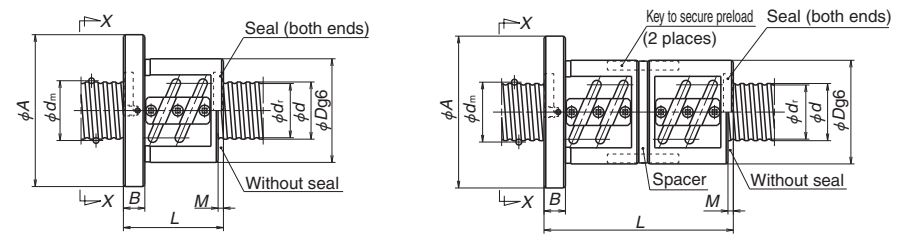


Circular shape I

Circular shape II

Model No.	Preload	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D_w</i>	Ball circle dia. <i>d_m</i>	Root dia. <i>d_r</i>	Effective ball turns Turns × Circuits	Basic load ratings (N)		Axial rigidity <i>K</i> (N/μm)	
								Dynamic <i>C_d</i>	Static <i>C_{0a}</i>		
ZFT 3606-5	Z	36	6	3.969	36.5	32.4	2.5×1	17 200	39 200	656	
PFT 3606-5	P						2.5×2	19 700	39 200	545	
PFT 3606-7.5	P						2.5×3	27 900	58 800	802	
SFT 3606-5	Clearance						2.5×2	31 300	78 400	648	
ZFT 3606-10	Z						2.5×2	31 300	78 400	1 271	
SFT 3606-7.5	Clearance						2.5×3	44 400	118 000	954	
ZFT 3606-15	Z		2.5×3	44 400	118 000	1 872					
PFT 3610-2.5	P		36	10	6.35	37.0	30.4	2.5×1	20 100	30 500	290
ZFT 3610-3	Z							1.5×1	20 600	36 600	422
PFT 3610-3	P							1.5×2	23 600	36 600	342
SFT 3610-2.5	Clearance							2.5×1	32 000	61 100	350
* ZFT 3610-5	Z							2.5×1	32 000	61 100	687
PFT 3610-5	P	2.5×2						36 600	61 100	562	
SFT 3610-3	Clearance	1.5×2		37 400	73 300	417					
ZFT 3610-6	Z	1.5×2		37 400	73 300	817					
PFT 3610-7.5	P	2.5×3		51 800	91 600	826					
SFT 3610-5	Clearance	2.5×2		58 000	122 000	678					
ZFT 3610-10	Z	2.5×2		58 000	122 000	1 329					
SFT 3610-7.5	Clearance	2.5×3		82 200	183 000	998					
PFT 4005-3	P	40	5	3.175	40.5	37.2	1.5×2	9 700	21 200	354	
SFT 4005-2.5	Clearance						2.5×1	13 200	35 300	354	
ZFT 4005-5	Z						2.5×1	13 200	35 300	695	
# PFT 4005-5	P						2.5×2	15 100	35 300	577	
SFT 4005-3	Clearance						1.5×2	15 400	42 300	421	
ZFT 4005-6	Z						1.5×2	15 400	42 300	826	
PFT 4005-7.5	P						2.5×3	21 300	52 900	848	
SFT 4005-5	Clearance						2.5×2	23 900	70 500	685	
#* ZFT 4005-10	Z						2.5×2	23 900	70 500	1 344	
SFT 4005-7.5	Clearance						2.5×3	33 900	106 000	1 009	
ZFT 4005-15	Z						2.5×3	33 900	106 000	1 979	
ZFT 4006-5	Z						40	6	3.969	40.5	36.4
PFT 4006-5	P	2.5×2	20 500	43 800	592						
SFT 4006-3	Clearance	1.5×2	21 000	52 500	433						
ZFT 4006-6	Z	1.5×2	21 000	52 500	850						
PFT 4006-7.5	P	2.5×3	29 100	65 600	872						
SFT 4006-5	Clearance	2.5×2	32 600	87 500	705						
ZFT 4006-10	Z	2.5×2	32 600	87 500	1 383						
SFT 4006-7.5	Clearance	2.5×3	46 200	131 000	1 038						
ZFT 4006-15	Z	2.5×3	46 200	131 000	2 036						

- Notes: 1. Circular shape I and Circular shape II flanges are used for shaft diameters of 20 mm or more. Select a flange suitable for the space available for nut installation.
 2. If no seal is used with nuts PFT, SFT, ZFT, or DFT, the nut length will be shortened by the amount of dimension *M*.
 3. Right-turn screws are standard. "L" is added to the end of the Model No. for left turn screws.
 4. Values for axial rigidity *K* above are theoretical values obtained from the elastic deformation between the screw groove



PFT, ZFT, SFT

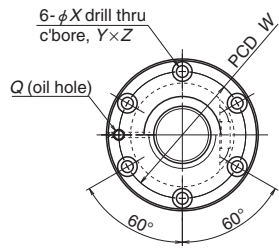
DFT

Unit: mm

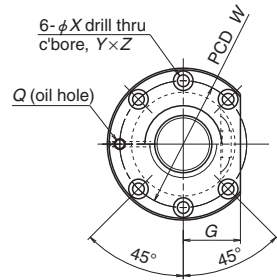
Nut total length <i>L</i>	Nut diameter <i>D</i>	Flange diameter <i>A</i>	Flange width <i>B</i>	Flange notch <i>G</i>	Seal dimension <i>M</i>	Bolt hole dimensions			Bolt hole PCD <i>W</i>	Oil hole <i>Q</i>
						<i>X</i>	<i>Y</i>	<i>Z</i>		
66	65	100	15	38	3	9	14	8.5	82	M6×1
66										
84										
66										
102										
84										
138										
73	75	120	18	45	7	11	17.5	11	98	M6×1
90										
90										
73										
103										
103										
90										
140	67	101	15	39	3	9	14	8.5	83	Rc1/8
133										
103										
163										
133										
56										
44										
59	70	104	15	40	3	9	14	8.5	86	Rc1/8
59										
56										
81										
74										
59										
89										
74										
119										
66	70	104	15	40	3	9	14	8.5	86	Rc1/8
66										
60										
90										
84										
66										
84										
102										
84										
138										

- and ball when axial load is 30% of the basic dynamic load rating *C_d*, for clearance (no preload), 10% for D-preload, and 5% for P-preload. Refer to the "Technical Description" on page B56 if axial load and preload differ from the conditions above or if deformation of the ball nut body must be considered.
 5. The basic load ratings with PFT nuts are different due to the installed spacer balls.
 6. Finished shaft end FA models are available for those models marked with an asterisk (*).
 7. P-preload refers to oversize ball preload and D-preload to double-nut preload. For details, see page B5.
 8. SRC type is recommended for markings (#).

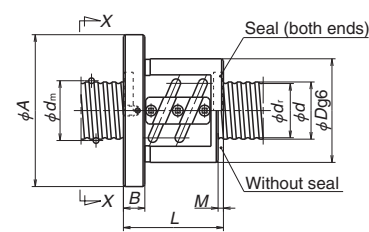
View X-X



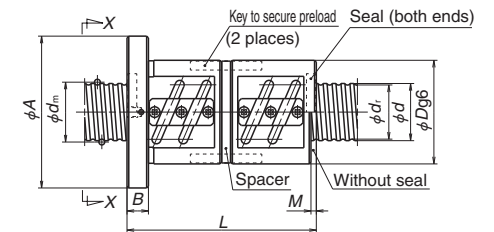
Circular shape I



Circular shape II



PFT, ZFT, SFT



DFT

Unit: mm

Model No.	Preload	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D_w</i>	Ball circle dia. <i>d_m</i>	Root dia. <i>d_r</i>	Effective ball turns × Circuits	Basic load ratings (N)		Axial rigidity <i>K</i> (N/μm)				
								Dynamic <i>C_d</i>	Static <i>C_{0b}</i>					
PFT 4008-3	P	40	8	4.762	40.5	35.5	1.5×2	16 700	31 200	370				
SFT 4008-2.5	Clearance						2.5×1	22 700	51 500	368				
ZFT 4008-5	Z						2.5×1	22 700	51 500	721				
PFT 4008-5	P						2.5×2	25 900	51 500	598				
SFT 4008-3	Clearance						1.5×2	26 500	62 500	440				
ZFT 4008-6	Z						1.5×2	26 500	62 500	863				
SFT 4008-5	Clearance						2.5×2	41 100	103 000	711				
ZFT 4008-10	Z						2.5×2	41 100	103 000	1 394				
PFT 4010-2.5	P						10	6.35	41	34.4	2.5×1	21 300	34 200	322
PFT 4010-3	P										1.5×2	24 900	41 000	383
SFT 4010-2.5	Clearance										2.5×1	33 700	68 300	383
ZFT 4010-5	Z										2.5×1	33 700	68 300	751
PFT 4010-5	P	2.5×2	38 600	68 300	623									
SFT 4010-3	Clearance	1.5×2	39 500	82 000	456									
ZFT 4010-6	Z	1.5×2	39 500	82 000	894									
ZFT 4010-7	Z	3.5×1	45 100	97 100	1 045									
SFT 4010-3.5	Clearance	3.5×1	45 100	97 100	533									
PFT 4010-7	P	3.5×2	51 500	97 100	859									
SFT 4010-5	Clearance	2.5×2	61 200	137 000	741									
ZFT 4010-10	Z	2.5×2	61 200	137 000	1 454									
SFT 4010-7	Clearance	3.5×2	81 800	194 000	1 032									
PFT 4012-2.5	P	12	7.144	41.5	34.1	2.5×1	24 900	38 600	323					
SFT 4012-2.5	Clearance					2.5×1	39 500	77 200	390					
ZFT 4012-5	Z					2.5×1	39 500	77 200	766					
PFT 4012-5	P					2.5×2	45 200	77 200	626					
PFT 4012-7.5	P					2.5×3	64 000	116 000	921					
SFT 4012-5	Clearance					2.5×2	71 700	154 000	756					
ZFT 4012-10	Z					2.5×2	71 700	154 000	1 482					
SFT 4012-7.5	Clearance					2.5×3	102 000	232 000	1 114					
ZFT 4016-3	Z					16	7.144	41.5	34.1	1.5×1	25 400	46 200	468	
SFT 4016-2.5	Clearance									2.5×1	39 300	77 000	388	
ZFT 4016-5	Z									2.5×1	39 300	77 000	760	
SFT 4016-3	Clearance									1.5×2	46 000	92 400	461	
ZFT 4016-6	Z	1.5×2	46 000	92 400	905									

Notes: 1. Circular shape I and Circular shape II flanges are used for shaft diameters of 20 mm or more. Select a flange suitable for the space available for nut installation.

2. If no seal is used with nuts PFT, SFT, ZFT, or DFT, the nut length will be shortened by the amount of dimension *M*.

3. Right-turn screws are standard. "L" is added to the end of the Model No. for left turn screws.

Ball nut dimensions										
Nut total length <i>L</i>	Nut diameter <i>D</i>	Flange diameter <i>A</i>	Flange width <i>B</i>	Flange notch <i>G</i>	Seal dimension <i>M</i>	Bolt hole dimensions			Bolt hole PCD <i>W</i>	Oil hole <i>Q</i>
						<i>X</i>	<i>Y</i>	<i>Z</i>		
71	74	108	15	41	5	9	14	8.5	90	Rc1/8
58										
82										
82										
71										
111										
82										
130										
73										
90										
73										
103										
103										
90										
140	82	124	18	47	7	11	17.5	11	102	Rc1/8
123										
83										
123										
103										
163										
123										
81										
81										
117										
117										
153										
153										
118										
102										
150	86	128	22	48	14	11	17.5	11	106	Rc1/8
118										
118										
182										

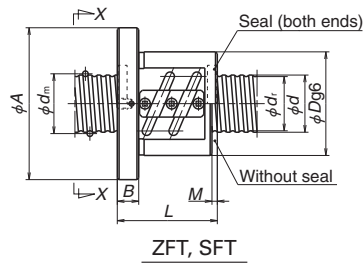
4. Values for axial rigidity *K* above are theoretical values obtained from the elastic deformation between the screw groove and ball when axial load is 30% of the basic dynamic load rating *C_d* for clearance (no preload), 10% for D-preload, and 5% for P-preload. Refer to the "Technical Description" on page B56 if axial load and preload differ from the conditions above or if deformation of the ball nut body must be considered.

5. The basic load ratings with PFT nuts are different due to the installed spacer balls.

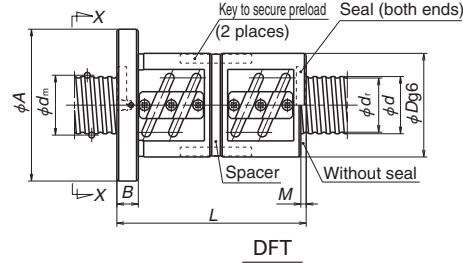
6. Finished shaft end FA models are available for those models marked with an asterisk (*).

7. P-preload refers to oversize ball preload and D-preload to double-nut preload. For details, see page B5.

8. SRC type is recommended for markings (#).

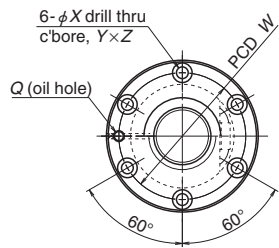


ZFT, SFT

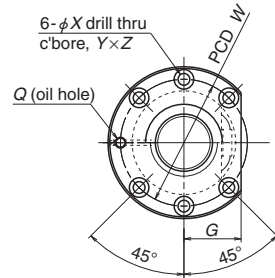


DFT

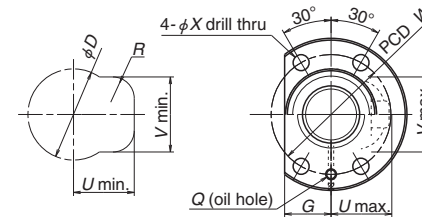
View X-X



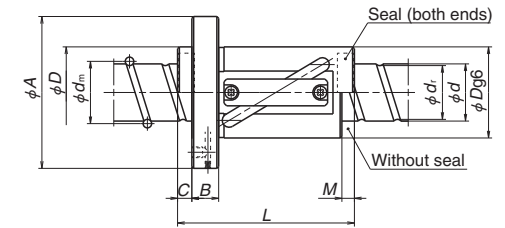
Circular shape I



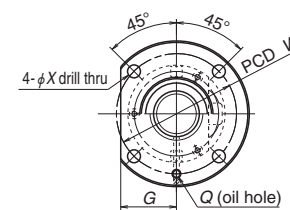
Circular shape II



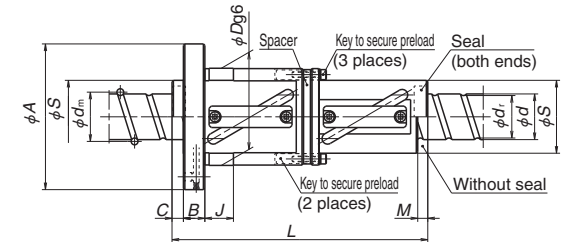
Housing hole and its clearance



LPFT, LSFT



LDFT



Unit: mm

Model No.	Preload	Shaft dia. d	Lead l	Ball dia. D _w	Ball circle dia. d _m	Root dia. d _r	Effective ball turns × Circuits	Basic load ratings (N)		Axial rigidity K (N/μm)	Nut total length L						
								Dynamic C ₀	Static C _{0a}								
LPFT 4025-2.5	P	40	25	6.35	41.75	35.1	2.5×1	21 500	35 100	324	123						
LPFT 4025-3	P						1.5×2	25 100	41 800	375	148						
LSFT 4025-2.5	Clearance D						2.5×1	34 100	70 100	385	123						
LDFT 4025-2.5	Clearance D						2.5×1	34 100	70 100	755	223						
LSFT 4025-3	Clearance D						1.5×2	39 900	83 600	456	148						
LDFT 4025-3	Clearance D						1.5×2	39 900	83 600	894	273						
LPFT 4032-2.5	P		32	6.35	41.75	35.1	2.5×1	2.5×1	21 200	35 300	316	146					
LPFT 4032-2.5	P							33 600	70 700	381	146						
LSFT 4032-2.5	Clearance D							33 600	70 700	747	274						
LDFT 4032-2.5	Clearance D							13 400	21 000	191	133						
LPFT 4040-1.5	P							40	6.35	41.75	35.1	1.5×1	2.5×1	21 200	42 000	227	133
LPFT 4040-1.5	P												21 200	42 000	446	253	
LSFT 4040-1.5	Clearance D	36 300	78 500	841	103												
LDFT 4040-1.5	Clearance D	55 400	109 000	947	123												
LPFT 4510-5	Z	45	10	6.35	46.0	39.4	2.5×3						58 800	118 000	1 015	133	
PFT 4510-7	P						2.5×2						65 800	157 000	830	103	
PFT 4510-7.5	P						2.5×2	65 800	157 000	1 627	163						
SFT 4510-5	Clearance Z						3.5×2	87 900	218 000	1 136	123						
ZFT 4510-10	Z						2.5×2	93 300	235 000	1 221	133						
SFT 4510-7	Clearance Z						2.5×3	93 300	235 000	2 395	253						
SFT 4510-7.5	Clearance Z		2.5×3	93 300	235 000	432	83										
DFT 4510-7.5	D		2.5×1	41 600	88 200	848	119										
SFT 4512-2.5	Clearance Z		2.5×1	41 600	88 200	838	119										
ZFT 4512-5	Z		2.5×2	75 600	176 000	838	119										
SFT 4512-5	Clearance Z		2.5×2	75 600	176 000	1 643	191										
ZFT 4512-10	Z		2.5×2	75 600	176 000	1 643	191										

Notes: 1. Circular shape I and Circular shape II flanges are used for shaft diameters of 20 mm or more. Select a flange suitable for the space available for nut installation.

2. If no seal is used with nuts PFT, ZFT, or SFT, the nut length will be shortened by dimension M.

3. If no seal is used with nuts LSFT or LDFT, the nut length will be shortened by the amount of dimension M and C.

4. Right-turn screws are standard. "L" is added to the end of the Model No. for left turn screws.

Ball nut dimensions															
Nut diameter		Flange diameter A	Flange width B	Flange notch G	Projecting tube dimensions			Seal dimensions		Diameter g6 J	Bolt hole dimensions			Oil hole Q	
D	S				U	V	R	M	C		X	Y	Z		PCD W
64	—	106	18	33	42	52	15	10	10	—	11	—	—	84	
64	—	106		33	42	52	15			84					
64	—	106		33	42	52	15			84					
84	64	126		48	—	—	—			104					
64	—	106		33	42	52	15			84					
84	64	126		48	—	—	—			104					
64	—	106	18	33	42	52	15	13	12	—	11	—	—	84	
64	—	106		33	42	52	15			84					
64	64	126		48	—	—	—			104					
64	—	106		33	42	52	15			84					
64	—	106		33	42	52	15			84					
84	64	126		48	—	—	—			104					
88	—	132	18	50	—	—	—	7	—	—	11	17.5	11	110	Rc1/8
90	—	132													

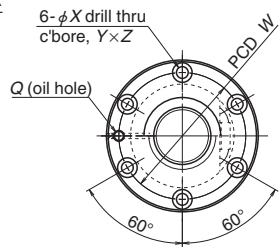
5. Values for axial rigidity K above are theoretical values obtained from the elastic deformation between the screw groove and ball when axial load is 30% of the basic dynamic load rating C, for clearance (no preload), 10% for D-preload, and 5% for P-preload. Refer to the "Technical Description" on page B56 if axial load and preload differ from the conditions above or if deformation of the ball nut body must be considered.

6. The basic load ratings with PFT and LPFT nuts are different due to the installed spacer balls.

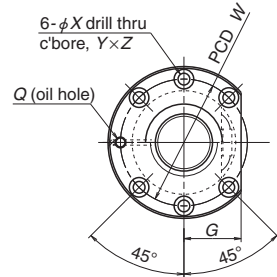
7. P-preload refers to oversize ball preload and D-preload to double-nut preload. For details, see page B5.

8. SRC type is recommended for markings (#).

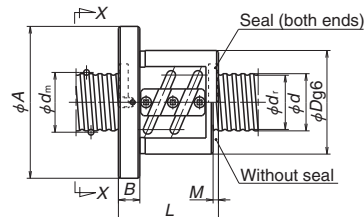
View X-X



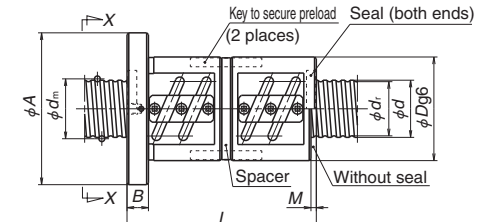
Circular shape I



Circular shape II



ZFT, SFT



DFT

Unit: mm

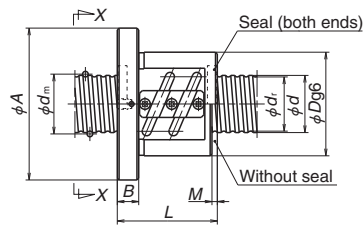
Model No.	Preload	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D_w</i>	Ball circle dia. <i>d_m</i>	Root dia. <i>d_r</i>	Effective ball turns Turns × Circuits	Basic load ratings (N)		Axial rigidity <i>K</i> (N/μm)
								Dynamic <i>C_d</i>	Static <i>C_s</i>	
SFT 5005-3	Clearance	50	5	3.175	50.5	47.2	1.5×2	16 800	52 500	499
ZFT 5005-6	Z						1.5×2	16 800	52 500	978
SFT 5005-4.5	Clearance						1.5×3	23 900	78 800	735
ZFT 5005-9	Z						1.5×3	23 900	78 800	1 442
SFT 5006-3	Clearance						1.5×2	23 000	66 100	519
ZFT 5006-6	Z						1.5×2	23 000	66 100	1 017
PFT 5006-7.5	P		6	3.969	50.5	46.4	2.5×3	31 900	82 700	1 045
SFT 5006-5	Clearance						2.5×2	35 700	110 000	844
ZFT 5006-10	Z						2.5×2	35 700	110 000	1 656
SFT 5006-7.5	Clearance						2.5×3	50 700	165 000	1 243
ZFT 5006-15	Z						2.5×3	50 700	165 000	2 438
SFT 5008-3	Clearance						8	4.762	50.5	45.5
ZFT 5008-6	Z	1.5×2	29 500	78 900	1 039					
SFT 5008-5	Clearance	2.5×2	45 700	131 000	859					
ZFT 5008-10	Z	2.5×2	45 700	131 000	1 685					
SFT 5008-7.5	Clearance	2.5×3	64 800	196 000	1 265					
ZFT 5008-15	Z	2.5×3	64 800	196 000	2 481					
SFT 5010-2.5	Clearance	10	6.35	51.0	44.4	2.5×1	37 500	87 200	464	
ZFT 5010-5	Z					2.5×1	37 500	87 200	909	
SFT 5010-3	Clearance					1.5×2	43 900	102 000	544	
ZFT 5010-6	Z					1.5×2	43 900	102 000	1 067	
ZFT 5010-7	Z					3.5×1	50 100	122 000	1 251	
PFT 5010-7.5	P					2.5×3	60 800	131 000	1 099	
SFT 5010-5	Clearance	12	7.938	51.5	43.2	2.5×2	68 100	174 000	898	
ZFT 5010-10	Z					2.5×2	68 100	174 000	1 761	
SFT 5010-7.5	Clearance					2.5×3	96 500	262 000	1 321	
DFT 5010-7.5	D					2.5×3	96 500	262 000	2 592	
SFT 5012-2.5	Clearance					2.5×1	50 400	109 000	478	
ZFT 5012-5	Z					2.5×1	50 400	109 000	937	
SFT 5012-5	Clearance	16	7.938	51.5	43.2	2.5×2	91 500	218 000	926	
ZFT 5012-10	Z					2.5×2	91 500	218 000	1 815	
SFT 5016-2.5	Clearance					2.5×1	50 300	109 000	476	
ZFT 5016-5	Z					2.5×1	50 300	109 000	933	
PFT 5016-7.5	P					2.5×3	81 400	163 000	1 125	
SFT 5016-5	Clearance					2.5×2	91 200	218 000	921	
ZFT 5016-10	Z	2.5×2	91 200	218 000	1 807					
SFT 5016-7.5	Clearance	20	7.938	51.5	43.2	2.5×3	129 000	326 000	1 355	
ZFT 5020-3	Z					1.5×1	32 300	63 800	563	
SFT 5020-2.5	Clearance					2.5×1	50 100	108 000	473	
ZFT 5020-5	Z					2.5×1	50 100	108 000	928	
SFT 5020-3	Clearance					1.5×2	58 600	128 000	556	
ZFT 5020-6	Z					1.5×2	58 600	128 000	1 090	

- Notes: 1. Circular shape I and Circular shape II flanges are used for shaft diameters of 20 mm or more. Select a flange suitable for the space available for nut installation.
 2. If no seal is used with nuts ZFT, SFT, or DFT, the nut length will be shortened by dimension M.
 3. Right-turn screws are standard. "L" is added to the end of the Model No. for left turn screws.

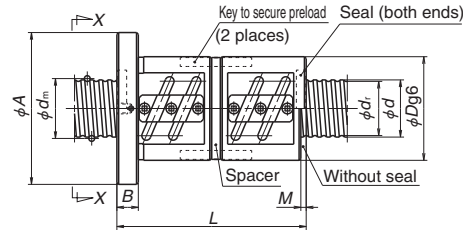
Ball nut dimensions

Nut total length <i>L</i>	Nut diameter <i>D</i>	Flange diameter <i>A</i>	Flange width <i>B</i>	Flange notch <i>G</i>	Seal dimension <i>M</i>	Bolt hole dimensions			Bolt hole PCD <i>W</i>	Oil hole <i>Q</i>
						<i>X</i>	<i>Y</i>	<i>Z</i>		
58	80	114	15	43	3	9	14	8.5	96	Rc1/8
83										
68										
103										
103										
62	84	118	15	45	3	9	14	8.5	100	Rc1/8
92										
86										
68										
104										
86	87	129	18	49	5	11	17.5	11	107	Rc1/8
140										
74										
114										
85										
73	93	135	18	51	7	11	17.5	11	113	Rc1/8
103										
90										
140										
123										
123	100	146	22	55	8	14	20	13	122	Rc1/8
133										
103										
163										
133										
253	100	146	22	55	14	14	20	13	122	Rc1/8
87										
123										
123										
195										
104	100	146	28	55	17	14	20	13	122	Rc1/8
152										
200										
152										
248										
200										
147	100	146	28	55	17	14	20	13	122	Rc1/8
127										
187										
147										
227										

4. Values for axial rigidity *K* above are theoretical values obtained from the elastic deformation between the screw groove and ball when axial load is 30% of the basic dynamic load rating *C_d*, for clearance (no preload), 10% for D-preload, and 5% for P-preload. Refer to the "Technical Description" on page B56 if axial load and preload differ from the conditions above or if deformation of the ball nut body must be considered.
 5. Standard finished shaft end SA models are available for those models marked with an asterisk (*).
 6. P-preload refers to oversize ball preload and D-preload to double-nut preload. For details, see page B6.
 7. The basic load ratings with PFT nuts are different due to the installed spacer balls.
 8. SRC type is recommended for markings (#).

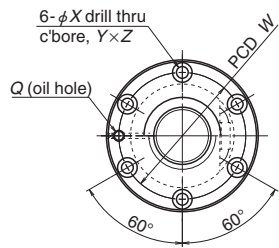


ZFT, SFT

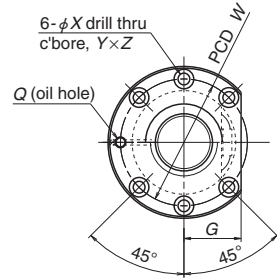


DFT

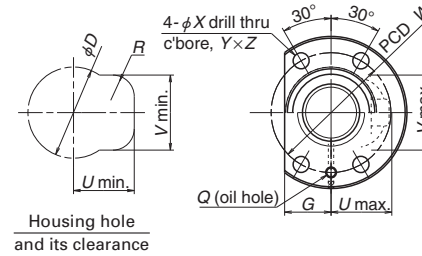
View X-X



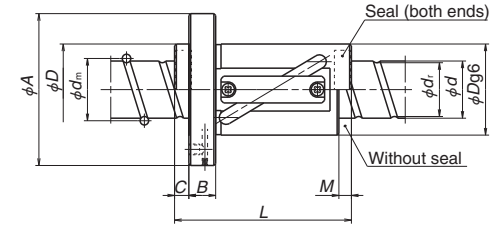
Circular shape I



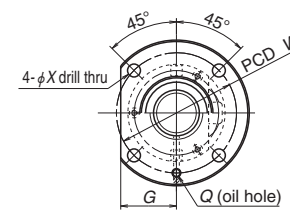
Circular shape II



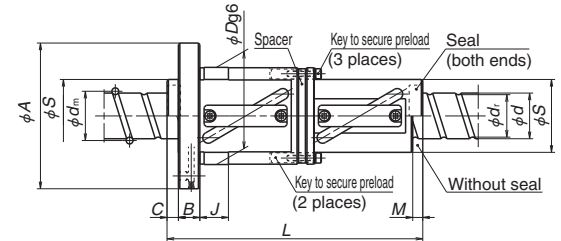
Housing hole and its clearance



LPFT, LSFT



LDFT



Unit: mm

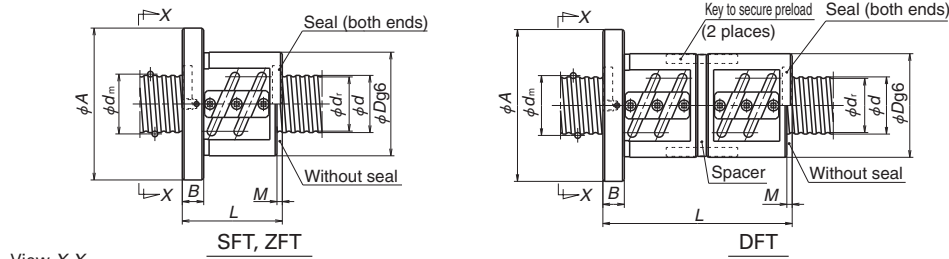
Model No.	Preload	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D_w</i>	Ball circle dia. <i>d_m</i>	Root dia. <i>d_r</i>	Effective ball turns Turns × Circuits	Basic load ratings (N)		Axial rigidity <i>K</i> (N/μm)	Nut total length <i>L</i>					
								Dynamic <i>C_d</i>	Static <i>C_{st}</i>							
LPFT 5025-2.5	P	25	7.938	52.25	44	2.5×1	32 300	55 100	403	129						
LPFT 5025-3	P						37 800	65 700	468	154						
LSFT 5025-2.5	Clearance Z						51 300	110 000	480	129						
ZFT 5025-5	Z						51 300	110 000	941	204						
LSFT 5025-3	Clearance D						60 100	131 000	569	154						
LDFT 5025-3	D						60 100	131 000	1 116	279						
LPFT 5032-2.5	P	50	32	7.938	44	2.5×1	32 000	54 700	397	151						
LPFT 5032-3	P						37 500	65 300	461	183						
LSFT 5032-2.5	Clearance Z						50 900	109 000	473	151						
LSFT 5032-3	Clearance D						50 900	109 000	928	279						
LDFT 5032-2.5	D						59 500	131 000	560	183						
LDFT 5032-3	D						59 500	131 000	1 099	343						
LPFT 5040-2.5	P	40	7.938	52.25	44	2.5×1	31 600	55 200	389	178						
LSFT 5040-2.5	Clearance Z						50 200	110 000	469	178						
LDFT 5040-2.5	D						50 200	110 000	920	338						
LPFT 5050-1.5	P						50	7.938	52.25	44	1.5×1	20 000	32 800	236	161	
LSFT 5050-1.5	Clearance Z											31 700	65 700	280	161	
LDFT 5050-1.5	D											31 700	65 700	549	312	
ZFT 5510-5	Z	55	10	6.35	56.0	49.4						2.5×1	38 700	96 000	977	103
SFT 5510-5	Clearance Z											2.5×2	70 200	192 000	964	103
ZFT 5510-10	Z											2.5×2	70 200	192 000	1 891	163
SFT 5510-7.5	Clearance Z						2.5×3	99 500	288 000	1 419	133					
ZFT 5510-15	Z						2.5×3	99 500	288 000	2 783	223					

Notes: 1. Circular shape I and Circular shape II flanges are used for shaft diameters of 20 mm or more. Select a flange suitable for the space available for nut installation.

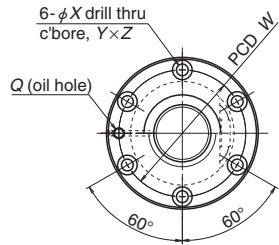
- If no seal is used with nuts PFT, ZFT, or SFT, the nut length will be shortened by dimension M.
- If no seal is used with nuts LSFT or LDFT, the nut length will be shortened by the amount of dimension M and C.
- Right-turn screws are standard. "L" is added to the end of the Model No. for left turn screws.

Ball nut dimensions																				
Nut diameter		Flange diameter	Flange width	Flange notch	Projecting tube dimensions			Seal dimensions		Diameter	Bolt hole dimensions			Bolt hole						
<i>D</i>	<i>S</i>	<i>A</i>	<i>B</i>	<i>G</i>	<i>U</i>	<i>V</i>	<i>R</i>	<i>M</i>	<i>C</i>	<i>g6</i>	<i>X</i>	<i>Y</i>	<i>Z</i>	PCD <i>W</i>						
Oil hole <i>Q</i>																				
80	—	126	22	41	52	64	19	11	11	—	14	—	—	102						
80	—	126		41	52	64	19			102										
80	—	126		41	52	64	19			102										
106	80	152		56	—	—	—			128										
80	—	126		41	52	64	19			102										
106	80	152		56	—	—	—			128										
80	—	126	22	41	52	64	19	14	12	—	14	—	—	102						
80	—	126		41	52	64	19			102										
80	—	126		41	52	64	19			102										
106	80	152		56	—	—	—			128										
80	—	126		41	52	64	19			102										
106	80	152		56	—	—	—			128										
80	—	126	22	41	52	64	19	21	16	—	14	—	—	102						
80	—	126		41	52	64	19			102										
80	—	126		41	52	64	19			102										
106	80	152		56	—	—	—			128										
102	—	144		18	54	—	—			—				7	—	—	11	17.5	11	122

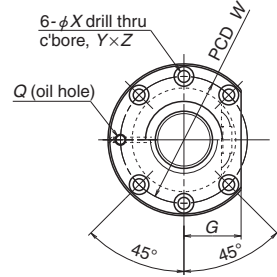
- Values for axial rigidity *K* above are theoretical values obtained from the elastic deformation between the screw groove and ball when axial load is 30% of the basic dynamic load rating *C*, for clearance (no preload), 10% for D-preload, and 5% for P-preload. Refer to the "Technical Description" on page B56 if axial load and preload differ from the conditions above or if deformation of the ball nut body must be considered.
- The basic load ratings with LPFT nuts are different due to the installed spacer balls.
- P-preload refers to oversize ball preload and D-preload to double-nut preload. For details, see page B5.



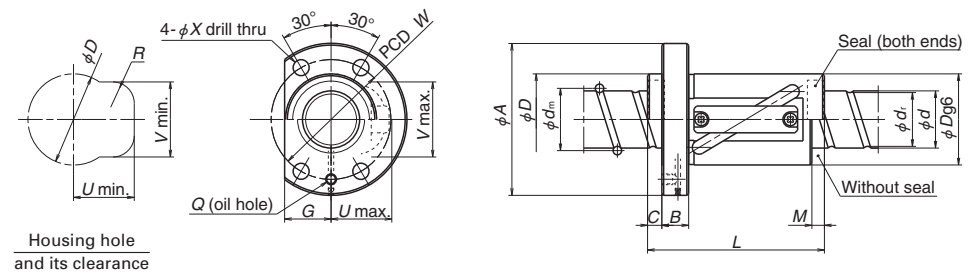
View X-X



Circular shape I

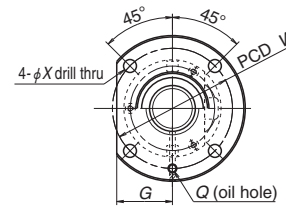


Circular shape II



Housing hole and its clearance

LPFT, LSFT



LDFT

Unit: mm

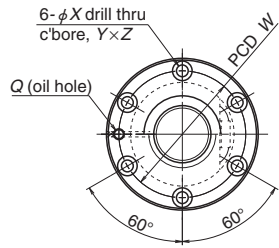
Model No.	Preload	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D_w</i>	Ball circle dia. <i>d_m</i>	Root dia. <i>d_r</i>	Effective ball turns Turns × Circuits	Basic load ratings (N)		Axial rigidity <i>K</i> (N/μm)	Nut total length <i>L</i>
								Dynamic <i>C_s</i>	Static <i>C_{0s}</i>		
SFT 6310-2.5	Clearance Z	63	10	6.35	64.0	57.4	2.5×1	41 100	111 000	557	77
ZFT 6310-5							2.5×1	41 100	111 000	1 091	107
PFT 6310-7.5	Clearance P						2.5×3	66 600	166 000	1 322	137
SFT 6310-5							2.5×2	74 600	221 000	1 078	107
ZFT 6310-10	Clearance Z						2.5×2	74 600	221 000	2 113	167
SFT 6310-7.5							2.5×3	106 000	332 000	1 588	137
ZFT 6310-15	Clearance Z						2.5×3	106 000	332 000	3 113	227
SFT 6312-5							2.5×1	55 900	136 000	1 119	123
ZFT 6312-2.5	Clearance Z						2.5×1	55 900	136 000	571	87
SFT 6312-5							2.5×2	102 000	273 000	1 107	123
ZFT 6312-10	Clearance Z		2.5×2	102 000	273 000	2 171	195				
SFT 6316-2.5			Clearance Z	2.5×1	93 600	227 000	746	110			
ZFT 6316-5	2.5×1			93 600	227 000	1 464	158				
PFT 6316-5	Clearance P		2.5×2	107 000	227 000	1 200	158				
SFT 6316-5			2.5×2	170 000	454 000	1 446	158				
ZFT 6316-10	Clearance Z		2.5×2	170 000	454 000	2 835	254				
SFT 6320-2.5			Clearance Z	2.5×1	93 400	227 000	744	127			
ZFT 6320-5	2.5×1			93 400	227 000	1 459	187				
PFT 6320-5	Clearance P		2.5×2	107 000	227 000	1 196	187				
SFT 6320-5			2.5×2	170 000	453 000	1 442	187				
ZFT 6320-10	Clearance Z	2.5×2	170 000	453 000	2 827	307					
LPFT 6340-2.5		Clearance P	2.5×1	35 300	69 200	472	178				
LPFT 6340-3	1.5×2		41 300	83 100	557	218					
LSFT 6340-2.5	Clearance D	2.5×1	56 000	138 000	567	178					
LDFT 6340-2.5		2.5×1	56 000	138 000	1 112	339					
LSFT 6340-3	Clearance D	1.5×2	65 500	166 000	674	218					
LDFT 6340-3		1.5×2	65 500	166 000	1 323	419					
LPFT 6350-1.5	Clearance P	1.5×1	22 400	41 100	282	161					
LPFT 6350-2.5		2.5×1	34 800	69 600	471	211					
LSFT 6350-1.5	Clearance D	1.5×1	35 600	82 200	341	161					
LDFT 6350-1.5		1.5×1	35 600	82 200	669	311					
LSFT 6350-2.5	Clearance D	2.5×1	55 300	139 000	561	211					
LDFT 6350-2.5		2.5×1	55 300	139 000	1 099	411					

Notes: 1. Circular shape I and Circular shape II flanges are used for shaft diameters of 20 mm or more. Select a flange suitable for the space available for nut installation.
 2. If no seal is used with nuts PFT, ZFT, or SFT, the nut length will be shortened by dimension M.
 3. If no seal is used with nuts LSFT or LDFT, the nut length will be shortened by the amount of dimension M and C.
 4. Right-turn screws are standard. "L" is added to the end of the Model No. for left turn screws.

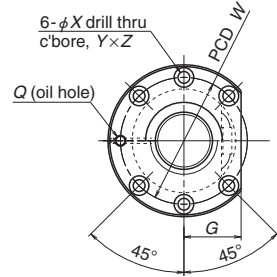
Nut diameter		Ball nut dimensions													
<i>D</i>	<i>S</i>	Flange diameter <i>A</i>	Flange width <i>B</i>	Flange notch <i>G</i>	Projecting tube dimensions			Seal dimensions		Diameter g6 <i>J</i>	Bolt hole dimensions			Bolt hole PCD <i>W</i>	Oil hole <i>Q</i>
					<i>U</i>	<i>V</i>	<i>R</i>	<i>M</i>	<i>C</i>		<i>X</i>	<i>Y</i>	<i>Z</i>		
108	—	154	22	58	—	—	—	7	—	—	14	20	13	130	Rc1/8
115	—	161	22	61	—	—	—	8	—	—	14	20	13	137	Rc1/8
122	—	180	28	69	—	—	—	—	—	—	18	26	17.5	150	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	—	—	—							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	—	—	—						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	—	—	—						144		
97	—	144	22	49	58	77	19	19	16	—	14	—	120	Rc1/8	
122	97	168		62	—	—	—						144		

5. Values for axial rigidity *K* above are theoretical values obtained from the elastic deformation between the screw groove and ball when axial load is 30% of the basic dynamic load rating *C_s* for clearance (no preload), 10% for D-preload, and 5% for P-preload. Refer to the "Technical Description" on page B56 if axial load and preload differ from the conditions above or if deformation of the ball nut body must be considered.
 6. The basic load ratings with LPFT nuts are different due to the installed spacer balls.
 7. P-preload refers to oversize ball preload and D-preload to double-nut preload. For details, see page B5.

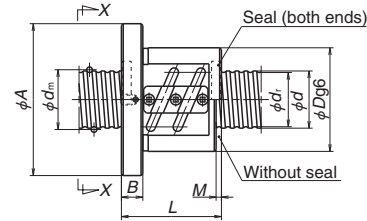
View X-X



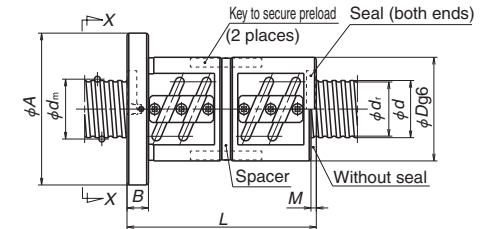
Circular shape I



Circular shape II



SFT



DFT

Unit: mm

Model No.	Preload	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D_w</i>	Ball circle dia. <i>d_m</i>	Root dia. <i>d_r</i>	Effective ball turns Turns × Circuits	Basic load ratings (N)		Axial rigidity <i>K</i> (N/μm)					
								Dynamic <i>C_a</i>	Static <i>C_{0a}</i>						
SFT 8010-5	Clearance	80	10	6.35	81.0	74.4	2.5×2	83 200	282 000	1 309					
ZFT 8010-10	Z						2.5×2	83 200	282 000	2 567					
SFT 8010-7.5	Clearance						2.5×3	118 000	423 000	1 927					
ZFT 8010-15	Z						2.5×3	118 000	423 000	3 779					
SFT 8012-5	Clearance						2.5×2	113 000	350 000	1 345					
ZFT 8012-10	Z						2.5×2	113 000	350 000	2 637					
SFT 8012-7.5	Clearance	2.5×3	161 000	525 000	1 983										
ZFT 8012-15	Z	2.5×3	161 000	525 000	3 889										
SFT 8016-5	Clearance	80	16	9.525	82.0	72.2	2.5×2	192 000	581 000	1 764					
ZFT 8016-10	Z						2.5×2	192 000	581 000	3 459					
SFT 8016-7.5	Clearance						2.5×3	271 000	872 000	2 593					
ZFT 8016-15	Z						2.5×3	271 000	872 000	5 085					
SFT 8020-5	Clearance						80	20	9.525	82.0	72.2	2.5×2	191 000	581 000	1 758
ZFT 8020-10	Z											2.5×2	191 000	581 000	3 447
SFT 8020-7.5	Clearance	2.5×3	271 000	871 000	2 588										
DFT 8020-7.5	D	2.5×3	271 000	871 000	5 075										
SFT 10012-5	Clearance	100	12	7.938	101.5	93.2						2.5×2	124 000	441 000	1 611
ZFT 10012-10	Z											2.5×2	124 000	441 000	3 159
SFT 10012-7.5	Clearance						2.5×3	176 000	661 000	2 372					
ZFT 10012-15	Z						2.5×3	176 000	661 000	4 659					
SFT 10016-5	Clearance						100	16	9.525	102	92.2	2.5×2	208 000	736 000	2 109
ZFT 10016-10	Z											2.5×2	208 000	736 000	4 136
SFT 10016-7.5	Clearance	2.5×3	295 000	1 100 000	3 105										
ZFT 10016-15	Z	2.5×3	295 000	1 100 000	6 089										
SFT 10020-5	Clearance	100	20	9.525	102	92.2						2.5×2	208 000	735 000	2 106
ZFT 10020-10	Z											2.5×2	208 000	735 000	4 131
SFT 10020-7.5	Clearance						2.5×3	294 000	1 100 000	3 098					
DFT 10020-7.5	D						2.5×3	294 000	1 100 000	6 075					
SFT 12516-5	Clearance						125	16	9.525	127	117.2	2.5×2	231 000	918 000	2 520
ZFT 12516-10	Z											2.5×2	231 000	918 000	4 942
SFT 12516-7.5	Clearance	2.5×3	327 000	1 380 000	3 708										
ZFT 12516-15	Z	2.5×3	327 000	1 380 000	7 272										
SFT 12520-5	Clearance	125	20	9.525	127	117.2						2.5×2	230 000	917 000	2 515
ZFT 12520-10	Z											2.5×2	230 000	917 000	4 931
SFT 12520-7.5	Clearance						2.5×3	327 000	1 380 000	3 705					
DFT 12520-7.5	D						2.5×3	327 000	1 380 000	7 266					

Notes: 1. Circular shape I and Circular shape II flanges are used for shaft diameters of 20 mm or more. Select a flange suitable for the space available for nut installation.

2. If no seal is used with nuts ZFT, SFT, or DFT, the nut length will be shortened by dimension M.

3. Right-turn screws are standard. "L" is added to the end of the Model No. for left turn screws.

Ball nut dimensions										
Nut total length <i>L</i>	Nut diameter <i>D</i>	Flange diameter <i>A</i>	Flange width <i>B</i>	Flange notch <i>G</i>	Seal dimension <i>M</i>	Bolt hole dimensions			Bolt hole PCD <i>W</i>	Oil hole <i>Q</i>
						<i>X</i>	<i>Y</i>	<i>Z</i>		
107	130	176	22	66	7	14	20	13	152	Rc1/8
167										
137										
227										
123										
195	136	182	22	68	8	14	20	13	158	Rc1/8
159										
267										
158										
254										
206	143	204	28	77	10	18	26	17.5	172	Rc1/8
350										
187										
307										
247										
467	143	204	28	77	17	18	26	17.5	172	Rc1/8
129										
201										
165										
273										
162	160	220	28	82	8	18	26	17.5	188	Rc1/8
258										
210										
354										
191										
311	170	243	32	91	10	22	32	21.5	205	Rc1/8
251										
471										
170										
266										
218	200	290	36	109	10	26	39	25.5	243	Rc1/8
362										
199										
319										
259										
499	200	290	36	109	12	26	39	25.5	243	Rc1/8

4. Values for axial rigidity *K* above are theoretical values obtained from the elastic deformation between the screw groove and ball when axial load is 30% of the basic dynamic load rating *C*, for clearance (no preload), 10% for D-preload, and 5% for P-preload. Refer to the "Technical Description" on page B56 if axial load and preload differ from the conditions above or if deformation of the ball nut body must be considered.

5. P-preload refers to oversize ball preload and D-preload to double-nut preload. For details, see page B5.

B-3-2.4 Deflector (Bridge) Recirculation Ball Screws

1. Features

Ball screws with deflector (bridge) recirculation systems have the smallest ball nut, making them suitable for fine lead operation.

2. Specifications

(1) Ball recirculation system

It has a small ball nut outside diameter and suits small lead ball screws. Fig. 1 shows the structure of the deflector (bridge) recirculation system.

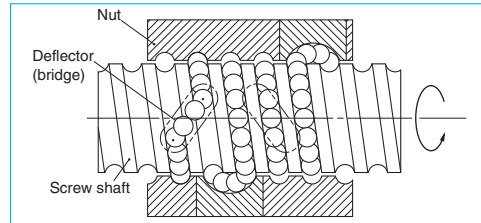


Fig. 1 Structure of deflector (bridge) recirculation system

Table 1 Accuracy grade and axial play

Accuracy grade	C0, C1, C2, C3, C5, Ct7 (Ct7 is not included in DFD)
Axial play	Z, 0 mm (preloaded); T, 0.005 mm or less S, 0.020 mm or less; N, 0.050 mm or less

(2) Accuracy grade and axial play

The available standard accuracy grades and axial play are shown in Table 1. Please consult NSK for other grades.

(3) Allowable $d \cdot n$ value and the criterion of maximum rotational speed

The allowable $d \cdot n$ value and criterion of maximum rotational speed are shown below. Please consult NSK if the rotational speed exceeds the permissible range below. Basic measures must be taken for the high speed ball screws.

Allowable $d \cdot n$ value:

Standard specification ; 84 000 or less

High-speed specification; 100 000 or less

Standard of rotational speed : 3 000 min⁻¹

Note: Please also review the critical speed. Refer to "Technical Description: Permissible Rotational Speed" (page B47) for details.

(4) Other specifications

Please consult NSK for specifications not listed in the dimension tables.

Table 2 Deflector (bridge) ball screw lineup

Nut	Shape	Flange shape	Preload
MSFD		Flanged Circular III	Nopreload, Slight axial play
MPFD			P-preload (light preload) no spacer ball
SFD		Screw shaft diameter of 16 mm or smaller: Flanged Screw shaft diameter of 20 mm or smaller: Rectangle Circular I, II	Nopreload, Slight axial play
ZFD		Flanged Circular I, II	Z-preload (medium preload)
DFD		Flanged Circular I, II	D-preload (medium preload) (heavy preload)

3. Lineup

There are four different preloads available (Table 2). Synthetic resin that shows superb characteristics against wear is used in the recirculation deflector (bridge) for MSFD and MPFD, and has enhanced the smooth recirculation of balls.

- The diameters of bearing journals and the gear or pulley seat must be less than the root diameter of ball groove d , specified in the dimension tables.

For general precautions regarding ball screws, refer to "Design Precautions" (page B83) and "Handling Precautions" (page B103).

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.

5. Structure of model number and reference number

The following explains the codes used in model numbers and ball screw reference numbers.

◇Model number

SFD 40 08 - 4

Nut: SFD, ZFD, DFD
MSFD, MPFD

Screw shaft diameter (mm)

Effective ball turns (Note)

Lead (mm)

Note: In ZFD, the number here is twice the effective ball turns.

◇Reference number for ball screws

W 40 08 - ** Z Y - C3 Z 5

Product code

Screw shaft diameter (mm)

Effective threaded length (in 100 mm units)

NSK design serial number

Preload code:
No code, no preload;
Z, Z-preload; D, D-preload; P, P-preload (page B5)

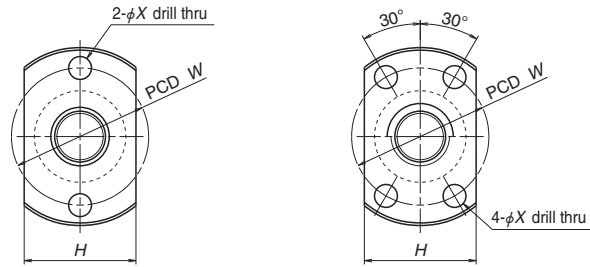
Lead (mm)

Axial play code:
Z, T, S, N (page B20)

Accuracy grade code:
C0, C1, C2, C3, C5, C7(Ct7) (page B37 to B42)

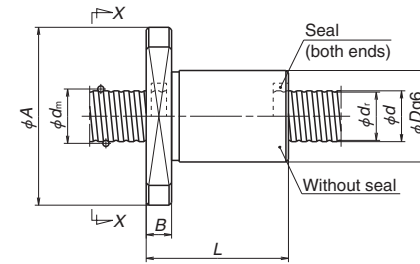
Deflector (bridge) recirculation system

View X-X



Lead $l = 0.5 \text{ mm}$

Lead $l \geq 1 \text{ mm}$



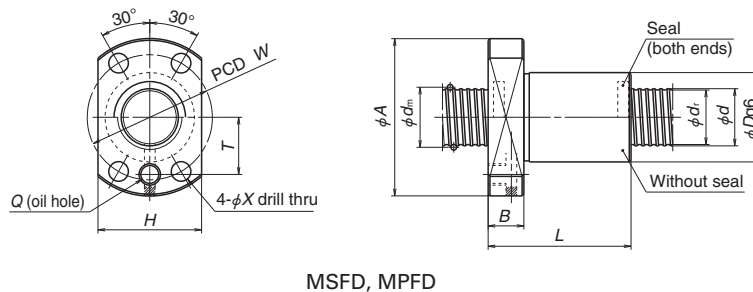
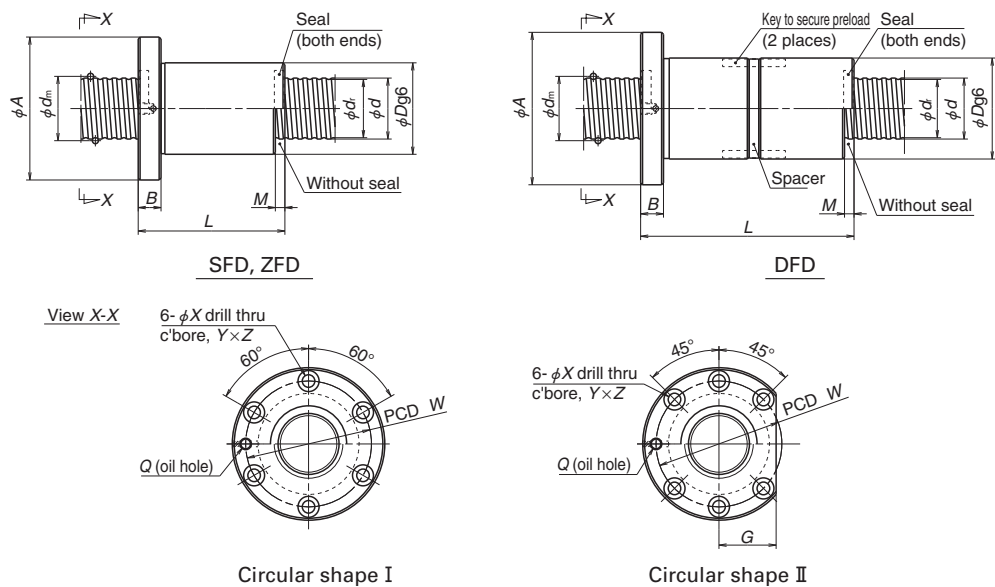
Unit: mm

Model No.	Preload	Shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns Turns × Circuits	Basic load ratings (N)	
								Dynamic C_a	Static C_{0a}
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	6	2	0.800	6.2	5.2	1×3	675	920
MSFD 0800.5-3 MPFD 0800.5-3	Clearance P		0.5	0.400	8.1	7.6	1×3	275	595
MSFD 0801-3 MPFD 0801-3	Clearance P	8	1	0.800	8.2	7.2	1×3	790	1 290
MSFD 0801.5-3 MPFD 0801.5-3	Clearance P		1.5	1.000	8.3	7.0	1×3	1 270	1 970
MSFD 0802-3 MPFD 0802-3	Clearance P	8	2	1.200	8.3	6.9	1×3	1 560	2 200
MSFD 1001-3 MPFD 1001-3	Clearance P		1	0.800	10.2	9.2	1×3	880	1 660
MSFD 1002-3 MPFD 1002-3	Clearance P	10	2	1.200	10.3	8.9	1×3	1 800	2 970
MSFD 1002.5-3 MPFD 1002.5-3	Clearance P		2.5	1.588	10.4	8.6	1×3	2 500	3 630
MSFD 1201-3 MPFD 1201-3	Clearance P	12	1	0.800	12.2	11.2	1×3	940	1 980
MSFD 1202-3 MPFD 1202-3	Clearance P		2	1.200	12.3	10.9	1×3	1 960	3 620
MSFD 1202.5-3 MPFD 1202.5-3	Clearance P	12	2.5	1.588	12.4	10.6	1×3	2 790	4 530
MSFD 1203-3 MPFD 1203-3	Clearance P		3	2.000	12.5	10.2	1×3	3 680	5 400
MSFD 1402-3 MPFD 1402-3	Clearance P	14	2	1.200	14.3	12.9	1×3	2 100	4 260
MSFD 1403-3 MPFD 1403-3	Clearance P		3	2.000	14.5	12.2	1×3	4 010	6 480

- Notes: 1. If the lead is 1 mm or less and the shaft OD is 6 mm or less, seals can not be equipped (See page B68 for details on dust protection.)
 2. Models with shaft OD under 14 mm do not have oil holes.
 3. Right-turn screws are standard. Contact NSK for left turn screws.

Axial rigidity K (N/μm)	Ball nut dimensions						
	Nut total length L	Nut diameter D	Flange diameter A	Flange width B	Flange dimension H	Bolt hole dimensions X	Bolt hole PCD W
32	13	10	22	3	11	3.4	16
50							
23	12	10	20	3	14	2.9	15
36							
44	13	12	24	3	13	3.4	18
69							
51	15	12	24	3.5	16	3.4	18
80							
51	17	13	25	4	17	3.4	19
79							
57	13	14	27	3	15	3.4	21
89							
67	16	14	27	4	18	3.4	21
104							
79	22	15	28	4	19	3.4	22
123							
76	26	16	29	4	20	3.4	23
119							
81	16	16	29	4	20	3.4	23
127							
97	28	18	35	5	22	4.5	27
151							
94	32	19	36	5	23	4.5	28
147							
93	16	18	31	4	22	3.4	25
145							
114	28	20	37	5	24	4.5	29
177							
113	32	21	38	5	25	4.5	30
176							
111	36	22	39	5	26	4.5	31
174							
129	29	22	41	6	26	5.5	32
201							
129	37	24	43	6	28	5.5	34
201							

4. Values for axial rigidity K above are theoretical values obtained from the elastic deformation between the screw groove and ball when axial load is 30% of the basic dynamic load rating C_a for clearance (no preload), and 5% for P-preload. Refer to the "Technical Description" on page B56 if axial load and preload differ from the conditions above or if deformation of the ball nut body must be considered.
 5. Standard finished shaft end MA models are available for those models marked with an asterisk (*).
 6. P-preload refers to oversize ball preload. For details, see page B5.

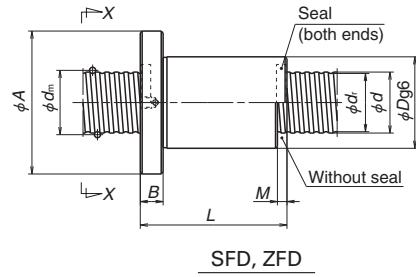


Model No.	Preload	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D_w</i>	Ball circle dia. <i>d_m</i>	Root dia. <i>d_r</i>	Effective ball turns Turns × Circuits	Basic load ratings (N)		Axial rigidity <i>K</i> (N/μm)
								Dynamic <i>C_a</i>	Static <i>C_{0a}</i>	
MSFD 1602-4	Clearance P	16	2	1.588	16.4	14.6	1×4	4 150	8 450	194
MPFD 1602-4	Clearance P									302
MSFD 1602.5-4	Clearance P	16	2.5	1.588	16.4	14.6	1×4	4 150	8 440	194
MPFD 1602.5-4	Clearance P									302
MSFD 2002-4	Clearance P	20	2	1.588	20.4	18.6	1×4	4 620	10 900	237
MPFD 2002-4	Clearance P									369
SFD 2005-3	Clearance Z	20	5	3.175	20.75	17.4	1×3	10 100	17 400	206
ZFD 2005-6	Clearance Z						1×3	10 100	17 400	404
SFD 2005-4	Clearance Z	20	5	3.175	20.75	17.4	1×4	13 000	23 300	271
ZFD 2005-8	Clearance Z						1×4	13 000	23 300	532
SFD 2006-3	Clearance Z	20	6	3.969	21	16.9	1×3	13 100	20 500	202
ZFD 2006-6	Clearance Z						1×3	13 100	20 500	396
SFD 2006-4	Clearance D	20	6	3.969	21	16.9	1×4	16 800	27 400	266
DFD 2006-4	Clearance D						1×4	16 800	27 400	521
MSFD 2502-4	Clearance P	25	2	1.588	25.4	23.6	1×4	5 100	13 900	287
MPFD 2502-4	Clearance P									447
SFD 2505-3	Clearance Z	25	5	3.175	25.75	22.4	1×3	11 600	22 900	257
ZFD 2505-6	Clearance Z						1×3	11 600	22 900	503
SFD 2505-4	Clearance Z	25	5	3.175	25.75	22.4	1×4	14 800	30 500	337
ZFD 2505-8	Clearance Z						1×4	14 800	30 500	661
SFD 2506-3	Clearance Z	25	6	3.969	26	21.9	1×3	15 200	27 300	254
ZFD 2506-6	Clearance Z						1×3	15 200	27 300	499
SFD 2506-4	Clearance Z	25	6	3.969	26	21.9	1×4	19 400	36 400	334
ZFD 2506-8	Clearance Z						1×4	19 400	36 400	656
SFD 2510-4	Clearance Z	25	10	4.762	26.25	21.3	1×2	13 300	21 200	337
ZFD 2510-3	Clearance Z						1×2	13 300	21 200	337
SFD 2510-3	Clearance D	25	10	4.762	26.25	21.3	1×3	18 900	31 800	253
DFD 2510-3	Clearance D						1×3	18 900	31 800	497

Notes: 1. Circular shape I and Circular shape II flanges are used for shaft diameters of 20 mm or more. Select a flange suitable for the space available for nut installation.
 2. If no seal is used with nuts SFD, ZFD, or DFD, the nut length will be shortened by dimension *M*. The nut lengths of MSFD and MPFD are the same with or without seals.
 3. Right-turn screws are standard. "L" is added to the end of the Model No. for left turn screws. Please consult NSK for MSFD and MPFD nuts.

Ball nut dimensions													
Nut total length <i>L</i>	Nut diameter <i>D</i>	Flange diameter <i>A</i>	Flange width <i>B</i>	Flange notch		Seal dimension <i>M</i>	Bolt hole dimensions			Bolt hole PCD <i>W</i>	Oil hole position <i>T</i>	Oil hole <i>Q</i>	
				<i>G</i>	<i>H</i>		<i>X</i>	<i>Y</i>	<i>Z</i>				
40	25	44	10	—	29	—	5.5	—	—	35	16	M6×1	
44	25	44	10	—	29	—	5.5	—	—	35	16	M6×1	
40	30	49	10	—	34	—	5.5	—	—	40	18.5	M6×1	
46	35	58	11	22.5	—	5	5.5	9.5	5.5	46	—	M6×1	
66													
51	76	52	35	58	11	22.5	—	—	—	46	—	M6×1	
76	52	35	58	11	22.5	—	6	5.5	9.5	5.5	46	—	M6×1
60	76	52	35	58	11	22.5	—	—	—	46	—	M6×1	
108	42	65	25	—	—	—	—	—	—	53	—	M6×1	
40	36	55	10	—	40	—	5.5	—	—	46	21.5	M6×1	
46	40	63	11	24	—	5	5.5	9.5	5.5	51	—	M6×1	
66													
51	76	52	40	63	11	24	—	—	—	51	—	M6×1	
76	52	35	58	11	24	—	6	5.5	9.5	5.5	51	—	M6×1
90	60	88	42	69	15	26	—	—	—	55	—	M6×1	
80	42	69	15	26	—	10	6.6	11	6.5	55	—	M6×1	
140	47	74	28	—	—	—	—	—	—	60	—	M6×1	

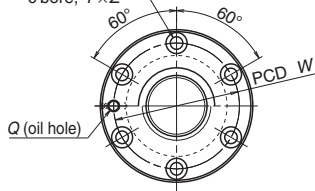
4. Values for axial rigidity *K* above are theoretical values obtained from the elastic deformation between the screw groove and ball when axial load is 30% of the basic dynamic load rating *C*, for clearance (no preload), 10% for Z-preload and D-preload, and 5% for P-preload. Refer to the "Technical Description" on page B56 if axial load and preload differ from the conditions above or if deformation of the ball nut body must be considered.
 5. We recommend using seals if shaft diameter is 16 mm or more and an oil hole is provided.
 6. Standard finished shaft end MA models are available for those models marked with an asterisk (*).
 7. Z-preload refers to offset preload, P-preload to oversize ball preload, and D-preload to double-nut preload. For details, see page B5.



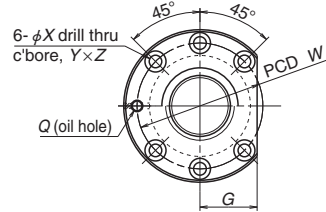
SFD, ZFD

View X-X

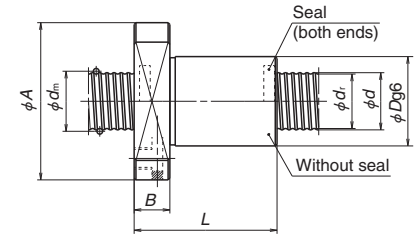
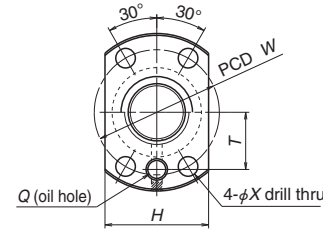
6- φX drill thru c'bore, Y×Z



Circular shape I



Circular shape II



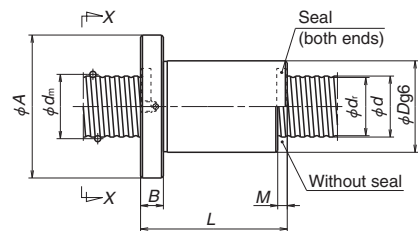
MSFD, MPFD

Model No.	Preload	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D_w</i>	Ball circle dia. <i>d_m</i>	Root dia. <i>d_r</i>	Effective ball turns Turns × Circuits	Basic load ratings (N)		Axial rigidity <i>K</i> (N/μm)
								Dynamic <i>C_a</i>	Static <i>C_{0a}</i>	
MSFD 3202-6	Clearance	32	2	1.588	32.4	30.6	1×6	8 030	27 100	521
MPFD 3202-6	P									811
SFD 3205-3	Clearance									322
ZFD 3205-6	Z		631							
SFD 3205-4	Clearance		5	3.175	32.75	29.4	1×4	16 800	40 600	424
ZFD 3205-8	Z									831
SFD 3205-6	Clearance									623
ZFD 3205-12	Z		97							
SFD 3206-3	Clearance		6	3.969	33	28.9	1×3	17 700	37 400	328
ZFD 3206-6	Z									643
SFD 3206-4	Clearance									431
ZFD 3206-8	Z									846
SFD 3206-6	Clearance	635								
ZFD 3206-12	Z	1 245								
SFD 3208-3	Clearance	8	4.762	33.25	28.3	1×3	21 600	41 700	316	
ZFD 3208-6	Z								619	
SFD 3208-4	Clearance								415	
ZFD 3208-8	Z								815	
SFD 3210-3	Clearance	10	6.35	33.75	27.1	1×3	30 500	52 500	313	
ZFD 3210-6	Z								614	
SFD 3210-4	Clearance								411	
ZFD 3210-8	Z								807	

- Notes: 1. Circular shape I and Circular shape II flanges are used for shaft diameters of 20 mm or more. Select a flange suitable for the space available for nut installation.
 2. If no seal is used with nuts SFD or ZFD, the nut length will be shortened by dimension *M*. The nut lengths of MSFD and MPFD are the same with or without seals.
 3. Right-turn screws are standard. "L" is added to the end of the Model No. for left turn screws. Please consult NSK for MSFD and MPFD nuts.

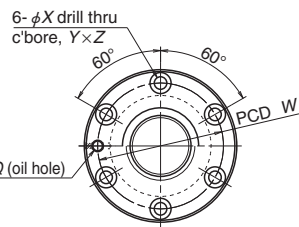
Ball nut dimensions												
Nut total length <i>L</i>	Nut diameter <i>D</i>	Flanged diameter <i>A</i>	Flanged width <i>B</i>	Flange notch		Seal dimension <i>M</i>	Bolt hole dimensions			Bolt hole PCD <i>W</i>	Oil hole position <i>T</i>	Oil hole <i>Q</i>
				<i>G</i>	<i>H</i>		<i>X</i>	<i>Y</i>	<i>Z</i>			
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												
52												
77												
62	48	75	12	29	—	6	6.6	11	6.5	61	—	M6×1
62												
97												
53												
77												
61												
90	50	84	15	32	—	8	9	14	8.5	66	—	M6×1
76												
116												
67												
99	54	88	15	34	—	10	9	14	8.5	70	—	M6×1
120												
90												
140												

4. Values for axial rigidity *K* above are theoretical values obtained from the elastic deformation between the screw groove and ball when axial load is 30% of the basic dynamic load rating *C_a*, for clearance (no preload), 10% for Z-preload, and 5% for P-preload. Refer to the "Technical Description" on page B56 if axial load and preload differ from the conditions above or if deformation of the ball nut body must be considered.
 5. We recommend using seals if shaft diameter is 16 mm or more and an oil hole is provided.
 6. Standard finished shaft end SS models are available for those models marked with an asterisk (*).
 7. Z-preload refers to offset preload, and P-preload to oversize ball preload. For details, see page B5.

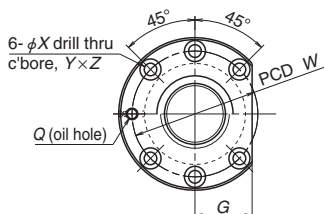


SFD, ZFD

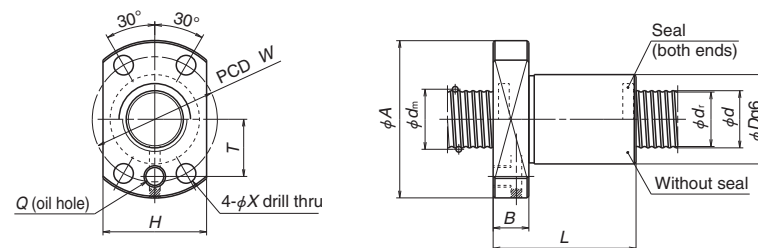
View X-X



Circular shape I



Circular shape II



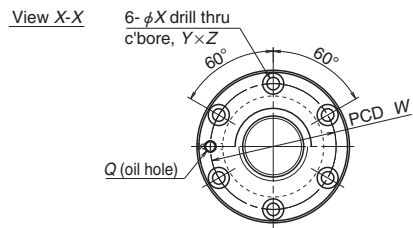
MSFD, MPFD

Model No.	Preload	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D_w</i>	Ball circle dia. <i>d_m</i>	Root dia. <i>d_r</i>	Effective ball turns × Circuits	Basic load ratings (N)		Axial rigidity <i>K</i> (N/μm)
								Dynamic <i>C_a</i>	Static <i>C_{0a}</i>	
MSFD 4002-6	Clearance P	40	2	1.588	40.4	38.6	1×6	8 720	33 900	620
MPFD 4002-6	Z									966
SFD 4005-4			5	3.175	40.75	37.4	1×4	18 700	52 200	517
ZFD 4005-8	Z									1 013
SFD 4005-6			Z	1×6	26 500	78 300	761			
ZFD 4005-12	Z							1 492		
SFD 4006-4			Clearance Z	6	3.969	41.0	36.9	1×4	25 100	63 500
ZFD 4006-8	Z									
SFD 4006-6			Clearance Z	1×6	35 600	95 200	768			
ZFD 4006-12	Z							1 506		
SFD 4008-4			Clearance Z	8	4.762	41.25	36.3	1×4	32 000	75 000
ZFD 4008-8	Z									
SFD 4008-6		Clearance Z	1×6	45 400	113 000	779				
ZFD 4008-12	Z						1 528			
SFD 4010-3		Clearance Z	10	6.35	41.75	35.1	1×3	35 300	69 800	394
ZFD 4010-6	Z									773
SFD 4010-4		Clearance Z	1×4	45 200	93 100	518				
ZFD 4010-8	Z						1 016			
SFD 5005-4		Clearance Z	5	3.175	50.75	47.4	1×4	20 700	66 700	627
ZFD 5005-8	Z									1 230
SFD 5005-6		Clearance Z	1×6	29 300	100 000	923				
ZFD 5005-12	Z						1 810			
SFD 5006-4		Clearance Z	6	3.969	51.0	46.9	1×4	27 900	81 600	636
ZFD 5006-8	Z									1 248
SFD 5006-6		Clearance Z	1×6	39 600	122 000	937				
ZFD 5006-12	Z						1 837			

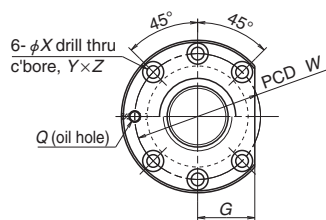
- Notes: 1. Circular shape I and Circular shape II flanges are used for shaft diameters of 20 mm or more. Select a flange suitable for the space available for nut installation.
 2. If no seal is used with nuts SFD or ZFD, the nut length will be shortened by dimension *M*. The nut lengths of MSFD and MPFD are the same with or without seals.
 3. Right-turn screws are standard. "L" is added to the end of the Model No. for left turn screws. Please consult NSK for MSFD and MPFD nuts.

Ball nut dimensions												
Nut total length <i>L</i>	Nut diameter <i>D</i>	Flanged diameter <i>A</i>	Flanged width <i>B</i>	Flange notch		Seal dimension <i>M</i>	Bolt hole dimensions			Bolt hole PCD <i>W</i>	Oil hole position <i>T</i>	Oil hole <i>Q</i>
				<i>G</i>	<i>H</i>		<i>X</i>	<i>Y</i>	<i>Z</i>			
50	51	74	10	—	55	—	6.6	—	—	63	31	M6×1
55	56	90	15	34	—	5	9	14	8.5	72	—	Rc1/8
80												
65												
101												
64	56	90	15	34	—	6	9	14	8.5	72	—	Rc1/8
93												
76												
118												
76	60	94	15	36	—	8	9	14	8.5	76	—	Rc1/8
116												
93												
149												
83	62	104	18	40	—	10	11	17.5	11	82	—	Rc1/8
123												
93												
143												
55	66	100	15	38	—	5	9	14	8.5	82	—	Rc1/8
80												
65												
101												
64	66	100	15	38	—	6	9	14	8.5	82	—	Rc1/8
93												
76												
118												

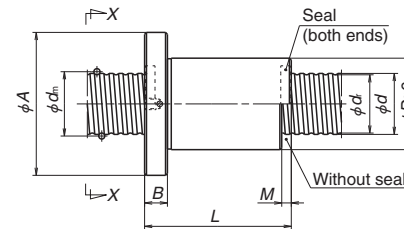
4. Values for axial rigidity *K* above are theoretical values obtained from the elastic deformation between the screw groove and ball when axial load is 30% of the basic dynamic load rating *C_a*, for clearance (no preload), 10% for Z-preload, and 5% for P-preload. Refer to the "Technical Description" on page B56 if axial load and preload differ from the conditions above or if deformation of the ball nut body must be considered.
 5. We recommend using seals if shaft diameter is 16 mm or more and an oil hole is provided.
 6. Z-preload refers to offset preload, and P-preload to oversize ball preload. For details, see page B5.



Circular shape I



Circular shape II



SFD, ZFD

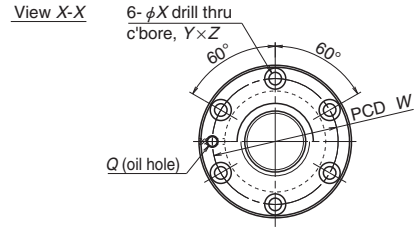
Unit: mm

Model No.	Preload	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D_w</i>	Ball circle dia. <i>d_m</i>	Root dia. <i>d_r</i>	Effective ball turns × Circuits	Basic load ratings (N)		Axial rigidity <i>K</i> (N/μm)				
								Dynamic <i>C_d</i>	Static <i>C_{0a}</i>					
SFD 5008-4	Clearance	50	8	4.762	51.25	46.3	1×4	35 300	94 700	635				
ZFD 5008-8	Z						1×4	35 300	94 700	1 246				
SFD 5008-6	Clearance						1×6	50 000	142 000	935				
ZFD 5008-12	Z						1×6	50 000	142 000	1 833				
SFD 5010-3	Clearance						1×3	40 200	91 500	489				
ZFD 5010-6	Z						1×3	40 200	91 500	960				
SFD 5010-4	Clearance		10	6.35	51.75	45.1	1×4	51 500	122 000	644				
ZFD 5010-8	Z						1×4	51 500	122 000	1 263				
SFD 5010-6	Clearance						1×6	72 900	183 000	947				
ZFD 5010-12	Z						1×6	72 900	183 000	1 858				
SFD 5012-3	Clearance						12	7.938	52.25	44	1×3	52 800	109 000	485
ZFD 5012-6	Z										1×3	52 800	109 000	952
SFD 5012-4	Clearance	1×4	67 600	145 000	639									
ZFD 5012-8	Z	1×4	67 600	145 000	1 252									
SFD 5020-3	Clearance	20	7.938	52.25	44	1×3					52 400	109 000	480	
ZFD 5020-6	Z					1×3					52 400	109 000	942	
SFD 6306-4	Clearance					63	6	3.969	64.0	59.9	1×4	30 800	104 000	772
ZFD 6306-8	Z										1×4	30 800	104 000	1 513
SFD 6306-6	Clearance										1×6	43 600	156 000	1 135
ZFD 6306-12	Z										1×6	43 600	156 000	2 226
SFD 6308-4	Clearance	8	4.762	64.25	59.3						1×4	39 600	124 000	787
ZFD 6308-8	Z										1×4	39 600	124 000	1 543
SFD 6308-6	Clearance						1×6	56 200	186 000	1 159				
ZFD 6308-12	Z						1×6	56 200	186 000	2 272				
SFD 6310-4	Clearance						10	6.35	64.75	58.1	1×4	58 700	162 000	810
ZFD 6310-8	Z										1×4	58 700	162 000	1 588
SFD 6310-6	Clearance	1×6	83 200	244 000	1 192									
ZFD 6310-12	Z	1×6	83 200	244 000	2 337									
ZFD 6312-6	Z	12	7.938	65.25	57	1×3					59 900	143 000	1 181	
SFD 6312-4	Clearance					1×4					76 800	191 000	793	
ZFD 6312-8	Z					1×4	76 800	191 000	1 555					
SFD 6312-6	Clearance					1×6	109 000	286 000	1 167					
ZFD 6312-12	Z					1×6	109 000	286 000	2 289					
SFD 6320-3	Clearance					20	9.525	65.75	56	1×3	98 400	231 000	766	
ZFD 6320-6	Z	1 503												

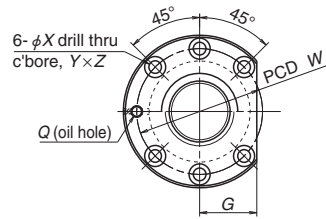
- Notes: 1. Circular shape I and Circular shape II flanges are used for shaft diameters of 20 mm or more. Select a flange suitable for the space available for nut installation.
 2. If no seal is used, the nut length will be shortened by dimension *M*.
 3. Right-turn screws are standard. "L" is added to the end of the Model No. for left turn screws. Please consult NSK for MSFD and MPFD nuts.

Ball nut dimensions										
Nut total length <i>L</i>	Nut diameter <i>D</i>	Flanged diameter <i>A</i>	Flanged width <i>B</i>	Flange notch <i>G</i>	Seal dimension <i>M</i>	Bolt hole dimensions			Bolt hole PCD <i>W</i>	Oil hole <i>Q</i>
						<i>X</i>	<i>Y</i>	<i>Z</i>		
79	70	112	18	43	8	11	17.5	11	90	Rc1/8
119										
96										
152										
83										
123										
93	72	114	18	44	10	11	17.5	11	92	Rc1/8
143										
114										
184										
99										
147										
111	75	121	22	47	12	14	20	13	97	Rc1/8
171										
146										
208										
67										
96										
79	80	122	18	47	6	11	17.5	11	100	Rc1/8
121										
79										
119										
96										
152										
97	82	124	18	47	8	11	17.5	11	102	Rc1/8
147										
118										
188										
147										
111										
171	85	131	22	50	10	14	20	13	107	Rc1/8
136										
220										
146										
228										
146										
228	95	153	28	59	20	18	26	17.5	123	Rc1/8

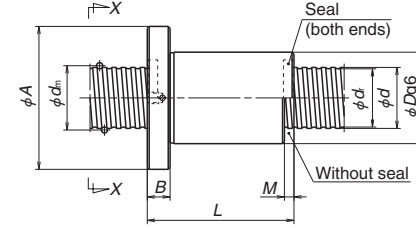
4. Values for axial rigidity *K* above are theoretical values obtained from the elastic deformation between the screw groove and ball when axial load is 30% of the basic dynamic load rating *C_d* for clearance (no preload), 10% for Z-preload, and 5% for P-preload. Refer to the "Technical Description" on page B56 if axial load and preload differ from the conditions above or if deformation of the ball nut body must be considered.
 5. We recommend using seals if shaft diameter is 16 mm or more and an oil hole is provided.
 6. Z-preload refers to offset preload. For details, see page B5.



Circular shape I



Circular shape II



SFD, ZFD

Model No.	Preload	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D_w</i>	Ball circle dia. <i>d_m</i>	Root dia. <i>d_r</i>	Effective ball turns Turns × Circuits	Basic load ratings (N)		Axial rigidity <i>K</i> (N/μm)														
								Dynamic <i>C_s</i>	Static <i>C_{0a}</i>															
SFD 8010-4	Clearance	80	10	6.35	81.75	75.1	1×4	65 100	209 000	987														
ZFD 8010-8	Z						1×4	65 100	209 000	1 935														
SFD 8010-6	Clearance						1×6	92 200	313 000	1 452														
ZFD 8010-12	Z						1×6	92 200	313 000	2 848														
SFD 8012-4	Clearance						1×4	87 400	254 000	996														
ZFD 8012-8	Z						1×4	87 400	254 000	1 954														
SFD 8012-6	Clearance	20	12	7.938	82.25	74	1×6	124 000	381 000	1 467														
ZFD 8012-12	Z						1×6	124 000	381 000	2 877														
SFD 8020-3	Clearance						1×3	114 000	312 000	978														
ZFD 8020-6	Z						1×3	114 000	312 000	1 918														
SFD 8020-4	Clearance						1×4	146 000	416 000	1 287														
ZFD 8020-8	Z						1×4	146 000	416 000	2 524														
SFD 10010-6	Clearance	100	10	6.35	101.75	95.1	1×6	102 000	400 000	1 762														
ZFD 10010-12	Z									3 456														
SFD 10012-6	Clearance									12	7.938	102.25	94	1×6	138 000	490 000	1 789							
ZFD 10012-12	Z																3 509							
SFD 10020-4	Clearance																20	9.525	102.75	93	1×4	161 000	525 000	1 546
ZFD 10020-8	Z																							3 031

- Notes
1. Circular shape I and Circular shape II flanges are used for shaft diameters of 20 mm or more. Select a flange suitable for the space available for nut installation.
 2. If no seal is used, the nut length will be shortened by dimension *M*.
 3. Right-turn screws are standard. "L" is added to the end of the Model No. for left turn screws.

Ball nut dimensions										
Nut total length <i>L</i>	Nut diameter <i>D</i>	Flanged diameter <i>A</i>	Flanged width <i>B</i>	Flange notch <i>G</i>	Seal dimension <i>M</i>	Bolt hole dimensions			Bolt hole PCD <i>W</i>	Oil hole <i>Q</i>
						<i>X</i>	<i>Y</i>	<i>Z</i>		
97	105	151	22	57	10	14	20	13	127	Rc1/8
147										
118										
188	110	156	22	59	12	14	20	13	132	Rc1/8
111										
171										
136										
220	115	173	28	66	20	18	26	17.5	143	Rc1/8
146										
226										
168										
268										
118	125	171	22	64	10	14	20	13	147	Rc1/8
188										
142										
226	130	188	28	71	12	18	26	17.5	158	Rc1/8
172										
272	135	205	32	79	20	22	32	21.5	169	Rc1/8

4. Values for axial rigidity *K* above are theoretical values obtained from the elastic deformation between the screw groove and ball when axial load is 30% of the basic dynamic load rating *C_s* for clearance (no preload), 10% for Z-preload, and 5% for P-preload. Refer to the "Technical Description" on page B56 if axial load and preload differ from the conditions above or if deformation of the ball nut body must be considered.
5. We recommend using seals if shaft diameter is 16 mm or more and an oil hole is provided.
6. Z-preload refers to offset preload. For details, see page B5.

B-3-2.5 High-speed Low-noise Deflector Recirculation Ball Screws

1. Features

Deflector (bridge) recirculation allows for the outer diameter of the nut to be extremely small. With optimizations to keep ball recirculation smooth, technology to reduce impact forces between balls, and specialized ball groove specifications to lower noise from ball travel by approximately 4dB(A) compared to conventional bridge deflectors, these high-speed, low-noise ball screws offer smooth and stable operating characteristics. In addition, revised internal designs provide higher load capacity for select sizes.

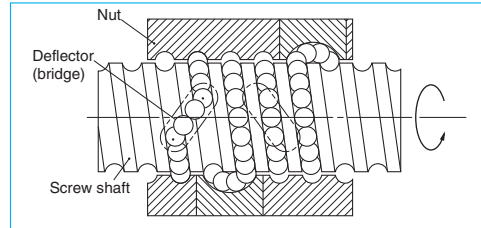


Fig. 1 Structure of deflector(bridge) recirculation system

Table 1 Accuracy grade and axial play

Accuracy grade	C0, C1, C2, C3, C5, Ct7
Axial play	Z, 0 mm (preloaded); T, 0.005 mm or less S, 0.020 mm or less; N, 0.050 mm or less

2. Specifications

(1) Ball recirculation system

Deflector (bridge) recirculation provides a compact nut outer diameter with relatively small leads. The structure of the recirculation system is shown in **Fig. 1**.

(2) Accuracy grade and axial play

The available standard accuracy grades and axial play are shown in **Table 1**. Please consult NSK for other grades.

(3) Allowable *d·n* value and the criterion of maximum rotational speed

The allowable *d·n* value and criterion of maximum rotational speed are shown below. Please consult NSK if the rotational speed exceeds the permissible range below.

Allowable *d·n* value: $\leq 160\ 000$
(For models SFYD6320, ZFYD6320, SFYD6330, and ZFYD6330: $\leq 150\ 000$)

Standard of rotational speed :5 000 min⁻¹

Note: Please also review the critical speed. Refer to "Technical Description: Permissible Rotational Speed" (page B47) for details.

Table 2

Nut	Shape	Flange shape	Preload
SFYD		Compliant with DIN standards. (Other shapes are also available.)	No preload, Slight axial play
ZFYD			Z-preload (medium preload)

3. Lineup

High-speed, low-noise deflector (bridge) recirculation ball screws are available with the preload/clearance configurations shown in **Table 2**.

4. Design Precautions

When designing the screw shaft end, one end of the screw must meet either one of the following conditions. If not, we cannot install the ball nut on the screw shaft.

- Cut the ball groove through to the shaft end.

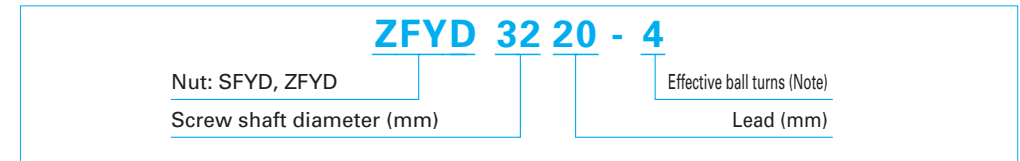
- The diameters of bearing journals and the gear or pulley seat must be less than the root diameter of ball groove *d*, specified in the dimension tables.

For general precautions regarding ball screws, refer to "Design Precautions" (page B83) and "Handling Precautions" (page B103).

5. Structure of model number and reference number

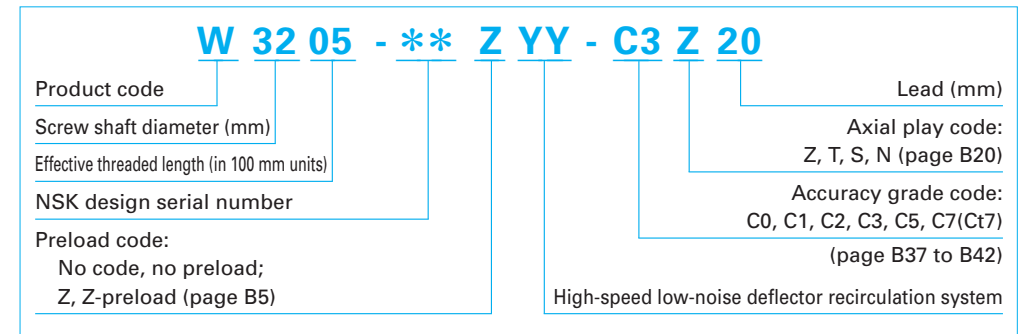
The following explains the codes used in model numbers and ball screw reference numbers.

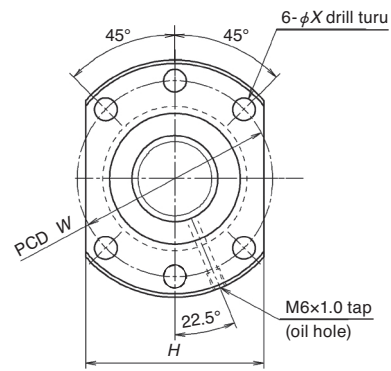
◇Model number



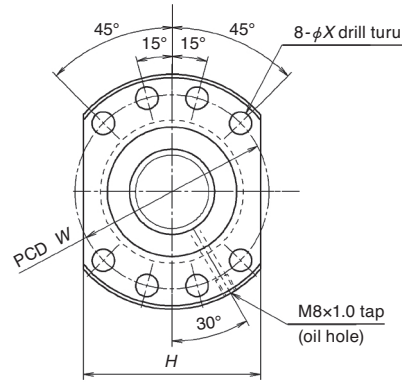
Note: In ZFYD, the number here is twice the effective ball turns.

◇Reference number for ball screws

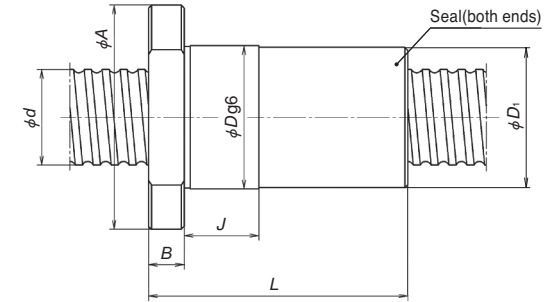




SFYD32, ZFYD32 (Screw shaft diameter d=32mm)



SFYD40, ZFYD40 (Screw shaft diameter d=40mm)
SFYD50, ZFYD50 (Screw shaft diameter d=50mm)
SFYD63, ZFYD63 (Screw shaft diameter d=63mm)



Unit: mm

Model No.	Preload	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D_w</i>	Root dia. <i>d_r</i>	Effective ball turns Turns × Circuits	Basic load ratings (N)	
							Dynamic <i>C_d</i>	Static <i>C_{st}</i>
SFYD 3210-5	Clearance Z	32	10	5.556	27.7	1×5	41 900	83 200
ZFYD 3210-10						1×5	41 900	83 200
SFYD 3215-3	Clearance Z	32	15	5.556	27.7	1×3	26 800	49 700
ZFYD 3215-6						1×3	26 800	49 700
SFYD 3220-2	Clearance Z	32	20	5.556	27.7	1×2	18 700	32 900
ZFYD 3220-4						1×2	18 700	32 900
SFYD 4010-4	Clearance Z	40	10	7.144	34.6	1×4	52 400	103 000
ZFYD 4010-8						1×4	52 400	103 000
SFYD 4015-3	Clearance Z	40	15	7.144	34.6	1×3	40 700	77 100
ZFYD 4015-6						1×3	40 700	77 100
SFYD 5010-4	Clearance Z	50	10	7.144	44.6	1×4	59 100	133 000
ZFYD 5010-8						1×4	59 100	133 000
SFYD 5020-4	Clearance Z	50	20	7.938	44	1×4	67 200	145 000
ZFYD 5020-8						1×4	67 200	145 000
SFYD 6310-5	Clearance Z	63	10	7.144	57.6	1×5	81 900	220 000
ZFYD 6310-10						1×5	81 900	220 000
SFYD 6320-5	Clearance Z	63	20	9.525	56	1×5	153 000	385 000
ZFYD 6320-10						1×5	153 000	385 000
SFYD 6330-3	Clearance Z	63	30	9.525	56	1×3	97 700	230 000
ZFYD 6330-6						1×3	97 700	230 000

Notes: 1. Values for axial rigidity *K* above are theoretical values obtained from the elastic deformation between the screw groove and ball when axial load is 30% of the basic dynamic load rating *C_d*, for clearance (no preload), 5% for P-preload. Refer to the "Technical Description" on page B56 if axial load and preload differ from the conditions above or if deformation of the ball nut body must be considered.




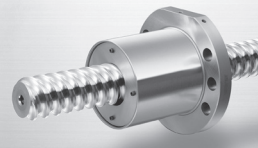
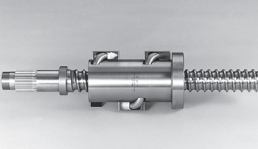


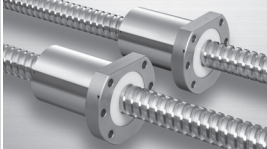
2. Mountings listed are based on dimensions specified by the German Institute for Standardization (DIN). Mounting dimensions can be adjusted to match other ball screws, etc. Please contact NSK for details.


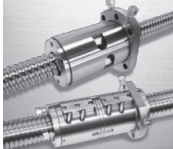


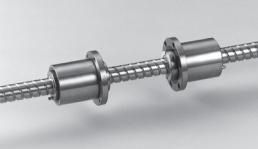
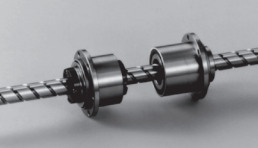

Axial rigidity <i>K</i> (N/μm)	Ball nut dimensions								
	Nut total length <i>L</i>	Nut diameter <i>D</i>	Flange diameter <i>A</i>	Nut diameter <i>D_i</i>	Diameter g6 <i>J</i>	Flange width <i>B</i>	Flange dimension <i>H</i>	Bolt hole dimension <i>X</i>	Bolt hole PCD <i>W</i>
537	94	50	80	(49)	40	12	62	9	65
836	156								
326	88	50	80	(49)	40	12	62	9	65
508	148								
218	81	50	80	(49)	40	12	62	9	65
339	132								
520	87	63	93	(62)	40	14	70	9	78
811	137								
393	95	63	93	(62)	40	14	70	9	78
612	155								
636	90	75	110	(74)	40	16	85	11	93
990	140								
633	140	75	110	(74)	40	16	85	11	93
984	240								
989	104	90	125	(89)	40	18	95	11	108
1 540	164								
1 248	166	95	135	(94)	40	20	100	13.5	115
1 943	286								
757	157	95	135	(94)	40	20	100	13.5	115
1 179	269								

1. HMD Model for High-Speed Machine Tools	B483
2. HMS Model for High-Speed Machine Tools	B487
3. For High-Load Drives	
3.1 HTF-SRC Model	B491
3.2 HTF-SRD Model	B495
3.3 HTF Model	B499
4. For Contaminated Environments	
4.1 VSS Model	B515
4.2 Ball Screw with X1 Seals for Contaminated Environments and Grease Retention	B519
5. Twin-Drive Ball Screws	B527
6. For High Precision Machine Tools	
6.1 Hollow Shaft Ball Screws	B528
6.2 Nut-Cooled Ball Screws	B533
6.3 Ball Screws for High-Accuracy Machine Tools	B537
6.4 High-Durability Precision Ball Screws	B538
7. Rotary Nut Ball Screws	B539
8. Σ Model for Robots	B547
9. Ball Screws with the "NSK K1™" Lubrication Unit	B559
10. Ball screws for Rechargeable Battery Manufacturing Equipment CAT.No.3171	B565
11. Special Ball Screws	B567

B-3-3 Dimension Tables and Reference Numbers for Application-Oriented Ball Screws

◆ Features and examples of application-oriented ball screws

Applications		Shape	Features	Equipment	Page
High-Speed Machine Tools	HMD Model		High-speed operation: 64 to 120 m/min Rigidity: 5% greater than the HMC model. High-load carrying capacity: 7% greater than the HMC model. New recirculation system reduces the noise level by 5 dB(A) or more compared with the HMC model	High-speed machining centers High-speed combined machine tools Die mold processing machine	B483
	HMS Model		Fine lead: 5 to 12 mm High-speed operation: 25 to 50 m/min Easy replacement: Dimensional interchangeability with tube recirculation ball screws. New recirculation system reduces the noise level by 5 dB(A) or more compared with tube recirculation.	Machining centers Die mold processing machine NC lathes Combined machine tools	B487
High-Load Drives	HTF-SRC Model		High-load capacity High-speed operation by high-speed rotation: 930 mm/sec Even load distribution to balls in the ball nut for high-load drive. Improved durability by NSK S1	Injection axis of injection molding machines Servo press machines Press brake Bending machines	B491
	HTF-SRD Model		High-load capacity High-speed operation by large screw lead: 1 600 mm/sec Improved durability by NSK S1	Clamping axis of injection molding machines Die cast machines Punch presses Lifting and lowering devices	B495
	HTF Model		High-load capacity Even load distribution to the balls in a ball nut for high-load drive Improved durability by NSK S1 Provides a wide range of screw diameter and lead combinations.	Injection molding machines Press machines Press fitting machines Lifting and lowering machines	B499
Contaminated Environments	VSS Model		High dust-resistant performance: Reduces particle penetration rate to less than 1/15 (compared with standard seal). More than four times longer service life than standard seals under contaminated environments.	Woodworking machines Laser cutting machines Graphite milling machines Tire molding machines Transfer equipment	B515
Contaminated Environments and Grease Retention	Ball Screws with X1 Seals		Highly dust-resistant: Particle penetration ratio reduced to less than 1/30 of existing standard seals. Superior grease retention: Can reduce lubricant consumption, also effective at suppressing grease splattering.	Machining centers Combined machine tools NC lathes Woodworking machines Laser cutting machines Graphite milling machines Tire molding machines	B519
Twin-Drive Systems	Twin-Drive Ball Screws		Controlled screw lead accuracy and variation of preload torque for twin drive. Improved axial rigidity, expected life and controllability by the paired up two ball-screw driving systems	Machining centers Combined machine tools Large-size machine tools	B527

Applications		Shape	Features	Equipment	Page
Precision Machine Tools	Hollow Shaft Ball Screws		Suppresses thermal deformation by cooling the shaft center. Prevent the machine base from deforming due to thermal expansion. NSK special support units and seal units are available.	High-precision die processing machines High-precision combined machine tools High-precision machining centers High-precision lathes	B528
	Nut-Cooled Ball Screws		Due to the simple nut cooling setup, cooling is achieved simply by attaching piping to the thermal displacement control nut. Cooling just as effective as core cooling. Insulation to prevent heat from affecting the table.	High-precision die processing machines High-precision combined machine tools High-precision machining centers High-precision lathes Large machine tools	B533
	Ball Screws for High-Accuracy Machine Tools		Stable friction during reversals of ball screw direction. This reduces motion errors and contributes to improved surface quality.	High-precision die processing machines High-precision combined machine tools High-precision machining centers High-Precision large-size machine tools	B537
	High-Durability Precision Ball Screws		The surface treatment technology retains the film and reduces wear. This contributes to increased precision life.	Machining centers Combined machine tools Die mold processing machine Electrical discharge machine Grinding machine	B538
Rotary Nut Ball Screws	NDT and NDD Models		Angular contact support bearings are integrated into the ball nut. Two or more ball nuts can be installed in a single ball screw shaft. NDD model ball screws can surpass the critical speed. A special vibration damper enables long-stroke-high-speed operation.	Woodworking machines Laser cutting machines Electronic component mounting devices Flat panel display manufacturing equipment Transfer equipment	B539
Robots	Σ Model		A ball screw and a ball spline are made in one shaft, combining a drive and guide system. A ball screw nut, a ball spline nut and support bearings are combined to the unit. Hollow shaft has weight saving. The shaft can be used for wiring and piping.	SCARA type robots Electronic-component mounting systems	B547
Ball Screws with the "NSK K1™" Lubrication Unit			Long-term, maintenance-free operation Maintains lubrication efficiency for a prolonged time in contaminated environments Does not pollute the environment Made of compatible material with the FDA regulations is also available.	Automotive manufacturing machines Woodworking machines Laser cutting machines Semiconductor/Flat panel display manufacturing equipment Food processing/Medical equipment	B559

B-3-3.1 HMD Model for High-Speed Machine Tools

Newly developed ball recirculation components, end deflectors, and middle deflectors contribute significantly to substantial improvements in maximum rotational speed and the level of noise as compared to the HMC model.

1. Features

- High speed
The permissible rotational speed ($d \cdot n$ value) has greatly increased to 160 000 compared with 135 000 of the HMC model.
- Low noise
Noise reduced by 5 dB(A) or more compared with HMC model ball screws for high-speed machine tools.
- Nut mounting dimensions
The ball nut diameters are the same as those of the HMC model.

2. Specifications

(1) Recirculation system

Fig.1 shows the structure of the middle-deflector recirculation system of the HMD model.

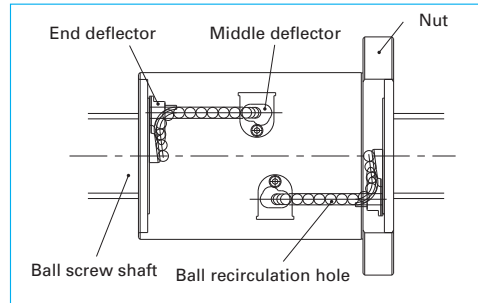


Fig. 1 Structure of middle-deflector recirculation system

(2) Accuracy grade and axial play

The available standard accuracy grades and axial play are as follows. Please consult NSK for other grades.

Table 1 Accuracy grade and axial play

Accuracy grade	C3, C5
Axial play	0 mm (preloaded)

(3) Allowable $d \cdot n$ value and the criterion of maximum rotational speed

The allowable $d \cdot n$ value and criterion of maximum rotational speed are shown below. Please consult NSK if the rotational speed exceeds the permissible range below.

Allowable $d \cdot n$ value: 160 000 or less

Criterion of maximum rotational speed : 4 000 min⁻¹

Note: Please also review the critical speed. See "Technical Description: Permissible Rotational Speed" (page B47) for details.

(4) Options

- For twin-drive systems (See page B527.)
Upon request, variations in lead accuracy and preload torque between paired twin-drive ball screws can be controlled for the further improvement of reliability.
- Hollow shaft ball screw (See page B528.)
- Nut-Cooled Ball Screws (See page B533.)

Temperature rise and measures to prevent thermal expansion of the ball screw drive mechanism are especially challenging for high-speed machine tools. We recommend using core forced cooling or nut cooling for the HMD model.

(5) Seal

Compact, thin plastic seals are available. Nut outside diameter is compact compared with the tube recirculation system.

3. Design precautions

For general precautions regarding ball screws, refer to "Design Precautions" (page B83) and "Handling Precautions" (page B103).

4. Lineup

The HMD model is available in the following varieties:

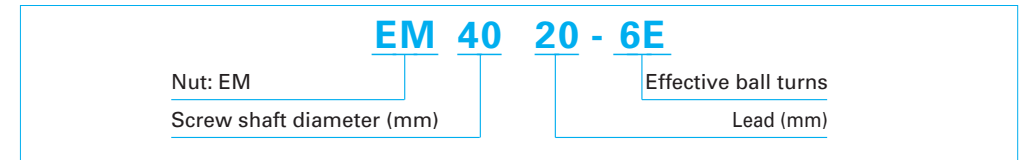
Table 2 HMD model lineup

Nut	Shape	Flange shape	Nut shape	Preload
EM		Flanged Circular III	Circular	Z-Preload (medium preload)

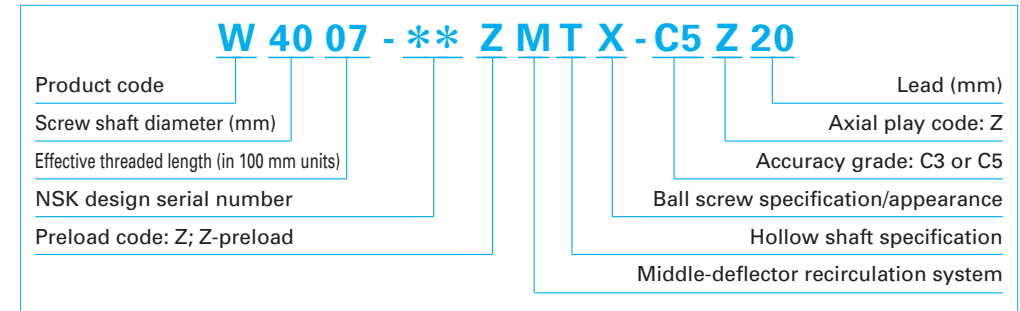
5. Structure of model number and reference number

The following explains the codes used in model numbers and ball screw reference numbers.

◇Model number



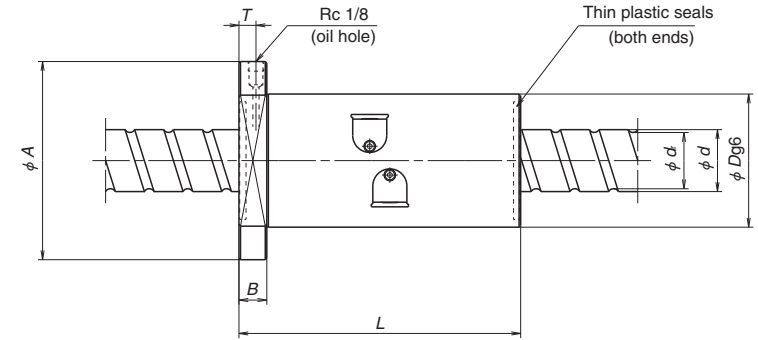
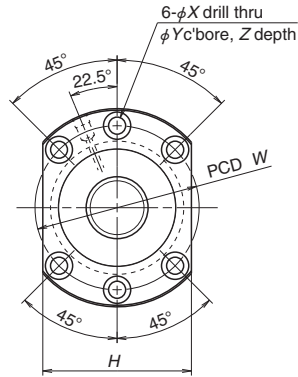
◇Reference number for ball screw



6. Handling Precautions

Maximum operating temperature: 80°C

If using NSK K1, operating temperature should not exceed 50°C. Refer to "Design Precautions" (page B83).



Model No.	Shaft dia. <i>d</i>	Lead <i>l</i>	Root dia. <i>d_r</i>	Basic load ratings (N)		Axial rigidity <i>K</i> (N/μm)
				Dynamic <i>C_a</i>	Static <i>C_{0a}</i>	
EM2812-4E	28	12	23.5	33 100	60 000	718
EM2816-4E		16	23.5	32 800	59 600	708
EM4016-4E	40	16	34.1	66 900	131 000	1 023
EM4020-6E		20	34.4	77 900	166 000	1 415
EM4020-4EG		20	34.1	66 500	131 000	1 013
EM4025-6E		25	34.1	91 300	191 000	1 442
EM4030-6E		30	34.1	90 400	190 000	1 419
EM4516-4E	45	16	39.1	69 900	146 000	1 121
EM4520-6E		20	39.4	83 200	187 000	1 573
EM4525-6E		25	39.1	95 700	214 000	1 589
EM5016-4E	50	16	44.1	72 700	161 000	1 216
EM5020-6E		20	44.4	85 700	205 000	1 695
EM5025-6E		25	44.1	103 000	232 000	1 731
EM5030-6E		30	44.1	102 000	235 000	1 730
EM5520-8E		55	20	49.4	118 000	309 000
EM6316-4E	63	16	55.2	131 000	338 000	1 696

Unit: mm

Nut length <i>L</i>	Nut dia. <i>D</i>	Ball nut dimensions			Bolt hole dimensions			Bolt hole PCD <i>W</i>	Oil hole position <i>T</i>	Max. feed speed (m/min)
		Flange dia. <i>A</i>	Flange width <i>B</i>	Flange dimension <i>H</i>	<i>X</i>	<i>Y</i>	<i>Z</i>			
120	60	88	18	66	6.6	11	6.5	73	9	48
153										64
160	86	128	18	96	11	17.5	11	106	11	64
150										80
192										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
192										103
170	122	180	28	138	18	26	17.5	150	14	40

Notes: 1. Right-turn screws are standard. Please contact NSK for left-turn screws.
2. Values for axial rigidity *K* are obtained when 5% of the basic dynamic load ratings is applied as the preload.

B-3-3.2 HMS Model for High-Speed Machine Tools

1. Features

- High speed
The permissible rotational speed (*d·n* value) has greatly increased to 160 000 compared with 100 000 for tube recirculation screws.
- Low noise
By adopting a SRC recirculation system, noise reduced by 5 dB(A) or more compared with tube recirculation screws.
- Nut mounting dimensions
The ball nut diameters are the same as those of tube recirculation screws.

2. Specifications

(1) Recirculation system

Fig.1 shows the structure of the SRC recirculation system of the HMS model.

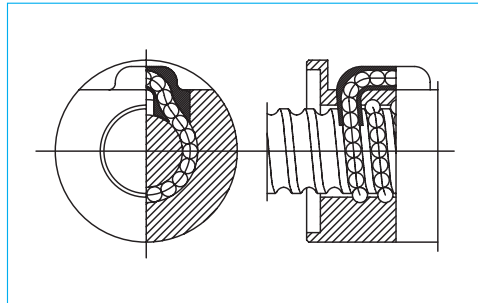


Fig. 1 Structure of SRC recirculation system

(2) Accuracy grade and axial play

The available standard accuracy grades and axial play are as follows. Please consult NSK for other grades.

Table 1 Accuracy grade and axial play

Accuracy grade	C3, C5
Axial play	0 mm (preloaded)

(3) Allowable *d·n* value and the criterion of maximum rotational speed

The allowable *d·n* value and criterion of maximum rotational speed are shown below. Please consult NSK if the rotational speed exceeds the permissible range below.

Allowable *d·n* value: 160 000 or less
 Criterion of maximum rotational speed : 5 000 min⁻¹

Note: Please also review the critical speed. See "Technical Description: Permissible Rotational Speed" (page B47) for details.

(4) Options

- For twin-drive systems (See page B527.)
Upon request, variations in lead accuracy and preload torque between paired twin-drive ball screws can be controlled for the further improvement of reliability.
- Hollow shaft ball screw (See page B528.)
- Nut-Cooled Ball Screws (See page B533.)
Temperature rise and measures to prevent thermal expansion of the ball screw drive mechanism are especially challenging for high-speed machine tools. We recommend using core forced cooling or nut cooling for the HMS model.


3. Design precautions

For general precautions regarding ball screws, refer to "Design Precautions" (page B83) and "Handling Precautions" (page B103).

4. Lineup

The HMS model is available in the following varieties:

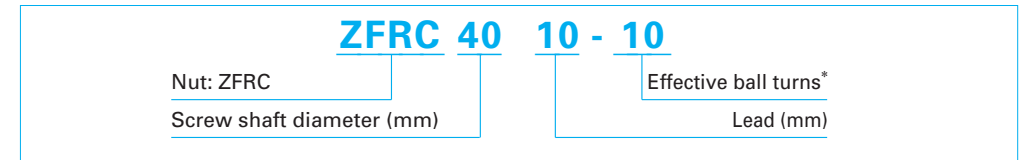
Table 2 HMS model lineup

Nut	Shape	Flange shape	Nut shape	Preload
ZFRC		Flanged Circular II	Circular	Z-Preload (medium preload)

5. Structure of model number and reference number

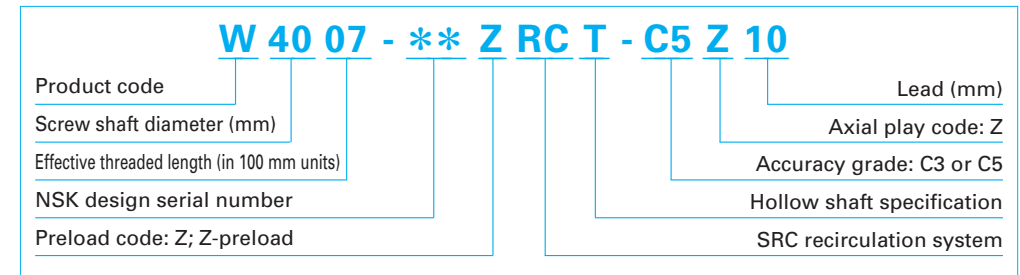
The following explains the codes used in model numbers and ball screw reference numbers.

◇Model number



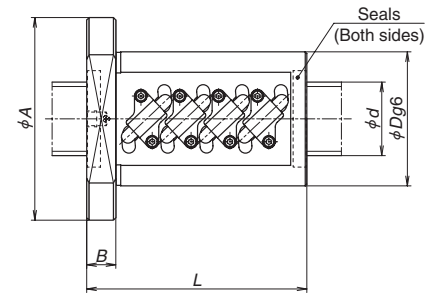
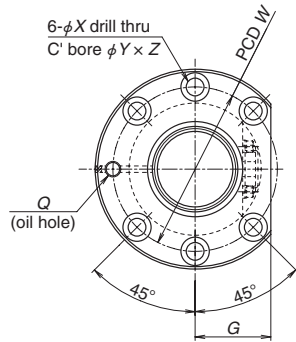
* In the case of Z-preload, the amount shown is twice the effective ball turns.

◇Reference number for ball screws



6. Handling Precautions

Maximum operating temperature: 60°C
 If using NSK K1, operating temperature should not exceed 50°C. Refer to "Design Precautions" (page B83).



Model No.	Shaft dia. <i>d</i>	Lead <i>l</i>	Root dia. <i>d_r</i>	Effective turns Turns × rows	Basic load ratings (N)		Axial rigidity <i>K</i> (N/μm)
					Dynamic <i>C_e</i>	Static <i>C_{0a}</i>	
ZFRC2812-7	28	12	23.5	3.5×1	26 100	50 200	592
ZFRC2816-5	28	16	22.4	2.5×1	27 400	47 400	437
ZFRC3205-10	32	5	29.2	2.5×2	21 800	56 000	891
ZFRC3210-10	32	10	26.4	2.5×2	54 500	110 000	970
ZFRC4005-10	40	5	37.2	2.5×2	23 900	70 500	1 067
ZFRC4010-10	40	10	34.4	2.5×2	61 200	137 000	1 154
ZFRC4012-10	40	12	34.1	2.5×2	71 700	154 000	1 177
ZFRC4508-10	45	8	40.5	2.5×2	44 000	118 000	1 234
ZFRC4510-10	45	10	39.4	2.5×2	65 800	157 000	1 291
ZFRC4512-10	45	12	39.1	2.5×2	75 600	176 000	1 304
ZFRC5010-10	50	10	44.4	2.5×2	68 100	174 000	1 397
ZFRC5012-10	50	12	43.2	2.5×2	91 500	218 000	1 441
ZFRC5508-10	55	12	50.5	2.5×2	47 300	144 000	1 439
ZFRC6312-14	63	12	56.2	3.5×2	136 000	385 000	2 388

Notes: 1. Right-turn screws are standard. Please contact NSK for left-turn screws.
2. Values for axial rigidity *K* are obtained when 5% of the basic dynamic load ratings is applied as the preload.

Unit: mm

Ball nut dimensions								Bolt hole PCD <i>W</i>	Oil hole position <i>Q</i>	Max. feed speed (m/min)
Nut length <i>L</i>	Nut dia. <i>D</i>	Flange dia. <i>A</i>	Flange width <i>B</i>	Notch dimension <i>G</i>	Bolt hole dimensions <i>X</i> <i>Y</i> <i>Z</i>					
128	60	88	15	33	6.6	11	6.5	73	M6×1	60
131	73	101	15	38	6.6	11	6.5	86	M6×1	80
89	58	85	12	32	6.6	11	6.5	71	M6×1	25
163	74	108	15	41	9	14	8.5	90	M6×1	50
92	67	101	15	39	9	14	8.5	83	M6×1	25
166	82	124	18	47	11	17.5	11	102	Rc1/8	40
192	86	128	18	48	11	17.5	11	106	Rc1/8	48
136	82	124	18	47	11	17.5	11	102	Rc1/8	28
166	88	132	18	50	11	17.5	11	110	Rc1/8	35
192	90	132	18	50	11	17.5	11	110	Rc1/8	42
166	93	135	18	51	11	17.5	11	113	Rc1/8	32
198	100	146	22	55	14	20	13	122	Rc1/8	38
133	94	136	18	52	11	17.5	11	114	Rc1/8	60
244	115	161	22	61	14	20	13	137	Rc1/8	30

HMS

B-3-3.3.1 HTF-SRC Model for High-Load Drives

1. Features

● High-speed operation and low noise
 The SRC recirculation system contributes to more than twice the feed speed ($d \cdot n$ value: 140 000 and 160 000) and 8 to 10 dB(A) less noise (half to 1/3 of noise) compared with the HTF model.

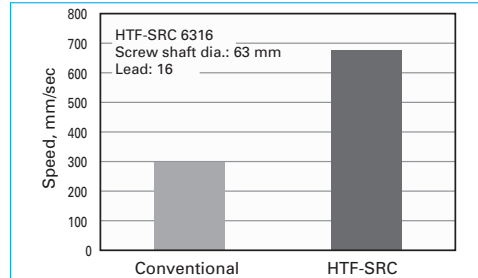


Fig. 1 Feed speed comparison

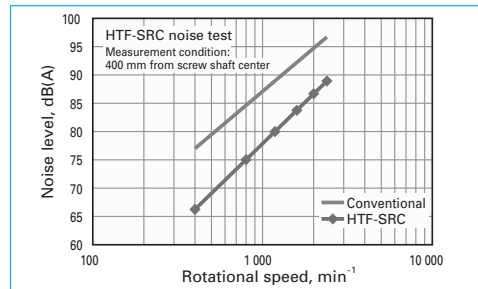


Fig. 2 Noise level comparison

2. Specifications

(1) Ball recirculation system

The SRC recirculation system picks up balls in the direction they are moving, and thus contributes to high-speed, low-noise operation. The structure of the recirculation system is as follows.

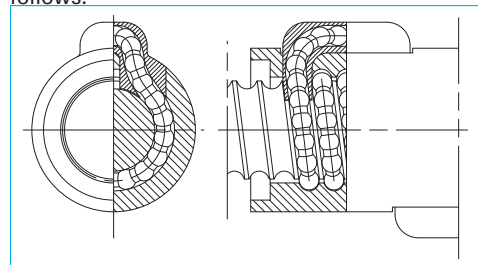


Fig. 3 Structure of SRC recirculation system

(2) Accuracy grade and axial play

The available standard accuracy grade and axial play are as follows. Please consult NSK for other grades.

Table 1 Accuracy grade and axial play

Accuracy grade	Ct7
Axial play	S,0.020 mm or less; N,0.050 mm or less

(3) Allowable $d \cdot n$ value and the criterion of maximum rotational speed

The allowable $d \cdot n$ 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 $d \cdot n$ value and the criterion of maximum rotational speed

Lead	14, 16 mm	20, 25 mm [*]
Allowable $d \cdot n$ value	160 000 or less	140 000 or less
Criterion of maximum rotational speed	3 225 min ⁻¹	

$d \cdot n$ value: shaft dia. d [mm] \times rotational speed n [min⁻¹]
 ☆ Allowable $d \cdot n$ value for HTF-SRC5020: 160 000

Note: Please also review the critical speed. See "Technical Description: Permissible Rotational Speed" (page B47) for details.

(4) Ball retaining piece NSK S1™

NSK S1 resin retainers between balls significantly extend ball screw durability to moment load.

(5) Other

Please consult NSK for special requests, such as the addition of a recirculation circuit to increase load capacity, or the arrangement of all recirculation circuits on the same phase of the ball nut circumference.

3. Design Precautions

The HTF-SRC model is designed to distribute the load uniformly to the balls in the high-load drive mechanism. We recommend installing the ball screws in the way shown for the full use of this characteristic.

In addition, we can provide a full analysis when you use the HTF-SRC model under extreme conditions such as extremely high loads or short strokes. Contact NSK about operating conditions (See page B513).

When designing the screw shaft end, one end

of the screw shaft must meet either one of the following conditions. If not, we cannot install the ball nut on the screw shaft.

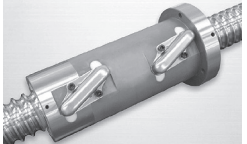
- Cut the ball groove through to the shaft end.
- The diameters of bearing journals and the gear or pulley seat must be less than the root diameter of ball groove d , specified in the dimension table.

For general precautions regarding ball screws, refer to "Design Precautions" (page B83) and "Handling Precautions" (page B103).

4. Lineup

The HTF-SRC model is available in the following varieties:

Table 3 HTF-SRC model lineup

Nut	Shape	Flange shape	Preload
HTF-SRC		Flanged Circular I	No preload Slight axial play

5. Structure of model number and reference number

The following explains the codes used in model numbers and ball screw reference numbers.

◇ Model number

HTF-SRC 63 20 - 7.5

Nut: HTF-SRC		Effective ball turns
Screw shaft diameter (mm)		Lead (mm)

◇ Reference number for ball screws

W 63 04 - ** RC SP - C7 S 20

Product code		Lead (mm)
Screw shaft diameter (mm)		Axial play code: S, N (page B20)
Effective threaded length (in 100 mm units)		Accuracy grade: C7 (Ct7) (page B37 to B42)
NSK design serial number		Ball retaining pieces: NSK S1 specification
SRC recirculation system		

6. Handling Precautions

Maximum operating temperature: 70°C (at outside diameter of ball nut)

As lubricant will deteriorate, we recommend an

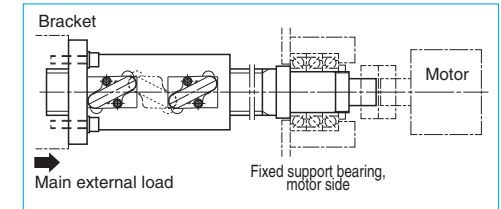
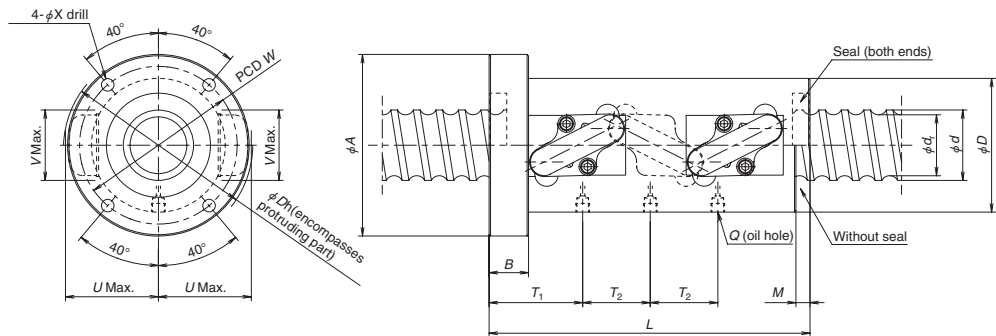
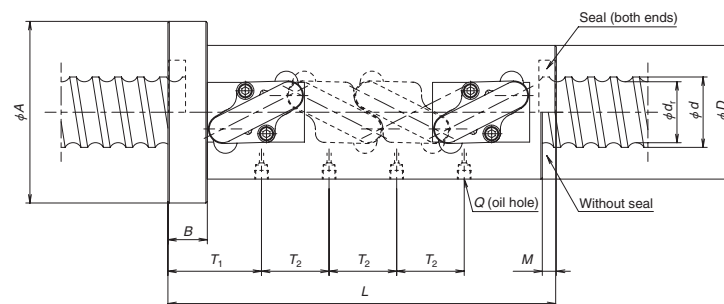


Fig. 4 Recommended installing direction of high-load drive ball screw

operating temperature of 60 °C or lower. Please consult NSK in the case of a short stroke operation less than or equal to four times the length of the ball screw lead.



Nut model I



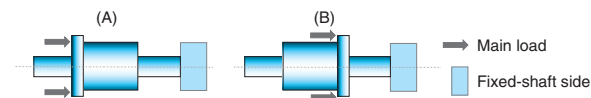
Nut model II

Model No.	Lead <i>l</i>	Shaft dia. <i>d</i>	Root dia. <i>d'</i>	Effective ball turns Turns x Circuits	Nut model	Basic load ratings (kN)				
						Dynamic <i>C_d</i>	Static <i>C_{0a}</i>	<i>D</i>	<i>A</i>	<i>B</i>
HTF-SRC5016-7.5	16	50	39	2.5x3	I	383	818	95	129	28
HTF-SRC6316-7.5	16	63	52	2.5x3	I	429	1 050	105	139	28
HTF-SRC6316-10	16	63	52	2.5x4	II	549	1 410	105	139	28
HTF-SRC6316-10.5	16	63	52	3.5x3	I	562	1 450	105	139	28
HTF-SRC6316-14	16	63	52	3.5x4	II	720	1 930	105	139	28
HTF-SRC8016-10.5	16	80	69	3.5x3	I	627	1 870	120	154	32
HTF-SRC8016-14	16	80	69	3.5x4	II	802	2 490	120	154	32
HTF-SRC5020-7.5	20	50	39	2.5x3	I	383	818	95	129	28
HTF-SRC6320-7.5	20	63	49	2.5x3	I	572	1 280	117	157	32
HTF-SRC6320-10	20	63	49	2.5x4	II	732	1 710	117	157	32
HTF-SRC8020-10.5	20	80	66	3.5x3	I	838	2 300	130	170	32
HTF-SRC10020-10.5	20	100	86	3.5x3	I	936	2 910	145	185	32
HTF-SRC10020-14	20	100	86	3.5x4	II	1 200	3 890	145	185	32
HTF-SRC12020-7.5	20	120	106	2.5x3	I	776	2 550	173	213	40
HTF-SRC12020-10	20	120	106	2.5x4	II	994	3 400	173	213	40
HTF-SRC6325-10.5	25	63	49	3.5x3	I	750	1 770	117	157	32
HTF-SRC8025-7.5	25	80	63	2.5x3	I	790	1 960	145	185	40
HTF-SRC10025-10.5	25	100	83	3.5x3	I	1 200	3 430	159	199	40
HTF-SRC10025-14	25	100	83	3.5x4	II	1 540	4 580	159	199	40
HTF-SRC12025-10.5	25	120	103	3.5x3	I	1 300	4 200	173	213	40
HTF-SRC12025-14	25	120	103	3.5x4	II	1 660	5 600	173	213	40

Remarks: 1. If no seals are equipped, the ball nut length will be shortened by dimension *M*.
 2. Contact NSK if the applied load will exceed the permissible axial load.
 3. Right-turn screws are standard. Contact NSK for left-turn screws.
 4. Values for permissible axial load are obtained with *S* clearance. If the amount of clearance or mounting conditions are different, the permissible axial load will also change.

Unit: mm

Ball nut dimensions										Permissible axial load (kN)	
<i>L</i>	<i>M</i>	<i>W</i>	<i>X</i>	<i>U</i>	<i>V</i>	<i>Dh</i>	<i>Q</i>	<i>T₁</i>	<i>T₂</i>	Mounting *See below	
										[A] Recommended	[B]
202	10	97	9	54.5	46	111	M6x1	69	42	104	76.8
228	10	112	9	66	50	134	Rc1/8	74.5	48	129	107
228	10	122	9	72.5	50	148	Rc1/8	74.5	48	184	142
276	10	122	9	72.5	50	148	Rc1/8	74.5	48	209	152
276	10	122	9	72.5	50	148	Rc1/8	74.5	64	217	157
340	10	122	9	72.5	50	148	Rc1/8	74.5	64	236	162
278	10	137	9	80	60	165	Rc1/8	78.5	64	321	209
342	10	137	9	80	60	165	Rc1/8	78.5	64	360	217
268	10	112	9	66	50	135	Rc1/8	83.5	60	121	99.4
279	12	137	11	80	62	163	Rc1/8	90	60	211	172
339	12	137	11	80	62	163	Rc1/8	90	60	232	182
339	12	150	11	88	64	180	Rc1/8	90	80	362	254
339	12	165	11	97	78	199	Rc1/8	90	80	524	325
419	12	165	11	97	78	199	Rc1/8	90	80	588	335
287	12	193	11	109.5	88	229	Rc1/8	98	60	525	376
347	12	193	11	109.5	88	229	Rc1/8	98	60	628	407
405	12	137	11	81.5	61	167	Rc1/8	101.75	100	222	172
347	17	165	11	99.5	73	202	Rc1/8	111.75	75	334	269
422	17	179	11	108	79	220	Rc1/8	111.75	100	560	383
522	17	179	11	108	79	220	Rc1/8	111.75	100	612	395
421	17	193	11	116	92	238	Rc1/8	111.25	100	750	465
521	17	193	11	116	92	238	Rc1/8	111.25	100	836	479



B-3-3.3.2 HTF-SRD Model for High-Load Drives

1. Features

● High-speed operation and low noise
Used with end deflectors, HTF-SRD model ball screws achieve a maximum feed speed of 1 600 mm/s. The ball nut body surface is completely round, thus enabling well balanced ball nut rotation.

A double start thread structure which has more recirculation circuits, and large diameter balls contribute to high load carrying capacity.

● Low noise and compact design
End deflector systems using a ball scooping mechanism in the direction of the screw spiral offer smoother ball recirculation, thus contributing to less than half the noise level compared with existing ball screws equipped with a tube.

A compact, high-performance seal is available. Nut outside diameter is compact compare with the tube recirculation system.

Compact, thin plastic seals are also available. Nut outside diameter is compact compared with the tube recirculation system.

2. Specifications

(1) Ball recirculation system

End-deflector recirculation systems feature high-speed, low-noise operation and a compact ball nut. The structure of recirculation parts are as follows.

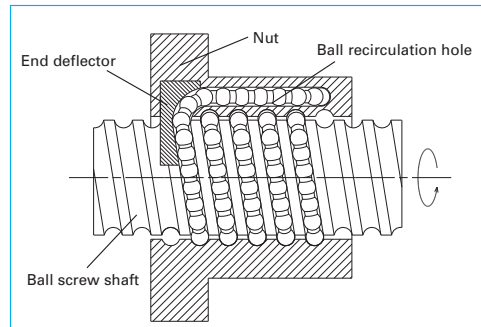


Fig. 1 Structure of End-deflector recirculation system

(2) Accuracy grade and axial play

The available standard accuracy grades and axial play are as follows. Please consult NSK for other grades.

Table 1 Accuracy grade and axial play

Accuracy grade	Ct7
Axial play	S, 0.020 mm or less; N, 0.050 mm or less

(3) Allowable *d·n* value and the criterion of maximum rotational speed

The allowable *d·n* value and criterion of maximum rotational speed are shown below. Please consult NSK if the rotational speed exceeds the permissible range below.

Table 2 Allowable *d·n* value and the criterion of maximum rotational speed

Allowable <i>d·n</i> value	120 000 or less
Criterion of maximum rotational speed	2 400 min ⁻¹

d·n value: shaft dia. *d* [mm] × rotational speed *n* [min⁻¹]

Note: Please also review the critical speed. See "Technical Description: Permissible Rotational Speed" (page B47) for details.

(4) Ball retaining piece NSK S1™

NSK S1 resin retainers between the balls significantly extend ball screw durability to moment load.

3. Design Precautions

The HTF-SRD model is designed to distribute the load uniformly to the balls of the high-load drive mechanism. We recommend installing the ball screws in the way shown below for the full use of this characteristic.

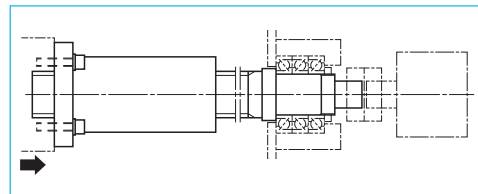


Fig. 2 Recommended installing direction of high-load drives ball screw

In addition, we will perform a full analysis when you use the HTF-SRD model under extreme conditions such as extremely high load or short strokes. Contact NSK about operating conditions (see page B513).

When designing the screw shaft end, one end

of the screw shaft must meet either one of the following conditions. If not, we cannot install the ball nut on the screw shaft.

- Cut the ball groove through to the shaft end.
- The diameters of bearing journals and the gear or pulley seat must be less than the root diameter of ball groove *d*, specified in the dimension table.

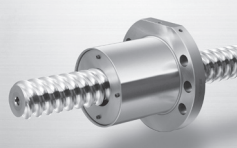
For general precautions regarding ball screws, refer to "Design Precautions" (page B83) and

"Handling Precautions" (page B103).

4. Lineup

The HTF-SRD model is available in the following varieties:

Table 3 HTF-SRD model lineup

Nut	Shape	Flange shape	Preload
HTF-SRD		Circular III	No preload Slight axial play

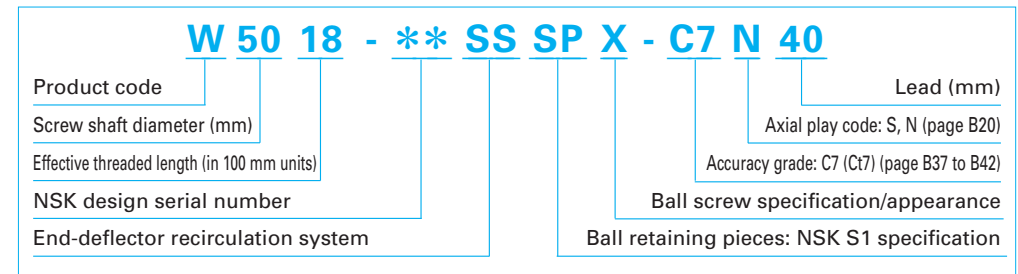
5. Structure of model number and reference number

The following explains the codes used in model numbers and ball screw reference numbers.

◇Model number



◇Reference number for ball screw



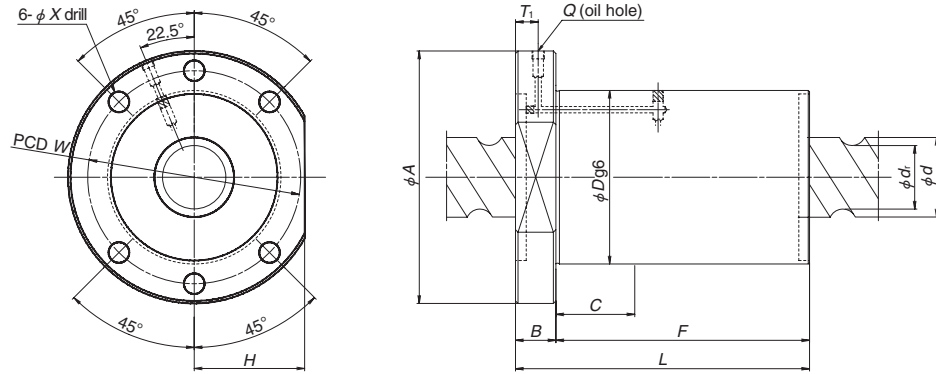
6. Handling Precautions

Maximum operating temperature: 70°C (at outside diameter of ball nut)

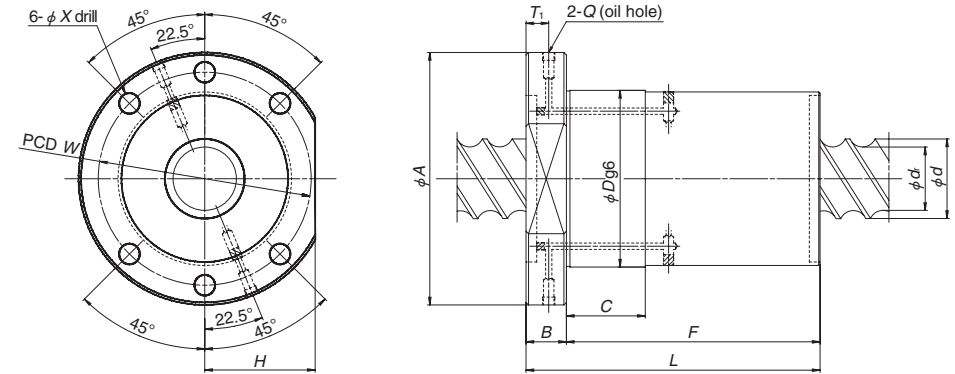
As lubricant will deteriorate, we recommend an

operating temperature of 60 °C or lower.

Please consult NSK in the case of short stroke operation less than or equal to four times the length of the ball screw lead.



Nut model I



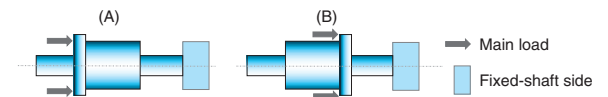
Nut model II

Unit: mm

Model No.	Lead <i>l</i>	Shaft dia. <i>d</i>	Root dia. <i>d'</i>	Nut model	Basic load ratings (kN)				
					Dynamic	Static	<i>D</i>	<i>A</i>	<i>B</i>
					<i>C₀</i>	<i>C_{0s}</i>			
HTF-SRD6332-4E	32	63	49	I	292	590	140	190	32
HTF-SRD5040-6E	40	50	39	II	243	491	115	165	28
HTF-SRD5040-8E	40	50	39	II	319	679	115	165	28
HTF-SRD6340-6E	40	63	49	II	363	768	140	200	32
HTF-SRD6340-8E	40	63	49	II	476	1 060	140	200	32
HTF-SRD5050-6E	50	50	39	II	243	491	115	165	28
HTF-SRD5050-8E	50	50	39	II	319	679	115	165	28
HTF-SRD8050-6E	50	80	63	II	502	1 180	175	250	40
HTF-SRD8050-8E	50	80	63	II	658	1 630	175	250	40
HTF-SRD6360-6E	60	63	49	II	363	768	140	200	32
HTF-SRD6360-8E	60	63	49	II	476	1 060	140	200	32
HTF-SRD10060-6E	60	100	83	II	583	1 490	195	270	40
HTF-SRD10060-8E	60	100	83	II	765	2 060	195	270	40
HTF-SRD12070-6E	70	120	103	II	630	1 810	210	285	50
HTF-SRD12070-8E	70	120	103	II	826	2 520	210	285	50
HTF-SRD8080-6E	80	80	63	II	502	1 180	175	250	40
HTF-SRD8080-8E	80	80	63	II	658	1 630	175	250	40
HTF-SRD100100-6E	100	100	83	II	583	1 490	195	270	40
HTF-SRD100100-8E	100	100	83	II	765	2 060	195	270	40
HTF-SRD80120-4E	120	80	63	II	337	751	175	250	40
HTF-SRD120120-6E	120	120	103	II	630	1 810	210	285	50
HTF-SRD120120-8E	120	120	103	II	826	2 520	210	285	50

Ball nut dimensions								Permissible axial load (kN)	
<i>F</i>	<i>C</i>	<i>L</i>	<i>H</i>	<i>W</i>	<i>X</i>	<i>Q</i>	<i>T₁</i>	Mounting *See below	
								[A] Recommended	[B]
144	—	176	85	165	14	Rc1/8	22	119	114
131	131	159	72.5	140	14	Rc1/8	18	106	99.1
171	171	199	72.5	140	14	Rc1/8	18	123	111
131	131	163	90	170	18	Rc1/8	22	181	169
171	171	203	90	170	18	Rc1/8	22	213	192
159	159	187	72.5	140	14	Rc1/8	18	102	94.6
209	209	237	72.5	140	14	Rc1/8	18	116	103
154	154	194	110	210	22	Rc1/8	30	284	263
204	204	244	110	210	22	Rc1/8	30	336	302
188	188	220	90	170	18	Rc1/8	22	168	153
248	248	280	90	170	18	Rc1/8	22	190	169
185	185	225	122	235	22	Rc1/8	30	366	330
245	245	285	122	235	22	Rc1/8	30	436	378
210	210	260	130	250	22	Rc1/8	40	451	393
280	280	330	130	250	22	Rc1/8	40	549	450
244	244	284	110	210	22	Rc1/8	30	258	234
324	100	364	110	210	22	Rc1/8	30	293	258
301	100	341	122	235	22	Rc1/8	30	336	294
401	100	441	122	235	22	Rc1/8	30	383	320
243	243	283	110	210	22	Rc1/8	30	185	172
356	100	406	130	250	22	Rc1/8	40	413	343
476	100	526	130	250	22	Rc1/8	40	480	375

- Remarks: 1. Contact NSK if the applied load will exceed the permissible axial load.
 2. Right-turn screws are standard. Contact NSK for left-turn screws.
 3. Values for permissible axial load are obtained with *S* clearance. If the amount of clearance or mounting conditions are different, the permissible axial load will also change.
 4. When *F* and *C* dimensions are the same, the total surface of *F* is $\phi Dg6$.



B-3-3.3.3 HTF Model for High-Load Drives

1. Features

- High load carrying capacity
Has an ideal design to bear heavy load. It significantly enhances load rating as well as maximum permissible load.

- Respond to various shaft end configurations
Additional ball screw shaft machining is not required. HTF models respond to various shaft ends that convey high torque.

The HTF model can be used with: involute spline (JIS B 1603), straight sided spline (JIS B 1601), key seat, etc.

2. Specifications

(1) Ball recirculation system

The structure of the recirculation system is shown in Fig. 1.

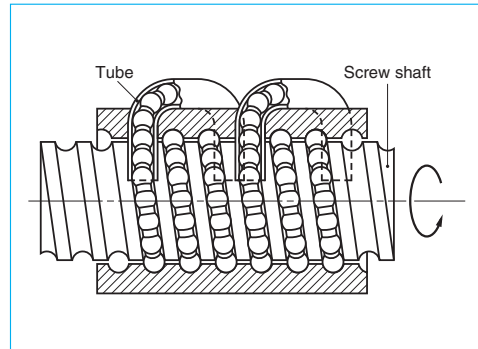


Fig. 1 Structure of tube recirculation system

(2) Accuracy grade and axial play

The allowable standard accuracy grades and axial play are as follows. Please consult NSK for other grades.

Table 1 Accuracy grade and axial play

Accuracy grade	Ct7
Axial play	S, 0.020 mm or under; N, 0.050 mm or under

(3) Allowable d·n value and the criterion of maximum rotational speed

The allowable d·n value and criterion of maximum rotational speed are shown below. Please consult NSK if the rotational speed exceeds the permissible range below. For higher-speed operation, the HTF-SRC model is recommend (See page B491).

Table 2 Allowable d·n value and the criterion of maximum rotational speed

Lead		- 20 mm	25 mm	30 - 32 mm
Allowable d·n value	Standard specification	70 000 or less	70 000 or less	50 000 or less
	High-speed specification	10 0000 or less	-	-
Criterion of maximum rotational speed		3 125 min ⁻¹		

d·n value: shaft dia. d [mm] × rotational speed n [min⁻¹]

Note: Please also review the critical speed. See "Technical Description: Permissible Rotational Speed" (page B47) for details.

(4) Ball retaining piece NSK S1™

NSK S1 resin retainers between the balls significantly extend ball screw durability to moment load.

(5) Other

Please consult NSK for special requests, such as the addition of a recirculation circuit to increase the load capacity, or the arrangement of all recirculation circuits on the same phase of the ball nut circumference.

3. Design precautions

When designing shaft end configurations, note that HTF model ball screws are specialized for high-load drives.

The HTF model is designed to distribute load uniformly to balls in the high-load drive mechanism.

We recommend installing ball screws in the way shown in Fig. 2 for the full use of this characteristic. In addition, we will perform a full analysis when you use the HTF model under extreme conditions such as application of extremely high load or operating in short stroke. Contact NSK about operating conditions (See page B513).

When designing the screw shaft end, the one end must be cut-through and the shaft end dimension must be less than the root diameter


of the ball groove. If not, the nut cannot be assembled.

For general precautions regarding ball screws, refer to "Design Precautions" (page B83) and "Handling Precautions" (page B103).

4. Lineup

The HTF model is available in the following varieties:

Table 3 HTF model lineup

Nut	Shape	Flange shape	Preload
HTF		Flanged Circular I	No preload Slight axial play

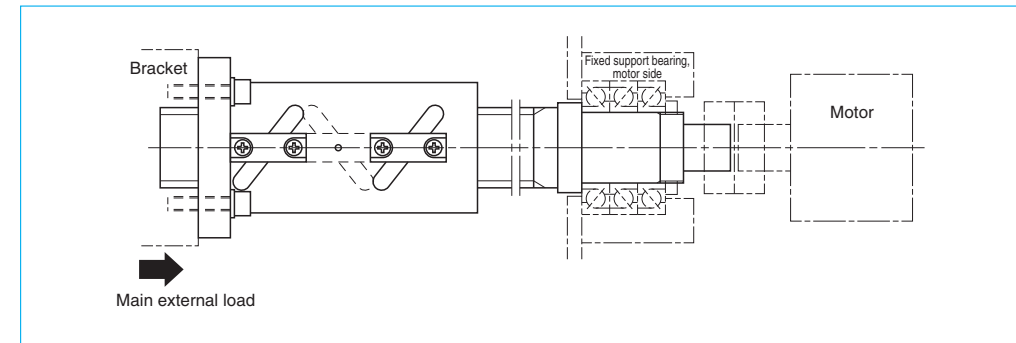
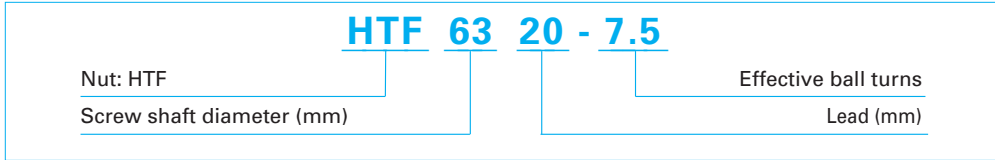


Fig. 2 Recommended installing direction of ball screws for high-load drives

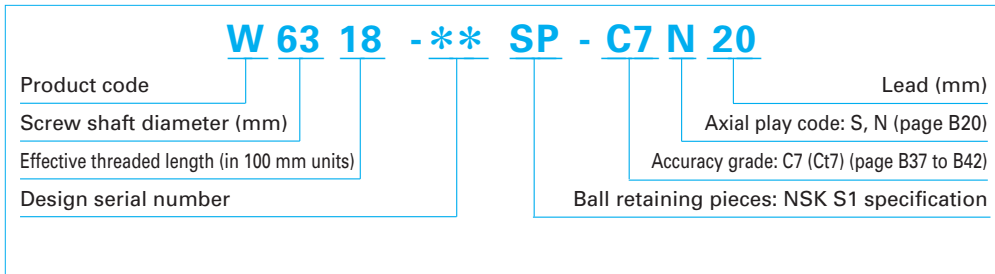
5. Structure of model number and reference number

The following explains the codes used in model numbers and ball screw reference numbers.

◇Model number



◇Reference number for ball screw



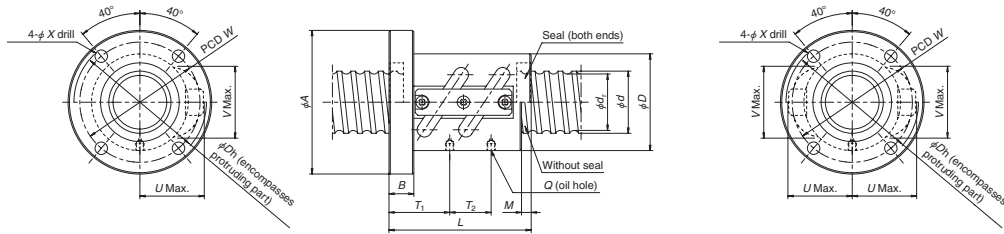
6. Handling precautions

Maximum operating temperature : 70°C
(at outside diameter of all nut)

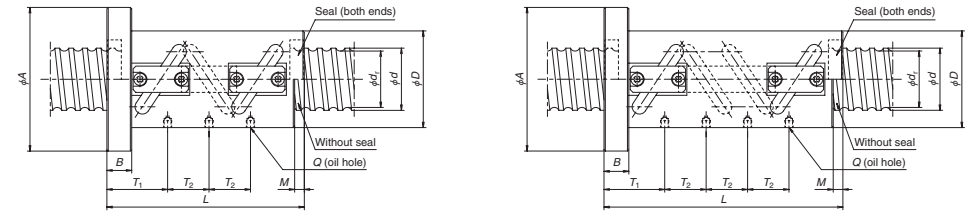
As lubricant will deteriorate, we recommend an operating temperature of 60 °C or lower.

Please consult NSK in the case of short stroke

operation less than or equal to four times the length of the ball screw lead.



Nut model I



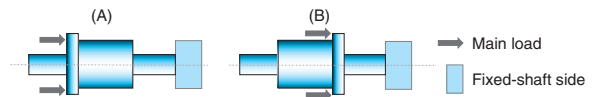
Nut model II

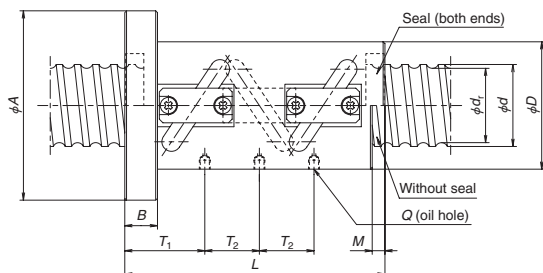
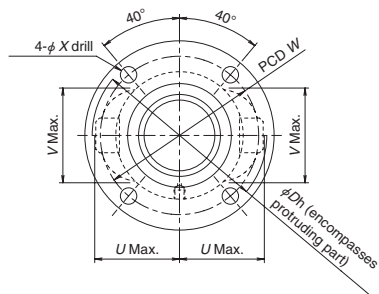
Nut model III

Model No.	Lead <i>l</i>	Shaft dia. <i>d</i>	Root dia. <i>d'</i>	Effective ball turns Turns × Circuits	Nut model	Basic load ratings (kN)				
						Dynamic <i>C_d</i>	Static <i>C_{0a}</i>	<i>D</i>	<i>A</i>	<i>B</i>
HTF3610-5	10	36	29.6	2.5×2	I	96.1	191	62	96	18
HTF4010-7.5	10	40	33.6	2.5×3	II	149	344	66	100	18
HTF4510-7.5	10	45	38.6	2.5×3	II	158	386	70	104	18
HTF4510-10	10	45	38.6	2.5×4	III	203	514	70	104	18
HTF5010-7.5	10	50	43.6	2.5×3	II	166	435	75	109	18
HTF5010-10	10	50	43.6	2.5×4	III	213	580	75	109	18
HTF5510-7.5	10	55	48.6	2.5×3	II	173	477	80	114	18
HTF5510-10	10	55	48.6	2.5×4	III	222	636	80	114	18
HTF3612-5	12	36	29	2.5×2	I	112	228	66	100	22
HTF4012-7.5	12	40	33	2.5×3	II	184	422	70	104	22
HTF4512-7.5	12	45	38	2.5×3	II	195	473	72	106	22
HTF5012-7.5	12	50	43	2.5×3	II	205	525	77	111	22
HTF5012-10	12	50	43	2.5×4	III	263	700	77	111	22
HTF5512-7.5	12	55	48	2.5×3	II	214	586	82	116	22
HTF5512-10	12	55	48	2.5×4	III	274	781	82	116	22
HTF6312-7.5	12	63	56	2.5×3	II	227	668	92	126	22
HTF6312-10	12	63	56	2.5×4	III	290	891	92	126	22

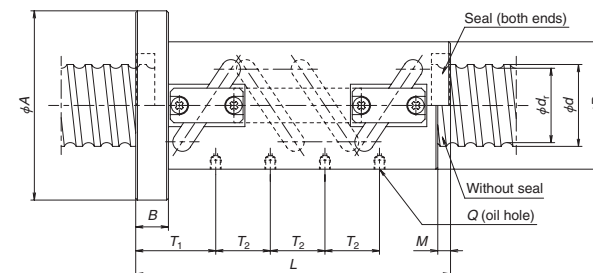
Remarks: 1. If no seals are equipped, the ball nut length will be shortened by dimension *M*.
 2. Contact NSK if the applied load will exceed the permissible axial load.
 3. Right-turn screws are standard. Contact NSK for left-turn screws.
 4. Values for permissible axial load are obtained with *S* clearance. If the amount of clearance or mounting conditions are different, the permissible axial load will also change.

Ball nut dimensions										Permissible axial load (kN)	
<i>L</i>	<i>M</i>	<i>W</i>	<i>X</i>	<i>U</i>	<i>V</i>	<i>Dh</i>	<i>Q</i>	<i>T₁</i>	<i>T₂</i>	Mounting *See below	
										[A] Recommended	[B]
103	7	75	9	40.5	42	82	M6×1	36.5	30	33.0	29.5
103	7	79	9	43	45	87	M6×1	36.5	30	37.5	33.3
143	7	83	9	45	48	91	M6×1	46.5	30	59.5	46.1
143	7	87	9	47	52	95	M6×1	46.5	30	70.2	52.3
173	7	87	9	47	52	95	M6×1	46.5	30	81.4	56.1
143	7	92	9	49	57	99	M6×1	46.5	30	82.0	59.6
173	7	92	9	49	57	99	M6×1	46.5	30	92.4	67.1
143	7	97	9	51.5	62	104	M6×1	46.5	30	92.8	66.2
173	7	97	9	51.5	62	104	M6×1	46.5	30	110	71.5
123	8	83	9	46.5	46	94	M6×1	44	36	42.8	38.2
171	8	87	9	47.5	50	96	M6×1	56	36	62.7	49.8
171	8	89	9	49.5	54	100	M6×1	56	36	75.9	56.5
171	8	94	9	52	59	105	M6×1	56	36	88.5	64.2
207	8	94	9	52	59	105	M6×1	56	36	102	68.5
171	8	99	9	54.5	63	110	M6×1	56	36	101	71.9
207	8	99	9	54.5	63	110	M6×1	56	36	118	77.0
171	8	109	9	58.5	70	118	M6×1	56	36	120	85.8
207	8	109	9	58.5	70	118	M6×1	56	36	143	92.5





Nut model II



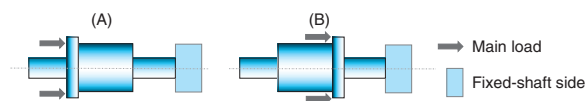
Nut model III

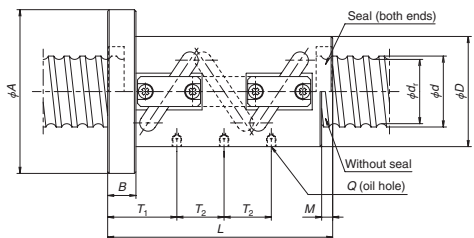
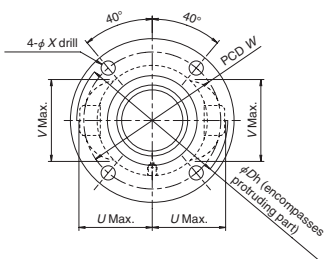
Unit: mm

Model No.	Lead <i>l</i>	Shaft dia. <i>d</i>	Root dia. <i>d'</i>	Effective ball turns Turns × Circuits	Nut model	Basic load ratings (kN)			<i>D</i>	<i>A</i>	<i>B</i>	
						Dynamic <i>C₀</i>	Static <i>C_{0s}</i>					
# HTF5014-7.5	14	50	41.7	2.5×3	II	264	623	80	114	28		
HTF5514-7.5	14	55	46.7	2.5×3	II	270	696	85	119	28		
HTF6314-7.5	14	63	54.7	2.5×3	II	291	800	94	128	28		
HTF6314-10	14	63	54.7	2.5×4	III	373	1 070	94	128	28		
HTF8014-7.5	14	80	71.7	2.5×3	II	327	1 020	116	150	28		
HTF8014-10	14	80	71.7	2.5×4	III	418	1 360	116	150	28		
# HTF5016-7.5	16	50	39	2.5×3	II	383	818	95	129	28		
HTF5516-7.5	16	55	44	2.5×3	II	399	922	99	133	28		
# HTF6316-7.5	16	63	52	2.5×3	II	429	1 050	105	139	28		
# HTF6316-10	16	63	52	2.5×4	III	549	1 410	105	139	28		
# HTF6316-10.5	16	63	52	3.5×3	II	562	1 450	105	139	28		
# HTF6316-14	16	63	52	3.5×4	III	720	1 930	105	139	28		
# HTF8016-7.5	16	80	69	2.5×3	II	478	1 340	120	154	32		
HTF8016-10	16	80	69	2.5×4	III	612	1 790	120	154	32		
# HTF8016-10.5	16	80	69	3.5×3	II	627	1 870	120	154	32		
# HTF8016-14	16	80	69	3.5×4	III	802	2 490	120	154	32		
HTF10016-7.5	16	100	89	2.5×3	II	529	1 710	145	185	32		
HTF10016-10	16	100	89	2.5×4	III	677	2 280	145	185	32		
HTF12016-7.5	16	120	109	2.5×3	II	572	2 050	173	213	32		
HTF12016-10	16	120	109	2.5×4	III	732	2 730	173	213	32		

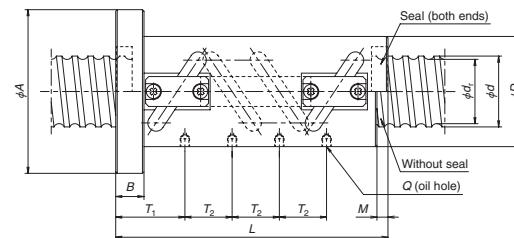
- Remarks: 1. If no seals are equipped, the ball nut length will be shortened by dimension *M*.
 2. Contact NSK if the applied load will exceed the permissible axial load.
 3. Right-turn screws are standard. Contact NSK for left-turn screws.
 4. Values for permissible axial load are obtained with *S* clearance. If the amount of clearance or mounting conditions are different, the permissible axial load will also change.
 5. For Model No. marked with #, it is recommended to use the HTF-SRC Model.

Ball nut dimensions										Permissible axial load (kN)	
<i>L</i>	<i>M</i>	<i>W</i>	<i>X</i>	<i>U</i>	<i>V</i>	<i>Dh</i>	<i>Q</i>	<i>T₁</i>	<i>T₂</i>	Mounting *See below	
										[A] Recommended	[B]
200	10	97	9	55.5	61	112	M6×1	66.5	42	104	76.8
200	10	102	9	57.5	65	116	M6×1	66.5	42	119	86.0
200	10	111	9	61.5	72	124	M6×1	66.5	42	145	102
242	10	111	9	61.5	72	124	M6×1	66.5	42	170	109
200	10	133	9	72	87	146	M6×1	66.5	42	195	139
242	10	133	9	72	87	146	M6×1	66.5	42	234	151
223	10	112	9	68	66	137	Rc1/8	73	48	128	109
223	10	116	9	70	70	141	Rc1/8	73	48	150	121
223	10	122	9	72.5	76	146	Rc1/8	73	48	184	142
271	10	122	9	72.5	76	146	Rc1/8	73	48	209	152
271	10	122	9	72.5	76	146	Rc1/8	73	64	217	157
335	10	122	9	72.5	76	146	Rc1/8	73	64	236	162
227	10	137	9	80	92	161	Rc1/8	77	48	259	186
275	10	137	9	80	92	161	Rc1/8	77	48	305	200
275	10	137	9	80	92	161	Rc1/8	77	64	321	209
339	10	137	9	80	92	161	Rc1/8	77	64	360	217
227	10	165	11	91	109	184	Rc1/8	77	48	347	250
275	10	165	11	91	109	184	Rc1/8	77	48	418	272
227	10	193	11	104	126	210	Rc1/8	77	48	425	318
275	10	193	11	104	126	210	Rc1/8	77	48	519	351





Nut model II



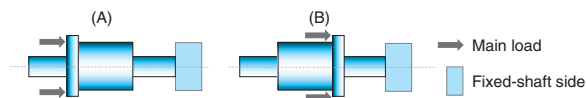
Nut model III

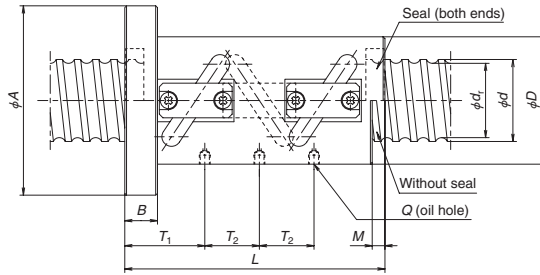
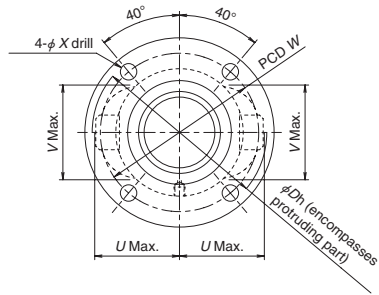
Unit: mm

Model No.	Lead <i>l</i>	Shaft dia. <i>d</i>	Root dia. <i>d'</i>	Effective ball turns Turns x Circuits	Nut model	Basic load ratings (kN)				
						Dynamic		Static		
						<i>C_d</i>	<i>C_{0d}</i>	<i>D</i>	<i>A</i>	<i>B</i>
# HTF6320-7.5	20	63	49	2.5x3	II	572	1 320	117	157	32
# HTF6320-10	20	63	49	2.5x4	III	732	1 760	117	157	32
HTF6320-10.5	20	63	49	3.5x3	II	749	1 810	117	157	32
HTF8020-7.5	20	80	66	2.5x3	II	639	1 690	130	170	32
HTF8020-10	20	80	66	2.5x4	III	818	2 250	130	170	32
HTF8020-10.5	20	80	66	3.5x3	II	838	2 300	130	170	32
HTF10020-7.5	20	100	86	2.5x3	II	713	2 140	145	185	32
HTF10020-10	20	100	86	2.5x4	III	914	2 850	145	185	32
HTF10020-10.5	20	100	86	3.5x3	II	935	2 920	145	185	32
# HTF10020-14	20	100	86	3.5x4	III	1 200	3 890	145	185	32
# HTF12020-7.5	20	120	106	2.5x3	II	775	2 550	173	213	40
# HTF12020-10	20	120	106	2.5x4	III	993	3 400	173	213	40
HTF12020-10.5	20	120	106	3.5x3	II	1 020	3 530	173	213	40
HTF12020-14	20	120	106	3.5x4	III	1 300	4 710	173	213	40
HTF14020-7.5	20	140	126	2.5x3	II	829	3 000	204	250	40
HTF14020-10	20	140	126	2.5x4	III	1 060	4 000	204	250	40
# HTF6325-10.5	25	63	49	3.5x3	II	749	1 810	117	157	32
# HTF8025-7.5	25	80	64	2.5x3	II	829	2 020	145	185	40
HTF10025-7.5	25	100	84	2.5x3	II	917	2 550	159	199	40
HTF10025-10	25	100	84	2.5x4	III	1 170	3 400	159	199	40
# HTF10025-10.5	25	100	84	3.5x3	II	1 200	3 490	159	199	40
# HTF10025-14	25	100	84	3.5x4	III	1 540	4 650	159	199	40
HTF12025-7.5	25	120	104	2.5x3	II	990	3 080	173	213	40
HTF12025-10	25	120	104	2.5x4	III	1 270	4 110	173	213	40
# HTF12025-10.5	25	120	104	3.5x3	II	1 300	4 200	173	213	40
# HTF12025-14	25	120	104	3.5x4	III	1 660	5 600	173	213	40
HTF14025-7.5	25	140	124	2.5x3	II	1 050	3 610	204	250	40
HTF14025-10	25	140	124	2.5x4	III	1 350	4 810	204	250	40
HTF14025-10.5	25	140	124	3.5x3	II	1 380	4 910	204	250	40
HTF14025-14	25	140	124	3.5x4	III	1 770	6 540	204	250	40
HTF16025-7.5	25	160	144	2.5x3	II	1 140	4 140	234	280	40
HTF16025-10	25	160	144	2.5x4	III	1 450	5 520	234	280	40

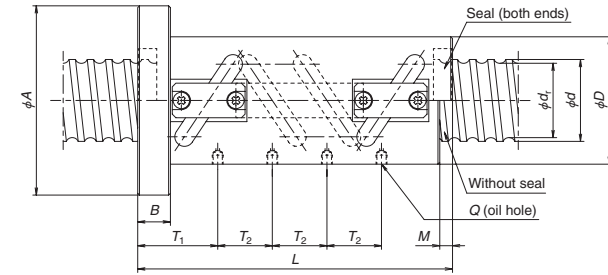
- Remarks: 1. If no seals are equipped, the ball nut length will be shortened by dimension *M*.
 2. Contact NSK if the applied load will exceed the permissible axial load.
 3. Right-turn screws are standard. Contact NSK for left-turn screws.
 4. Values for permissible axial load are obtained with *S* clearance. If the amount of clearance or mounting conditions are different, the permissible axial load will also change.
 5. For Model No. marked with #, it is recommended to use the HTF-SRC Model.

Ball nut dimensions										Permissible axial load (kN)	
<i>L</i>	<i>M</i>	<i>W</i>	<i>X</i>	<i>U</i>	<i>V</i>	<i>D_h</i>	<i>Q</i>	<i>T₁</i>	<i>T₂</i>	Mounting *See below	
										[A] Recommended	[B]
273	12	137	11	83.5	81	168	Rc1/8	88	60	212	173
333	12	137	11	83.5	81	168	Rc1/8	88	60	234	183
333	12	137	11	83.5	81	168	Rc1/8	88	80	243	190
273	12	150	11	89.5	96	181	Rc1/8	88	60	310	233
333	12	150	11	89.5	96	181	Rc1/8	88	60	353	247
333	12	150	11	89.5	96	181	Rc1/8	88	80	365	255
273	12	165	11	97.5	114	196	Rc1/8	88	60	427	295
333	12	165	11	97.5	114	196	Rc1/8	88	60	501	314
333	12	165	11	97.5	114	196	Rc1/8	90	80	520	324
413	12	165	11	97.5	114	196	Rc1/8	90	80	582	335
281	12	193	11	111	130	223	Rc1/8	96	60	522	376
341	12	193	11	111	130	223	Rc1/8	96	60	624	407
341	12	193	11	111	131	223	Rc1/8	96	80	657	424
421	12	193	11	111	131	223	Rc1/8	96	80	748	442
281	12	226	14	122.5	148	248	Rc1/8	96	60	630	468
341	12	226	14	122.5	148	248	Rc1/8	96	60	765	514
398	12	137	11	83.5	83	169	Rc1/8	98.75	100	228	175
338	17	165	11	102	100	206	Rc1/8	109.25	75	338	271
338	17	179	11	108.5	118	219	Rc1/8	109.25	75	484	354
413	17	179	11	108.5	118	219	Rc1/8	109.25	75	554	375
413	17	179	11	108.5	118	219	Rc1/8	109.25	100	575	388
513	17	179	11	108.5	118	219	Rc1/8	109.25	100	629	399
338	17	193	11	116	135	223	Rc1/8	109.25	75	612	424
413	17	193	11	116	135	223	Rc1/8	109.25	75	712	450
413	17	193	11	116	134	233	Rc1/8	109.25	100	739	464
513	17	193	11	116	134	233	Rc1/8	109.25	100	821	479
338	17	226	14	127.5	153	258	Rc1/8	109.25	75	752	531
413	17	226	14	127.5	153	258	Rc1/8	109.25	75	897	572
413	17	226	14	127.5	153	258	Rc1/8	109.25	100	939	594
513	17	226	14	127.5	153	258	Rc1/8	109.25	100	1 060	618
338	17	256	14	138	173	279	Rc1/8	109.25	75	874	638
413	17	256	14	138	173	279	Rc1/8	109.25	75	1 050	696





Nut model II



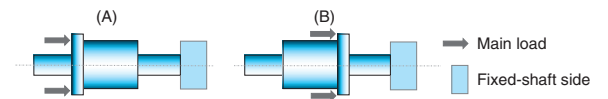
Nut model III

Model No.	Lead <i>l</i>	Shaft dia. <i>d</i>	Root dia. <i>d'</i>	Effective ball turns Turns × Circuits	Nut model	Basic load ratings (kN)				
						Dynamic <i>C₀</i>	Static <i>C_{0s}</i>	<i>D</i>	<i>A</i>	<i>B</i>
HTF14030-10	30	140	121	2.5×4	III	1 670	5 490	222	282	50
HTF14030-10.5	30	140	121	3.5×3	II	1 710	5 710	222	282	50
HTF16030-7.5	30	160	141	2.5×3	II	1 400	4 760	234	294	50
HTF16030-10	30	160	141	2.5×4	III	1 790	6 340	234	294	50
HTF16030-10.5	30	160	141	3.5×3	II	1 830	6 520	234	294	50
HTF20030-7.5	30	200	181	2.5×3	II	1 550	5 960	290	350	50
HTF20030-10	30	200	181	2.5×4	III	1 980	7 950	290	350	50
HTF14032-7.5	32	140	118	2.5×3	II	1 590	4 740	222	296	70
HTF14032-10	32	140	118	2.5×4	III	2 040	6 320	222	296	70
HTF14032-10.5	32	140	118	3.5×3	II	2 080	6 420	222	296	70
HTF16032-7.5	32	160	138	2.5×3	II	1 660	5 370	234	308	70
HTF16032-10	32	160	138	2.5×4	III	2 130	7 160	234	308	70
HTF16032-10.5	32	160	138	3.5×3	II	2 180	7 460	234	308	70
HTF20032-7.5	32	200	178	2.5×3	II	1 840	6 840	290	364	70
HTF20032-10	32	200	178	2.5×4	III	2 360	9 120	290	364	70

- Remarks: 1. If no seals are equipped, the ball nut length will be shortened by dimension *M*.
 2. Contact NSK if the applied load will exceed the permissible axial load.
 3. Right-turn screws are standard. Contact NSK for left-turn screws.
 4. Values for permissible axial load are obtained with S clearance. (For models with 32mm lead, values are obtained with N clearance, which is the basic specification.) If the amount of clearance or mounting conditions are different, the permissible axial load will also change.

Unit: mm

Ball nut dimensions										Permissible axial load (kN)	
<i>L</i>	<i>M</i>	<i>W</i>	<i>X</i>	<i>U</i>	<i>V</i>	<i>Dh</i>	<i>Q</i>	<i>T₁</i>	<i>T₂</i>	Mounting *See below	
										[A] Recommended	[B]
411	22	252	18	139	160	281	Rc1/8	134.5	90	809	613
501	22	252	18	139	160	281	Rc1/8	134.5	90	938	659
501	22	252	18	139	160	281	Rc1/8	134.5	120	987	688
411	22	264	18	148	177	299	Rc1/8	134.5	90	1 010	708
501	22	264	18	148	177	299	Rc1/8	134.5	90	1 190	761
501	22	264	18	148	177	299	Rc1/8	134.5	120	1 240	786
411	22	320	18	178	212	359	Rc1/8	134.5	90	1 300	955
501	22	320	18	178	212	359	Rc1/8	134.5	90	1 570	1 040
465	22	259	22	148	163	299	Rc1/8	166.5	96	828	621
561	22	259	22	148	163	299	Rc1/8	166.5	96	954	664
561	22	259	22	148	163	299	Rc1/8	166.5	128	998	690
465	22	271	22	152	181	307	Rc1/8	166.5	96	1 020	708
561	22	271	22	152	181	307	Rc1/8	166.5	96	1 200	757
561	22	271	22	152	181	307	Rc1/8	166.5	128	1 270	791
465	22	327	22	182	215	367	Rc1/8	166.5	96	1 340	968
561	22	327	22	182	215	367	Rc1/8	166.5	96	1 610	1 050



NSK Technical Data Sheet for NSK High-Load Drive Ball Screws

Custom-made ball screw

Company name:	Date:	NSK sales office
Section:	Contact person:	
Address:		

Name of machine*1: Electric injection molding machine; 200-ton capacity Application*2: Injection axis

Drawing/rough sketch attached?: Yes No

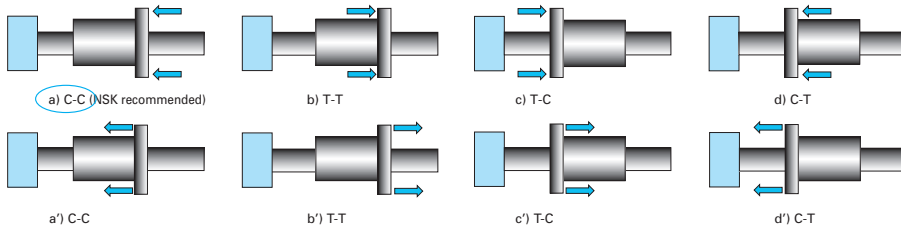
*1 Please specify the capacity of injection molding machines or presses.

*2 Please indicate the axis of injection molding machines (injection, clamping, etc.).

1. Use conditions

Operating conditions	<input checked="" type="checkbox"/> Shaft rotation — Moving nut	<input checked="" type="checkbox"/> Normal operation	Degree of vibration/impacts	<input type="checkbox"/> Smooth operation without impacts
	<input type="checkbox"/> Shaft rotation — Moving shaft	<input type="checkbox"/> Back drive operation		<input checked="" type="checkbox"/> Normal operation
Direction of load*3	<input type="checkbox"/> Per image below	<input type="checkbox"/> Other (<i>Attached</i>)	Mounting orientation	<input checked="" type="checkbox"/> Horizontal
	<input type="checkbox"/> Nut rotation — Moving nut			<input type="checkbox"/> Vertical (Indicate direction of gravity)
Lubricant	<input checked="" type="checkbox"/> Grease (Brand name: <i>High-load grease with an extreme pressure additive</i>)	Lubricant replenishment method	<input type="checkbox"/> Manual (grease gun, etc.)	<input checked="" type="checkbox"/> Automatic
Oil holes	<input type="checkbox"/> Oil		(cm ³ / cycles)	
Seals	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	NSK S1 ball retaining piece	<input checked="" type="checkbox"/> Per NSK recommendations <input type="checkbox"/> No
Environment	Temp: <u>40</u> °C/°F	Contaminants <input type="checkbox"/> Yes: Particle size (a) 0.1 or less, (b) 0.1 to 0.3, (c) Over 0.3; Material: <input checked="" type="checkbox"/> No		
Surface treatment	<input checked="" type="checkbox"/> Not required	<input type="checkbox"/> Low-temperature chrome plating	<input type="checkbox"/> Fluoride low-temperature chrome plating	<input type="checkbox"/> Other
Quantity for mass-production	/Month	/Year	/Lot	Quantity used per machine: <u>1</u> pcs./machine

*3 Please specify load direction using the images below. (Fixed-shaft side: , Main load:) Load applied in the opposite direction of the main load indicated by the arrows is defined as "load in direction opposite main load."



*4 Confirm the strength of the ball screw and nut sections for both load in the direction of main load and in the direction opposite the main load.

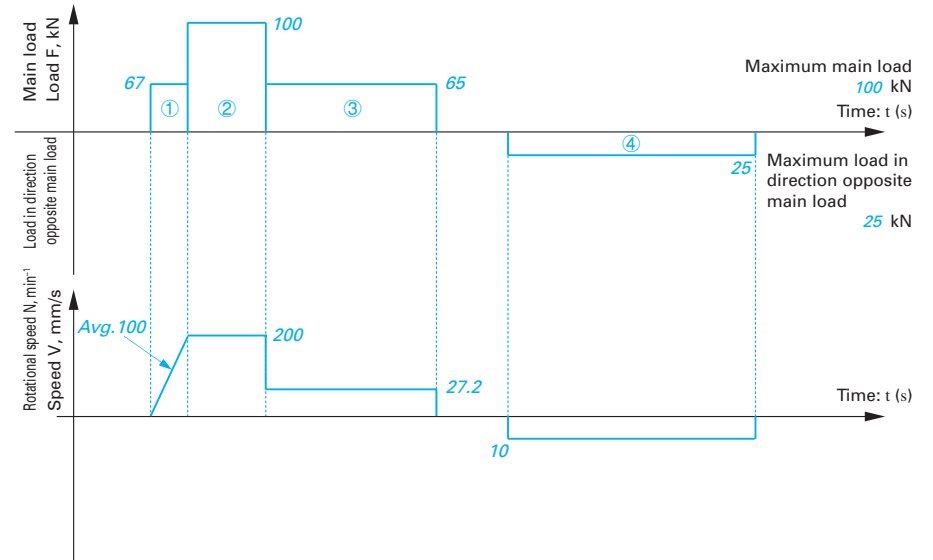
2. Specifications

Shaft diameter	φ 63 mm	Lead	16 mm	Accuracy grade	C17	Axial play	0.050 or less mm max.
Nut Model No.	HTF-SRC 6316-7.5-S1	Effective ball circuits	2.5 × 3	Direction of turn	right	Thread length/ Overall shaft length	800 / 1200

Special Notes / Requests

NSK Technical Data Sheet for NSK High-Load Drive Ball Screws

3. Load chart (If using multiple ball screws, fill out the axial load per ball screw.)



	Axial load* F (kN)	Rotational speed or Average speed N (min ⁻¹)	V (mm/s)	Time t (s)	Stroke St (mm)	Remarks
①	67		100	0.1	10	
②	100		200	0.5	100	
③	65		27.2	7	190	
④	25		10	30	300	
⑤	0		0	10.4	0	
⑥				Total: 48	Total: 600	
⑦						
⑧						
⑨						
⑩						

Main load: Dynamic axial load (Max.)*: 100 (kN) Static axial load (Max.)* (at 0 mm/s): (kN)
 Load in direction opposite main load: Dynamic axial load (Max.)*: 25 (kN) Static axial load (Max.)* (at 0 mm/s): (kN)
 Stroke in normal use: 300 (mm) Maximum stroke: 500 (mm)
 Cycle time: 48 (s) Required life: 40000 (h or cycles)

* If using multiple ball screws, fill out the axial load per ball screw.

4. Durability test

Test conducted in actual machine Yes No

No → Test scheduled (Date: From Mid-March 20XX)
 No → Not scheduled (Reason: _____)

Endurance of the ball screw

- (1) Mounting accuracy, load conditions, and lubricating conditions are the main factors affecting ball screw fatigue life. Therefore, we recommend evaluating the influence of those factors on actual machines.
- (2) Temperature rise caused by operational and environmental conditions may reduce the effectiveness of lubricant.
- (3) Insufficient or incorrect information for the direction or size of loads may lead to premature failure.

NSK Technical Data Sheet for NSK High-Load Drive Ball Screws

Custom-made ball screw

Company name:	Date:	NSK sales office
Section:	Contact person:	
Address:		

Name of machine*1: _____ Application*2: _____

Drawing/rough sketch attached?: Yes No

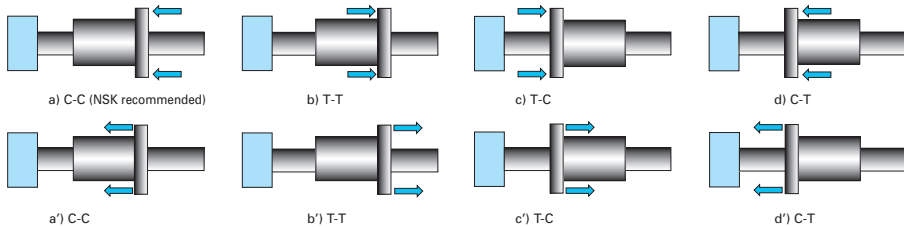
*1 Please specify the capacity of injection molding machines or presses.

*2 Please indicate the axis of injection molding machines (injection, clamping, etc.).

1. Use conditions

Operating conditions	<input type="checkbox"/> Shaft rotation — Moving nut	<input type="checkbox"/> Normal operation	Degree of vibration/impacts	<input type="checkbox"/> Smooth operation without impacts
	<input type="checkbox"/> Shaft rotation — Moving shaft	<input type="checkbox"/> Back drive operation		<input type="checkbox"/> Normal operation
Direction of load*3	<input type="checkbox"/> Per image below	<input type="checkbox"/> Other ()	Mounting orientation	<input type="checkbox"/> Horizontal
				<input type="checkbox"/> Vertical (Indicate direction of gravity)
Lubricant	<input type="checkbox"/> Grease (Brand name:) <input type="checkbox"/> Oil (Maker:)		Lubricant replenishment method	<input type="checkbox"/> Manual (grease gun, etc.)
Oil holes	<input type="checkbox"/> Per NSK recommendations <input type="checkbox"/> Yes <input type="checkbox"/> No			<input type="checkbox"/> Automatic (cm ² / cycles)
Seals	<input type="checkbox"/> Yes <input type="checkbox"/> No		NSK S1 ball retaining piece	<input type="checkbox"/> Per NSK recommendations <input type="checkbox"/> No
Environment	Temp: °C / °F	Contaminants <input type="checkbox"/> Yes : Particle size (a) 0.1 or less, (b) 0.1 to 0.3, (c) Over 0.3; Material: <input type="checkbox"/> No		
Surface treatment	<input type="checkbox"/> Not required <input type="checkbox"/> Low-temperature chrome plating <input type="checkbox"/> Fluoride low-temperature chrome plating <input type="checkbox"/> Other			
Quantity for mass-production	/Month	/Year	/Lot	Quantity used per machine pcs./machine

*3 Please specify load direction using the images below. (Fixed-shaft side: , Main load:)
Load applied in the opposite direction of the main load indicated by the arrows is defined as "load in direction opposite main load."



*4 Confirm the strength of the ball screw and nut sections for both load in the direction of main load and in the direction opposite the main load.

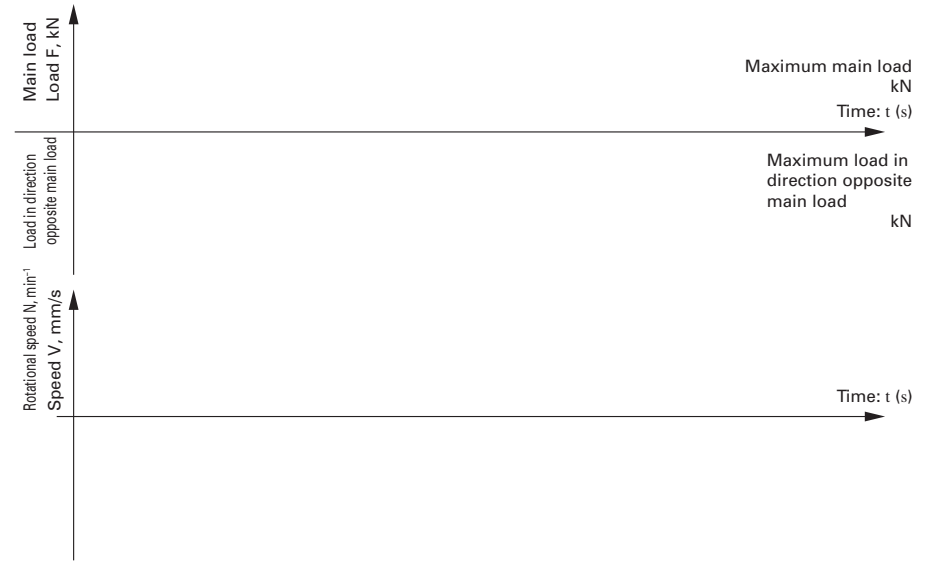
2. Specifications

Shaft diameter	φ mm	Lead	mm	Accuracy grade		Axial play	mm max.
Nut Model No.		Effective ball circuits		Direction of turn		Thread length/ Overall shaft length	/

Special Notes / Requests

NSK Technical Data Sheet for NSK High-Load Drive Ball Screws

3. Load chart (If using multiple ball screws, fill out the axial load per ball screw.)



	Axial load* 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						

Main load	Dynamic axial load (Max.)*: (kN)	Static axial load (Max.)* (at 0 mm/s): (kN)
Load in direction opposite main load	Dynamic axial load (Max.)*: (kN)	Static axial load (Max.)* (at 0 mm/s): (kN)
	Stroke in normal use: (mm)	Maximum stroke: (mm)
	Cycle time: (s)	Required life: (□h or □cycles)

* If using multiple ball screws, fill out the axial load per ball screw.

4. Durability test

Test conducted in actual machine Yes No

No → Test scheduled (Date:)
 No → Not scheduled (Reason:)

Endurance of the ball screw

- (1) Mounting accuracy, load conditions, and lubricating conditions are the main factors affecting ball screw fatigue life. Therefore, we recommend evaluating the influence of those factors on actual machines.
- (2) Temperature rise caused by operational and environmental conditions may reduce the effectiveness of lubricant.
- (3) Insufficient or incorrect information for the direction or size of loads may lead to premature failure.

B-3-3.4.1 VSS Model for Contaminated Environments

1. Features

● High dust-resistance
Specially profiled screw shaft grooves and high performance seals prevent the entry of fine contaminants. Reduces particle penetration rate to less than 1/15 existing standard products.

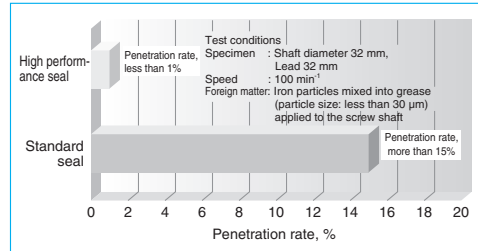


Fig. 1 Particle penetration rate

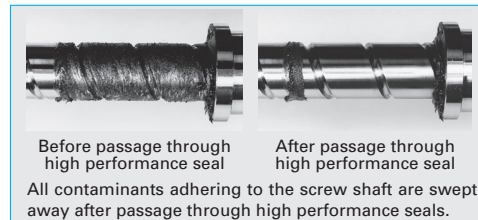


Fig. 2 Contamination before and after particle penetration test

● Long life
High performance seals extend ball screw durability under severely contaminated environments with iron powder. Extreme durability tests under contaminated environments show the durability of the VSS model extends life by more than four times that with a standard seal.

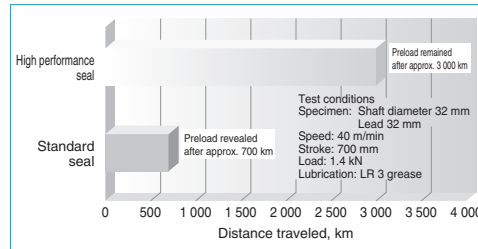


Fig. 3 Extreme durability test results using iron particles

● High speed
For ultimate smoothness of ball recirculation, the internal ball recirculation system enables high-speed operation at a maximum of $d \cdot n$

150 000. Large lead specifications allow high-speeds of 150 m/min.

● Low-noise
Reduces noise by more than 6 dB(A) compared with our conventional tube recirculation ball screws, thereby providing low-noise and good noise tone features.

● Compact size
Ball nut external diameter is up to 25% smaller than our conventional models.

2. Specifications

(1) Ball recirculation system
End-deflector recirculation systems feature high-speed operation with low-noise, and compact ball nut. The structure of recirculation system is shown in Fig. 4.

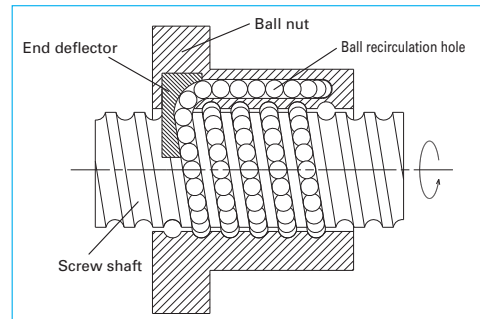


Fig. 4 Structure of end deflector recirculation system

(2) Accuracy grade and axial play
The available standard accuracy grade and axial play are as follows. Please consult NSK for other grades.

Table 1 Accuracy grade and axial play

Accuracy grade	C5
Axial play	Z, 0 mm (preloaded) T, 0.005 mm or less; S, 0.020 mm or less

(3) Allowable $d \cdot n$ value and the criterion of maximum rotational speed

The allowable $d \cdot n$ value and criterion of maximum rotational speed are shown below. Please consult NSK if the rotational speed exceeds the permissible range below.
Allowable $d \cdot n$ value: 150 000 or less
Criterion of maximum rotational speed: 3 000 min^{-1}

Note: Please also review critical speed. See "Technical Description: Permissible Rotational Speed" (page B47) for details.

(4) High performance seal
A high performance seal with special lip that contacts the screw shaft cross-section and prevents entry of fine contaminants.

(5) Lubrication unit
Incorporates NSK K1 lubrication unit to sufficiently lubricate the high performance seal lip, reduce friction, and improve durability.

(6) Options
Non-contact metal protector that traces the ball screw grooves and safeguards the seal against high-temperature foreign matter.

3. Design precautions

When designing the screw shaft end, one end of

the screw must meet either one of the following conditions. If not, we cannot install the ball nut on the screw shaft.

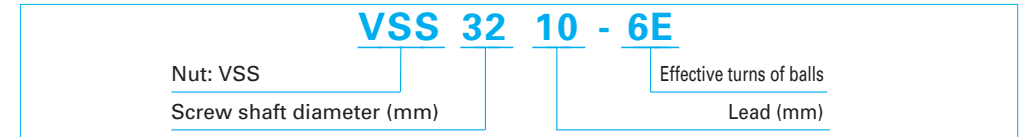
- Cut the ball groove through to the shaft end.
- The diameters of bearing journals and the gear or pulley seat must be less than the root diameter of ball groove d , specified in the dimension tables.

High performance seals may increase torque, which may in turn increase temperature. Please inform NSK about your service conditions using the technical data sheet on page B526. For general precautions regarding ball screws, refer to "Design Precautions" (page B83) and "Handling Precautions" (page B103).

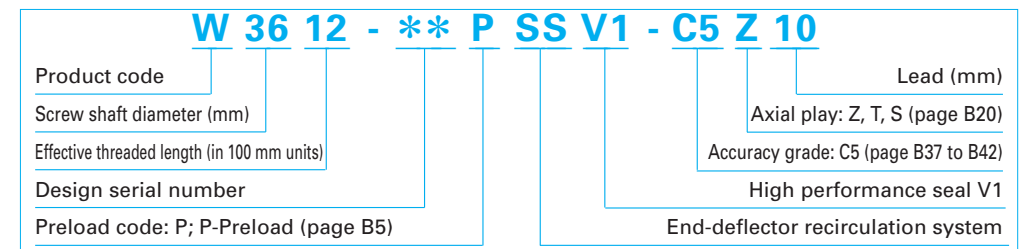
4. Structure of model number and reference number

The following explains the codes used in model numbers and ball screw reference numbers.

◇ Model number



◇ Reference number for ball screws

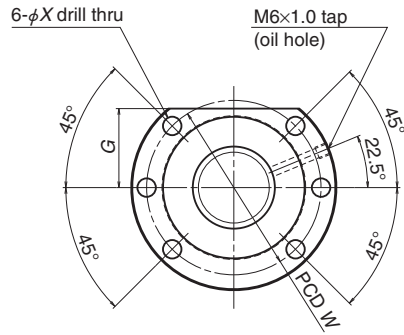


5. Handling Precautions

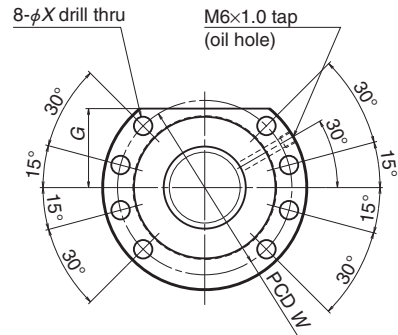
Maximum operating temperature: 50°C
Maximum momentary operating temperature: 80°C
Chemical precautions: Never expose the ball screw to grease-removing organic solvents such as hexane or thinner. Never immerse the ball screw in kerosene or rust preventive oils which contain kerosene.

The data shown in the catalogs are the results of our tests, and no warranty is given to sealing performance on actual usage on machinery. Sealing performance is affected by usage environment and lubrication conditions. Dust covers and other measures to keep machinery free of dust are recommended.

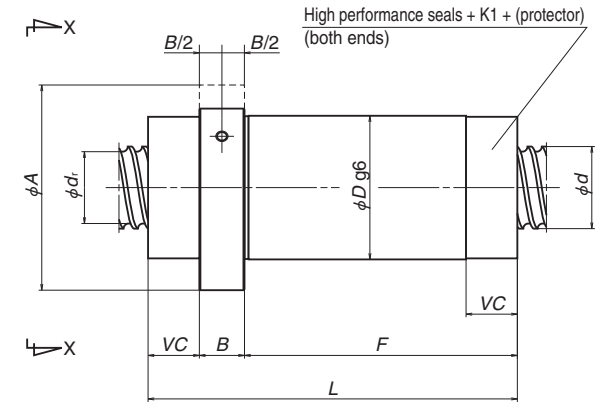
View X-X



Screw shaft diameter $d = 32$ mm



Screw shaft diameter $d \geq 40$ mm



Model No.	Shaft dia. d	Lead l	Root dia. d_r	Effective ball turns	Basic load ratings (N)		Axial rigidity K (N/ μ m)
					Dynamic C_a	Static C_{0a}	
VSS3210-6E	32	10	27.2	6	50 900	110 000	720
VSS3216-5E		16		5	44 300	90 800	600
VSS3220-5E		20		5	43 900	91 200	596
VSS3232-4E		32		4	32 100	65 800	421
VSS4040-4E	40	40	34.4	4	42 900	94 300	513
VSS5050-4E	50	50	44.4	4	47 400	117 000	606

Notes: 1. Right-turn screws are standard. Contact NSK for left-turn screws.

2. Values for axial rigidity K above are theoretical values obtained from the elastic deformation between the screw groove and ball when preload is 1.5% of the basic dynamic load rating C_a and axial load is applied. Refer to the "Technical Description" on page B37 if axial load and preload differ from the conditions above or if deformation of the ball nut body must be considered.

3. Products with clearance (axial play) may have partially negative clearance (preload) depending on the screw length. Refer to page B20 for details.

Unit: mm

Ball nut dimensions									Maximum shaft length
Nut total length L	Nut outside diameter D	Flange outside diameter A	Flange width B	Nut length F	Notch dimensions G	Seal installation dimensions VC	Bolt hole PCD W	Bolt hole dimensions X	
132	56	86	18	89.5	34	24.5	71	9	2 800
150				107.5					
169				126.5					
122				79.5					
144	70	100	22	94.5	38.5	27.5	85	9	3 800
164	82	118	22	114.5	46	27.5	100	11	5 000

B-3-3.4.2 Ball Screws with X1 Seals for Contaminated Environments and Grease Retention

1. Features

● High dust resistance

Particle penetration ratio reduced to less than 1/30 existing standard seals, thus contributing to longer service life for machine tools.

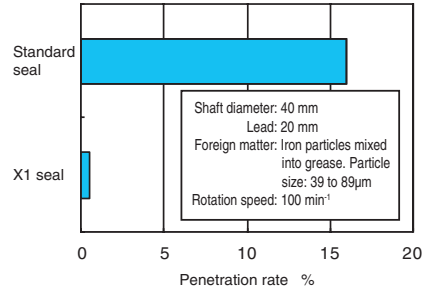


Fig. 1 Results of particle penetration rate test

● Superior grease retention

Automatically adding grease makes it possible to reduce the amount used and keep it from spattering.

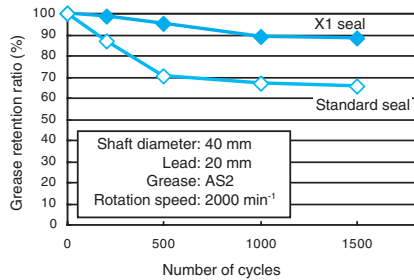


Fig. 2 Results of grease leakage test

● Contact seal with low torque

Optimizing the seal shape reduces torque and enhances seal performance.

2. Specifications

(1) Structure

The ball screw with X1 seals has a double seal structure combining a dust-resistant seal and a grease-retaining seal.

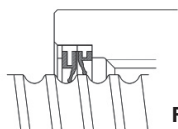


Fig. 3 Seal structure

(2) Scope of application

This model is standard for the following four types.

Ball screws for high-speed machine tools	HMS model	Nut: ZFRC
	HMD model	Nut: EM
	BSS model	Nut: BSS
	Deflector (bridge) recirculation	Nut: ZFD

For specifications other than above, please consult NSK. Table 1 shows the minimum nut outer diameter on which X1 seals can be mounted.

Table 1 The minimum nut outer diameter on which X1 seals can be mounted

Shaft diameter: 28 mm	60 mm
Shaft diameter: 32 mm	56 mm (58 mm)
Shaft diameter: 36 mm	70 mm
Shaft diameter: 40 mm	70 mm (68 mm)
Shaft diameter: 45 mm	82 mm
Shaft diameter: 50 mm	82 mm (78 mm)

Values in parentheses are applicable to the deflector (bridge) recirculation.

(3) Accuracy grade / axial play

Table 2 shows standard tolerance classes and axial clearances. Please consult NSK for tolerance classes other than those in the table.

Table 2 Accuracy grade and axial play

Accuracy grade	C3, C5
Axial play	0 mm (preloaded)

(4) Design-related precautions

When designing the screw shaft end, assume that the end of the screw shaft is cut.

The temperature will increase somewhat when torque is applied if an X1 seal is attached. Please inform NSK about your service conditions using the technical data sheet on page B526. Maximum overall shaft length is 2900 mm.

For general precautions regarding ball screws, refer to "Design Precautions" (page B83) and "Handling Precautions" (page B103).

Right-turn screws are the standard. For specifications on left-turn screws, contact NSK.



HMS model



HMD model



End deflector recirculation



Deflector (bridge) recirculation

Fig. 4 External appearance

3. Example reference number

The following explains the codes used in ball screw reference numbers.

◇Reference number for ball screws

W4010--ZMX1-C5Z16**

X1 seal equipped ball screw code

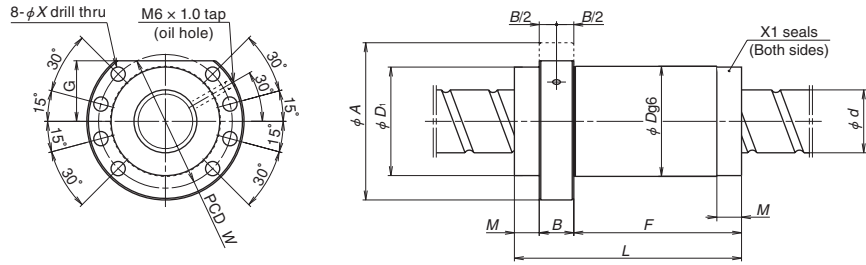
4. Precautions for use

Temperature range for use: Maximum temperature: 60°C (at outside diameter of ball nut)

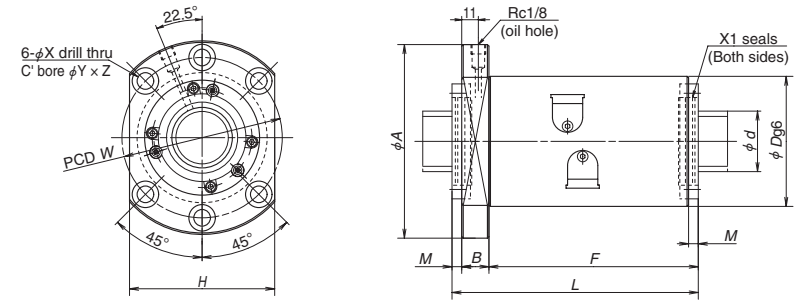
Chemicals to avoid contact with:
Do not leave ball screw in organic solvent, white kerosene such as hexane, thinner which removes oil, or rust preventive oil which contains white kerosene.

The data shown in the catalogs are the results of our tests, and no warranty is given to sealing performance on actual usage on machinery. Sealing performance is affected by usage environment and lubrication conditions. Dust covers and other measures to keep machinery free of dust are recommended.

Ball Screws with X1 Seals for Contaminated Environments and Grease Retention



End deflector recirculation (Nut: BSS)



HMD model (Nut: EM)

Applicable dimensions for End deflector recirculation

Unit: mm

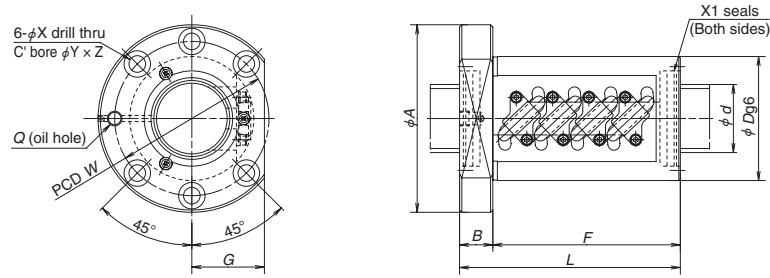
Model No.	Shaft dia. <i>d</i>	Lead <i>l</i>	Basic load ratings (N)		Nut dimensions										Bolt holes					
			Dynamic <i>C_a</i>	Static <i>C_{0a}</i>	<i>L</i>	<i>F</i>	<i>M</i>	<i>B</i>	<i>D</i>	<i>D₁</i>	<i>A</i>	<i>G</i>	<i>X</i>	<i>W</i>						
BSS3205-4E	32	5	16 800	41 700	72	41	19	12	56	55	86	34	9	71						
BSS3210-6E		10	50 900	110 000	114	80.5	15.5	18		55.5										
BSS3232-4E		32	32 100	65 800	106.5	73				55.4										
BSS3616-10E	36	16	99 100	232 000	140	101	17	22	70	69	100	38.5	9	85						
BSS3620-12E		20	116 000	282 000	175	138	15		70	69	100	38.5								
BSS4010-5E	40	10	58 100	130 000	112	73	17	22	70	69	100	38.5	9	85						
BSS4016-10E		16	105 000	261 000	140	101														
BSS4020-5E		20	57 400	130 000	159	120														
BSS4020-10E		20	104 000	260 000																
BSS4030-6E		30	74 500	168 000	129	101									6	80	76	110	43.5	95
BSS4040-4E		40	42 900	94 300	117	81									14	70	69	100	38.5	85
BSS5010-4E	50	10	52 600	129 000	102	63	17	22	82	81	118	46	11	100						
BSS5020-8E		20	94 700	259 000	139	100			82	81	118	46								
BSS5050-4E		50	64 100	147 000	140	105			13	90	85	135			51	11	112			

Applicable dimensions for HMD model

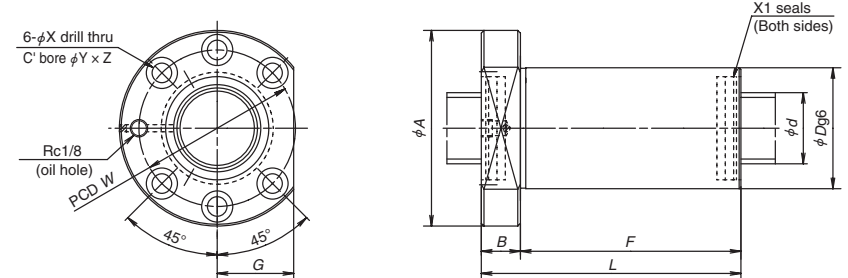
Unit: mm

Model No.	Shaft dia. <i>d</i>	Lead <i>l</i>	Basic load ratings (N)		Nut dimensions										Bolt holes			
			Dynamic <i>C_a</i>	Static <i>C_{0a}</i>	<i>L</i>	<i>F</i>	<i>M</i>	<i>B</i>	<i>D</i>	<i>A</i>	<i>H</i>	<i>X</i>	<i>Y</i>	<i>Z</i>	<i>W</i>			
EM2812-3E	28	12	20 900	38 800	115	85.5	11.5	18	65	99	76	9	14	8.5	81			
EM4016-4E	40	16	66 900	131 000	172	148	6	18	86	128	96	11	17.5	11	106			
EM4020-6E		20	77 900	166 000	164	139	7											
EM4030-6E	45	30	90 400	190 000	226	201.5	6.5	18	92	134	102	11	17.5	11	112			
EM4516-4E		16	69 900	146 000	173	148.5	6.5											
EM4520-6E	50	20	83 200	187 000	164	139	7	18	98	140	107	11	17.5	11	118			
EM5016-4E		16	72 700	161 000	173	148.5	6.5											
EM5020-6E		20	85 700	205 000	164	139	7											
EM5025-6E		25	103 000	232 000	196	171												
EM5030-6E	30	102 000	235 000	227	202	7	18	98	140	107	11	17.5	11	118				

X1 seals



HMS model (Nut: ZFRC)



Deflector (bridge) recirculation (Nut: ZFD)

Applicable dimensions for HMS model

Unit: mm

Model No.	Shaft dia. <i>d</i>	Lead <i>l</i>	Basic load ratings (N)		Nut dimensions										Oil hole <i>Q</i>
			Dynamic <i>C_a</i>	Static <i>C_{0a}</i>	<i>L</i>	<i>F</i>	<i>B</i>	<i>D</i>	<i>A</i>	<i>G</i>	Bolt holes				
											<i>X</i>	<i>Y</i>	<i>Z</i>	<i>W</i>	
ZFRC2812-7	28	12	26 100	50 200	141	122	19	60	88	33	6.6	11	10.5	73	M6×1
ZFRC3205-10	32	5	21 800	56 000	107	87	20	58	85	32	6.6	11	6.5	71	M6×1
ZFRC4010-10	40	10	61 200	137 000	173	151	22	82	124	47	11	17.5	11	102	Rc1/8
ZFRC4012-10		12	71 700	154 000	197	175		86	128	48				106	Rc1/8
ZFRC4508-10	45	8	44 000	118 000	146	124	22	82	124	47	11	17.5	11	102	Rc1/8
ZFRC5010-10	50	10	68 100	174 000	174	151	23	93	135	51	11	17.5	11	113	Rc1/8
ZFRC5012-10		12	91 500	218 000	200	177		100	146	55				14	20

Applicable dimensions for Deflector (bridge) recirculation

Unit: mm

Model No.	Shaft dia. <i>d</i>	Lead <i>l</i>	Basic load ratings (N)		Nut dimensions												
			Dynamic <i>C_a</i>	Static <i>C_{0a}</i>	<i>L</i>	<i>F</i>	<i>B</i>	<i>D</i>	<i>A</i>	<i>G</i>	Bolt holes						
											<i>X</i>	<i>Y</i>	<i>Z</i>	<i>W</i>			
ZFD3210-8	32	10	28 600	58 600	150	130	20	58	92	36	9	14	8.5	74			
ZFD4005-12	40	5	26 500	78 300	119	97	22	68	102	40	9	14	8.5	84			
ZFD4006-12		6	35 600	95 200	135	113											
ZFD4008-8		8	32 000	75 000	131	109											
ZFD4010-8		10	45 200	93 100	153	131									11	17.5	11
ZFD4012-8		12	52 300	103 000	177	155											
ZFD5010-8		50	10	51 500	122 000	154									131	23	78
ZFD5020-6	20		52 400	109 000	199	176											

X1 seals

NSK Data Sheet for Ball Screws in Contaminated Environments
 [Example] (Please copy) 1/1

Model: Washing machine Location: Workpiece transfer axis

1. Operating Conditions

Operating Conditions	a) Shaft rotation – nut moving b) Shaft rotation – shaft moving c) Nut rotation – nut moving d) Nut rotation – shaft moving	Stroke in Normal Use	400 [mm] (Please indicate operating pattern)
		Mounting Orientation	a) Vertical b) Horizontal
Lubricant	a) Grease (Brand: AS2) b) Oil (Brand:)	Lubricating Method	a) Automatic b) Grease gun (cm ³ / min)
Operating Duration	years 6 months	Axial play: 0.1 mm	Seal: standard /

2. Ball Screw Environment (Accessories & Contamination)

Contaminant	Iron particles and washing solution	Contaminant Size	Particle size 30 µm max. -
Cause of Contamination	Does not fall directly on it, but there is a possibility that it could happen. (Please reference with photographs)		
Countermeasures (For already assembled parts, complete after inspection)	a) Telescopic cover -b) Bellow -c) Dust collector -d) Dust-resistant lubricant e) Other () (Please supply drawings to demonstrate dust countermeasures)		

3. Ball Screw Dimensions

Screw Shaft Diameter	Φ 32	Lead	5 mm	Accuracy Grade	C5	Axial Play	Z
Nut	ZFRC	Effective ball turns	2.5×2	Direction of Turn	Right	Screw/Overall Length	510 / 750

Remarks
Request X1 seal

4. Durability Test

Durability test → Scheduled Scheduled to perform functional evaluation for about 2 months.
 → Not scheduled (Reason:)

Ball Screw Use in Contaminated Environments
 ※Please read the below and tick the relevant boxes

The results for evaluation tests carried out by NSK for dust-resistant seals represent an example under set testing conditions (foreign matter and operating conditions). Seals may be unable to completely prevent contamination under actual conditions and life may be affected by the environment, lubrication conditions, etc.

Dust-resistant accessories (covers, lubrication, collectors, etc.) are required in addition to the seals to improve wear life in contaminated environments.

Ball screw wear life is greatly impacted by foreign matter entering the nut, offset load from misalignment, and lubricating conditions. The customer is responsible for evaluating and checking final durability in the actual machine.

Company Name:	Date:	NSK Ltd. Sales Representative	NSK Ltd. Sales Manager
Department:	Name:	Sign	Sign
Address:	Tel:	Fax:	

NSK Data Sheet for Ball Screws in Contaminated Environments
 (Please copy) 1/1

Model: _____ Location: _____

1. Operating Conditions

Operating Conditions	a) Shaft rotation – nut moving b) Shaft rotation – shaft moving c) Nut rotation – nut moving d) Nut rotation – shaft moving	Stroke in Normal Use	[mm] (Please indicate operating pattern)
		Mounting Orientation	a) Vertical b) Horizontal
Lubricant	a) Grease (Brand:) b) Oil (Brand:)	Lubricating Method	a) Automatic b) Grease gun (cm ³ / min)
Operating Duration	years months	Axial play: mm	Seal: standard /

2. Ball Screw Environment (Accessories & Contamination)

Contaminant		Contaminant Size	Particle size -
Cause of Contamination	(Please reference with photographs)		
Countermeasures (For already assembled parts, complete after inspection)	a) Telescopic cover b) Bellow c) Dust collector d) Dust-resistant lubricant e) Other () (Please supply drawings to demonstrate dust countermeasures)		

3. Ball Screw Dimensions

Screw Shaft Diameter	φ	Lead	mm	Accuracy Grade		Axial Play	
Nut		Effective ball turns		Direction of Turn		Screw/Overall Length	/

Remarks

4. Durability Test

Durability test → Scheduled
 → Not scheduled (Reason:)

Ball Screw Use in Contaminated Environments
 ※Please read the below and tick the relevant boxes

The results for evaluation tests carried out by NSK for dust-resistant seals represent an example under set testing conditions (foreign matter and operating conditions). Seals may be unable to completely prevent contamination under actual conditions and life may be affected by the environment, lubrication conditions, etc.

Dust-resistant accessories (covers, lubrication, collectors, etc.) are required in addition to the seals to improve wear life in contaminated environments.

Ball screw wear life is greatly impacted by foreign matter entering the nut, offset load from misalignment, and lubricating conditions. The customer is responsible for evaluating and checking final durability in the actual machine.

Company Name:	Date:	NSK Ltd. Sales Representative	NSK Ltd. Sales Manager
Department:	Name:	Sign	Sign
Address:	Tel:	Fax:	

B-3-3.5 Twin-Drive Ball Screws

(1) Features

Variations in the lead accuracy and preload torque between two ball screws, which make up a twin-drive unit, are controlled, improving travel accuracy and ball screw operating lifetime.

Fig. 1 shows measured variation in lead accuracy while Fig. 2 displays an example of variation in thermal expansion between the two ball screws.

Fig. 3 is a schematic diagram comparing the travel accuracy between a twin-drive ball screw and conventional model.

● High rigidity and long lifetime

Twin-drive systems are superior to single-drive systems in system rigidity, supporting the design of the long-life feeding mechanism, even at one size smaller shaft diameter.

● High responsiveness to positioning commands
Twin-drive systems permit the use of screw shaft diameters that are one size smaller, thereby reducing screw shaft inertia by up to 50%, offering high responsiveness to positioning commands.

● Improved high-speed capability and noise level
Twin-drive systems allow the use of smaller screw diameters, resulting in no increase in the level of noise. The end-deflector recirculation system significantly improves high-speed capability and noise levels compared with existing tube recirculation systems, offering high-speed feeding of up to 1 200 mm/min (shaft dia. 40 mm, lead 30 mm, rotational speed 4 000 min⁻¹).

(2) Specifications

Table 1 Specifications of twin-drive systems

Item	End-deflector, Tube, Deflector (bridge)
Shaft dia.	32 – 63 mm
Lead	10 – 30 mm
Accuracy grade	C5
Screw shaft length	3 m or less

(3) Optional specifications

- Hollow shaft ball screw and nut-cooled ball screw
- Provides high accuracy through the use of forced cooling. Please refer to ball screws for high precision machine tools (page B528 to B538) for more details.

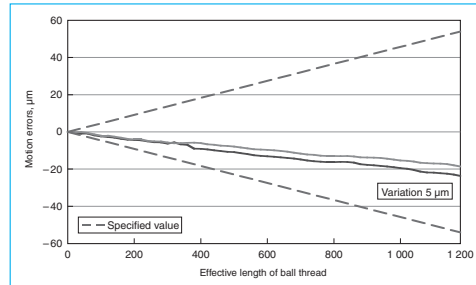


Fig. 1 Example of measured variation in lead accuracy

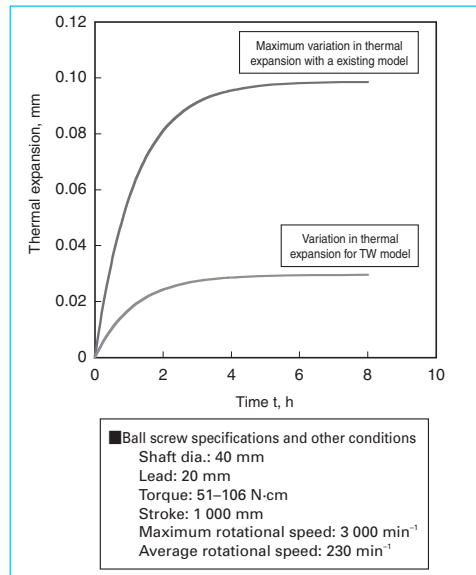


Fig. 2 Calculation example of the variation of thermal expansion

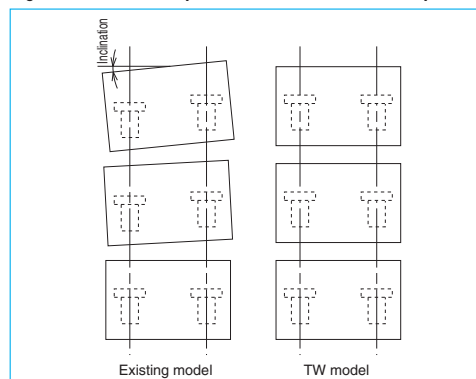


Fig. 3 Schematic diagram of travel accuracy

B-3-3.6.1 Hollow Shaft Ball Screws for High Precision Machine Tools

The increase in speed of the feeding mechanism for highly accurate positioning may require some measures against thermal expansion of the ball screw (forced cooling using hollow ball screw). NSK standardized hollowed screw shafts and shaft end configurations (sealing section and support bearing seat). NSK recommends this as the most effective measure against thermal expansion.

1. Features

● Stable positioning accuracy
Suppresses expansion of the ball screw shaft by rising temperature, and provides stable, precise positioning.

● Prevents displacement of various sections
Minimizes deformation of the ball screw support bearings as well as machine base caused by thermal expansion of the ball screw. Forced cooling keeps heat from spreading to other sections, and prevents the processing table from deforming due to heat.

● Reduces warm-up time
Temperature does not rise high, therefore shortening the machine warm-up period.

● Maintains lubricant's effect
Removes heat from the ball screw, deterring lubricant deterioration.

● Easy design for installation
Uses a specialized bearing support unit for NSK ball screws (high speed and high load capacity support unit for machine tools, see page B393) and seal unit (page B531) on the standardized shaft end. This makes designing for mounting easy.

NSK also provides nut-cooled ball screws. The

3. Structure of model no.

The following explains the codes used in model numbers:

◇ Example model no.

Screw shaft model H	H 32 - 10	Hollow bore (mm)
		Screw shaft diameter (mm)

level of temperature rise for nut-cooled ball screw is equal to hollow shaft ball screw thanks to the optimized nut internal design for cooling. Please refer to nut-cooled ball screws (page B533) for more details.

2. Design precautions

Refer to the HMC model, end-deflector recirculation system, tube recirculation system, and deflector (bridge) recirculation system for ball screw specifications. If the overall ball screw length exceeds 3 000 mm, contact NSK. For general precautions regarding ball screws, refer to "Design Precautions" (page B83) and "Handling precautions" (page B103).

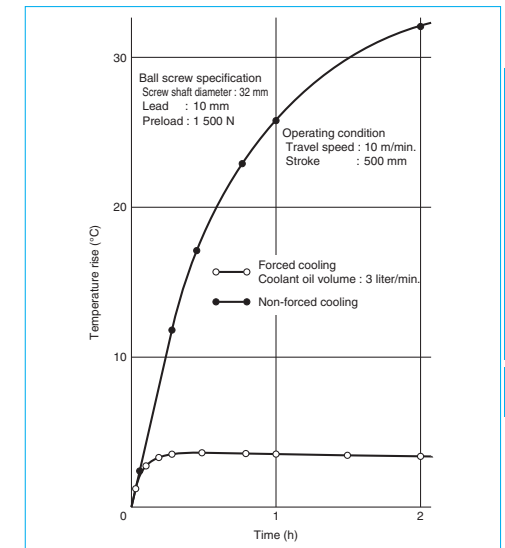
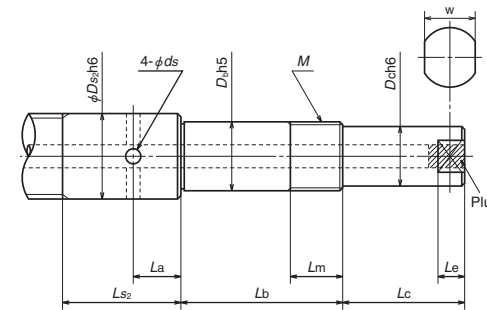
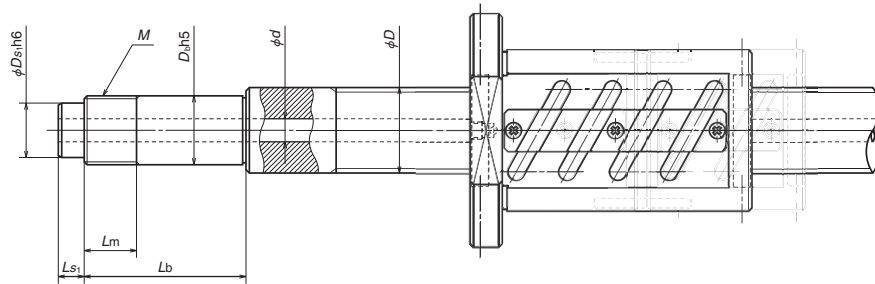
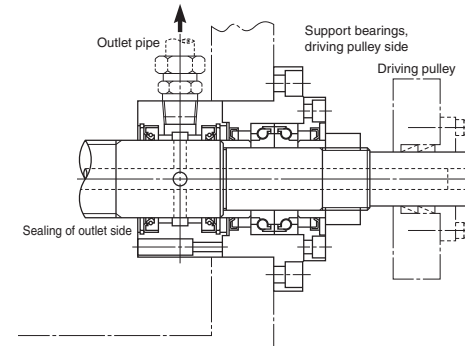
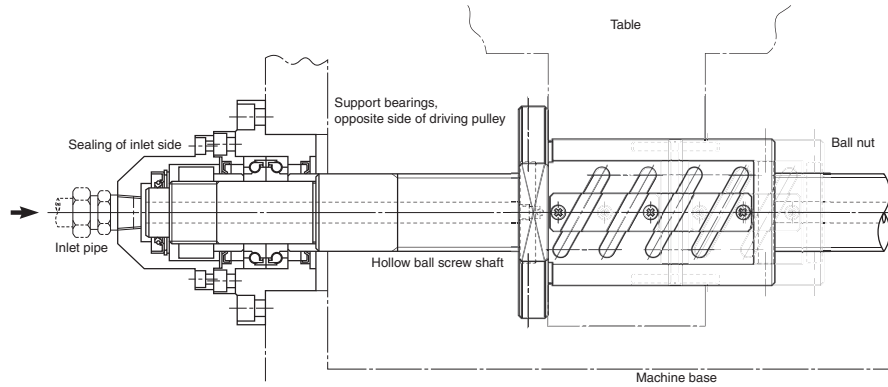


Fig. 1 Effect of forced cooling by hollow shaft ball screw

4. Installation example and standard dimensions



Model No.	Screw shaft		Bearing seat				Sealing					
	Outside dia. D	Bore dia. d	Outside dia. D_b	Lock nut			Inlet		Outlet			
				M	L_m	L_b	D_{s1}	L_{s1}	D_{s2}	L_{s2}	L_a	ds
H32-10	32	10	25	M25×1.5	26	89	20	15	32	60	25	6
						104						
						119						
H40-12	40	12	30	M30×1.5	26	89	25	15	40	60	25	7
						104						
						119						
H50-15	50	15	40	M40×1.5	30	92	32	15	50	65	27	8
						107						
						122						

Notes: 1. Please consult NSK for other models.
2. See B404 for bearing arrangement codes.

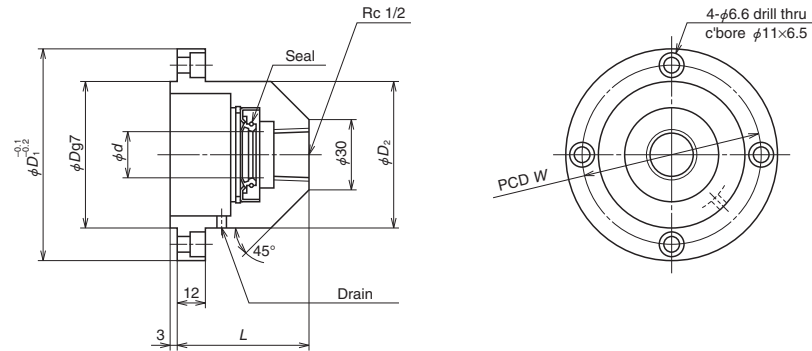
Drive side		Spanner flats		Applicable support unit	Applicable bearing	Equipped seal unit	
D_c	L_c	w	L_e			Shaft end	Shaft outer surface
20	40	17	8	WBK25DF-31H	25TAC62CSUHPN7C DF arrangement	WSK20A-01	WSK32B-01
				WBK25DFD-31H	25TAC62CSUHPN7C DFD arrangement (25TAC62CSUHPN7C DFF arrangement)		
25	50	22	10	WBK30DF-31H	30TAC62CSUHPN7C DF arrangement	WSK25A-01	WSK40B-01
				WBK30DFD-31H	30TAC62CSUHPN7C DFD arrangement (30TAC62CSUHPN7C DFF arrangement)		
35	70	30	13	WBK40DF-31H	40TAC72CSUHPN7C DF arrangement	WSK32A-01	WSK50B-01
				WBK40DFD-31H	40TAC72CSUHPN7C DFD arrangement		
				WBK40DFD-31H	40TAC72CSUHPN7C DFF arrangement		

Unit: mm

5. Seal units for hollow ball screw shafts (available by order)

This is an exclusive joint for coolant for the hollow ball screw shaft.

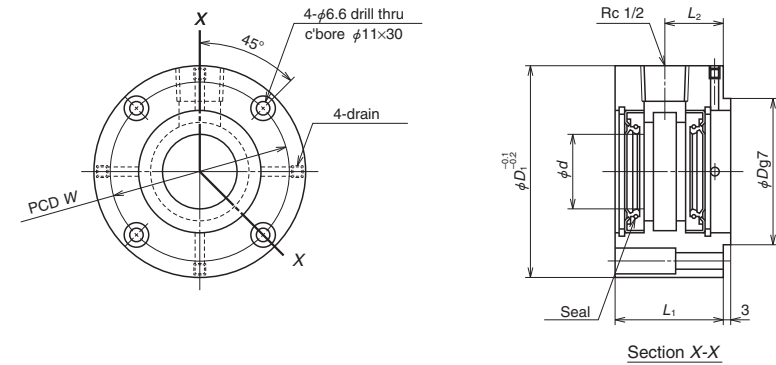
A Type (for shaft end)



Unit: mm

Reference No.	d	D	D_1	D_2	L	W	Fixing bolt
WSK20A-01	20	57	85	57	56	70	M6
WSK25A-01	25	57	85	57	56	70	M6
WSK32A-01	32	69	95	67	61	80	M6

B Type (for shaft outer surface)



Unit: mm

Reference No.	d	D	D_1	L_1	L_2	W	Fixing bolt
WSK32B-01	32	57	85	46	25	70	M6
WSK40B-01	40	57	85	46	25	70	M6
WSK50B-01	50	69	95	49	27	80	M6

◇ Handling precautions

- Use NSK support units (high speed and high load capacity support units for machine tools on page B393) for installation in order to maintain the eccentricity between screw shaft and seal unit.

- Apply grease to the lip section for protection at the time of installation to the ball screw.
- Make certain that the drain holes (one for A Type, four for B Type) of the seal unit directly face downward when the unit is installed.

B-3-3.6.2 Nut-Cooled Ball Screws for High Precision Machine Tools

Nut-cooled ball screws are easily cooled with a ball nut cooling system and are ideal for use in high-speed and high-precision machine tools that have nut cooling systems.

Using nut-cooled ball screws makes it possible to cool long ball screws that are difficult to cool with hollow-core cooling, and they accommodate the broad high-precision needs of machine tools both small and large.

1. Features

● Cooling effects

By optimizing the cooling structure inside the nut, cooling capacity equivalent to hollow shaft cooling has been achieved. The nut in contact with the table is cooled, so that heat conduction from the table to the ball screw is blocked. Moreover, by cooling the hollow shaft in parallel, the screw shaft and ball nut can be cooled at the same time for even more precise temperature control.

● Internal design in consideration of preload torque change

The nut-cooled ball screw has double contact-point preload in the tensile direction. This prevents an increase in preload torque when the nut is cooled, enabling effective cooling of the ball screw.

◇Reference number for nut-cooled ball screws

W4012-ZMNC-C5Z20**

Nut-cooled ball screw code

● Cooling structure

The cooling fluid goes in a balanced way through the nut.

● Improved handling

Ball screws can be cooled by simply attaching piping to the exterior flange part.* Sliding seals and rotary joints for hollow shaft cooling are not needed. Dimensions for mounting area (without nut cooling) are the same as conventional products, so the nut cooling can be implemented without changing machine designs.

● Long ball screws can be cooled at a low cost

Since these products are suitable for long ball screws for which hollow hole processing is difficult, improved precision of large machine tools can be achieved at a low cost.

2. Design precautions

If heat from the bearing is too great, separate cooling for the bearing and surrounding areas is recommended. For details, please contact NSK.

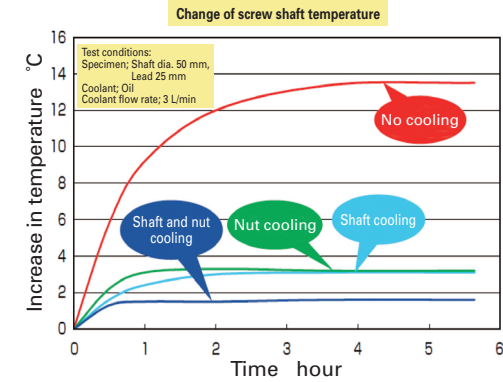


Fig. 1 Effect of forced cooling by nut-cooled ball screw

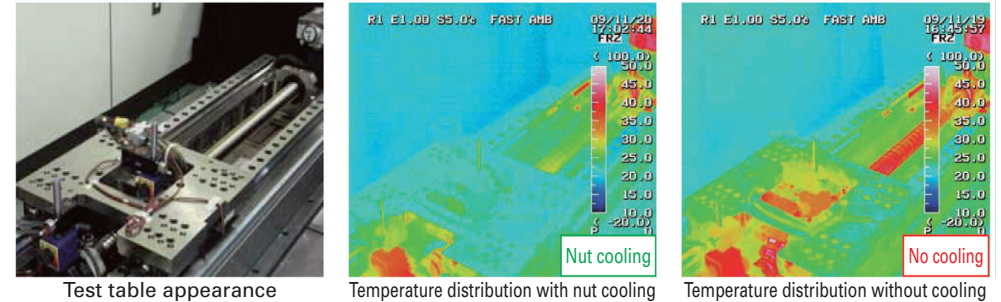


Fig. 2 Effect of forced cooling by nut-cooled ball screw

Cooling structure

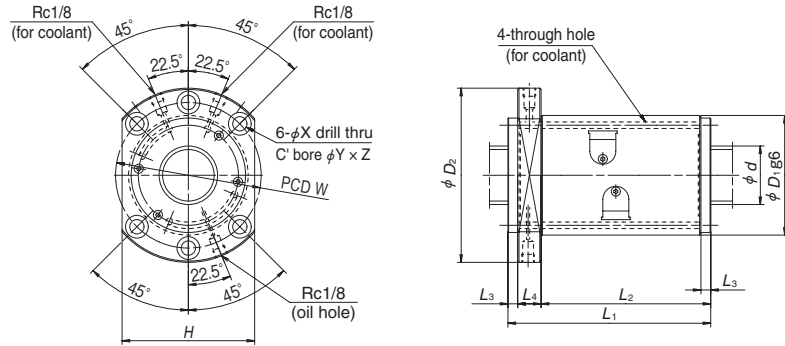


Single nut

Fig. 3 Cooling structure of a nut-cooled ball screw

Nut-Cooled Ball Screws: Dimension Tables

● Nut-cooled ball screws (for HMD model, nut: EM)

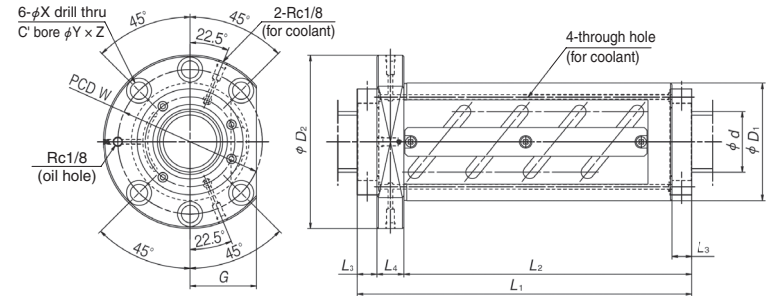


Applicable dimensions for HMD model

Unit: mm

Model No.	Shaft dia. <i>d</i>	Lead <i>l</i>	Nut dimensions										
			<i>D</i> ₁	<i>D</i> ₂	<i>H</i>	<i>L</i> ₁	<i>L</i> ₂	<i>L</i> ₃	<i>L</i> ₄	<i>W</i>	<i>X</i>	<i>Y</i>	<i>Z</i>
EM4016-4E	40	16	86	128	96	166	140.5	7.5	18	106	11	17.5	11
EM4020-6E		20				156	130.5						
EM4025-6E		25				188	162.5						
EM4030-6E		30				219	193.5						
EM4516-4E	45	16	92	134	102	166	140.5	7.5	18	112	11	17.5	11
EM4520-6E		20				156	130.5						
EM4525-6E		25				188	162.5						
EM5016-4E	50	16	98	140	107	166	140.5	7.5	18	118	11	17.5	11
EM5020-6E		20				156	130.5						
EM5025-6E		25				188	162.5						
EM5030-6E		30				219	193.5						
EM6316-4E	63	16	122	180	138	176	139	9	28	150	18	26	17.5

● Nut-cooled ball screws (tube recirculation, nut: ZFT)



Dimensions for tube recirculation

Unit: mm

Model No.	Shaft dia. <i>d</i>	Lead <i>l</i>	Nut dimensions										
			<i>D</i> ₁	<i>D</i> ₂	<i>L</i> ₁	<i>L</i> ₂	<i>L</i> ₃	<i>L</i> ₄	<i>G</i>	<i>W</i>	<i>X</i>	<i>Y</i>	<i>Z</i>
ZFT5010-15	50	10	93	135	243	205	10	18	51	113	11	17.5	11
ZFT5012-10		12	100	146	219	173	12	22	55	122	14	20	13
ZFT5016-10		16	100	146	280	226	16	22					
ZFT5020-6		20	100	146	257	189	20	28					
ZFT5510-10	55	10	102	144	183	145	10	18	54	122	11	17.5	11
ZFT6310-15	63	10	108	154	247	205	10	22	58	130	14	20	13
ZFT6312-10		12	115	161	219	173	12	22	61	137	14	20	13
ZFT6316-10		16	122	180	272	226	16	28	69	150	18	26	17.5
ZFT6320-10		20	122	180	347	279	20	28					
ZFT8010-10	80	10	130	176	187	145	10	22	66	152	14	20	13
ZFT8012-10		12	136	182	219	173	12	22	68	158	14	20	13
ZFT8016-10		16	143	204	286	226	16	28	77	172	18	26	17.5
ZFT8020-10		20	143	204	343	275	20	28					
ZFT10012-10	100	12	160	220	225	173	12	28	82	188	18	26	17.5
ZFT10016-10		16	170	243	286	226	16	32	91	205	22	32	21.5
ZFT10020-10		20	170	243	347	275	20	32					

B-3-3.6.3 Ball Screws for High-Accuracy Machine Tools

In typical ball screws, when the drive system reverses direction, the motor cannot maintain proper tracking for the resulting sudden changes in friction characteristics (driving torque). This causes motion errors called “quadrant glitches” that leave streaks on the surface of the workpiece requiring additional machining. When using ball screws with offset preload and double nut preload, quadrant glitches appear as two error peaks.

Though this problem was thought to be unavoidable, these ball screws with quadrant glitch control eliminate the “low torque area” characteristic of typical designs. This advancement completely erases the 2nd peak and improves surface finish quality through smooth motion.

1. Features

- Improve surface finish quality
Controlling the 2nd peak with the ball screw itself allows the servo controller to better correct for the 1st peak. As there’s no need to correct for the 2nd peak, control parameters can be identified more easily, greatly reducing quadrant glitches overall. With simplified controller compensation, machine tools can achieve a higher quality finished surface.
- Compatible with Existing Mountings
Mountings are fully interchangeable with those of conventional products, allowing ball screws for high-accuracy machine tools to be used without costly equipment changes.

2. Specifications

Table 1 Specifications of Ball Screws for High-Accuracy Machine Tools

Recirculation System	All
Preload Type	<ul style="list-style-type: none"> • Offset preload (Z preload) • Double-nut preload (D preload) • Spring double-nut preload (J preload)
Shaft Dia.	25 - 63 mm
Lead	Lead / Shaft Dia. $\leq 1/2$
Accuracy Grade	C0 - C5

Note: Some configurations are not available.

Please contact NSK for details.

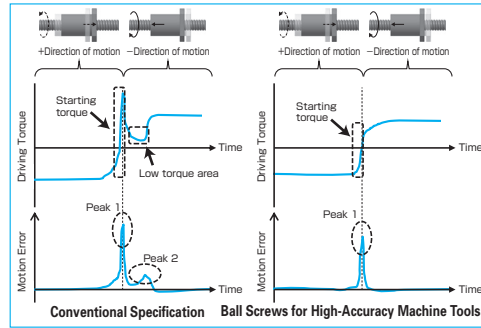


Fig. 1 Motion error and drive torque when reversing direction (schematic)

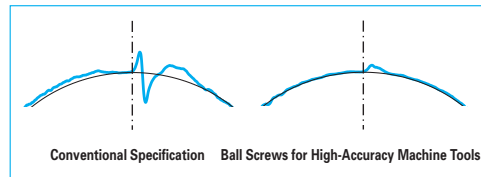


Fig. 2 Motion error during circular interpolation machining (with servo controller compensation, schematic)

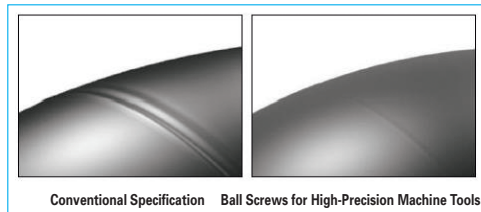


Fig. 3 Enlarged view of machined surface (representation)

3. Design Precautions

Machined surface quality is affected by various factors. This product is designed to improve surface quality by suppressing the 2nd peak of quadrant glitches that occur when using ball screws with offset preload or double-nut preload. This product may not improve the quality of machined surfaces affected by other factors.

The relationship between preload, dynamic preload torque, and nut rigidity for this product is different than that for conventional ball screws.

Please contact NSK for details.

B-3-3.6.4 High-Durability Precision Ball Screws

High-durability precision ball screws use NSK’s exclusive surface-processing technology to improve the formation of the lubricating oil film on the surface of the ball screw raceway. This helps suppress screw wear, enabling long-term stable operation of equipment and extended periods between maintenance.

1. Features

- Preserves high precision over time
Improved oil film formation helps suppress wear caused by metal-to-metal contact and maintains high precision over long periods. This capability makes high-durability precision ball screws especially suited to low-speed and short-stroke operations where oil film formation is difficult.
- Extended maintenance cycles
Longer accuracy life allows for stable operation of equipment long-term, with extended intervals between maintenance.
- Reduced energy consumption
Improved oil film formation reduces dynamic friction torque at low speeds by up to 40% compared to conventional products, helping to save energy.
- Compatible with Existing Mountings
Mountings are fully interchangeable with those of conventional products, allowing high-durability precision ball screws to be used without costly equipment changes.

2. Specifications

Table 1 Available Specifications for High-Durability Precision Ball Screws

Recirculation System	Any
Preload Type	Any
Shaft Dia.	20 - 63 mm
Shaft Length	Up to 3000 mm
Nut Length	Up to 250 mm
Accuracy Grade	Any except C0
Seal	Any
Surface Treatment (Plating, etc.)	None

Please contact NSK for availability of other options.

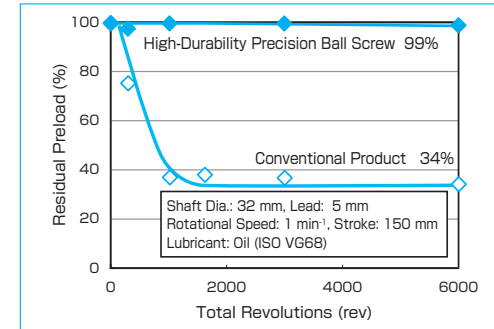


Fig. 1 Low-speed wear test results

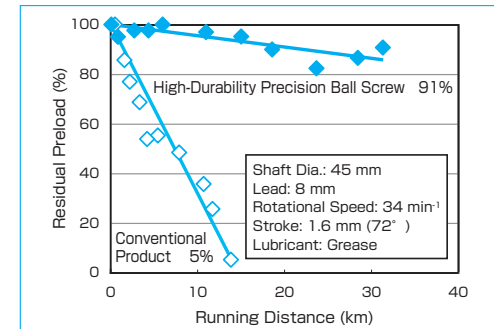


Fig. 2 Short-stroke wear test results

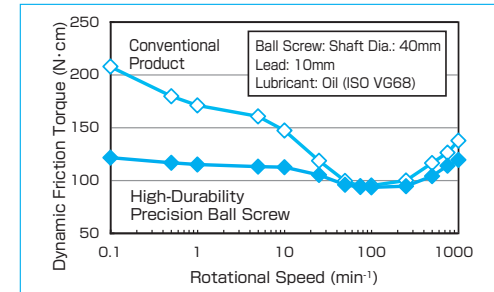


Fig. 3 Test results about rotational speed and dynamic friction torque

Note:

Data shown is based on testing and is not a guarantee of performance in actual equipment. As the accuracy life of ball screws is significantly affected by the operating environment, take measures to protect equipment from dust and contaminants using covers, seals, etc. as necessary.

B-3-3.7 Rotary Nut Ball Screws

A rotary nut ball screw is developed as a unit into which angular contact support ball bearings are integrated. It is best suited for an application that requires rotation of the ball nut while the screw shaft is fixed.

NDT model

1. Structure

Balls are installed between the assembly housing and the ball nut. The outer bearing rings are integrated into the assembly housing and thus, a compact design is attained. A timing pulley (prepared by the user) is directly secured to the end face of the nut.

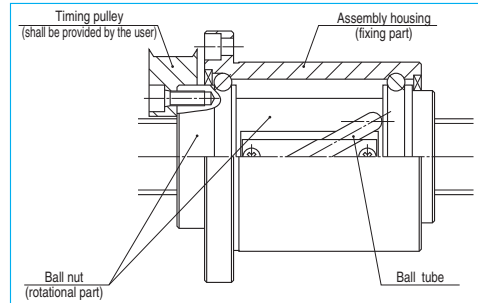


Fig. 1 Ball nut structure

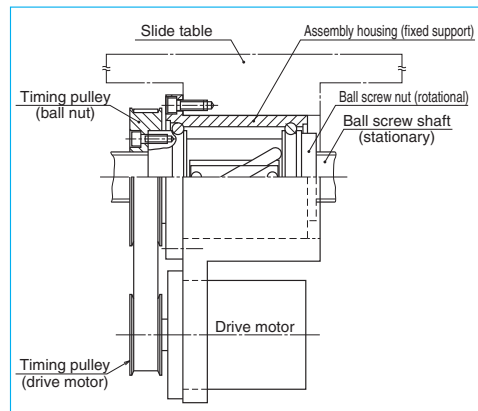


Fig. 2 Example of installation to the slide

2. Features

- Multi-nut drive
Two or more nut units can be installed in a single ball screw shaft. They can be operated by respective motors.
- High operation speed
High feeding speed operation, yet low rotational speed is feasible by medium to high-helix lead ball screws.
- Easy installation
Merely install a mount housing to the table of the machine to take advantage of this multi-nut rotation system.
- Simple shaft end configuration
Shaft end configuration is simple because this unit does not need support bearings.
- Shaft diameter/lead combination
There are 10 types of "shaft diameter/lead" combinations.
Selections are: Shaft diameters -- 32, 40, 50 mm;
Leads -- 20, 25, 32, 40, 50 mm.
- Low inertia
Compared to conventional NSK products (end cap ball recirculation system), rotational inertia was reduced by up to 16%.

3. Specifications

(1) Ball recirculation system

The structure of the tube recirculation system is shown below.

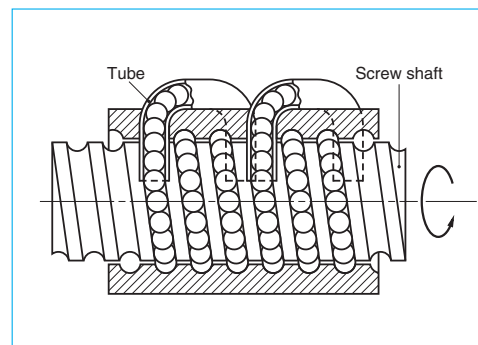


Fig. 3 Structure of ball tube recirculation system

(2) Accuracy grade and axial play

The available standard accuracy grades and axial play are as follows. Please consult NSK for other grades.

Axial play code	Z	T	S
Axial play	0	0.005 mm or less	0.020 mm or less

Table 2 Combination of accuracy grades and axial play

Accuracy grade	C3	C5	Ct7
Axial play code	Z, T, S	Z, T, S	S

4. Allowable d·n value and the criterion of maximum rotational speed

The allowable d·n value and criterion of maximum rotational speed are shown below. Please consult NSK if the rotational speed exceeds the permissible range below.

Note: The basic concept is the same as that of general ball screws. Refer to "Technical Description: Permissible Rotational Speed" (page B47).

Table 3 Allowable d·n value and the criterion of maximum rotational speed

Allowable d·n value	Standard specification	70 000 or less
	High-speed specification	100 000 or less
Criterion of maximum rotational speed	3 000 min ⁻¹	

d·n value: shaft dia. d [mm] × rotational speed n [min⁻¹]

● Critical speed n_c

As shown Fig. 4, calculate mounting distance (mm) of L₁, L₂, and L₃ (assume that the nut section is a fixed support.) Table 4 shows coefficient "f" of each shaft end mounting condition.

$$n_c = f \cdot \frac{d_r}{L_1^2} \times 10^7 \text{ (min}^{-1}\text{)} \quad \text{(III-1)}$$

d_r: Screw shaft root diameter (See the dimension table.)

L_i: Distance between support positions (mm) (See Fig. 4)

f: Factor determined by the ball screw shaft end mounting condition

Table 4

Shaft end mounting condition	f
Fixed -- Fixed	21.9
Fixed -- Simple	15.1
Fixed -- Free	3.4

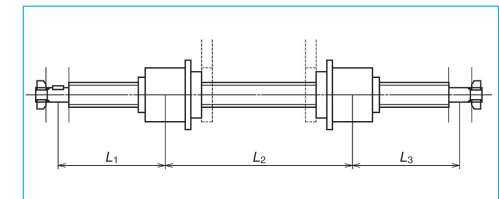


Fig. 4 Installation example

5. Design precautions

One end of the screw thread should be cut-through to the end. Also, if the nut must be removed from the screw shaft, the user should have an arbor to prevent the balls from falling out during this process. (NSK manufactures arbors on request.)

For general precautions regarding ball screws, refer to "Design Precautions" (page B83) and "Handling Precautions" (page B103).

NDD model: (Incorporating vibration damper)

An increase in stroke length may restrict required rotational speed of a ball screw due to critical speed even if there is no $d \cdot n$ limitation. In such a case, we recommend using NDD model rotary nut ball screws equipped with vibration dampers. This makes it possible to operate a ball screw exceeding the critical speed, which is conventionally considered impossible.

Notes: 1) However, the NDD model cannot be used exceeding the $d \cdot n$ limitation. Please consult with NSK in such a case.

2) You cannot rotate the screw shaft of the NDD model.

1. Structure

Hollow ball screw shafts have a mechanism to absorb vibration energy (vibration damper). This increases dynamic rigidity of the screw shaft and lowers vibration when exceeding the critical speed.

Construction of the ball nuts are the same as those of the NDT model.

2. Features

- No need for measures against critical speed. Conventionally, an increase in screw shaft diameter or use of intermediate support is the measure against critical speed. NDD model ball screw will make these measures needless.

- Dimensional interchangeability with NDT model ball screws
The vibration damper is set inside the ball screw shaft, and therefore, there is no difference with the existing model in regards to external dimensions. The ball nuts of NDD models are interchangeable with those of NDT models.

- Others
Benefits include multiple ball nuts on a screw shaft, high feeding speed for long stroke, easy installation, and low inertia of ball nuts identical to the NDT model.

3. Specifications

Recirculation system, accuracy grade, axial play and preload are the same as the NDT model.

4. Design precautions

Design precautions are identical to those of the NDT model.

5. Permissible rotational speed

The $d \cdot n$ value is the same as the NDT model. You don't need to consider the critical speed.

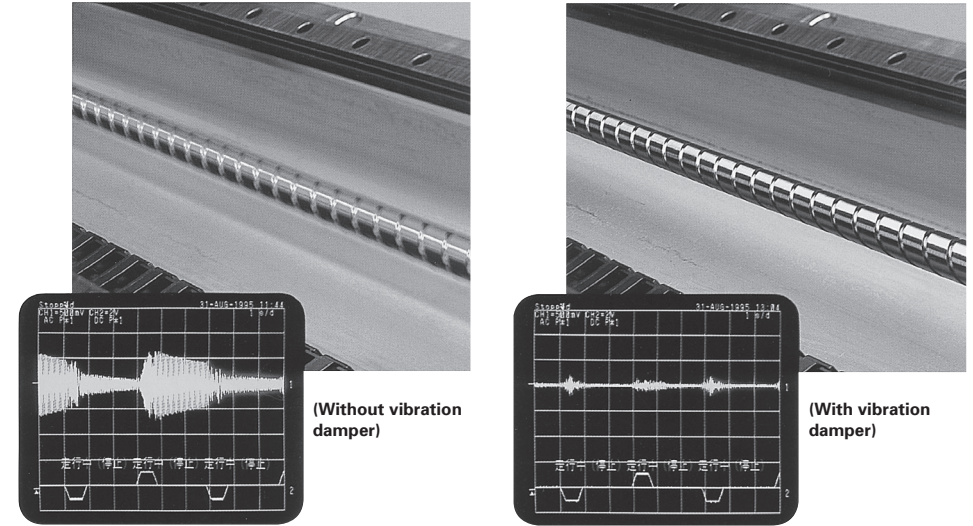


Fig. 6 Vibration of screw shaft when nut is rotating

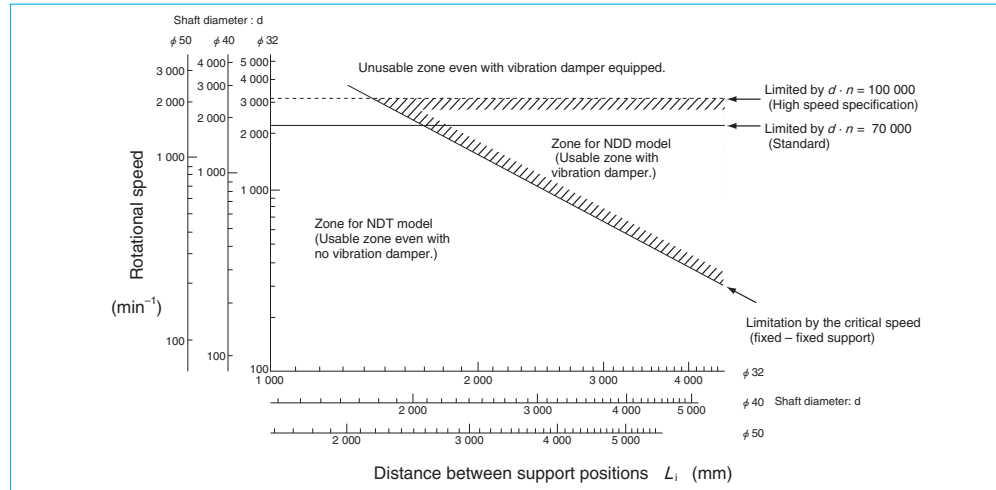


Fig. 5 Rotational speed and distance between support positions for NDT and NDD models

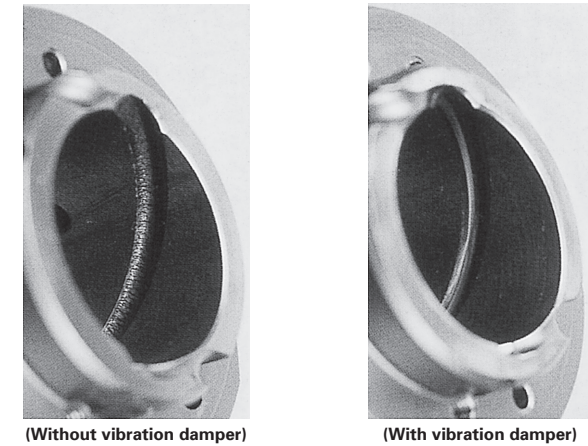


Fig. 7 Effect of vibration damper (results of endurance test)

Example calculation of permissible rotational speed

[Example calculation]

Assume a system which moves two nuts on a shaft as shown below.

Does this system operate appropriately if: both ends of the ball screw (shaft diameter 40 mm/lead 40 mm) are fixed, and the travel speed is at 60 m/min?

[Answer]

The rotational speed n (min^{-1}) when the lead of the ball screw is 40 mm, and the travel speed is at 60 m/min is:

$$n = \frac{60 \times 10^3}{40} = 1\,500 \text{ (min}^{-1}\text{)}$$

● Calculate $d \cdot n$ value

As the $d \cdot n$ value of standard specification is 7 000, therefore, permissible rotational speed is:

$$n \leq \frac{70\,000}{40} = 1\,750 \text{ (min}^{-1}\text{)}$$

● Calculate critical speed

The maximum distance between support positions comes between Nut A and B.

$$L_2 = 3\,300 \text{ (mm)}$$

$$f = 21.9 \text{ (Fixed-Fixed)}$$

$$\text{Root diameter: } d_r = 35.1 \text{ (mm)}$$

Therefore, the permissible rotational speed is;

$$n \leq \frac{21.9 \times 35.1}{3\,300^2} \times 10^7 = 706 \text{ (min}^{-1}\text{)}$$

The calculation indicates that the $d \cdot n$ value is at the safe level. But critical speed exceeds the limitation. However, with a vibration damper, the system can be operated at 1 500 min^{-1} .

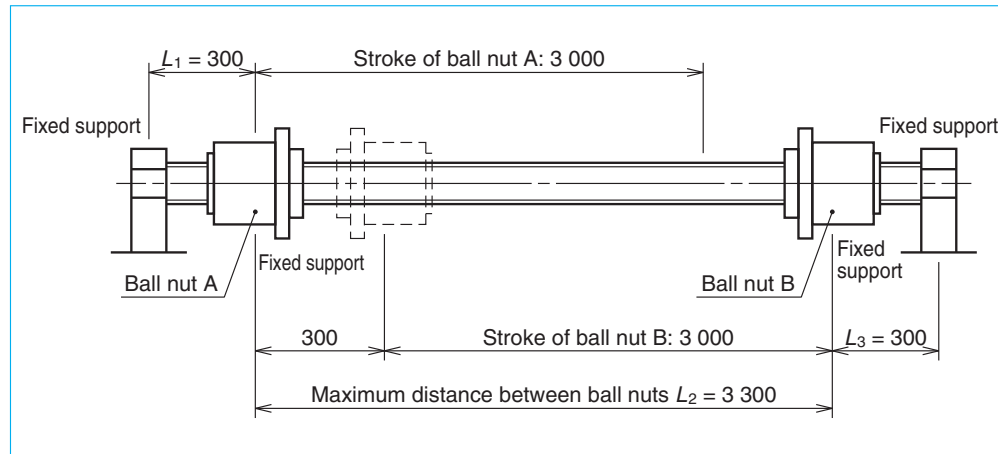


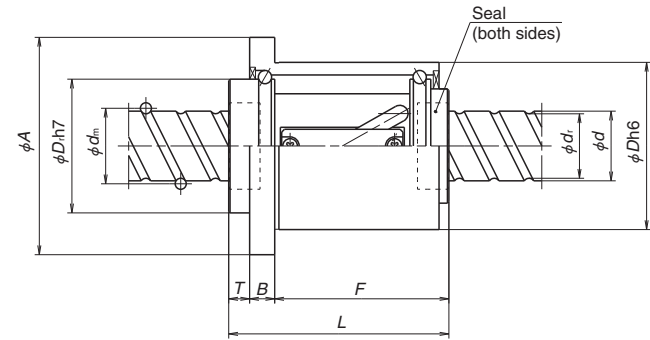
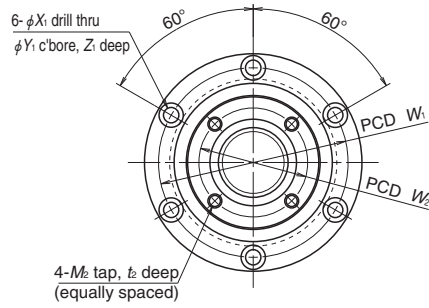
Fig. 8 Example calculation of permissible rotational speed

Structure of reference number

The following explains the codes used in reference numbers:

◇Reference number for ball screws

W 40 15 - ** P XU - C5 Z 40	
Product code	Lead (mm)
Screw shaft diameter (mm)	Axial play code: Z, T, S (page B20)
Effective threaded length (in 100 mm units)	Accuracy grade: C3, C5, C7 (Ct7) (page B37 to B42)
Design serial number	Appearance/specification code ("T" is added for NDD model.)
Preload code: No code, No preload; P, P-preload (page B5)	



Unit: mm

Model No.	Shaft dia. d	Lead l	Ball dia. D_w	Ball pitch circle dia. d_m	Root dia. d_r	Effective ball turns Turns × Circuits	Basic load ratings (N)		Moment of inertia, ball nut J ($\text{kg}\cdot\text{cm}^2$)	Ball nut mass W (kg)
							Dynamic C_a	Static C_{0a}		
NDT NDD 3220-2.5	32	20	4.762	33.25	28.3	2.5×1	20 700	41 900	6.2	2.9
NDT NDD 3225-2.5		25	4.762	33.25	28.3	2.5×1	20 400	42 200	6.7	3.2
NDT NDD 3232-1.5		32	4.762	33.25	28.3	1.5×1	13 300	25 200	6.2	2.9
NDT NDD 3232-3						1.5×2	24 100	50 400		
NDT NDD 4025-2.5		40	25	6.35	41.75	35.1	2.5×1	34 100	70 100	19.3
NDT NDD 4032-1.5	32		6.35	41.75	35.1	1.5×1	21 600	41 300	18.0	5.5
NDT NDD 4032-3						1.5×2	39 300	82 700		
NDT NDD 4040-1.5	40		6.35	41.75	35.1	1.5×1	21 200	42 000	19.2	6.0
NDT NDD 4040-3						1.5×2	38 500	84 000		
NDT NDD 5025-2.5	50	25	7.938	52.25	44.0	2.5×1	51 300	110 000	45.7	8.5
NDT NDD 5032-2.5		32	7.938	52.25	44.0	2.5×1	50 900	109 000	48.9	9.4
NDT NDD 5040-1.5		40	7.938	52.25	44.0	1.5×1	32 300	64 600	45.5	8.5
NDT NDD 5040-3						1.5×2	58 700	129 000		
NDT NDD 5050-1.5		50	7.938	52.25	44.0	1.5×1	31 700	65 700	48.7	9.4
NDT NDD 5050-3	1.5×2					57 500	131 000			

Notes: 1. Right-turn screws are standard. Contact NSK for left-turn screws.
 2. Seals are standard equipment.

Ball nut dimensions													Tap hole PCD W_2
Nut total length L	Nut outside diameter D	Flange outside diameter A	Flange width B	Nut length F	Projection tube dimensions D_r T		Bolt hole dimensions X_1 Y_1 Z_1			Bolt hole PCD W_1	Tap hole dimensions M_2 t_2		
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

ND Model

B-3-3.8 Σ (Sigma) Model for Robots

1. Features

Σ model (NSK's Robotte) is a ball screw with a high-performance spline. It is ideal for various actuators such as the vertical axis of SCARA robots.

A ball screw groove and a ball spline groove are made in one shaft, combining the ball screw and the ball spline.

Mount housing, nuts, and support bearings are combined into a single unit.

Timing pulley (prepared by the user) is directly secured at the end face of the nut.

● High functions

A single shaft has both feeding mechanism and guide functions. This allows the shaft ends to move back and forth (linear motion), as well as to rotate.

● Compact and lightweight

A ball screw nut and a spline nut are placed on one shaft, and support bearings are combined to the unit. This allows for a compact and high-precision design. Hollow shafts are standard to reduce weight. The hollow shaft can be used for wiring and piping. Other components are also designed to be light in weight.

● Low inertia

Tube recirculation decreases the outside diameter of the nut, allowing for a low inertia design.

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. Thereby the shaft can move in any direction -- linear and rotational. Table 1 shows the relationship between power input and output.

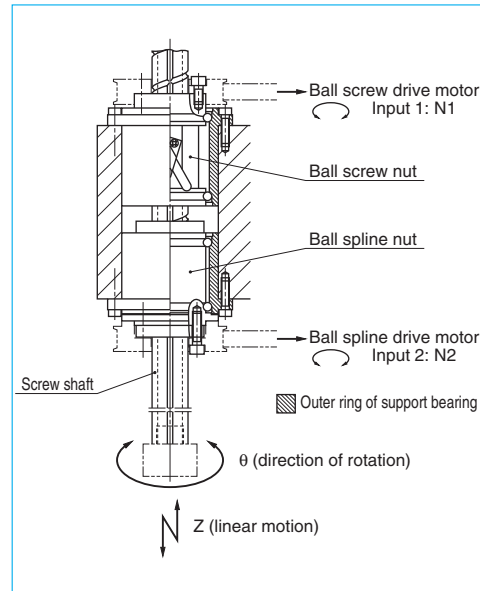


Fig. 1 Example structure of Z axis plus θ axis actuator

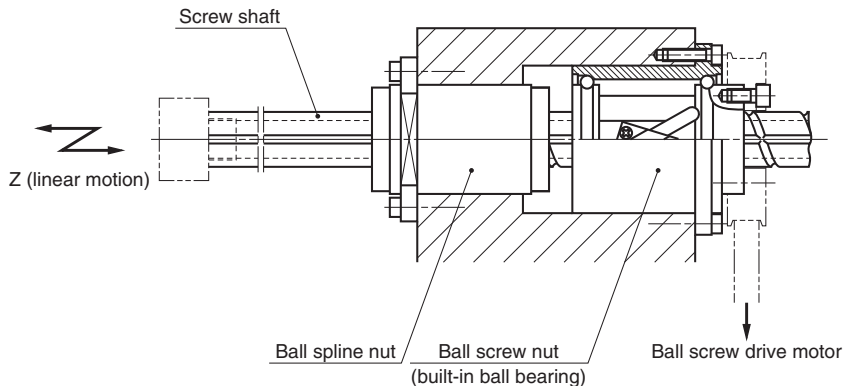


Fig. 2 Example structure of single Z axis unit

Table 1 Power input and output of Σ model

Shaft movement (output)	θ (rotational movement) (min ⁻¹)	Input		Notes
		① Ball screw (min ⁻¹)	② Spline (min ⁻¹)	
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) Ball recirculation system

The structure of the tube recirculation system is shown below.

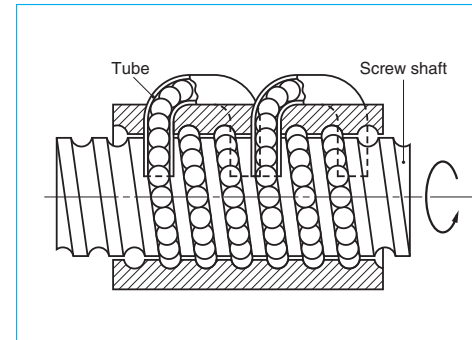


Fig. 3 Structure of tube recirculation system

(2) Accuracy grade and axial play

The available standard accuracy grades and axial play for ball screw are as follows. The axial play for the spline is 0 mm (preloaded product). Please consult NSK for other grades.

Table 2 Accuracy grade and axial play

Accuracy grade	C3, C5, Ct7
Axial play	Z, 0 mm (preloaded) T, 0.005 mm or less; S, 0.020 mm or less

(3) Allowable d·n value, the criterion of maximum rotational speed and maximum speed

The allowable *d·n* value and criterion of maximum rotational speed are shown below. Please consult NSK if the rotational speed exceeds the permissible range below.
Permissible *d·n* value: 70 000 or less
Criterion of maximum rotational speed: 3 000 min⁻¹
Maximum speed: 100 m/min
Note: Please also review the critical speed.
For details, see "Technical Description: Permissible Rotational Speed" (page B47).

(4) Applications

SCARA and Cartesian industrial robots, semiconductor manufacturing machines, machines for automobile production facilities, material handling systems, other Z (vertical) axis and Z axis plus θ (rotation) axis actuators.

4. Design precautions

The overall length L can be extended to 25 times the shaft diameter.

To remove the spline nut from the shaft for assembling, use an arbor as shown in Fig. 4. (page B573). Avoid removing ball screw nuts as much as possible. Refer to root diameter in the dimension tables for arbor diameters. (NSK manufactures arbors on request.)

For general precautions regarding ball screws, refer to "Design Precautions" (page B83) and "Handling Precautions" (page B103).

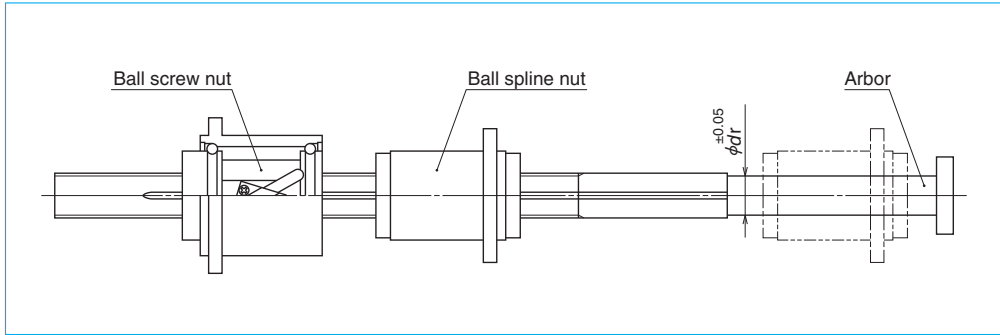


Fig. 4 Removing spline nut

5. Lineup

The Σ model (NSK's Robotte) comes in four varieties with different functions and performance. Select a standard model if rigidity is important. A compact system is recommended for reducing weight.

Table 3 Σ Model lineup

Model	Appearance	Size	Structure (Movement)
Σ		Standard	Z+ θ Unit
ΣZ		Standard	Z Unit
ΣC		Compact	Z+ θ Unit
ΣCZ		Compact	Z Unit

6. Load rating and life

The relationship between load rating of the ball spline section and life is the same as other NSK linear motion products. However, various loads that apply to Robotte must be taken into account. For example, the following factors must be considered in calculating life when the product is used as shown in Fig. 5.

- F_a : Load that is generated when the shaft moves vertically. (Load is applied to the ball screw nut.)
- T : Torque that is generated to the shaft by F_a .
- F_r : Load that is generated by moment of inertia of the shaft and the work attached to Robotte as well as by centrifugal force when the arm rotates.
- θ : Direction of F_r load that changes by shaft rotation.

NSK has life calculation programs which take these factors into account. Please ask NSK for more details.

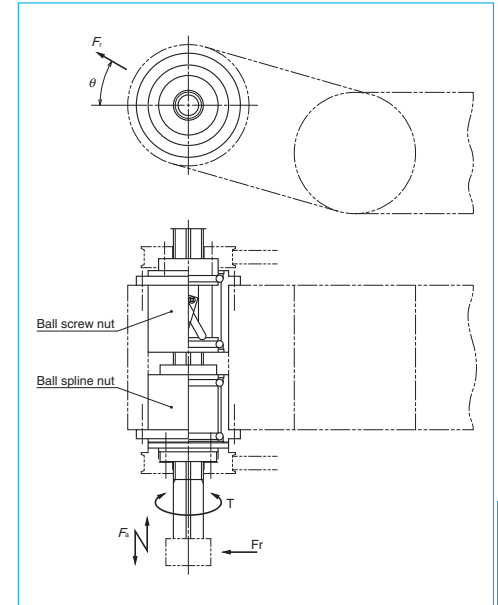


Fig. 5 Example structure of Z axis plus θ axis actuator

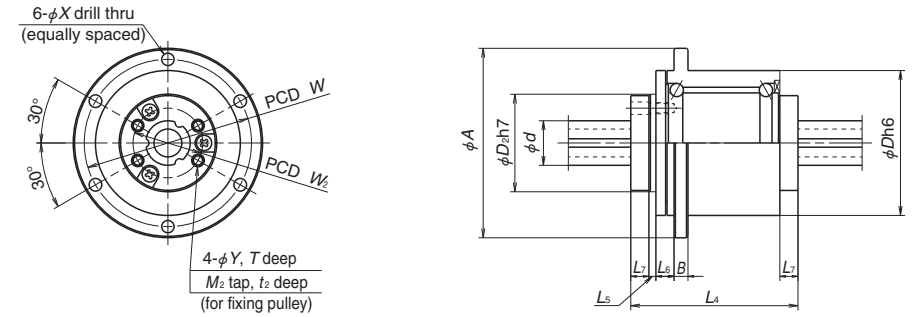
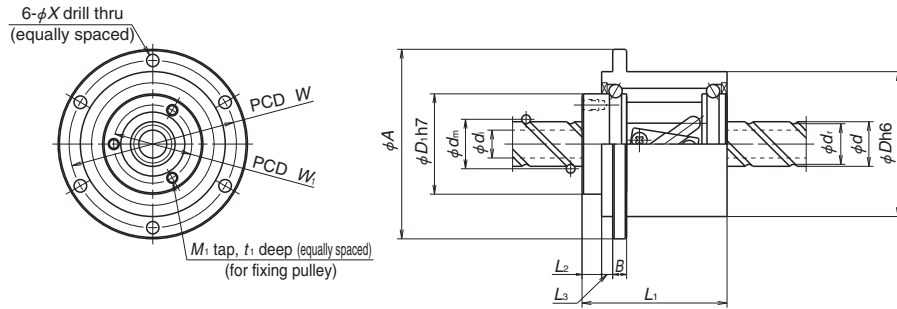
7. Structure of reference number

The following explains the codes used in reference numbers:

◇Reference number for ball screws

PW 25 02 - ** P T U - C5 Z 20

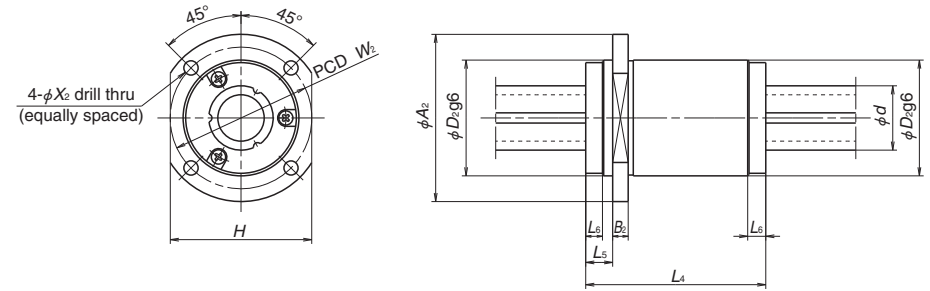
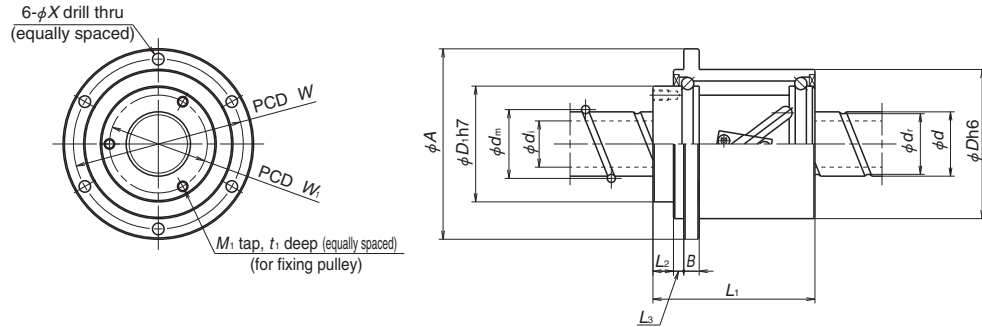
Product code	Screw shaft diameter (mm)	Effective threaded length (in 100 mm units)	Design serial number	Preload code: No code, No preload; P, P-preload (page B5)	Lead (mm)
					Axial play code: Z, T, S (page B20)
					Accuracy grade: C3, C5, C7 (Ct7) (page B37 to B42)
					Support unit
					Hollow shaft ball screw specification



Unit: mm

Model No.	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D_w</i>	Ball circle dia. <i>d_m</i>	Root dia. <i>d_r</i>	Screw shaft bore dia. <i>d_s</i>	Ball screw nut															Moment of inertia (kg·cm ²)
							Basic load ratings (N)		Dimensions											X		
							Dynamic <i>C_a</i>	Static <i>C_{0a}</i>	<i>D</i>	<i>A</i>	<i>B</i>	<i>L₁</i>	<i>L₂</i>	<i>L₃</i>	<i>M₁</i>	<i>t₁</i>	<i>W₁</i>	<i>D₁</i>	<i>W</i>			
Σ1610	16	10	3.175	16.75	13.4	(8)	5 610	8 300	48	64	5	47	7	4	3-M4	6	28	35	56	4.5	0.41	
Σ1632	16	32	3.175	16.75	13.4	(8)	3 600	5 200	48	64	5	52	7	4	3-M4	6	28	35	56	4.5	0.44	
Σ2010	20	10	3.175	20.75	17.4	(14)	9 560	17 300	54	70	6	57	8	4	3-M4	6	32	40	62	4.5	0.64	
Σ2020	20	20	3.175	20.75	17.4	(14)	6 100	10 500	54	70	6	63	8	4	3-M4	6	32	40	62	4.5	0.65	
Σ2040	20	40	3.175	20.75	17.4	(14)	4 050	7 020	54	70	6	57	8	4	3-M4	6	32	40	62	4.5	0.64	
Σ2510	25	10	3.175	25.75	22.4	(18)	10 700	22 000	58	74	6	57	8	4	3-M4	6	38	45	66	4.5	1.10	
Σ2520	25	20	3.175	25.75	22.4	(18)	6 860	13 100	58	74	6	63	8	4	3-M4	6	38	45	66	4.5	1.18	
Σ2525	25	25	3.175	25.75	22.4	(18)	6 720	13 300	58	74	6	72	8	4	3-M4	6	38	45	66	4.5	1.30	
Σ2550	25	50	3.175	25.75	22.4	(18)	4 490	8 270	58	74	6	64	8	4	3-M4	6	38	45	66	4.5	1.20	
Σ3220	32	20	3.175	32.75	29.4	(25)	7 710	16 900	70	95	8	70	10	6	3-M5	10	44	53	82	6.6	2.60	
Σ3232	32	32	3.175	32.75	29.4	(25)	7 590	16 700	70	95	8	91	10	6	3-M5	10	44	53	82	6.6	3.15	
Σ4020	40	20	3.969	41.0	36.9	(30)	11 600	26 500	85	110	8	73	10	6	4-M5	10	58	67	96	6.6	5.96	
Σ4040	40	40	3.969	41.0	36.9	(30)	11 300	26 200	85	110	8	107	10	6	4-M5	10	58	67	96	6.6	7.85	
Σ4520	45	20	3.969	46.0	41.9	(35)	12 000	30 000	90	115	8	73	10	6	4-M5	10	63	72	101	6.6	7.73	
Σ4540	45	40	3.969	46.0	41.9	(35)	11 800	29 700	90	115	8	107	10	6	4-M5	10	63	72	101	6.6	10.3	

Mass (kg)	Basic load ratings (N)		Basic torque (N·m)		Ball spline nut															Moment of inertia (kg·cm ²)	Mass (kg)
	Dynamic <i>C_r</i>	Static <i>C_{0r}</i>	Dynamic <i>C_t</i>	Static <i>C_{0t}</i>	Dimensions											X					
	<i>C_r</i>	<i>C_{0r}</i>	<i>C_t</i>	<i>C_{0t}</i>	<i>D</i>	<i>A</i>	<i>B</i>	<i>L₄</i>	<i>L₅</i>	<i>L₆</i>	<i>L₇</i>	<i>Y</i>	<i>T</i>	<i>M₂</i>	<i>t₂</i>		<i>W₂</i>	<i>D₂</i>	<i>W</i>		
0.50	5 530	7 270	61.5	91.3	48	64	5	60	2.5	6.5	6.5	4.5	6.5	M4	7	25	35	56	4.5	0.71	0.63
0.55	5 890	8 000	65.5	100	48	64	5	60	2.5	6.5	6.5	4.5	6.5	M4	7	25	35	56	4.5	0.71	0.63
0.74	6 260	8 720	86.3	135	54	70	6	65	2.5	6.5	6.5	5.5	6.5	M5	8	30.5	40	62	4.5	1.15	0.87
0.81	6 610	9 450	91.1	145	54	70	6	65	2.5	6.5	6.5	5.5	6.5	M5	8	30.5	40	62	4.5	1.15	0.87
0.74	6 610	9 450	91.1	145	54	70	6	65	2.5	6.5	6.5	5.5	6.5	M5	8	30.5	40	62	4.5	1.15	0.87
0.81	6 630	9 450	115	185	58	74	6	70	2.5	6.5	6.5	5.5	6.5	M5	8	35.5	45	66	4.5	1.88	1.03
0.88	7 290	10 900	125	210	58	74	6	70	2.5	6.5	6.5	5.5	6.5	M5	8	35.5	45	66	4.5	1.88	1.03
1.00	7 290	10 900	125	210	58	74	6	70	2.5	6.5	6.5	5.5	6.5	M5	8	35.5	45	66	4.5	1.88	1.03
0.91	7 290	10 900	125	210	58	74	6	70	2.5	6.5	6.5	5.5	6.5	M5	8	35.5	45	66	4.5	1.88	1.03
1.46	7 630	11 600	165	285	70	95	8	75	2.5	7.5	6.5	5.5	6.5	M5	8	42	50	82	6.6	3.80	1.62
1.83	7 950	12 400	175	305	70	95	8	75	2.5	7.5	6.5	5.5	6.5	M5	8	42	50	82	6.6	3.80	1.62
2.02	10 600	14 800	290	455	85	110	8	80	4	7.5	8	5.5	8	M5	8	55	65	96	6.6	9.74	2.38
2.85	11 200	15 900	305	490	85	110	8	80	4	7.5	8	5.5	8	M5	8	55	65	96	6.6	9.74	2.38
2.17	11 200	15 900	340	550	90	115	8	85	4	7.5	8	5.5	8	M5	8	60	70	101	6.6	12.5	2.56
3.06	11 700	17 000	360	590	90	115	8	85	4	7.5	8	5.5	8	M5	8	60	70	101	6.6	12.5	2.56

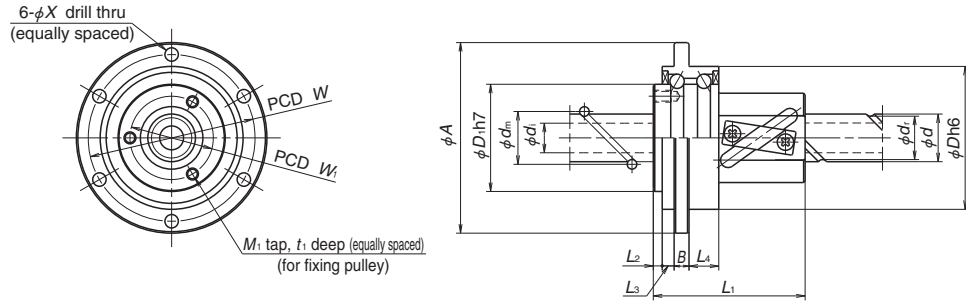


Unit: mm

Model No.	Shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Screw shaft bore dia. d_1	Ball screw nut													
							Basic load ratings (N)		Dimensions											
							Dynamic C_a	Static C_{0a}	D	A	B	L_1	L_2	L_3	M_1	t_1	W_1	D_1	W	X
ΣZ1610	16	10	3.175	16.75	13.4	(8)	5 610	8 300	48	64	5	47	7	4	3-M4	6	28	35	56	4.5
ΣZ1632	32	3 600					5 200	52												
ΣZ2010	20	10	3.175	20.75	17.4	(14)	9 560	17 300	54	70	6	57	8	4	3-M4	6	32	40	62	4.5
ΣZ2020		20					6 100	10 500				63								
ΣZ2040		40					4 050	7 020				57								
ΣZ2510	25	10	3.175	25.75	22.4	(18)	10 700	22 000	58	74	6	57	8	4	3-M4	6	38	45	66	4.5
ΣZ2520		20					6 860	13 100				63								
ΣZ2525		25					6 720	13 300				72								
ΣZ2550		50					4 490	8 270				64								
ΣZ3220	32	20	3.175	32.75	29.4	(25)	7 710	16 900	70	95	8	70	10	6	3-M5	10	44	53	82	6.6
ΣZ3232		32					7 590	16 700				91								
ΣZ4020	40	20	3.969	41.0	36.9	(30)	11 600	26 500	85	110	8	73	10	6	4-M5	10	58	67	96	6.6
ΣZ4040		40					11 300	26 200				107								
ΣZ4520	45	20	3.969	46.0	41.9	(35)	12 000	30 000	90	115	8	73	10	6	4-M5	10	63	72	101	6.6
ΣZ4540		40					11 800	29 700				107								

Moment of inertia (kg·cm ²)	Mass (kg)	Ball spline nut																	Mass (kg)
		Basic load ratings (N)		Basic torque (N·m)		Dimensions													
		Dynamic C_t	Static C_{0t}	Dynamic C_r	Static C_{0r}	D_2	A_2	B_2	L_4	L_5	L_6	H	W_2	X_2					
0.41	0.50	5 530	7 270	61.5	91.3	35	55	6	60	10.5	6.5	45	4.5	4.5	0.35				
0.44	0.55	5 890	8 000	65.5	100														
0.64	0.74	6 260	8 720	86.5	135	40	60	6	65	10.5	6.5	50	50	5.5	0.46				
0.65	0.81	6 610	9 450	91.1	145														
0.64	0.74	6 610	9 450	91.1	145	45	65	6	70	10.5	6.5	55	55	5.5	0.57				
1.10	0.81	6 630	9 450	115	185														
1.18	0.88	7 290	10 900	125	210														
1.30	1.00	7 290	10 900	125	210														
1.20	0.91	7 290	10 900	125	210														
2.60	1.46	7 630	11 600	165	285														
3.15	1.83	7 950	12 400	175	305	50	70	6	75	10.5	6.5	60	60	5.5	0.64				
5.96	2.02	10 600	14 800	290	455														
7.85	2.85	11 200	15 900	305	490	65	88	8	80	12	8	76	76	6.6	1.20				
7.73	2.17	11 200	15 900	340	550														
10.3	3.06	11 700	17 000	360	590	70	93	8	85	12	8	81	81	6.6	1.39				

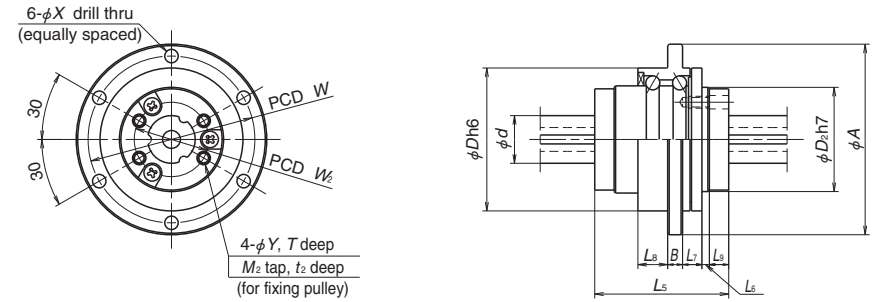
Σ Model for Robots



Model No.	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D_w</i>	Ball circle dia. <i>d_m</i>	Root dia. <i>d_r</i>	Screw shaft bore dia. <i>d_i</i>	Ball screw nut																
							Basic load ratings (N)		Dimensions													Moment of inertia (kg·cm ²)	
							Dynamic <i>C_a</i>	Static <i>C_{0a}</i>	<i>D</i>	<i>A</i>	<i>B</i>	<i>L₁</i>	<i>L₂</i>	<i>L₃</i>	<i>L₄</i>	<i>M₁</i>	<i>t₁</i>	<i>W₁</i>	<i>D₁</i>	<i>W</i>	<i>X</i>		
ΣC1610	16	10	3.175	16.75	13.4	(8)	5 670	8 300	48	64	5	46	3	4	10	3-M4	6	28	35	56	4.5	0.40	
ΣC1632		32					3 600	5 200				51										0.43	
ΣC2010	20	10	3.175	20.75	17.4	(14)	9 560	17 300	54	70	6	56	4	4	10	3-M4	6	32	40	62	4.5	0.63	
ΣC2020		20					6 100	10 500				63										0.65	
ΣC2040		40					4 050	7 020				56										0.63	
ΣC2510	25	10	3.175	25.75	22.4	(18)	10 700	22 000	58	74	6	56	4	4	10	3-M4	6	38	45	66	4.5	1.04	
ΣC2520		20					6 860	13 100				63										1.13	
ΣC2525		25					6 720	13 300				71										1.24	
ΣC2550		50					4 490	8 270				63										1.13	

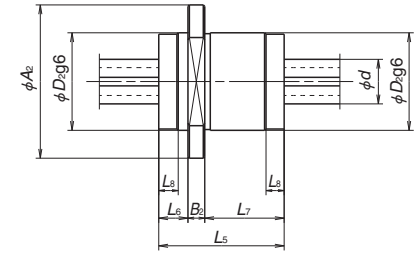
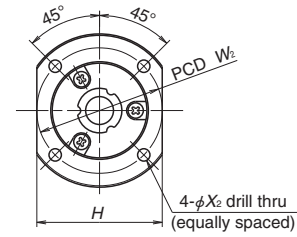
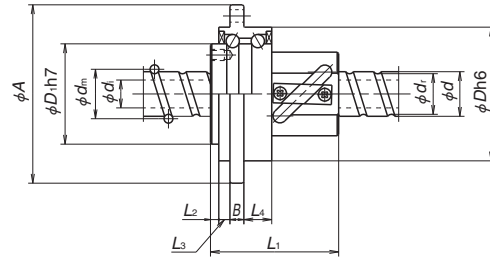
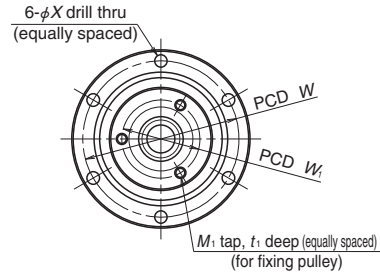
Σ C Model

NSK



Unit: mm

Mass (kg)	Ball spline nut																	Moment of inertia (kg·cm ²)	Mass (kg)			
	Basic load ratings (N)		Basic torque(N·m)		Dimensions																	
	Dynamic <i>C_r</i>	Static <i>C_{0r}</i>	Dynamic <i>C_t</i>	Static <i>C_{0t}</i>	<i>D</i>	<i>A</i>	<i>B</i>	<i>L₅</i>	<i>L₆</i>	<i>L₇</i>	<i>L₈</i>	<i>L₉</i>	<i>Y</i>	<i>T</i>	<i>M₂</i>	<i>t₂</i>	<i>W₂</i>			<i>D₂</i>	<i>W</i>	<i>X</i>
0.41	4 300	5 090	47.9	63.9	48	64	5	45	2.5	6.5	10	6.5	4.5	6.5	M4	7	25	35	56	4.5	0.52	0.42
0.43																						
0.53	4 730	5 820	65.1	90.5	54	70	6	50	2.5	6.5	10	6.5	5.5	6.5	M5	8	30.5	40	62	4.5	0.86	0.56
0.56	5 110	6 540	70.5	100																		
0.53	5 110	6 540	70.5	100	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
0.60	5 130	6 540	87.8	125																		
0.64	5 870	8 000	100	155																		
0.69	5 870	8 000	100	155																		
0.64	5 870	8 000	100	155	58	74	6	55	2.5	6.5	10	6.5	5.5	6.5	M5	8	35.5	45	66	4.5	1.44	0.67
0.64	5 870	8 000	100	155																		



Unit: mm

Model No.	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D_w</i>	Ball circle dia. <i>d_m</i>	Root dia. <i>d_r</i>	Screw shaft bore dia. <i>d_i</i>	Ball screw nut															
							Basic load ratings (N)		Dimensions													Mass (kg)
							Dynamic <i>C_s</i>	Static <i>C_{0s}</i>	<i>D</i>	<i>A</i>	<i>B</i>	<i>L₁</i>	<i>L₂</i>	<i>L₃</i>	<i>L₄</i>	<i>M₁</i>	<i>t₁</i>	<i>W₁</i>	<i>D₁</i>	<i>W</i>	<i>X</i>	
ΣCZ1610	16	10	3.175	16.75	13.4	(8)	5 670	8 300	48	64	5	46	3	4	10	3-M4	6	28	35	56	4.5	
ΣCZ1632		32					3 600	5 200	51	56												
ΣCZ2010	20	10	3.175	20.75	17.4	(14)	9 560	17 300	54	70	6	63	4	4	10	3-M4	6	32	40	62	4.5	
ΣCZ2020		20					6 100	10 500														56
ΣCZ2040		40					4 050	7 020														56
ΣCZ2510	25	10	3.175	25.75	22.4	(18)	10 700	22 000	58	74	6	63	4	4	10	3-M4	6	38	45	66	4.5	
ΣCZ2520		20					6 860	13 100														71
ΣCZ2525		25					6 720	13 300														71
ΣCZ2550		50					4 490	8 270														63

Moment of inertia (kg·cm ²)	Mass (kg)	Ball spline nut																	Mass (kg)
		Basic load ratings (N)		Basic torque (N·m)		Dimensions													
		Dynamic <i>C_r</i>	Static <i>C_{0r}</i>	Dynamic <i>C_t</i>	Static <i>C_{0t}</i>	<i>D₂</i>	<i>A₂</i>	<i>B₂</i>	<i>L₅</i>	<i>L₆</i>	<i>L₇</i>	<i>L₈</i>	<i>H</i>	<i>W₂</i>	<i>X₂</i>				
0.40	0.41	4 300	5 090	47.9	63.9	35	55	6	45	10.5	28.5	6.5	45	45	4.5	0.26			
0.43	0.43																		
0.63	0.53	4 730	5 820	65.1	90.5	40	60	6	50	10.5	33.5	6.5	50	50	5.5	0.35			
0.65	0.56																		
0.63	0.53	5 110	6 540	70.5	100	45	65	6	55	10.5	38.5	6.5	55	55	5.5	0.44			
1.04	0.60																		
1.13	0.64	5 870	8 000	100	155	45	65	6	55	10.5	38.5	6.5	55	55	5.5	0.44			
1.24	0.69																		
1.13	0.64	5 870	8 000	100	155	45	65	6	55	10.5	38.5	6.5	55	55	5.5	0.44			
1.13	0.64																		

B-3-3.9 Ball Screws with the "NSK K1™" Lubrication Unit

1. Features

NSK K1 is a new, efficient lubrication unit. Equipped with NSK K1, ball screws demonstrate superb performance as shown below.

● Long-term, maintenance-free usage

In mechanical environments where lubrication is difficult to apply, long-term running efficiency is maintained by using the NSK K1 in combination with grease.

[ex.] For automotive component processing lines, etc.

● Does not pollute the environment

A very small volume of grease combined with NSK K1 can provide sufficient lubrication in environments where grease is undesirable as well as in environments where high cleanliness is required.

[ex.] Food processing equipment, medical equipment, flat panel display/ semiconductor manufacturing equipment, etc.

● Good for environments where lubricant is washed away

When used with grease, life of the machine is prolonged even when the machine is washed entirely by water, or in an environment where the machine is exposed to rain or wind.

[ex.] Food processing equipment, housing/ construction machines, etc.

● Maintains efficiency in dusty environments

In environments where oil- and grease-absorbing dust is produced, long-term efficiency in lubrication and protection from foreign matter entry are maintained by using the NSK K1 in combination with grease.

[ex.] Woodworking machines, etc.

● Comparative duration test of samples with and without NSK K1

Samples, testing conditions, and test results are shown in **Table 1** and **Fig. 1**.

Without lubricant, operation became impossible after running 8.6 km. With NSK K1 alone, it was possible to continue running past 10 000 km.

NSK conducts various tests under different conditions. Please consult NSK for details.

Table 1 Sample and testing conditions

Ball screw	Shaft dia. 20 mm, lead 20 mm
Lubrication	Comparison with only NSK K1 against no lubrication
Speed	4 000 min ⁻¹ (80 m/min)
Stroke	600 mm

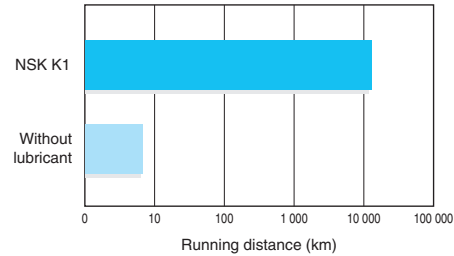


Fig. 1 Duration test results of ball screws without lubricant

2. Specifications

(1) Structure

The structure makes it possible to have stable contact between the NSK K1 and outside a ball screw with moderate force by a garter spring which fits outside the NSK K1.

NSK K1 is installed between the ball screw nut and the labyrinth seal. The overall nut length is slightly longer than that of standard ball screws. Combinations of NSK standard grease (factory-packed in the nut) and NSK K1 are standard specifications.

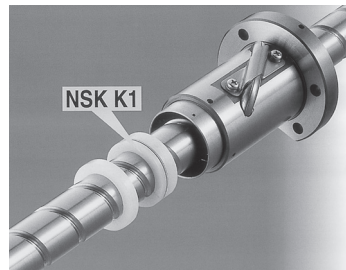


Fig. 2 NSK K1

(2) Accuracy grade and axial play

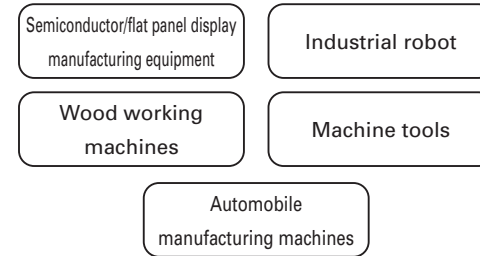
Accuracy grades, clearance and preload specifications remain unchanged from existing products. There is a slight increase in torque due to the equipped NSK K1.

(3) Overall nut length equipped with NSK K1™

The nut length becomes longer than that of standard ball screws. The nut length equipped with K1 is shown in pages B561 to B563 for each type of ball recirculation. NSK K1 can be installed on other types not listed in the dimension tables. Please consult with NSK if you require K1 for a special ball nut.

(4) Application examples

Ball screws equipped with NSK K1 are maintenance-free for a long period. Its application is expanding in various industries.



◇Reference number for ball screws equipped with NSK K1

W1401 - P K1 - C3 Z10**

NSK K1 equipped ball screw code

3. Precautions for use

Temperature range for use: Maximum temperature: 50°C
Momentary maximum temperature: 80°C

Chemicals that should not contact K1:

Do not leave NSK K1 in organic solvents, white kerosene such as hexane, thinners which remove oil, and rust preventive oils which contain white kerosene.

Note: Water-type cutting oil, oil-type cutting oil, grease such as mineral-type AS2 and ester-type PS2 do not damage K1.

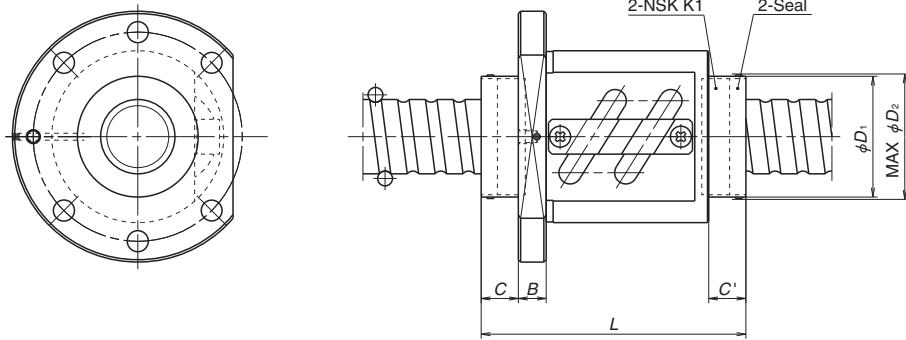
Note: NSK K1 is not applicable to the Compact FA model.

4. Example reference number

The following explains the codes used in reference numbers:

Note: "K1" is added at the end of the nut code and provisional Ref. No.

(1) Tube recirculation



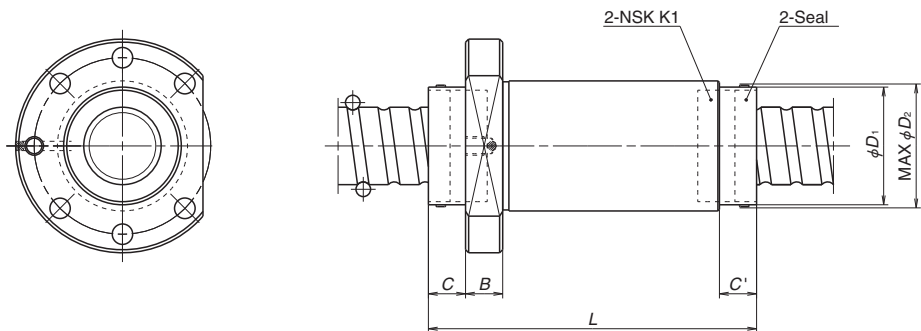
Tube recirculation

Model No.	Screw shaft dia. <i>d</i>	Lead <i>l</i>	K1 mounting dimensions		Flange width <i>B</i>	Overall length with K1 <i>L</i>	K1 cap dimensions	
			<i>C</i>	<i>C'</i>			Cap dia. ϕD_1	Protrusion dimension ϕD_2
PFT1004-2.5	10	4	14	15	10	61.5	$\phi 22$	MAX $\phi 24$
PFT1205-2.5	12	5	14	15	10	66	$\phi 26.5$	MAX $\phi 29$
LPFT1210-2.5		10		17		79		
PFT1405-2.5	14	5	14	15	10	65	$\phi 30$	MAX $\phi 32$
LPFT1510-2.5	15	10	14	15	10	76	$\phi 30$	MAX $\phi 32$
PFT1605-2.5	16	5	14	15	10	67	$\phi 32$	MAX $\phi 34$
PFT2005-5	20	5	14	14	10	81	$\phi 38$	MAX $\phi 40$
LPFT2010-2.5		10				78		
LPFT2020-1.5		20				84		
ZFT2505-10	25	5	16	17	10	115	$\phi 44$	MAX $\phi 46$
PFT2506-5		6	16	17	12	93	$\phi 44$	MAX $\phi 46$
PFT2510-2.5		10	16	17	12	89	$\phi 44$	MAX $\phi 46$
ZFT2510-3						103		
LPFT2520-2.5		20	12	12	12	109	$\phi 38$	MAX $\phi 40$
LPFT2525-1.5		25	12	12	12	98	$\phi 38$	MAX $\phi 40$
DFT2805-5	28	5	16	17	12	137	$\phi 48$	MAX $\phi 50$
PFT2810-2.5		10				90		
DFT2810-3						174		
PFT3206-5	32	6	16	17	12	93	$\phi 52$	MAX $\phi 54$
ZFT3206-10						129		
PFT3210-5		10	16	17	17	122	$\phi 52$	MAX $\phi 54$
ZFT3210-5						122		
DFT3210-5		16	16	12	212	$\phi 52$	MAX $\phi 54$	
PFT3212-3		12	16	17	16	114	$\phi 52$	MAX $\phi 54$
DFT3212-3	198							
LPFT3225-2.5	25	12	12		122	$\phi 46$	MAX $\phi 48$	
LPFT3232-1.5	32	12	12		109	$\phi 46$	MAX $\phi 48$	

Notes: 1. NSK K1 can be installed in other types not listed in the table. Please consult NSK.
2. *C*, *C'*, and *L* refer to dimensions when one NSK K1 is equipped to both ends of the nut.

Model No.	Screw shaft dia. <i>d</i>	Lead <i>l</i>	K1 mounting dimensions		Flange width <i>B</i>	Overall length with K1 <i>L</i>	K1 cap dimensions					
			<i>C</i>	<i>C'</i>			Cap dia. ϕD_1	Protrusion dimension ϕD_2				
PFT3610-5	36	10	19	20	15	131	$\phi 56$	MAX $\phi 58$				
DFT3610-5				19		221						
HZF3616-5				19		163						
HZF3620-3.5		20		19		146						
PFT4008-5	40	8	19	20	16	117	$\phi 62$	MAX $\phi 64$				
ZFT4008-10				165								
ZFT4010-7		10	19	20		152	$\phi 62$	MAX $\phi 64$				
DFT4010-5				19		222						
PFT4012-5		12	19	19		20	144	$\phi 62$	MAX $\phi 64$			
DFT4012-5						19	252					
HZF4016-5						16	19	19		164	$\phi 61$	MAX $\phi 64$
HZF4020-5						20	19	19		189	$\phi 61$	MAX $\phi 64$
LPFT4032-2.5						32	14	14		151	$\phi 54$	MAX $\phi 56$
LPFT4040-1.5						40	14	14		133	$\phi 54$	MAX $\phi 56$
DFT4510-5	45	10	19	19	16	222	$\phi 72$	MAX $\phi 75$				
DFT4512-5		12			16	254						
HZF4520-5		20			18	190						
ZFT5010-10	50	10	19	20	18	194	$\phi 73$	MAX $\phi 76$				
DFT5012-5		12		19		256						
ZFT5016-5		16		20		172			19	300		
DFT5016-5				19		300						
HZF5020-5		20		19		192						
HZF5025-5		25		19		221						
DFT5516-5	55	16	22	22	18	178	$\phi 81$	MAX $\phi 87$				
HZF5520-5		20			198							
HZF5525-5		25			227							
DFT6316-5	63	16	22	22	18	322	$\phi 89$	MAX $\phi 95$				
DFT6320-5		20			362							

(2) Deflector (bridge) recirculation



Deflector (bridge) recirculation

Model No.	Screw shaft dia. <i>d</i>	Lead <i>l</i>	K1 mounting dimensions		Flange width <i>B</i>	Overall length with K1 <i>L</i>	K1 cap dimensions	
			<i>C</i>	<i>C'</i>			Cap dia. ϕD_1	Protrusion dimension ϕD_2
ZFD2005-6	20	5	9	9	12	87	$\phi 32$	MAX $\phi 34$
ZFD2506-6	25	6	12	—	12	102	$\phi 38$	MAX $\phi 40$
ZFD2510-4		10		12		106		
ZFD3208-8	32	8	12	12	12	136	$\phi 46$	MAX $\phi 48$
ZFD3210-6		10				138		
ZFD3212-6		12				153		
ZFD4010-8	40	10	14	14	16	167	$\phi 54$	MAX $\phi 57$
ZFD4012-8		12				189		
ZFD5010-8	50	10	14	14	18	169	$\phi 64$	MAX $\phi 67$
ZFD5012-6		12				167		

Notes: 1. NSK K1 can be installed in other types not listed in the table. Please consult NSK.
 2. *C*, *C'*, and *L* refer to dimensions when one NSK K1 is equipped to both ends of the nut.

B-3-3.10 Ball screws for Rechargeable Battery Manufacturing Equipment CAT.No.3171

1. Features

Limited the use of hazardous copper and zinc plating in the manufacture of rechargeable batteries. Screw shafts, nuts, and other parts are also available in stainless steel. Low-dust emission is achieved by packing in metal element-free LGU grease.

2. Specifications

(1) Scope of application

Combination of shaft diameter and lead for rechargeable battery manufacturing equipment are shown in Table 1.1

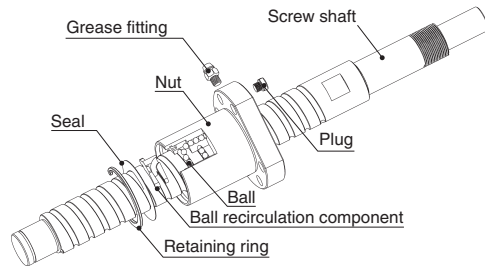


Table 1.1 Combination of shaft diameter and lead

Unit : mm

Shaft diameter	Lead	Shaft length						Material of components						Lubrication · Surface treatment
		300	500	1000	1200	1500	2000	Screw shaft · Nut	Ball	Ball recirculation component	Seal	Screws · #2 Retaining ring	Grease #2 Fitting · Plug	
8	2*1	●						Accuracy Ct7 · Standard specifications Carbon steel	· Standard specifications Bearing steel	· Accuracy Ct7 Synthetic resin	· Accuracy Ct7 Synthetic resin	· Standard specifications Standard material		Lubrication · LGU grease · AS2 grease · Antirust oil
	10	●												
10	2	●						Accuracy Ct7 · Standard specifications Carbon steel	· Standard specifications Bearing steel	· Accuracy Ct7 Synthetic resin	· Accuracy Ct7 Synthetic resin	· Standard specifications Standard material		Lubrication · LGU grease · AS2 grease · Antirust oil
	5	●												
12	5		●					· Stainless specifications Stainless	· Standard specifications Bearing steel	· Accuracy Ct7 Synthetic resin	· Accuracy Ct7 Synthetic resin	· Standard specifications Standard material		Lubrication · LGU grease · AS2 grease · Antirust oil
	10		●											
14	5			○				· Stainless specifications Stainless	· Standard specifications Bearing steel	· Accuracy Ct7 Synthetic resin	· Accuracy Ct7 Synthetic resin	· Standard specifications Standard material		Lubrication · LGU grease · AS2 grease · Antirust oil
	10			○										
15	5				●			· Stainless specifications Stainless	· Standard specifications Bearing steel	· Accuracy Ct7 Synthetic resin	· Accuracy Ct7 Synthetic resin	· Standard specifications Standard material		Lubrication · LGU grease · AS2 grease · Antirust oil
	20				●									
20	5					●		· Stainless specifications Stainless	· Standard specifications Bearing steel	· Accuracy Ct7 Synthetic resin	· Accuracy Ct7 Synthetic resin	· Standard specifications Standard material		Lubrication · LGU grease · AS2 grease · Antirust oil
	10					●								
25	10						○	Accuracy Ct10 · Standard specifications Carbon steel	· Standard specifications Bearing steel	· Accuracy Ct10 Synthetic resin	· Accuracy Ct10 Synthetic resin	· Stainless specifications Stainless		Surface treatment · Fluoride low temperature chrome plating
	20						○							
32	10							Accuracy Ct10 · Standard specifications Carbon steel	· Standard specifications Bearing steel	· Accuracy Ct10 Synthetic resin	· Accuracy Ct10 Synthetic resin	· Stainless specifications Stainless		Surface treatment · Fluoride low temperature chrome plating
	32													
40	10							Accuracy Ct10 · Standard specifications Carbon steel	· Standard specifications Bearing steel	· Accuracy Ct10 Synthetic resin	· Accuracy Ct10 Synthetic resin	· Stainless specifications Stainless		Surface treatment · Fluoride low temperature chrome plating
	20													

● : Accuracy Ct7 ○ Accuracy Ct10
 ※1) Screw shaft diameter φ 8 lead 2mm is only for standard specifications
 ※2) Available range : Accuracy Ct7, Screw shaft diameter φ 10~ φ 25

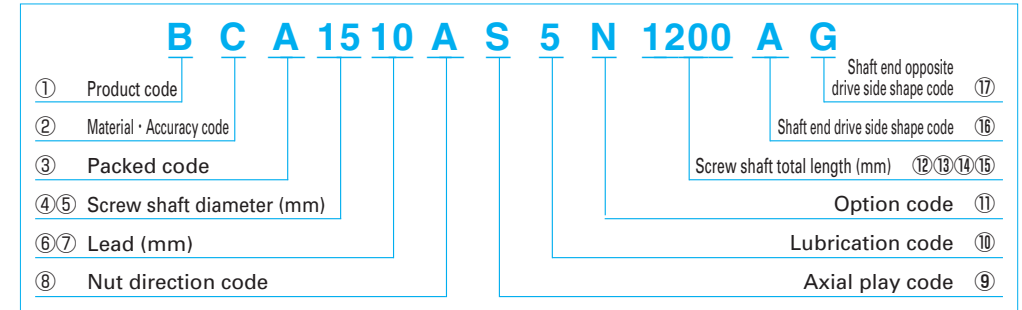
(2) Recommended specifications

Recommended ball screw specifications by usage environment is shown in Table 1.2.

Table 1.2 Recommended specifications by usage environment

	Low dew point · Clean environment	General environment
Screw shaft · Nut material	Standard specification Stainless specification	Standard specification Stainless specification
Screws	Stainless specification	Standard specification
Lubrications	LGU grease	AS2 Grease
Surface treatment	Low temperature chrome plating Fluoride low temperature chrome plating	—

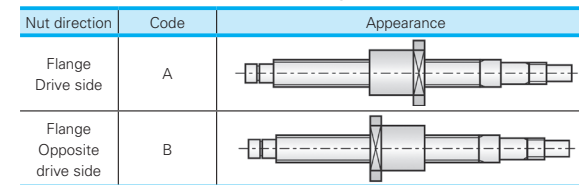
3. Reference number for ball screws



No.	Classification	Detail	Code
①	Product code	Ball Screw for Rechargeable Battery Manufacturing Equipment	B
②	Material Accuracy	Carbon steel, Ct7	C
		Carbon steel + low temperature chrome plating, Ct7	D
		Carbon steel + fluoride low temperature chrome plating, Ct7	E
		Stainless, Ct7	S
		Stainless + low temperature chrome plating, Ct7	T
		Stainless + fluoride low temperature chrome plating, Ct7	H
		Carbon steel, Ct10	R
		Carbon steel + low temperature chrome plating, Ct10 Carbon steel + fluoride low temperature chrome plating, Ct10	V K
③	Packed code	Combination	A
④⑤	Shaft diameter	Screw shaft diameter (mm)	15
		Lead (mm)	10
⑥⑦	Lead	Flange - Drive side	A
		Flange - Opposite drive side	B
⑧	Nut direction	Flange - Drive side Flange - Opposite drive side	A B
⑨*1	Axial play	0.2mm or less	L
		0.010mm or less *2	S
⑩	Lubrication	0mm (Preload)	Z
		AS2 (For general use / high load)	1
		LGU (For cleanroom environments)	5
⑪	Option	Antirust oil *3	9
		—	N
⑫⑬⑭⑮	Screw shaft total length	4 digits (Round down decimal point)	1200
		Ct7, For coupling Ct7, For pulley Ct10, For coupling Ct10, For pulley Ct10, Blank shaft end	A B C D E
⑰*4	Shaft end drive side shape	Free	F
		Support	G
⑱	Shaft end opposite drive side shape	Free	F
		Support	G

*1) Select [S],[Z] in case of accuracy Ct7. Select [L] in case of accuracy Ct10
 Screw shaft diameter φ 8 lead 10 is only for [S] specification with clearance of 0.01mm
 *2) Some may provide with pre-loaded
 *3) In case of use of other grease or oil lubrication
 *4) Screw shaft diameter φ 14 or less is only for coupling and blank shaft end

Table 2 Nut direction (8th digit reference number)



4. Options

Available options are listed in Table 3

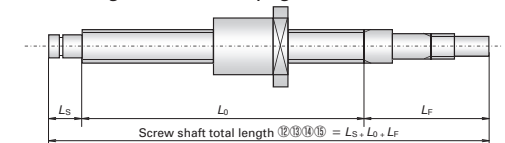
Table 3 Available options

Column	Detail
Nut direction	Flange Drive side/Opposite drive side
Lubrication	AS2 (For general use / high load) LGU (For cleanroom environments) Antirust oil
Screw shaft · Nut material	Carbon steel Stainless
Surface treatment	Low temperature chrome plating Fluoride low temperature chrome plating

5. Design precaution

The total length of the screw shaft is calculated by the screw shaft length and the shaft end lengths of the drive and opposite drive sides as shown in the figure below.

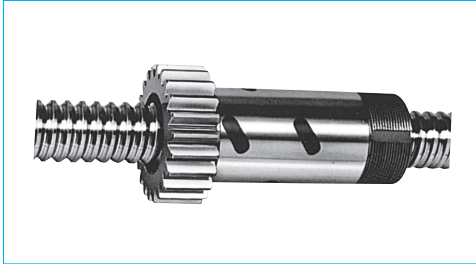
For general precautions regarding ball screws, Refer to "Design Precautions" (page B83) and "Handling Precautions" (page B103)



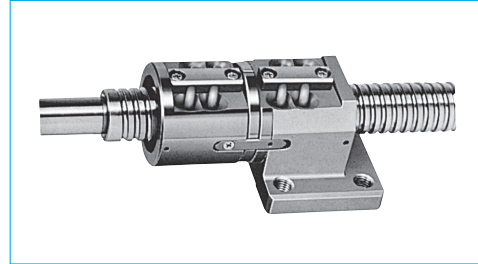
B-3-3.11 Special Ball Screws

In addition to standard ball screws, NSK manufactures various types of ball screws in special shapes as shown below.

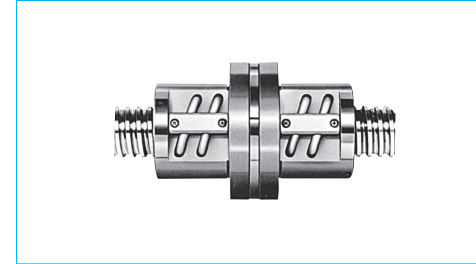
Thoroughly consult with NSK before determining specifications and ordering ball screws with special shapes.



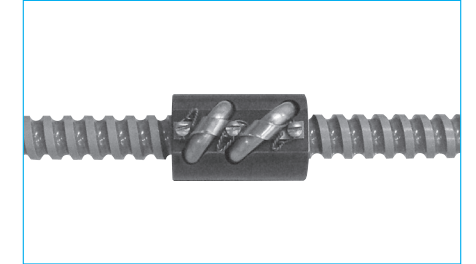
Nut with gear



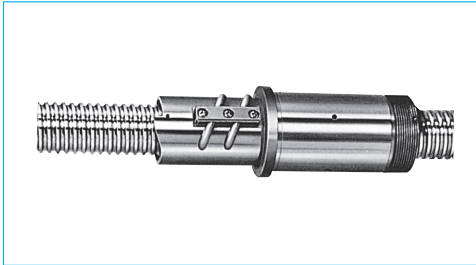
Double nut with flat mounting surface



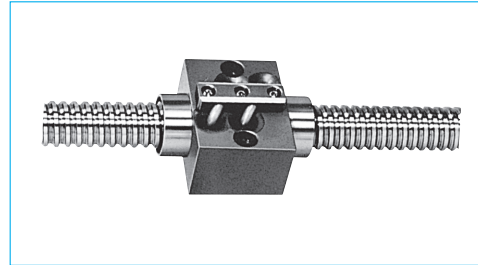
Flange to flange ball nut



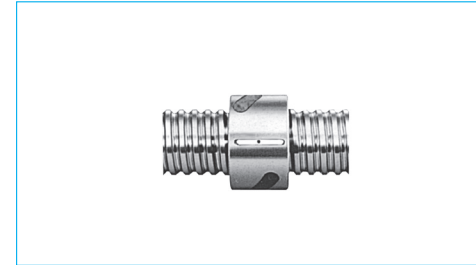
Ball screw for aircraft



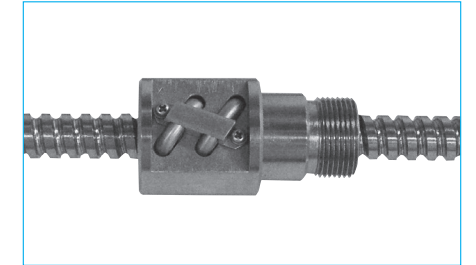
Lightly preloaded single nut with bearing seat



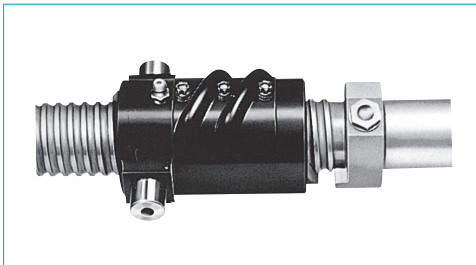
Lightly preloaded single nut with flat mounting surface



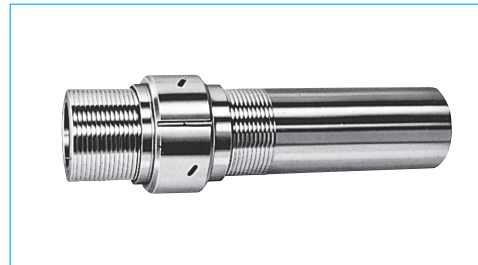
Cylindrical nut



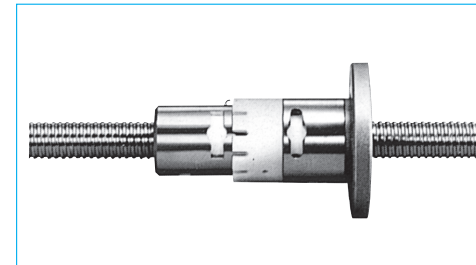
Ball screw for nuclear power plants



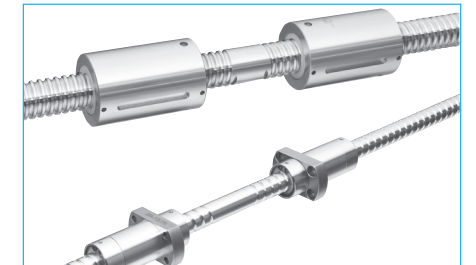
Nut with trunion



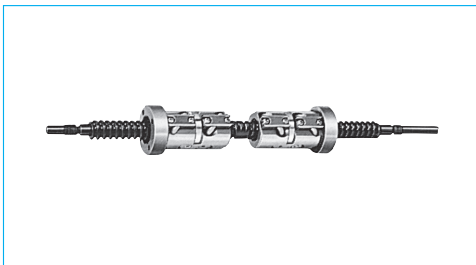
Hollow shaft, lightly preloaded single nut, with large shaft diameter and fine lead



Spring preloaded ball screw



Right and left hand thread on each side of screw



Double nut with right and left turn thread on each side of screw shaft

C-1 Monocarrier™

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5. NSK Clean Grease LG2 Specification ..	C148

C BLOCK

Monocarrier™

Toughcarrier™

C3-C92

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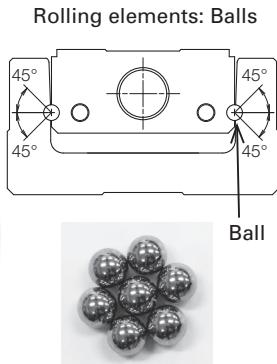
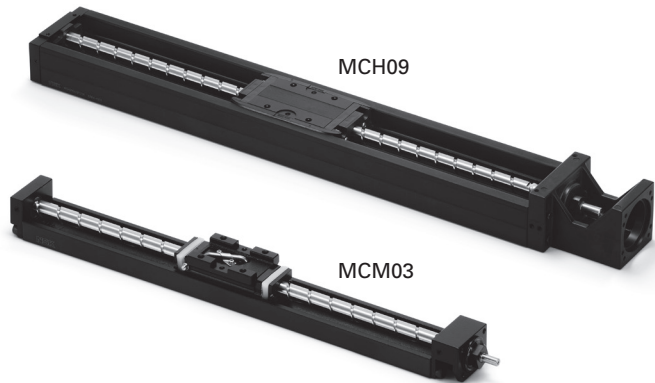
C141
-C148

Monocarrier™, Toughcarrier™

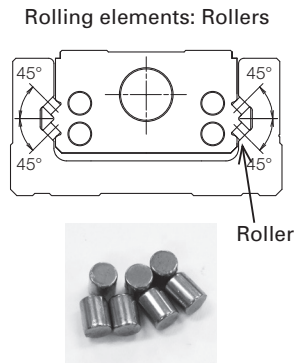
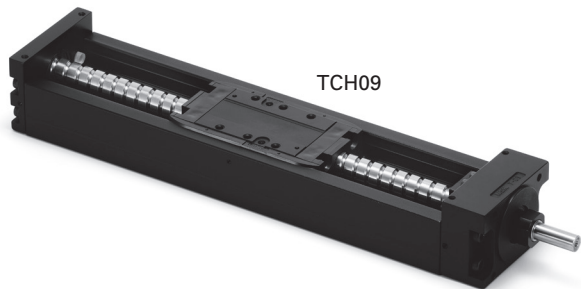
All-in-one structure (integrated ball screw, linear guide and base) results in a light and compact actuator without extra work for design or adjustment when installing. Design and assembly loads can be reduced by unit type. Also, the many variations make it possible to deal with many different uses.

Monocarrier™ and Toughcarrier™ Classifications

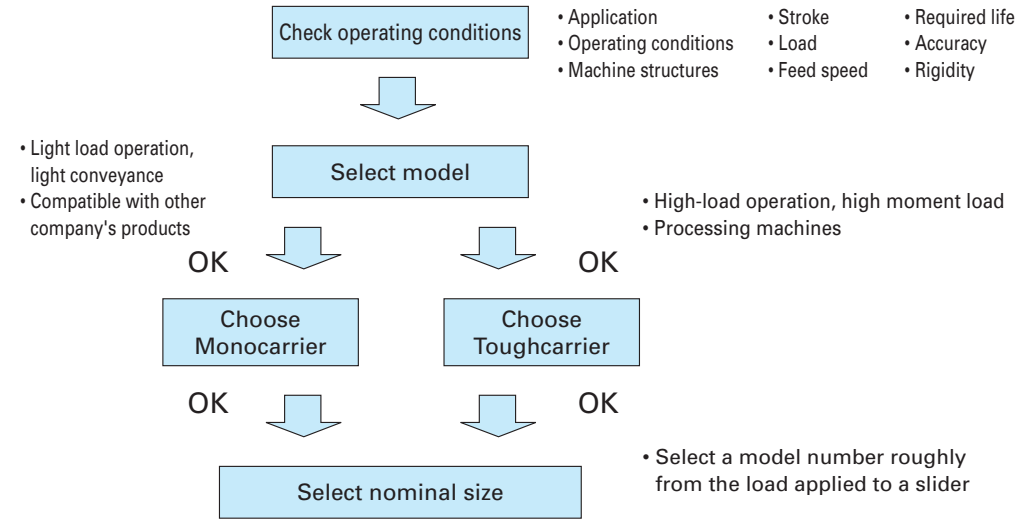
● Monocarrier™



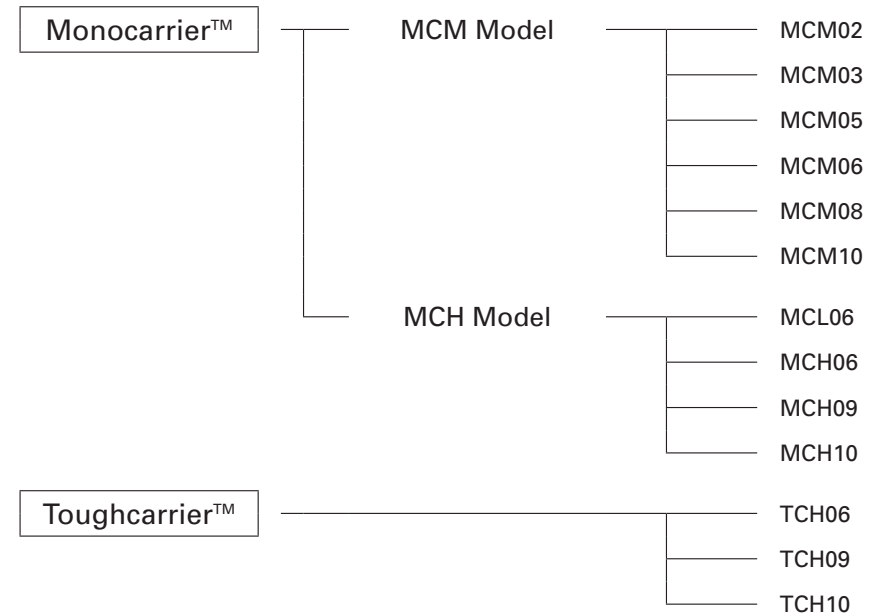
● Toughcarrier™: High load capacity



Selecting Monocarrier™ and Toughcarrier™ Actuators



Monocarrier™ and Toughcarrier™ Composition



C-1 Monocarrier™

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6 MCH Model	C73
6.1 MCH Model Reference Number Coding	C75
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C-1 Monocarrier™

C-1 Monocarrier™

C-1-1 Features

NSK's Monocarrier is the culmination of technology and innovation in linear motion. This lightweight, compact single axis linear actuator integrates quality NSK ball screw, linear guide and support bearings into one unit.

1 Light weight, compact design

- Available in two different shapes of cross-section, depending on application.
Light weight type: MCM Series
Rigid type: MCH Series

2 All-in-one structure

- The all-in-one structure integrates a ball screw, a linear guide and support bearings into a single unit to significantly reduce design and installation time.
- Multiple datum planes, the bottom and a lateral side of the rail, facilitate highly accurate installation.
- Immediate operation after installation and run-in is possible.
- A wide selection of fine to high helix leads are available.

4 Long term maintenance free

- Use of NSK K1 Lubrication Units and grease maintains smooth lubricating performance for long periods in mechanical environments where lubrication is difficult, where use of oil is not permitted because of hygienic issues, or where the mechanical equipment is subjected to frequent wash downs.
- NSK K1 lubrication unit is available for food processing machines and medical equipment.
- Grease for clean environments and for general machinery is available.

3 Superb antirust capability

- Low temperature chrome plating is a standard feature for the bodies and sliders to control rusting in normal operating and storing environments. Fluoride low temperature chrome plating is optionally available for much higher rust prevention.



5 Quick Delivery

MONOCARRIER™

C-1-2 Classification and Models

Table 2.1

	Light Weight	Beam Rigidity	Moment Rigidity
MCM Model	○	○	○
MCH Model	○	◎	○

◎: Excellent ○: Suitable

	Accuracy	Long Stroke	Size Variation
	○	○	◎
	◎	◎	○

[MCM Model Cross-sections]

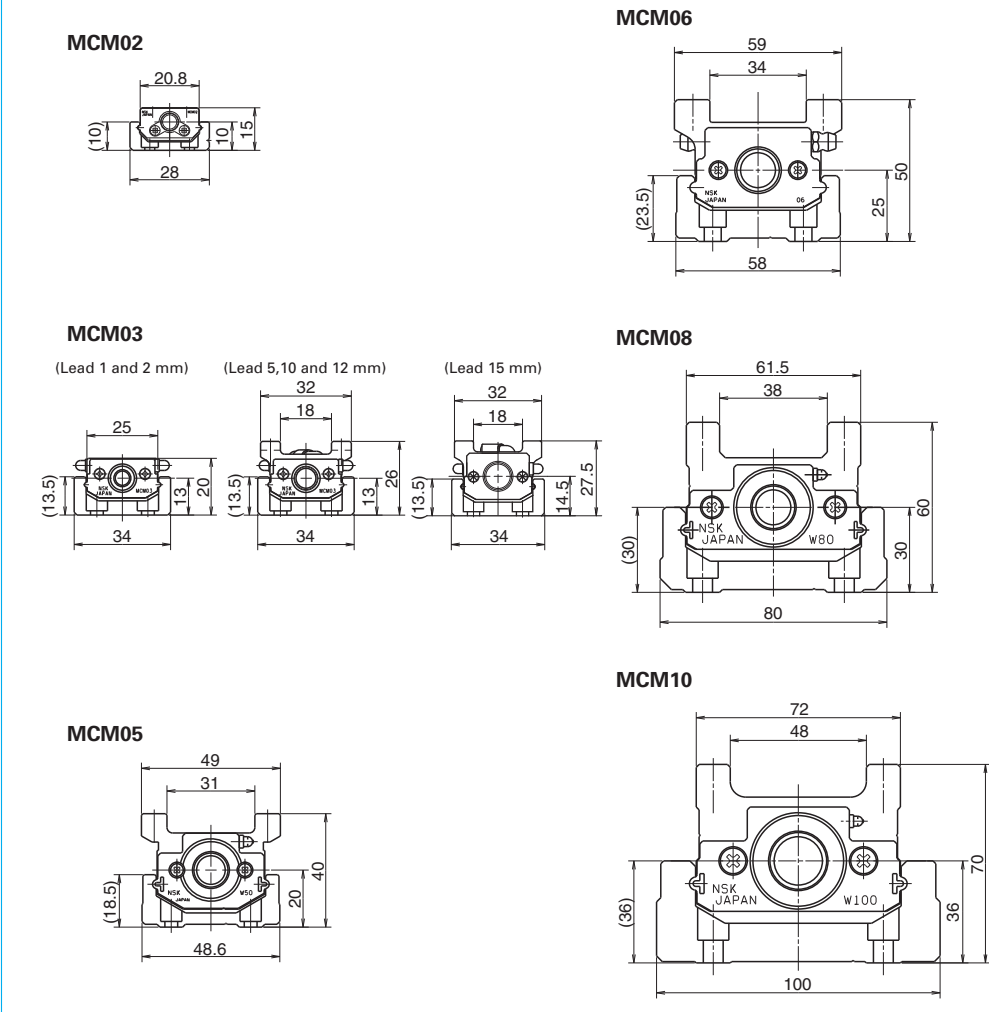


Fig. 2.1

[MCH Model Cross-sections]

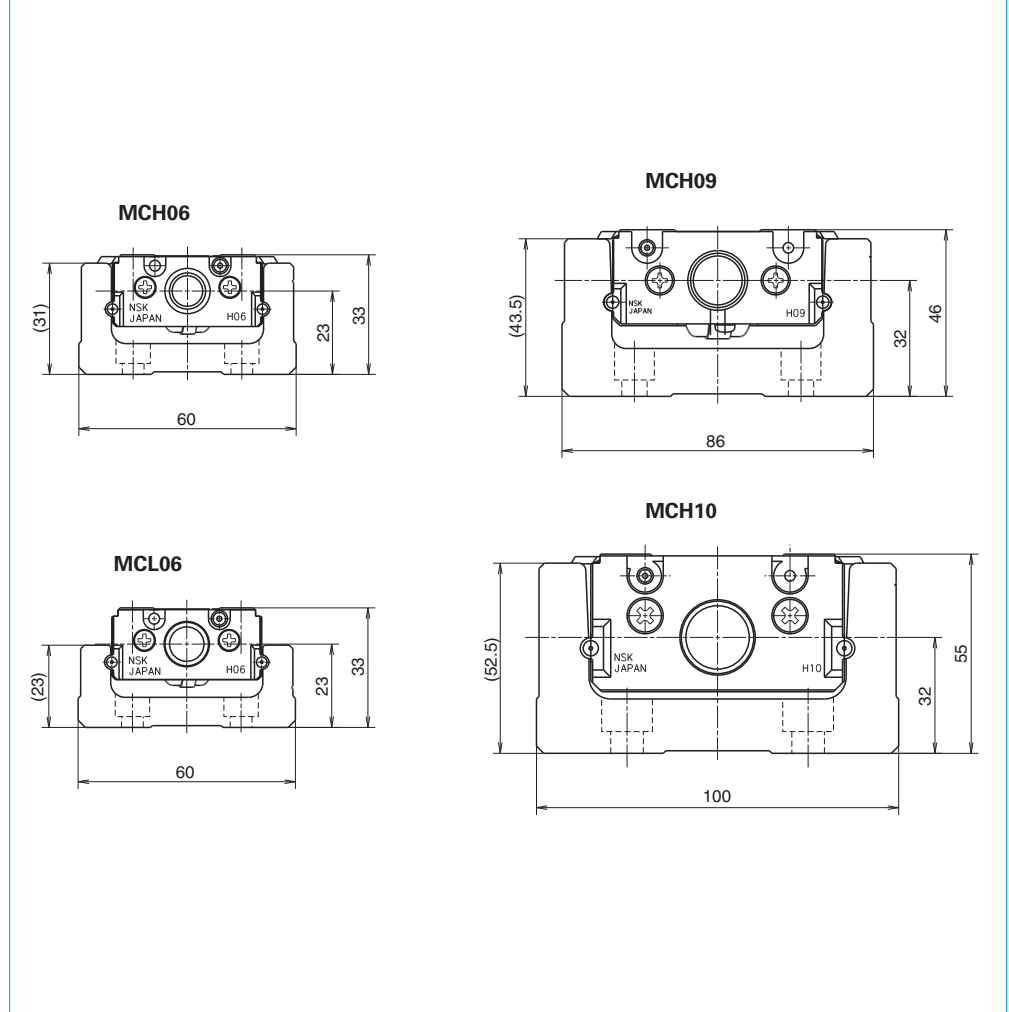


Fig. 2.2

C-1-3 Accessories

MCM Model

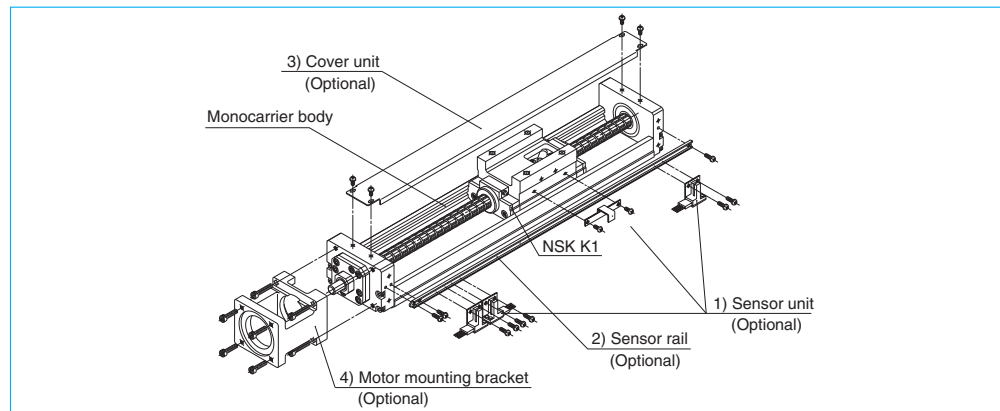


Fig. 3.1 Assembly: Accessories for MCM10 (example)

1) Sensor unit: Sensors, sensor mounting parts and a sensor dog are available in a set.

* When a sensor unit is used, the full cover unit cannot be used.

2) Sensor rail: Rail for sensor mounting is available.

3) Cover unit: Top cover or full cover (included top cover and side cover) is available.

4) Motor bracket for motor mounting: Available for a variety of models.

Note: We assemble accessories upon request.

MCH Model

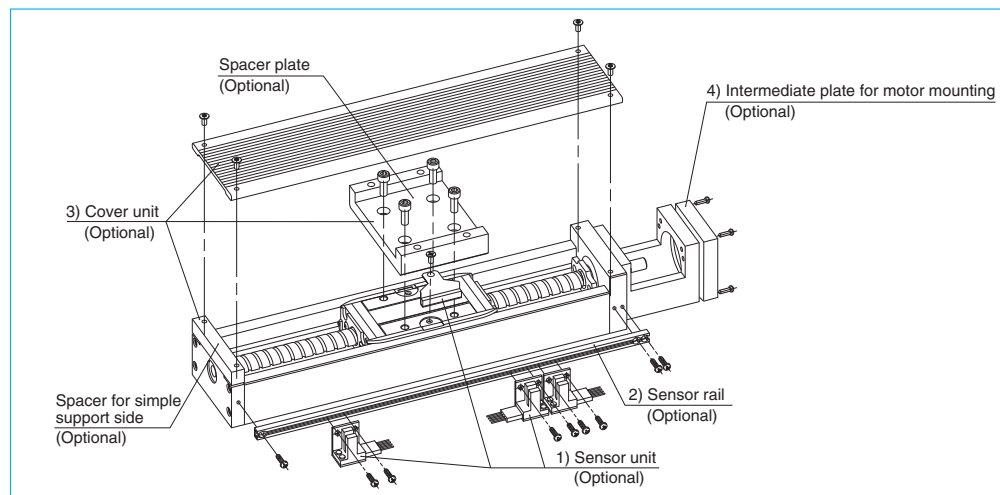


Fig. 3.2 Assembly: Accessories for MCH10 (example)

1) Sensor unit: Sensors, sensor mounting parts and a sensor dog are available in a set.

2) Sensor rail: Rail for sensor mounting is available.

3) Cover unit: Top cover (included spacer plate and spacer for simple support side) is available.

4) Intermediate plate for motor mounting: Available for a variety of models.

Note: We assemble accessories upon request.

C-1-4 Selection of Monocarrier

C-1-4. 1 Selection Procedures

Select a model of Monocarrier based on stroke and rigidity (refer to **Figs. 4.2**, and **4.3**).



Select a ball screw lead referring to "**C-1-4.3 Maximum Speed**" so that the rotational speed does not exceed the limit.



Study the loads to be applied to the linear guide and obtain the equivalent load (F_e) substituting them for equation (1) or (2) on page C19. Obtain the mean effective load (F_m) substituting them for equation 3) on page C20, then calculate the life.



Study the loads to be applied to the ball screw and support unit. Obtain the mean effective load (F_m) substituting them for equation 3) on page C20, then calculate the life.

C-1-4. 2 Rigidity

Rigidity of rail

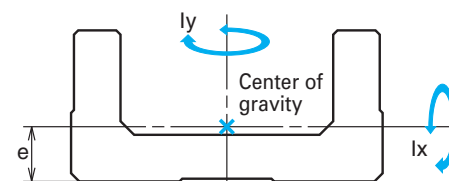


Fig. 4.1

Table 4.1 Rigidity of rail

Model No.	Geometrical moment of inertia $\times 10^4$ (mm ⁴)		Center of gravity (mm)	Mass (kg/100 mm)
	Ix	Iy	e	
MCM02	0.097	1.32	3.3	0.11
MCM03	0.30	3.3	4.5	0.18
MCM05	0.78	11.4	6.0	0.31
MCM06	2.14	26.1	7.0	0.57
MCM08	5.90	81.0	9.2	0.88
MCM10	15.6	219	12.2	1.52
MCL06	2.58	29.6	7.8	0.56
MCH06	6.5	38.2	10.8	0.67
MCH09	28.7	172	15.5	1.48
MCH10	54.0	307	18	1.93

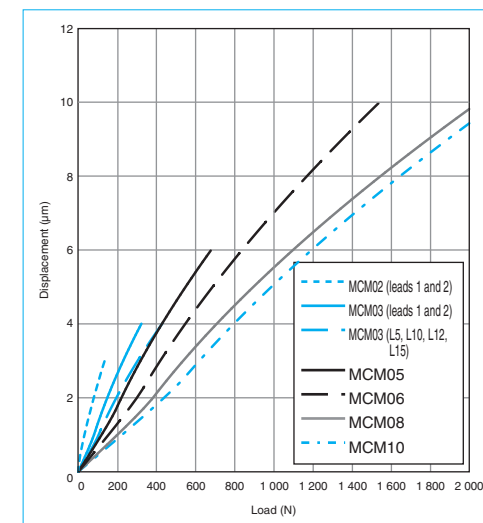


Fig. 4.2 MCM Model rigidity in radial direction

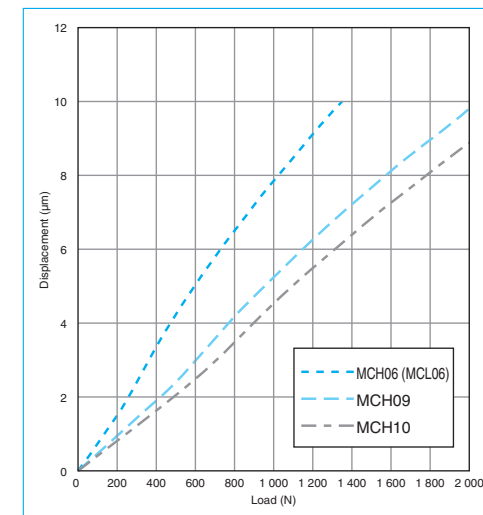


Fig. 4.3 MCH Model rigidity in radial direction

C-1-4. 3 Maximum Speed

(1) Maximum Speed of MCM Model

Maximum speed of a Monocarrier actuator is determined by critical speed of ball screw shaft and $d \cdot n$ value.

Do not exceed maximum speeds in the table below.

Table 4.2

	Ball screw lead	Stroke (mm)	Rail length L ₂ (mm)	Maximum speed (mm/s)	
MCM02 Single slider	1	50	100	50	
		100	150		
		150	200		
	2	50	100	100	
		100	150		
		150	200		
MCM03 Single slider	1	50	115	50	
		100	190		
		150	240		
	2	50	115	100	
		100	190		
		150	240		
	5	50 to 250	140 to 340	410	
	10	50 to 250	140 to 340	830	
	12	50 to 250	140 to 340	1 000	
	15	50 to 250	140 to 340	1 250	
	MCM05 Single slider	5	50 to 400	180 to 530	410
			500	630	370
600			730	270	
10		50 to 400	180 to 530	830	
		500	630	750	
		600	730	540	
20		50 to 400	180 to 530	1 660	
		500	630	1 470	
		600	730	1 070	
30		50 to 400	180 to 530	2 500	
		500	630	2 160	
		600	730	1 570	
MCM05 Double slider		10	60 to 410	280 to 630	830
			510	730	710
		20	60 to 410	280 to 630	1 660
	510		730	1 460	

	Ball screw lead	Stroke (mm)	Rail length L ₂ (mm)	Maximum speed (mm/s)
MCM06 Single slider	5	50 to 500	190 to 640	410
		600	740	330
		700	840	250
		800	940	190
		50 to 500	190 to 640	830
	10	600	740	650
		700	840	500
		800	940	390
		50 to 500	190 to 640	1 660
	20	600	740	1 300
		700	840	990
		800	940	780
110 to 510		340 to 640	410	
MCM06 Double slider	5	110 to 410	340 to 640	410
		110 to 510	190 to 640	830
		610	740	660
	10	710	840	500
		210 to 510	440 to 640	1 660
		610	740	1 310
20	710	940	1 000	

- Notes: 1) Please consult NSK before operating Monocarrier actuators near maximum speed.
 2) Maximum rotational speed is (5000 min⁻¹). (For leads 5,10,12,15,20 & 30)
 3) Refer to the above table for maximum speed for each stroke.

	Ball screw lead	Stroke (mm)	Rail length L ₂ (mm)	Maximum speed (mm/s)
MCM08 Single slider	5	50 to 500	220 to 670	410
		600	770	320
		700	870	250
		800	970	190
		50 to 500	220 to 670	830
		500	670	640
	10	600	770	490
		700	870	380
		800	970	380
		50 to 500	220 to 670	1 660
	20	600	770	1 280
		700	870	980
		800	970	770
		400	570	2 500
	30	500	670	2 480
		600	770	1 830
		700	870	1 400
	MCM08 Double slider	10	80 to 380	370 to 670
480			770	810
580			870	630
680			970	500
20		180 to 380	470 to 670	1 660
		480	770	1 640
		580	870	1 270
		680	970	1 010

	Ball screw lead	Stroke (mm)	Rail length L ₂ (mm)	Maximum speed (mm/s)	
MCM10 Single slider	10	50 to 600	280 to 780	830	
		700	880	660	
		800	980	520	
		900	1 080	420	
		1 000	1 180	340	
		50 to 600	280 to 780	1 660	
	20	700	880	1 310	
		800	980	1 030	
		900	1 080	840	
		1 000	1 180	690	
	30	500	680	2 500	
		600	780	2 430	
		700	880	1 870	
		800	980	1 480	
	MCM10 Double slider	10	70 to 570	380 to 880	830
			670	980	660
			870	1 180	450
		20	170 to 570	480 to 880	1 660
670			980	1 340	
870			1 180	910	

- Notes: 1) Please consult NSK before operating Monocarrier actuators near maximum speed.
 2) Maximum rotational speed is (5000 min⁻¹). (For leads 5,10,12,15,20 & 30)
 3) Refer to the above table for maximum speed for each stroke.

(2) Maximum Speed of MCH Model

Maximum speed of a Monocarrier actuator is determined by critical speed of ball screw shaft and $d \cdot n$ value.

Do not exceed maximum speeds in the table below.

Table 4.3

	Ball screw lead	Stroke (mm)	Rail length L ₂ (mm)	Maximum speed (mm/s)	
MCH06 MCL06 Single slider	5	50 to 500	150 to 600	410	
		10	50 to 500	150 to 600	830
	20		50 to 400	150 to 500	1 660
			500	600	1 610
	MCH06 Double slider	5	100 to 300	300 to 500	410
		10	100 to 400	300 to 600	830
20		400	600	1 660	
MCH09 Single slider	5	100 to 500	240 to 640	410	
		600	740	360	
		700	840	270	
		800	940	210	
	10	100 to 500	240 to 640	830	
		600	740	710	
		700	840	530	
		800	940	410	
	20	100 to 500	240 to 640	1 660	
		600	740	1 410	
		700	840	1 060	
		800	940	830	
MCH09 Double slider	5	150 to 350	440 to 640	410	
		150 to 450	440 to 740	830	
	10	650	940	530	
		450	740	1 660	
	20	650	940	1 080	

	Ball screw lead	Stroke (mm)	Rail length L ₂ (mm)	Maximum speed (mm/s)
MCH10 Single slider	10	50 to 600	280 to 780	830
		700	880	670
		800	980	530
		900	1 080	420
		1 000	1 180	350
		1 100	1 280	290
		1 200	1 380	250
	20	50 to 600	280 to 780	1 660
		700	880	1 330
		800	980	1 050
		900	1 080	840
		1 000	1 180	700
1 100		1 280	580	
	1 200	1 380	490	
MCH10 Double slider	10	250 to 550	580 to 880	830
		650	980	660
	20	250 to 550	580 to 880	1 660
		650	980	1 340
		750	1 080	1 100
		850	1 180	910
	950	1 280	760	
	1 050	1 380	630	

Notes: 1) Please consult NSK before operating Monocarrier actuators near maximum speed.

2) Maximum rotational speed is (5000 min⁻¹). (For leads 5,10,12,15,20 & 30)

3) Refer to the above table for maximum speed for each stroke.

C-1-4. 6 Basic Load Rating

(1) MCM Model Basic Load Ratings

Table 4.10 Basic Load Ratings

Model No.	Lead l (mm)	Shaft dia d (mm)	Basic dynamic load ratings (N)				Basic static load ratings (N)		Support unit Allowable load (N)
			Ball screw C_a	Linear guide C	Support unit C_s	Rated running distance L_a (km)	Ball screw C_{0a}	Linear guide C_0	
MCM02	1	$\phi 6$	405(High grade) 480(Precision)	4 910	615	1	555(High grade) 615(Precision)	2 120	490
			400(High grade) 475(Precision)				610(Precision)		
	2			2					
MCM03	1	$\phi 6$	870	10 900	3 350	1	1 230	4 900	725
	2		865	8 650		2	1 220		
	5	2 090	7 850	5		2 830	6 620		
	10	1 310	6 250	10		1 710			
	12	1 320	5 880	12		1 730			
15	$\phi 10$	2 000	5 440	15	2 740				
MCM05	5	$\phi 12$	4 390	15 600	5 550	5	6 260	10 900	1 020
	10		2 740	12 400		10	3 820		
	20		2 660	9 850		20	3 800		1 910
	30		3 300	8 600		30	5 390		
MCM06	5	$\phi 15$	8 300	25 200	8 300	5	12 700	17 000	1 910
	10		8 140	20 000		10	12 800		
	20		5 080	15 900		20	7 460		
MCM08	5	$\phi 15$	8 300	30 800	9 000	5	12 700	22 800	2 130
	10		8 140	24 400		10	12 800		
	20		5 080	19 400		20	7 460		
	30		5 500	16 930		30	8 580		
MCM10	10	$\phi 20$	12 800	33 500	9 600	10	21 400	29 400	2 360
	20		8 190	26 600		20	12 600		
	30		13 200	23 200		30	22 900		

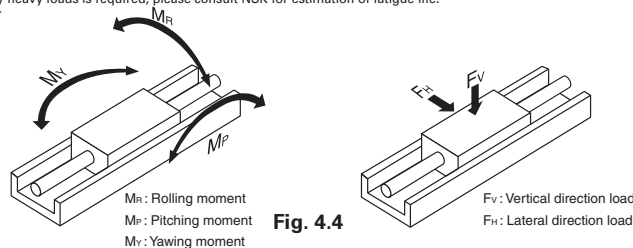
Notes: ● Basic dynamic and static load ratings indicate values for one slider. ● Basic load ratings for the linear guide are loads perpendicular to the axis that allow 90% of a group of the same Monocarriers to operate to the rated running distance in the table, that is equivalent to 1 million revolutions of ball screw and support unit under the same conditions without causing flaking by rolling contact fatigue. ● Basic dynamic load ratings for the ball screw are axial loads that allow 90% of ball screws of a group of the same Monocarriers to rotate 1 million revolutions under the same conditions without causing flaking by rolling contact fatigue. ● Basic dynamic load ratings for the support unit are constant axial loads that allow 90% of support units of the same group of Monocarriers to rotate 1 million revolutions under the same conditions without causing flaking by rolling contact fatigue. ● Basic static load ratings are loads that result in combined permanent deformations at the contact point between a ball and the ball groove to 0.01% of the ball diameter.

Table 4.11 Basic static moment loads of linear guide

Model No.	Lead (mm)	Slider	Basic static moments (N · m)		
			Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
MCM02	1, 2	Single	24	8	8
MCM03	1, 2		68	28	28
MCM03	5, 10, 12, 15	Single	92	51	51
			MCM05	5, 10, 20, 30*	Single
MCM05	5, 10, 20, 30*	Double	455	765	765
		MCM06	5, 10, 20	Single	415
MCM06	5, 10, 20	Double	825	1 220	1 220
		MCM08	5, 10, 20, 30*	Single	770
Double	1 540			2 050	2 050
MCM08	5, 10, 20, 30*	Single	1 170	425	425
		Double	2 340	2 940	2 940
MCM10	10, 20, 30*	Single	1 170	425	425
		Double	2 340	2 940	2 940

Notes: ● Basic static moments for double sliders are values when two sliders equipped with NSK K1 are butted against each other. ● Basic static moments are values when the rolling contact pressure of balls exceeds 4 000 N/mm². ● If support for extremely heavy loads is required, please consult NSK for estimation of fatigue life.

*) Applicable only to single slider



(2) MCH Model Basic Load Ratings

Table 4.12 Basic Load Ratings

Model No.	Lead l (mm)	Shaft dia d (mm)	Basic dynamic load ratings (N)				Basic static load ratings (N)		Support unit Allowable load (N)	
			Ball screw C_a	Linear guide C	Support unit C_s	Rated running distance L_a (km)	Ball screw C_{0a}	Linear guide C_0		
MCH06 (MCL06)	5	$\phi 12$	4 390	22 800	5 550	5	6 260	16 300	1 020	
	10		2 740	18 100			10			3 820
	20		2 660	14 400			20			3 800
MCH09	5	$\phi 15$	8 300	40 600	9 000	5	12 700	30 500	2 130	
	10		8 140	32 200			10			12 800
	20		5 080	25 500			20			7 460
MCH10	10	$\phi 20$	12 800	44 600	9 600	10	21 400	42 000	2 360	
	20		8 190	35 400			20			12 600

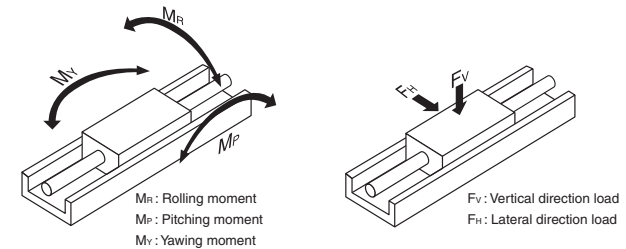
Notes: ● Basic dynamic and static load ratings indicate values for one slider. ● Basic load ratings for the linear guide are loads perpendicular to the axis that allow 90% of a group of the same Monocarriers to operate to the rated running distance in the table, that is equivalent to 1 million revolutions of ball screw and support unit under the same conditions without causing flaking by rolling contact fatigue. ● Basic dynamic load ratings for the ball screw are axial loads that allow 90% of ball screws of a group of the same Monocarriers to rotate 1 million revolutions under the same conditions without causing flaking by rolling contact fatigue. ● Basic dynamic load ratings for the support unit are constant axial loads that allow 90% of support units of the same group of Monocarriers to rotate 1 million revolutions under the same conditions without causing flaking by rolling contact fatigue. ● Basic static load ratings are loads that result in combined permanent deformations at the contact point between a ball and the ball groove to 0.01% of the ball diameter.

Table 4.13 Basic static moment loads of linear guide

Model No.	Slider	Basic static moments (N · m)		
		Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
MCH06 (MCL06)	Single	335	133	133
	Double	770	730	730
MCH09	Single	890	385	385
	Double	1 780	2 070	2 070
MCH10	Single	1 460	610	610
	Double	2 920	3 430	3 430

Notes: ● Basic static moments for double sliders are values when two sliders equipped with NSK K1 are butted against each other. ● Basic static moments are values when the rolling contact pressure of balls exceeds 4 000 N/mm². ● If support for extremely heavy loads is required, please consult NSK for estimation of fatigue life.

*) Applicable only to single slider



C-1-4. 7 Estimation of Life Expectancy

(1) Life of Linear Guide

Study the load to be applied to the linear guide of Monocarrier (Fig. 4.6). Equivalent load F_e is determined by inputting the appropriate loads into the equations below. Use equation 1) for single sliders and equation 2) for double sliders.

● For a single slider

$$F_e = Y_H F_H + Y_V F_V + Y_R \epsilon_R M_R + Y_P \epsilon_P M_P + Y_Y \epsilon_Y M_Y \dots\dots\dots 1)$$

● For a double slider

$$F_e = \frac{Y_H F_H}{2} + \frac{Y_V F_V}{2} + Y_R \epsilon_{Rd} M_R + Y_P \epsilon_{Pd} M_P + Y_Y \epsilon_{Yd} M_Y \dots\dots\dots 2)$$

- 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_{Rr} ϵ_{Rd} : Dynamic equivalent coefficient to rolling moment
- ϵ_{Pr} ϵ_{Pd} : Dynamic equivalent coefficient to pitching moment
- ϵ_{Yr} ϵ_{Yd} : Dynamic equivalent coefficient to yawing moment

Refer to **Table 4.14** about Dynamic equivalent coefficients.

- Y_{Hr} Y_{Vr} Y_{Rr} Y_{Pr} Y_{Yr} : 1.0 or 0.5

To obtain equivalent load F_e from equation 1) or 2), among F_H , F_V , $\epsilon_P M_P$, $\epsilon_R M_R$, $\epsilon_Y M_Y$, the maximum load is assumed to be 1.0, and others to be 0.5.

Table 4.14 Dynamic equivalent coefficient

Model No.	MCM02	MCM03		MCM05	MCM06	MCM08	MCM10	MCH06 MCL06	MCH09	MCH10
		Lead 1, 2	Lead 5, 10, 12, 15							
ϵ_R	95.2	79.4	79.4	52.6	45.5	32.5	27.8	48.3	34.5	28.6
ϵ_P	174	113.9	84.2	81.3	65.1	48.8	45.2	75.1	47.9	41.0
ϵ_Y	174	113.9	84.2	81.3	65.1	48.8	45.2	75.1	47.9	41.0
ϵ_{Rd}	-	-	-	26.3	22.7	16.3	13.9	24.2	17.2	14.3
ϵ_{Pd}	-	-	-	10.4 (12.2)	9.7 (11.5)	7.6 (8.6)	7.1 (8.0)	11.4 (13.2)	8.11 (9.10)	6.98 (7.82)
ϵ_{Yd}	-	-	-	10.4 (12.2)	9.7 (11.5)	7.6 (8.6)	7.1 (8.0)	11.4 (13.2)	8.11 (9.10)	6.98 (7.82)

Note: Parenthesized figures are dynamic equivalent coefficients for Monocarrier actuators without NSK K1.

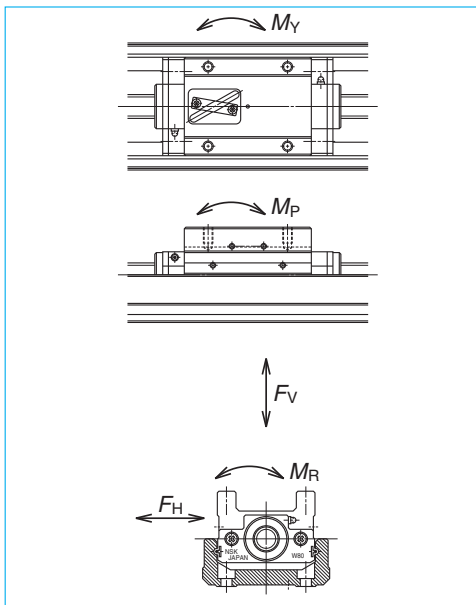


Fig. 4.6 Direction of load

In cases when the load acting on the slider may fluctuate (In general, M_r , M_y may fluctuate with the acceleration/deceleration of slider), the mean effective load is determined by Eq. 3).

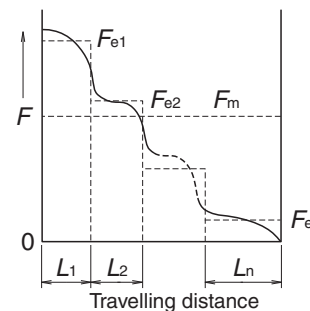


Fig. 4.7 Stepwise Fluctuating Load

Travelling distance under the equivalent load F_{e1} : L_1
 Travelling distance under the equivalent load F_{e2} : L_2

 Travelling distance under the equivalent load F_{en} : L_n

$$F_m = \sqrt[3]{\frac{1}{L} (F_{e1}^3 L_1 + F_{e2}^3 L_2 + \dots + F_{en}^3 L_n) \dots 3)$$

F_m : Mean effective load of fluctuating loads
 L : Total travelling distance

The life of linear guide is calculated by Eq. 4).

$$L = L_a \times \left(\frac{C}{f_w \cdot F_m} \right)^3 \dots\dots\dots 4)$$

- L : Life of linear guide (km)
- F_m : Mean effective load acting on the linear guide (N)
- C : Basic dynamic load rating of the linear guide (N)
- L_a : Travelling distance (km)
- f_w : Load factor (refer to **Table 4.15**)

When the estimated life does not clear the required life, the life of the linear guide is to be calculated again after the following measures are taken:

1. Change from a single slider to a double slider.
2. Use a larger size Monocarrier.

(2) Life of Ball Screw (Support unit)

The mean effective load is determined from axial loads.

For calculation of the mean effective load, use Eq. 3.

The life of ball screw is calculated by Eq. 5).

$$L = \ell \times \left(\frac{C_a}{f_w \cdot F_m} \right)^3 \times 10^6 \dots\dots\dots 5)$$

- ℓ : Lead of ball screw (mm)
- L : Life of ball screw (mm)
- C_a : Basic dynamic load rating of the ball screw (N)
- F_m : Mean effective load acting on the ball screw (N)
- f_w : Load factor (refer to **Table 4.15**)

The life of a support unit is calculated by Eq. 5). If the life of ball screw/support unit does not clear the required life, use a larger size Monocarrier. After applying the calculations mentioned above, selection of the Monocarrier is completed.

Table 4.15 Values of load factor f_w

Operating conditions	Load factor f_w
Smooth operation with no mechanical shock	1.0 – 1.2
Normal operation	1.2 – 1.5
Operation with mechanical shock and vibrations	1.5 – 3.0

C-1-4. 8 Example Life Estimation

This section offers an example how to estimate the life of Monocarrier based on the life of each component.

<<Example calculation-1>>

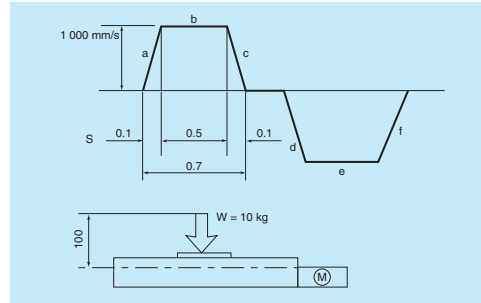


Fig. 4.8

1. Use condition

- Stroke : 600 mm
- Maximum speed : 1000 mm/s
- Load mass : W = 10 kg
- Acceleration : g = 9.80 m/s²
- Setting position : Horizontal
- Operating profile : See above figure

2. Selection of model (Interim Selection)

Firstly, select a greater ball screw lead as the maximum speed is 1000 mm/s. The interim selection is MCM06060H20K00, a single slider specification MCM06 that has 600 mm stroke, as the stroke is 600 mm.

3. Calculation

3-1. Linear guide

3-1-1. Fatigue life:

Multiply the result of Eq. 1) by the dynamic equivalent coefficient (Table 4.14 single slider) to convert the load volume. From above operation profile,

- i) Constant speed $F_{e1} = Y_V \cdot F_V = Y_V \cdot W \cdot g = 1 \cdot 10 \cdot 9.8 = 98 \text{ N}$
- ii) Accelerating $F_{e2} = Y_V \cdot F_V + Y_P \cdot \epsilon_P \cdot M_P = 0.5 \cdot 10 \cdot 9.8 + 1.65 \cdot 1 \cdot 0.1 \cdot 100 = 700 \text{ N}$
- iii) Decelerating $F_{e3} = Y_V \cdot F_V + Y_P \cdot \epsilon_P \cdot M_P = 0.5 \cdot 10 \cdot 9.8 + 1.65 \cdot 1 \cdot 0.1 \cdot 100 = 700 \text{ N}$

Mean effective load F_m

$$F_m = \sqrt[3]{\frac{1}{L} (F_{e1}^3 \cdot L_1 + F_{e2}^3 \cdot L_2 + F_{e3}^3 \cdot L_3)}$$

$$= \sqrt[3]{\frac{1}{600} (98^3 \cdot 500 + 700^3 \cdot 50 + 700^3 \cdot 50)}$$

$$= 387 \text{ N}$$

$$L = \left(\frac{C}{f_w \cdot F_m} \right)^3 \times L_a$$

$$= \left(\frac{15900}{1.2 \cdot 387} \right)^3 \times 20$$

$$= 8.02 \times 10^5 \text{ km}$$

3-1-2. Static safety factor: Divide the basic static load rating by the maximum load.

$$F_s = \frac{C_0}{F_e} = \frac{C_0}{F_{e2}} = \frac{17000}{700} = 24.2$$

3-2. Ball screw

3-2-1. Fatigue life: Obtain the axial load of each stage of operation referring to the operation profile, then calculate the mean load.

By the process above,

- i) Constant speed $F_{e1} = \mu \cdot W \cdot g = 0.01 \cdot 10 \cdot 9.8 = 0.98 \text{ N}$
- ii) Accelerating $F_{e2} = F_{e1} + W \cdot \alpha = 101 \text{ N}$
- iii) Decelerating $F_{e3} = F_{e1} - W \cdot \alpha = 99 \text{ N}$

Axial mean effective load F_m

$$F_m = \sqrt[3]{\frac{1}{L} (F_{e1}^3 \cdot L_1 + F_{e2}^3 \cdot L_2 + F_{e3}^3 \cdot L_3)}$$

$$= \sqrt[3]{\frac{1}{600} (0.98^3 \cdot 500 + 101^3 \cdot 50 + 99^3 \cdot 50)}$$

$$= 55 \text{ N}$$

$$L = \left(\frac{C_a}{f_w \cdot F_m} \right)^3 \times \ell \times 10^6$$

$$= \left(\frac{5080}{1.2 \cdot 55} \right)^3 \times 20 \times 10^6 \text{ (mm)}$$

$$= 9.1 \times 10^6 \text{ km}$$

3-2-2. Static safety factor: Divide the basic static load rating by the maximum axial load.

$$F_s = \frac{C_{0a}}{F_e} = \frac{C_{0a}}{F_{e2}} = \frac{7460}{101} = 73.8$$

3-2-3. Maximum rotational speed: According to the table of maximum speed on page C11, MCM06 with 20 mm lead and 600 mm stroke is possible to operate under the maximum speed

of 1 300 mm/s.

3-3. Support unit

3-3-1. Fatigue life: Use the axial load $F_m = 55 \text{ N}$, that is the result of above calculation 3-2-1.

$$L = \left(\frac{C_a}{f_w \cdot F_m} \right)^3 \times \ell \times 10^6 = \left(\frac{8300}{1.2 \times 55} \right)^3 \times 20 \times 10^6 \text{ (mm)}$$

$$= 3.97 \times 10^7 \text{ km}$$

3-3-2. Static safety factor: Divide the Allowable load by the maximum axial load.

$$F_s = \frac{C_{0a}}{F_e} = \frac{C_{0a}}{F_{e2}} = \frac{1910}{101} = 18.9$$

3-4. Results

MCM06060H20K00	Linear guide	Ball screw	Support unit
Fatigue life	8.02 × 10 ⁵ km	9.1 × 10 ⁶ km	3.97 × 10 ⁷ km
Static safety factor	24.2	73.8	18.9

In this case, the linear guide has the shortest fatigue life of the components. Therefore, the linear guide fatigue life is used as the life of the Monocarrier. The interim selection of MCM06060H20K00, that is chosen based on the use conditions, satisfies the required life.

<<Example calculation-2>>

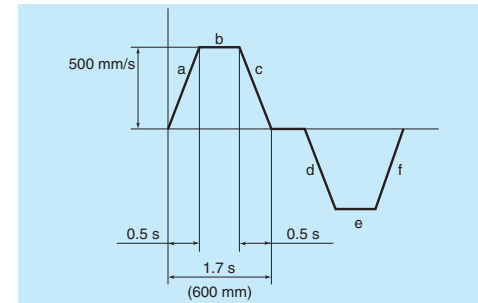


Fig. 4.9

1. Use condition

- Stroke : 600 mm
- Maximum speed : 500 mm/s
- Load mass : W = 20 kg
- Acceleration : 9.8 m/s²
- Setting position : Horizontal
- Operating profile : See above figure

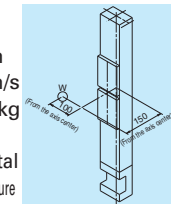


Fig. 4.10

2. Selection of model (Interim Selection) Select a 10 mm lead ball screw as the maximum speed

is 500 mm/s.

The interim selection is MCM08068H10D00 as a double slider specification of MCM08 has 680 mm stroke, and the setting position is vertical.

3. Calculation

3-1. Linear guide

3-1-1. Fatigue life: Multiply the result of the Eq. 2) by the dynamic equivalent coefficient (Table 4.14. double slider) to convert the load volume. From operation profile (Fig. 4.9), the acceleration is 1 m/s².

- i) Constant speed $F_{e1} = Y_P \cdot \epsilon_{Pd} \cdot M_P + Y_V \cdot \epsilon_{Vd} \cdot M_V = 1 \cdot 7.6 \cdot 20 \cdot 9.8 \cdot 0.15 + 0.5 \cdot 7.6 \cdot 20 \cdot 9.8 \cdot 0.1 = 298 \text{ N}$
- ii) Accelerating $F_{e2} = Y_P \cdot \epsilon_{Pd} \cdot M_P + Y_V \cdot \epsilon_{Vd} \cdot M_V = 1 \cdot 7.6 \cdot 20 \cdot (9.8 + 1.0) \cdot 0.15 + 0.5 \cdot 7.6 \cdot 20 \cdot (9.8 + 1.0) \cdot 0.1 = 329 \text{ N}$
- iii) Decelerating $F_{e3} = Y_P \cdot \epsilon_{Pd} \cdot M_P + Y_V \cdot \epsilon_{Vd} \cdot M_V = 1 \cdot 7.6 \cdot 20 \cdot (9.8 - 1.0) \cdot 0.15 + 0.5 \cdot 7.6 \cdot 20 \cdot (9.8 - 1.0) \cdot 0.1 = 268 \text{ N}$

Mean effective load F_m

$$F_m = \sqrt[3]{\frac{1}{L} (F_{e1}^3 \cdot L_1 + F_{e2}^3 \cdot L_2 + F_{e3}^3 \cdot L_3)}$$

$$= \sqrt[3]{\frac{1}{600} (298^3 \cdot 350 + 329^3 \cdot 125 + 268^3 \cdot 125)}$$

$$= 300 \text{ N}$$

$$L = L_a \times \left(\frac{C}{f_w \cdot F_m} \right)^3$$

$$= 10 \times \left(\frac{24400}{1.2 \cdot 300} \right)^3$$

$$= 3.11 \times 10^6 \text{ km}$$

3-1-2. Static safety factor: Divide the basic static load rating by the maximum load.

$$F_s = \frac{C_0}{F_e} = \frac{C_0}{F_{e2}} = \frac{22800}{329} = 69.3$$

3-2. Ball screw

3-2-1. Fatigue life: Obtain the axial load of each stage of operation referring to the operation profile, then calculate the mean load.

- i) Constant speed $F_{e1} = W \cdot g = 20 \cdot 9.8 = 196 \text{ N}$
- ii) Accelerating $F_{e2} = F_{e1} + W \cdot \alpha = 196 + 20 \cdot 1 = 216 \text{ N}$
- iii) Decelerating $F_{e3} = F_{e1} - W \cdot \alpha = 196 - 20 \cdot 1 = 176 \text{ N}$

Axial mean effective load F_m

$$F_m = \sqrt[3]{\frac{1}{L} (F_{e1}^3 \cdot L_1 + F_{e2}^3 \cdot L_2 + F_{e3}^3 \cdot L_3)}$$

$$= \sqrt[3]{\frac{1}{600} (196^3 \cdot 350 + 216^3 \cdot 125 + 176^3 \cdot 125)}$$

$$= 197 \text{ N}$$

$$L = \ell \times \left(\frac{C_a}{f_w \cdot F_m} \right)^3 \times 10^6$$

$$= 10 \times \left(\frac{8\,140}{1.2 \cdot 197} \right)^3 \times 10^6 \text{ (mm)}$$

$$= 4.08 \times 10^5 \text{ km}$$

3-2-2. Static safety factor: Divide the basic static load rating by the maximum axial load.

$$F_s = \frac{C_{0a}}{F_e} = \frac{C_{0a}}{F_{e2}} = \frac{12\,800}{216} = 59.2$$

3-3. Support unit

3-3-1. Fatigue life: Use the axial load $F_m = 197 \text{ N}$, that is the result of above calculation 3-2-1.

$$L = \ell \times \left(\frac{C_a}{f_w \cdot F_m} \right)^3 \times 10^6 = 10 \times \left(\frac{9\,000}{1.2 \times 197} \right)^3 \times 10^6 \text{ (mm)}$$

$$= 5.51 \times 10^5 \text{ km}$$

3-3-2. Static safety factor: Divide the Allowable load by the maximum axial load.

$$F_s = \frac{C_{0a}}{F_e} = \frac{C_{0a}}{F_{e2}} = \frac{2\,130}{216} = 9.8$$

3-4. Results

MCM08068H10D00	Linear guide	Ball screw	Support unit
Fatigue life	3.11 × 10 ⁶ km	4.08 × 10 ⁶ km	5.51 × 10 ⁶ km
Static safety factor	69.3	59.2	9.8

**C-1-5 MCM Model**

1 MCM Model Reference Number C27

Coding

**2 MCM Model Dimension Tables for
Standard Products**

MCM02 C28

MCM03 C29

MCM05 C33

MCM06 C37

MCM08 C41

MCM10 C45

3 MCM Model Accessories

3.1 Sensor Unit C49

3.2 Cover Unit C53

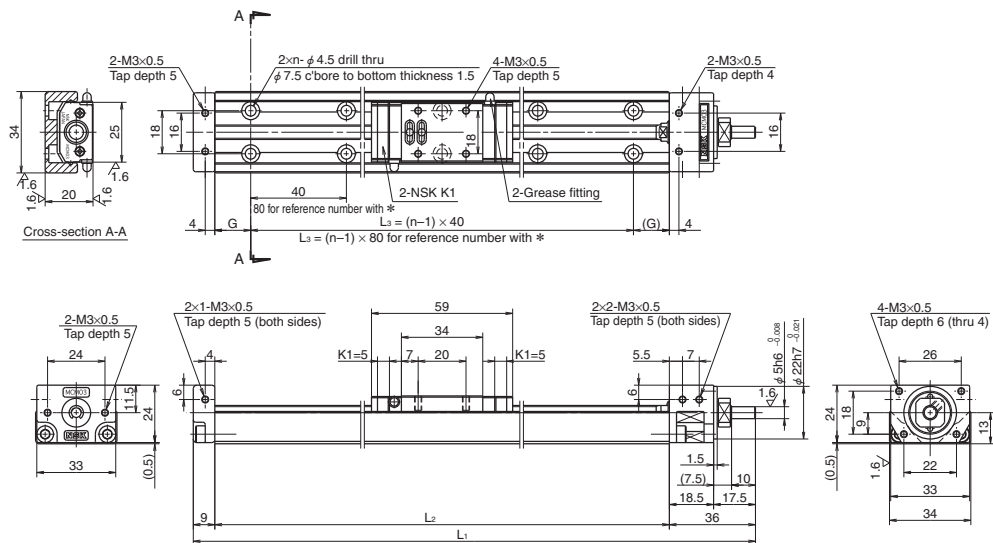
3.3 Motor Bracket C55

MCM Model

MCM03

Accuracy grade: Precision (P)

Ball screw leads 1 and 2



Dimensions of MCM03 (Single slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm)				No. of mounting holes <i>n</i>	Inertia $\times 10^{-5}$ (kg · m ²)	Mass (kg)
				L ₁	L ₂	G	L ₃			
*MCM03005P01K00	50	56 (66)	1	160	115	17.5	80	2	0.015	0.6
*MCM03005P02K00			2							
MCM03010P01K00	100	131 (141)	1	235	190	15	160	5	0.021	0.7
MCM03010P02K00			2							
MCM03015P01K00	150	181 (191)	1	285	240	20	200	6	0.025	0.8
MCM03015P02K00			2							

Note: Bolt hole pitch L₃ on items marked with * is 80 mm.

Monocarrier dynamic torque specification (N · cm)

Ball screw lead (mm)	Accuracy grade	
	High grade	Precision
1	0.2 - 2.5	0.6 - 4.4
2	0.3 - 3.0	0.7 - 4.9

Notes:

- Frictional resistance of NSK K1 is included in dynamic torque in table.
- Grease is packed into ball screws, linear guide parts and support units.
- Consult NSK for life estimates under large moment loads.
- A spacer plate is required when using a cover unit or sensor unit for MCM03 with a lead of 1 or 2 mm. (See page C53.)

Basic load ratings

Lead <i>l</i> (mm)	Shaft dia <i>d</i> (mm)	Basic dynamic load ratings (N)				Basic static load ratings (N)		Support unit Allowable load (N)
		Ball screw <i>C_a</i>	Linear guides <i>C</i>	Support unit <i>C_a</i>	Rated running distance <i>L_a</i> (km)	Ball screw <i>C_{0a}</i>	Linear guides <i>C₀</i>	
1	φ 6	870	10 900	3 350	1	1 230	4 900	725
2		865	8 650		2	1 220		

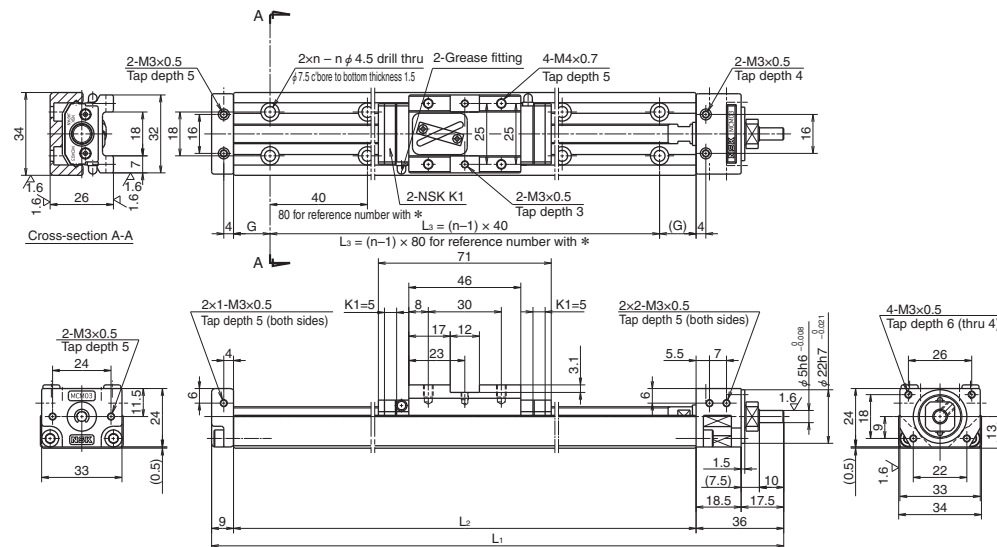
Basic static moment loads of linear guide

Slider	Basic static moment load (N · m)		
	Rolling M _{RO}	Pitching M _{PO}	Yawing M _{VO}
Single	68	28	28

MCM03

Accuracy grade: High grade (H)

Ball screw leads 5, 10 and 12



Dimensions of MCM03 (Single slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm)				No. of mounting holes <i>n</i>	Inertia $\times 10^{-5}$ (kg · m ²)	Mass (kg)	
				L ₁	L ₂	G	L ₃				
*MCM03005H05K00	50	69 (79)	5	185	140	30	80	2	0.057	0.6	
*MCM03005H10K00			10								0.080
*MCM03005H12K00			12								0.097
MCM03010H05K00	100	119 (129)	5	235	190	15	160	5	0.073	0.7	
MCM03010H10K00			10								0.092
MCM03010H12K00			12								0.109
MCM03015H05K00	150	169 (179)	5	285	240	20	200	6	0.089	0.8	
MCM03015H10K00			10								0.105
MCM03015H12K00			12								0.122
MCM03020H05K00	200	219 (229)	5	335	290	25	240	7	0.104	0.9	
MCM03020H10K00			10								0.118
MCM03020H12K00			12								0.135
MCM03025H05K00	250	269 (279)	5	385	340	30	280	8	0.120	1.0	
MCM03025H10K00			10								0.131
MCM03025H12K00			12								0.147

Note: Bolt hole pitch L₃ on items marked with * is 80 mm.

Monocarrier dynamic torque specification (N · cm)

Ball screw lead (mm)	Accuracy grade	
	High grade	Precision
5	0.2 - 2.5	0.6 - 4.4
10	0.3 - 3.0	0.7 - 4.9
12		

Notes:

- Frictional resistance of NSK K1 is included in dynamic torque in table.
- Grease is packed into ball screws, linear guide parts and support units.
- Consult NSK for life estimates under large moment loads.

Basic load ratings

Lead <i>l</i> (mm)	Shaft dia <i>d</i> (mm)	Basic dynamic load ratings (N)				Basic static load ratings (N)		Support unit Allowable load (N)		
		Ball screw <i>C_a</i>	Linear guides <i>C</i>	Support unit <i>C_a</i>	Rated running distance <i>L_a</i> (km)	Ball screw <i>C_{0a}</i>	Linear guides <i>C₀</i>			
5	φ 8	2 090	7 850	3 350	5	2 830	6 620	725		
10		1 310	6 250						10	1 710
12		1 320	5 880						12	1 730

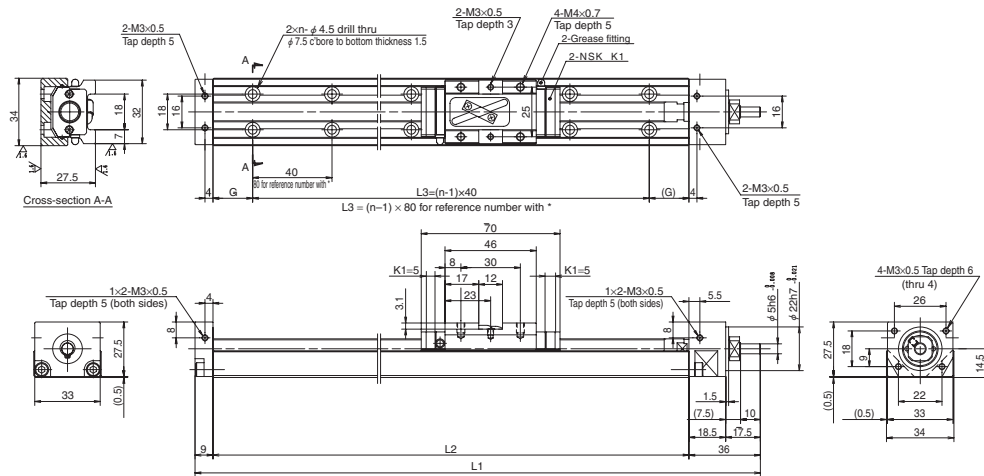
Basic static moment loads of linear guide

Slider	Basic static moment load (N · m)		
	Rolling M _{RO}	Pitching M _{PO}	Yawing M _{VO}
Single	92	51	51

MCM03

Ball screw lead 15

Accuracy grade: High grade (H)



Dimensions of MCM03 (Single slider)

Reference No.	Nominal stroke (mm)	Stroke limit (without K1)	Ball screw lead (mm)	Ball screw diameter (mm)	Body length (mm)				No. of mounting holes n	Inertia $\times 10^{-4}$ (kg·m ²)	Mass (kg)
					L ₁	L ₂	G	L ₃			
* MCM03005H15K00	50	70 (80)	15	φ 10	185	140	30	80	2	0.183	0.67
MCM03010H15K00	100	120(130)			235	190	15	160	5	0.222	0.77
MCM03015H15K00	150	170(180)			285	240	20	200	6	0.260	0.87
MCM03020H15K00	200	220(230)			335	290	25	240	7	0.298	0.97
MCM03025H15K00	250	270(280)			385	340	30	280	8	0.336	1.07

Note: Bolt hole pitch L₃ on items marked with * is 80 mm.

Monocarrier dynamic torque specification (N·cm)

Ball screw lead (mm)	15	0.3 – 5.6
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Notes:

- Frictional resistance of NSK K1 is included in dynamic torque in tables.
- Grease is packed into ball screws, linear guide parts and support units.
- Consult NSK for life estimates under large moment loads.
- When a cover unit is added, an optional spacer plate is required. (See page C53.)
- There is no P grade (precision grade) for Lead 15.

Basic load ratings

Lead l (mm)	Shaft dia d (mm)	Basic dynamic load ratings (N)				Rated running distance L_R (km)	Basic static load ratings (N)		Support unit Allowable load (N)
		Ball screw C_a	Linear guides C	Support unit C_A	Ball screw C_{0a}		Linear guide C_0		
15	φ 10	2 000	5 440	3 350	15	2 740	6 620	725	

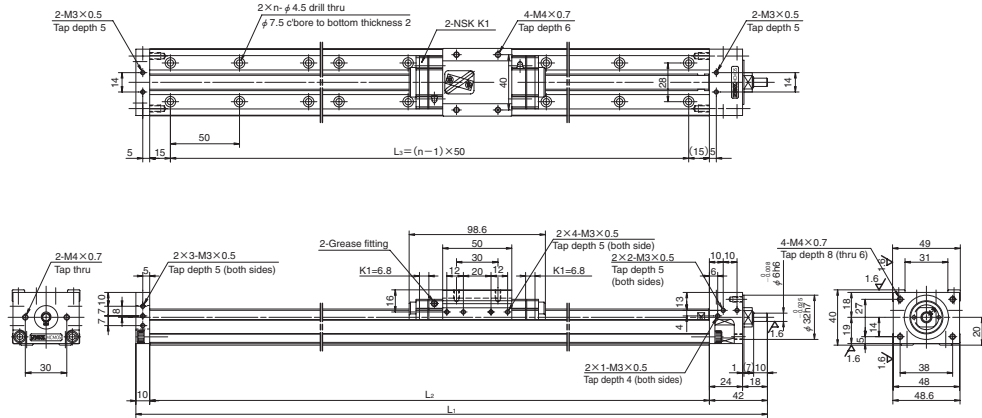
Basic static loads of linear guide

Slider	Basic static moment load (N·m)		
	Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Single	92	51	51

MCM05

Accuracy grade: High grade (H)

Ball screw leads 5, 10 and 20



Dimensions of MCM05 (Single slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm)			No. of mounting holes <i>n</i>	Inertia $\times 10^{-4}$ (kg · m ²)	Mass (kg)
				<i>L</i> ₁	<i>L</i> ₂	<i>L</i> ₃			
MCM05005H05K00	50	81 (95)	5	232	180	150	4	0.025	1.4
MCM05005H10K00			10						
MCM05005H20K00			20						
MCM05010H05K00	100	131 (145)	5	282	230	200	5	0.031	1.6
MCM05010H10K00			10						
MCM05010H20K00			20						
MCM05015H05K00	150	181 (195)	5	332	280	250	6	0.036	1.8
MCM05015H10K00			10						
MCM05015H20K00			20						
MCM05020H05K00	200	231 (245)	5	382	330	300	7	0.042	2.0
MCM05020H10K00			10						
MCM05020H20K00			20						
MCM05025H05K00	250	281 (295)	5	432	380	350	8	0.047	2.2
MCM05025H10K00			10						
MCM05025H20K00			20						

Monocarrier dynamic torque specification (N · cm)

Ball screw lead(mm)	Accuracy grade	
	High grade	Precision
5	1.0 – 4.8	1.9 – 7.7
10	1.1 – 5.8	2.1 – 8.7
20	1.6 – 7.9	2.5 – 10.7
30	1.8 – 13.1	—

Notes:

- Frictional resistance of NSK K1 is included in dynamic torque in table.
- Grease is packed into ball screws, linear guide parts and support units.
- Consult NSK for life estimates under large moment loads.

Basic load ratings

Lead <i>l</i> (mm)	Shaft dia <i>d</i> (mm)	Basic dynamic load ratings (N)				Basic static load ratings (N)		Support unit Allowable load (N)
		Ball screw <i>C</i> _a	Linear guides <i>C</i>	Support unit <i>C</i> _a	Rated running distance <i>L</i> _a (km)	Ball screw <i>C</i> _{0a}	Linear guides <i>C</i> ₀	
5	φ 12	4 390	15 600	5 550	5	10 900	1 020	
10		2 740	12 400		10			
20		2 660	9 850		20			
30		3 300	8 600		30			

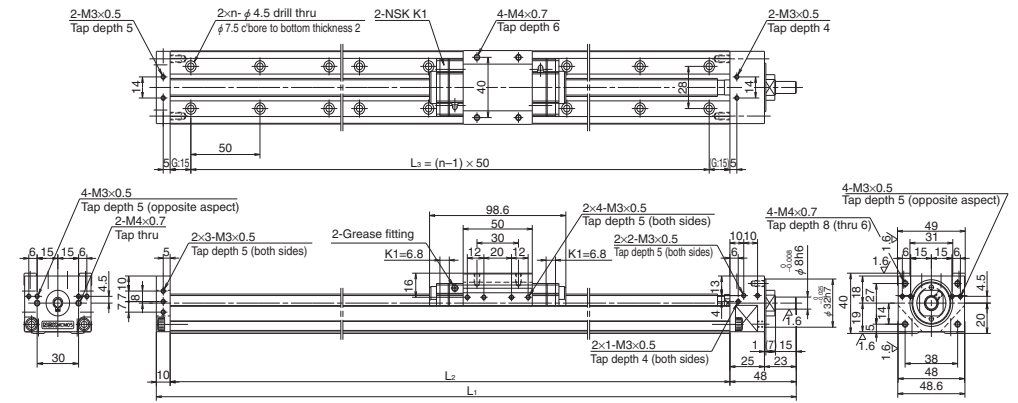
Basic static moment loads of linear guide

Slider	Basic static moment load (N · m)		
	Rolling <i>M</i> _{RO}	Pitching <i>M</i> _{PO}	Yawing <i>M</i> _{VO}
Single	229	89	89

MCM05

Accuracy grade: High grade (H)

Ball screw lead 30



Dimensions of MCM05 (Single slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm)			No. of mounting holes <i>n</i>	Inertia $\times 10^{-4}$ (kg · m ²)	Mass (kg)
				<i>L</i> ₁	<i>L</i> ₂	<i>L</i> ₃			
MCM05030H05K00	300	331 (345)	5	482	430	400	9	0.053	2.3
MCM05030H10K00			10						
MCM05030H20K00			20						
MCM05030H30K00			30						
MCM05040H05K00	400	431 (445)	5	582	530	500	11	0.064	2.7
MCM05040H10K00			10						
MCM05040H20K00			20						
MCM05040H30K00			30						
MCM05050H05K00	500	531 (545)	5	682	630	600	13	0.076	3.1
MCM05050H10K00			10						
MCM05050H20K00			20						
MCM05050H30K00			30						
MCM05060H05K00	600	631 (645)	5	782	730	700	15	0.087	3.5
MCM05060H10K00			10						
MCM05060H20K00			20						
MCM05060H30K00			30						

Monocarrier dynamic torque specification (N · cm)

Ball screw lead(mm)	Accuracy grade	
	High grade	Precision
5	1.0 – 4.8	1.9 – 7.7
10	1.1 – 5.8	2.1 – 8.7
20	1.6 – 7.9	2.5 – 10.7
30	1.8 – 13.1	—

Notes:

- Frictional resistance of NSK K1 is included in dynamic torque in table.
- Grease is packed into ball screws, linear guide parts and support units.
- Consult NSK for life estimates under large moment loads.

Basic load ratings

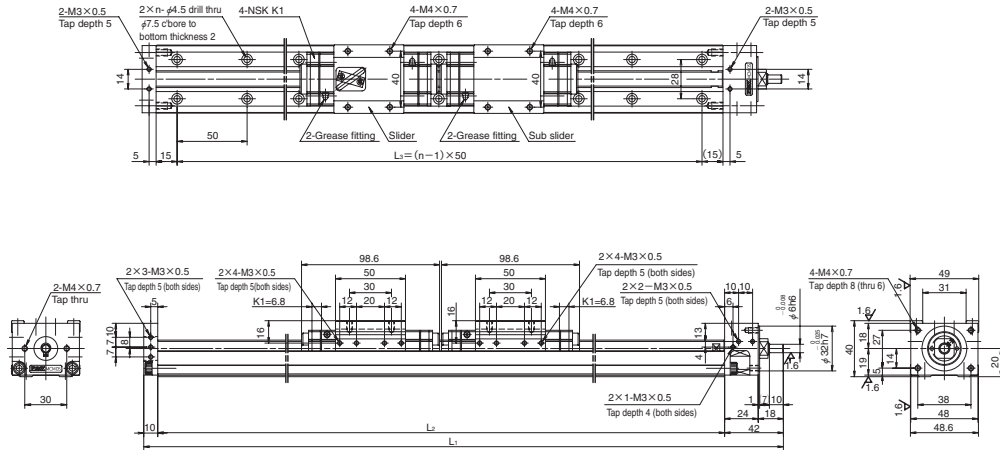
Lead <i>l</i> (mm)	Shaft dia <i>d</i> (mm)	Basic dynamic load ratings (N)				Basic static load ratings (N)		Support unit Allowable load (N)
		Ball screw <i>C</i> _a	Linear guides <i>C</i>	Support unit <i>C</i> _a	Rated running distance <i>L</i> _a (km)	Ball screw <i>C</i> _{0a}	Linear guides <i>C</i> ₀	
5	φ 12	4 390	15 600	5 550	5	10 900	1 020	
10		2 740	12 400		10			
20		2 660	9 850		20			
30		3 300	8 600		30			

Basic static moment loads of linear guide

Slider	Basic static moment load (N · m)		
	Rolling <i>M</i> _{RO}	Pitching <i>M</i> _{PO}	Yawing <i>M</i> _{VO}
Single	229	89	89

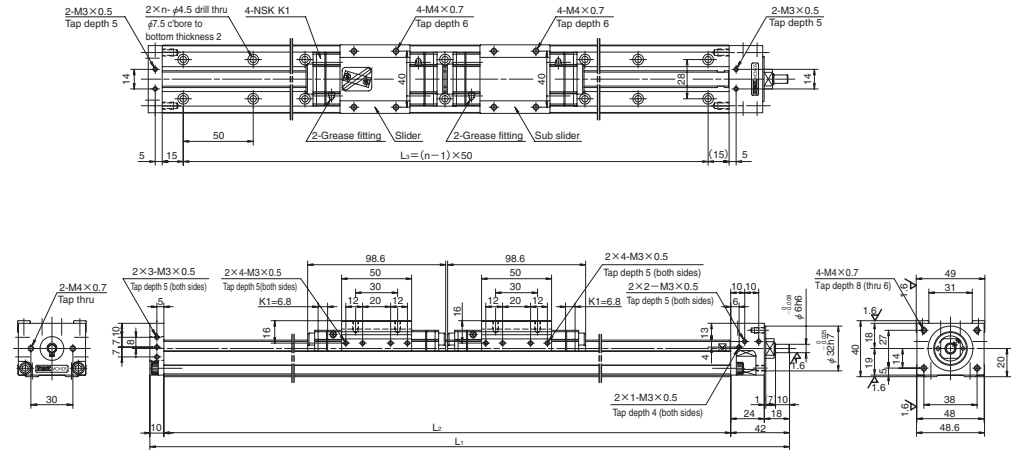
MCM05 (Double slider)

Accuracy grade: High grade (H)



MCM05 (Double slider)

Accuracy grade: High grade (H)



Dimensions of MCM05 (Double slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm)			No. of mounting holes <i>n</i>	Inertia ×10 ⁻⁴ (kg·m ²)	Mass (kg)
				L ₁	L ₂	L ₃			
MCM05006H10D00	60	82 (110)	10	332	280	250	6	0.058	2.3
MCM05011H10D00	110	132 (160)	10	382	330	300	7	0.064	2.5
MCM05016H10D00	160	182 (210)	10	432	380	350	8	0.070	2.7
MCM05021H10D00	210	232	10	482	430	400	9	0.075	2.8
MCM05021H20D00		(260)	20					0.151	

Dimensions of MCM05 (Double slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm)			No. of mounting holes <i>n</i>	Inertia ×10 ⁻⁴ (kg·m ²)	Mass (kg)
				L ₁	L ₂	L ₃			
MCM05031H10D00	310	332 (360)	10	582	530	500	11	0.086	3.2
MCM05031H20D00			20					0.162	
MCM05041H10D00	410	432 (460)	10	682	630	600	13	0.098	3.6
MCM05041H20D00			20					0.174	
MCM05051H10D00	510	532 (560)	10	782	730	700	15	0.109	4.2
MCM05051H20D00			20					0.185	

Monocarrier dynamic torque specification (N·cm)

Ball screw lead(mm)	Accuracy grade	
	High grade	Precision
10	1.5 - 7.6	2.4 - 10.6
20	2.3 - 11.8	3.2 - 14.8

Notes:

- Frictional resistance of NSK K1 is included in dynamic torque in table.
- Grease is packed into ball screws, linear guide parts and support units.
- Consult NSK for life estimates under large moment loads.

Basic load ratings

Lead <i>ℓ</i> (mm)	Shaft dia <i>d</i> (mm)	Basic dynamic load ratings (N)				Basic static load ratings (N)		Support unit Allowable load (N)
		Ball screw <i>C_a</i>	Linear guides <i>C</i>	Support unit <i>C_a</i>	Rated running distance <i>L_a</i> (km)	Ball screw <i>C_{0a}</i>	Linear guides <i>C₀</i>	
5	φ 12	4 390	15 600	5 550	5	6 260	10 900	1 020
10		2 740	12 400		10	3 820		
20		2 660	9 850		20	3 800		

Basic static moment loads of linear guide

Slider	Basic static moment load (N·m)		
	Rolling M _{RO}	Pitching M _{PO}	Yawing M _{YO}
Double	455	765	765

Monocarrier dynamic torque specification (N·cm)

Ball screw lead(mm)	Accuracy grade	
	High grade	Precision
10	1.5 - 7.6	2.4 - 10.6
20	2.3 - 11.8	3.2 - 14.8

Notes:

- Frictional resistance of NSK K1 is included in dynamic torque in table.
- Grease is packed into ball screws, linear guide parts and support units.
- Consult NSK for life estimates under large moment loads.

Basic load ratings

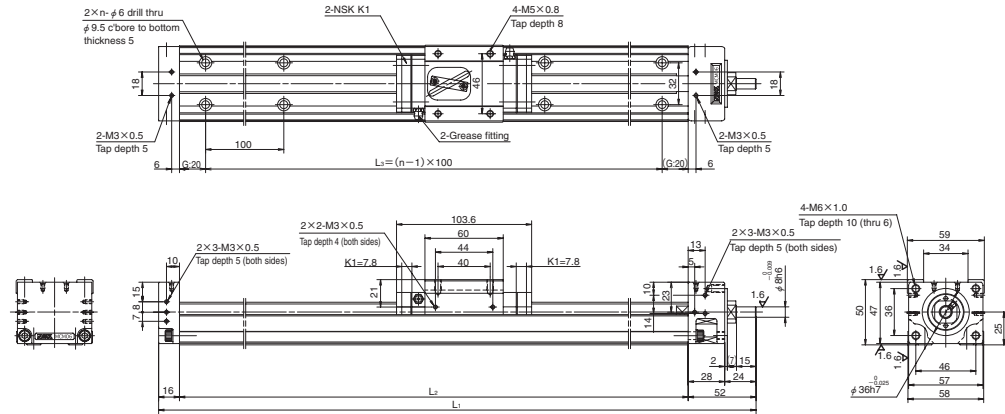
Lead <i>ℓ</i> (mm)	Shaft dia <i>d</i> (mm)	Basic dynamic load ratings (N)				Basic static load ratings (N)		Support unit Allowable load (N)
		Ball screw <i>C_a</i>	Linear guides <i>C</i>	Support unit <i>C_a</i>	Rated running distance <i>L_a</i> (km)	Ball screw <i>C_{0a}</i>	Linear guides <i>C₀</i>	
5	φ 12	4 390	15 600	5 550	5	6 260	10 900	1 020
10		2 740	12 400		10	3 820		
20		2 660	9 850		20	3 800		

Basic static moment loads of linear guide

Slider	Basic static moment load (N·m)		
	Rolling M _{RO}	Pitching M _{PO}	Yawing M _{YO}
Double	455	765	765

MCM06

Accuracy grade: High grade (H)



Dimensions of MCM06 (Single slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm)			No. of mounting holes n	Inertia x 10 ⁻⁴ (kg · m ²)	Mass (kg)
				L ₁	L ₂	L ₃			
◇MCM06005H05K02	50	86 (102)	5	258	190	100	2	0.066	2.7
◇MCM06005H10K00			10					0.077	
◇MCM06005H20K00			20					0.122	
MCM06010H05K02	100	136 (152)	5	308	240	200	3	0.080	3.0
MCM06010H10K00			10					0.092	
MCM06010H20K00			20					0.137	
◇MCM06015H05K02	150	186 (202)	5	358	290	200	3	0.095	3.5
◇MCM06015H10K00			10					0.106	
◇MCM06015H20K00			20					0.152	
MCM06020H05K02	200	236 (252)	5	408	340	300	4	0.110	3.8
MCM06020H10K00			10					0.121	
MCM06020H20K00			20					0.167	
◇MCM06025H05K02	250	286 (302)	5	458	390	300	4	0.125	4.2
◇MCM06025H10K00			10					0.136	
◇MCM06025H20K00			20					0.181	
MCM06030H05K02	300	336 (352)	5	508	440	400	5	0.139	4.5
MCM06030H10K00			10					0.150	
MCM06030H20K00			20					0.196	

Notes: 1. Dimension G is 45 for items marked with ◇.
2. Reference numbers above are for high-grade grease specifications. In the case of other specifications, see the following table for the 13th and 14th digits.

Coding for columns 13 and 14

Grease	Lead	High-grade, precision-grade
Standard	5	02
	10, 20	00
LG2	5	B2
	10, 20	B0

Basic load ratings

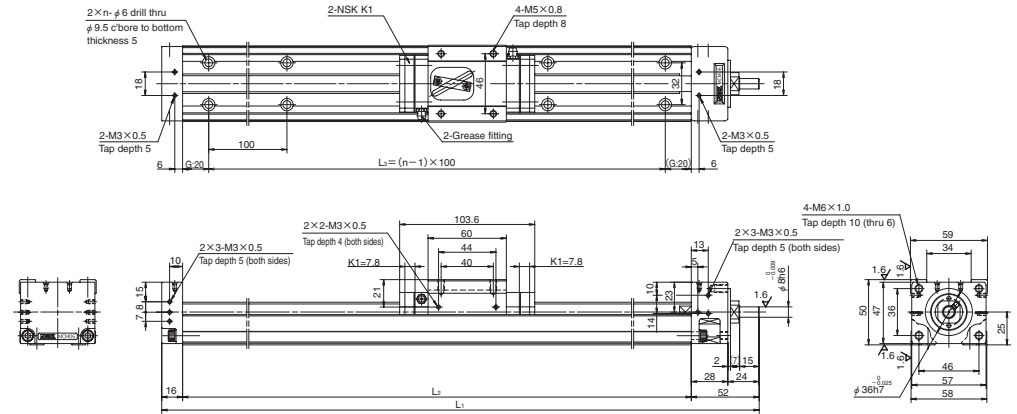
Lead l (mm)	Shaft dia d (mm)	Basic dynamic load ratings (N)				Basic static load ratings (N)			Support unit Allowable load (N)
		Ball screw C _a	Linear guides C	Support unit C _a	Rated running distance L _a (km)	Ball screw C _{0a}	Linear guides C ₀		
5	φ 15	8 300	25 200	8 300	5	12 700	17 000	1 910	
10		8 140	20 000		10	12 800			
20		5 080	15 900		20	7 460			

Basic static moment loads of linear guide

Slider	Basic static moment load (N · m)		
	Rolling M _{RO}	Pitching M _{PO}	Yawing M _{VO}
Single	415	174	174

Accuracy grade: High grade (H)

MCM06



Dimensions of MCM06 (Single slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm)			No. of mounting holes n	Inertia x 10 ⁻⁴ (kg · m ²)	Mass (kg)
				L ₁	L ₂	L ₃			
MCM06040H05K02	400	436 (452)	5	608	540	500	6	0.169	5.2
MCM06040H10K00			10					0.180	
MCM06040H20K00			20					0.225	
MCM06050H05K02	500	536 (552)	5	708	640	600	7	0.198	6.0
MCM06050H10K00			10					0.209	
MCM06050H20K00			20					0.255	
MCM06060H05K02	600	636 (652)	5	808	740	700	8	0.228	6.7
MCM06060H10K00			10					0.239	
MCM06060H20K00			20					0.284	
MCM06070H05K02	700	736 (752)	5	908	840	800	9	0.257	7.4
MCM06070H10K00			10					0.268	
MCM06070H20K00			20					0.314	
MCM06080H05K02	800	836 (852)	5	1 008	940	900	10	0.286	8.1
MCM06080H10K00			10					0.298	
MCM06080H20K00			20					0.343	

Note: Reference numbers above are for high-grade grease specifications. In the case of other specifications, see the following table for the 13th and 14th digits.

Coding for columns 13 and 14

Grease	Lead	High-grade, precision-grade
Standard	5	02
	10, 20	00
LG2	5	B2
	10, 20	B0

Basic load ratings

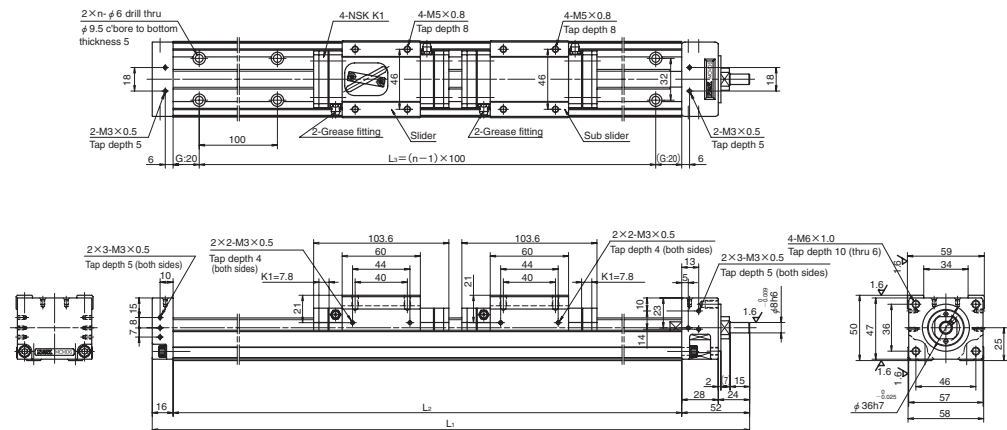
Lead l (mm)	Shaft dia d (mm)	Basic dynamic load ratings (N)				Basic static load ratings (N)			Support unit Allowable load (N)
		Ball screw C _a	Linear guides C	Support unit C _a	Rated running distance L _a (km)	Ball screw C _{0a}	Linear guides C ₀		
5	φ 15	8 300	25 200	8 300	5	12 700	17 000	1 910	
10		8 140	20 000		10	12 800			
20		5 080	15 900		20	7 460			

Basic static moment loads of linear guide

Slider	Basic static moment load (N · m)		
	Rolling M _{RO}	Pitching M _{PO}	Yawing M _{VO}
Single	415	174	174

MCM06 (Double slider)

Accuracy grade: High grade (H)



Dimensions of MCM06 (Double slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm)			No. of mounting holes n	Inertia $\times 10^4$ (kg · m ²)	Mass (kg)
				L ₁	L ₂	L ₃			
MCM06011H05D02	110	132 (164)	5	408	340	300	4	0.114	4.4
MCM06011H10D00			10					0.136	
MCM06021H05D02			5					0.143	
MCM06021H10D00	210	232 (264)	5	508	440	400	5	0.166	5.1
MCM06021H20D00			10					0.257	
MCM06031H05D02			20					0.173	
MCM06031H10D00	310	332 (364)	5	608	540	500	6	0.195	5.8
MCM06031H20D00			10					0.286	
MCM06031H20D00			20						

Note: Reference numbers above are for high-grade grease specifications. In the case of other specifications, see the following table for the 13th and 14th digits.

Coding for columns 13 and 14

Grease	Lead	High-grade, precision-grade
Standard	5	02
	10, 20	00
LG2	5	B2
	10, 20	B0

Monocarrier dynamic torque specification (N · cm)

Ball screw lead(mm)	Accuracy grade	
	High grade	Precision
5	2.3 – 8.5	3.7 – 13.5
10	2.7 – 10.9	4.2 – 16.4
20	4.0 – 15.9	5.5 – 21.3

Notes:

- Frictional resistance of NSK K1 is included in dynamic torque in table.
- Grease is packed into ball screws, linear guide parts and support units.
- Consult NSK for life estimates under large moment loads.

Basic load ratings

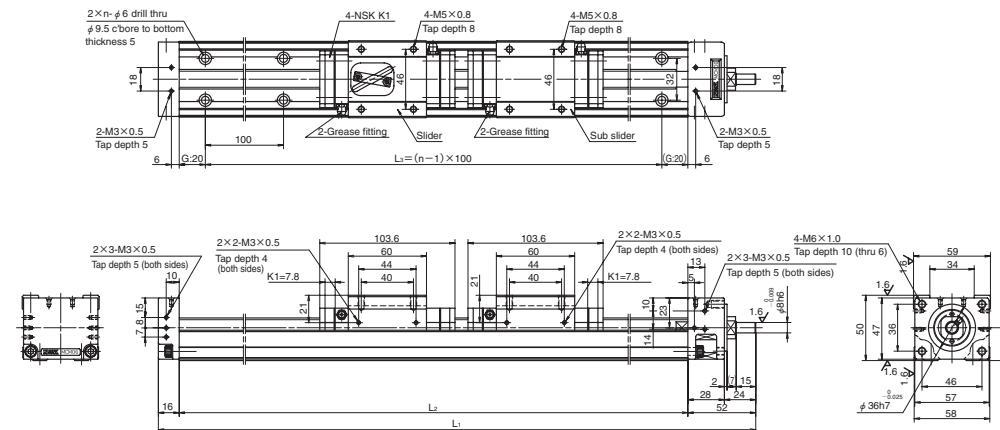
Lead l (mm)	Shaft dia d (mm)	Basic dynamic load ratings (N)				Basic static load ratings (N)		Support unit Allowable load (N)
		Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_R (km)	Ball screw C_{0a}	Linear guides C_0	
5	$\phi 15$	8 300	25 200	8 300	5	12 700	17 000	1 910
10		8 140	20 000		10	12 800		
20		5 080	15 900		20	7 460		

Basic static moment loads of linear guide

Slider	Basic static moment load (N · m)		
	Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Double	825	1 220	1 220

MCM06 (Double slider)

Accuracy grade: High grade (H)



Dimensions of MCM06 (Double slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm)			No. of mounting holes n	Inertia $\times 10^4$ (kg · m ²)	Mass (kg)
				L ₁	L ₂	L ₃			
MCM06041H05D02	410	432 (464)	5	708	640	600	7	0.202	6.6
MCM06041H10D00			10					0.224	
MCM06041H20D00			20					0.316	
MCM06051H10D00	510	532 (564)	10	808	740	700	8	0.254	7.3
MCM06051H20D00			20					0.345	
MCM06061H10D00			10					0.283	
MCM06061H20D00	610	632 (664)	10	908	840	800	9	0.375	8.0
MCM06071H10D00			20					0.313	
MCM06071H20D00			10					0.404	

Note: Reference numbers above are for high-grade grease specifications. In the case of other specifications, see the following table for the 13th and 14th digits.

Coding for columns 13 and 14

Grease	Lead	High-grade, precision-grade
Standard	5	02
	10, 20	00
LG2	5	B2
	10, 20	B0

Monocarrier dynamic torque specification (N · cm)

Ball screw lead(mm)	Accuracy grade	
	High grade	Precision
5	2.3 – 8.5	3.7 – 13.5
10	2.7 – 10.9	4.2 – 16.4
20	4.0 – 15.9	5.5 – 21.3

Notes:

- Frictional resistance of NSK K1 is included in dynamic torque in table.
- Grease is packed into ball screws, linear guide parts and support units.
- Consult NSK for life estimates under large moment loads.

Basic load ratings

Lead l (mm)	Shaft dia d (mm)	Basic dynamic load ratings (N)				Basic static load ratings (N)		Support unit Allowable load (N)
		Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_R (km)	Ball screw C_{0a}	Linear guides C_0	
5	$\phi 15$	8 300	25 200	8 300	5	12 700	17 000	1 910
10		8 140	20 000		10	12 800		
20		5 080	15 900		20	7 460		

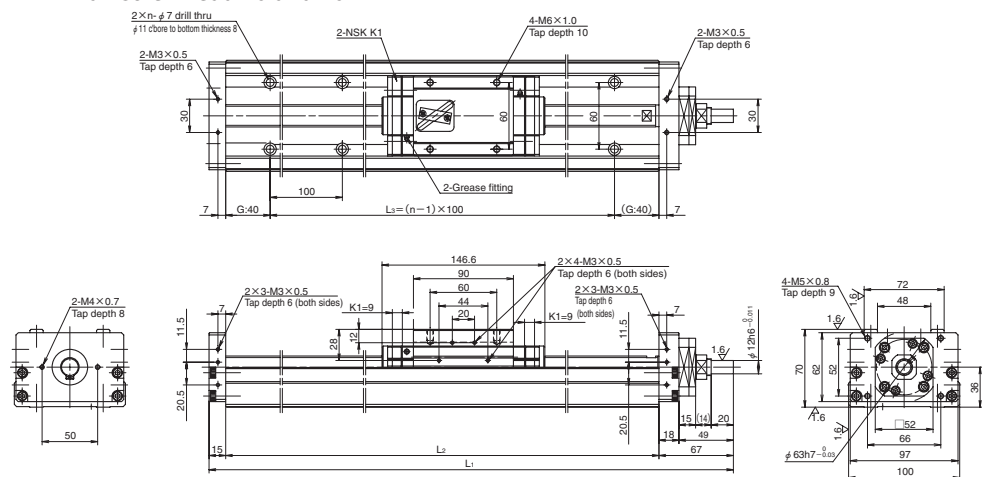
Basic static moment loads of linear guide

Slider	Basic static moment load (N · m)		
	Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Double	825	1 220	1 220

MCM10

Accuracy grade: High grade (H)

Ball screw lead 10 and 20



Dimensions of MCM10 (Single slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm)			No. of mounting holes <i>n</i>	Inertia $\times 10^{-4}$ (kg · m ²)	Mass (kg)
				<i>L</i> ₁	<i>L</i> ₂	<i>L</i> ₃			
MCM10010H10K00	100	133	10	362	280	200	2*	0.332	7.8
MCM10010H20K00		(151)	20						
◇MCM10015H10K00	150	183	10	412	330	300	4	0.378	8.7
◇MCM10015H20K00		(201)	20						
MCM10020H10K00	200	233	10	462	380	300	4	0.425	9.5
MCM10020H20K00		(251)	20						
◇MCM10025H10K00	250	283	10	512	430	400	5	0.472	10.4
◇MCM10025H20K00		(301)	20						
MCM10030H10K00	300	333	10	562	480	400	5	0.519	11.2
MCM10030H20K00		(351)	20						
MCM10040H10K00	400	433	10	662	580	500	6	0.612	13.0
MCM10040H20K00		(451)	20						
MCM10050H10K00	500	533 (551)	10	762	680	600	7	0.706	14.6
MCM10050H20K00			20					0.820	
MCM10050H30K00			30					1.010	

Notes: 1) Dimension G is 15 for items marked with ◇.
2) *: Use mounting holes on each end of the rail.

Monocarrier dynamic torque specification (N · cm)

Ball screw lead (mm)	Accuracy grade	
	High grade	Precision
10	2.7 – 10.8	4.7 – 19.7
20	3.1 – 12.7	5.2 – 21.6
30	5.1 – 18.0	—

Notes:

- Frictional resistance of NSK K1 is included in dynamic torque in table.
- Grease is packed into ball screws, linear guide parts and support units.
- Consult NSK for life estimates under large moment loads.

Basic load ratings

Lead <i>ℓ</i> (mm)	Shaft dia <i>d</i> (mm)	Basic dynamic load ratings (N)				Basic static load ratings (N)			Support unit Allowable load (N)
		Ball screw <i>C</i> _a	Linear guides <i>C</i>	Support unit <i>C</i> _a	Rated running distance <i>L</i> _s (km)	Ball screw <i>C</i> _{0a}	Linear guides <i>C</i> ₀		
10	φ 20	12 800	33 500	9 600	10	21 400	29 400	2 360	
20		8 190	26 600		20	12 600			
30		13 200	23 200		30	22 900			

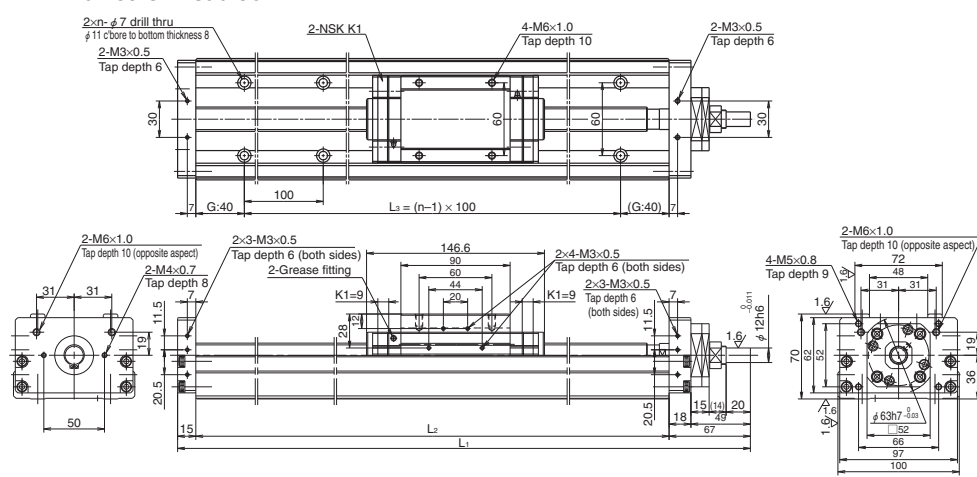
Basic static moment loads of linear guide

Slider	Basic static moment loads (N · m)		
	Rolling <i>M</i> _{RO}	Pitching <i>M</i> _{PO}	Yawing <i>M</i> _{VO}
Single	1 170	425	425

Accuracy grade: High grade (H)

MCM10

Ball screw lead 30



Dimensions of MCM10 (Single slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm)			No. of mounting holes <i>n</i>	Inertia $\times 10^{-4}$ (kg · m ²)	Mass (kg)	
				<i>L</i> ₁	<i>L</i> ₂	<i>L</i> ₃				
MCM10060H10K00	600	633 (651)	10	862	780	700	8	0.800	16.3	
MCM10060H20K00			20							0.914
MCM10060H30K00			30							1.104
MCM10070H10K00	700	733 (751)	10	962	880	800	9	0.893	18.0	
MCM10070H20K00			20							1.007
MCM10070H30K00			30							1.197
MCM10080H10K00	800	833 (851)	10	1 062	980	900	10	0.987	19.7	
MCM10080H20K00			20							1.101
MCM10080H30K00			30							1.291
MCM10090H10K00	900	933 (951)	10	1 162	1 080	1 000	11	1.081	21.4	
MCM10090H20K00			20							1.195
◇MCM10100H10K00			1 000							1 033 (1 051)
◇MCM10100H20K00	20	1.288								

Note: Dimension G is 90 for items marked with ◇.

Monocarrier dynamic torque specification (N · cm)

Ball screw lead (mm)	Accuracy grade	
	High grade	Precision
10	2.7 – 10.8	4.7 – 19.7
20	3.1 – 12.7	5.2 – 21.6
30	5.1 – 18.0	—

Notes:

- Frictional resistance of NSK K1 is included in dynamic torque in table.
- Grease is packed into ball screws, linear guide parts and support units.
- Consult NSK for life estimates under large moment loads.

Basic load ratings

Lead <i>ℓ</i> (mm)	Shaft dia <i>d</i> (mm)	Basic dynamic load ratings (N)				Basic static load ratings (N)			Support unit Allowable load (N)
		Ball screw <i>C</i> _a	Linear guides <i>C</i>	Support unit <i>C</i> _a	Rated running distance <i>L</i> _s (km)	Ball screw <i>C</i> _{0a}	Linear guides <i>C</i> ₀		
10	φ 20	12 800	33 500	9 600	10	21 400	29 400	2 360	
20		8 190	26 600		20	12 600			
30		13 200	23 200		30	22 900			

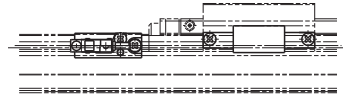
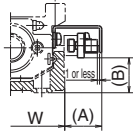
Basic static moment loads of linear guide

Slider	Basic static moment loads (N · m)		
	Rolling <i>M</i> _{RO}	Pitching <i>M</i> _{PO}	Yawing <i>M</i> _{VO}
Single	1 170	425	425

C-1-5.3 MCM Model Accessories

C-1-5. 3. 1 Sensor Unit

● Proximity switch

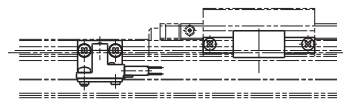
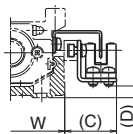


(Example assembly)

Model No.	Reference No.			A (mm)	B (mm)	Body width W (mm)
MCM02	MC-SR02-00	MC-SR02-01	MC-SR02-02	17	2	28
MCM03	MC-SR03-10	MC-SR03-11	MC-SR03-12	17	3	34
MCM05	MC-SR05-10	MC-SR05-11	MC-SR05-12	17	15	48.6
MCM06	MC-SR06-10	MC-SR06-11	MC-SR06-12	17	19	58
MCM08	MC-SR08-10	MC-SR08-11	MC-SR08-12	16	27	80
MCM10	MC-SR10-10	MC-SR10-11	MC-SR10-12	16	35	100
Quantity	Proximity switch (normally open contact)	—	3	1	E2S-W13 (OMRON Corp.)	
	Proximity switch (normally close contact)	3	—	2	E2S-W14 (OMRON Corp.)	

Notes: 1. See page C137 for proximity switch specifications.
 2. A sensor unit consists of sensors, a sensor dog, and sensor mounting parts.
 3. Sensor units for MCM02 contain two sensor dogs.
 4. A spacer plate is required when using a cover unit or sensor unit for MCM03 with a lead of 1 or 2 mm. (Refer to page C53.)

● Photo sensor



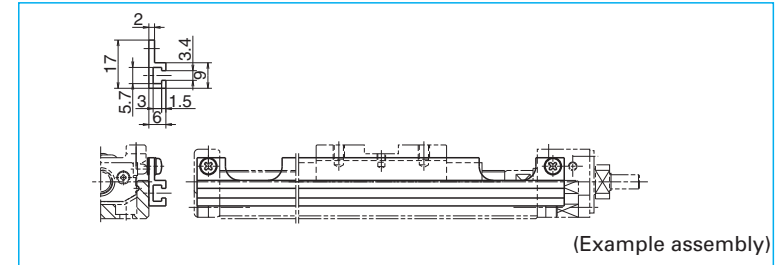
(Example assembly)

Model No.	Reference No.	C (mm)	D (mm)	Body width W (mm)	Remarks
MCM03	MC-SR03-13	24	0.5	34	EE-SX674 (OMRON Corp.) 3 sets (EE-1001 connector attachment)
MCM05	MC-SR05-13	24	5	48.6	
MCM06	MC-SR06-13	24	9	58	
MCM08	MC-SR08-13	23	17	80	
MCM10	MC-SR10-13	22	24	100	

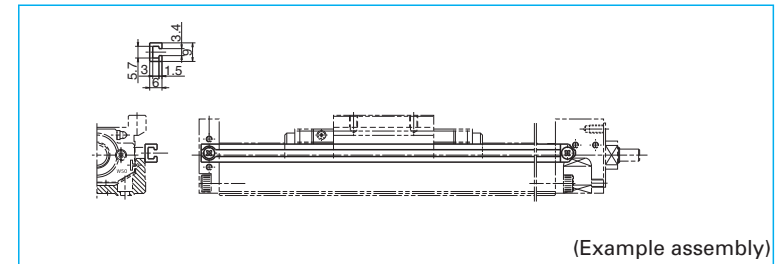
Notes: 1. See page C138 for photo sensor specifications.
 2. A sensor unit consists of sensors, a sensor dog, and sensor mounting parts.
 3. A spacer plate is required when using a cover unit or sensor unit for MCM03 with a lead of 1 or 2 mm. (Refer to page C53.)

(1) Sensor Rail

Sensor rail for MCM03: MC-SRL3- * * * *



Sensor rail for MCM05: MC-SRL5- * * * *

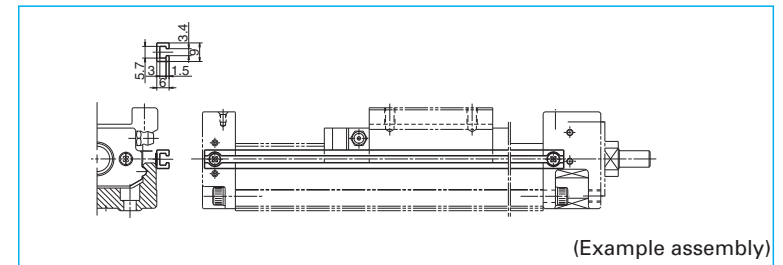


Sensor rail for MCM02: MC-SRL2- * * * *

Sensor rail for MCM06: MC-SRL6- * * * *

Sensor rail for MCM08: MC-SRL8- * * * *

Sensor rail for MCM10: MC-SRL1- * * * *



Notes: 1. * * * * is the same as rail dimension L₂.
 2. Please assemble the attached seat between the sensor rail and the support unit for MCM03, MCM05, MCM06 and MCM08.
 3. For combinations of sensors and rails, see pages C51 to C52.

MCM Model Sensor Rail Combinations

Table 4

Model No.	Body length L ₂ (mm)	Reference No.	Sensor rail reference No.
MCM02	100	MCM02005H01K MCM02005P01K MCM02005H02K MCM02005P02K	MC-SRL2-0100 ^{**}
		MCM02010H01K MCM02010P01K MCM02010H02K MCM02010P02K	MC-SRL2-0150
		MCM02015H01K MCM02015P01K MCM02015H02K MCM02015P02K	MC-SRL2-0200
MCM03	115	MCM03005P01K00 MCM03005P02K00	MC-SRL3-0115
		MCM03005H05K00 MCM03005H10K00 MCM03005H12K00 MCM03005H15K00	MC-SRL3-0140
		MCM03010P01K00 MCM03010P02K00 MCM03010H05K00 MCM03010H10K00 MCM03010H12K00 MCM03010H15K00	MC-SRL3-0190
MCM03	140	MCM03015P01K00 MCM03015P02K00 MCM03015H05K00 MCM03015H10K00 MCM03015H12K00 MCM03015H15K00	MC-SRL3-0240
		MCM03020H05K00 MCM03020H10K00 MCM03020H12K00 MCM03020H15K00	MC-SRL3-0290
		MCM03025H05K00 MCM03025H10K00 MCM03025H12K00 MCM03025H15K00	MC-SRL3-0340
MCM05	180	MCM05005H05K00 MCM05005H10K00 MCM05005H20K00	MC-SRL5-0180
		MCM05010H05K00 MCM05010H10K00 MCM05010H20K00	MC-SRL5-0230
		MCM05015H05K00 MCM05015H10K00 MCM05015H20K00 MCM05006H10D00	MC-SRL5-0280
MCM05	230	MCM05020H05K00 MCM05020H10K00 MCM05020H20K00 MCM05011H10D00	MC-SRL5-0330
		MCM05025H05K00 MCM05025H10K00 MCM05025H20K00 MCM05016H10D00	MC-SRL5-0380
		MCM05030H05K00 MCM05030H10K00 MCM05030H20K00 MCM05030H30K00 MCM05021H10D00 MCM05021H20D00	MC-SRL5-0430
MCM05	380	MCM05040H05K00 MCM05040H10K00 MCM05040H20K00 MCM05040H30K00 MCM05031H10D00	MC-SRL5-0530

Model No.	Body length L ₂ (mm)	Reference No.	Sensor rail reference No.
MCM05	530	MCM05031H20D00	MC-SRL5-0530
		MCM05050H05K00 MCM05050H10K00 MCM05050H20K00 MCM05050H30K00 MCM05041H10D00 MCM05041H20D00	MC-SRL5-0630
		MCM05060H05K00 MCM05060H10K00 MCM05060H20K00 MCM05060H30K00 MCM05051H10D00 MCM05051H20D00	MC-SRL5-0730
MCM06	190	MCM06005H05K02 MCM06005H10K00 MCM06005H20K00	MC-SRL6-0190
		MCM06010H05K02 MCM06010H10K00 MCM06010H20K00	MC-SRL6-0240
		MCM06015H05K02 MCM06015H10K00 MCM06015H20K00	MC-SRL6-0290
MCM06	240	MCM06020H05K02 MCM06020H10K00 MCM06020H20K00 MCM06011H05D02 MCM06011H10D00	MC-SRL6-0340
		MCM06025H05K02 MCM06025H10K00 MCM06025H20K00	MC-SRL6-0390
		MCM06030H05K02 MCM06030H10K00 MCM06030H20K00 MCM06021H05D02 MCM06021H10D00 MCM06021H20D00	MC-SRL6-0440
MCM06	340	MCM06040H05K02 MCM06040H10K00 MCM06040H20K00 MCM06031H05D02 MCM06031H10D00 MCM06031H20D00	MC-SRL6-0540
		MCM06050H05K02 MCM06050H10K00 MCM06050H20K00 MCM06041H05D02 MCM06041H10D00 MCM06041H20D00	MC-SRL6-0640
		MCM06060H05K02 MCM06060H10K00 MCM06060H20K00 MCM06051H10D00 MCM06051H20D00	MC-SRL6-0740
MCM06	440	MCM06070H05K02 MCM06070H10K00 MCM06070H20K00 MCM06061H10D00 MCM06061H20D00	MC-SRL6-0840
		MCM06080H05K02 MCM06080H10K00 MCM06080H20K00 MCM06071H10D00 MCM06071H20D00	MC-SRL6-0940

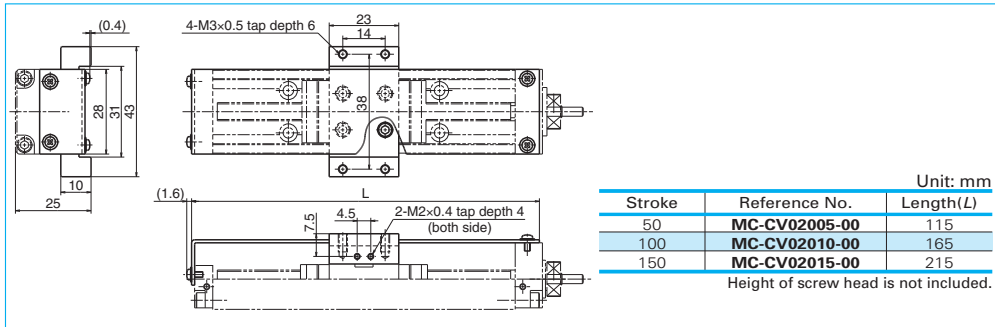
*) When using NSK standard sensors, prepare two sensor rails. Two sensor rails will also be required for other Monocarriers depending on signal points of sensors. Contact NSK for details.

Model No.	Body length L ₂ (mm)	Reference No.	Sensor rail reference No.
MCM08	220	MCM08005H05K02 MCM08005H10K00	MC-SRL8-0220
		MCM08010H05K02 MCM08010H10K00 MCM08010H20K00	MC-SRL8-0270
		MCM08015H05K02 MCM08015H10K00 MCM08015H20K00	MC-SRL8-0320
MCM08	270	MCM08020H05K02 MCM08020H10K00 MCM08020H20K00	MC-SRL8-0370
		MCM08025H05K02 MCM08025H10K00 MCM08025H20K00	MC-SRL8-0420
		MCM08030H05K02 MCM08030H10K00 MCM08030H20K00 MCM08018H10D00 MCM08018H20D00	MC-SRL8-0470
MCM08	320	MCM08040H05K02 MCM08040H10K00 MCM08040H20K00 MCM08028H10D00 MCM08028H20D00	MC-SRL8-0570
		MCM08050H05K02 MCM08050H10K00 MCM08050H20K00 MCM08038H10D00 MCM08038H20D00	MC-SRL8-0670
		MCM08060H05K02 MCM08060H10K00 MCM08060H20K00 MCM08060H30K00 MCM08048H10D00 MCM08048H20D00	MC-SRL8-0770
MCM08	370	MCM08070H05K02 MCM08070H10K00 MCM08070H20K00 MCM08070H30K00 MCM08058H10D00 MCM08058H20D00	MC-SRL8-0870
		MCM08080H05K02 MCM08080H10K00 MCM08080H20K00 MCM08080H30K00 MCM08068H10D00 MCM08068H20D00	MC-SRL8-0970

Model No.	Body length L ₂ (mm)	Reference No.	Sensor rail reference No.
MCM10	280	MCM10010H10K00 MCM10010H20K00	MC-SRL1-0280
		MCM10015H10K00 MCM10015H20K00	MC-SRL1-0330
		MCM10020H10K00 MCM10020H20K00 MCM10007H10D00	MC-SRL1-0380
MCM10	330	MCM10025H10K00 MCM10025H20K00	MC-SRL1-0430
		MCM10030H10K00 MCM10030H20K00 MCM10017H10D00 MCM10017H20D00	MC-SRL1-0480
		MCM10040H10K00 MCM10040H20K00 MCM10027H10D00 MCM10027H20D00	MC-SRL1-0580
MCM10	380	MCM10050H10K00 MCM10050H20K00 MCM10037H10D00 MCM10037H20D00	MC-SRL1-0680
		MCM10060H10K00 MCM10060H20K00 MCM10060H30K00 MCM10047H10D00 MCM10047H20D00	MC-SRL1-0780
		MCM10070H10K00 MCM10070H20K00 MCM10070H30K00 MCM10057H10D00 MCM10057H20D00	MC-SRL1-0880
MCM10	430	MCM10080H10K00 MCM10080H20K00 MCM10080H30K00 MCM10067H10D00 MCM10067H20D00	MC-SRL1-0980
		MCM10090H10K00 MCM10090H20K00	MC-SRL1-1080
		MCM10100H10K00 MCM10100H20K00 MCM10087H10D00 MCM10087H20D00	MC-SRL1-1180

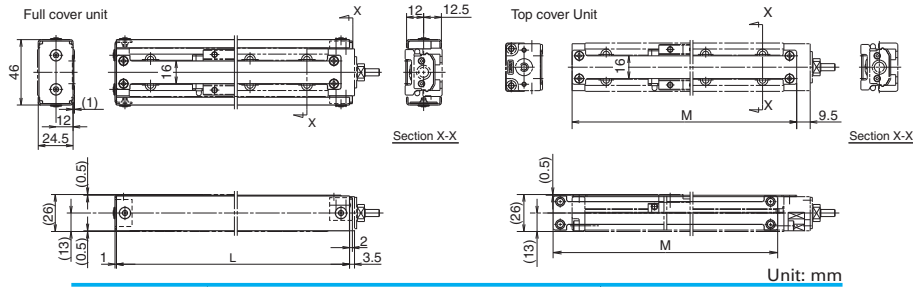
C-1-5. 3. 2 Cover Unit

Cover Unit for MCM02



Cover Unit for MCM03

- Notes:1. When the cover is used for leads 1 and 2, an optional spacer plate (nominal No.: MC-SP03-00) is required.
- 2. When the cover is used for lead 15, an optional spacer plate (nominal No.: MC-SP03-01) is required.
- 3. A full cover unit cannot be installed for lead 15.

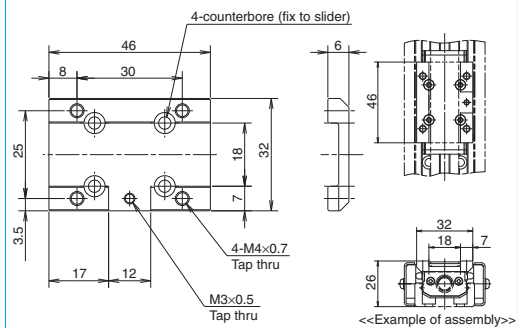


Stroke	Reference No.		Cover length	
	Top cover unit	Full cover unit	Length (L)	Length (M)
50 (lead 1, 2)	MC-CV03005-02	*MC-CV03005-01	139	133
50 (lead 5, 10, 12, 15)	MC-CV03005-02A	*MC-CV03005-01A	164	158
100	MC-CV03010-02	*MC-CV03010-01	214	208
150	MC-CV03015-02	*MC-CV03015-01	264	258
200	MC-CV03020-02	*MC-CV03020-01	314	308
250	MC-CV03025-02	*MC-CV03025-01	364	358

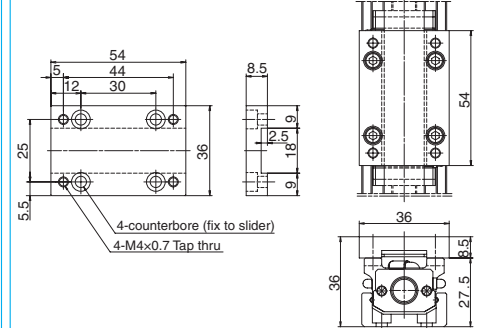
*1) The full-cover unit cannot be used when the sensor unit is used. Height of screw head is not included.

Spacer for MCM03 (Optional)

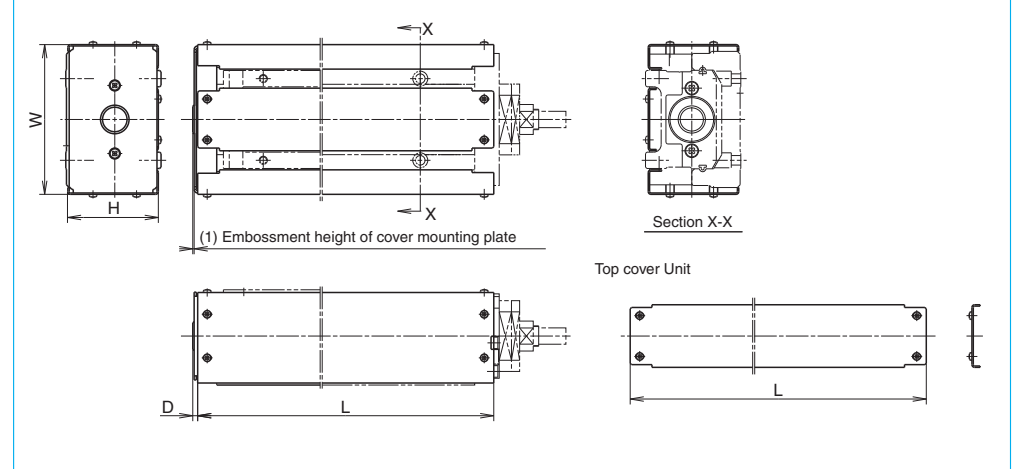
MC-SP03-00 (for ball screw lead 1 and 2 mm)



MC-SP03-01 (for ball screw lead 15 mm)



Cover unit for MCM05, 06, 08, and 10



Model No.	Stroke		Cover unit reference No.		Cover length			
	Single slider	Double slider	Top cover Unit	Full cover Unit*1	Length (L)	Height (H)	Width (W)	End part (D)
MCM05	50	—	MC-CV05005-01	MC-CV05005-00	200	38.5	65	2.6
	100	—	MC-CV05010-01	MC-CV05010-00	250			
	150	60	MC-CV05015-01	MC-CV05015-00	300			
	200	110	MC-CV05020-01	MC-CV05020-00	350			
	250	160	MC-CV05025-01	MC-CV05025-00	400			
	300	210	MC-CV05030-01	MC-CV05030-00	450			
	400	310	MC-CV05040-01	MC-CV05040-00	550			
	500	410	MC-CV05050-01	MC-CV05050-00	650			
600	510	MC-CV05060-01*3	MC-CV05060-00*3	750				
MCM06	50	—	MC-CV06005-01	MC-CV06005-00	225	48.5	75	*2
	100	—	MC-CV06010-01	MC-CV06010-00	275			
	150	—	MC-CV06015-01	MC-CV06015-00	325			
	200	110	MC-CV06020-01	MC-CV06020-00	375			
	250	—	MC-CV06025-01	MC-CV06025-00	425			
	300	210	MC-CV06030-01	MC-CV06030-00	475			
	400	310	MC-CV06040-01	MC-CV06040-00	575			
	500	410	MC-CV06050-01	MC-CV06050-00	675			
	600	510	MC-CV06060-01	MC-CV06060-00	775			
	700	610	MC-CV06070-01	MC-CV06070-00	875			
800	710	MC-CV06080-01*3	MC-CV06080-00*3	975				
MCM08	50	—	MC-CV08005-01	MC-CV08005-00	248	56.5	90	2.6
	100	—	MC-CV08010-01	MC-CV08010-00	298			
	150	—	MC-CV08015-01	MC-CV08015-00	348			
	200	80	MC-CV08020-01	MC-CV08020-00	398			
	250	—	MC-CV08025-01	MC-CV08025-00	448			
	300	180	MC-CV08030-01	MC-CV08030-00	498			
	400	280	MC-CV08040-01	MC-CV08040-00	598			
	500	380	MC-CV08050-01	MC-CV08050-00	698			
	600	480	MC-CV08060-01	MC-CV08060-00	798			
	700	580	MC-CV08070-01	MC-CV08070-00	898			
800	680	MC-CV08080-01	MC-CV08080-00	998				
MCM10	100	—	MC-CV10010-01	MC-CV10010-00	308	66.5	110	3.6
	150	—	MC-CV10015-01	MC-CV10015-00	358			
	200	70	MC-CV10020-01	MC-CV10020-00	408			
	250	—	MC-CV10025-01	MC-CV10025-00	458			
	300	170	MC-CV10030-01	MC-CV10030-00	508			
	400	270	MC-CV10040-01	MC-CV10040-00	608			
	500	370	MC-CV10050-01	MC-CV10050-00	708			
	600	470	MC-CV10060-01	MC-CV10060-00	808			
	700	570	MC-CV10070-01	MC-CV10070-00	908			
	800	670	MC-CV10080-01	MC-CV10080-00	1008			
	900	—	MC-CV10090-01	MC-CV10090-00	1108			
	1000	870	MC-CV10100-01*3	MC-CV10100-00*3	1208			

Note: The dimensions of covers shown above do not include the head height of fixing machine screws. Add the head of machine screws of approximately 2.5 mm to the outer measurement of a cover unit. Set a margin for mechanical interference with surrounding components.

*1) When using sensor units, full-cover units cannot be used.

*2) A cover mounting plate is not used with MCM06.

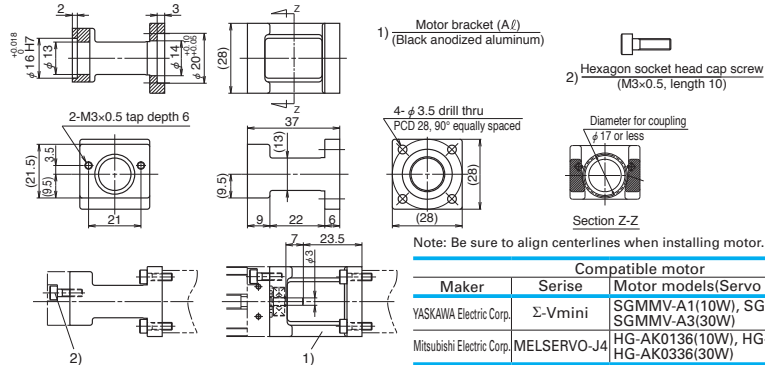
*3) Do not use the target nominal number for ceiling suspension.

C-1-5. 3.3 Motor Bracket

Motor models are subject to change at motor manufacturers. For details, please contact the manufacturer.

Motor bracket for MCM02

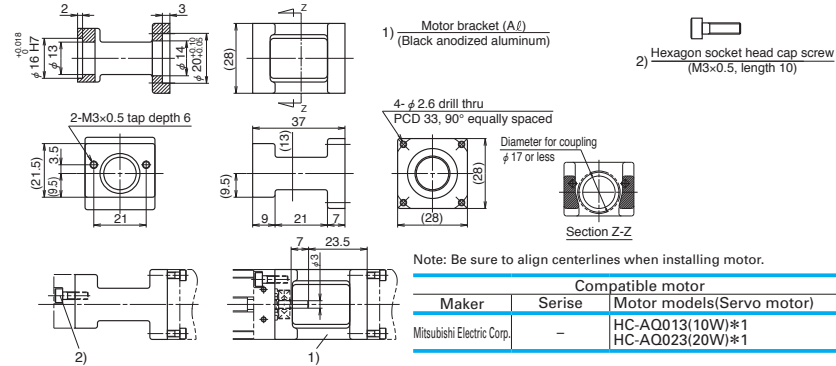
Reference number
MC-BK02-128-00



Compatible motor

Maker	Series	Motor models(Servo motor)
YASKAWA Electric Corp.	Σ-Vmini	SGMMV-A1(10W), SGMMV-A2(20W) SGMMV-A3(30W)
Mitsubishi Electric Corp.	MELSERVO-J4	HG-AK0136(10W), HG-AK0236(20W) HG-AK0336(30W)

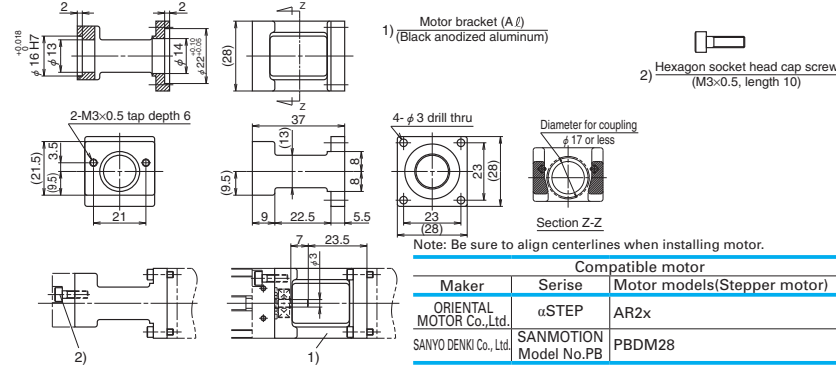
Reference number
MC-BK02-133-00



Compatible motor

Maker	Series	Motor models(Servo motor)
Mitsubishi Electric Corp.	-	HC-AQ013(10W)*1 HC-AQ023(20W)*1

Reference number
MC-BK02-223-00



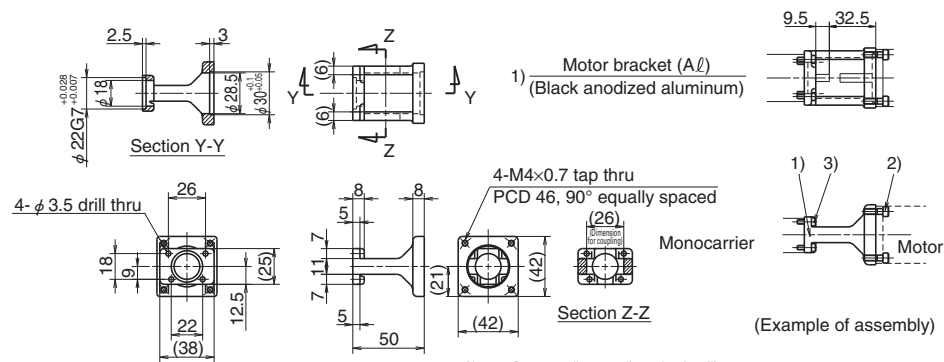
Compatible motor

Maker	Series	Motor models(Stepper motor)
ORIENTAL MOTOR Co.,Ltd.	αSTEP	AR2x
SANYO DENKI Co., Ltd.	SANMOTION Model No.PB	PBDM28

*1 The manufacturer models listed are discontinued motors.

Motor bracket for MCM03

Reference number
MC-BK03-146-00



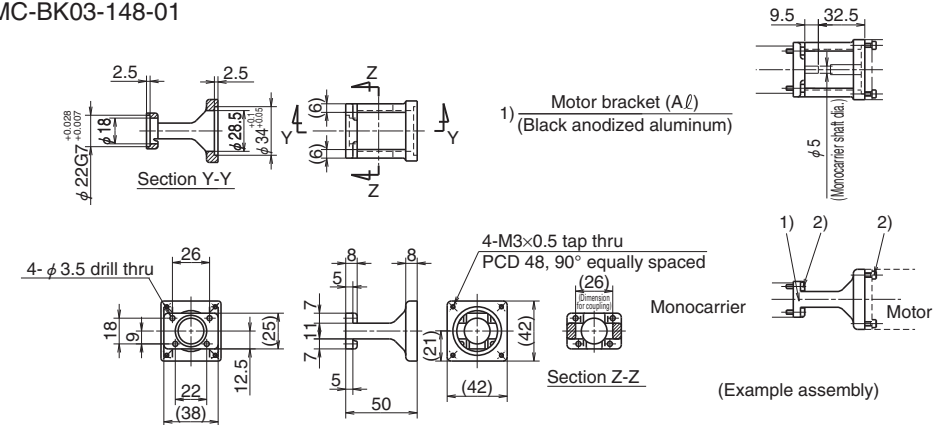
Notes: 1. Be sure to align centerlines when installing motor.
2. Be sure to align centerlines when installing motor.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

Compatible motor

Maker	Series	Motor models(Servo motor)
YASKAWA Electric Corp.	Σ-7	SGM7J-A5(50W), SGM7A-A5(50W)
Mitsubishi Electric Corp.	MELSERVO-J4	HG-KR053(50W), HG-MR053(50W)
OMRON Corp.	G5	R88M-K05030(50W)
SANYO DENKI Co., Ltd.	SANMOTION R	R2□A04003(30W), R2□A04005(50W)

Motor bracket for MCM03

Reference number
MC-BK03-148-01



Notes: 1. Be sure to align centerlines when installing motor.
2. Be sure to align centerlines when installing motor.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

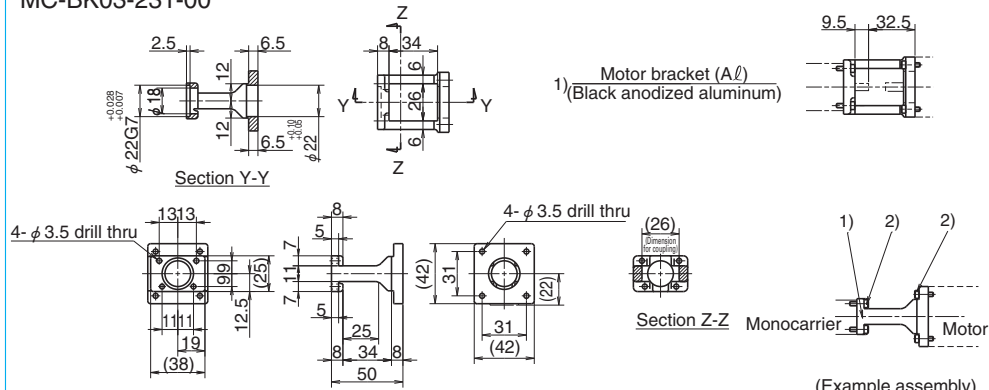
Compatible motor

Maker	Series	Motor models(Servo motor)
SANYO DENKI Co., Ltd.	-	P50B04006(60W)*1 P50B04010(100W)*1

*1 The manufacturer models listed are discontinued motors.

Motor bracket for MCM03

Reference number
MC-BK03-231-00



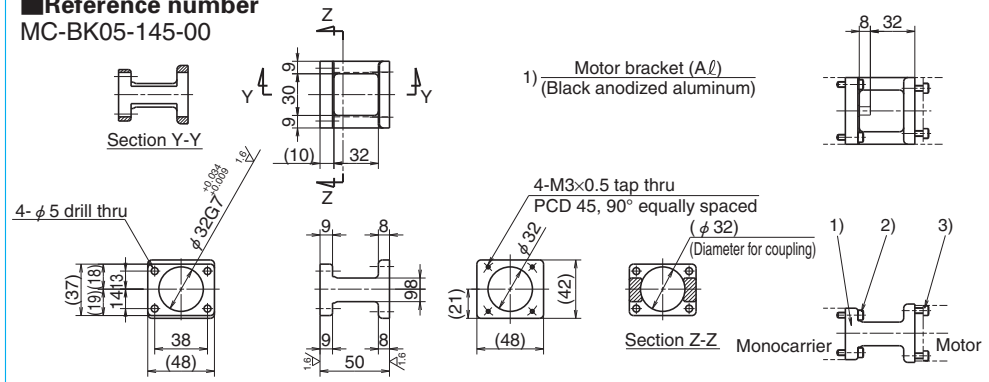
Notes: 1. Be sure to align centerlines when installing motor.
2. Be sure to align centerlines when installing motor.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

Compatible motor		
Maker	Series	Motor models(Stepper motor)
ORIENTAL MOTOR Co.,Ltd.	αSTEP	AR46x, ARL46x, AZ46x
MOTOR Co.,Ltd.	CRK, CVK, RKII	CRK54x, CVK54x, RKS54x, CVK24x
SANYO DENKI Co., Ltd.	SANMOTION Model No.P8	PBxM423, PBxR423, PBxP423

2) Hexagon socket head cap screw (M3, length 10)

Motor bracket for MCM05

Reference number
MC-BK05-145-00



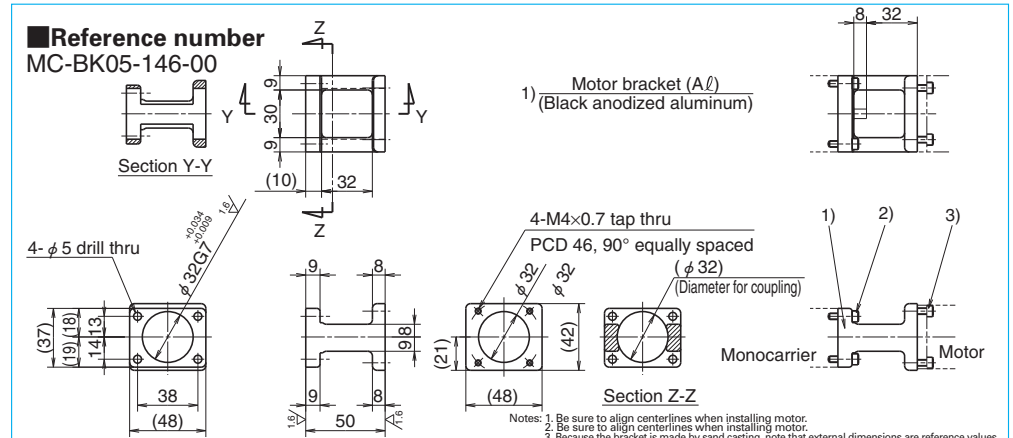
Compatible motor		
Maker	Series	Motor models(Servo motor)
PANASONIC Co.,Ltd.	MINAS A6	MSMF5A(50W), MSMF01(100W)

2) Hexagon socket head cap screw (M4, length 15)

3) Hexagon socket head cap screw (M3, length 12)

Motor bracket for MCM05

Reference number
MC-BK05-146-00



Notes: 1. Be sure to align centerlines when installing motor.
2. Be sure to align centerlines when installing motor.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

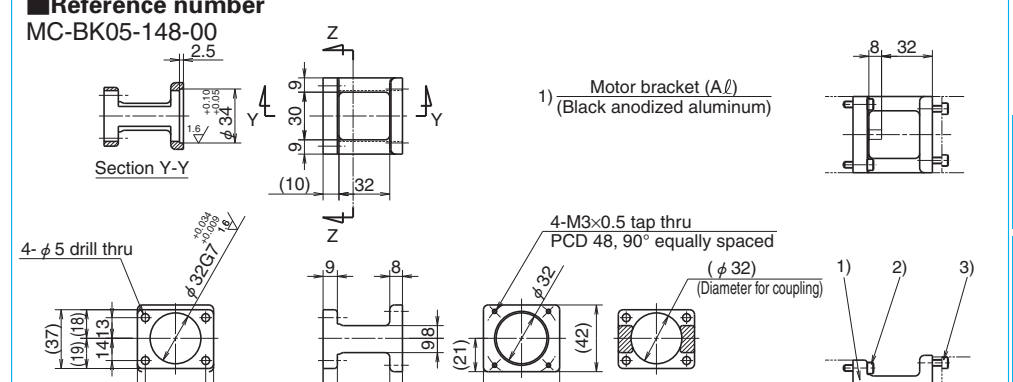
Compatible motor		
Maker	Series	Motor models(Servo motor)
YASKAWA Electric Corp.	Σ-7	SGM7A-A5(50W), SGM7A-01(100W), SGM7A-C2(150W) SGM7J-A5(50W), SGM7J-01(100W), SGM7J-C2(150W)
Mitsubishi Electric Corp.	MELSERVO-J4	HG-KR053(50W), HG-MR053(50W) HG-KR13(100W), HG-MR13(100W)
OMRON Corp.	G5	R88M-K05030(50W), R88M-K10030(100W)
SANYO DENKI Co., Ltd.	SANMOTION R	R2-A04005(50W), R2-A04010(100W)

2) Hexagon socket head cap screw (M4, length 15)

3) Hexagon socket head cap screw (M4, length 12)

Motor bracket for MCM05

Reference number
MC-BK05-148-00



Compatible motor		
Maker	Series	Motor models(Servo motor)
PANASONIC Co.,Ltd.	-	MAMA01(100W)*1

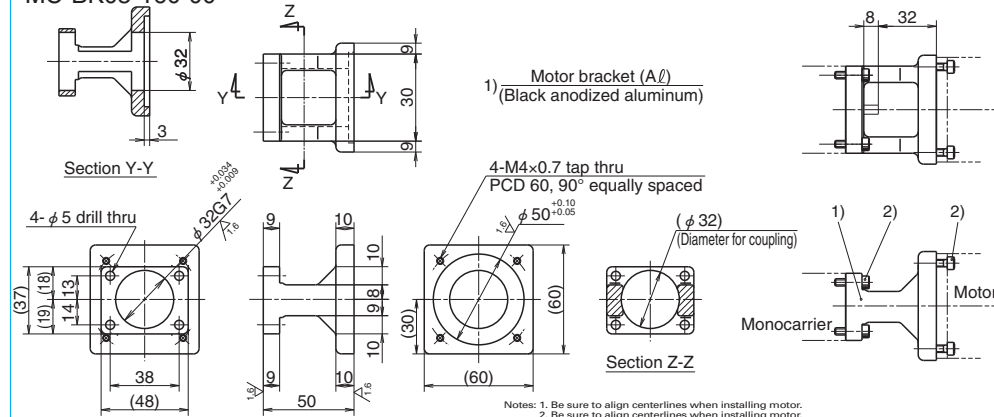
2) Hexagon socket head cap screw (M4, length 15)

3) Hexagon socket head cap screw (M3, length 12)

*1 The manufacturer models listed are discontinued motors.

Motor bracket for MCM05

Reference number
MC-BK05-160-00



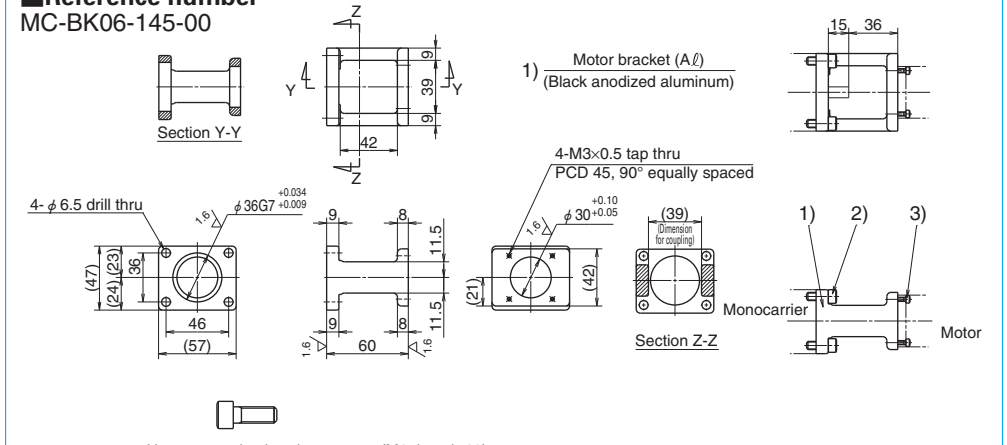
Notes: 1. Be sure to align centerlines when installing motor.
2. Be sure to align centerlines when installing motor.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

Compatible motor		
Maker	Series	Motor type(Servo motor)
SANYO DENKI Co., Ltd.	-	P50B05005(50W)*1 P50B05010(100W)*1 P50B05020(200W)*1

- Hexagon socket head cap screw (M4, length 15)

Motor bracket for MCM06

Reference number
MC-BK06-145-00



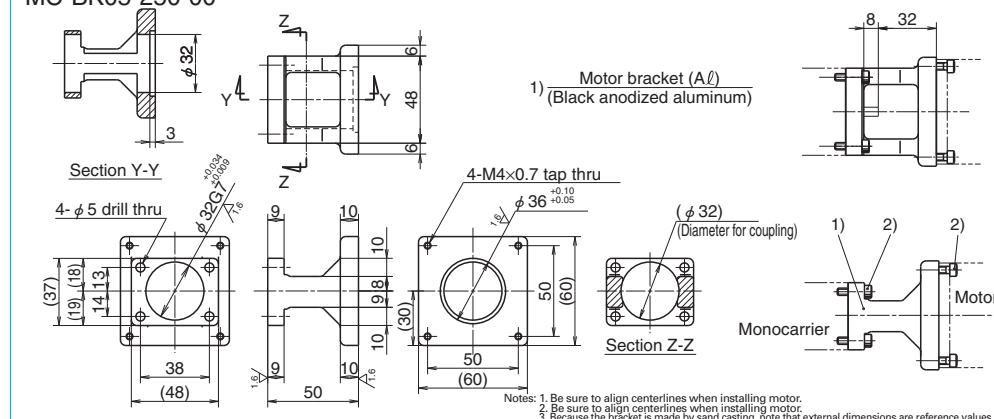
Notes: 1. Be sure to align centerlines when installing motor.
2. Be sure to align centerlines when installing motor.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

- Hexagon socket head cap screw (M6, length 16)
- Hexagon socket head cap screw (M3, length 12)

Compatible motor		
Maker	Series	Motor type(Servo motor)
PANASONIC Co.,Ltd.	MINAS A6	MSMF5A(50W), MSMF01(100W)

Motor bracket for MCM05

Reference number
MC-BK05-250-00



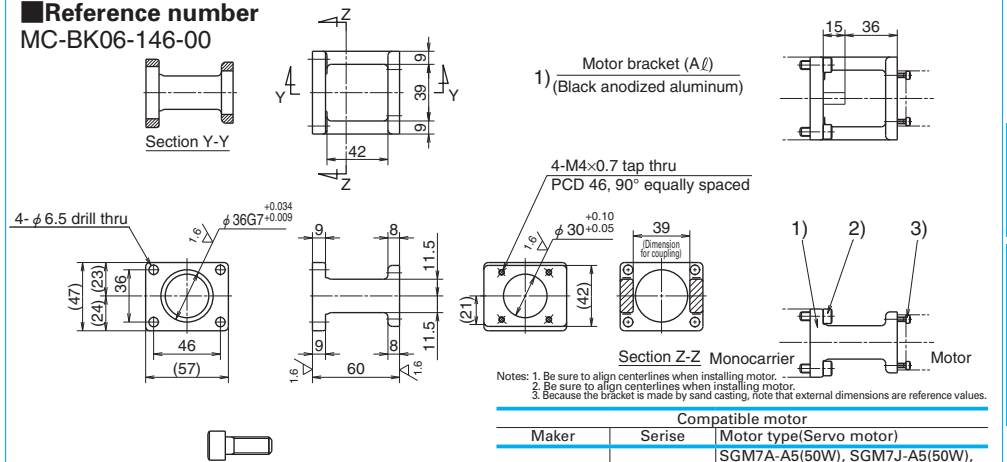
Notes: 1. Be sure to align centerlines when installing motor.
2. Be sure to align centerlines when installing motor.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

Compatible motor		
Maker	Series	Motor models(Stepper motor)
ORIENTAL MOTOR Co.,Ltd.	αSTEP	AR6x, ARL6x, AZ6x
MOTOR Co.,Ltd.	CRK, CVK, RKII	CRK56x, CVK56x, RKS56x
SANYO DENKI Co., Ltd.	SANMOTION	PBDM60x, PB-R60x
	Model No.PB	PB-P60x

- Hexagon socket head cap screw (M4, length 15)

Motor bracket for MCM06

Reference number
MC-BK06-146-00



Notes: 1. Be sure to align centerlines when installing motor.
2. Be sure to align centerlines when installing motor.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

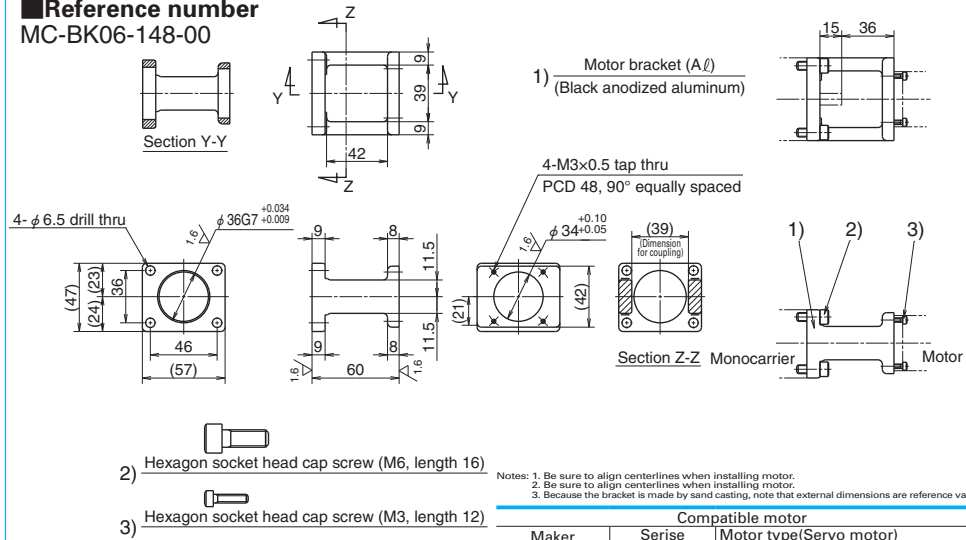
- Hexagon socket head cap screw (M6, length 16)
- Hexagon socket head cap screw (M4, length 12)

Compatible motor		
Maker	Series	Motor type(Servo motor)
YASKAWA Electric Corp.	Σ-7	SGM7A-A5(50W), SGM7J-A5(50W), SGM7A-01(100W), SGM7J-01(100W), SGM7A-C2(150W), SGM7J-C2(150W)
Mitsubishi Electric Corp.	MELSERVO-J4	HG-KR053(50W), HG-MR053(50W), HG-KR13(100W), HG-MR13(100W)
OMRON Corp.	G5	R88M-K05030(50W), R88M-K10030(100W)
SANYO DENKI Co.,Ltd.	SANMOTION R	R2-A04005(50W), R2-A04010(100W)

*1 The manufacturer models listed are discontinued motors.

Motor bracket for MCM06

Reference number
MC-BK06-148-00

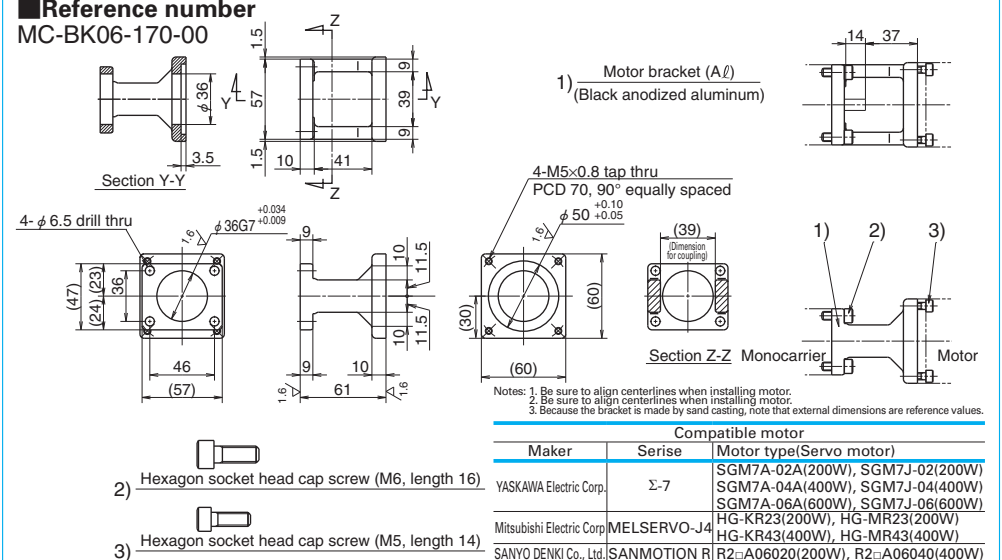


Notes: 1. Be sure to align centerlines when installing motor.
2. Be sure to align centerlines when installing motor.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

Compatible motor		
Maker	Series	Motor type(Servo motor)
Panasonic Co., Ltd.	-	MAMA01(100W)*1

Motor bracket for MCM06

Reference number
MC-BK06-170-00

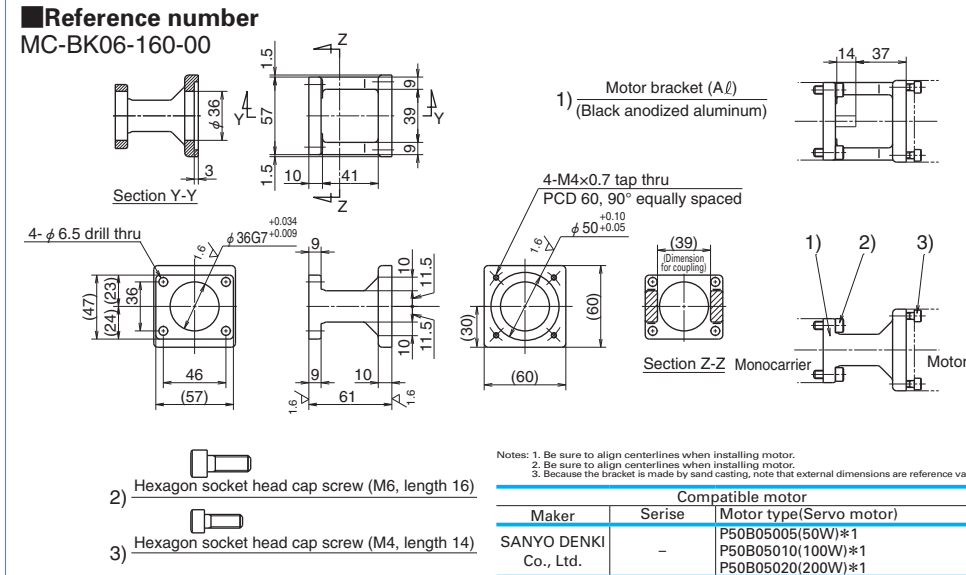


Notes: 1. Be sure to align centerlines when installing motor.
2. Be sure to align centerlines when installing motor.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

Compatible motor		
Maker	Series	Motor type(Servo motor)
YASKAWA Electric Corp.	Σ-7	SGM7A-02A(200W), SGM7J-02(200W) SGM7A-04A(400W), SGM7J-04(400W) SGM7A-06A(600W), SGM7J-06(600W)
Mitsubishi Electric Corp.	MELSERVO-J4	HG-KR23(200W), HG-MR23(200W) HG-KR43(400W), HG-MR43(400W)
SANYO DENKI Co., Ltd.	SANMOTION R	R2-A06020(200W), R2-A06040(400W)

Motor bracket for MCM06

Reference number
MC-BK06-160-00

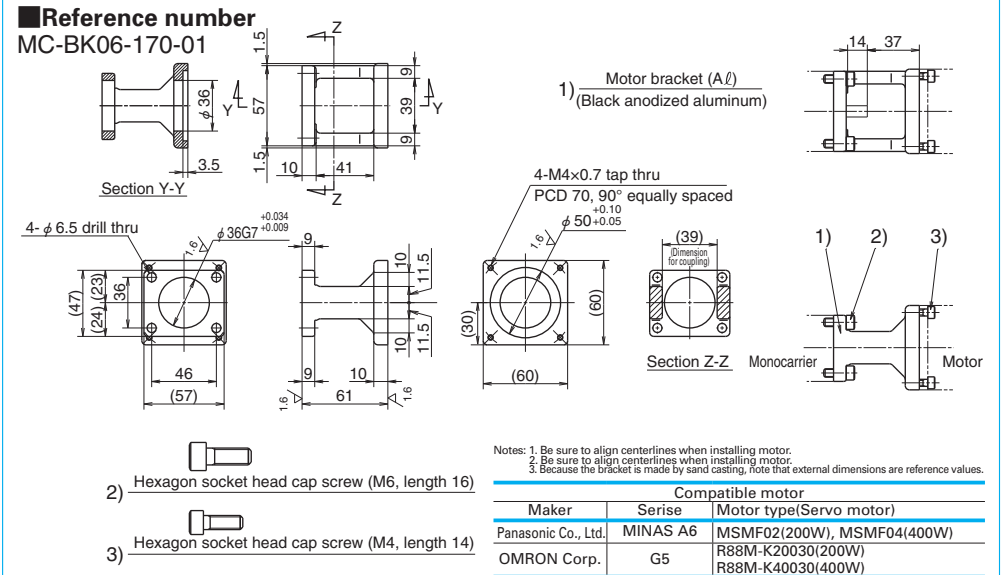


Notes: 1. Be sure to align centerlines when installing motor.
2. Be sure to align centerlines when installing motor.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

Compatible motor		
Maker	Series	Motor type(Servo motor)
SANYO DENKI Co., Ltd.	-	P50B05005(50W)*1 P50B05010(100W)*1 P50B05020(200W)*1

Motor bracket for MCM06

Reference number
MC-BK06-170-01



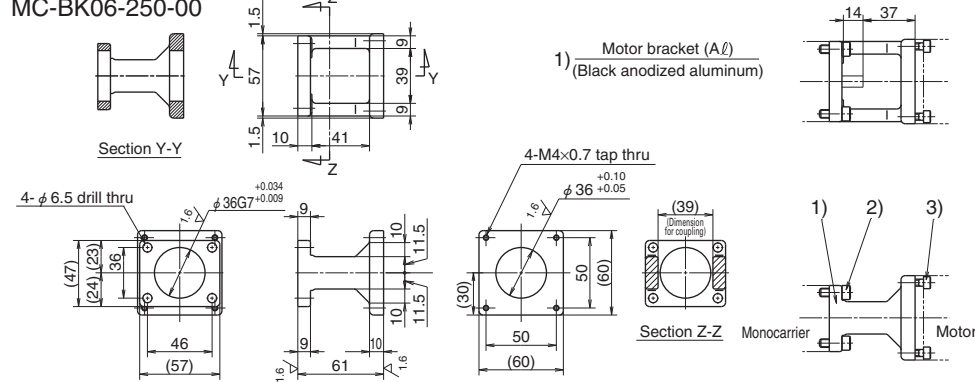
Notes: 1. Be sure to align centerlines when installing motor.
2. Be sure to align centerlines when installing motor.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

Compatible motor		
Maker	Series	Motor type(Servo motor)
Panasonic Co., Ltd.	MINAS A6	MSMF02(200W), MSMF04(400W)
OMRON Corp.	G5	R88M-K20030(200W) R88M-K40030(400W)

*1 The manufacturer models listed are discontinued motors.

Motor bracket for MCM06

Reference number
MC-BK06-250-00



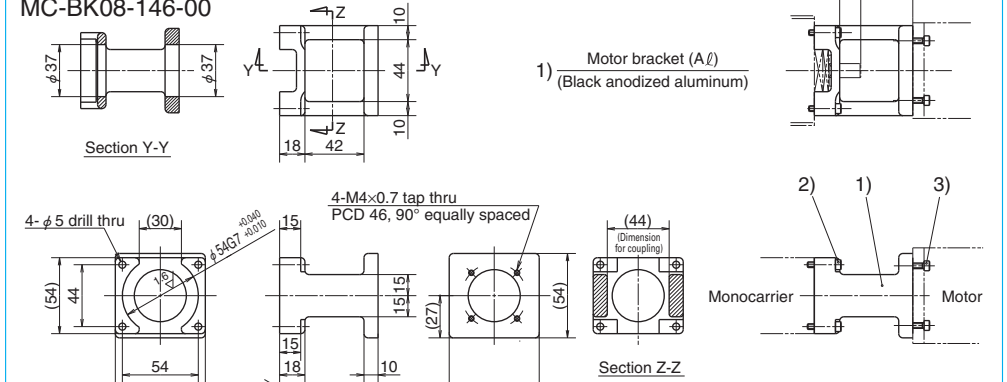
Notes: 1. Be sure to align centerlines when installing motor.
2. Be sure to align centerlines when installing motor.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

Compatible motor		
Maker	Series	Motor type(Stepper motor)
ORIENTAL	αSTEP	AR6x, ARL6x, AZ6x
MOTOR Co.,Ltd.	CRK, CVK, RKII	CRK56x, CVK56x, RKS56x
SANYO DENKI Co., Ltd.	SANMOTION Model No.PB	PBDM60x, PB=R60x, PB=P60x

- 2) Hexagon socket head cap screw (M6, length 16)
- 3) Hexagon socket head cap screw (M4, length 14)

Motor bracket for MCM08

Reference number
MC-BK08-146-00



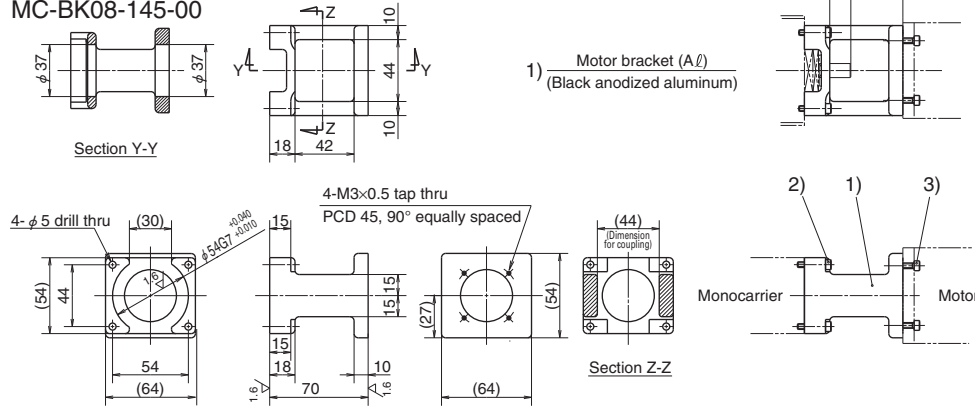
Notes: 1. Be sure to align centerlines when installing motor.
2. Be sure to align centerlines when installing motor.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

Compatible motor		
Maker	Series	Motor type(Servo motor)
YASKAWA Electric Corp.	Σ-7	SGM7A-A5(50W), SGM7A-01(100W), SGM7A-C2(150W) SGM7J-A5(50W), SGM7J-01(100W), SGM7J-C2(150W)
Mitsubishi Electric Corp	MELSERVO-J4	HG-KR13(30W), HG-MR13(50W), HG-KR13(100W), HG-MR13(100W)
OMRON Corp.	GS	R88M-K05030(50W), R88M-KT0030(100W)
SANYO DENKI Co., Ltd.	SANMOTION R	R2=A04005(50W), R2=A04010(100W)

- 2) Hexagon socket head cap screw (M4, length 20)
- 3) Hexagon socket head cap screw (M4, length 14)

Motor bracket for MCM08

Reference number
MC-BK08-145-00



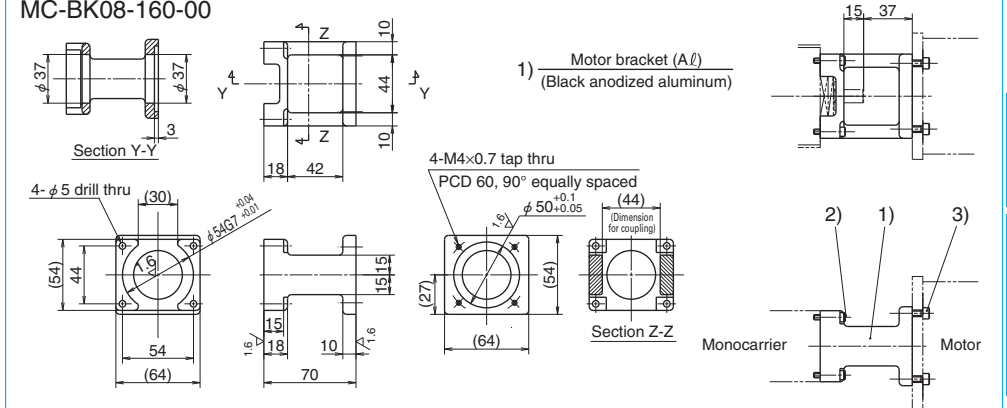
Notes: 1. Be sure to align centerlines when installing motor.
2. Be sure to align centerlines when installing motor.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

Compatible motor		
Maker	Series	Motor type(Servo motor)
Panasonic Co., Ltd.	MINAS A6	MSMF5A(50W), MSMF01(100W)

- 2) Hexagon socket head cap screw (M4, length 20)
- 3) Hexagon socket head cap screw (M3, length 12)

Motor bracket for MCM08

Reference number
MC-BK08-160-00



Notes: 1. Be sure to align centerlines when installing motor.
2. Be sure to align centerlines when installing motor.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

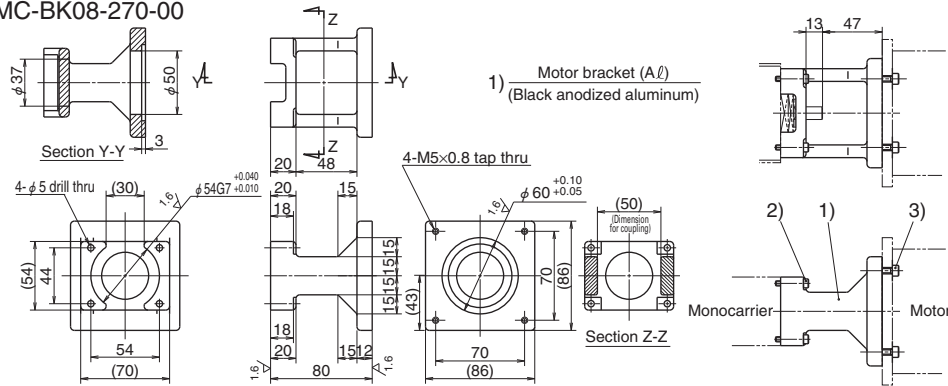
Compatible motor		
Maker	Series	Motor type(Servo motor)
SANYO DENKI Co., Ltd.	-	P50B05005(50W)*1 P50B05010(100W)*1 P50B05020(200W)*1

- 2) Hexagon socket head cap screw (M4, length 20)
- 3) Hexagon socket head cap screw (M4, length 14)

*1 The manufacturer models listed are discontinued motors.

Motor bracket for MCM08

Reference number
MC-BK08-270-00



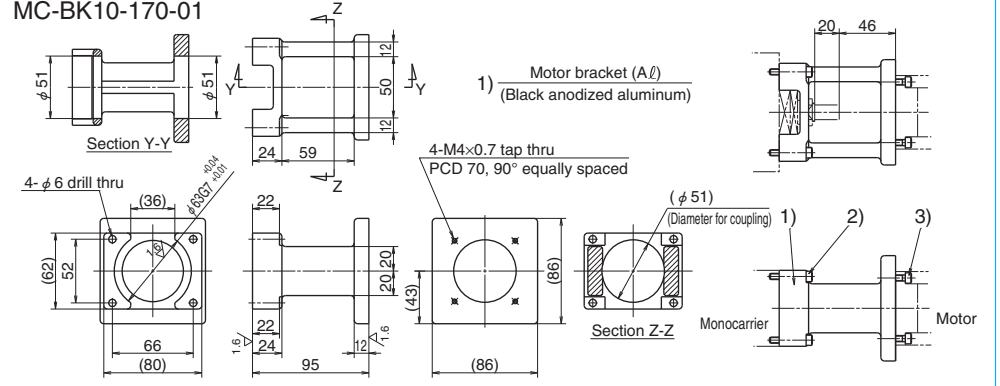
Notes: 1. Be sure to align centerlines when installing motor.
2. Be sure to align centerlines when installing motor.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

Compatible motor		
Maker	Series	Motor type(Stepper motor)
ORIENTAL MOTOR Co.,Ltd.	αSTEP RKII	AR9x, ARL9x, AZ9x RKS59x

- Hexagon socket head cap screw (M4, length 22)
- Hexagon socket head cap screw (M5, length 16)

Motor bracket for MCM10

Reference number
MC-BK10-170-01



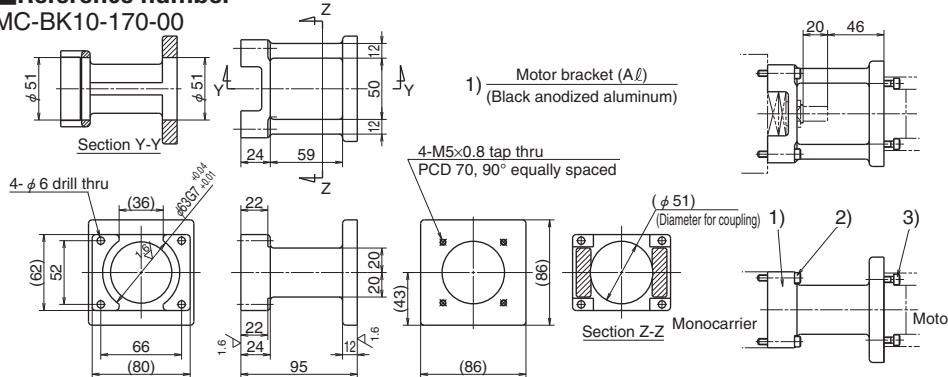
Notes: 1. Be sure to align centerlines when installing motor.
2. Be sure to align centerlines when installing motor.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

Compatible motor		
Maker	Series	Motor type(Servo motor)
Panasonic Co., Ltd.	MINAS A6	MSMF02(200W), MSMF04(400W)
OMRON Corp.	G5	R88M-K20030(200W) R88M-K40030(400W)

- Hexagon socket head cap screw (M5, length 30)
- Hexagon socket head cap screw (M4, length 16)

Motor bracket for MCM10

Reference number
MC-BK10-170-00



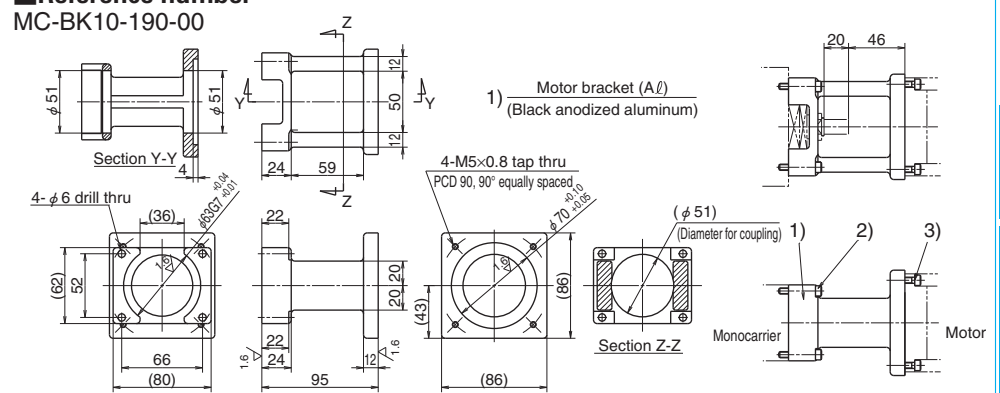
Notes: 1. Be sure to align centerlines when installing motor.
2. Be sure to align centerlines when installing motor.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

Compatible motor		
Maker	Series	Motor type(Servo motor)
YASKAWA Electric Corp.	Σ-7	SGM7A-02A(200W), SGM7J-02(200W) SGM7A-04A(400W), SGM7J-04(400W) SGM7A-06A(600W), SGM7J-06(600W)
Mitsubishi Electric Corp.	MELSERVO-J4	HG-KR23(200W), HG-MR23(200W) HG-KR43(400W), HG-MR43(400W)
SANYO DENKI Co., Ltd.	SANMOTION R	R2=A06020(200W), R2=A06040(400W)

- Hexagon socket head cap screw (M5, length 30)
- Hexagon socket head cap screw (M5, length 16)

Motor bracket for MCM10

Reference number
MC-BK10-190-00



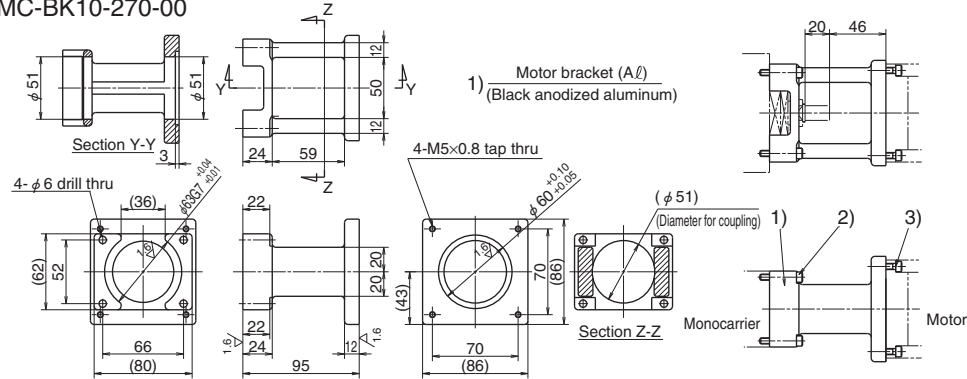
Notes: 1. Be sure to align centerlines when installing motor.
2. Be sure to align centerlines when installing motor.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

Compatible motor		
Maker	Series	Motor type(Servo motor)
Panasonic Co., Ltd.	MINAS A6	MSMF08(750W)
OMRON Corp.	G5	R88M-K75030(750W)

- Hexagon socket head cap screw (M5, length 30)
- Hexagon socket head cap screw (M5, length 16)

Motor bracket for MCM10

Reference number
MC-BK10-270-00



Notes: 1. Be sure to align centerlines when installing motor.
2. Be sure to align centerlines when installing motor.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

Compatible motor		
Maker	Series	Motor type(Stepper motor)
ORIENTAL MOTOR Co.,Ltd.	αSTEP	AR9x, ARL9x, AZ9x
	RKII	RKS59x

2) Hexagon socket head cap screw (M5, length 30)

3) Hexagon socket head cap screw (M5, length 18)

MCM Model Motor Bracket Compatibility

Table 5

Model No.	Reference No. code	Motor bracket reference No.	Motor manufacturer	Series	Stepper motor model No.	Wattage of AC servo motor																				
						10	20	30	50	60	100	150	200	300	400	600	750									
MCM02	1	MC-BK02-128-00	YASKAWA Electric Corp.	Σ-Vmini		SGMMV-A1	SGMMV-A2	SGMMV-A3																		
			Mitsubishi Electric Corp.	MELSERVO-J4		HG-AK0136	HG-AK0236	HG-AK0336																		
			Mitsubishi Electric Corp.	αSTEP	AR2x		HC-A013*1	HC-A023*1																		
	2	MC-BK03-135-00*1	ORIENTAL MOTOR Co., Ltd.	αSTEP	AR2x																					
	3	MC-BK02-223-00	SANYO DENKI Co., Ltd.	SANMOTION Model No.PB	PBDM28																					
MCM03	1	MC-BK03-146-00	YASKAWA Electric Corp.	Σ-7																						
			Mitsubishi Electric Corp.	MELSERVO-J4																						
			OMRON Corp.	GS																						
	2	MC-BK03-148-01*1	SANYO DENKI Co., Ltd.	SANMOTION R																						
			SANYO DENKI Co., Ltd.	αSTEP	AR46x, ARL46x, AZ46x																					
			ORIENTAL MOTOR Co.,Ltd.	CRK, CVK, RKII	CRK54x, CVK54x, RKS54x, CVK34x																					
			SANYO DENKI Co., Ltd.	SANMOTION Model No.PB	PBxM423, PBxR423, PBxP423																					
MCM05	1	MC-BK05-145-00	Panasonic Co., Ltd.	MINAS A6																						
			YASKAWA Electric Corp.	Σ-7																						
			Mitsubishi Electric Corp.	MELSERVO-J4																						
	2	MC-BK05-146-00	Mitsubishi Electric Corp.	MELSERVO-J4																						
			OMRON Corp.	GS																						
			SANYO DENKI Co., Ltd.	SANMOTION R																						
	3	MC-BK05-148-00*1	Panasonic Co., Ltd.	αSTEP	AR6x, ARL6x, AZ6x																					
	4	MC-BK05-160-00*1	SANYO DENKI Co., Ltd.	αSTEP	CRK, CVK, RKII																					
			SANYO DENKI Co., Ltd.	SANMOTION Model No.PB	PBDM60x, PBxR60x, PBxP60x																					
MCM06	1	MC-BK06-145-00	Panasonic Co., Ltd.	MINAS A6																						
			YASKAWA Electric Corp.	Σ-7																						
			Mitsubishi Electric Corp.	MELSERVO-J4																						
	2	MC-BK06-146-00	Mitsubishi Electric Corp.	MELSERVO-J4																						
			OMRON Corp.	GS																						
			SANYO DENKI Co., Ltd.	SANMOTION R																						
	3	MC-BK06-148-00*1	Panasonic Co., Ltd.	αSTEP	AR6x, ARL6x, AZ6x																					
	4	MC-BK06-160-00*1	SANYO DENKI Co., Ltd.	αSTEP	CRK, CVK, RKII																					
			SANYO DENKI Co., Ltd.	SANMOTION Model No.PB	PBDM60x, PBxR60x, PBxP60x																					
	5	MC-BK06-170-00	YASKAWA Electric Corp.	Σ-7																						
			Mitsubishi Electric Corp.	MELSERVO-J4																						
			SANYO DENKI Co., Ltd.	SANMOTION R																						
			Panasonic Co., Ltd.	MINAS A6																						
			OMRON Corp.	GS																						
			SANYO DENKI Co., Ltd.	αSTEP	AR6x, ARL6x, AZ6x																					
			ORIENTAL MOTOR Co.,Ltd.	CRK, CVK, RKII	CRK56x, CVK56x, RKS56x																					
			SANYO DENKI Co., Ltd.	SANMOTION Model No.PB	PBDM60x, PBxR60x, PBxP60x																					

*1 The manufacturer models listed are discontinued motors.

(Table 5 cont.)

Model No.	Reference No. code	Motor bracket reference No.	Motor manufacturer	Series	Stepper motor model No.	Wattage of AC servo motor																	
						10	20	30	50	60	100	150	200	300	400	600	750						
MCM08	1	MC-BK08-145-00	Panasonic Co., Ltd.	MINAS A6							M5MF5A		M5MF01										
	2	MC-BK08-146-00	YASKAWA Electric Corp.	Σ-7								SGM7A-A5 SGM7J-A5		SGM7A-01 SGM7J-01		SGM7A-C2 SGM7J-C2							
			Mitsubishi Electric Corp.	MELSERVO-J4									HG-KR03 HG-MR03		HG-KR13 HG-MR13								
			OMRON Corp.	G5									R88M-K10303		R88M-K11030								
			SANYO DENKI Co., Ltd.	SANMOTION R									R2-A04005		R2-A04010								
	3	MC-BK08-160-00*1	SANYO DENKI Co., Ltd.	-																			
	4	MC-BK08-170-00	YASKAWA Electric Corp.	Σ-7																			
			Mitsubishi Electric Corp.	MELSERVO-J4																			
			SANYO DENKI Co., Ltd.	SANMOTION R																			
			Panasonic Co., Ltd.	MINAS A6																			
	5	MC-BK08-170-01	OMRON Corp.	G5																			
	6	MC-BK08-190-00*1	SANYO DENKI Co., Ltd.	-																			
7	MC-BK08-250-00	ORIENTAL MOTOR Co., Ltd.	αSTEP	AR6x,ARL6x, AZ6x																			
			CRK, CVK, RKII	CRK56x, CVK56x, RK56x																			
		SANYO DENKI Co., Ltd.	SANMOTION Model No. PB	PBDM60x, PB-R60x, PB-P60x																			
			αSTEP	AR9x,ARL9x, AZ9x																			
8	MC-BK08-270-00	ORIENTAL MOTOR Co., Ltd.	RKII	RK559x																			
MCM10	1	MC-BK10-170-00	YASKAWA Electric Corp.	Σ-7																			
	2	MC-BK10-170-01	Mitsubishi Electric Corp.	MELSERVO-J4																			
			SANYO DENKI Co., Ltd.	SANMOTION R																			
			Panasonic Co., Ltd.	MINAS A6																			
			OMRON Corp.	G5																			
	3	MC-BK10-190-00	Panasonic Co., Ltd.	MINAS A6																			
	4	MC-BK10-270-00	ORIENTAL MOTOR Co., Ltd.	αSTEP	AR9x,ARL9x, AZ9x																		
				RKII	RK559x																		
			SANYO DENKI Co., Ltd.	SANMOTION R																			
				OMRON Corp.	G5																		

*1 The manufacturer models listed are discontinued motors.



C-1-6 MCH Model

- | | |
|---|-----|
| 1. MCH Model Reference Number | C75 |
| Coding | |
| 2. MCH Model Dimension Tables for Standard Products | |
| MCL06 | C76 |
| MCH06 | C77 |
| MCH09 | C79 |
| MCH10 | C81 |
| 3. MCH Model Accessories | |
| 3.1 Sensor Unit | C83 |
| 3.2 Cover Unit | C85 |
| 3.3 Intermediate Plate for Motor | C89 |

MCH Model

C-1-6 MCH Model

C-1-6. 1 MCH Model Reference Number Coding

[Body]

Example: **MC H 06 040 H 10 K (B2)**

Monocarrier

H: MCH Model
L: MCH Model low profile rail (only for 06 size)

Nominal size (rail width, Unit: 10mm)

Stroke (Unit: 10mm)

Accuracy grade (H, high grade; P, precision grade)

*1

NSK management number (0 or 2)

Grease specification: B (LG2) (See page C142.)

Slider specification K: Single slider
D: Double slider (See page C16.)

Ball screw lead (mm)

Note: *1: These two code fields are added except for standard grease.

The 14th digit is set by NSK and cannot be specified by a customer. For details, see the relevant page for the Reference No.

[With Accessories]

Example: **MC S 06 040 H 10 K 0 2 K 0 0 0**

S: With MCH Accessories
R: With MCL Accessories

NSK management number

Sensor unit

Cover unit

Intermediate plate for motor

Note: Option parts are available separately.

Table 1 Sensor unit (See page C83.)

Reference No. code	Specification	Reference No.
0	N/A	—
1	Proximity switch (Normally close contact 3 pieces)	MC—SRHxx—10
2	Proximity switch (Normally open contact 3 pieces)	MC—SRHxx—11
3	Proximity switch (Normally open contact 1 piece, Normally close contact 2 pieces)	MC—SRHxx—12
4	Photo sensor 3 pieces	MC—SRHxx—13

Notes: 1) xx: Nominal size
2) Sensor rails are not included with sensor units. If you require a rail, please specify this when ordering. (See page C83 to C84.)

Table 2 Cover unit (See page C85 to C87.)

Reference No. code	Specification	Reference No.
0	N/A	—
1	For single slider	MC—HVxxxx—00
	For double slider	MC—HVxxxxD00

Note: xxxxx; Nominal size and stroke number

Table 3 Intermediate plate for motor (See page C89 to C92.)

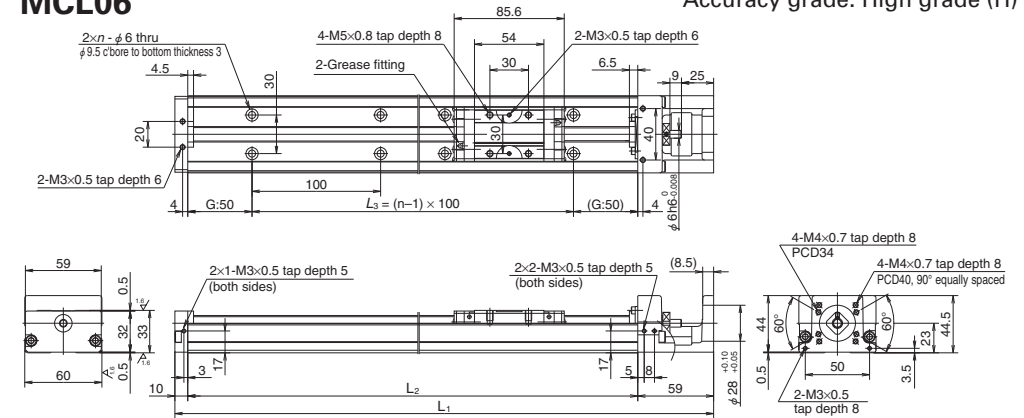
Reference No. code	Model No.		
	MCH06 (MCL06)	MCH09	MCH10
0	N/A	N/A	N/A
1	MC-BKH06-145-00	MC-BKH09-145-00	MC-BKH10-170-00
2	MC-BKH06-146-00	MC-BKH09-146-00	MC-BKH10-170-01
3	MC-BKH06-231-00	MC-BKH09-170-00	MC-BKH10-190-00
4	MC-BKH06-250-00	MC-BKH09-170-01	MC-BKH10-190-01
5	—	MC-BKH09-231-00	MC-BKH10-250-00
6	—	MC-BKH09-250-00	MC-BKH10-270-00

N/A: Not applicable

C-1-6. 2 MCH Model Dimension Tables for Standard Products

MCL06

Accuracy grade: High grade (H)



- Rail for MCL 06 is made lighter than that for MCH 06 by lowering rail height. Weight ratio between MCH 06 and MCL 06 is 5 to 4.
- Double slider specification is also available for MCL 06.
- Combinations of stroke and ball screw lead for MCL 06 are the same as those for MCH 06.

Dimensions of MCL06 (Single slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm)				Inertia $\times 10^{-6}(\text{kg} \cdot \text{m}^2)$	Mass (kg)
				L ₁	L ₂	L ₃	n		
◇ MCL06005H05K02	50	53	5	219	150	100	2	2.38	1.0
◇ MCL06005H10K02		(65)	10					3.45	
MCL06010H05K02	100	103	5	269	200	100	2	3.17	1.3
MCL06010H10K02		(115)	10					4.12	
MCL06020H05K02	200	203	5	369	300	200	3	4.51	1.9
MCL06020H10K02		(215)	10					5.46	
MCL06030H10K02	300	303	10	469	400	300	4	6.80	2.6
MCL06030H20K02		(315)	20					10.6	
MCL06040H10K02	400	403	10	569	500	400	5	8.13	3.2
MCL06040H20K02		(415)	20					11.9	
MCL06050H10K02	500	503	10	669	600	500	6	9.47	3.9
MCL06050H20K02		(515)	20					13.3	

Notes: 1. Dimension G is 25 for items marked with ◇.
2. Reference numbers above are high-grade grease specifications. In the case of other specifications, see the following table for the 13th and 14th digits.

Coding for columns 13 and 14

Grease	High-grade	Precision-grade
Standard	02	(None)
LG2	B2	B0

Ball screw lead(mm)	Monocarrier dynamic torque specification (N · cm)	
	Accuracy grade	
	High grade	Precision
5	1.0 – 4.8	1.9 – 7.6
10	1.1 – 5.8	2.1 – 8.9
20	1.6 – 7.9	2.5 – 10.6

Notes:
1. Frictional resistance of NSK K1 is included in dynamic torque in table.
2. Grease is packed into the ball screw, linear guide parts and support unit.
3. Consult NSK for life estimates under large moment loads.

Basic load ratings

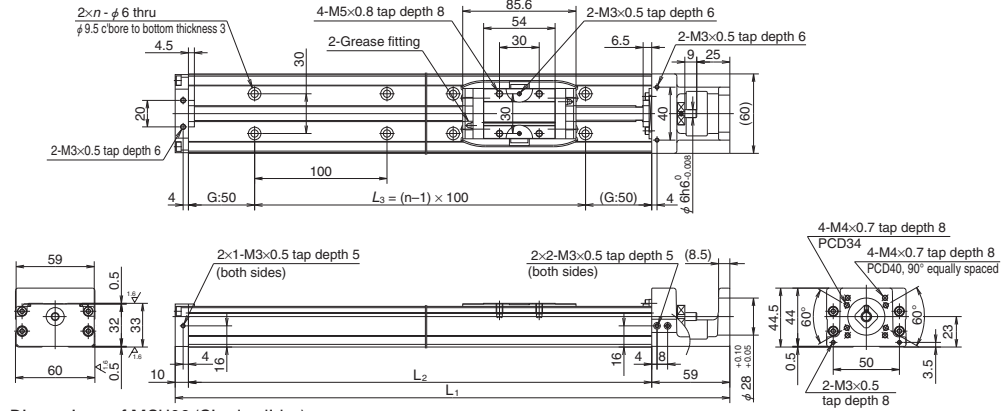
Lead l (mm)	Shaft dia d (mm)	Basic dynamic load ratings (N)				Basic static load ratings (N)		Support unit load limit (N)
		Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_a (km)	Ball screw C_{0a}	Linear guides C_0	
5	φ 12	4 390	22 800	5 550	5	6 260	16 300	1 020
10		2 740	18 100		10	3 820		
20		2 660	14 400		20	3 800		

Basic static moment loads of linear guide

Slider	Basic static moment load (N · m)		
	Rolling M_{R0}	Pitching M_{P0}	Yawing M_{Y0}
Single	335	133	133

MCH06

Accuracy grade: High grade (H)



Dimensions of MCH06 (Single slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm)				Inertia $\times 10^{-6}(\text{kg} \cdot \text{m}^2)$	Mass (kg)
				L ₁	L ₂	L ₃	n		
◇MCH06005H05K02	50	53 (65)	5	219	150	100	2	2.38	1.8
◇MCH06005H10K02			10					3.45	
◇MCH06005H20K02			20					7.25	
MCH06010H05K02	100	103 (115)	5	269	200	100	2	3.17	2.2
MCH06010H10K02			10					4.12	
MCH06010H20K02			20					7.92	
MCH06020H05K02	200	203 (215)	5	369	300	200	3	4.51	3.0
MCH06020H10K02			10					5.46	
MCH06020H20K02			20					9.26	
MCH06030H05K02	300	303 (315)	5	469	400	300	4	5.85	3.7
MCH06030H10K02			10					6.80	
MCH06030H20K02			20					10.6	
MCH06040H05K02	400	403 (415)	5	569	500	400	5	7.18	4.5
MCH06040H10K02			10					8.13	
MCH06040H20K02			20					11.9	
MCH06050H05K02	500	503 (515)	5	669	600	500	6	8.52	5.2
MCH06050H10K02			10					9.47	
MCH06050H20K02			20					13.3	

Notes: 1. Dimension G is 25 for items marked with ◇.
2. Reference numbers above are for high-grade grease specifications. In the case of other specifications, see the following table for the 13th and 14th digits.

Coding for columns 13 and 14

Grease	High-grade	Precision-grade
Standard	02	(None)
LG2	B2	B0

Ball screw lead(mm)	Monocarrier dynamic torque specification (N · cm)	
	Accuracy grade	
	High grade	Precision
5	1.0 – 4.8	1.9 – 7.6
10	1.1 – 5.8	2.1 – 8.9
20	1.6 – 7.9	2.5 – 10.6

Notes:
1. Frictional resistance of NSK K1 is included in dynamic torque in table.
2. Grease is packed into the ball screw, linear guide parts and support unit.
3. Consult NSK for life estimates under large moment loads.

Basic load ratings

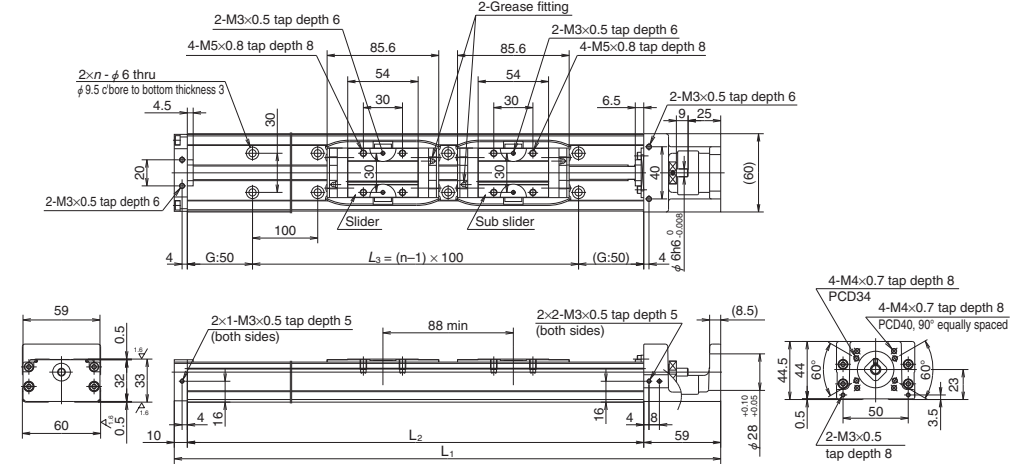
Lead ℓ (mm)	Shaft dia d (mm)	Basic dynamic load ratings (N)				Basic static load ratings (N)		Support unit load limit (N)
		Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_r (km)	Ball screw C_{0a}	Linear guides C_0	
5	φ 12	4 390	22 800	5 550	5	6 260	16 300	1 020
10		2 740	18 100		10	3 820		
20		2 660	14 400		20	3 800		

Basic static moment loads of linear guide

Slider	Basic static moment load (N · m)		
	Rolling M_{RO}	Pitching M_{PO}	Yawing M_{VO}
Single	335	133	133

MCH06 (Double slider)

Accuracy grade: High grade (H)



Dimensions of MCH06 (Double slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm)				Inertia $\times 10^{-6}(\text{kg} \cdot \text{m}^2)$	Mass (kg)
				L ₁	L ₂	L ₃	n		
MCH06010H05D02	100	115 (139)	5	369	300	200	3	4.82	3.5
MCH06010H10D02			10					6.72	
MCH06020H05D02	200	215 (239)	5	469	400	300	4	6.16	4.2
MCH06020H10D02			10					8.06	
MCH06030H05D02	300	315 (339)	5	569	500	400	5	7.50	5.0
MCH06030H10D02			10					9.40	
MCH06040H10D02	400	415 (439)	10	669	600	500	6	10.7	5.7
MCH06040H20D02			20					18.3	

Note: Reference numbers above are for high-grade grease specifications. In the case of other specifications, see the following table for the 13th and 14th digits.

Coding for columns 13 and 14

Grease	High-grade	Precision-grade
Standard	02	(None)
LG2	B2	B0

Ball screw lead(mm)	Monocarrier dynamic torque specification (N · cm)	
	Accuracy grade	
	High grade	Precision
5	1.2 – 5.2	2.1 – 8.5
10	1.5 – 9.6	2.5 – 10.7
20	2.3 – 11.8	3.4 – 14.1

Notes:
1. Frictional resistance of NSK K1 is included in dynamic torque in table.
2. Grease is packed into the ball screw, linear guide parts and support unit.
3. Consult NSK for life estimates under large moment loads.

Basic load ratings

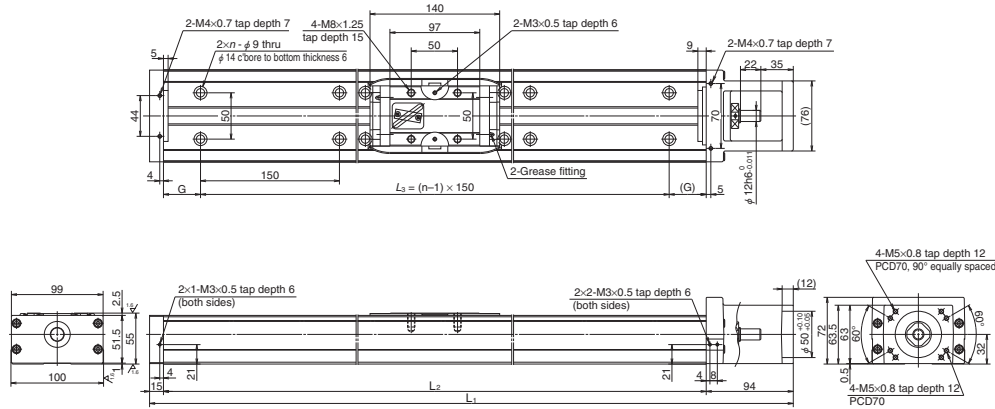
Lead ℓ (mm)	Shaft dia d (mm)	Basic dynamic load ratings (N)				Basic static load ratings (N)		Support unit load limit (N)
		Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_r (km)	Ball screw C_{0a}	Linear guides C_0	
5	φ 12	4 390	22 800	5 550	5	6 260	16 300	1 020
10		2 740	18 100		10	3 820		
20		2 660	14 400		20	3 800		

Basic static moment loads of linear guide

Slider	Basic static moment load (N · m)		
	Rolling M_{RO}	Pitching M_{PO}	Yawing M_{VO}
Double	770	730	730

MCH10

Accuracy grade: High grade (H)



Dimensions of MCH10 (Single slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm)					Inertia $\times 10^6$ (kg · m ²)	Mass (kg)
				L ₁	L ₂	G	L ₃	n		
MCH10010H10K02	100	126 (142)	10	389	280	65	150	2	33.2	7.3
MCH10010H20K02		20	41.1							
MCH10020H10K02	200	226 (242)	10	489	380	40	300	3	43.4	9.5
MCH10020H20K02		20	51.3							
MCH10030H10K02	300	326 (342)	10	589	480	15	450	4	53.7	12
MCH10030H20K02		20	61.6							
MCH10040H10K02	400	426 (442)	10	689	580	65	450	4	62.4	14
MCH10040H20K02		20	71.8							
MCH10050H10K02	500	526 (542)	10	789	680	40	600	5	74.7	16
MCH10050H20K02		20	82.3							
MCH10060H10K02	600	626 (642)	10	889	780	15	750	6	84.9	19
MCH10060H20K02		20	92.5							
MCH10070H10K02	700	726 (742)	10	989	880	65	750	6	95.1	21
MCH10070H20K02		20	103							
MCH10080H10K02	800	826 (842)	10	1 089	980	40	900	7	105	23
MCH10080H20K02		20	113							
MCH10090H10K02	900	926 (942)	10	1 189	1 080	15	1 050	8	116	25
MCH10090H20K02		20	123							
MCH10100H10K02	1 000	1 026 (1 042)	10	1 289	1 180	65	1 050	8	126	27
MCH10100H20K02		20	133							
MCH10110H10K02	1 100	1 126 (1 142)	10	1 389	1 280	40	1 200	9	136	29
MCH10110H20K02		20	143							
MCH10120H10K02	1 200	1 226 (1 242)	10	1 489	1 380	15	1 350	10	146	32
MCH10120H20K02		20	154							

Note: Reference numbers above are for high-grade grease specifications. In the case of other specifications, see the following table for the 13th and 14th digits.

Coding for columns 13 and 14

Grease	High-grade	Precision-grade
Standard	O2	(None)
LG2	B2	B0

Ball screw lead (mm)	Monocarrier dynamic torque specification (N · cm)	
	Accuracy grade	
	High grade	Precision
10	2.7 – 10.8	3.3 – 17.5
20	3.1 – 12.7	3.8 – 20.4

Notes:

- Frictional resistance of NSK K1 is included in dynamic torque in table.
- Grease is packed into ball screws, linear guide parts and support units.
- Consult NSK for life estimates under large moment loads.

Basic load ratings

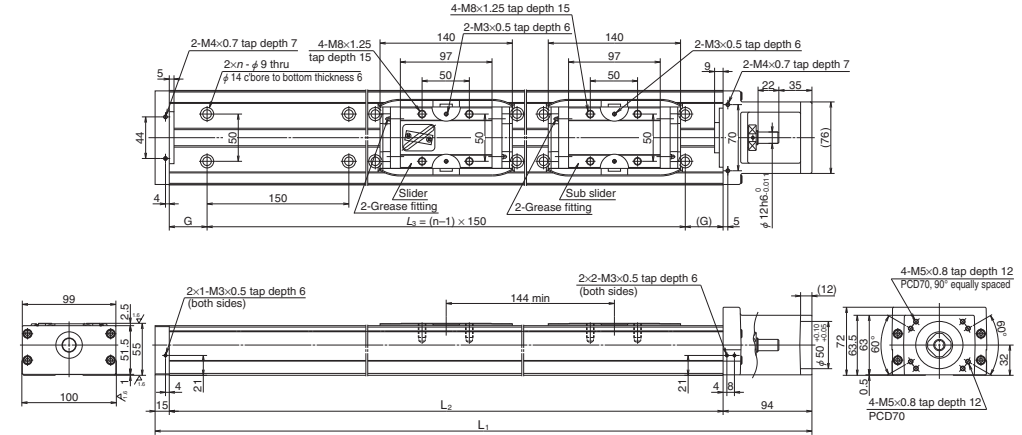
Lead l (mm)	Shaft dia d (mm)	Basic dynamic load ratings (N)				Basic static load ratings (N)		Support unit load limit (N)
		Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_R (km)	Ball screw C_{0a}	Linear guides C_0	
10	φ20	12 800	44 600	9 600	10	21 400	42 000	2 360
20		8 190	35 400		20	12 600		

Basic static moment loads of linear guide

	Basic static moment loads (N · m)		
	Rolling M_{R0}	Pitching M_{P0}	Yawing M_{V0}
Slider	1 460	610	610
Single	1 460	610	610

MCH10 (Double slider)

Accuracy grade: High grade (H)



Dimensions of MCH10 (Double slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm)					Inertia $\times 10^6$ (kg · m ²)	Mass (kg)
				L ₁	L ₂	G	L ₃	n		
MCH10025H10D02	250	282 (314)	10	689	580	65	450	4	67.1	15
MCH10025H20D02		20	82.4							
MCH10035H10D02	350	382 (414)	10	789	680	40	600	5	77.3	17
MCH10035H20D02		20	92.5							
MCH10045H10D02	450	482 (514)	10	889	780	15	750	6	87.5	20
MCH10045H20D02		20	103							
MCH10055H10D02	550	582 (614)	10	989	880	65	750	6	97.7	22
MCH10055H20D02		20	113							
MCH10065H10D02	650	682 (714)	10	1 089	980	40	900	7	108	24
MCH10065H20D02		20	123							
MCH10075H20D02	750	782 (814)	20	1 189	1 080	15	1 050	8	133	26
MCH10085H20D02	850	882 (914)	20	1 289	1 180	65	1 050	8	143	28
MCH10095H20D02	950	982 (1 014)	20	1 389	1 280	40	1 200	9	154	30
MCH10105H20D02	1 050	1 082 (1 114)	20	1 489	1 380	15	1 350	10	164	33

Note: Reference numbers above are for high-grade grease specifications. In the case of other specifications, see the following table for the 13th and 14th digits.

Coding for columns 13 and 14

Grease	High-grade	Precision-grade
Standard	O2	(None)
LG2	B2	B0

Ball screw lead (mm)	Monocarrier dynamic torque specification (N · cm)	
	Accuracy grade	
	High grade	Precision
10	4.2 – 15.6	4.4 – 21.6
20	5.0 – 19.6	5.6 – 27.4

Notes:

- Frictional resistance of NSK K1 is included in dynamic torque in table.
- Grease is packed into ball screws, linear guide parts and support units.
- Consult NSK for life estimates under large moment loads.

Basic load rating

Lead l (mm)	Shaft dia d (mm)	Basic dynamic load ratings (N)				Basic static load ratings (N)		Support unit load limit (N)
		Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_R (km)	Ball screw C_{0a}	Linear guides C_0	
10	φ20	12 800	44 600	9 600	10	21 400	42 000	2 360
20		8 190	35 400		20	12 600		

Basic static moment loads of linear guide

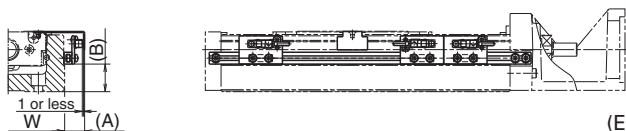
	Basic static moment loads (N · m)		
	Rolling M_{R0}	Pitching M_{P0}	Yawing M_{V0}
Slider	2 920	3 430	3 430
Double	2 920	3 430	3 430

C-1-6. 3 MCH Model Accessories

C-1-6. 3. 1 Sensor Unit

● Proximity switch

Sensor rails are not included with sensor units



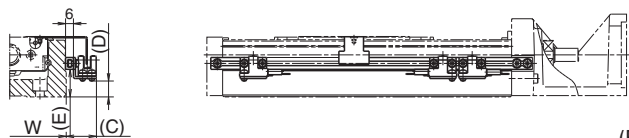
(Example assembly)

Model No.	Reference No.			A (mm)	B (mm)	Body width W (mm)
MCH06	MC-SRH06-10	MC-SRH06-11	MC-SRH06-12	17	10	60
MCH09	MC-SRH09-10	MC-SRH09-11	MC-SRH09-12	16	21	86
MCH10	MC-SRH10-10	MC-SRH10-11	MC-SRH10-12	16	16	100
Quantity	Proximity switch (normally open contact)	—	3	1	E2S-W13 (OMRON Corp.)	
	Proximity switch (normally close contact)	3	—	2	E2S-W14 (OMRON Corp.)	

Notes: 1. See page C137 for proximity switch specifications. 2. A sensor unit consists of sensors, a sensor dog and sensor mounting parts.

● Photo sensor

Sensor rails are not included with sensor units



(Example assembly)

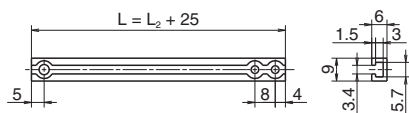
Model No.	Reference No.	C (mm)	D (mm)	E (mm)	Body width W (mm)	Remarks
MCH06	MC-SRH06-13	24	2	11	60	EE-SX674 (OMRON Corp.)
MCH09	MC-SRH09-13	23	12	21	86	3 sets
MCH10	MC-SRH10-13	23	29	16	100	(EE-1001 connector attachment)

Notes: 1. See page C138 for proximity switch specifications. 2. A sensor unit consists of sensors, a sensor dog and sensor mounting parts.

(1) Sensor rail

Reference number: MC-SRL- * * * *

● * * * * is the same as rail dimension L_2 .



Note: For combinations of sensors and rails, see page C82.

MCH Model Sensor Rail Combinations

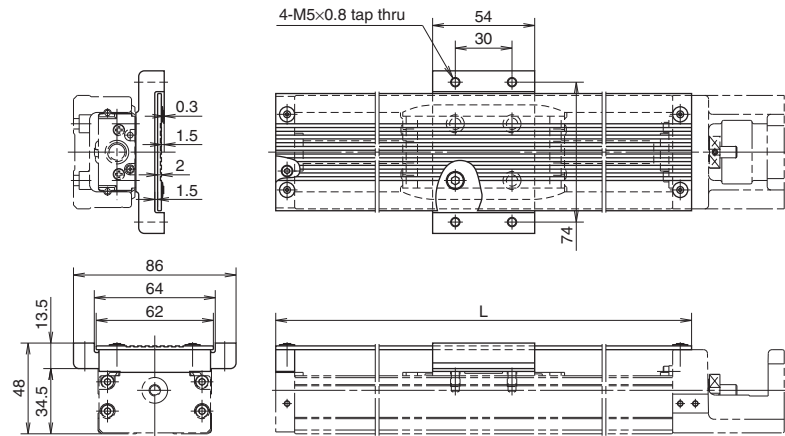
Table 4

Model No.	Body length L_2 (mm)	Reference No.	Sensor rail reference No.
MCH09	150	MCH06005H05K02	MC-SRL-0150
		MCH06005H10K02	
		MCH06005H20K02	
MCH06	200	MCH06010H05K02	MC-SRL-0200
		MCH06010H10K02	
		MCH06010H20K02	
MCH06	300	MCH06020H05K02	MC-SRL-0300
		MCH06020H10K02	
		MCH06020H20K02	
MCH06	400	MCH06030H05K02	MC-SRL-0400
		MCH06030H10K02	
		MCH06030H20K02	
MCH06	500	MCH06040H05K02	MC-SRL-0500
		MCH06040H10K02	
		MCH06040H20K02	
MCH06	600	MCH06050H05K02	MC-SRL-0600
		MCH06050H10K02	
		MCH06050H20K02	
MCH06	150	MCL06005H05K02	MC-SRL-0150
		MCL06010H05K02	
		MCL06010H10K02	
		MCL06020H05K02	
		MCL06020H10K02	
		MCL06020H20K02	
MCH06	200	MCL06030H05K02	MC-SRL-0200
		MCL06030H10K02	
		MCL06030H20K02	
		MCL06040H05K02	
		MCL06040H10K02	
		MCL06040H20K02	
MCH06	300	MCL06050H05K02	MC-SRL-0300
		MCL06050H10K02	
		MCL06050H20K02	
		MCL06060H05K02	
		MCL06060H10K02	
		MCL06060H20K02	
MCH06	400	MCL06070H05K02	MC-SRL-0400
		MCL06070H10K02	
		MCL06070H20K02	
		MCL06080H05K02	
		MCL06080H10K02	
		MCL06080H20K02	
MCH06	500	MCL06090H05K02	MC-SRL-0500
		MCL06090H10K02	
		MCL06090H20K02	
		MCL06100H05K02	
		MCL06100H10K02	
		MCL06100H20K02	
MCH06	600	MCL06110H05K02	MC-SRL-0600
		MCL06110H10K02	
		MCL06110H20K02	
		MCL06120H05K02	
		MCL06120H10K02	
		MCL06120H20K02	
MCH09	240	MCH09010H05K02	MC-SRL-0240
		MCH09010H10K02	
		MCH09010H20K02	
		MCH09020H05K02	
		MCH09020H10K02	
		MCH09020H20K02	
MCH09	340	MCH09030H05K02	MC-SRL-0340
		MCH09030H10K02	
		MCH09030H20K02	
		MCH09015H05D02	
		MCH09015H10D02	
		MCH09015H20D02	
MCH09	440	MCH09040H05K02	MC-SRL-0440
		MCH09040H10K02	
		MCH09040H20K02	
		MCH09025H05D02	
		MCH09025H10D02	
		MCH09025H20D02	
MCH09	540	MCH09050H05K02	MC-SRL-0540
		MCH09050H10K02	
		MCH09050H20K02	
		MCH09035H05D02	
		MCH09035H10D02	
		MCH09035H20D02	
MCH09	640	MCH09060H05K02	MC-SRL-0640
		MCH09060H10K02	
		MCH09060H20K02	
		MCH09045H10D02	
		MCH09045H20D02	
		MCH09045H20D02	
MCH09	740	MCH09060H05K02	MC-SRL-0740
		MCH09060H10K02	
		MCH09060H20K02	
		MCH09045H10D02	
		MCH09045H20D02	
		MCH09045H20D02	

Model No.	Body length L_2 (mm)	Reference No.	Sensor rail reference No.
MCH09	840	MCH09070H05K02	MC-SRL-0840
		MCH09070H10K02	
		MCH09070H20K02	
MCH09	940	MCH09080H05K02	MC-SRL-0940
		MCH09080H10K02	
		MCH09080H20K02	
MCH10	280	MCH10010H10K02	MC-SRL-0280
		MCH10010H20K02	
		MCH10020H10K02	
MCH10	380	MCH10020H20K02	MC-SRL-0380
		MCH10030H10K02	
		MCH10030H20K02	
MCH10	480	MCH10040H10K02	MC-SRL-0480
		MCH10040H20K02	
		MCH10055H10D02	
MCH10	580	MCH10025H10D02	MC-SRL-0580
		MCH10050H10K02	
		MCH10050H20K02	
MCH10	680	MCH10055H10D02	MC-SRL-0680
		MCH10035H10D02	
		MCH10035H20D02	
MCH10	780	MCH10060H10K02	MC-SRL-0780
		MCH10060H20K02	
		MCH10045H10D02	
MCH10	880	MCH10045H20D02	MC-SRL-0880
		MCH10070H10K02	
		MCH10070H20K02	
MCH10	980	MCH10055H10D02	MC-SRL-0980
		MCH10055H20D02	
		MCH10080H10K02	
MCH10	1 080	MCH10080H20K02	MC-SRL-1080
		MCH10065H10D02	
		MCH10065H20D02	
MCH10	1 080	MCH10090H10K02	MC-SRL-1080
		MCH10090H20K02	
		MCH10075H20D02	
MCH10	1 180	MCH10100H10K02	MC-SRL-1180
		MCH10100H20K02	
		MCH10085H20D02	
MCH10	1 280	MCH10110H10K02	MC-SRL-1280
		MCH10110H20K02	
		MCH10095H20D02	
MCH10	1 380	MCH10120H10K02	MC-SRL-1380
		MCH10120H20K02	
		MCH10105H20D02	

C-1-6. 3. 2 Cover Unit

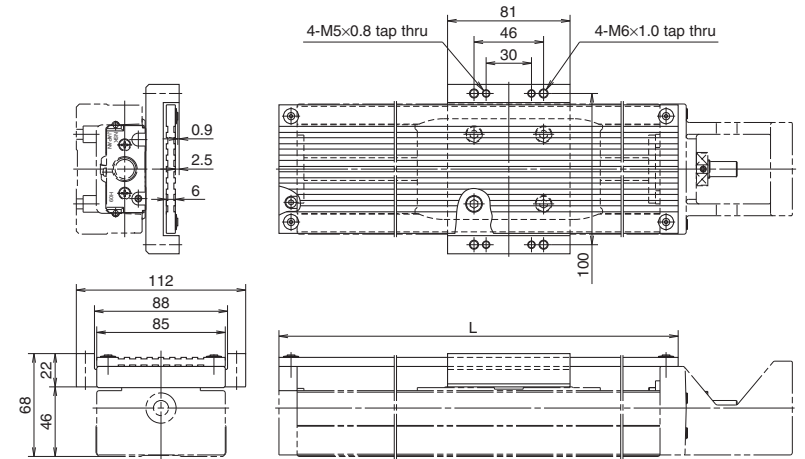
Cover unit for MCH06 and MCL06



Unit: mm

Single slider		Double slider		Top cover length L
Stroke	Reference No.	Stroke	Reference No.	
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 MCH09

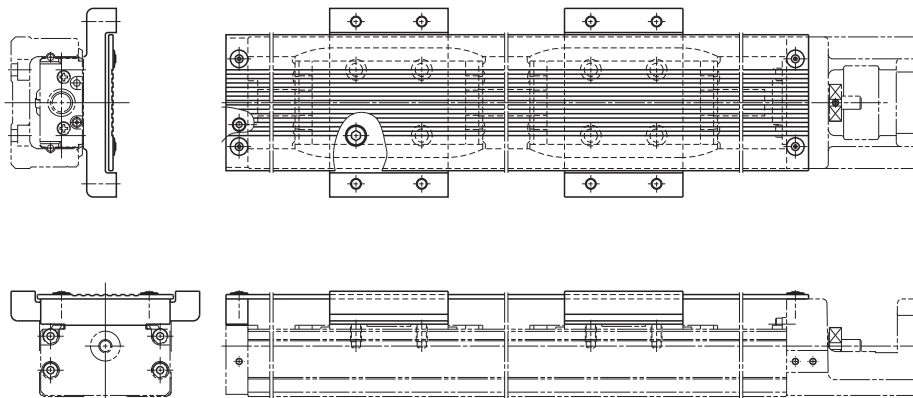


Unit: mm

Single slider		Double slider		Top cover length L
Stroke	Reference No.	Stroke	Reference No.	
100	MC-HV09010-00	-	-	264
200	MC-HV09020-00	-	-	364
300	MC-HV09030-00	150	MC-HV09015D00	464
400	MC-HV09040-00	250	MC-HV09025D00	564
500	MC-HV09050-00	350	MC-HV09035D00	664
600	MC-HV09060-00	450	MC-HV09045D00	764
700	MC-HV09070-00	-	-	864
800	MC-HV09080-00	650	MC-HV09065D00	964

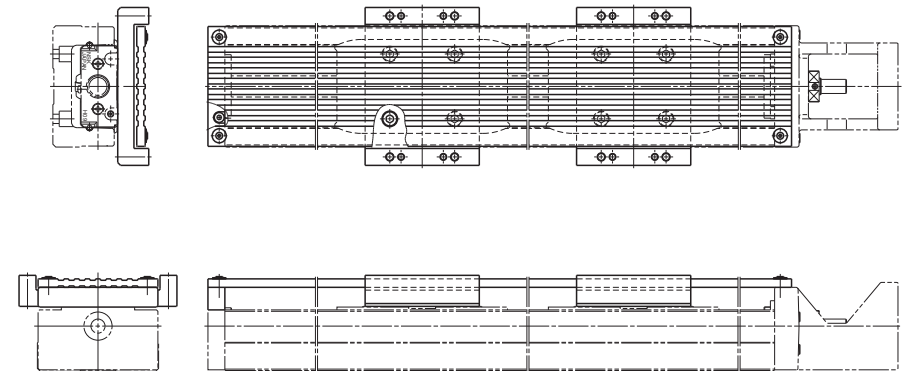
● Cover unit for double sliders

Two spacers are provided for double sliders.

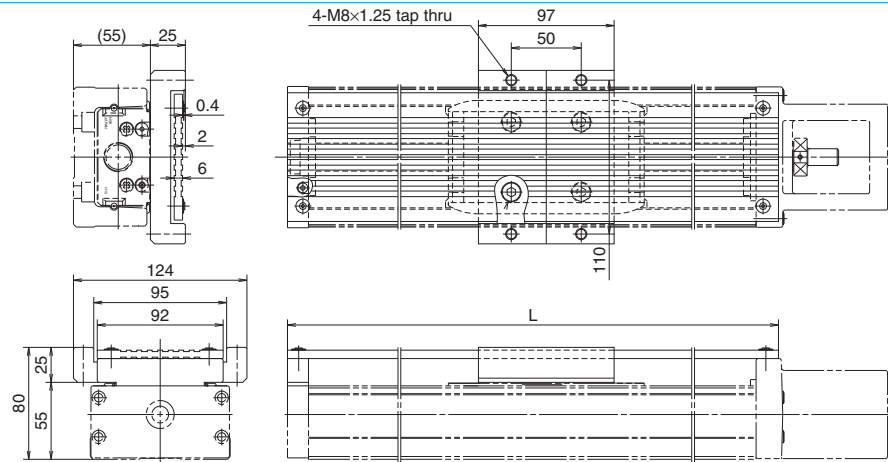


● Cover unit for double sliders

Two spacers are provided for double sliders.



Cover unit for MCH10

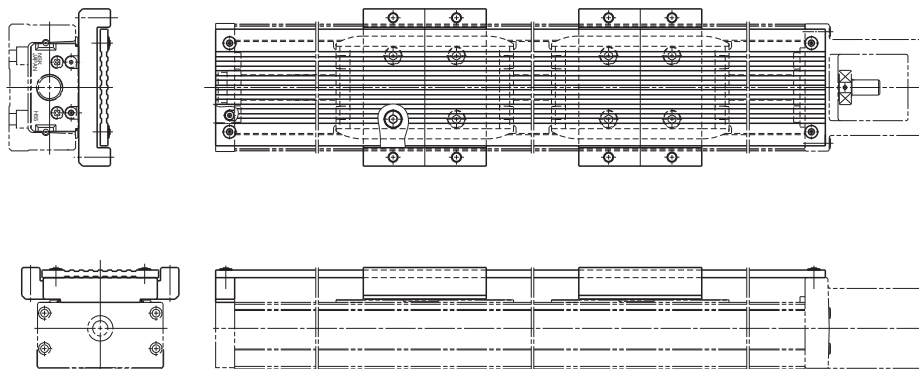


Unit: mm

Single slider		Double slider		Top cover length L
Stroke	Reference No.	Stroke	Reference No.	
100	MC-HV10010-00	-	-	310
200	MC-HV10020-00	-	-	410
300	MC-HV10030-00	-	-	510
400	MC-HV10040-00	250	MC-HV10025D00	610
500	MC-HV10050-00	350	MC-HV10035D00	710
600	MC-HV10060-00	450	MC-HV10045D00	810
700	MC-HV10070-00	550	MC-HV10055D00	910
800	MC-HV10080-00	650	MC-HV10065D00	1 010
900	MC-HV10090-00	750	MC-HV10075D00	1 110
1 000	MC-HV10100-00	850	MC-HV10085D00	1 210
1 100	MC-HV10110-00	950	MC-HV10095D00	1 310
1 200	MC-HV10120-00	1 050	MC-HV10105D00	1 410

●Cover unit for double sliders

Two spacers are provided for double sliders.

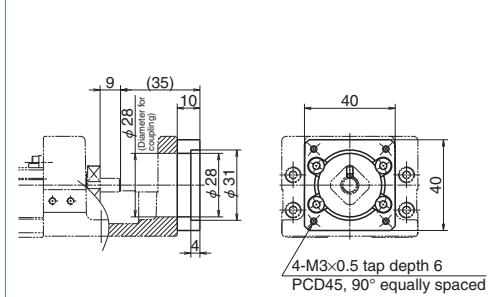


C-1-6. 3. 3 Intermediate Plate for Motor

- Please ask NSK about motors not listed in the compatible motor list.
- If using a parallel motor mount, please consult with NSK. ● Be sure to align centerlines when installing motor.
- Motor models are subject to change at motor manufacturers. For details, please contact the manufacturer.

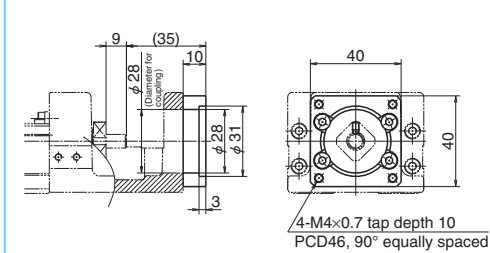
Motor Bracket for MCH06 and MCL06

Reference number: MC-BKH06-145-00



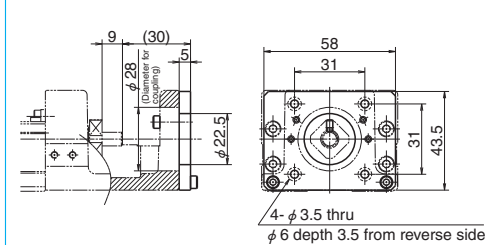
Compatible motor		
Maker	Series	Motor models(Servo motor)
Panasonic Co.,Ltd.	MINAS A6	MSMF5A(50W), MSMF01(100W)

Reference number: MC-BKH06-146-00



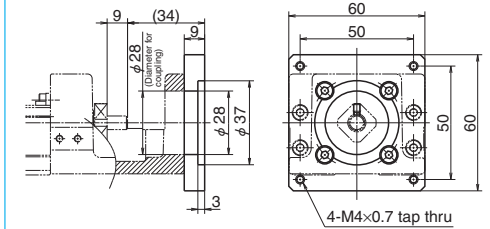
Compatible motor		
Maker	Series	Motor models(Servo motor)
YASKAWA Electric Corp.	Σ-7	SGM7A-A5(50W), SGM7J-A5(50W) SGM7A-01(100W), SGM7J-01(100W) SGM7A-C2(150W), SGM7J-C2(150W)
Mitsubishi Electric Corp.	MELSERVO-J4	HG-KR053(50W), HG-MR053(50W) HG-KR13(100W), HG-MR13(100W)
OMRON Corp.	G5	R88M-K05030(50W), R88M-K10030(100W)
SANYO DENKI Co., Ltd.	SANMOTION R	R2=A04005(50W), R2=A04010(100W)

Reference number: MC-BKH06-231-00



Compatible motor		
Maker	Series	Motor models(Stepper motor)
ORIENTAL MOTOR Co.,Ltd.	αSTEP	AR46x, ARL46x, AZ46x
MOTOR Co.,Ltd.	CRK, CVK, RKII	CRK54x, CVK54x, RKS54x, CVK24x
SANYO DENKI Co.,Ltd.	SANMOTION Model No.PB	PBDM423x, PB=R423x, PB=P423x

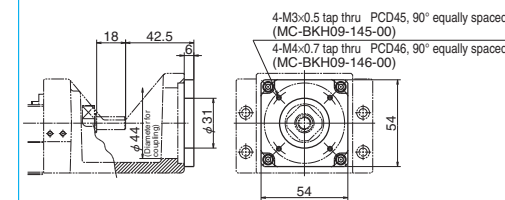
Reference number: MC-BKH06-250-00



Compatible motor		
Maker	Series	Motor models(stepping motor)
ORIENTAL MOTOR Co.,Ltd.	αSTEP	AR6x, ARL6x, AZ6x
MOTOR Co.,Ltd.	CRK, CVK, RKII	CRK56x, CVK56x, RKS56x
SANYO DENKI Co.,Ltd.	SANMOTION Model No.PB	PBDM60x, PB=R60x, PB=P60x

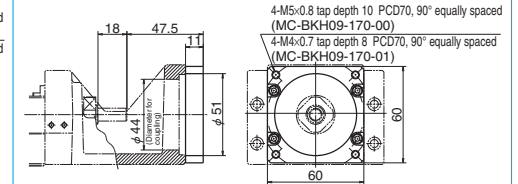
Motor Bracket for MCH09

Reference number: MC-BKH09-145-00
MC-BKH09-146-00



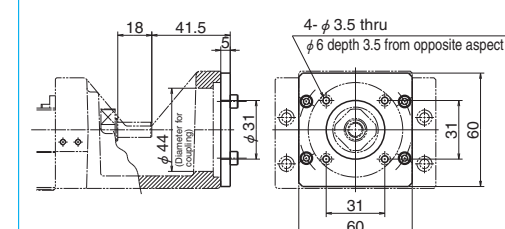
Reference No.	Compatible motor		
	Maker	Series	Motor models(Servo motor)
MC-BKH09-145-00	Panasonic Co.,Ltd.	MINAS A6	MSMF5A(50W), MSMF01(100W)
MC-BKH09-146-00	YASKAWA Electric Corp.	Σ-7	SGM7A-A5(50W), SGM7J-A5(50W) SGM7A-01(100W), SGM7J-01(100W) SGM7A-C2(150W), SGM7J-C2(150W)
	Mitsubishi Electric Corp.	MELSERVO-J4	HG-KR053(50W), HG-MR053(50W) HG-KR13(100W), HG-MR13(100W)
MC-BKH09-170-01	OMRON Corp.	G5	R88M-K05030(50W), R88M-K10030(100W)
	SANYO DENKI Co.,Ltd.	SANMOTION R	R2=A04005(50W), R2=A04010(100W)

Reference number: MC-BKH09-170-00
MC-BKH09-170-01



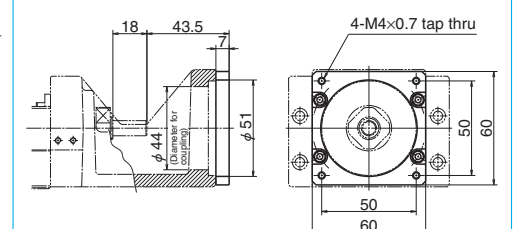
Reference No.	Compatible motor		
	Maker	Series	Motor models(Servo motor)
MC-BKH09-170-00	YASKAWA Electric Corp.	Σ-7	SGM7A-02A(200W), SGM7J-02(200W) SGM7A-04A(400W), SGM7J-04(400W) SGM7A-06A(600W), SGM7J-06(600W)
MC-BKH09-170-01	Mitsubishi Electric Corp.	MELSERVO-J4	HG-KR23(200W), HG-MR23(200W) HG-KR43(400W), HG-MR43(400W)
	SANYO DENKI Co., Ltd.	SANMOTION R	R2=A06020(200W), R2=A06040(400W)
MC-BKH09-170-01	Panasonic Co.,Ltd.	MINAS A6	MSMF02(200W), MSMF04(400W)
	OMRON Corp.	G5	R88M-K20030(200W), R88M-K40030(400W)

Reference number: MC-BKH09-231-00



Compatible motor		
Maker	Series	Motor models(stepping motor)
ORIENTAL MOTOR Co.,Ltd.	αSTEP	AR46x, ARL46x, AZ46x
MOTOR Co.,Ltd.	CRK, CVK, RKII	CRK54x, CVK54x, RKS54x, CVK24x
SANYO DENKI Co.,Ltd.	SANMOTION Model No.PB	PBDM423x, PB=R423x, PB=P423x

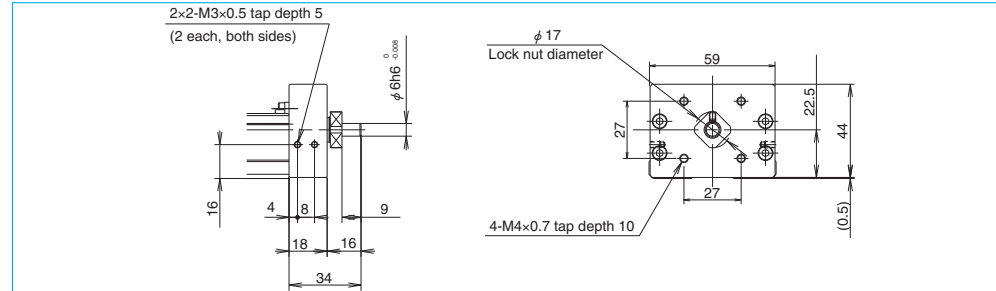
Reference number: MC-BKH09-250-00



Compatible motor		
Maker	Series	Motor models(Stepper motor)
ORIENTAL MOTOR Co.,Ltd.	αSTEP	AR6x, ARL6x, AZ6x
MOTOR Co.,Ltd.	CRK, CVK, RKII	CRK56x, CVK56x, RKS56x
SANYO DENKI Co.,Ltd.	SANMOTION Model No.PB	PBDM60x, PB=R60x, PB=P60x

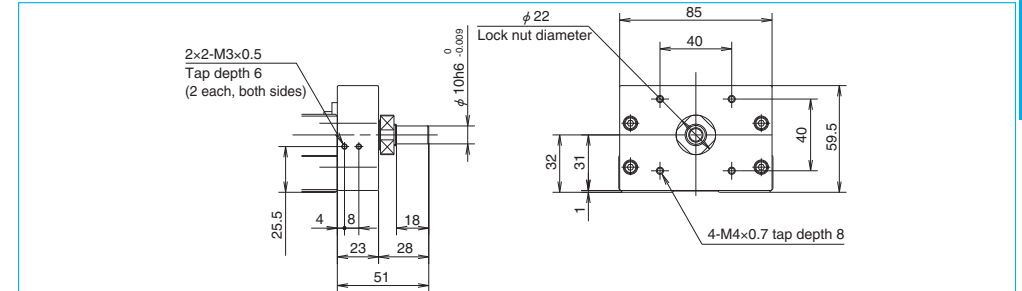
Diameter of ball screw shaft end to install a pulley for parallel motor mount of MCH06

(* These specifications are not subject to catalog standards.)



Diameter of ball screw shaft end to install a pulley for parallel motor mount of MCH09

(* These specifications are not subject to catalog standards.)

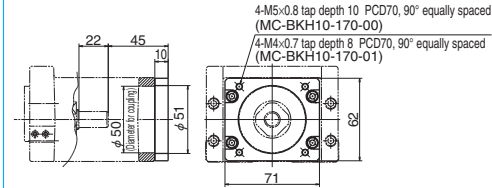


Compatible Motors for Intermediate Plates of the MCH Model

Model No.	Reference No. code	Motor bracket reference No.	Motor manufacturer	Motor Serise	Stepping motor model No.	Wattage of AC servo motor							
						50	100	150	200	400	600	750	
MCH06 MCL06	1	MC-BKH06-145-00	Panasonic Co.,Ltd.	MINAS A6		MSMF5A	MSMF01						
			YASKAWA Electric Corp.	Σ-7		SGM7A-A5 SGM7J-A5	SGM7A-01 SGM7J-01	SGM7A-C2 SGM7J-C2					
			Mitsubishi Electric Corp.	MELSERVO-J4		HG-KR053 HG-MR053	HG-KR13 HG-MR13						
			OMRON Corp.	G5		R88M-K05030	R88M-K10030						
			SANYO DENKI Co.,Ltd.	SANMOTION R		R2=A04005	R2=A04010						
MCH09	1	MC-BKH09-145-00	Panasonic Co.,Ltd.	MINAS A6		MSMF5A	MSMF01						
			YASKAWA Electric Corp.	Σ-7		SGM7J-A5 SGM7A-A5	SGM7A-01 SGM7J-01	SGM7A-C2 SGM7J-C2					
			Mitsubishi Electric Corp.	MELSERVO-J4		HG-KR053 HG-MR053	HG-KR13 HG-MR13						
			OMRON Corp.	G5		R88M-K05030	R88M-K10030						
			SANYO DENKI Co.,Ltd.	SANMOTION R		R2=A04005	R2=A04010						
MCH10	1	MC-BKH10-170-00	YASKAWA Electric Corp.	Σ-7					SGM7A-02A SGM7J-02	SGM7A-04A SGM7J-04	SGM7A-06A SGM7J-06		
			Mitsubishi Electric Corp.	MELSERVO-J4		HG-KR23 HG-MR23	HG-KR43 HG-MR43						
			SANYO DENKI Co.,Ltd.	SANMOTION R		R2=A06020 R2=A06040	R2=A06020 R2=A06040						
			Panasonic Co.,Ltd.	MINAS A6		MSMF02(200W),MSMF04(400W)							
			OMRON Corp.	G5		R88M-K20030(200W),R88M-K40030(400W)							
MCH10	2	MC-BKH10-170-01	YASKAWA Electric Corp.	Σ-7					SGM7A-02A SGM7J-02	SGM7A-04A SGM7J-04	SGM7A-06A SGM7J-06		
			Mitsubishi Electric Corp.	MELSERVO-J4		HG-KR23 HG-MR23	HG-KR43 HG-MR43						
			SANYO DENKI Co.,Ltd.	SANMOTION R		R2=A06020 R2=A06040	R2=A06020 R2=A06040						
			Panasonic Co.,Ltd.	MINAS A6		MSMF02(200W),MSMF04(400W)							
			OMRON Corp.	G5		R88M-K20030(200W),R88M-K40030(400W)							
MCH10	3	MC-BKH10-190-00	YASKAWA Electric Corp.	Σ-7					SGM7A-08A(750W),SGM7J-A08(750W)				
			Mitsubishi Electric Corp.	MELSERVO-J4		HG-KR73(750W),HG-MR73(750W)							
			Panasonic Co.,Ltd.	MINAS A6		MSMF08(750W)							
			OMRON Corp.	G5		R88M-K75030(750W)							
MCH10	4	MC-BKH10-190-01	YASKAWA Electric Corp.	Σ-7					SGM7A-08A(750W),SGM7J-A08(750W)				
			Mitsubishi Electric Corp.	MELSERVO-J4		HG-KR73(750W),HG-MR73(750W)							
			Panasonic Co.,Ltd.	MINAS A6		MSMF08(750W)							
			OMRON Corp.	G5		R88M-K75030(750W)							
MCH10	5	MC-BKH10-250-00	ORIENTAL MOTOR Co.,Ltd.	αSTEP	AR6x, ARL6x, AZ6x								
			CRK, CVK, RKII	CRK56x, CVK56x, RKS56x									
			SANMOTION Model No.PB	PBDM60x, PB=R60x, PB=P60x									
			Panasonic Co.,Ltd.	MINAS A6		MSMF02(200W),MSMF04(400W)							
MCH10	6	MC-BKH10-270-00	ORIENTAL MOTOR Co.,Ltd.	αSTEP	AR9x, ARL9x, AZ9x								
			CRK, CVK, RKII	CRK56x, CVK56x, RKS56x									
			SANMOTION Model No.PB	PBDM60x, PB=R60x, PB=P60x									
			Panasonic Co.,Ltd.	MINAS A6		MSMF02(200W),MSMF04(400W)							

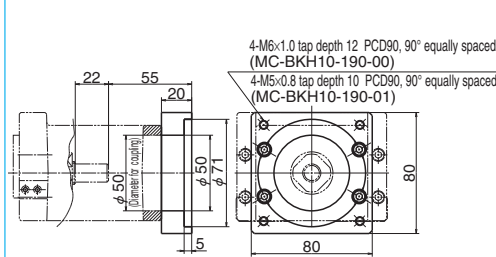
Motor Bracket for MCH10

Reference number: MC-BKH10-170-00
MC-BKH10-170-01



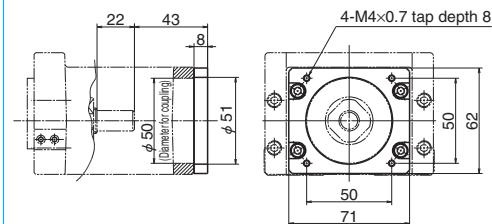
Reference No.	Compatible motor		
	Maker	Serise	Motor models(Servo motor)
MC-BKH10-170-00	YASKAWA Electric Corp.	Σ-7	SGM7A-02A(200W),SGM7J-02(200W) SGM7A-04A(400W),SGM7J-04(400W) SGM7A-06A(600W),SGM7J-06(600W)
	Mitsubishi Electric Corp.	MELSERVO-J4	HG-KR23(200W),HG-MR23(200W) HG-KR43(400W),HG-MR43(400W)
	SANYO DENKI Co.,Ltd.	SANMOTION R	R2=A06020(200W),R2=A06040(400W)
MC-BKH10-170-01	Panasonic Co.,Ltd.	MINAS A6	MSMF02(200W),MSMF04(400W)
	OMRON Corp.	G5	R88M-K20030(200W),R88M-K40030(400W)

Reference number: MC-BKH10-190-00
MC-BKH10-190-01



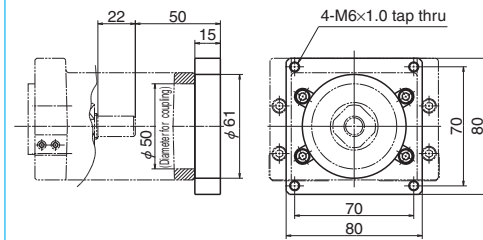
Reference No.	Compatible motor		
	Maker	Serise	Motor models(Servo motor)
MC-BKH10-190-00	YASKAWA Electric Corp.	Σ-7	SGM7A-08A(750W),SGM7J-A08(750W)
	Mitsubishi Electric Corp.	MELSERVO-J4	HG-KR73(750W),HG-MR73(750W)
MC-BKH10-190-01	Panasonic Co.,Ltd.	MINAS A6	MSMF08(750W)
	OMRON Corp.	G5	R88M-K75030(750W)

Reference number: MC-BKH10-250-00



Maker	Compatible motor	
	Serise	Motor models(steping motor)
OMRON Corp.	αSTEP	AR6x, ARL6x, AZ6x
	CRK, CVK, RKII	CRK56x, CVK56x, RKS56x
SANYO DENKI Co.,Ltd.	SANMOTION Model No.PB	PBDM60x, PB=R60x, PB=P60x

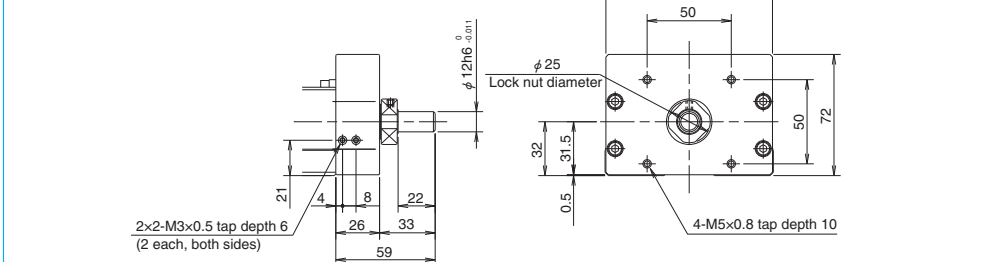
Reference number: MC-BKH10-270-00



Maker	Compatible motor	
	Serise	Motor models(steping motor)
ORIENTAL MOTOR Co.,Ltd.	αSTEP	AR46x, ARL46x, AZ46x
	CRK, CVK, RKII	CRK54x, CVK54x, RKS54x, CVK24x

Diameter of ball screw shaft end to install a pulley for parallel motor mount of MCH10

(* These specifications are not subject to catalog standards.)



C-2 Toughcarrier™

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5. TCH Model Dimension Tables for Standard Products	C111
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C-2 Toughcarrier™

C-2 Toughcarrier™

C-2-1 Features

Greatly improved load capacity due to switching of rolling elements to rollers.
Mounting dimensions are compatible with those of the MCH Model, allowing substitution.

● **Lightweight and compact design**

Taking into account part composition and rigidity, the cross sections of the rail and slider are the same as the MCH model.

● **Superb rust-preventive ability**

Low-temperature chrome plating comes standard.

● **All-in-one structure**

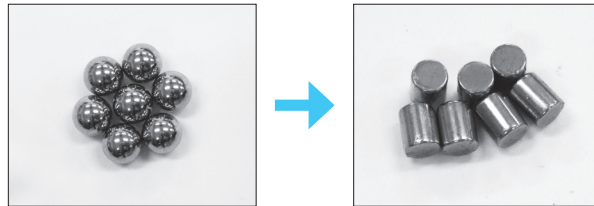
- 1) The all-in-one structure integrates a ball screw, a linear guide, and a support unit into a single structure to significantly reduce design time.
- 2) The bottom and one side of the rail are datum surfaces to facilitate highly accurate installation. Models with pin holes are also available as standard.
- 3) Immediate operation after installation and run-in is possible due to pre-packed grease.
- 4) A wide selection of ball screw leads are available.

● **Long-term maintenance-free operation**

Use of NSK K1 lubrication unit and grease maintains smooth lubricating performance for long periods.

● **Updated rolling elements**

Rollers are installed as rolling elements for the first time anywhere.

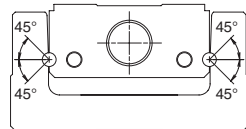


C-2-2 Classification and Models

Structure

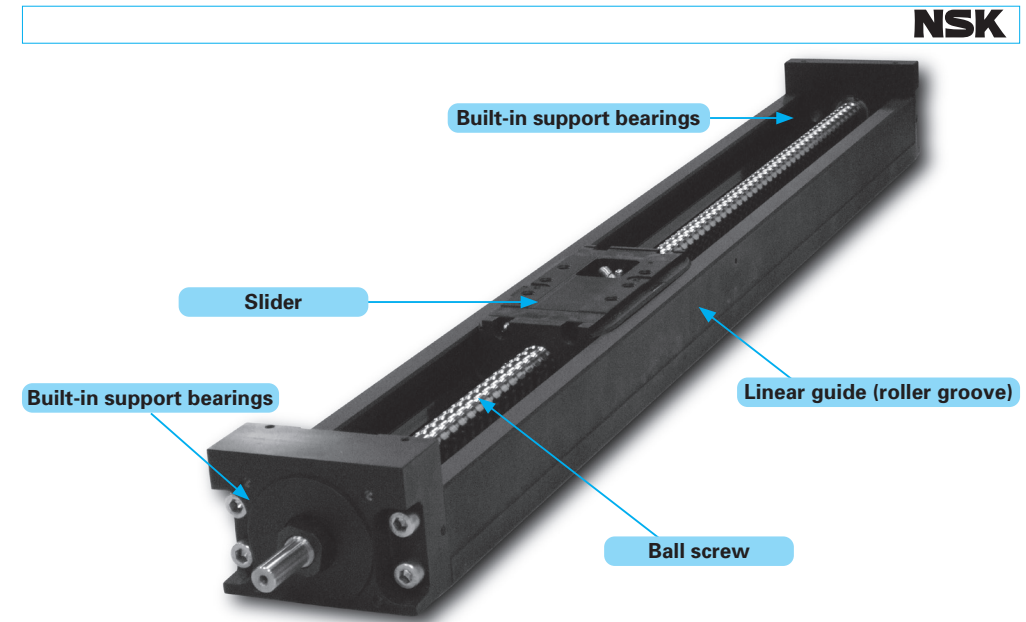
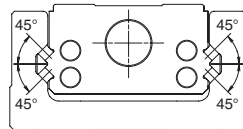
Rolling elements: Balls

MCH Model

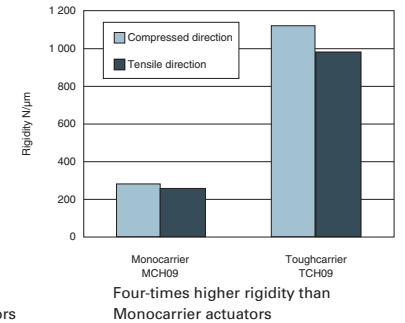
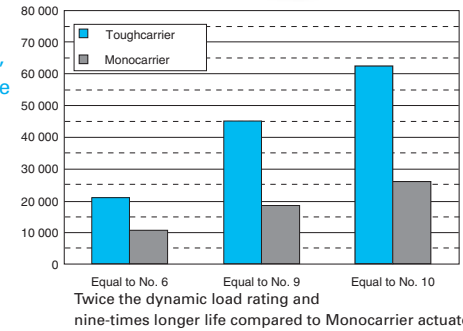


Rolling elements: Rollers

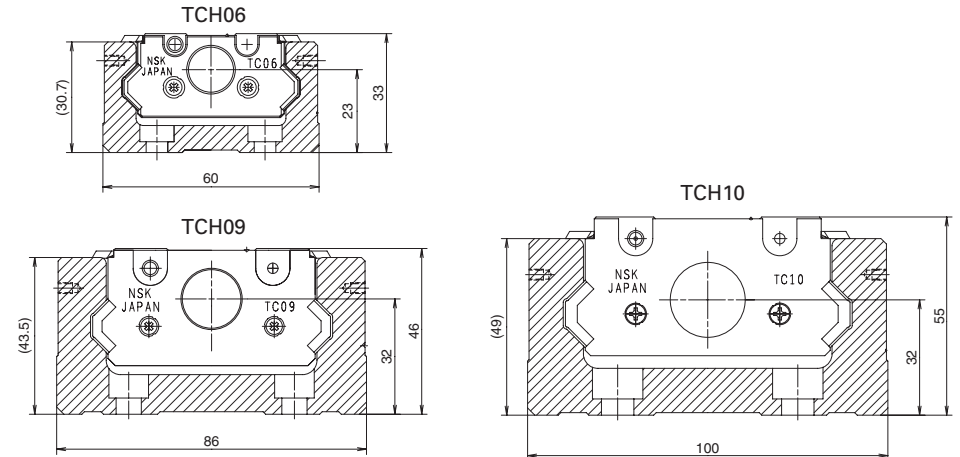
TCH Model



● **High rigidity, long life (N)**

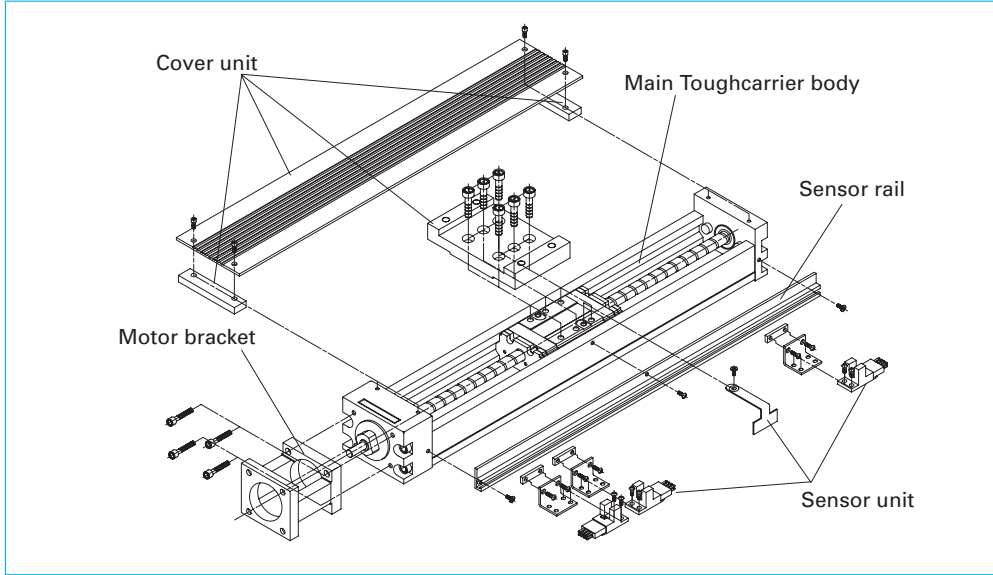


Cross-sections of TCH Models



C-2-3 Accessories

Accessories for Toughcarrier



Assembly Example

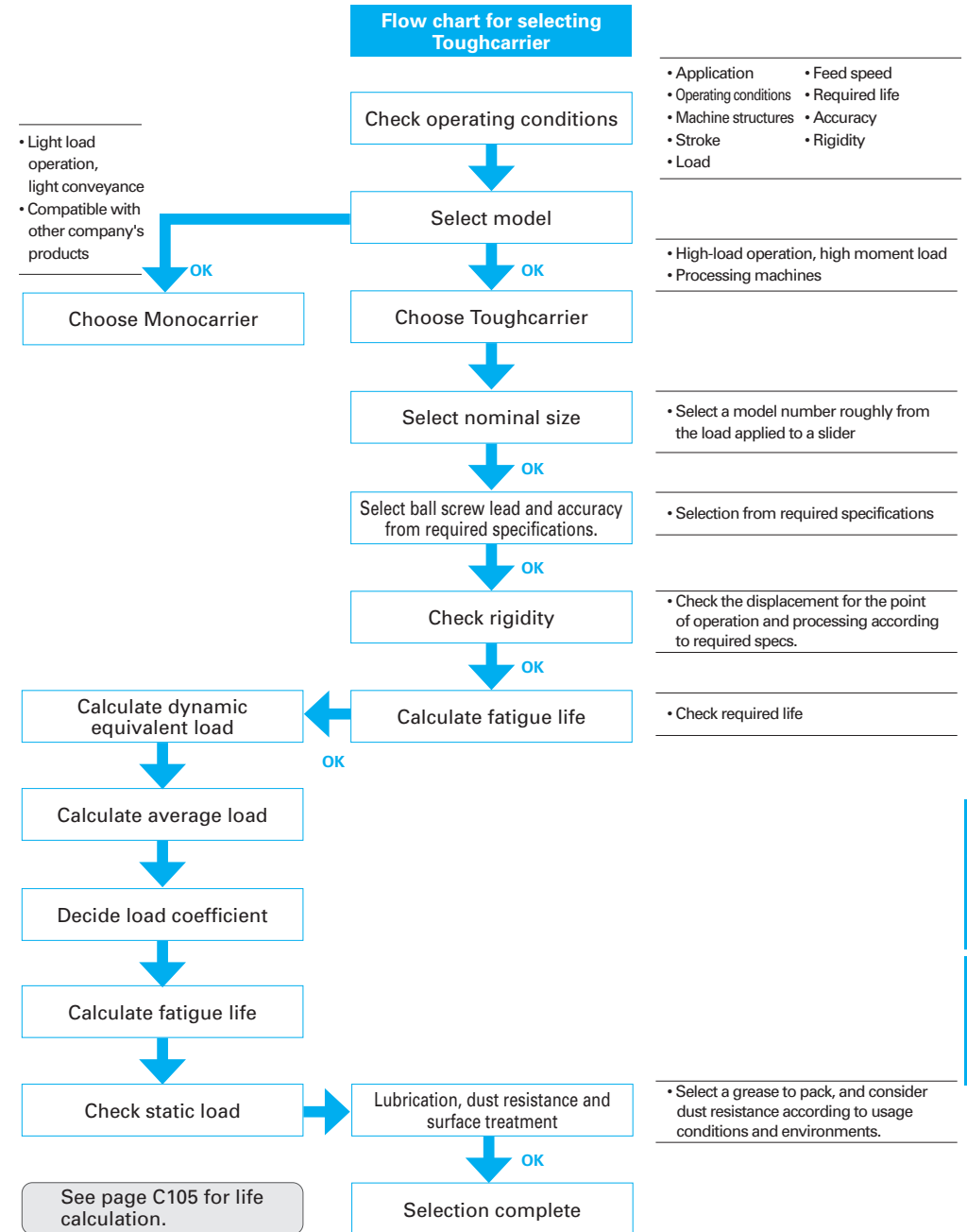
Sensor units, cover units, motor brackets and sensor rails are available as options for Toughcarrier actuators.

Contact NSK for specifications other than those of NSK standard accessories.

1. Sensor unit:
 - Photo sensor...Use both OMRON EE-SX674 and EE-1001
 - Proximity switch...Use OMRON E2S-W13, E2S-W14
 Available in a unit including sensor fitting clamps.
2. Sensor rail : This rail holds the sensor. Please order the appropriate rail according to the stroke.
3. Cover unit : This unit consists of a top cover and spacer plate.
4. Motor bracket: Brackets are available for a variety of models from different motor manufacturers. Please consult NSK when mounting dimensions differ.

C-2-4 Selection of Toughcarrier

C-2-4. 1 Selection Procedure



C-2-4. 2 Stroke and Lead

◆ Combinations of rail length and lead

● TCH06

Slider type Lead (mm) Rail length (mm)	Standard slider						Short slider					
	Single slider			Double slider			Single slider			Double slider		
	5	10	20	5	10	20	5	10	20	5	10	20
150	✓	✓	✓				✓	✓				
200	✓	✓	✓				✓	✓				
300	✓	✓	✓	✓	✓		✓	✓		✓	✓	
400	✓	✓	✓	✓	✓		✓	✓		✓	✓	
500	✓	✓	✓	✓	✓		✓	✓		✓	✓	
600	✓	✓	✓		✓	✓	✓	✓			✓	

*20 mm lead for short sliders not available.

● TCH09

Slider type Lead (mm) Rail length (mm)	Standard slider						Short slider					
	Single slider			Double slider			Single slider			Double slider		
	5	10	20	5	10	20	5	10	20	5	10	20
240	✓	✓	✓				✓	✓	✓			
340	✓	✓	✓				✓	✓	✓			
440	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	
540	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	
640	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	
740	✓	✓	✓		✓	✓	✓	✓	✓		✓	✓
840	✓	✓	✓		✓	✓	✓	✓	✓			
940	✓	✓	✓		✓	✓	✓	✓	✓		✓	✓

● TCH10

Slider type Lead (mm) Rail length (mm)	Standard slider				Short slider			
	Single slider		Double slider		Single slider		Double slider	
	10	20	10	20	10	20	10	20
280	✓	✓			✓	✓		
380	✓	✓			✓	✓		
480	✓	✓			✓	✓		
580	✓	✓	✓	✓	✓	✓	✓	✓
680	✓	✓	✓	✓	✓	✓	✓	✓
780	✓	✓	✓	✓	✓	✓	✓	✓
880	✓	✓	✓	✓	✓	✓	✓	✓
980	✓	✓	✓	✓	✓	✓	✓	✓
1 080	✓	✓			✓	✓		
1 180	✓	✓			✓	✓		
1 280	✓	✓			✓	✓		
1 380	✓	✓			✓	✓		

◆ Availability

Model No.	Lead (mm)	Slider	Rail length (mm)
TCH06	5, 10, 20	Single	600
		Double	
TCH09	5, 10, 20	Single	940
		Double	
TCH10	10, 20	Single	1 380
		Double	

C-2-4. 3 Reference Number Coding and Accuracy Grade

● Reference number coding for TCH Model

Body
Reference number: TC H 06 030 H 10 K 0 0

Toughcarrier
 Model: TCH Model
 (with accessories: TCS)
 Nominal size (rail width, 10 mm units)
 Stroke (10 mm units)
 Accuracy grade: H, High grade; P, Precision grade

NSK control number (0: without pin holes)
 (1: with pin holes)
 Grease (0: YS2, standard)
 Slider specification*
 Ball screw lead (mm)

* K: Single slider
 D: Double slider
 A: Single short slider
 B: Double short slider

Special specifications

Reference number: TC H 06 030 H 10 K - [] XXB

3: Toughcarrier for special specs
 5: Toughcarrier high-thrust model*
 Design serial number

* For the specifications of the High-Thrust Model, see page C134.

● Reference number for accessories

1. Sensor unit
Reference number: TC - SRH XX - 00
 Toughcarrier
 Sensor unit
 Nominal size: 06, 09 and 10
 Control no.: see page C117

2. Sensor rail
Reference number: TC - SRL X - XXXX
 Toughcarrier
 Sensor rail
 Nominal size: 06 is 6, 09 is 9, and 10 is 1.
 Body rail length

3. Cover unit
Reference number: TC - HV XX XXX K 00
 Toughcarrier
 Cover unit
 Nominal size: 06, 09 and 10
 Stroke (nominal)
 Slider specs: refer to the body reference no.
 Control no.: See pages C118 to C120

4. Motor bracket
Reference number: TC - BKH XX - XXX - 00
 Toughcarrier
 Motor bracket
 Nominal size: 06, 09 and 10
 Dimension for motor mounting
 Control no.

◆ Accuracy grade

Stroke (mm)	High grade (H grade)			Precision grade (P grade)			
	Repeatability	Running parallelism (vertical)	Backlash	Repeatability	Positioning accuracy	Running parallelism (vertical)	Backlash
to 200	±10	14	20 or less	±3	20	8	3 or less
to 400		16			10		
to 600		20			12		
to 700		23			15		
to 1 000					35		
to 1 200					40	20	

High and precision grades are available. Consult NSK for your requirements.

C-2-4. 4 Maximum Speed

● Maximum speed (standard slider)

Maximum speed of a Toughcarrier actuator is determined by the critical speed of the ball screw shaft and the d · n value.

Do not exceed the maximum speed in the table below.

	Stroke (nominal)	Ball screw lead (mm)	Body rail length L ₂ (mm)	Maximum speed (mm/s)
TCH06 Single slider	50	5	150	250
	100		200	
	200		300	
	300		400	
	400		500	
	500	600		
	50	10	150	500
	100		200	
	200		300	
	300		400	
	400		500	
	500	600		
	50	20	150	1 000
	100		200	
	200		300	
300	400			
400	500			
500	600			
TCH06 Double slider	130	5	300	250
	230		400	
	330		500	
	130	10	300	500
	230		400	
	330		500	
430	20	600	1 000	
100		240		
200		340		
TCH09 Single slider	100	5	440	250
	200		540	
	300		640	
	400		740	
	500		840	
	600	940		
	100	10	240	500
	200		340	
	300		440	
	400		540	
	500		640	
	600	740		
	700	840		
	800	940		
	100	20	240	410
200	340			
300	440			
400	540			
500	640			
600	740			
700	840			
800	940			
TCH10 Double slider	170	5	440	250
	270		540	
	370		640	
	470		740	
	570		840	
	670	940		
	170	10	440	500
	270		540	
	370		640	
	470		740	
	570		840	
	670	940		
	100	20	280	1 000
	200		380	
	300		480	
400	580			
500	680			
600	780			
700	880			
800	980			
900	1 080			
1 000	1 180			
1 100	1 280			
1 200	1 380			
TCH10 Single slider	100	5	280	250
	200		380	
	300		480	
	400		580	
	500		680	
	600	780		
	700	880		
	800	980		
	900	1 080		
	1 000	1 180		
	1 100	1 280		
	1 200	1 380		
	100	10	280	500
	200		380	
	300		480	
400	580			
500	680			
600	780			
700	880			
800	980			
900	1 080			
1 000	1 180			
1 100	1 280			
1 200	1 380			
100	20	280	1 000	
200		380		
300		480		
400		580		
500		680		
600	780			
700	880			
800	980			
900	1 080			
1 000	1 180			
1 100	1 280			
1 200	1 380			

- Notes: 1) Please consult NSK before operating Toughcarrier actuators near maximum speed.
 2) Maximum rotational speed is (3000 min⁻¹).
 3) Refer to the above table for maximum speed for each stroke.

● Maximum speed (short slider)

Maximum speed of a Toughcarrier actuator is determined by the critical speed of the ball screw shaft and the d · n value.

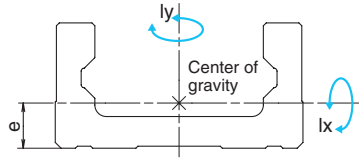
Do not exceed the maximum speed in the table below.

	Stroke (nominal)	Ball screw lead (mm)	Body rail length L ₂ (mm)	Maximum speed (mm/s)	
TCH06 Single slider	70	5	150	250	
	120		200		
	220		300		
	320		400		
	420		500		
	520	600			
	70	10	150	500	
	120		200		
	220		300		
	320		400		
	420		500		
	520	600			
	TCH06 Double slider	170	5	300	250
		270		400	
		370		500	
170		10	300	500	
270			400		
370			500		
TCH09 Single slider	140	5	240	250	
	240		340		
	340		440		
	440		540		
	540		640		
	640	740			
	740	840			
	840	940			
	140	10	240	500	
	240		340		
	340		440		
	440		540		
	540		640		
	640	740			
	740	840			
840	940				
140	20	240	1 000		
240		340			
340		440			
440		540			
540		640			
640	740				
740	840				
840	940				
TCH10 Double slider	250	5	440	250	
	350		540		
	450		640		
	550		740		
	650		840		
	750	940			
	250	10	440	500	
	350		540		
	450		640		
	550		740		
	650		840		
	750	940			
	160	20	280	1 000	
	260		380		
	360		480		
460	580				
560	680				
660	780				
760	880				
860	980				
960	1 080				
1 060	1 180				
1 160	1 280				
1 260	1 380				
TCH10 Single slider	160	5	280	250	
	260		380		
	360		480		
	460		580		
	560		680		
	660	780			
	760	880			
	860	980			
	960	1 080			
	1 060	1 180			
	1 160	1 280			
	1 260	1 380			
	160	10	280	500	
	260		380		
	360		480		
460	580				
560	680				
660	780				
760	880				
860	980				
960	1 080				
1 060	1 180				
1 160	1 280				
1 260	1 380				
TCH10 Double slider	360	5	580	500	
	460		680		
	560		780		
	660		880		
	760		980		
	860	1 080			
	960	1 180			
	1 060	1 280			
	1 160	1 380			
	360	10	580	1 000	
	460		680		
	560		780		
	660		880		
	760		980		
	860	1 080			
960	1 180				
1 060	1 280				
1 160	1 380				

- Notes: 1) Please consult NSK before operating Toughcarrier actuators near maximum speed.
 2) Maximum rotational speed is (3000 min⁻¹).
 3) Refer to the above table for maximum speed for each stroke.

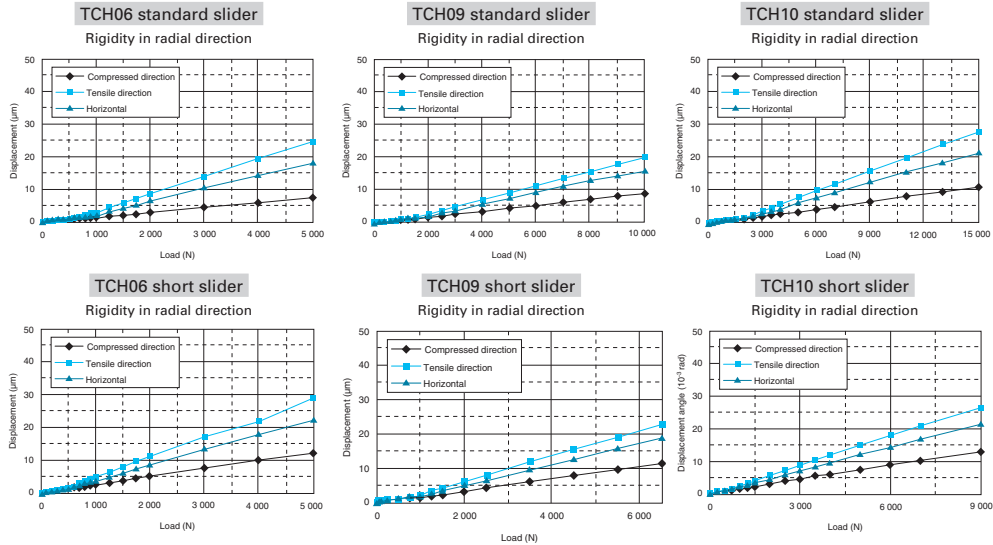
C-2-4. 5 Rigidity

Rigidity of rail

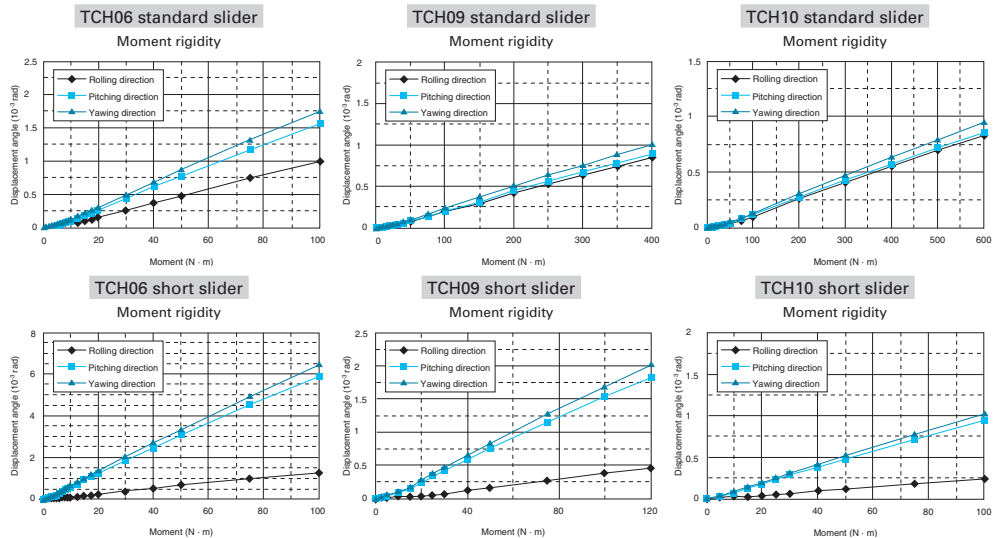


Model no.	Geometrical moment of inertia ¹⁾ (mm ⁴)		Center of gravity (mm)	Mass (kg/100mm)
	lx	ly	e	w
TCH06	6.47	36.2	10.6	0.6
TCH09	28.4	162	15.7	1.32
TCH10	46	283	17.2	1.73

◆ Rigidity in radial direction



◆ Moment in radial direction



C-2-4. 6 Basic Load Ratings

◆ Basic load ratings for TCH model

Standard slider

Model no.	Lead l (mm)	Shaft dia. d (mm)	Basic dynamic load ratings (N)			Basic static load ratings (N)		Support unit Allowable load (N)
			Ball screw C_a	Linear guide C	Support bearings C_a	Ball screw C_{0a}	Linear guide C_0	
TCH06	5	$\phi 12$	4 390	20 900	8 300	6 260	45 000	1 890
	10		2 740			3 820		
	20		2 660			3 800		
TCH09	5	$\phi 15$	8 300	44 900	11 100	12 700	96 900	3 560
	10		8 140			12 800		
	20		5 080			7 460		
TCH10	10	$\phi 20$	12 800	62 400	12 100	21 400	132 000	3 970
	20		8 190			12 600		

Short slider

Model no.	Lead l (mm)	Shaft dia. d (mm)	Basic dynamic load ratings (N)			Basic static load ratings (N)		Support unit Allowable load (N)
			Ball screw C_a	Linear guide C	Support bearings C_a	Ball screw C_{0a}	Linear guide C_0	
TCH06	5	$\phi 12$	4 390	12 200	8 300	6 260	22 500	1 890
	10		2 740			3 820		
TCH09	5	$\phi 15$	8 300	27 900	11 100	12 700	52 500	3 560
	10		8 140			12 800		
	20		5 080			7 460		
TCH10	10	$\phi 20$	12 800	38 700	12 100	21 400	71 500	3 970
	20		8 190			12 600		

- Basic dynamic and static load ratings indicate values for one slider.
- The basic dynamic load rating for a linear guide is a load that allows for a 50- km rating fatigue life and is vertical and constant on the ball mounting surface.
- The basic dynamic load rating for a ball screw is a load in the axial direction that allows 90% of ball screws of a group of the same Toughcarriers to rotate 1 million revolutions under the same conditions without causing flaking by rolling contact fatigue.
- The basic dynamic load rating for support bearings is a load that allows 1 million revolutions under the same conditions.
- Basic static load rating is load that results in combined permanent deformations at contact points of rolling elements and rolling surfaces of respective parts at a diameter of 0.01%.

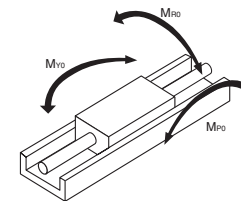
◆ Basic static moment loads of linear guide

Standard slider

Model no.	Slider	Basic static moment loads (N·m)		
		Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
TCH06	Single	800	340	340
TCH09	Single	2 510	1 340	1 340
TCH10	Single	3 980	2 150	2 150

Short slider

Model no.	Slider	Basic static moment loads (N·m)		
		Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
TCH06	Single	400	85	85
TCH09	Single	1 350	390	390
TCH10	Single	2 150	630	630



M_{RO} : Rolling moment
 M_{PO} : Pitching moment
 M_{YO} : Yawing moment

C-2-4. 7 Estimation of Life Expectancy

(1) Life of linear guide for Toughcarrier

Study the load to be applied to the linear guide of Toughcarrier (Fig. 1). Equivalent load F_e is determined by inputting the appropriate loads into the equations below. Use equation 1) for single sliders and equation 2) for double sliders.

● For single sliders

$$F_e = Y_H F_{Hh} + Y_V F_{Vv} + Y_R \epsilon_R M_R + Y_P \epsilon_P M_P + Y_Y \epsilon_Y M_Y \dots\dots\dots 1)$$

● For double sliders

For double sliders, calculation of the load applied to each slider is required.

Dynamic equivalent load is only for rolling moment.

This is the same procedure as for linear guide selection where two sliders are installed in a rail. Check the mean load for each slider, and calculate shortest life becomes the life of linear guide.

When lateral direction (F_H) and vertical direction (F_V) loads are applied to the center of the coordinate in Fig. 1,

$$F_{HA} = \frac{F_H}{2} + \frac{M_Y}{\ell}, F_{VA} = \frac{F_V}{2} + \frac{M_P}{\ell}$$

$$F_{HB} = \frac{F_H}{2} - \frac{M_Y}{\ell}, F_{VB} = \frac{F_V}{2} - \frac{M_P}{\ell}$$

[Slider A]

$$F_{eA} = Y_H \cdot F_{HA} + Y_V \cdot F_{VA} + Y_R \epsilon_R \frac{M_R}{2} \dots\dots\dots 2)$$

$$= Y_H \left(\frac{F_H}{2} + \frac{M_Y}{\ell} \right) + Y_V \left(\frac{F_V}{2} + \frac{M_P}{\ell} \right) + Y_R \epsilon_R \frac{M_R}{2}$$

[Slider B]

$$F_{eB} = Y_H \cdot F_{HB} + Y_V \cdot F_{VB} + Y_R \epsilon_R \frac{M_R}{2} \dots\dots\dots 2)'$$

$$= Y_H \left(\frac{F_H}{2} - \frac{M_Y}{\ell} \right) + Y_V \left(\frac{F_V}{2} - \frac{M_P}{\ell} \right) + Y_R \epsilon_R \frac{M_R}{2}$$

- F_H : Lateral direction load acting on the slider (N)
- F_V : Vertical direction load acting on the slider (N)
- M_R : Rolling moment acting on the slider (N · m)
- M_P : Pitching moment acting on the slider (N · m)
- M_Y : Yawing moment acting on the slider (N · m)
- ϵ_R : Dynamic equivalent coefficient to rolling moment
- ϵ_P : Dynamic equivalent coefficient to pitching moment
- ϵ_Y : Dynamic equivalent coefficient to yawing moment
- ℓ : Sliders span (m)

*For dynamic equivalent coefficients, see Table 1.

Y_H, Y_V, Y_R, Y_P, Y_Y : 1.0 or 0.5

In equations 1), 2) and 2') for obtaining equivalent load F_e , the maximum value of Y in the values for each equation is assumed to be 1.0. For others it is assumed to be 0.5.

Fig.1 Direction of load

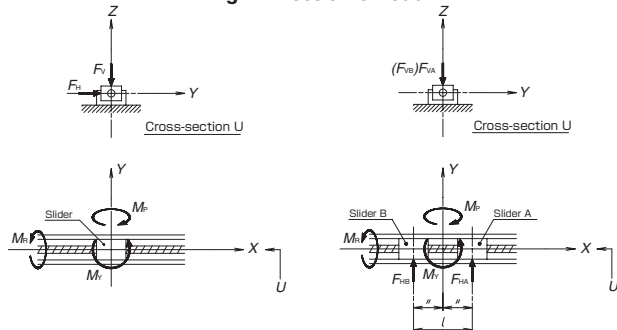
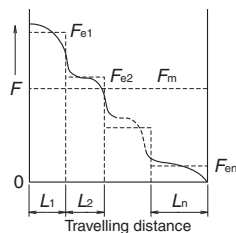


Fig. 2 Stepwise Fluctuating Load



If the loads acting on the slider fluctuate (in general, M_P and M_Y may fluctuate with the acceleration/deceleration of slider), the mean effective load is determined by Eq. 3).

- Travelling distance under the equivalent load F_{e1} : L_1
- Travelling distance under the equivalent load F_{e2} : L_2
-
- Travelling distance under the equivalent load F_{en} : L_n

Mean effective load F_m is calculated by the following equation.

$$F_m = \sqrt[10]{\frac{1}{L} (F_{e1}^{10} \cdot L_1 + F_{e2}^{10} \cdot L_2 + \dots + F_{en}^{10} \cdot L_n) \dots\dots 3)}$$

- F_m : Mean effective load of fluctuating loads (N)
- L : Total travelling distance (mm)

The life of linear guide for Toughcarrier is determined by Eq. 4).

$$L = 50 \times \left(\frac{C}{f_w \cdot F_m} \right)^{\frac{10}{3}} \dots\dots\dots 4)$$

- L : Life of linear guide (km)
- C : Basic dynamic load rating of linear guide (N)
- F_m : Mean effective load acting on linear guide (N)
- f_w : Load coefficient (see Table 2)

When the estimated life does not meet the required life, the life of the linear guide is calculated again after following measures are taken,

- 1: Change from single slider to double slider.
- 2: Use a larger Toughcarrier.

(2) Life of Ball Screw (Support Bearing)

The mean effective load is determined from the axial load.

Axial direction mean effective load F_m

$$F_m = \sqrt[3]{\frac{1}{L} (F_{a1}^3 \cdot L_1 + F_{a2}^3 \cdot L_2 + \dots + F_{an}^3 \cdot L_n) \dots\dots 5)}$$

The life of ball screw is determined by Eq. 6).

$$L = \ell \times \left(\frac{C_a}{f_w \cdot F_m} \right)^3 \times 10^6 \dots\dots\dots 6)$$

- ℓ : Ball screw lead (mm)
- L : Life of ball screw (mm)
- C_a : Basic dynamic load rating of ball screw (N)
- F_m : Mean effective load acting on ball screw (N)
- f_w : Load factor (see Table 2)

The life of a support bearing is calculated by Eq. 6). If the life of ball screw/support bearing does not meet the required life, use a larger size Toughcarrier. After applying the calculations mentioned above, selection of the Toughcarrier is completed.

Table 2 Value of load factor

Operating conditions	Load factor f_w
Smooth operation with no mechanical shock	1.0 – 1.2
Normal operation	1.2 – 1.5
Operation with mechanical shock and vibration	1.5 – 3.0

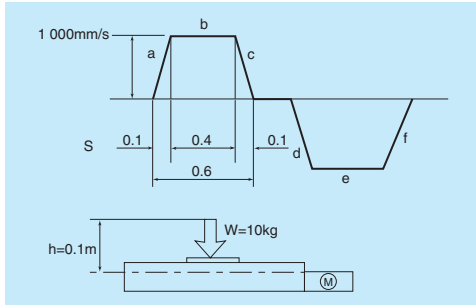
*When the bottom of rail is not fastened, the load factor is 1.5 or greater.

Table 1 Dynamic equivalent coefficient

	TCH06			TCH09			TCH10		
	Rolling	Pitching	Yawing	Rolling	Pitching	Yawing	Rolling	Pitching	Yawing
Standard slider	56	93	93	39	51	51	33	44	44
Short slider	56	186	186	39	95	95	33	80	80

C-2-4. 8 Example Life Estimation
Example life estimation for Toughcarrier

Example-1



1. Use condition
- Stroke : 500 mm
 - Maximum speed : 1 000 mm/s
 - Load mass : $W = 10 \text{ kg}$
 - Acceleration : 9.80 m/s^2
 - Setting position : Horizontal
 - Operating profile : See figure to above

2. Selection of model (interim selection)
 First, select a greater ball screw lead as the maximum speed is 1 000 mm/s.
 The interim selection is TCH06050H20K00, a single slider specification TCH06 that has 500 mm stroke, as the stroke is 500 mm.

3. Calculation
 3-1. Linear guide
 3-1-1. Fatigue life: Multiply the result of Eq. 1) by the dynamic equivalent coefficient (Table 1 single slider) to convert the load volume. From operation profile in the above figure, the acceleration is 10 m/s^2 .

- i) Constant speed $F_{e1} = Y_V \cdot F_V = Y_V \cdot W \cdot g$
 $= 1 \cdot 10 \cdot 9.8 = 98 \text{ N}$
- ii) Accelerating $F_{e2} = Y_V \cdot F_V + Y_p \cdot \epsilon_p \cdot M_p$
 $= Y_V \cdot W \cdot g + Y_p \cdot \epsilon_p h W \alpha$
 $= 0.5 \cdot 10 \cdot 9.8 + 1.93 \cdot 0.1 \cdot 10 \cdot 10$
 $= 979 \text{ N}$
- iii) Decelerating $F_{e3} = Y_V \cdot F_V + Y_p \cdot \epsilon_p \cdot M_p$
 $= Y_V \cdot W \cdot g + Y_p \cdot \epsilon_p h W \alpha$
 $= 0.5 \cdot 10 \cdot 9.8 + 1.93 \cdot 0.1 \cdot 10 \cdot 10$
 $= 979 \text{ N}$

Mean effective load F_m

$$F_m = \sqrt[3]{\frac{1}{L} (F_{e1}^3 \cdot L_1 + F_{e2}^3 \cdot L_2 + F_{e3}^3 \cdot L_3)}$$

$$= \sqrt[3]{\frac{1}{500} (98^3 \cdot 400 + 979^3 \cdot 50 + 979^3 \cdot 50)}$$

$$= 605 \text{ N}$$

$$L = 50 \times \left(\frac{C}{f_w \cdot F_m} \right)^3$$

$$= 50 \times \left(\frac{20\,900}{1.2 \cdot 605} \right)^3$$

$$= 3.65 \times 10^6 \text{ km}$$

3-1-2. Static safety factor: Divide the basic static load rating by the maximum load.

$$F_s = \frac{C_0}{F_e} = \frac{C_0}{F_{e2}} = \frac{45\,000}{979} = 45.9$$

3-2. Ball screw
 3-2-1. Fatigue life: Obtain the axial load of each stage of operation referring to the operation profile, and then calculate the mean load.
 By the process above,

- i) Constant speed $F_{e1} = \mu \cdot W \cdot g = 0.01 \cdot 10 \cdot 9.8 = 0.98 \text{ N}$
- ii) Accelerating $F_{e2} = F_{e1} + W \cdot \alpha = 0.98 + 10 \cdot 10 = 101 \text{ N}$
- iii) Decelerating $F_{e3} = F_{e1} + W \cdot \alpha = 0.98 - 10 \cdot 10 = 99 \text{ N}$

Axial mean effective load

$$F_m = \sqrt[3]{\frac{1}{L} (F_{e1}^3 \cdot L_1 + F_{e2}^3 \cdot L_2 + F_{e3}^3 \cdot L_3)}$$

$$= \sqrt[3]{\frac{1}{500} (0.98^3 \cdot 400 + 101^3 \cdot 50 + 99^3 \cdot 50)}$$

$$= 59 \text{ N}$$

$$L = \ell \times \left(\frac{C_a}{f_w \cdot F_m} \right)^3 \times 10^6$$

$$= 20 \times \left(\frac{2\,660}{1.2 \cdot 59} \right)^3 \times 10^6$$

$$= 10.6 \times 10^5 \text{ km}$$

3-2-2. Static safety factor: Divide the basic static load rating by the maximum axial load.

$$F_s = \frac{C_{0a}}{F_e} = \frac{C_{0a}}{F_{e2}} = \frac{3\,800}{101} = 37.6$$

3-3. Support bearings
 3-3-1. Fatigue life: Use the axial load $F_m = 59 \text{ N}$ that is the result of the calculation in 3-2-1, above.

$$L = \ell \times \left(\frac{C_a}{f_w \cdot F_m} \right)^3 \times 10^6$$

$$= 20 \times \left(\frac{8\,300}{1.2 \cdot 59} \right)^3 \times 10^6$$

$$= 3.22 \times 10^7 \text{ km}$$

3-3-2. Static safety factor: Divide the Allowable load by the maximum axial load.

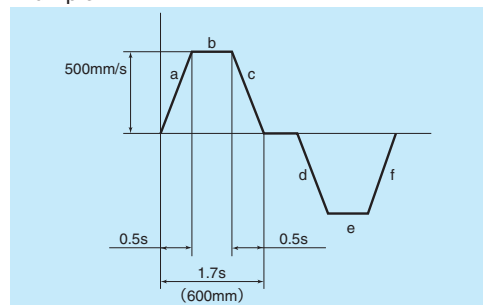
$$F_s = \frac{C_{0a}}{F_e} = \frac{C_{0a}}{F_{e2}} = \frac{1\,890}{101} = 18.7$$

3-4. Results

TCH06050H20K00	Linear guide	Ball screw	Support bearings
Fatigue life	3.65 × 10 ⁶ km	10.6 × 10 ⁵ km	3.22 × 10 ⁷ km
Static safety factor	45.9	37.6	18.7

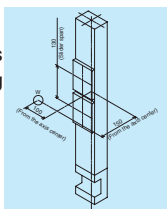
Example life estimation

Example-2



1. Use condition

- Stroke : 600 mm
- Maximum speed : 500 mm/s
- Load mass : $W = 20$ kg
- Acceleration : 9.8 m/s²
- Setting position : Vertical
- Operating profile : See figure to above



2. Selection of model (interim selection)

Select a 10 mm lead ball screw as the maximum speed is 500 mm/s.

The interim selection is TCH09067H10D00 (double slider specification) from the stroke and the vertical setting position.

3. Calculation

3-1. Linear guide

3-1-1. Fatigue life: Multiply the result of Eq. 2) and 2') by the dynamic equivalent coefficient (Table 1 double slider) to convert the load volume. From operation profile in the above figure, the acceleration is 1 m/s². The interim slider span is 0.13.

Under this condition,

$$F_H = 0, F_V = 0, M_R = 0$$

in Eq. 2), and both sliders have the same load with different direction.

i) Constant speed

$$F_{e1} = Y_H \cdot \frac{M_V}{\ell} + Y_V \cdot \frac{M_P}{\ell}$$

$$= 0.5 \cdot \frac{0.1 \cdot 20 \cdot 9.8}{0.13} + 1.0 \cdot \frac{0.15 \cdot 20 \cdot 9.8}{0.13}$$

$$= 302 \text{ N}$$

ii) Accelerating

$$F_{e2} = Y_H \cdot \frac{M_V}{\ell} + Y_V \cdot \frac{M_P}{\ell}$$

$$= 0.5 \cdot \frac{0.1 \cdot 20 \cdot (9.8 + 1.0)}{0.13} + 1.0 \cdot \frac{0.15 \cdot 20 \cdot (9.8 + 1.0)}{0.13}$$

$$= 333 \text{ N}$$

iii) Decelerating

$$F_{e3} = Y_H \cdot \frac{M_V}{\ell} + Y_V \cdot \frac{M_P}{\ell}$$

$$= 0.5 \cdot \frac{0.1 \cdot 20 \cdot (9.8 - 1.0)}{0.13} + 1.0 \cdot \frac{0.15 \cdot 20 \cdot (9.8 - 1.0)}{0.13}$$

$$= 271 \text{ N}$$

Mean effective load F_m

$$F_m = \sqrt[3]{\frac{1}{L} (F_{e1}^{10} \cdot L_1 + F_{e2}^{10} \cdot L_2 + F_{e3}^{10} \cdot L_3)}$$

$$= \sqrt[3]{\frac{1}{600} (302^{10} \cdot 350 + 333^{10} \cdot 125 + 271^{10} \cdot 125)}$$

$$= 304 \text{ N}$$

$$L = 50 \times \left(\frac{C}{f_w \cdot F_m} \right)^{\frac{10}{3}}$$

$$= 50 \times \left(\frac{44900}{1.2 \cdot 304} \right)^{\frac{10}{3}}$$

$$= 4.63 \times 10^8 \text{ km}$$

3-1-2. Static safety factor: Divide the basic static load rating by the maximum load.

$$F_s = \frac{C_0}{F_e} = \frac{C_0}{F_{e2}} = \frac{96900}{333} = 290$$

3-2. Ball screw

3-2-1. Fatigue life: Obtain the axial load of each stage of operation referring to the operation profile, and then calculate the mean load.

i) Constant speed

$$F_{e1} = W \cdot g = 20 \cdot 9.8 = 196 \text{ N}$$

ii) Accelerating

$$F_{e2} = F_{e1} + W \cdot \alpha = 196 + 20 \cdot 1.0 = 216 \text{ N}$$

iii) Decelerating

$$F_{e3} = F_{e1} - W \cdot \alpha = 196 - 20 \cdot 1.0 = 176 \text{ N}$$

Axial mean effective load F_m

$$F_m = \sqrt[3]{\frac{1}{L} (F_{e1}^{10} \cdot L_1 + F_{e2}^{10} \cdot L_2 + F_{e3}^{10} \cdot L_3)}$$

$$= \sqrt[3]{\frac{1}{600} (196^{10} \cdot 350 + 216^{10} \cdot 125 + 176^{10} \cdot 125)}$$

$$= 197 \text{ N}$$

$$L = \ell \times \left(\frac{C_a}{f_w \cdot F_m} \right)^3 \times 10^6$$

$$= 10 \times \left(\frac{8140}{1.2 \cdot 197} \right)^3 \times 10^6$$

$$= 4.08 \times 10^5 \text{ km}$$

3-2-2. Static safety factor: Divide the basic static load rating by the maximum axial load.

$$F_s = \frac{C_{0a}}{F_e} = \frac{C_{0a}}{F_{e2}} = \frac{12800}{216} = 59.2$$

3-3. Support bearings

3-3-1. Fatigue life: Use the axial load $F_m = 197$ N that is the result of the calculation in 3-2-1, above.

$$L = \ell \times \left(\frac{C_a}{f_w \cdot F_m} \right)^3 \times 10^6$$

$$= 10 \times \left(\frac{11000}{1.2 \cdot 197} \right)^3 \times 10^6$$

$$= 1.00 \times 10^6 \text{ km}$$

3-3-2. Static safety factor: Divide the Allowable load by the maximum axial load.

$$F_s = \frac{C_{0a}}{F_e} = \frac{C_{0a}}{F_{e2}} = \frac{3560}{216} = 16.4$$

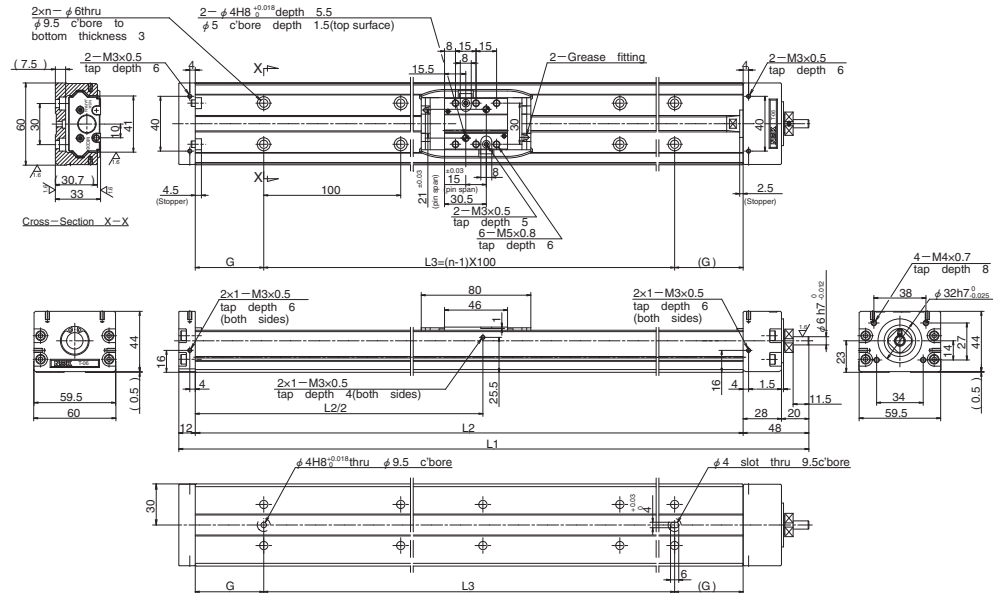
3-4. Result

TCH09067H10D00	Linear guide	Ball screw	Support bearings
Fatigue life	4.63 × 10 ⁸ km	4.08 × 10 ⁵ km	1.00 × 10 ⁶ km
Static safety factor	290	59.2	16.4

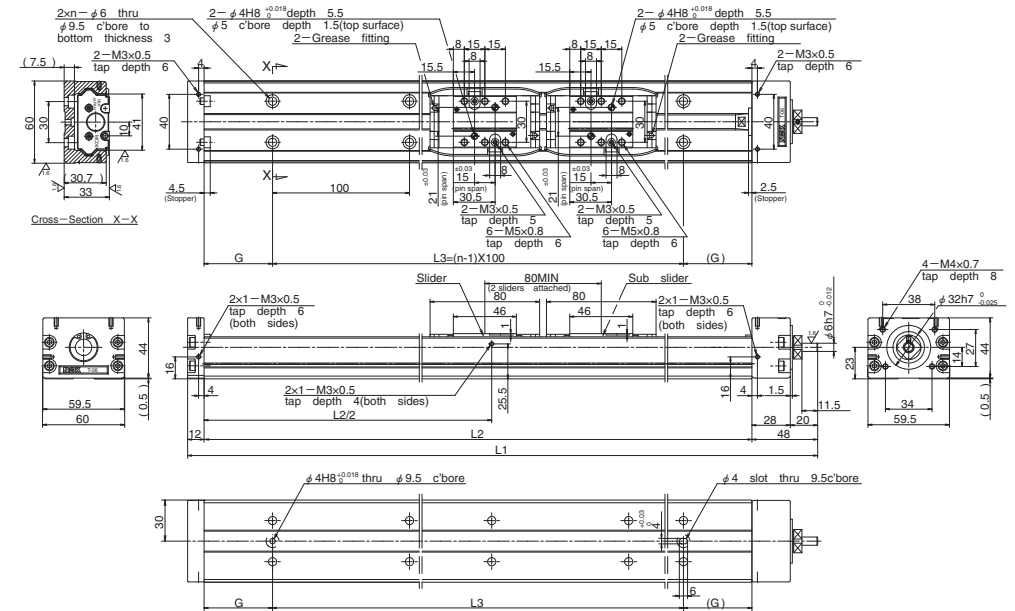
C-2-5 TCH Model Dimension Tables for Standard Products

C-2-5. 1 TCH06 model

◆ TCH06 Single Standard Slider Specifications(with pin holes)



◆ TCH06 Double standard slider Specifications(with pin holes)



TCH06 Standard Slider Specifications (Single)

Reference number	Nominal stroke (mm)	Stroke limit (mm)	Ball screw lead (mm)	Body length (mm)				No. of mounting holes n	Inertia $\times 10^6$ (kg · m ²)	Mass (kg)
				L ₁	L ₂	L ₃	G			
* TCH06005H05K00 (01)	50	63	5	210	150	100	25	2.94	2.2	
* TCH06005H10K00 (01)			10							
* TCH06005H20K00 (01)			20							
* TCH06010H05K00 (01)	100	113	5	260	200	100	50	4.18	2.5	
* TCH06010H10K00 (01)			10							
* TCH06010H20K00 (01)			20							
TCH06020H05K00 (01)	200	213	5	360	300	200	50	5.78	3.3	
TCH06020H10K00 (01)			10							
TCH06020H20K00 (01)			20							
TCH06030H05K00 (01)	300	313	5	460	400	300	50	7.28	3.9	
TCH06030H10K00 (01)			10							
TCH06030H20K00 (01)			20							
TCH06040H05K00 (01)	400	413	5	560	500	400	50	8.88	4.6	
TCH06040H10K00 (01)			10							
TCH06040H20K00 (01)			20							
TCH06050H05K00 (01)	500	513	5	660	600	500	50	10.5	5.3	
TCH06050H10K00 (01)			10							
TCH06050H20K00 (01)			20							

Items marked with * are unavailable for upside-down operation.

TCH06 Standard Slider Specifications (Double)

Reference number	Nominal stroke (mm)	Stroke limit (mm)	Ball screw lead (mm)	Body length (mm)				No. of mounting holes n	Inertia $\times 10^6$ (kg · m ²)	Mass (kg)
				L ₁	L ₂	L ₃	G			
* TCH06013H05D00 (01)	130	133	5	360	300	200	50	5.47	3.6	
* TCH06013H10D00 (01)			10							
* TCH06023H05D00 (01)			5							
* TCH06023H10D00 (01)	230	233	5	460	400	300	50	7.06	4.2	
* TCH06033H05D00 (01)			10							
* TCH06033H10D00 (01)			5							
* TCH06043H10D00 (01)	430	433	10	560	500	400	50	8.64	4.9	
TCH06043H10D00 (01)			10							
TCH06043H20D00 (01)			20							

Items marked with * are unavailable for upside-down operation.

Toughcarrier dynamic torque specifications

Unit: N · cm

Model no.	Slider specifications	Ball screw lead (mm)	Accuracy grade	
			High grade	Precision grade
TCH06	Single standard slider	5	1.0 – 6.0	1.8 – 9.0
		10	1.1 – 7.2	2.0 – 10.6
		20	1.6 – 9.5	2.2 – 12.9

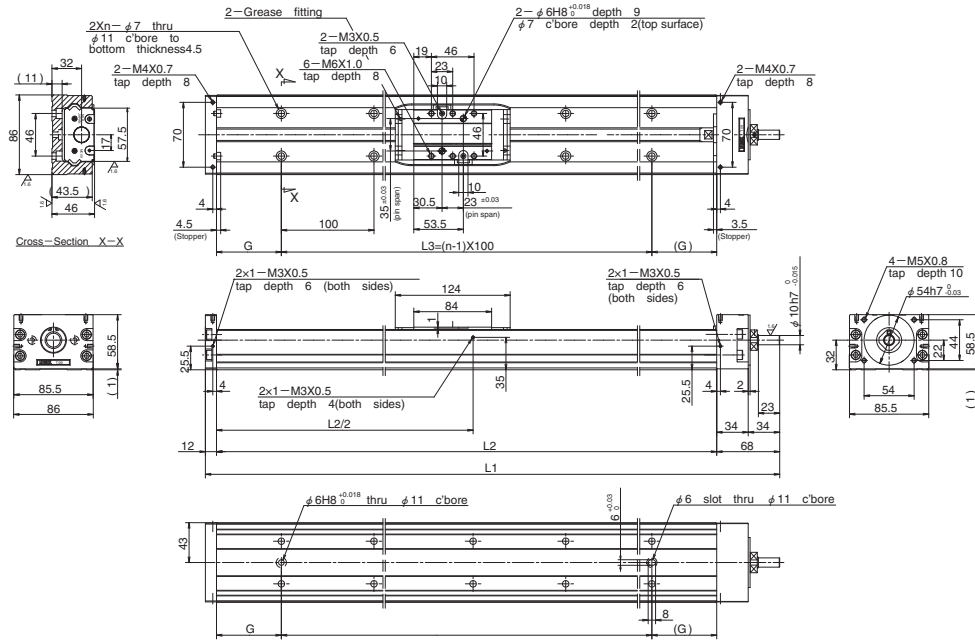
Toughcarrier dynamic torque specifications

Unit: N · cm

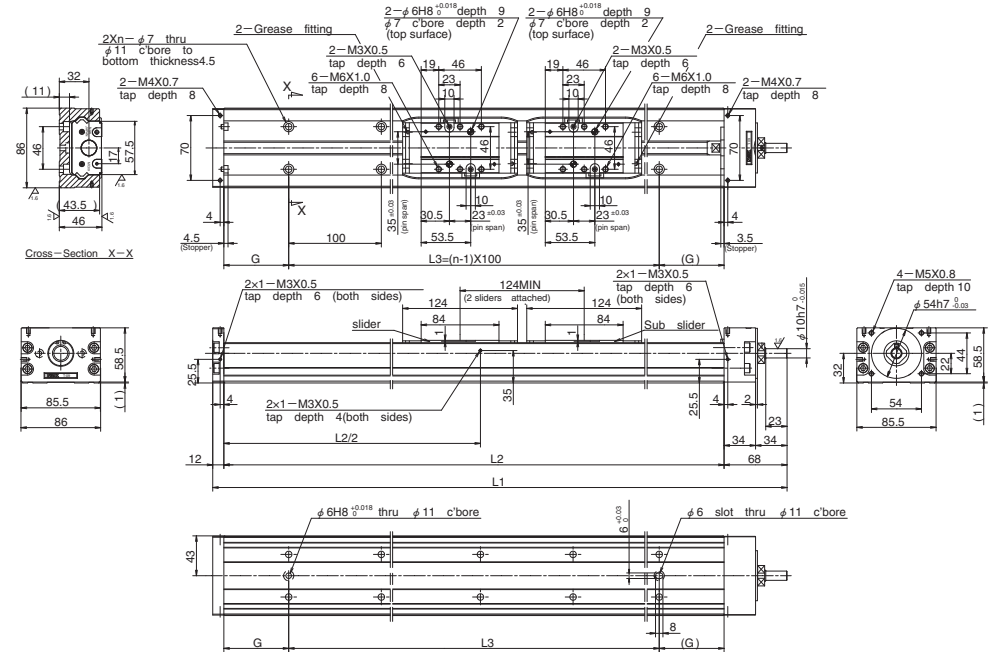
Model no.	Slider specifications	Ball screw lead (mm)	Accuracy grade	
			High grade	Precision grade
TCH06	Double standard sliders	5	1.2 – 7.2	2.0 – 10.1
		10	1.2 – 9.5	2.2 – 12.9
		20	1.8 – 14.1	2.8 – 17.5

C-2-5. 2 TCH09 Model

◆ TCH09 Single Standard Slider Specifications(with pin holes)



◆ TCH09 Double standard slider Specifications(with pin holes)



TCH09 Standard Slider Specifications (Single)

Reference number	Nominal stroke (mm)	Stroke limit (mm)	Ball screw lead (mm)	Body length (mm)				No. of mounting holes n	Inertia × 10 ⁶ (kg · m ²)	Mass (kg)
				L ₁	L ₂	L ₃	G			
*TCH09010H05K00 (01)	100	108	5	320	240	100	70	2	9.13	6.5
TCH09010H10K00 (01)			10						11.0	
*TCH09010H20K00 (01)			20						18.6	
TCH09020H05K00 (01)	200	208	5	420	340	200	70	3	14.2	7.9
TCH09020H10K00 (01)			10						16.0	
TCH09020H20K00 (01)			20						23.6	
TCH09030H05K00 (01)	300	308	5	520	440	300	70	4	18.1	9.4
TCH09030H10K00 (01)			10						19.9	
TCH09030H20K00 (01)			20						27.5	
TCH09040H05K00 (01)	400	408	5	620	540	400	70	5	21.9	10.8
TCH09040H10K00 (01)			10						23.8	
TCH09040H20K00 (01)			20						31.4	
TCH09050H05K00 (01)	500	508	5	720	640	500	70	6	25.9	12.3
TCH09050H10K00 (01)			10						27.7	
TCH09050H20K00 (01)			20						35.3	
TCH09060H05K00 (01)	600	608	5	820	740	600	70	7	29.4	13.6
TCH09060H10K00 (01)			10						31.3	
TCH09060H20K00 (01)			20						38.9	
TCH09070H05K00 (01)	700	708	5	920	840	700	70	8	33.5	15.0
TCH09070H10K00 (01)			10						35.4	
TCH09070H20K00 (01)			20						43.0	
TCH09080H05K00 (01)	800	808	5	1020	940	800	70	9	37.4	16.4
TCH09080H10K00 (01)			10						39.3	
TCH09080H20K00 (01)			20						46.9	

Items marked with * are unavailable for upside-down operation.

TCH09 Standard Slider Specifications (Double)

Reference number	Nominal stroke (mm)	Stroke limit (mm)	Ball screw lead (mm)	Body length (mm)				No. of mounting holes n	Inertia × 10 ⁶ (kg · m ²)	Mass (kg)
				L ₁	L ₂	L ₃	G			
*TCH09017H05D00 (01)	170	184	5	520	440	300	70	4	19.47	10.3
*TCH09017H10D00 (01)			10						22.89	
*TCH09027H05D00 (01)			5						23.35	
*TCH09027H10D00 (01)	270	284	10	620	540	400	70	5	26.77	11.7
TCH09037H05D00 (01)			5						27.22	
TCH09037H10D00 (01)			10						30.64	
TCH09047H10D00 (01)	470	484	10	820	740	600	70	7	34.55	14.5
TCH09047H20D00 (01)			20						48.24	
TCH09067H10D00 (01)			10						42.27	
TCH09067H20D00 (01)	670	684	20	1020	940	800	70	9	55.96	17.3

Items marked with * are unavailable for upside-down operation.

Toughcarrier dynamic torque specifications

Unit: N · cm

Model no.	Slider specifications	Ball screw lead (mm)	Accuracy grade	
			High grade	Precision grade
TCH09	Single standard slider	5	2.8 - 7.7	4.2 - 12.8
		10	3.7 - 9.5	4.5 - 15.1
		20	3.7 - 12.6	5.1 - 17.9

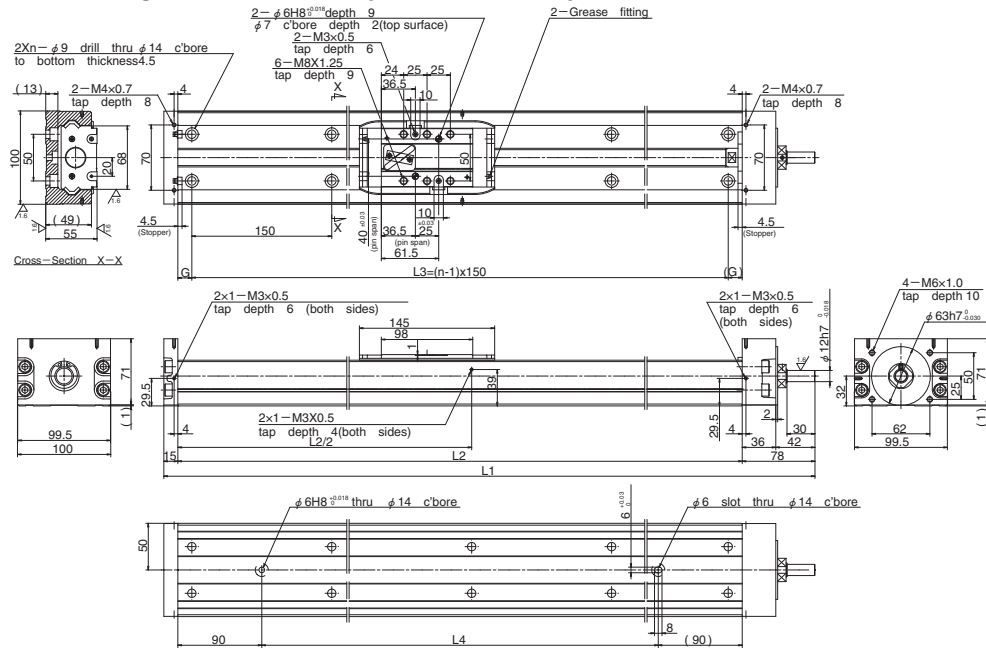
Toughcarrier dynamic torque specifications

Unit: N · cm

Model no.	Slider specifications	Ball screw lead (mm)	Accuracy grade	
			High grade	Precision grade
TCH09	Double standard sliders	5	3.2 - 8.7	4.5 - 14.1
		10	4.2 - 12.6	5.1 - 17.9
		20	5.7 - 18.9	6.3 - 23.3

C-2-5. 3 TCH 10 Model

◆ TCH10 Single Standard Slider Specifications(with pin holes)



TCH10 Standard Slider Specifications (Single)

Reference number	Nominal stroke (mm)	Stroke limit (mm)	Ball screw lead (mm)	Body length (mm)					No. of mounting holes n	Inertia × 10 ⁶ (kg · m ²)	Mass (kg)
				L ₁	L ₂	L ₃	L ₄	G			
* TCH10010H10K00 (01)	100	126	10	373	280	150	100	65	2	42.72	9.6
* TCH10010H20K00 (01)			20								
TCH10020H10K00 (01)	200	226	10	473	380	300	200	40	3	54.97	11.5
TCH10020H20K00 (01)			20								
TCH10030H10K00 (01)	300	326	10	573	480	450	300	15	4	67.22	13.5
TCH10030H20K00 (01)			20								
TCH10040H10K00 (01)	400	426	10	673	580	450	400	65	4	79.47	15.4
TCH10040H20K00 (01)			20								
TCH10050H10K00 (01)	500	526	10	773	680	600	500	40	5	91.72	17.4
TCH10050H20K00 (01)			20								
TCH10060H10K00 (01)	600	626	10	873	780	750	600	15	6	104.02	19.3
TCH10060H20K00 (01)			20								
TCH10070H10K00 (01)	700	726	10	973	880	750	700	65	6	116.22	21.2
TCH10070H20K00 (01)			20								
TCH10080H10K00 (01)	800	826	10	1 073	980	900	800	40	7	128.52	23.2
TCH10080H20K00 (01)			20								
TCH10090H10K00 (01)	900	926	10	1 173	1 080	1 050	900	15	8	140.70	25.2
TCH10090H20K00 (01)			20								
TCH10100H10K00 (01)	1 000	1 026	10	1 273	1 180	1 050	1 000	65	8	152.94	27.1
TCH10100H20K00 (01)			20								
TCH10110H10K00 (01)	1 100	1 126	10	1 373	1 280	1 200	1 100	40	9	165.19	29.1
TCH10110H20K00 (01)			20								
TCH10120H10K00 (01)	1 200	1 226	10	1 473	1 380	1 350	1 200	15	10	177.43	31.1
TCH10120H20K00 (01)			20								

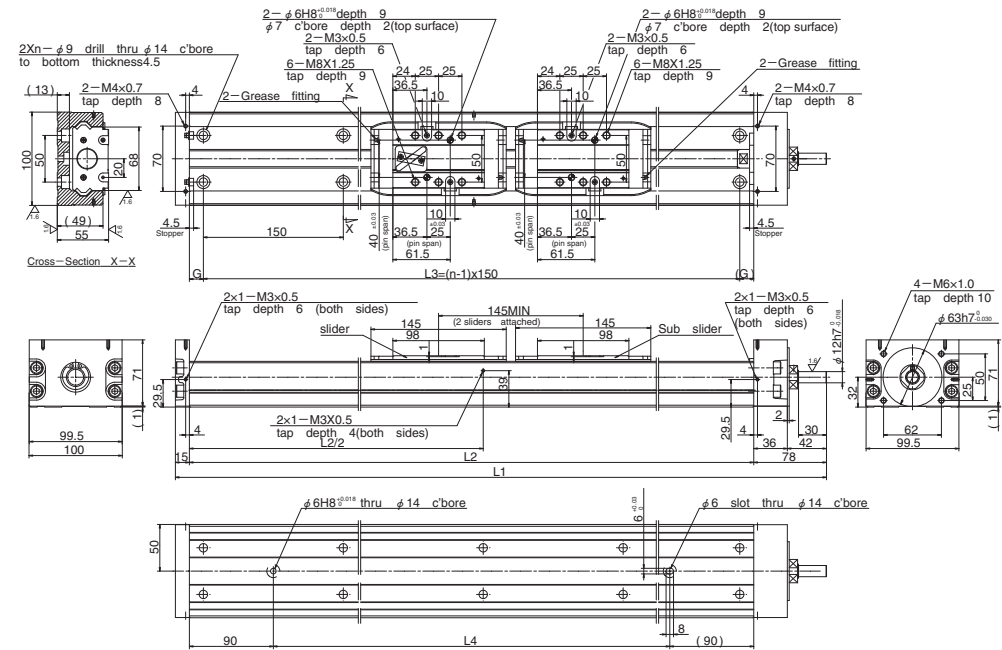
Items marked with * are unavailable for upside-down operation

Toughcarrier dynamic torque specifications

Unit: N · cm

Model no.	Slider specifications	Ball screw lead (mm)	Accuracy grade	
			High grade	Precision grade
TCH10	Single standard slider	10	3.5 – 12.3	3.7 – 21.2
		20	4.1 – 16.6	4.3 – 25.5

◆ TCH10 Double standard slider Specifications(with pin holes)



TCH10 Standard Slider Specifications (Double)

Reference number	Nominal stroke (mm)	Stroke limit (mm)	Ball screw lead (mm)	Body length (mm)					No. of mounting holes n	Inertia × 10 ⁶ (kg · m ²)	Mass (kg)
				L ₁	L ₂	L ₃	L ₄	G			
* TCH10027H10D00 (01)	270	281	10	673	580	450	400	65	4	83.02	16.8
* TCH10027H20D00 (01)			20								
* TCH10037H10D00 (01)	370	381	10	773	680	600	500	40	5	95.27	18.8
* TCH10037H20D00 (01)			20								
TCH10047H10D00 (01)	470	481	10	873	780	750	600	15	6	107.57	20.7
TCH10047H20D00 (01)			20								
TCH10057H10D00 (01)	570	581	10	973	880	750	700	65	6	119.77	22.6
TCH10057H20D00 (01)			20								
TCH10067H10D00 (01)	670	681	10	1 073	980	900	800	40	7	132.07	24.6
TCH10067H20D00 (01)			20								
TCH10077H20D00 (01)	770	781	20	1 173	1 080	1 050	900	15	8	165.54	26.6
TCH10087H20D00 (01)			20								
TCH10097H20D00 (01)	970	981	20	1 273	1 180	1 050	1 000	65	8	177.78	28.5
TCH10107H20D00 (01)			20								
TCH10117H20D00 (01)	1 070	1 081	20	1 373	1 280	1 200	1 100	40	9	190.03	30.5
TCH10127H20D00 (01)			20								

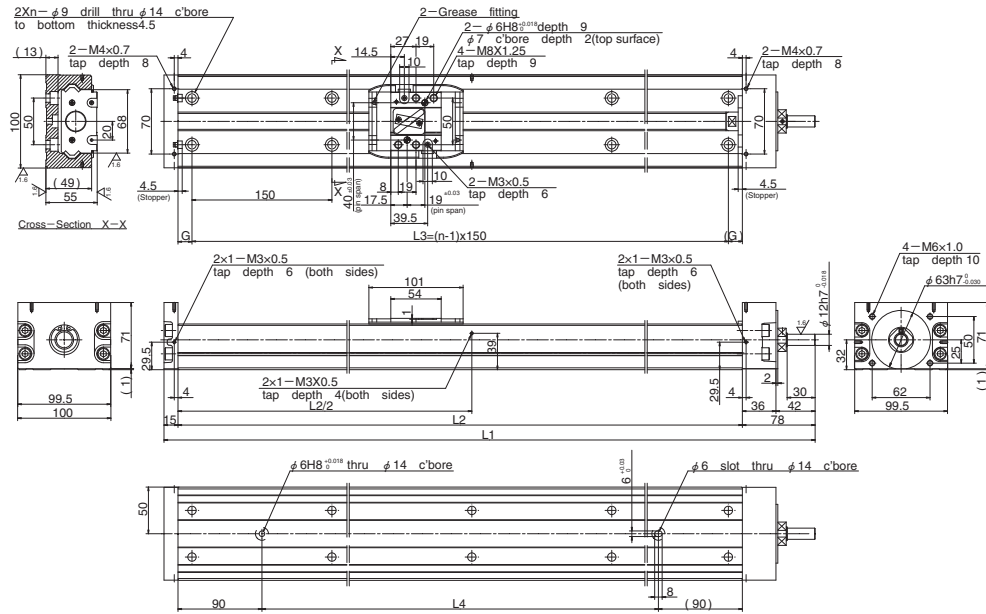
Items marked with * are unavailable for upside-down operation

Toughcarrier dynamic torque specifications

Unit: N · cm

Model no.	Slider specifications	Ball screw lead (mm)	Accuracy grade	
			High grade	Precision grade
TCH10	Double standard sliders	10	4.1 – 16.6	4.3 – 25.5
		20	5.4 – 25.2	5.6 – 34.1

◆ TCH10 Single Short Slider Specifications(with pin holes)



TCH10 Short Slider Specifications (Single)

Reference number	Nominal stroke (mm)	Stroke limit (mm)	Ball screw lead (mm)	Body length (mm)					No. of mounting holes <i>n</i>	Inertia × 10 ⁶ (kg · m ²)	Mass (kg)
				L ₁	L ₂	L ₃	L ₄	G			
*TCH10016H10A00 (01)	160	170	10	373	280	150	100	65	2	41.19	8.9
TCH10016H20A00 (01)			20								
TCH10026H10A00 (01)	260	270	10	473	380	300	200	40	3	53.45	10.9
TCH10026H20A00 (01)			20								
TCH10036H10A00 (01)	360	370	10	573	480	450	300	15	4	65.70	12.8
TCH10036H20A00 (01)			20								
TCH10046H10A00 (01)	460	470	10	673	580	450	400	65	4	77.95	14.8
TCH10046H20A00 (01)			20								
TCH10056H10A00 (01)	560	570	10	773	680	600	500	40	5	90.20	16.7
TCH10056H20A00 (01)			20								
TCH10066H10A00 (01)	660	670	10	873	780	750	600	15	6	102.50	18.6
TCH10066H20A00 (01)			20								
TCH10076H10A00 (01)	760	770	10	973	880	750	700	65	6	114.70	20.6
TCH10076H20A00 (01)			20								
TCH10086H10A00 (01)	860	870	10	1 073	980	900	800	40	7	127.00	22.6
TCH10086H20A00 (01)			20								
TCH10096H10A00 (01)	960	970	10	1 173	1 080	1 050	900	15	8	139.18	24.5
TCH10096H20A00 (01)			20								
TCH10106H10A00 (01)	1 060	1 070	10	1 273	1 180	1 050	1 000	65	8	151.42	26.5
TCH10106H20A00 (01)			20								
TCH10116H10A00 (01)	1 160	1 170	10	1 373	1 280	1 200	1 100	40	9	163.67	28.4
TCH10116H20A00 (01)			20								
TCH10126H10A00 (01)	1 260	1 270	10	1 473	1 380	1 350	1 200	15	10	175.91	30.4
TCH10126H20A00 (01)			20								

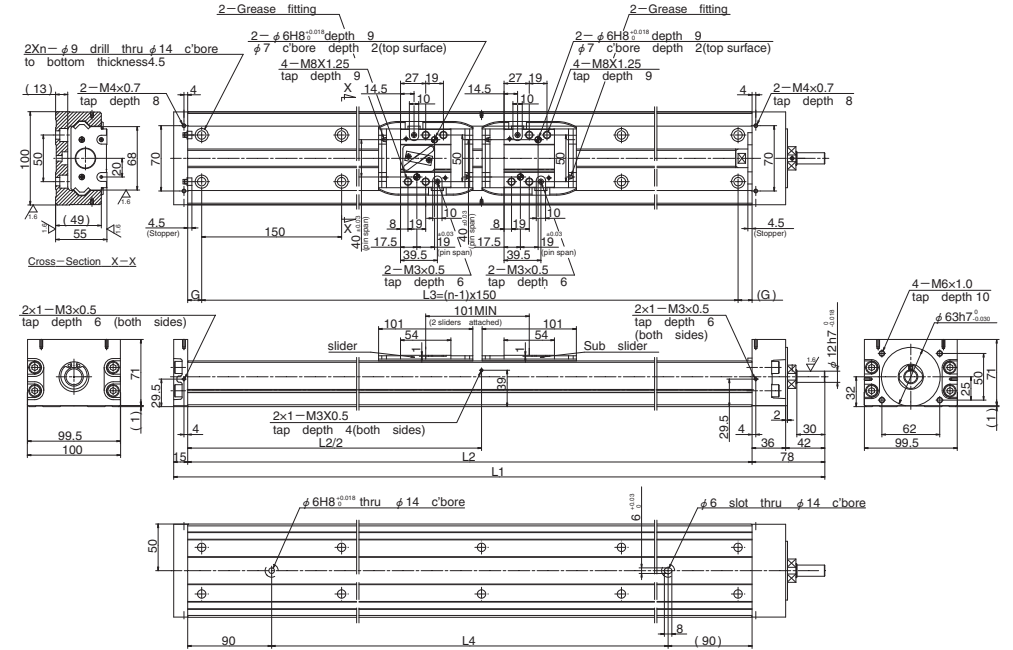
Items marked with * are unavailable for upside-down operation

Toughcarrier dynamic torque specifications

Unit: N · cm

Model no.	Slider specifications	Ball screw lead (mm)	Accuracy grade	
			High grade	Precision grade
TCH10	Single short slider	10	3.6 – 11.7	3.8 – 20.5
		20	4.4 – 15.4	4.6 – 24.2

◆ TCH10 Double Short slider Specifications(with pin holes)



TCH10 Short Slider Specifications (Double)

Reference number	Nominal stroke (mm)	Stroke limit (mm)	Ball screw lead (mm)	Body length (mm)					No. of mounting holes <i>n</i>	Inertia × 10 ⁶ (kg · m ²)	Mass (kg)
				L ₁	L ₂	L ₃	L ₄	G			
TCH10036H10B00 (01)	360	369	10	673	580	450	400	65	4	79.97	15.6
TCH10036H20B00 (01)			20								
TCH10046H10B00 (01)	460	469	10	773	680	600	500	40	5	92.22	17.5
TCH10046H20B00 (01)			20								
TCH10056H10B00 (01)	560	569	10	873	780	750	600	15	6	104.39	19.4
TCH10056H20B00 (01)			20								
TCH10066H10B00 (01)	660	669	10	973	880	750	700	65	6	116.72	21.4
TCH10066H20B00 (01)			20								
TCH10076H10B00 (01)	760	769	10	1 073	980	900	800	40	7	129.02	23.4
TCH10076H20B00 (01)			20								
TCH10086H10B00 (01)	860	869	20	1 173	1 080	1 050	900	15	8	153.37	25.3
TCH10086H20B00 (01)			10								
TCH10096H10B00 (01)	960	969	20	1 273	1 180	1 050	1 000	65	8	165.61	27.3
TCH10096H20B00 (01)			10								
TCH10106H10B00 (01)	1 060	1 069	20	1 373	1 280	1 200	1 100	40	9	177.86	29.2
TCH10106H20B00 (01)			10								
TCH10116H10B00 (01)	1 160	1 169	20	1 473	1 380	1 350	1 200	15	10	190.10	31.2
TCH10116H20B00 (01)			10								

Items marked with * are unavailable for upside-down operation

Toughcarrier dynamic torque specifications

Unit: N · cm

Model no.	Slider specifications	Ball screw lead (mm)	Accuracy grade	
			High grade	Precision grade
TCH10	Double short sliders	10	4.4 – 15.4	4.6 – 24.2
		20	6.0 – 22.7	6.2 – 31.5

C-2-6 Accessories

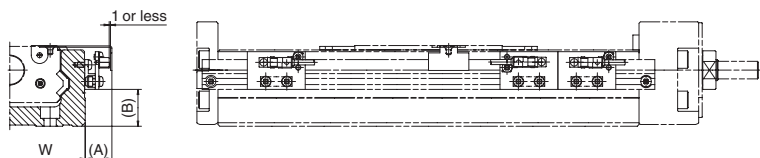
C-2-6. 1 Sensor Unit

Reference number TC - SRH - 1

Nominal size

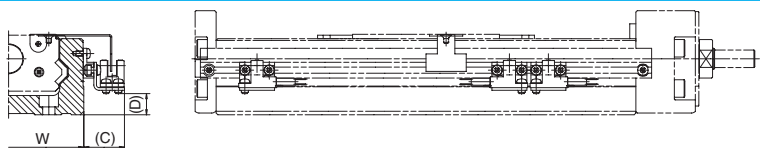
Coding for model no.
 0: Proximity switch (3 b-contacts)
 1: Proximity switch (3 a-contacts)
 2: Proximity switch (1 a-contact, 2 b-contacts)
 3: Photo sensor (3 sensors)

◆ Proximity switch



Model no.	Reference number			Dimensions		
				A (mm)	B (mm)	Body width W (mm)
TCH06	TC-SRH06-10	TC-SRH06-11	TC-SRH06-12	17	10	60
TCH09	TC-SRH09-10	TC-SRH09-11	TC-SRH09-12	16	21	86
TCH10	TC-SRH10-10	TC-SRH10-11	TC-SRH10-12	16	25	100
Quantity	Proximity switch (a-contact)	—	3	1	E2S-W13 (OMRON Corp.)	
	Proximity switch (b-contact)	3	—	2	E2S-W14 (OMRON Corp.)	

◆ Photo sensor



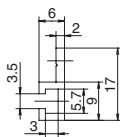
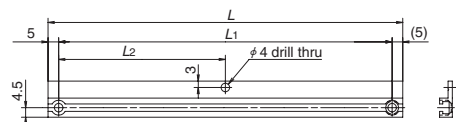
Model no.	Reference number	Dimensions			Note
		C (mm)	D (mm)	Body width W (mm)	
TCH06	TC-SRH06-13	24	2	60	EE-SX674 (OMRON Corp.) 3 sets (EE-1001 connector included)
TCH09	TC-SRH09-13	24	12	86	
TCH10	TC-SRH10-13	24	16	100	

(1) Sensor Rail

Reference number TC - SRL

Body rail length

Nominal no. 06→6
 09→9
 10→1



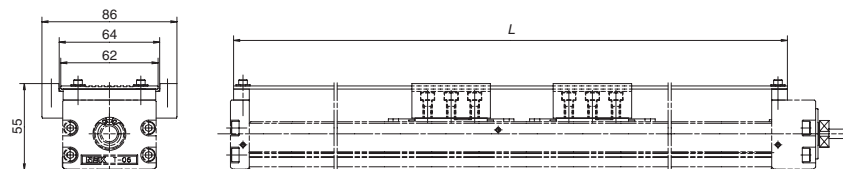
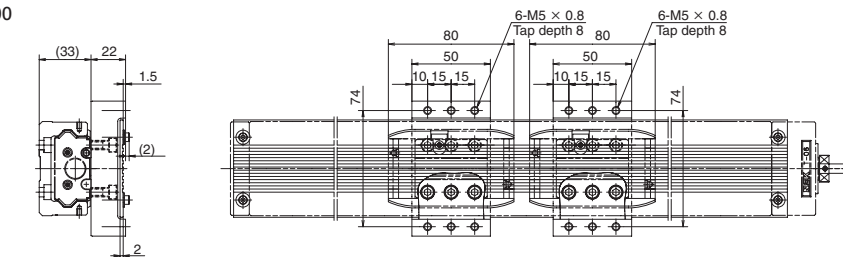
Model no.	Body rail length	Dimensions		
		L	L ₁	L ₂
TCH06	150	168	158	79
	200	218	208	104
	300	318	308	154
	400	418	408	204
	500	518	508	254
	600	618	608	304
TCH09	240	258	248	124
	340	358	348	174
	440	458	448	224
	540	558	548	274
	640	658	648	324
	740	758	748	374
TCH10	840	858	848	424
	940	958	948	474
	280	298	288	144
	380	398	388	194
	480	498	488	244
	580	598	588	294
	680	698	688	344
	780	798	788	394
	880	898	888	444
	980	998	988	494
	1 080	1 098	1 088	544
	1 180	1 198	1 188	594
	1 280	1 298	1 288	644
	1 380	1 398	1 388	694

C-2-6. 2 Cover Unit

◆ Cover Unit

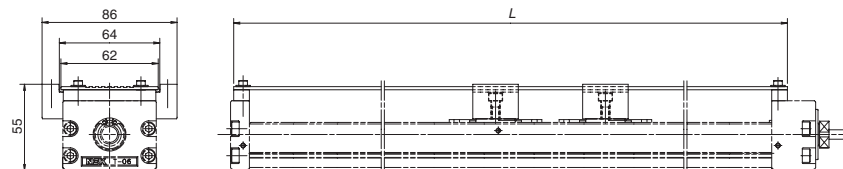
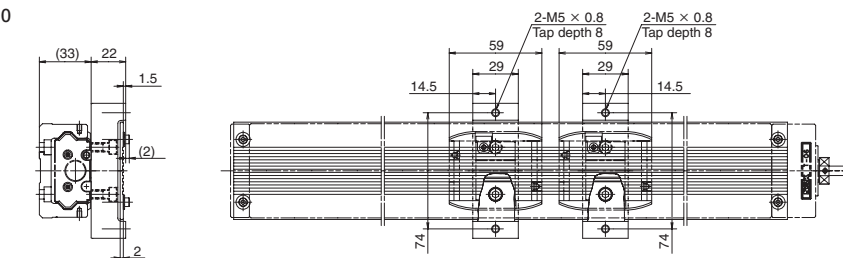
TC-HV06XXXK00

TC-HV06XXXD00



TC-HV06XXXA00

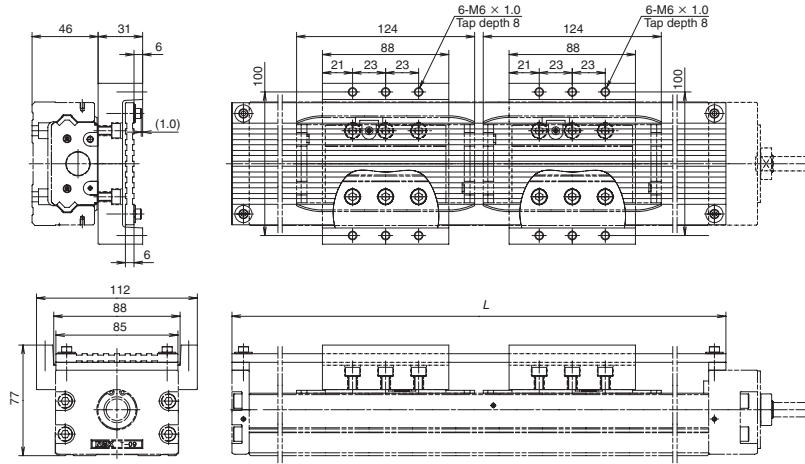
TC-HV06XXXB00



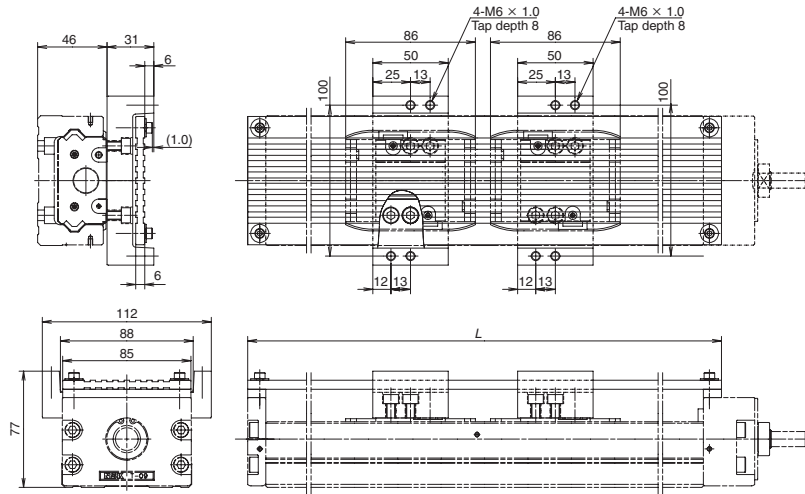
TCH06

Body rail length	Dimensions	Slider specifications			
		Standard		Short	
		Single	Double	Single	Double
150	L	TC-HV06005K00	—	TC-HV06007A00	—
200	220	TC-HV06010K00	—	TC-HV06012A00	—
300	320	TC-HV06020K00	TC-HV06013D00	TC-HV06022A00	TC-HV06017B00
400	420	TC-HV06030K00	TC-HV06023D00	TC-HV06032A00	TC-HV06027B00
500	520	TC-HV06040K00	TC-HV06033D00	TC-HV06042A00	TC-HV06037B00
600	620	TC-HV06050K00	TC-HV06043D00	TC-HV06052A00	TC-HV06047B00

TC-HV09XXXXK00
TC-HV09XXXD00



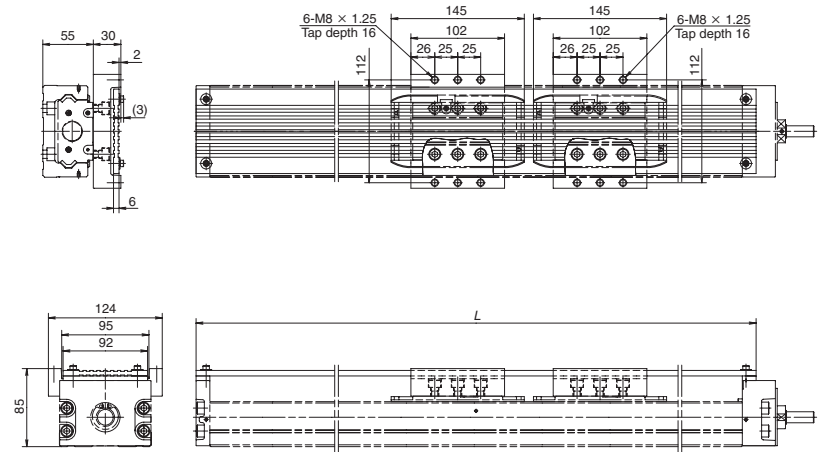
TC-HV09XXXXA00
TC-HV09XXXB00



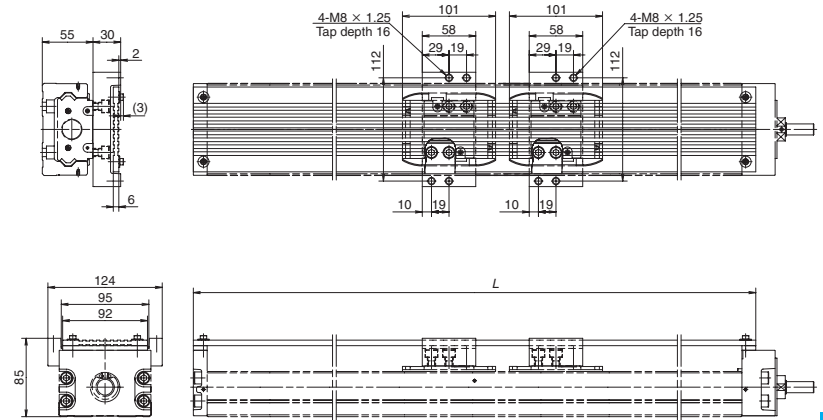
TCH09

Body rail length	Dimensions L	Slider specifications			
		Standard		Short	
		Single	Double	Single	Double
240	264	TC-HV09010K00	—	TC-HV09014A00	—
340	364	TC-HV09020K00	—	TC-HV09024A00	—
440	464	TC-HV09030K00	TC-HV09017D00	TC-HV09034A00	TC-HV09025B00
540	564	TC-HV09040K00	TC-HV09027D00	TC-HV09044A00	TC-HV09035B00
640	664	TC-HV09050K00	TC-HV09037D00	TC-HV09054A00	TC-HV09045B00
740	764	TC-HV09060K00	TC-HV09047D00	TC-HV09064A00	TC-HV09055B00
840	864	TC-HV09070K00	—	TC-HV09074A00	—
940	964	TC-HV09080K00	TC-HV09067D00	TC-HV09084A00	TC-HV09075B00

TC-HV10XXXXK00
TC-HV10XXXD00



TC-HV10XXXXA00
TC-HV10XXXXB00



TCH10

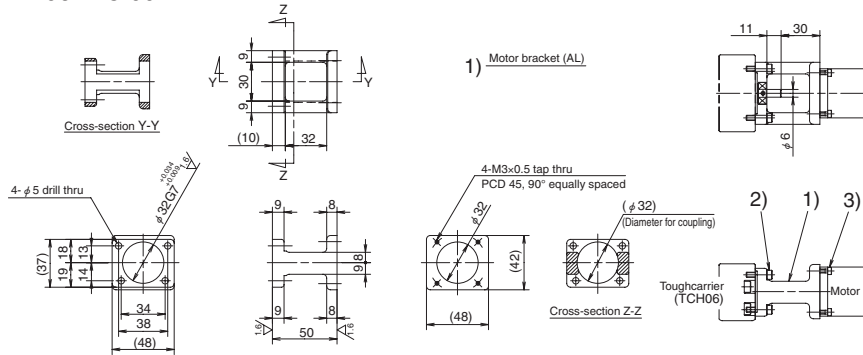
Body rail length	Dimensions L	Slider specifications			
		Standard		Short	
		Single	Double	Single	Double
280	310	TC-HV10010K00	—	TC-HV10016A00	—
380	410	TC-HV10020K00	—	TC-HV10026A00	—
480	510	TC-HV10030K00	—	TC-HV10036A00	—
580	610	TC-HV10040K00	TC-HV10027D00	TC-HV10046A00	TC-HV10036B00
680	710	TC-HV10050K00	TC-HV10037D00	TC-HV10056A00	TC-HV10046B00
780	810	TC-HV10060K00	TC-HV10047D00	TC-HV10066A00	TC-HV10056B00
880	910	TC-HV10070K00	TC-HV10057D00	TC-HV10076A00	TC-HV10066B00
980	1 010	TC-HV10080K00	TC-HV10067D00	TC-HV10086A00	TC-HV10076B00
1 080	1 110	TC-HV10090K00	TC-HV10077D00	TC-HV10096A00	TC-HV10086B00
1 180	1 210	TC-HV10100K00	TC-HV10087D00	TC-HV10106A00	TC-HV10096B00
1 280	1 310	TC-HV10110K00	TC-HV10097D00	TC-HV10116A00	TC-HV10106B00
1 380	1 410	TC-HV10120K00	TC-HV10107D00	TC-HV10126A00	TC-HV10116B00

C-2-6. 3 Motor Bracket

◆ Motor bracket

Motor models are subject to change at motor manufacturers. For details, please contact the manufacturer. For motors other than shown below, please contact NSK.

■ Reference number
TC-BKH06-145-00

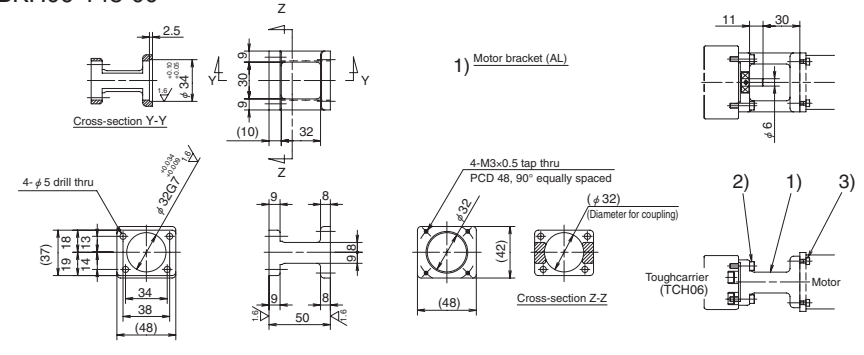


- 2) Hexagon socket head cap screw (M4, length 16)
- 3) Hexagon socket head cap screw (M3, length 12)

Notes: 1. Be sure to align the center lines when installing the motor.
2. Take care regarding the assembly orientation of the bracket.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

Compatible motor		
Maker	Series	Motor models(Servo motor)
Panasonic Co., Ltd.	MINAS A6	MSMF5A(50W), MSMF01(100W)

■ Reference number
TC-BKH06-148-00

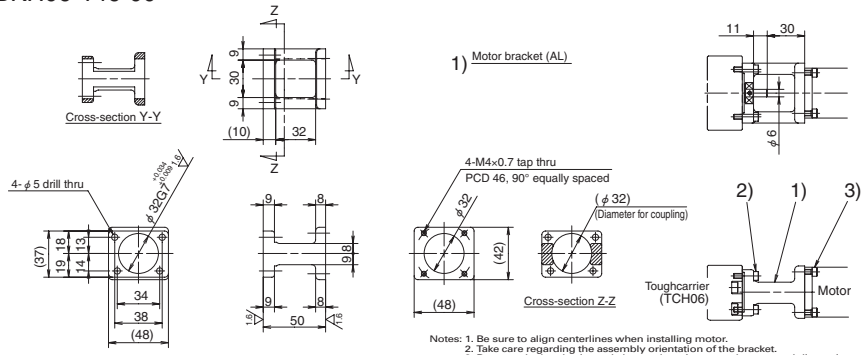


- 2) Hexagon socket head cap screw (M4, length 16)
- 3) Hexagon socket head cap screw (M3, length 12)

Notes: 1. Be sure to align centerlines when installing motor.
2. Take care regarding the assembly orientation of the bracket.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

Compatible motor		
Maker	Series	Motor models(Servo motor)
Panasonic Co., Ltd.	-	MAMA01(100W)*1

■ Reference number
TC-BKH06-146-00

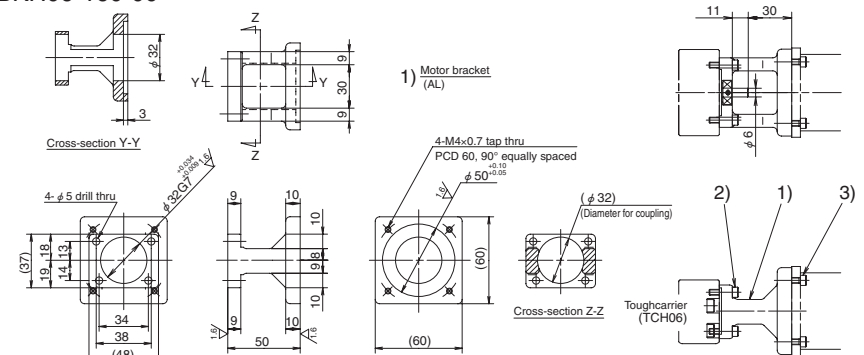


- 2) Hexagon socket head cap screw (M4, length 16)
- 3) Hexagon socket head cap screw (M4, length 14)

Notes: 1. Be sure to align centerlines when installing motor.
2. Take care regarding the assembly orientation of the bracket.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

Compatible motor		
Maker	Series	Motor models(Servo motor)
YASKAWA Electric Corp.	Σ-7	SGM7A-A5(50W), SGM7A-01(100W), SGM7A-C2(150W) SGM7J-A5(50W), SGM7J-01(100W), SGM7J-C2(150W)
Mitsubishi Electric Corp.	MELSERVO-J4	HG-KR053(50W), HG-MR053(50W) HG-KR13(100W), HG-MR13(100W)
OMRON Corp.	G5	R88M-K05030(50W), R88M-K10030(100W)
SANYO DENKI Co., Ltd.	SANMOTION R	R2□A04005(50W), R2□A04010(100W)

■ Reference number
TC-BKH06-160-00



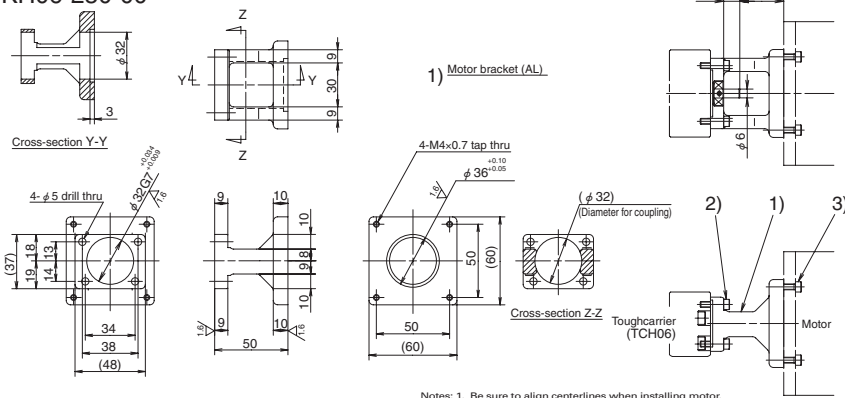
- 2) Hexagon socket head cap screw (M4, length 16)
- 3) Hexagon socket head cap screw (M4, length 14)

Notes: 1. Be sure to align centerlines when installing motor.
2. Take care regarding the assembly orientation of the bracket.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

Compatible motor		
Maker	Series	Motor models(Servo motor)
SANYO DENKI Co., Ltd.	-	P50B05005(50W)*1 P50B05010(100W)*1 P50B05020(200W)*1

*1 The manufacturer models listed are discontinued motors.

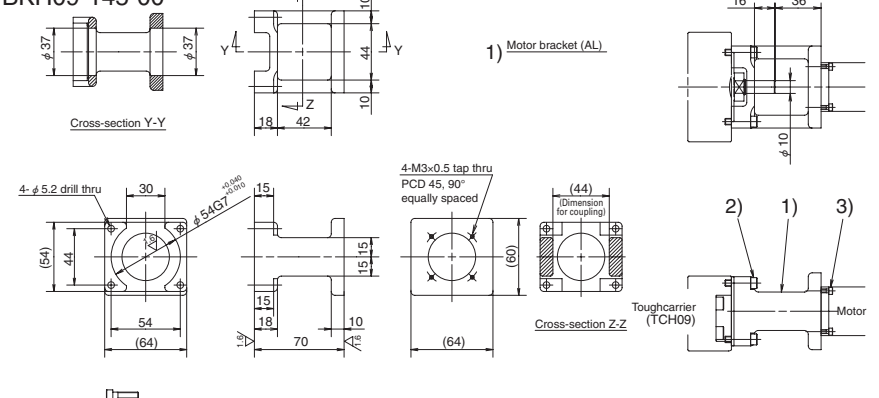
Reference number
TC-BKH06-250-00



- 2) Hexagon socket head cap screw (M4, length 16)
- 3) Hexagon socket head cap screw (M4, length 14)

Compatible motor		
Maker	Series	Motor models(Servo motor)
ORIENTAL MOTOR Co.,Ltd.	αSTEP	AR6x, ARL6x, AZ6x
	CRK, CVK, RKII	CRK56x, CVK56x, RKS56x
SANYO DENKI Co.,Ltd.	SANMOTION Model No.PB	PBDM60x, PB=R60x, PB=P60x

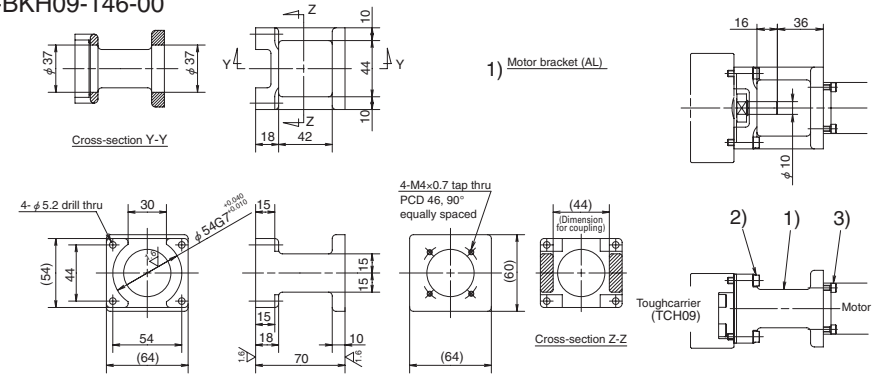
Reference number
TC-BKH09-145-00



- 2) Hexagon socket head cap screw (M5, length 20)
- 3) Hexagon socket head cap screw (M3, length 12)

Compatible motor		
Maker	Series	Motor models(Servo motor)
Panasonic Co., Ltd.	MINAS A6	MSMF5A(50W), MSMF01(100W)

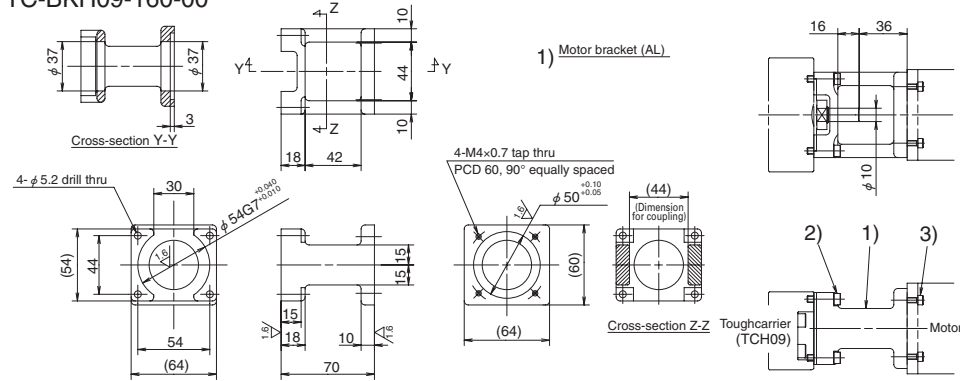
Reference number
TC-BKH09-146-00



- 2) Hexagon socket head cap screw (M5, length 20)
- 3) Hexagon socket head cap screw (M4, length 14)

Compatible motor		
Maker	Series	Motor models(Servo motor)
YASKAWA Electric Corp.	Σ-7	SGM7A-A5(50W), SGM7A-01(100W), SGM7A-C2(150W) SGM7J-A5(50W), SGM7J-01(100W), SGM7J-C2(150W)
Mitsubishi Electric Corp.	MELSERVO-J4	HG-KR053(50W), HG-MR053(50W), HG-KR13(100W), HG-MR13(100W)
OMRON Corp.	G5	R88M-K05030(50W), R88M-K10030(100W)
SANYO DENKI Co.,Ltd.	SANMOTION R	R2=A04005(50W), R2=A04010(100W)

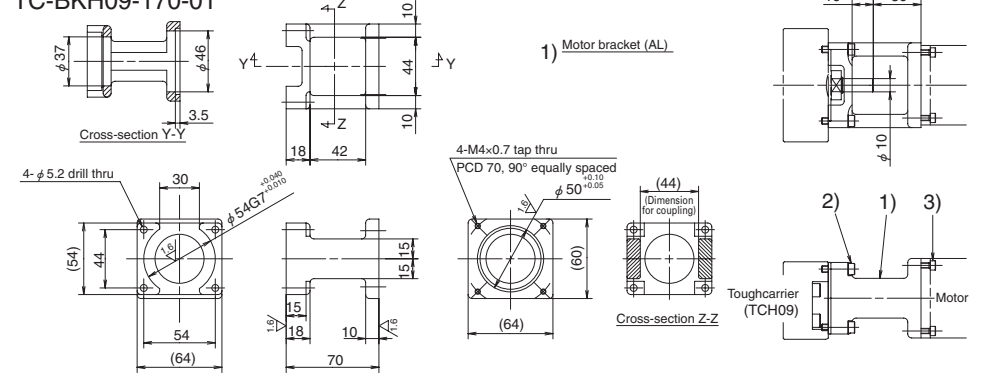
Reference number
TC-BKH09-160-00



- 2) Hexagon socket head cap screw (M5, length 20)
- 3) Hexagon socket head cap screw (M4, length 14)

Compatible motor		
Maker	Series	Motor models(Servo motor)
SANYO DENKI Co.,Ltd.	-	P50B05005(50W)*1 P50B05010(100W)*1 P50B05020(200W)*1

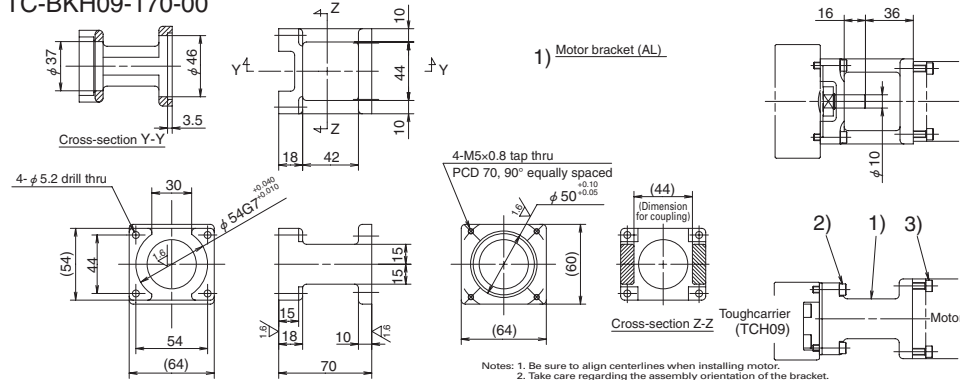
Reference number
TC-BKH09-170-01



- 2) Hexagon socket head cap screw (M5, length 20)
- 3) Hexagon socket head cap screw (M4, length 14)

Compatible motor		
Maker	Series	Motor models(Servo motor)
Panasonic Co., Ltd.	MINAS A6	MSMF02(200W),MSMF04(400W)
OMRON Corp.	G5	R88M-K20030(200W),R88M-K40030(400W)

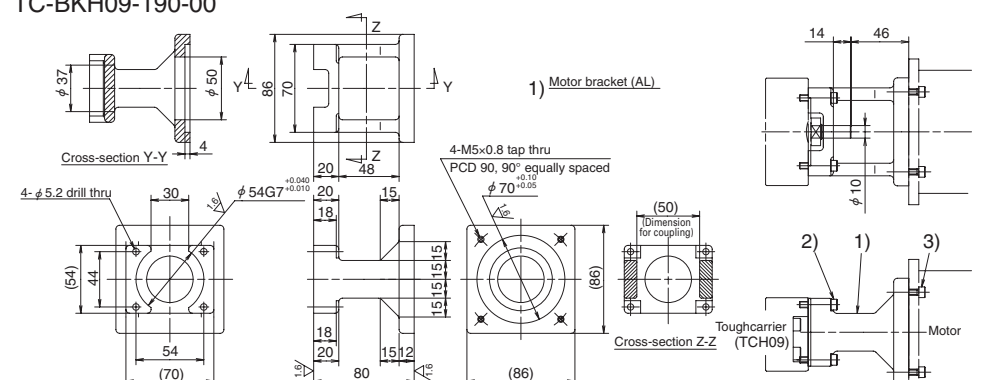
Reference number
TC-BKH09-170-00



- 2) Hexagon socket head cap screw (M5, length 20)
- 3) Hexagon socket head cap screw (M5, length 14)

Compatible motor		
Maker	Series	Motor models(Servo motor)
YASKAWA Electric Corp.	Σ-7	SGM7A-02A(200W), SGM7J-02(200W) SGM7A-04A(400W), SGM7J-04(400W) SGM7A-06A(600W), SGM7J-06(600W)
Mitsubishi Electric Corp.	MELSERVO-J4	HG-KR23(200W), HG-MR023(200W) HG-KR43(400W), HG-MR43(400W)
SANYO DENKI Co.,Ltd.	SANMOTION R	R2□A06020(200W), R2□A06040(400W)

Reference number
TC-BKH09-190-00



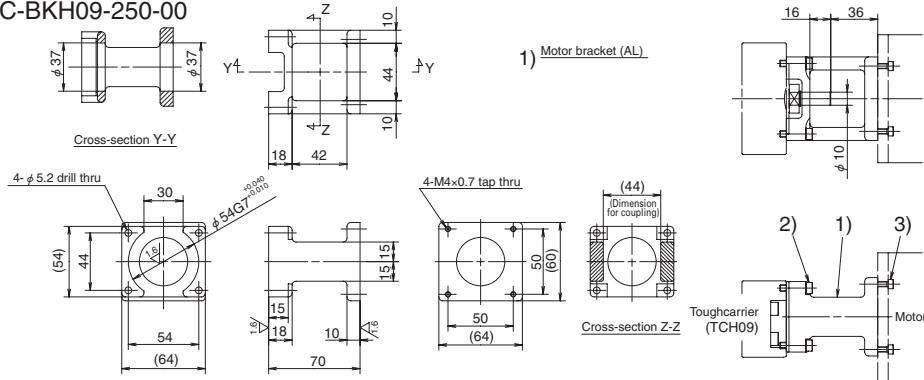
- 2) Hexagon socket head cap screw (M5, length 25)
- 3) Hexagon socket head cap screw (M5, length 16)

Compatible motor		
Maker	Series	Motor models(Servo motor)
SANYO DENKI Co.,Ltd.	-	P50B07020*1(200W) P50B07030*1(300W) P50B07040*1(400W)

*1 The manufacturer models listed are discontinued motors.

*1 The manufacturer models listed are discontinued motors.

Reference number
TC-BKH09-250-00

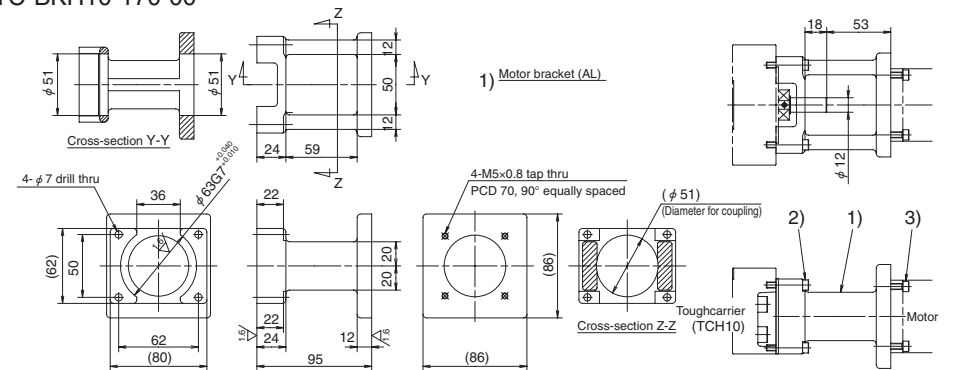


Notes: 1. Be sure to align centerlines when installing motor.
2. Take care regarding the assembly orientation of the bracket.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

Compatible motor		
Maker	Series	Motor models (stepping motor)
ORIENTAL MOTOR Co.,Ltd.	αSTEP	AR6x, ARL6x, AZ6x
MOTOR Co.,Ltd.	CRK, CVK, RKII	CRK56x, CVK56x, RKS56x
SANYO DENKI Co.,Ltd.	SANMOTION Model No.PB	PBDM60x, PB□R60x, PB□P60x

- 1) Motor bracket (AL)
- 2) Hexagon socket head cap screw (M5, length 20)
- 3) Hexagon socket head cap screw (M4, length 14)

Reference number
TC-BKH10-170-00

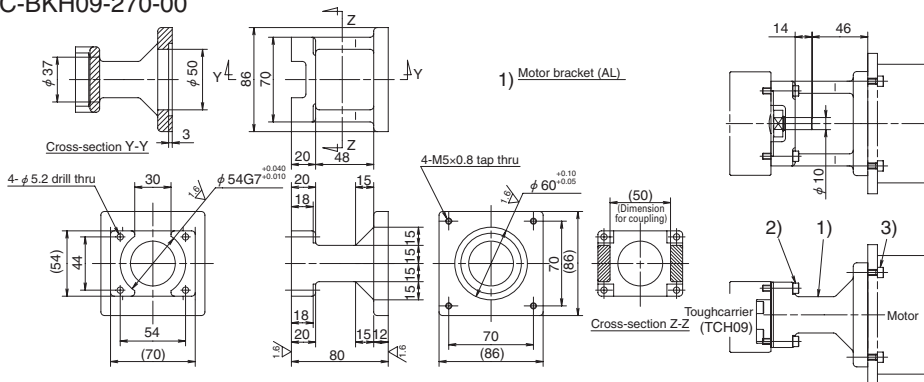


Notes: 1. Be sure to align centerlines when installing motor.
2. Take care regarding the assembly orientation of the bracket.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

Compatible motor		
Maker	Series	Motor models (Servo motor)
YASKAWA Electric Corp.	Σ-7	SGM7A-02A(200W), SGM7A-04A(400W), SGM7A-06A(600W) SGM7J-02(200W), SGM7J-04(400W), SGM7J-06(600W)
Mitsubishi Electric Corp.	MELSERVO-J4	HG-KR23(200W), HG-MR23(200W) HG-KR43(400W), HG-MR43(400W)
SANYO DENKI Co.,Ltd.	SANMOTION R	R2□A06020(200W) R2□A06040(400W)

- 1) Motor bracket (AL)
- 2) Hexagon socket head cap screw (M6, length 30)
- 3) Hexagon socket head cap screw (M5, length 20)

Reference number
TC-BKH09-270-00

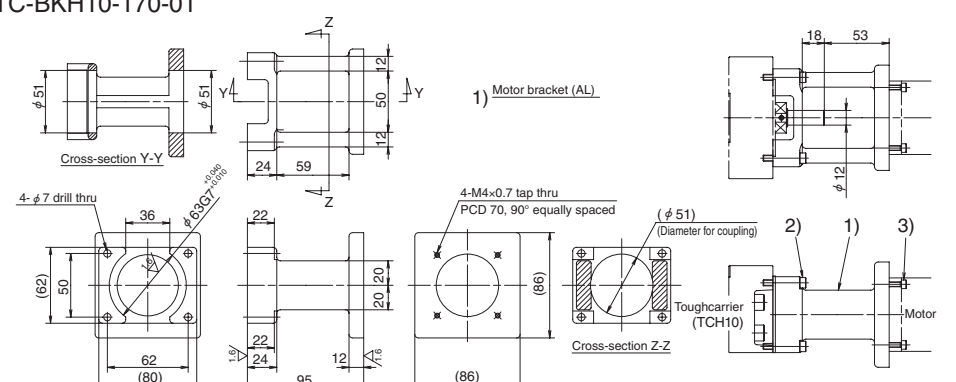


Notes: 1. Be sure to align centerlines when installing motor.
2. Take care regarding the assembly orientation of the bracket.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

Compatible motor		
Maker	Series	Motor models (stepping motor)
ORIENTAL MOTOR Co.,Ltd.	αSTEP	AR9x, ARL9x, AZ9x
MOTOR Co.,Ltd.	RKII	RKS59x

- 1) Motor bracket (AL)
- 2) Hexagon socket head cap screw (M5, length 25)
- 3) Hexagon socket head cap screw (M5, length 16)

Reference number
TC-BKH10-170-01



Notes: 1. Be sure to align centerlines when installing motor.
2. Take care regarding the assembly orientation of the bracket.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

Compatible motor		
Maker	Series	Motor models (Servo motor)
Panasonic Co., Ltd.	MINAS A6	M5MF02(200W), M5MF04(400W)
OMRON Corp.	G5	R88M-K20030(200W) R88M-K40030(400W)

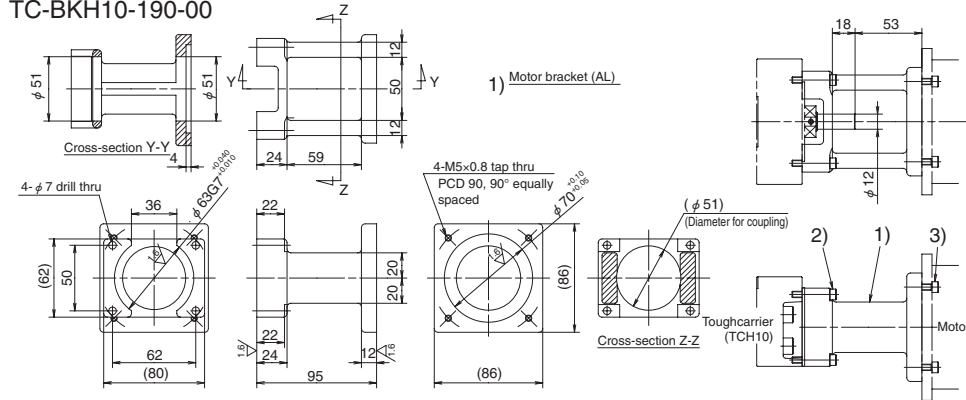
- 1) Motor bracket (AL)
- 2) Hexagon socket head cap screw (M6, length 30)
- 3) Hexagon socket head cap screw (M4, length 16)

C-2-7 Motor Bracket Compatibility

Model No	Motor bracket reference No.	Motor manufacturer	Serie	Stepper motor model No.	Wattage of AC servo motor													
					30	50	60	100	150	200	300	400	600	750				
TCH06	TC-BKH06-145-00	Panasonic Co., Ltd.	MINAS A6			MSMF5A		MSMF01										
		YASKAWA Electric Corp.	Σ-7			SGM7A-A5 SGM7J-A5		SGM7A-01 SGM7J-01		SGM7A-C2 SGM7J-C2								
		Mitsubishi Electric Corp.	MELSERVO-J4			HG-KR053 HG-MR053		HG-KR13 HG-MR13										
		OMRON Corp.	G5			R88M-K05030		R88M-K10030										
		SANYO DENKI Co., Ltd.	SANMOTION R			R2:A04005		R2:A04010										
	TC-BKH06-148-00*1	Panasonic Co., Ltd.	-					MAMA01*1										
	TC-BKH06-160-00*1	SANYO DENKI Co., Ltd.	-					P5080501*1				P5080502*1						
		ORIENTAL MOTOR Co., Ltd.	αSTEP	AR6x, ARL6x, AZ6x														
		OMRON Corp.	CRK, CVK, RKII	CRK56x, CVK56x, RKS56x														
		SANYO DENKI Co., Ltd.	SANMOTION Model No. PB	PBDM60x, PB:R60x, PB:P60x														
TCH09	TC-BKH09-145-00	Panasonic Co., Ltd.	MINAS A6			MSMF5A		MSMF01										
		YASKAWA Electric Corp.	Σ-7			SGM7A-A5 SGM7J-A5		SGM7A-01 SGM7J-01		SGM7A-C2 SGM7J-C2								
		Mitsubishi Electric Corp.	MELSERVO-J4			HG-KR053 HG-MR053		HG-KR13 HG-MR13										
		OMRON Corp.	G5			R88M-K05030		R88M-K10030										
		SANYO DENKI Co., Ltd.	SANMOTION R			R2:A04005		R2:A04010										
	TC-BKH09-160-00*1	SANYO DENKI Co., Ltd.	-					P5080501*1										
		YASKAWA Electric Corp.	Σ-7					SGM7A-02A SGM7J-02		SGM7A-04A SGM7J-04		SGM7A-06A SGM7J-06						
		Mitsubishi Electric Corp.	MELSERVO-J4			HG-KR23 HG-MR23		HG-KR43 HG-MR43										
		SANYO DENKI Co., Ltd.	SANMOTION R			R2:A06020		R2:A06040										
		Panasonic Co., Ltd.	MINAS A6					MSMF02		MSMF04								
	OMRON Corp.	G5					R88M-K20030		R88M-K40030									
	SANYO DENKI Co., Ltd.	-					P5080702*1		P5080703*1		P5080704*1							
	ORIENTAL MOTOR Co., Ltd.	αSTEP	AR6x, ARL6x, AZ6x															
	OMRON Corp.	CRK, CVK, RKII	CRK56x, CVK56x, RKS56x															
	SANYO DENKI Co., Ltd.	SANMOTION Model No. PB	PBDM60x, PB:R60x, PB:P60x															
	ORIENTAL MOTOR Co., Ltd.	αSTEP RKII	AR9x, ARL9x, AZ9x RKS59x															
TCH10	TC-BKH10-170-00	YASKAWA Electric Corp.	Σ-7							SGM7A-02A SGM7J-02		SGM7A-04A SGM7J-04		SGM7A-06A SGM7J-06				
		Mitsubishi Electric Corp.	MELSERVO-J4							HG-KR23 HG-MR23		HG-KR43 HG-MR43						
		SANYO DENKI Co., Ltd.	SANMOTION R							R2:A06020		R2:A06040						
		Panasonic Co., Ltd.	MINAS A6							MSMF02		MSMF04						
		OMRON Corp.	G5							R88M-K20030		R88M-K40030						
		Panasonic Co., Ltd.	MINAS A6															MSMF08
	OMRON Corp.	G5															R88M-K75030	
	SANYO DENKI Co., Ltd.	-																
	ORIENTAL MOTOR Co., Ltd.	αSTEP RKII	AR9x, ARL9x, AZ9x RKS59x															

*1 The manufacturer models listed are discontinued motors.

Reference number TC-BKH10-190-00

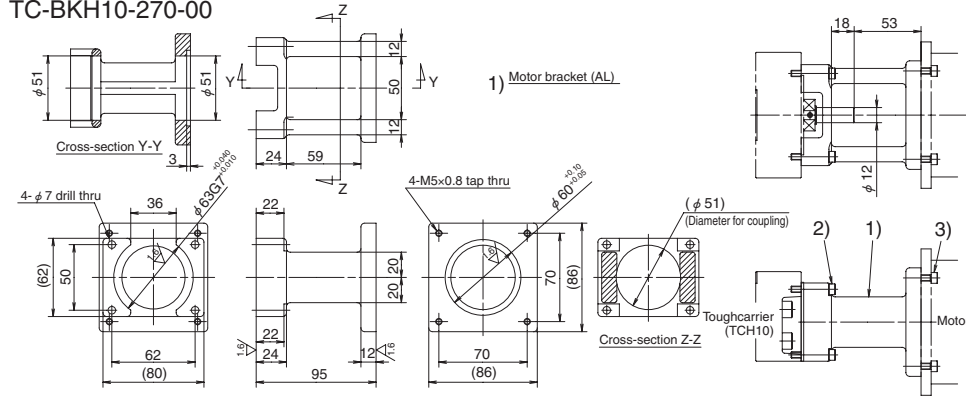


2) Hexagon socket head cap screw (M6, length 30)

3) Hexagon socket head cap screw (M5, length 16)

Compatible motor		
Maker	Serie	Motor models(Servo motor)
Panasonic Co., Ltd.	MINAS A6	MSMF08(750W)
OMRON Corp.	G5	R88M-K75030(750W)

Reference number TC-BKH10-270-00



2) Hexagon socket head cap screw (M6, length 30)

3) Hexagon socket head cap screw (M5, length 16)

Compatible motor		
Maker	Serie	Motor models(steping motor)
ORIENTAL MOTOR Co.,Ltd.	αSTEP	AR9x, ARL9x, AZ9x
	RKII	RKS59x

C-2-8 Sensor Rail and Top Cover Unit Combinations

Model No.	Reference number	Rail length (L)	Sensor rail reference number	Cover unit reference number			
TCH06	TCH06005H05K00	150	TC-SRL6-0150	TC-HV06005K00			
	TCH06005H10K00						
	TCH06005H20K00						
	TCH06007H05A00						
	TCH06007H10A00	200	TC-SRL6-0200	TC-HV06007A00			
	TCH06010H05K00						
	TCH06010H10K00						
	TCH06010H20K00						
	TCH06012H05A00	300	TC-SRL6-0300	TC-HV06012A00			
	TCH06012H10A00						
	TCH06020H05K00						
	TCH06020H10K00						
	TCH06020H20K00						
	TCH06013H05D00						
	TCH06013H10D00						
	TCH06022H05A00						
	TCH06022H10A00						
	TCH06017H05B00						
	TCH06017H10B00						
	TCH06030H05K00				400	TC-SRL6-0400	TC-HV06030K00
	TCH06030H10K00						
	TCH06030H20K00						
	TCH06023H05D00						
	TCH06023H10D00						
	TCH06032H05A00						
	TCH06032H10A00						
	TCH06027H05B00						
	TCH06027H10B00						
	TCH06040H05K00	500	TC-SRL6-0500	TC-HV06040K00			
	TCH06040H10K00						
	TCH06040H20K00						
	TCH06033H05D00						
	TCH06033H10D00						
	TCH06042H05A00						
	TCH06042H10A00						
	TCH06037H05B00						
	TCH06037H10B00						
	TCH06050H05K00				600	TC-SRL6-0600	TC-HV06050K00
	TCH06050H10K00						
	TCH06050H20K00						
	TCH06043H10D00						
	TCH06043H20D00						
	TCH06052H05A00						
	TCH06052H10A00						
	TCH06047H10B00						
	TCH06047H20B00						

- Sensor rail reference numbers are determined according to the rail length. Select a sensor rail appropriate for your requirements.
- Shapes and numbers of spacer plates for cover units are selected according to slider specifications.

Model No.	Reference number	Rail length (L)	Sensor rail reference number	Cover unit reference number			
TCH09	TCH09010H05K00	240	TC-SRL9-0240	TC-HV09010K00			
	TCH09010H10K00						
	TCH09010H20K00						
	TCH09014H05A00						
	TCH09014H10A00	340	TC-SRL9-0340	TC-HV09014A00			
	TCH09014H20A00						
	TCH09020H05K00						
	TCH09020H10K00						
	TCH09020H20K00	440	TC-SRL9-0440	TC-HV09020K00			
	TCH09024H05A00						
	TCH09024H10A00						
	TCH09024H20A00						
	TCH09030H05K00						
	TCH09030H10K00						
	TCH09030H20K00						
	TCH09017H05D00						
	TCH09017H10D00						
	TCH09034H05A00						
	TCH09034H10A00						
	TCH09034H20A00						
	TCH09025H05B00	540	TC-SRL9-0540	TC-HV09025B00			
	TCH09025H10B00						
	TCH09040H05K00						
	TCH09040H10K00						
	TCH09040H20K00						
	TCH09027H05D00						
	TCH09027H10D00						
	TCH09044H05A00						
	TCH09044H10A00						
	TCH09044H20A00						
	TCH09035H05B00						
	TCH09035H10B00						
	TCH09050H05K00	640	TC-SRL9-0640	TC-HV09050K00			
	TCH09050H10K00						
	TCH09050H20K00						
	TCH09037H05D00						
	TCH09037H10D00						
	TCH09054H05A00						
	TCH09054H10A00						
	TCH09054H20A00						
	TCH09045H05B00						
	TCH09045H10B00						
	TCH09060H05K00				740	TC-SRL9-0740	TC-HV09060K00
	TCH09060H10K00						
	TCH09060H20K00						
	TCH09047H10D00						
	TCH09047H20D00						
	TCH09064H05A00						
TCH09064H10A00							
TCH09064H20A00							
TCH09055H10B00							
TCH09055H20B00							
TCH09070H05K00	840	TC-SRL9-0840	TC-HV09070K00				
TCH09070H10K00							
TCH09070H20K00							
TCH09074H05A00							
TCH09074H10A00							
TCH09074H20A00							
TCH09080H05K00							
TCH09080H10K00							
TCH09080H20K00							
TCH09067H10D00							
TCH09067H20D00							
TCH09084H05A00				940	TC-SRL9-0940	TC-HV09084A00	
TCH09084H10A00							
TCH09084H20A00							
TCH09075H10B00							
TCH09075H20B00							

- Sensor rail reference numbers are determined according to the rail length. Select a sensor rail appropriate for your requirements.
- Shapes and numbers of spacer plates for cover units are selected according to slider specifications.

C-2-9 Toughcarrier High-Thrust Model (Special product)

◆ Specifications

The life of the feeding system is improved by use of higher load capacity ball screw and support bearings for standard Toughcarriers.

		TCH06	TCH09		TCH10	
Ball screw	Shaft diameter (mm)	12	20		25	
	Lead (mm)	10	10	20	20	25
	Basic dynamic load rating Ca (N)	4 260	13 400	10 100	11 400	11 400
	Basic static load rating Coa (N)	6 260	25 400	18 700	23 600	23 600
Linear guide	Basic dynamic load rating C (N)	20 900	44 900		62 400	
	Basic static load rating Co (N)	45 000	96 900		132 000	
Support bearings	Basic dynamic load rating (N)	7 450	25 100		27 600	
	Load limit (N)	3 500*	18 600*		26 600*	

*Permissible axial load is 0.7 times the limiting axial load.

- 1) Only compatible with standard sliders.
- 2) Applicable strokes are as follows.
 TCH06: Stroke 500 mm
 TCH09: Stroke 800 mm
 TCH10: Stroke 1 200 mm
- 3) High and precision grades are available for accuracy.

◆ Features

- 1) Mounting dimensions are the same as Monocarrier MCH Models and standard Toughcarrier actuators. (Interchangeable)
- 2) Permissible rotational speed is faster than standard Toughcarrier actuators due to a different ball recirculation system.

Model No.	Reference number	Rail length (L)	Sensor rail reference number	Cover unit reference number				
TCH10	TCH10010H10K00	280	TC-SRL1-0280	TC-HV10010K00				
	TCH10010H20K00			TC-HV10016A00				
	TCH10016H10A00	380	TC-SRL1-0380	TC-HV10020K00				
	TCH10016H20A00			TC-HV10026A00				
	TCH10020H10K00			480	TC-SRL1-0480	TC-HV10030K00		
	TCH10020H20K00					TC-HV10036A00		
	TCH10026H10A00	580	TC-SRL1-0580			TC-HV10040K00		
	TCH10026H20A00					TC-HV10027D00		
	TCH10030H10K00					TC-HV10046A00		
	TCH10030H20K00					TC-HV10036B00		
	TCH10036H10A00			680	TC-SRL1-0680	TC-HV10050K00		
	TCH10036H20A00					TC-HV10037D00		
	TCH10040H10K00					TC-HV10056A00		
	TCH10040H20K00					TC-HV10046B00		
	TCH10027H10D00					780	TC-SRL1-0780	TC-HV10060K00
	TCH10027H20D00							TC-HV10047D00
	TCH10046H10A00	TC-HV10066A00						
	TCH10046H20A00	TC-HV10056B00						
	TCH10036H10B00	880	TC-SRL1-0880					TC-HV10070K00
	TCH10036H20B00							TC-HV10057D00
	TCH10050H10K00			TC-HV10076A00				
	TCH10050H20K00			TC-HV10066B00				
	TCH10037H10D00			980	TC-SRL1-0980			TC-HV10080K00
	TCH10037H20D00							TC-HV10067D00
	TCH10056H10A00					TC-HV10086A00		
	TCH10056H20A00					TC-HV10076B00		
	TCH10070H10K00					1 080	TC-SRL1-1080	TC-HV10090K00
	TCH10070H20K00							TC-HV10077D00
	TCH10066H10B00	TC-HV10096A00						
	TCH10066H20B00	TC-HV10086B00						
	TCH10077H10D00	1 180	TC-SRL1-1180					TC-HV10100K00
	TCH10077H20D00							TC-HV10087D00
	TCH10080H10K00			TC-HV10106A00				
	TCH10080H20K00			TC-HV10096B00				
	TCH10067H10D00			1 280	TC-SRL1-1280			TC-HV10110K00
	TCH10067H20D00							TC-HV10097D00
	TCH10086H10A00					TC-HV10116A00		
	TCH10086H20A00					TC-HV10106B00		
	TCH10076H10B00					1 380	TC-SRL1-1380	TC-HV10120K00
	TCH10076H20B00							TC-HV10107D00
	TCH10090H10K00	TC-HV10126A00						
	TCH10090H20K00	TC-HV10116B00						
	TCH10077H20D00	1 380	TC-SRL1-1380					TC-HV10120K00
	TCH10096H10A00							TC-HV10107D00
	TCH10096H20A00			TC-HV10126A00				
	TCH10100H10K00			TC-HV10116B00				
	TCH10100H20K00							
	TCH10087H20D00							
	TCH10106H10A00							
	TCH10106H20A00							
	TCH10096H20B00							
	TCH10110H10K00							
	TCH10110H20K00							
	TCH10097H20D00							
	TCH10116H10A00							
	TCH10116H20A00							
	TCH10106H20B00							
	TCH10120H10K00							
	TCH10120H20K00							
	TCH10107H20D00							
	TCH10126H10A00							
	TCH10126H20A00							
	TCH10116H20B00							

• Sensor rail reference numbers are determined according to the rail length. Select a sensor rail appropriate for your requirements.
 • Shapes and numbers of spacer plates for cover units are selected according to slider specifications.

C-3 Technical Materials

1. Sensor Specifications	C143
1.1 Proximity Switch	C143
1.2 Photo Sensor	C144
2. Characteristics and Evaluation Methods	C145
2.1 Positioning Accuracy	C145
2.2 Repeatability	C145
2.3 Running Parallelism	C145
3. Special Specifications	C146
4. Maintenance	C147
4.1 Maintenance Methods	C147
4.2 NSK K1™ Lubricant Unit	C147
5. NSK Clean Grease LG2 Specification	C148

C-3 Technical Materials

C-3-1 Sensor Specifications

C-3-1. 1 Proximity Switch

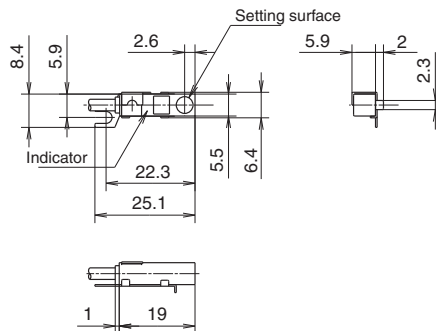
Use of OMRON E2S-W13 and E2S-W14

Item	E2S-W13 type	E2S-W14 type
Setting surface	Front face	
Sensing distance	1.6 mm ±15%	
Setting distance	0 to 1.2 mm	
Differential travel	10% max. of sensing distance	
Detectable objects	Ferrous metal	
Standard sensing object	Iron, 12 × 12 × 1 mm	
Response frequency	1 kHz min.	
Power supply voltage (operating voltage range)	12 to 24 VDC; ripple (p-p), 10% max (10 to 30 VDC)	
Current consumption	13 mA max. at 24 VDC with no load	
Control output (Switching Capacity)	NPN open collector output, 50 mA max. (30 VDC max.)	
Control output (Residual voltage)	1.0 V max. with a load current of 50 mA and a cable length of 1 m	
Indicator	Operation indicator (orange)	
Operating status (with sensing object approaching)	NO (Normally open contact)	NC (Normally close contact)
Wire lead length	1 000 mm	

Notes: 1) Take care to avoid errors with sensor wiring.
2) Please contact NSK for PNP output type.

Movement mode	Output type	Type	Time chart	Output circuit
NO	NPN	E2S-W13		
		E2S-W14		

E2S-W13 (Normally open contact)
E2S-W14 (Normally close contact)
The external appearances are the same.



C-3-1. 2 Photo Sensor

Use of OMRON EE-SX674

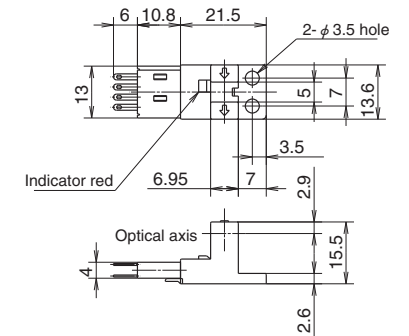
Item	EE-SX674 type
Slot width	5 mm
Standard reference object	Opaque, 2 × 0.8 mm
Differential distance	0.025 mm
Light source	GaAs infrared LED with peak wavelength of 940 nm
Indicator (without detecting object)	ON GaP red LED (peak emission wavelength, 690 nm)
Supply voltage	5 to 24 VDC ±10%; ripple (p-p), 10% max.
Current consumption	35 mA max.
Control output	NPN open collector output models, 5 to 24 VDC, 100 mA load current
Response frequency	1 kHz max. (3 kHz typ.)
Ambient illumination	Fluorescent light, 1 000 lx max.
Ambient temperature	-25°C to 55°C (-13°F to 131°F) (for operating); -30°C to 80°C (-22°F to 176°F) (for storing)
Ambient humidity	5 to 85% RH (for operating); 5 to 95% RH (for storing)
Connecting method	EE-1001/1006 Connectors, soldering terminals

Notes: 1) Take care to avoid errors with sensor wiring.
2) Please contact NSK for PNP output type.

Type	Movement mode	Time chart	Connection terminal	Output circuit
EE-SX674	Light-ON		When terminals L and ⊕ are short circuited	
	Dark-ON		When terminals L and ⊕ are open circuited	

EE-SX674 (Sensor)
EE-1001 (Connector)

A connector is mounted to the sensor in the right figure.



C-3-2 Characteristics and Evaluation Methods

C-3-2. 1 Positioning Accuracy

Perform successive positioning from the reference position in a specific direction. Measure the difference between the actual and desired travel distances for each point from the reference position. Repeat this measurement seven times to determine the average value. Measure such average values over the entire travel distance at the intervals specified for each model and take the maximum difference of the average values determined at respective positions as the measured value.

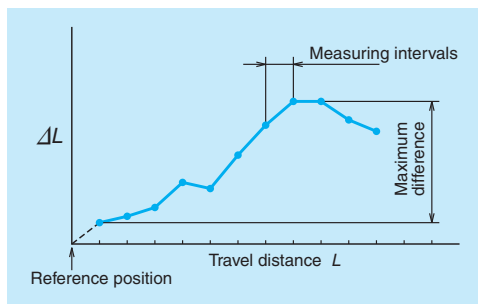


Fig. 1

C-3-2. 3 Running Parallelism (Vertical direction)

We specify the parallelism of slider to the datum bottom surface of rail. An indicator is moved in the axial direction making its stylus slightly touch the rail bottom surface. The slider is moved in the axial direction for the check. We define the total indicator reading as the running parallelism. During the check, the rail is not fixed to the table base. Please be aware that, in general applications, the rail is fixed to the machine base, and thus wobbly rolling error will be added to the running parallelism.

C-3-2. 2 Repeatability

Repeat positioning at any point seven times from the same direction to measure the stopping position and determine one half of the maximum difference of readings. Repeat this measurement over the entire travel distance at the intervals specified for each model. Take the maximum difference of the determined values as the measured value. Express one half of the maximum difference with a plus-or-minus (\pm) sign.

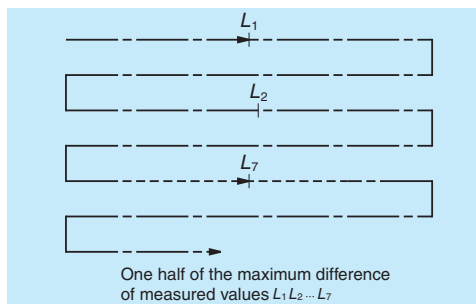


Fig. 2

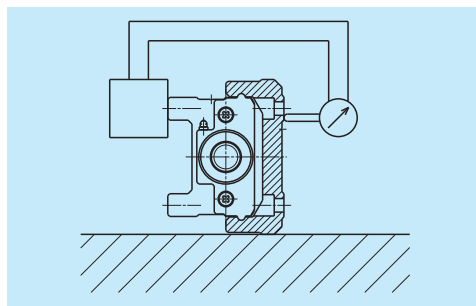


Fig. 3 Setting of indicator

C-3-3 Special Specifications

Please consult NSK if standard products do not meet your requirements.

(1) Surface Treatment

- Fluoride low temperature chrome plating

Note: Ball screw parts (including low temperature chrome plating.)

(2) Special Machining (Processing)

- i) Shaft end processing
 - Key way processing
 - One flat or two flats processing
- ii) Pin hole processing
 - Slider
 - Rail

Note: Due to interference with the internal construction, the position of pin holes is limited. Please consult with NSK about pin positions.

(3) Motor Bracket and Intermediate Plate for Motor Mounting

- We provide motor mounting brackets and intermediate plates that are not listed in the catalog.
- We assemble motors upon request if the motor is provided in advance.

Note: Motion check of the motor is unavailable.

(4) Reversed Motor Mount

A reversed motor mount is available. Please consult NSK.

Notes: 1) We do not check motor running condition.

2) Please refer to the bottom of page C89 to C91 for the configuration of reversed motor mounting for the MCH model.

(5) Right and Left Turn Thread

Right and left turn ball screws are available. Please consult with NSK for available leads.

(6) Ball-Screw-Less Specification (Only Linear Guide Part)

A ball-screw-less rail part with the same cross section of standard Monocarriers is available for a driven linear guide. It will lessen height adjustment work compared with a construction with two standard Monocarriers. Note: Height grinding adjustment of the two-axis assembly is not available.

C-3-4 Maintenance

C-3-4.1 Maintenance Method

1. For standard Monocarrier actuators we pack grease in the slider, linear guides, and ball screw.
2. Monocarrier actuators are equipped with NSK K1 Lubrication Unit as a standard feature, therefore, you may use it for 5 years or 10 000 km depending on your application, whichever comes first, without maintenance. However, replenishment of grease may extend life substantially.
3. The NSK K1 Lubrication Unit is ideal in environments where oily dust exists. However, the life may be shorter than described in Clause 2 above. Such cases require increasing the frequency of replenishment.

4. A Nozzle for the NSK grease pump for MCH Monocarrier actuators is available as an option. NSK reference number: NSK HGP NZ8

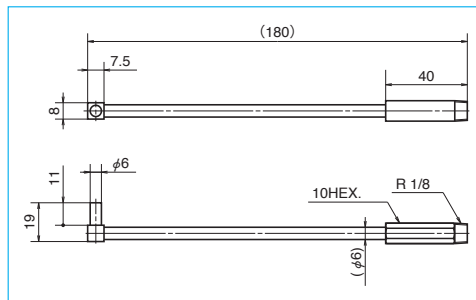


Fig. 4 NSK HGP NZ8

Precautions for handling

1. Please consult with NSK when the motor is coupled to the ball screw using a pulley because there is a restriction on allowable load to the end of ball screw shaft.
2. To extend high performance of NSK K1 lubrication unit, please observe the following.

1. Temperature range Ambient temperature: 50°C
Max. instantaneous temperature: 80°C
2. Use of chemicals Never leave a Monocarrier actuators in close proximity of grease removing organic solvents such as hexane or thinner.
Never immerse it in an antirust solvent that contains kerosene.

Note: Other oils, such as water-based and oil based cutting oil, and grease do not cause any problems.

C-3-4. 2 NSK K1™ Lubricant Unit

NSK K1 lubrication units exhibit outstanding features, confirmed by abundant experimental data, along with proven performance of linear guides and ball screws equipped with NSK K1.

(1) High-Speed Durability Test of Linear Guides without Lubricant

Results of high-speed durability testing of a linear guide without lubricant are shown in Fig. 5 While the linear guide cannot be operated without lubricant for even short periods without damage, installation of the NSK K1 permits the linear guide to run over 25 000 km without any problems.

Conditions	Test piece: LH30AN (Preload Z1)
	Speed: 3.3 m/s
	Stroke: 1 800 mm
No lubricant	All grease removed
NSK K1	All grease removed + NSK K1

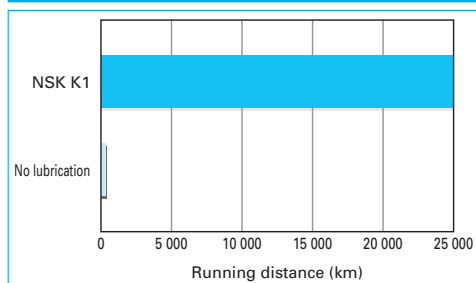


Fig. 5 Results of high-speed durability test of linear guides without lubricant

(2) High-Speed Durability Test of Ball Screws without Lubricant

Results of high-speed durability testing of a ball screw without lubrication are shown in Fig. 6 While the ball screw cannot be operated without lubricant at 8.5 km without damage, the installation of the NSK K1 permits the ball screw to run over 10 000 km without any problems.

Conditions	Test piece: BS2020 (Ball screw)
	Shaft diameter: 20 mm
	Lead: 20 mm
	Load: none
	Speed: 1.3 m/s (4 000 min ⁻¹)
	Stroke: 600 mm
No lubricant	All grease removed
NSK K1	All grease removed + NSK K1

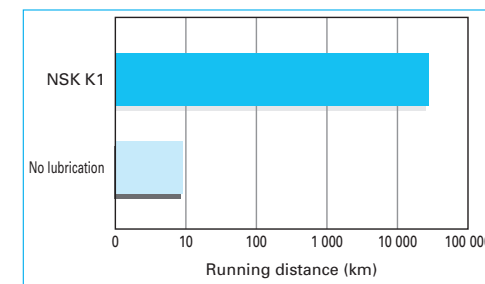


Fig. 6 Results of high-speed durability test of ball screws without lubricant

● **NSK K1 Lubrication Units for food processing and medical devices are available.**

For safe food processing and medical care, NSK provides Monocarrier actuators equipped with special NSK K1 Lubrication Units made of materials approved by the FDA. Dimensions are the same as the standard NSK K1 Lubrication Unit, and special handling is not required.

C-3-5 NSK Clean Grease LG2 Specification

● Features

This grease was developed by NSK to be exclusively used for linear guides and ball screws in cleanrooms. Compared to fluoride grease commonly used in clean rooms, LG2 has several advantages such as: higher lubrication function, longer lubrication life, more stable torque (resistant to wear), and higher rust prevention. In dust generation, LG2 is more than equal to fluoride grease in keeping dust volume low. Since the base oil is not a special oil but a mineral oil, LG2 can be handled in the same manner as general grease.

● Applications

LG2 is lubrication grease for rolling contact machine components such as linear guides and ball screws for processing equipment for semiconductors and flat panel display which require highly clean environments at normal pressure in normal temperatures. It cannot be used in a vacuum environment.

● Nature

Thickener	Lithium soap base
Base oil	Mineral oil + Synthetic hydrocarbon oil
Consistency	199
Dropping point	201°C
Volume of evaporation	1.40% (99°C, 22 hr)
Copper plate corrosion test	Satisfactory (Method B, 100°C, 24 hr)
Oil separation	0.8% (100°C, 24 hr)
Base oil kinematic Viscosity	32 mm ² /s (40°C)

Other

Other

- 1. Special Environments D1
 - 1.1 Specifications for Special Environments D1
 - 1.2 Lubrication and Materials D3
 - 1.3 Rust Prevention and Surface Treatment..... D5
 - 1.4 Measures Against Special Environments D7
 - 1.5 Compatibility with Special Environments D11
 - 1.6 Precautions for Handling..... D12
- 2. Lubrication D13
 - 2.1 Grease Lubrication..... D13
 - 2.2 Oil Lubrication D24
- 3. RoHS Compliance D24

1 Special Environments

1.1 Specifications for Special Environments

1. Linear guide

Table 1.1 Linear guide specifications

Environment	Condition	NSK linear guide specifications				Technical Explanation Page No.
		Rail, slide	Steel balls/rollers	Ball recirculation component	Lubrication/surface treatment	
Cleanroom	Atmosphere, normal temperature	Standard material	Standard material	Standard material	LG2, LGU Grease	D8
					NSK K1-L/K1 lubrication unit	A58
		Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel	LG2, LGU Grease	D8
					NSK K1-L/K1 lubrication unit	A58
Atmosphere-Vacuum, normal temperature			Fluoride low temperature chrome plating	D5		
Atmosphere-Vacuum up to 200°C			Fluoride grease			
Vacuum	Atmosphere-Vacuum, normal temperature	Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel	Fluoride grease	
	Atmosphere-Vacuum up to 200°C					
	Atmosphere-Vacuum up to 300°C				Molybdenum disulfide	
	High vacuum up to 500°C				Special silver film	D7
Corrosive	Vapor, steam	Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel		
	Acid, alkali	Standard material	Standard material	Standard material	Fluoride low temperature chrome plating	D5
	Acid, alkali, clean	Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel	Fluoride low temperature chrome plating	D5
					LG2, LGU Grease	D8
	Strong acid, strong alkali				Fluoride low temperature chrome plating	D5
Organic solvent				Fluoride grease		
High temperature	Atmosphere up to 150°C	Standard material	Standard material	Austenitic stainless steel	ET-100K Grease	
	Atmosphere up to 200°C				Fluoride grease	
	Atmosphere up to 200°C, Corrosion resistant				Fluoride grease	
Low temperature	-273°C and higher	Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel	Solid lubricant	
Radioactive	Atmosphere	Standard material	Standard material	Standard material	Radiation resistant grease	
		Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel		
Foreign matter	Fine particles, wooden chips	Standard material	Standard material	Standard material	NSK K1-L/K1 lubrication unit	A58
			Martensitic stainless steel	Austenitic stainless steel		
	Water, under water	Martensitic stainless steel	Standard material	Standard material		
			Martensitic stainless steel	Austenitic stainless steel		

2. Ball screw

Table 1.2 Ball screw specifications

Environment	Condition	NSK Ball screw specification				Technical Explanation Page No.		
		Screw shaft, ball nut	Steel balls	Ball Recirculation component	Lubrication/surface treatment			
Cleanroom	Atmosphere, normal temperature	Standard material	Standard material	Standard material	LG2, LGU Grease	D8		
					NSK K1 lubrication unit	B559		
		Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel	LG2, LGU Grease	D8		
					NSK K1 lubrication unit	B559		
Atmosphere-Vacuum, normal temperature			Fluoride low temperature chrome plating	D5				
Atmosphere-Vacuum up to 200°C			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				Ceramic	Ceramic	Ceramic	Fluoride grease
	High vacuum up to 500°C							
Corrosive	Acid, alkali, clean	Standard material	Standard material	Austenitic stainless steel	Fluoride low temperature chrome plating	D5		
		Martensitic stainless steel	Martensitic stainless steel		Fluoride grease			
	Strong acid, strong alkali, clean, nonmagnetic	Precipitation hardening stainless steel	Precipitation hardening stainless steel					
		Ceramic	Ceramic					
Nonmagnetic	Atmosphere-Vacuum, clean	Special austenitic stainless steel	Ceramic	Austenitic stainless steel	Fluoride grease			
	Atmosphere-Vacuum, up to 200°C, clean	Ceramic			Fluoroplastic			
High temperature	Atmosphere up to 200°C	Standard material	Standard material	Austenitic stainless steel	Fluoride grease			
	Atmosphere up to 200°C	Martensitic stainless steel	Martensitic stainless steel		Fluoride low temperature chrome plating	D5		
	Atmosphere up to 500°C, corrosion resistance	Ceramic	Ceramic		Fluoride grease			
Low temperature	-273°C and higher	Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel	Solid lubricant			
Radioactive	Atmosphere	Standard material	Standard material	Standard material	Radiation resistant grease			
		Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel				
Foreign matter	Fine particles, wooden chips	Standard material	Standard material	Standard material	NSK K1 lubrication unit	B559		
			Martensitic stainless steel	Martensitic stainless steel				
	Water, under water	Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel				

1.2 Lubrication and Materials

1. Lubrication

Grease can be used for high rotation and magnetic field. However, grease evaporates or solidifies in special environment such as vacuum, high temperature, and low temperature. Solid lubricant is

used when it is difficult to use grease. Functions of solid lubricant differ greatly by condition where it is used. It is important to select the most suitable solid lubrication for the environment.

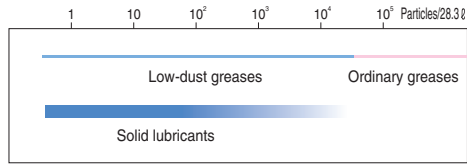


Fig. 2.1 Lubrication in clean environment

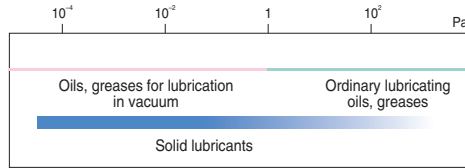


Fig. 2.2 Lubrication in vacuum

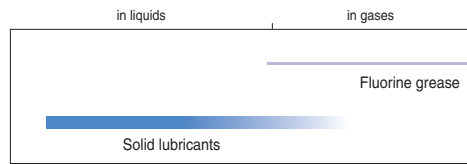


Fig. 2.3 Lubrication in corrosive environment

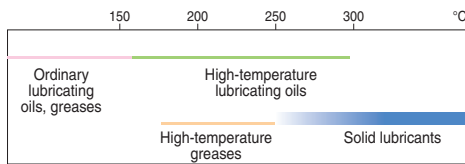


Fig. 2.4 Lubrication in high temperature

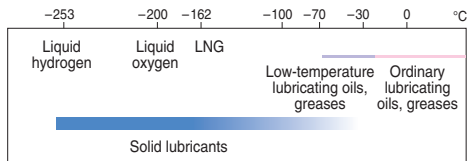


Fig. 2.5 Lubrication in low temperature

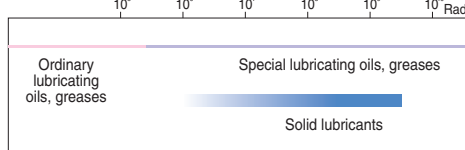


Fig. 2.6 Lubrication in radioactive environment

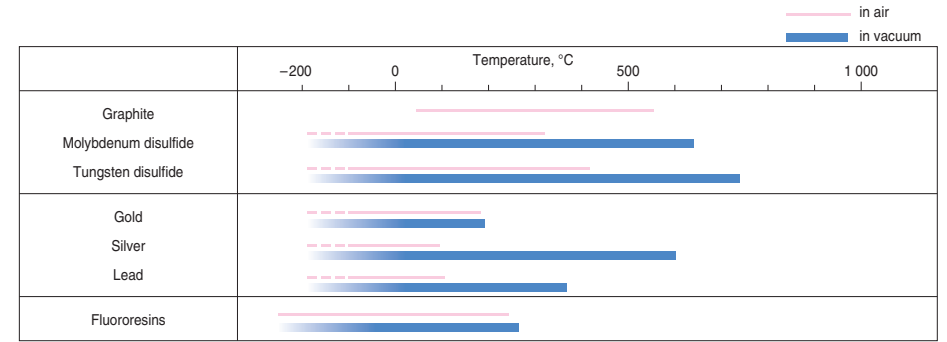


Fig. 2.7 Temperature range for using solid lubricants

2. Materials

Iron metals are used in vacuum, high temperature, and high speed environments as the basic material.

We generally use nonmagnetic stainless steel for nonmagnetic materials.

Table 2.1 Characteristics of metal materials

Application	Type of steel	Linear expansivity ×10 ⁻⁶ /°C	Young's modulus GPa	Hardness* HB
For clean environment, vacuum environment, corrosion resistance, low temperature, high temperature, radioactive resistance	Martensitic stainless steel SUS440C	10.1	200	580
	Austenitic stainless steel SUS304	16.3	193	150
	Precipitation hardening stainless steel SUS630	10.8	200	277 – 363
Nonmagnetic	Nonmagnetic stainless steel	17.0	195	420

*) Hardness of steel is usually indicated by Rockwell C Scale. For comparison, these figures are expressed by Brinell number.

1.3 Rust Prevention and Surface Treatment

1. Fluoride low temperature chrome plating
NSK linear guides, ball screws, and Monocarrier/Toughcarrier actuators are used in various applications and environments, from industrial machinery to semiconductor/FPD manufacturing and aerospace equipment. Preventing rust from developing in these applications is crucial, particularly for machines around water such as part/device washers and for semiconductor/FPD manufacturing equipment involved in chemical wet processing. NSK applies a fluororesin coating to an electrolytic black plating (fluoride low-temperature chrome plating) on these products for optimal rust resistance.

● **What is "Fluoride low temperature chrome plating?"**

This type of black chrome plating forms a black film (1 to 2 μm in thickness) on the metal surface. Fluoroplastic coating is added to the film to increase corrosion resistance.

- Accuracy control is easily manageable due to low temperature treatment and to the absence of hydrogen embrittlement.
- Product accuracy is less affected due to the thin film which has high corrosion resistance.
- This method is superior to other surface treatments in durability on the rolling surface.
- Inexpensive compared with products with other surface treatment and stainless steel products.

Do not use organic solvent because it adversely affects antirust property of the plating.

● **Humidity chamber test**

Table 3.1 Results of the humidity test

Test sample	Fluoride low temperature chrome plating (recommended)	Hard chrome plating (reference)	Electroless nickel plating (reference)	Equivalent to SUS440C material	Standard steel	
Characteristic						
Rusting	Top	(Ground) B	(Ground) B	(Ground) C	(Ground) D	
	Side	(Ground) A	(Ground) A	(Ground) C	(Ground) E	
	Bottom	(Ground) A	(Ground) A	(Ground) C	(Ground) E	
	End	(Machined) A	(Machined) A	(Machined) C	(Machined) E	
Chamfer/grinding recess	(Drawn) A	(Drawn) D	(Drawn) A	(Drawn) C	(Drawn) E	
Corrosion-resistant property	<p><Test conditions></p> <ul style="list-style-type: none"> ● Testing chamber: High temperature, highly moist chamber (made by DABAI ESPEC) ● Temperature: 70°C ● Relative humidity: 95% ● Testing time: 96 h <p>Time to "ramp-up" and "ramp-down" condition of the temperature and the humidity conditions</p> <p>Ramp-up: 5 h Ramp-down: 2 h</p>					
	Film thickness	5 μm	0.5 – 7 μm	10 μm	—	—
		Rusting	A: No rust C: Spotty rust	B: Not rusted, but slightly discolored D: slightly rusted	E: Completely rusted	

● **Chemical corrosion resistance test**

Table 3.2 Results of the corrosion resistance test

Test conditions	Rail base material: Equivalent to SUS440C Chemical density: 1 mol/l		
Fluoride low temperature chrome plating	Immersed in solution for 24 hrs Nitric acid	Hard chrome plating	None surface treatment
	Immersed in solution for 24 hrs Fluoride		
	Exposed to vapor for 72 hrs Hydrochloric acid type washing solution HCℓ : H ₂ O ₂ : H ₂ O = 1 : 1 : 8		
○	Hydrochloric acid (immersed)	○	▲
○	Sulfuric acid (immersed)	○	X
○	Ammonia or sodium hydroxide	○	△

○: Normal △: Partial surface damage ▲: Overall surface damage X: Corroded

● **Surface treatment durability test**

Peeling resistance of surface treatment

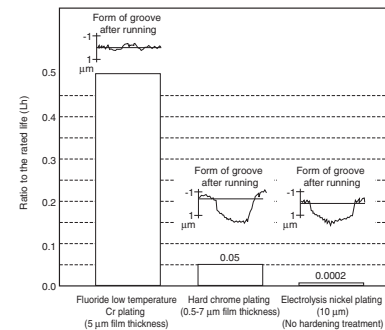


Fig. 3.1 Results of durability test

● **Total evaluation**

Table 3.3 Evaluation

	Available length	Rust prevention ability	Quality stability	Durability	Cost
Fluoride low temperature chrome plating	◎ (4 m)	◎	○	◎	◎
Hard chrome plating	△ (2 m)	○	X	△	△
Electroless nickel plating	◎ (4 m)	◎	△	X	△
Material equivalent to SUS440C	○ (3.5 m)	○	◎	◎	△

◎: Excellent ○: Suitable in use
△: Not so good for use X: Problem in use

1.4 Measures Against Special Environments

1. In vacuum

● Silver-film plated ball screw

Ball screws that are plated by soft metal (special silver film) as a solid lubricant are developed the application for vacuum environment such as semiconductor manufacturing equipment and surface modification systems.

● Durability test in high vacuum

Test equipment and conditions

Table 4.1 shows ball screw specifications. Fig. 4.1 is a schematic of the testing system in vacuum chamber.

Table 4.2 shows testing conditions.

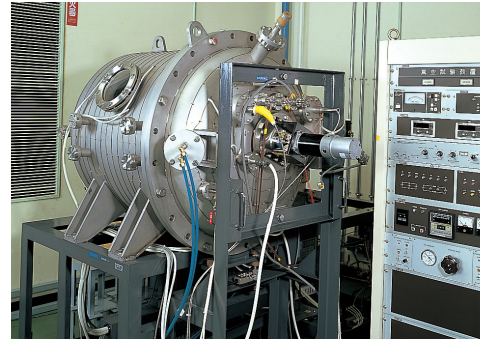


Photo 4.1 Vacuum testing system

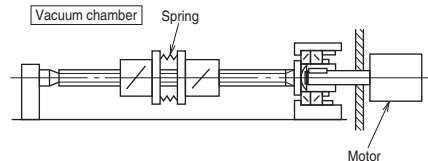


Fig. 4.1 Schematic of the testing system

Table 4.1 Ball screw specifications		
Shaft diameter	12 mm	
Lead	4 mm	
Steel ball diameter	2.381 mm	
Numbers of circuit of balls	2.5 turns, 1 circuit	
Axis load (preload)	29.4 N	
Maximum surface pressure (preload volume)	about 690 MPa	
Material	Shaft	SUS630
	Nut	SUS440C
	Ball tube	SUS304
	Steel balls	SUS440C
Solid lubricant	Special silver film	

Table 4.2 Testing conditions	
Rotational speed	300 min ⁻¹
Vacuum chamber pressure	1.3×10 ⁻⁵ – 1.3×10 ⁻⁶ Pa
Stroke	160 mm

Evaluation method

It is understood that the rolling bearing with solid lubrication reaches end of life when the lubrication film deteriorates, resulting in sudden rise of friction torque. In this test, ball screw rotation torque was constantly measured to study durability and operation. Results were then evaluated.

Test results

Fig. 4.2 shows two distinctive examples obtained in the torque characteristic test.

Test results of the ball screw (a)

The torque tendency was stable until about 1 × 10⁷ rev. Then the torque characteristics slightly deteriorated. At about 1.35 × 10⁷ rev, the torque suddenly rose. At this point, it was determined that the ball screw reached the end of its life.

Test results of the ball screw (b)

Torque value is a little higher in the test (a). The value is also little unstable. The torque momentarily soared several times during the test (some 10 N·cm). It is thought this is attributable to the repeated peeling/sticking of the surface film made of soft metal (silver, etc.).

When the torque finally soared at 1.13 × 10⁷ rev., it was determined that the ball screw reached the end of its life.

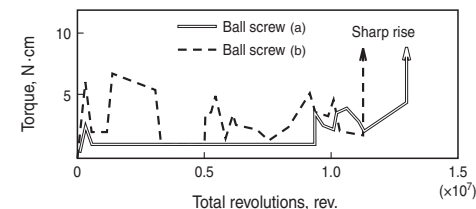


Fig. 4.2 Torque variation

Table 4.3 Ball screw durability

Classification	Ball screw (a)	Ball screw (b)
Total revolutions (rev.)	1.35×10 ⁷	1.13×10 ⁷
Total traveling distance (km)	54.0	45.2
Total traveling hours*(h)	750	628

*) Total traveling hours when operated constantly at 300 min⁻¹

Conclusion

Table 4.3 explains results of the two ball screw durability tests.

From these results and other findings, it is estimated that a life of more than 1 × 10⁷ rev. is possible with a load of about 29.4 N.

Torque may soar momentarily before the ball screw reaches its final life due to peeling/sticking of the surface film made of soft metal like silver. For this reason, it is recommendable to select a drive motor with extra torque capacity.

2. Clean environment

● NSK Clean Grease LG2 and LGU

LG2 and LGU "clean" greases are utilized for low-dust specifications of NSK products such as linear guides, ball screws, Monocarriers, Megatorque Motors, XY modules and XY tables. These greases are excellent for cleanrooms thanks to their lower particle emissions and better resistance to corrosion than fluorine greases. Their proven track record makes them particularly suitable for semiconductor production equipment.

Features

- Remarkably low dust emission
- Long life -- More than ten times longer than fluoride greases, and equivalent to ordinary greases.
- Excellent rust prevention -- Significantly higher capacity than fluorine greases.
- Low and stable torque -- 20% or less than that of fluorine greases

Table 4.4 Nature of Clean Grease LG2 and LGU

Name	Thickener	Base oil	Base oil kinematic viscosity mm ² /s (40°C)	Consistency	Dropping point °C
Clean Grease LG2	Lithium soap	Synthetic hydrocarbon oil + mineral oil	32	199	201
Clean Grease LGU	Diurea	Synthetic hydrocarbon oil	95.8	201	260

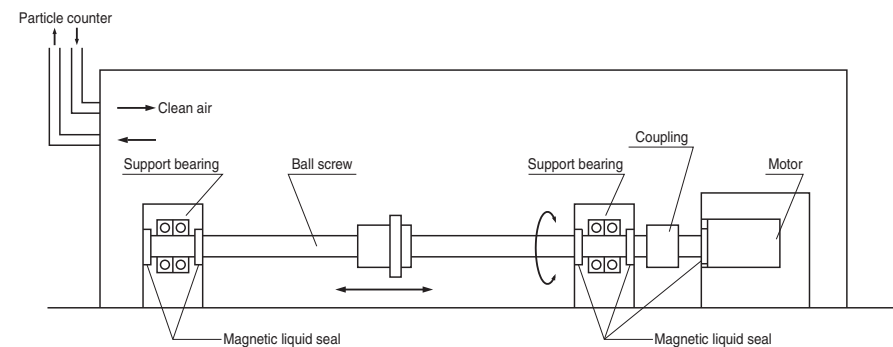


Fig. 4.3 Setting to measure dust generated by ball screw

● Feature 1: Remarkably low dust emission

Compared with fluoride greases, dust emission by LG2 is low and stable for long period of time.

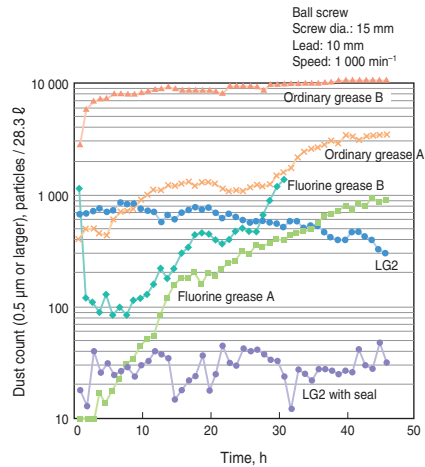


Fig. 4.4 Comparison in dust emission characteristics

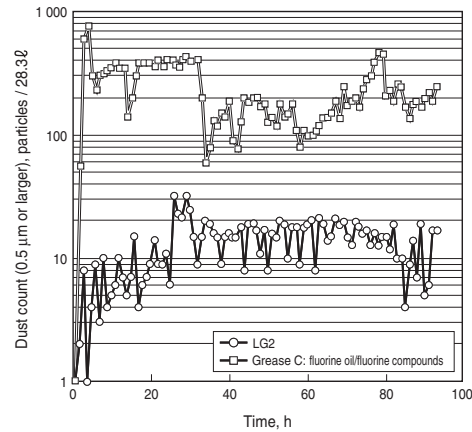


Fig. 4.5 Dust emission from linear guide (Linear guide: LU09)

● Feature 2: Long life

Life is ten times or longer than fluorine greases, and equivalent to ordinary greases. This stretches maintenance intervals.

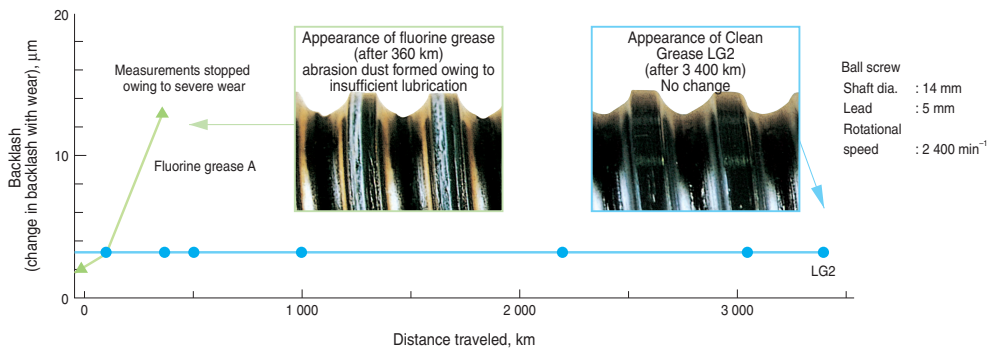


Fig. 4.6 Results of ball screw durability test

● Feature 3: Excellent rust prevention capacity

The rust prevention capacity is significantly higher than fluoride greases. Handling and preparation for operation are easy.

Ball screw rust prevention test (test conditions: 96 hr at humidity 95%, temperature 70°C)

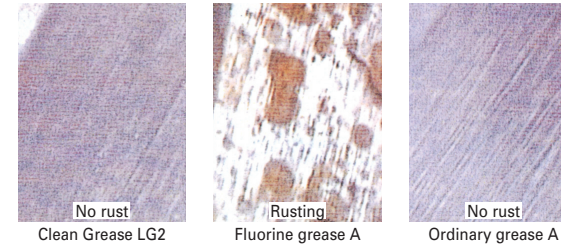


Photo 4.2

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.

● 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

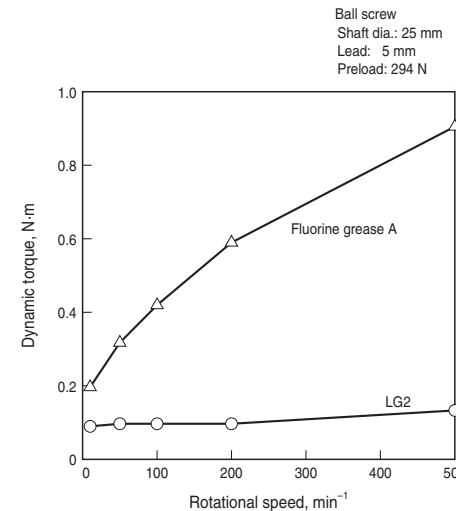


Fig. 4.7 Comparison of torque characteristics

3. Environment with foreign matters

● NSK Linear Guides Dust-resistant VH model

High-performance end seals with a multi-lip structure prevent the entry of various kinds of foreign matter. The VH model is equipped with the NSK K1-L™ lubrication unit as standard. The outstanding lubrication support provided by NSK K1-L units further improves resistance to dust and durability. For NSK Linear Guides dust-resistant VH model, refer to page A127. For NSK Linear Guides dust-resistant DV model, refer to page A203.

1.5 Comptability With Special Environments

1. Linear guides

Model	Model No.	Special environment which linear guide can tolerate					
		Cleanroom	Vacuum	Corrosive	High-temperature	Hygienic	Dust-contaminated
NH	NH15	○		○			
	NH20	○		○			
	NH25	○	○	○			
	NH30	○	○	○			
	NH35	○		○			
	NH45	○		○			
VH	NH55	○		○			
	NH65	○		○			
	VH15	○		○			○
	VH20	○		○			○
	VH25	○		○			○
	VH30	○		○			○
NS	VH35	○		○			○
	VH45	○		○			○
	VH55	○		○			○
	VH65	○		○			○
	NS15	○	○	○			
	NS20	○	○	○			
LW	NS25	○	○	○			
	NS30	○	○	○*			
	NS35	○	○	○			
	LW17	○		○*			
	LW21	○		○*			
	LW27	○		○			
DH	LW35	○		○			
	LW50	○		○			
	DH15	○		○			
	DH20	○		○			
	DH25	○		○			
	DH30	○		○			
DV	DH35	○		○			
	DH45	○		○			
	DH55	○		○			
	DH65	○		○			
	DV15	○		○			○
	DV20	○		○			○
DS	DV25	○		○			○
	DV30	○		○			○
	DV35	○		○			○
	DV45	○		○			○
	DV55	○		○			○
	DS15	○		○			○
HA	DS20	○		○			○
	DS25	○		○			○
	DS30	○		○			○
	DS35	○		○			○

*) Dust-resistant parts for these models are not compatible with high temperatures.

And For lubrication unit NSK K1-L, refer to the catalog "NSK Linear Guides™ NSK K1-L Lubrication Unit" (CAT No.E3335).

● RA model: Specification with highly dust-resistant V1 seals

RA25, RA30, RA35, RA45, RA55, and RA65 have specifications featuring dust-resistant V1 end seals with enhanced abrasion resistance. Refer to the catalog "NSK Linear Guides Roller Guide with highly dust-resistant V1 seals and V1 bottom seals" (CAT No.E3334).

Model	Model No.	Special environment which linear guide can tolerate					
		Cleanroom	Vacuum	Corrosive	High-temperature	Hygienic	Dust-contaminated
PU	PU09	○		○			○
	PU12	○		○			○
	PU15	○		○			○
LU	LU05	○		○			○
	LU07	○		○			○
	LU09_L	○	○	○	○	○	○
	LU09_R	○	○	○	○	○	○
	LU12_L	○	○	○	○	○	○
	LU12_R	○	○	○	○*	○	○
PE	LU15	○	○	○	○*	○	○
	PE09	○		○			○
	PE12	○		○			○
	PE15	○		○			○
	LE05	○		○			○
	LE07	○		○	○*		○
LE	LE09_L	○	○	○	○*	○	○
	LE09_R	○	○	○	○*	○	○
	LE12_L	○	○	○	○	○	○
	LE12_R	○	○	○	○	○	○
	LE15_L	○	○	○	○	○	○
	LE15AR	○		○			○
RA	LH08	○		○			○
	LH10	○		○			○
	LH12	○	○	○	○*	○	○
	RA15	○		○			○
	RA20	○		○			○
	RA25	○		○			○
RB	RA30	○		○			○
	RA35	○		○			○
	RA45	○		○			○
	RA55	○		○			○
	RA65	○		○			○
	RB30	○		○			○
LA	RB35	○		○			○
	RB45	○		○			○
	RB55	○		○			○
	RB65	○		○			○
	LA25	○		○			○
	LA30	○		○			○
HA	LA35	○		○			○
	LA45	○		○			○
	LA55	○		○			○
	LA65	○		○			○
	HA25	○		○			○
	HA30	○		○			○
HS	HA35	○		○			○
	HA45	○		○			○
	HA55	○		○			○
	HS15	○		○			○
	HS20	○		○			○
	HS25	○		○			○
HS	HS30	○		○			○
	HS35	○		○			○

2. Ball screws

Model	Special environment				
	Clean	Vacuum	Rust prevention	High temp.	Foreign matter
KA Model	○	○	○		
For Contaminated environments VSS Type					○
Made-to-order ball screw	○*	○*	○*	○*	○*

*Available for made-to-order ball screws.

Please consult NSK.

3. Monocarriers

Please consult with NSK for special environmental use.

1.6 Precautions for Handling

Please observe the following precautions to maintain ball screw and linear guide performance in special environments over a long period.

- Products are washed to remove oil, and wrapped in a way to protect them from moisture. Use the product as soon as possible after opening the package.
- After opening, store the ball slide (interchangeable linear guide) and ball nut (R model ball screw) in a clean, air-tight container such as desiccater with desiccating agent (e.g. silica gel). Do not apply rust preventive oil or paper or product that vaporizes rust preventive agents.
- Wear plastic gloves and handle products in clean place.

2. Lubrication

There are two types of lubricating methods -- grease and oil -- for NSK linear products.

Use a lubricant agent and method most suitable to condition requirements and purpose to optimize the functions of the ball screw, linear guide, or Monocarrier. Note that Monocarriers typically use grease.

In general, lubricants with low base oil kinematic viscosity are used for high-speed operation, in which thermal expansion has a large impact, and in low temperatures.

Lubrication with high base oil kinematic viscosity is used for oscillating operations, low speeds, and high temperatures.

The following provides more details on grease and oil lubrication methods.

2.1 Grease Lubrication

Grease lubrication is widely used because it does not require a special oil supply system or piping. Grease lubricants made by NSK include:

- Various types of grease in bellows tubes that can be instantly attached to a grease pump;
- NSK Grease Units that consist of a hand grease pump and various nozzles. They are compact and easy to use.

1. NSK grease lubricants

Table 1.1 shows the marketed general grease widely used for linear guides, ball screws and monocarrier for specific uses, conditions and purposes.

Table 1.1 Grease lubricant for linear guides, ball screws, and monocarriers

Type	Thickener	Base oil	Base oil kinematic viscosity mm ² /s (40°C)	Range of use temperature (°C)	Purpose
AS2	Lithium	Mineral oil	130	-10 to 110	For general use at high load
PS2	Lithium	Synthetic oil + synthetic hydrocarbon oil	15.9	-50 to 110	For low temperature and high frequency operation
LR3	Lithium	Synthetic oil	30	-30 to 130	For high speed, medium load
LG2	Lithium	Mineral oil + synthetic hydrocarbon oil	32	-20 to 70	For cleanroom environments
LGU	Diurea	Synthetic hydrocarbon oil	95.8	-30 to 120	For cleanroom environments
NF2	Urea	Synthetic hydrocarbon oil	26	-40 to 100	For fretting resistance

(1) NSK Grease AS2

• Features

An environmentally friendly and widely used grease for high load applications. AS2 is a mineral oil based grease containing lithium thickener and several additives. It is superb in load resistance as well as stable against oxidization. It not only maintains good lubrication over a long period of time, but also demonstrates superb capability in retaining water. Even containing a large amount of water, AS2 resists softening and grease loss.

• Application

AS2 is a standard grease for general NSK linear guides, ball screws and monocarriers. It is prevalently used in many applications because of its high base oil viscosity, high load resistance, and stability against oxidization.

(2) NSK Grease LR3

• Features

LR3 contains a special synthetic oil for high temperatures and stability, and a carefully selected anti-oxidation agent. This grease dramatically increases lubrication life under high temperature conditions. It is used for high speed and medium loads. Lubrication life exceeded 2 000 hours in the endurance test at 150°C. Its rust prevention capacity in severe conditions such as water and moist environments is further strengthened.

• Application

LR3 is a standard grease for PSS model (shaft dia. 15 mm or over), FSS model, FA model (except shaft dia. 10 mm with lead of 4 mm and shaft dia. 12 mm with lead of 5 mm) and VFA model ball screws. It is ideal for operation with medium load at high speeds such as positioning in high tact material handling

(3) NSK Grease PS2

• Features

The major base oil component is synthetic oil with mineral oil. PS2 is excellent for low-temperature operation and suits high-speed and light-load applications.

• Application

PS2 is a standard grease for NSK miniature linear guides and ball screws. It is especially superb for low temperature operation, but also functions well in normal temperatures, making it ideal for small equipment with light load.

• Nature

Thickener	Lithium soap base
Base oil	Mineral oil
Consistency	275
Dropping point	181°C
Volume of evaporation	0.24% (99°C, 22 hr)
Copper plate corrosion test	Satisfactory (Method B, 100°C, 24 hr)
Oil separation	2.8% (100°C, 24 hr)
Base oil kinematic viscosity	130 mm ² /s (40°C)

equipment.

• Nature

Thickener	Lithium soap base
Base oil	Synthetic oil
Consistency	228
Dropping point	208°C
Volume of evaporation	0.58% (99°C, 22 hr)
Copper plate corrosion test	Satisfactory (Method B, 100°C, 24 hr)
Oil separation	1.9% (100°C, 24 hr)
Base oil kinematic viscosity	30 mm ² /s (40°C)

• Nature

Thickener	Lithium soap base
Base oil	Synthetic oil + Synthetic hydrocarbon oil
Consistency	275
Dropping point	190°C
Volume of evaporation	0.60% (99°C, 22 hr)
Copper plate corrosion test	Satisfactory (Method B, 100°C, 24 hr)
Oil separation	3.6% (100°C, 24 hr)
Base oil kinematic viscosity	15.9 mm ² /s (40°C)

(4) NSK Grease LG2

• Features

This grease was developed by NSK to be exclusively used for linear guides, ball screws, and Monocarriers in cleanrooms. Compared to fluorine grease which are commonly used in cleanrooms, LG2 has several advantages such as:

- Higher lubrication function
- Longer lubrication life
- More stable torque (resistant to wear)
- Higher rust prevention.

In dust generation, LG2 is more than equal to fluorine grease in keeping dust volume low. Since the base oil is not a special oil but a mineral oil, LG2 can be handled in the same manner as general greases.

• Application

LG2 is a lubrication grease for rolling element products such as linear guides, ball screws, and Monocarriers for semiconductor and flat panel display (FPD) processing equipment which require a highly clean environment. Because LG2 is exclusively for cleanroom environments at normal temperatures, however, it cannot be used in a vacuum environment. Refer to "Special environment" on page D8 for detailed data on the superb characteristics of NSK Grease LG2.

• Nature

Thickener	Lithium soap base
Base oil	Mineral oil + Synthetic hydrocarbon oil
Consistency	199
Dropping point	201°C
Volume of evaporation	1.40% (99°C, 22 hr)
Copper plate corrosion test	Satisfactory (Method B, 100°C, 24 hr)
Oil separation	0.8% (100°C, 24 hr)
Base oil kinematic viscosity	32 mm ² /s (40°C)

(5) NSK Grease LGU

• Features

This is a proprietary urea base grease of NSK featuring low dust emissions exclusively for linear guides, ball screws, and Monocarriers used in cleanrooms.

In comparison with fluorine base grease, which has

been used commonly in cleanrooms, LGU has better lubricating properties, longer duration of lubricant, better torque variation, much better anti-rust properties, and equivalent or better dust emissions. In addition, this grease can be handled in the same way as the other common grease because high-grade synthetic oil is used as the base oil.

LGU grease contains much fewer metallic elements compared to LG2 grease. It can be used in high temperature environments.

• Application

This is exclusive lubrication grease for linear guides, ball screws, and Monocarriers installed in equipment that requires cleanliness like LG2 grease, and it can be used in temperatures -30 to 120°C.

This grease cannot be used in vacuum.

• Nature

Thickener	Diurea
Base oil	Synthetic hydrocarbon oil
Consistency	201
Dropping point	260°C
Volume of evaporation	0.09% (99°C, 22 hr)
Copper plate corrosion test	Satisfactory (Method B, 100°C, 24 hr)
Oil separation	0.6% (100°C, 24 hr)
Base oil kinematic viscosity	95.8 mm ² /s (40°C)

(6) NSK Grease NF2

• Features

NF2 uses high-grade synthetic oil as the base oil and urea base organic compound as the thickener. It has remarkable anti-fretting properties. It can be used in a wide temperature range and has superior lubrication life.

• Application

This grease is suitable for ball screws and linear guides applications with oscillating operations. Allowable temperature range is -40 to 100°C.

• Nature

Thickener	Diurea
Base oil	Synthetic hydrocarbon oil
Consistency	288
Dropping point	260°C
Volume of evaporation	0.22% (99°C, 22 hr)
Copper plate corrosion test	Satisfactory (Method B, 100°C, 24 hr)
Oil separation	0.5% (100°C, 24 hr)
Base oil kinematic viscosity	26 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 cleanroom environments at normal temperatures.

Note) Refer to NSK Grease Unit Catalog (CAT. No.3317) for details of NSK Grease.

2. Before use of NSK Precision Products

Wipe off the rust preventive oil before use.

If grease is not applied, apply grease, and move ball slide or ball nut a few strokes so the grease permeates into the ball slide and inside the nut. (Move the ball slide or the ball nut 5 to 10 times with full stroke.)

Then wipe off the excess grease.

3. How to replenish grease and volume of grease to be replenished

Use a grease fitting if an exclusive grease supply component is not used. Supply the required amount through grease fitting by a grease pump.

Wipe off old grease and accumulated dust before supplying new grease. If grease fitting is not used or there is no oil filler due to size limitations, apply grease directly to the rail or to the ball groove of the screw shaft. Remove the seal if possible, move a ball slide or ball nut a few strokes so that the grease permeates into the ball slide, nut and inside the slide. Once grease is replenished, another supply is not required for a long time. But under some operational conditions, it is necessary to periodically replenish grease. The following are replenishing methods.

* When replenishing using a grease pump:

Use a grease pump and fill the inside of ball slide, ball nut and monocarrier slider with grease. Supply grease until it comes out from the ball slide, ball nut or monocarrier slider area. Move ball slide, ball nut or monocarrier slider by hand while filling them with grease, so the grease permeates all areas. Do not operate the machine immediately after replenishing. Always try the system a few times to spread the grease throughout the system and to remove excess grease. Trial operations are necessary because the resistance to sliding force and screw torque greatly increases immediately after replenishment (full-pack state) and may cause problems. The agitating resistance of grease is responsible for this phenomenon. Wipe off excess grease that accumulates at end of rail and screw shaft after trial runs so the grease does not move to other areas.

* When there is an exclusive grease supply system and the volume from the spout can be controlled, the criterion is:

- All at once, replenish the amount that fills about 50% of the internal space of the ball slide or the internal space of the ball nut. This method eliminates waste of grease and is efficient.

Tables 1.2, 1.3 and 1.4 show internal spaces of ball slide, ball nut and monocarrier slider for reference.

Table 1.2 Internal space of the slide of linear guide

NH, DH Models Unit: cm³

Model No.	NH, DH	
	High-load type	Super-high-load type
15	3	4
20	6	8
25	9	13
30	13	20
35	22	30
45	47	59
55	80	100
65	139	186

PU, LU Models Unit: cm³

Model No.	PU		LU	
	Standard type	High-load type	Standard type	High-load type
05	-	-	0.1	-
07	-	-	0.1	-
09	0.2	0.3	0.2	0.3
12	0.3	0.4	0.3	0.4
15	0.8	1.1	0.8	1.1

VH, DV Models Unit: cm³

Model No.	VH, DV	
	High-load type	Super-high-load type
15	3	4
20	6	8
25	9	13
30	13	20
35	22	30
45	47	59
55	80	100

PE, LE Models Unit: cm³

Model No.	PE		LE		
	Standard type	High-load type	Medium-load type	Standard type	High-load type
05	-	-	0.1	0.1	-
07	-	-	0.1	0.2	0.3
09	0.4	0.5	0.2	0.4	0.5
12	0.5	0.7	0.3	0.5	0.7
15	1.2	1.6	0.8	1.2	1.6

NS, DS Models Unit: cm³

Model No.	NS, DS	
	Medium-load type	High-load type
15	2	3
20	3	4
25	5	8
30	8	12
35	12	19

Miniature LH Model Unit: cm³

Model No.	LH
08	0.2
10	0.4
12	1.2

LW Model Unit: cm³

Model No.	LW
17	3
21	3
27	7
35	24
50	52

RA Model Unit: cm³

Model No.	RA	
	High-load type	Super-high-load type
15	1	1.5
20	2	2.5
25	3	3.5
30	5	6
35	6	8
45	10	13
55	15	20
65	33	42

RB Model Unit: cm³

Model No.	RB	
	High-load type	Super-high-load type
30	5	6
35	6	8
45	10	13
55	15	20
65	33	42

LA Model Unit: cm³

Model No.	LA	
	High-load type	Super-high-load type
25	8	12
30	14	18
35	21	29
45	38	48
55	68	86
65	130	177

HA, HS Models Unit: cm³

Model No.	HA	HS
15	-	5
20	-	9
25	16	16
30	27	25
35	42	40
45	67	-
55	122	-

Table 1.3 Inside space of ball nut
Tube recirculation (single nut)

Unit: cm ³		Unit: cm ³		Unit: cm ³		Unit: cm ³	
Nut model	Inside space	Nut model	Inside space	Nut model	Inside space	Nut model	Inside space
1004 - 2.5	0.8	2004 - 5	2.7	2520 - 2.5	12	3225 - 2.5	17
1205 - 2.5	1.2	2005 - 5	4.3	2525 - 1.5	7.5	3232 - 1.5	15
1210 - 2.5	1.4	2010 - 2.5	4.7	2805 - 5	6	3610 - 5	32
1405 - 2.5	2.2	2020 - 1.5	4.2	2805 - 10	9	4005 - 10	14
1408 - 2.5	2.1	2504 - 5	3.2	2806 - 5	6	4010 - 5	30
1510 - 2.5	2.3	2505 - 5	5	2806 - 10	9.5	4012 - 5	34
1605 - 2.5	2.6	2506 - 5	7	3205 - 5	7	4510 - 5	34
1616 - 1.5	2.1	2510 - 3	9.5	3206 - 5	9.5	5010 - 5	37
				3210 - 5	22	5010 - 10	59

Deflector (bridge) recirculation (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 recirculation Unit: cm³

Nut model	Inside space
1520 - 1.5	1.9
1632 - 1	2
2040 - 1	2.8
2550 - 1	4.2

Note:
Nut model: shaft diameter, lead, total ball turns
Please consult NSK for other specifications.
Refer to B110 to B146 for Compact FA Model.

Table 1.4 Monocarrier slide internal space

MCM Model			MCH Model					
Model No.	Unit: cm ³		Model No.	Unit: cm ³		Model No.	Unit: cm ³	
	Lead (mm)	Internal Space		Lead (mm)	Internal Space		Lead (mm)	Internal Space
MCM02	1	0.3	MCM06	5	8.3	MCH06	5	2.8
	2	0.3		10	6.5		MCL06	10
MCM03	1	1		20	5.5	MCH09	20	2.7
	2	0.9	5	11.6	5		5.8	
	10	1.8	10	9.8	10	5.8		
	12	1.7	20	8.7	20	5.6		
MCM05	5	4.2	MCM08	30	4.3	MCH10	10	10.9
	10	4		10	19.4		20	10.1
	20	2.1	20	17.4				
	30	2.0	30	8.8				

4. Intervals of checks and replenishments

Even high-quality grease gradually deteriorates and loses its lubricating functionality. Additionally, grease in the slide and ball nut is gradually removed by stroke movement. In some environments, the grease may become dirty and foreign matter may enter the

slide and the ball nut. New grease should be supplied depending on the frequency of use. The following is a guide of intervals of grease replenishment for linear guides and ball screws.

Table 1.5 Intervals of checks and replenishments for grease lubrication

Intervals of checks	Items to check	Intervals of replenishments
3-6 months	Dirt, foreign matters such as cutting chips	Usually once per year. Every 3 000 km for material handling system that travels more than 3 000 km per year. Replenish if check results warrant it necessary.

- Notes: 1) As a general rule, do not mix greases of different brands.
2) Grease viscosity varies by temperature. Viscosity is particularly high in winter due to low temperatures. Pay attention to increases in linear guide and monocarrier sliding resistance and ball screw and monocarrier torque in such conditions.
3) When the ambient temperature is low, or in Winter, if it is difficult to pump out the grease from the container, wait until the grease is softened.
4) In locations where coolant is dispersed or scattered, the emulsification of lubricants and rinsing with water may significantly deteriorate the integrity of the lubricant and efficiency of the grease. Protect the grease unit from coolant by shielding it with a cover, etc.

5. NSK Grease Unit

Easily supply grease to NSK linear products with this manual grease pump by simply attaching a bellows

tube filled with grease. We offer several types of grease (80 g) to suit your needs.



Grease in bellows tube



(1) Composition of NSK Grease Unit

Components and grease types are shown below.

NSK Grease Unit		Name	(Tube color)	Reference number
NSK Grease (80 g in a bellows tube)	NSK Grease AS2	NSK Grease AS2	(Brown)	NSK GRS AS2
	NSK Grease PS2	NSK Grease PS2	(Orange)	NSK GRS PS2
	NSK Grease LR3	NSK Grease LR3	(Green)	NSK GRS LR3
	NSK Grease LG2	NSK Grease LG2	(Blue)	NSK GRS LG2
	NSK Grease LGU	NSK Grease LGU	(Yellow)	NSK GRS LGU
	NSK Grease NF2	NSK Grease NF2	(Gray)	NSK GRS NF2
NSK Hand Grease Pump Unit				
	NSK Hand Grease Pump (Straight nozzle NSK HGP NZ1 -- One nozzle is provided with hand pump.)			NSK HGP
Grease nozzle (used with hand grease pump)				
	NSK straight nozzle			NSK HGP NZ1
	NSK chuck nozzle			NSK HGP NZ2
	NSK drive-in fitting nozzle			NSK HGP NZ3
	NSK point nozzle			NSK HGP NZ4
	NSK flexible nozzle			NSK HGP NZ5
	NSK flexible extension pipe			NSK HGP NZ6
	NSK straight extension pipe			NSK HGP NZ7
	NSK nozzle for MCH			NSK HGP NZ8

(2) NSK Grease (80 g in bellows tube)

Refer to pages D14 and D15 for characteristics and other details.

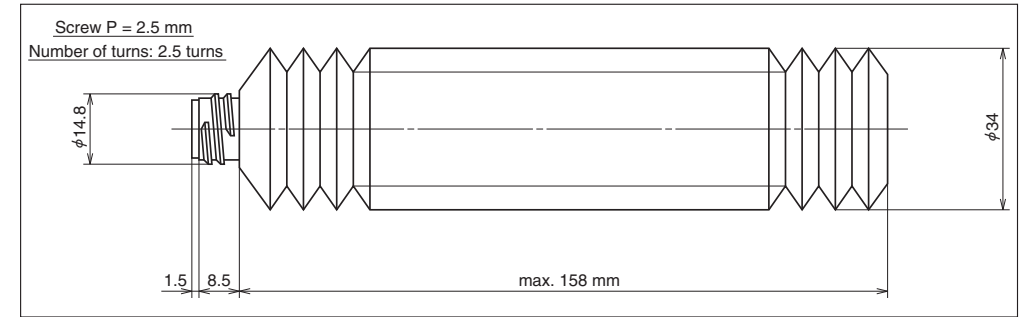


Fig. 1.1 Bellows tube

(3) NSK Manual Grease Pump Unit

a) NSK Hand Grease Pump (Reference number: NSK HGP)

● Features

- Light-weight Can be operated by one hand, no worry to make a mistake.
- Inserting by high pressure..... Insert at 15 Mpa.
- No leaking Does not leak when held upside down.
- Easy to change grease..... Simply attach grease in bellows tube.
- Remaining grease Can be confirmed through slit on tube.
- Several nozzles Six types of nozzles to choose from.

● Specifications

- Discharge pressure .. 15 Mpa
- Spout volume 0.35 cc/shot
- Mass of main body ... Without nozzle 240 g
Provided nozzle 90 g
- Grease tube outer diameter φ 38.1
- Accessory..... Several nozzles for unique applications can be attached

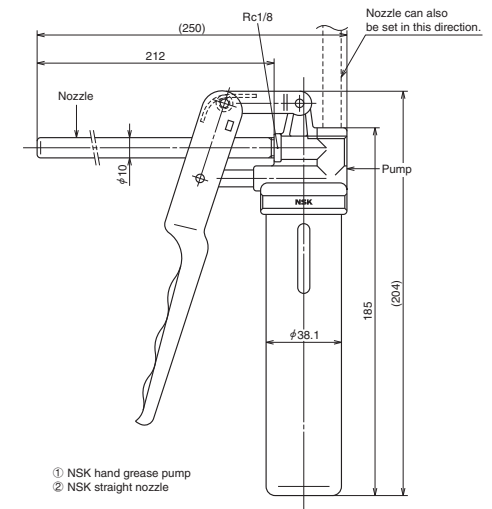


Fig. 1.2 NSK Hand Grease Pump with NSK straight nozzle

*Unopened bellows tubes contain a small amount of air that may take several dozen pumps to flush out. Be sure to pump out all air from the bellows tube before use.

b) Nozzles

Table 1.6 Nozzles that can be attached to NSK Hand Grease Pumps

Name	Designation code	Use	Dimensions
NSK straight nozzle	NSK HGP NZ1	Application Used with grease fittings A, B, and C under the JIS B1575 standard.	
NSK chuck nozzle	NSK HGP NZ2	Same as above except the nozzle and fitting are coupled by a chucking mechanism at the tip that makes pressing the pump unnecessary.	
NSK drive-in fitting nozzle	NSK HGP NZ3	Exclusively used with the φ3 drive-in grease fitting.	
NSK point nozzle	NSK HGP NZ4	Used for linear guides that do not have a grease fitting. Supplies grease directly to the ball grooves or to the inside through an opening in the slide.	
NSK flexible nozzle	NSK HGP NZ5	Features a flexible chuck nozzle. Used where straight nozzles can't be used.	
NSK flexible extension pipe	NSK HGP NZ6	Used for longer reach. A flexible extension pipe connects the grease pump and nozzle.	
NSK straight extension pipe	NSK HGP NZ7	Used for longer reach. A straight extension pipe connects the grease pump and nozzle.	
NSK nozzle for MCH	NSK HGP NZ8	For MCH Model grease replenishment	

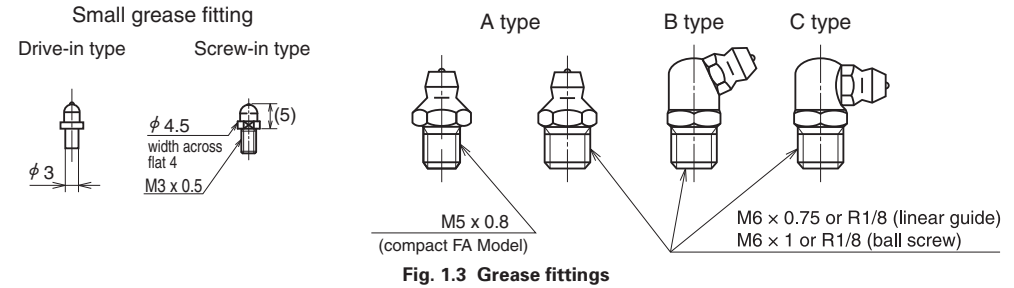


Table 1.7 Grease fittings used for NSK linear guides

Model	Model number	Tap hole for grease fitting	Standard grease fitting	Straight nozzle NZ1	Chuck nozzles NZ2	Drive-in fitting nozzle NZ3	Point nozzle NZ4	Flexible nozzle NZ5
NH	NH15	φ 3	Drive-in type			○		
	NH20, 25, 30, 35*	M6×0.75	B type	○	○			○
	NH45, 55, 65	Rc1/8	B type	○	○			○
VH	VH15	φ 3	Drive-in type			○		
	VH20, 25, 30, 35*	M6×0.75	B type	○	○			○
	VH45, 55	Rc1/8	B type	○	○			○
NS	NS15	φ 3	Drive-in type			○		
	NS20, 25, 30, 35*	M6×0.75	B type	○	○			○
	LW17	φ 3	Drive-in type			○		
LW	LW21, 27, 35*	M6×0.75	B type	○	○			○
	LW50	Rc1/8	B type	○	○			○
	DH	DH15	φ 3	Drive-in type			○	
DH20, 25, 30, 35*		M6×0.75	B type	○	○			○
DH45, 55, 65		Rc1/8	B type	○	○			○
DV	DV15	φ 3	Drive-in type			○		
	DV20, 25, 30, 35*	M6×0.75	B type	○	○			○
	DV45, 55	Rc1/8	B type	○	○			○
DS	DS15	φ 3	Drive-in type			○		
	DS20, 25, 30, 35*	M6×0.75	B type	○	○			○
PU	PU09, 12	-	-				○	
	PU15	φ 3	Drive-in type			○		
LU	LU05, 07, 09, 12, 15	-	-				○	
	PE09, 12	-	-				○	
PE	PE15	φ 3	Drive-in type			○		
	LE	LE05, 07, 09, 12, 15	-	-				○
LH08, 10		-	-				○	
	Miniature LH	LH12	φ 3	Drive-in type			○	
RA		RA15, 20	φ 3	Drive-in type			○	
	RA25, 30, 35*	M6×0.75	B type	○	○			○
	RA45, 55, 65	Rc1/8	B type	○	○			○
RB	RB30	φ 3	Drive-in type			○		
	RB35, 45	M6×0.75	B type	○	○			○
	RB55, 65	Rc1/8	B type	○	○			○
LA	LA25, 30, 35*	M6×0.75	B type	○	○			○
	LA45, 55, 65	Rc1/8	B type	○	○			○
HA	HA25, 30, 35*	M6×0.75	B type	○	○			○
	HA45, 55	Rc1/8	B type	○	○			○
HS	HS15	φ 3	Drive-in type			○		
	HS20, 25, 30, 35*	M6×0.75	B type	○	○			○

*) If using a chuck nozzle, avoid interference with table and rail.

- Note: 1) Use a point nozzle to apply grease directly to the ball groove etc. of PU, LU, PE, LE, and Miniature LH models.
 2) A long threaded grease fitting is required for dust-resistant parts. Please refer to the sections pertaining to the lubrication and dust-resistant parts of each model.

Table 1.8 Applicable grease nozzles for ball screws

Category	Type/Application	Model	Tap hole for grease fitting	Standard grease fitting	Straight nozzle NZ1	Chuck nozzle NZ2	Drive-in fitting nozzle NZ3	Point nozzle NZ4	Flexible nozzle NZ5
Finished shaft end	Compact FA	High-accuracy, clean	USS	M5x0.8	A type	○	○	○	○
		General	PSS		A type	○*1	○*1	○	○*1
		Transfer equipment	FSS		A type	○*1	○*1	○	○*1
	Miniature, fine lead	MA	Shaft dia. 12 or less Shaft dia. 16 or over	–	–	–	–	○	–
	Small equipment	FA	–	M6x1	–	○*2	○*2	○	○*2
	Machine tools	SA	Shaft dia. 36 or less	M6x1	–	○	○	○	○
			Shaft dia. 40 or over	Rc1/8	–	○	○	○	○
	Stainless steel	KA	Shaft dia. 12 or less and lead 2 or less	M3x0.5	–	–	–	○	○
			except above	M6x1	–	○*2	○*2	○	○*2
	Transfer equipment	VFA	Shaft dia. 12 or less	φ 2.7	–	–	–	–	○
Shaft dia. 15 or over			φ 3.5	–	–	–	–	○	
RMA		–	–	–	–	–	○	–	
Blank shaft end	Miniature, fine lead	MS	Shaft dia. 12 or less Shaft dia. 16 or over	–	–	–	–	○	○
	Small equipment	FS	–	M6x1	–	○*2	○*2	○	○*2
	Machine tools	SS	Shaft dia. 36 or less	M6x1	–	○	○	○	○
			Shaft dia. 40 or over	Rc1/8	–	○	○	○	○
	Transfer equipment	HSS	–	M6x1	–	○	○	○	○
		RMS	–	–	–	–	–	○	–
		RNFTL	Shaft dia. 12 or less	M3x0.5	–	–	–	○	○
			Shaft dia. 14 or over	M6x1	–	○	○	○	○
		RNFBL	Shaft dia. 12 or less	M3x0.5	–	–	–	○	○
			Shaft dia. 14 or over	M6x1	–	○	○	○	○
RNCT	–	–	–	–	–	○	○		
RNFCL	Shaft dia. 12 or less	M3x0.5	–	–	–	○	○		
	Shaft dia. 15 or over	M6x1	–	○	○	○	○		
RNSTL	–	M6x1	–	○	○	○	○		

*1 Unavailable for shaft dia. 25 mm *2 Installation of nozzle may not be possible with A-type grease fitting.
 Notes: 1) NSK ball screws are not normally equipped with grease fittings excluding the Compact FA model. Tap holes are provided for users to install grease fittings as necessary.
 2) Small (screw-in) fittings are available for M3 x 0.5 tap holes. Please contact NSK.
 3) VFA models do not support grease fittings. Apply grease directly inside the nut through the oil hole using a point nozzle.
 4) MA, RMA, MS, RMS, and RNCT models have no tap hole, apply grease directly to the screw shaft and ball grooves using a point nozzle.

Table 1.9 Applicable grease nozzles for Monocarriers

Model	Model No.	Tap hole for grease fitting	Standard grease fitting	Straight nozzle NZ1	Chuck nozzles NZ2	Drive-in fitting nozzle NZ3	Flexible nozzle NZ5	MCH-exclusive fitting nozzle NZ8
MCM	MCM02	–	–	–	–	–	–	–
	MCM03,05,08,10	φ 3	Drive-in type	–	–	○	–	○*
	MCM06	M6x0.75	A type	○	○	–	○	–
MCH	MCH06,09,10	φ 3	Drive-in type	–	–	–	–	○

*) Use of NZ3 is recommended.

2.2 Oil Lubrication

Required amount of new oil is regularly supplied by:
 • Manual or automatic intermittent supply system;
 • Oil mist lubricating system via piping.

Equipment for oil lubrication is more costly than grease lubrication. However, oil mist lubricating system supplies air as well as oil, raising the inner pressure of the ball slide. This prevents foreign matters from entering, and the air cools the system. Use an oil of high atomizing rate such as ISO VG 32 to 68 for the oil mist lubrication system. ISO VG 68 to 220 are recommended for common intermittent replenishment system. Approximate volume of oil Q for a ball slide of linear guide per hour can be obtained by the following formula.

For ball-type linear guides excluding the LA model:

$$Q \geq n/150 \text{ (cm}^3\text{/hr)}$$

For LA, RA, and RB models:

$$Q \geq n/100 \text{ (cm}^3\text{/hr)}$$

n: Linear guide code

e.g. When NH45 is used,

$$n = 45$$

Therefore,

$$Q = 45/150 = 0.3 \text{ cm}^3\text{/hr}$$

Similarly, approximate oil supply volume Q to ball screw can be obtained by the following formula.

$$Q = d/15 \text{ (cm}^3\text{/hr)}$$

d: Nominal shaft diameter of the ball screw

e.g. When the shaft diameter is 50,

$$d = 50$$

Therefore,

$$Q = 50/15 = 3.3 \text{ cm}^3\text{/hr}$$

For oil lubrication by gravity drip, the oil supply position and installation position of the ball slide or ball nut are crucial. In case of linear guide, unless it is installed to a horizontal position, the oil flows only on the down side, and does not spread to all raceway surface. This may cause insufficient lubrication. For ball screw lubrication as well, oil does not spread if the oil orifice is installed at the bottom, causing insufficient lubrication. Please consult NSK to correct such situations prior to use. NSK has internal design which allows oil lubricant to flow throughout the system. **Table 2.1** shows the criterion of intervals of oil checks and replenishments.

Table 2.1 Intervals of checks and replenishments

Method	Intervals of checks	Items to check	Replenishment or intervals of changes
Automatic intermittent supply	Weekly	Volume of oil, dirt, etc.	Replenish at each check. Suitable volume for tank capacity.
Oil bath	Daily before operation	Oil surface	Make a suitable criterion based on consumption

Notes: 1) As with grease lubrication, do not mix oil lubricant with different types.

2) Some components of the linear guide and ball screw are made of plastic. Avoid using an oil that adversely affects synthetic resin.

3) When using oil mist lubricating systems, please confirm oil supply amounts at each outlet part.

3. RoHS Compliance

Please contact NSK for country-specific details on RoHS compliance.

APPENDICES



Appendices

1. Conversion from International System of Units (SI) E1
2. N-kgf Force conversion table E3
3. kg-lb Mass conversion table E4
4. Hardness conversion table .. E5
5. Tolernce for shaft diameters E7
6. Tolerance for housing bore diameters E9

1. Conversion from International System of Units (SI)

Comparison of SI, CGS, and engineering system units

Items System of units	Length		Mass	Time	Temperature	Acceleration	Force	Stress	Pressure	Energy	Power
	SI	m	kg	s	K, °C	m/s ²	N	Pa	Pa	J	W
CGS system	cm	g	s	°C		Gal	dyn	dyn/cm ²	dyn/cm ²	erg	erg/s
Engineering system	m	kgf • s ² /m	s	°C		m/s ²	kgf	kgf/m ²	kgf/m ²	kgf • m	kgf • m/s

Conversion factors from SI units

Item	SI unit		Units other than SI units		Conversion factor from SI unit
	Name of unit	Abbreviation	Name of unit	Abbreviation	
Angle	Radian	rad	Degree	°	180/π
			Minute	'	10 800/π
			Second	"	648 000/π
Length	Meter	m	Micron	μ	10 ⁶
			Angstrom	Å	10 ¹⁰
Area	Square meter	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
Rotational speed	Times per second	s ⁻¹	Times per minute	rpm	60
Velocity	Meter per second	m/s	Kilometer per hour	km/h	3 600/1 000
			Knot	kn	3 600/1 852
Acceleration	Meter per square second	m/s ²	Gal	Gal	10 ²
			G	G	1/9.806 65
Mass	Kilogram	kg	Ton	t	10 ⁻³
Force	Newton	N	Weight kilogram	kgf	1/9.806 65
			Weight ton	tf	1/(9.806 65×10 ³)
			Dyne	dyn	10 ⁵
Torque and moment of force	Newton meter	N • m	Weight kilogram meter	kgf • m	1/9.806 65
Stress	Pascal (Newtons per square meter)	Pa (N/m ²)	Weight kilogram per square centimeter	kgf/cm ²	1/(9.806 65×10 ⁴)
			Weight kilogram per square millimeter	kgf/mm ²	1/(9.806 65×10 ⁶)

Prefixes for SI units

Powers of 10	Prefix Name	Code	Powers of 10	Prefix Name	Code
10 ¹⁸	exa	E	10 ⁻¹	deci	d
10 ¹⁵	peta	P	10 ⁻²	centi	c
10 ¹²	tera	T	10 ⁻³	milli	m
10 ⁹	giga	G	10 ⁻⁶	micro	μ
10 ⁶	mega	M	10 ⁻⁹	nano	n
10 ³	kilo	k	10 ⁻¹²	pico	p
10 ²	hecto	h	10 ⁻¹⁵	femto	f
10 ¹	deca	da	10 ⁻¹⁸	atto	a

Conversion factors from SI units (continued from previous page)

Item	SI unit		Units other than SI units		Conversion factor from SI unit
	Name of unit	Abbreviation	Name of unit	Abbreviation	
Pressure	Pascal (newton per square meter)	Pa (N/m ²)	Weight kilogram per square meter	kgf/m ²	1/9.806 65
			Water column meter	mH ₂ O	1/(9.806 65×10 ³)
			Mercurial column millimeter	mmHg	760/(1.013 25×10 ⁵)
			Torr	Torr	760/(1.013 25×10 ⁵)
			Bar	bar	10 ⁻⁵
Energy	Joule (newton meter)	J (N • m)	Erg	erg	10 ⁷
			Calorie (international)	cal _{IT}	1/4.186 8
			Weight kilogram meter	kgf • m	1/9.806 65
			Kilowatt hour	kW • h	1/(3.6×10 ⁶)
			Metric horsepower/hour	PS • h	≈3.776 72×10 ⁻⁷
Electric power, power	Watt (joules per second)	W (J/s)	Weight kilogram meter per second	kgf • m/s	1/9.806 65
			Kilo calorie per hour	kcal/h	1/1.163
			Metric horsepower	PS	≈1/735.498 8
Viscosity, Viscosity index	Pascal second	Pa • s	Poise	P	10
Kinematic viscosity, Kinematic viscosity index	Square meter per second	m ² /s	Stokes	St	10 ⁴
			Centistokes	cSt	10 ⁶
Temperature, Difference in temperature	Kelvin, Celsius degrees	K, °C	Degree	°C	[See Note (1)]
Electrical current, magnetomotive force	Ampere	A	Ampere	A	1
Electrical power, electromotive force	Volt	V	(Watt per ampere)	(W/A)	1
Magnetic field intensity	Ampere per meter	A/m	Oersted	Oe	4π/10 ³
Magnetic flux density	Tesla	T	Gauss	Gs	10 ⁴
			Gamma	γ	10 ⁹
Electrical resistance	Ohm	Ω	(Volt per ampere)	(V/A)	1

Note (1) Conversion from *TK* to θ °C is : $\theta = T - 273.15$. To indicate temperature difference: $\Delta T = \Delta\theta$. 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. N-kgf Force conversion table

[Using this table]

To convert between units, find the figure in the shaded column that corresponds to the number in the unit you wish to convert. Then, look to the appropriate column on the right or left in the same row for the converted value, For example, from this table:

10 N = 1.0197 kgf, while 10 kgf = 98.066 N.

$$1 \text{ N} = 0.1019716 \text{ kgf}$$

$$1 \text{ kgf} = 9.80665 \text{ N}$$

N to kgf			kgf to N		
N		kgf	N		kgf
9.8066	1	0.1020	333.43	34	3.4670
19.613	2	0.2039	343.23	35	3.5690
29.420	3	0.3059	353.04	36	3.6710
39.227	4	0.4079	362.85	37	3.7729
49.033	5	0.5099	372.65	38	3.8749
58.840	6	0.6118	382.46	39	3.9769
68.647	7	0.7138	392.27	40	4.0789
78.453	8	0.8158	402.07	41	4.1808
88.260	9	0.9177	411.88	42	4.2828
98.066	10	1.0197	421.69	43	4.3848
107.87	11	1.1217	431.49	44	4.4868
117.68	12	1.2237	441.30	45	4.5887
127.49	13	1.3256	451.11	46	4.6907
137.29	14	1.4279	460.91	47	4.7927
147.10	15	1.5296	470.72	48	4.8946
156.91	16	1.6315	480.53	49	4.9966
166.71	17	1.7335	490.33	50	5.0986
176.52	18	1.8355	500.14	51	5.2006
186.33	19	1.9375	509.95	52	5.3025
196.13	20	2.0394	519.75	53	5.4045
205.94	21	2.1414	529.56	54	5.5065
215.75	22	2.2434	539.37	55	5.6084
225.55	23	2.3453	549.17	56	5.7104
235.36	24	2.4473	558.98	57	5.8124
245.17	25	2.5493	568.79	58	5.9144
254.97	26	2.6513	578.59	59	6.0163
264.78	27	2.7532	588.40	60	6.1183
274.59	28	2.8552	598.21	61	6.2203
284.39	29	2.9572	608.01	62	6.3222
294.20	30	3.0591	617.82	63	6.4242
304.01	31	3.1611	627.63	64	6.5262
313.81	32	3.2631	637.43	65	6.6282
323.62	33	3.3651	647.24	66	6.7301
			657.05	67	6.8321
			666.85	68	6.9341
			676.66	69	7.0360
			686.47	70	7.1380
			696.27	71	7.2400
			706.08	72	7.3420
			715.89	73	7.4439
			725.69	74	7.5459
			735.50	75	7.6479
			745.31	76	7.7498
			755.11	77	7.8518
			764.92	78	7.9538
			774.73	79	8.0558
			784.53	80	8.1577
			794.34	81	8.2597
			804.15	82	8.3617
			813.95	83	8.4636
			823.76	84	8.5656
			833.57	85	8.6676
			843.37	86	8.7696
			853.18	87	8.8715
			862.99	88	8.9735
			872.79	89	9.0755
			882.60	90	9.1774
			892.41	91	9.2794
			902.21	92	9.3814
			912.02	93	9.4834
			921.83	94	9.5853
			931.63	95	9.6873
			941.44	96	9.7893
			951.25	97	9.8912
			961.05	98	9.9932
			970.86	99	10.095

3. kg-lb Mass conversion table

[Using this table]

To convert between units, find the figure in the shaded column that corresponds to the number in the unit you wish to convert. Then, look to the appropriate column on the right or left in the same row for the converted value, For example, from this table 10 kg = 22.046 lb, while 10 lb = 4.536 kg.

$$1 \text{ kg} = 2.2046226 \text{ lb}$$

$$1 \text{ lb} = 0.45359237 \text{ kg}$$

kg to lb			lb to kg		
kg		lb	kg		lb
0.454	1	2.205	15.422	34	74.957
0.907	2	4.409	15.876	35	77.162
1.361	3	6.614	16.329	36	79.366
1.814	4	8.818	16.783	37	81.571
2.268	5	11.023	17.237	38	83.776
2.722	6	13.228	17.690	39	85.980
3.175	7	15.432	18.144	40	88.185
3.629	8	17.637	18.597	41	90.390
4.082	9	19.842	19.051	42	92.594
4.536	10	22.046	19.504	43	94.799
4.990	11	24.251	19.958	44	97.003
5.443	12	26.455	20.412	45	99.208
5.897	13	28.660	20.865	46	101.41
6.350	14	30.865	21.319	47	103.62
6.804	15	33.069	21.772	48	105.82
7.257	16	35.274	22.226	49	108.03
7.711	17	37.479	22.680	50	110.23
8.165	18	39.683	23.133	51	112.44
8.618	19	41.888	23.587	52	114.64
9.072	20	44.092	24.040	53	116.84
9.525	21	46.297	24.494	54	119.05
9.979	22	48.502	24.948	55	121.25
10.433	23	50.706	25.401	56	123.46
10.886	24	52.911	25.855	57	125.66
11.340	25	55.116	26.308	58	127.87
11.793	26	57.320	26.762	59	130.07
12.247	27	59.525	27.216	60	132.28
12.701	28	61.729	27.669	61	134.48
13.154	29	63.934	28.123	62	136.69
13.608	30	66.139	28.576	63	138.89
14.061	31	68.343	29.030	64	141.10
14.515	32	70.548	29.484	65	143.30
14.969	33	72.753	29.937	66	145.51
			30.391	67	147.71
			30.844	68	149.91
			31.298	69	152.12
			31.751	70	154.32
			32.205	71	156.53
			32.659	72	158.73
			33.112	73	160.94
			33.566	74	163.14
			34.019	75	165.35
			34.473	76	167.55
			34.927	77	169.76
			35.380	78	171.96
			35.834	79	174.17
			36.287	80	176.37
			36.741	81	178.57
			37.195	82	180.78
			37.648	83	182.98
			38.102	84	185.19
			38.555	85	187.39
			39.009	86	189.60
			39.463	87	191.80
			39.916	88	194.01
			40.370	89	196.21
			40.823	90	198.42
			41.277	91	200.62
			41.730	92	202.83
			42.184	93	205.03
			42.638	94	207.23
			43.091	95	209.44
			43.545	96	211.64
			43.998	97	213.85
			44.452	98	216.05
			44.906	99	218.26

4. Hardness conversion table

Rockwell C Scale hardness (1 471 N)	Vickers hardness	Brinell hardness		Rockwell hardness		Shore hardness
		Standard ball	Tungsten carbide ball	A Scale	B Scale	
				Load 588.4 N Brale indenter	Load 980.7 N Diameter 1.5888 mm {1/16 in} sphere	
68	940	—	—	85.6	—	97
67	900	—	—	85.0	—	95
66	865	—	—	84.5	—	92
65	832	—	739	83.9	—	91
64	800	—	722	83.4	—	88
63	772	—	705	82.8	—	87
62	746	—	688	82.3	—	85
61	720	—	670	81.8	—	83
60	697	—	654	81.2	—	81
59	674	—	634	80.7	—	80
58	653	—	615	80.1	—	78
57	633	—	595	79.6	—	76
56	613	—	577	79.0	—	75
55	595	—	560	78.5	—	74
54	577	—	543	78.0	—	72
53	560	—	525	77.4	—	71
52	544	500	512	76.8	—	69
51	528	487	496	76.3	—	68
50	513	475	481	75.9	—	67
49	498	464	469	75.2	—	66
48	484	451	455	74.7	—	64
47	471	442	443	74.1	—	63
46	458	432	432	73.6	—	62
45	446	421	421	73.1	—	60
44	434	409	409	72.5	—	58
43	423	400	400	72.0	—	57
42	412	390	390	71.5	—	56
41	402	381	381	70.9	—	55
40	392	371	371	70.4	—	54
39	382	362	362	69.9	—	52

Rockwell C Scale hardness (1 471 N)	Vickers hardness	Brinell hardness		Rockwell hardness		Shore hardness
		Standard ball	Tungsten carbide ball	A Scale	B Scale	
				Load 588.4 N Brale indenter	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. Tolerances for Shaft Diameters

Unit: μm

Classification of diameter (mm)		d6	e6	f6	g5	g6	h5	h6	h7	h8	h9	h10	js5	js6
Over	or less													
—	3	-20 -26	-14 -20	-6 -12	-2 -6	-2 -8	0 -4	0 -6	0 -10	0 -14	0 -25	0 -40	± 2	± 3
3	6	-30 -38	-20 -28	-10 -18	-4 -9	-4 -12	0 -5	0 -8	0 -12	0 -18	0 -30	0 -48	± 2.5	± 4
6	10	-40 -49	-25 -34	-13 -22	-5 -11	-5 -14	0 -6	0 -9	0 -15	0 -22	0 -36	0 -58	± 3	± 4.5
10	18	-50 -61	-32 -43	-16 -27	-6 -14	-6 -17	0 -8	0 -11	0 -18	0 -27	0 -43	0 -70	± 4	± 5.5
18	30	-65 -78	-40 -53	-20 -33	-7 -16	-7 -20	0 -9	0 -13	0 -21	0 -33	0 -52	0 -84	± 4.5	± 6.5
30	50	-80 -96	-50 -66	-25 -41	-9 -20	-9 -25	0 -11	0 -16	0 -25	0 -39	0 -62	0 -100	± 5.5	± 8
50	80	-100 -119	-60 -79	-30 -49	-10 -23	-10 -29	0 -13	0 -19	0 -30	0 -46	0 -74	0 -120	± 6.5	± 9.5
80	120	-120 -142	-72 -94	-36 -58	-12 -27	-12 -34	0 -15	0 -22	0 -35	0 -54	0 -87	0 -140	± 7.5	± 11
120	180	-145 -170	-85 -110	-43 -68	-14 -32	-14 -39	0 -18	0 -25	0 -40	0 -63	0 -100	0 -160	± 9	± 12.5
180	250	-170 -199	-100 -129	-50 -79	-15 -35	-15 -44	0 -20	0 -29	0 -46	0 -72	0 -115	0 -185	± 10	± 14.5
250	315	-190 -222	-110 -142	-56 -88	-17 -40	-17 -49	0 -23	0 -32	0 -52	0 -81	0 -130	0 -210	± 11.5	± 16
315	400	-210 -246	-125 -161	-62 -98	-18 -43	-18 -54	0 -25	0 -36	0 -57	0 -89	0 -140	0 -230	± 12.5	± 18
400	500	-230 -270	-135 -175	-68 -108	-20 -47	-20 -60	0 -27	0 -40	0 -63	0 -97	0 -155	0 -250	± 13.5	± 20
500	630	-260 -304	-145 -189	-76 -120	—	-22 -66	—	0 -44	0 -70	0 -110	0 -175	0 -280	—	± 22
630	800	-290 -340	-160 -210	-80 -130	—	-24 -74	—	0 -50	0 -80	0 -125	0 -200	0 -320	—	± 25
800	1 000	-320 -376	-170 -226	-86 -142	—	-26 -82	—	0 -56	0 -90	0 -140	0 -230	0 -360	—	± 28
1 000	1 250	-350 -416	-195 -261	-98 -164	—	-28 -94	—	0 -66	0 -105	0 -165	0 -260	0 -420	—	± 33
1 250	1 600	-390 -468	-220 -298	-110 -188	—	-30 -108	—	0 -78	0 -125	0 -195	0 -310	0 -500	—	± 39
1 600	2 000	-430 -522	-240 -332	-120 -212	—	-32 -124	—	0 -92	0 -150	0 -230	0 -370	0 -600	—	± 46

		j5	j6	j7	k5	k6	k7	m5	m6	n6	p6	r6	r7	Classification of diameter (mm)	
														Over	or less
± 2	+ 4	+ 6	+ 4	+ 6	+ 10	+ 6	+ 8	+ 10	+ 12	+ 16	+ 20	+ 16	+ 20	—	3
+ 3	+ 6	+ 8	0	0	0	+ 2	+ 2	+ 4	+ 6	+ 10	+ 10	+ 10	+ 10	3	6
- 2	- 2	- 4	+ 1	+ 1	+ 1	+ 4	+ 4	+ 8	+ 12	+ 16	+ 20	+ 20	+ 20	6	10
+ 4	+ 7	+ 10	+ 7	+ 10	+ 16	+ 12	+ 15	+ 19	+ 24	+ 28	+ 34	+ 24	+ 28	10	18
- 2	- 2	- 5	+ 1	+ 1	+ 1	+ 6	+ 6	+ 10	+ 15	+ 19	+ 24	+ 15	+ 19	18	30
+ 5	+ 8	+ 12	+ 9	+ 12	+ 19	+ 15	+ 18	+ 23	+ 29	+ 34	+ 41	+ 29	+ 34	30	50
- 3	- 3	- 6	+ 1	+ 1	+ 1	+ 7	+ 7	+ 12	+ 18	+ 23	+ 28	+ 18	+ 23	50	65
+ 5	+ 9	+ 13	+ 11	+ 15	+ 23	+ 17	+ 21	+ 28	+ 35	+ 41	+ 49	+ 35	+ 41	65	80
- 4	- 4	- 8	+ 2	+ 2	+ 2	+ 8	+ 8	+ 15	+ 22	+ 28	+ 34	+ 22	+ 28	80	100
+ 6	+ 11	+ 15	+ 13	+ 18	+ 27	+ 20	+ 25	+ 33	+ 42	+ 50	+ 59	+ 42	+ 50	100	120
- 5	- 5	- 10	+ 2	+ 2	+ 2	+ 9	+ 9	+ 17	+ 26	+ 34	+ 43	+ 26	+ 34	120	140
+ 6	+ 12	+ 18	+ 15	+ 21	+ 32	+ 24	+ 30	+ 39	+ 51	+ 60	+ 71	+ 41	+ 41	140	160
- 7	- 7	- 12	+ 2	+ 2	+ 2	+ 11	+ 11	+ 20	+ 32	+ 41	+ 51	+ 32	+ 41	160	180
+ 6	+ 13	+ 20	+ 18	+ 25	+ 38	+ 28	+ 35	+ 45	+ 59	+ 73	+ 86	+ 51	+ 51	180	200
- 9	- 9	- 15	+ 3	+ 3	+ 3	+ 13	+ 13	+ 23	+ 37	+ 46	+ 56	+ 37	+ 46	200	225
+ 7	+ 14	+ 22	+ 21	+ 28	+ 43	+ 33	+ 40	+ 52	+ 68	+ 86	+ 103	+ 68	+ 86	225	250
- 11	- 11	- 18	+ 3	+ 3	+ 3	+ 15	+ 15	+ 27	+ 43	+ 54	+ 65	+ 43	+ 54	250	280
+ 7	+ 16	+ 25	+ 24	+ 33	+ 50	+ 37	+ 46	+ 60	+ 79	+ 99	+ 126	+ 79	+ 99	280	315
- 13	- 13	- 21	+ 4	+ 4	+ 4	+ 17	+ 17	+ 31	+ 50	+ 62	+ 77	+ 31	+ 50	315	355
+ 7	+ 16	+ 25	+ 27	+ 36	+ 56	+ 43	+ 52	+ 66	+ 88	+ 108	+ 134	+ 66	+ 88	355	400
- 16	± 16	± 26	+ 4	+ 4	+ 4	+ 20	+ 20	+ 34	+ 56	+ 71	+ 88	+ 34	+ 56	400	450
+ 7	± 18	+ 29	+ 29	+ 40	+ 61	+ 46	+ 57	+ 73	+ 98	+ 126	+ 155	+ 73	+ 98	450	500
- 18	± 18	- 28	+ 4	+ 4	+ 4	+ 21	+ 21	+ 37	+ 62	+ 80	+ 101	+ 37	+ 62	500	560
+ 7	± 20	+ 31	+ 32	+ 45	+ 68	+ 50	+ 63	+ 80	+ 108	+ 138	+ 172	+ 80	+ 108	560	630
- 20	± 20	- 32	+ 5	+ 5	+ 5	+ 23	+ 23	+ 40	+ 68	+ 90	+ 115	+ 40	+ 68	630	710
—	—	—	—	+ 44	+ 70	—	+ 70	+ 88	+ 122	+ 155	+ 194	+ 88	+ 122	710	800
—	—	—	—	0	0	—	+ 80	+ 100	+ 138	+ 175	+ 220	+ 100	+ 138	800	900
—	—	—	—	0	0	—	+ 90	+ 112	+ 144	+ 185	+ 235	+ 112	+ 144	900	1 000
—	—	—	—	+ 56	+ 90	—	+ 90	+ 112	+ 156	+ 200	+ 266	+ 112	+ 156	1 000	1 120
—	—	—	—	0	0	—	+ 106	+ 132	+ 186	+ 245	+ 316	+ 132	+ 186	1 120	1 250
—	—	—	—	+ 66	+ 105	—	+ 106	+ 132	+ 186	+ 255	+ 336	+ 132	+ 186	1 250	1 400
—	—	—	—	0	0	—	+ 126	+ 156	+ 218	+ 290	+ 378	+ 156	+ 218	1 400	1 600
—	—	—	—	+ 78	+ 125	—	+ 126	+ 156	+ 218	+ 295	+ 390	+ 156	+ 218	1 600	1 800
—	—	—	—	0	0	—	+ 150	+ 184	+ 262	+ 345	+ 462	+ 184	+ 262	1 800	2 000
—	—	—	—	+ 92	+ 150	—	+ 150	+ 184	+ 262	+ 355	+ 475	+ 184	+ 262	2 000	
—	—	—	—	0	0	—	+ 58	+ 92	+ 126	+ 170	+ 225	+ 92	+ 126		

6. Tolerances for Housing Bore Diameters

Unit: μm

Classification of diameter (mm)		E6		F6		F7		G6		G7		H6		H7		H8		J6		J7		JS6		JS7	
Over	or less																								
—	3	+20	+14	+12	+6	+16	+6	+12	+8	+2	+12	+2	+6	+10	+14	+4	+4	+2	+4	-4	-6	±3	±5		
3	6	+28	+20	+18	+10	+22	+10	+16	+12	+4	+16	+4	+8	+12	+18	+0	+0	+5	±6	-3	-3	±4	±6		
6	10	+34	+25	+22	+13	+28	+13	+20	+14	+5	+20	+5	+9	+15	+22	+0	+0	+5	+8	-4	-7	±4.5	±7.5		
10	18	+43	+32	+27	+16	+34	+16	+24	+17	+6	+24	+6	+11	+18	+27	+0	+0	+6	+10	-5	-8	±5.5	±9		
18	30	+53	+40	+33	+20	+41	+20	+28	+20	+7	+28	+7	+13	+21	+33	+0	+0	+8	+12	-5	-9	±6.5	±10.5		
30	50	+66	+50	+41	+25	+50	+25	+34	+25	+9	+34	+9	+16	+25	+39	+0	+0	+10	+14	-6	-11	±8	±12.5		
50	80	+79	+60	+49	+30	+60	+30	+40	+29	+10	+40	+10	+19	+30	+46	+0	+0	+13	+18	-6	-12	±9.5	±15		
80	120	+94	+72	+58	+36	+71	+36	+47	+34	+12	+47	+12	+22	+35	+54	+0	+0	+16	+22	-6	-13	±11	±17.5		
120	180	+110	+85	+68	+43	+83	+43	+54	+39	+14	+54	+14	+25	+40	+63	+0	+0	+18	+26	-7	-14	±12.5	±20		
180	250	+129	+100	+79	+50	+96	+50	+61	+44	+15	+61	+15	+29	+46	+72	+0	+0	+22	+30	-7	-16	±14.5	±23		
250	315	+142	+110	+88	+56	+108	+56	+69	+49	+17	+69	+17	+32	+52	+81	+0	+0	+25	+36	-7	-16	±16	±26		
315	400	+161	+125	+98	+62	+119	+62	+75	+54	+18	+75	+18	+36	+57	+89	+0	+0	+29	+39	-7	-18	±18	±28.5		
400	500	+175	+135	+108	+68	+131	+68	+83	+60	+20	+83	+20	+40	+63	+97	+0	+0	+33	+43	-7	-20	±20	±31.5		
500	630	+189	+145	+120	+76	+146	+76	+92	+66	+22	+92	+22	+44	+70	+110	+0	+0	—	—	—	—	±22	±35		
630	800	+210	+160	+130	+80	+160	+80	+104	+74	+24	+104	+24	+50	+80	+125	+0	+0	—	—	—	—	±25	±40		
800	1 000	+226	+170	+142	+86	+176	+86	+116	+82	+26	+116	+26	+56	+90	+140	+0	+0	—	—	—	—	±28	±45		
1 000	1 250	+261	+195	+164	+98	+203	+98	+133	+94	+28	+133	+28	+66	+105	+165	+0	+0	—	—	—	—	±33	±52.5		
1 250	1 600	+298	+220	+188	+110	+235	+110	+155	+108	+30	+155	+30	+78	+125	+195	+0	+0	—	—	—	—	±39	±62.5		
1 600	2 000	+332	+240	+212	+120	+270	+120	+182	+124	+32	+182	+32	+92	+150	+230	+0	+0	—	—	—	—	±46	±75		

Classification of diameter (mm)		K5		K6		K7		M5		M6		M7		N5		N6		N7		P6		P7		Classification of diameter (mm)	
Over	or less																							Over	or less
—	3	0	-4	0	-6	0	-10	-2	-6	-2	-8	-2	-12	-4	-8	-4	-10	-4	-14	-6	-12	-6	-16	—	3
3	6	0	-5	+2	-6	+3	-9	-3	-8	-1	-9	0	-12	-7	-12	-5	-13	-4	-16	-9	-17	-8	-20	3	6
6	10	+1	-5	+2	-7	+5	-10	-4	-10	-3	-12	0	-15	-8	-14	-7	-16	-4	-19	-12	-21	-9	-24	6	10
10	18	+2	-6	+2	-9	+6	-12	-4	-12	-4	-15	0	-18	-9	-17	-9	-20	-5	-23	-15	-26	-11	-29	10	18
18	30	+1	-8	+2	-11	+6	-15	-5	-14	-4	-17	0	-21	-12	-21	-11	-24	-7	-28	-18	-31	-14	-35	18	30
30	50	+2	-9	+3	-13	+7	-18	-5	-16	-4	-20	0	-25	-13	-24	-12	-28	-8	-33	-21	-37	-17	-42	30	50
50	80	+3	-10	+4	-15	+9	-21	-6	-19	-5	-24	0	-30	-15	-28	-14	-33	-9	-39	-26	-45	-21	-51	50	80
80	120	+2	-13	+4	-18	+10	-25	-8	-23	-6	-28	0	-35	-18	-33	-16	-45	-10	-45	-30	-52	-24	-59	80	120
120	180	+3	-15	+4	-21	+12	-28	-9	-27	-8	-33	0	-40	-21	-39	-20	-52	-12	-52	-36	-61	-28	-68	120	180
180	250	+2	-18	+5	-24	+13	-33	-11	-31	-8	-37	0	-46	-25	-45	-22	-60	-14	-60	-41	-70	-33	-79	180	250
250	315	+3	-20	+5	-27	+16	-36	-13	-36	-9	-41	0	-52	-27	-50	-25	-66	-14	-66	-47	-79	-36	-88	250	315
315	400	+3	-22	+7	-29	+17	-40	-14	-39	-10	-46	0	-57	-30	-55	-26	-73	-16	-73	-51	-87	-41	-98	315	400
400	500	+2	-25	+8	-32	+18	-45	-16	-43	-10	-50	0	-63	-33	-60	-27	-80	-17	-80	-55	-95	-45	-108	400	500
500	630	—	—	0	-44	0	-70	—	—	-26	-70	-26	-96	—	—	-44	-114	-44	-114	-78	-122	-78	-148	500	630
630	800	—	—	0	-50	0	-80	—	—	-30	-80	-30	-110	—	—	-50	-130	-50	-130	-88	-138	-88	-168	630	800
800	1 000	—	—	0	-56	0	-90	—	—	-34	-90	-34	-124	—	—	-56	-146	-56	-146	-100	-156	-100	-190	800	1 000
1 000	1 250	—	—	0	-66	0	-105	—	—	-40	-106	-40	-145	—	—	-66	-171	-66	-171	-120	-186	-120	-225	1 000	1 250
1 250	1 600	—	—	0	-78	0	-125	—	—	-48	-126	-48	-173	—	—	-78	-203	-78	-203	-140	-218	-140	-265	1 250	1 600
1 600	2 000	—	—	0	-92	0	-150	—	—	-58	-150	-58	-208	—	—	-92	-242	-92	-242	-170	-262	-170	-320	1 600	2 000

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