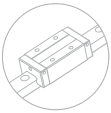
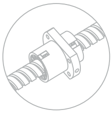
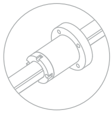
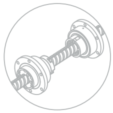
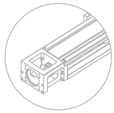
TBI

TBI TBIMOTION

LINEAR MOTION COMPONENTS

Linear Guide | Ball Screw | Ball Spline | Rotary Series | Single Axis Actuator | Accessory

About TBI MOTION

TBI MOTION TECHNOLOGY CO., LTD., as a specialized manufacturer in Linear Motion Industry in Taiwan, possesses critical core technology and concentrating on product development and innovation. Our products are under patent design with ISO 9001, ISO14001, ISO45001 and credited with Taiwan Excellence Awards. We look forward to working with you as your best partner providing you with solution and professional product to create a better future.

Philosophy ／ TBI MOTION creates advantageous circumstances through collaboration and keeps being innovative to satisfy the needs of our customers.

Mission ／ Best Partners of Production & Solution in Linear Motion.

Vision ／ TBI inside, as the prospect of helping our clients explore the infinite possibility of technology for life by utilizing our products inside of them.

TBI MOTION Taiwan Headquarter

History

1986 TBI
- Founded in Tucheng, Taipei, we established the first factory that specialized in Rolled Ball Screw in Taiwan.
- We built our first R&D center focusing on the development of Ground Ball Screw.

1988
- The Fengyuan factory in Taichung started to operate and focused on manufacturing Ground Ball Screws.

2002 COMTOP
- The **COMTOP** system was founded as a professional marketing division.

2010 TBIMOTION
- By integrating **TBI** with **COMTOP** Marketing System, **TBI MOTION** officially became the brand that led the trend in the market.
- Established Yingge factory.

2014
- The Shulin Headquarter officially operated.

2016
- **TBI MOTION** officially Initial Public Offering(IPO).

2018
- **TBI MOTION** is officially a Initial Public Offering (IPO) Company. Stock No. 4540

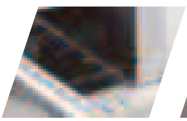
2019
- Establishing brand image. TBI MOTION
- Market positioning. TBIMOTION

2020
- Established China office. TBI MOTION CHINA
- Established USA office. TBI MOTION USA

2022
- Established Taiwan office. 全傳智能 TBI MOTION

Quality Policy

HIGH PERFORMANCE | HIGH RIGIDITY | HIGH MECHANICAL EFFICIENCY | HIGH DURABILITY | EASY TO MAINTAIN

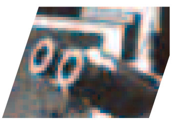


Laser Conduction Test

Outline Measurement

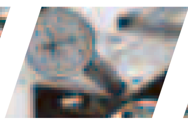
Projection Measurement

Rigidity Test



Metallographic Test

Torque Test



Accuracy Test

Durability Test

Applicable Fields

Professional motion component manufacturer
TBI MOTION possesses complete product line with MIT(made in Taiwan) quality.
We produce Ball Screw, Linear Guide, Ball Spline, Rotary Series, Single Axis Actuator, Linear Bearing, Coupling, Support Unit of Ball Screw, etc. All of them perform remarkably in each application field. With the professional technical support and industry analysis, we fulfill our clients' demand and attain differentiation.

Our products apply to various fields as below :

Sales Location

Through TBI MOTION international sales teams and the distributors around the globe, we are connected to the world, constantly surpassing ourselves to overcome every challenge in the future.

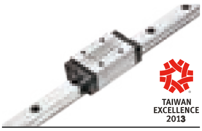
【Taiwan Branch】TBI MOTION INTELLIGENCE CO., LTD.
【China Branch】TBI MOTION TECHNOLOGY (SUZHOU) CO., LTD.
【USA Branch】TBI MOTION TECHNOLOGY(USA) LLC

Taiwan	Japan	France	Poland
China	Indonesia	Hungary	Austria
Korea	United States	Romania	Portugal
Thailand	Brazil	Slovakia	United Kingdom
Vietnam	Germany	Ukraine	Australia
Singapore	Italy	Turkey	
Malaysia	Netherlands	Finland	

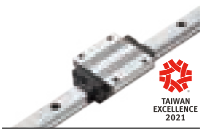
Product

Linear Guide

Standard TR-V

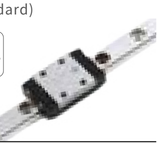


Standard TR-F



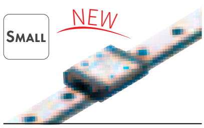
Miniature TH-N
(Standard)

SMALL



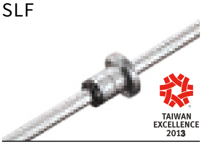
Miniature TM-W
(Wide version)

SMALL NEW

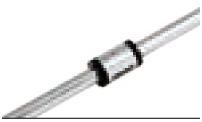


Ball Spline

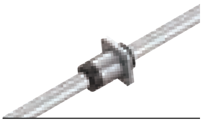
SLF



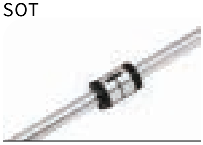
SLT



SOF

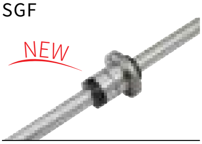


SOT



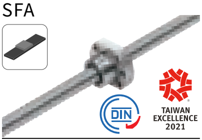
SGF

NEW



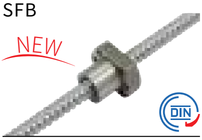
Ball Screw

SFA

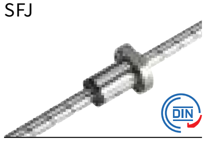


SFB

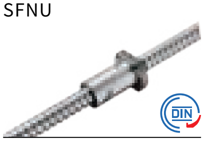
NEW



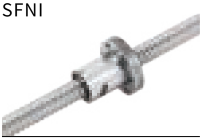
SFJ



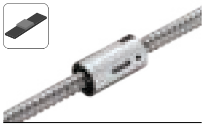
SFNU



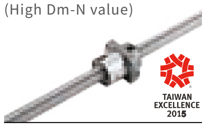
SFNI



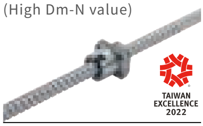
SCNH



SFY
(High Dm-N value)

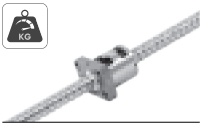


SFYA
(High Dm-N value)



SFV

XSV

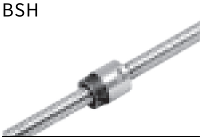


SFK

SMALL

SCI

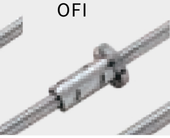
BSH



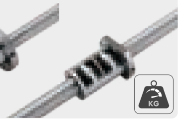
Integrated Double Nut

OFU

OFI



OFV



ICON Description

SMALL Miniature

Specially for Milling Machine

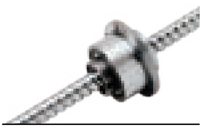
Specially for Actuator

Capable to use in high speed and heavy loading

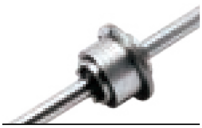
DIN Certificated

Rotary Series

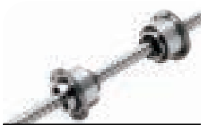
RFBY



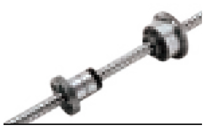
RLBF



RBBY

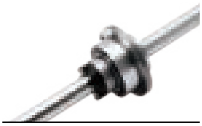


RBLY

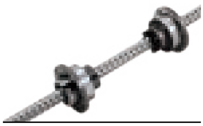


RFSY

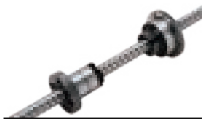
RLSF



RSSY

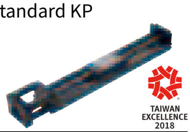


RSLY

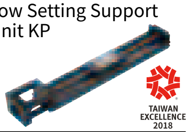


Single Axis Actuator

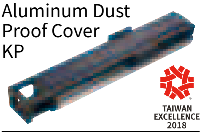
Standard KP



Low Setting Support Unit KP



Aluminum Dust Proof Cover KP



Accessory

Support Unit for Ball Screw

Linear Bearing

Coupling

Index

A

Linear Guide

A

B Ball Spline

Index

C

Ball Screw

D Rotary Series

E Single Axis Actuator

Index

F

G

H

Linear Guide

1-1 Features of *TBI MOTION* Linear Guide

■ 1-1-1 High Accuracy

Linear Guide has little friction, only a small driving force is needed to move the load. Low friction helps the temperature rising effect to stay low. Thus, the friction is decreased and the accuracy can be maintained for a long period than tradition slide system.

■ 1-1-2 High Rigidity

The design of Linear Guide features an equal load rating in all directions that provide sufficient rigidity load in all directions, self-aligning capability to absorb installation-error. Moreover, a sufficient preload can be achieved to increase rigidity and makes it suitable for any kind of installation.

■ 1-1-3 Easy for Maintenance

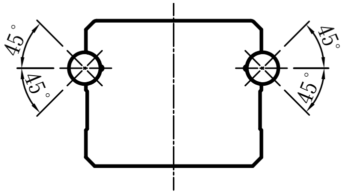
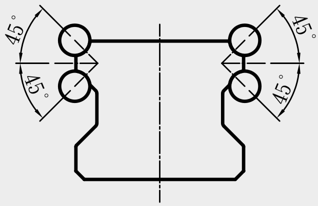
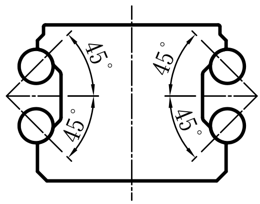
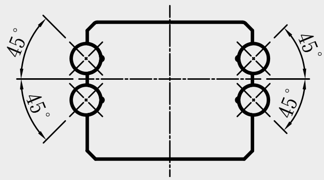
Compared with high-skill required scrapping process of traditional slide system, the Linear Guide can offer high precision even if the mounting surface is machined by milling or grinding. Moreover, the interchangeability of Linear Guide gives a convenience for installation and future maintenance.

■ 1-1-4 High Speed

Linear Guide block, rail and ball apply by contact point of rolling system. Due to the characteristic of low friction, the required driving force is much lower than that in other systems, thus the power consumption is low. Moreover the temperature rising effect is lower even under high speed operation.

■ 1-1-5 High Mechanical Efficiency without Clearance

Table 1.1.1

Drawing	Characteristics, Performance
	● Two trains of balls. ● In a Gothic-arch groove, each ball contacts the raceway at four points 45°- 45°. ● It has constant contact point between ball and arc groove. ● Rigidity has high stability. ● Two-row design is able to perform an equal load rating in four directions.
	● Four trains of balls. ● The circular-arc groove has two contact points at 45°- 45°(DF)-Four-Row Design features an equal load rating in all four directions with high rigidity. ● Four-row design is able to perform an equal load rating in four directions. ● Self-Aligning to absorb installation-error.
	● Four trains of balls. ● The circular-arc groove has two contact points at 45°- 45° (DB). ● Four-Row Design features an equal load rating in all four directions with high rigidity. ● Low friction promotes smooth operating condition.
	● Four trains of balls. ● In the Gothic-arch groove, each ball contacts the raceway at two points 45°- 45°, Light preload, two contact points, Heavy preload, four contact points. ● Compared with traditional DB type, it has higher rigidity.

A

Linear Guide

1-1 Features of *TBI MOTION* Linear Guide

The Contract table of four-row design with equal load rating and two-row Gothic design.

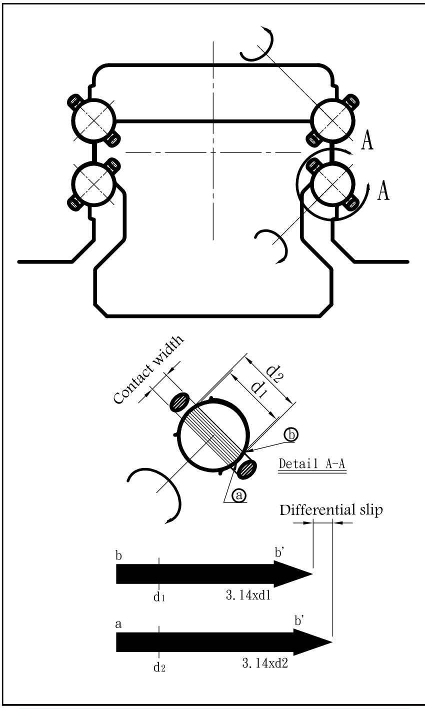


Fig 1.1.1 Four-Row Equal Load Ratting Design

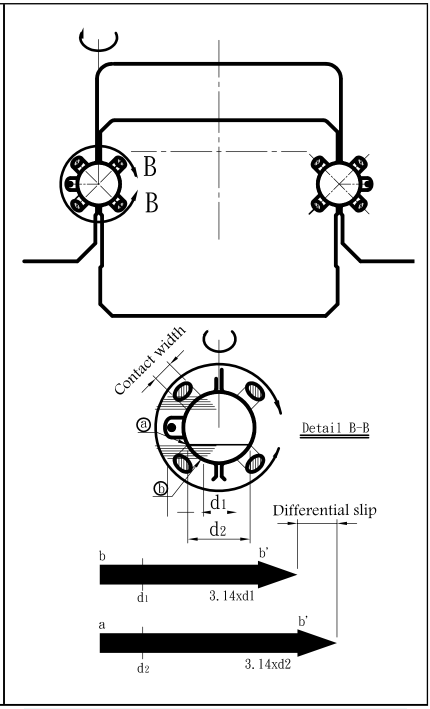


Fig 1.1.2 Two-Row Equal Load Ratting Design

As shown in the diagram, the difference between inner surface circumference(πd_1)and outer surface circumference(πd_2)which is the contact point of ball, it is the slip that will occur while the ball rolling, this is called differential slip.. if the differential slip is larger, the ball will rotate while rolling, increasing the friction coefficient and friction resistance. Under the condition with preload and loading, due to the two point of contact the difference between d_1 and d_2 is little, the differential slip is little as well, the smoothness of rolling can be achieved and thus increase efficiency.

1-2 The Procedure of Select Linear Guide

■ 1-2-1 Flowchart

1 Set the operating conditions

Set the conditions for the design of loads on the Linear Guide.
- Space available for the guide part.
- Dimensions (span, No. of blocks, No. of rails, and thrust).
- Installation direction (horizontal, vertical, tilted, wall-hung, or suspended).
- Magnitude of the applied load, direction, and location.
- Frequency of use (duty cycle).
- Velocity (acceleration).
- Stroke length.
- Required service life.
- Service environment.
- Motion precision .

Span, No. of blocks, and No. of rails changed

2 Select the correct type

- Select proper type, size and quantity (If applied with ballscrew, the size of guideway should be similar to diameter of ballscrew).

Type or size changed

3 Calculate the applied load

- Calculate the load that a Linear Guide block exerts on the Linear Guide.

4 Calculate the equivalent load

- Convert the load that Linear Guide blocks exert in each direction into an equivalent load.

5 Calculate the static safety factor

- Verify the value of the static safety factor for the basic static-load rating and Maximum applied load.

Is the static safety factor verified? NO / YES

6 Calculate the mean load

- Average the applied loads which fluctuate during operation, and convert them into a mean load.

7 Calculate the nominal life

- Calculate the running distance using the service-life equation.

8 Calculate the service life in hours

- Using the service-life equation to calculate the running distance or hours

Convert the running distance obtained into the service life in hours. Does the value obtained satisfy the enquired Service life? NO / YES

9 Forecast the rigidity

- Determine the radial clearance to be used.
- Determine the fastening methods to be used.
- Determine the rigidity at the fastened areas.

10 Select the accuracy and preload

- Determine the accuracy grade to be applied.
- Determine the mounting surface precision to be used.
- Select the preload level.

11 Safety design

- Determine the lubricants (grease, oil, special lubrication, etc.) to be used.
- Determine the lubrication method (periodic greasing, forced lubrication, etc.) to be used.
- Determine the material (Standard, stainless steel, etc.) to be used.
- Completion of selection.
- Determine the surface treatment (anti-corrosion, appearance protection, etc.) to be provided.
- Design contaminant protection (bellows, telescopic cover, etc.)

12 Completion of selection

1-3 Basic Load Rating and Service Life of Linear Guide

When determining a model that would suit your service conditions for a linear motion system, the load carrying capacity and service life of the model must be considered. To consider the load carrying capacity you should know the static safety factor of the model calculation based on the basic static load rating. Service life can be assessed by calculating the nominal life based on the basic dynamic load rating and checking to see if the obtained value meet your requirements.

The service life of a linear motion system refers to the total running distance that the linear motion system travels until flaking (the disintegration of a metal surface in scale-like pieces) occurs there to as a result of the rolling fatigue of the material caused by repeated stress on raceways and rolling elements.

Basic Load Rating : There are two basic load ratings for linear motion systems : basic static load rating (C_0), which sets the static permissible limits, and basic dynamic load rating (C).

■ 1-3-1 Basic Static Load Rating (C_0)

If a linear motion system, whether at rest or in low speed motion, receives an excessive load or a large impact, a partial permanent deformation develops between the raceway and rolling elements. If the magnitude of the permanent deformation exceeds a certain limit, it hinders the smoothness of the motion system.

The basic static load rating refers to a static load in a given direction with given magnitude such that the sum of the permanent set of the rolling elements and that of the raceway at the contact area under the most stress is 0.0001 times greater than the rolling element diameter.

In linear motion systems, the basic static load rating is defined as the radial load. Thus the basic static load rating provides a limit on the static permissible load.

■ 1-3-2 Basic Permissible Moment (M_x, M_y, M_z)

When a Linear Guide gets a force that makes the balls distorted to 1/10,000 of their diameter, we call the force as basic static permissible moment. Values of M_x, M_y, M_z are shown on Fig 1.3.1, which suggest 3 axis of moment on a Linear Guide slide.

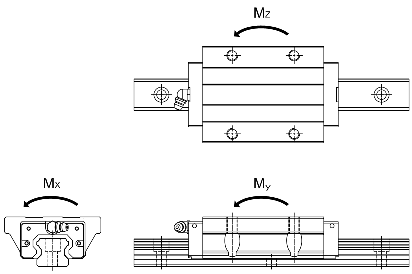


Fig 1.3.1

■ 1-3-3 Static Safety Factor f_s

$$f_s = \frac{C_0}{P} \text{ or } \frac{M_0}{M}$$

f_s : static safety factor
C_0 : basic static load rating (kg)
M_0 : static permissible moment (kg-mm)
P : calculated load (kg)
M : calculated moment (kg-mm)

A linear motion system may possibly receive an unpredictable external force due to vibration and impact while it is at rest or is moving or due to inertia resulting from start and stop. It is therefore necessary to consider the static safety factor against operating loads like these. The static safety factor (f_s) indicates the ratio of a linear motion system load carrying capacity 【basic static load rating C_0】 to the load exerted there on.

To calculate the applied load on Linear Guide, mean load and static safety factor must be obtained in advance. In the working environment with high intensity while start and stop, cantilever or cutting, a unexpected heavy load may occurs, therefore the maximum load must be acquired. Datum values of static safety factor are shown below;

Table 1.3.1 Static Safety Factor f_s

Machine Used	Loading Conditions	f_s lower limit
Ordinary Industrial Machine	Receives no vibration or impact	1.0-1.3
	Receives vibration and impact	2.0-3.0
Machine Tool	Receives no vibration or impact	1.0-1.5
	Receives vibration and impact	2.5-7.0

For large radial loads	$\frac{f_h \cdot f_t \cdot f_c \cdot C_0}{P_R} \geqq f_s$
For large reverse-radial loads	$\frac{f_h \cdot f_t \cdot f_c \cdot C_{0L}}{P_L} \geqq f_s$
For large lateral loads	$\frac{f_h \cdot f_t \cdot f_c \cdot C_{0T}}{P_T} \geqq f_s$

f_s : Static safety factor
C_0 : Basic static-load rating (radial) (kg)
C_{0L} : Basic static-load rating (reverse-radial) (kg)
C_{0T} : Basic static-load rating (lateral) (kg)
P_R : Calculated load (radial) (kg)
P_L : Calculated load (reverse-radial) (kg)
P_T : Calculated load (lateral) (kg)
f_h : Hardness factor (Fig1.3.2)
f_t : Temperature factor (Fig1.3.3)
f_c : Contact factor (Table1.3.2)

A
Linear Guide

1-3 Basic Load Rating and Service Life of Linear Guide

■ 1-3-4 Service Life (L)

Even when identical linear guideways in a group are manufactured in the same way or applied under the same condition, the service life may be varied. Thus, the service life is used as an indicator for determining the service life of a linear guideway system. The nominal life (L) is defined as the total running distance that 90% of identical linear guideways in a group, when they are applied under the same conditions, can work without developing flaking.

■ 1-3-5 Basic Dynamic Load Rating (C)

Basic dynamic load rating (C) can be used to calculate the service life when linear guideway system response to a load. The basic dynamic load rating (C) is defined as a load in a given direction and with a given magnitude that when a group of linear guideways operate under the same conditions. As the rolling element is a ball, the nominal life of the linear guideway is 50 km. Moreover, as the rolling element is a roller, the nominal life is 100 km.

■ 1-3-6 Calculation of Nominal Life

The service lives of linear motion system more or less various from system to system even if they are manufactured to the same specifications and remain in service under the same operating conditions. Hence, a guideline for determining the service life of a linear motion system is based on nominal life, which is defined as follows. The nominal life refers to the total running distance that 90% of identical linear motion systems in a group, when interlocked with one another under the same conditions, can achieve without developing flaking. The nominal life (L) of a linear motion system can be obtained from the basic dynamic load rating (C) and load imposed (P_c) using the following equations.

For a linear motion system with balls

$$L = \left(\frac{f_h \cdot f_t \cdot f_c}{f_W} \cdot \frac{C}{P_C} \right)^3 \cdot 50$$

For a linear motion system with rollers

$$L = \left(\frac{f_h \cdot f_t \cdot f_c}{f_W} \cdot \frac{C}{P_C} \right)^{\frac{10}{3}} \cdot 100$$

Service-Life Equation

The service life of the Linear Guide can be obtained using the following equation :

$$L = \left(\frac{f_h \cdot f_t \cdot f_c}{f_W} \cdot \frac{C}{P_C} \right)^3 \cdot 50\ \text{km}$$

(total distance that can be traveled by at least 90% of a group of Linear Guide operated under the same conditions)

C : basic dynamic-load rating	(kg)
P_c : calculated load	(kg)
f_h : hardness factor	(Fig 1.3.2)
f_t : temperature factor	(Fig 1.3.3)
f_c : contact factor	(Table 1.3.2)
f_w : load factor(N)	(Table 1.3.3)

(Once nominal life (L) is obtained using this equation. The Linear Guide service life can be calculated by using the following equation if the stroke length and the number of reciprocating cycles are constant)

$$L_h = \frac{L \cdot 10^6}{2 \cdot \ell_s \cdot N_1 \cdot 60}$$

L_h : service life in hours (h)
ℓ_s : stroke length (mm)
N_1 : No. of reciprocating cycles per min (min^{-1})

【f_h : Hardness factor】

To ensure achievement of the optimum load-bearing capacity of the Linear Guide, the raceway hardness must be 58~64 HRC. At a hardness below this range, the basic dynamic and static-load ratings decrease. The ratings must therefore be multiplied by the respective hardness factors (f_h). As the Linear Guide has sufficient hardness, fh for the Linear Guide is 1.0 unless otherwise specified.

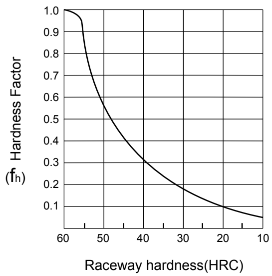


Fig 1.3.2 Hardness Factor (f_h)

【f_t : Temperature factor】

For Linear Guide used at ambient temperatures over 100°C, a temperature factor corresponding to the ambient temperature, selected from the diagram below, must be taken into consideration. In addition, please note that selected Linear Guide itself must be a model with high-temperature specifications.

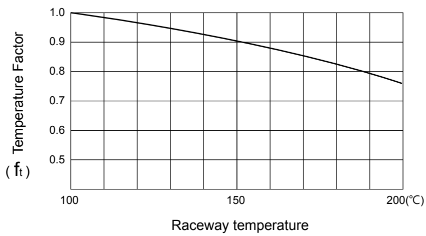


Fig 1.3.3 Temperature Factor (f_t)

※When used at ambient temperatures higher than 80°C, the seals, end caps, and ball cages used must be changed to those with high-temperature specifications.

1-3 Basic Load Rating and Service Life of Linear Guide

【f_c : Contact factor】

When multiple Linear Guide blocks are laid by each other, moments and mounting-surface precision will affect operation, making it difficult to achieve uniform load distribution. For Linear Guide blocks used laid over one another, multiply the basic load rating (C), (C_0) by a contact factor selected from the table below.

Table 1.3.2 Contact factor (f_c)

No. of Blocks Used	Contact Factor (f_c)
In normal use	1
2	0.81
3	0.72
4	0.66
5	0.61
6 or more	0.6

※When the non-uniform load distribution can be predicted, as in a large system, consider using a contact factor.

【f_w : Load factor】

In general, machines in reciprocal motion are likely to cause vibration and impact during operation, and it is particularly difficult to determine the magnitude of vibration that develops during high-speed operation as well as that of impact during repeated starting and stopping in normal use. Therefore, where the effects of speed and vibration are estimated to be significant divide the basic dynamic-load rating (C) by a load factor selected from the table below.

Table 1.3.3 Load Factor (f_w)

Vibration and Impact	Velocity (V)	f_w
Very Slight	Very Low V≤0.25 m/s	1~1.2
Slight	Low 0.25<V≤1 m/s	1.2~1.5
Moderate	Medium 1<V≤2 m/s	1.5~2
Strong	High V>2 m/s	2~3.5

Calculation Examples :

Application : Machine Center
Block model number : TRH30FE
(Basic static load C_0 = 9004 kg, Basic dynamic load C = 4791 kg)
The calculated load P_c = 266.5 kg
The formula of calculating the life time by travel is

$$L = \left(\frac{f_h \cdot f_t \cdot f_c}{f_w} \cdot \frac{C}{P_c} \right)^3 \cdot 50\ \text{km}$$

Since using only one block in this application, we take f_c = 1
Supposed the speed is not very high between 0.25~1 m/s, so we take f_w = 1.5
The temperature of working environment is under 100°C. The temperature factor f_t = 1
The hardness of raceway is HRC 58~62, so the hardness f_h = 1

With all above data, the life time by travel of this application L = 86,112 km

To calculate the life time by using hours :
We supposed the distance of travel Ls = 3000 mm
Times (Back and forth) per mins N1 = 4 (min^{-1})
The life time by travel is 86,112 km, the distance of travel is 3 m (3000 mm), so each back and forth is 6 m.
The total times of back and forth would be 86,112 x 1000/6 = 14,352,000
The life time by using minutes is 14,352,000/4 = 3,588,000 mins = 59,800 hours

■ 1-3-7 Service-Life Equation L_h

The Service Life can be calculated by operating term and velocity Nominal Life.

$$L_h = \left(\frac{L \cdot 10^3}{V_e \cdot 60}\right) = \frac{\left(\frac{C}{P}\right)^3 \cdot 50 \cdot 10^3}{V_e \cdot 60} \cdot hr$$

L_h : Service Life in Hour L : Nominal life (km)

V_e : Velocity (m/min) C/P : Load Ratio

Calculating Life Time

Formula (A) calculating hour

L_h **:** Lifetime (h)
L **:** Nominal life (km)
L_S **:** Distance of travel (mm)
N_1 **:** Times of travel per minute (min^{-1})

$$L_h = \frac{L \cdot 10^6}{2 \cdot L_s \cdot N_1 \cdot 60}$$

Formula (B) calculating year

L_y **:** Lifetime (year)
L **:** Nominal life (km)
L_S **:** Distance of travel (mm)
N_1 **:** Times of travel per minute (min^{-1})
M_n **:** Minutes of running per day (min/hr)
H_n **:** Hours of running per day (hr/day)
D_n **:** Days of running per year (day/year)

$$L_y = \frac{L \cdot 10^6}{2 \cdot L_s \cdot N_1 \cdot M_n \cdot H_n \cdot D_n}$$

Notes : The service life is verified by different environments and other usage conditions. Please confirm this information with the costumer. For environment factors, please refer to page A08~A10.

A
Linear Guide

1-3 Basic Load Rating and Service Life of Linear Guide

Example 1 :

There is a working station using linear guides with a nominal life of 45000 km, how should we calculate its service life in hours.

Known :
L_S : Distance of travel = 3000 mm (mm)
N_1 : 4 times of travel per minute (min^{-1})

$$L_h = \frac{L \cdot 10^6}{2 \cdot L_s \cdot N_1 \cdot 60} = \frac{45000 \cdot 10^6}{2 \cdot 3000 \cdot 4 \cdot 60} = 31250 \text{ hr}$$

Example 2 :

There is a working station using linear guides with a nominal life 71231.5 km, how should we calculate its service life in year.

Known :
L_S : Distance of travel = 4000 mm (mm)
N_1 : 5 times of travel per minute (min^{-1})
M_S : Running 60 mins per hour (min/hr)
H_S : Running 24 hours per day (hr/day)
D_S : Running 360 days per year (day/year)

$$L_y = \frac{L \cdot 10^6}{2 \cdot L_s \cdot N_1 \cdot M_s \cdot H_s \cdot D_s} = \frac{71231.5 \cdot 10^6}{2 \cdot 4000 \cdot 5 \cdot 60 \cdot 24 \cdot 360} = 3.435 \text{ year}$$

1-4 Friction

The construction of Linear Guide are block, rail and motion system which has rolling elements, such as balls and rollers, placed between two raceways. The rolling motion that rolling elements give rise to reduce the frictional resistance to 1/20 th to 1/40 th of that in a slide guide. Static friction, in particular, is much lower in a linear motion system than in other system, and there is little difference between static and dynamic friction, so that stick-slip does not occur. Therefore, Linear Guide could apply in various precision motion system. Frictional resistance in a linear motion system varies with the type of linear motion system, the magnitude of the preload, the viscosity resistance of the lubricant used the load exerted on the system, and other factors. Table shows Friction of Linear Guide.

Table 1.4.1 Friction Coefficient u of Various Linear Motion Systems µ

Type of Linear Motion System	Friction Coefficient
Linear Guide	0.002~0.003
Ball Spline	0.002~0.003
Linear Guide Roller	0.0050~0.010
Cross Roller Guide	0.0010~0.0025
Linear Ball Slide	0.0006~0.0012

A

Linear Guide

1-5 Working Load

■ 1-5-1 Working Load

The load applied to the Linear Guide, varies with the external force exerted thereon, such as the location of the center of gravity of an object been moved, the location of the thrust developed, inertia due to acceleration and deceleration during starting and stopping, and the machining resistance. To select the correct type of Linear Guide, the magnitude of applied loads must be determined in consideration of the above conditions to calculate accurate applied load.

To obtain the magnitude of an applied load and the service life in hours, the operating conditions of the Linear Guide system must first be set.

(1) Mass : m (kg)
(2) Direction of the action load
(3) Location of the action point
(e.g., center of gravity) : L_2, L_3, h_1 (mm)
(4) Location of the thrust developed : L_4, h_2 (mm)
(5) Linear Guide system arrangement : L_0, L_1 (mm)
(6) Velocity diagram
Velocity : V (mm/s)
Time : t_n (s)
Acceleration : a_n (mm/s^2)

$$a_n = \left(\frac{\Delta V}{t_n}\right)$$

Gravitational acceleration g = 9.8 m/s^2

(7) Duty cycle (No : of reciprocating cycles per min) : N_1 (min^{-1})
(8) Stroke length : L (mm)
(9) Mean velocity : V_m (mm/s)
(10) Required service life in hours : L_h (h)

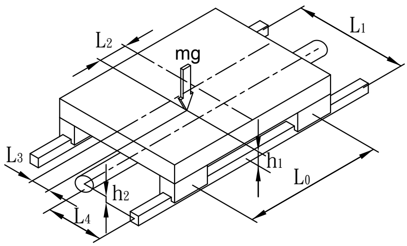


Fig 1.5.1

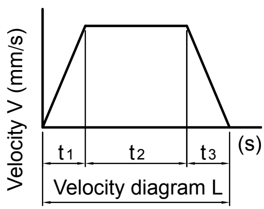


Fig 1.5.2

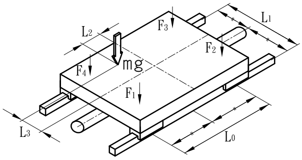
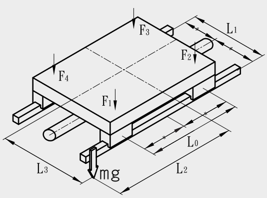
Calculating the Working Load

The load applied to the Linear Guide varies with the external force exerted thereon, such as the location of the center of gravity of an object being moved, the location of the thrust developed, inertia due to acceleration and deceleration during starting and stopping, and the machining resistance.To select the correct type of Linear Guide, the magnitude of applied loads must be determined in consideration of the above conditions. Using the following Table 1.5.1, we will now calculate the loads applied to the Linear Guide.

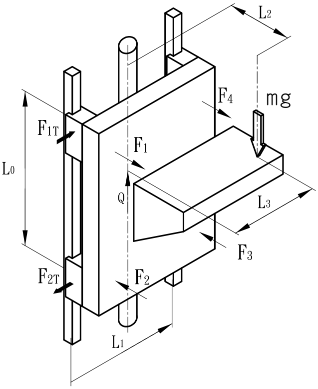
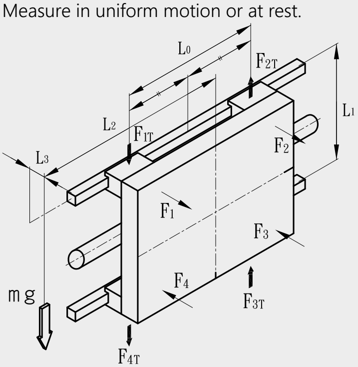
m : Mass	(kg)
L_n : Distance	(mm)
F_n : External force	(kg)
P_n : Applied load (radial and reverse-radial directions)	(kg)
P_{nT} : Applied load	(kg)
g : Gravitational acceleration (g=9.8 m/s^2)	(m/s^2)
V : Velocity	(m/s)
t_n : Time	(s)
a_n : Acceleration	(m/s^2)

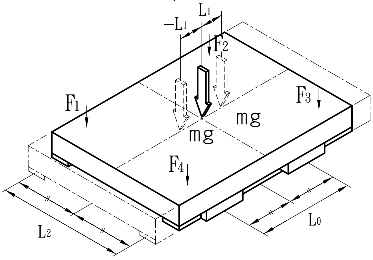
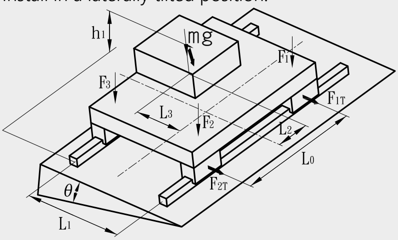
$$a_n = \left(\frac{\Delta V}{t_n}\right)$$

Table 1.5.1 Calculation Load

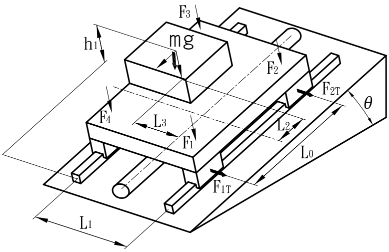
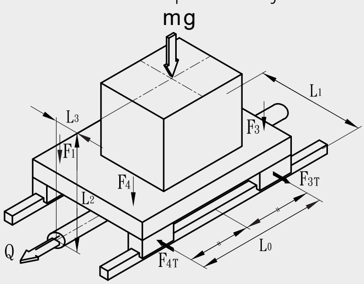
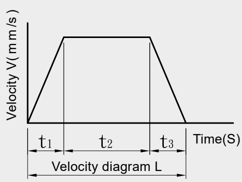
No.	Opearating Conditions	Equation for Calculating Applied Load
1	Install in a horizontal position. (Move the block) Measure in uniform motion or at rest. 	$F_1 = \frac{mg}{4} + \frac{mg \cdot L_2}{2 \cdot L_0} - \frac{mg \cdot L_3}{2 \cdot L_1}$ $F_2 = \frac{mg}{4} - \frac{mg \cdot L_2}{2 \cdot L_0} - \frac{mg \cdot L_3}{2 \cdot L_1}$ $F_3 = \frac{mg}{4} - \frac{mg \cdot L_2}{2 \cdot L_0} + \frac{mg \cdot L_3}{2 \cdot L_1}$ $F_4 = \frac{mg}{4} + \frac{mg \cdot L_2}{2 \cdot L_0} + \frac{mg \cdot L_3}{2 \cdot L_1}$
2	Install in an overhung horizontal positon. (Move the block) Measure in uniform motion or at rest. 	$F_1 = \frac{mg}{4} + \frac{mg \cdot L_2}{2 \cdot L_0} + \frac{mg \cdot L_3}{2 \cdot L_1}$ $F_2 = \frac{mg}{4} - \frac{mg \cdot L_2}{2 \cdot L_0} + \frac{mg \cdot L_3}{2 \cdot L_1}$ $F_3 = \frac{mg}{4} - \frac{mg \cdot L_2}{2 \cdot L_0} - \frac{mg \cdot L_3}{2 \cdot L_1}$ $F_4 = \frac{mg}{4} + \frac{mg \cdot L_2}{2 \cdot L_0} - \frac{mg \cdot L_3}{2 \cdot L_1}$

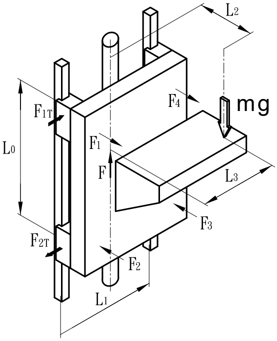
1-5 Working Load

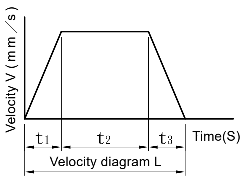
No.	Opearating Conditions	Equation for Calculating Applied Load
3	Install in a vertical position. Measure in uniform motion or at rest.  (EX) On the vertical axis of industrial robots in automatic painting machines and lifters	$F_1=F_2=F_3=F_4=\dfrac{mg\cdot L_2}{2\cdot L_0}$ $F_{1T}=F_{2T}=F_{3T}=F_{4T}=\dfrac{mg\cdot L_3}{2\cdot L_0}$
4	On a wall. Measure in uniform motion or at rest.  (EX) On cross rails loader travel axis	$F_1=F_2=F_3=F_4=\dfrac{mg\cdot L_3}{2\cdot L_1}$ $F_{1T}=F_{4T}=\dfrac{mg}{4}-\dfrac{mg\cdot L_2}{2\cdot L_0}$ $F_{2T}=F_{3T}=\dfrac{mg}{4}+\dfrac{mg\cdot L_2}{2\cdot L_0}$

No.	Opearting Conditions	Equation for Calculating Applied Load
5	Move on Linear Guide rail Install in a horizontal position.  (EX) X - Y table/Sliding fork	$F_{1max}=F_{2max}=F_{3max}=F_{4max}=\frac{mg}{4}+\frac{mg\cdot L_1}{2\cdot L_0}$ $F_{1min}=F_{2min}=F_{3min}=F_{4min}=\frac{mg}{4}-\frac{mg\cdot L_1}{2\cdot L_0}$
6	Install in a laterally tilted position.  (EX) NC lathe/Carriage (for the lathe)	$F_1=+\frac{mg\cdot\cos\theta}{4}+\frac{mg\cdot\cos\theta\cdot L_2}{2\cdot L_0}-\frac{mg\cdot\cos\theta\cdot L_3}{2\cdot L_1}+\frac{mg\cdot\sin\theta\cdot h_1}{2\cdot L_1}$ $F_{1T}=\frac{mg\cdot\sin\theta}{4}+\frac{mg\cdot\sin\theta\cdot L_2}{2\cdot L_0}$ $F_2=+\frac{mg\cdot\cos\theta}{4}-\frac{mg\cdot\cos\theta\cdot L_2}{2\cdot L_0}-\frac{mg\cdot\cos\theta\cdot L_3}{2\cdot L_1}+\frac{mg\cdot\sin\theta\cdot h_1}{2\cdot L_1}$ $F_{2T}=\frac{mg\cdot\sin\theta}{4}-\frac{mg\cdot\sin\theta\cdot L_2}{2\cdot L_0}$ $F_3=+\frac{mg\cdot\cos\theta}{4}-\frac{mg\cdot\cos\theta\cdot L_2}{2\cdot L_0}+\frac{mg\cdot\cos\theta\cdot L_3}{2\cdot L_1}-\frac{mg\cdot\sin\theta\cdot h_1}{2\cdot L_1}$ $F_{3T}=\frac{mg\cdot\sin\theta}{4}-\frac{mg\cdot\sin\theta\cdot L_2}{2\cdot L_0}$ $F_4=+\frac{mg\cdot\cos\theta}{4}+\frac{mg\cdot\cos\theta\cdot L_2}{2\cdot L_0}+\frac{mg\cdot\cos\theta\cdot L_3}{2\cdot L_1}-\frac{mg\cdot\sin\theta\cdot h_1}{2\cdot L_1}$ $F_{4T}=\frac{mg\cdot\sin\theta}{4}+\frac{mg\cdot\sin\theta\cdot L_2}{2\cdot L_0}$

1-5 Working Load

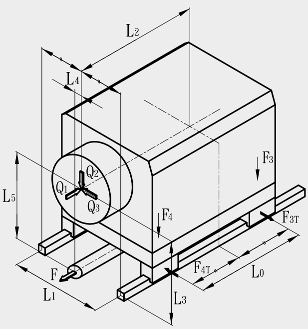
No.	Opearating Conditions	Equation for Calculating Applied Load
7	Install in a longitudinally tilted position.  (EX) NC lathe/Tool res (for the lathe)	$F_1 = +\frac{mg\cdot\cos\theta}{4} + \frac{mg\cdot\cos\theta\cdot L_2}{2\cdot L_0} - \frac{mg\cdot\cos\theta\cdot L_3}{2\cdot L_1} + \frac{mg\cdot\sin\theta\cdot h_1}{2\cdot L_0}$ $F_{1T} = +\frac{mg\cdot\sin\theta\cdot L_3}{2\cdot L_0}$ $F_2 = +\frac{mg\cdot\cos\theta}{4} - \frac{mg\cdot\cos\theta\cdot L_2}{2\cdot L_0} - \frac{mg\cdot\cos\theta\cdot L_3}{2\cdot L_1} - \frac{mg\cdot\sin\theta\cdot h_1}{2\cdot L_0}$ $F_{2T} = -\frac{mg\cdot\sin\theta\cdot L_3}{2\cdot L_0}$ $F_3 = +\frac{mg\cdot\cos\theta}{4} - \frac{mg\cdot\cos\theta\cdot L_2}{2\cdot L_0} + \frac{mg\cdot\cos\theta\cdot L_3}{2\cdot L_1} - \frac{mg\cdot\sin\theta\cdot h_1}{2\cdot L_0}$ $F_{3T} = -\frac{mg\cdot\sin\theta\cdot L_3}{2\cdot L_0}$ $F_4 = +\frac{mg\cdot\cos\theta}{4} + \frac{mg\cdot\cos\theta\cdot L_2}{2\cdot L_0} + \frac{mg\cdot\cos\theta\cdot L_3}{2\cdot L_1} + \frac{mg\cdot\sin\theta\cdot h_1}{2\cdot L_0}$ $F_{4T} = +\frac{mg\cdot\sin\theta\cdot L_3}{2\cdot L_0}$
8	Install in a horizontal position subjected to inertia.   $a_n = \frac{\Delta V}{t_n}$ (EX) Wagon Truck	$F_1 = F_4 = \frac{mg}{4} - \frac{mg\cdot a_1\cdot L_2}{2\cdot L_0\cdot g}$ $F_2 = F_3 = \frac{mg}{4} + \frac{mg\cdot a_1\cdot L_2}{2\cdot L_0\cdot g}$ $F_{1T} = F_{4T} = \frac{mg\cdot a_1\cdot L_3}{2\cdot L_0\cdot g}$ $F_{2T} = F_{3T} = \frac{-mg\cdot a_1\cdot L_3}{2\cdot L_0\cdot g}$ $F_1 = F_2 = F_3 = F_4 = \frac{mg}{4}$ $F_1 = F_4 = \frac{mg}{4} - \frac{mg\cdot a_3\cdot L_2}{2\cdot L_0\cdot g}$ $F_2 = F_3 = \frac{mg}{4} + \frac{mg\cdot a_3\cdot L_2}{2\cdot L_0\cdot g}$ $F_{1T} = F_{4T} = \frac{mg\cdot a_3\cdot L_3}{2\cdot L_0\cdot g}$ $F_{2T} = F_{3T} = \frac{-mg\cdot a_3\cdot L_3}{2\cdot L_0\cdot g}$

<table>
<tr><th>No.</th><th>Opearating Conditions</th><th>Equation for Calculating Applied Load</th></tr>
<tr><td>9</td><td>Mount in a vertical position subjected to inertia.




$a_n=\dfrac{\Delta V}{t_n}$
(EX) Elevator.</td><td>$F_1=F_2=F_3=F_4=\dfrac{(mg+mg\cdot a_1/g)\cdot L_2}{2\cdot L_0}$
$F_{1T}=F_{2T}=F_{3T}=F_{4T}=\dfrac{(mg+mg\cdot a_1/g)\cdot L_3}{2\cdot L_0}$

$F_1=F_2=F_3=F_4=\dfrac{mg\cdot L_2}{2\cdot L_0}$
$F_{1T}=F_{2T}=F_{3T}=F_{4T}=\dfrac{mg\cdot L_2}{2\cdot L_0}$

$F_1=F_2=F_3=F_4=\dfrac{(mg-mg\cdot a_3/g)\cdot L_2}{2\cdot L_0}$
$F_{1T}=F_{2T}=F_{3T}=F_{4T}=\dfrac{(mg-mg\cdot a_3/g)\cdot L_3}{2\cdot L_0}$</td></tr>
<tr><td>10</td><td>Install on a horizontal position subjected to external force.

</td><td>$F_1=F_4=\dfrac{Q_1\cdot L_5}{2\cdot L_0}$
$F_2=F_3=\dfrac{-Q_1\cdot L_5}{2\cdot L_0}$
$F_{1T}=F_{2T}=F_{3T}=F_{4T}=\dfrac{Q_1\cdot L_4}{2\cdot L_0}$

$F_1=F_4=\dfrac{Q_2}{4}+\dfrac{Q_2\cdot L_2}{2\cdot L_0}$
$F_2=F_3=\dfrac{Q_2}{4}-\dfrac{Q_2\cdot L_2}{2\cdot L_0}$

$F_1=F_2=F_3=F_4=\dfrac{Q_3\cdot L_3}{2\cdot L_1}$
$F_{1T}=F_{4T}=\dfrac{Q_3}{4}+\dfrac{Q_3\cdot L_2}{2\cdot L_0}$
$F_{2T}=F_{3T}=\dfrac{Q_3}{4}-\dfrac{Q_3\cdot L_2}{2\cdot L_0}$</td></tr>
</table>

A

Linear Guide

1-6 Safety Factor and Load

■ 1-6-1 Equivalent Factors of Linear Guide Block

Where a sufficient installation space is not available you may be obliged to use just one Linear Guide block or two Linear Guide blocks laid over one another for the Linear Guide. In such a setting, the load distribution cannot be uniform, as a result, an excessive load is exerted in localized areas (e.g., rail ends). Continued use under such conditions may result in flaking in those areas, consequently shortening the service life. In such a case, calculating true load by multiplying the moment value by any one of the moment-equivalent factors specified in Tables.

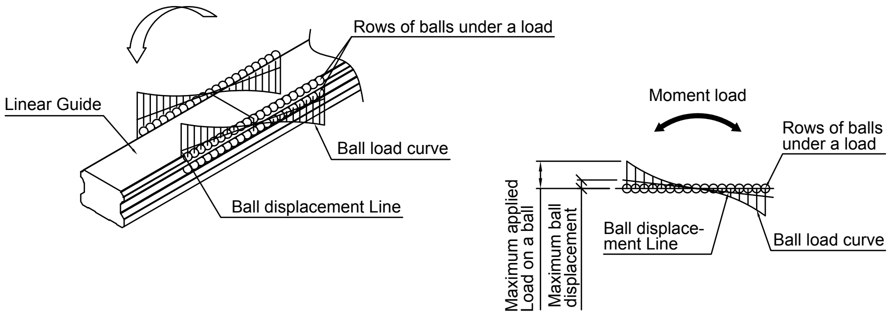


Fig 1.6.1 Ball Load Effected by a Moment

An equivalent-load equation applicable when a moment acts on a Linear Guides is shown below.

$P=K \cdot M$

P : Equivalent load per Linear Guide (kg)

K : Equivalent moment factor

M : Developed moment (kg-mm)

K_x, K_y, K_z represent the equivalent moment factors in directions M_x, M_y, M_z respectively.

Calculation Examples

Two Linear Guide blocks are used laid over one another.
Model No : TRH30FE
Gravitational Acceleration g = 9.8 m/s^2
Mass w = 5 kg
M_x = 5・150 = 750 (kg-mm)
M_y = 5・200 = 1000 (kg-mm)

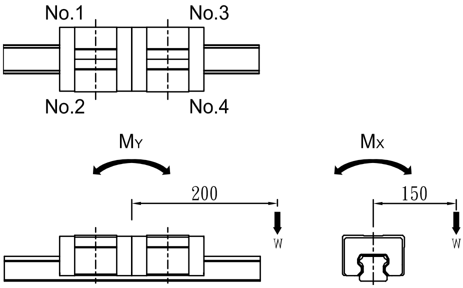


Fig 1.6.2

$$P_1 = K_x \cdot \frac{M_x}{2} + K_y \cdot M_y + \frac{W}{2} = 7.15 \cdot 10^{-2} \cdot \frac{750}{2} + 1.3 \cdot 10^{-2} \cdot 1000 + \frac{5}{2} = 42.3 \text{ (kgf)}$$

$$P_2 = -K_x \cdot \frac{M_x}{2} + K_y \cdot M_y + \frac{W}{2} = -7.15 \cdot 10^{-2} \cdot \frac{750}{2} + 1.3 \cdot 10^{-2} \cdot 1000 + \frac{5}{2} = -11.3 \text{ (kgf)}$$

$$P_3 = K_x \cdot \frac{M_x}{2} - K_y \cdot M_y + \frac{W}{2} = 7.15 \cdot 10^{-2} \cdot \frac{750}{2} - 1.3 \cdot 10^{-2} \cdot 1000 + \frac{5}{2} = 16.3 \text{ (kgf)}$$

$$P_4 = -K_x \cdot \frac{M_x}{2} - K_y \cdot M_y + \frac{W}{2} = -7.15 \cdot 10^{-2} \cdot \frac{750}{2} - 1.3 \cdot 10^{-2} \cdot 1000 + \frac{5}{2} = -37.3 \text{ (kgf)}$$

※Note.1
Since a Linear Guide in a vertical position receives only a moment load, there is no need to apply other loads (w).

※Note.2
In some models, load ratings differ depending on the direction of the applied load. With such a model, calculate an equivalent load in a direction in which conditions are comparably bad.

1-6 Safety Factor and Load

Table 1.6.1 TRH-V

ModelNo.	Equivalent Factors K_y(mm^{-1})		Equivalent Factors K_z(mm^{-1})		Equivalent Factors K_x(mm^{-1})
	Equivalent Load Calculation for a system Using One Linear Guide Block	Equivalent Load Calculation for a system Using Two Linear Guide Blocks laid Over One-Another	Equivalent Load Calculation for a system Using One Linear Guide Block	Equivalent Load Calculation for a system Using Two Linear Guide Blocks laid Over One-Another	
TRH15VN	1.48×10^{-1}	3.11×10^{-2}	1.48×10^{-1}	3.11×10^{-2}	1.34×10^{-1}
TRH15VL	1.26×10^{-1}	2.70×10^{-2}	1.26×10^{-1}	2.70×10^{-2}	1.34×10^{-1}
TRH20VN	1.11×10^{-1}	2.35×10^{-2}	1.11×10^{-1}	2.35×10^{-2}	9.90×10^{-2}
TRH20VE	8.00×10^{-2}	1.78×10^{-2}	8.00×10^{-2}	1.78×10^{-2}	9.90×10^{-2}
TRH25VN	1.04×10^{-1}	2.17×10	1.04×10^{-1}	2.17×10	8.62×10^{-2}
TRH25VE	7.35×10^{-2}	1.60×10^{-2}	7.35×10^{-2}	1.60×10^{-2}	8.62×10^{-2}
TRH30VN	6.52×10^{-2}	1.34×10^{-2}	6.52×10^{-2}	1.34×10^{-2}	7.69×10^{-2}
TRH30VE	6.12×10^{-2}	1.33×10^{-2}	6.12×10^{-2}	1.33×10^{-2}	7.15×10^{-2}
TRH35VN	6.95×10^{-2}	1.43×10^{-2}	6.95×10^{-2}	1.43×10^{-2}	6.29×10^{-2}
TRH35VE	5.25×10^{-2}	1.15×10^{-2}	5.25×10^{-2}	1.15×10^{-2}	5.85×10^{-2}
TRH45VL	5.80×10^{-2}	1.24×10^{-2}	5.80×10^{-2}	1.24×10^{-2}	4.38×10^{-2}
TRH45VE	4.59×10^{-2}	1.00×10^{-2}	4.59×10^{-2}	1.00×10^{-2}	4.38×10^{-2}
TRH55VL	5.25×10^{-2}	1.07×10^{-2}	5.25×10^{-2}	1.07×10^{-2}	3.78×10^{-2}
TRH55VE	4.08×10^{-2}	8.69×10^{-3}	4.08×10^{-2}	8.69×10^{-3}	3.78×10^{-2}
TRH65VL	4.52×10^{-2}	8.76×10^{-3}	4.52×10^{-2}	8.76×10^{-3}	3.24×10^{-2}
TRH65VE	3.27×10^{-2}	6.77×10^{-3}	3.27×10^{-2}	6.77×10^{-3}	3.24×10^{-2}

K_x : Equivalent moment factor in the rolling direction.
K_y : Equivalent moment factor in the pitching direction.
K_z : Equivalent moment factor in the deflection direction.

Table 1.6.2 TRH-F

Model No.	Equivalent Factors K_y(mm^{-1}): Equivalent Load Calculation for a system Using One Linear Guide Block	Equivalent Factors K_y(mm^{-1}): Equivalent Load Calculation for a system Using Two Linear Guide Blocks laid Over One-Another	Equivalent Factors K_z(mm^{-1}): Equivalent Load Calculation for a system Using One Linear Guide Block	Equivalent Factors K_z(mm^{-1}): Equivalent Load Calculation for a system Using Two Linear Guide Blocks laid Over One-Another	Equivalent Factors K_x(mm^{-1})
TRH15FN	1.48×10^{-1}	3.11×10^{-2}	1.48×10^{-1}	3.11×10^{-2}	1.34×10^{-1}
TRH15FL	1.26×10^{-1}	2.70×10^{-2}	1.26×10^{-1}	2.70×10^{-2}	1.34×10^{-1}
TRH20FN	1.11×10^{-1}	2.35×10^{-2}	1.11×10^{-1}	2.35×10^{-2}	9.90×10^{-2}
TRH20FE	8.00×10^{-2}	1.78×10^{-2}	8.00×10^{-2}	1.78×10^{-2}	9.90×10^{-2}
TRH25FN	1.04×10^{-1}	2.17×10	1.04×10^{-1}	2.17×10	8.62×10
TRH25FE	7.35×10^{-2}	1.60×10^{-2}	7.35×10^{-2}	1.60×10^{-2}	8.62×10^{-2}
TRH30FN	6.52×10^{-2}	1.34×10^{-2}	6.52×10^{-2}	1.34×10^{-2}	7.69×10^{-2}
TRH30FE	6.12×10^{-2}	1.33×10^{-2}	6.12×10^{-2}	1.33×10^{-2}	7.15×10^{-2}
TRH35FN	6.95×10^{-2}	1.43×10^{-2}	6.95×10^{-2}	1.43×10^{-2}	6.29×10^{-2}
TRH35FE	5.25×10^{-2}	1.15×10^{-2}	5.25×10^{-2}	1.15×10^{-2}	5.85×10^{-2}
TRH45FL	5.80×10^{-2}	1.24×10^{-2}	5.80×10^{-2}	1.24×10^{-2}	4.38×10^{-2}
TRH45FE	4.59×10^{-2}	1.00×10^{-2}	4.59×10^{-2}	1.00×10^{-2}	4.38×10^{-2}
TRH55FL	5.25×10^{-2}	1.07×10^{-2}	5.25×10^{-2}	1.07×10^{-2}	3.78×10^{-2}
TRH55FE	4.08×10^{-2}	8.69×10^{-3}	4.08×10^{-2}	8.69×10^{-3}	3.78×10^{-2}
TRH65FL	4.52×10^{-2}	8.76×10^{-3}	4.52×10^{-2}	8.76×10^{-3}	3.24×10^{-2}
TRH65FE	3.27×10^{-2}	6.77×10^{-3}	3.27×10^{-2}	6.77×10^{-3}	3.24×10^{-2}

K_x : Equivalent moment factor in the rolling direction.
K_y : Equivalent moment factor in the pitching direction.
K_z : Equivalent moment factor in the deflection direction.

1-6 Safety Factor and Load

Table 1.6.3 TRS-V

Model No.	Equivalent Factors K_y(mm^{-1})		Equivalent Factors K_z(mm^{-1})		Equivalent Factors K_x(mm^{-1})
	Equivalent Load Calculation for a system Using One Linear Guide Block	Equivalent Load Calculation for a system Using Two Linear Guide Blocks laid Over One-Another	Equivalent Load Calculation for a system Using One Linear Guide Block	Equivalent Load Calculation for a system Using Two Linear Guide Blocks laid Over One-Another	
TRS15VS	2.29×10^{-1}	4.39×10^{-2}	2.29×10^{-1}	4.39×10^{-2}	1.34×10^{-1}
TRS15VN	1.48×10^{-1}	3.11×10^{-2}	1.48×10^{-1}	3.11×10^{-2}	1.34×10^{-1}
TRS20VS	2.00×10^{-1}	3.58×10^{-2}	2.00×10^{-1}	3.58×10^{-2}	9.90×10^{-2}
TRS20VN	1.25×10^{-1}	2.60×10^{-2}	1.25×10^{-1}	2.60×10^{-2}	9.90×10^{-2}
TRS25VS	1.60×10^{-1}	3.07×10^{-2}	1.60×10^{-1}	3.07×10^{-2}	8.62×10^{-2}
TRS25VN	1.04×10^{-1}	2.17×10^{-2}	1.04×10^{-1}	2.17×10^{-2}	8.62×10^{-2}
TRS30VS	1.47×10^{-1}	2.57×10^{-2}	1.47×10^{-1}	2.57×10^{-2}	7.15×10^{-2}
TRS30VN	8.65×10^{-2}	1.82×10^{-2}	8.65×10^{-2}	1.82×10^{-2}	7.15×10^{-2}
TRS35VN	7.87×10^{-2}	1.61×10^{-2}	7.87×10^{-2}	1.61×10^{-2}	5.85×10^{-2}
TRS35VE	5.25×10^{-2}	1.15×10^{-2}	5.25×10^{-2}	1.15×10^{-2}	5.85×10^{-2}
TRS45VN	6.89×10^{-2}	1.39×10^{-2}	6.89×10^{-2}	1.39×10^{-2}	4.38×10^{-2}

K_x : Equivalent moment factor in the rolling direction.
K_y : Equivalent moment factor in the pitching direction.
K_z : Equivalent moment factor in the deflection direction.

Table 1.6.4 TRS-F

Model No.	Equivalent Factors K_y(mm^{-1})		Equivalent Factors K_z(mm^{-1})		Equivalent Factors K_x(mm^{-1})
	Equivalent Load Calculation for a system Using One Linear Guide Block	Equivalent Load Calculation for a system Using Two Linear Guide Blocks laid Over One-Another	Equivalent Load Calculation for a system Using One Linear Guide Block	Equivalent Load Calculation for a system Using Two Linear Guide Blocks laid Over One-Another	
TRS15FS	2.29×10^{-1}	4.39×10^{-2}	2.29×10^{-1}	4.39×10^{-2}	1.34×10^{-1}
TRS15FN	1.48×10^{-1}	3.11×10^{-2}	1.48×10^{-1}	3.11×10^{-2}	1.34×10^{-1}
TRS20FS	2.00×10^{-1}	3.58×10^{-2}	2.00×10^{-1}	3.58×10^{-2}	9.90×10^{-2}
TRS20FN	1.25×10^{-1}	2.60×10^{-2}	1.25×10^{-1}	2.60×10^{-2}	9.90×10^{-2}
TRS25FN	1.04×10^{-1}	2.17×10^{-2}	1.04×10^{-1}	2.17×10^{-2}	8.62×10^{-2}

K_x : Equivalent moment factor in the rolling direction.
K_y : Equivalent moment factor in the pitching direction.
K_z : Equivalent moment factor in the deflection direction.

Table 1.6.5 TRC-V

Model No.	Equivalent Factors K_y(mm^{-1})		Equivalent Factors K_z(mm^{-1})		Equivalent Factors K_x(mm^{-1})
	Equivalent Load Calculation for a system Using One Linear Guide Block	Equivalent Load Calculation for a system Using Two Linear Guide Blocks laid Over One-Another	Equivalent Load Calculation for a system Using One Linear Guide Block	Equivalent Load Calculation for a system Using Two Linear Guide Blocks laid Over One-Another	
TRC25VE	7.35×10^{-2}	1.60×10^{-2}	7.35×10^{-2}	1.60×10^{-2}	8.62×10^{-2}

K_x : Equivalent moment factor in the rolling direction.
K_y : Equivalent moment factor in the pitching direction.
K_z : Equivalent moment factor in the deflection direction.

1-6 Safety Factor and Load

Table 1.6.6 TH-N

Model No.	Equivalent Factors K_y(mm^{-1})		Equivalent Factors K_z(mm^{-1})		Equivalent Factors K_x(mm^{-1})
	Equivalent Load Calculation for a system Using One Linear Guide Block	Equivalent Load Calculation for a system Using Two Linear Guide Blocks laid Over One-Another	Equivalent Load Calculation for a system Using One Linear Guide Block	Equivalent Load Calculation for a system Using Two Linear Guide Blocks laid Over One-Another	
TH07NN	8.88×10^{-1}	6.31×10^{-2}	8.88×10^{-1}	6.31×10^{-2}	2.74×10^{-1}
TH07NL	4.41×10^{-1}	5.16×10^{-2}	4.41×10^{-1}	5.16×10^{-2}	2.74×10^{-1}
TH09NN	4.41×10^{-1}	5.26×10^{-2}	4.41×10^{-1}	5.26×10^{-2}	2.19×10^{-1}
TH09NL	2.76×10^{-1}	4.08×10^{-2}	2.76×10^{-1}	4.08×10^{-2}	2.19×10^{-1}
TH12NN	4.90×10^{-1}	4.32×10^{-2}	4.90×10^{-1}	4.32×10^{-2}	1.64×10^{-1}
TH12NL	2.67×10^{-1}	3.42×10^{-2}	2.67×10^{-1}	3.42×10^{-2}	1.64×10^{-1}
TH15NN	3.60×10^{-1}	3.61×10^{-2}	3.60×10^{-1}	3.61×10^{-2}	1.32×10^{-1}
TH15NL	1.94×10^{-1}	2.76×10^{-2}	1.94×10^{-1}	2.76×10^{-2}	1.32×10^{-1}

K_x : Equivalent moment factor in the rolling direction.
K_y : Equivalent moment factor in the pitching direction.
K_z : Equivalent moment factor in the deflection direction.

■ 1-6-2 Calculating the Equivalent Load

The Linear Guide can bear loads and moments from all directions, including a radial load (P_R), reverse-radial load (P_L), and lateral load (P_T), simultaneously.

P_R : Radial load
P_L : Reverse-radial load
P_T : Lateral load

M_X : Moment in the rolling direction
M_y : Moment in the pitching direction
M_Z : Moment in the deflection direction

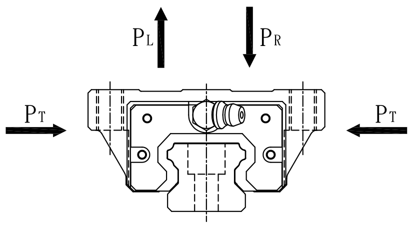


Fig 1.6.3 Directions of the Load and Moment Exerted on the Linear Guide

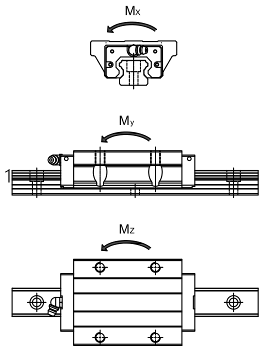


Fig 1.6.4

Equivalent load P_E

When more than one load (e.g., radial and lateral loads) is exerted on the Linear Guide simultaneously, the service life and static safety factors should be calculated by using equivalent load values obtained by converting all loads involved into radial, lateral, and other loads involved.

Equivalent-load equation

The Linear Guide can bear loads and moments from all directions, including a radial load (P_R), reverse-radial load (P_L) and lateral load (P_T) simultaneously.

When a radial load ($P_{R(L)}$) and a lateral (P_T) are applied simultaneously the equivalent load can be obtained by using the following equation.

P_E : (equivalent load) = $X \cdot P_{R(L)} + Y \cdot P_T$
$P_{R(L)}$: Radial load
P_T : Lateral load
X, Y = 1

1-7 Calculation of Average Working Load

■ 1-7-1 Calculating the Mean Load

An industrial robot grasp a workpiece by its arm as it advances, moving forward with the load, when it returns, the arm has no load other than its tare. In a machine tool, Linear Guide blocks receive variable loads according to the host-system operating conditions. Therefore, the calculation of service life should take such fluctuation into consideration.

When the service life of a Linear Guide with variable load is equal to the one with certain load then that certain load is called the Mean Load (P_m).

$$P_m = \sqrt[3]{\frac{1}{L} \cdot \Sigma \left(P_n^3 \cdot L_n \right)}$$

P_m : Mean load (kg)
P_n : Varying load (kg)
L_c : Total running distance (mm)
L_n : Running distance under load Pn(mm)

(1) For Loads with Stepwise Change

$$P_m = \sqrt[3]{\frac{1}{L}\left(P_1^3 \cdot L_1 + P_2^3 \cdot L_2 \cdot ...+ P_n^3 \cdot L_n\right)} \quad ....(1)$$

P_m : Mean load (kg)
P_n : Varying load (kg)
L_c : Total running distance (mm)
L_n : Running distance under load Pn(mm)

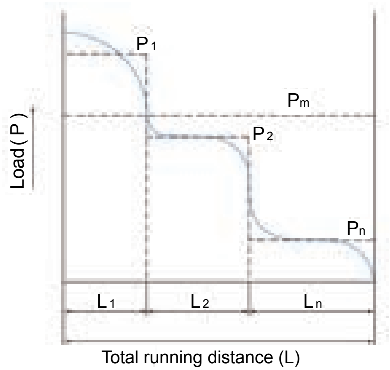


Fig 1.7.1

※This equation and equation (1) below apply in cases in which therolling elements are balls.

(2) For Loads with Monotonous Changes

$$P_m \fallingdotseq \frac{1}{3}\left(P_{min} + 2 \cdot P_{max}\right) \text{.........(2)}$$

P_{min} : minimum load (kg)
P_{max} : maximum load (kg)

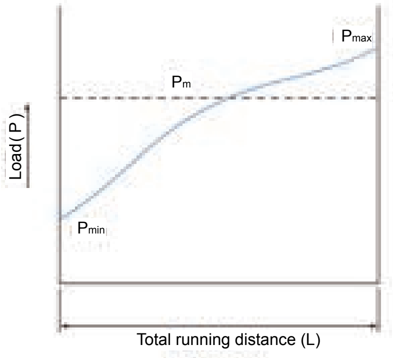


Fig 1.7.2

(3) For Loads with Sinusoidal Changes

$P_m \fallingdotseq 0.65P_{max}$ ....(3)

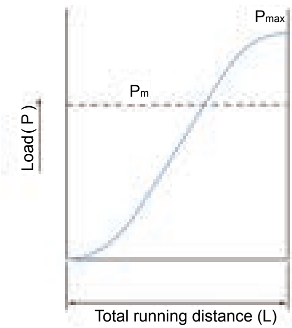


Fig 1.7.3

$P_m \fallingdotseq 0.75P_{max}$ ....(4)

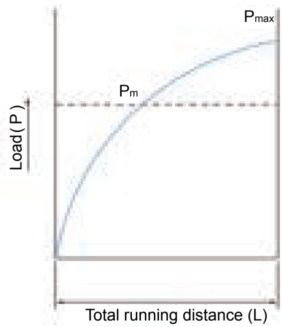


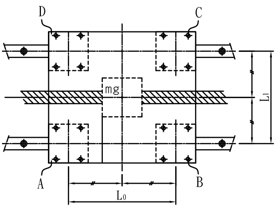
Fig 1.7.4

A Linear Guide

1-7 Calculation of Average Working Load

■ 1-7-2 Mean Load Calculation Example (I)

(1) Horizontal Installations are subjected to Acceleration and Deceleration



$$\alpha_1 = \frac{V}{t_1}\ m/s^2$$

Fig 1.7.5

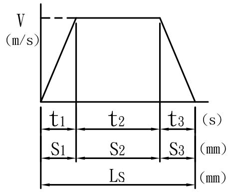


Fig 1.7.6

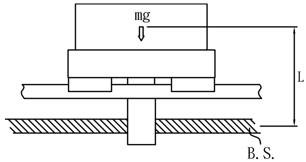


Fig 1.7.7

(2) Load Applied to the Linear Guide Block

1. During uniform motion

$$P_1 = +\frac{mg}{4}$$
$$P_2 = +\frac{mg}{4}$$
$$P_3 = +\frac{mg}{4}$$
$$P_4 = +\frac{mg}{4}$$

2. During acceleration

$$P_{a_1} = P_1 + \frac{m \cdot \alpha_1 \cdot L_2}{2 \cdot L_0}$$
$$P_{a_2} = P_2 + \frac{m \cdot \alpha_1 \cdot L_2}{2 \cdot L_0}$$
$$P_{a_3} = P_3 + \frac{m \cdot \alpha_1 \cdot L_2}{2 \cdot L_0}$$
$$P_{a_4} = P_4 + \frac{m \cdot \alpha_1 \cdot L_2}{2 \cdot L_0}$$

3. During deceleration

$$P_{d_1} = P_1 - \frac{m \cdot \alpha_1 \cdot L_2}{2 \cdot L_0}$$
$$P_{d_2} = P_2 + \frac{m \cdot \alpha_1 \cdot L_2}{2 \cdot L_0}$$
$$P_{d_3} = P_3 + \frac{m \cdot \alpha_1 \cdot L_2}{2 \cdot L_0}$$
$$P_{d_4} = P_4 + \frac{m \cdot \alpha_1 \cdot L_2}{2 \cdot L_0}$$

(3) Mean Load

$$P_{m_1} = \sqrt[3]{\frac{1}{L_s}\left(P_{a_1}^3 \cdot S_1 + P_1^3 \cdot S_2 + P_d^3 \cdot S_3\right)}$$
$$P_{m_3} = \sqrt[3]{\frac{1}{L_s}\left(P_{a_3}^3 \cdot S_1 + P_3^3 \cdot S_2 + P_{d_3}^3 \cdot S_3\right)}$$
$$P_{m_2} = \sqrt[3]{\frac{1}{L_s}\left(P_{a_2}^3 \cdot S_1 + P_2^3 \cdot S_2 + P_{d_2}^3 \cdot S_3\right)}$$
$$P_{m_4} = \sqrt[3]{\frac{1}{L_s}\left(P_{a_4}^3 \cdot S_1 + P_4^3 \cdot S_2 + P_{d_4}^3 \cdot S_3\right)}$$

※Pan1・Pdn represent loads exerted on the Linear Guide block. The suffix "n" indicates the block number in the diagram above.

Mean Load Calculation Example (II)

(1) Operating conditions-Installations on Rails.

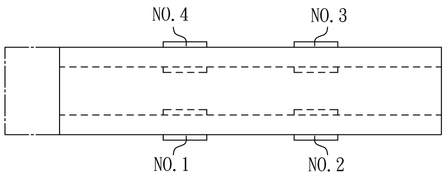


Fig 1.7.8

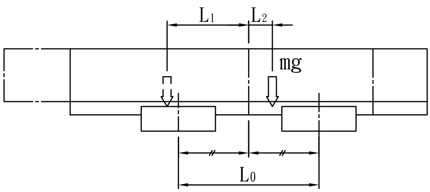


Fig 1.7.9

(2) Load applied to the Linear Guide block

1. At the left of the arm

$$P_{L1}=+\frac{mg}{4}+\frac{mg\cdot L_1}{2\cdot L_0}$$

$$P_{L2}=+\frac{mg}{4}-\frac{mg\cdot L_1}{2\cdot L_0}$$

$$P_{L3}=+\frac{mg}{4}-\frac{mg\cdot L_1}{2\cdot L_0}$$

$$P_{L4}=+\frac{mg}{4}+\frac{mg\cdot L_1}{2\cdot L_0}$$

2. At the right of the arm

$$P_{r1}=+\frac{mg}{4}-\frac{mg\cdot L_1}{2\cdot L_0}$$

$$P_{r2}=+\frac{mg}{4}+\frac{mg\cdot L_1}{2\cdot L_0}$$

$$P_{r3}=+\frac{mg}{4}+\frac{mg\cdot L_1}{2\cdot L_0}$$

$$P_{r4}=+\frac{mg}{4}-\frac{mg\cdot L_1}{2\cdot L_0}$$

(3) Mean load

$$P_{m1}=\frac{1}{3}\left(2\cdot|P_{L1}|+|P_{r1}|\right)$$

$$P_{m1}=\frac{1}{3}\left(2\cdot|P_{L2}|+|P_{r2}|\right)$$

$$P_{m1}=\frac{1}{3}\left(2\cdot|P_{L3}|+|P_{r3}|\right)$$

$$P_{m1}=\frac{1}{3}\left(2\cdot|P_{L4}|+|P_{r4}|\right)$$

※PLn・Pm represent loads exerted on the Linear Guide block. The suffix "n" indicates the block number in the diagram above.

1-8 Calculation Example

■ 1-8-1 Calculation Examples (I)

(1) Operating conditions-Horizontal installations subjected to high acceleration and deceleration.

Model number : TRH30FE
Basic dynamic-load rating C = 4791 kg
Basic static-load rating C_0 = 9004 kg
Gravitational acceleration : g = 9.8 (m/s^2)
Load : m_1 = 600 kg
Load : m_2 = 380 kg
Velocity : V = 0.5 m/s
Time : t_1 = 0.05 s
Time : t_2 = 2.8 s
Time : t_3 = 0.15 s

Acceleration : a_1 = 10 m/s^2
Deceleration : a_3 = 3.333 m/s^2
Stroke : L_s = 1450 mm
Distance : L_0 = 600 mm
L_1 = 400 mm
L_2 = 100 mm
L_3 = 50 mm
L_4 = 200 mm
L_5 = 400 mm

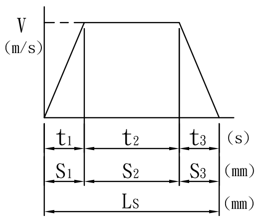


Fig 1.8.1

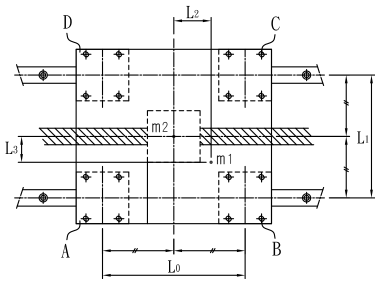


Fig 1.8.2

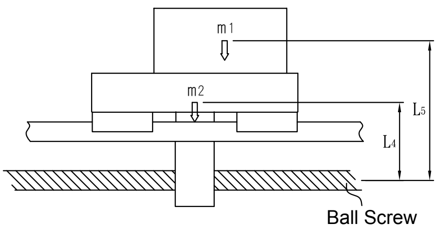


Fig 1.8.3

(2) Load Exerted on the Linear Guide by the Linear Guide Block

The calculations of blocks' load distribution under various circumstances.

1. In uniform motion Load applied in radial direction P_n (Base on the first condition of load exerted (please refer to page A15, No.1), taking m_1 and m_2 into consideration.

$$P_A=\frac{m_1}{4}-\frac{m_1\cdot L_2}{2\cdot L_0}+\frac{m_1\cdot L_3}{2\cdot L_1}+\frac{m_2}{4}=232.5\text{ kg} \qquad P_C=\frac{m_1}{4}+\frac{m_1\cdot L_2}{2\cdot L_0}-\frac{m_1\cdot L_3}{2\cdot L_1}+\frac{m_2}{4}=257.5\text{ kg}$$

$$P_B=\frac{m_1}{4}+\frac{m_1\cdot L_2}{2\cdot L_0}+\frac{m_1\cdot L_3}{2\cdot L_1}+\frac{m_2}{4}=332.5\text{ kg} \qquad P_D=\frac{m_1}{4}-\frac{m_1\cdot L_2}{2\cdot L_0}-\frac{m_1\cdot L_3}{2\cdot L_1}+\frac{m_2}{4}=157.5\text{ kg}$$

2. During acceleration to the left Load applied in radial direction P_nL_a and lateral direction $P_{nt}L_a$ (Base on the 8th condition of load exerted (please refer to page A18. No.8). The load should allocate on the central of table, and $\frac{m_1}{4}$ should be re-placed (please refer to page A15. No.1) by P_n).

$$P_AL_a=P_A-\frac{m_1\cdot a_1\cdot L_5}{2\cdot L_0\cdot g}-\frac{m_2\cdot a_1\cdot L_4}{2\cdot L_0\cdot g}=-36.206\text{ kg} \qquad P_CL_a=P_C-\frac{m_1\cdot a_1\cdot L_5}{2\cdot L_0\cdot g}-\frac{m_2\cdot a_1\cdot L_4}{2\cdot L_0\cdot g}=-11.206\text{ kg}$$

$$P_BL_a=P_B-\frac{m_1\cdot a_1\cdot L_5}{2\cdot L_0\cdot g}-\frac{m_2\cdot a_1\cdot L_4}{2\cdot L_0\cdot g}=63.794\text{ kg} \qquad P_DL_a=P_D-\frac{m_1\cdot a_1\cdot L_5}{2\cdot L_0\cdot g}-\frac{m_2\cdot a_1\cdot L_4}{2\cdot L_0\cdot g}=-111.206\text{ kg}$$

$$P_{At}L_a=-\frac{m_1\cdot a_1\cdot L_3}{2\cdot L_0\cdot g}=-25.51\text{ kg} \qquad P_{Ct}L_a=\frac{m_1\cdot a_1\cdot L_3}{2\cdot L_0\cdot g}=25.51\text{ kg}$$

$$P_{Bt}L_a=\frac{m_1\cdot a_1\cdot L_3}{2\cdot L_0\cdot g}=25.51\text{ kg} \qquad P_{Dt}L_a=-\frac{m_1\cdot a_1\cdot L_3}{2\cdot L_0\cdot g}=-25.51\text{ kg}$$

3. During deceleration to the left Load applied in radial direction P_nL_d

$$P_AL_d=P_A+\frac{m_1\cdot a_3\cdot L_5}{2\cdot L_0\cdot g}+\frac{m_2\cdot a_3\cdot L_4}{2\cdot L_0\cdot g}=334.53\text{ kg} \qquad P_CL_d=P_C-\frac{m_1\cdot a_3\cdot L_5}{2\cdot L_0\cdot g}-\frac{m_2\cdot a_3\cdot L_4}{2\cdot L_0\cdot g}=155.47\text{ kg}$$

$$P_BL_d=P_B-\frac{m_1\cdot a_3\cdot L_5}{2\cdot L_0\cdot g}-\frac{m_2\cdot a_3\cdot L_4}{2\cdot L_0\cdot g}=230.47\text{ kg} \qquad P_DL_d=P_D+\frac{m_1\cdot a_3\cdot L_5}{2\cdot L_0\cdot g}+\frac{m_2\cdot a_3\cdot L_4}{2\cdot L_0\cdot g}=259.53\text{ kg}$$

Load applied in lateral direction $P_{nt}L_d$

$$P_{At}L_d=\frac{m_1\cdot a_3\cdot L_3}{2\cdot L_0\cdot g}=2.721\text{ kg} \qquad P_{Ct}L_d=-\frac{m_1\cdot a_3\cdot L_3}{2\cdot L_0\cdot g}=-2.721\text{ kg}$$

$$P_{Bt}L_d=-\frac{m_1\cdot a_3\cdot L_3}{2\cdot L_0\cdot g}=-2.721\text{ kg} \qquad P_{Dt}L_d=\frac{m_1\cdot a_3\cdot L_3}{2\cdot L_0\cdot g}=2.721\text{ kg}$$

1-8 Calculation Example

4. During acceleration to the right Load applied in radial direction P_nR_a

$$P_AR_a = P_A + \frac{m_1 \cdot a_1 \cdot L_5}{2 \cdot L_0 \cdot g} + \frac{m_2 \cdot a_1 \cdot L_4}{2 \cdot L_0 \cdot g} = 501.206 \text{ kg} \qquad P_CR_a = P_C - \frac{m_1 \cdot a_1 \cdot L_5}{2 \cdot L_0 \cdot g} - \frac{m_2 \cdot a_1 \cdot L_4}{2 \cdot L_0 \cdot g} = -21.206 \text{ kg}$$

$$P_BR_a = P_B - \frac{m_1 \cdot a_1 \cdot L_5}{2 \cdot L_0 \cdot g} - \frac{m_2 \cdot a_1 \cdot L_4}{2 \cdot L_0 \cdot g} = 63.794 \text{ kg} \qquad P_DR_a = P_D + \frac{m_1 \cdot a_1 \cdot L_5}{2 \cdot L_0 \cdot g} + \frac{m_2 \cdot a_1 \cdot L_4}{2 \cdot L_0 \cdot g} = 426.206 \text{ kg}$$

Load applied in lateral direction P_nR

$$P_{At}R_d = \frac{m_1 \cdot a_1 \cdot L_3}{2 \cdot L_0 \cdot g} = 25.51 \text{ kg} \qquad P_{Ct}R_d = -\frac{m_1 \cdot a_1 \cdot L_3}{2 \cdot L_0 \cdot g} = -25.51 \text{ kg}$$

$$P_{Bt}R_d = -\frac{m_1 \cdot a_1 \cdot L_3}{2 \cdot L_0 \cdot g} = -25.51 \text{ kg} \qquad P_{Dt}R_d = \frac{m_1 \cdot a_1 \cdot L_3}{2 \cdot L_0 \cdot g} = 25.51 \text{ kg}$$

5. During deceleration to the right Load applied in radial direction P_nR_d and Load applied in lateral direction P_nR_d

$$P_AR_d = P_A - \frac{m_1 \cdot a_3 \cdot L_5}{2 \cdot L_0 \cdot g} - \frac{m_2 \cdot a_3 \cdot L_4}{2 \cdot L_0 \cdot g} = 130.47 \text{ kg}$$

$$P_BR_d = P_B + \frac{m_1 \cdot a_3 \cdot L_5}{2 \cdot L_0 \cdot g} + \frac{m_2 \cdot a_3 \cdot L_4}{2 \cdot L_0 \cdot g} = 434.53 \text{ kg}$$

$$P_CR_d = P_C + \frac{m_1 \cdot a_3 \cdot L_5}{2 \cdot L_0 \cdot g} + \frac{m_2 \cdot a_3 \cdot L_4}{2 \cdot L_0 \cdot g} = 359.53 \text{ kg}$$

$$P_DR_d = P_D - \frac{m_1 \cdot a_3 \cdot L_5}{2 \cdot L_0 \cdot g} - \frac{m_2 \cdot a_3 \cdot L_4}{2 \cdot L_0 \cdot g} = 55.47 \text{ kg}$$

Load applied in lateral direction $P_{nt}R_d$

$$P_{At}R_d = -\frac{m_1 \cdot a_3 \cdot L_3}{2 \cdot L_0 \cdot g} = -2.721 \text{ kg} \qquad P_{Ct}R_d = \frac{m_1 \cdot a_3 \cdot L_3}{2 \cdot L_0 \cdot g} = 2.721 \text{ kg}$$

$$P_{Bt}R_d = \frac{m_1 \cdot a_3 \cdot L_3}{2 \cdot L_0 \cdot g} = 2.721 \text{ kg} \qquad P_{Dt}R_d = -\frac{m_1 \cdot a_3 \cdot L_3}{2 \cdot L_0 \cdot g} = -2.721 \text{ kg}$$

(3) Combined radial and thrust load P_{En}

1. In uniform motion P_{En}

$P_{EA}=P_A=232.5$ kg
$P_{EB}=P_B=332.5$ kg
$P_{EC}=P_C=257.5$ kg
$P_{ED}=P_D=157.5$ kg

2. During acceleration to the left $P_{En}L_a$

$P_{EA}L_a=|P_AL_a|+|P_{At}L_a|=61.716$ kg
$P_{EB}L_a=|P_BL_a|+|P_{Bt}L_a|=89.304$ kg
$P_{EC}L_a=|P_CL_a|+|P_{Ct}L_a|=36.716$ kg
$P_{ED}L_a=|P_DL_a|+|P_{Dt}L_a|=136.716$ kg

3. During deceleration to the left $P_{En}L_d$

$P_{EA}L_d=|P_AL_d|+|P_{At}L_d|=337.251$ kg
$P_{EB}L_d=|P_BL_d|+|P_{Bt}L_d|=233.191$ kg
$P_{EC}L_d=|P_CL_d|+|P_{Ct}L_d|=158.191$ kg
$P_{ED}L_d=|P_DL_d|+|P_{Dt}L_d|=262.251$ kg

4. During acceleration to the right $P_{En}R_a$

$P_{EA}R_a=|P_AR_a|+|P_{At}R_a|=526.716$ kg
$P_{EB}R_a=|P_BR_a|+|P_{Bt}R_a|=89.304$ kg
$P_{EC}R_a=|P_CR_a|+|P_{Ct}R_a|=46.716$ kg
$P_{ED}R_a=|P_DR_a|+|P_{Dt}R_a|=451.716$ kg

5. During deceleration to the right $P_{En}L_d$

$P_{EA}R_d=|PAR_d|+|P_{At}R_d|=133.191$ kg
$P_{EB}R_d=|P_BR_d|+|P_{Bt}R_d|=437.261$ kg
$P_{EC}R_d=|P_CR_d|+|P_{Ct}R_d|=360.251$ kg
$P_{ED}R_d=|P_DR_d|+|P_{Dt}R_d|=58.191$ kg

(4) Static Safety Factor

As shown above, it is during acceleration of the A Linear Guide to the right when the maximum load is exerted on the Linear Guide. Therefore, the static safety factor (f_s) becomes as follows :

$$f_s = \frac{C_0}{526.716} = \frac{9004}{526.716} = 17.09$$

1-8 Calculation Example

(5) Mean Load P_{mn}

For each block, load is different under uniform speed, acceleration and deceleration circumstances. To acquire service life, mean load must be calculated by acquiring the travel distance of each block during uniform speed, acceleration and deceleration in advance.

$_1=\frac{1}{2}t_1V=\frac{1}{2}(0.05)(0.5)\ m=0.0125\ m=12.5\ mm$ $\quad S_3=\frac{1}{2}t_3V=(0.15)(0.5)\ m=0.0375\ m=37.5\ mm$

$S_2=t_2V=(2.8)(0.5)\ m=1.4\ m=1400\ mm$ $\quad$ Nominal Life $L_s=S_1+S_2+S_3=1450\ mm$

The mean load on each LM block is as follows :

$$P_{mA}=\sqrt[3]{\frac{1}{2\cdot L_s}(P_{EA\ell a}^3\cdot S_1+P_{EA}^3\cdot S_2+P_{EA\ell d}^3\cdot S_3+P_{EARa}^3\cdot S_1+P_{EA}^3\cdot S_2+P_{EARd}^3\cdot S_3)}=236.88\ kg$$

$$P_{mB}=\sqrt[3]{\frac{1}{2\cdot L_s}(P_{EB\ell a}^3\cdot S_1+P_{EB}^3\cdot S_2+P_{EB\ell d}^3\cdot S_3+P_{EBRa}^3\cdot S_1+P_{EB}^3\cdot S_2+P_{EBRd}^3\cdot S_3)}=332.45\ kg$$

$$P_{mC}=\sqrt[3]{\frac{1}{2\cdot L_s}(P_{EC\ell a}^3\cdot S_1+P_{EC}^3\cdot S_2+P_{EC\ell d}^3\cdot S_3+P_{ECRa}^3\cdot S_1+P_{EC}^3\cdot S_2+P_{ECRd}^3\cdot S_3)}=257.84\ kg$$

$$P_{mD}=\sqrt[3]{\frac{1}{2\cdot L_s}(P_{ED\ell a}^3\cdot S_1+P_{ED}^3\cdot S_2+P_{ED\ell d}^3\cdot S_3+P_{EDRa}^3\cdot S_1+P_{ED}^3\cdot S_2+P_{EDRd}^3\cdot S_3)}=164.07\ kg$$

(6) Nominal life Ln (Assume f_w = 1.5)

$$L_A=\left(\frac{C}{f_w\cdot P_{mA}}\right)^3\cdot 50=122568.85\ km \qquad L_C=\left(\frac{C}{f_w\cdot P_{mC}}\right)^3\cdot 50=95044.15\ km$$

$$L_B=\left(\frac{C}{f_w\cdot P_{mB}}\right)^3\cdot 50=44339.87\ km \qquad L_D=\left(\frac{C}{f_w\cdot P_{mD}}\right)^3\cdot 50=368902.68\ km$$

※From these calculations, 44339.87 km (the running distance of Linear Guide No.B) is obtained as the service life of the Linear Guide used in a machine or system under the operating conditions specified above.

In the example above, we assume that we have two loads(W_1 and W_2). If there is only one load W_1, simply take W_2 as zero. The appropriate formula determined by condition of loading.

Example (II)

(1) Operation Conditions-Vertical Installations Table (L type) has combined blocks weight w_1 and w_2. Furthermore, the mass w_0 is applied during uniform ascent by Distance 1000 mm. After the mass is dropped, empty table is removed during uniform descent. The table has total four Linear Guide blocks.

Model number : TRH30FE	
(dynamic-load rating : C = 4791 kg)	L_0 =300 mm
(static-load rating : C_0 = 9004 kg)	L_1 =80 mm
Gravitational Acceleration : g = 9.8 (m/s^2)	L_2 =50 mm
Mass : m_0 = 200 kg	L_3 =280 mm
Weight of Table1 : m_1 = 400 kg	L_4 =150 mm
Weight of Table2 : m_2 = 200 kg	L_5 =250 mm

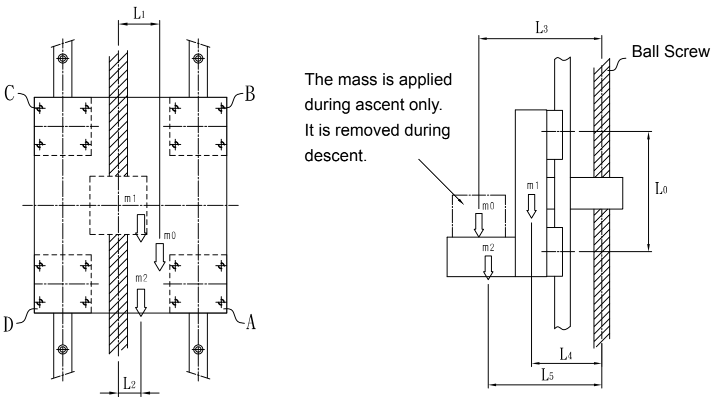


Fig 1.8.4

A Linear Guide

1-8 Calculation Example

(2) Calculation of blocks load distribution under various circumstances.

When the Linear Guide move vertically, take M_0, M_1 and M_2 into consideration individually by using the third condition shown in 1.5.1【please refer to A16. No.3】

1. The radial load(P_m) of blocks while ascending with load M_0.

$$P_{AU} = \frac{m_1 \cdot L_4}{2 \cdot L_0} + \frac{m_2 \cdot L_5}{2 \cdot L_0} + \frac{m_0 \cdot L_3}{2 \cdot L_0} = 276.7 \text{ kg} \qquad P_{CU} = -\frac{m_1 \cdot L_4}{2 \cdot L_0} - \frac{m_2 \cdot L_5}{2 \cdot L_0} - \frac{m_0 \cdot L_3}{2 \cdot L_0} = -276.7 \text{ kg}$$

$$P_{BU} = -\frac{m_1 \cdot L_4}{2 \cdot L_0} - \frac{m_2 \cdot L_5}{2 \cdot L_0} - \frac{m_0 \cdot L_3}{2 \cdot L_0} = -276.7 \text{ kg} \qquad P_{DU} = \frac{m_1 \cdot L_4}{2 \cdot L_0} + \frac{m_2 \cdot L_5}{2 \cdot L_0} + \frac{m_0 \cdot L_3}{2 \cdot L_0} = 276.7 \text{ kg}$$

Lateral load PnTu of blocks while ascending.

$$P_{A}T_{U} = \frac{m_1 \cdot L_2}{2 \cdot L_0} + \frac{m_2 \cdot L_2}{2 \cdot L_0} + \frac{m_0 \cdot L_1}{2 \cdot L_0} = 76.7 \text{ kg} \qquad P_{C}T_{U} = -\frac{m_1 \cdot L_2}{2 \cdot L_0} - \frac{m_2 \cdot L_2}{2 \cdot L_0} - \frac{m_0 \cdot L_1}{2 \cdot L_0} = -76.7 \text{ kg}$$

$$P_{B}T_{U} = -\frac{m_1 \cdot L_2}{2 \cdot L_0} - \frac{m_2 \cdot L_2}{2 \cdot L_0} - \frac{m_0 \cdot L_1}{2 \cdot L_0} = -76.7 \text{ kg} \qquad P_{D}T_{U} = \frac{m_1 \cdot L_2}{2 \cdot L_0} + \frac{m_2 \cdot L_2}{2 \cdot L_0} + \frac{m_0 \cdot L_1}{2 \cdot L_0} = 76.7 \text{ kg}$$

2. Radial load of each block while descending with no load.

$$P_{AD} = \frac{m_1 \cdot L_4}{2 \cdot L_0} + \frac{m_2 \cdot L_5}{2 \cdot L_0} = 183.3 \text{ kg} \qquad P_{CD} = -\frac{m_1 \cdot L_4}{2 \cdot L_0} - \frac{m_2 \cdot L_5}{2 \cdot L_0} = -183.3 \text{ kg}$$

$$P_{BD} = -\frac{m_1 \cdot L_4}{2 \cdot L_0} - \frac{m_2 \cdot L_5}{2 \cdot L_0} = -183.3 \text{ kg} \qquad P_{DD} = \frac{m_1 \cdot L_4}{2 \cdot L_0} + \frac{m_2 \cdot L_5}{2 \cdot L_0} = 183.3 \text{ kg}$$

Lateral load of block while descending.

$$P_{A}T_{D} = \frac{m_2 \cdot L_2}{2 \cdot L_0} + \frac{m_0 \cdot L_2}{2 \cdot L_0} = 33.3 \text{ kg} \qquad P_{C}T_{D} = -\frac{m_2 \cdot L_2}{2 \cdot L_0} - \frac{m_0 \cdot L_2}{2 \cdot L_0} = -33.3 \text{ kg}$$

$$P_{B}T_{D} = -\frac{m_2 \cdot L_2}{2 \cdot L_0} - \frac{m_0 \cdot L_2}{2 \cdot L_0} = -33.3 \text{ kg} \qquad P_{D}T_{D} = \frac{m_2 \cdot L_2}{2 \cdot L_0} + \frac{m_0 \cdot L_2}{2 \cdot L_0} = 33.3 \text{ kg}$$

(3) Combined radial and thrust load P_{En}

1. During ascent

$P_{EAU} = |P_{AU}| + |P_A T_U| = 353.4$ kg
$P_{EBU} = |P_{BU}| + |P_B T_U| = 353.4$ kg
$P_{ECU} = |P_{CU}| + |P_C T_U| = 353.4$ kg
$P_{EDU} = |P_{DU}| + |P_D T_U| = 353.4$ kg

$P_{EAD} = |P_{AD}| + |P_A T_D| = 216.6$ kg
$P_{EBD} = |P_{BD}| + |P_B T_D| = 216.6$ kg
$P_{ECD} = |P_{CD}| + |P_C T_D| = 216.6$ kg
$P_{EDD} = |P_{DD}| + |P_D T_D| = 216.6$ kg

(4) Static Safety Factor

The static safety factor (f_s) of a machine or system under the operating conditions shown above becomes the following :

$$f_s = \frac{C_0}{353.4\text{kg}} = \frac{9004}{353.4} = 25.48$$

(5) Mean Load P_{mn}

$$P_{mA} = \sqrt[3]{\frac{1}{2\ell s}\left(P_{EAU}^3 \cdot \ell_s + P_{EAD}^3 \cdot \ell_s\right)} = 300.6 \text{ kg} \quad P_{mC} = \sqrt[3]{\frac{1}{2\ell s}\left(P_{ECU}^3 \cdot \ell_s + P_{ECD}^3 \cdot \ell_s\right)} = 300.6 \text{ kg}$$

$$P_{mB} = \sqrt[3]{\frac{1}{2\ell s}\left(P_{EBU}^3 \cdot \ell_s + P_{EBD}^3 \cdot \ell_s\right)} = 300.6 \text{ kg} \quad P_{mD} = \sqrt[3]{\frac{1}{2\ell s}\left(P_{EDU}^3 \cdot \ell_s + P_{EDD}^3 \cdot \ell_s\right)} = 300.6 \text{ kg}$$

(6) Nominal life L_n (Assume $f_w = 1.2$)

$$L_A = \left(\frac{C}{f_w \cdot P_{mA}}\right)^3 \cdot 50\text{km} = 117148.8 \text{ km} \qquad L_C = \left(\frac{C}{f_w \cdot P_{mC}}\right)^3 \cdot 50\text{km} = 117148.8 \text{ km}$$

$$L_B = \left(\frac{C}{f_w \cdot P_{mB}}\right)^3 \cdot 50 \text{ km} = 117148.8 \text{ km} \qquad L_D = \left(\frac{C}{f_w \cdot P_{mD}}\right)^3 \cdot 50\text{km} = 117148.8 \text{ km}$$

A

Linear Guide

1-9 Accuracy

■ 1-9-1 Accuracy Standards

The accuracy of rail is determined by the tolerance of its parallelism, height and width, if there is multiple blocks on a rail or multiple Linear Guide on a surface, the difference of height and width between each block and Linear Guide are standardized and shown in the catalogue.

Running Parallelism

Mount a Linear Guide on a datum surface and measure the parallelism difference of block while operating its full travel distance.

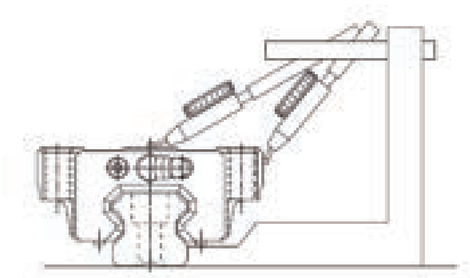


Fig 1.9.1 Running Parallelism

Difference in Height M among Linear Guide Blocks

On the same datum surface, the difference between maximum and minimum height of each block.

Difference in Rail-to-Block Lateral Distance W_2 among Linear Guide Blocks

On the same rail, the difference between maximum and minimum width of each block.

※Note.1
With two or more sets of Linear Guide installed in parallel on the same plane, the tolerance for the rail-to-block lateral distance (W2) and the differences therein among Linear Guide blocks apply to the master – rail side only.

※Note.2
Accuracy measurements indicate mean values of measurements taken at the center or central area of each Linear Guide block.

※Note.3
Linear Guide rails are smoothly curved so that when they are installed on a machine they are easily straightened, and pressing them onto the machine reference base enables the design accuracy to be achieved. If installed on a base lacking rigidity, such as an aluminum base, the bend of LinearGuide rails may affect machine precision. In such a case, the straightness should be set in advance.

■ 1-9-2 Averaging Effect

The Linear Guide incorporates precision balls with high circularity, enabling a constrained structure with no clearance. Moreover, in a multiple-axis configuration with the axis arranged in parallel to one another, the component Linear Guides therein combine to form an entire constrained guideway.

The effect of equalization is different, due to the error of length, size, preload of rail, axis constrained structure and etc, as the table shown below; adding one rail a straightness error and its actual operating accuracy is shown in the diagram below. Through the feature of equalization, a high operating accuracy structure can be provided.

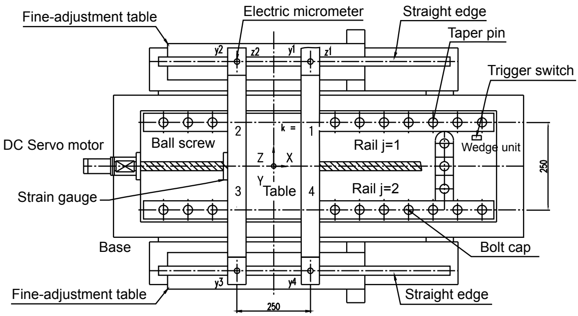


Fig 1.9.2

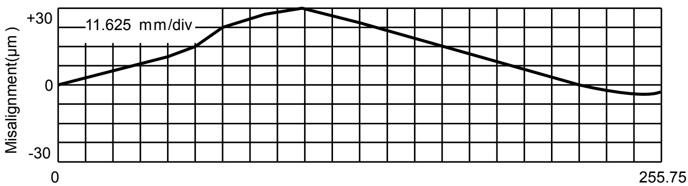


Fig 1.9.3 Misalignment profile

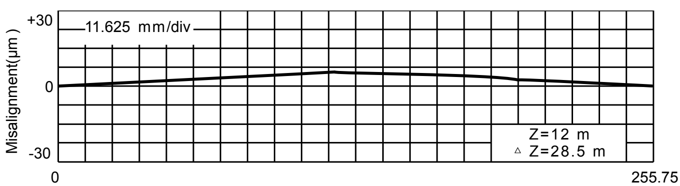


Fig 1.9.4 Horizontal displacement of the table

1-10 Predicting the Rigidity

■ 1-10-1 Determining Radial Clearance and the Magnitude of a Preload Radial Clearance

The radial clearance of the Linear Guide is the displacement of Linear Guide block caused by the vertical plane when the block is lightly pushed forward or backward at the longitudinal center of the Linear Guide rail secured in place.

The radial clearance is divided into ZF (Slight Clearance), Z0 (No Preload), Clearance Z1 (light preload), Z2 (medium preload) and Z3 (heavy preload).The most appropriate clearance can be selected in accordance with the intended applications. The radial clearances and preload values are standardized for each type of Linear Guide.

The radial clearance of the Linear Guide significantly affects its running precision, load-withstanding performance, and rigidity. It is therefore particularly important to select the correct clearance for your purpose. In generally, a negative clearance has a favorable effect on service life and precision, if the Linear Guide is subjected to significant vibration and impact due to reciprocal motion.

Preload

The preload is an internal load exerted on rolling elements in the Linear Guide block, for the purpose of increasing the block rigidity and reducing clearance. Clearance symbol for the Liner Guide, ZF, Z0, Z1, Z2 and Z3 represent negative clearance resulting from a preload and are expressed in negative values. All Linear Guide models (excluding the separate type) are shipped with their clearance adjusted to user specifications. Therefore, it is not necessary for users to adjust the preload themselves. We will select the clearance suited to your operating conditions. Please contact us.

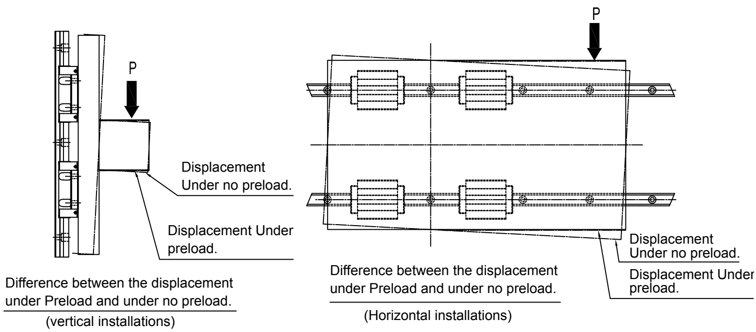


Fig 1.10.1 Relationship Between Preload and Displacement

Table 1.10.1

	Preload		
	ZF~Z0 Slight Clearance, Zero Preload.	Z1 Zero Clearance, Light Preload.	Z2 Zero Clearance, Medium preload.
OperatingConditions	The loading direction is fixed; impact and vibration are slight; two axes are installed in parallel. High precision is not required and the sliding resistance must be low.	The location in under an overhang and a moment load. The Linear Guide is used in a one-axis configuration. The location with light load and high precision requirement.	The location requires light rigidity and is subjected to vibration and impact. The application is a heavy-cutting machine tool or the like.
SampleApplications	◆ Beam-welding machine. ◆ Book-binding machine. ◆ Automatic packing machine. ◆ General-industrial-machine ◆ X-axis and Y-axis. ◆ Automatic sash-bar finishing machine. ◆ Welding machine. ◆ Circuit breaker. ◆ Tool changer. ◆ Various kinds of maternal feedeer.	◆ Grinding-machine table feed shaft. ◆ Automatic painting machine. ◆ Industrial robot. ◆ Various kinds of high-speed material feeder. ◆ NC drilling machine. ◆ General-industrial-machine ◆ Z-axis. ◆ Printed-cricuit-board drilling machine. ◆ Electric discharge machine. ◆ Measuring instrument. ◆ Precision XY table.	◆ Machining center. ◆ NC lathe. ◆ Grinding-machine grinding-wheel feed shaft. ◆ Milling machine. ◆ Vertical-and horizontal-boring machines. ◆ Tool rest guide. ◆ Machine-tool Z-axis.

Applied Load and Service Life Considering

When the Linear Guide is used under a preload (medium), the Linear Guide block receives an internal load. Therefore, the service life should be calculated in consideration of the preload. For preload considerations, please contact us, specifying the model numbers you have selected.

■ 1-10-2 Rigidity

When the Linear Guide receives a load, the steel balls, Linear Guide blocks, and rails undergo elastic deformation within a permissible range. The ratio of deformation to the load is the rigidity value. The rigidity of the Linear Guide increases as the preload increases. The Fig below shows the differences among the ordinary clearance Z1 and clearance Z2, Z3. As shown, in the case of the four-way equal-load type, the effect of preloading remains valid until the load increases to some 2.8 times the preload applied.

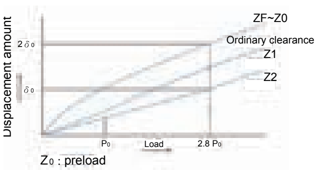


Fig 1.10.2 Rigidity Data

$$K = \frac{P}{\delta}$$

δ : Displacement (μm)
P : Load (kg)
K : Rigidity Value (kg/μm)

1-11 Installation of Linear Guide

■ 1-11-1 Datum Representation

The reference side of a rail is pointed by the ↑ at the end of TBI label, and the reference side for a carriage is at the opposite side TBI label, please see the picture below :

Marks

Rail: S30VN 120618-0001-P

- S30VN: Product Code
- 120618-0001: Production Number
- P: Accuracy Level

Block: S30VN B1234567-0003-P

- S30VN: Product Code
- B1234567-0003: Production Number
- P: Accuracy Level
- QR code: Production Number QR-Code

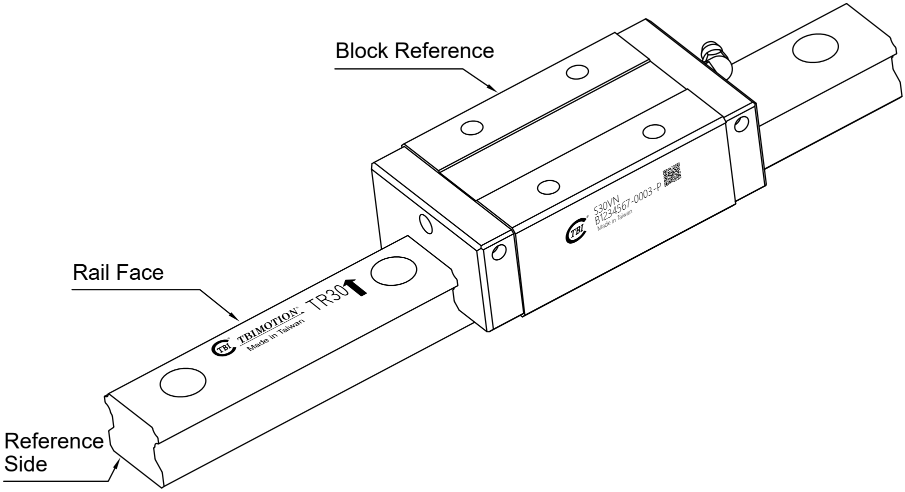


Fig 1.11.1 Datum Representation

■ 1-11-2 Recognizing of Master Rail

Linear rails to be applied on the same plane are all marked with the same serial number, and "M" is marked at the end of serial number for indicating the master rail, shown as the figure below. The reference side of carriage is the surface where is ground to a specified accuracy. For normal grade (N), it has no mark "M" on rail which means any one of rails with same serial number could be the master rail.

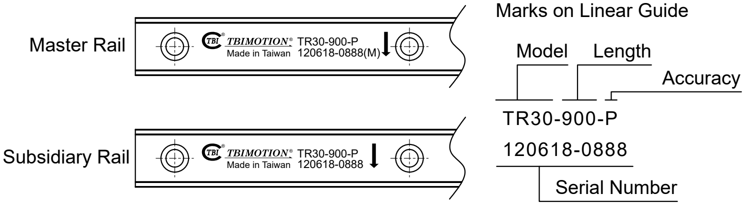


Fig 1.11.2 Recognizing of Master Rail

Combined Use of Rail and Carriage

For combined use, the rail and carriage must have the same serial number. When reinstalling the carriage back to the rail, make sure they have the same serial number and the reference side of carriage should be in accordance with that of rail.

1-11 Installation of Linear Guide

■ 1-11-3 For Butt-joint Rail

Accuracy may deviate at joints when carriages pass the joint simultaneously. Therefore, the joints should be interlaced for avoiding such accuracy problem.

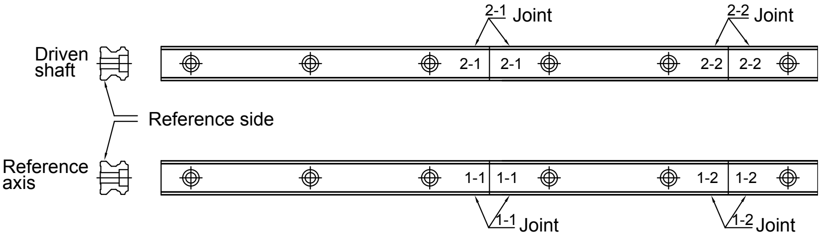


Fig 1.11.3 Butt-joint

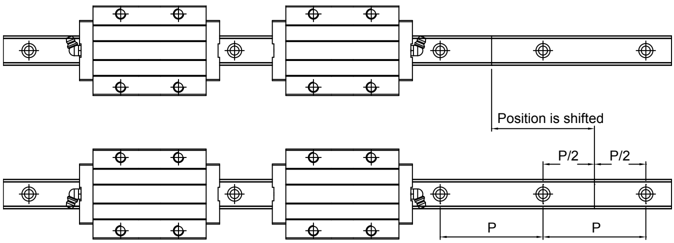
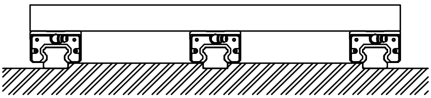
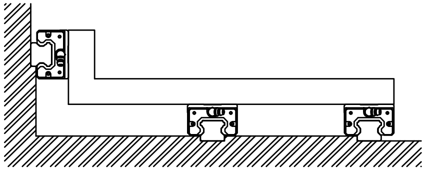
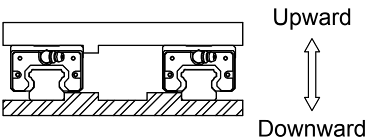
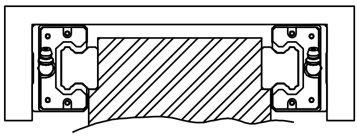
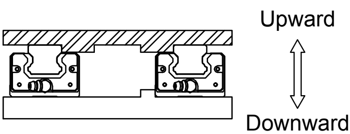
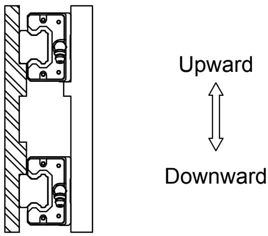
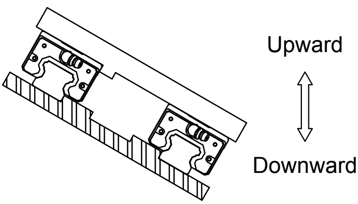
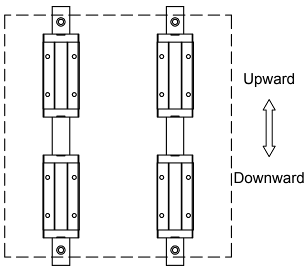


Fig 1.11.4

■ 1-11-4 Mounting Methods

Linear rail is designed to absorb the load of four dimensions; therefore, it can be mounted according to the load and structure of the equipment.

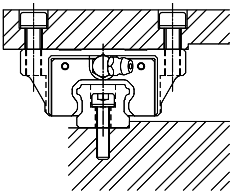
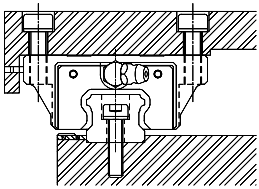
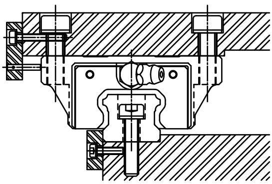
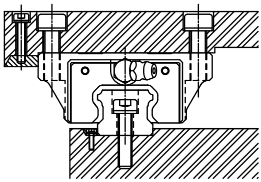
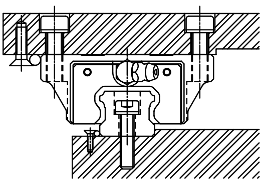
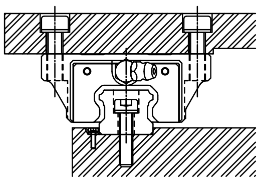
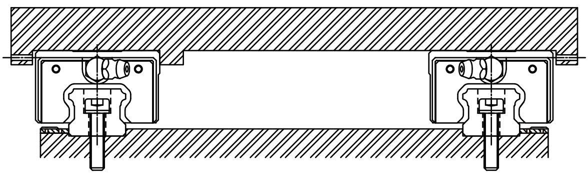
Table 1.11.1

(A)Three-Axis Configuration.	(B)Three-Axis Configuration.
	
Horizontal Configuration.	Two-Axis External Configuration.
	
Upside down Configuration.	Vertical Configuration.
	
Tilted Configuration.	Install on the wall.
	

1-11 Installation of Linear Guide

■ 1-11-5 Common Fastening Method of Linear Guide

Table 1.11.2

Fastened by pressing both Linear Guide blocks and rail against their respective reference surfaces.	Fastened by using push screws.
	
Fastened by using a hold-down plate.	Fastened by using a tapered gib.1
	
Fastened by using screws.	Fastened by using a tapered gib.2
	
A Setting Where the Host Machine is Subjected to Impact and Vibration.	
	

■ 1-11-6 Mounting the Linear Guide

Mounting Procedures

※Sample Installation of the Linear Guide on a Vibration-and-Impact Susceptible Machine that Requires Rigidity and High Precision.

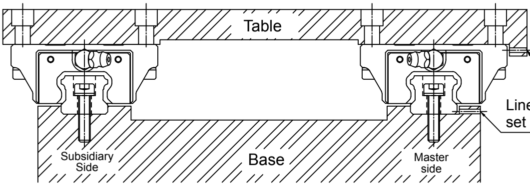


Fig 1.11.5 Mounting the Linear Guide on a Machine Susceptible to Vibration and Impact

Mounting the Linear Guide Rail

(A) Prior to assembly, always remove all burrs, dents and dust that are likely to form on the mounting surface of the machine on which Linear Guide is to be installed. (Fig 1.11.6)

CAUTION : The Linear Guide is delivered with an anticorrosive oil applied. Prior to assembly, be sure to remove the oil from the reference surface using a wash oil. If the anticorrosive oil is removed, the surface is likely to rust. The application of a low-viscosity spindle oil or the like is therefore recommended.

(B) Gently place a Linear Guide rail on the base, and temporarily tighten the bolts so that the rail lightly contacts the mounting surface. Hold the line marked side of the Linear Guide rail against matching the base-side reference surface (Fig 1.11.7)

CAUTION : Use clean bolts to fasten the Linear Guide. When inserting bolts into the Linear Guide rail mounting holes, make sure the threads of the bolt and nut are properly aligned. (Fig 1.11.8)

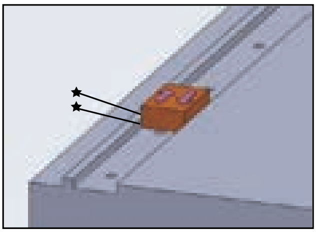


Fig 1.11.6 Checking the Mounting Surface.

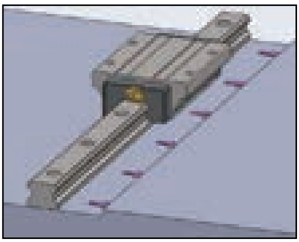


Fig 1.11.7 Holding an Linear Guide rail against the Reference Surface

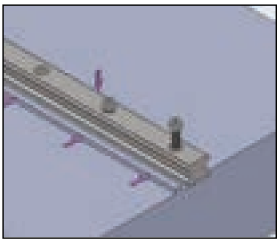


Fig 1.11.8 Checking Bolt Play

1-11 Installation of Linear Guide

Table 1.11.3 Tightening Torque for Allen Bolt Unit : N-cm

ModelNo.	TighteningTorque		
	Iron	Casting	Aluminum
M2	57	39.2	29.4
M2.3	78.4	53.9	39.2
M2.6	118	78.4	58.8
M3	186	127	98.0
M4	392	274	206
M5	882	588	441
M6	1370	921	686
M8	3040	2010	1470
M10	6760	4510	3330
M12	11800	7840	5880
M14	15700	10500	7840
M16	19600	13100	9800
M20	38200	25500	19100
M22	51900	34800	26000
M24	65700	44100	32800
M30	130000	87200	65200

(C) Tighten the Linear Guide rail set screws in sequence, until they lightly contact the rail-mounting side surface.(Fig 1.11.9)

(D) Using a torque wrench, tightening the mounting bolts to the specific torque.(Fig 1.11.10)
CAUTION : The sequence for tightening the Linear Guide rail mounting bolts should start from the center to the end. Following this sequence to maintain accuracy.

(E) Following the same procedures for the remaining Linear Guide rails, complete Linear Guide rail installation.

(F) Drive caps into the bolt holes on the Linear Guide rails so that they are flush with the rail top surface.

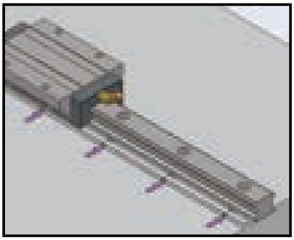


Fig 1.11.9 Tightening Set Screws

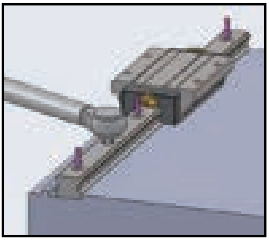


Fig 1.11.10 Full Tightening of Mounting Bolts

Mounting the Linear Guide Block

(A) Gently place a table on the Linear Guide blocks and temporarily tighten the mounting bolts.

(B) Using set screws, hold the master-rail Linear Guide block against the table reference-side surface, and position the table.

(C) Fully tighten the mounting bolts on both the master and subsidiary sides. This completes Linear Guide block installation.

CAUTION：To ensure uniform fastening of the table, tighten the mounting bolts diagonally, as shown in (Fig 1.11.11) in accordance with the numbers.

(D) Using a torque wrench, tightening the mounting bolts to the specified torque.(Fig 1.11.10)

CAUTION : The sequence for tightening the Linear Guide rail mounting bolts should start from the center to the end. Following this sequence to maintain.

The method specified above minimizes the time required to ensure the straightness of the Linear Guide-rail. Moreover, there is no need to use the fastening knock pins, thereby greatly reducing the required assembly man-hours.

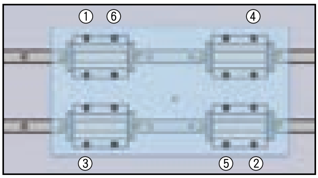


Fig 1.11.11

※Sample Installation of the Linear Guide without Set Screws on the Master Linear Guide Rail.

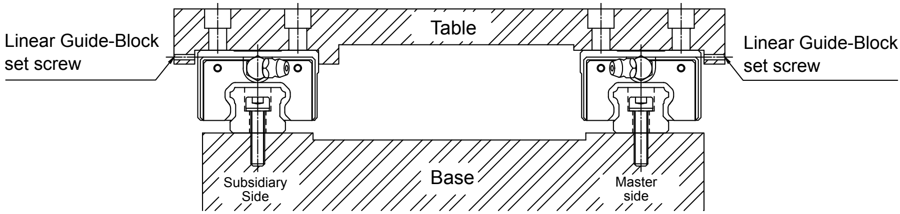


Fig 1.11.12 Mounting the Linear Guide without Set Screws on the Master Linear Guide Rail

A

Linear Guide

1-11 Installation of Linear Guide

Mounting the Master Linear Guide Rail

After temporarily tightening the mounting bolts, use a small device or the like to firmly press the rail to the side, against the reference section. Fully tighten the mounting bolts. Repeat this for each mounting bolt in sequence. (Fig 1.11.13)

Mounting the Subsidiary Linear Guide Rail

To ensure parallelism of the subsidiary Linear Guide rail with the master Linear Guide rail properly mounted, the following methods are recommended.

Use a Straight Edge

Position a straight edge between the two rails then confirm parallelism with a dial gauge. Using the straight edge as a reference to confirm subsidiary rail straightness from one end to the other, tightening the mounting bolts in sequence as you go. (Fig 1.11.14)

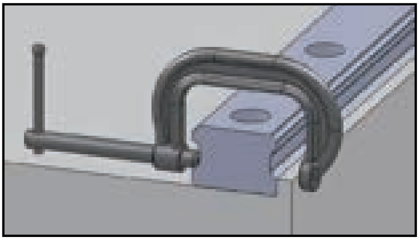


Fig 1.11.13 Mounting the master Linear Guide rail

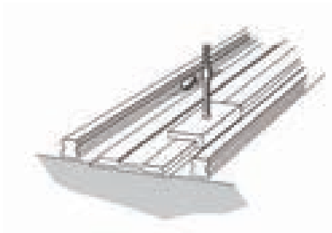


Fig 1.11.14 Use a straight edge

Move the Table

Fasten two Linear Guide blocks on the master side to the table (or a temporary measurement table). Temporary fasten the subsidiary Linear Guide rail and block to the base and table. From the dial-gauge stand, with a dial gauge contact the subsidiary rail Linear Guide block side, move the table from the rail end and check the parallelism between the block and the subsidiary Linear Guide rail, fastening the bolts on sequences as you go. (Fig 1.11.15)

Compare to the Master Linear Guide Rail

Make sure the master Linear Guide rail is properly installed.Temporarily fasten the subsidiary Linear Guide rail in place.Place a table on the Linear Guide blocks mounted on the master rail and on the temporarily fastened subsidiary Linear Guide rail. Fully tighten the mounting bolts on the two Linear Guide blocks on the subsidiary rail. With the remaining Linear Guide block on the subsidiary rail temporarily fastened, correct the position of the subsidiary Linear Guide rail, fully tightening its mounting bolts in sequence as you go. (Fig 1.11.16)

Method Using a Jig

Using a jig as shown in (Fig 1.11.17) confirm parallelism between the master-rail-side reference surface and that of the subsidiary rail at each mounting hole, and fully tighten the mounting bolt there.

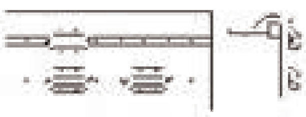


Fig 1.11.15 Move the table

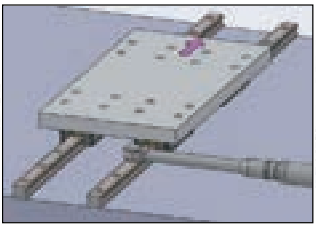


Fig 1.11.16 Compare to the master Linear Guide rail

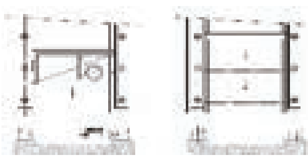


Fig 1.11.17

※Sample Installation of the Linear Guide without a Reference Section for the Master Linear Guide Rail.

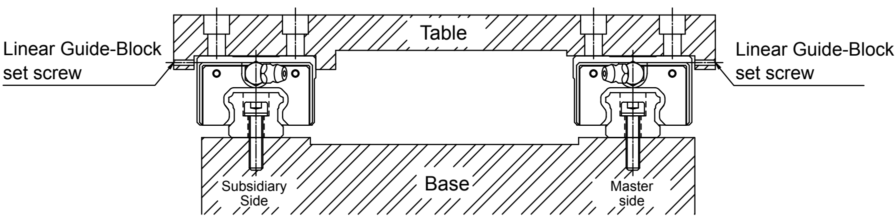


Fig 1.11.18 Installation of the Linear Guide without a Reference Section for the Master Linear Guide Rail

1-11 Installation of Linear Guide

Mounting the Master Linear Guide Rail

Use a Temporary Reference Surface from end to end to acquire Linear Guide rail straightness. For this method, however, two Linear Guide block must be fastened together, positioned on the top of each other while attached to a measurement plate, as shown in (Fig1.11.19).

Use a Straight Edge

After temporarily tightening the mounting bolts, use a dial gauge to check the straightness of the Linear Guide-rail-side reference surface from end to end, fully tightening the mounting bolts in sequence as you go, as shown in (Fig 1.11.20).

To mount the subsidiary Linear Guide rail, follow the procedures specified in the second paragraph on the previous page.

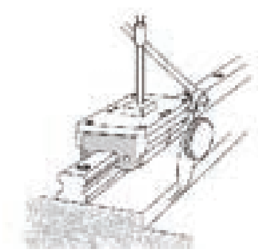


Fig 1.11.19 Use a Temporary Reference Surface

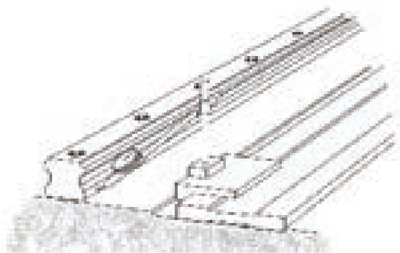


Fig 1.11.20 Use a Straight Edge

Shoulder Heights and Chamfers

Improper shoulder heights and chamfers of mounting surfaces will cause deviations in accuracy and rail or block interference with the chamfered part. When recommended shoulder heights and chamfers are used, problems with installation accuracy should be eliminated.

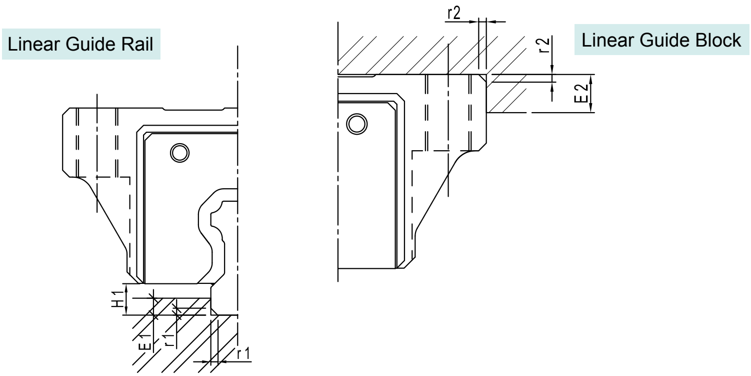


Fig 1.11.21

Table 1.11.4 Shoulder Height and Chamfer

Unit : mm

Model No.	Max.chamfer of the rail r1	Max.chamfer of the block r2	Max.chamfer of the rail E1	Max.chamfer of the rail E2	Max.chamfer of the block H1
TR15	0.5	0.5	3	4	3.2
TR20	0.5	0.5	3.5	5	4.6
TR25	1.0	0.9	5	5	5.8
TR30	1.0	1	5	5	7
TR35	1.0	1	6	6	7.5
TR45	1.0	1	8	8	8.9
TR55	1.5	1.5	10	10	13
TR65	1.5	1.5	8	10	14.3

1-12 Lubrication

Lubrication

Lubrication is essential to linear motion system. Without lubrication, the friction of rolling parts increases and might be the main factor of service life shortening.

A lubricant :

(1) Reduces friction on moving parts, thereby to prevent wearing due to raise in temperature.
(2) Forms an oil film on rolling surfaces, thus decreasing stress that develops on the surfaces and safeguarding the system against rolling fatigue.
(3) Covers metal surfaces with an oil film, thereby preventing rust.

To tap the full function of a linear motion system, lubrication is essential to meet the system service conditions.

※Even the linear motion system is sealed, it cannot completely prevent the leakage of lubricants no matter how negligible the amount of leakage is at any given time. It is therefore necessary to replenish the lubricant periodically according to the operating conditions.

Classification of Lubricants

Primarily grease and sliding surface oil are used as lubricants for linear motion systems.

In general a lubricant must :

(1) Form a strong oil film.
(2) Reduce wear as much as possible.
(3) Have high wear resistance.
(4) Have high thermal stability.
(5) Be non-corrosive.
(6) Be highly rust-preventive.
(7) Be free from dust and some moisture.
(8) Be free from significant fluctuations in consistency against repeated agitation of grease.

Table1.12.1 Lubricants in General Use

Lubricant	Classification	Item
Grease	Lithium-based grease (JIS No.2) Urea-base grease (JIS No.2)	※4FB Grease (TBI MOTION) Daphne Eponex Grease No.2 (Idemitsu Kosan) or equivalent.
Oil	Sliding surface oil or turbine oil ISO VG32~68	Super Multi 32 to 68 (Idemitsu Kosan) Vactra No.2S (Mobile Oil) DT Oil (Mobile Oil) Tonner Oil (Showa Shell Sekiyu) or equivalent

※Feeding Should be performed every 100 km of travel under normal usage conditions to prevent incomplete lubrication by exhausted lubrication.

1-13 Precautions of Linear Guide

Handling

(1) Tilting the linear guideway may cause the block falling out from the rail by their own weight.
(2) Hitting or Dropping the linear guideway may cause its function to be damaged, even if the product looks intact.
(3) Do not disassemble the block, this may cause contamination to enter into the carriage or decrease the installation accuracy.

Lubrication

(1) Please remove the anti-rust oil.
(2) Please do not mix different kinds of lubricants.
(3) Lubrication can be varied, please consult TBI Motion before use.

Usage

(1) The temperature of the place where linear guideways are used should not exceed 80°C. A higher temperature may damage the plastic end cap, do not exceed 100°c in friction.
(2) Using under special conditions, such as constant vibration, high contamination or the temperature exceed our suggested...etc., please contact TBI MOTION.

Storage

When storing the linear guideway, enclose it in a package and store it in a horizontal orientation while avoiding high temperature, low temperature and high humidity.

2-1 The Types of *TBI MOTION* Linear Guide

In an effort to meet customer's requirement, TBI MOTION offers several different types of guides. Except for TR international standard series, TBI MOTION develops TR series with self lubrication system which is designed for environment with high contamination and miniature TM series for small machines and semiconductor industry.

Table 2.1.1 ***TBI MOTION*** Linear guide table with all series

Type	Height of Assembly Type	Square	Flange Mounting from Above, Mounting from Below
TR	High-Assembly	TRH-V	TRH-F
	Low-Assembly	TRS-V	TRS-F
	Middle-Assembly	TRC-V	-

Table 2.1.2 ***TBI MOTION*** Linear Guide - Type & Series

Type	Accessory	Characteristics	EndCap
TR	XN : Strong Bottom Seal+Strong Double-lip end seals	Strong dust-proof Environment with high pollution	Reinforcement Type
	XNC : Strong Bottom Seal+Low Resistance End Seal		
	UN : Strong Top Seal+Strong Bottom Seal+Double-lip end seals		
	ZN : Strong Top Seal+Strong Bottom Seal+Strong Two Double-lip end seals		
	WW : Strong Bottom Seal+Felt+Strong Double-lip end seals	Self-lubrication/ Strong dust-proof Application with low rating load	
	WU : Strong Top Seal+Strong Bottom Seal+Felt+Strong Double-lip end seals		
	WZ : Strong Top Seal+Strong Bottom Seal+Felt+Strong Two Double-lip end seals		
	SU：Strong Top Seal+Strong Bottom Seal+Strong Double-lip end seals+Strong Metal Scraper	Strong dust-proof / Application with low rating load	
	SZ：Strong Top Seal+Strong Bottom Seal+Strong Two Double-lip end seals+Strong Metal Scraper		
	DU：Strong Top Seal+Strong Bottom Seal+Strong Double-lip end seals+Felt+Strong Metal Scraper	Self-lubrication/ Strong dust-proof / Application with low rating load	
	DZ：Strong Top Seal+Strong Bottom Seal+Strong Two Double-lip end seals+Felt+Strong Metal Scraper		
	BN : Strong Bottom Seal+Strong Double-lipendseals+Oil Reservoir	Long effects Self-lubrication/ Strong dust-proof	

※If Strengthen seals and Felt is required, please upgrade the block with enhanced end cap.
※XNC(Low Resistance End Seal) can be applied to TR15 to TR30.

2-2 TRH / TRS / TRC International Standard Linear Guide

■ 2-2-1 *TBI MOTION* The Characteristics of TR Series

Smooth Movement

TBI MOTION circulation system of Linear Guide block is designed to perform smooth movement.

High Stability

TBI MOTION Linear Guide block is designed under TBI's exclusive patent that can increases depth of material to improve the strength capacity, prevent deflection and provide high rigidity.

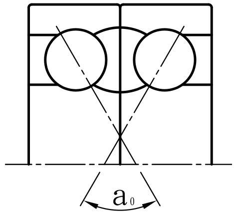


Fig 2.2.1

High Durability

TBI MOTION the exclusive contact point design promotes high rigidity. Moreover, self-aligning balances load rating in all directions. This design also improves performance in running accuracy and service life of the Linear Guide.

Easy Installation with Interchangeability

TBI MOTION Linear Guide is easy for installation even without fixture. The design of seal is able to combine with side seal or inner seal to save material.

■ 2-2-2 The Structure of TR-Series

Circulation unit :
① Block, ② Rail, ③ End Cap, ④ Steel Balls,
⑤ Circulation tube.

Lubrication unit :
⑥ Grease nipple.

Anti-Dust Unit :
⑦ End Seal, ⑧ Bottom Seal, ⑨ Mounting Hole Cap.

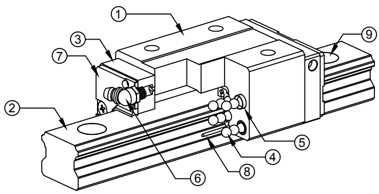


Fig 2.2.2

Fig 2.2.2 Material

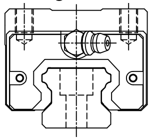
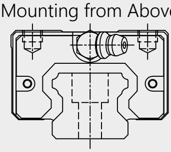
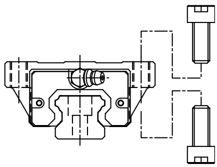
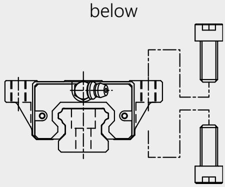
Item	Material	Hardness
TR-Rail	S55C	HRC 58°~62°
TR-Block	SCM420H	

2-2 TRH / TRS / TRC International Standard Linear Guide

■ 2-2-3 TR-Series

TBI MOTION offers standard and flange type. The assembly height and category are listed below :

Table 2.2.2

Type	Model	Shape	Height	Rail Length	Main Application
Standard	TRH-V TRC-V	Mounting from Above 	28 ↓ 90	100 ↓ 4000	● Machine Centers. ● NC Lathes. ● Food Machine. ● Grinding Machines. ● CNC Machine. ● Heavy Cutting Machines. ● Punching Machine. ● Injection Molding Machine. ● Automation Equipment. ● Transportation Equipment. ● Sealing machine.
	TRS-V	Mounting from Above 	24 ↓ 60	100 ↓ 4000	
Flange	TRH-F	Mounting from above and below 	24 ↓ 90	100 ↓ 4000	
	TRS-F	Mounting from above and below 	24 ↓ 60	100 ↓ 4000	

■ 2-2-4 Nominal Model Code for Non-Interchangeable TR Type

TR series can be classified into Separated and Assembled types. The sizes are identical; the only difference between the two types is that the accuracy of non-interchangeable types could reach up to UP grade since ***TBI MOTION*** makes the linear guide set under strict international regulation. Interchangeable blocks and rails can be freely exchanged; however, the accuracy could be up to H grade only due to technical issue. It is much more convenient for customers who do not need linear guides with high accuracy to have interchange blocks and rails.

Non-interchangeable Type code :

T	R	H	20	F	N	-	2	-		-	1200	-	N	-	Z0	-	II	-	K	+	N3	N3
①	②	③	④	⑤	⑥		⑦		⑧		⑨		⑩		⑪		⑫		⑬		⑭	⑮

①

Nominal Model
T

②

Block Type
R : Standard
X : Special

③

Height of Assembly Type
S : Low-Assembly
C : Middle-Assembly
H : High-Assembly

④

Dimension
15, 20, 25, 30, 35, 45, 55, 65

⑤

Flange Type
F : With Flange
V : Without Flange

⑥

Length of Block
S : Short
N : Normal
L : Long
E : Extra-Long

⑦

Number of Block Per Rail
EX : 2

⑧

Accessory Code
□ : Standard (Please refer to page A58)

⑨

Length of Rail
Unit : mm

⑩

Accuracy Grade
N : Normal
H : High
P : Precision
SP : Super-Precision
UP : Ultra-Precision

⑪

Preload
ZF : Slight Clearance
Z0 : No Preload
Z1 : Light Preload
Z2 : Medium Preload
Z3 : Heavy Preload

⑫

Two Sets per Axis
II

⑬

Rail Special Machining
□ : Mounting from Top
K : Mounting from Bottom
X : Rail with Special Machining

⑭

Block Surface Treatment
S : Standard
B1 : Black Oxidation
N1 : Hard Chrome Plating
P : Phosphating
N3 : Nickel Plating
N4 : Raydent
N5 : Chrome Plating

⑮

Rail Surface Treatment
S : Standard
B1 : Black Oxidation
N1 : Hard Chrome Plating
P : Phosphating
N3 : Nickel Plating
N4 : Raydent
N5 : Chrome Plating

※No symbol required when plating is not needed.

2-2 TRH / TRS / TRC International Standard Linear Guide

■ 2-2-5 Nominal Model Code for Interchangeable TR Type

Interchangeable Type of Block :

T	R	H	20	F	N	-		-	N	-	Z0	+	B1
①	②	③	④	⑤	⑥		⑦		⑧		⑨		⑩

①

Nominal Model
T

②

Block Type
R : Standard
X : Special

③

Height of Assembly Type
S : Low-Assembly
C : Middle-Assembly
H : High-Assembly

④

Dimension
15, 20, 25, 30, 35, 45, 55, 65

⑤

Flange Type
F : With Flange
V : Without Flange

⑥

Length of Block
S : Short
N : Normal
L : Long
E : Extra-Long

⑦

Accessory Code
□ : Standard

⑧

Accuracy Grade
N : Normal

⑨

Preload
ZF : Slight Clearance
Z0 : No Preload

⑩

Block Surface Treatment
□ : Standard
B1 : Black Oxidation
N1 : Hard Chrome Plating
P : Phosphating
N3 : Nickel Plating
N4 : Raydent
N5 : Chrome Plating

Interchangeable Type of Rail :

T R 20 - 4000 - N - K + B1

① ② ③ ④ ⑤ ⑥ ⑦

①

Nominal Model
T

②

Block Type
R : Standard
X : Special

③

Dimension
15, 20, 25, 30, 35, 45, 55, 65

④

Length of Rail
Unit : mm

⑤

Accuracy Grade
N : Normal

⑥

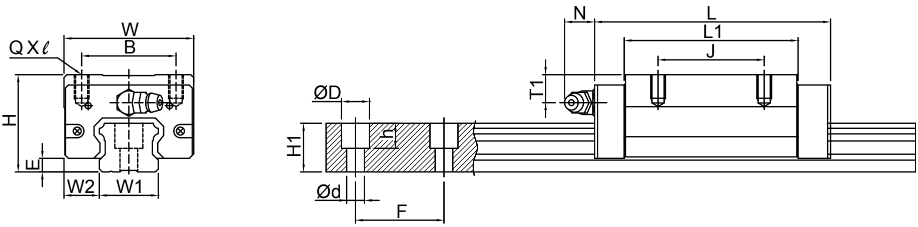
Rail Special Machining
□ : Mounting from Top
K : Mounting from Bottom
X : Rail with Special Machining

⑦

Rail Surface Treatment
□ : Standard
B1 : Black Oxidation
N1 : Hard Chrome Plating
P : Phosphating
N3 : Nickel Plating
N4 : Raydent
N5 : Chrome Plating

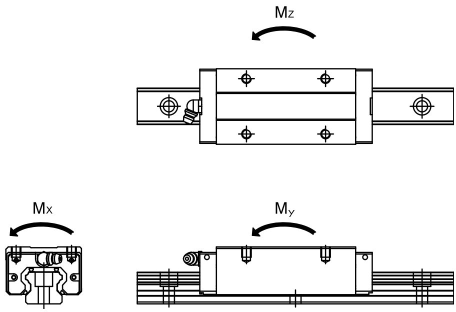
2-2 TRH / TRS / TRC International Standard Linear Guide

TRH-V Series Specifications



Model No.	Assembly (mm)			Block Dimension (mm)									Rail (mm)					
	H	W2	E	W	B	J	L	L1	QXℓ	T1	Oil Hole	N	W1	H1	ØD	h	Ød	F
TRH15VN	28	9.5	3.2	34	26	26	56.9	39.5	M4X8	9.5	M4X0.7	7	15	13	7.5	6	4.5	60
TRH15VL							65.4	48										
TRH20VN	30	12	4.6	44	32	36	75.6	54	M5X7	6.5	M6X1	14	20	16.5	9.5	8.5	6	60
TRH20VE						50	99.6	78										
TRH25VN	40	12.5	5.8	48	35	35	81	59	M6X8	11.5	M6X1	14	23	20	11	9	7	60
TRH25VE						50	110	88										
TRH30VN	45	16	7	60	40	40	96.3	69.3	M8X10	11	M6X1	14	28	23	14	12	9	80
TRH30VE						60	132	105										
TRH35VN	55	18	7.5	70	50	50	109	79	M8X10	15	M6X1	14	34	26	14	12	9	80
TRH35VE						72	153	123										
TRH45VL	70	20.5	8.9	85.5	60	60	140	106	M10X15	20.5	PT1/8	12.5	45	32	20	17	14	105
TRH45VE						80	174	140										
TRH55VL	80	23.5	13	100	75	75	162	118	M12X18	21	PT1/8	12.5	53	44	23	20	16	120
TRH55VE						95	200.1	156.1										
TRH65VL	90	31.5	14	126	76	70	197	147	M16X20	19	PT1/8	12.5	63	53	26	22	18	150
TRH65VE						120	256.5	206.5										

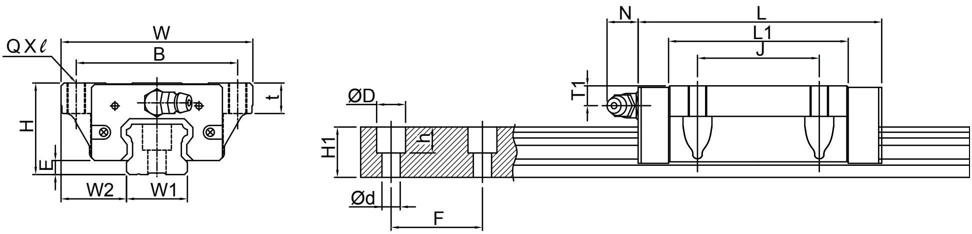
※The above specifications provided are dedicated to XN, UN, please check table 2.10.1 for detail, if other accessories is required, please refer to page A86.



Model No.	Load Rating (kgf)		Static Permissible Moment					Weight	
			Mx (kg-mm)	My (kg-mm)		Mz (kg-mm)		Block (kg)	Rail (kg/m)
	C	Co	Single Block	Single Block	Double Block	Single Block	Double Block		
TRH15VN	1206	2206	16,436	14,884	70,960	14,884	70,960	0.15	1.32
TRH15VL	1343	2574	19,175	20,429	95,224	20,429	95,224	0.22	
TRH20VN	2050	3696	37,334	33,268	157,298	33,268	157,298	0.31	2.28
TRH20VE	2553	5058	51,089	63,229	284,163	63,229	284,163	0.44	
TRH25VN	2581	4503	52,239	43,407	207,324	43,407	207,324	0.52	3.17
TRH25VE	3248	6255	72,554	85,112	391,311	85,112	391,311	0.77	
TRH30VN	3807	6483	90,722	74,970	355,321	74,970	355,321	0.85	4.54
TRH30VE	4791	9004	126,003	147,000	677,068	147,000	677,068	1.3	
TRH35VN	5090	8346	142,722	106,070	519,799	106,070	519,799	1.47	6.27
TRH35VE	6667	12274	209,885	233,977	1,070,533	233,977	1,070,533	2.26	
TRH45VL	7572	12808	292,657	220,751	1,030,183	220,751	1,030,183	3.00	10.4
TRH45VE	8852	16010	365,821	348,554	1,598,703	348,554	1,598,703	3.90	
TRH55VL	14703	21613	571,342	411,729	2,019,184	411,729	2,019,184	4.42	16.1
TRH55VE	17349	27377	723,699	670,530	3,148,637	670,530	3,148,637	5.50	
TRH65VL	22526	31486	973,074	695,840	3,594,277	695,840	3,594,277	8.66	22.54
TRH65VE	27895	42731	1,320,601	1,307,568	6,312,759	1,307,568	6,312,759	10.30	

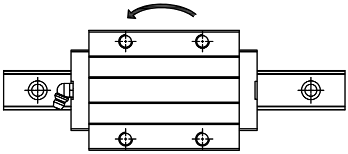
2-2 TRH / TRS / TRC International Standard Linear Guide

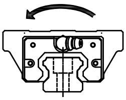
TRH-F Series Specifications

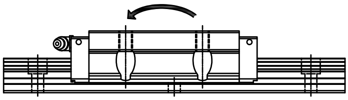


Model No.	Assembly (mm)			Block Dimension (mm)										Rail (mm)					
	H	W2	E	W	B	J	t	L	L1	QXℓ	T1	Oil Hole	N	W1	H1	ØD	h	Ød	F
TRH15FN	24	16	3.2	47	38	30	8	56.9	39.5	M5X8	5.5	M4X0.7	7	15	13	7.5	6	4.5	60
TRH15FL								65.4	48										
TRH20FN	30	21.5	4.6	63	53	40	10	75.6	54	M6X10	6.5	M6X1	14	20	16.5	9.5	8.5	6	60
TRH20FE								99.6	78										
TRH25FN	36	23.5	5.8	70	57	45	12	81	59	M8X12	7.5	M6X1	14	23	20	11	9	7	60
TRH25FE								110	88										
TRH30FN	42	31	7	90	72	52	15	96.3	69.3	M10X15	8	M6X1	14	28	23	14	12	9	80
TRH30FE								132	105										
TRH35FN	48	33	7.5	100	82	62	15	109	79	M10X15	8	M6X1	14	34	26	14	12	9	80
TRH35FE								153	123										
TRH45FL	60	37.5	8.9	120	100	80	18	140	106	M12X18	10.5	PT1/8	12.5	45	32	20	17	14	105
TRH45FE								174	140										
TRH55FL	70	43.5	13	140	116	95	29	162	118	M14X17	11	PT1/8	12.5	53	44	23	20	16	120
TRH55FE								200.1	156.1										
TRH65FL	90	53.5	14	170	142	110	37	197	147	M16X23	19	PT1/8	12.5	63	53	26	22	18	150
TRH65FE								256.5	206.5										

※The above specifications provided are dedicated to XN, UN, please check table 2.10.1 for detail, if other accessories is required, please refer to page A86.



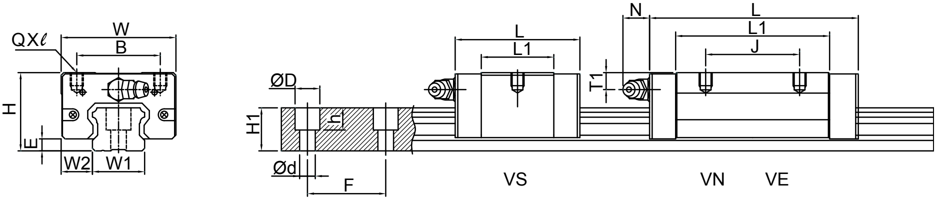




Model No.	Load Rating (kgf)		Static Permissible Moment					Weight	
			Mx (kg-mm)	My (kg-mm)		Mz (kg-mm)		Block (kg)	Rail (kg/m)
	C	Co	Single Block	Single Block	Double Block	Single Block	Double Block		
TRH15FN	1206	2206	16,436	14,884	70,960	14,884	70,960	0.18	1.32
TRH15FL	1343	2574	19,175	20,429	95,224	20,429	95,224	0.22	
TRH20FN	2050	3696	37,334	33,268	157,298	33,268	157,298	0.39	2.28
TRH20FE	2553	5058	51,089	63,229	284,163	63,229	284,163	0.58	
TRH25FN	2581	4503	52,239	43,407	207,324	43,407	207,324	0.60	3.17
TRH25FE	3248	6255	72,554	85,112	391,311	85,112	391,311	0.85	
TRH30FN	3807	6483	90,722	74,970	355,321	74,970	355,321	1.01	4.54
TRH30FE	4791	9004	126,003	147,000	677,068	147,000	677,068	1.54	
TRH35FN	5090	8346	142,722	106,070	519,799	106,070	519,799	1.47	6.27
TRH35FE	6667	12274	209,885	233,977	1,070,533	233,977	1,070,533	2.29	
TRH45FL	7572	12808	292,657	220,751	1,030,183	220,751	1,030,183	2.80	10.4
TRH45FE	8852	16010	365,821	348,554	1,598,703	348,554	1,598,703	3.79	
TRH55FL	12598	14798	571,342	411,729	2,019,184	411,729	2,019,184	4.22	16.1
TRH55FE	15404	19731	723,699	670,530	3,148,637	670,530	3,148,637	5.6	
TRH65FL	20254	23098	973,074	695,840	3,594,277	695,840	3,594,277	9.31	22.54
TRH65FE	24777	30797	1,320,601	1,307,568	6,312,759	1,307,568	6,312,759	12.98	

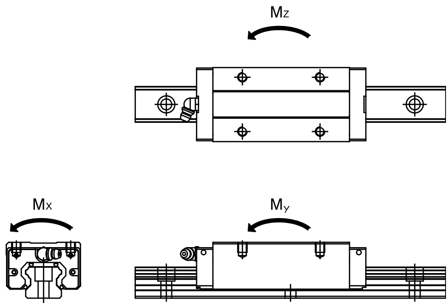
2-2 TRH / TRS / TRC International Standard Linear Guide

TRS-V Series Specifications



Model No.	Assembly(mm)			Block Dimension(mm)									Rail(mm)					
	H	W2	E	W	B	J	L	L1	QXℓ	T1	Oil Hole	N	W1	H1	ØD	h	Ød	F
TRS15VS	24	9.5	3.2	34	26		40.3	22.9	M4X5	5.5	M4X0.7	7	15	13	7.5	6	4.5	60
TRS15VN						26	56.9	39.5										
TRS20VS	28	11	4.6	42	32		49.4	27.8	M5X6	4.5	M6X1	14	20	16.5	9.5	8.5	6	60
TRS20VN						32	68.3	46.7										
TRS25VS	33	12.5	5.8	48	35		57.2	35.2	M6X6.5	4.5	M6X1	14	23	20	11	9	7	60
TRS25VN						35	81	59										
TRS30VS	42	16	7	60	40		67.4	40.4	M8X8	8	M6X1	14	28	23	14	12	9	80
TRS30VN						40	96.3	69.3										
TRS35VN	48	18	7.5	70	50	50	109	79	M8X8	8	M6X1	14	34	26	14	12	9	80
TRS35VE						72	153	123										
TRS45VN	60	20.5	8.9	85.5	60	60	124.5	90.5	M10X15	10.5	PT1/8	12.5	45	32	20	17	14	105

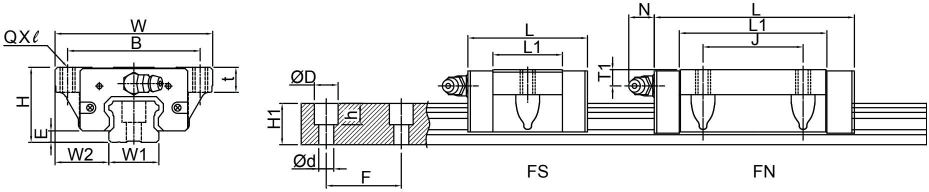
※The above specifications provided are dedicated to XN, UN, please check table 2.10.1 for detail, if other accessories is required, please refer to page A86.



Model No.	Load Rating (kgf)		Static Permissible Moment					Weight	
			Mx (kg-mm)	My (kg-mm)		Mz (kg-mm)		Block (kg)	Rail (kg/m)
	C	Co	Single Block	Single Block	Double Block	Single Block	Double Block		
TRS15VS	908	1471	10,957	6,420	33,531	6,420	33,531	0.09	1.32
TRS15VN	1206	2206	16,436	14,884	70,960	14,884	70,960	0.15	
TRS20VS	1398	2140	21,615	10,700	59,798	10,700	59,798	0.15	2.28
TRS20VN	1896	3307	33,404	26,459	126,998	26,459	126,998	0.23	
TRS25VS	1943	3002	34,826	18,725	97,890	18,725	97,890	0.25	3.17
TRS25VN	2581	4503	52,239	43,407	207,324	43,407	207,324	0.39	
TRS30VS	2697	3962	55,442	26,950	154,224	26,950	154,224	0.48	4.54
TRS30VN	3807	6483	90,722	74,970	355,321	74,970	355,321	0.77	
TRS35VN	5090	8346	142,722	106,070	519,799	106,070	519,799	1.15	6.27
TRS35VE	6667	12274	209,885	233,977	1,070,533	233,977	1,070,533	1.54	
TRS45VN	6758	10887	248,758	158,011	782,271	158,011	782,271	1.98	10.4

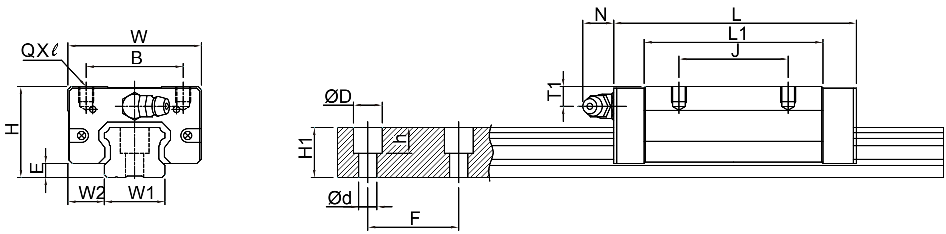
2-2 TRH / TRS / TRC International Standard Linear Guide

TRS-F Series Specifications



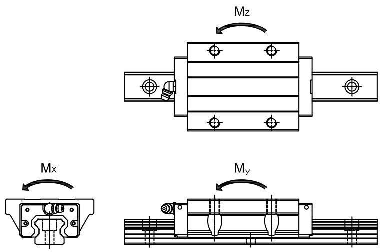
Model No.	Assembly(mm)			Block Dimension(mm)										Rail(mm)					
	H	W2	E	W	B	J	t	L	L1	QXℓ	T1	Oil Hole	N	W1	H1	ØD	h	Ød	F
TRS15FS	24	18.5	3.2	52	41		7	40.3	22.9	M5X7	5.5	M4X0.7	7	15	13	7.5	6	4.5	60
TRS15FN						26		56.9	39.5										
TRS20FS	28	19.5	4.6	59	49		9	49.4	27.8	M6X9	4.5	M6X1	14	20	16.5	9.5	8.5	6	60
TRS20FN						32		68.3	46.7										
TRS25FN	33	25	5.8	73	60	35	10	81	59	M8X10	4.5	M6X1	14	23	20	11	9	7	60

※The above specifications provided are dedicated to XN, UN, please check table 2.10.1 for detail, if other accessories is required, please refer to page A86.

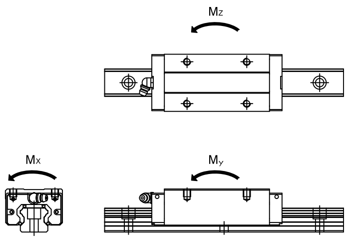


Model No.	Assembly(mm)			Block Dimension(mm)									Rail(mm)					
	H	W2	E	W	B	J	L	L1	QXℓ	T1	Oil Hole	N	W1	H1	ØD	h	Ød	F
TRC25VE	36	12.5	5.8	48	35	50	110	88	M6X6.5	7.5	M6X1	14	23	20	11	9	7	60

※The above specifications provided are dedicated to XN, UN, please check table 2.10.1 for detail, if other accessories is required, please refer to page A86.



Model No.	Load Rating (kgf)		Static Permissible Moment					Weight	
			Mx (kg-mm)	My (kg-mm)		Mz (kg-mm)		Block (kg)	Rail (kg/m)
	C	Co	Single Block	Single Block	Double Block	Single Block	Double Block		
TRS15FS	908	1471	10,957	6,420	33,531	6,420	33,531	0.12	1.32
TRS15FN	1206	2206	16,436	14,884	70,960	14,884	70,960	0.19	
TRS20FS	1398	2140	21,615	10,700	59,798	10,700	59,798	0.19	2.28
TRS20FN	1896	3307	33,404	26,459	126,998	26,459	126,998	0.29	
TRS25FN	2581	4503	52,239	43,407	207,324	43,407	207,324	0.51	3.17



Model No.	Load Rating (kgf)		Static Permissible Moment					Weight	
			Mx (kg-mm)	My (kg-mm)		Mz (kg-mm)		Block (kg)	Rail (kg/m)
	C	Co	Single Block	Single Block	Double Block	Single Block	Double Block		
TRC25VE	3248	6255	72,554	85,112	391,311	85,112	391,311	0.65	3.17

2-3 The Standard Length and Maxima Length of Linear Rail

TBI MOTION offer our customers standard and customized rail length to meet the requirement of our customers. TBI suggests that when ordering customized rail length, to prevent unstable running performance after mounting, the end cap value G should be no greater than 1/2F.

L = [n-1]・F+2・G

L : Total Length of Rail (mm)
n : Number of Mounting Holes
F : Distance Between Any Two Holes (mm)
G : Distance from the Center of the Last Hole to the Edge (mm)

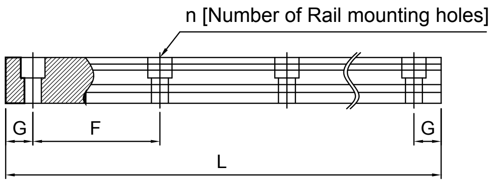


Fig 2.3.1

Table 2.3.1

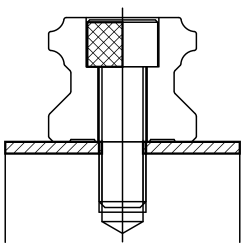
Unit : mm

Item	TR15	TR20	TR25	TR30	TR35	TR45	TR55	TR65
F : Pitch	60	60	60	80	80	105	120	150
G : Suggested Distance to End	20	20	20	20	20	22.5	30	35
L : Max. Length	4000	4000	4000	4000	4000	4000	4000	4000

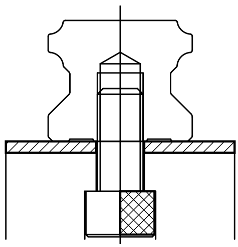
■ 2-4 Mounting Type of Linear Rail

Besides the standard top mounting type, ***TBI MOTION*** also offers bottom mounting type rails.

Table 2.4.1



Mounting from Above



Mounting from Below

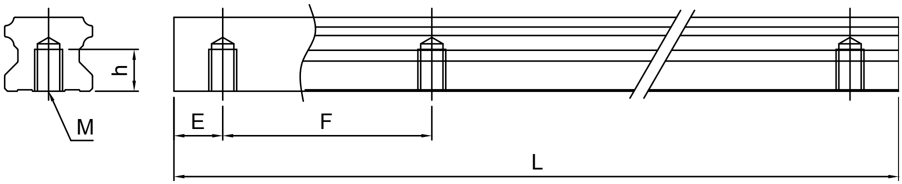


Fig 2.4.1 Mounting from below

Table 2.4.2 Rail Size Chart

Unit : mm

	M	h	E	F
TR15	M5×0.8	8	20	60
TR20	M6×1	10	20	60
TR25	M6×1	12	20	60
TR30	M8×1.25	15	20	80
TR35	M8×1.25	17	20	80
TR45	M12×1.75	24	22.5	105
TR55	M14×2	24	30	120
TR65	M20×2.5	30	35	150

2-5 Accuracy Standard

The accuracy standards of TR-Series range, from normal (N), high (H), precision (P), super-precision (SP) and ultra-precision (UP). It allows our user to choose according to the accuracy standards of the equipment.

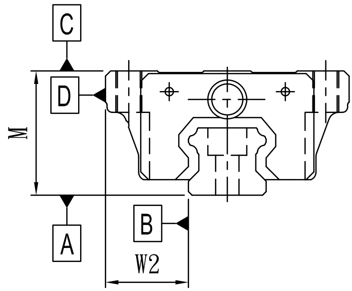


Fig 2.5.1 Accuracy Standard

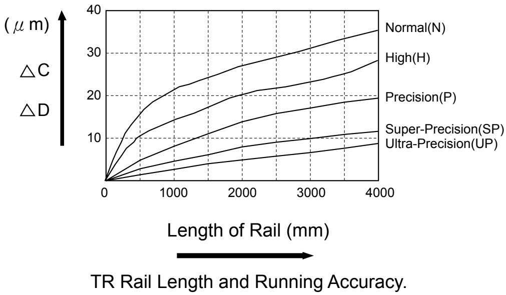


Fig 2.5.2

Table 2.5.1 TR-Accuracy of Running Parallelism

TR Rail Length (mm)	Accuracy (μm)				
	N	H	P	SP	UP
0~125	5	3	2	1.5	1
125~200	5	3.5	2	1.5	1
200~250	6	4	2.5	1.5	1
250~315	7	4.5	3	1.5	1
315~400	8	5	3.5	2	1.5
400~500	9	6	4.5	2.5	1.5
500~630	16	11	6	2.5	1.5
630~800	18	12	7	3	2
800~1000	20	14	8	4	2
1000~1250	22	16	10	5	2.5
1250~1600	25	18	11	6	3
1600~2000	28	20	13	7	3.5
2000~2500	30	22	15	8	4
2500~3000	32	24	16	9	4.5
3000~3500	33	25	17	11	5
3500~4000	34	26	18	12	6

Table 2.5.2

Unit : mm

Accuracy Standard										
	TR 15 20					TR 25 30 35				
Accuracy Standard	Normal	High	Precision	Super Precision	Ultra Precision	Normal	High	Precision	Super Precision	Ultra Precision
Item	N	H	P	SP	UP	N	H	P	SP	UP
Tolerance for height M	±0.1	±0.03	0 -0.03	0 -0.015	0 -0.008	±0.1	±0.04	0 -0.04	0 -0.02	0 -0.01
Tolerance for height M difference among Linear Guide Block	0.02	0.01	0.006	0.004	0.003	0.02	0.015	0.007	0.005	0.003
Tolerance for rail-to-block lateral distance W2	±0.1	±0.03	0 -0.03	0 -0.015	0 -0.008	±0.1	±0.04	0 -0.04	0 -0.02	0 -0.01
Tolerance for rail-to-block lateral distance W2 difference among Linear Guide Block	0.02	0.01	0.006	0.004	0.003	0.03	0.015	0.007	0.005	0.003
Running parallelism of Linear Guide Block surface C with respect to surface A	Δ C, TR Rail Length and Running Accuracy (Fig 2.5.2)					Δ C, TR Rail Length and Running Accuracy (Fig 2.5.2)				
Running parallelism of Linear Guide Block surface D with respect to surface B	Δ D, TR Rail Length and Running Accuracy (Fig 2.5.2)					Δ D, TR Rail Length and Running Accuracy (Fig 2.5.2)				

Accuracy Standard										
	TR 45 55					TR 65				
Accuracy Standard	Normal	High	Precision	Super Precision	Ultra Precision	Normal	High	Precision	Super Precision	Ultra Precision
Item	N	H	P	SP	UP	N	H	P	SP	UP
Tolerance for height M	±0.1	±0.05	0 -0.05	0 -0.03	0 -0.02	±0.1	±0.07	0 -0.07	0 -0.05	0 -0.03
Tolerance for height M difference among Linear Guide Block	0.03	0.015	0.007	0.005	0.003	0.03	0.02	0.01	0.007	0.005
Tolerance for rail-to-block lateral distance W2	±0.1	±0.05	0 -0.05	0 -0.03	0 -0.02	±0.1	±0.07	0 -0.07	0 -0.05	0 -0.03
Tolerance for rail-to-block lateral distance W2 difference among Linear Guide Block	0.03	0.02	0.01	0.007	0.005	0.03	0.025	0.015	0.01	0.007
Running parallelism of Linear Guide Block surface C with respect to surface A	Δ C, TR Rail Length and Running Accuracy (Fig 2.5.2)					Δ C, TR Rail Length and Running Accuracy (Fig 2.5.2)				
Running parallelism of Linear Guide Block surface D with respect to surface B	Δ D, TR Rail Length and Running Accuracy (Fig 2.5.2)					Δ D, TR Rail Length and Running Accuracy (Fig 2.5.2)				

2-6 Determining the Magnitude of a Preload

What's Preload

Using larger rolling elements helps strengthen the entire rigidity of the block while there exists clearance within ball circulation.

Increasing preload would decrease the vibration and reduce the corrosion caused by running back and forth. However, it would also add the workload within those rolling elements. The greater the preload is, the greater the inner workload is. Therefore, choosing preload has to consider the effect carefully between vibration and preload.

Table 2.6.1 Preload Grade

C : Dynamic load rating

Grade	Symbol	Preload Force
Slight Clearance	ZF	0
No Preload	Z0	0
Light Preload	Z1	0.02C
Medium Preload	Z2	0.05C
Heavy Preload	Z3	0.07C

Table 2.6.2 TR Series Radial Clearances

Unit : μm

Preload / Model No.	ZF	Z0	Z1	Z2	Z3
TR15	5~12	-4~4	-12~-5	-20~-13	-28~-21
TR20	6~14	-5~5	-14~-6	-23~-15	-32~-24
TR25	7~16	-6~6	-16~-7	-26~-17	-36~-27
TR30	8~18	-7~7	-18~-8	-29~-19	-40~-30
TR35	9~20	-8~8	-20~-9	-32~-21	-44~-33
TR45	10~22	-9~9	-22~-10	-35~-23	-48~-36
TR55	11~24	-10~10	-24~-11	-38~-25	-52~-39
TR65	12~26	-11~11	-26~-12	-41~-27	-56~-42

Table 2.6.3 The Difference between Interchageability and Non-Interchageability

	Non-Interchangeable					Interchangeable
Slight Clearance	UP	SP	P	H	N	N
Preload	Z1 Z2 Z3	Z1 Z2 Z3	Z0 Z1 Z2 Z3	Z0 Z1 Z2 Z3	ZF Z0 Z1 Z2	ZF Z0 Z1

■ 2-7 Mounting Location of Grease Nipples

The standard location of the grease nipple is at both ends of the block, but the nipple can be mounted at each side of block. For lateral installation, we recommend that the nipple be mounted at the non-reference side, otherwise please contact us. It is possible to perform lubrication by using the oil-piping joint.

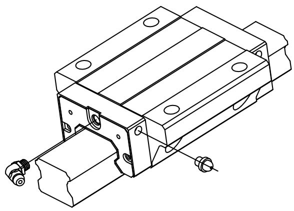


Fig 2.7.1 Mounting Location

Table 2.7.1 The Lubricant Amount for a Block Filled with Grease

Size	Grease (c.c.)
TR15	1.3
TR20	2.5
TR25	2.5
TR30	7
TR35	9
TR45	15.2
TR55	40
TR65	75

Table 2.7.2 Oil Refilling Rate

Size	Oil refilling rate (cm^2/hr)
TR15	0.2
TR20	0.2
TR25	0.3
TR30	0.3
TR35	0.3
TR45	0.4
TR55	0.5
TR65	0.6

2-8 Grease Nipples

Table 2.8.1 Grease Nipples

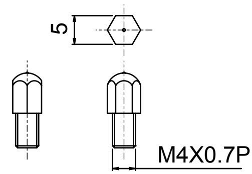
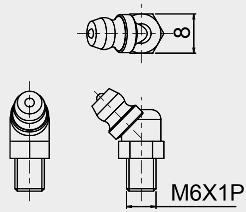
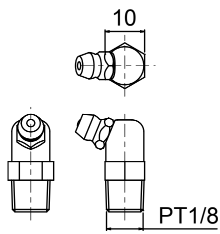
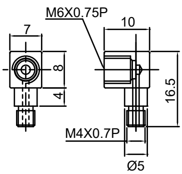
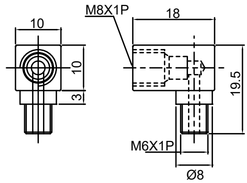
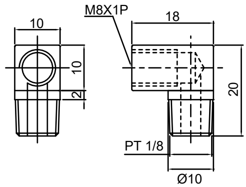
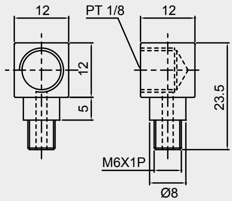
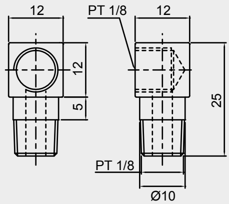
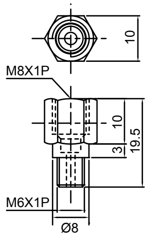
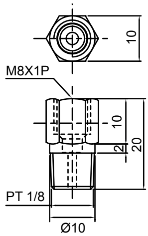
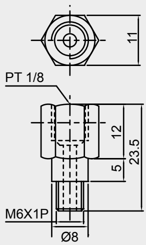
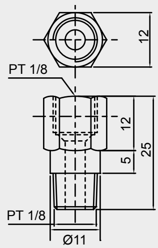
Model	Accessory Code	Grease Nipple Code	Size
TR15	XN, XNC, UN	SD-020	M4X0.7P 
	SU, ZN	SD-024	
	SZ	SD-066	
	WW, WU, WZ, DU, DZ	-	
TR20 TR25 TR30	XN, XNC, UN	SD-021	M6X1P 
	SU	SD-025	
	SZ	SD-026	
	ZN	SD-075	
	WW, WU, WZ, DU, DZ	-	
TR35	XN, UN	SD-021	
	SU, ZN	SD-026	
	SZ	SD-060	
	WW, WU, WZ, DU, DZ	-	
TR45	XN, XNC, UN	SD-011	PT1/8 
	SZ, ZN	SD-027	
	SU	SD-068	
	WW, WU, WZ, DU, DZ	-	
TR55	XN, XNC, UN	SD-011	
	SZ, ZN	SD-059	
	SU	SD-068	
	WW, WU, WZ	-	
TR65	XN, XNC, UN	SD-011	
	SU	SD-059	
	SZ, ZN	SD-058	
	WW, WU, WZ	-	

Table 2.8.2 Types of Lubrication Coupler

Model	TR15	TRH20, 25 / TR30, 35	TR45, 55, 65
Types of Lubrication Coupler	SD-037 	SD-038 	SD-039 
		SD-029 	SD-040 
		SD-041 	SD-042 
		SD-043 	SD-044 

※If the types of lubrication coupler in TRS20、TRS25 are needed, please contact TBI MOTION.

A
Linear Guide

2-9 Strong Dust-proof/Self-Lubricating Linear Guide Series Accessory

TBI MOTION Linear Guide with Double-lip End Seal

Characteristics of ***TBI MOTION*** Dust-proof End Seal

1. Seal Function : Seal design from single-lip to double-lip is to prevent more dust from going into the block.
2. Hardness : Heat treatment harden the end seal to absorb impact while operating.
3. Environment : Better solution for dust-proof when using double seals in environment with high contamination.
4. Lifetime Extension : Double-lip seal prevents dust go into the block and provides a solution for block damage due to dust issue.

Characteristics of ***TBI MOTION*** Metal Scraper

The scraper decreases the possibility of high temperature iron chip or dust entering the block.

Characteristics of ***TBI MOTION*** Self-Lubricating Linear Guide Series

There is a Felt accessory between end cap and seals. Felt with oil lubricates the rail when operating and grease nipple is not needed. The design is shown below. (Fig 2.9.1)

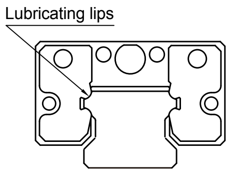


Fig 2.9.1

Example

WZ (Top Seal+Bottom Seal+Two Double-lip end seals+Felt)

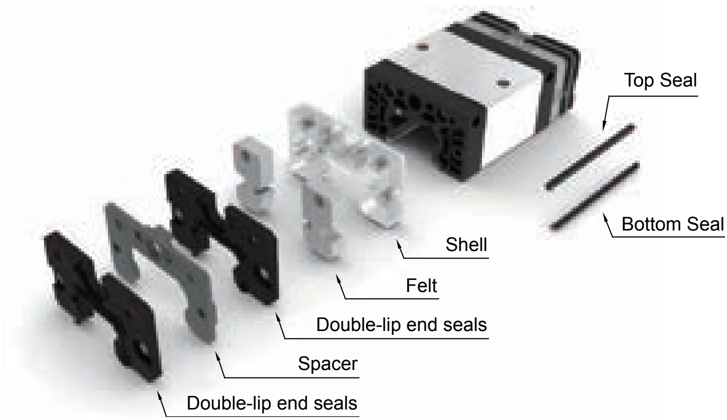


Fig 2.9.2

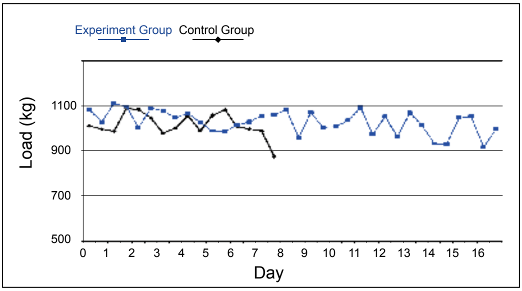
Life Comparison

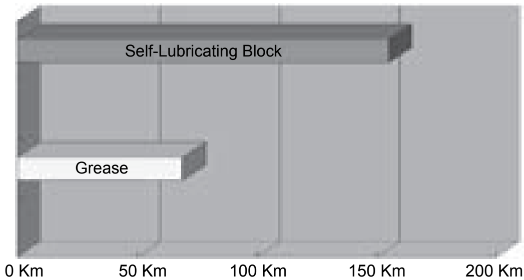
As shown in the chart, the lifetime of self-lubricating blocks is twice as long as standard series blocks.

Table 2.9.1 Test

	Control Group	Experiment Group
Test Environment	**Standard**	**Self-Lubricating**
Model No.	TRH20VN	TRH20VN
Load Rating	1000 kg	1000 kg
Speed	6 m/min	6 m/min
Travel Length	600 mm	600 mm

※ No extra grease is added during the test for both standard series and self-lubricating series.





2-9 Strong Dust-proof/Self-Lubricating Linear Guide Series Accessory

Instructions of Self-Lubricating Block Felt

The felt has already filled in with lubricant. It is suggested to soak the whole felt in the oil tank for more than 8 hours before using.

Characteristics of Suggested Oil :

(1) Form a strong oil film.

(2) Reduce wear as much as possible.

(3) Have high wear resistance.

(4) Have high thermal stability.

(5) Be noncorrosive.

(6) Be highly rust-preventive.

(7) Be free from dust and some moisture.

Characteristics of Block Felt

(1) Easy Assembly and Removal - Only screws are needed when assembling and disassembling the accessory.

(2) Environmental Friendly - No need of grease nipple and other equipment to save energy.

(3) Low Maintenance - Prevents oil leaking, making it a ideal solution for clean working environments.

(4) Strong Dust-Proof - With dust-proof accessory, service life is extended.

The Suggested Operating Temperature

The suggested operating temperature is between -10°C to 60°C. If operating temperature is over suggested criteria, please contact TBI MOTION.

Self-Lubricating Linear Guide Oil Cassette Units

Self lubrication system is designed with lubrication mechanism between end cap and wiper. The structure units are shown as follow. The Cassette unit is comprised with fluid channel which is soaked with oil and act to release the lubricants thoroughly during operation. With this smart and simple design, the linear guide can be lubricated without extra oil feeding units thus minimize unnecessary parts and waste which triggers higher cost and higher risk in mounting error.

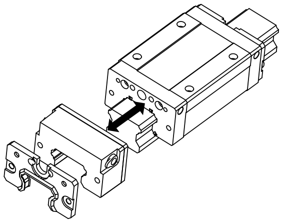


Fig 2.9.3 Installation Method

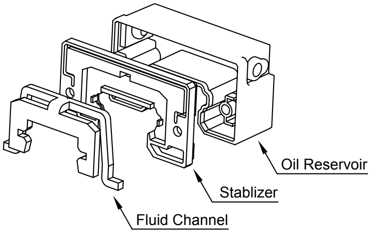


Fig 2.9.4 Cassette Unit

Characteristics of Self-Lubricating Units

(1) No extra oil feeding unit is required.
(2) Applicable in highly required clean envirionment.
(3) May maintain lubrication for a period of time.
(4) Lubricates thoroughly in any operating positions.
(5) Interchangeable to any grease/oil.
(6) Improves dust-proof effienciency when assembled to the block.

Applications

(1) Machine Tool
(2) Industrial Automation : Plastic and rubber manufacturers, Typography, Paper, Textiles, Food.
(3) Electronic and Component manufacturing : Semiconductor, X-Y Platform, Measurement, Equipment
(4) Others : Medical Equipment, Conveyers

2-9 Strong Dust-proof/Self-Lubricating Linear Guide Series Accessory

Characteristics of Lubrication Oil

The Self lubrication cassette is filled in with Synthetic Hydro Carbon oil (SHC). The performance of the oil is list as follows :
(1) Solvent refined oil without wax and impurity.
(2) High grade of consistency in extreme temperature.
(3) Corrosion free to metal and high polymer.
(4) Unique woven texture provides oil film on the contact point to prevent wear.
(5) High chemical stability and durability.

2-10 Dust-proof/Accessory

If the following accessories are needed, please add the code followed by the model number.

Special Option：Steel end seal, Steel end cap, Cover Strip, please contact TBI Motion.

Standard Accessories :

End seal and Bottom seal
To prevent life reduction caused by iron chips or dust entering the block.

Other Accessories :

Top Seal
Efficiently prevents dust from the surface of rail or tapping hole getting inside the block.

Double end seal
Enhances the wiping effect, foreign matter can be completely wiped off.

Double-lip end seals
Double-lip end seal is suitable for environment with high contamination.

Characteristics of ***TBI MOTION*** Metal Scraper
The scraper decreases the possibility of high temperature iron chip or dust entering the block.

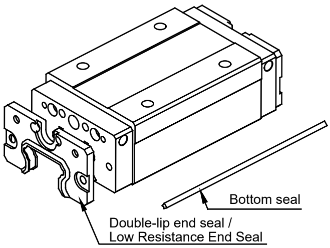
Felt
Double-lip end seal is suitable for environment with high contamination. Felt lubricates the ball track of the rail extending the lifetime. This accessory is suitable for light rating load environment.

Oil Reservoir
After installation, oil reservoir can extend lubricating effect.

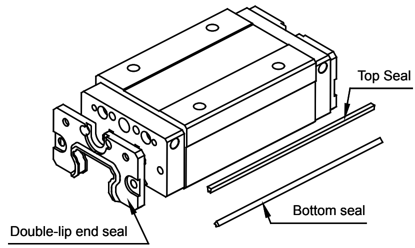
2-10 Dust-proof/Accessory

Table 2.10.1 Codes of Accessories

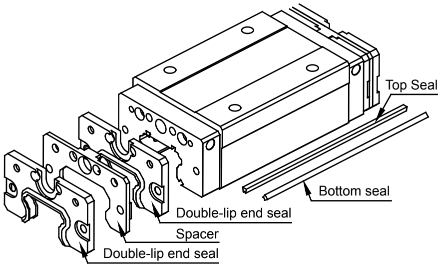
XN (Double-lip end seals+Bottom Seal)
XNC (Low Resistance End Seal+Bottom Seal)



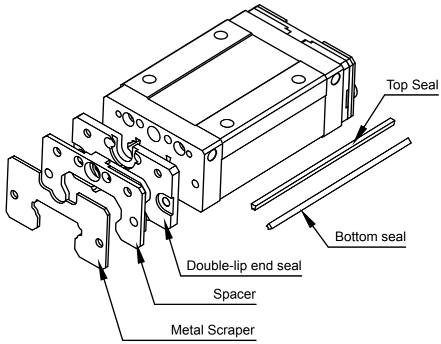
UN (Double-lip end seals+Bottom seals+Top seals)



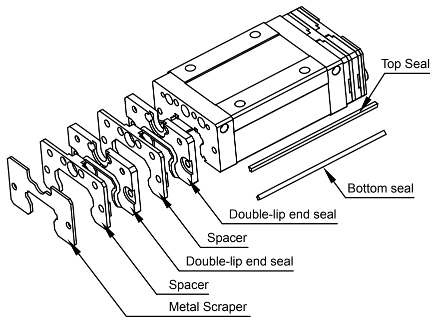
ZN (Two Double-lip end seals+Bottom seals+Top seals)



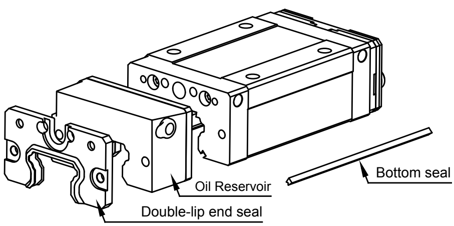
SU (Double-lip end seals+Bottom seals+Top seals+
Metal Scraper)



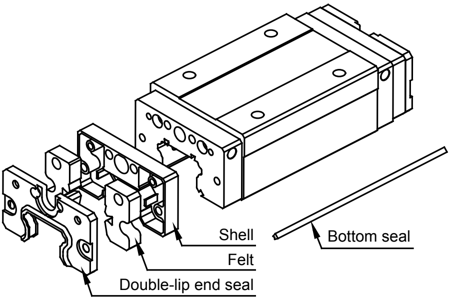
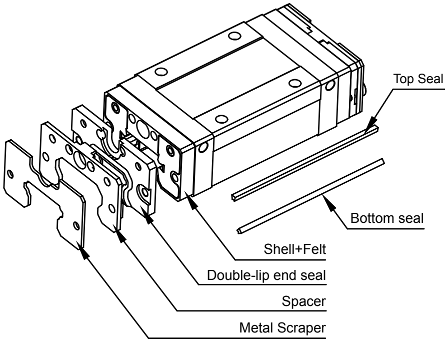
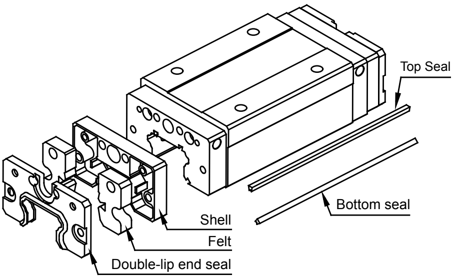
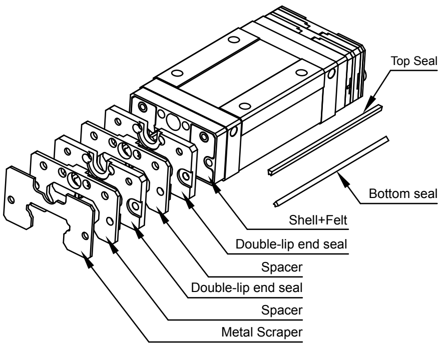
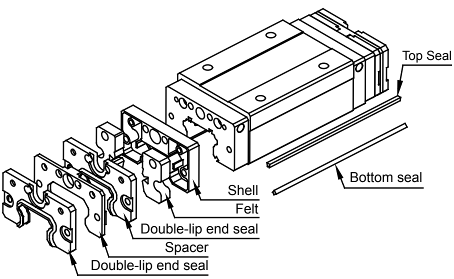
SZ (Two Double-lip end seals+Bottom seals+Top seals
+Metal Scraper)



BN (Double-lip end seals+Bottom seals+Oil Reservior)



※After selection of different accessories increase the overall length of the slider, see table 2.10.2.

WW (Double-lip end seals+Bottom seals+Felts)	DU (Double-lip end seals+Bottom seals+Top seals+Felts+Metal Scraper)
	
WU (Double-lip end seals+Bottom seals+Top Seals+Felts)	
	
	DZ (Two Double-lip end seals+Bottom seals+Top seals+Felts+Metal Scraper)
WZ (Two Double-lip end seals+Bottom seals+Top Seals+Felts)	
	

2-10 Dust-proof/Accessory

Table 2.10.2 TR Type Block Length of Accessories

Unit : mm

Two Double-lip end seals (ZN)								
Length of Block Code \ Type	TR15	TR20	TR25	TR30	TR35	TR45	TR55	TR65
S	47.9	58.4	65.6	76.4	-	-	-	-
N	64.5	TRS (77.3) TRH (84.6)	89.4	105.3	118	134.5	-	-
L	73	-	-	-	-	150	173	207.9
E	-	108.6	118.4	141	162	184	211.1	267.4

Low Resistance end seal (XNC)								
Length of Block Code \ Type	TR15	TR20	TR25	TR30	TR35	TR45	TR55	TR65
S	39.3	47.8	56.2	65.8	-	-	-	-
N	55.9	66.7(TRS) 74(TRH)	80	94.7	107.4	121.9	-	-
L	64.4	-	-	-	-	137.4	158.4	193.3
E	-	98	109	130.4	151.4	171.4	196.5	252.8

Double-lip end seals+Metal Scraper (SU)								
Length of Block Code \ Type	TR15	TR20	TR25	TR30	TR35	TR45	TR55	TR65
S	44.5	54.4	62.2	72.4	-	-	-	-
N	61.1	TRS (73.3) TRH (80.6)	86	101.3	114	129.5	-	-
L	69.6	-	-	-	-	145	167	201.9
E	-	104.6	115	137	158	179	205.1	261.4

Two Double-lip end seals+Metal Scraper (SZ)								
Length of Block Code \ Type	TR15	TR20	TR25	TR30	TR35	TR45	TR55	TR65
S	52.1	63.4	70.6	81.4	-	-	-	-
N	68.7	TRS (82.3) TRH (89.6)	94.4	110.3	123	139.5	-	-
L	77.2	-	-	-	-	155	178	212.9
E	-	113.6	123.4	146	167	189	216.1	272.4

Double-lip end seals+Oil Reservoir (BN)								
Length of Block Code \ Type	TR15	TR20	TR25	TR30	TR35	TR45	TR55	TR65
S	55.8	66.4	73.2	83.4	-	-	-	-
N	72.4	TRS (85.3) TRH (92.6)	97	112.3	125	144	-	-
L	80.9	-	-	-	-	159.5	-	-
E	-	116.6	126	148	169	193.5	-	-

Table 2.10.2 TR Type Block Length of Accessories

Unit : mm

Double-lip end seals+Felt (WW, WU)								
Length of Block Code \ Type	TR15	TR20	TR25	TR30	TR35	TR45	TR55	TR65
S	51.8	60.9	68.7	78.9	-	-	-	-
N	68.4	TRS (79.8) TRH (87.1)	92.5	107.8	120.5	136	-	-
L	76.9	-	-	-	-	151.5	-	-
E	-	111.1	121.5	143.5	164.5	185.5	-	-

Two Double-lip end seals+Felt (WZ)								
Length of Block Code \ Type	TR15	TR20	TR25	TR30	TR35	TR45	TR55	TR65
S	59.4	69.9	77.1	87.9	-	-	-	-
N	76	TRS (88.8) TRH (96.1)	100.9	116.8	129.5	146	-	-
L	84.5	-	-	-	-	161.5	-	-
E	-	120.1	129.9	152.5	173.5	195.5	-	-

Double-lip end seals+Felt+Metal Scraper (DU)								
Length of Block Code \ Type	TR15	TR20	TR25	TR30	TR35	TR45	TR55	TR65
S	56	65.9	73.7	83.9	-	-	-	-
N	72.6	TRS (84.8) TRH (92.1)	97.5	112.8	125.5	141	-	-
L	81.1	-	-	-	-	156.5	-	-
E	-	116.1	126.5	148.5	169.5	190.5	-	-

Two Double-lip end seals+Felt+Metal Scraper (DZ)								
Length of Block Code \ Type	TR15	TR20	TR25	TR30	TR35	TR45	TR55	TR65
S	63.6	74.9	82.1	92.9	-	-	-	-
N	80.2	TRS (93.8) TRH (101.1)	105.9	121.8	134.5	151	-	-
L	88.7	-	-	-	-	166.5	-	-
E	-	125.1	134.9	157.5	178.5	200.5	-	-

2-10 Dust-proof/Accessory

Dust-proof Rails
Once the Linear Guide is operating in a cutting machine, dust and foreign matter that enter the Linear Guide may cause abnormal wear and shorten the service life.

Linear Guide rail mounting-hole cap
Chips and foreign matter clogging the mounting holes of a Linear Guide rail may enter the Linear Guide block. To prevent this situation, the mounting holes must be closed with dedicated caps, which must be installed to flush with the Linear Guide rail top surface. To insert a dedicated cap into a mounting hole, drive the cap in using a plastic hammer with a flat metal pad placed over the cap until it matches with the Linear Guide rail top surface. (Fig 2.10.1)

Rail with tapped holes
Fixing a rail with tapped hole is different from fixing a standard one. A major strength of it is the shape of the tapped hole ; dust and chippings would not enter. (Fig 2.10.1)

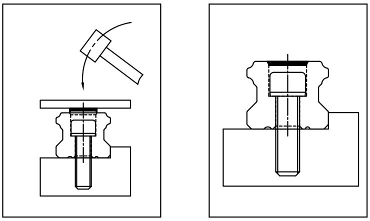


Fig 2.10.1- Dust-proof

■ 2-11 Friction

The figure showed in the chart is the maximum friction. (Table 2.11.1)

Table 2.11.1 End Cap friction rate Unit : kgf

Model No.	Double-lip end seals XN	Low Resistance End Seal XNC
	End Cap friction rate (Max)(Kgf)	End Cap friction rate (Max)(Kgf)
TR15	0.3	0.18
TR20	0.4	0.25
TR25	0.6	0.34
TR30	0.8	0.45
TR35	1.7	-
TR45	2.3	-
TR55	2.5	-
TR65	4.1	-

2-12 Mounting-Surface Dimensional Tolerance

TR series Linear Guide is a Four-Way Equal-Load design, a slight dimensional error in the mounting surface can be absorbed by the self-adjusting capability, thus ensuring smooth linear motion. In the table below are the dimensional tolerances for the mounting surface of TR Linear Guide.

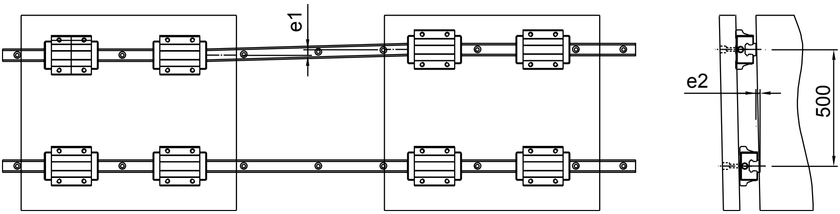


Fig 2.12.1

Table 2.12.1

Unit : µm

Model No.	Tolerance for Parallelism Between Two Axis(e1)					Tolerance for Parallelism Between Two Axis(e2)				
	Z3	Z2	Z1	Z0	ZF	Z3	Z2	Z1	Z0	ZF
TR15	-	-	18	25	35	-	-	85	130	190
TR20	-	18	20	25	35	-	50	85	130	190
TR25	15	20	22	30	42	60	70	85	130	195
TR30	20	27	30	40	55	80	90	110	170	250
TR35	22	30	35	50	68	100	120	150	210	290
TR45	25	35	40	60	85	110	140	170	250	350
TR55	34	45	50	70	98	130	170	210	300	410
TR65	42	55	60	80	105	150	200	250	350	460

A

Linear Guide

3-1 TH Miniature Linear Guide

■ 3-1-1 The Characteristics of TH Series

Dust-Proof Design

TH Series Standard end seals provide extreme protection from dust, metal scrapers to maintain long service life and shorten maintenance period. Unique low friction seal lips provide best smoothness and lower friction.

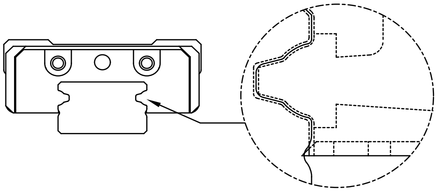


Fig 3.1.1

High Loading and Moment Capacity Performance

TH Miniature Linear Guide series uses two row circulation with Gothic 45° contact angle on the rail groove to achieve equal load capacity in four directions. Larger steel balls are used to enhance the loading and torsion resistance performance in limited space.

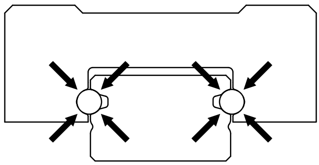


Fig 3.1.2 The Gothic 45° four-direction load structure

■ 3-1-2 The Structure of TH-series

Recirculation system : End cap + Recirculation tube + Ball retainer
Sealing system : Side + Bottom system

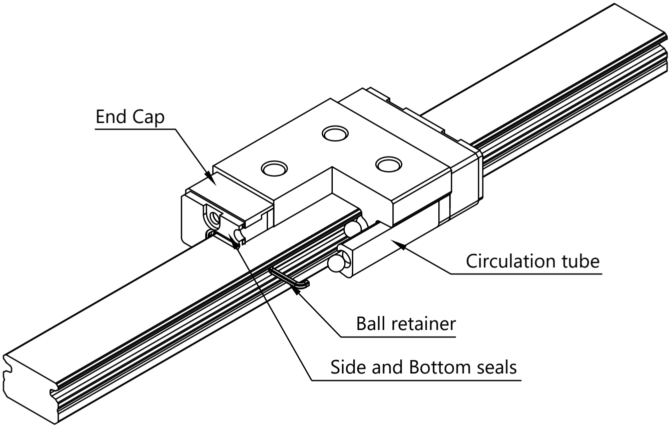
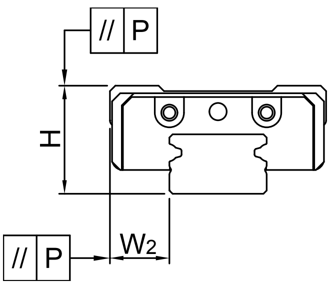


Fig 3.1.3

■ 3-1-3 Accuracy

Miniature Linear Guide TH-series provides P, H, N three accuracy grades for customer to choose.

Table 3.1.1



Accuracy (μm)		Precision P	High H	Normal N
Tolerance of Height H	H	±10	±20	±40
Variation of height with different block on same spot of the rail	△H	7	15	25
Tolerance of width W2	W2	±15	±25	±40
Variation with width on different block on same spot of the rail	△W2	10	20	30

3-1 TH Miniature Linear Guide

Speed

The maximum acceleration of TH-series can reach V_{max} > 5 m/s, α_{max} = 300 m/s^2 (60 m/s^2 without preload).

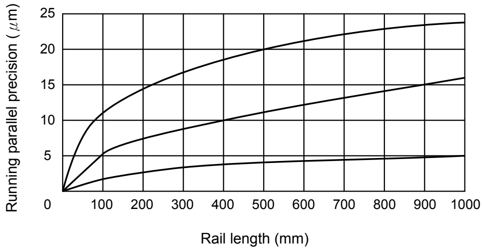


Fig 3.1.4 Running parallel precision slide relative to the rails datum

■ 3-1-4 Preload

Preload Value

Miniature Linear Guide TH-series offers three preloading level, ZF, Z0, Z1. A proper preload enhances performance on rigidity, precision, and torsion resistance; However, an improper preload shorten service life and increase friction.

Table 3.1.2 Table

Preload Grade	Pressure	Preload(μm)				Applications
		7	9	12	15	
ZF	Slight Clearance	+4~0	+4~0	+5~0	+6~0	Running smoothly
Z0	Zero Preload	+2~0	+2~0	+2~0	+3~0	Precision applications, Running smoothly
Z1	Light Preload	0~-3	0~-4	0~-5	0~-6	High steel, Precision applications, Running smoothly

Permissible Operational Temperature

The Miniature Linear Guide TH-series is sufficient to operate between -20°C~+80°C. For sudden temperature rise the temperature can reach up to +100°C.

■ 3-1-5 Types of Lubrication

Grease

When a linear guide is well lubricated, the contact point between rail and rolling steel balls will be separated by 1 micro meter. Therefore, a good lubrication increases the service life of linear guide.

Clean room Lubrication
Suitable for low contamination environment.

Lubrication
General usage, ISO VG32~68.

※If Special oil is required please contact ***TBI MOTION***.

Table 3.1.3

Model	Lubrication amount (cc)
TH07NN	0.3
TH07NL	0.4
TH09NN	0.4
TH09NL	0.6
TH12NN	0.9
TH12NL	1.3
TH15NN	1.4
TH15NL	2.0

■ 3-1-6 Order Information

Customized Requirement :

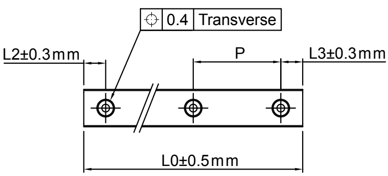


Table 3.1.4

Rail Length	Dimension			
	TH7	TH9	TH12	TH15
Pitch (mm)	15	20	25	40
Wide Pitch (mm)	—	30	40	40
L2, L3 min	3	4	4	4
L2, L3 max	10	20	20	35
Lmax	1300	1300	1300	1300

※If special dimension is required please contact ***TBI MOTION***.

3-1 TH Miniature Linear Guide

Height of Shoulder on Mounting Surface and Chamfering

Height of shoulder should be taken into consideration when installing a Linear Guide, if the block or rail is over-chamfered, the tip part has the possibility to effect the accuracy of Linear Guide, or if the height of shoulder is too high, it interferes the operation of block. Install the Linear Guide as suggested, the accuracy of Linear Guide can be maintained.

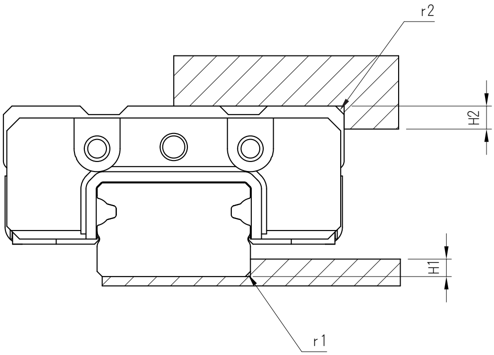


Table 3.1.5 Height of shoulder and chamfer

Model No.	Corner Radius of Mounting Surface r1	Corner Radius of Mounting Surface r2	Shoulder height on rail side H1	Shoulder height on rail side H2
TH07N	0.3	0.2	1	3
TH09N	0.3	0.3	1.7	3
TH12N	0.5	0.4	2.5	4
TH15N	0.5	0.5	2.5	5

Table 3.1.6 Condition with Hexagonal Head Bolt

Model No.	Screw No.	Fasten Torque		
		Steel	Casting	Aluminum Alloy
TH07N	M2	57	39.2	29.4
TH09N	M3	186	127	98
TH12N	M3	186	127	98
TH15N	M3	186	127	98

■ 3-1-7 Nominal Model Code for Non-Interchangeable TH Type

Length of Block

Perform joint treatment when required lengths exceed 1300. Please contact TBI MOTION for detailed information.

T	H	07	N	L	S	-	2	-		-	1000	-	N	S	-	Z0	-	II	-	X
①	②	③	④	⑤	⑥		⑦		⑧		⑨		⑩	⑪		⑫		⑬		⑭

①

Nominal Model
T

②

Block Type
H : Mini
X : Special

(Drawing will be provided for special item in order to distinguish the height of the rail.)

③

Dimension
07, 09, 12, 15

④

Width of Rail
N : Standard

⑤

Length of Block
N : Standard
L : Long

⑥

Material of Block
S : Stainless steel

⑦

Quantity of Block
(Mark 1 when there is only 1 runner block)

⑧

Accessory Code
□ : Standard (End seal + Side seal)
NW : Self-Lubricating

(Please refer to page A100)

⑨

Length of Rail
Unit : mm

⑩

Accuracy Grade
N : Normal
H : High
P : Precision

⑪

Material of Rail
S : Stainless steel

⑫

Preload
ZF : Slight Clearance
Z0 : No Preload
Z1 : Light Preload

⑬

Two Sets per Axis
(No need to be marked when there is only one rail) II

⑭

Rail Special Machining
□ : Mounting from Top
X : Rail with Special Machining

※No symbol required when no plating is need.

A Linear Guide

3-1 TH Miniature Linear Guide

■ 3-1-8 Nominal Model Code for Interchangeable TH Type

Interchangeable Type of Block :

T	H	07	N	L	-		-	N	-	ZF
①	②	③	④	⑤		⑥		⑦		⑧

①

Nominal Model
T

②

Block Type
H : Mini
X : Special

(Drawing will be provided for special item in order to distinguish the height of the rail.)

③

Dimension
07, 09, 12, 15

④

Width of Rail
N : Standard

⑤

Length of Block
N : Standard
L : Long

⑥

Accessory Code
□ : Standard (End seal + Side seal)
NW : Self-Lubricating

⑦

Accuracy Grade
N : Normal

⑧

Preload
ZF : Slight Clearance
Z0 : No Preload

Interchangeable Type of Rail :

T	H	07	N	-	1000	-	N	-	X
①	②	③	④		⑤		⑥		⑦

①

Nominal Model
T

②

Rail Type
H : Mini

(Drawing will be provided for special item in order to distinguish the height of the rail.)

③

Dimension
07, 09, 12, 15

④

Width of Rail
N : Standard

⑤

Length of Rail
Unit : mm

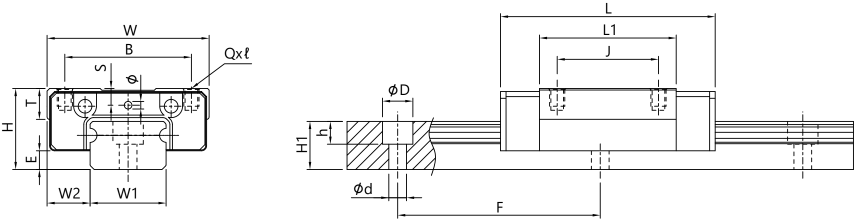
⑥

Accuracy Grade
N : Normal

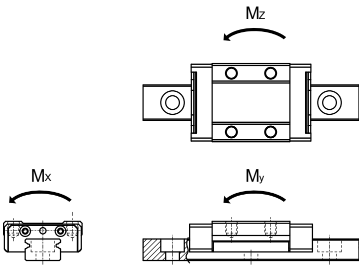
⑦

Rail Special Machining
□ : Mounting from Top
X : Rail with Special Machining

TH-N Series Specifications



Model No.	Assembly (mm)			Block(mm)									Rail(mm)					
	H	W2	E	W	B	S	J	T	L	L1	Qxℓ	Ø	W1	H1	ØD	h	Ød	F
TH07NN	8	5	1.2	17	12	1.6	8	2.95	23.1	12.3	M2×2.1	1.2	7	4.7	4.1	2.3	2.4	15
TH07NL	8	5	1.2	17	12	1.6	13	2.95	31.1	20.3	M2×2.1	1.2	7	4.7	4.1	2.3	2.4	15
TH09NN	10	5.5	1.9	20	15	2.2	10	3.75	30.6	19.2	M3×2.7	1.2	9	5.9	5.9	3.3	3.5	20
TH09NL	10	5.5	1.9	20	15	2.2	16	3.75	40.9	29.5	M3×2.7	1.2	9	5.9	5.9	3.3	3.5	20
TH12NN	13	7.5	2.7	27	20	3	15	4.62	34.4	20.6	M3×3.2	1.3	12	7.5	6	4.5	3.5	25
TH12NL	13	7.5	2.7	27	20	3	20	4.62	46.9	33.1	M3×3.2	1.3	12	7.5	6	4.5	3.5	25
TH15NN	16	8.5	3.7	32	25	3.5	20	6.1	42.8	27	M3×3.5	1.5	15	9.5	6	4.5	3.5	40
TH15NL	16	8.5	3.7	32	25	3.5	25	6.1	59.8	44	M3×3.5	1.5	15	9.5	6	4.5	3.5	40



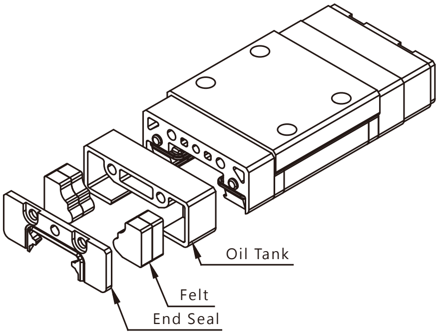
Model No.	Load Rating (kgf)		Static Permissible Moment					Weight	
			Mx (kg-mm)	My(kg-mm)		Mz(kg-mm)		Block (kg)	Rail (kg/m)
	C	Co	Single Block	Single Block	Double Block	Single Block	Double Block		
TH07NN	144	204	745	232	3,234	232	3,234	0.005	0.21
TH07NL	220	374	1,367	849	7,261	849	7,261	0.009	
TH09NN	220	374	1,713	849	7,117	849	7,117	0.013	0.32
TH09NL	299	579	2,648	2,099	14,174	2,099	14,174	0.020	
TH12NN	381	536	3,269	1,094	12,391	1,094	12,391	0.024	0.61
TH12NL	555	919	5,604	3,437	26,857	3,437	26,857	0.039	
TH15NN	581	834	6,336	2,316	23,096	2,316	23,096	0.048	1
TH15NL	860	1,459	11,088	7,527	52,908	7,527	52,908	0.080	

3-1 TH Miniature Linear Guide

■ 3-1-9 Self-Lubricating Accessory of TH Series

Table 3.1.7 Self-Lubricating Accessory Code of TH Series

Specifications : TH07N, 09N
Accessory Code : TH-NW



Specifications : TH12N, 15N
Accessory Code : TH-NW

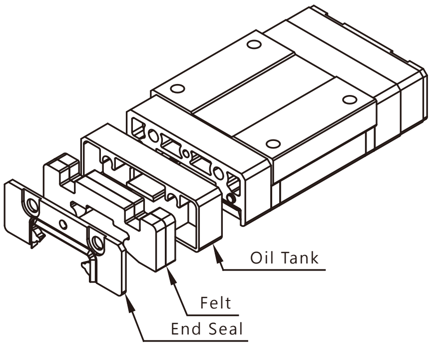


Table 3.1.8 Miniature TH Block with Self-Lubrication Accessory Unit : mm

Type / Length of Block Code	TH07	TH09	TH12	TH15
N	33.1	40.6	44.4	54.8
L	41.1	50.9	56.9	71.8

4-1 TM Miniature Wide Linear Guide

■ 4-1-1 The Characteristics of TM Series

High Accuracy: The miniature linear guide is manufactured to high precision standards, which enables accurate positioning and motion control.

Excellent Stability: The surfaces of the miniature linear guide undergo specialized treatments that result in a low friction coefficient, ensuring smooth operation and extended service life.

Robust Load Capacity: Despite its compact size, the miniature linear guide features an enhanced load capacity due to material optimization and specialized surface treatments, allowing it to withstand significant forces.

Low Noise: The special surface treatment minimizes friction, ensuring smooth movement and reducing operational noise.

Space Efficiency: The compact design of the miniature linear guide facilitates the use of smaller actuators and motors, effectively saving space while supporting substantial loads.

Easy Maintenance: The simple design of the miniature linear guide makes maintenance convenient and improves the efficiency of the replacement and cleaning processes.

High Accuracy

Customized high-accuracy machining equipment and processes are utilized to manufacture linear guides with an accuracy of ±1μm/1000mm.

Interchangeability

Precision control of machining tolerances allows for interchangeability of rails and blocks across different batches, significantly reducing inventory pressure.

High Speed

Extremely low surface roughness provides a smooth rolling track, contributing to high durability and enabling exceptional smoothness and speed.

High Rigidity

The use of large steel balls enhances circulation smoothness, increasing rigidity and torque while extending service life.

4-1 TM Miniature Wide Linear Guide

■ 4-1-2 Selection Process

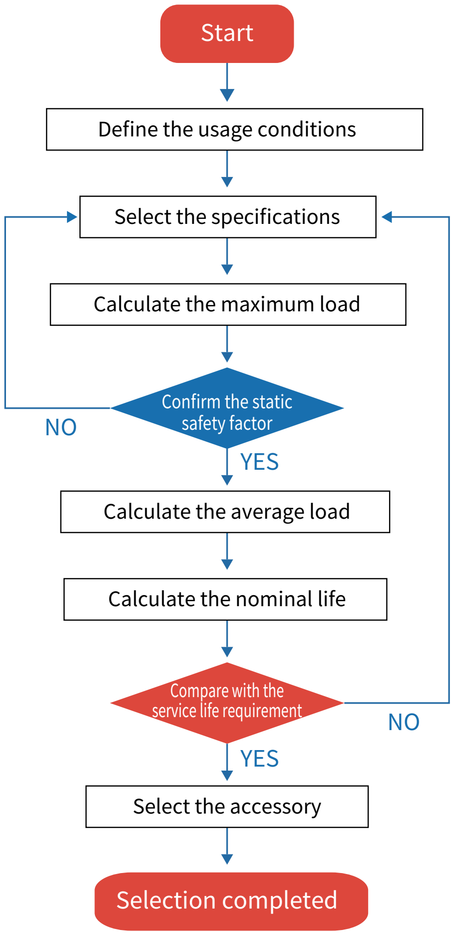
Please note the following information regarding usage requirements:

A. Combination Methods (span dimensions, number of blocks, number of rails)

B. Installation Directions (horizontal, vertical, tilted, wall-mounted)

C. Load Requirements (magnitude, direction, point of application; confirm if it includes fictitious forces)

D. Usage Frequency (load cycle)



A. Combination Methods

A-1 Span Dimensions:

Relative position of the blocks (as shown in Fig 4.1.1):

L0: Distance between blocks on the same rail

L1: Distance between dual rails

A-2. Number of blocks: Increasing the number of blocks enhances load capacity, rigidity, and service life, but shortens the available travel space.

A-3. Number of rails: Using dual rails can improve the MR capability for the system.

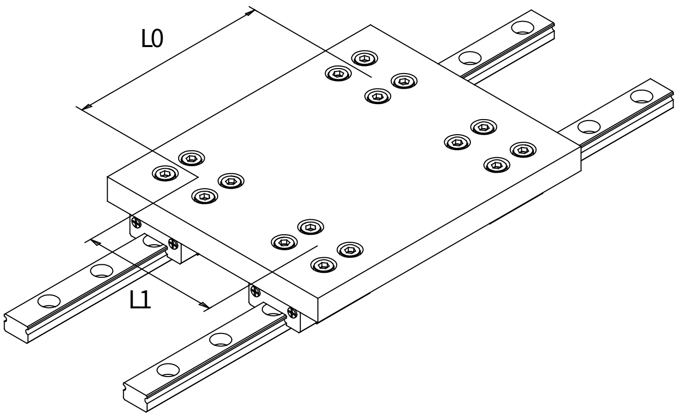


Fig 4.1.1 Span Dimensions

4-1 TM Miniature Wide Linear Guide

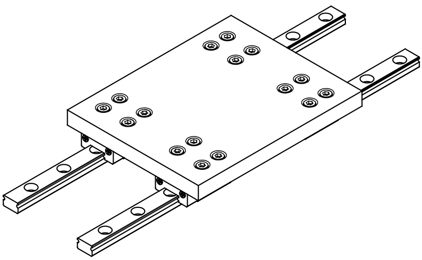
B. Installation Directions

Choosing the ideal installation type can significantly reduce the impact of load moments on the linear motion system. Generally, the rail and block assembly methods can be categorized into the following types:

1. Horizontal Position
2. Wall-Mounted Position
3. Vertical Position
4. Other Methods (such as tilted position, inverted position)

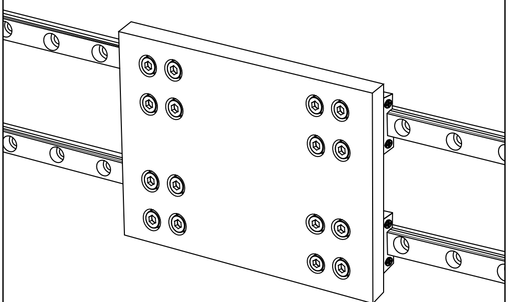
Horizontal Position

The most commonly used assembly method is the horizontal position, which better withstands vertical loads and is frequently employed in general positioning and feeding machines.



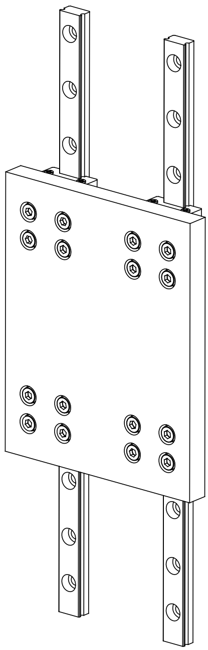
Wall-Mounted Position

It is important to consider the reactive moment caused by gravity when selecting this method. Increasing the distance between the rails can enhance load distribution.



Vertical Position

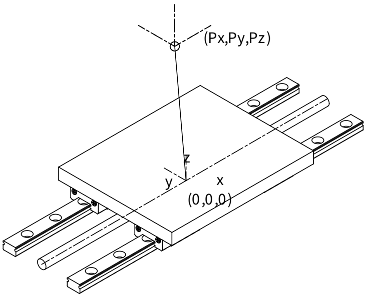
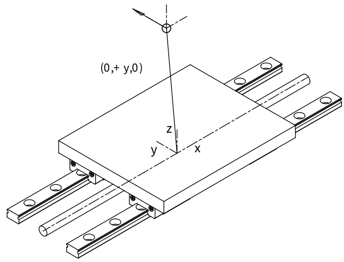
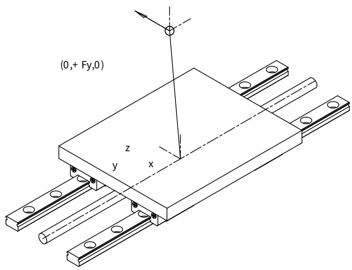
Typically used in lifting mechanisms. Attention should be paid to the gravitational load when extending the plate length. Increasing the distance between blocks on the same rail can enhance load distribution.



C. Load Requirements

Definition of a load requires three key elements:

1. Magnitude
2. Direction
3. Point of application

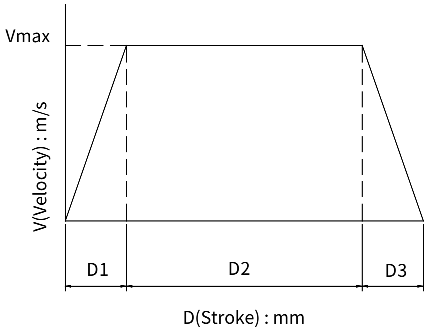
The point of application is shown as the right diagram.	
The direction is shown as the right diagram.	
The force and direction are shown as the right diagram.	

4-1 TM Miniature Wide Linear Guide

D. Velocity

V_{max}: Maximum speed during the process

D: Length of the travel (D1, D2, D3 are the distances for acceleration, constant speed and deceleration.)



Statistics on the usage of the mechanism within a unit of time help to evaluate whether the system meets actual demands.

Example:

There is a machine that operates 100 km daily with a service life requirement of three years and 300 working days per year.

Required service life: 3 years

Usage Frequency: 100 km/day

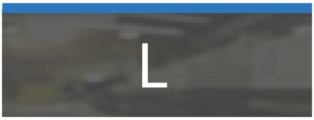
The required lifespan is calculated as follows:

3 years × 300 days/year × 100 km/day = 90,000 km

■ 4-1-3 Load and Service Life

During load movements on linear guides, the rolling elements and rolling surfaces experience compressive force and corresponding tensile force. When these forces are applied repeatedly over a certain number of cycles and distance, fatigue damage may occur in the rolling surfaces or rolling elements. This results in metal flakes resembling fish scales, referred to as metal flaking. When this happens, the system cannot maintain accuracy anymore, which means the product's lifespan has ended.

Below are explanations of the key parameters:



Nominal Life (km)

Linear guides are mass-produced products. Even under the same conditions, they may not have the same service life. The nominal life is defined as the operation of a batch of linear guides under the same conditions, where 90% of the products in the same batch meet the standard and do not experience the metal flaking over a specified total travel distance.

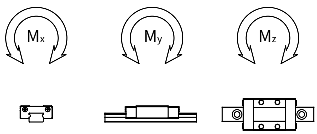
Basic Static Load Rating (N)

The load value that causes a permanent deformation of 0.0001 times the diameter of the rolling elements and the rolling surfaces, under constant direction and magnitude. This is used to calculate the static safety factor for the linear guide.

Basic Dynamic Load Rating (N)

The same specifications for each batch of linear guides with individual operational tests which are conducted under consistent conditions, where the load and direction remain unchanged. In this context, 90% of the products in the batch demonstrate a nominal life corresponding to a load value of 50 km.

M_x, M_y, M_z Permissible Moment (N-m):



The total moment value causes a permanent deformation of 0.0001 times the diameter of the rolling elements and the rolling surfaces, under constant direction and magnitude. Define M_x, M_y, and M_z in three axes when calculating the static safety factor.

4-1 TM Miniature Wide Linear Guide

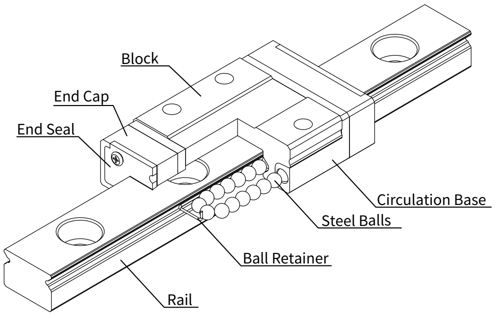


Fig 4.1.2 Structure of TM

fs : Static Safety Factor

It is the ratio of the load capacity of linear guides (basic static load rating) and the maximum calculated load.

The formula is as follows:

$$f_s = \frac{f_c \cdot C_0}{P} \qquad f_s = \frac{f_c \cdot M_0}{M}$$

f_s : Static Safety Factor

C_0 : Basic Static Load Rating

M_0 : Static Permissible Moment

P : Design Load

M : Design Moment

f_c : Contact Factor

Operating Conditions	Loading Conditions	Minimum fs
General Static Conditions	Minor impacts and offsets	1.0~1.3
	Heavy impacts and vibrations	2.0~3.0
General Motion Conditions	Minor impacts and twists	1.0~1.5
	Heavy impacts and vibrations	2.5~5.0

Additional Influence Parameters

Additional influence parameters mainly address variations in usage methods and environmental conditions, allowing for appropriate adjustments to correct calculation errors.

f_c : Contact Factor

f_h : Hardness Factor

f_t : Temperature Factor

f_w : Load Factor

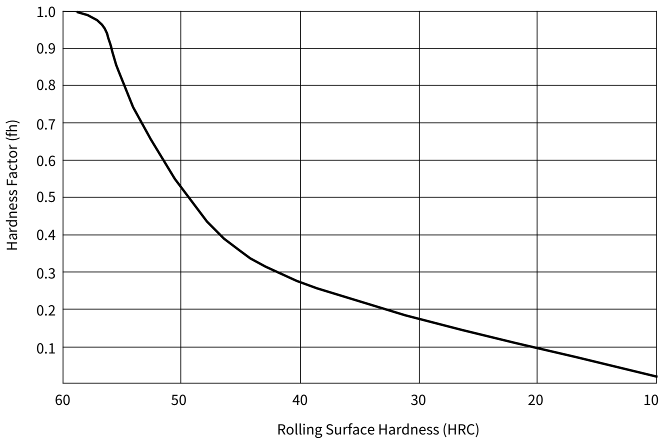
f_c : Contact Factor

Contact Factor: When multiple blocks are closely arranged with each other, the load distribution on the steel balls becomes uneven. Therefore, a correction factor needs to be included in the lifespan calculation.

Number of Used Blocks	Contact Factor fc
In normal use	1
2	0.81
3	0.72
4	0.66
5	0.61

f_h : Hardness Factor

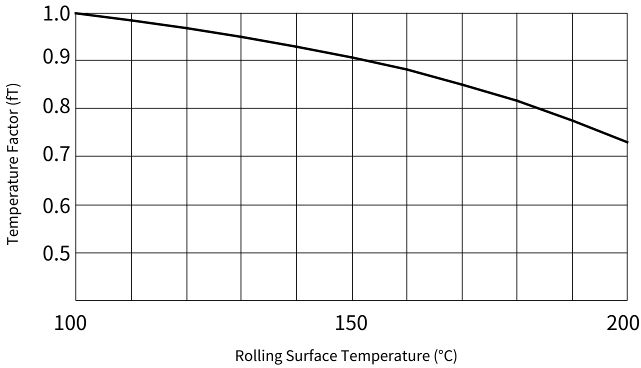
Hardness Factor: The hardness for the rolling elements and rolling surfaces of linear guides is between 58~62 HRC. If any conditions lead to a decrease in hardness, a correction factor needs to be included in the lifespan calculation.



4-1 TM Miniature Wide Linear Guide

f_t: Temperature Factor

Temperature Factor: When rolling surfaces and rolling elements are in high-temperature environments, their lifespan diminishes as the operating temperature increases. If the ambient temperature exceeds the conditions shown in the diagram, it should be considered when evaluating lifespan. For linear guide with plastic components and end seals, it is advisable to keep the operating temperature below 80°C.



f_w: Load Factor

Load Factor: Reciprocating mechanisms can easily generate vibrations or impacts, especially during high-speed operations or frequent starts and stops, which produce inertial shocks. Estimating a reasonable load under these conditions can be quite challenging. Therefore, when the impact of speed vibrations is significant, please refer to the following load coefficients, based on empirical data, and divide them by the basic dynamic load rating (C).

Vibration and Impact	Velocity (V)	Measured Vibration (G)	fw
Very Slight	V≤15m/min	G≤0.5	1~1.5
Slight	15<V≤60m/min	0.5<G≤1.0	1.5~2.0
Strong	V>60m/min	1.0<G≤2.0	2.0~3.5

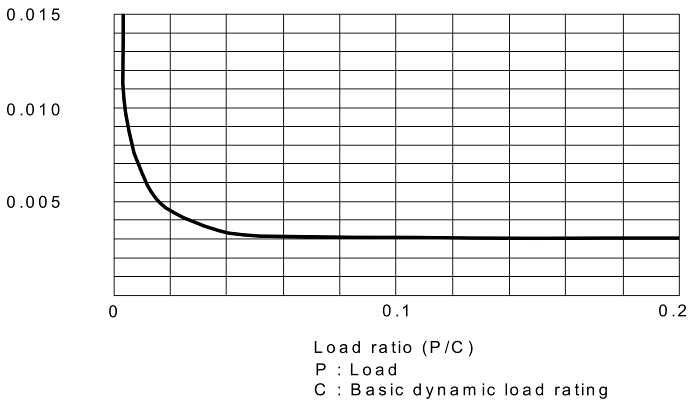
The formula is as follows:

$$L=\left[\frac{f_h\cdot f_t\cdot f_c}{f_w}\cdot\frac{C}{P}\right]^3\cdot 50km$$

C : Basic Dynamic Load Rating
P : Calculated Load
f_h : Hardness Factor
f_t : Temperature Factor
f_c : Contact Factor
f_w : Load Factor

(The selection process section will provide a more in-depth introduction.)

Friction



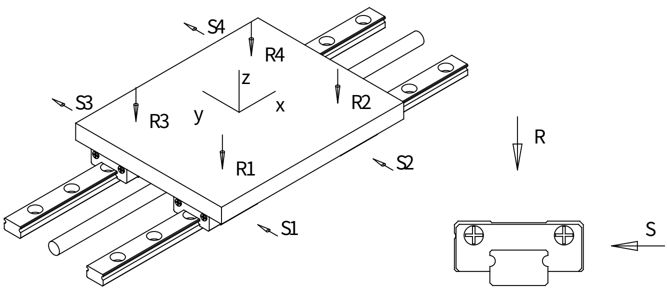
Linear guides enable load movement using rolling elements like balls or rollers, resulting in friction that is 1/40th of the one found in traditional sliding systems. The causes of friction include the viscous resistance of lubricants, preload friction resistance, and friction generated by the applied force. The diagram above illustrates the coefficient of friction when the linear guide is subjected to force.

F=uW+f
F : Friction
W : Load
u : Friction Factor
f : Friction Resistance from Block Accessory

4-1 TM Miniature Wide Linear Guide

Load Calculation

The definition of load calculation is shown in the diagram below. The letter “R” represents the radial load on the block, and “S” represents the lateral load on the block, with numbers indicating their positions. The load calculation for the block is as follows:



$$R_1 = \frac{-F_z}{4} + \frac{(F_z \cdot P_y - F_y \cdot P_z)}{2 \cdot L1} - \frac{(F_x \cdot P_z - F_z \cdot P_x)}{2 \cdot L0}$$

$$R_2 = \frac{-F_z}{4} + \frac{(F_z \cdot P_y - F_y \cdot P_z)}{2 \cdot L1} - \frac{(F_x \cdot P_z - F_z \cdot P_x)}{2 \cdot L0}$$

$$R_3 = \frac{-F_z}{4} + \frac{(F_z \cdot P_y - F_y \cdot P_z)}{2 \cdot L1} - \frac{(F_x \cdot P_z - F_z \cdot P_x)}{2 \cdot L0}$$

$$R_4 = \frac{-F_z}{4} + \frac{(F_z \cdot P_y - F_y \cdot P_z)}{2 \cdot L1} - \frac{(F_x \cdot P_z - F_z \cdot P_x)}{2 \cdot L0}$$

$$S_1 = \frac{F_y}{4} + \frac{(F_y \cdot P_x - F_x \cdot P_y)}{2 \cdot L0}$$

$$S_2 = \frac{F_y}{4} + \frac{(F_y \cdot P_x - F_x \cdot P_y)}{2 \cdot L0}$$

$$S_3 = \frac{F_y}{4} + \frac{(F_y \cdot P_x - F_x \cdot P_y)}{2 \cdot L0}$$

$$S_4 = \frac{F_y}{4} + \frac{(F_y \cdot P_x - F_x \cdot P_y)}{2 \cdot L0}$$

■ 4-1-4 Preload

Preload is crucial to the overall precision performance of the mechanism. The mechanism may experience overall oscillation due to external forces or inertia from accelerations. Below are reference preload levels for various types of machinery.

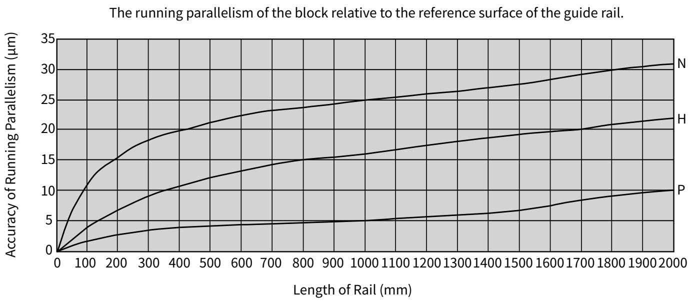
Preload	Slight Clearance	Zero Clearance	Light Preload
Operating Conditions	1. Slight impact	1. Slight impact	1. Cantilever
	2. One-axis usage	2. Two-axes usage in parallel	2. One-axis usage
	3. High smoothness requirement	3. High smoothness requirement	3. Light load
	4. Slight sliding resistance	4. Low sliding resistance	4. High accuracy
	5. Low reciprocating load case	5. Low reciprocating load case	
Application Examples	1. Conveyor	1. Welding machine	1. NC lathe
	2. Fully automatic sewing machine	2. Cutting machine	2. Electrical discharge machine
	3. Vending machine	3. Material feeding systems	3. Precision XY table
	4. Laser engraving machine	4. Automatic tool changer	4. Z-axis for general machinery
	5. Banner printing machine	5. XY-axis for general machinery	5. Industrial robotic arm
	6. Screen printing equipment	6. Packing machine	6. PCB drilling machine

Preload and Clearance

When selecting preload, it is important to consider the potential for clearance or additional preload forces. Be sure to assess the impact on precision and lifespan during the selection process. Miniature linear guides are generally not suitable for medium to high preload applications involving heavier loads because of the limitations in its profile and rigidity.

Preload	Mark	Clearance or Preload Force
Slight Clearance	F	4~10μm
No Clearance	0	2μm~0.01C
Light Preload	1	0.01C~0.02C

Note. The letter “C” in preload force is Dynamic Load Rating.



4-1 TM Miniature Wide Linear Guide

■ 4-1-5 Accuracy

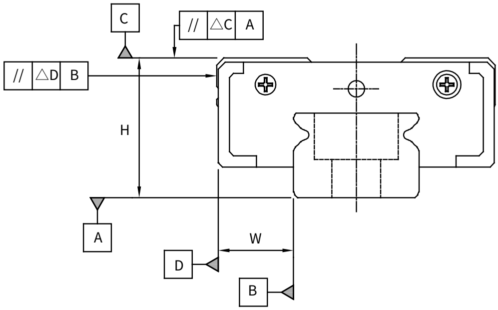


Table 4.1.1 Assembly Accuracy (Non-Interchangeable Type)

Type	Item	Accuracy Level		
		Normal "N"	High "H"	Precision "P"
07 09 12 15	Tolerance for Height H	±0.04	±0.02	±0.01
	Tolerance for Width W	±0.04	±0.025	±0.015
	Tolerance for Height H difference among the blocks	0.03	0.015	0.007
	Tolerance for Width W difference among the blocks	0.03	0.02	0.01
	Running parallelism of block surface "C" against surface "A"	Running parallelism (Table 4.1.3)		
	Running parallelism of block surface "D" against surface "B"	Running parallelism (Table 4.1.3)		

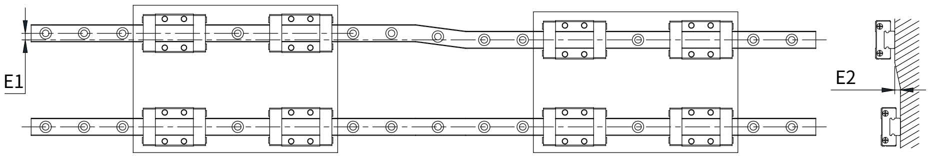
Flatness of the Mounting Surfaces of the Block and Guide Rail

Due to the Gothic structure of miniature linear guides, any accuracy errors in the mounting surfaces may negatively affect their operation.

Table 4.1.2 Flatness of the Mounting Surfaces of the Block and Guide Rail **Unit: mm**

Model No.	Flatness Tolerance
07	0.025/200
09	0.035/200
12	0.050/200
15	0.060/200

Note.1. For installation surfaces, accuracy can be influenced by a combination of factors in different cases. Therefore, it is recommended to use values below 70% of those listed in the table.
Note.2. The values mentioned above apply to slight clearances. When using a zero-clearance two-axes system, it is recommended to use values below 50% of those specified above.



Unit: μm

	Tolerance for Dual-Axis Parallelism Error E1			Tolerance for Dual-Axis Levelness Error E2		
Model No.	Slight Clearance	Zero Clearance	Light Preload	Slight Clearance	Zero Clearance	Light Preload
7	3	3	3	25	25	3
9	4	4	3	35	35	6
12	9	9	5	50	50	12
15	10	10	6	60	60	20

4-1 TM Miniature Wide Linear Guide

■ 4-1-6 Accuracy Standard

Table 4.1.3 Rail Length for TM Series and Running Parallelism

Rail Length for TM Series		Running Parallelism (μm)		
Above	Below	N	H	P
	40	8	4	1
40	70	10	4	1
70	100	11	4	2
100	130	12	5	2
130	160	13	6	2
160	190	14	7	2
190	220	15	7	3
220	250	16	8	3
250	2803	17	8	3
280	310	17	9	3
310	340	18	9	3
340	370	18	10	3
370	400	19	10	3
400	430	20	11	4
430	460	20	12	4
460	490	21	12	4
490	520	21	12	4
520	550	22	12	4
550	580	22	13	4
580	610	22	13	4
610	640	22	13	4
640	670	23	13	4
670	700	23	13	5
700	730	23	14	5
730	760	23	14	5
760	790	23	14	5
790	820	23	14	5
820	850	24	14	5
850	880	24	15	5
880	910	24	15	5
910	940	24	15	5
940	970	24	15	5
970	1000	25	16	5
1000	1030	25	16	5

Table 4.1.3 Rail Length for TM Series and Running Parallelism

Rail Length for TM Series		Running Parallelism (μm)		
Above	Below	N	H	P
1030	1060	25	16	6
1060	1090	25	16	6
1090	1120	25	16	6
1120	1150	25	16	6
1150	1180	26	17	6
1180	1210	26	17	6
1210	1240	26	17	6
1240	1270	26	17	6
1270	1300	26	17	6
1300	1330	26	17	6
1330	1360	27	18	6
1360	1390	27	18	6
1390	1420	27	18	6
1420	1450	27	18	7
1450	1480	27	18	7
1480	1510	27	18	7
1510	1540	28	19	7
1540	1570	28	19	7
1570	1600	28	19	7
1600	1700	29	20	8
1700	1800	30	21	9
1800	1900	30	21	9
1900	2000	31	22	10

4-1 TM Miniature Wide Linear Guide

■ 4-1-7 Mounting Type of Linear Rail

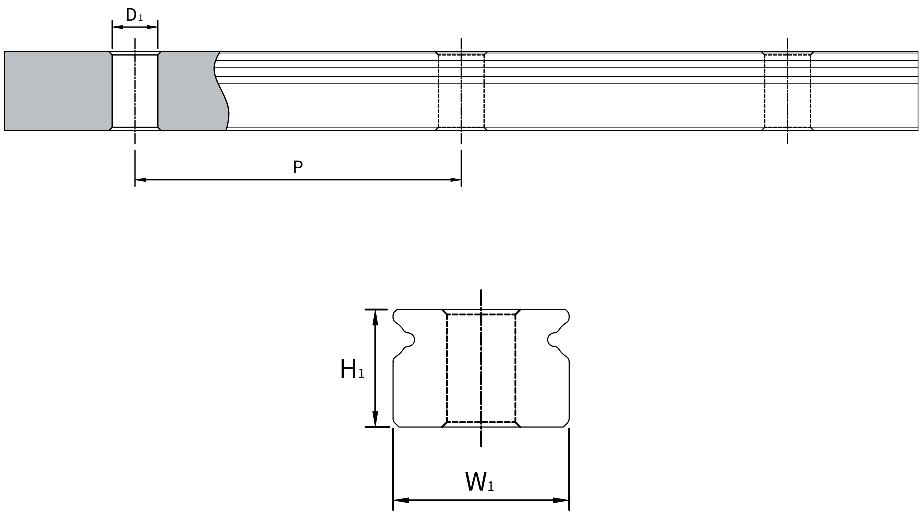


Fig 4.1.3 Mounting from Below

Table 4.1.4 Rail Size

Unit: mm

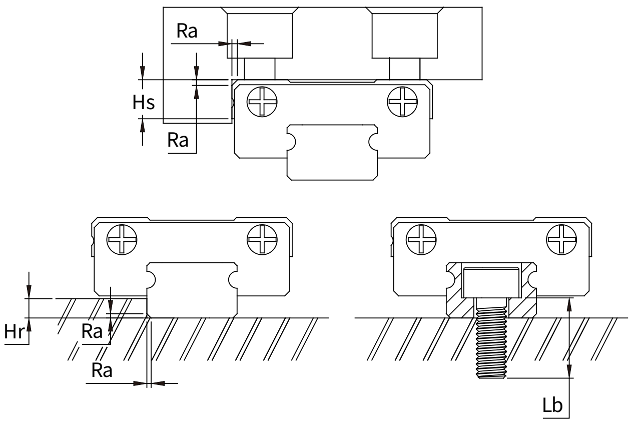
Model No.	Rail Size			
	H1	W1	P	D1
TM07W	5.2	14	30	M4*0.7
TM09W	6.5	18	30	M4*0.7
TM12W	8.5	24	40	M5*0.8
TM15W	9.5	42	40	M5*0.8

■ 4-1-8 Installation

Installation Process

Good installation quality is built on detailed planning during the design phase and the implementation of installation processes. The following are dimensions and design considerations that should be noted in the early design phase, as well as detailed tasks that need to be considered during the installation process.

Dimensions to Consider in the Design Phase

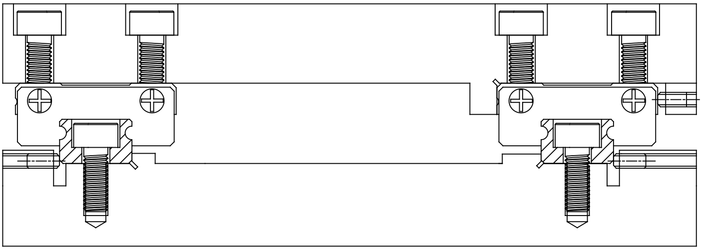


Item	Hr	Hs	Ra	Lb
TM07W	1.7	3	0.2	M3×10L
TM09W	2.5	3.2	0.2	M3×10L
TM12W	3.5	4	0.3	M4×12L
TM15W	3.5	4	0.4	M4×14L

Hr : Maximum height of the rail support surface (mm)
Hs : Recommended height for block support (mm)
Ra : Maximum fillet radius for the support corner (mm)
Lb : Recommended specifications for fixed screws

4-1 TM Miniature Wide Linear Guide

Basic Structure



The above image provides a basic introduction to the application of linear guides.

The basic structure is mainly divided into:

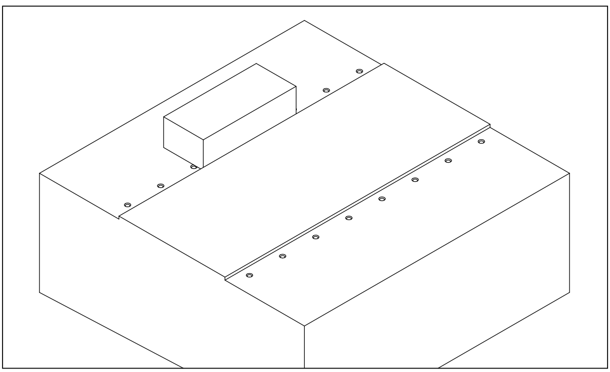
1. Fixed Platform: The above image features a rail mounting surface, with lateral set screws that securely align the rail with the reference surface.

2. Moving Platform: The above image includes a mounting surface for the block, with lateral set screws tightened to ensure the accuracy and stability between the block and the moving platform.

3. Rake Angle Design: Rails and blocks feature basic chamfers to prevent assembly interference. However, to facilitate maintenance, incorporating a rake angle design can also be beneficial.

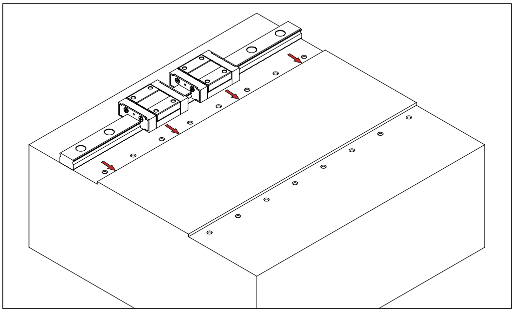
Step 1.

Basic Preparatory Work: To achieve good installation quality, use a cleaning oil to remove the rust-proof oil layer from the reference surface before installation. Additionally, use a honing stone to eliminate any machining burrs or surface defects.



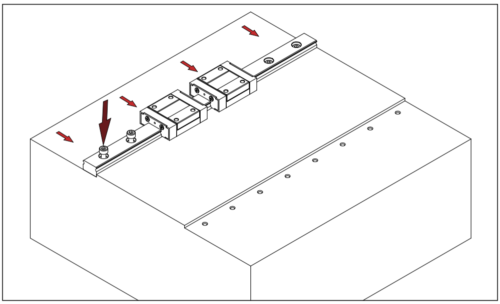
Step 2.

Installation Reference Surface Confirmation: Verify the installation orientation of the reference surface for the rail and block to ensure precise positioning accuracy.



Step 3.

Rail Pre-Positioning: Place the rail onto the reference surface, ensuring it rests against the side installation reference surface. Tighten the set screws to maintain clamping force without fully locking them. Follow the specified sequence for tightening screws, ensuring that the rotation direction aligns the linear guide with the holes of the adjacent reference surface. Proceed in sequence to avoid any misalignment.



4-1 TM Miniature Wide Linear Guide

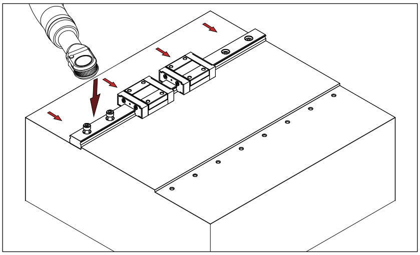
Step 4.

Selection of Tightening Torque: Please confirm the material of the installation platform and the size of the set screws. Then, select the appropriate tightening torque accordingly.

Model No.	Tightening Torque (kg-cm)		
	Steel	Cast Iron	Aluminum
M2	6.3	4.2	3.1
M2.3	8.4	5.7	4.2
M2.6	12.6	8.4	6.3
M3	21	13.6	10.5
M4	44.1	29.3	22
M5	94.5	63	47.2
M6	146.7	98.6	73.5
M8	325.7	215.3	157.5

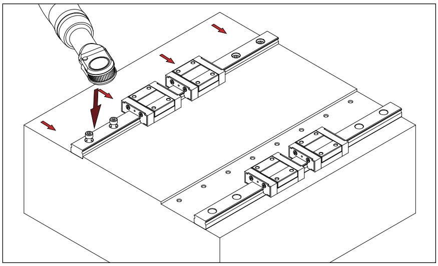
Step 5.

Tightening with Torque Wrench: Use a torque wrench to tighten the screws in stages for accurate positioning. This can be done in two or three stages (with a three-stage tightening distribution of 40%, 70%, and 100% of the final torque output).



Step 6.

Sub-Rail Installation: Follow the same steps as above, paying attention to the torque and the selected order of tightening for the supporting surfaces. Tighten in stages for accurate positioning.



Step 7.

Installation of Moving Platform:

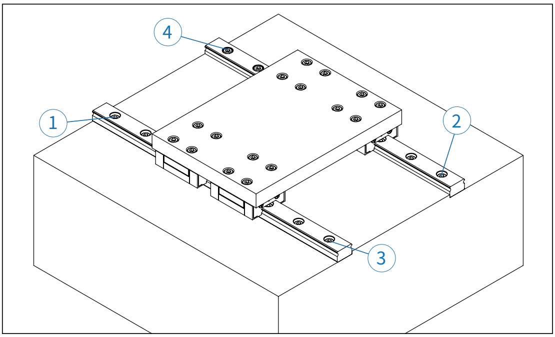
1.Carefully place the moving platform on the assembled block, ensuring that the mounting surface aligns with the lateral clamping position.

2. Tightening can be done in two or three stages (with a three-stage tightening distribution of 40%, 70%, and 100% of the final torque output).

3. Follow a diagonal tightening sequence for the set screws, proceeding in stages as shown in installation step 6.

4. After completing the first stage of tightening at 30%, proceed to apply lateral clamping for the first stage output.

5. After completing the first stage, continue to the next stage, progressing to 100% completion.



4-1 TM Miniature Wide Linear Guide

■ 4-1-9 Nominal Model Code for TM Series

Length of Rail

If the required length exceeds 1300 mm, it will be assembled using two or more sections. Please contact TBI MOTION for detailed information.

T	M	07	W	L	S	-	2	-		-	1000	-	N	S	-	Z0	-	II	-	K
①	②	③	④	⑤	⑥		⑦		⑧		⑨		⑩	⑪		⑫		⑬		⑭

①

Nominal Model
T

②

Block Type
M: Miniature
X: Special

(Drawing will be provided for special item in order to distinguish the height of the rail.)

③

Dimension
07, 09, 12, 15

④

Width of Rail
W: Wide

⑤

Length of Block
N: Standard
L: Long

⑥

Material of Block
S: Stainless Steel

⑦

Number of Block Per Rail
(Mark 1 when there is only 1 block)

⑧

Accessory Code
□ : Standard (End seal + Bottom seal)

⑨

Length of Rail
Unit: mm

⑩

Accuracy Grade
N: Normal
H: High
P: Precision

⑪

Material of Rail
S: Stainless steel

⑫

Preload
ZF: Slight Clearance
Z0: Zero Clearance
Z1: Light Preload

⑬

Two Sets per Axis
(No need to be marked when there is only one rail) II

⑭

Rail Special Machining
K: Mounting from Bottom
X: Rail with Special Machining
□: Mounting from Top

※There is no surface treatment for Miniature Wide Series.

Interchangeable Type of Block:

T	M	07	W	L	-	N	S	-	Z0
①	②	③	④	⑤		⑥	⑦		⑧

①

Nominal Model
T

②

Block Type
M: Miniature
X: Special

(Drawing will be provided for special item in order to distinguish the height of the rail.)

③

Dimension
07, 09, 12, 15

④

Width of Rail
W: Wide

⑤

Length of Block
N: Standard
L: Long

⑥

Accuracy Grade
N: Normal
H: High
P: Precision

⑦

Material of Block
S: Stainless steel

⑧

Preload
ZF: Slight Clearance
Z0: Zero Clearance
Z1: Light Preload

Interchangeable Type of Rail:

T	M	07	W	-	1000	-	N	S	-	K
①	②	③	④		⑤		⑥	⑦		⑧

①

Nominal Model
T

②

Block Type
M: Miniature
X: Special

(Drawing will be provided for special item in order to distinguish the height of the rail.)

③

Dimension
07, 09, 12, 15

④

Width of Rail
W: Wide

⑤

Length of Rail
Unit: mm

⑥

Accuracy Grade
N: Normal
H: High
P: Precision

⑦

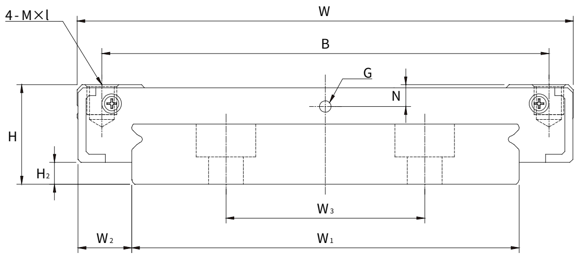
Material of Rail
S: Stainless steel

⑧

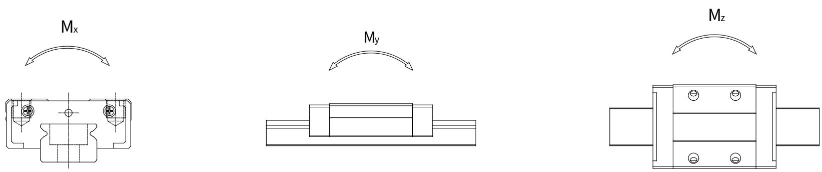
Rail Special Machining
K: Mounting from Bottom
X: Rail with Special Machining
□: Mounting from Top

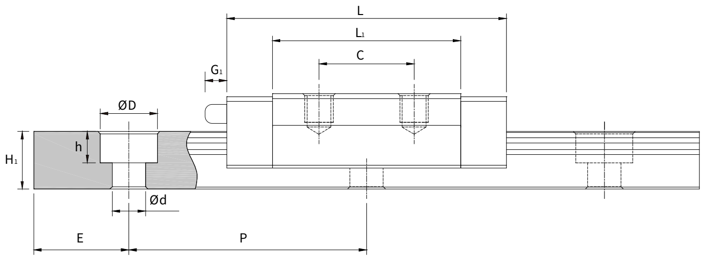
4-1 TM Miniature Wide Linear Guide

TM-W Series Specification



Model No.	Assembly (mm)			Block Dimension (mm)								
	H	H2	W2	W	L	L1	B	C	M×l	N	G	G1
TM07WN	9	2	5.5	25	30.6	21	19	10	M3x3	1.8	1.2	-
TM07WL	9	2	5.5	25	40.4	30.8	19	19	M3x3	1.8	1.2	-
TM09WN	12	3	6	30	38.7	26.1	21	12	M3x3	2.8	1.2	-
TM09WL	12	3	6	30	50.5	37.9	23	24	M3x3	2.8	1.2	-
TM12WN	14	4	8	40	44	29.4	28	15	M3x4	2.85	1.2	-
TM12WL	14	4	8	40	59	44.4	28	28	M3x4	2.85	1.2	-
TM15WN	16	4	9	60	54.8	37.8	45	20	M4x4.5	3	M3	4.5
TM15WL	16	4	9	60	73.8	56.8	45	35	M4x4.5	3	M3	4.5





Rail Dimension (mm)						Load Rating (kgf)		Static Permissible Moment (kg-mm)					Weight	
								M_x	M_y		M_z		Block (kg)	Rail (kg/m)
W1	W3	H1	P	D×h×d	E	C	C0	Single Block	Single Block	Double Block	Single Block	Double Block		
14	-	5.2	30	6x3.2x3.5	10	139	209	1601	728	3753	728	3753	0.02	0.52
14	-	5.2	30	6x3.2x3.5	10	180	320	2391	1581	8392	1581	8392	0.029	
18	-	6.5	30	6x3.5x3.5	10	279	368	4093	1935	9514	1935	9514	0.035	0.95
18	-	6.5	30	6x3.5x3.5	10	354	604	5588	3489	18385	3489	18385	0.048	
24	-	8.5	40	8x4.5x4.5	15	402	571	7174	2839	14918	2839	14918	0.06	1.53
24	-	8.5	40	8x4.5x4.5	15	525	847	10493	5864	29806	5864	29806	0.086	
42	23	9.5	40	8x4.5x4.5	15	694	942	20440	5919	31988	5919	31988	0.122	2.9
42	23	9.5	40	8x4.5x4.5	15	918	1375	30642	12634	61937	12634	61937	0.174	

5-1 Accessory list / Accessory combination list

Table 5.1.1 Accessory list

Type	Codes of Accessories	XN	XNC	UN	ZN	SU	SZ	BN	WW	WU	WZ	DU	DZ	TH
TR15S		O	O	O	O	O	O	O	O	O	O	O	O	-
TR15N		O	O	O	O	O	O	O	O	O	O	O	O	-
TR15L		O	O	O	O	O	O	O	O	O	O	O	O	-
TR20S		O	O	O	O	O	O	O	O	O	O	O	O	-
TR20N		O	O	O	O	O	O	O	O	O	O	O	O	-
TR20E		O	O	O	O	O	O	O	O	O	O	O	O	-
TR25S		O	O	O	O	O	O	O	O	O	O	O	O	-
TR25N		O	O	O	O	O	O	O	O	O	O	O	O	-
TR25E		O	O	O	O	O	O	O	O	O	O	O	O	-
TR30S		O	O	O	O	O	O	O	O	O	O	O	O	-
TR30N		O	O	O	O	O	O	O	O	O	O	O	O	-
TR30E		O	O	O	O	O	O	O	O	O	O	O	O	-
TR35N		O	O	O	O	O	O	O	O	O	O	O	O	-
TR35E		O	O	O	O	O	O	O	O	O	O	O	O	-
TR45N		O	O	O	O	O	O	O	O	O	O	O	O	-
TR45L		O	O	O	O	O	O	O	O	O	O	O	O	-
TR45E		O	O	O	O	O	O	O	O	O	O	O	O	-
TR55L		O	O	O	O	O	O	-	-	-	-	-	-	-
TR55E		O	O	O	O	O	O	-	-	-	-	-	-	-
TR65L		O	O	O	O	O	O	-	-	-	-	-	-	-
TR65E		O	O	O	O	O	O	-	-	-	-	-	-	-
TH07		-	-	-	-	-	-	-	-	-	-	-	-	O
TH09		-	-	-	-	-	-	-	-	-	-	-	-	O
TH12		-	-	-	-	-	-	-	-	-	-	-	-	O
TH15		-	-	-	-	-	-	-	-	-	-	-	-	O

A

Linear Guide

Table 5.1.2 Accessory combination list

Type / Accessories	XN	XNC	UN	ZN	SU	SZ	BN	WW	WU	WZ	DU	DZ	TH
Strong Double-lip end seals	O	-	O	-	O	-	O	O	O	-	O	-	-
Strong Two Double-lip end seals	-	-	-	O	-	O	-	-	-	O	-	O	-
Low Resistance End Seal	-	O	-	-	-	-	-	-	-	-	-	-	O
Spacer	-	-	-	O	O	-	-	-	-	O	O	-	-
Double Spacer	-	-	-	-	-	O	-	-	-	-	-	O	-
Metal Scraper	-	-	-	-	O	O	-	-	-	-	O	O	-
Bottom Seal	O	O	O	O	O	O	O	O	O	O	O	O	O
Top Seal	-	-	O	O	O	O	-	-	O	O	O	O	-
Oil Reservoir	-	-	-	-	-	-	O	-	-	-	-	-	-
Oil Tank	-	-	-	-	-	-	-	O	O	O	O	O	O
Mounting Hole Cap	O	O	O	O	O	O	O	O	O	O	O	O	O
Grease Nipple SD-020	O	O	O	-	-	-	-	-	-	-	-	-	-
Grease Nipple SD-024	-	-	-	O	O	-	-	-	-	-	-	-	-
Grease Nipple SD-066	-	-	-	-	-	O	-	-	-	-	-	-	-
Grease Nipple SD-021	O	O	O	-	-	-	-	-	-	-	-	-	-
Grease Nipple SD-025	-	-	-	-	O	-	-	-	-	-	-	-	-
Grease Nipple SD-026	-	-	-	O	-	O	-	-	-	-	-	-	-
Grease Nipple SD-075	-	-	-	O	-	-	-	-	-	-	-	-	-
Grease Nipple SD-060	-	-	-	-	-	O	-	-	-	-	-	-	-
Grease Nipple SD-011	O	O	O	-	-	-	-	-	-	-	-	-	-
Grease Nipple SD-027	-	-	-	O	-	O	-	-	-	-	-	-	-
Grease Nipple SD-068	-	-	-	-	O	-	-	-	-	-	-	-	-
Grease Nipple SD-059	-	-	-	O	-	O	-	-	-	-	-	-	-
Grease Nipple SD-058	-	-	-	O	-	O	-	-	-	-	-	-	-
Grease Nipple SD-037	O	O	O	-	-	-	-	-	-	-	-	-	-
Grease Nipple SD-038	O	O	O	-	-	-	-	-	-	-	-	-	-
Grease Nipple SD-039	O	O	O	-	-	-	-	-	-	-	-	-	-
Grease Nipple SD-029	O	O	O	-	-	-	-	-	-	-	-	-	-
Grease Nipple SD-040	O	O	O	-	-	-	-	-	-	-	-	-	-
Grease Nipple SD-041	O	O	O	-	-	-	-	-	-	-	-	-	-
Grease Nipple SD-042	O	O	O	-	-	-	-	-	-	-	-	-	-
Grease Nipple SD-043	O	O	O	-	-	-	-	-	-	-	-	-	-
Grease Nipple SD-044	O	O	O	-	-	-	-	-	-	-	-	-	-

Memo

Ball Spline

ABOUT BALL SPLINE

1-1 Structure and Benefits of *TBI MOTION* Ball Spline

■ 1-1-1 Basic Structure of *TBI MOTION* Ball Spline

The design of TBI Ball spline is to utilize the friction through the contact of steel balls within in the Spline Nut and the grooves on the Spline Shaft. With TBI MOTION's unique 40° angular contact design which enables the Ball spline delivers high sensitivity and extreme high load carrying capacity. The concept is optimal for the application involve with high speed, vibration, impacts of loading and precise positioning requirements. Also when the Ball spline is used to function as linear bushing, the Ball spline provides ten times loading capacity than the linear bush on the like model but with a compact profile. Namely, Durability and reliablility is the reason to choose TBI Ball spline in your application.

■ 1-1-2 *TBI MOTION* Nut Design and Shaft Specifications

TBI MOTION Spline Nut is available in five different designs : SLF/SGF (Flange design), SLT (Non-flange design), SOF (Cylindrical flange design), SOT (Round design), Point of contacts on the Spline shaft is provided in two grooves (180°) (SLF/SLT 6~20), (SOT/ SOF 6~25) and four grooves (70°) base on the diameter of the Spline shaft. Also TBI provides Hollow Spline shaft for alternative.

Fig 1.1.1

■ 1-1-3 Features of *TBI MOTION* Ball Spline

High Load-Carrying Capacity

Every groove on the TBI Spline shaft is precision ground to form a perfect 40° angular contact point. The concept of 40° contact design is to increases the load carrying capacity and rigidity to handle a greater moment load.

Zero Angular Clearance / Backlash

Grooves on the TBI Spline shaft is precision ground to form a perfect Gothic arch. The design eliminates clearance that could generate deflections, and therefore best suited for the applications that required high precision.

High Sensitivity

The unique TBI 40° angular contact is designed to operate with the minimum friction while the design performs high sensitivity and rigidity.

High Rigidity

A wide contact angle and an appropriate level of preload are combined to provide high rigidity and stiffness.

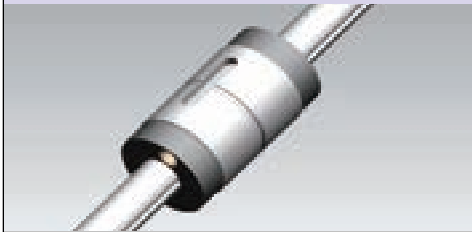
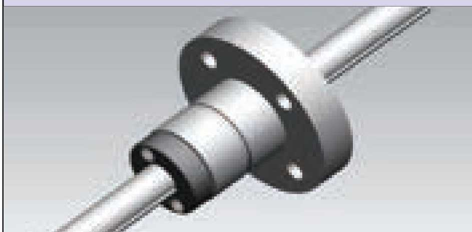
Mount-Simple on Design

TBI Ball Spline is low maintenance design, therefore, when removing the spline nut is necessary due to the ball retaining design the steel balls will not fall apart like the traditional nut design.

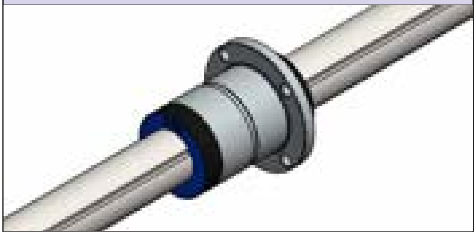
ABOUT BALL SPLINE

1-1 Structure and Benefits of *TBI MOTION* Ball Spline

■ 1-1-4 *TBI MOTION* Ball Spline Type and Feature

Spline Nut	Spline Shaft
SLT, SOT Non-flanged Spline Nut	**Standard Precision Spline Shaft (S-Type)**
	
SLT, SOT Spline nut is with a straight cylindrical shape without flange. The standard mode of mounting a cylindrical nut is by using a key. The cylindrical nut will have a keyway and separate key. A matching keyway must be bored into the housing or block that will be mounted on the cylinder nut. The type SLT, SOT is the most compact profile Spline nut in TBI Ball Spline product line.	The Standard precision Spline shaft is precisely ground to reach high accuracy and smoothness.
SLF, Flanged Spline Nut	**Hollow Spline Shaft (H-Type)**
	
Flange nut is simpler to install because it only requires a rough bore and mounting holes drilled and tapped to secure the flange to the housing.	Hollow Spline shaft is optional for the customer to choose for its application. Hollow Spline shaft is designed to reduce weight, accommodate pipes and ventilation.
SOF, Square Flanged Spline Nut	**Custom Machining Spline Shaft**
	
The nut with square flange is easy to be installed to the housing through mounting holes and will be applied to 3C industry and semiconductor industry.	TBI has the capability to manufacture custom made Spline shaft by machining it to meet the requirements of special Spline Shaft shape. For example, a shaft with a bigger diameter on both ends or on the center of Spline shaft can be manufactured upon request.

Spline Nut

SGF, Flanged Spline Nut

Flange nut is simpler to install because it only requires a rough bore and mounting holes drilled and tapped to secure the flange to the housing.

1-2 The Procedure of Select Ball Spline

Table 1.2.1

Steps	Description	
1.Set the Operational conditions	● Stroke Length : Ls ● Velocity : V ● The Applied Load : W ● Size ● Installation	● Operation environment ● Service life expectancy ● Accuracy ● Frequency of use (load cycle) ● Rigidity
2.Select a Type	● Refer to Type, Shaft Spec to determine the your Ballspline.	
3.Calculating the strength of Spline shaft	● Spline Shaft Diameter ● Spline-Shaft Length ● End Fixity ● The permissible load of Ballspline ● The displacement under torque and deflection	
4.Service expectancy	IF: Calculating TBI Ball spline service life expectancy by using expectancy formula. NO: NO Required service life.	
5.Determined the preload	● Determined the permissible axial clearance/ backlash	
6.Determine the Accuracy Grade	● Accuracy Grades	
7.Operational condition	● Lubrication ● Lubrication methods ● Surface treatment ● Dust prevention methods	
	Selected	

2-1 The Strength of Spline Shaft

The Spline shaft is designed to absorb radial load and torque during operation. Therefore, the strength of Spline shaft must be taken into consideration when the Ball spline operates under extreme loading or torque.

■ 2-1-1 The Bending Load Applied on the Operating Ball Spline

The maximum of bending moment (M) can be attributed to multi-factor such as the end fixity methods, length of Spline shaft, load capacity, etc. Equation (1) is equipped to help the user to obtain the ideal length of the Spline shaft in order to be the reference of obtaining the ideal strength of Ball spline.

$M = \sigma \cdot Z$ and $Z = \frac{M}{\sigma}$ .....(1)

M：Bending moment (N-mm)
σ：Shaft permissible bending stress (98 N/mm^2)
Z：Shaft section modulus (mm^3)
※Refer to Table 2.1.2, 2.1.3

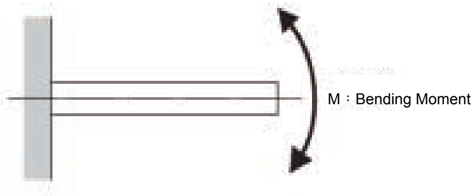


Fig 2.1.1

■ 2-1-2 The Torque Applied on the Operating Ball Spline

The maximum torque applied on the Spline shaft can be calculated through maximum twisting moment (T). Equation (2) is equipped to help the user to obtain the ideal length of the Spline shaft.

$T = \tau_a \cdot Z_P$ and $Z_P = \frac{T}{\tau_a}$ .....(2)

T：Maximum twisting moment (N・mm)
τ_a：Shaft permissible twisting Stress (49 N/mm^2)
Z_p：Shaft polar section modulus (mm^3)
※Refer to Table 2.1.2, 2.1.3

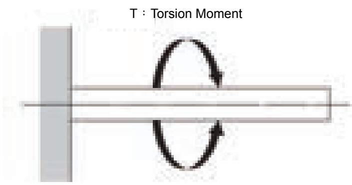


Fig 2.1.2

■ 2-1-3 Both Bending Moment and Twisting Moment Applied Simultaneously on the Spline Shaft

To calculate the figure for both bending (M) and twisting moments (T) applied on the Spline shaft via equation (3) and (4) get the equivalent bending moment (Me) and equivalent twisting moment (Te). Adopt the greater value from equation (3) and (4) to determine the ideal Spline-shaft length.

Equivalent Bending Moment

$$Me = \frac{M + \sqrt{M^2 + T^2}}{2} = \frac{M}{2}\left\{1 + \sqrt{1 + \left(\frac{T}{M}\right)^2}\right\} \text{.....(3)}$$

$Me = \sigma \cdot Z$

Equivalent Twisting Moment

$$Te = \sqrt{M^2 + T^2} = M \cdot \sqrt{1 + \left(\frac{T}{M}\right)^2} \text{.....(4)}$$

$Te = \tau_a \cdot Z_P$

■ 2-1-4 Rigidity of the Spline Shaft

The rigidity of the Spline Shaft is expressed in torsion angle caused by twisting moment. The twisting angle should be limited to no further than 0.25° per 1000 mm.

$$\theta = 57.3 \cdot \frac{T \times L}{G \times Ip} \text{.....(5)}$$

$$\text{Shaft Rigidity} = \text{Torsion Angle / Unit Length} = \frac{\theta \cdot \ell}{L} < \frac{1^\circ}{4}$$

θ : Torsion Angle (°)
L : Shaft Length (mm)
G : Shear Elastic Modulus (7.9×10^4 N/mm^2)
ℓ : Unit Length (1000 mm)
Ip : Polar Moment of Inertia Ip (mm^4)
※Table 2.1.2, 2.1.3

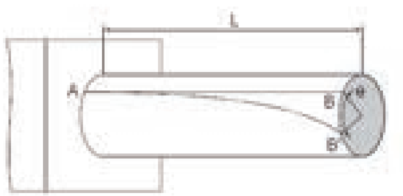


Fig 2.1.3

B

Ball Spline

2-1 The Strength of Spline Shaft

■ 2-1-5 Deflection and Deflection Angle of the Spline Shaft

These should be calculated by using equations that satisfying the relevant operating conditions. Table 2.1.1 presents the operating conditions and the corresponding equations. Tables 2.1.2 & 2.1.3 presents the cross-section factors (Z) and cross-section secondary moments (I). Through the use of the Z, I values given in these tables, the strength and degree of displacement (deflection) of Ball spline model can be obtained.

Table 2.1.1 Deflection and Deflection-Angle Equation

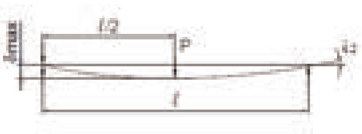
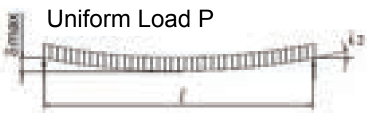
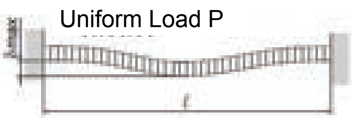
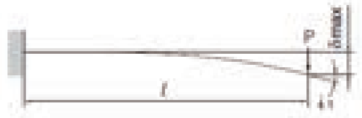
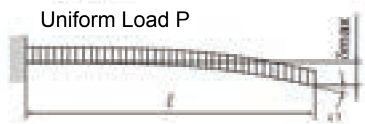
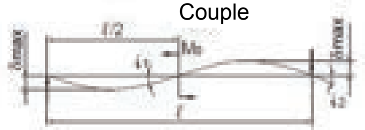
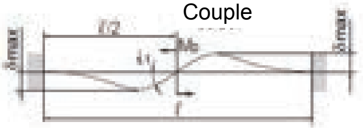
End Fixity	Specification Conditions	Deflection Equation	Deflection-Angle Equation
Both Ends Free		$\delta_{max} = \frac{P\ell^3}{48EI}$	$i_1 = 0$ $i_2 = \frac{P\ell^2}{16EI}$
Both Ends Fixed		$\delta_{max} = \frac{P\ell^3}{192EI}$	$i_1 = 0$ $i_2 = 0$
Both Ends Free		$\delta_{max} = \frac{5P\ell^4}{384EI}$	$i_2 = \frac{P\ell^3}{24EI}$
Both Ends Fixed		$\delta_{max} = \frac{P\ell^4}{384EI}$	$i_2 = 0$

Table 2.1.1 Deflection and Deflection-Angle Equation

End Fixity	Specification Conditions	Deflection Equation	Deflection-Angle Equation
One Ends Fixed		$\delta_{max} = \dfrac{P\ell^3}{3EI}$	$i_1 = \dfrac{P\ell^2}{2EI}$ $i_2 = 0$
One Ends Fixed		$\delta_{max} = \dfrac{P\ell^4}{8EI}$	$i_1 = \dfrac{P\ell^3}{6EI}$ $i_2 = 0$
Both Ends Free		$\delta_{max} = \dfrac{\sqrt{3}\,M_0\ell^2}{216EI}$	$i_1 = \dfrac{M_0\ell}{12EI}$ $i_2 = \dfrac{M_0\ell}{24EI}$
Both Ends Fixed		$\delta_{max} = \dfrac{M_0\ell^2}{216EI}$	$i_1 = \dfrac{M_0\ell}{16EI}$ $i_2 = 0$

δ_{max} : Maximum Deflection (mm)
i_1 : Deflection Angle at a Loading Point (deg)
i_2 : Deflection Angle at a Supporting Point (deg)
M_0 : Moment (N-mm)
P : Concentrated Load (N)

p : Uniform Load (N/mm)
ℓ : Span (mm)
I : Geometrical Moment of Inertia (mm^4)
E : Longitudinal Elastic Modulus
2.06×10^5(N/mm^2)

B

Ball Spline

2-1 The Strength of Spline Shaft

■ 2-1-6 Critical Speed of Spline Shaft

When an operating Ball spline reaches critical speed, the mechanical resonance occurs, no further operation can be performed. Namely, to keep Ball Spline under ideal operational, the speed limit must be kept under monitor. Therefore, to set an ideal operational speed for safety factor must be settled as 80% of critical speed as shown on equation.

Critical Speed

$$Nc:\ \frac{60\lambda^2}{2\pi \times \ell_b^2} \times \sqrt{\frac{E \times 10^3 \times 1}{\gamma \times A}} \times 0.8$$

Nc : Critical Shaft Speed (min^{-1})

ℓ_b : Center Distance (mm)

E : Young's Modulus ($2.06 \cdot 10^5$ N/mm^2)

I : Moment of Inertia of the Shaft (mm^4)

$$I = \frac{\pi}{64} d_1^2$$

d_1 : Diameter (mm)

γ : Density (Specific Gravity) ($7.85 \cdot 10^{-6}$ kg/mm^3)

$$A = \frac{\pi}{4} d_1^2$$

d_1 : Diameter (mm)

A : Spline-Shaft Cross-Sectional Area (mm^2)

λ : Installation-Method-Dependent Factor

(Fig 2.1.4) Fixed-Free λ= 1.875

(Fig 2.1.5) Supported-Supported λ= 3.142

(Fig 2.1.6) Fixed-Supported λ= 3.927

(Fig 2.1.7) Fixed-Fixed λ= 4.73

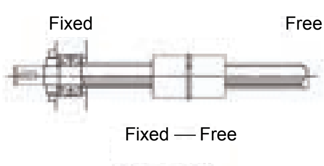


Fig 2.1.4

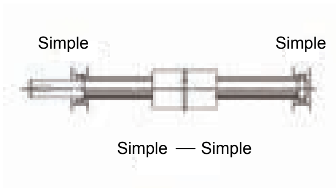


Fig 2.1.5

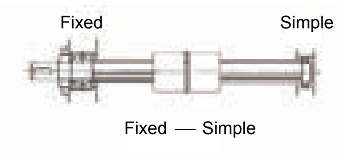


Fig 2.1.6

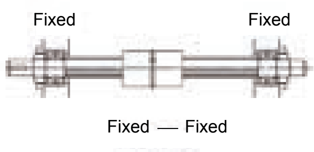


Fig 2.1.7

■ 2-1-7 Spline-Shaft Cross-Section

Table 2.1.2

Nominal Diameter		I (mm^4)	I_p (mm^4)	Z (mm^3)	Z_p (mm^3)
SL 006	Solid	63.49	119.23	18.58	39.74
	Hollow	62.70	117.33	18.32	39.22
SL 008	Solid	200.93	387.53	46.65	96.88
	Hollow	196.96	379.57	45.65	94.89
SL 010	Solid	490.25	933.29	86.61	186.66
	Hollow	477.68	908.16	86.10	181.63
SL 013	Solid	1400.81	2691.54	198.57	414.08
	Hollow	1282.96	2455.82	180.44	377.82
SL 016	Solid	3215.60	6242.70	378.39	780.34
	Hollow	3014.53	5840.57	353.25	730.07
SL 020	Solid	7851.80	15336.59	748.48	1533.66
	Hollow	7360.93	14354.84	699.39	1435.48
SL 025	Solid	18466.30	36932.60	1477.30	2954.61
	Hollow	15981.25	31962.50	1278.50	2557.00
SL 030	Solid	33122.31	77392.48	2579.75	4416.31
	Hollow	29905.32	70958.50	2365.28	3987.38
SL 032	Solid	50322.85	100645.70	3145.18	6290.36
	Hollow	36586.19	73172.38	2286.64	4573.27
SL 040	Solid	120667.43	241334.90	6033.37	12066.74
	Hollow	112813.45	225626.90	5640.67	11281.35
SL 050	Solid	297123.73	594247.50	11884.95	23769.90
	Hollow	274691.98	549384.00	10987.68	21975.36

I：Geometrical moment of inertia (mm^4)

I_p：Polar moment of inertia (mm^4)

Z：Section modulus (mm^3)

Z_p：Polar section modulus (mm^3)

2-1 The Strength of Spline Shaft

Table 2.1.3

Nominal Diameter		I (mm^4)	I_p (mm^4)	Z (mm^3)	Z_p (mm^3)
SO 006	Solid	60.67	124.27	20.22	41.42
	Hollow	59.89	122.7	19.96	40.9
SO 008	Solid	200.95	389.81	47.22	97.45
	Hollow	196.97	381.86	46.22	95.46
SO 010	Solid	490.68	956.77	93.22	191.35
	Hollow	478.11	931.64	90.71	186.33
SO 012	Solid	1017.67	1998.75	163.51	333.13
	Hollow	954.05	1871.52	152.91	311.92
SO 015	Solid	1678.22	3241.10	212.50	476.63
SO 020	Solid	5382.92	10422.07	553.75	1145.28
SO 025	Solid	12796.48	24659.94	1048.86	2186.30

I：Geometrical moment of inertia (mm^4)
Z：Section modulus (mm^3)
I_p：Polar moment of inertia (mm^4)
Z_p：Polar section modulus (mm^3)

Table 2.1.4

Nominal Diameter		I (mm^4)	I_P (mm^4)	Z (mm^3)	Z_P (mm^3)
SG 006	Solid	63.49	119.23	18.58	39.74
	Hollow	62.70	117.33	18.32	39.22
SG 008	Solid	200.93	387.53	46.65	96.88
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SG 010	Solid	490.25	933.29	86.61	186.66
	Hollow	477.68	908.16	86.10	181.63
SG 013	Solid	1400.81	2691.54	198.57	414.08
	Hollow	1282.96	2455.82	180.44	377.82
SG 016	Solid	3215.60	6242.70	378.39	780.34
	Hollow	3014.53	5840.57	353.25	730.07
SG 020	Solid	7851.80	15336.59	748.48	1553.66
	Hollow	7360.93	14354.84	699.39	1435.48
SG 025	Solid	18466.30	36932.60	1477.30	2954.61
	Hollow	15981.25	31962.50	1278.50	2557.00
SG 030	Solid	33122.31	77392.48	2579.75	4416.31
	Hollow	29905.32	70958.50	2365.28	3987.38
SG 040	Solid	120667.43	241334.90	6033.37	12066.74
	Hollow	112813.45	225626.90	5640.67	11281.35
SG 050	Solid	297123.73	594247.50	11884.95	23769.90
	Hollow	274691.98	549384.00	10987.68	21975.36

I ： Geometrical moment of inertia (mm^4)
I_p ： Polar moment of inertia (mm^4)
Z ： Section modulus (mm^3)
Z_p ： Polar section modulus (mm^3)

2-2 Service Life Expectancy

■ 2-2-1 Nominal Service Life

TBI MOTION define the nominal service life of Ball Spline as 90% of the average running distance before flaking within in the Ball Spline on the same manufacture cycle. Please note that the nominal life expectancy is only for reference use.

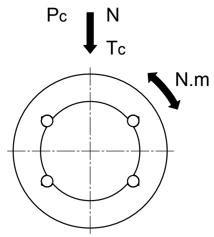


Fig 2.2.1

■ 2-2-2 Calculating Nominal Service Life

The factors which influence the service life for Ball Splines can be attributed to three main aspects, the torque, radial load and moment. The influence of each aspect can be calculated through equations (7) to (10).

Under a Torque

$$L = \left(\frac{f_T \cdot f_C}{f_W} \cdot \frac{C_T}{T_C} \right)^3 \cdot 50 \;.....(7)$$

Under a Radial Load

$$L = \left(\frac{f_T \cdot f_C}{f_W} \cdot \frac{C}{P_C} \right)^3 \cdot 50 \;.....(8)$$

L : Nominal Service Life (km)
C_T : Basic Dynamic-Torque (N-m)
T_c : Calculated Torque Applied (N-m)
C : Basic Dynamic-Load Rating (N)
P_c : Radial Load (N)
f_T : Temperature (See Fig 2.2.2)
f_c : Contact (See Table 2.2.1)
f_w : Load Factor (See Table 2.2.2)

Under both a moment and radial load applied simultaneously

Calculate the service life from the sum of the radial load and the equivalent radial load.

Under both a torque and radial load applied simultaneously

In this case, calculate the equivalent radial load to determine service life by equation (9).

$$P_E = P_C + \frac{4 \cdot T_C \cdot 10^3}{i \cdot BCD \cdot \cos\alpha} \;.....(9)$$

P_E : Equivalent radial Load (N)
cosα : Contact Angle
i: Number of Loaded Rows of Balls
BCD : Ball Center to Center Shaft Diameter (mm) (See Table 3.1.1)

Under a moment on a spline nut or two closely attached to one another

Obtain the equivalent radial load using the equation,
and determine the service life by equation (10).
$P_u = K \cdot M$ .....(10)
P_u : Equivalent Radial Load (N)(Moment Applied)
K : Equivalent Factor (See Table 2.2.3)
M : Applied Moment (N-mm)
However, M should be within the range of the stacic permissible moment.

Calculating Nominal Service Life

Once the nominal life (L) is obtained, if the stroke length and the number of reciprocal operations are consistent, the service life in hours can be obtained by using the following equation.

$$L_h = \frac{L \cdot 10^3}{2 \cdot \ell_s \cdot n_1 \cdot 60}$$

L_h : Service Life in Hours (h)
ℓ_s : Stroke Length (m)
n_1 : Number of Reciprocal Operations per Minute (min^{-1})

Temperature Factor (f_T)

When the Ball Spline operates in an environment which the temperature reaches 100°C or higher, considering that the heat may adversely affect the operation of the Ball Spline. To avoid malfunction under extreme temperature, Fig 2.2.2 should be taken into consideration. In addition that the material of Ball Spline should be heat resistant and custom made when use under extreme environment.

※Please inform TBI sales for upgrading the material for the operation environment exceeds 80°C for the reason that the materials of seal and retainers should be upgraded to sustain the high-temperature.

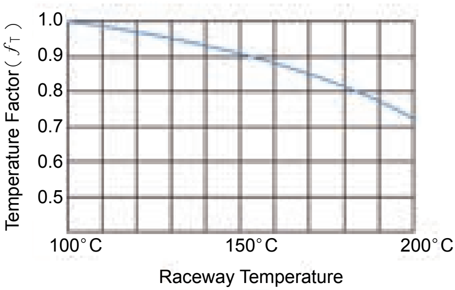


Fig 2.2.2 Temperature Factor (f_T)

Contact Factor (f_c)

When one or multiple Spline nuts are mounted on the Spline shaft closeley , their linear motion is affected by moments and mounting accuracy, resulting in nonuniform load distribution. When closely linked spline nuts are used, multiply the basic load rating (C or C_0) by one of the contact factors specifiedbelow.

※If a nonuniform load distribution is expected, as in large equipment, take the contact factor explained in Table 4 into account.

Table 2.2.1 Contact Factor (f_c)

No. of Spline nuts Linked	f_c
2	0.81
3	0.72
4	0.66
5	0.61
In Normal Use	1.0

Load Factor (f_w)

The operation of reciprocal machines is likely to cause vibration and impact. It is difficult to determine the rating of vibration, impact in the event of vibration, and repeated impact during high speed operation, and triggering and ceasing of operation. Therefore, when loads exerted on a linear-motion or operation velocity and vibration is extreme.Take the basic load rating (C or C_0) and multiply the figure shown in table 2.2.2

Table 2.2.2 Load Factor (f_w)

Vibration Impact	Velocity (V)	f_w
Minor	Minor velocity $V \leqq 0.25$ m/s	1-1.2
Little	Low velocity $0.25 < V \leqq 1.0$ m/s	1.2-1.5
Medium	Medium Velocity $1.0 < V \leqq 2.0$ m/s	1.5-2.0
Heavy	High velocity $V > 2.0$ m/s	2.0-3.5

B

Ball Spline

2-2 Service Life Expectancy

■ 2-2-3 Calculating the Average Applied Load

The applied load fluctuates during the operation, for instance the applied load is different during the activities of an industrial robotic arm, industrial robot arm initiates with a workpiece and returns without one, the Ball Spline nut receives variable loads. The fluctuation of applied load influence the service life of Ball Spline, therefore the calculation of service life must take such fluctuation into consideration. When the service life of a Ball Spline with variable load is equal to the one with certain load then that certain load is called the Mean Load.

The Equation is as below

$$P_m = \sqrt[3]{\frac{1}{L} \cdot \sum_{n=1}^{n} (P_n^3 \cdot L_n)}$$

P_m : Mean Load (N)
P_n : Fluctuating Load (N)
L : Total Stroke
L_n : Stroke under Load P_n (mm)

For Loads That Change Stepwise

$$P_m = \sqrt[3]{\frac{1}{L} (P_1^3 \cdot L_1 + P_2^3 \cdot L_2 \ldots\ldots P_n^3 \cdot L_n)}$$

P_m ： Mean Load (N)
P_n ： Fluctuating Load (N)
L ： Total Running Distance (mm)
L_n ： Running Distance Under Load P_n (mm)

For Loads That Change Monotonically

$$P_m = \sqrt[3]{\frac{1}{L} (P_1^3 \cdot L_1 + P_2^3 \cdot L_2 \ldots\ldots P_n^3 \cdot L_n)}$$

P_{min} : Minimum Load (N)
P_{max} : Maximum Load (N)

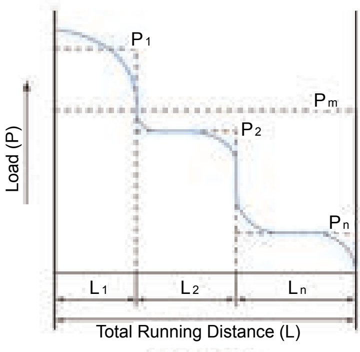


Fig 2.2.3

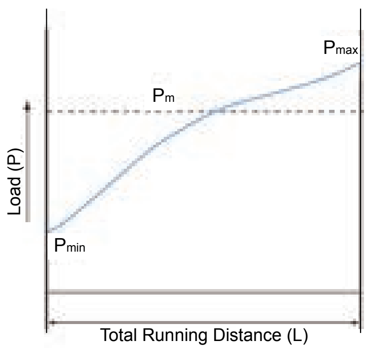


Fig 2.2.4

For Loads That Change Sinusoidal

(a) $P_m \fallingdotseq 0.65\ P_{max}$

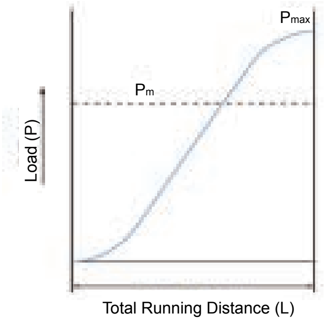


Fig 2.2.5

(b) $P_m \fallingdotseq 0.75\ P_{max}$

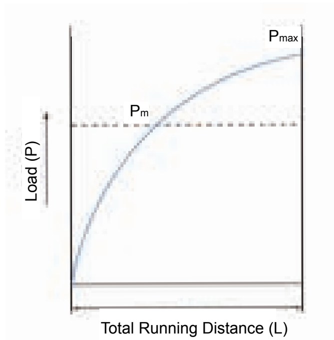


Fig 2.2.6

■ 2-2-4 Equivalent Factor

Table 2.2.3 Equivalent Factor

Model No.	Equivalent Factor : K	
	One Spline Nut	Two Spline Nuts
SL 06	0.577	0.065
SL 08	0.577	0.059
SL 10	0.418	0.047
SL 13	0.360	0.043
SL 16	0.229	0.033
SL 20	0.201	0.029
SL 25	0.154	0.023
SL 30	0.126	0.021
SL 40	0.110	0.016
SL 50	0.109	0.013
SO 06	0.505	0.072
SO 08	0.400	0.061
SO 10	0.308	0.052
SO 12	0.253	0.046
SO 15	0.219	0.040
SO 20	0.186	0.031
SO 25	0.154	0.026

Model No.	Equivalent Factor : K	
	One Spline Nut	Two Spline Nuts
SG 006	0.577	0.065
SG 008	0.577	0.059
SG 010	0.418	0.047
SG 013	0.36	0.043
SG 016	0.229	0.033
SG 020	0.229	0.032
SG 025	0.181	0.026
SG 030	0.152	0.024
SG 040	0.13	0.019
SG 050	0.1	0.015

2-3 Calculating the Service Life

Horizontal Application

A 300 mm long Ball Spline supported by two fixed nuts in a horizontal application, the load of the Spline falls vertically downward on the fixed side with 30 mm away from the center of ball spline with the gravity force of W = 30 kg. The figure is shown as Fig 2.3.1

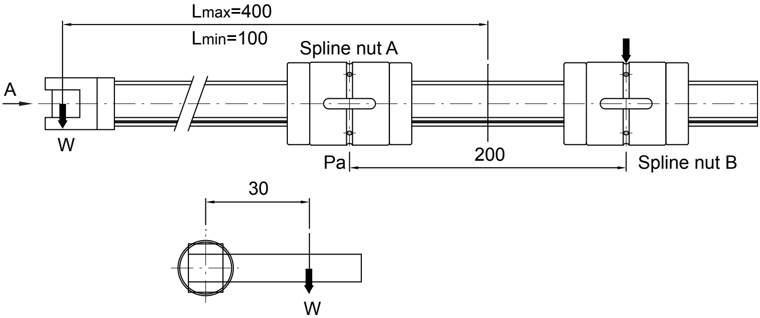


Fig 2.3.1

A.Calculates the Spline Shaft Strength

The presented structure of ball spline is an extended bridge, it is designed to absorb torque, therefore, the maximum bending load occurs on Spline nut A :

Maximum Bending Moment $M = 30 \cdot 9.81 \cdot 400 = 117720$ N-mm

Maximum Torsion Moment $T = 30 \cdot 9.81 \cdot 30 = 8829$ N-mm

For Ball Spline shafts subjected to the simultaneous application of torsion and bending loads, thus the calculation should include Equivalent Bending Moment, M_e and Equivalent Torsion Moment T_e **:**

$$M_e = \frac{M + \sqrt{M^2 + T^2}}{2} = 117885 \text{ N-mm} \qquad T_e = \sqrt{M^2 + T^2} = 118051 \text{ N-mm}$$

$T_e > M_e$

$\therefore T_e = \tau_a \cdot Z_p$

$\therefore Z_p = T_e/\tau_a = 118051/49 = 2409.2 \text{ mm}^3$

According to figure of cross section showed on the spline (Table 2.1.2, 2.1.3), the minimum diameter, 25mm is required in order to gain enough strength of Ball Spline, therefore, SLF25 matches the requirement above thus choose SLF25.

B.Calculating the Mean Load

When the shaft extension reached L_{max} = 400 mm, it reaches it' maxima load (P_{max})

When it retrieved back to L_{min} = 100mm, it absorbed the minimum of load (P_{min})

According to mechanics it allows us to acquire the maximum and minimum Radial Load of Nut A and nut B :

$P_{Amax} = 30 \cdot 9.81 \cdot (400+200)/200 = 882.9$ N $\qquad P_{Bmax} = 30 \cdot 9.81 \cdot 400/200 = 588.6$ N

$P_{Amin} = 30 \cdot 9.81 \cdot (100+200)/200 = 441.5$ N $\qquad P_{Bmin} = 30 \cdot 9.81 \cdot 100/200 = 147.2$ N

When the movement of Ball Spline occurs, the load on the spline is gradual and repeated, according to Fig 2.2.4 the equation of the load on ball spline is shown as :

$P_{Am} = 1/3\ (PA_{min} + 2PA_{max}) = 735.8$ N $\qquad P_{Bm} = 1/3\ (PB_{min} + 2PB_{max}) = 441.5$ N

The nuts receive both torsion and bending load simultaneously, therefore assuming that the torsion distributes equally on the nuts. The equation for torsion is shown as T' :

$T' = T/2 = 30 \cdot 9.81 \cdot 30/2 = 4414.5$ N-mm

The equivalent factor P_e (B12, equation (9)) :

$$P_e = P_m + \frac{4 \cdot T'}{i \cdot dp \cdot \cos\alpha}$$

$$P_{AE} = 735.8 + \frac{4 \cdot 4414.5}{4 \cdot 27 \cdot \cos 50^\circ} = 990.2\ \text{N} \qquad P_{BE} = 441.5 + \frac{4 \cdot 4414.5}{4 \cdot 27 \cdot \cos 50^\circ} = 695.9\ \text{N}$$

C.Service Life Ball Spline

$$\text{Nut A life } L_A = \left(\frac{f_T \cdot f_C}{f_W} \cdot \frac{C}{P_{AE}}\right)^3 \cdot 50 = 14518\ \text{km}$$

$$\text{Nut B life } L_B = \left(\frac{f_T \cdot f_C}{f_W} \cdot \frac{C}{P_{BE}}\right)^3 \cdot 50 = 41829\ \text{km}$$

Factors
f_T : Temperature = 1
f_C : Friction = 1
f_W : Load = 1.5
C : Coa = 9835 N

The service life of Ball Spline correlates with nut A and the service life is 14518 km by estimate.

Vertical Application

A 1200 mm long ball spline with stroke of 1000 mm is mounted on a working platform supported by two fixed nuts on both end. The geometry is shown as Fig 2.3.2

The point of drive force F is X_1 = 50 mm, from the center of Ball Spline, the weight platform W_1 is 27 kg, the center of the weight is X_2 = 300 mm, away from the center of ball spline, the working cycle of platform is a carriage of W_2 = 5 kg, with a downward movement for 5 sec and holds for 10 sec, then elevates for 5 sec and holds for 10 sec to unload the carriage repeatedly. The center of gravity of carriage is X_3 = 500 mm, from the center of ball spline, the travelling of velocity is shown as Fig 2.3.2

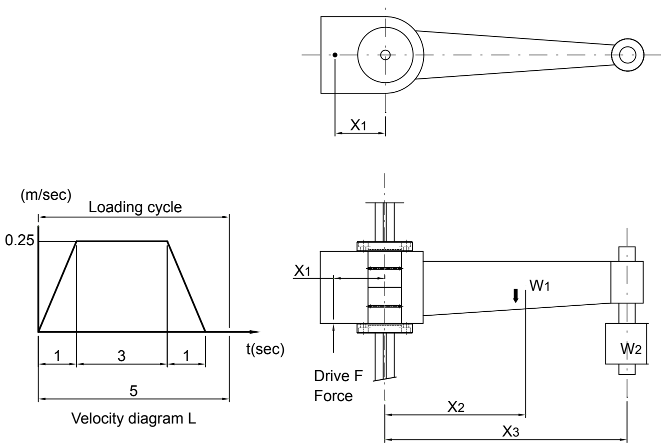


Fig 2.3.2

2-3 Calculating the Service Life

A. Analysis on Different Stage of Exertion

Inertial force occurs when a platform is in working modes, drive force is the source of the inertial force.

Inertial force of a m/s^2 in accelerated ascent and decelerated decent : $F = W \cdot (9.81+a)$
Inertial force of Constant velocity in acceleration and deceleration : $F = W \cdot (9.81)$
Inertial force of a m/s^2 in accelerated decent and decelerated ascent : $F = W \cdot (9.81-a)$

Below are the equations of the bending force absorb by the nuts during acceleration, constant velocity, deceleration while ball ascent and decent.

(1) Without carriage (Acceleration while decent)
$M_{da} = W_1 \cdot (9.81\text{-}a) \cdot 300 + W_1 \cdot (9.81\text{-}a) \cdot 50 = 90342$ N-mm

(2) Without carriage (Constant velocity while decent)
$M_{dc} = W_1 \cdot (9.81) \cdot 300 + W_1 \cdot (9.81) \cdot 50 = 92704.5$ N-mm

(3) Without carriage (Deceleration while decent)
$M_{dd} = W_1 \cdot (9.81+a) \cdot 300 + W_1 \cdot (9.81+a) \cdot 50 = 95067$ N-mm

(4) With carriage (Acceleration while ascent)
$M_{aa} = W_1 \cdot (9.81+a) \cdot 300 + W_1 \cdot (9.81+a) \cdot 50 + W_2 \cdot (9.81+a) \cdot 500 + W_2 \cdot (9.81+a) \cdot 50 = 122732$ N-mm

(5) With carriage (Constant velocity while ascent)
$M_{ac} = W_1 \cdot (9.81) \cdot 300 + W_1 \cdot (9.81) \cdot 50 + W_2 \cdot (9.81) \cdot 500 + W_2 \cdot (9.81) \cdot 50 = 119682$ N-mm

(6) With carriage (Deceleration while ascent)
$M_{ad} = W_1 \cdot (9.81\text{-}a) \cdot 300 + W_1 \cdot (9.81\text{-}a) \cdot 50 + W_2 \cdot (9.81\text{-}a) \cdot 500 + W_2 \cdot (9.81\text{-}a) \cdot 50 = 116632$ N-mm

B. The Calculation of Spline Strength

The presented structure of ball spline is supported by two fixed nuts on both ends with an bridge of absorbing bending in the middle. it designed to absorb torque. According to mechanics the Maximum bending load occurs on the supporting end. The Maximum Bending Moment should occur at the end of acceleration.

Maximum Bending Moment $M = 122732$ N-mm
$\therefore Z = M/\sigma a = 122732/98 = 1252.4\ mm^3$

According to figure of cross section showed on the spline, the minimum diameter 25 mm is required in order to gain enough of strength for Ball Spline, therefore SLF25 matches the requirement above thus choose SLF25.

C. Calculating the Mean Load

The nuts and spline mainly affect by the force of bending, therefore converting the force of bending into rail load by using (B12, equation(10)).

$Pn = K \cdot M$

According to Table 2.2.3, when joint two SLF25 nuts, The equivalent factor K = 0.023

$P_{da} = 0.023 \cdot 90342 = 2078$ N
$P_{dc} = 0.023 \cdot 92704.5 = 2132.2$ N
$P_{dd} = 0.023 \cdot 95067 = 2186.5$ N
$P_{aa} = 0.023 \cdot 122732 = 2822.8$ N
$P_{ac} = 0.023 \cdot 119682 = 2752.7$ N
$P_{ad} = 0.023 \cdot 116632 = 2682.5$ N

The average load in every time peroid can be calculate as P_m :

$$P_m = \sqrt[3]{\frac{1}{L} \cdot \sum_{n=1}^{n} (P_n^3 \cdot L_n)}$$

P_m : Average Load (N)
P_n : Load in variable (N)
L : Total service distances (mm)
L_n : Pn Service distances under loading (mm)

$$P_m = \sqrt[3]{\frac{1}{1000} \left\{125 \cdot 2078^3 + 750 \cdot (2132.2)^3 + 125 \cdot (2822.8)^3 + 750 \cdot (2752.7)^3 + 125 \cdot (2682.5)^3\right\}}$$

$= 2481.6$ N

D. Analysis of Ball Spline Service Life

$$\text{Service Life } L_A = \left(\frac{f_T \cdot f_C}{f_W} \cdot \frac{C}{P_m}\right)^3 \cdot 50 = 922 \text{ km}$$

f_T : Temperature = 1
f_C : Friction = 1
f_W : Load = 1.5
C : Coa = 9835 N

2-4 Determining the Preload

The preload, a significant factor that influence the accuracy, load capacity and rigidity of Ball Spline during operation. Therefore, it is very important to determine the most appropriate size of the clearance for your requirements. The size of the clearance is standardized for each type, enabling the one best-suited for operating conditions to be selected.

■ 2-4-1 Clearance in the Rotational Direction

With the Ball Spline, the sum of clearances in the circumferential direction is standardized as the clearance in the rotational direction. Clearance in the Rotational Direction. (BCD)

■ 2-4-2 Preload and Rigidity

The preload is the load applied to balls prior to use for the purposes of eliminating angular backlash (clearance in the rotational direction) and improving rigidity. The application of a preload can eliminate angular backlash in the Ball Spline in accordance with the level of applied preload, and can improve rigidity. Fig 2.4.2 shows the amount of displacement in the rotational direction when a rotational torque is applied. As shown in Fig 2.4.2, the effect of pre-loading continues until the torque becomes

Fig 2.4.2 2.8 times greater than the preload applied. Compared with a setting without a preload, the displacement at the same rotational torque is half of the one with a preload and the rigidity is twice as great.

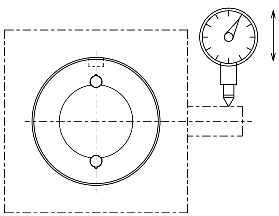


Fig 2.4.1

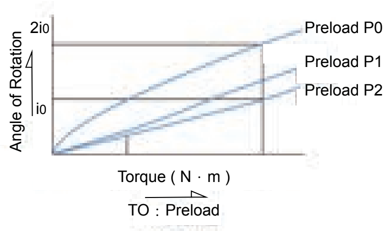


Fig 2.4.2

■ 2-4-3 Operating Conditions and Determination of the Preload Level

Table 2.4.1 presents guidelines for determining the appropriate clearance in the rotational direction for different operating environment. The rotational clearance of the Ball Spline significantly affects the accuracy and rigidity of the Spline nut. Therefore, it is critical to select the clearance best suited to the intended uses of the Ball Spline. Normally, the Ball Spline is preloaded. When it is subjected to repeated swiveling and reciprocal linear motion, the system receives heavy vibration and impact. In such an environment, preload prolongs the service life and improves accuracy.

Table 2.4.1 Guidelines for Determining an Appropriate Ball Spline Clearance according the Rotational Direction.

	Preload	Operating conditions	Applications
Clearance in the Rotational Direction	Medium Preload P2	● High rigidity is required.Vibration and impact are severe. ● The moment load must be borne by a single spline nut.	● Construction-work-vehicle steering shaft. ● Spot-welding-machine shaft. ● Automatic-lathe-tool rest indexing shaft.
	Light Preload P1	● Hanging loads and moments are applied. ● High position accuracy is required. ● Alternate loads are applied.	● Industrial robot arm Various automatic. ● loaders. ● Automatic-painting-machine guideshaft. ● Electric-discharge-machine spindle. ● Press die-set guideshaft. ● Drilling-machine spindle.
	No Preload P0	● Smooth movement should be achieved with only a low magnitude of force. ● Torque is continually applied in a given direction.	● Various measuring instruments. ● Automatic drafting machine. ● Shape-measuring instrument. ● Dynamometer. ● Wirewinder. ● Automatic arccutter. ● Honing-machine spindle. ● Automatic packing machine.

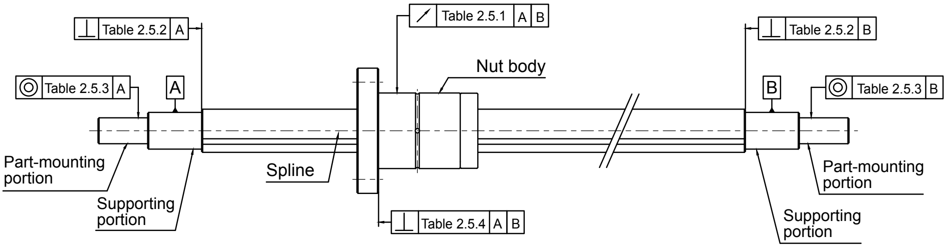
Table 2.4.2

Preload Nominal Diameter					No Preload P0	Slight Preload P1	Medium Preload P2
6	8	10	12	13	-2 ~+1	-6 ~ -2	-
15	16	20			-2 ~+1	-6 ~ -2	-9 ~ -5
25	30				-3 ~+2	-10 ~ -4	-14 ~ -8
40	50				-4 ~+2	-16 ~ -8	-22 ~-14

2-5 Accuracy

■ 2-5-1 Accuracy Grade

The accuracy of the Ball Spline is determined by the spline-nut and thus divided into three accuracy grades of Normal (N), High (H), and Precision (P).



■ 2-5-2 Accuracy Specifications

Tables 2.5.1~2.5.4 indicate the tolerance of callout of the Ball Spline.

Table 2.5.1 The tolerance of Spline Nut on the Support Unit Unit : μm

Nominal Diameter (mm) / Length (mm)		6, 8			10			12, 13, 15, 16, 20			25, 30			40, 50		
Above	Below	N	H	P	N	H	P	N	H	P	N	H	P	N	H	P
-	200	72	46	26	59	36	20	56	34	18	53	32	18	53	32	16
200	315	133	89	57	83	54	32	71	45	25	58	39	21	58	36	19
315	400	185	126	82	103	68	41	83	53	31	70	44	25	63	39	21
400	500	236	163	108	123	82	51	95	62	38	78	50	29	68	43	24
500	630	-	-	-	151	102	65	112	75	46	88	57	34	74	47	27
630	800	-	-	-	190	130	85	137	92	58	103	68	42	84	54	32
800	1000	-	-	-	-	-	-	170	115	75	124	83	52	97	63	38
1000	1250	-	-	-	-	-	-	-	-	-	151	102	65	114	76	47

Table 2.5.2 The Maximum Perpendicularity of Spline Shaft End on the Journal Ends

Unit : μm

Nominal Diameter (mm) \ Accuracy					Normal (N)	High (H)	Precision (P)
6	8	10			22	9	6
12	13	15	16	20	27	11	8
25	30				33	13	9
40	50				39	16	11

Table 2.5.3 The Maximum Radial Call Out on the Attach Surface

Unit : μm

Nominal Diameter (mm) \ Accuracy					Normal (N)	High (H)	Precision (P)
6	8				33	14	8
10					41	17	10
12	13	15	16	20	46	19	12
25	30				53	22	13
40	50				62	25	15

Table 2.5.4 The Perpendicularity of Flange on the Attach Surface

Unit : μm

Nominal Diameter (mm) \ Accuracy					Normal (N)	High (H)	Precision (P)
6	8				17	11	8
10	12	13			33	13	9
15	16	20	25	30	30	16	11
40	50				46	19	13

2-6 Lubrication

The spline nut is prelubricated prior to shipment for immediate use and the maintenance period is varied according to the operating conditions. TBI suggested that under normal operation condition please lubricate your TBI Ball Spline after 100 Km (6-12 months) of operation. Apply lubricant within the nut body or on the groove of Spline shaft.

2-7 Material and Surface Treatment

Provides customize material and surface treatment in order to meet extreme operation condition. Please contact service window for customized surface treatment and material.

2-8 Precautions of Ball Spline

■ 2-8-1 General Maintenance

(1) Disassemble ball spline without supervise of certified engineer will cause malfunction of the ball spline.
(2) Gravity causes the spline nut slides when lining the ball spline, handle with care.
(3) Do not hammer, free fall the ball spline, such action will damaging the ball spline and might hinder the performance of ball spline.
(4) Prevent debris, scraps from intervene the ball spline cause it will decrease the performance to ball spline or lead to malfunction.
(5) Prevent the ball spline operates under extreme condition. Contact service window when the TBI MOTION ball spline is intend to use under extreme condition.
(6) Coolant might cause malfunction on the ball spline, please consult certified engineer for the use of coolant.
(7) Clean attached debris and scraps before relubrication.
(8) Please consult certified engineer when the ball spline is designed to operate under frequent vibration, vacuum, extreme high and low temperature condition.
(9) Please consult certified engineer when mounting a through hole on the flanged ball spline.

■ 2-8-2 Lubrication

(1) Remove anti-dust oil before seal the ball spline with grease.
(2) Prevent mixing of different kind of grease, it will cause unexpected chemical deform.
(3) Please contact certified engineer for consulting the use of grease when the ball spline is designed to operate under frequent vibration, vacuum, extreme high and low temperature condition.
(4) Please consult certified engineer for the use of non-certified grease.
(5) When using motor oil to serve the purpose of lubrication, it might cause performance declining due to the improper installation, please consult certified engineer.

■ 2-8-3 Storage

Prevent extreme temperature and humidity while storing the ball spline, please use certified seal and storage in a horizontal position.

2-9 Mounting

■ 2-9-1 Tolerance on Support Unit

Ball spline nut and its support unit is bore to minimize the clearance. If high accuracy is not required, then a clearance fit can be used.

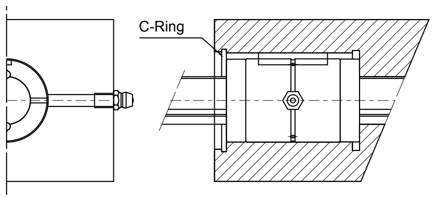
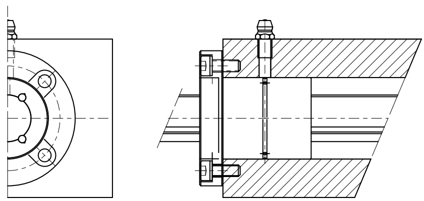
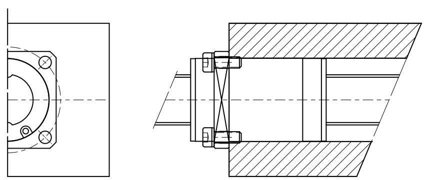
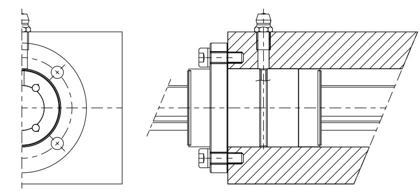
Table 2.9.1

Condition	Tolerance within Support Unit
General Operation Condition	H7
Operation Under Minimize of Axial Clearance	J6

■ 2-9-2 Installation of Ball Spline

The installation of the Ball Spline is shown as Fig 2.9.2. Though the strength of mounting is not strictly required, but it has to be certain that the spline shaft firmly fixed on the support unit.

Table 2.9.2 Sample of Spline-Nut Assembly

SLT,SOT (C-Ring Type)	
SLF (Flange One- Stage Type)	
SOF (Flange One- Stage Type)	
SGF (Flange One- Stage Type)	

■ 2-9-3 Installation of Spline Nut

When installing a spline nut into the spline shaft, use a jig shown in Fig 2.9.1 to insert the spline with care.

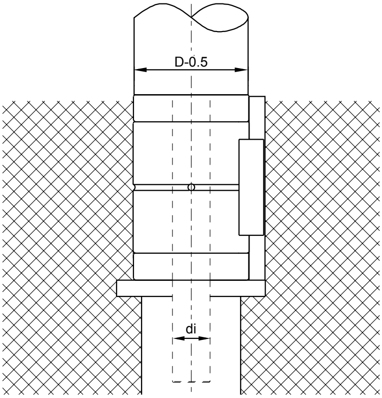


Fig 2.9.1

Table 2.9.3 Specifications of the jig

Unit : mm

Model	Nominal Diameter	6	8	10	13	16	20	25	30	40	50
SL	di	5.0	7.0	8.5	11.5	14.5	18.5	23.0	28.0	37.0	46.5
Model	**Nominal Diameter**	**6**	**8**	**10**	**12**	**15**	**20**	**25**	**-**	**-**	**-**
SO	di	5.0	7.0	8.5	10.5	11.0	16.0	20.5	-	-	-
Model	**Nominal Diameter**	**6**	**8**	**10**	**13**	**16**	**20**	**25**	**30**	**40**	**50**
SG	di	5.0	7.0	8.5	11.5	14.5	18.5	23.0	28.0	37.0	46.5

B

Ball Spline

3-1 Nominal Model Code of Ball Spline SL Series

■ 3-1-1 Nominal Model Code

TBI MOTION Ball Spline is classified into interchangeable and non-interchangeable types. Their dimensions are the same; the only difference between two types is that for non-interchangeable series, ***TBI MOTION*** will finish every process in the production line to meet customers' demands. Interchangeable nuts and shafts can be freely exchanged and the standard preload is P0. Customers could adjust the preload by changing the steel balls inside of the nut by themselves. It is very convenient for customers to have ***TBI MOTION*** Ball Spline in inventory and make the preload and end machining by themselves. ***TBI MOTION*** is proud of internal quality control process which is under strict international regulation.

Non-interchangeable Type Code：

SLF	006	T2	N	N	S	-	500	-	P0	-	B2	+	N3	N3
①	②	③	④	⑤	⑥		⑦		⑧		⑨		⑩	⑪

①

Spline Nut
SLF : Flanged
SLT : Cylindrical

②

Nominal Diameter
Unit : mm

③

Groove
T2 : 2 Rows
T4 : 4 Rows

④

Flange Type
N : Round (No Symbol When It is Without the Flange)

⑤

Accuracy Grade of Spline Shaft
N : Normal
H : High
P : Precision

⑥

Spline Shaft Type
S : Solid
H : Hollow

⑦

Overall Length of Spline Shaft
Unit : mm

⑧

Preload Value
P0 : No preload
P1 : Light preload
P2 : Medium preload

⑨

Number of Spline Nut
(Leave blank if only one nut is required) Ex : Install two spline nuts on a shaft.B2

⑩

Nut Surface Treatment
S : Standard
B1 : Black Oxidation
N1 : Hard Chrome Plating
P : Phosphating
N3 : Nickel Plating
N4 : Raydent
N5 : Chrome Plating

⑪

Shaft Surface Treatment
S : Standard
B1 : Black Oxidation
N1 : Hard Chrome Plating
P : Phosphating
N3 : Nickel Plating
N4 : Raydent
N5 : Chrome Plating

※No symbol required when plating is not needed.

Nominal Model Code for Interchangeable SL Type

Interchangeable Type of Spline Nut :

SLF 006 T2 N + N3

① ② ③ ④ ⑤

①

Spline Nut
SLF : Flanged
SLT : Cylindrical

②

Nominal Diameter
Unit : mm

③

Groove
T2 : 2 Rows
T4 : 4 Rows

④

Flange Type
N : Round (No Symbol When It is Without the Flange)

⑤

Nut Surface Treatment
S : Standard
B1 : Black Oxidation
N1 : Hard Chrome Plating
P : Phosphating
N3 : Nickel Plating
N4 : Raydent
N5 : Chrome Plating

Interchangeable Type of Spline Shaft :

SC 006 T2 N S - 500 + N3

① ② ③ ④ ⑤ ⑥ ⑦

①

Nominal Model Code

②

Nominal Diameter
Unit : mm

③

Groove
T2 : 2 Rows
T4 : 4 Rows

④

Accuracy Grade of Spline Shaft
N : Normal

⑤

Spline Shaft Type
S : Solid
H : Hollow

⑥

Overall Length of Spline Shaft
Unit : mm

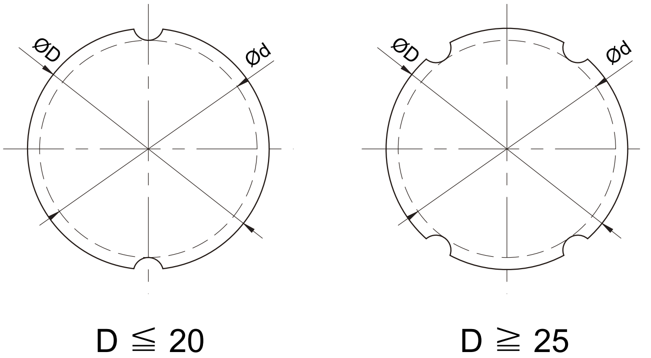
⑦

Nut Surface Treatment
S : Standard
B1 : Black Oxidation
N1 : Hard Chrome Plating
P : Phosphating
N3 : Nickel Plating
N4 : Raydent
N5 : Chrome Plating

3-1 Nominal Model Code of Ball Spline SL Series

SLF, SLT Spline Shaft Cross-Sectional Shape

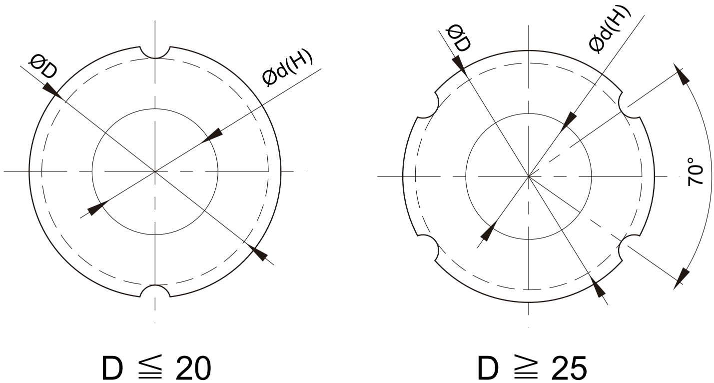
Table 3.1.1, 3.1.2 indicates the cross-section of spline shaft. When the shaft end is round pillar type the minor diameter must not be greater than the diameter of groove ridge.



Solid Spline Shaft

Table 3.1.1 Solid Spline Shaft Cross-Sectional Shape Unit : mm

Nominal Diameter / Stats	6	8	10	13	16	20	25	30	40	50
Inner Diameter Ød	5.25	7.27	8.97	11.82	14.72	18.63	23.43	28.53	37.3	47.05
Outer Diameter ØD h7	6	8	10	13	16	20	25	30	40	50
Weight (kg/m)	0.22	0.39	0.6	1.03	1.56	2.44	3.8	5.49	9.69	15.19
Ball Ø	1.5	1.5	2.381	2.778	2.778	3.175	3.5	3.5	6.35	7.144
Tolerance µm	0 -15	0 -15	0 -18	0 -18	0 -18	0 -21	0 -21	0 -25	0 -25	0 -30



Hollow Spline Shaft

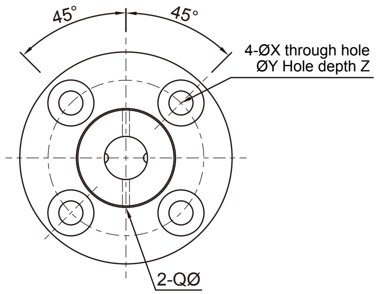
Table 3.1.2 Solid Spline Shaft Cross-Sectional Shape

Unit : mm

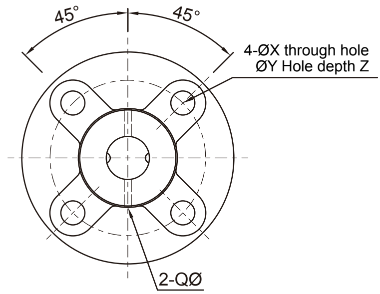
Nominal Diameter / Stats	6	8	10	13	16	20	25	30	40	50
Inner Diameter Ød	2	3	4	7	8	10	15	16	20	26
Outer Diameter ØD h7	6	8	10	13	16	20	25	30	40	50
Weight (kg/m)	0.177	0.33	0.506	0.872	1.25	1.82	2.92	3.93	6.75	11.4
Ball Ø	1.5	1.5	2.381	2.778	2.778	3.175	3.5	3.5	6.35	7.144
Tolerance µm	0 -15	0 -15	0 -18	0 -18	0 -18	0 -21	0 -21	0 -25	0 -25	0 -30

3-1 Nominal Model Code of Ball Spline SL Series

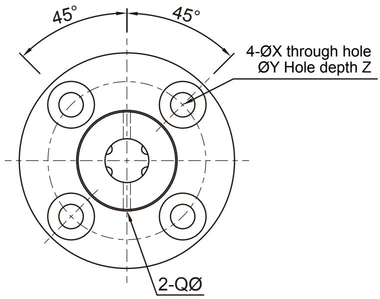
SLF Series Specifications



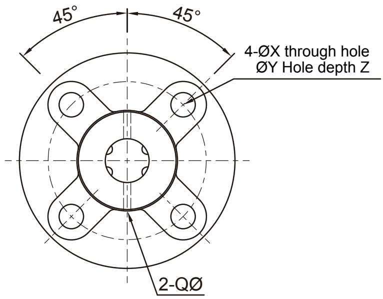
【Two Starts】Type：06、10、13



【Two Starts】Type：08、16、20

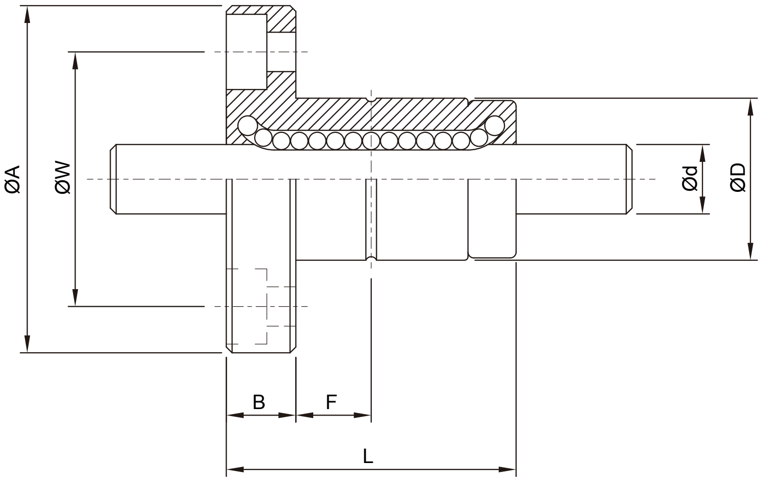


【Four Starts】Type：40、50



【Four Starts】Type：25、30

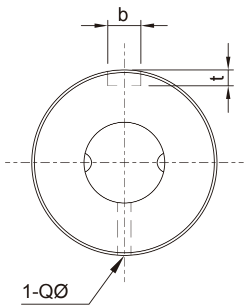
Model No.	Diameter	Row	Spline Nut Dimension									
	d		D	L	A	B	F	Oil Hole	W	Mounting Hole		
	h7							Q		X	Y	Z
SLF006	6	2	14	25	30	6	7.5	1	22	3.4	6.5	3.5
SLF008	8	2	16	27	32	8	7.5	1.5	24	3.4	6.5	4.5
SLF010	10	2	21	33	42	9	10.5	1.5	32	4.5	8	4
SLF013	13	2	24	36	44	9	11	1.5	33	4.5	8	4.5
SLF016	16	2	31	50	51	10	18	2	40	4.5	8	6
SLF020	20	2	35	56	58	10	18	2	45	5.5	9.5	5.4
SLF025	25	4	42	71	65	13	26.5	3	52	5.5	9.5	8
SLF030	30	4	47	80	75	13	30	3	60	6.6	11	8
SLF040	40	4	64	100	100	18	36	4	82	9	14	12
SLF050	50	4	80	125	124	20	46.5	4	102	11	17.5	12



Model No.	Basic Load Rating		Basic Torsion		Static Permissible Moment		Weight	
	C	C_0	C_T	C_{0T}	M_{A1}	M_{A2}	Spline Nut	Spline Shaft
	kgf	kgf	kgf · m	kgf · m	kgf · m	kgf · m	g	kg/m
SLF006	137	225	0.46	0.76	0.39	3.48	36.7	0.22
SLF008	137	225	0.60	0.99	0.39	3.82	47	0.39
SLF010	285	397	1.62	2.25	0.95	8.53	100	0.60
SLF013	396	540	2.89	3.94	1.50	12.46	117	1.03
SLF016	545	849	4.77	7.43	3.71	26.09	226	1.56
SLF020	724	1109	7.90	12.09	5.53	38.00	303	2.44
SLF025	1003	1593	21.99	43.01	10.35	68.59	458	3.80
SLF030	1160	1980	30.26	62.93	15.68	93.27	633	5.49
SLF040	2972	4033	105.37	176.05	36.59	246.34	1430	9.69
SLF050	4086	5615	179.89	304.35	51.58	428.72	2756	15.19

3-1 Nominal Model Code of Ball Spline SL Series

SLT Series Specifications



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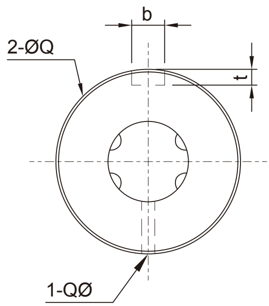

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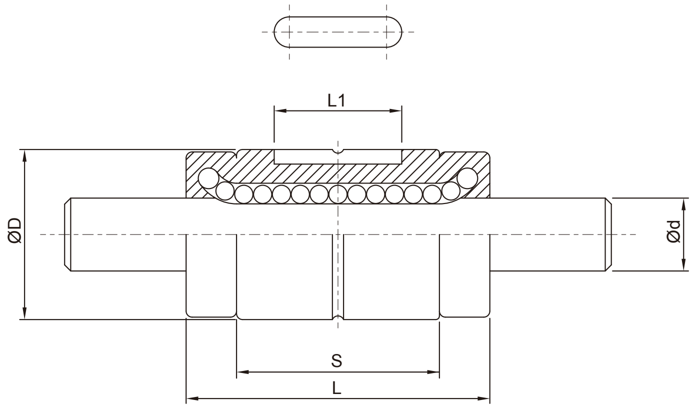
Shaft diameter d ≦ 20 **Shaft diameter d ≧ 25**

Model No.	Diameter	Row	Spline Nut Dimension					Keyway Dimensions	
	d		D	L	S	L1	Oil Hole	b	t
	h7						Q	H8	+0.05 ~0
SLT006	6	2	14	25	16.7	10.5	1	2.5	1.2
SLT008	8	2	16	27	15.7	10.5	1.5	2.5	1.2
SLT010	10	2	21	33	20	13	1.5	3	1.5
SLT013	13	2	24	36	23	15	1.5	3	1.5
SLT016	16	2	31	50	34	17.5	2	3.5	2
SLT020	20	2	35	56	39.7	29	2	4	2.5
SLT025	25	4	42	71	50.3	36	3	4	2.5
SLT030	30	4	47	80	60	42	3	4	2.5
SLT040	40	4	64	100	70	52	4	6	3.5
SLT050	50	4	80	125	91	58	4	8	4



Model No.	Basic Load Rating		Basic Torsion		Static Permissible Moment		Weight	
	C	C_0	C_T	C_{0T}	M_{A1}	M_{A2}	Spline Nut	Spline Shaft
	kgf	kgf	kgf · m	kgf · m	kgf · m	kgf · m	g	kg/m
SLT006	137	225	0.46	0.76	0.39	3.48	14	0.22
SLT008	137	225	0.60	0.99	0.39	3.82	16	0.39
SLT010	285	397	1.62	2.25	0.95	8.53	37	0.60
SLT013	396	540	2.89	3.94	1.50	12.46	52	1.03
SLT016	545	849	4.77	7.43	3.71	26.09	130	1.56
SLT020	724	1109	7.90	12.09	5.53	38.00	188	2.44
SLT025	1003	1593	21.99	43.01	10.35	68.59	285	3.80
SLT030	1160	1960	30.26	62.93	15.68	93.27	395	5.49
SLT040	2972	4033	105.37	176.05	36.59	264.34	843	9.69
SLT050	4086	5615	179.89	304.35	51.58	428.72	1758	15.19

3-2 Nominal Model Code of Ball Spline SO Series

■ 3-2-1 Nominal Model Code

TBI MOTION ball Splines is classified into interchangeable and non- interchangeable types. Their dimensions are the same; the only difference between the two types is that for non-interchangeable series, ***TBI MOTION*** will finish every process in the production line and meet customers' demands. Interchangeable nuts and shafts can be freely exchanged and the standard of the preload is P0. Customers could adjust the preload by changing the steel balls inside of the nut by themselves. It is very convenient for customers to have ***TBI MOTION*** ball splines in inventory and make the preload and end machining by themselves. ***TBI MOTION*** is proud of internal quality control process which is under strict international regulation.

Non-interchangeable Type Code :

SOF	008	T2	D	N	S	-	500	-	P0	-	B2	+	N3	N3
①	②	③	④	⑤	⑥		⑦		⑧		⑨		⑩	⑪

①

Spline Nut
SOF : Flanged
SOT : Cylindrical

②

Nominal Diameter
Unit : mm

③

Groove
T2 : 2 Rows

④

Flange Type
D : Flange cutting (No Symbol When It is Without the Flange)

⑤

Accuracy Grade of Spline Shaft
N : Normal
H : High
P : Precision

⑥

Spline Shaft Type
S : Solid
H : Hollow

⑦

Overall Length of Spline Shaft
Unit : mm

⑧

Preload Value
P0 : No preload
P1 : Light preload

⑨

Number of Spline Nut
(Leave blank if only one nut is required) Ex : Two install spline nuts on a shaft : B2

⑩

Nut Surface Treatment
S : Standard
B1 : Black Oxidation
N1 : Hard Chrome Plating
P : Phosphating
N3 : Nickel Plating
N4 : Raydent
N5 : Chrome Plating

⑪

Shaft Surface Treatment
S : Standard
B1 : Black Oxidation
N1 : Hard Chrome Plating
P : Phosphating
N3 : Nickel Plating
N4 : Raydent
N5 : Chrome Plating

※No symbol required when plating is not needed.

Nominal Model Code for Interchangeable SO Type

Interchangeable Type of Spline Nut :

SOF 013 T2 D + N3

① ② ③ ④ ⑤

① Spline Nut
SOF : Flanged
SOT : Cylindrical

② Nominal Diameter
Unit : mm

③ Groove
T2 : 2 Rows

④ Flange Type
N : Round (No Symbol When It is Without the Flange)

⑤ Nut Surface Treatment
S : Standard
B1 : Black Oxidation
N1 : Hard Chrome Plating
P : Phosphating
N3 : Nickel Plating
N4 : Raydent
N5 : Chrome Plating

Interchangeable Type of Spline Shaft :

SK 008 T2 N S - 500 + N3

① ② ③ ④ ⑤ ⑥ ⑦

① Nominal Model Code

② Nominal Diameter
Unit : mm

③ Groove
T2 : 2 Rows

④ Accuracy Grade of Spline Shaft
N : Normal

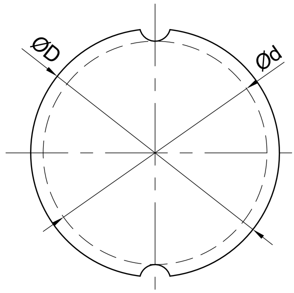
⑤ Spline Shaft Type
S : Solid
H : Hollow

⑥ Overall Length of Spline Shaft
Unit : mm

⑦ Shaft Surface Treatment
S : Standard
B1 : Black Oxidation
N1 : Hard Chrome Plating
P : Phosphating
N3 : Nickel Plating
N4 : Raydent
N5 : Chrome Plating

3-2 Nominal Model Code of Ball Spline SO Series

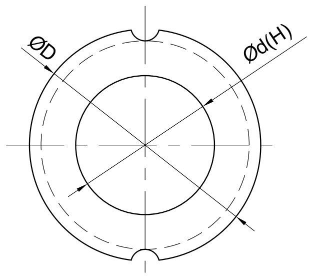
SOF, SOT Spline Shaft Cross-Sectional Shape



Solid Spline Shaft

Table 3.2.1 Solid Spline Shaft Cross-Sectional Shape Unit : mm

Stats \ Nominal Diameter	6	8	10	12	15	20	25
Inner Diameter Ød	5.2	7	8.9	10.9	11.6	15.7	19.4
Outer Diameter ØD h7	6	8	10	12	13.6	18.2	22.6
Weight (kg/m)	0.19	0.39	0.605	0.875	1.11	2.02	3.1
Ball Ø	1.5	2	2.381	2.381	2.778	3.572	4.762
Tolerance µm	0 -12	0 -15	0 -18	0 -18	0 -18	0 -21	0 -21



Hollow Spline Shaft

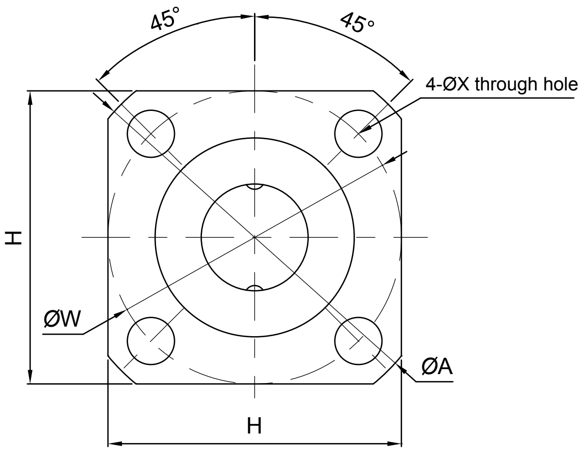
Table 3.2.2 Hollow Spline Shaft Cross-Sectional Shape

Unit : mm

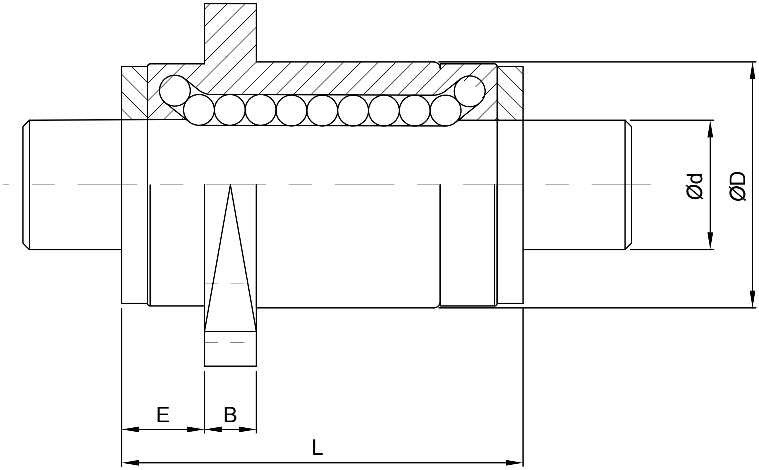
Nominal Diameter / Stats	6	8	10	12
Inner Diameter Ød	2	3	4	6
Outer Diameter ØD h7	6	8	10	12
Weight (kg/m)	0.165	0.33	0.51	0.66
Ball Ø	1.5	2	2.381	2.381
Tolerance μm	0 -12	0 -15	0 -18	0 -18

3-2 Nominal Model Code of Ball Spline SO Series

SOF Series Specifications



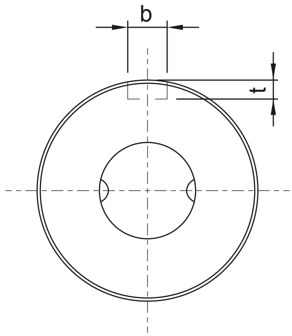
Model No.	Diameter d h7	Row	Spline Nut Dimension							
			D	L	A	B	E	F	W	Mounting Hole X
SOF006	6	2	12	21	20	2.7	4.3	20	19	3.4
SOF008	8	2	15	25	28	3.8	5.2	22	22	3.4
SOF010	10	2	19	30	36	4.1	5.9	28	28	4.5
SOF012	12	2	21	35	38	4	6	30	30	4.5
SOF015	13.6	2	23	40	40	4.5	6.5	31	32	4.5
SOF020	18.2	2	30	50	46	5.5	8.5	35	38	4.5
SOF025	22.6	2	37	60	57	6.6	10.4	43	47	5.5



Model No.	Basic Load Rating		Basic Torsion		Static Permissible Moment		Weight	
	C	C_0	C_T	C_{0T}	M_{A1}	M_{A2}	Spline Nut	Spline Shaft
	kgf	kgf	kgf · m	kgf · m	kgf · m	kgf · m	g	kg/m
SOF006	72	86	0.25	0.31	0.17	1.19	13.9	0.19
SOF008	121	136	0.56	0.63	0.34	2.24	23.5	0.39
SOF010	192	219	1.11	1.27	0.71	4.23	45	0.61
SOF012	222	274	1.51	1.87	1.08	6.02	59	0.88
SOF015	426	619	3.19	4.65	2.83	15.49	77	1.11
SOF020	673	922	6.73	9.22	4.95	29.36	150	2.02
SOF025	1142	1458	14.17	18.14	9.46	56.17	255	3.10

3-2 Nominal Model Code of Ball Spline SO Series

SOT Series Specifications



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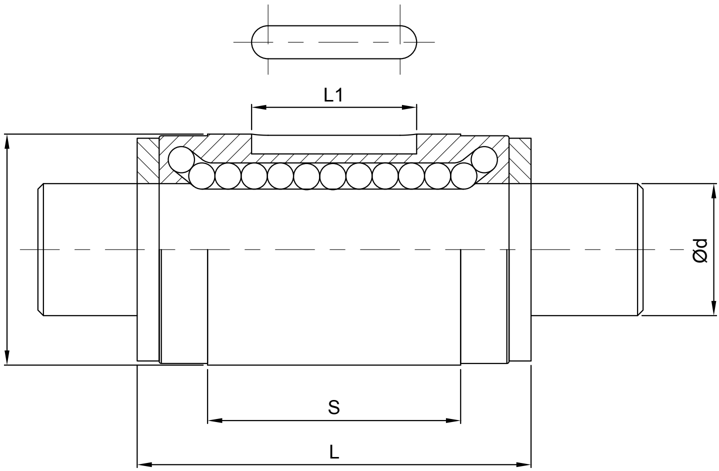
Shaft diameter

Model No.	Diameter	Row	Spline Nut Dimension				Keyway Dimensions	
	d		D	L	S	L1	b	t
	h7						H8	+0.05 ~ 0
SOT006	6	2	12	21	12.4	8	2	1.2
SOT008	8	2	15	25	14.6	8.5	2.5	1.5
SOT010	10	2	19	30	18.2	11	3	1.8
SOT012	12	2	21	35	23	15	3	1.8
SOT015	13.6	2	23	40	27	20	3.5	2
SOT020	18.2	2	30	50	33	26	4	2.5
SOT025	22.6	2	37	60	39.2	29	5	3



Model No.	Basic Load Rating		Basic Torsion		Static Permissible Moment		Weight	
	C	C_0	C_T	C_{0T}	M_{A1}	M_{A2}	Spline Nut	Spline Shaft
	kgf	kgf	kgf · m	kgf · m	kgf · m	kgf · m	g	kg/m
SOT006	72	86	0.25	0.31	0.17	1.19	8.9	0.19
SOT008	121	136	0.56	0.63	0.34	2.24	15.9	0.39
SOT010	192	219	1.11	1.27	0.71	4.23	31.5	0.61
SOT012	222	274	1.51	1.87	1.08	6.02	44	0.88
SOT015	426	619	3.19	4.65	2.83	15.49	59.5	1.11
SOT020	673	922	6.73	9.22	4.95	29.36	130	2.02
SOT025	1142	1458	14.17	18.14	9.46	56.17	220	3.10

3-3 Nominal Model Code of Ball Spline SG Series

■ 3-3-1 Nominal Model Code

TBI MOTION Ball Spline is classified into interchangeable and non-interchangeable types. Their dimensions are the same; the only difference between two types is that for non-interchangeable series, ***TBI MOTION*** will finish every process in the production line to meet customers' demands. Interchangeable nuts and shafts can be freely exchanged and the standard preload is P0. Customers could adjust the preload by changing the steel balls inside of the nut by themselves. It is very convenient for customers to have ***TBI MOTION*** Ball Spline in inventory and make the preload and end machining by themselves. ***TBI MOTION*** is proud of internal quality control process which is under strict international regulation.

Non-interchangeable Type Code：

SGF	020	T2	N	N	S	-	500	-	P0	-	B2	+	N3	N3
①	②	③	④	⑤	⑥		⑦		⑧		⑨		⑩	⑪

①

Spline Nut
SGF : Flanged

②

Nominal Diameter
Unit : mm

③

Groove
T2 : 2 Rows
T4 : 4 Rows

④

Flange Type
N : Round (No Symbol When It is Without the Flange)

⑤

Accuracy Grade of Spline Shaft
N : Normal
H : High
P : Precision

⑥

Spline Shaft Type
S : Solid
H : Hollow

⑦

Overall Length of Spline Shaft
Unit : mm

⑧

Preload Value
P0 : No preload
P1 : Light preload
P2 : Medium preload

⑨

Number of Spline Nut
(Leave blank if only one nut is required) Ex : Install two spline nuts on a shaft.B2

⑩

Nut Surface Treatment
S : Standard
B1 : Black Oxidation
N1 : Hard Chrome Plating
P : Phosphating
N3 : Nickel Plating
N4 : Raydent
N5 : Chrome Plating

⑪

Shaft Surface Treatment
S : Standard
B1 : Black Oxidation
N1 : Hard Chrome Plating
P : Phosphating
N3 : Nickel Plating
N4 : Raydent
N5 : Chrome Plating

※No symbol required when plating is not needed.

Nominal Model Code for Interchangeable SG Type

Interchangeable Type of Spline Nut :

SGF 020 T2 N + N3

① ② ③ ④ ⑤

①

Spline Nut
SGF : Flanged

②

Nominal Diameter
Unit : mm

③

Groove
T2 : 2 Rows
T4 : 4 Rows

④

Flange Type
N : Round (No Symbol When It is Without the Flange)

⑤

Nut Surface Treatment
S : Standard
B1 : Black Oxidation
N1 : Hard Chrome Plating
P : Phosphating
N3 : Nickel Plating
N4 : Raydent
N5 : Chrome Plating

Interchangeable Type of Spline Shaft :

SC 020 T2 N S - 500 + N3

① ② ③ ④ ⑤ ⑥ ⑦

①

Nominal Model Code

②

Nominal Diameter
Unit : mm

③

Groove
T2 : 2 Rows
T4 : 4 Rows

④

Accuracy Grade of Spline Shaft
N : Normal

⑤

Spline Shaft Type
S : Solid
H : Hollow

⑥

Overall Length of Spline Shaft
Unit : mm

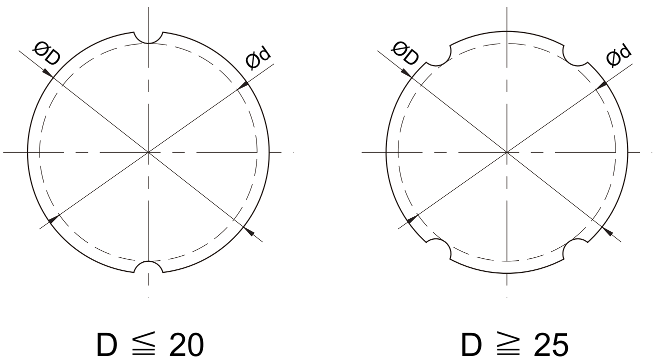
⑦

Nut Surface Treatment
S : Standard
B1 : Black Oxidation
N1 : Hard Chrome Plating
P : Phosphating
N3 : Nickel Plating
N4 : Raydent
N5 : Chrome Plating

3-3 Nominal Model Code of Ball Spline SG Series

SGF Spline Shaft Cross-Sectional Shape

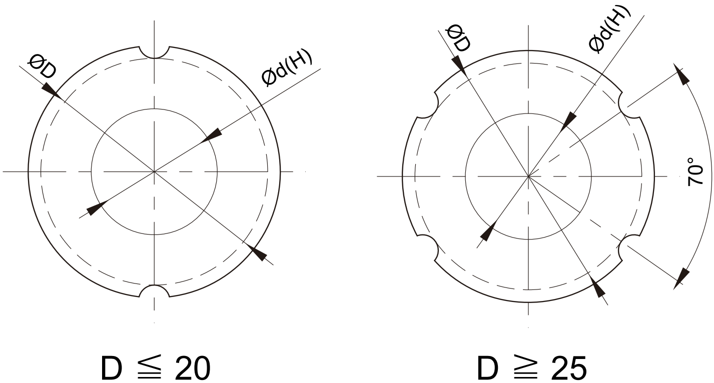
Table 3.3.1, 3.3.2 indicates the cross-section of spline shaft. When the shaft end is round pillar type the minor diameter must not be greater than the diameter of groove ridge.



Solid Spline Shaft

Table 3.3.1 Solid Spline Shaft Cross-Sectional Shape — Unit : mm

Stats \ Nominal Diameter	6	8	10	13	16	20	25	30	40	50
Inner Diameter Ød	5.25	7.27	8.97	11.82	14.72	18.63	23.43	28.53	37.3	47.05
Outer Diameter ØD h7	6	8	10	13	16	20	25	30	40	50
Weight (kg/m)	0.22	0.39	0.6	1.03	1.56	2.44	3.8	5.49	9.69	15.19
Ball Ø	1.5	1.5	2.381	2.778	2.778	3.175	3.5	3.5	6.35	7.144
Tolerance μm	0 -15	0 -15	0 -18	0 -18	0 -18	0 -21	0 -21	0 -25	0 -25	0 -30



Hollow Spline Shaft

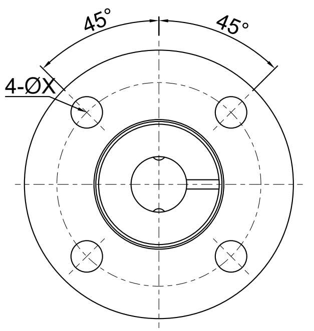
Table 3.3.2 Solid Spline Shaft Cross-Sectional Shape

Unit : mm

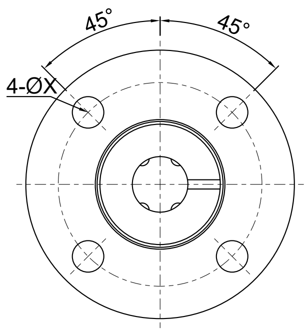
Stats \ Nominal Diameter	6	8	10	13	16	20	25	30	40	50
Inner Diameter Ød	2	3	4	7	8	10	15	16	20	26
Outer Diameter ØD h7	6	8	10	13	16	20	25	30	40	50
Weight (kg/m)	0.177	0.33	0.506	0.872	1.25	1.82	2.92	3.93	6.75	11.4
Ball Ø	1.5	1.5	2.381	2.778	2.778	3.175	3.5	3.5	6.35	7.144
Tolerance μm	0 -15	0 -15	0 -18	0 -18	0 -18	0 -21	0 -21	0 -25	0 -25	0 -30

3-3 Nominal Model Code of Ball Spline SG Series

SGF Series Specifications



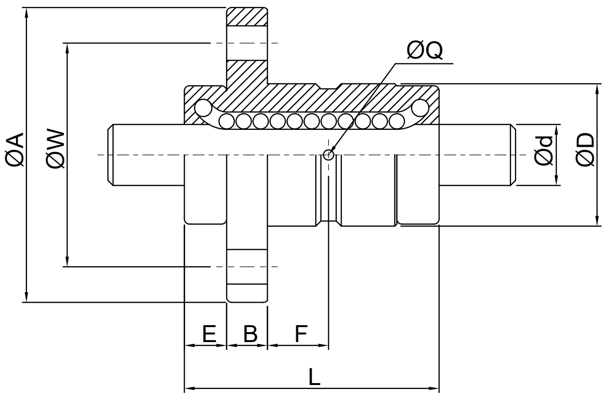
【Two Starts】
Type：06、08、10、13、16、20



【Four Starts】
Type：25、30、40、50

Model No.	Diameter d h7	Row	Spline Nut Dimension								
			D	L	A	E	B	F	Oil Hole Q	W	Mounting Hole X
SGF006	6	2	14	27	29	5.15	4	6	1	22	3.4
SGF008	8	2	16	29	31	6.65	4	6	1.5	24	3.4
SGF010	10	2	21	35	40	7.5	6	7	1.5	32	4.5
SGF013	13	2	24	38	42	7.5	6	8.5	1.5	33	4.5
SGF016	16	2	31	52	48	9	6	14	2	40	4.5
SGF020	20	2	35	60	58	10.1	8	16	2	45	5.5
SGF025	25	4	42	73.5	63	11.6	10	20	3	52	5.5
SGF030	30	4	47	83	73	11.5	10	25	3	60	6.6
SGF040	40	4	64	103	98	16.5	11	29.5	4	82	9
SGF050	50	4	80	128	119	18.5	12	39	4	102	11

※SGF06, 08, 10, 13, 16, the ball tracks of the models are produced by wire electrical discharge machining.



Model No.	Basic Load Rating		Basic Torsion		Static Permissible Moment		Weight	
	C	C_0	C_T	C_{0T}	M_{A1}	M_{A2}	Spline Nut	Spline Shaft
	kgf	kgf	kgf · m	kgf · m	kgf · m	kgf · m	g	kg/m
SGF006	124	196	0.42	0.66	0.31	2.54	29	0.22
SGF008	124	196	0.54	0.86	0.34	2.82	33	0.39
SGF010	267	359	1.51	2.04	0.68	6.26	77	0.6
SGF013	397	530	2.90	3.87	1.34	9.97	92	1.03
SGF016	526	795	4.61	6.95	2.97	20.55	183	1.56
SGF020	655	958	7.14	10.44	4.19	29.85	257	2.44
SGF025	1,042	1,891	19.69	36.66	10.45	71.82	396	3.8
SGF030	1,193	2,296	26.80	52.92	15.14	97.66	560	5.49
SGF040	3,646	5,888	111.37	184.55	45.30	313.75	1150	9.96
SGF050	4,991	8,131	189.33	316.42	81.31	534.59	2125	15.19

Memo

Ball Screw

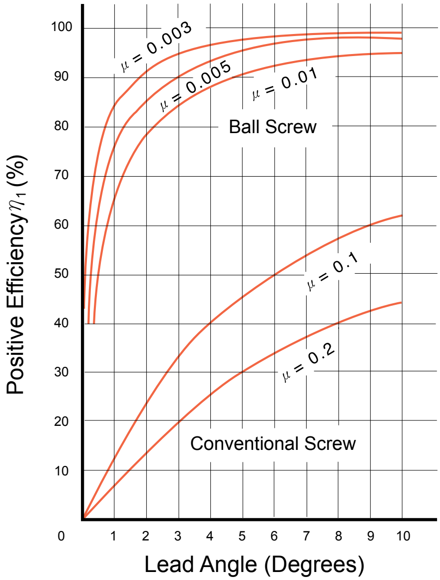
1-1 Features of *TBI MOTION* Ball Screw

(1) High Reliability

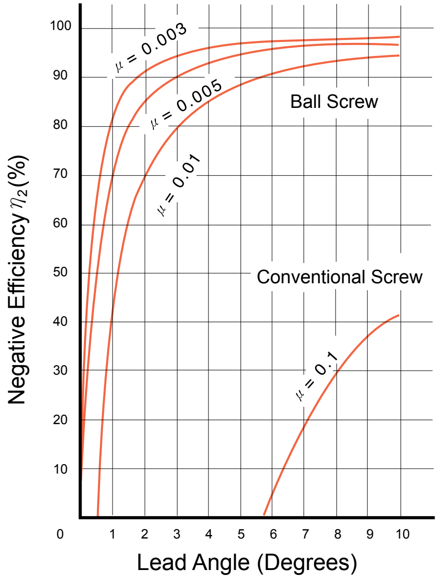
TBI MOTION applies stringent quality control standards on every production process. With proper lubrication and use, trouble-free operation for an extended period of time is possible.

(2) Smooth Operation

The high efficiency of ball screw is vastly superior than conventional screws as shown in Fig 1.1.1. It takes less than 30% torque to make the linear motion into rotary motion.



Normal usage (to convert rotary motion to linear motion)



Special usage (to convert linear motion to rotary motion)

μ : Friction Coefficient (Ground Ball Screw μ=0.005, Rolled Ball Screw μ=0.01)

$$P = \frac{2\pi\eta_1 \times T}{\ell}$$

T = Torque kgf · cm
P = Force kgf
ℓ = Lead cm
η1 = Efficiency

$$T = \frac{\ell \times \eta_2 \times P}{2\pi}$$

T = Torque kgf · cm
P = Force kgf
ℓ = Lead cm
η2 = Efficiency

Fig 1.1.1 Mechanical Efficiency of Ball Screws

C

Ball Screw

(3) High Rigidity and Preload

As figure 1.1.2 shown in below, the ball screw of TBI MOTION is designed with Gothic arch groove, which makes the screw easy to rotate even using minimum axial play. To make the rigidity more appropriate to using condition, you can change the preload between one or two screw nuts to reduce axial play.

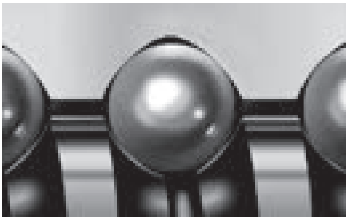


Fig 1.1.2 Groove Shape of ***TBI MOTION*** Precision Ball Screw

(4) Circulation Method

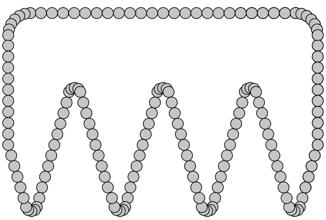


Fig 1.1.3 External Ball Circulation Nuts

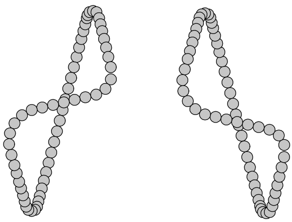


Fig 1.1.4 Internal Ball Circulation Nuts

(5) High Durability

TBI MOTION Rigidly selected materials, intensive heat treating and processing techniques, backed by years of experience, have resulted in the most durable ball screws manufactured. (See Table1.1.1 & Fig1.1.5)

Table 1.1.1 Material and Heat Treatment

Item	Material	Hardness
Screw	High-Carbon Steel Chrome Molybdenum Steel	HRC 58°~64°
Nut	Chrome Molybdenum Steel	HRC 58°~62°
Steel Ball	Chrome Molybdenum Steel	HRC 62°UP

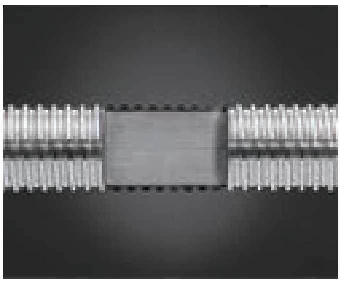
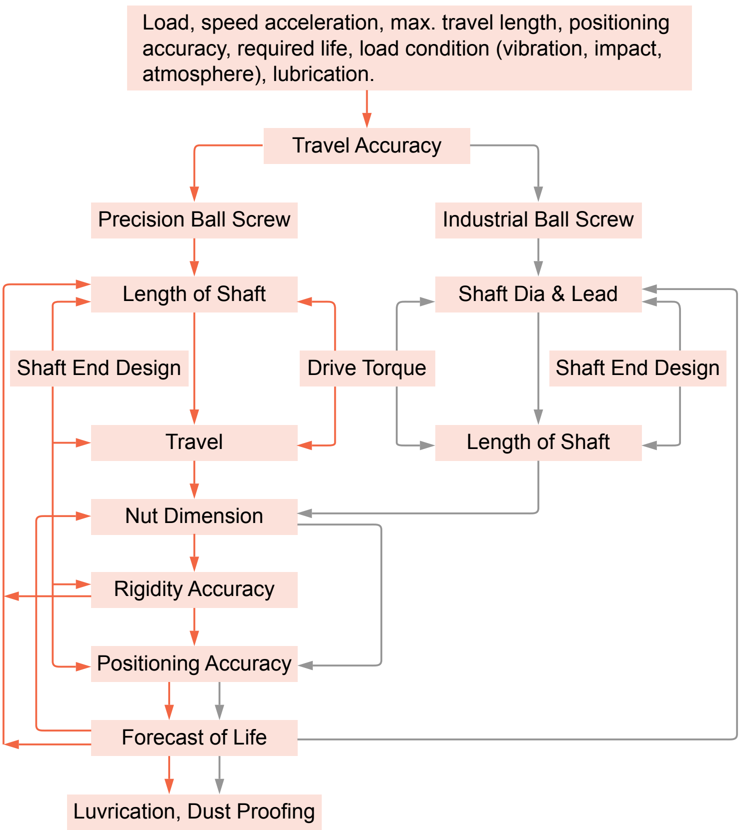


Fig 1.1.5 Heat Treatment

C

Ball Screw

1-2 Ball Screw Selection Precedure



Accuracy (C05)
Screw Shaft Design (C11)
Drive Torque (C17)
Nut Design (C19)

Rigidity (C21)
Positioning Accuracy (C24)
Life Design (C26)
Lubrication and safety design (C32)

1-3 Accuracy

■ 1-3-1 Lead/Travel Accuracy

According to the standard of JIS,we classified our lead accuracy through E, e, e_{300} and $e_{2\pi}$, four main regulations. As figure 1.3.1 ~ 1.3.3 shown in below, all the definition and tolerance are specified. To test the accumulated travel deviations for grade C7 and C10, the tolerance will be chosen in random 300 mm of useful length and evaluated if it is qualified with the e300 table of 1.3.3.

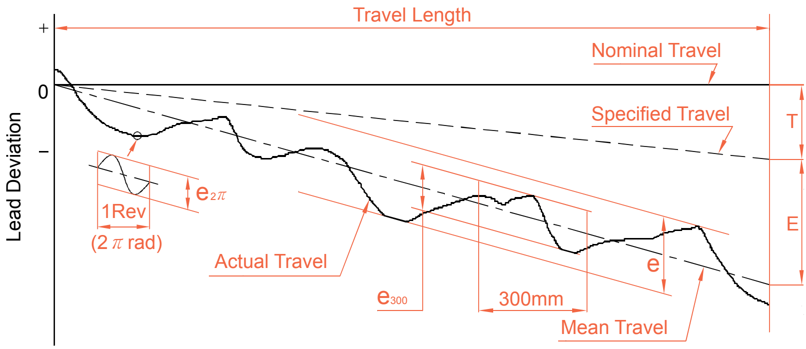


Fig 1.3.1 Diagram of Lead Accuracy(ISO 3408)

Terms	Reference	Definition	Allowable
Travel Compensation	T	Travel compensation is the deduction between specified and nominal travel in the useful travel. A slightly smaller value compared with nominal travel is often selected by customer, to compensate for an expected elongation caused by temperature rise or external load. Therefore " T " is usually a negative value. Note : if no compensation is needed, specified travel is the same as nominal travel.	
Actual Travel		Actual travel is the axial displacement of the nut relative to the screw shaft.	
Mean Travel		Mean travel is the linear best fit line of actual. This could be obtained by the least squares method. This line represents the tendency of actual travel.	
Mean Travel Deviation	E	Mean travel deviation is the deduction between mean travel and specified travel within travel length.	Table 1.3.2
Travel Variations	e e_{300} $e_{2\pi}$	Travel variations is the coverage of 2 lines drawn parallel to the mean travel. Maximum width of variation within the travel length. Actual width of variation for the length of 300mm taken anywhere within the travel length.Wobble error, actual width of variation for one revolution (2π radian)	Table 1.3.2 Table 1.3.3 Table 1.3.3

C

Ball Screw

1-3 Accuracy

Table 1.3.2 Mean Travel Deviation (±E) and Travel Variation (e) (JIS B 1192) Unit : μm

<table>
<tr><th colspan="3">Grade</th><th colspan="2">C0</th><th colspan="2">C1</th><th colspan="2">C2</th><th colspan="2">C3</th><th colspan="2">C5</th><th>C7</th><th>C10</th></tr>
<tr><td rowspan="20">Travel Length (mm)</td><td>Over</td><td>Incl.</td><td>±E</td><td>e</td><td>±E</td><td>e</td><td>±E</td><td>e</td><td>±E</td><td>e</td><td>±E</td><td>e</td><td>e</td><td>e</td></tr>
<tr><td></td><td>100</td><td>3</td><td>3</td><td>3.5</td><td>5</td><td>5</td><td>7</td><td>8</td><td>8</td><td>18</td><td>18</td><td rowspan="19">±50/300 mm</td><td rowspan="19">±210/300 mm</td></tr>
<tr><td>100</td><td>200</td><td>3.5</td><td>3</td><td>4.5</td><td>5</td><td>7</td><td>7</td><td>10</td><td>8</td><td>20</td><td>18</td></tr>
<tr><td>200</td><td>315</td><td>4</td><td>3.5</td><td>6</td><td>5</td><td>8</td><td>7</td><td>12</td><td>8</td><td>23</td><td>18</td></tr>
<tr><td>315</td><td>400</td><td>5</td><td>3.5</td><td>7</td><td>5</td><td>9</td><td>7</td><td>13</td><td>10</td><td>25</td><td>20</td></tr>
<tr><td>400</td><td>500</td><td>6</td><td>4</td><td>8</td><td>5</td><td>10</td><td>7</td><td>15</td><td>10</td><td>27</td><td>20</td></tr>
<tr><td>500</td><td>630</td><td>6</td><td>4</td><td>9</td><td>6</td><td>11</td><td>8</td><td>16</td><td>12</td><td>30</td><td>23</td></tr>
<tr><td>630</td><td>800</td><td>7</td><td>5</td><td>10</td><td>7</td><td>13</td><td>9</td><td>18</td><td>13</td><td>35</td><td>25</td></tr>
<tr><td>800</td><td>1000</td><td>8</td><td>6</td><td>11</td><td>8</td><td>15</td><td>10</td><td>21</td><td>15</td><td>40</td><td>27</td></tr>
<tr><td>1000</td><td>1250</td><td>9</td><td>6</td><td>13</td><td>9</td><td>18</td><td>11</td><td>24</td><td>16</td><td>46</td><td>30</td></tr>
<tr><td>1250</td><td>1600</td><td>11</td><td>7</td><td>15</td><td>10</td><td>21</td><td>13</td><td>29</td><td>18</td><td>54</td><td>35</td></tr>
<tr><td>1600</td><td>2000</td><td></td><td></td><td>18</td><td>11</td><td>25</td><td>15</td><td>35</td><td>21</td><td>65</td><td>40</td></tr>
<tr><td>2000</td><td>2500</td><td></td><td></td><td>22</td><td>13</td><td>30</td><td>18</td><td>41</td><td>24</td><td>77</td><td>46</td></tr>
<tr><td>2500</td><td>3150</td><td></td><td></td><td>26</td><td>15</td><td>36</td><td>21</td><td>50</td><td>29</td><td>93</td><td>54</td></tr>
<tr><td>3150</td><td>4000</td><td></td><td></td><td>30</td><td>18</td><td>44</td><td>25</td><td>60</td><td>35</td><td>115</td><td>65</td></tr>
<tr><td>4000</td><td>5000</td><td></td><td></td><td></td><td></td><td>52</td><td>30</td><td>72</td><td>41</td><td>140</td><td>77</td></tr>
<tr><td>5000</td><td>6300</td><td></td><td></td><td></td><td></td><td>65</td><td>36</td><td>90</td><td>50</td><td>170</td><td>93</td></tr>
<tr><td>6300</td><td>8000</td><td></td><td></td><td></td><td></td><td></td><td></td><td>110</td><td>60</td><td>210</td><td>115</td></tr>
<tr><td>8000</td><td>10000</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>260</td><td>140</td></tr>
<tr><td>10000</td><td>12500</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>320</td><td>170</td></tr>
</table>

Table 1.3.3 International standard of accuracy grade for ball screw Unit : μm

<table>
<tr><th colspan="2" rowspan="3">Grade</th><th colspan="5" rowspan="2">Ground</th><th></th><th colspan="2">Ground</th></tr>
<tr><th colspan="3">Rolled</th></tr>
<tr><th>C0</th><th>C1</th><th>C2</th><th>C3</th><th>C5</th><th>C5</th><th>C7</th><th>C10</th></tr>
<tr><td rowspan="3">e_{300}</td><td>ISO, DIN</td><td>-</td><td>6</td><td>-</td><td>12</td><td>23</td><td>23</td><td>52</td><td>210</td></tr>
<tr><td>JIS</td><td>3.5</td><td>5</td><td>-</td><td>8</td><td>18</td><td>18</td><td>50</td><td>210</td></tr>
<tr><td>TBI MOTION</td><td>3.5</td><td>5</td><td>7</td><td>8</td><td>18</td><td>23</td><td>50</td><td>210</td></tr>
</table>

■ 1-3-2 Axial Play

Axial play of ***TBI MOTION's*** precision ball screw is shown below:

Table 1.3.4 Classification of Axial Play

Grade	P0	P1	P2	P3	P4
Axial Play	Yes	No	No	No	No
Preload	No	No	Light	Medium	Heavy

Table 1.3.5 Axial Play (P0) Clearance in the Axial Direction of Rolled and Ground Ball Screw Unit : mm

Nominal Diameter	Rolled Ball Screw Clearance in the Axial Direction (max.)	Ground Ball Screw Clearance in the Axial Direction (max.)
Ø04~Ø14 miniature ball screw	0.05	0.015
Ø15~Ø40 middle size of ball screw	0.08	0.025
Ø50~Ø100 big size of ball screw	0.12	0.05

1-3 Accuracy

■ 1-3-3 Definition of Mounting Accuracy and Tolerance on Ball Screw

The main items of the mounting accuracy of ball screw are listed in below.

(1) Periphery run-out of the supporting part of the screw shaft to the screw groove.
(2) Concentricity of a mounting portion of the shaft to the adjacent ground portion of the screw shaft.
(3) Perpendicularity of the shoulders to the adjacent ground portion of tha screw shaft.
(4) Perpendicularity of the nut flange to the axis of the screw shaft.
(5) Concentricity of the ball nut diameter to the screw groove.
(6) Parallelism of the mounting surface of a ball nut to the screw groove.
(7) Total run-out of the screw shaft to the axis of the screw shaft.

All ***TBI MOTION*** ball screws are manufactured, inspected and guaranteed to be within specifications.

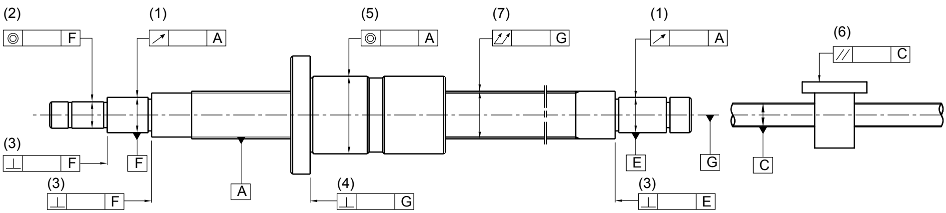


Fig 1.3.2 Mounting Accuracy and Tolerance(ISO 3408)

■ 1-3-4 Preload Torque

As figure 1.3.3 shown in below, it specified all the type of preload torque generated by rotating a preloaded ball screw.

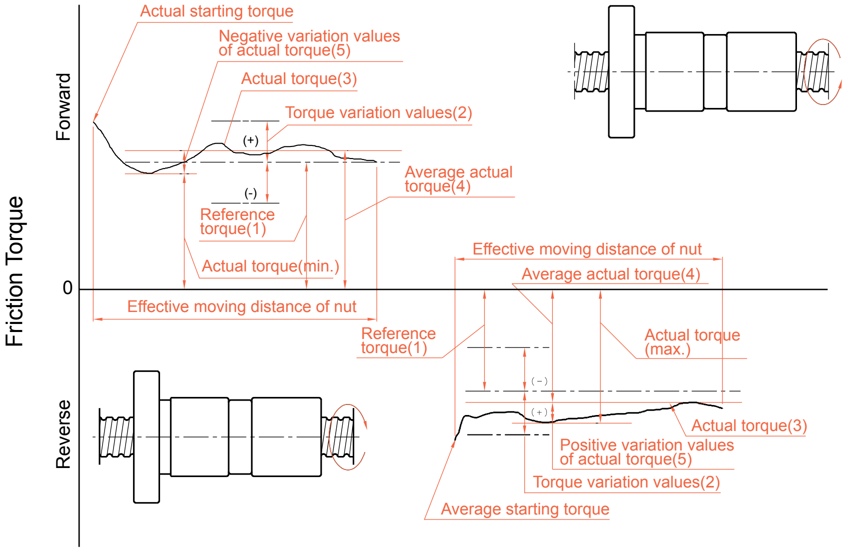


Fig 1.3.3 Descriptions of preload torque

Glossary

(1) Preload

To generate the inner force inside the ball screw to decrease the clearence and increase the rigidity, a set of one gage (approximately 2 μ) larger steel balls is filled inside the nut or two nuts which are executing mutual displacement in axial direction.

(2) Preload dynamic torque

The dynamic torque required for continuously rotating the screws shaft or the nuts under unload condition and the preload has applied to the ball screws.

(3) Reference torque

The targeted preload dynamic torque Fig 1.3.3

(4) Torque variation values

The variation values of the targeted preload torque variation rates are specified generally based on JIS standards as indicated in Fig 1.3.3.

(5) Torque variation rate

The variation ratio of reference torque.

(6) Actual torque

The actual measured preload dynamic torque of the ball screws.

(7) Average actual torque

The arithmetic average of the maximal and minimal actual torque values measured when the nuts are doing reciprocating movements.

(8) Actual torque variation values

After the nut doing reciprocating movements on the effective length of the thread, the biggest variation tested will be the actual torque variation value, which is covered between the positive and negative minimum value relative to the actual torque.

(9) Actual torque variation rate

The rate of actual torque variation values in relation of the average actual torque.

C
Ball Screw

1-3 Accuracy

Table 1.3.6 Permissible ranges of toque variation rates

Reference torque kgf•cm		Effective threading length mm										
		Below 4000								4000~10000		
		Slenderness 1 : below 40				Slenderness1 : 40~1 : 60				-		
		Grade				Grade				Grade		
Over	Incl	C0	C1	C2, C3	C5	C0	C1	C2, C3	C5	C1	C2, C3	C5
2	4	±35%	±40%	±45%	±55%	±45%	±45%	±55%	±65%	-	-	-
4	6	±25%	±30%	±35%	±45%	±38%	±38%	±45%	±50%	-	-	-
6	10	±20%	±25%	±30%	±35%	±30%	±30%	±35%	±40%	-	±40%	±45%
10	25	±15%	±20%	±25%	±30%	±25%	±25%	±30%	±35%	-	±35%	±40%
25	63	±10%	±15%	±20%	±25%	±20%	±20%	±25%	±30%	-	±30%	±35%
63	100	-	-	±15%	±20%	-	-	±20%	±25%	-	±25%	±30%

Remarks : 1. Slenderness is the value of dividing the screws shaft outside diameter with the screws shaft threading length.
2. For reference torque less than 2 kgf・cm, ***TBI MOTION*** specifications will apply.

Calculation of Reference Torque T_p

The equation for computing reference torque of the ball screws is given in following :

$$T_P = 0.05\,(\tan\beta)^{-0.5} \cdot \frac{Fao \cdot \ell}{2\pi}$$

Where, Fao = Preload (kgf)
β = Lead angle
ℓ = Lead (cm)

Measurement Conditions

The measure condition as indicated in Fig 1.3.4, the preload dynamic torque will be the multiplication of F (The force to make the nut stay still during rotating the screw) and L (The arm of force).

T_p = F・L

Measure conditions

(1) Measurment is executed under the condition of unattached with scraper.
(2) The rotating speed during measurement maintains at 100 rpm.
(3) According to ISO 6743-9 the lubrication oil used should be in complience with ISO VG68.

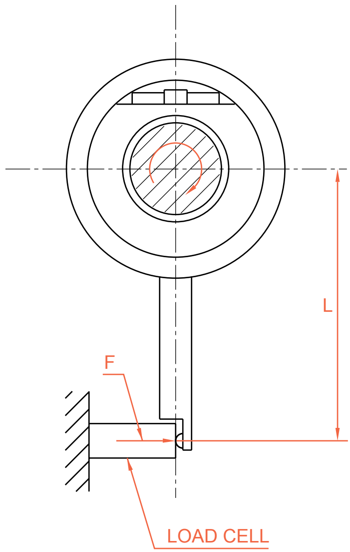


Fig 1.3.4 Preload dynamic torque measuring method

1-4 Screw Shaft Design

■ 1-4-1 Mounting Methods

It's important to consider mounting method (Fig 1.4.1~1.4.8) during your selection of ball screw specification. If you have special requirement related with mounting method, please consult TBI MOTION.

(Mounting Screw and Nut)

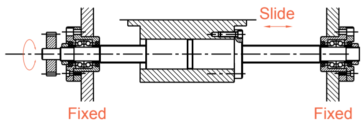


Fig 1.4.1

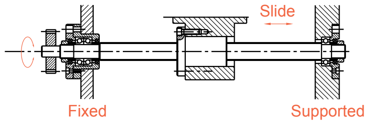


Fig 1.4.5

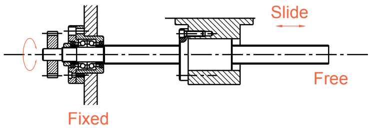


Fig 1.4.2

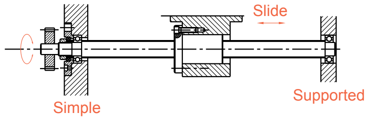


Fig 1.4.6

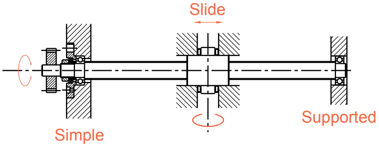


Fig 1.4.3

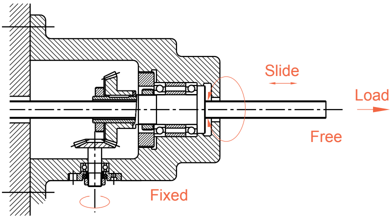


Fig 1.4.7

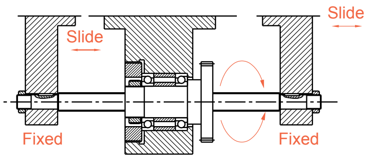


Fig 1.4.4

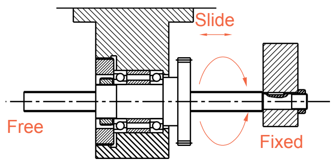


Fig 1.4.8

C

Ball Screw

1-4 Screw Shaft Design

(The mounting method for common types of machinery.)

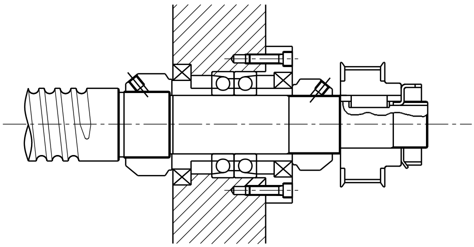


Fig 1.4.9

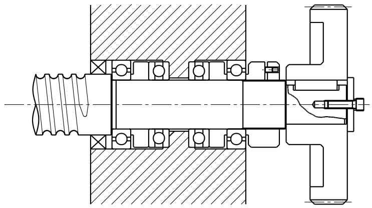


Fig 1.4.11

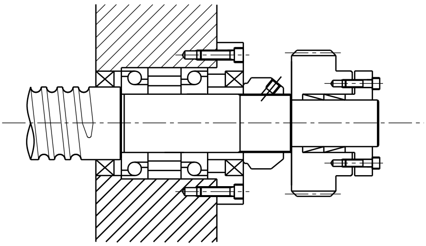


Fig 1.4.10

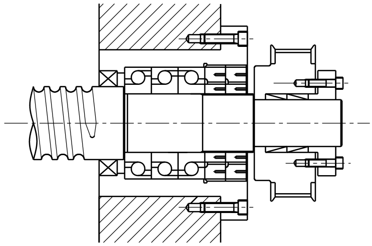


Fig 1.4.12

(The mounting method for bearing in a given pretension.)

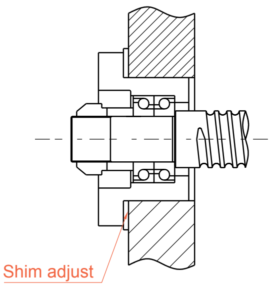


Fig 1.4.13

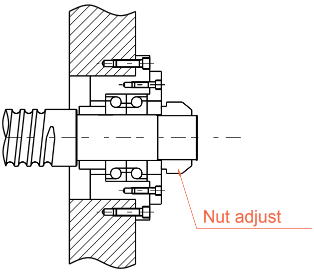


Fig 1.4.14

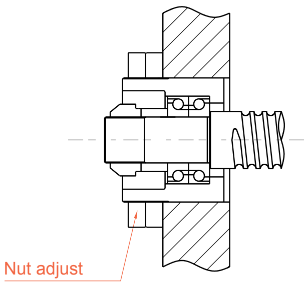


Fig 1.4.15

■ 1-4-2 Allowable Load of Axial Direction

(1) Buckling Load

The safety of the screw shaft against buckling needs to be checked when the shaft is expected to receive buckling loads. Fig 1.4.16 shows a diagram which summarizes the allowable compressive load for buckling for each nominal outside diameter of screw shaft.

Calculate with the equation shown in below when the nominal outside diameter of the screw shaft exceeds 125 mm.

Select the graduation of allowable axial load according to the method of ball screw support method.

$$P = \alpha \cdot \frac{I \cdot N \cdot \pi^2 \cdot E}{L^2} = m \frac{dr^4}{L^2} \cdot 10^3$$

Where

α= Safty Factor (α= 0.5)

E : Vertical elastic modules ($E = 2.1 \cdot 10^4$ kgf/mm^2)

I : Min. secondary moment of screw shaft sectional area

$I = \frac{\pi}{64} dr^4$ (mm^4)

dr : Screw shaft root diameter (mm)

L : Mounting distance (mm)

m・N : Coefficient determined from mounting method of ball screw

Floated-Floated	m = 5.1	(N = 1)
Fixed-Floated	m = 10.2	(N = 2)
Fixed-Fixed	m = 20.3	(N = 4)
Fixed-Free	m = 1.3	(N = 1/4)

(2) Allowable Tensile/Buckling Load

With shorter mounting distance, please calculate the two items describe in below :

- The allowable tensile / buckling load which equals to the derating stress.
- Allowable load of the screw's groove.

$P = \sigma A = 11.8\, dr^2$ (kgf)

Where,

P : Compression load (kgf)

σ : Allowable tensile compressive stress (kgf/mm^2)

A : Sectional area of screw shaft root bottom diameter (mm^2)

dr : Screw shaft root diameter (mm)

1-4 Screw Shaft Design

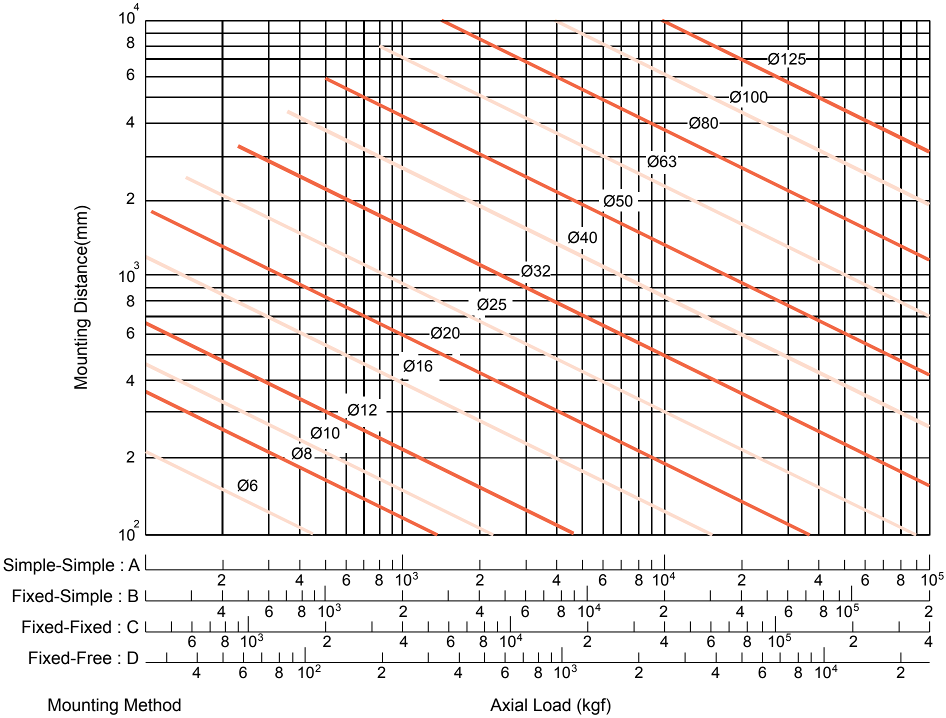


Fig 1.4.16 Buckling Load vs. Nominal Diameter and Length

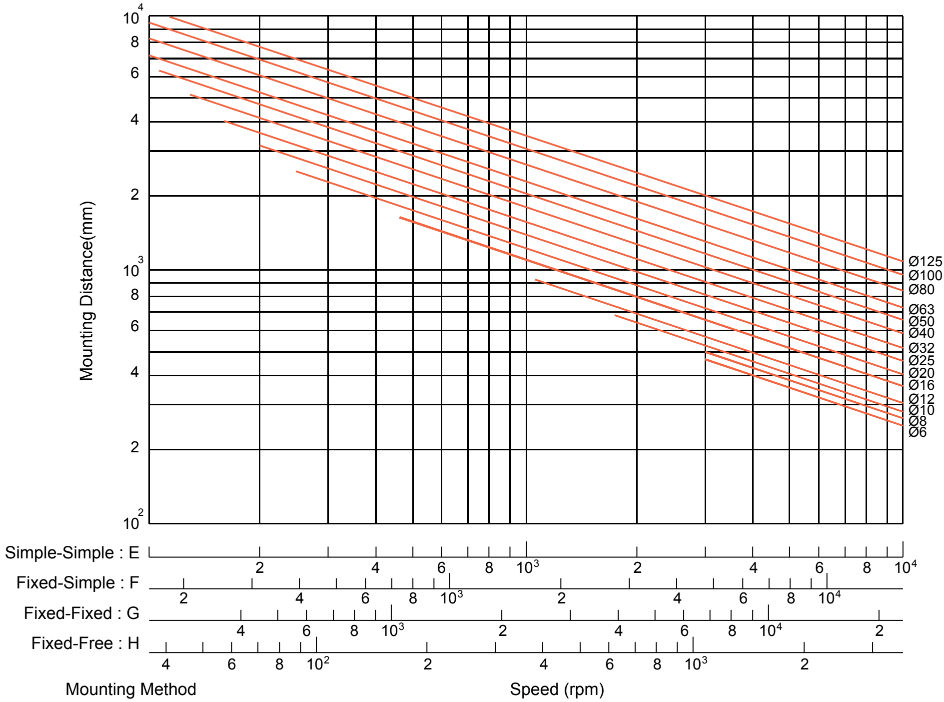


Fig 1.4.17 Critical Speed vs. Nominal Diameter

C

Ball Screw

1-4 Screw Shaft Design

■ 1-4-3 Critical Speed

(1) Dangerous speed

To prevent the screw's natural frequency attain resonance which will occur critical speed, it's necessary to look into the ball screw allowable rotation speed (Below 80% of the Critical Speed). More detail of allowable rotation speed classified though screw diameter please refer to Fig 1.4.17.

※When ε, the ratio of screw length and shaft diameter has exceeded 70, please contact with TBIMOTION to arrange the special arrangement for production.

$$n = \alpha \cdot \frac{60\lambda^2}{2\pi L^2}\sqrt{\frac{EIg}{\gamma A}} = f\,\frac{dr}{L^2} \cdot 10^7\ (\text{rpm})$$

Where

α : Safty factor (α = 0.8)

E : Verticle elastic modules (E = $2.1 \cdot 10^4$ kgf/mm^2)

I : Minimum secondary torque of axial section plane

$I = \frac{\pi}{64} dr^4$ (mm^4)

dr : Screw shaft root diameter (mm)

g : Acceleration of gravity (g = $9.8 \cdot 10^3$ mm/s^2)

γ : Density (γ = $7.8 \cdot 10^{-6}$ kgf/mm^3)

A : Screw shaft sectional area (A = $\pi dr^2/4$ mm^2)

L : Mounting distance (mm)

f, λ : Coefficient determined from the ball screw mounting method

Floated-Floated f = 9.7 (λ =π)

Fixed-Floated f = 15.1 (λ = 3.927)

Fixed-Fixed f = 21.9 (λ = 4.730)

Fixed-Free f = 3.4 (λ = 1.875)

(2) Dm•n value

The allowable rotation speed is regulated also by the Dm x N value (Dm : diameter of central circle of steel ball, N : Revolution speed, rpm) which expresses the peripheral speed.

Generally,

For precision

(Ground shaft C7 to C0)	For general industry (Rolled shaft)
Dm x N ≤ 70,000	Dm x N ≤ 50,000

If your requirement about the product will exceed the limitation, please contact with TBI MOTION to discuss the detailed solution for the ideal product.

※Need to use NLGI No.2 grease.

1-5 Driving Torque

■ 1-5-1 Driving torque Ts of the transmission shaft

$T_S = T_P + T_D + T_F$ (in fixed speed)
$T_S = T_G + T_P + T_D + T_F$ (when accelerating)
T_G : Acceleration torque (1) T_P : Load torque (2)
T_D : Preload torque (3) T_F : Friction torque (4)

(1) Acceleration T_G

$T_G = J\alpha$(kgf・cm)

$\alpha = \frac{2\pi n}{60\Delta t}$ (rad/s²)

J : Moment of inertia (kgf・cm・s²)
α : Angular acceleration (rad/s²)
n : Revolutions (min⁻¹)
△ t : Starting time (sec)

(3) Preload torque T_D

$T_D = \frac{K \cdot P_{PL} \cdot \ell}{\sqrt{\tan\alpha} \cdot 2\pi}$ (kgf・cm)

K : Internal coefficient
(0.05 is usually adopted)
P_{PL} : Preload (kgf)
ℓ : Lead (cm)
α : Lead angle

(4) Fricition torque T_F

$T_F = T_B + T_O + T_J$ (kgf・cm)
T_B : Friction torque of bracing shaft
T_O : Friction torque of free shaft
T_J : Friction torque motor shaft

(2) Lead torque T_P

$T_P = \frac{P \cdot \ell}{2\pi\eta_1}$ (kgf・cm)

$P = F + \mu Mg$
P : Axial load (kgf)
ℓ : Load (cm)
η_1 : Positive efficiency
The efficiency when rotating motion is altered to linear motion
F : Cutting force (kgf)
μ : Friction
M : Mass of moving object (kg)
g : Acceleration of gravity (9.8 m/s²)

$T_P = \frac{P \cdot \ell \cdot \eta_2}{2\pi}$ (kgf・cm)

η_2 : Reverse efficiency
The efficiency when linear motion returns to rotating motion

The friction torque of the bracing shaft would be affected by the volume of lubrication oil. Besides, be careful with the excessive tight end seal may lead to unexpected over friction torque or temperature rise.

【For reference】Moment of inertia of load (refer to Table 1.5.1)

$J = J_{BS} + J_{CU} + J_W + J_M$

J_{BS} : Moment of inertia Ball screws shaft
J_{CU} : Moment of inertia Coupler
J_W : Moment of inertia Linear motion part
J_M : Moment of inertia Roller shaft part of motor shaft

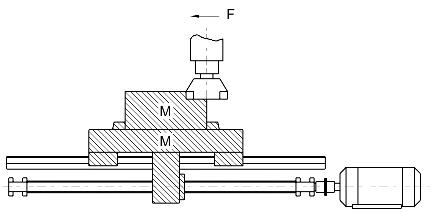


Fig 1.5.1 Moment of inertia of load

C
Ball Screw

1-5 Driving Torque

Table1.5.1 Conversion formula for moment of inertia of load

Formula / Moment of inertia converted from motor shaft	J
Cylinder load	$\frac{\pi \rho L D^4}{32}$
Linearly moving object	$\frac{M}{4}\left(\frac{V\ell}{\pi \cdot N_M}\right)^2 = \frac{M}{4}\left(\frac{P}{\pi}\right)^2$
Unit	kg . m^2
Moment of inertia during deceleration	$J_M = \left(\frac{J\ell}{N_M}\right)^2 J\ell$

ρ : Density (kg/m^3) $\rho = 7.8 \cdot 10^3$
L : Cylinder length (m)
D : Cylinder diameter (m)
M : Mass of the linear motion part (kg)
V : Velocity of the linear moving object (m/min)
N_M : Motor shaft revolutions (min^{-1})

P : The moving magnitude of the linearly moving object per rotation of the motor (m)
$N\ell$: Rotations in longitudinal moving direction (min^{-1})
$J\ell$: Moment of inertia in load direction
J_M : Moment of inertia in motor direction

1-6 Nut Design

■ 1-6-1 Selection of Nut

(1) Series

When making selection of series, please take demanded accuracy, intended delivery time, dimensions(the outside diameter of screw, ratio of lead/ the outside diameter of screw) preload and etc into consideration.

(2) Circulation type

Selection of circulation type : Please consider the efficiency of screw nut's mounting space. The advantage of each circulation type will be specified in Table1.6.1.

(3) Number of loop circuits

Performance and service life should be considered when selecting number of loop circuits.

(4) Shape of flanges (FLANGE)

Please make selection based on the available space for the installation of nuts.

(5) Oil hole

Oil holes are provided for the precision ball screws, please use them during machine assembling and regular furnishing.

1-6 Nut Design

Table1.6.1 Circulation type

Circulation type	Model		Characteristic
	Single Nut	Double Nuts	
Internal circulation type	SFNI SFNU SFK SFI BSH SFU	OFU OFI	●Delicated diameter of screw takes only little space. ●Applicable to those with smaller lead / the outside diameter of the screw
External circulation type	SFV XSV BSH	OFV	●Economy ●Applicable to larger lead and diameter. ●Applicable for high loading purpose. (TBI MOTION patent nut)
End-caps circulation type	SFY SFJ SFA SFYA SFB		●Suitable for high speed positioning

■ 1-6-2 Nut Types

U, I - Type Nut

In these types of nuts, by using the internal circulator which makes the ball pass over the crest diagonally, the ball will return to the starting point. Normally, one roll of balls will fit with one circulation. As figure 1.6.1 specified, these types of nuts need at least one side which is completely threading, which is applicable for smaller shaft diameter.

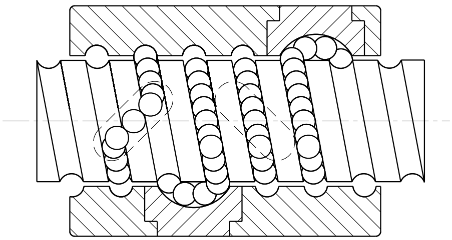


Fig 1.6.1 U, I - Type Nut

K - Type Nut

It applies the similar circulation as that of I-type, but circulation takes place in key slots of identical angle for different circulation. (see Fig 1.6.2)

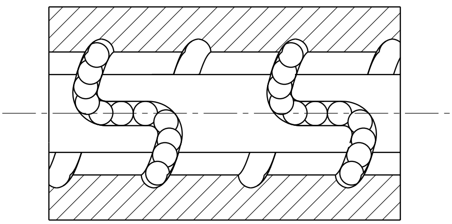


Fig 1.6.2 K - Type Nut

1-6 Nut Design

V - Type Nut

Using outer circulation, the special design of circulator allows the balls to roll along the thread direction. By so, the smoothness of circulation is increased and meanwhile decrease the mutual collision. It's a suitable type for high speed and heavy loading.

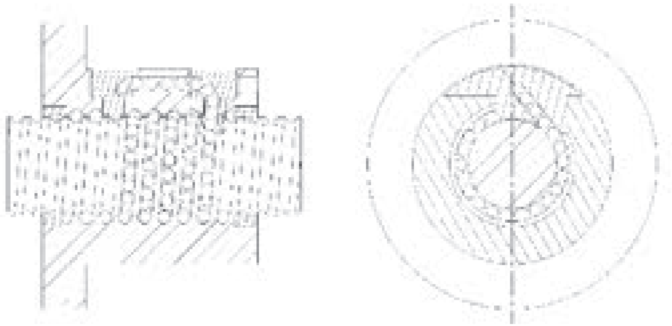


Fig 1.6.3 V - Type Nut

Y, YA, A, J, B - Type Nut

By using thin and flexible dust cap on both side, the performance of wiping had been enhanced. Moreover, the enhancement of circulation structure increase both the function of high rigidity and speed.

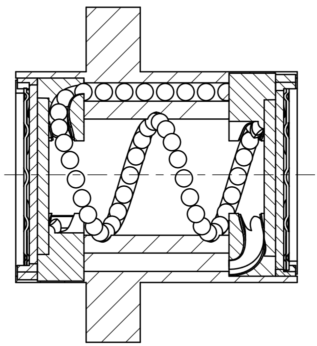


Fig 1.6.4 Y, YA, A, J - Type nut

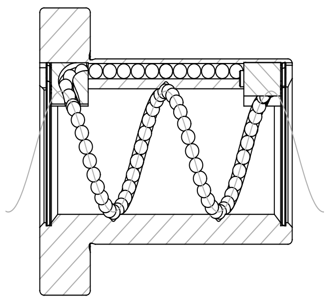


Fig 1.6.5 B - Type Nut

1-7 Rigidity

Excessively weak rigidity of the screw's peripheral structure is one of the primary causes that result in lost motion. Therefore, in order to achieve excellent position accuracy for the precison machines such as NC working machines and etc, axial rigidity balance as well as torsional rigidity for the parts at various portions of the transmission screw have to be taken into consideration at time of designing.

Static Rigidity K

The axial elastic deformation and rigidity of the transmission screw system can be determined by the formula below.

$K=\frac{P}{e}$ (kgf/mm)

P : Axial load (kgf) borne by the transmission screw system

e : Axial flexural displacement (mm)

$\frac{1}{K}=\frac{1}{K_S}+\frac{1}{K_N}+\frac{1}{K_B}+\frac{1}{K_H}$ (mm/kgf)

K_S : Axial rigidity of screw shaft (1)

K_N : Axial rigidity of nut (2)

K_B : Axial rigidity of support shaft (3)

K_H : Axial rigidity of installation (4)

(1) Axial rigidity Ks and displacement δs

$K_S=\frac{P}{\delta_S}$ (kgf/mm)

P : Axial load (kgf)

For places of Fixed - Fixed installation

$\delta_{SF}=\frac{PL}{4AE}$ (mm)

For places other than Fixed - Fixed installation

$\delta_{SS}=\frac{PL_0}{AE}$ (mm)

$\delta_{SS}=4\delta_{SF}$

δ_{SF} : Directional displacement at places of fixed-fixed

δ_{SS} : Directional displacement at places excluding fixed-fixed installation

A : Cross-sectional area of the screw shaft tooth root diameter (mm^2)

E : Longitudinal elastic modulus ($2.1 \cdot 10^4$ kgf/mm^2)

L : Distance between installations (mm)

L_0 : Distance between load applying points (mm)

1-7 Rigidity

(2) Axial rigidity K_N and displacement δ_N of steel balls and nuts

$$K_N = \frac{P}{\delta_S}\ \text{(kgf/mm)}$$

(a) In case of single nut

$$\delta_{NS} = \frac{K}{\sin\beta}\left(\frac{Q^2}{d}\right)^{\frac{1}{3}} \cdot \frac{1}{\zeta}\ \text{(mm)}$$

$$Q = \frac{P}{n \cdot \sin\beta}\ \text{(kgf)}$$

$$n = \frac{D_0 \pi m}{d}\ \text{(each)}$$

Q : Load of one steel ball (kgf)
n : Amount of steel ball
k : Constant determined based on material, shape, dimensions
$k \fallingdotseq 5.7 \cdot 10^{-4}$

β : Angle of contact (45°)
P : Axial load (kgf)
d : Steel ball diameter (mm)
ζ : Accuracy, internal structure coefficient
m : Effective amount of balls
D_0 : Steel ball center diameter (mm)

$$D_0 = \frac{\ell}{\tan\alpha \cdot \pi}\ \text{(kgf/mm)}$$

ℓ : Lead (mm)
α : Lead angle

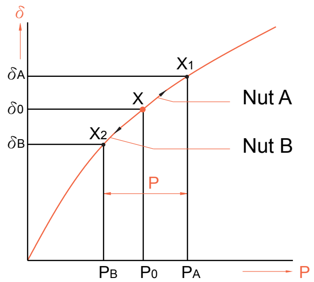


Fig 1.7.1

(b) In case of double nuts

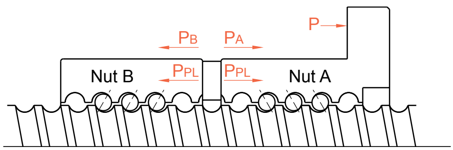


Fig 1.7.2 Preloaded for the double nuts

As bearing weight of preload (P_{PL}) exert, there will be approximately three times of axial loading(P). To eliminate the preload of nut b, please set the bearing weight of preload (P_{PL}) under 1/3 of the maximum axial load weight. Take 0.25 Ca as maximum load weight of preload. When the displacement under the preload which equals to three times of the bearing load of the axial direction, the value will be 1/2 of single nut's displacement.

$$K_N = \frac{P}{\delta_{NW}} = \frac{3P_{PL}}{\delta_{NS/2}} = \frac{6P_{PL}}{\delta_{NS}}\ \text{(kgf/mm)}$$

δ_{NS} : Displacement of single nut (mm)
δ_{NW} : Displacement of doulbe nuts (mm)

(Explanation of the rigidity of double nuts)
As shown in Fig 1.7.1 and 1.7.2, when a preload P_{PL} is applied on the nut A and B both nuts A, B would produce flexural deformations that will reach point X. If an external force P is exerted from here, nut A moves from point X to point X1, while nut B moves from X to X2.

Then, based on the computing formula for displacement δNS of the single nut, we can obtain :
$\delta_0 = aP_{PL}^{\frac{2}{3}}$

Since nut A and B have the displacement of $\delta_a = aP_{PL}^{\frac{2}{3}}$ while external force (P) gave the same displacement on nut A and B, we can obtain that $\delta_A - \delta_0 = \delta_0 - \delta_B$.
In other cases, if external force applied on nut A and B is P only, and cause the increase of P_A, we will get the formula of $P_A - P_B = P \quad \delta_B = 0$
$P_A - P_B = P$
$\delta_B = 0$
For preventing the external force applied on nut B being absorbed by nut A thus decreaseing, so when $\delta_B = 0$
$aP_A^{\frac{2}{3}} - aP_{PL}^{\frac{2}{3}} = aP_{PL}^{\frac{2}{3}}$
$P_A^{\frac{2}{3}} = 2P_{PL}^{\frac{2}{3}}$
$P_A = \sqrt{8}\ P_{PL} \fallingdotseq 3P_{PL}$
As Fig 1.7.3 shown in below, if the axial direction loading weight equals to three times of preload, the single nut's displacement will be cut into half and gain two times stronger of rigidity.

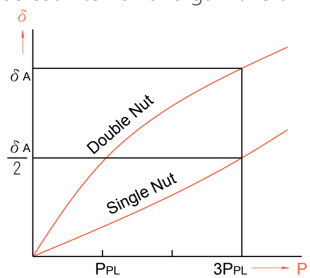


Fig 1.7.3

(3) Axial rigidity K_B and displacement δ_B of support bearing

$K_B = \frac{P}{\delta_B}$ (kgf/mm)

Being the support bearing of ball screw and meanwhile applying on precision machines, we can calculate the rigidity of bevel ball bearing through the formula below.

$\delta_B = \frac{2}{\sin\beta}\left(\frac{Q^2}{d}\right)^{\frac{1}{3}}$ (mm) $\quad Q = \frac{P}{n \cdot \sin\beta}$ (kgf)

Q : Load of one steel ball (kgf)
n : Amount of steel balls
β : Angle of contact (45°)
P : Axial load (kgf)
d : Steel ball diameter (mm)
a : Effective stroke

(4) Look into the nut and bearing mounting part's axial direction, the rigidity K_H and displacement δ_H should aware of the requirement of high rigidity on mounting portion during the initial machine development.

$K_H = \frac{P}{\delta_H}$ (kgf/mm)

1-8 Positioning Accuracy

Among the factors that cause feed accuracy errors, lead accuracy and feed system rigidity are the key points for review, while other factors such as heat deformation due to temperature rise as well as assembly accuracy for the guiding surface, etc. should also be considered.

■ 1-8-1 Accuracy Selection

Table 1.8.1 shows the recommended application ranges for various ball screws accuracy classes based on different.

Table 1.8.1 Examples of ball screws accuracy classes for different uses

Application			Accuracy Grade						
			C0	C1	C2	C3	C5	C7	C10
NC Machine Tools	Lathe	X	○	○	○	○	○	○	
		Y				○	○	○	
	Milling Machine Boring Machine	XY		○	○	○	○	○	
		Z			○	○	○	○	
	Machine Center	XY		○	○	○	○		
		Z			○	○	○		
	Jig Borer	Y	○	○					
		Z	○	○					
	Drilling Machine	XY				○	○	○	
		Z					○	○	
	Grinding Machine	X	○	○	○	○	○	○	
		Z		○	○	○	○	○	
	Electro-discharge Machine (EDM)	XY		○	○	○	○	○	
		(Z)			○	○	○	○	
	Wire Cut (EDM)	Y		○	○	○			
		UV		○	○	○	○	○	
	Punching Press	XY				○	○	○	
	Laser Cutting Mathine	XY				○	○		
		Z				○	○		
	Wood Working Machine					○	○	○	○
Machines of General use and special Use					○	○	○	○	○
Semiconductor Machines	Explosure Equipments		○	○					
	Chemical Treatment					○	○	○	○
	Wire Bonder			○	○	○			
	Prober		○	○	○	○			
	Inserter				○	○	○	○	
	PCB Driller			○	○	○	○	○	
Industrial Robots	Orthogonal Type	As'sy		○	○	○	○	○	
		Others					○	○	○
	Mulititi-joints Type	As'sy			○	○	○		
		Others				○	○	○	
	SCARA Type				○	○	○	○	
Machines for Steel molding							○	○	○
Injection Molding Machines							○	○	○
Three-Dimensonal Measuring Machines			○	○	○				
Business Machines							○	○	○
Pattern Image Machines			○	○					
Nuclear	Rod Control					○	○	○	
	Mechnaical Snubber							○	○
Aircrafts						○	○		

■ 1-8-2 Countermeasure Against Thermal Displacement

Thermal displacement of the screw shaft results in deterioration of the position accuracy. The magnitude of the thermal displacement is calculated as follows :

$\triangle \ell = \alpha \cdot \triangle t \cdot L$

$\triangle \ell$: Thermal displacement

α : Coefficient of thermal expansion

$\triangle t$: Temperature rise (deg) at screw shaft

L : Effective length of screw thread

Namely, the screw shaft develops elongation of 12 μm per 1 m when the temperature rises by 1°C. The ball screw, which lead has been machined to high accuracy, may fail to meet high level requirments because of the thermal displacement due to temperature rise. As high speed is applied during ball screw usage, the heat will rise as well and cause more influence.

The thermal displacement countermeasures for ball screws include the following :

(1) Control of heat generation

- Optimization of preload
- Correct selection and supply of lubricant
- Increase in ball screw lead, with reduced rotation speed

(2) Forced cooling

- Hollow screw shaft to allow cooling fluid to flow through
- Cooling of screw shaft exterior with cooling oil or air

(3) Aviod influence of temperature rise

Warming up the machine through high speed to attain the stable temperature :

- Operates after the temperature become stable
- Pre-tension on screw shaft
- Preset a negative value on target value of the cumulative lead.
- Use the closed loop for positioning

1-9 Service Life Design

■ 1-9-1 Service Life of Ball Screws

Even the ball screw is used under correct conditions, it would still fail after a period time of usage. From the beginning to the unusable condition of ball screw, this period of time is called service life of ball screw, which is generally classified into the fatigue life when delamination phenomenon occurs and the accuracy deterioration life caused by wear-out, etc.

■ 1-9-2 Basic Static Load Rating C_{0a}

The basic load rating is an axial static load which will produce a permanent deformation at contact points of the steel balls to ball grooves equal to 0.01% of ball diameter.

■ 1-9-3 Basic Dynamic Load Rating C_a

The basic dynamic load rating is an axial load which allow 90% of a group of identical ball screws (rotated under the same condition) to rotate without flaking for 10^6 revolutions. This basic dynamic load rating is shown in the table of dimensions.

Relation between load and service life $L_\alpha = \left(\frac{1}{P}\right)^3$ L : Service life P : Load

■ 1-9-4 Fatigue Life

Average load P_e

(1) When axial load keeps changing, please calcuate in order the average load for the equivalent fatigue life under different load condition changes. (see Table 1.9.1)

$$\left(P_e = \frac{P_1^3 n_1 t_1 + P_2^3 n_2 t_2 + \dots + P_n^3 n_n t_n}{n_1 t_1 + n_2 t_2 + \dots + n_n t_n}\right)^{\frac{1}{3}} \text{(kgf)}$$

Axial Load (kgf)	Rotating Speed (min^{-1})	Time(%)
P1	n1	t1
P2	n2	t2
.	.	.
.	.	.
.	.	.
Pn	nn	tn

But, $t_1 + t_2 + t_3 + \dots + t_n = 100$

Table 1.9.1 Service Life in Different Application.

Usage	Life in hours (h)
Working machines	20000
General industrial machines	10000
Automatic control machines	15000
Measurement machines	15000

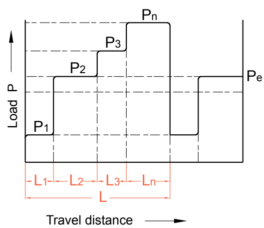


Fig 1.9.1

$$P_e = \frac{2P_{max} + P_{min}}{3} \text{ (kgf)}$$

P_{max} : Maximal axial load (kgf)
P_{min} : Minimal axial load (kgf)

(2) When load changes according to sine curve (see Fig 1.9.2)

$P_e \fallingdotseq 0.65\ P_{max}$ ..... (Fig A)
$P_e \fallingdotseq 0.75\ P_{max}$ ..... (Fig B)

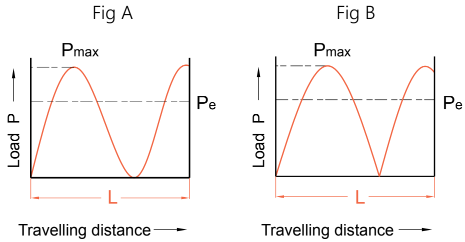


Fig 1.9.2

■ 1-9-5 Calculation of Service Life

The fatigue life is generally expressed by the total number of revolutions. The total rotation hours or total travel distance may also be used to express service life. The fatigue life is calculated as follow :

$$L = \left(\frac{C_a}{P_a \cdot f_w}\right)^3 \cdot 10^6 \qquad L_t = \frac{L}{60_n} \qquad L_s = \frac{L \cdot \ell}{10^6}$$

Where
L : Rated fatigue life (rev)
L_s : Life in travel distance (km)
P_a : Axial load (kgf)
f_w : Load Coefficient
(Required coefficient to operate)
L_t : Life in hours (h)
C_a : Basic dynamic load rating (kgf)
n : Rotating speed (rpm)
ℓ : Lead (mm)

Table 1.9.2 Load Factor (fw)

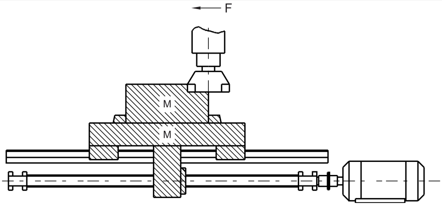
Vibration and impact	Velocity (V)	fw
Minor	V ≦ 0.25 m/sVery Low	1~1.2
Little	0.25 < V ≦ 1m/s Low	1.2~1.5
Moderate	1 < V ≦ 2 m/sMedium	1.5~2
Heavy	V > 2 m/sHigh	2~3.5

Table 1.9.3 Factor of Safety (fs)

Usage	Operation	fs
Machine tool	Normal operation	1.0 ~ 1.3
	Operation with impact and vibration	2.0 ~ 3.0
Industrial machine	Normal operation	1.0 ~ 1.5
	Operation with impact and vibration	2.5 ~ 7.0

Basic Dynamic Load Rating C_a
$C_a = P_e \cdot f_s$
Basic Static Load Rating C_{0a}
$C_{0a} = P_{max} \cdot f_s$

1-9 Life Design

Key Points for Ball Screws Selection	Calculation for Ball Screws Selection
To choose a perfect fit ball screw, users need to understand operating requirement, which is the fundamental principal of deciding the design. Besides, the main factors of selection include load weight, stroke, torque, positioning accuracy in a single time and repeatedly, rigidity, lead and nut's inner diameter. Among all the factors, any single factor's change will cause the change of other factors. Therefore, the balance between all factors is a must to pay attention to.	

Design conditions

1. Working table weight	300 Kg
2. Working object weight	400 Kg
3. Max Stroke	700 mm
4. Feeding speed	10 m/min
5. Minimal disassembly ability	10μm/stroke
6. Driving motor DC motor	(MAX 1000 min)
7. Guiding surface friction coefficient	(μ= 0.05~0.1)
8. Running rate	60 %
9. Accuracy review items	
10. Inertia generated during acceleration/ deceleration	can be neglected because the time periods involved are comparatively small.

1. Setting of operation conditions

(a) Machine service life time calculation of H (hr)

H= ______ · ______ · ______ · ______

hours/day   days/year   life years   running rate

(b) Mechanical conditions

Calculation Items / Different Operations	Speed/ rotations	Cutting resistance	Sliding resistance	Time used
Fast feed	m/min/ min^{-1}	kgf	kgf	%
Light cutting	/			
Medium cutting	/			
Heavy cutting	/			

(c) Position determination accuracy

Feed accuracy error factor includes load accuracy and system rigidity. Other factors which caused by temperature rise such as heat deformation and mounting accuracy of surface are needed to be considered.

1. Setting of operation conditions

(a) Machine service life time calculation of H (hr)

H = 12 hr · 250 days · 10 years · 0.6 Running rate
= 18000 hr

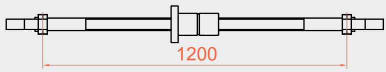
(b) Mechanical conditions

Calculation Items / Different Operations	Speed/ rotations (m/min) / (min^{-1})	Cutting resistance Kgf	Sliding resistance Kgf	Time used %
Fast feed	10 / 1000	0	70	10
Light cutting	6/600	100	70	50
Medium cutting	2/200	200	70	30
Heavy cutting	1/100	300	70	10

Sliding resistance = (300 + 400) · 0.1 = 70 kgf
Maximum Rotational Speed = 1000 min-1
Pmax = 300 + 70 = 370 kgf

Key Points for Ball Screws Selection	Calculation for Ball Screws Selection
2. Ball screw lead ℓ (mm) $\ell = \dfrac{\text{Feeding speed (m/min)} \cdot 1000}{\text{Max. Rotating speed (min}^{-1}\text{) of motor}}$ (mm)	2. Ball screw lead ℓ (mm) $\ell = \dfrac{10000}{1000} = 10$ (mm) Minimal disassembly = $\dfrac{10\text{ mm}}{1000\text{ stroke}}$ = 0.01 mm/stroke
3. Computation of average load P_e (kgf) Select appropriately according to the different operating speeds, refer to Figures 1.9.1 and 1.9.2 $P_e = \left(\dfrac{P_1^3 n_1 t_1 + P_2^3 n_2 t_2 + \ldots + P_n^3 n_n t_n}{n_1 t_1 + n_2 t_2 + \ldots + n_n t_n} \right)^{\frac{1}{3}}$ $P_e = \dfrac{2P_{max} + P_{min}}{3}$ $P_e \fallingdotseq 0.65\ P_{max}$ $P_e \fallingdotseq 0.75\ P_{max}$	3. Computation of average load P_e (kgf) $P_e = \left[\dfrac{70^3 \cdot 1000 \cdot 10 + 170^3 \cdot 600 \cdot 50 + 270^3 \cdot 200 \cdot 30 + 370^3 \cdot 100 \cdot 10}{1000 \cdot 10 + 600 \cdot 50 + 200 \cdot 30 + 100 \cdot 10} \right]^{\frac{1}{3}}$ $= \left(\dfrac{31.7 \cdot 10^{10}}{4.7 \cdot 10^4} \right)^{\frac{1}{3}}$ $\fallingdotseq 189$ kgf
4. Average number of rotations n_m $n_m = \dfrac{n_1 t_1 + n_2 t_2 + \ldots + n_n t_n}{100}$	4. Average number of rotations n_m $n_m = \dfrac{1000 \cdot 10 + 600 \cdot 50 + 200 \cdot 30 + 100 \cdot 10}{100}$ $= \dfrac{4.7 \cdot 10^4}{100} = 470\ \text{min}^{-1}$
5. Calculation of required dynamic rated load C_a $C_a = P_e \cdot f_s$	5. Calculation of required dynamic rated load C_a $C_a = 189 \cdot 5 = 945$ (kgf)
6. Calculation of required static rated load C_{0a} $C_{0a} = P_{max} \cdot fs$	6. Calculation of required static rated load C_{0a} $C_{0a} = 370 \cdot 5 = 1850$ (kgf)
7. Selection of nut type $C_a > 945$ $C_{0a} > 1850$ Select the nut types with basic dynamic rated load and and basic static rated load as specified above.	7. Selection of nut type Choose SFNI 2510 on the catalogue $C_a = 2954$ (kgf) $C_{0a} = 7295$ (kgf)

1-9 Life Design

Key Points for Ball Screws Selection	Calculation for Ball Screws Selection
8. Calculation of service life L_t (h) $L_t = \frac{L}{60 \cdot n} = (\frac{C_a}{P_e \cdot f_w})^3 \cdot 10^6 \cdot \frac{1}{60 \cdot n}$	8. Calculation of service life Lt (h) $Lt = (\frac{2954}{189 \cdot 2})^3 \cdot 10^6 \cdot \frac{1}{60 \cdot 470} = 42544$ (h)
9. Mounting distance between supporting bearings	9. Mounting distance between supporting bearings 
10. Determination of screw length Screw length = Maximal stroke + Nut length + Two reserved length at shaft end	10. Determination of screw length Screw length = 700 + 85 + 76 + 76 = 937 mm 937 mm<1200 mm
11. Permissible axial load	11. Permissible axial load Omitted because of F-F support
12. Permissible revolution speed n and DN $n = \alpha \cdot \frac{60\lambda^2}{2\pi L^2}\sqrt{\frac{Elg}{\gamma A}} = f\frac{dr}{L^2} \cdot 10^7$(rpm) DN = Shaft dia · Maximal speed	12. Permissible revolution speed n and DN $n = \frac{21.9 \cdot 21.86 \cdot 10^7}{1200^2} = 3324\ min^{-1} < n_{max}$ DN = 25 · 1000 = 25000 < 100000(For general transformation)
13. Countermeasure against thermal displacement $\triangle\ell = \alpha \cdot \triangle t \cdot L$ $\triangle\ell$: Thermal displacement α : Coefficient of thermal expansion $\triangle t$: Temperature rise (deg) at screw shaft L : Effective length of screw thread	13. Countermeasure against thermal displacement It is estimated there would be a temperature rise 2~5°C with the ball screws of the general machinery, take temperature rise of 2°C to compute the extension of ball screw. $\triangle\ell = \alpha \cdot \triangle t \cdot L = 11.7 \cdot 10 \cdot 2 \cdot 700$ mm $\fallingdotseq 0.016$ mm $F_p = \frac{EA\triangle\ell}{L}$ $= \frac{2.06 \cdot 10^4 \frac{\pi \cdot 21.86^2}{4} \cdot 0.016}{700}$ $\fallingdotseq 177$ (kgf)

Key Points for Ball Screws Selection	Calculation for Ball Screws Selection
14. Rigidity (1) Axial rigidity Ks of screw shaft $Ks = \frac{P}{\delta s} = \frac{4AE}{L}$ (kgf/mm).......(with reference to page C21) P : Axial load (kgf) (2) Rigidity KN of steel balls and nuts $\delta_{NS} = \frac{K}{\sin\beta}\left(\frac{Q^2}{d}\right)^{\frac{1}{3}} \cdot \frac{1}{\zeta}$ (mm) $Q = \frac{P}{n\cdot\sin\beta}$ (kgf) $n = \frac{D_0\pi m}{d}$ (each).......(with reference to page C22) (3) Axial rigidity K_B of bracing shaft $K_B = \frac{P}{\delta_B}$ (kgf/mm).......(with reference to page C23) (4)Axial rigidity K of screw system $\frac{1}{K} = \frac{1}{K_S} + \frac{1}{K_N} + \frac{1}{K_B}$ ....(參考 C21)	14. Rigidity (1) Axial rigidity Ks of screw shaft $Ks = \frac{P}{\delta s} = \frac{4AE}{L} = \frac{4 \cdot 375.12 \cdot 20600}{1200}$ =25758.23 kgf/mm (2) Rigidity of steel ball and nut groove $n = \frac{26.62\cdot\pi\cdot 4}{4.762} = 70$ $Q = \frac{370}{70\sin45^\circ} = 10$ $\delta_{NS} = \frac{0.00057}{\sin45^\circ}\left(\frac{10^2}{4.762}\right)^{\frac{1}{3}} \cdot \frac{1}{0.7}$ $= 3.2 \cdot 10$ mm $K_N = \frac{370}{3.2\cdot10^{-3}} = 1.27 \cdot 10^5$ kgf/mm (3) Axial rigidity KB of support bearing Where, bearing rigidity 51 kgf/μm $\delta_B = \frac{370}{51\cdot2} = 3.6$ μm $K_B = \frac{370}{0.0036} = 1 \cdot 10^5$ kgf/mm (4)Axial rigidity K of screw system $\frac{1}{K} = \frac{1}{25758.23} + \frac{1}{1.27\cdot10^5} + \frac{1}{1\cdot10^5} = 0.00005647$
15.Confirmation of the ball screw life	15.Confirmation of the ball screw life L = 42544 (h)>18000 (h)

1-10 Cautions About Use of Ball Screws

Ball screw assemblies are delicate components. Therefore, extra care must be taken to prevent the ball track from damages that caused by edged component or tools. Meanwhile, to prevent steel ball fall out of the nut through the disassembly of screw and nut or over stroke, please be careful while operating. If the steel ball falls out, please contact with TBI MOTION for further instruction. (Do not attempt to reassemble, which might cause permanent damage to the ball screw.)

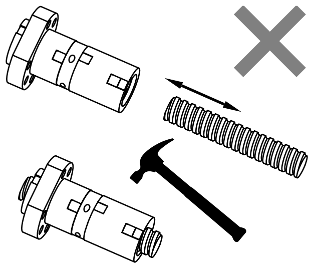


Fig 1.10.1 Error installation

If disassemble is required, please use a transfer pipe which has minor diameter than the screw diameter to transfer the nut to prevent falling out of the steel balls.

■ 1-10-1 Lubrication

Adequate lubrication must be provided when ball screw is used, insufficient lubrication will result in collision of metal, which leads to increase of friction and detrition, thus cause failure or shortening the service life.

Lubricants applied to ball screws can be divided into 2 types, namely lubricating oil and consistent grease. In general speaking, in respect of maintenance, consistent grease will lead to increase of dynamic friction torque linearly along with increase of rotating speed, hence oil lubrication is deemed the better way when speed exceeds 3-5 m/min; however, don't forget the fact that there have been examples that using grease has been capable of achieving speed of 10 m/min, with respect to the equipment.

In terms of equipments, there are some cheaper lubricant that can be used. In general, to fully utilize the function of ball screw, lubricating oil of 5 m/minute is the best option to choose.In figure 1.10.1, we provide the standard of lubricating oil inspection and supplement interval. Before replenishing, please clean up the previous grease to continue.

Table 1.10.1 Inspection of lubrication and interval of refill

Method	Interval	Check Item	Replenish or Change Interval
Auto. Periodial oil supply	Weekly	Oil level, contamination	Add at each check, as required depending on tank level
Grease	Initially 2~3 months	Contamination on entry of chip	replenish yearly or according to the inspection result.
Oil bath	Daily	Oil level	To be determined according to consumption

■ 1-10-2 Dust Proof / Prevention

Any foreign matter or water, if entering to the ball screw, may increase friction and cause damage. For example, the entry of chips or cutting oil may be expected with machine tools according to the work environment. Where entry of foreign matter is anticipated, use a bellows or telescopic cover as shown in Fig 1.10.2, to cover the screw shaft completely.

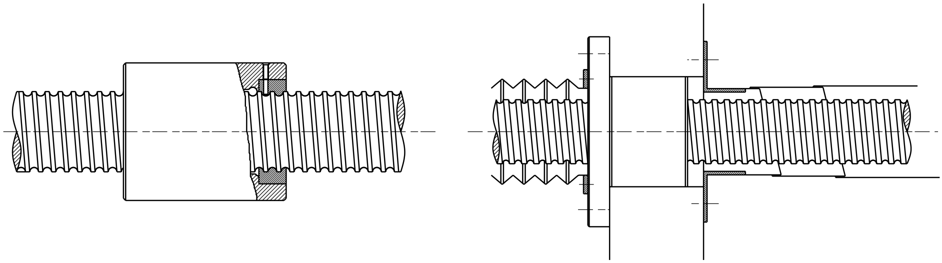


Fig 1.10.2 Dust proof Method by Telescopic Cover and Bellows

■ 1-10-3 Offset Load

When offset load phenomenon occurs, screw life and noise tend to be directly affected, which would usually be accompanied with hand feel of rough running. As the smoothness of single shaft and assembled ball screw might be different. In addition to single shaft's accuracy, the offset phenomenon was mostly occurred by failed assemble accuracy which is shown in Fig 1.10.3.

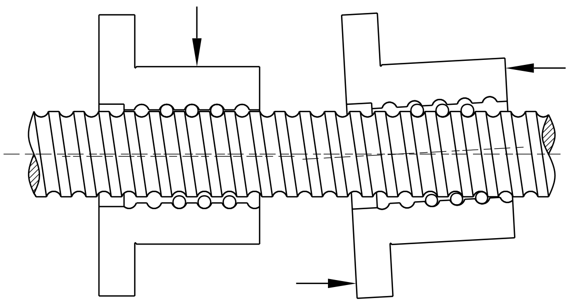


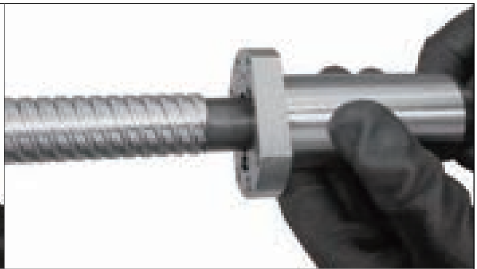
Fig 1.10.3 Offset Load

1-10 Cautions About Use of Ball Screws

■ 1-10-4 Assembling the Ball Screws

If rolled ball nut is shipped un-assembled please follow the procedure as below.

Table 1.10.2 Procedure

	
(1) Remove the band.	(2) Attached the mandrel towards machine ends.
	
(3) Rotate the ball nut into the screw along the thread.	(4) Ensure that the ball nut is fully inserted before remove the mandrel.

■ 1-10-5 Machining Specifications

(1) For the Ball Screws with internal or end cap type circulation ball nut, it is required to have at least one end with complete thread to the end of screw, it is also required to have the journal area is with diameter to be smaller than the diameter of thread root as Fig 1.10.4 shown.

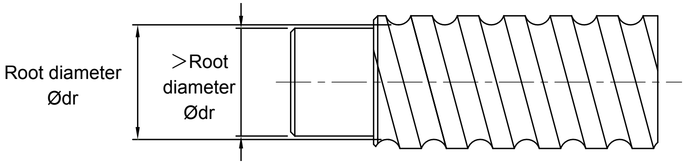


Fig 1.10.4 For Internal Circulation

(2) The thread on screw shaft are hardened by induction hardening. It shall cause about 10~20 mm at both ends journal purpose. The unhardened area will be labeled.

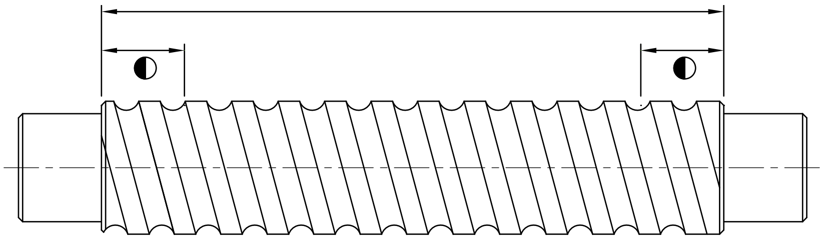


Fig 1.10.5 Harden Area

C

Ball Screw

2-1 Nominal Model Code of Ball Screw

SFU	R	025	05	T4	D	G	C5	-	600	-	P1	-	B2	+	N3	N3
①	②	③	④	⑤	⑥	⑦	⑧		⑨		⑩		⑪		⑫	⑬

①

Nominal Model	
S	S : Single nut
S	O : Offset double nut
F	F : With flange
F	C : Without flange
U	NI : NI type nut
U	NU : NU type nut
U	A : A type nut
U	B : B type nut
U	J : J type nut
U	NH : NH nut (A solution for slide table)
U	Y : Y type nut
U	YA : YA type nut
U	V : V type nut
U	U : U type nut
U	K : K type nut

②

Threading Direction
R : Right
L : Left

③

Nominal Diameter
Unit : mm

④

Lead
Unit : mm

⑤

Number of Turns (Turn·Row)
Turn : T : 1
A : 1.5 (or 1.7/1.8)
B : 2.5/2.8
C : 3.5
D : 4.8
E : 5.8
ex : (2.5 × 2 = B2)

⑥

Flange Type
N : Not cutting
S : Single cutting
D : Double cutting

⑦

Product Code
G : Ground
F : Rolled

⑧

Accuracy Grade
C0, C1, C2, C3, C5, C7, C10

⑨

Overall Length of Shaft
Unit : mm

⑩

Axial Clearance and Preload Value
P0, P1, P2, P3, P4

⑪

Number of Nut
(Leave blank if only one nut is required) Ex : Install two nuts on a shaft B2

⑫

Nut Surface Treatment
S : Standard
B1 : Black Oxidation
N1 : Hard Chrome Plating
P : Phosphating
N3 : Nickel Plating
N4 : Raydent
N5 : Chrome Plating

⑬

Shaft Surface Treatment
S : Standard
B1 : Black Oxidation
N1 : Hard Chrome Plating
P : Phosphating
N3 : Nickel Plating
N4 : Raydent
N5 : Chrome Plating

※No symbol required when plating is not needed.
※An inspection report is provided for ground ball screws with an accuracy higher than C5.

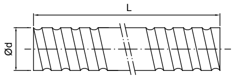


Fig 2.1.1 Screw Shaft Nominial Diameter

Table 2.1.1 Ground Ball Screw Specifications Ø4~32

Model No.			Accuracy Grade	Threading Direction R : Right L : Left	Number of Grooves	Standard Code of Shaft	Type of Nut
Ød	**l**	**Da**					
4	1	0.8	C7, C5, C3	R	1	SCR00401	K
6	1	0.8	C7, C5, C3	R	1	SCR00601	K
	6	1.2	C7, C5, C3	R	1	SCR00606	J
8	1	0.8	C7, C5, C3	R/L	1	SCR00801	K
	2	1.2	C7, C5, C3	R/L	1	SCR00802	K
	2.5	1.2	C7, C5, C3	R	1	SCR0082.5	K, BSH
	8	1.2	C7, C5, C3	R	1	SCR00808	J
10	2	1.2	C7, C5, C3	R/L	1	SCR01002	K, BSH
	4	2	C7, C5, C3	R	1	SCR01004	K, BSH
12	2	1.2	C7, C5, C3	R/L	1	SCR01202	K
	4	2.5	C7, C5, C3	R	1	SCR01204	U, BSH
	5	2.5	C7, C5, C3	R	1	SCR01205	K
	5	2.5	C7, C5, C3	R	1	SSR01205	V, BSH, A, B
	10	2.5	C7, C5, C3	R	1	SCR01210-B	V
14	2	1.2	C7, C5, C3	R/L	1	SCR01402	K
	4	2.5	C7, C5, C3	R	1	SCR01404	K, BSH
15	10	3.175	C7, C5, C3	R	1	SCR01510	V
	20	3.175	C7, C5, C3	R	1	SCR01520	V
16	4	2.381	C7, C5, C3	R	1	SCR01604(N)	I, U, BSH
	5	3.175	C7, C5, C3	R/L	1	SCR01605	V, NI, NU, BSH
	10	3.175	C7, C5, C3	R/L	1	SCR01610	V, NI, NU, BSH
	16	2.778	C7, C5, C3	R	2	SCR01616	Y, YA
	32	2.778	C7, C5, C3	R	2	SCR01632	Y, YA
20	2	1.2	C7, C5, C3	R	1	SCR02002	K
	4	2.381	C7, C5, C3	R	1	SCR02004(N)	I, U
	5	3.175	C7, C5, C3	R/L	1	SCR02005	V, NI, NU, BSH, A, B
	10	3.969	C7, C5, C3	R	1	SCR02010	V
	20	3.175	C7, C5, C3	R	1	SCR02020, SSR02020	V, A, B
	20	3.175	C7, C5, C3	R	2	SCR02020, SSR02020	Y, YA
	40	3.175	C7, C5, C3	R	2	SCR02040	Y, YA
25	2	1.2	C7, C5, C3	R	1	SCR02502	K
	4	2.381	C7, C5, C3	R	1	SCR02504(N)	I, U
	5	3.175	C7, C5, C3	R/L	1	SCR02505	V, NI, NU, BSH, A, B
	6	3.969	C7, C5, C3	R	1	SCR02506	V, U
	8	4.762	C7, C5, C3	R	1	SCR02508	V, U
	10	4.762	C7, C5, C3	R/L	1	SCR02510-A	NI, NU, BSH
	10	6.35	C7, C5, C3	R	1	SCR02510-B	V
	25	3.969	C7, C5, C3	R	2	SCR02525	Y, YA
	50	3.969	C7, C5, C3	R	2	SCR02550	Y, YA
32	4	2.381	C7, C5, C3	R	1	SCR03204(N)	V, I, U
	5	3.175	C7, C5, C3	R/L	1	SCR03205	V, NI, NU, A, B
	6	3.969	C7, C5, C3	R	1	SCR03206	V, U
	8	4.762	C7, C5, C3	R	1	SCR03208	V, U
	10	6.35	C7, C5, C3	R/L	1	SCR03210	V, NI, NU
	20	6.35	C7, C5, C3	R	1	SCR03220	V
	32	4.762	C7, C5, C3	R	2	SCR03232	Y, YA
	64	4.762	C7, C5, C3	R	2	SCR03264	Y, YA

2-1 Nominal Model Code of Ball Screw

Table 2.1.2 Standard Specifications Ø40~80 Unit : mm

Model No.			Accuracy Grade	Threading Direction R : Right L : Left	Number of Grooves	Standard Code of Shaft	Type of Nut
Ød	l	Da					
40	5	3.175	C7, C5, C3	R / L	1	SCR04005	V, NI, NU, A
	6	3.969	C7, C5, C3	R	1	SCR04006	V, U
	8	4.762	C7, C5, C3	R	1	SCR04008	V, U
	10	6.35	C7, C5, C3	R / L	1	SCR04010	V, NI, NU
	20	6.35	C7, C5, C3	R	1	SCR04020	V
	40	6.35	C7, C5, C3	R	2	SCR04040	Y, YA
	80	6.35	C7, C5, C3	R	2	SCR04080	YA
50	5	3.175	C7, C5, C3	R	1	SCR05005	V, A
	10	6.35	C7, C5, C3	R / L	1	SCR05010	V, NI, NU
	20	7.144	C7, C5, C3	R	1	SCR05020	NU
	20	9.525	C7, C5, C3	R	1	SCR05020	V
	50	7.938	C7, C5, C3	R	2	SCR05050	Y, YA
	100	7.938	C7, C5, C3	R	2	SCR050100	Y, YA
63	10	6.35	C7, C5, C3	R	1	SCR06310	V, NI, NU
	20	9.525	C7, C5, C3	R	1	SCR06320	V, NU
80	10	6.35	C7, C5, C3	R	1	SCR08010	V, NI, NU
	20	9.525	C7, C5, C3	R	1	SCR08020	V, NU

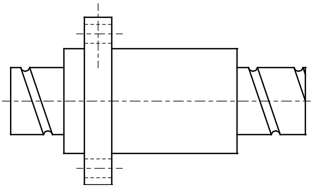
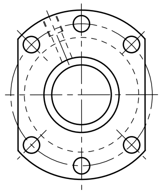
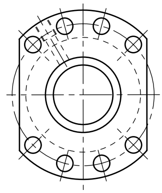
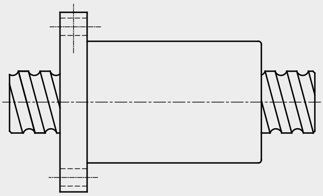
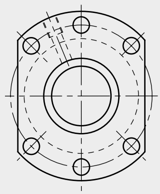
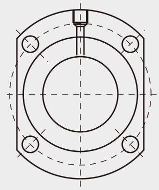
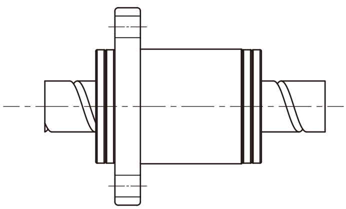
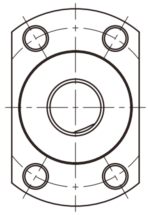
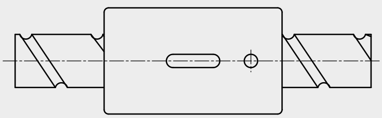
Table 2.1.3 H/A/J/B-type Specifications Ø16~50 Unit : mm

Model No.			Accuracy Grade	Threading Direction R : Right L : Left	Number of Grooves	Type-H Code of Shaft	Type of Nut
Ød	l	Da					
12	10	2.5	C7, C5, C3	R	1	SSR01210	A, B
16	5	2.778	C7, C5, C3	R	1	SSR01605	A, B
	10	2.778	C7, C5, C3	R	1	SSR01610	A, B
	16	2.778	C7, C5, C3	R	1	SSR01616	A, B
	20	2.778	C7, C5, C3	R	1	SSR01620	A, B
	30	2.778	C7, C5, C3	R	1	SSR01630	A
20	10	3.175	C7, C5, C3	R	1	SSR02010	A, B
25	10	3.175	C7, C5, C3	R	1	SSR02510	A, B
	25	3.175	C7, C5, C3	R	1	SSR02525	A, V, B
32	10	3.969	C7, C5, C3	R	1	SSR03210	A, B
	20	3.969	C7, C5, C3	R	1	SSR03220	A, B
	32	6.35	C7, C5, C3	R	1	SSR03232	A
40	10	6.35	C7, C5, C3	R	1	SSR04010	A
	20	6.35	C7, C5, C3	R	1	SSR04020	A
	40	6.35	C7, C5, C3	R	1	SSR04040	A
50	10	6.35	C7, C5, C3	R	1	SSR05010	A
	20	6.35	C7, C5, C3	R	1	SSR05020	A
	50	6.35	C7, C5, C3	R	1	SSR05050	A

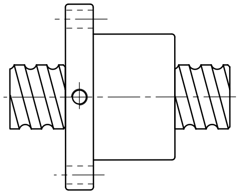
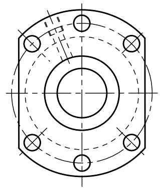
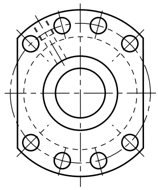
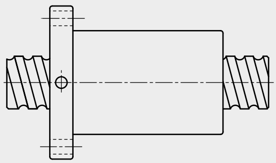
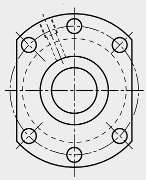
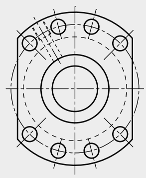
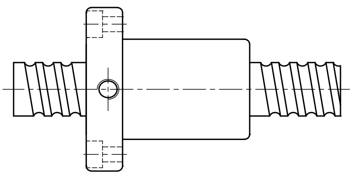
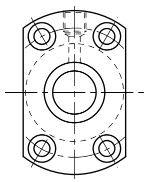
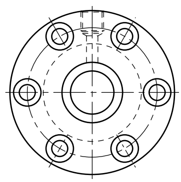
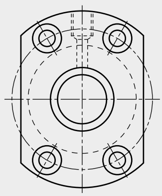
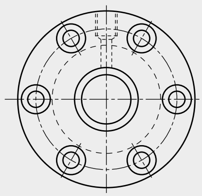
※The information is for specifications, if customized products are needed please contact ***TBI MOTION***.

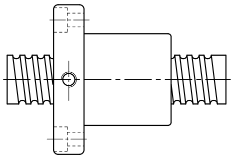
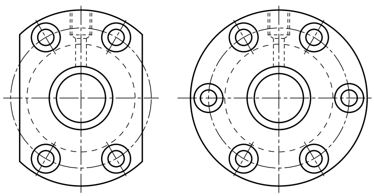
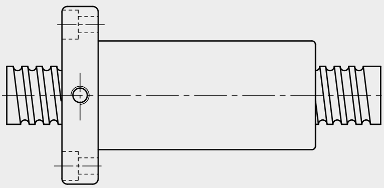
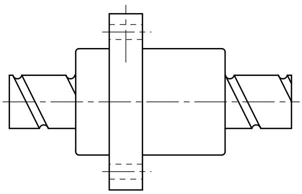
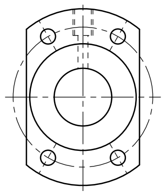
2-2 Precision Ground Ball Screw Series

■ 2-2-1 *TBI MOTION* Nut of Precision Ground Ball Screw Type

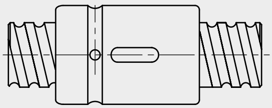
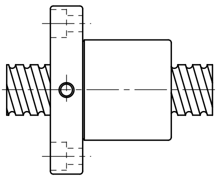
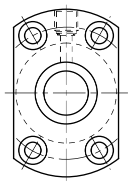
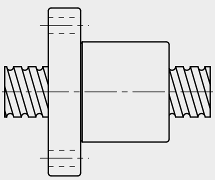
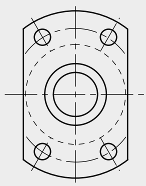
Nut Type		Flange Type
A (High Speed/Strong dust-proof type)	SFA (DIN)  C44	 d≤32  d≥40
B (High-speed reinforced silent and dust-proof type)	SFB (DIN)  C45	 d≤32  1205/1210
J (Low Noise/Strong dust-proof type)	SFJ (DIN)  C46	
CNH (A solution for slide table)	SCNH  C47	No-Flange

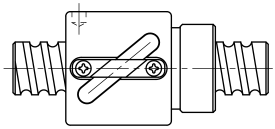
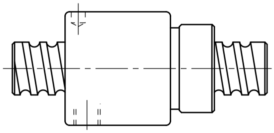
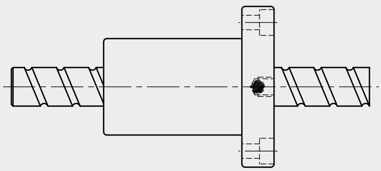
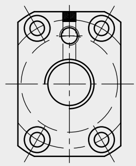
2-2 Precision Ground Ball Screw Series

	Nut Type	Flange Type	
NU/U (Strong dust-proof type)	SFNU/SFU (DIN)  C48	 d≤32	 d≥40
OFU (OFF set double nut)	OFU (DIN)  C49		
NI/I (Strong dust-proof type)	SFNI/SFI  C50		
OFI (OFF set double nut)	OFI  C51		

	Nut Type	Flange Type
V (High Load External Circulation type)	SFV  C52	
OFV (OFF set double nut)	OFV  C53	
Y/YA (High DM-N Rating)	SFY/SFYA  C54, 55	

2-2 Precision Ground Ball Screw Series

	Nut Type	Flange Type
CNI/I (Standard)	SCNI/SCI  C56	No-Flange
K (Miniature type)	SFK  C57	 (SFK 01004) (SFK 02002) (SFK 02502)
	SFK  C57	

	Nut Type	Flange Type
BSH	BSH  d≤12  d≥14 C58	No-Flange
XSV (Design for factory automation)	XSV  C59~63	

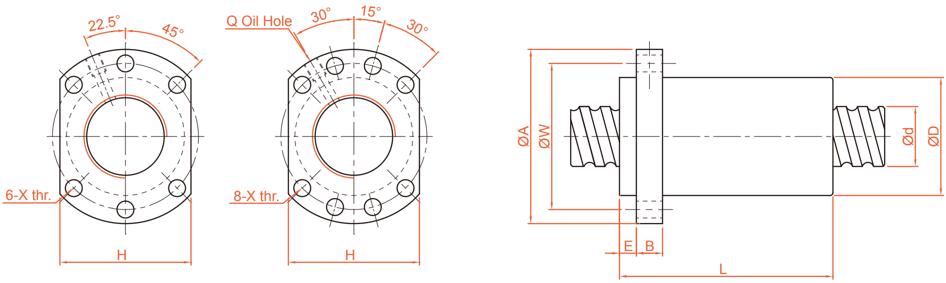
※The information is for specifications, if customized products is are needed please contact ***TBI MOTION***.

Table 2.2.1 Preload Chart

Preload	I, U-type	A, J, B-type	Y, YA-type	V-type	BSH-type	K-type
P0						
P1	√	√	√	√	√	√
P2	√	√	√	√	√	
P3	√	√	√	√	√	
P4				√		

2-2 Precision Ground Ball Screw Series

SFA (DIN 69051 FORM B) Series Specifications

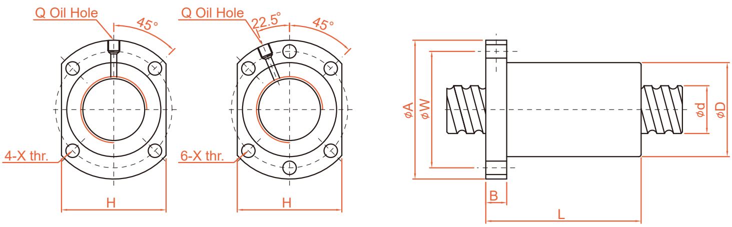


d≦32   d≧40

Unit : mm

Model No.	d	l	Da	Dimension										Load Rating		K
				D	A	E	B	L	W	H	X	Q	n	Ca (kgf)	C0a (kgf)	kgf/μm
SFA01205-2.8	12	5	2.5	24	40	5	10	30	32	30	4.5		2.8×1	661	1316	19
SFA01210-2.8		10	2.5	24	40	5	10	42	32	30	4.5		2.8×1	642	1287	19
SFA01605-3.8	15	5	2.778	28	48	5	10	31	38	40	5.5	M6	3.8×1	1112	2507	30
SFA01610-2.8		10	2.778	28	48	5	10	42	38	40	5.5	M6	2.8×1	839	1821	23
SFA01616-1.8		16	2.778	28	48	5	10	43	38	40	5.5	M6	1.8×1	552	1137	14
SFA01616-2.8		16	2.778	28	48	5	10	59	38	40	5.5	M6	2.8×1	808	1769	22
SFA01620-1.8		20	2.778	28	48	5	10	50	38	40	5.5	M6	1.8×1	554	1170	14
SFA01630-1.8		30	2.778	28	48	7	10	70	38	40	5.5	M6	1.8×1	534	1195	14
SFA02005-3.8	20	5	3.175	36	58	7	10	33	47	44	6.6	M6	3.8×1	1484	3681	37
SFA02010-3.8		10	3.175	36	58	7	10	52	47	44	6.6	M6	3.8×1	1516	3833	40
SFA02020-1.8		20	3.175	36	58	7	10	52	47	44	6.6	M6	1.8×1	764	1758	19
SFA02020-2.8		20	3.175	36	58	7	10	72	47	44	6.6	M6	2.8×1	1118	2734	29
SFA02505-3.8	25	5	3.175	40	62	7	10	33	51	48	6.6	M6	3.8×1	1650	4658	43
SFA02510-3.8		10	3.175	40	62	7	12	52	51	48	6.6	M6	3.8×1	1638	4633	45
SFA02525-1.8		25	3.175	40	62	7	12	60	51	48	6.6	M6	1.8×1	843	2199	22
SFA02525-2.8		25	3.175	40	62	7	12	85	51	48	6.6	M6	2.8×1	1232	3421	34
SFA03205-3.8	32	5	3.175	50	80	9	12	35	65	62	9	M6	3.8×1	1839	6026	51
SFA03210-3.8	31	10	3.969	50	80	9	12	53	65	62	9	M6	3.8×1	2460	7255	55
SFA03220-2.8		20	3.969	50	80	9	12	72	65	62	9	M6	2.8×1	1907	5482	43
SFA03232-1.8		32	3.969	50	80	9	12	78	65	62	9	M6	1.8×1	1257	3426	27
SFA03232-2.8		32	3.969	50	80	9	12	110	65	62	9	M6	2.8×1	1838	5329	42
SFA04005-3.8	40	5	3.175	63	93	9	14	39	78	70	9	M8	3.8×1	2018	7589	60
SFA04010-3.8	38	10	6.35	63	93	9	14	57	78	70	9	M8	3.8×1	5035	13943	67
SFA04020-2.8		20	6.35	63	93	9	14	78	78	70	9	M8	2.8×1	3959	10715	54
SFA04040-1.8		40	6.35	63	93	9	14	96	78	70	9	M8	1.8×1	2585	6648	34
SFA04040-2.8		40	6.35	63	93	9	14	136	78	70	9	M8	2.8×1	3780	10341	52
SFA05005-3.8	50	5	3.175	75	110	10.5	15	42	93	85	11	M8	3.8×1	2207	9542	68
SFA05010-3.8	48	10	6.35	75	110	10.5	18	57	93	85	11	M8	3.8×1	5638	17852	79
SFA05020-3.8		20	6.35	75	110	10.5	18	98	93	85	11	M8	3.8×1	5749	18485	87
SFA05050-1.8		50	6.35	75	110	10.5	18	117	93	85	11	M8	1.8×1	2946	8749	42
SFA05050-2.8		50	6.35	75	110	10.5	18	167	93	85	11	M8	2.8×1	4308	13610	65

SFB (DIN 69051 FORM B) Series Specifications



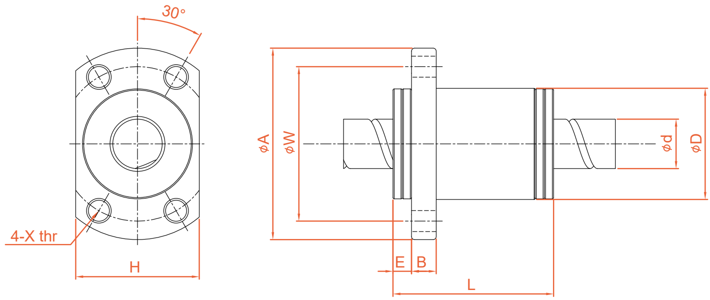
1205/1210 d≦32

Unit : mm

Model No.	d	l	Da	Dimension									Load Rating		K kgf/μm
				D	A	B	L	W	H	X	Q	n	Ca (kgf)	C0a (kgf)	
SFB01205-2.8	12	5	2.5	24	40	10	30	32	30	4.5	M6	2.8x1	661	1316	19
SFB01210-2.8		10	2.5	24	40	10	42	32	30	4.5	M6	2.8x1	642	1287	19
SFB01605-3.8	15	5	2.778	28	48	10	31	38	40	5.5	M6	3.8x1	1112	2507	30
SFB01610-2.8		10	2.778	28	48	10	42	38	40	5.5	M6	2.8x1	839	1821	23
SFB01616-1.8		16	2.778	28	48	10	43	38	40	5.5	M6	1.8x1	552	1137	14
SFB01616-2.8		16	2.778	28	48	10	59	38	40	5.5	M6	2.8x1	808	1769	22
SFB01620-1.8		20	2.778	28	48	10	50	38	40	5.5	M6	1.8x1	554	1170	14
SFB02005-3.8	20	5	3.175	36	58	10	33	47	44	6.6	M6	3.8x1	1484	3681	37
SFB02010-3.8		10	3.175	36	58	10	52	47	44	6.6	M6	3.8x1	1516	3833	40
SFB02020-1.8		20	3.175	36	58	10	52	47	44	6.6	M6	1.8x1	764	1758	19
SFB02020-2.8		20	3.175	36	58	10	72	47	44	6.6	M6	2.8x1	1118	2734	29
SFB02505-3.8	25	5	3.175	40	62	10	33	51	48	6.6	M6	3.8x1	1650	4658	43
SFB02510-3.8		10	3.175	40	62	12	52	51	48	6.6	M6	3.8x1	1638	4633	45
SFB02525-1.8		25	3.175	40	62	12	60	51	48	6.6	M6	1.8x1	843	2199	22
SFB02525-2.8		25	3.175	40	62	12	85	51	48	6.6	M6	2.8x1	1232	3421	34
SFB03205-3.8	32	5	3.175	50	80	12	35	65	62	9	M6	3.8x1	1839	6026	51
SFB03210-3.8	31	10	3.969	50	80	12	53	65	62	9	M6	3.8x1	2460	7255	55
SFB03220-2.8		20	3.969	50	80	12	72	65	62	9	M6	2.8x1	1907	5482	43
SFB03232-1.8		32	3.969	50	80	12	78	65	62	9	M6	1.8x1	1257	3426	27
SFB03232-2.8		32	3.969	50	80	12	110	65	62	9	M6	2.8x1	1838	5329	42

2-2 Precision Ground Ball Screw Series

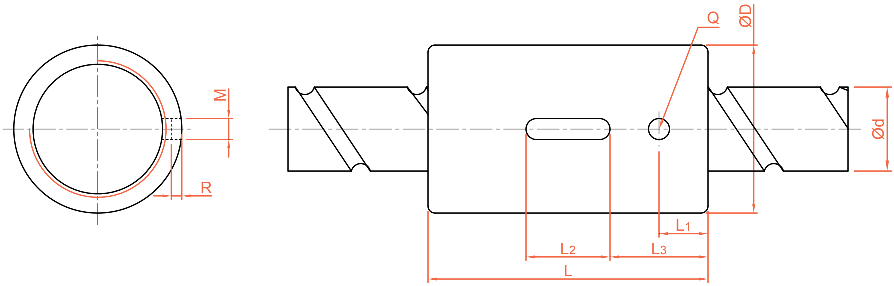
SFJ (DIN 69051 FORM B) Series Specifications



單位 : mm

Model No.	d	I	Da	Dimension										Load Rating		K kgf/μm
				D	A	E	B	L	W	H	X	Q	n	Ca (kgf)	C0a (kgf)	
SFJ00606-1.8	6	6	1.2	14	27	3	4	21	21	16	3.4	-	1.8x1	78	122	4
SFJ00808-1.8	8	8		18	31	3	4	26	25	20	3.4	-	1.8x1	89	164	5

SCNH Series Specifications

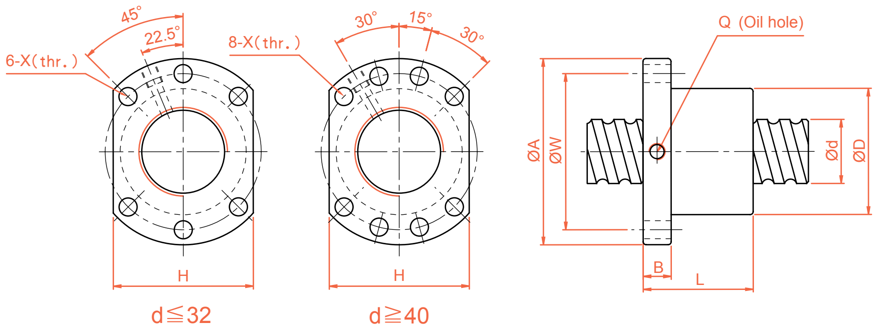


Unit : mm

Model No.	d	l	Da	Dimension									Load Rating		K
				D	L	L1	L2	L3	M	R	Q	n	Ca (kgf)	C0a (kgf)	kgf/μm
SCNH01205-4.8	12	5	2.5	24	40	7	12	14	3	1.5	3	4.8x1	1011	2105	34
SCNH01210-2.8		10	2.5	24	45	8	15	15	3	1.5	3	2.8x1	642	1287	19
XCNH01210-1.8		10	2.5	24	40	10.5	12	14	3	1.5	3	1.8x1	439	827	33
SCNH01605-5.8	15	5	2.778	28	45	7	20	12.5	5	3	3	5.8x1	1599	3827	49
SCNH01610-2.8		10	2.778	28	45	7	20	12.5	5	3	3	2.8x1	839	1821	23
SCNH01616-1.8		16	2.778	28	45	7	20	12.5	5	3	3	1.8x1	552	1137	18
SCNH01620-1.8		20	2.778	28	58	10	20	19	5	3	3	1.8x1	554	1170	14
SCNH02005-5.8	20	5	3.175	36	47	8	20	13.5	5	3	3	5.8x1	2134	5619	60
SCNH02010-3.8		10	3.175	36	55	8	20	17.5	5	3	3	3.8x1	1516	3833	40
SCNH02020-1.8		20	3.175	36	55	8	20	17.5	5	3	3	1.8x1	764	1758	19

2-2 Precision Ground Ball Screw Series

SFNU/SFU (DIN 69051 FORM B) Series Specifications

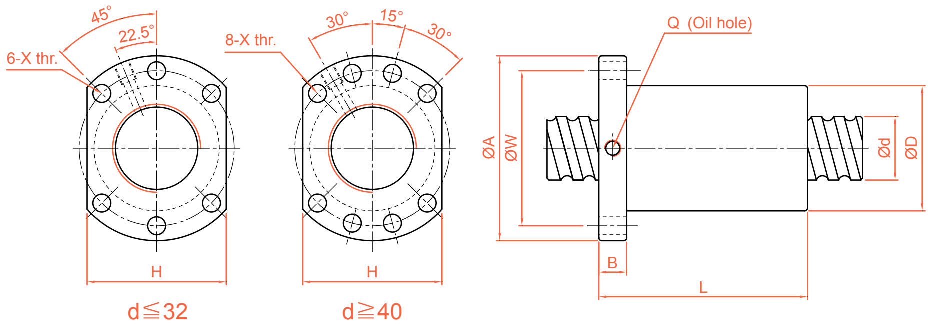


Unit : mm

Model No.	d	l	Da	Dimension									Load Rating		K
				D	A	B	L	W	H	X	Q	n	Ca (kgf)	C0a (kgf)	kgf/μm
SFNU01605-4☆	16	5	3.175	28	48	10	45	38	40	5.5	M6	1x4	1380	3052	32
SFNU01610-3☆		10	3.175	28	48	10	57	38	40	5.5	M6	1x3	1103	2401	26
SFNU02005-4☆	20	5	3.175	36	58	10	51	47	44	6.6	M6	1x4	1551	3875	39
SFNU02505-4☆	25	5	3.175	40	62	10	51	51	48	6.6	M6	1x4	1724	4904	45
SFNU02510-4☆		10	4.762	40	62	12	80	51	48	6.6	M6	1x4	2954	7295	50
SFNU03205-4☆	32	5	3.175	50	80	12	52	65	62	9	M6	1x4	1922	6343	54
SFNU03210-4☆		10	6.35	50	80	12	85	65	62	9	M6	1x4	4805	12208	61
SFNU04005-4☆	40	5	3.175	63	93	14	55	78	70	9	M8	1x4	2110	7988	63
SFNU04010-4☆		10	6.35	63	93	14	88	78	70	9	M8	1x4	5399	15500	73
SFNU05010-4☆	50	10	6.35	75	110	16	88	93	85	11	M8	1x4	6004	19614	85
SFNU05020-4	50	20	7.144	75	110	16	138	93	85	11	M8	1x4	7142	22588	94
SFNU06310-4	63	10	6.35	90	125	18	93	108	95	11	M8	1x4	6719	25358	99
SFNU06320-4	63	20	9.525	95	135	20	149	115	100	13.5	M8	1x4	11444	36653	112
SFNU08010-4	80	10	6.35	105	145	20	93	125	110	13.5	M8	1x4	7346	31953	109
SFNU08020-4	80	20	9.525	125	165	25	154	145	130	13.5	M8	1x4	12911	47747	138
SFU01204-4	12	4	2.5	24	40	10	40	32	30	4.5		1x4	902	1884	26
SFU01604-4	16	4	2.381	28	48	10	40	38	40	5.5	M6	1x4	973	2406	32
SFU02004-4	20	4	2.381	36	58	10	42	47	44	6.6	M6	1x4	1066	2987	38
SFU02504-4	25	4	2.381	40	62	10	42	51	48	6.6	M6	1x4	1180	3795	43
SFU02506-4		6	3.969	40	62	10	54	51	48	6.6	M6	1x4	2318	6057	47
SFU02508-4		8	4.762	40	62	10	63	51	48	6.6	M6	1x4	2963	7313	49
SFU03204-4	32	4	2.381	50	80	12	44	65	62	9	M6	1x4	1296	4838	51
SFU03206-4		6	3.969	50	80	12	57	65	62	9	M6	1x4	2632	7979	57
SFU03208-4		8	4.762	50	80	12	65	65	62	9	M6	1x4	3387	9622	60
SFU04006-4	40	6	3.969	63	93	14	60	78	70	9	M6	1x4	2873	9913	66
SFU04008-4		8	4.762	63	93	14	67	78	70	9	M6	1x4	3712	11947	70
SFU10020-4	100	20	9.525	150	202	30	180	170	155	17.5	M8	1x4	14303	60698	162

※ ☆ Left helix available ※Standard ball nut SFU01204-4 is assembled without wiper.

OFU (DIN 69051 FORM B) Series Specifications

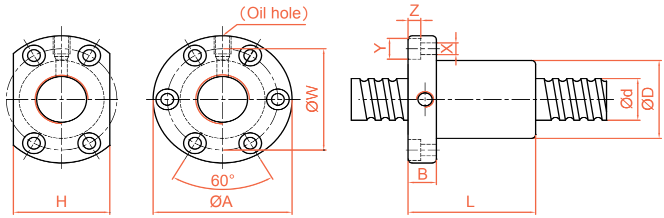


Unit : mm

Model No.	d	l	Da	Dimension										Load Rating		K
				D	A	B	L	W	H	X	Q	n		Ca (kgf)	C0a (kgf)	kgf/μm
OFU01605-4	16	5	3.175	28	48	10	75	38	40	5.5	M6	1x4		1380	3052	44
OFU02005-4	20	5	3.175	36	58	10	85	47	44	6.6	M6	1x4		1551	3875	53
OFU02505-4	25	5	3.175	40	62	10	86	51	48	6.6	M6	1x4		1724	4904	62
OFU02510-4		10	4.762	40	62	12	130	51	48	6.6	M6	1x4		2954	7295	67
OFU03205-4	32	5	3.175	50	80	12	87	65	62	9	M6	1x4		1922	6343	74
OFU03210-4		10	6.35	50	80	12	145	65	62	9	M6	1x4		4805	12208	82
OFU04005-4	40	5	3.175	63	93	14	90	78	70	9	M8	1x4		2110	7988	87
OFU04010-4		10	6.35	63	93	14	148	78	70	9	M8	1x4		5399	15500	99
OFU05010-4	50	10	6.35	75	110	16	148	93	85	11	M8	1x4		6004	19614	117
OFU06310-4	63	10	6.35	90	125	18	153	108	95	11	M8	1x4		6719	25358	139
OFU08010-4	80	10	6.35	105	145	20	153	125	110	13.5	M8	1x4		7346	31953	156

2-2 Precision Ground Ball Screw Series

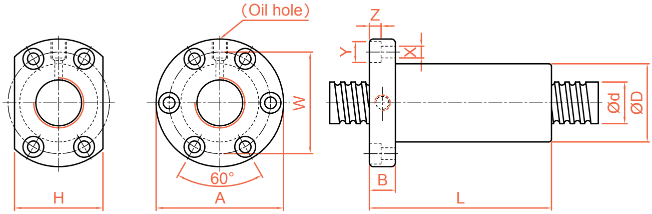
SFNI/SFI Series Specifications



Unit : mm

Model No.	d	l	Da	Dimension											Load Rating		K
				D	A	B	L	W	H	X	Y	Z	Q	n	Ca (kgf)	C0a (kgf)	kgf/μm
SFNI01605-4*	16	5	3.175	30	49	10	45	39	34	4.5	8	4.5	M6	1x4	1380	3052	33
SFNI01610-3*		10	3.175	34	58	10	57	45	34	5.5	9.5	5.5	M6	1x3	1103	2401	27
SFNI02005-4*	20	5	3.175	34	57	11	51	45	40	5.5	9.5	5.5	M6	1x4	1551	3875	39
SFNI02505-4*	25	5	3.175	40	63	11	51	51	46	5.5	9.5	5.5	M8	1x4	1724	4904	45
SFNI02510-4*		10	4.762	46	72	12	80	58	52	6.5	11	6.5	M6	1x4	2954	7295	51
SFNI03205-4*	32	5	3.175	46	72	12	52	58	52	6.5	11	6.5	M8	1x4	1922	6343	52
SFNI03210-4*		10	6.35	54	88	15	85	70	62	9	14	8.5	M8	1x4	4805	12208	62
SFNI04005-4*	40	5	3.175	56	90	15	55	72	64	9	14	8.5	M8	1x4	2110	7988	59
SFNI04010-4*		10	6.35	62	104	18	88	82	70	11	17.5	11	M8	1x4	5399	15500	72
SFNI05010-4*	50	10	6.35	72	114	18	88	92	82	11	17.5	11	M8	1x4	6004	19614	83
SFNI06310-4	63	10	6.35	85	131	22	93	107	95	14	20	13	M8	1x4	6719	25358	95
SFNI08010-4	80	10	6.35	105	150	22	93	127	115	14	20	13	M8	1x4	7346	31953	109
SFI01604-4	16	4	2.381	30	49	10	45	39	34	4.5	8	4.5	M6	1x4	973	2406	32
SFI02004-4	20	4	2.381	34	57	11	46	45	40	5.5	9.5	5.5	M6	1x4	1066	2987	37
SFI02504-4*	25	4	2.381	40	63	11	46	51	46	5.5	9.5	5.5	M6	1x4	1180	3795	43
SFI03204-4	32	4	2.381	46	72	12	47	58	52	6.5	11	6.5	M6	1x4	1296	4838	49

OFI Series Specifications

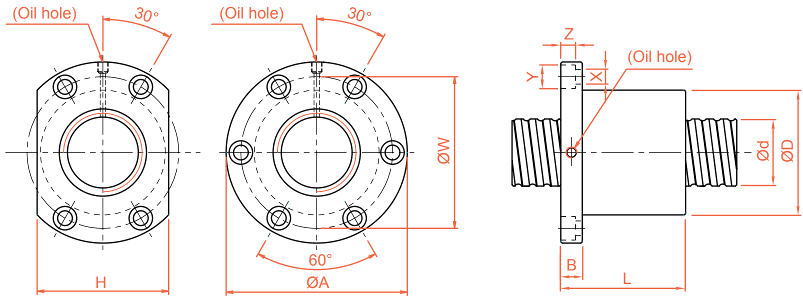


Unit : mm

ModelNo.	d	I	Da	Dimension											LoadRating		K
				D	A	B	L	W	H	X	Y	Z	Q	n	Ca (kgf)	C0a (kgf)	kgf/μm
OFI01605-4	16	5	3.175	30	49	10	75	39	34	4.5	8	4.5	M6	1x4	1380	3052	44
OFI02005-4	20	5	3.175	34	57	11	85	45	40	5.5	9.5	5.5	M6	1x4	1551	3875	52
OFI02505-4	25	5	3.175	40	63	11	86	51	46	5.5	9.5	5.5	M8	1x4	1724	4904	62
OFI02510-4		10	4.762	46	72	12	130	58	52	6.5	11	6.5	M6	1x4	2954	7295	68
OFI03205-4	32	5	3.175	46	72	12	87	58	52	6.5	11	6.5	M8	1x4	1922	6343	72
OFI03210-4		10	6.35	54	88	15	145	70	62	9	14	8.5	M8	1x4	4805	12208	83
OFI04005-4	40	5	3.175	56	90	15	90	72	64	9	14	8.5	M8	1x4	2110	7988	84
OFI04010-4		10	6.35	62	104	18	148	82	70	11	17.5	11	M8	1x4	5399	15500	99
OFI05010-4	50	10	6.35	72	114	18	148	92	82	11	17.5	11	M8	1x4	6004	19614	115
OFI06310-4	63	10	6.35	85	131	22	153	107	95	14	20	13	M8	1x4	6719	25358	135
OFI08010-4	80	10	6.35	105	150	22	153	127	115	14	20	13	M8	1x4	7346	31953	156

2-2 Precision Ground Ball Screw Series

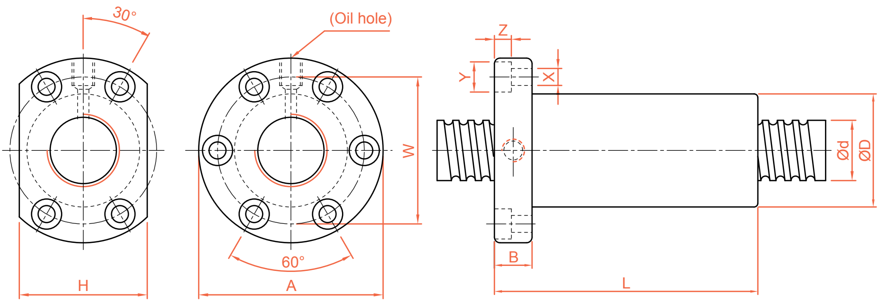
SFV Series Specifications



Unit : mm

Model No.	d	l	Da	Dimension											Load Rating		K
				D	A	B	L	W	H	X	Y	Z	Q	n	Ca (kgf)	C0a (kgf)	kgf/μm
SFV01205-2.8	12	5	2.5	30	50	10	42	40	32	4.5	8	4.5	M6	2.8x1	661	1316	19
SFV01210-2.7		10	2.5	30	50	10	53	40	32	4.5	8	4.5	M6	2.7x1	623	1241	18
SFV01510-2.7	15	10	3.175	34	58	10	57	45	34	5.5	9.5	5.5	M6	2.7x1	972	2020	23
SFV01605-4.8	16	5	3.175	40	63	11	58	51	42	5.5	9.5	5.5	M6	4.8x1	1614	3662	40
SFV01610-2.7		10	3.175	40	63	11	56	51	42	5.5	9.5	5.5	M6	2.7x1	1008	2161	24
SFV02005-4.8	20	5	3.175	44	67	11	57	55	52	5.5	9.5	5.5	M6	4.8x1	1814	4650	47
SFV02010-2.7		10	3.969	46	74	13	57	59	46	6.6	11	6.5	M6	2.7x1	1518	3398	30
SFV02020-1.8		20	3.175	46	74	13	70	59	46	6.6	11	6.5	M6	1.8x1	764	1758	19
SFV02505-4.8	25	5	3.175	50	73	11	55	61	52	5.5	9.5	5.5	M8	4.8x1	2017	5884	56
SFV02506-4.8		6	3.969	53	76	11	62	64	58	5.5	9.5	5.5	M6	4.8x1	2711	7268	58
SFV02508-4.8		8	4.762	56	85	13	70	71	64	6.5	11	6.5	M6	4.8x1	3466	8776	61
SFV02510-2.7		10	6.35	68	102	15	70	84	82	9	14	8.5	M8	2.7x1	3040	6547	37
SFV02525-1.8		25	3.175	50	73	13	83	61	52	5.5	9.5	5.5	M8	1.8x1	843	2199	22
SFV03204-4.8	32	4	2.381	54	81	12	50	67	64	6.6	11	6.5	M6	4.8x1	1517	5806	62
SFV03205-4.8		5	3.175	58	85	12	56	71	64	6.6	11	6.5	M8	4.8x1	2249	7612	66
SFV03206-4.8		6	3.969	62	89	12	60	75	68	6.6	11	6.5	M8	4.8x1	3079	9575	70
SFV03208-4.8		8	4.762	66	100	15	75	82	76	9	14	8.5	M8	4.8x1	3962	11547	74
SFV03210-4.8		10	6.35	74	108	15	96	90	82	9	14	9	M8	4.8x1	5620	14649	76
SFV03220-2.7		20	6.35	74	108	16	100	90	82	9	14	8.5	M8	2.7x1	3509	8644	46
SFV04005-4.8	40	5	3.175	67	101	15	59	83	72	9	14	8.5	M8	4.8x1	2468	9586	76
SFV04010-4.8		10	6.35	82	124	18	100	102	94	11	17.5	11	M8	4.8x1	6316	18600	90
SFV04020-2.7		20	6.35	82	124	18	100	102	90	11	17.5	11	M8	2.7x1	3935	10893	56
SFV05005-4.8	50	5	3.175	80	114	15	60	96	82	9	14	8.5	M8	4.8x1	2698	12053	87
SFV05010-4.8		10	6.35	93	135	16	93	113	98	11	17.5	11	M8	4.8x1	7023	23537	106
SFV05020-2.7		20	9.525	105	152	28	121	128	110	14	20	13	M8	2.7x1	7336	19700	68
SFV06310-4.8	63	10	6.35	108	154	22	105	130	110	14	20	13	M8	4.8x1	7860	30430	126
SFV06320-2.7		20	9.525	122	180	28	120	150	130	18	26	17.5	M8	2.7x1	8162	24741	80
SFV08010-4.8	80	10	6.35	130	176	22	105	152	132	14	20	13	M8	4.8x1	8593	38344	145
SFV08020-4.8		20	9.525	143	204	28	180	172	148	18	26	18	M8	4.8x1	15103	57296	168
SFV08020-7.6		20	9.525	143	204	28	240	172	148	18	26	18	M8	3.8x2	22423	90719	260

OFV Series Specifications



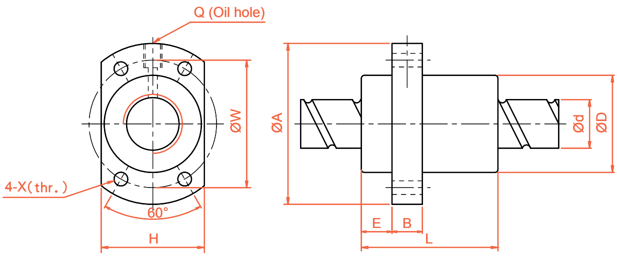
Unit : mm

Model No.	d	l	Da	Dimension											Load Rating		K
				D	A	B	L	W	H	X	Y	Z	Q	n	Ca (kgf)	C0a (kgf)	kgf/μm
OFV01605-4.8	16	5	3.175	40	63	11	100	51	42	5.5	9.5	5.5	M6	4.8x1	1614	3662	53
OFV02005-4.8	20	5	3.175	44	67	11	102.5	55	52	5.5	9.5	5.5	M6	4.8x1	1814	4650	63
OFV02505-4.8	25	5	3.175	50	73	11	96	61	52	5.5	9.5	5.5	M8	4.8x1	2017	5884	75
OFV03205-4.8	32	5	3.175	58	85	12	98	71	64	6.6	11	6.5	M8	4.8x1	2249	7612	90
OFV03210-4.8		10	6.35	74	108	15	166	90	82	9	14	9	M8	4.8x1	5620	14649	101
OFV04005-4.8	40	5	3.175	67	101	15	100	83	72	9	14	8.5	M8	4.8x1	2468	9586	105
OFV04010-4.8		10	6.35	82	124	18	174	102	94	11	17.5	11	M8	4.8x1	6316	18600	121
OFV05010-4.8	50	10	6.35	93	135	16	167	113	98	11	17.5	11	M8	4.8x1	7023	23537	144
OFV06310-4.8	63	10	6.35	108	154	22	177	130	110	14	20	13	M8	4.8x1	7860	30430	172
OFV08010-4.8	80	10	6.35	130	176	22	178	152	132	14	20	13	M8	4.8x1	8593	38344	201

Note : For double ball screw nut order, please contact ***TBI MOTION*** in advance.

2-2 Precision Ground Ball Screw Series

SFY Series Specifications

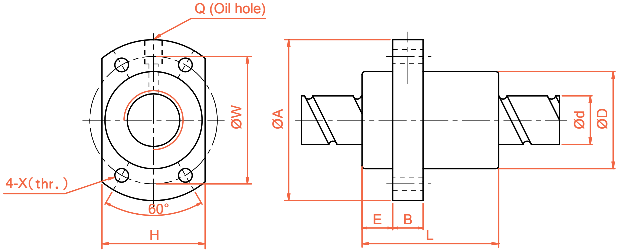


Unit : mm

Large Lead Model No.	d	l	Da	Dimension										Load Rating		K kgf/μm
				D	A	E	B	L	W	H	X	Q	n	Ca (kgf)	C0a (kgf)	
SFY01616-5.6	16	16	2.778	32	53	10.1	10	61	42	34	4.5	M6	2.8x2	1568	3968	47
SFY02020-3.6	20	20	3.175	39	62	13	10	52	50	41	5.5	M6	1.8x2	1387	3515	37
SFY02020-5.6		20	3.175	39	62	13	10	72	50	41	5.5	M6	2.8x2	2029	5468	56
SFY02525-3.6	25	25	3.969	47	74	15	12	64	60	49	6.6	M6	1.8x2	2074	5494	45
SFY02525-5.6		25	3.969	47	74	15	12	89	60	49	6.6	M6	2.8x2	3032	8546	69
SFY03232-5.6	32	32	4.762	58	92	17	12	110	74	60	9	M6	2.8x2	4417	13517	88
SFY04040-3.6	40	40	6.35	73	114	19.5	15	99	93	75	11	M6	1.8x2	4831	14062	70
SFY04040-5.6		40	6.35	73	114	19.5	15	139	93	75	11	M6	2.8x2	7065	21874	106
SFY05050-3.6	50	50	7.938	90	135	21.5	20	117	112	92	14	M6	1.8x2	7220	21974	86

Twin Lead Model No.	d	l	Da	Dimension										Ca (kgf)	C0a (kgf)	K kgf/μm
				D	A	E	B	L	W	H	X	Q	n			
SFY01632-1.6	16	32	2.778	32	53	10.1	10	42.5	42	34	4.5	M6	0.8x2	493	1116	11
SFY01632-3.6		32	2.778	32	53	10.1	10	74.5	42	34	4.5	M6	1.8x2	989	2511	23
SFY02040-3.6		40	3.175	39	62	13	10	88	50	41	5.5	M6	1.8x2	1311	3592	30
SFY02550-1.6	25	50	3.969	47	74	15	12	58	60	49	6.6	M6	0.8x2	976	2495	19
SFY02550-3.6		50	3.969	47	74	15	12	108	60	49	6.6	M6	1.8x2	1960	5614	32
SFY03264-1.6	32	64	4.762	58	92	17	12	71	74	60	9	M6	0.8x2	1374	3571	22
SFY03264-3.6		64	4.762	58	92	17	12	135	74	60	9	M6	1.8x2	2759	8441	46
SFY050100-1.6	50	100	7.938	90	135	21.5	20	111	112	92	14	M6	0.8x2	3398	9980	35
SFY050100-3.6		100	7.938	90	135	21.5	20	211	112	92	14	M6	1.8x2	6824	22455	72

SFYA Series Specifications



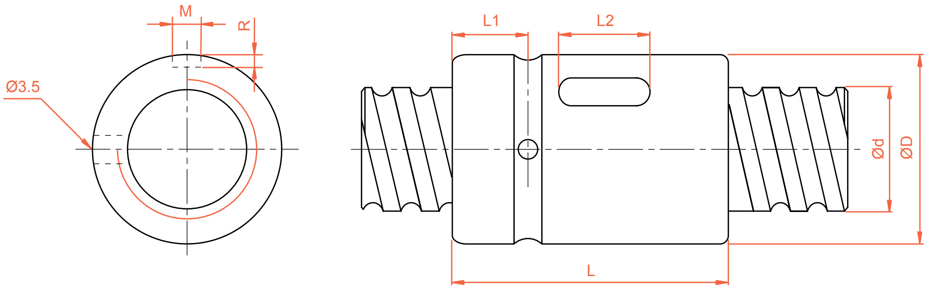
Unit : mm

Large Lead Model No.	d	l	Da	Dimension										Load Rating		K kgf/μm
				D	A	E	B	L	W	H	X	Q	n	Ca (kgf)	C0a (kgf)	
SFYA01616-3.6	16	16	2.778	32	53	10.1	10	45	42	34	4.5	M6	1.8*2	1073	2551	31
SFYA01616-5.6	16	16	2.778	32	53	10.1	10	61	42	34	4.5	M6	2.8*2	1568	3968	47
SFYA02020-3.6	20	20	3.175	39	62	13	10	52	50	41	5.5	M6	1.8*2	1387	3515	37
SFYA02020-5.6	20	20	3.175	39	62	13	10	72	50	41	5.5	M6	2.8*2	2029	5468	56
SFYA02525-3.6	25	25	3.969	47	74	15	12	64	60	49	6.6	M6	1.8*2	2074	5494	45
SFYA02525-5.6	25	25	3.969	47	74	15	12	89	60	49	6.6	M6	2.8*2	3032	8546	69
SFYA03232-3.6	32	32	4.762	58	92	17	12	78	74	60	9	M6	1.8*2	3021	8690	58
SFYA03232-5.6	32	32	4.762	58	92	17	12	110	74	60	9	M6	2.8*2	4417	13517	88
SFYA04040-3.6	40	40	6.35	73	114	19.5	15	99	93	75	11	M6	1.8*2	4831	14062	70
SFYA04040-5.6	40	40	6.35	73	114	19.5	15	139	93	75	11	M6	2.8*2	7065	21874	106
SFYA05050-3.6	50	50	7.938	90	135	21.5	20	117	112	92	14	M6	1.8*2	7220	21974	86
SFYA05050-5.6	50	50	7.938	90	135	21.5	20	167	112	92	14	M6	2.8*2	10558	34182	131

Twin Lead Model No.	d	l	Da	Dimension										Ca (kgf)	C0a (kgf)	K kgf/μm
				D	A	E	B	L	W	H	X	Q	n			
SFYA01632-1.6	16	32	2.778	32	53	10.1	10	42.5	42	34	4.5	M6	0.8*2	493	1116	11
SFYA01632-3.6	16	32	2.778	32	53	10.1	10	74.5	42	34	4.5	M6	1.8*2	989	2511	23
SFYA02040-1.6	20	40	3.175	39	62	13	10	48	50	41	5.5	M6	0.8*2	653	1597	15
SFYA02040-3.6	20	40	3.175	39	62	13	10	88	50	41	5.5	M6	1.8*2	1311	3592	30
SFYA02550-1.6	25	50	3.969	47	74	15	12	58	60	49	6.6	M6	0.8*2	976	2495	19
SFYA02550-3.6	25	50	3.969	47	74	15	12	108	60	49	6.6	M6	1.8*2	1960	5614	32
SFYA03264-1.6	32	64	4.762	58	92	17	12	71	74	60	9	M6	0.8*2	1374	3571	22
SFYA03264-3.6	32	64	4.762	58	92	17	12	135	74	60	9	M6	1.8*2	2759	8441	46
SFYA04080-1.6	40	80	6.35	73	114	19.5	15	90	93	75	11	M6	0.8*2	2273	6387	29
SFYA04080-3.6	40	80	6.35	73	114	19.5	15	170	93	75	11	M6	1.8*2	4566	14370	50
SFYA050100-1.6	50	100	7.938	90	135	21.5	20	111	112	92	14	M6	0.8*2	3398	9980	35
SFYA050100-3.6	50	100	7.938	90	135	21.5	20	211	112	92	14	M6	1.8*2	6824	22455	72

2-2 Precision Ground Ball Screw Series

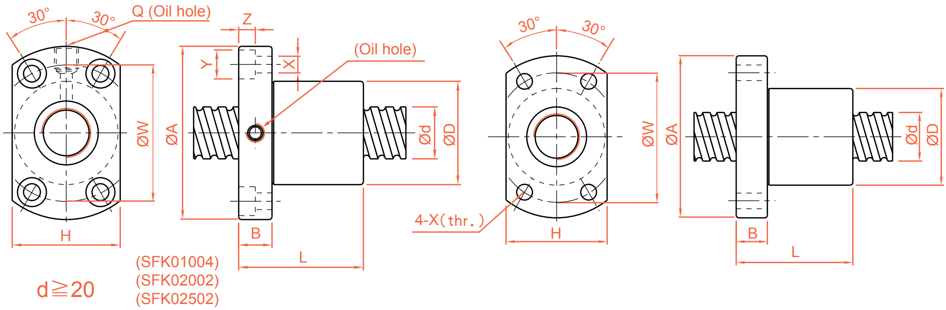
SCNI/SCI Series Specifications



Unit : mm

Model No.	d	l	Da	Dimension							Load Rating		K kgf/μm
				D	L	L1	L2	M	R	n	Ca (kgf)	C0a (kgf)	
SCNI 01605-4	16	5	3.175	30	45	9	20	5	3	1x4	1380	3052	33
SCNI 02005-4	20	5	3.175	34	45	9	20	5	3	1x4	1551	3875	39
SCNI 02505-4	25	5	3.175	40	45	9	20	5	3	1x4	1724	4904	45
SCNI 02510-4		10	4.762	46	85	13	30	5	3	1x4	2954	7295	51
SCNI 03205-4	32	5	3.175	46	45	9	20	5	3	1x4	1922	6343	52
SCNI 03210-4		10	6.35	54	85	13	30	5	3	1x4	4805	12208	62
SCNI 04005-4	40	5	3.175	56	45	9	20	5	3	1x4	2110	7988	59
SCNI 04010-4		10	6.35	62	85	13	30	5	3	1x4	5399	15500	72
SCNI 05010-4	50	10	6.35	72	85	13	30	5	3	1x4	6004	19614	83
SCNI 06310-4	63	10	6.35	85	85	13	30	6	3.5	1x4	6719	25358	95
SCNI 08010-4	80	10	6.35	105	85	13	30	8	4.5	1x4	7346	31953	109
SCI 01604-4	16	4	2.381	30	40	9	15	3	1.5	1x4	973	2406	32
SCI 02004-4	20	4	2.381	34	40	9	15	3	1.5	1x4	1066	2987	37
SCI 02504-4	25	4	2.381	40	40	9	15	3	1.5	1x4	1180	3795	43
SCI 03204-4	32	4	2.381	46	40	9	15	3	1.5	1x4	1296	4838	49

SFK Series Specifications



Unit : mm

Model No.	d	I	Da	Dimension											Ca (kgf)	C0a (kgf)	K kgf/μm
				D	A	B	L	W	H	X	Y	Z	Q	n			
SFK00401	4	1	0.8	10	20	3	12	15	14	2.9	-	-	-	1x2	64	97	5
SFK00601	6	1	0.8	12	24	3.5	15	18	16	3.4	-	-	-	1x3	111	224	9
SFK00801☆	8	1	0.8	14	27	4	16	21	18	3.4	-	-	-	1x4	161	403	14
SFK00802☆		2	1.2	14	27	4	18	21	18	3.4	-	-	-	1x3	222	458	13
SFK0082.5		2.5	1.2	16	29	4	26	23	20	3.4	-	-	-	1x3	221	457	13
SFK01002☆	10	2	1.2	18	35	5	28	27	22	4.5	-	-	-	1x3	243	569	15
SFK01004		4	2	20	37	6	34	29	28	4.5	-	-	-	1x3	468	905	17
SFK01202☆	12	2	1.2	20	37	5	28	29	24	4.5	-	-	-	1x4	334	906	22
SFK01205		5	2.5	22	37	8	39	29	24	4.5	-	-	-	1x3	702	1409	17
SFK01402☆	14	2	1.2	21	40	6	23	31	26	5.5	-	-	-	1x4	354	1053	24
SFK01404		4	2.5	25	42	10	45	35	29	4.5	-	-	-	1x4	957	2145	16
SFK02002	20	2	1.2	50	80	15	55	65	68	6.5	10.5	6	M6x1	1x6	581	2284	48
SFK02502	25	2	1.2	50	80	13	43	65	68	6.5	10.5	6	M6x1	1x5	540	2381	46
XSK01004	10	4	2	26	46	10	34	36	28	4.5	8	4.5	M6x1	1x3	468	905	17
XSK01404	14	4	2.5	26	46	10	45	36	28	4.5	8	4.5	M6x1	1x4	957	2145	16

※ ☆ Left helix available

※Standard ball nut SFK00401 is without wiper, other type K standard ball nut is available for with or without wiper, please contact TBI sales representatives.

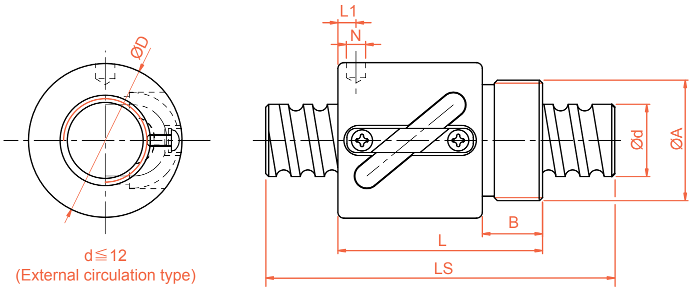
Unit : mm

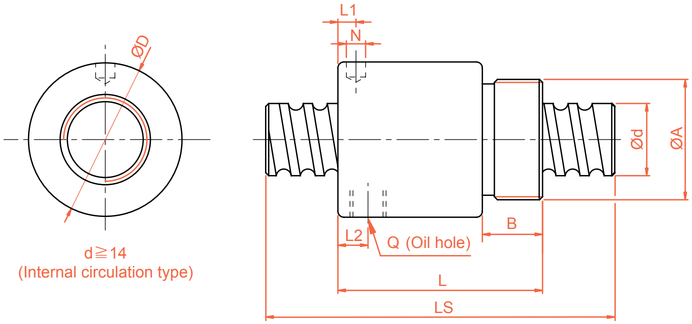
Model No.	d	I	Da	Dimension											Ca (kgf)	C0a (kgf)	K kgf/μm
				D	A	B	L	W	H	X	Y	Z	Q	n			
XSUR01204T3D-02	12	4	2.5	24	40	6	28	32	25	3.5	-	-	-	1x3	454	722	-

※Standard ball nut XSUR01204T3D-02 is assembled without wiper.

2-2 Precision Ground Ball Screw Series

BSH Series Specifications



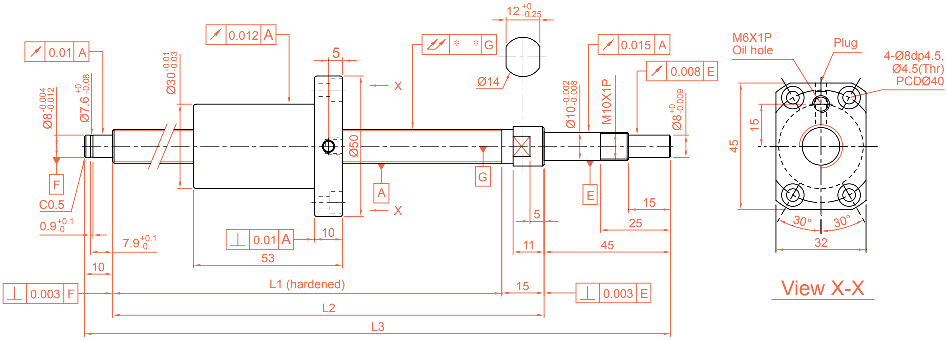


Unit : mm

Model No.	d	l	Da	Dimension									Ca (kgf)	C0a (kgf)	K kgf/µm
				D	A	B	L	L1	N	L2	Q	n			
BSH0082.5-2.5	8	2.5	1.2	17.5	M15x1P	7.5	23.5	10	3	-	-	2.5x1	189	381	11
BSH01002-3.5	10	2	1.2	19.5	M17x1P	7.5	22	3	3.2	-	-	3.5x1	277	664	17
BSH01004-2.5		4	2	25	M20x1P	10	34	3	3	-	-	2.5x1	400	754	14
BSH01204-3.5	12	4	2.5	25.5	M20x1P	10	34	13	3	-	-	3.5x1	804	1649	23
BSH01205-3.5		5	2.5	25.5	M20x1P	10	39	16.25	3	-	-	3.5x1	801	1644	24
BSH01404-3	14	4	2.5	32.1	M25x1.5P	10	35	11	3	-	-	1x3	748	1609	26
BSH01604-3	16	4	2.381	29	M22x1.5P	8	32	4	3.2	-	-	1x3	759	1804	24
BSH01605-3		5	3.175	32.5	M26x1.5P	12	42	19.25	3	-	-	1x3	1077	2289	25
BSH01610-2		10	3.175	32	M26x1.5P	12	50	3	4	3	M4	1x2	779	1601	14
BSH02005-3	20	5	3.175	38	M35x1.5P	15	45	20.3	3	-	-	1x3	1211	2906	30
BSH02505-4	25	5	3.175	43	M40x1.5P	19	69	32.11	3	8	M6	1x4	1724	4904	37
BSH02510-4		10	4.762	43	M40x1.5P	19	84	8	6	8	M6	1x4	2954	7295	41

※Standard ball nut from Ø8~Ø16 is assembled without wiper.

XSVR01210-01 Series Specifications (Finish Shaft Ends)



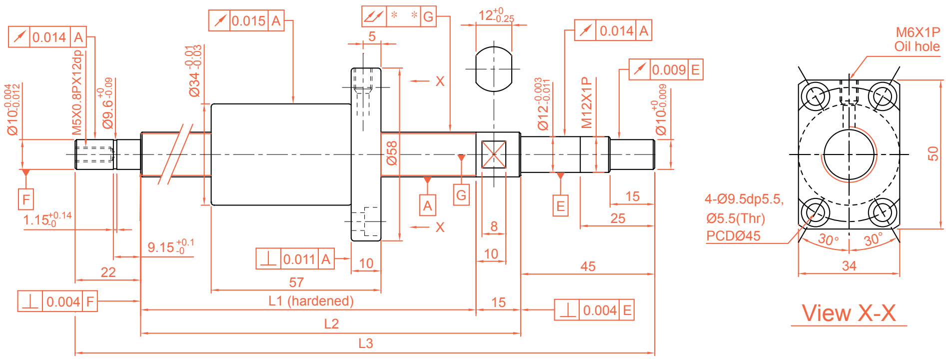
BCD	12.85
Ball Dia (mm)	2.5
Lead (mm)	10
No. of Turns	2.7x1
Lead Angle	13.91°
Threading Direction	R
Spring Force (kg)	0.1~0.2
Preload (kgf)	25
Dynamic Load Rating Ca (kgf)	623
Static Load Rating C0a (kgf)	1241
Accuracy Grade	0.018

Unit : mm

Travel Length (mm)	Model No.	Shaft Length (mm)			Slant of Axle Center
		L1	L2	L3	⌰
100	XSVR01210B1DGC5-230-P1	160	175	230	0.035
150	XSVR01210B1DGC5-280-P1	210	225	280	0.035
250	XSVR01210B1DGC5-380-P1	310	325	380	0.050
350	XSVR01210B1DGC5-480-P1	410	425	480	0.060
450	XSVR01210B1DGC5-580-P1	510	525	580	0.075

2-2 Precision Ground Ball Screw Series

XSVR01510-00 Series Specifications (Finish Shaft Ends)

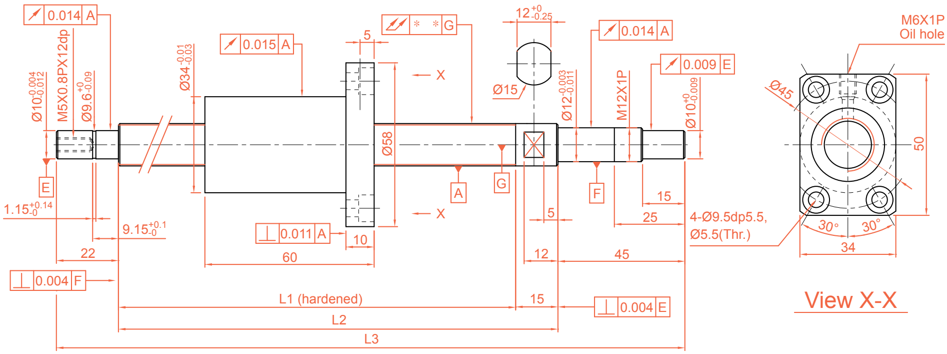


BCD	15.5
Ball Dia (mm)	3.175
Lead (mm)	10
No. of Turns	2.7x1
Lead Angle	11.6°
Threading Direction	R
Spring Force (kg)	0.1~0.3
Preload (kgf)	38
Dynamic Load Rating Ca (kgf)	972
Static Load Rating C0a (kgf)	2020
Accuracy Grade	0.018

Unit : mm

Travel Length (mm)	Model No.	Shaft Length (mm)			Slant of Axle Center
		L1	L2	L3	⌰
100	XSVR01510B1DGC5-271-P1	189	204	271	0.025
150	XSVR01510B1DGC5-321-P1	239	254	321	0.035
200	XSVR01510B1DGC5-371-P1	289	304	371	0.035
250	XSVR01510B1DGC5-421-P1	339	354	421	0.040
300	XSVR01510B1DGC5-471-P1	389	404	471	0.040
350	XSVR01510B1DGC5-521-P1	439	454	521	0.050
400	XSVR01510B1DGC5-571-P1	489	504	571	0.050
450	XSVR01510B1DGC5-621-P1	539	554	621	0.050
500	XSVR01510B1DGC5-671-P1	589	604	671	0.065
550	XSVR01510B1DGC5-721-P1	639	654	721	0.065
600	XSVR01510B1DGC5-771-P1	689	704	771	0.065
700	XSVR01510B1DGC5-871-P1	789	804	871	0.085
800	XSVR01510B1DGC5-971-P1	889	904	971	0.085

XSVR01520-01 Series Specifications (Finish Shaft Ends)



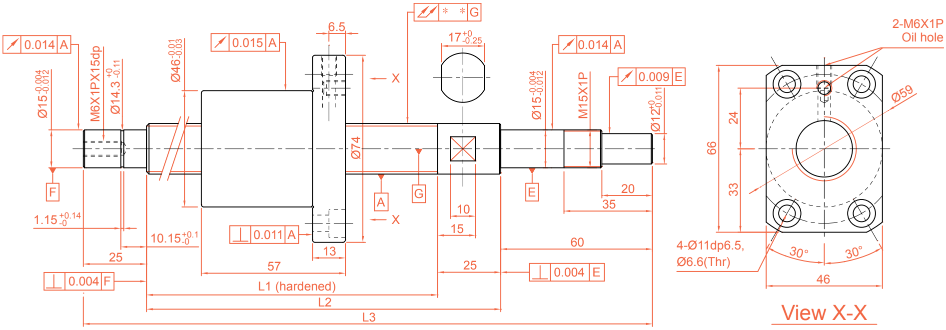
BCD	15.5
Ball Dia (mm)	3.175
Lead (mm)	20
No. of Turns	1.8x1
Lead Angle	22.33°
Threading Direction	R
Spring Force (kg)	0.1~0.3
Preload (kgf)	38
DynamicLoad Rating Ca (kgf)	580
Static Load Rating C0a (kgf)	875
Accuracy Grade	0.018

Unit : mm

Travel Length (mm)	Model No.	Shaft Length (mm)			Slant of Axle Center
		L1	L2	L3	⌰
100	XSVR01520A1DGC5-271-P1	189	204	271	0.025
150	XSVR01520A1DGC5-321-P1	239	254	321	0.035
200	XSVR01520A1DGC5-371-P1	289	304	371	0.035
250	XSVR01520A1DGC5-421-P1	339	354	421	0.040
300	XSVR01520A1DGC5-471-P1	389	404	471	0.040
350	XSVR01520A1DGC5-521-P1	439	454	521	0.050
400	XSVR01520A1DGC5-571-P1	489	504	571	0.050
450	XSVR01520A1DGC5-621-P1	539	554	621	0.050
500	XSVR01520A1DGC5-671-P1	589	604	671	0.065
550	XSVR01520A1DGC5-721-P1	639	654	721	0.065
600	XSVR01520A1DGC5-771-P1	689	704	771	0.065
700	XSVR01520A1DGC5-871-P1	789	804	871	0.085
800	XSVR01520A1DGC5-971-P1	889	904	971	0.085

2-2 Precision Ground Ball Screw Series

XSVR02010-00 Series Specifications (Finish Shaft Ends)

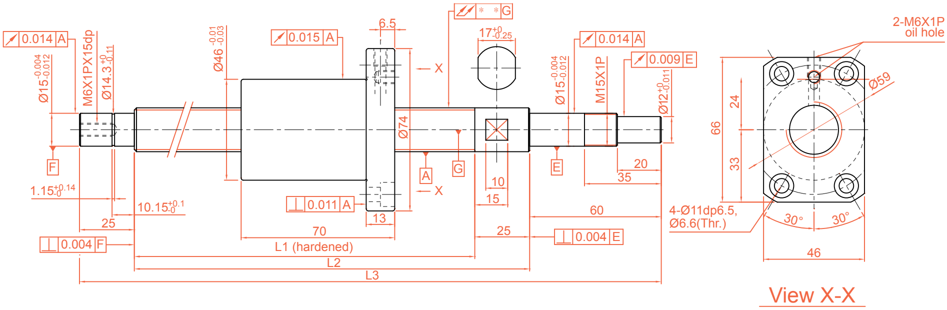


BCD	21.35
Ball Dia (mm)	3.969
Lead (mm)	10
No. of Turns	2.7x1
Lead Angle	8.48°
Threading Direction	R
Spring Force (kg)	0.1~0.3
Preload (kgf)	43
Dynamic Load Rating Ca (kgf)	1518
Static Load Rating C0a (kgf)	3398
Accuracy Grade	0.018

Unit : mm

Travel Length (mm)	Model No.	Shaft Length (mm)			Slant of Axle Center
		L1	L2	L3	⌰
200	XSVR02010B1DGC5-399-P1	289	314	399	0.035
300	XSVR02010B1DGC5-499-P1	389	414	499	0.040
400	XSVR02010B1DGC5-599-P1	489	514	599	0.050
500	XSVR02010B1DGC5-699-P1	589	614	699	0.065
600	XSVR02010B1DGC5-799-P1	689	714	799	0.065
700	XSVR02010B1DGC5-899-P1	789	814	899	0.085
800	XSVR02010B1DGC5-999-P1	889	914	999	0.085
900	XSVR02010B1DGC5-1099-P1	989	1014	1099	0.110
1000	XSVR02010B1DGC5-1199-P1	1089	1114	1199	0.110

XSVR02020-00 Series Specifications (Finish Shaft Ends)



BCD	20.75
Ball Dia (mm)	3.175
Lead (mm)	20
No. of Turns	1.8x1
Lead Angle	17.05°
Threading Direction	R
Spring Force (kg)	0.1~0.3
Preload (kgf)	31
Dynamic Load Rating Ca (kgf)	764
Static Load Rating C0a (kgf)	1758
Accuracy Grade	0.018

Unit : mm

Travel Length (mm)	Model No.	Shaft Length (mm)			Slant of Axle Center
		L1	L2	L3	⌰
200	XSVR02020A1DGC5-399-P1	289	314	399	0.035
300	XSVR02020A1DGC5-499-P1	389	414	499	0.040
400	XSVR02020A1DGC5-599-P1	489	514	599	0.050
500	XSVR02020A1DGC5-699-P1	589	614	699	0.065
600	XSVR02020A1DGC5-799-P1	689	714	799	0.065
700	XSVR02020A1DGC5-899-P1	789	814	899	0.085
800	XSVR02020A1DGC5-999-P1	889	914	999	0.085
900	XSVR02020A1DGC5-1099-P1	989	1014	1099	0.110
1000	XSVR02020A1DGC5-1199-P1	1089	1114	1199	0.110

2-3 Rolled Ball Screw

■ 2-3-1 Rolled Screws

Rolled screws are made through thread roller. Generally rolled screw has a smoother operation while lowering friction and backlash. Therefore, it gradually replaced the traditional ACME screws and trapezoidal screws. Moreover, rolled screws can eliminate axial play by preloading nut with a cost effective pricing compare to ground screw.

■ 2-3-2 The Features of *TBI MOTION* Rolled Ball Screw

(1) Lead Accuracy Up to Grade C5

C7 and C10 Screws have been Standardized. C5 on request.

(2) Precision Ground Ball Nut

High Precision Ball Nut are interchangeable between ground and rolled screws.

(3) Available to ship separately

Ball screw and ball nuts can be shipped separated ensure shortest delivery time. The ball nuts are standardized with P0 preloaded, preload value can be adjusted through reballing.

■ 2-3-3 Nominal Model Code of Rolled Ball Screws

Nominal Model Code of Shaft

SC	R	025	05	F	C7	-	1000	+	N3
①	②	③	④	⑤	⑥		⑦		⑧

①

Type of Screw Shaft
SC : standard
SS : For H, NH type nut

②

Threading Direction
R : Right
L : Left

③

Nominal Diameter
Unit : mm

④

Lead
Unit : mm

⑤

Product Code
F : Rolled

⑥

Accuracy Grade
C5, C7, C10

⑦

Overall Length of Shaft
Unit : mm

⑧

Shaft Surface Treatment
□ : Standard
B1 : Black Oxidation
N1 : Hard Chrome Plating
P : Phosphating
N3 : Nickel Plating
N4 : Raydent
N5 : Chrome Plating

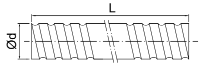


Fig 2.3.1 Screw Shaft Nominal Diameter

Table 2.3.1 Rolled Ball Screw Specifications Ø6~32

Unit : mm

Model No. d	l	Da	Accuracy Grade	Threading Direction R : Right L : Left	Number of Grooves	Standard Code of Shaft	Type of Nut	Overall Length of Shaft
6	1	0.8	C10, C7, C5	R	1	SCR00601	K	1000
	6	1.2	C10, C7, C5	R	2	SCR00606	J	1000
8	1	0.8	C10, C7, C5	R	1	SCR00801	K	1000
	2	1.2	C10, C7, C5	R	1	SCR00802	K	
	2.5	1.2	C10, C7, C5	R	1	SCR0082.5	K, BSH	
	8	1.2	C10, C7, C5	R	4	SCR00808	J	1000
10	2	1.2	C10, C7, C5	R	1	SCR01002	K, BSH	3000
	4	2	C10, C7, C5	R	1	SCR01004	K, BSH	
12	2	1.2	C10, C7, C5	R	1	SCR01202	K	3000
	4	2.5	C10, C7, C5	R	1	SCR01204	U, BSH	
	5	2.5	C10, C7, C5	R	1	SCR01205	K	
	5	2.5	C10, C7, C5	R	1	SSR01205	V, BSH, A, B	
	10	2.5	C10, C7, C5	R	1	SCR01210-B	V	
	20	2.5	C10, C7, C5	R	4	SCR01220	Y	
14	2	1.2	C10, C7, C5	R	1	SCR01402	K	3000
	4	2.5	C10, C7, C5	R	1	SCR01404	K, BSH	3000
16	4	2.381	C10, C7, C5	R	1	SCR01604(N)	V, I, U, BSH	3000
	5	3.175	C10, C7, C5	R/L	1	SCR01605	NI, NU, BSH	
	10	3.175	C10, C7, C5	R	1	SCR01610	V, NI, NU, BSH	
	16	2.778	C10, C7, C5	R	4	SCR01616	YA	
	32	2.778	C10, C7, C5	R	8	SCR01632	Y, YA	
20	4	2.381	C10, C7, C5	R	1	SCR02004(N)	I, U	3000
	5	3.175	C10, C7, C5	R/L	1	SCR02005	V, NI, NU, BSH, A, B	
	20	3.175	C10, C7, C5	R	4	SCR02020, SSR02020	V, Y, YA, A, B	
	40	3.175	C10, C7, C5	R	8	SCR02040	YA	
25	4	2.381	C10, C7, C5	R	1	SCR02504(N)	I, U	6000
	5	3.175	C10, C7, C5	R/L	1	SCR02505	V, NI, NU, BSH, A, B	
	10	4.762	C10, C7, C5	R	1	SCR02510-A	NI, NU, BSH	
	25	3.969	C10, C7, C5	R	4	SCR02525	Y, YA	
	50	3.969	C10, C7, C5	R	8	SCR02550	Y, YA	
32	4	2.381	C10, C7, C5	R	1	SCR03204(N)	V, I, U	6000
	5	3.175	C10, C7, C5	R/L	1	SCR03205	V, NI, NU, A	
	10	6.35	C10, C7, C5	R/L	1	SCR03210	V, NI, NU	
	32	4.762	C10, C7, C5	R	4	SCR03232	YA	
	64	4.762	C10, C7, C5	R	8	SCR03264	Y, YA	

※The information is for standard production, if required accuracy grade C5 or other needs, please contact ***TBI MOTION*** .
※If the extended type in YA nut is needed, please contact TBI MOTION.

C Ball Screw

2-3 Rolled Ball Screw

Table2.3.2 Standard Specifications Ø40~80 Unit : mm

Model No. d	l	Da	Accuracy Grade	Threading Direction R : Right L : Left	Number of Grooves	Standard Code of Shaft	Type of Nut	Overall Length of Shaft
40	5	3.175	C10, C7, C5	R/L	1	SCR04005	V, NI, NU, A	6000
	10	6.35	C10, C7, C5	R/L	1	SCR04010	V, NI, NU	
	20	6.35	C10, C7, C5	R	1	SCR04020	V	
	40	6.35	C10, C7, C5	R	4	SCR04040	Y, YA	
	80	6.35	C10, C7, C5	R	8	SCR04080	YA	
50●	5	3.175	C10, C7, C5	R	1	SCR05005	V, A	6000
	10	6.35	C10, C7, C5	R/L	1	SCR05010	V, NI, NU	
	20	9.525	C10, C7, C5	R	1	SCR05020	V	
	50	7.938	C10, C7, C5	R	4	SCR05050	Y, YA	
	100	7.938	C10, C7, C5	R	8	SCR050100	Y, YA	
63●	10	6.35	C10, C7, C5	R	1	SCR06310	V, NI, NU	7000
	20	9.525	C10, C7, C5	R	1	SCR06320	V, NU	
80●	10	6.35	C10, C7, C5	R	1	SCR08010	V, NI, NU	7000
	20	9.525	C10, C7, C5	R	1	SCR08020	V, NU	

Table2.3.3 H/A/J/B-Type Specifications Ø16~50 Unit : mm

Model No. d	l	Da	Accuracy Grade	Threading Direction R : Right L : Left	Number of Grooves	Type-H Code of Shaft	Type of Nut	Overall Length of Shaft
12	10	2.5	C10, C7, C5	R	2	SSR01210	A, B	3000
16	5	2.778	C10, C7, C5	R	1	SSR01605	A, B	3000
	10	2.778	C10, C7, C5	R	2	SSR01610	A, B	
	16	2.778	C10, C7, C5	R	4	SSR01616	A, B	
	20	2.778	C10, C7, C5	R	4	SSR01620	A, B	
20	10	3.175	C10, C7, C5	R	2	SSR02010	A, B	3000
25	10	3.175	C10, C7, C5	R	2	SSR02510	A, B	6000
	25	3.175	C10, C7, C5	R	4	SSR02525	A, V, B	
32	10	3.969	C10, C7, C5	R	1	SSR03210	A, B	6000
	20	3.969	C10, C7, C5	R	2	SSR03220	A, B	
	32	3.969	C10, C7, C5	R	4	SSR03232	A, B	
40	10	6.35	C10, C7, C5	R	1	SSR04010	A	6000
	20	6.35	C10, C7, C5	R	2	SSR04020	A	
	40	6.35	C10, C7, C5	R	4	SSR04040	A	
50●	10	6.35	C10, C7, C5	R	1	SSR05010	A	6000
	20	6.35	C10, C7, C5	R	2	SSR05020	A	
	50	6.35	C10, C7, C5	R	4	SSR05050	A	

※The information is for standard production, if required accuracy grade C5 or other needs, please contact ***TBI MOTION*** .
※Please contact TBI MOTION if the marked types (●) are required.
※If the extended type in YA nut is needed, please contact TBI MOTION.

Nominal Model Code of Nut

G SFU R 025 05 T4 D + N3

①　②　③　④　⑤　⑥　⑦　⑧

①

Product Code

②

Nominal Model	
S	S : Single nut
F	F : With flange
	C : Without flange
U	NI : NI type nut
	NU : NU type nut
	A : A type nut
	J : J type nut
	B : B type nut
	NH : NH nut (A solution for slide table)
	Y : Y type nut
	YA : YA type nut
	V : V type nut
	U : U type nut
	K : K type nut

③

Threading Direction
R : Right
L : Left

④

Nominal Diameter
Unit : mm

⑤

Lead
Unit : mm

⑧

Nut Surface Treatment
S : Standard
B1 : Black Oxidation
N1 : Hard Chrome Plating
P : Phosphating
N3 : Nickel Plating
N4 : Raydent
N5 : Chrome Plating

⑥

Number of Turns (Turn·Row)
Turn : T : 1
A : 1.5 (or 1.7/1.8)
B : 2.5/2.8
C : 3.5
D : 4.8
E : 5.8
ex : (2.5 ✕ 2 = B2)

⑦

Flange Type
N : Not cutting
S : Single cutting
D : Double cutting

C **Ball Screw**

■ 2-3-4 Preload of Rolled Ball Screw

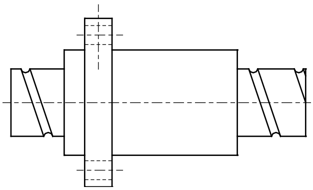
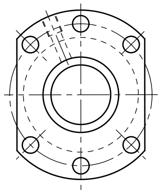
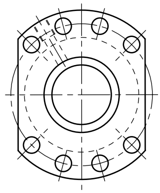
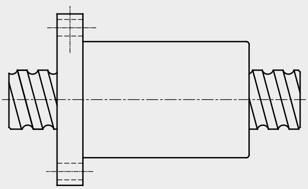
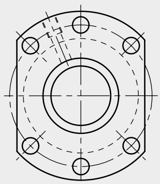
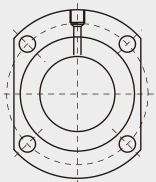
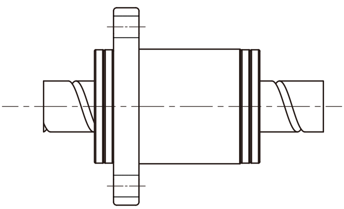
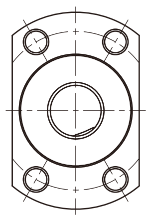
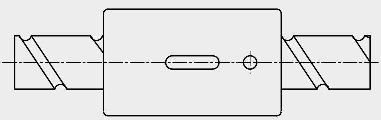
The standard preloading for Rolled Ball Screw is P0. If P1 preloading is required, please contact ***TBI MOTION***.

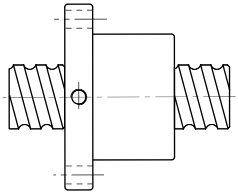
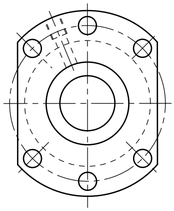
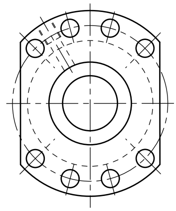
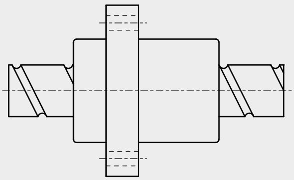
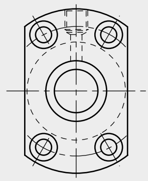
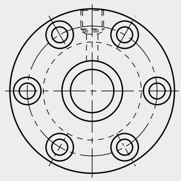
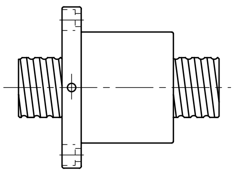
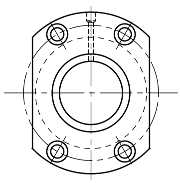
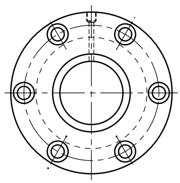
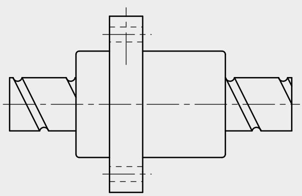
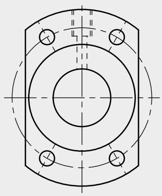
Table2.3.4 Accuracy grade of rolled ball screw　　Unit : μm

Grade		Rolled		
		C5	C7	C10
e_{300}	ISO, DIN	23	52	210
	JIS	18	50	210
	TBI MOTION	23	50	210

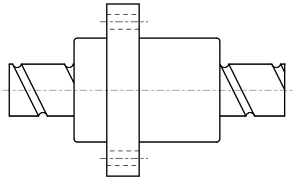
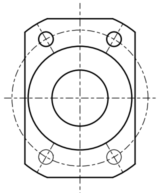
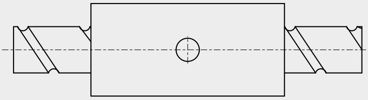
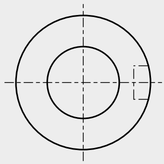
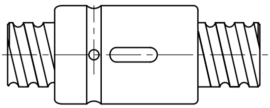
2-4 Rolled Ball Screw Series

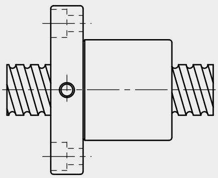
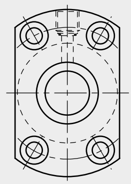
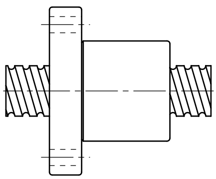
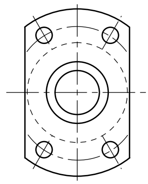
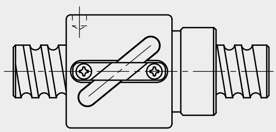
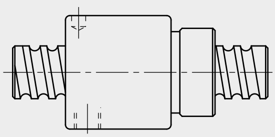
■ 2-4-1 *TBI MOTION* Nut of Rolled Ball Screw Type

	Nut Type	Flange Type
A (High Speed/Strong dust-proof type)	SFA (DIN)  C72	 d≤32  d≥40
B (High-speed reinforced silent and dust-proof type)	SFB (DIN)  C73	 d≤32  1205/1210
J (Low Noise/Strong dust-proof type)	SFJ (DIN)  C74	
CNH (A solution for slide table)	SCNH  C75	No-Flange

	Nut Type	Flange Type
NU/U (Strong dust-proof type)	SFNU/ SFU (DIN)  C76	 d≤32  d≥40
NI/I (Strong dust-proof type)	SFNI/SFI  C77	 
V (High Load External Circulation type)	SFV  C78	 
Y/YA (High DM-N Rating)	SFY/SFYA  C79, 80	

2-4 Rolled Ball Screw Series

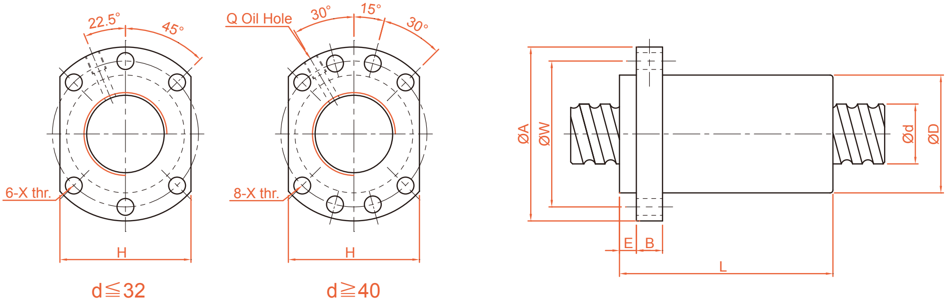
	Nut Type	Flange Type
XSY (Miniature type)	XSY  C81	
XCYA	XCYA  C81	
CNI/I (Standard)	SCNI/SCI  C82	No-Flange

Nut Type		Flange Type
K (Miniature type)	SFK  C83	 (SFK 01004) (SFK 02002) (SFK 02502)
	SFK  C83	
BSH	BSH  d≤12  d≥14 C84	No-Flange

※The information is for specifications, if customized products are needed please contact ***TBI MOTION***.

2-4 Rolled Ball Screw Series

SFA (DIN 69051 FORM B) Series Specifications

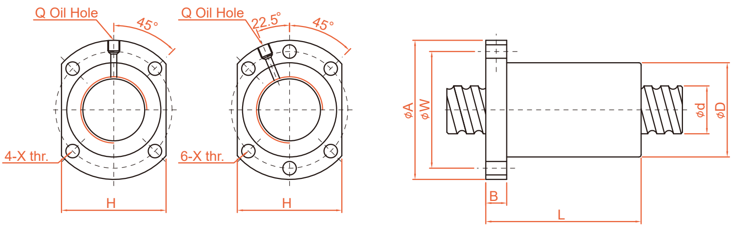


Unit : mm

Model No.	d	l	Da	Dimension										Load Rating		K
				D	A	E	B	L	W	H	X	Q	n	Ca (kgf)	C0a (kgf)	kgf/µm
SFA01205-2.8	12	5	2.5	24	40	5	10	30	32	30	4.5	-	2.8×1	661	1316	19
SFA01210-2.8		10	2.5	24	40	5	10	42	32	30	4.5	-	2.8×1	642	1287	19
SFA01605-3.8	15	5	2.778	28	48	5	10	31	38	40	5.5	M6	3.8×1	1112	2507	30
SFA01610-2.8		10	2.778	28	48	5	10	42	38	40	5.5	M6	2.8×1	839	1821	23
SFA01616-1.8		16	2.778	28	48	5	10	43	38	40	5.5	M6	1.8×1	552	1137	14
SFA01616-2.8		16	2.778	28	48	5	10	59	38	40	5.5	M6	2.8×1	808	1769	22
SFA01620-1.8		20	2.778	28	48	5	10	50	38	40	5.5	M6	1.8×1	554	1170	14
SFA02005-3.8	20	5	3.175	36	58	7	10	33	47	44	6.6	M6	3.8×1	1484	3681	37
SFA02010-3.8		10	3.175	36	58	7	10	52	47	44	6.6	M6	3.8×1	1516	3833	40
SFA02020-1.8		20	3.175	36	58	7	10	52	47	44	6.6	M6	1.8×1	764	1758	19
SFA02020-2.8		20	3.175	36	58	7	10	72	47	44	6.6	M6	2.8×1	1118	2734	29
SFA02505-3.8	25	5	3.175	40	62	7	10	33	51	48	6.6	M6	3.8×1	1650	4658	43
SFA02510-3.8		10	3.175	40	62	7	12	52	51	48	6.6	M6	3.8×1	1638	4633	45
SFA02525-1.8		25	3.175	40	62	7	12	60	51	48	6.6	M6	1.8×1	843	2199	22
SFA02525-2.8		25	3.175	40	62	7	12	85	51	48	6.6	M6	2.8×1	1232	3421	34
SFA03205-3.8	32	5	3.175	50	80	9	12	35	65	62	9	M6	3.8×1	1839	6026	51
SFA03210-3.8	31	10	3.969	50	80	9	12	53	65	62	9	M6	3.8×1	2460	7255	55
SFA03220-2.8		20	3.969	50	80	9	12	72	65	62	9	M6	2.8×1	1907	5482	43
SFA03232-1.8		32	3.969	50	80	9	12	78	65	62	9	M6	1.8×1	1257	3426	27
SFA03232-2.8		32	3.969	50	80	9	12	110	65	62	9	M6	2.8×1	1838	5329	42
SFA04005-3.8	40	5	3.175	63	93	9	14	39	78	70	9	M8	3.8×1	2018	7589	60
SFA04010-3.8	38	10	6.35	63	93	9	14	57	78	70	9	M8	3.8×1	5035	13943	67
SFA04020-2.8		20	6.35	63	93	9	14	78	78	70	9	M8	2.8×1	3959	10715	54
SFA04040-1.8		40	6.35	63	93	9	14	96	78	70	9	M8	1.8×1	2585	6648	34
SFA04040-2.8		40	6.35	63	93	9	14	136	78	70	9	M8	2.8×1	3780	10341	52
SFA05005-3.8●	50	5	3.175	75	110	10.5	15	42	93	85	11	M8	3.8×1	2207	9542	68
SFA05010-3.8●	48	10	6.35	75	110	10.5	18	57	93	85	11	M8	3.8×1	5638	17852	79
SFA05020-3.8●		20	6.35	75	110	10.5	18	98	93	85	11	M8	3.8×1	5749	18485	87
SFA05050-1.8●		50	6.35	75	110	10.5	18	117	93	85	11	M8	1.8×1	2946	8749	42
SFA05050-2.8●		50	6.35	75	110	10.5	18	167	93	85	11	M8	2.8×1	4308	13610	65

※Please contact TBI MOTION if the marked types (●) are required.

SFB (DIN 69051 FORM B) Series Specifications



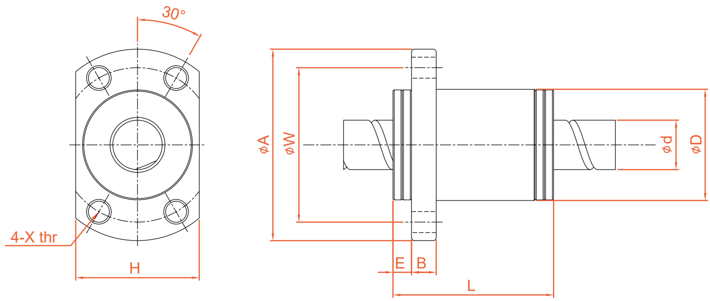
1205/1210 d≦32

單位 : mm

Model No.	d	I	Da	Dimension									Load Rating		K
				D	A	B	L	W	H	X	Q	n	Ca (kgf)	C0a (kgf)	kgf/μm
SFB01205-2.8	12	5	2.5	24	40	10	30	32	30	4.5	M6	2.8x1	661	1316	19
SFB01210-2.8		10	2.5	24	40	10	42	32	30	4.5	M6	2.8x1	642	1287	19
SFB01605-3.8	15	5	2.778	28	48	10	31	38	40	5.5	M6	3.8x1	1112	2507	30
SFB01610-2.8		10	2.778	28	48	10	42	38	40	5.5	M6	2.8x1	839	1821	23
SFB01616-1.8		16	2.778	28	48	10	43	38	40	5.5	M6	1.8x1	552	1137	14
SFB01616-2.8		16	2.778	28	48	10	59	38	40	5.5	M6	2.8x1	808	1769	22
SFB01620-1.8		20	2.778	28	48	10	50	38	40	5.5	M6	1.8x1	554	1170	14
SFB02005-3.8	20	5	3.175	36	58	10	33	47	44	6.6	M6	3.8x1	1484	3681	37
SFB02010-3.8		10	3.175	36	58	10	52	47	44	6.6	M6	3.8x1	1516	3833	40
SFB02020-1.8		20	3.175	36	58	10	52	47	44	6.6	M6	1.8x1	764	1758	19
SFB02020-2.8		20	3.175	36	58	10	72	47	44	6.6	M6	2.8x1	1118	2734	29
SFB02505-3.8	25	5	3.175	40	62	10	33	51	48	6.6	M6	3.8x1	1650	4658	43
SFB02510-3.8		10	3.175	40	62	12	52	51	48	6.6	M6	3.8x1	1638	4633	45
SFB02525-1.8		25	3.175	40	62	12	60	51	48	6.6	M6	1.8x1	843	2199	22
SFB02525-2.8		25	3.175	40	62	12	85	51	48	6.6	M6	2.8x1	1232	3421	34
SFB03205-3.8	32	5	3.175	50	80	12	35	65	62	9	M6	3.8x1	1839	6026	51
SFB03210-3.8	31	10	3.969	50	80	12	53	65	62	9	M6	3.8x1	2460	7255	55
SFB03220-2.8		20	3.969	50	80	12	72	65	62	9	M6	2.8x1	1907	5482	43
SFB03232-1.8		32	3.969	50	80	12	78	65	62	9	M6	1.8x1	1257	3426	27
SFB03232-2.8		32	3.969	50	80	12	110	65	62	9	M6	2.8x1	1838	5329	42

2-4 Rolled Ball Screw Series

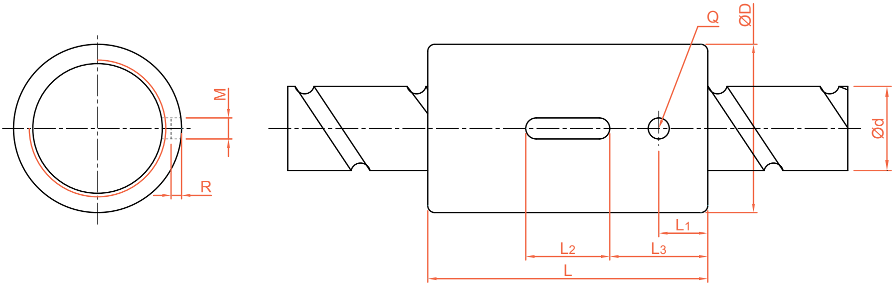
SFJ (DIN 69051 FORM B) Series Specifications



Unit : mm

Model No.	d	I	Da	Dimension										Load Rating		K
				D	A	E	B	L	W	H	X	Q	n	Ca (kgf)	C0a (kgf)	kgf/μm
SFJ00606-1.8	6	6	1.2	14	27	3	4	21	21	16	3.4	-	1.8x1	78	122	4
SFJ00808-1.8	8	8		18	31	3	4	26	25	20	3.4	-	1.8x1	89	164	5

SCNH Series Specifications

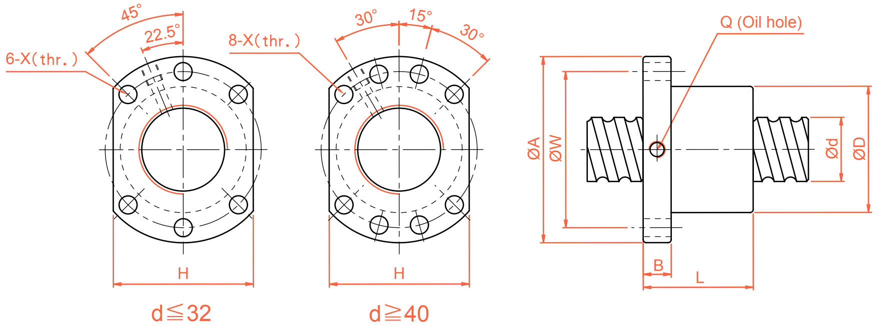


Unit : mm

Model No.	d	l	Da	Dimension									Load Rating		K
				D	L	L1	L2	L3	M	R	Q	n	Ca (kgf)	C0a (kgf)	kgf/µm
SCNH01205-4.8	12	5	2.5	24	40	7	12	14	3	1.5	3	4.8x1	1051	2255	34
SCNH01210-2.8		10	2.5	24	45	8	15	15	3	1.5	3	2.8x1	642	1287	19
XCNH01210-1.8		10	2.5	24	40	10.5	12	14	3	1.5	3	1.8x1	439	827	33
SCNH01605-5.8	15	5	2.778	28	45	7	20	12.5	5	3	3	5.8x1	1599	3827	49
SCNH01610-2.8		10	2.778	28	45	7	20	12.5	5	3	3	2.8x1	839	1821	23
SCNH01616-1.8		16	2.778	28	45	7	20	12.5	5	3	3	1.8x1	552	1137	18
SCNH01620-1.8		20	2.778	28	58	10	20	19	5	3	3	1.8x1	554	1170	14
SCNH02005-5.8	20	5	3.175	36	47	8	20	13.5	5	3	3	5.8x1	2134	5619	60
SCNH02010-3.8		10	3.175	36	55	8	20	17.5	5	3	3	3.8x1	1516	3833	40
SCNH02020-1.8		20	3.175	36	55	8	20	17.5	5	3	3	1.8x1	764	1758	19

2-4 Rolled Ball Screw Series

SFNU/SFU (DIN 69051 FORM B) Series Specifications

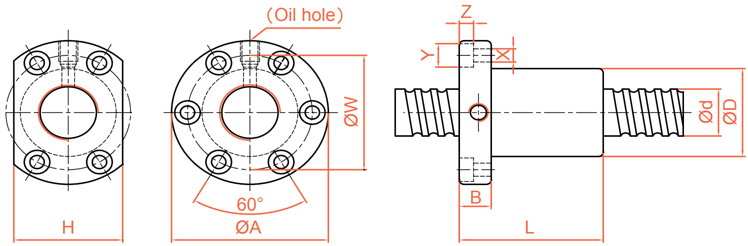


Unit : mm

Model No.	d	I	Da	Dimension									Load Rating		K kgf/μm
				D	A	B	L	W	H	X	Q	n	Ca (kgf)	C0a (kgf)	
SFNU01605-4☆	16	5	3.175	28	48	10	45	38	40	5.5	M6	1x4	1380	3052	32
SFNU01610-3		10	3.175	28	48	10	57	38	40	5.5	M6	1x3	1103	2401	26
SFNU02005-4☆	20	5	3.175	36	58	10	51	47	44	6.6	M6	1x4	1551	3875	39
SFNU02505-4☆	25	5	3.175	40	62	10	51	51	48	6.6	M6	1x4	1724	4904	45
SFNU02510-4		10	4.762	40	62	12	80	51	48	6.6	M6	1x4	2954	7295	50
SFNU03205-4☆	32	5	3.175	50	80	12	52	65	62	9	M6	1x4	1922	6343	54
SFNU03210-4☆		10	6.35	50	80	12	85	65	62	9	M6	1x4	4805	12208	61
SFNU04005-4☆	40	5	3.175	63	93	14	55	78	70	9	M8	1x4	2110	7988	63
SFNU04010-4☆		10	6.35	63	93	14	88	78	70	9	M8	1x4	5399	15500	73
SFNU05010-4☆●	50	10	6.35	75	110	16	88	93	85	11	M8	1x4	6004	19614	85
SFNU06310-4●	63	10	6.35	90	125	18	93	108	95	11	M8	1x4	6719	25358	99
SFNU06320-4●	63	20	9.525	95	135	20	149	115	100	13.5	M8	1x4	11444	36653	112
SFNU08010-4●	80	10	6.35	105	145	20	93	125	110	13.5	M8	1x4	7346	31953	109
SFNU08020-4●	80	20	9.525	125	165	25	154	145	130	13.5	M8	1x4	12911	47747	138
SFU01204-4	12	4	2.5	24	40	10	40	32	30	4.5		1x4	902	1884	26
SFU01604-4	16	4	2.381	28	48	10	40	38	40	5.5	M6	1x4	973	2406	32
SFU02004-4	20	4	2.381	36	58	10	42	47	44	6.6	M6	1x4	1066	2987	38
SFU02504-4	25	4	2.381	40	62	10	42	51	48	6.6	M6	1x4	1180	3795	43
SFU03204-4	32	4	2.381	50	80	12	44	65	62	9	M6	1x4	1296	4838	51
SFU10020-4●	100	20	9.525	150	202	30	180	170	155	17.5	M8	1x4	14303	60698	162

※ ☆ Left helix available ※Please contact TBI MOTION if the marked types (●) are required.
※Standard ball nut SFU01204-4 is assembled without wiper.

SFNI/SFI Series Specifications



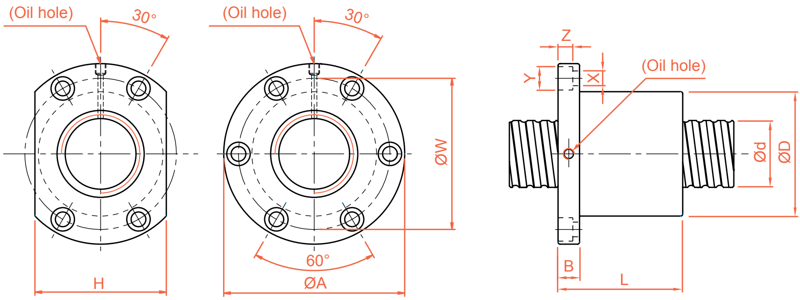
Unit : mm

Model No.	d	l	Da	Dimension											Load Rating		K
				D	A	B	L	W	H	X	Y	Z	Q	n	Ca (kgf)	C0a (kgf)	kgf/μm
SFNI01605-4★	16	5	3.175	30	49	10	45	39	34	4.5	8	4.5	M6	1x4	1380	3052	33
SFNI01610-3		10	3.175	34	58	10	57	45	34	5.5	9.5	5.5	M6	1x3	1103	2401	27
SFNI02005-4★	20	5	3.175	34	57	11	51	45	40	5.5	9.5	5.5	M6	1x4	1551	3875	39
SFNI02505-4★	25	5	3.175	40	63	11	51	51	46	5.5	9.5	5.5	M8	1x4	1724	4904	45
SFNI02510-4		10	4.762	46	72	12	80	58	52	6.5	11	6.5	M6	1x4	2954	7295	51
SFNI03205-4★	32	5	3.175	46	72	12	52	58	52	6.5	11	6.5	M8	1x4	1922	6343	52
SFNI03210-4★		10	6.35	54	88	15	85	70	62	9	14	8.5	M8	1x4	4805	12208	62
SFNI04005-4★	40	5	3.175	56	90	15	55	72	64	9	14	8.5	M8	1x4	2110	7988	59
SFNI04010-4★		10	6.35	62	104	18	88	82	70	11	17.5	11	M8	1x4	5399	15500	72
SFNI05010-4★●	50	10	6.35	72	114	18	88	92	82	11	17.5	11	M8	1x4	6004	19614	83
SFNI06310-4●	63	10	6.35	85	131	22	93	107	95	14	20	13	M8	1x4	6719	25358	95
SFNI08010-4●	80	10	6.35	105	150	22	93	127	115	14	20	13	M8	1x4	7346	31953	109
SFI01604-4	16	4	2.381	30	49	10	45	39	34	4.5	8	4.5	M6	1x4	973	2406	32
SFI02004-4	20	4	2.381	34	57	11	46	45	40	5.5	9.5	5.5	M6	1x4	1066	2987	37
SFI02504-4	25	4	2.381	40	63	11	46	51	46	5.5	9.5	5.5	M6	1x4	1180	3795	43
SFI03204-4	32	4	2.381	46	72	12	47	58	52	6.5	11	6.5	M6	1x4	1296	4838	49

※Please contact TBI MOTION if the marked types (●) are required.

2-4 Rolled Ball Screw Series

SFV Series Specifications

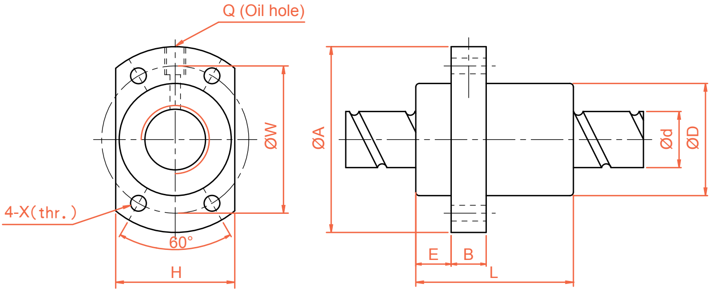


Unit : mm

Model No.	d	l	Da	Dimension											Load Rating		K
				D	A	B	L	W	H	X	Y	Z	Q	n	Ca (kgf)	C0a (kgf)	kgf/μm
SFV01205-2.8	12	5	2.5	30	50	10	42	40	32	4.5	8	4.5	M6	2.8x1	661	1316	19
SFV01210-2.7		10	2.5	30	50	10	53	40	32	4.5	8	4.5	M6	2.7x1	623	1241	18
SFV01605-4.8	16	5	3.175	40	63	11	58	51	42	5.5	9.5	5.5	M6	4.8x1	1614	3662	40
SFV01610-2.7		10	3.175	40	63	11	56	51	42	5.5	9.5	5.5	M6	2.7x1	1008	2161	24
SFV02005-4.8	20	5	3.175	44	67	11	57	55	52	5.5	9.5	5.5	M6	4.8x1	1814	4650	47
SFV02020-1.8		20	3.175	46	74	13	70	59	46	6.6	11	6.5	M6	1.8x1	764	1758	19
SFV02505-4.8	25	5	3.175	50	73	11	55	61	52	5.5	9.5	5.5	M8	4.8x1	2017	5884	56
SFV02525-1.8		25	3.175	50	73	13	83	61	52	5.5	9.5	5.5	M8	1.8x1	843	2199	22
SFV03204-4.8	32	4	2.381	54	81	12	50	67	64	6.6	11	6.5	M6	4.8x1	1517	5806	62
SFV03205-4.8		5	3.175	58	85	12	56	71	64	6.6	11	6.5	M8	4.8x1	2249	7612	66
SFV03210-4.8		10	6.35	74	108	15	96	90	82	9	14	9	M8	4.8x1	5620	14649	76
SFV04005-4.8	40	5	3.175	67	101	15	59	83	72	9	14	8.5	M8	4.8x1	2468	9586	76
SFV04010-4.8		10	6.35	82	124	18	100	102	94	11	17.5	11	M8	4.8x1	6316	18600	90
SFV04020-2.7		20	6.35	82	124	18	100	102	90	11	17.5	11	M8	2.7x1	3935	10893	56
SFV05005-4.8●	50	5	3.175	80	114	15	60	96	82	9	14	8.5	M8	4.8x1	2698	12053	87
SFV05010-4.8●		10	6.35	93	135	16	93	113	98	11	17.5	11	M8	4.8x1	7023	23537	106
SFV05020-2.7●		20	9.525	105	152	28	121	128	110	14	20	13	M8	2.7x1	7336	19700	68
SFV06310-4.8●	63	10	6.35	108	154	22	105	130	110	14	20	13	M8	4.8x1	7860	30430	126
SFV06320-2.7●		20	9.525	122	180	28	120	150	130	18	26	17.5	M8	2.7x1	8162	24741	80
SFV08010-4.8●	80	10	6.35	130	176	22	105	152	132	14	20	13	M8	4.8x1	8593	38344	145
SFV08020-4.8●		20	9.525	143	204	28	180	172	148	18	26	18	M8	4.8x1	15103	57296	168
SFV08020-7.6●		20	9.525	143	204	28	240	172	148	18	26	18	M8	3.8x2	22423	90719	260

※Please contact TBI MOTION if the marked types (●) are required.

SFY Series Specifications



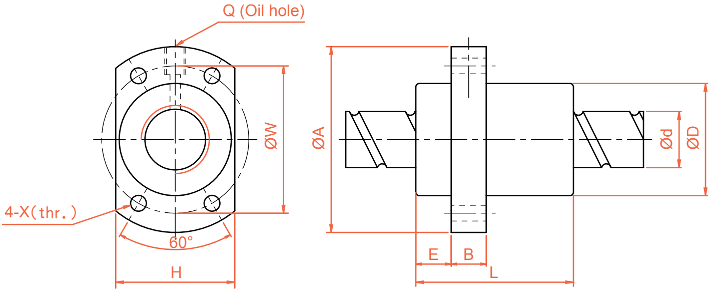
Unit : mm

Large Lead Model No.	d	l	Da	Dimension										Load Rating		K
				D	A	E	B	L	W	H	X	Q	n	Ca (kgf)	C0a (kgf)	kgf/μm
SFY02020-3.6	20	20	3.175	39	62	13	10	52	50	41	5.5	M6	1.8x2	1387	3515	37
SFY02525-3.6	25	25	3.969	47	74	15	12	64	60	49	6.6	M6	1.8x2	2074	5494	45
SFY04040-3.6	40	40	6.35	73	114	19.5	15	99	93	75	11	M6	1.8x2	4831	14062	70
SFY05050-3.6●	50	50	7.938	90	135	21.5	20	117	112	92	14	M6	1.8x2	7220	21974	86
Twin Lead Model No.	**d**	**l**	**Da**	**Dimension**										**Ca (kgf)**	**C0a (kgf)**	**K kgf/μm**
				D	**A**	**E**	**B**	**L**	**W**	**H**	**X**	**Q**	**n**			
SFY01632-1.6	16	32	2.778	32	53	10.1	10	42.5	42	34	4.5	M6	0.8x2	493	1116	11
SFY02550-1.6	25	50	3.969	47	74	15	12	58	60	49	6.6	M6	0.8x2	976	2495	19
SFY03264-1.6	32	64	4.762	58	92	17	12	71	74	60	9	M6	0.8x2	1374	3571	22
SFY050100-1.6●	50	100	7.938	90	135	21.5	20	111	112	92	14	M6	0.8x2	3398	9980	35

※Please contact TBI MOTION if the marked types (●) are required.

2-4 Rolled Ball Screw Series

SFYA Series Specifications

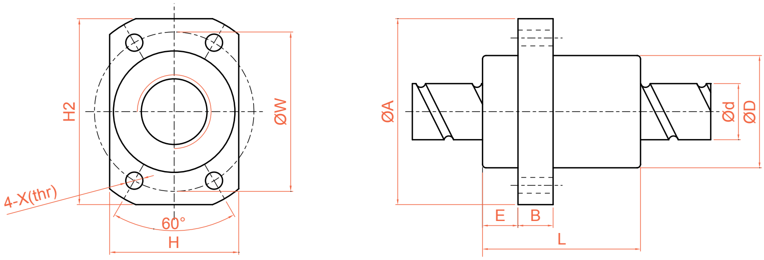


Unit : mm

Large Lead Model No.	d	l	Da	Dimension										Load Rating		K kgf/μm
				D	A	E	B	L	W	H	X	Q	n	Ca (kgf)	C0a (kgf)	
SFYA01616-3.6	16	16	2.778	32	53	10.1	10	45	42	34	4.5	M6	1.8*2	1073	2551	31
SFYA02020-3.6	20	20	3.175	39	62	13	10	52	50	41	5.5	M6	1.8*2	1387	3515	37
SFYA02525-3.6	25	25	3.969	47	74	15	12	64	60	49	6.6	M6	1.8*2	2074	5494	45
SFYA03232-3.6	32	32	4.762	58	92	17	12	78	74	60	9	M6	1.8*2	3021	8690	58
SFYA04040-3.6	40	40	6.35	73	114	19.5	15	99	93	75	11	M6	1.8*2	4831	14062	70
SFYA05050-3.6	50	50	7.938	90	135	21.5	20	117	112	92	14	M6	1.8*2	7220	21974	86
Twin Lead Model No.	**d**	**l**	**Da**	**Dimension**										**Ca (kgf)**	**C0a (kgf)**	**K kgf/μm**
				D	**A**	**E**	**B**	**L**	**W**	**H**	**X**	**Q**	**n**			
SFYA01632-1.6	16	32	2.778	32	53	10.1	10	42.5	42	34	4.5	M6	0.8*2	493	1116	11
SFYA02040-1.6	20	40	3.175	39	62	13	10	48	50	41	5.5	M6	0.8*2	653	1597	15
SFYA02550-1.6	25	50	3.969	47	74	15	12	58	60	49	6.6	M6	0.8*2	976	2495	19
SFYA03264-1.6	32	64	4.762	58	92	17	12	71	74	60	9	M6	0.8*2	1374	3571	22
SFYA04080-1.6	40	80	6.35	73	114	19.5	15	90	93	75	11	M6	0.8*2	2273	6387	29
SFYA050100-1.6	50	100	7.938	90	135	21.5	20	111	112	92	14	M6	0.8*2	3398	9980	35

※Please contact TBI MOTION if the marked types (●) are required.

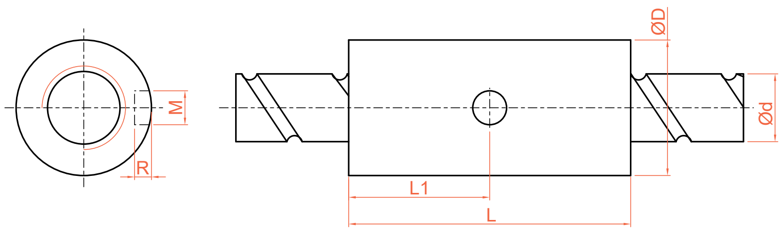
XSY Series Specifications



Unit : mm

Model No.	d	I	Da	Dimension										Load Rating		K
				D	A	E	B	L	W	H	H2	X	n	Ca (kgf)	C0a (kgf)	kgf/μm
XSYR01220A2D-00	12	20	2.5	24	41	3.8	5	50	32	24	36	4.5	1.8x2	777	1718	13

XCYA Series Specifications



單位 : mm

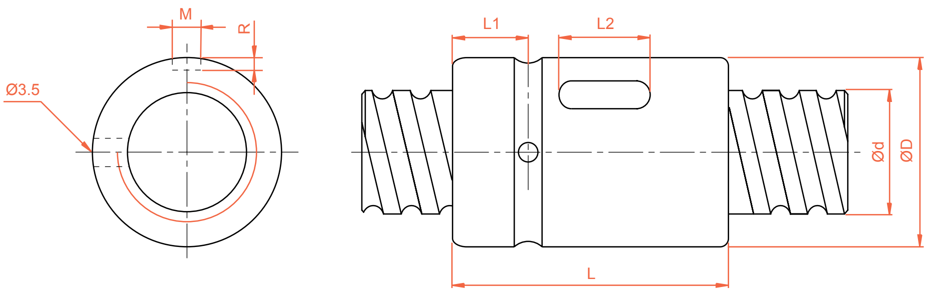
Model No.	d	I	Da	Dimension						Load Rating		K
				D	L	L_1	M	R	n	Ca (kgf)	C0a (kgf)	kgf/μm
XCYAR01220A2-00	12	20	2.5	24	50	25	6	3	1.8*2	777	1718	13

C

Ball Screw

2-4 Rolled Ball Screw Series

SCNI/SCI Series Specifications

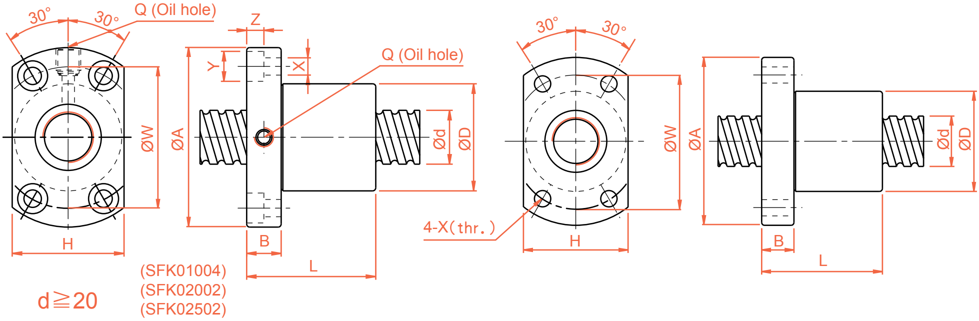


Unit : mm

Model No.	d	I	Da	Dimension							Load Rating		K
				D	L	L1	L2	M	R	n	Ca (kgf)	C0a (kgf)	kgf/μm
SCNI 01605-4	16	5	3.175	30	45	9	20	5	3	1x4	1380	3052	33
SCNI 02005-4	20	5	3.175	34	45	9	20	5	3	1x4	1551	3875	39
SCNI 02505-4	25	5	3.175	40	45	9	20	5	3	1x4	1724	4904	45
SCNI 02510-4		10	4.762	46	85	13	30	5	3	1x4	2954	7295	51
SCNI 03205-4	32	5	3.175	46	45	9	20	5	3	1x4	1922	6343	52
SCNI 03210-4		10	6.35	54	85	13	30	5	3	1x4	4805	12208	62
SCNI 04005-4	40	5	3.175	56	45	9	20	5	3	1x4	2110	7988	59
SCNI 04010-4		10	6.35	62	85	13	30	5	3	1x4	5399	15500	72
SCNI 05010-4●	50	10	6.35	72	85	13	30	5	3	1x4	6004	19614	83
SCNI 06310-4●	63	10	6.35	85	85	13	30	6	3.5	1x4	6719	25358	95
SCNI 08010-4●	80	10	6.35	105	85	13	30	8	4.5	1x4	7346	31953	109
SCI 01604-4	16	4	2.381	30	40	9	15	3	1.5	1x4	973	2406	32
SCI 02004-4	20	4	2.381	34	40	9	15	3	1.5	1x4	1066	2987	37
SCI 02504-4	25	4	2.381	40	40	9	15	3	1.5	1x4	1180	3795	43
SCI 03204-4	32	4	2.381	46	40	9	15	3	1.5	1x4	1296	4838	49

※Please contact TBI MOTION if the marked types (●) are required.

SFK Series Specifications



Unit : mm

Model No.	d	l	Da	Dimension											Ca (kgf)	C0a (kgf)	K kgf/μm
				D	A	B	L	W	H	X	Y	Z	Q	n			
SFK00601	6	1	0.8	12	24	3.5	15	18	16	3.4	-	-	-	1x3	111	224	9
SFK00801	8	1	0.8	14	27	4	16	21	18	3.4	-	-	-	1x4	161	403	14
SFK00802		2	1.2	14	27	4	18	21	18	3.4	-	-	-	1x3	222	458	13
SFK0082.5		2.5	1.2	16	29	4	26	23	20	3.4	-	-	-	1x3	221	457	13
SFK01002	10	2	1.2	18	35	5	28	27	22	4.5	-	-	-	1x3	243	569	15
SFK01004		4	2	20	37	6	34	29	28	4.5	-	-	-	1x3	468	905	17
SFK01202	12	2	1.2	20	37	5	28	29	24	4.5	-	-	-	1x4	334	906	22
SFK01205		5	2.5	22	37	8	39	29	24	4.5	-	-	-	1x3	702	1409	17
SFK01402	14	2	1.2	21	40	6	23	31	26	5.5	-	-	-	1x4	354	1053	24
SFK01404		4	2.5	25	42	10	45	35	29	4.5	-	-	-	1x4	957	2155	16
XSK01004	10	4	2	26	46	10	34	36	28	4.5	8	4.5	M6x1	1x3	468	905	17
XSK01404	14	4	2.5	26	46	10	45	36	28	4.5	8	4.5	M6x1	1x4	957	2145	16

※Type K standard ball Nut is available for with or without wiper, please contact TBI sales representatives.

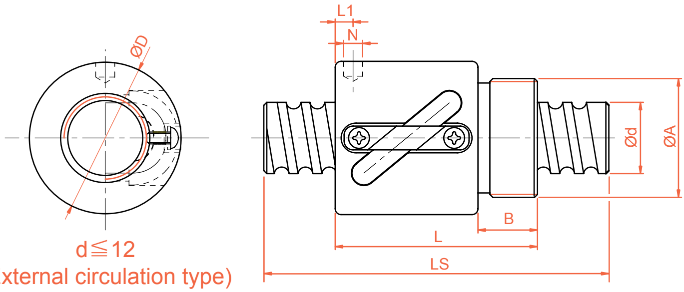
Unit : mm

Model No.	d	l	Da	Dimension											Ca (kgf)	C0a (kgf)	K kgf/μm
				D	A	B	L	W	H	X	Y	Z	Q	n			
XSUR01204T3D-02	12	4	2.5	24	40	6	28	32	25	3.5	-	-	-	1x3	454	722	-

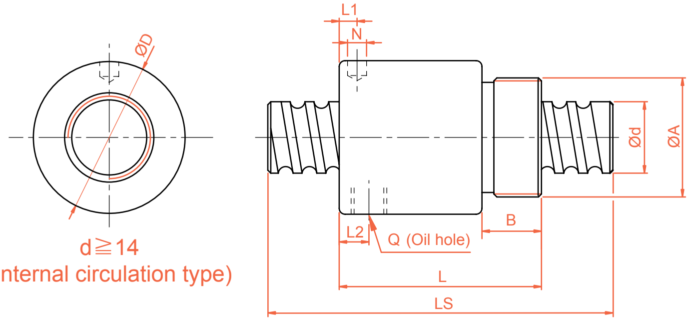
※Standard ball nut XSUR01204T3D-02 is assembled without wiper.

2-4 Rolled Ball Screw Series

BSH Series Specifications



d≦12
(External circulation type)



d≧14
(Internal circulation type)

Unit : mm

Model No.	d	l	Da	Dimension									Ca (kgf)	C0a (kgf)	K kgf/μm
				D	A	B	L	L1	N	L2	Q	n			
BSH0082.5-2.5	8	2.5	1.2	17.5	M15x1P	7.5	23.5	10	3	-	-	2.5x1	189	381	11
BSH01002-3.5	10	2	1.2	19.5	M17x1P	7.5	22	3	3.2	-	-	3.5x1	277	664	17
BSH01004-2.5		4	2	25	M20x1P	10	34	3	3	-	-	2.5x1	400	754	14
BSH01204-3.5	12	4	2.5	25.5	M20x1P	10	34	13	3	-	-	3.5x1	804	1649	23
BSH01205-3.5		5	2.5	25.5	M20x1P	10	39	16.25	3	-	-	3.5x1	801	1644	24
BSH01404-3	14	4	2.5	32.1	M25x1.5P	10	35	11	3	-	-	1x3	748	1609	26
BSH01604-3	16	4	2.381	29	M22x1.5P	8	32	4	3.2	-	-	1x3	759	1804	24
BSH01605-3		5	3.175	32.5	M26x1.5P	12	42	19.25	3	-	-	1x3	1077	2289	25
BSH01610-2		10	3.175	32	M26x1.5P	12	50	3	4	3	M4	1x2	779	1601	14
BSH02005-3	20	5	3.175	38	M35x1.5P	15	45	20.3	3	-	-	1x3	1211	2906	30
BSH02505-4	25	5	3.175	43	M40x1.5P	19	69	32.11	3	8	M6	1x4	1724	4904	37
BSH02510-4		10	4.762	43	M40x1.5P	19	84	8	6	8	M6	1x4	2954	7295	41

※Standard ballnut from Ø8~Ø16 is assembled without wiper.

2-5 Ball Screw Weight List

Model No.	Weight	
	Ball Nut(kg)	Screw Shaft(kg/m)
SFA		
SFA01205-2.8	0.112	0.87
SFA01210-2.8	0.135	0.87
SFA01605-3.8	0.165	1.37
SFA01610-2.8	0.195	1.37
SFA01616-1.8	0.202	1.37
SFA01616-2.8	0.245	1.37
SFA01620-1.8	0.218	1.37
SFA01630-1.8	0.285	1.37
SFA02005-3.8	0.234	2.45
SFA02010-3.8	0.329	2.45
SFA02020-1.8	0.324	2.45
SFA02020-2.8	0.425	2.45
SFA02505-3.8	0.259	3.83
SFA02510-3.8	0.374	3.83
SFA02525-1.8	0.409	3.83
SFA02525-2.8	0.554	3.83
SFA03205-3.8	0.466	6.29
SFA03210-3.8	0.626	5.89
SFA03220-2.8	0.780	5.89
SFA03232-1.8	0.824	5.89
SFA03232-2.8	1.176	5.89
SFA04005-3.8	0.808	9.84
SFA04010-3.8	0.993	8.82
SFA04020-2.8	1.26	8.82
SFA04040-1.8	1.500	8.82
SFA04040-2.8	2.135	8.82
SFA05005-3.8	1.15	15.39
SFA05010-3.8	1.43	14.12
SFA05020-3.8	2.149	14.12
SFA05050-1.8	2.400	14.12
SFA05050-2.8	3.5	14.12
SFB		
SFB01205-2.8	0.112	0.87
SFB01210-2.8	0.14	0.87
SFB01605-3.8	0.164	1.37
SFB01610-2.8	0.196	1.37
SFB01616-1.8	0.199	1.37
SFB01616-2.8	0.245	1.37
SFB01620-1.8	0.221	1.37
SFB02005-3.8	0.236	2.45

Model No.	Weight	
	Ball Nut(kg)	Screw Shaft(kg/m)
SFB02010-3.8	0.328	2.45
SFB02020-1.8	0.329	2.45
SFB02020-2.8	0.425	2.45
SFB02505-3.8	0.267	3.83
SFB02510-3.8	0.385	3.83
SFB02525-1.8	0.426	3.83
SFB02525-2.8	0.554	3.83
SFB03205-3.8	0.464	6.29
SFB03210-3.8	0.637	5.89
SFB03220-2.8	0.783	5.89
SFB03232-1.8	0.824	5.89
SFB03232-2.8	1.176	5.89
SFJ		
SFJ00606-1.8	0.019	0.2
SFJ00808-1.8	0.050	0.405
SCNH		
SCNH01205-4.8	0.092	0.87
SCNH01210-2.8	0.100	0.87
XCNH01210-1.8	0.080	0.87
SCNH01605-5.8	0.139	1.37
SCNH01610-2.8	0.136	1.37
SCNH01616-1.8	0.136	1.37
SCNH01620-1.8	0.166	1.37
SCNH02005-5.8	0.214	2.45
SCNH02010-3.8	0.254	2.45
SCNH02020-1.8	0.249	2.45
SFNU		
SFNU01605-4	0.183	1.56
SFNU01610-3	0.215	1.56
SFNU02005-4	0.306	2.45
SFNU02505-4	0.336	3.83
SFNU02510-4	0.471	3.81
SFNU03205-4	0.581	6.29
SFNU03210-4	0.751	6.23
SFNU04005-4	0.965	9.84
SFNU04010-4	1.218	9.78
SFNU05010-4	1.847	15.33
SFNU05020-4	2.674	15.31
SFNU06310-4	2.508	24.39
SFNU06320-4	4.353	24.28
SFNU08010-4	2.950	39.38

2-5 Ball Screw Weight List

Model No.	Weight	
	Ball Nut(kg)	Screw Shaft(kg/m)
SFNU08020-4	8.720	39.27
SFU		
SFU01204-4	0.13	0.87
SFU01604-4	0.168	1.57
SFU02004-4	0.291	2.45
SFU02504-4	0.384	3.84
SFU02506-4	0.4	3.82
SFU02508-4	0.410	3.81
SFU03204-4	0.566	6.30
SFU03206-4	0.660	6.28
SFU03208-4	0.73	6.27
SFU04006-4	1.076	9.83
SFU04008-4	1.200	9.82
SFU10020-4	10	61.47
OFU		
OFU01605-4	0.270	1.56
OFU02005-4	0.471	2.45
OFU02505-4	0.521	3.83
OFU02510-4	0.808	3.81
OFU03205-4	0.878	6.29
OFU03210-4	1.253	6.23
OFU04005-4	1.467	9.84
OFU04010-4	2.042	9.78
OFU05010-4	2.841	15.33
OFU06310-4	3.903	24.39
OFU08010-4	4.645	39.38
SFNI		
SFNI01605-4	0.194	1.56
SFNI01610-3	0.325	1.56
SFNI02005-4	0.269	2.45
SFNI02505-4	0.339	3.83
SFNI02510-4	0.744	3.81
SFNI03205-4	0.401	6.29
SFNI03210-4	1.140	6.23
SFNI04005-4	0.888	9.84
SFNI04010-4	1.310	9.78
SFNI05010-4	1.712	15.33
SFNI06310-4	2.674	24.39
SFNI08010-4	3.90	39.38
SFI		
SFI01604-4	0.195	1.57

Model No.	Weight	
	Ball Nut(kg)	Screw Shaft(kg/m)
SFI02004-4	0.269	2.45
SFI02504-4	0.330	3.84
SFI03204-4	0.425	6.30
OFI		
OFI01605-4	0.318	1.56
OFI02005-4	0.440	2.45
OFI02505-4	0.570	3.83
OFI02510-4	1.348	3.81
OFI03205-4	0.63	6.29
OFI03210-4	1.65	6.23
OFI04005-4	1.055	9.84
OFI04010-4	2.082	9.78
OFI05010-4	2.581	15.33
OFI06310-4	3.44	24.39
OFI08010-4	5.233	39.38
SFV		
SFV01205-2.8	0.215	0.87
SFV01210-2.7	0.265	0.87
SFV01510-2.7	0.350	1.37
SFV01605-4.8	0.500	1.56
SFV01610-2.7	0.474	1.56
SFV02005-4.8	0.581	2.45
SFV02010-2.7	0.661	2.43
SFV02020-1.8	0.700	2.45
SFV02505-4.8	0.656	3.83
SFV02506-4.8	0.672	3.82
SFV02508-4.8	1.165	3.81
SFV02510-2.7	1.944	3.77
SFV02525-1.8	0.850	3.83
SFV03204-4.8	0.850	6.30
SFV03205-4.8	0.883	6.29
SFV03206-4.8	0.950	6.28
SFV03208-4.8	1.725	6.27
SFV03210-4.8	2.673	6.23
SFV03220-2.7	2.908	6.23
SFV04005-4.8	1.262	9.84
SFV04010-4.8	3.389	9.78
SFV04020-2.7	3.315	9.78
SFV05005-4.8	1.836	15.39
SFV05010-4.8	3.626	15.33
SFV05020-2.7	6.526	15.23

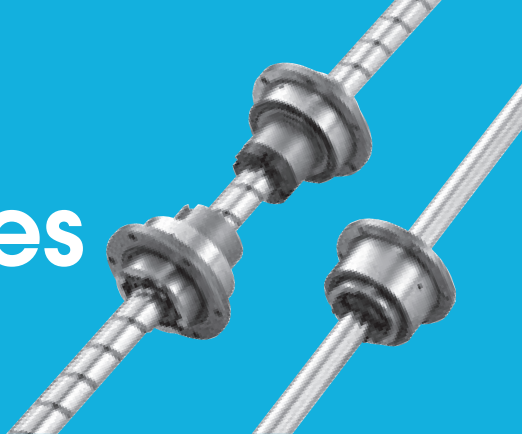
Model No.	Weight	
	Ball Nut(kg)	Screw Shaft(kg/m)
SFV06310-4.8	5.278	24.39
SFV06320-2.7	9.430	24.28
SFV08010-4.8	7.201	39.38
SFV08020-4.8	16.023	39.27
SFV08020-7.6	21.478	39.27
OFV		
OFV01605-4.8	0.800	1.56
OFV02005-4.8	1.066	2.45
OFV02505-4.8	1.212	3.83
OFV03205-4.8	1.418	6.29
OFV03210-4.8	4.978	6.23
OFV04005-4.8	2.226	9.84
OFV04010-4.8	5.450	9.78
OFV05010-4.8	6.086	15.33
OFV06310-4.8	8.358	24.39
OFV08010-4.8	12.890	39.38
SFY		
SFY01616-5.6	0.305	1.55
SFY01632-1.6	0.215	1.55
SFY01632-3.6	0.360	1.55
SFY02020-3.6	0.380	2.42
SFY02020-5.6	0.506	2.42
SFY02040-3.6	0.604	2.42
SFY02525-3.6	0.655	3.79
SFY02525-5.6	0.884	3.79
SFY02550-1.6	0.596	3.79
SFY02550-3.6	1.056	3.79
SFY03232-5.6	1.670	6.22
SFY03264-1.6	1.066	6.22
SFY03264-3.6	2.006	6.22
SFY04040-3.6	2.288	9.70
SFY04040-5.6	3.24	9.70
SFY05050-3.6	4.025	15.15
SFY50100-1.6	3.818	15.15
SFY50100-3.6	7.12	15.15
SFYA		
SFYA01616-3.6	0.230	1.37
SFYA01616-5.6	0.925	1.37
SFYA01632-1.6	0.217	1.37
SFYA01632-3.6	0.355	1.37
SFYA02020-3.6	0.384	2.45

Model No.	Weight	
	Ball Nut(kg)	Screw Shaft(kg/m)
SFYA02020-5.6	0.530	2.45
SFYA02040-1.6	0.357	2.45
SFYA02040-3.6	0.614	2.45
SFYA02525-3.6	0.649	3.83
SFYA02525-5.6	0.895	3.83
SFYA02550-1.6	0.604	3.83
SFYA02550-3.6	1	3.83
SFYA03232-3.6	1.161	5.89
SFYA03232-5.6	1.671	5.89
SFYA03264-1.6	1.071	5.89
SFYA03264-3.6	1.996	5.89
SFYA04040-3.6	2.317	8.82
SFYA04040-5.6	3.290	8.82
SFYA04080-1.6	2.010	8.82
SFYA04080-3.6	3.620	8.82
SFYA05050-3.6	3.790	14.12
SFYA05050-5.6	5.700	14.12
SFYA050100-1.6	3.847	14.12
SFYA050100-3.6	7.162	14.12
SCNI		
SCNI01605-4	0.145	1.56
SCNI02005-4	0.168	2.45
SCNI02505-4	0.220	3.83
SCNI02510-4	0.656	3.81
SCNI03205-4	0.243	6.29
SCNI03210-4	0.766	6.23
SCNI04005-4	0.393	9.84
SCNI04010-4	0.905	9.78
SCNI05010-4	1.190	15.33
SCNI06310-4	1.520	24.39
SCNI08010-4	2.292	39.38
SCI01604-4	0.130	1.57
SCI02004-4	0.160	2.45
SCI02504-4	0.220	3.84
SCI03204-4	0.200	6.30
SFK		
SFK00401	0.012	0.1
SFK00601	0.014	0.22
SFK00801	0.022	0.39
SFK00802	0.019	0.39
SFK0082.5	0.034	0.39

2-5 Ball Screw Weight List

Model No.	Weight	
	Ball Nut(kg)	Screw Shaft(kg/m)
SFK01002	0.049	0.61
SFK01004	0.080	0.61
SFK01202	0.055	0.88
SFK01205	0.080	0.87
SFK01402	0.650	1.21
SFK01404	0.116	1.2
SFK02002	1	2.46
SFK02502	0.380	3.85
XSK01004	0.146	0.61
XSK01404	0.121	1.2
XSU		
XSU01204T3D-02	0.087	0.87
BSH		
BSH0082.5-2.5	0.033	0.39
BSH01002-3.5	0.031	0.61
BSH01004-2.5	0.085	0.61
BSH01204-3.5	0.077	0.87
BSH01205-3.5	0.102	0.87
BSH01404-3	0.144	1.20
BSH01604-3	0.112	1.57
BSH01605-3	0.140	1.56
BSH01610-2	0.170	1.56
BSH02005-3	0.215	2.45
BSH02505-4	0.388	3.83
BSH02510-4	0.504	3.81
XSV		
XSV01210-01	0.262	0.87
XSV01510-00	0.314	1.37
XSV01520-01	0.329	1.37
XSV02010-00	0.646	2.43
XSV02020-00	0.745	0.39
XSY		
XSY01220A2D-00	0.124	0.87
XCYA		
XCYA01220A2-00	0.095	0.87

Rotary Series



1-1 Features of *TBI MOTION* Precision Rotary Ball Screw/Spline

TBI MOTION rotary ball screw and spline is designed to move linearly and rotationally in one assembly, with symmetrical orientation design between the outer and inner ball screw or spline nut. Both rotary and spiral movement can be achieved simultaneously.

TBI MOTION rotary line is the most ideal key component in scara robots, industrial robots, pick & place, laser engraving, transporting and many other multi-directional application.

Feature

Zero clearance/High rigidity

TBI MOTION rotary series featured 40° angular (Back to back) contact angle within in the bearing. It enables self-aligning with minor mounting error and bears higher axial load to achieve better accuracy. Custom preload can be applied to reduce clearance and increase high rigidity. (as shown in Fig 1.1.1)

High speed/Smooth running performance

The rotary series uses ***TBI MOTION*** high lead screw to maintain high speed and smoothness during operating.

Noise reduction

The precision ground screw thread and spline groove make sure the ball bearing travel fluently during operations which reduce the skidding, friction and noise level and thus improve the service performance and life.

Easy-Assembly/Compactness

TBI MOTION rotary line features a one-piece compact and easy mounting design.

Accuracy

Please refer to chart D05~09 for detail.

Spline alternative

TBI MOTION offers customized end for ball spline. Hollow spline is also available for special operation requirement such as pipe or wire-arrangement, evacuating and light weight.

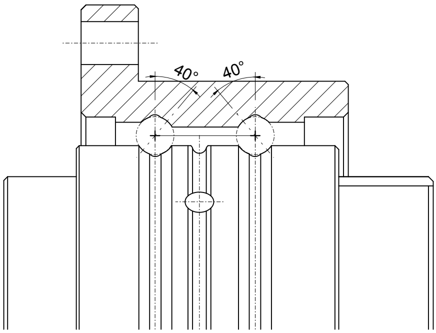
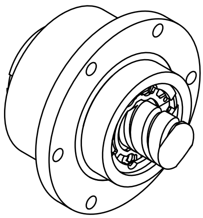
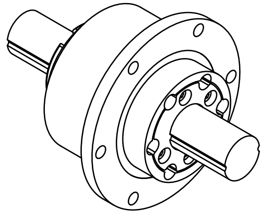
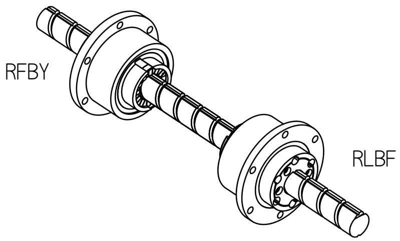
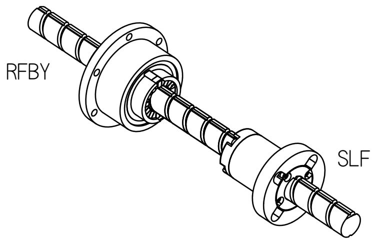


Fig 1.1.1 DB-type (Back to back)

Table 1.1.1 Mass series

Rotary Ball Screw - RFBY Type	Rotary Ball Spline - RLBF Type
	
Ball Screw/Spline - RBBY Type	**Ball Screw/Spline - RBLY Type**
	

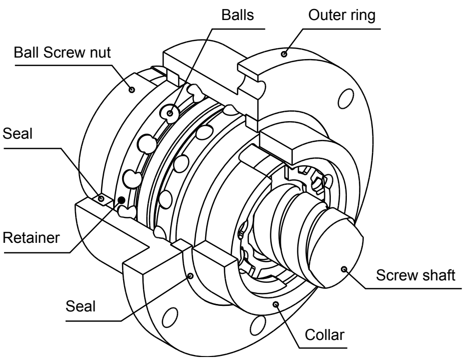


Fig 1.1.2 The Structure of RFBY - series

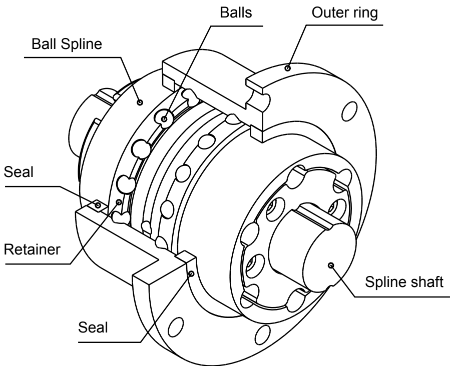
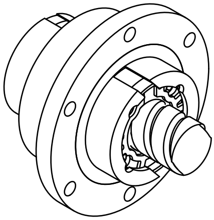
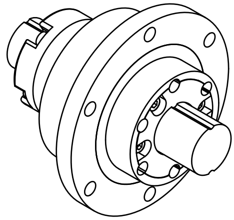
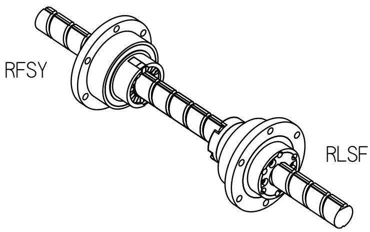
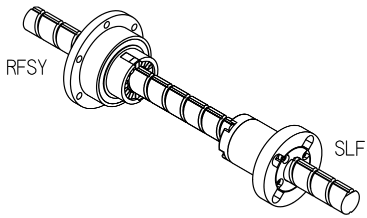


Fig 1.1.3 The Structure of RLBF - series

1-1 Features of *TBI MOTION* Precision Rotary Ball Screw/Spline

Table 1.1.2 Compact series

Rotary Ball Screw - RFSY Type	Rotary Ball Spline - RLSF Type
	
Ball Screw/Spline - RSSY Type	**Ball Screw/Spline - RSLY Type**
	

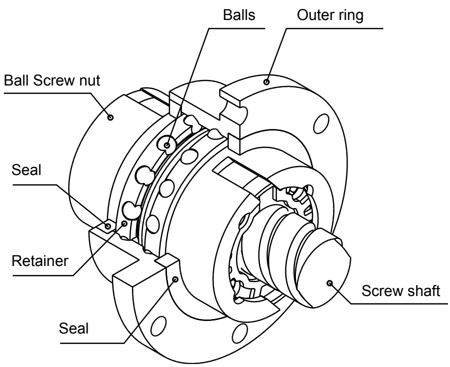


Fig 1.1.4 The Structure of RFSY - series

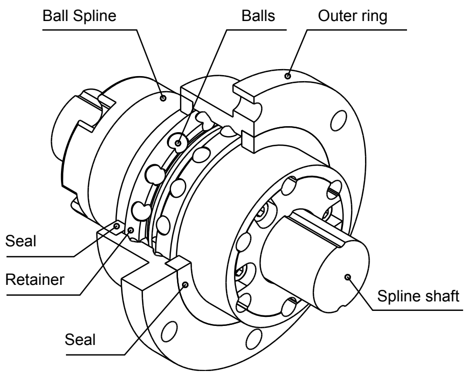


Fig 1.1.5 The Structure of RLSF - series

1-2 Accuracy

■ 1-2-1 RBBY, RBLY Accuracy Standards

The Ball Screw/Spline is manufactured as the following specifications.

【Ball Screw】

Axial clearance : 0 or less
Lead accuracy : C5
(Refer to C06 for more details)

【Ball Spline】

Clearance in the rotational direction : 0 or less
(P1 : light preload)
(Refer to B20-21 for more details)
Accuracy grade : class H
(Refer to B22 for more details)

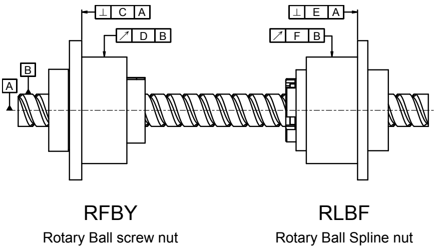


Fig 1.2.1 RBBY - series

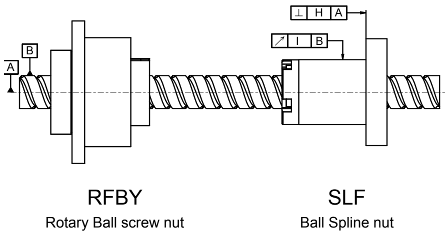


Fig 1.2.2 RBLY - series

Model No.	C	D	E	F	H	I
RBBY01616 RBLY01616	0.018	0.021	0.016	0.020	0.013	0.016
RBBY02020 RBLY02020	0.018	0.021	0.016	0.020	0.013	0.016
RBBY02525 RBLY02525	0.021	0.021	0.018	0.024	0.016	0.016
RBBY03232 RBLY03232	0.021	0.021	0.018	0.024	0.016	0.016
RBBY04040 RBLY04040	0.025	0.025	0.021	0.033	0.019	0.019
RBBY05050 RBLY05050	0.025	0.025	0.021	0.033	0.019	0.019

1-2 Accuracy

■ 1-2-2 RFBY Accuracy Standards

The accuracy of model RFBY is according to JIS standard (JIS B 1192-1997) except for the circular runout of Ball Screw axis(D) and the perpendicularity of the flange-mounting surface against the screw axis (C).

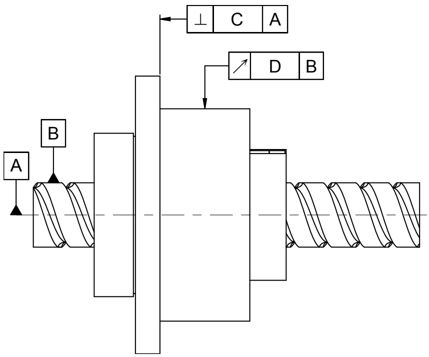


Fig 1.2.3 RFBY - series

Unit : mm

Lead angle accuracy	Rolled C7		Rolled C10		Ground C7		Ground C5		Ground C3	
Model No.	C	D	C	D	C	D	C	D	C	D
RFBY01616	0.035	0.065	0.035	0.065	0.023	0.035	0.016	0.020	0.013	0.017
RFBY02020	0.035	0.065	0.035	0.065	0.023	0.035	0.016	0.020	0.013	0.017
RFBY02525	0.035	0.065	0.035	0.065	0.023	0.035	0.018	0.024	0.015	0.020
RFBY03232	0.035	0.065	0.035	0.065	0.023	0.035	0.018	0.024	0.015	0.020
RFBY04040	0.046	0.086	0.046	0.086	0.026	0.046	0.021	0.033	0.018	0.026
RFBY05050	0.046	0.086	0.046	0.086	0.026	0.046	0.021	0.033	0.018	0.026

■ 1-2-3 RSSY, RSLY Accuracy Standards

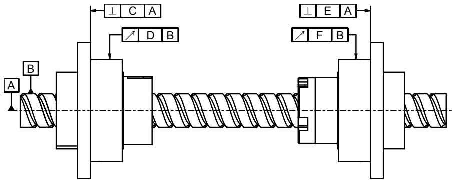
The Ball Screw/Spline is manufactured as the following specifications.

【Ball Screw】

Axial clearance : 0 or less
Lead accuracy : C5
(Refer to C06 for more details)

【Ball Spline】

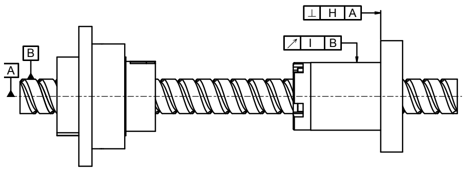
Clearance in the rotational direction : 0 or less
(P1 : light preload)
(Refer to B20-21 for more details)
Accuracy grade : class H
(Refer to B22 for more details)



RFSY
Rotary Ball screw nut

RLSF
Rotary Ball Spline nut

Fig 1.2.4 RSSY - series



RFSY
Rotary Ball screw nut

SLF
Ball Spline nut

Fig 1.2.5 RSLY - series

Model No.	C	D	E	F	H	I
RSSY01616 RSLY01616	0.018	0.021	0.016	0.020	0.013	0.016
RSSY02020 RSLY02020	0.018	0.021	0.016	0.020	0.013	0.016
RSSY02525 RSLY02525	0.021	0.021	0.018	0.024	0.016	0.016
RSSY03232 RSLY03232	0.021	0.021	0.018	0.024	0.016	0.016
RSSY04040 RSLY04040	0.025	0.025	0.021	0.033	0.019	0.019

■ 1-2-4 RFSY Accuracy Standards

The accuracy of model RFBY is according to JIS standard (JIS B 1192-1997) except for the circular runout of Ball Screw axis (D) and the perpendicularity of the flange-mounting surface against the screw axis (C).

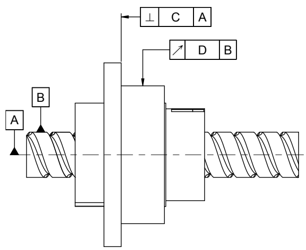


Fig 1.2.3 RFSY - series

1-2 Accuracy

Unit : mm

Lead angle accuracy	Rolled C7		Rolled C10		Ground C7		Ground C5		Ground C3	
Model No.	C	D	C	D	C	D	C	D	C	D
RFSY01616	0.035	0.065	0.035	0.065	0.023	0.035	0.016	0.020	0.013	0.017
RFSY02020	0.035	0.065	0.035	0.065	0.023	0.035	0.016	0.020	0.013	0.017
RFSY02525	0.035	0.065	0.035	0.065	0.023	0.035	0.018	0.024	0.015	0.020
RFSY03232	0.035	0.065	0.035	0.065	0.023	0.035	0.018	0.024	0.015	0.020
RFSY04040	0.046	0.086	0.046	0.086	0.026	0.046	0.021	0.033	0.018	0.026

■ 1-2-5 RLBF, RLSF Accuracy Standards

Accuracy Grades

The accuracy of the Ball Spline is determined by the nodding action of the spline-nut and classified into three accuracy class : Normal (N), High (H) and Precision (P).

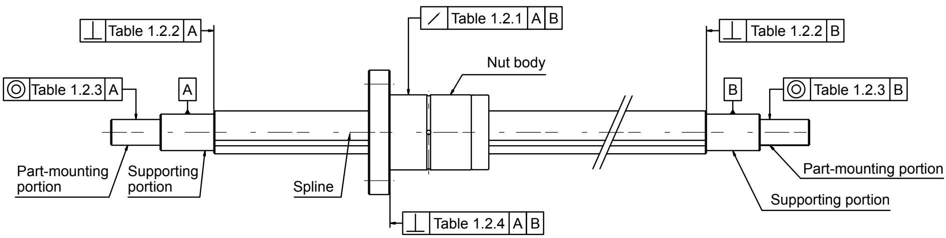


Fig 1.2.7

Accuracy Specification

Tables 1.2.1 ~ 5 indicate the the measurement items of Ball Spline.

Table1.2.1 The Maximum nodding action of Spline Nut on the support unit. Unit : μm

Length \ Nominal Diameter		16, 20			25, 32			40, 50		
Above	Below	N	H	P	N	H	P	N	H	P
-	200	56	34	18	53	32	18	53	32	16
200	315	71	45	25	58	39	21	58	36	19
315	400	83	53	31	70	44	25	63	39	21
400	500	95	62	38	78	50	29	68	43	24
500	630	112	-	-	88	57	34	74	47	27
630	800	-	-	-	103	68	42	84	54	32

Table1.2.2 The Maximum perpendicularity of Spline-shaft end on the support unit. Unit : μm

Nominal Diameter \ Accuracy		Normal (N)	High (H)	Precision (P)
16	20	27	11	8
25	32	33	13	9
40	50	39	16	11

Table1.2.3 The concentricity between components assembly part and attach surface. Unit : μm

Nominal Diameter \ Accuracy		Normal (N)	High (H)	Precision (P)
16	20	46	19	12
25	32	53	22	13
40	50	62	25	15

Table1.2.4 The perpendicularity of flange on the attach surface Unit : μm

Nominal Diameter \ Accuracy				Normal (N)	High (H)	Precision (P)
16	20	25	32	30	16	11
40		50		46	19	13

Table1.2.5 The accuracy grade on the effective length accuracy Unit : μm

Accuracy	Normal (N)	High (H)	Precision (P)
Permissible Value	33	13	6

Note : Measurement only applies to any 100mm on the Spline shaft.

1-3 Example of Assembly - RFBY

■ 1-3-1 Example of Mounting Rotary Ball Screw Model RFBY

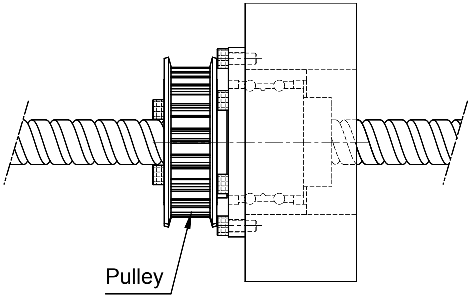


Fig 1.3.1

Example of Mounting Model RFBY

(1) Ball screw nut fixed, screw shaft floated. (Suitable for a long table)

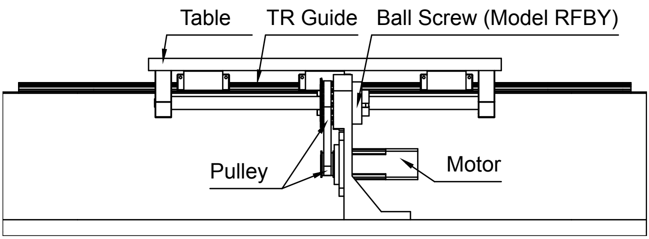


Fig 1.3.2

(2) Ball screw nut floated, screw shaft fixed. (Suitable for a short table and a long stroke)

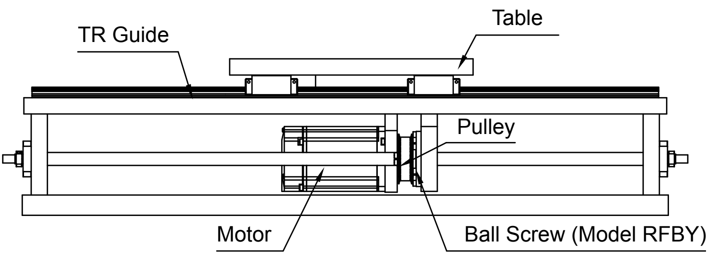


Fig 1.3.3

1-4 Example of Assembly - RBBY

■ 1-4-1 Example of Mounting Precision Ball Screw/Spline Model RBBY

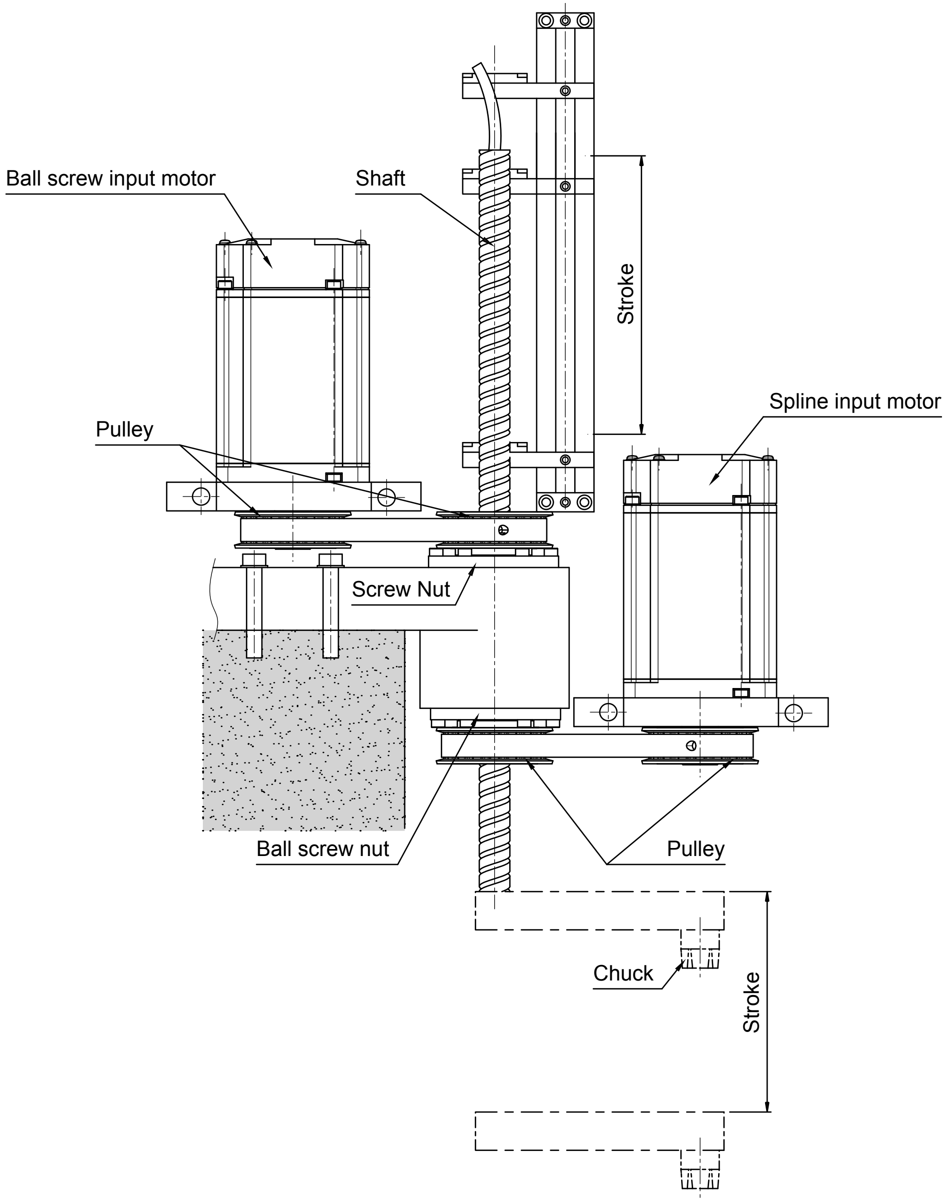


Fig 1.4.1

1-5 Nominal Model Code of Rotary Series

Nominal Model Code of Rotary Ball Screw

RFSY	R	016	16	A2	N	G	C5	-	500	-	P0	(2A)
①	②	③	④	⑤	⑥	⑦	⑧		⑨		⑩	⑪

①

Nominal Model
RFSY
RFBY

②

Threading Direction
R : Right

③

Nominal Diameter
Unit : mm

④

Lead
Unit : mm

⑤

Number of Turns (Turn·Row)
Turn : A : 1.8
ex : (1.8×2 = A2)

⑥

Flange Type
N : Round

⑦

Product Code
G : Ground
F : Rolled

⑧

Accuracy Grade
C0, C1, C2, C3, C5, C7, C10

⑨

Overall Length of Shaft
Unit : mm

⑩

Axial Clearance and Preload Value
P0, P1, P2, P3, P4

⑪

Number of Grooves
1A : Single start screw
2A : Doube start screw

Nominal Model Code of Rotary Ball Spline

RLSF	016	T2	N	N	H	-	500	-	P0
①	②	③	④	⑤	⑥		⑦		⑧

①

Nominal Model
RLSF
RLBF

②

Nominal Diameter
Unit : mm

③

Groove
T2 : 2 Rows
T4 : 4 Rows

④

Flange Type
N : Round

⑤

Accuracy Grade of Spline Shaft
N : Normal
H : High
P : Precision

⑥

Spline Shaft Type
S : Solid
H : Hollow

⑦

Overall Length of Shaft
Unit : mm

⑧

Preload Value
P0 : No preload
P1 : Light preload
P2 : Medium preload

Nominal Model Code of Rotary Ball Screw and Ball Spline

RSSY R 016 16 A1 G C5 H H - 500 - P1 (1A)

RSSY	R	016	16	A1	G	C5	H	H	500	P1	(1A)
①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	⑫

①

Nominal Model
RSSY (RFSY+RLSF)
RSLY (RFSY+SLF)
RBBY (RFBY+RLBF)
RBLY (RFBY+SLF)

②

Threading Direction
R : Right

③

Nominal Diameter
Unit : mm

④

Lead
Unit : mm

⑤

Number of Turns (Turn·Row)
Turn : A : 1.8
ex : (1.8×1 = A1)

⑥

Product Code
G : Ground

⑦

Accuracy Grade of Ball Screw
C5

⑧

Accuracy Grade of Spline Shaft
H : High

⑨

Spline Shaft Type
S : Solid
H : Hollow

⑩

Overall Length of Assembly
Unit : mm

⑪

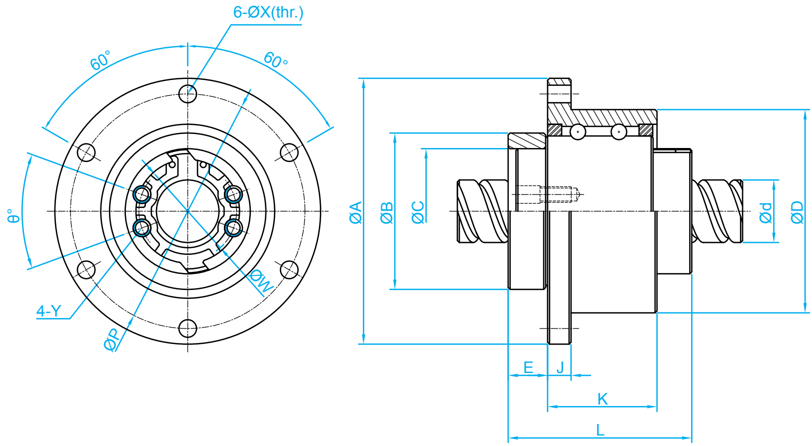
Preload Value
P1 : Light preload

⑫

Number of Grooves
1A : Single start screw

1-5 Nominal Model Code of Rotary Series

RFBY Series Specifications

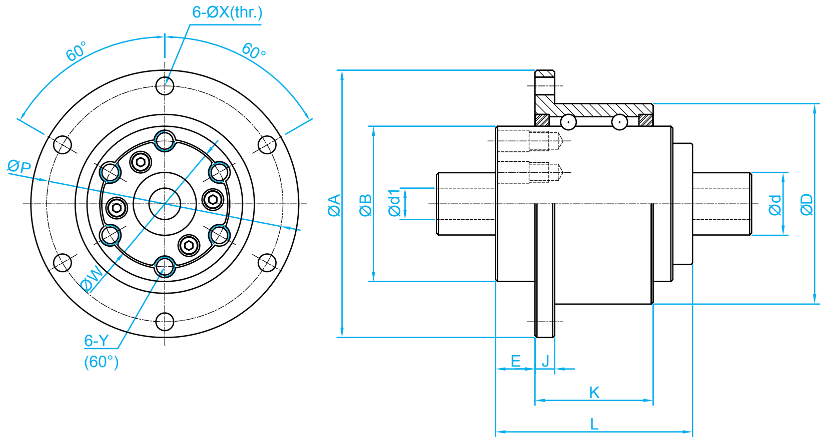


Unit : mm

Model No.	d	l	Da	n	Support Bearing Load Rating		Ball Screw Nut Dimension														Screw Nut Load Rating	
					Ca (kgf)	C0a (kgf)	D	A	B	L	C	E	J	K	P	X	W	Y	θ	Ca (kgf)	C0a (kgf)
RFBY01616-1.8	16	16	2.778	1.8x1	750	1593	$52^{0}_{-0.007}$	68	$40^{0}_{-0.025}$	47	$32^{+0.025}_{0}$	10.1	6	28	60	4.5	25	M4	40	591	1275
RFBY01616-3.6	16	16	2.778	1.8x2	750	1593	$52^{0}_{-0.007}$	68	$40^{0}_{-0.025}$	47	$32^{+0.025}_{0}$	10.1	6	28	60	4.5	25	M4	40	1073	2551
RFBY02020-1.8	20	20	3.175	1.8x1	1066	2452	$62^{0}_{-0.007}$	78	$50^{0}_{-0.025}$	53.5	$39^{+0.025}_{0}$	11	7	34.5	70	4.5	31	M5	40	764	1758
RFBY02020-3.6	20	20	3.175	1.8x2	1066	2452	$62^{0}_{-0.007}$	78	$50^{0}_{-0.025}$	53.5	$39^{+0.025}_{0}$	11	7	34.5	70	4.5	31	M5	40	1387	3515
RFBY02525-1.8	25	25	3.969	1.8x1	1119	2765	$72^{0}_{-0.007}$	92	$58^{0}_{-0.03}$	65	$47^{+0.025}_{0}$	15.8	8	35	81	5.5	38	M6	40	1142	2747
RFBY02525-3.6	25	25	3.969	1.8x2	1119	2765	$72^{0}_{-0.007}$	92	$58^{0}_{-0.03}$	65	$47^{+0.025}_{0}$	15.8	8	35	81	5.5	38	M6	40	2074	5494
RFBY03232-1.8◆	32	32	4.762	1.8x1	2087	5586	$80^{0}_{-0.007}$	105	$66^{0}_{-0.03}$	81	$58^{+0.03}_{0}$	21.5	9	42.5	91	6.6	48	M6	40	1664	4345
RFBY04040-1.8◆	40	40	6.35	1.8x1	3183	9306	$110^{0}_{-0.008}$	140	$90^{0}_{-0.035}$	102	$73^{+0.03}_{0}$	16.5	11	64.5	123	9	61	M8	50	2662	7031
RFBY05050-1.8◆	50	50	7.938	1.8x1	4328	12573	$120^{0}_{-0.008}$	156	$100^{0}_{-0.035}$	121	$90^{+0.035}_{0}$	29	12	70	136	11	75	M10	50	3978	10987

※Items labeled with ◆ are customized products. For these product orders, please contact TBI in advance.

RLBF Series Specifications

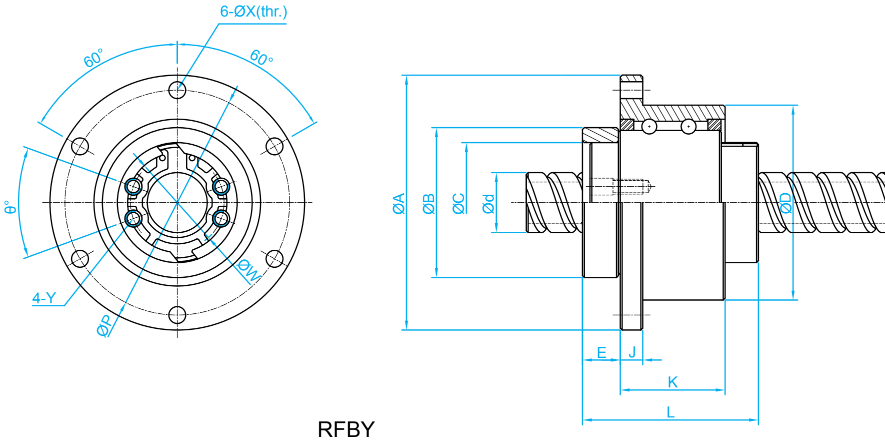


Unit : mm

Model No.	d	d1	Ball Ø	Row	Support Bearing Load Rating		Spline Nut Dimension											Ball Spline Load Rating	
					Ca (kgf)	C0a (kgf)	D	A	B	L	E	J	K	P	X	W	Y	Ca (kgf)	C0a (kgf)
RLBF016	16	8	2.778	2	746	1597	$52^{0}_{-0.007}$	68	$39.5^{0}_{-0.025}$	50	10	5	30	60	4.5	32	M5	545	849
RLBF020	20	10	3.175	2	1011	2138	$56^{0}_{-0.007}$	72	$43.5^{0}_{-0.025}$	63	12	6	42	64	4.5	36	M5	736	1124
RLBF025	25	15	3.5	4	1558	4616	$62^{0}_{-0.007}$	78	$53^{0}_{-0.03}$	71	13	6	49	70	4.5	45	M6	1003	1593
RLBF032	32	16	3.969	4	2087	5586	$80^{0}_{-0.007}$	105	$65.5^{0}_{-0.03}$	80	17	9	54	91	6.6	55	M6	1324	2251
RLBF040	40	20	6.35	4	3141	8705	$100^{0}_{-0.008}$	130	$79.5^{0}_{-0.03}$	100	23	11	63	113	9	68	M6	2972	4033
RLBF050	50	26	7.144	4	4317	12585	$120^{0}_{-0.008}$	156	$99.5^{0}_{-0.035}$	125	25	12	87	136	11	85	M10	4086	5615

1-5 Nominal Model Code of Rotary Series

RBBY Series Specifications



RFBY

Unit : mm

Model No.	d	l	Da	n	Support Bearing Load Rating		Ball Screw Nut Dimension														Screw Nut Load Rating	
					Ca (kgf)	C0a (kgf)	D	A	B	L	C	E	J	K	P	X	W	Y	θ		Ca (kgf)	C0a (kgf)
RBBY01616-1.8	16	16	2.778	1.8x1	750	1593	$52^{0}_{-0.007}$	68	$40^{0}_{-0.025}$	47	$32^{+0.025}_{0}$	10.1	6	28	60	4.5	25	M4	40		591	1275
RBBY02020-1.8	20	20	3.175	1.8x1	1066	2452	$62^{0}_{-0.007}$	78	$50^{0}_{-0.025}$	53.5	$39^{+0.025}_{0}$	11	7	34.5	70	4.5	31	M5	40		764	1758
RBBY02525-1.8	25	25	3.969	1.8x1	1119	2765	$72^{0}_{-0.007}$	92	$58^{0}_{-0.03}$	65	$47^{+0.025}_{0}$	15.8	8	35	81	5.5	38	M6	40		1142	2747
RBBY03232-1.8◆	32	32	4.762	1.8x1	2087	5586	$80^{0}_{-0.007}$	105	$66^{0}_{-0.03}$	81	$58^{+0.03}_{0}$	21.5	9	42.5	91	6.6	48	M6	40		1664	4345
RBBY04040-1.8◆	40	40	6.35	1.8x1	3183	9306	$110^{0}_{-0.008}$	140	$90^{0}_{-0.035}$	102	$73^{+0.03}_{0}$	16.5	11	64.5	123	9	61	M8	50		2662	7031
RBBY05050-1.8◆	50	50	7.938	1.8x1	4328	12573	$120^{0}_{-0.008}$	156	$100^{0}_{-0.035}$	121	$90^{+0.035}_{0}$	29	12	70	136	11	75	M10	50		3978	10987

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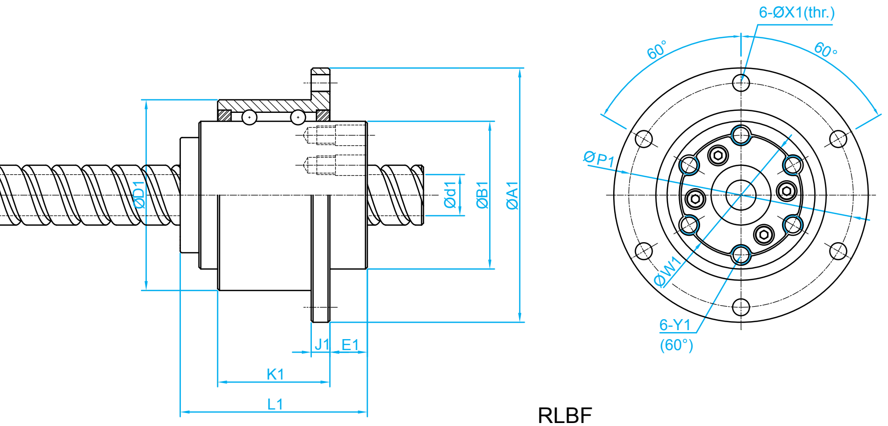


RLBF

Unit : mm

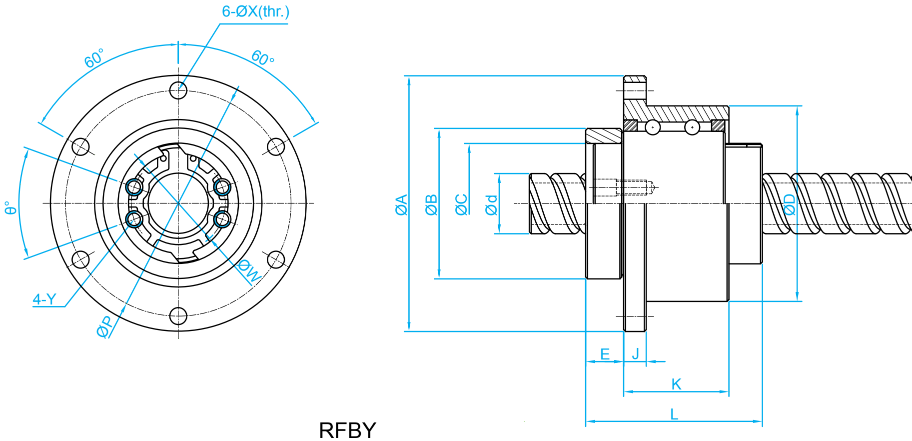
Model No.	d	d1	Ball Ø	Row	Support Bearing Load Rating		Spline Nut Dimension											Ball Spline Load Rating	
					Ca (kgf)	C0a (kgf)	D1	A1	B1	L1	E1	J1	K1	P1	X1	W1	Y1	Ca (kgf)	C0a (kgf)
RBBY01616	16	11	2.778	2	746	1597	$52^{0}_{-0.007}$	68	$39.5^{0}_{-0.025}$	50	10	5	30	60	4.5	32	M5	545	849
RBBY02020	20	14	3.175	2	1011	2138	$56^{0}_{-0.007}$	72	$43.5^{0}_{-0.025}$	63	12	6	42	64	4.5	36	M5	736	1124
RBBY02525	25	18	3.5	4	1558	4616	$62^{0}_{-0.007}$	78	$53^{0}_{-0.03}$	71	13	6	49	70	4.5	45	M6	1003	1593
RBBY03232	32	23	3.969	4	2087	5586	$80^{0}_{-0.007}$	105	$65.5^{0}_{-0.03}$	80	17	9	54	91	6.6	55	M6	1324	2251
RBBY04040	40	29	6.35	4	3141	8705	$100^{0}_{-0.008}$	130	$79.5^{0}_{-0.03}$	100	23	11	63	113	9	68	M6	2972	4033
RBBY05050	50	36	7.144	4	4317	12585	$120^{0}_{-0.008}$	156	$99.5^{0}_{-0.035}$	125	25	12	87	136	11	85	M10	4086	5615

D

Rotary Ball Screw/Spline

1-5 Nominal Model Code of Rotary Series

RBLY Series Specifications



RFBY

Unit : mm

Model No.	d	l	Da	n	Support Bearing Load Rating		Ball Screw Nut Dimension													Screw Nut Load Rating	
					Ca (kgf)	C0a (kgf)	D	A	B	L	C	E	J	K	P	X	W	Y	θ	Ca (kgf)	C0a (kgf)
RBLY01616-1.8	16	16	2.778	1.8x1	750	1593	$52^{0}_{-0.007}$	68	$40^{0}_{-0.025}$	47	$32^{+0.025}_{0}$	10.1	6	28	60	4.5	25	M4	40	591	1275
RBLY02020-1.8	20	20	3.175	1.8x1	1066	2452	$62^{0}_{-0.007}$	78	$50^{0}_{-0.025}$	53.5	$39^{+0.025}_{0}$	11	7	34.5	70	4.5	31	M5	40	764	1758
RBLY02525-1.8	25	25	3.969	1.8x1	1119	2765	$72^{0}_{-0.007}$	92	$58^{0}_{-0.03}$	65	$47^{+0.025}_{0}$	15.8	8	35	81	5.5	38	M6	40	1142	2747
RBLY03232-1.8◆	32	32	4.762	1.8x1	2087	5586	$80^{0}_{-0.007}$	105	$66^{0}_{-0.03}$	81	$58^{+0.03}_{0}$	21.5	9	42.5	91	6.6	48	M6	40	1664	4345
RBLY04040-1.8◆	40	40	6.35	1.8x1	3183	9306	$110^{0}_{-0.008}$	140	$90^{0}_{-0.035}$	102	$73^{+0.03}_{0}$	16.5	11	64.5	123	9	61	M8	50	2662	7031
RBLY05050-1.8◆	50	50	7.938	1.8x1	4328	12573	$120^{0}_{-0.008}$	156	$100^{0}_{-0.035}$	121	$90^{+0.035}_{0}$	29	12	70	136	11	75	M10	50	3978	10987

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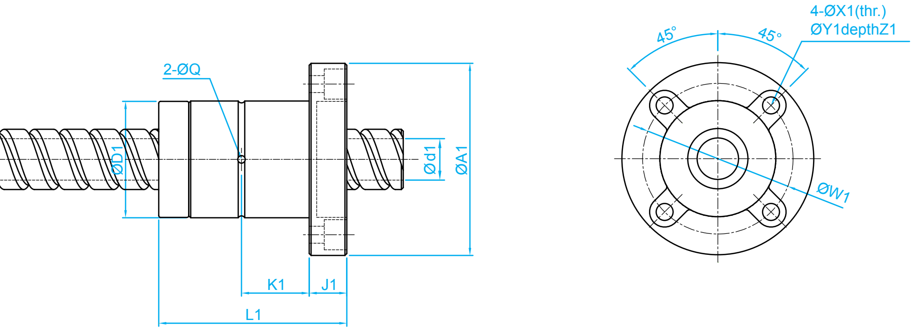


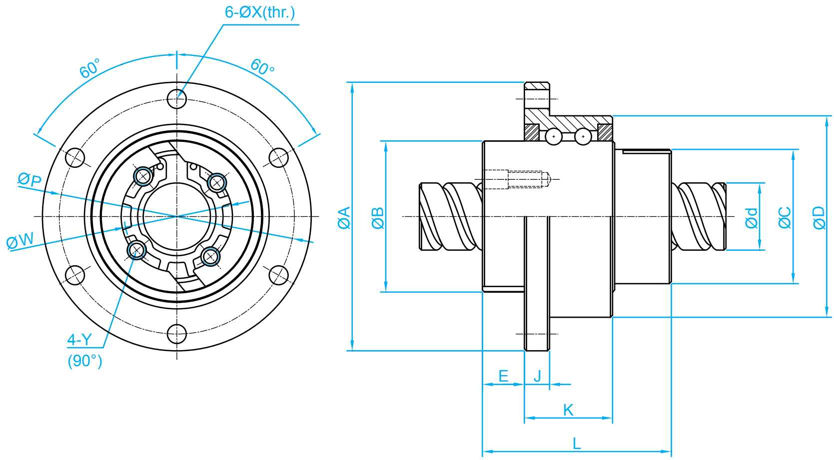
SLF

Unit : mm

Model No.	d	d1	Row	Spline Nut Dimension										Ball Spline Load Rating	
				D1	A1	L1	J1	K1	W1	X1	Y1	Z1	Q	Ca (kgf)	C0a (kgf)
RBLY01616	16	11	2	$31^{0}_{-0.016}$	51	50	10	18	40	4.5	8	6	2	545	849
RBLY02020	20	14	2	$35^{0}_{-0.016}$	58	56	10	18	45	5.5	9.5	5.4	2	724	1109
RBLY02525	25	18	4	$42^{0}_{-0.016}$	65	71	13	26.5	52	5.5	9.5	8	3	1003	1593
RBLY03232	32	23	4	$49^{0}_{-0.016}$	77	80	13	30	62	6.6	11	6.5	3	1324	2251
RBLY04040	40	29	4	$64^{0}_{-0.019}$	100	100	18	36	82	9	14	12	4	2972	4033
RBLY05050	50	36	4	$80^{0}_{-0.019}$	124	125	20	46.5	102	11	17.5	12	4	4086	5615

1-5 Nominal Model Code of Rotary Series

RFSY Series Specifications



Unit : mm

Model No.	d	l	Da	n	Support Bearing Load Rating		Ball Screw Nut Dimension													Screw Nut Load Rating	
					Ca (kgf)	C0a (kgf)	D	A	B	L	C	E	J	K	P	X	W	Y	Ca (kgf)	C0a (kgf)
RFSY01616-1.8	16	16	2.778	1.8x1	730	1484	$48^{-0.009}_{-0.025}$	64	$36^{0}_{-0.025}$	45	32	10	6	21	56	4.5	25	M4	591	1275
RFSY01616-3.6	16	16	2.778	1.8x2	730	1484	$48^{-0.009}_{-0.025}$	64	$36^{0}_{-0.025}$	45	32	10	6	21	56	4.5	25	M4	1073	2551
RFSY02020-1.8	20	20	3.175	1.8x1	788	1811	$56^{0.01}_{-0.029}$	72	$43.5^{0}_{-0.025}$	52	39	11	6	21	64	4.5	31	M5	764	1758
RFSY02020-3.6	20	20	3.175	1.8x2	788	1811	$56^{0.01}_{-0.029}$	72	$43.5^{0}_{-0.025}$	52	39	11	6	21	64	4.5	31	M5	1387	3515
RFSY02525-1.8	25	25	3.969	1.8x1	1094	2607	$66^{0.01}_{-0.029}$	86	$52^{0}_{-0.03}$	64	47	13	7	25	75	5.5	38	M6	1142	2747
RFSY02525-3.6	25	25	3.969	1.8x2	1094	2607	$66^{0.01}_{-0.029}$	86	$52^{0}_{-0.03}$	64	47	13	7	25	75	5.5	38	M6	2074	5494
RFSY03232-1.8◆	32	32	4.762	1.8x1	1191	3233	$78^{0.01}_{-0.029}$	103	$63^{0}_{-0.03}$	78	58	14	8	25	89	6.6	48	M6	1664	4345
RFSY04040-1.8◆	40	40	6.35	1.8x1	2216	6685	$100^{0.012}_{-0.034}$	130	$79.5^{0}_{-0.035}$	99	73	16.5	10	33	113	9	61	M8	2662	7031

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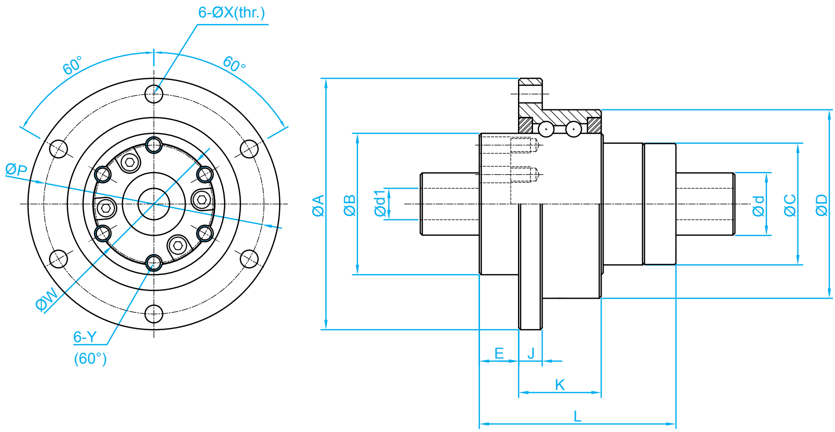
RLSF Series Specifications

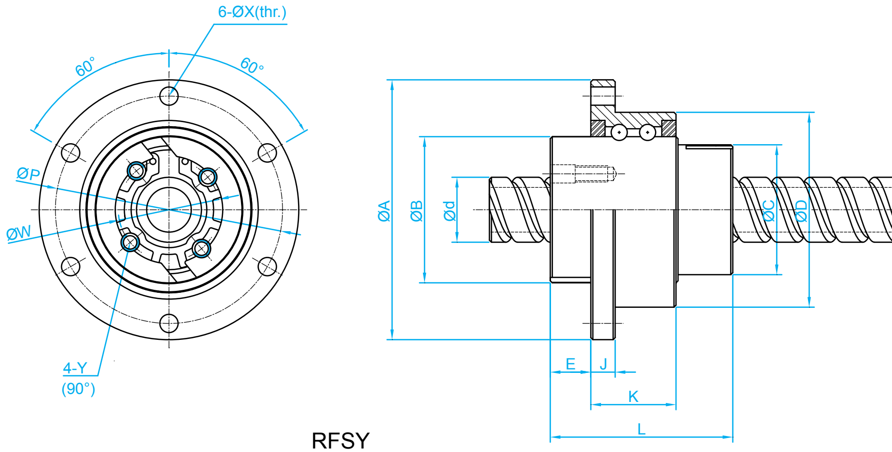


Unit : mm

Model No.	d	d1	Ball Ø	Row	Support Bearing Load Rating		Spline Nut Dimension												Ball Spline Load Rating	
					Ca (kgf)	C0a (kgf)	D	A	B	L	C	E	J	K	P	X	W	Y	Ca (kgf)	C0a (kgf)
RLSF016	16	8	2.778	2	730	1484	$48^{-0.009}_{-0.025}$	64	$36^{0}_{-0.025}$	50	31	10	6	21	56	4.5	30	M4	545	849
RLSF020	20	10	3.175	2	788	1811	$56^{-0.01}_{-0.029}$	72	$43.5^{0}_{-0.025}$	63	35	12	6	21	64	4.5	36	M5	736	1124
RLSF025	25	15	3.5	4	1094	2607	$66^{-0.01}_{-0.029}$	86	$52^{0}_{-0.03}$	71	42	13	7	25	75	5.5	44	M5	1003	1593
RLSF032	32	16	3.969	4	1191	3233	$78^{-0.01}_{-0.029}$	103	$63^{0}_{-0.03}$	80	52	17	8	25	89	6.6	54	M6	1324	2251
RLSF040	40	20	6.35	4	2216	6685	$100^{-0.012}_{-0.034}$	130	$79.5^{0}_{-0.035}$	100	64	20	10	33	113	9	68	M6	2972	4033

1-5 Nominal Model Code of Rotary Series

RSSY series specifications



RFSY

Unit : mm

Model No.	d	l	Da	n	Support Bearing Load Rating		Ball Screw Nut Dimension												Screw Nut Load Rating	
					Ca (kgf)	C0a (kgf)	D	A	B	L	C	E	J	K	P	X	W	Y	Ca (kgf)	C0a (kgf)
RSSY01616-1.8	16	16	2.778	1.8x1	730	1484	$48^{-0.009}_{-0.025}$	64	$36^{0}_{-0.025}$	45	32	10	6	21	56	4.5	25	M4	591	1275
RSSY02020-1.8	20	20	3.175	1.8x1	788	1811	$56^{0.01}_{-0.029}$	72	$43.5^{0}_{-0.025}$	52	39	11	6	21	64	4.5	31	M5	764	1758
RSSY02525-1.8	25	25	3.969	1.8x1	1094	2607	$66^{0.01}_{-0.029}$	86	$52^{0}_{-0.03}$	64	47	13	7	25	75	5.5	38	M6	1142	2747
RSSY03232-1.8◆	32	32	4.762	1.8x1	1191	3233	$78^{0.01}_{-0.029}$	103	$63^{0}_{-0.03}$	78	58	14	8	25	89	6.6	48	M6	1664	4345
RSSY04040-1.8◆	40	40	6.35	1.8x1	2216	6685	$100^{0.012}_{-0.034}$	130	$79.5^{0}_{-0.035}$	99	73	16.5	10	33	113	9	61	M8	2662	7031

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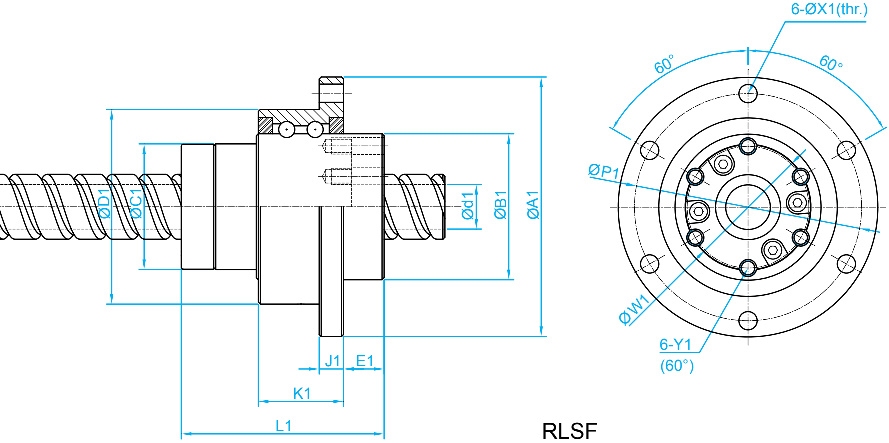


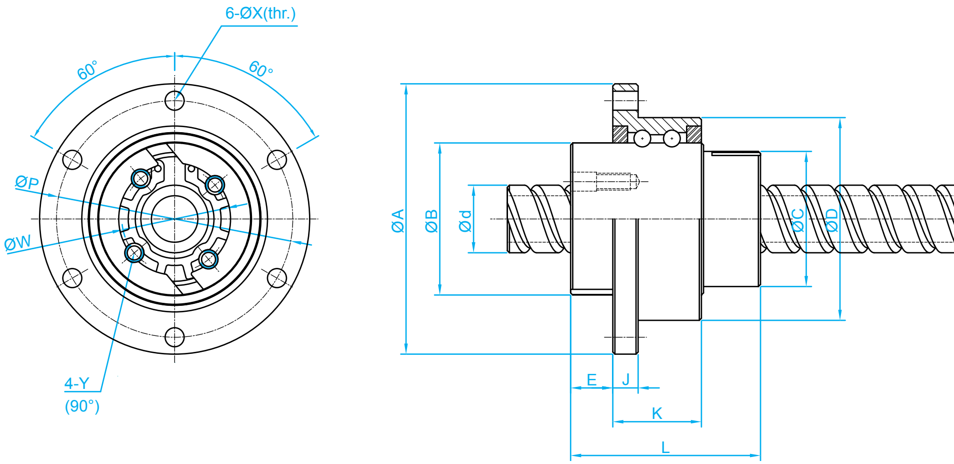
RLSF

Unit : mm

Model No.	d	d1	Ball Ø	Row	Support Bearing Load Rating		Spline Nut Dimension												Ball Spline Load Rating	
					Ca (kgf)	C0a (kgf)	D1	A1	B1	L1	C1	E1	J1	K1	P1	X1	W1	Y1	Ca (kgf)	C0a (kgf)
RSSY01616	16	11	2.778	2	730	1484	$48^{-0.009}_{-0.025}$	64	$36^{0}_{-0.025}$	50	31	10	6	21	56	4.5	30	M4	545	849
RSSY02020	20	14	3.175	2	788	1811	$56^{-0.01}_{-0.029}$	72	$43.5^{0}_{-0.025}$	63	35	12	6	21	64	4.5	36	M5	736	1124
RSSY02525	25	18	3.5	4	1094	2607	$66^{-0.01}_{-0.029}$	86	$52^{0}_{-0.03}$	71	42	13	7	25	75	5.5	44	M5	1003	1593
RSSY03232	32	23	3.969	4	1191	3233	$78^{-0.01}_{-0.029}$	103	$63^{0}_{-0.03}$	80	52	17	8	25	89	6.6	54	M6	1324	2251
RSSY04040	40	29	6.35	4	2216	6685	$100^{-0.012}_{-0.034}$	130	$79.5^{0}_{-0.035}$	100	64	20	10	33	113	9	68	M6	2972	4033

1-5 Nominal Model Code of Rotary Series

RSLY Series Specifications



Unit : mm

Model No.	d	l	Da	n	Support Bearing Load Rating		Ball Screw Nut Dimension												Screw Nut Load Rating	
					Ca (kgf)	C0a (kgf)	D	A	B	L	C	E	J	K	P	X	W	Y	Ca (kgf)	C0a (kgf)
RSLY01616-1.8	16	16	2.778	1.8x1	730	1484	$48^{-0.009}_{-0.025}$	64	$36^{0}_{-0.025}$	45	32	10	6	21	56	4.5	25	M4	591	1275
RSLY02020-1.8	20	20	3.175	1.8x1	788	1811	$56^{-0.01}_{-0.029}$	72	$43.5^{0}_{-0.025}$	52	39	11	6	21	64	4.5	31	M5	764	1758
RSLY02525-1.8	25	25	3.969	1.8x1	1094	2607	$66^{-0.01}_{-0.029}$	86	$52^{0}_{-0.03}$	64	47	13	7	25	75	5.5	38	M6	1142	2747
RSLY03232-1.8◆	32	32	4.762	1.8x1	1191	3233	$78^{-0.01}_{-0.029}$	103	$63^{0}_{-0.03}$	78	58	14	8	25	89	6.6	48	M6	1664	4345
RSLY04040-1.8◆	40	40	6.35	1.8x1	2216	6685	$100^{-0.012}_{-0.034}$	130	$79.5^{0}_{-0.035}$	99	73	16.5	10	33	113	9	61	M8	2662	7031

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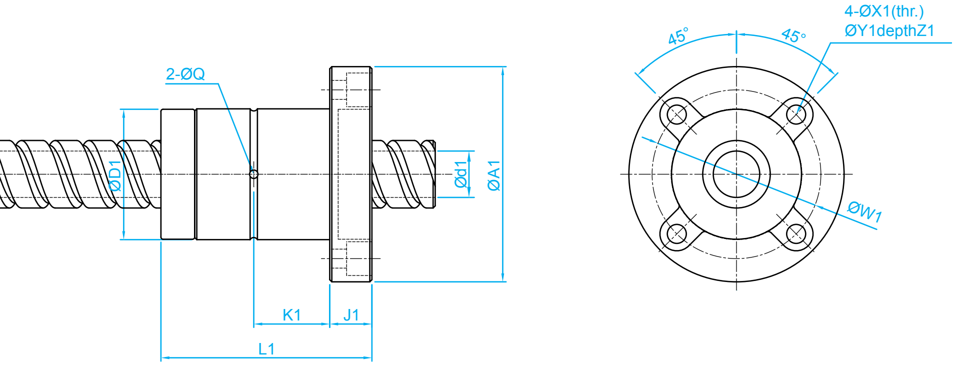


Unit : mm

Model No.	d	d1	Row	Spline Nut Dimension										Ball Spline Load Rating	
				D1	A1	L1	J1	K1	W1	X1	Y1	Z1	Q	Ca (kgf)	C0a (kgf)
RSLY01616	16	11	2	$31^{\ 0}_{-0.016}$	51	50	10	18	40	4.5	8	6	2	545	849
RSLY02020	20	14	2	$35^{\ 0}_{-0.016}$	58	56	10	18	45	5.5	9.5	5.4	2	724	1109
RSLY02525	25	18	4	$42^{\ 0}_{-0.016}$	65	71	13	26.5	52	5.5	9.5	8	3	1003	1593
RSLY03232	32	23	4	$49^{\ 0}_{-0.016}$	77	80	13	30	62	6.6	11	6.5	3	1324	2251
RSLY04040	40	29	4	$64^{\ 0}_{-0.019}$	100	100	18	36	82	9	14	12	4	2972	4033

1-6 Roary Series Weight List

Mass series

Model No.	Weight					
	Ball Nut (kg)	Spline Nut (Kg)	Solid		Hollow	
			Screw Shaft (kg/m)	Spline Shaft (kg/m)	Screw Shaft (kg/m)	Spline Shaft (kg/m)
RFBY						
RFBY01616-1.8	0.502	-	1.56	-	-	-
RFBY01616-3.6	0.462	-	1.55	-	-	-
RFBY02020-1.8	0.822	-	2.45	-	-	-
RFBY02020-3.6	0.538	-	2.42	-	-	-
RFBY02525-1.8	1.264	-	3.82	-	-	-
RFBY02525-3.6	1.274	-	3.79	-	-	-
RFBY03232-1.8	1.543	-	6.27	-	-	-
RFBY04040-1.8	4.648	-	9.78	-	-	-
RFBY05050-1.8	6.096	-	15.28	-	-	-
RLBF						
RLBF016	-	0.52	-	1.56	-	1.18
RLBF020	-	0.75	-	2.44	-	1.85
RLBF025	-	0.964	-	3.80	-	2.47
RLBF032	-	2.002	-	6.255	-	4.74
RLBF040	-	3.616	-	9.69	-	7.40
RLBF050	-	6.43	-	15.19	-	11.25
RBBY						
RBBY01616-1.8	0.502	0.52	1.54	-	0.83	-
RBBY02020-1.8	0.822	0.75	2.42	-	1.26	-
RBBY02525-1.8	1.264	0.964	3.77	-	1.86	-
RBBY03232-1.8	1.543	2.002	6.21	-	3.05	-
RBBY04040-1.8	4.648	3.616	9.61	-	4.68	-
RBBY05050-1.8	6.096	6.43	15.06	-	7.42	-
RBLY						
RBLY01616-1.8	0.502	0.226	1.54	-	0.83	-
RBLY02020-1.8	0.822	0.303	2.42	-	1.26	-
RBLY02525-1.8	1.264	0.458	3.77	-	1.86	-
RBLY03232-1.8	1.543	0.713	6.21	-	3.05	-
RBLY04040-1.8	4.648	1.430	9.61	-	4.68	-
RBLY05050-1.8	6.096	2.756	15.06	-	7.42	-

Compact series

Model No.	Weight					
	Ball Nut (kg)	Spline Nut (Kg)	Solid		Hollow	
			Screw Shaft (kg/m)	Spline Shaft (kg/m)	Screw Shaft (kg/m)	Spline Shaft (kg/m)
RFSY						
RFSY01616-1.8	0.324	-	1.56	-	-	-
RFSY01616-3.6	0.372	-	1.55	-	-	-
RFSY02020-1.8	0.536	-	2.45	-	-	-
RFSY02020-3.6	0.534	-	2.42	-	-	-
RFSY02525-1.8	0.9	-	3.82	-	-	-
RFSY02525-3.6	0.906	-	3.79	-	-	-
RFSY03232-1.8	1.085	-	6.27	-	-	-
RFSY04040-1.8	2.214	-	9.78	-	-	-
RLSF						
RLSF016	-	0.37	-	1.56	-	1.18
RLSF020	-	0.552	-	2.44	-	1.85
RLSF025	-	0.650	-	3.80	-	2.47
RLSF032	-	0.629	-	6.255	-	4.74
RLSF040	-	1.999	-	9.69	-	7.40
RSSY						
RSSY01616-1.8	0.324	0.37	1.54	-	0.83	-
RSSY02020-1.8	0.536	0.552	2.42	-	1.26	-
RSSY02525-1.8	0.9	0.650	3.77	-	1.86	-
RSSY03232-1.8	1.085	0.629	6.21	-	3.05	-
RSSY04040-1.8	2.214	1.999	9.61	-	4.68	-
RSLY						
RSLY01616-1.8	0.324	0.37	1.54	-	0.83	-
RSLY02020-1.8	0.536	0.552	2.42	-	1.26	-
RSLY02525-1.8	0.9	0.650	3.77	-	1.86	-
RSLY03232-1.8	1.085	0.629	6.21	-	3.05	-
RSLY04040-1.8	2.214	1.999	9.61	-	4.68	-

Memo

Single Axis Actuator

1-1 Structure and Features of *TBI MOTION* Actuator

■ 1-1-1 Basic Structure of *TBI MOTION* Actuator

Adopting the advantages of TBI Motion linear guide and screws into an integral mechanism with the design of the nut and screw. With the highly rigid U-Rail track optimized section, it minimize the required space and the time for assembly. This ensures its demand for high rigidity and high accuracy. The ball rolling face adopts an excellent design of a 2-row Gothic arc and 45° contact angle. Moreover, the design allows the X-axis and Y-axis to bear loads from all directions.

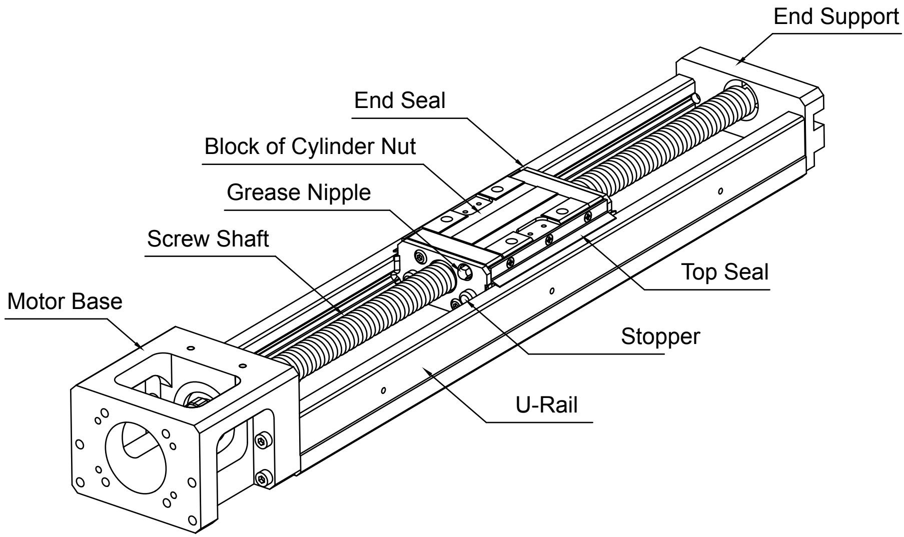


Fig 1.1.1 Structure of the Single Axis Actuator body

1-2 Features of the Single Axis Actuator

■ 1-2-1 Advantages of Modularized Design

The combination of ball screw and linear guide makes simple installation possible, shortens replacement time and prolong service life. The conventional linear platform device requires guides and drive elements. It features easy-assembly, high rigidity, compact in size.

■ 1-2-2 Loads from all Directions

The contact surface of ball and groove is designed to be 45° and can bear the same rated load of any type of installation, radially, reverse-radially or laterally.

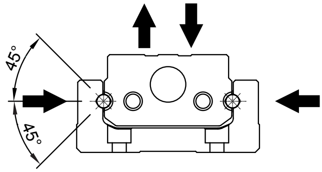


Fig 1.2.1

■ 1-2-3 High Rigidity

The Ansys optimized U-Rail track design allows the track to be lightweight, accomplishing higher rigidity at a cantilever load to achieve a perfect balance between rigidity and volume.

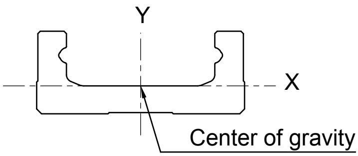


Fig 1.2.2

Table 1.1.1 Unit : mm^4

Model	I x	I y
KP26	$1.116x10^4$	$1.393x10^5$
KP33	$3.542x10^4$	$3.243x10^5$
KP46	$1.256x10^5$	$1.305x10^6$

(Note) Ix : 2nd moment revolves of area around the X axis ;
Iy : 2nd moment revolves of area around the Y axis.

■ 1-2-4 High Accuracy, Saving Space

The variable loading minimizes the friction to meet a high accuracy demand. A combination of the nut with the slide allows minimal space and optimized allocation possible.

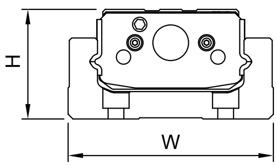


Fig 1.2.3

Table 1.1.2 Unit : mm

Model	H	W
KP26	26	50
KP33	33	60
KP46	46	86

E

Single Axis Actuator

1-3 Purchase of Peripherals

■ 1-3-1 About the Single Axis Actuator

To satisfy various industrial operations, the KP Axis Actuator can be purchased additionally with a dust cap, a dust expansion sleeve, a sensor and a motor adapting flange.

● Dust Cap & Dust Expansion Sleeve : prevent foreign objects from entering and ensure the overall accuracy, service life and smoothness.
● Motor Adapting Flange : fit for different motors and secured on the Single Axis Actuator.
● Sensor : a safety protection device which assists with slide positioning, original start up and traveling.

Components and Accessories of the Single Axis Actuator

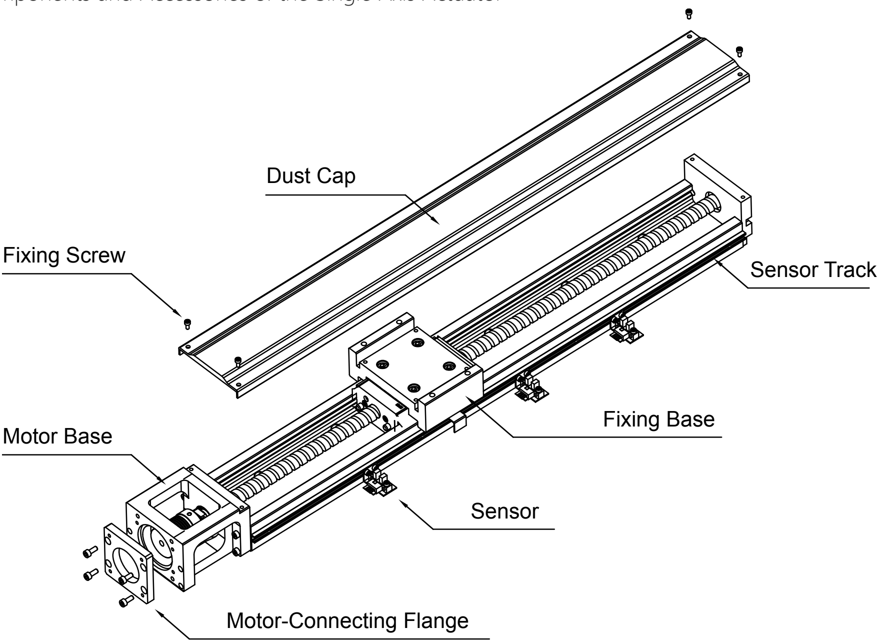


Fig 1.3.1 Components and Accessories

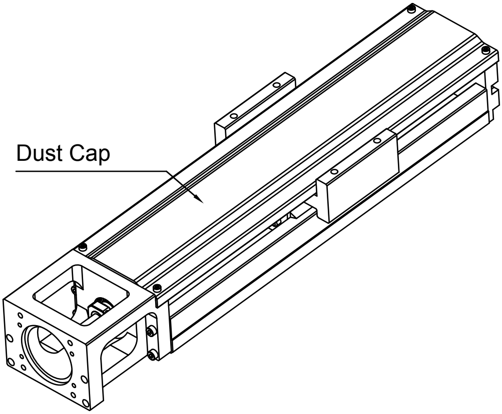


Fig 1.3.2 Dust Cap

1-3 Purchase of Peripherals

■ 1-3-2 KP Series Nominal Model Codes

KP	026	02	K	N	-	2	-	300	-	P	(D)	+	M01	F01	C01	S01
①	②	③	④	⑤		⑥		⑦		⑧	⑨		⑩	⑪	⑫	⑬

①

Nominal Model
KP

②

Size
26, 33, 46

③

Lead
KP26 : 2
KP33 : 5, 10
KP46 : 10, 20

④

Nut Type
K, V : Standard X : Special (K No. 26, V Nos. 33 & 46)

⑤

Carriage Length
N : Standard S : Light Load

⑥

No. of Slides
1, 2

⑦

Stroke
Unit : mm

⑧

Accuracy Level
P : Precise H : High N : Normal

⑨

Thickened Shaft End
□:None (D):Thickened Shaft End

※Model: No thickened shaft end service for KP26.
※Accuracy: No thickened shaft end service for Normal class.

⑩

Motor
□ : None M : Motor (ref. E29~32)

⑪

Motor Adapting Flange
(ref. E33~37)

⑫

Dust Cap
□ : None C01 : Dust Cap C02 : Dust Expansion Sleeve

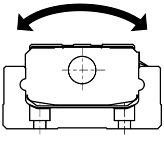
⑬

Include Sensor
□ : Standard no Sensor
S01~03 : Only Sensor (ref. E38, Table 1.9.6)
S04~06 : Omron SX671
S07~09 : Omron SX674
S10~12 : SUNX GX-F12A
S13~15 : SUNX GX-F12A-P

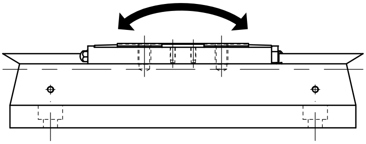
※When choosing the Single Axis Actuator, each set has 3 set of sensors included. Please consult ***TBI MOTION*** for special requirements.

KP Load Specs

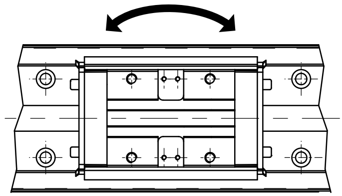
M_x



M_y



M_z



Model No.		Ball Screw				Linear Guide															
		d	l	Ca (kgf)	C0a (kgf)	Ca (kgf)		C0a (kgf)		Static Permissible Moment											
										M_y(N-m)				M_z(N-m)				M_x(N-m)			
						N	S	N	S	LS	LD	NS	ND	LS	LD	NS	ND	LS	LD	NS	ND
	Precise			187	366																
KP2602N	High	8	2	187	366	822	-	1079	-	62	481	-	-	62	481	-	-	180	360	-	-
	Normal			159	311																
	Precise			408	740																
KP3305N	High	12	5	408	740	1142	-	1513	-	108	720	49	413	108	720	49	413	310	620	207	413
	Normal			347	629																
	Precise			408	740																
KP3305S	High	12	5	408	740	-	861	-	1009	-	-	49	413	-	-	49	413	-	-	207	413
	Normal			347	629																
	Precise			275	469																
KP3310N	High	12	10	275	469	1142	-	1513	-	108	720	-	-	108	720	-	-	310	620	-	-
	Normal			234	398																
	Precise			275	469																
KP3310S	High	12	10	275	469	-	861	-	1009	-	-	49	413	-	-	49	413	-	-	207	413
	Normal			234	398																
	Precise			600	1136																
KP4610N	High	15	10	600	1136	4067	-	5810	-	610	4021	-	-	610	4021	-	-	1728	3456	-	-
	Normal			-	-																
	Precise			600	1136																
KP4610S	High	15	10	600	1136	-	3390	-	4519	-	-	307	2517	-	-	307	2517	-	-	1344	2688
	Normal			-	-																
	Precise			387	718																
KP4620N	High	15	20	387	718	4067	-	5810	-	610	4021	-	-	610	4021	-	-	1728	3456	-	-
	Normal			-	-																
	Precise			387	718																
KP4620S	High	15	20	387	718	-	3390	-	4519	-	-	307	2517	-	-	307	2517	-	-	1344	2688
	Normal			-	-																

1-4 Accuracy Design

■ 1-4-1 Accuracy Level

The accuracy of the Single Axis Actuator is split into Ground (P), High (H) and Rolled (N), as shown below.

Table 1.4.1

Unit : mm

<table>
<tr><th rowspan="2">Model</th><th rowspan="2">Stroke</th><th colspan="3">Positioning Repeatability</th><th colspan="3">Positioning Accuracy</th><th colspan="3">Positioning Parallelism</th><th colspan="3">Max. Starting Torque (N-cm)</th></tr>
<tr><th>Precise</th><th>High</th><th>Normal</th><th>Precise</th><th>High</th><th>Normal</th><th>Precise</th><th>High</th><th>Normal</th><th>Precise</th><th>High</th><th>Normal</th></tr>
<tr><td rowspan="4">KP26</td><td>150</td><td rowspan="4">±0.003</td><td rowspan="4">±0.005</td><td rowspan="4">±0.01</td><td rowspan="4">0.020</td><td rowspan="4">0.060</td><td rowspan="4">-</td><td rowspan="4">0.010</td><td rowspan="4">0.025</td><td rowspan="4">-</td><td rowspan="4">4</td><td rowspan="4">2</td><td rowspan="4">2</td></tr>
<tr><td>200</td></tr>
<tr><td>250</td></tr>
<tr><td>300</td></tr>
<tr><td rowspan="6">KP33</td><td>150</td><td rowspan="4">±0.003</td><td rowspan="4">±0.005</td><td rowspan="4">±0.01</td><td rowspan="4">0.020</td><td rowspan="4">0.060</td><td rowspan="4">-</td><td rowspan="4">0.010</td><td rowspan="4">0.025</td><td rowspan="4">-</td><td rowspan="6">15</td><td rowspan="6">7</td><td rowspan="6">7</td></tr>
<tr><td>200</td></tr>
<tr><td>300</td></tr>
<tr><td>400</td></tr>
<tr><td>500</td><td rowspan="2">±0.003</td><td rowspan="2">±0.005</td><td rowspan="2">±0.01</td><td rowspan="2">0.025</td><td rowspan="2">0.100</td><td rowspan="2">-</td><td rowspan="2">0.015</td><td rowspan="2">0.035</td><td rowspan="2">-</td></tr>
<tr><td>600</td></tr>
<tr><td rowspan="6">KP46</td><td>340</td><td rowspan="4">±0.003</td><td rowspan="4">±0.005</td><td rowspan="4">-</td><td rowspan="4">0.025</td><td rowspan="4">0.100</td><td rowspan="4">-</td><td rowspan="4">0.015</td><td rowspan="4">0.035</td><td rowspan="4">-</td><td rowspan="4">15</td><td rowspan="6">10</td><td rowspan="4">-</td></tr>
<tr><td>440</td></tr>
<tr><td>540</td></tr>
<tr><td>640</td></tr>
<tr><td>740</td><td>±0.003</td><td>±0.005</td><td>-</td><td>0.030</td><td>0.120</td><td>-</td><td>0.020</td><td>0.040</td><td>-</td><td>17</td><td>-</td></tr>
<tr><td>940</td><td>±0.003</td><td>±0.005</td><td>-</td><td>0.040</td><td>0.150</td><td>-</td><td>0.030</td><td>0.050</td><td>-</td><td>25</td><td>-</td></tr>
</table>

1-5 Maximum Speed

■ 1-5-1 Maximum Length and Maximum Moving Speed

Restricted by the critical speed and DN value of the screw, the Single Axis Robot's max. moving speed is shown below.

Table 1.4.1

Model	Lead (mm)	Stroke (mm)	Speed (mm/sec)		
			Precise	High	Normal
KP26	02	150	270	270	270
		200	270	270	270
		250	270	270	270
		300	270	270	270
KP33	05	150	550	550	390
		200	550	550	390
		300	550	550	390
		400	550	550	390
		500	550	550	390
		600	340	340	340
	10	150	1100	1100	790
		200	1100	1100	790
		300	1100	1100	790
		400	1100	1100	790
		500	1100	1100	790
		600	670	670	670
KP46	10	340	740	740	520
		440	740	740	520
		540	740	740	520
		640	740	740	520
		740	740	740	520
		940	610	610	430
	20	340	1480	1480	1050
		440	1480	1480	1050
		540	1480	1480	1050
		640	1480	1480	1050
		740	1480	1480	1050
		940	1220	1220	870

1-6 Calculation of Service Life

■ 1-6-1 Static Safety Factor

1. Analyze the Track :

When calculating the load of a track, first we must assess the average load required for the service life, as well as the maximum load required at a static rating. In particular, a travel distance that is too short may cause a big moment due to cantilever load, leading to an excessive load.

$$f_s = \frac{C_0}{P_{max}}$$

f_s : Static safety factor
C_0 : Basic static load rating (kg)
P_{max} : Max. load (kg)

2. Analyze the Bearing Support End of the Ball Screw : Single Axis Actuator takes extra axial force due to the inertia force caused by start-stop therefore the static safety factor of Single Axis Actuator must be considered.

$$f_s = \frac{C_{0a}}{F_{max}}$$

f_s : Static safety factor
C_{0a} : Basic static load rating (kg)
F_{max} : Max. load (kg)

Table 1.6.1 Static Safety Factor fs

Machines that use the linear motion system	Load conditions	Lower limit of fs
Integrated industrial machines	No vibration & impact	1.0 - 3.5
	With vibration & impact	2.0 - 5.0

※The reference value of the static safety factor may defer depending on the environment, the lubrication, the accuracy or rigidity of installation.

■ 1-6-2 Service Life

KP is constituted with a track, a ball screw and supporting bearings. The life of each component part can be calculated as follows :

【f_c : Contact Factor】

With KP-LD, 2 internal slides when used close to each other, the contact factor multiplied by the basic static load rating is 0.81 . Please refer to A10. Table 1.3.2 (when used closely, the number of slides is 1 or 2).

【f_w : Load Factor】

Please refer to A10. Table 1.3.3.

When Single Axis Actuator operating with load, the load distribution on the track becomes uneven and partial loads get heavier as well. At this point, multiply the moment factor that equivalent to the moment value in Table 1.6.2 for load calculating.

Model	Equivalentfactor K_y(mm^{-1})	Equivalentfactor K_z(mm^{-1})	Equivalentfactor K_x(mm^{-1})
KP26-N-LS	$1.70x10^{-1}$	$1.70x10^{-1}$	$5.88x10^{-2}$
KP26-N-LD	$2.19x10^{-2}$	$2.19x10^{-2}$	$5.88x10^{-2}$
KP33-S-NS	$1.37x10^{-1}$	$1.37x10^{-1}$	$4.79x10^{-2}$
KP33-S-ND	$2.06x10^{-2}$	$2.06x10^{-2}$	$4.79x10^{-2}$
KP33-N-LS	$2.0x10^{-1}$	$2.0x10^{-1}$	$4.79x10^{-2}$
KP33-N-LD	$2.39x10^{-2}$	$2.39x10^{-2}$	$4.79x10^{-2}$
KP46-S-NS	$1.44x10^{-1}$	$1.44x10^{-1}$	$3.29x10^{-2}$
KP46-S-ND	$1.76x10^{-2}$	$1.76x10^{-2}$	$3.29x10^{-2}$
KP46-N-LS	$9.33x10^{-2}$	$9.33x10^{-2}$	$3.29x10^{-2}$
KP46-N-LD	$1.41x10^{-2}$	$1.41x10^{-2}$	$3.29x10^{-2}$

K_x : Moment equivalent coefficient of rolling.
K_y : Moment equivalent coefficient of trimming.
K_z : Moment equivalent coefficient of shifting.

1. Analyze the track :

Rating Life

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

L : Rated Life (km)
C : Basic Dynamic Rated Load (kg)
P_C : Value of the Calculated Load (kg)
f_C : Contact Factor
f_w : Load Factor

1-6 Calculation of Service Life

In a KP-LD, when 2 internal slides working in close proximity to each other generates moment, refer to Table 1.6.2, multiply the equivalent factor with the load moment, having an equivalent load.

$P_m = K \times M$
P_m : Equivalent load of the slide (kgf)
K : Moment factor of equivalence (mm)
M : Moment load (kgf×mm)

When apply a M_c moment on a KP-LD :

$$P_m = \frac{K_C \cdot M_C}{2}$$

Apply a radial load (P) and a moment on a KP-LD at the same time :

$P_E = P + P_m$
P_E : Total radial load of equivalence (kg)

【Service Life】

After a rated service life is calculated, service life can be calculated by using the following formula(Under the circumstances that the travel distance and the number of reciprocating cycles per minute are stable).

$$L_h = \frac{L \cdot 10^6}{2 \cdot \ell_S \cdot N_1 \cdot 60}$$

L_h : Service life (h)
ℓ_S : Distance of travel (mm)
N_1 : No. of reciprocating cycles per minute (min^{-1})

2. Analyze the Bearing Support End of ball screw :

Rating Life

$$L = \left(\frac{C_a}{f_W \cdot F_a}\right)^3 \cdot 10^6$$

L : Service life (rev)
C_a : Basic dynamic rated load (kg)
F_a : Value of calculated load (kg)
f_w : Load factor (refer to E10. Table 1.6.1)

1-7 Calculation of Service Life/ Lubrication

【Service Life】

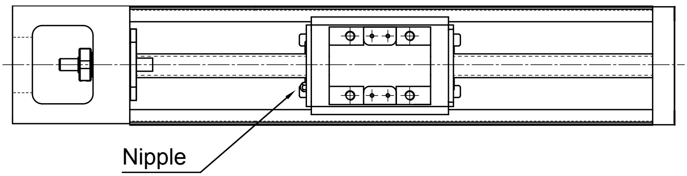
After a rated service life is calculated, service life can be calculated by using the following formula (provided that the travel distance and the number of reciprocating cycles per minute are not changed).

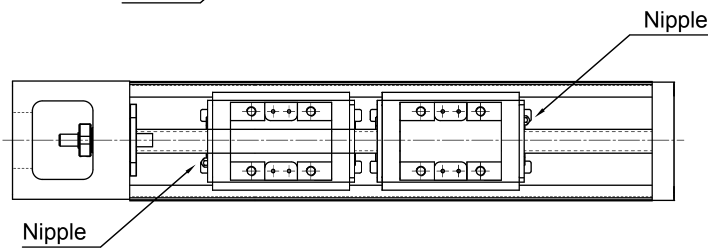
$$L_h = \frac{L \cdot \ell}{2 \cdot \ell_s \cdot N_1 \cdot 60}$$

L_h : Service life (h)
ℓ_s : Distance of travel (mm)
N_1 : No. of reciprocating cycles per minute (min^{-1})
ℓ : Screw lead (mm)

■ 1-7-1 Notice on Lubrication

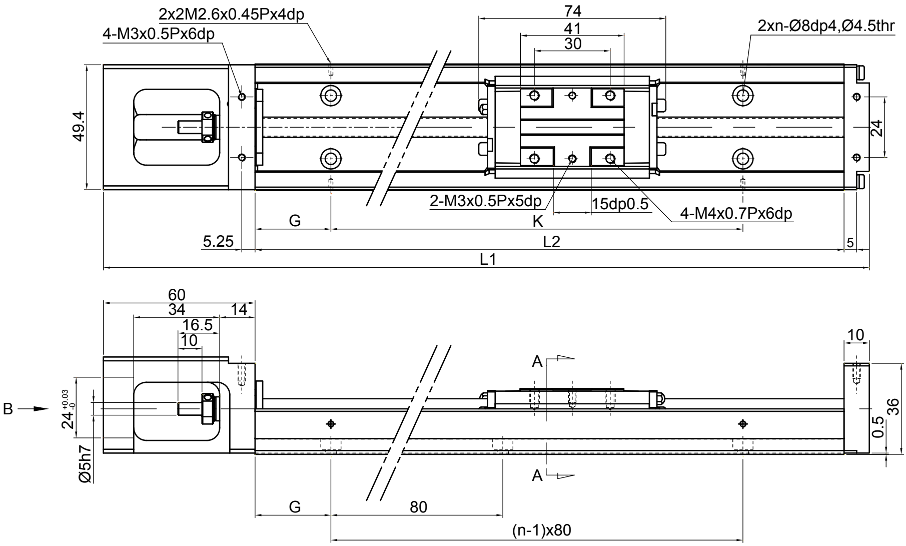
Lubrication is essential to Single Axis Actuator, otherwise the friction increase may be the leading factor to shorten service life. It is suggested that every 100 km travel distance Single Axis Actuator should be lubricated through the grease nipple on the slide. Grease only applies to the working environment which is slower than 60 m/min and cooling is not required.

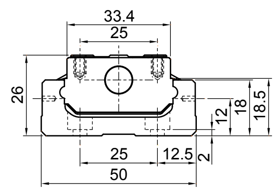




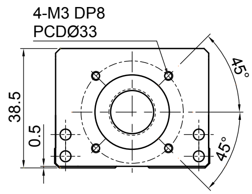
1-8 KP Product Series

KP26 (Standard Type)





SECTION A-A

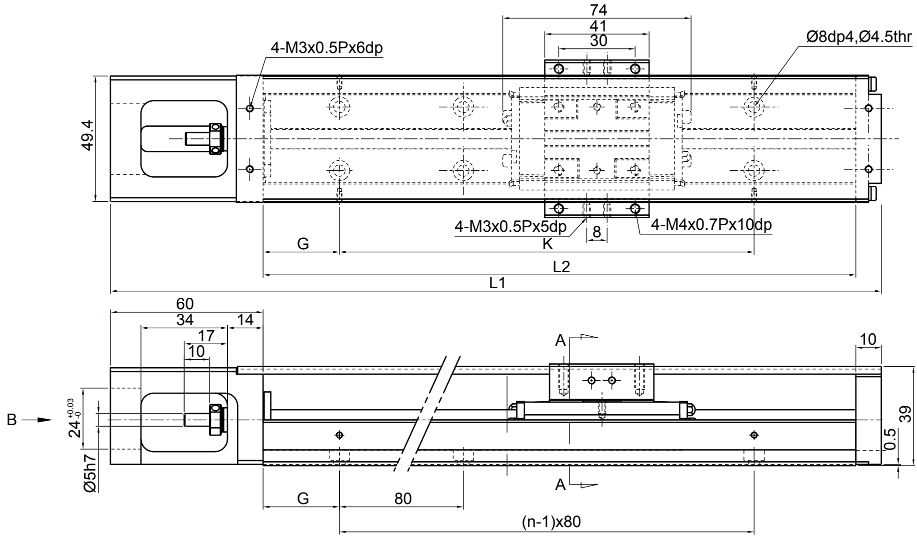


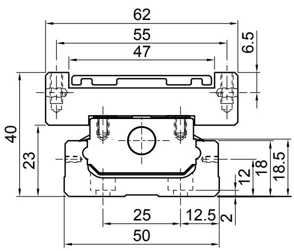
View B

Stroke L2(mm)	Overall length L1(mm)	Max.travel(mm)		G(mm)	K(mm)	n	Total weight(kg)	
		LS	LD				LS	LD
150	220	73	-	35	80	2	1	-
200	270	123	54	20	160	3	1.2	1.4
250	320	173	104	45	160	3	1.4	1.6
300	370	223	154	30	240	4	1.6	1.8

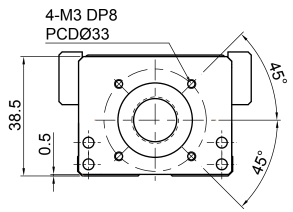
※LS slide base : with one slide base, LD slide base : with two slide bases.

KP26 (Standard Type with Protective Cap)





SECTION A-A



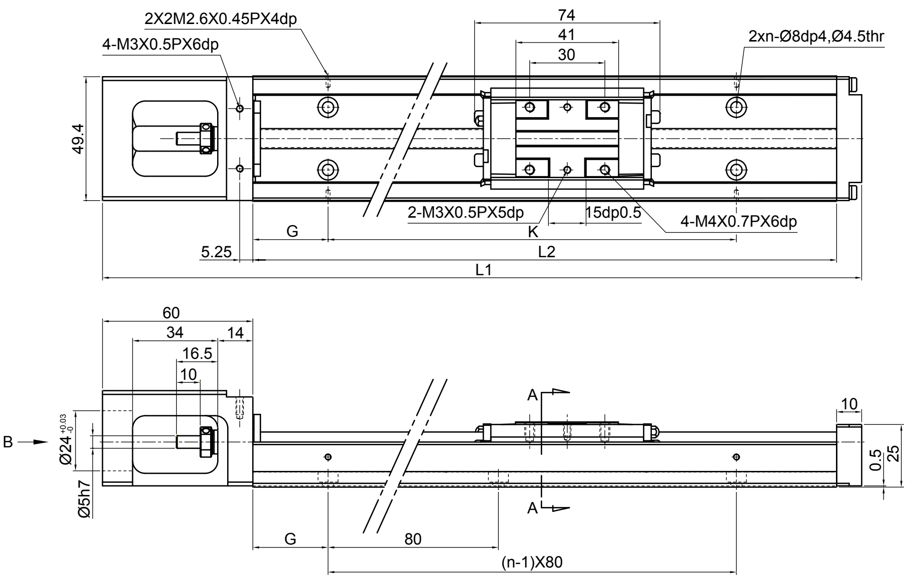
View B

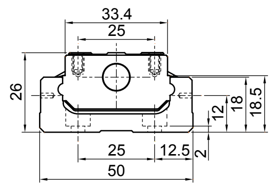
Stroke L2(mm)	Overall length L1(mm)	Max.travel(mm)		G(mm)	K(mm)	n	Total weight(kg)	
		LS	LD				LS	LD
150	220	73	-	35	80	2	1.1	-
200	270	123	54	20	160	3	1.3	1.5
250	320	173	104	45	160	3	1.5	1.8
300	370	223	154	30	240	4	1.8	2.0

※LS slide base : with one slide base, LD slide base : with two slide bases.

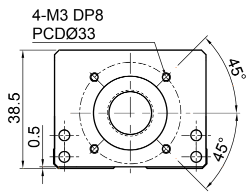
1-8 KP Product Series

KP26 (Low-Assembly)





SECTION A-A

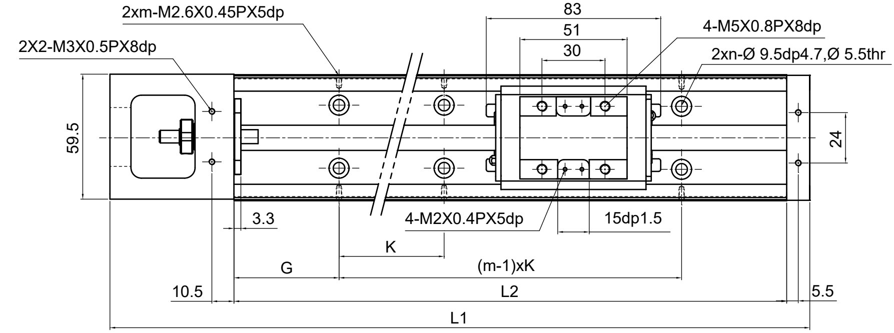


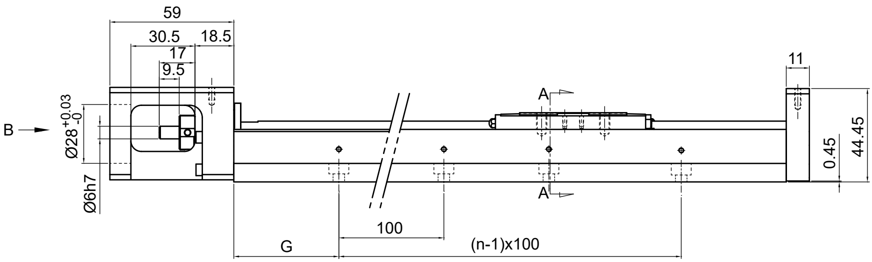
View B

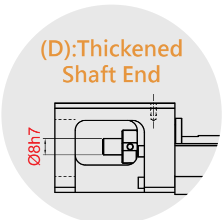
Stroke L2(mm)	Overall length L1(mm)	Max.travel(mm)		G(mm)	K(mm)	n	Total weight(kg)	
		LS	LD				LS	LD
150	220	73	-	35	80	2	1	-
200	270	123	54	20	160	3	1.2	1.4
250	320	173	104	45	160	3	1.4	1.6
300	370	223	154	30	240	4	1.6	1.8

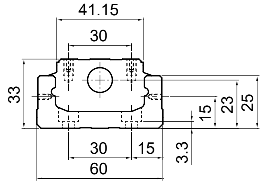
※LS slide base : with one slide base, LD slide base : with two slide bases.

KP33 (Standard Type)

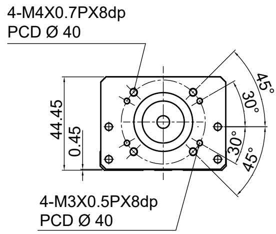








SECTION A-A



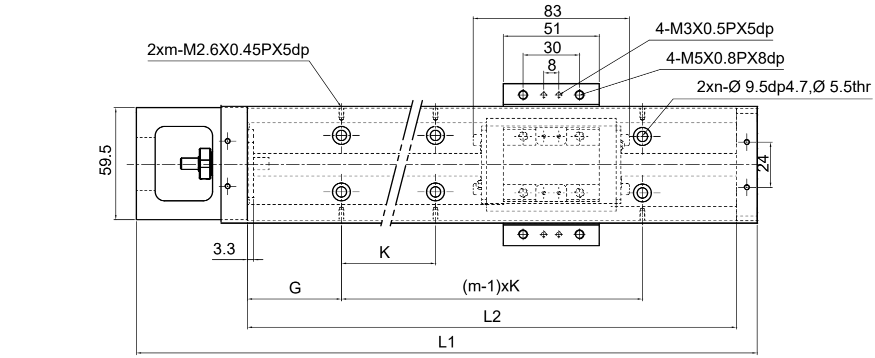
View B

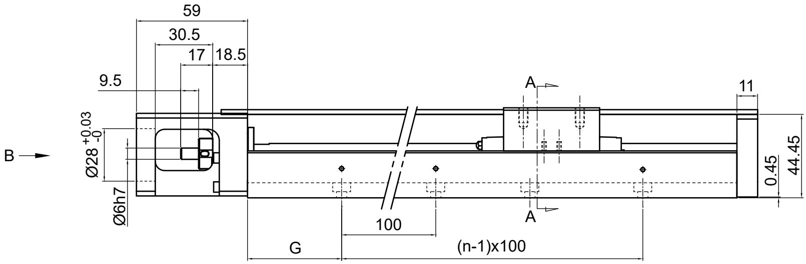
Stroke L2(mm)	Overall length L1(mm)	Max.travel(mm)		G(mm)	K(mm)	n	m	Total weight(kg)	
		LS	LD					LS	LD
150	220	63.5	-	25	100	2	2	1.5	-
200	270	113.5	36.5	50	100	2	2	1.8	2.1
300	370	213.5	136.5	50	200	3	2	2.4	2.7
400	470	313.5	236.5	50	100	4	4	3	3.3
500	570	413.5	336.5	50	200	5	3	3.6	3.9
600	670	513.5	436.5	50	100	6	6	4.2	4.6

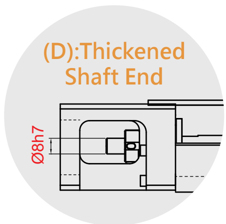
※LS slide base : with one slide base, LD slide base : with two slide bases.

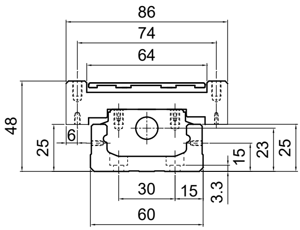
1-8 KP Product Series

KP33 (Standard Type with Protective Cap)

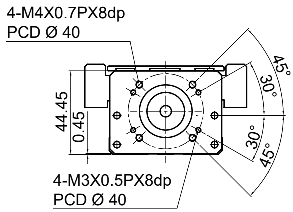








SECTION A-A

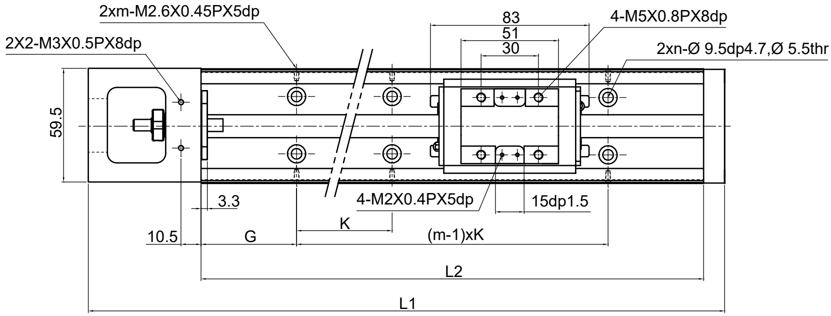


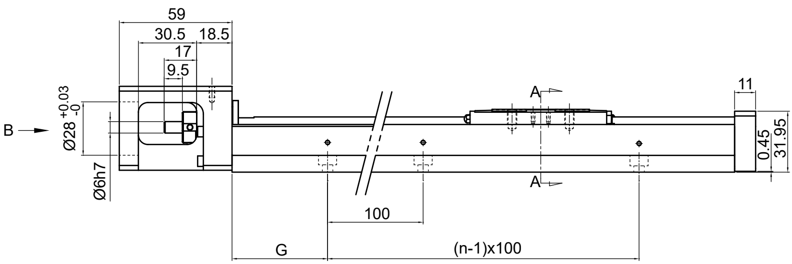
View B

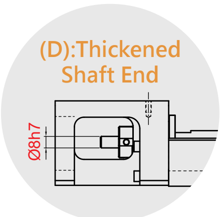
Stroke L2 (mm)	Overall length L1 (mm)	Max. travel (mm)		G(mm)	K(mm)	n	m	Total weight (kg)	
		LS	LD					LS	LD
150	220	63.5	-	25	100	2	2	1.5	-
200	270	113.5	36.5	50	100	2	2	1.8	2.1
300	370	213.5	136.5	50	200	3	2	2.4	2.7
400	470	313.5	236.5	50	100	4	4	3	3.3
500	570	413.5	336.5	50	200	5	3	3.6	3.9
600	670	513.5	436.5	50	100	6	6	4.2	4.6

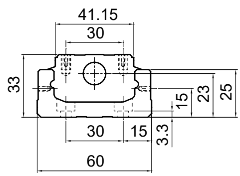
※LS slide base : with one slide base, LD slide base : with two slide bases.

KP33 (Low-Assembly)

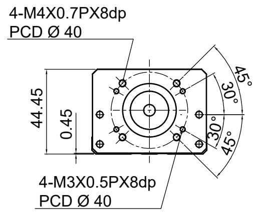








SECTION A-A



View B

Stroke L2 (mm)	Overall length L1 (mm)	Max. travel (mm)		G(mm)	K(mm)	n	m	Total weight (kg)	
		LS	LD					LS	LD
150	220	63.5	-	25	100	2	2	1.5	-
200	270	113.5	36.5	50	100	2	2	1.8	2.1
300	370	213.5	136.5	50	200	3	2	2.4	2.7
400	470	313.5	236.5	50	100	4	4	3	3.3
500	570	413.5	336.5	50	200	5	3	3.6	3.9
600	670	513.5	436.5	50	100	6	6	4.2	4.6

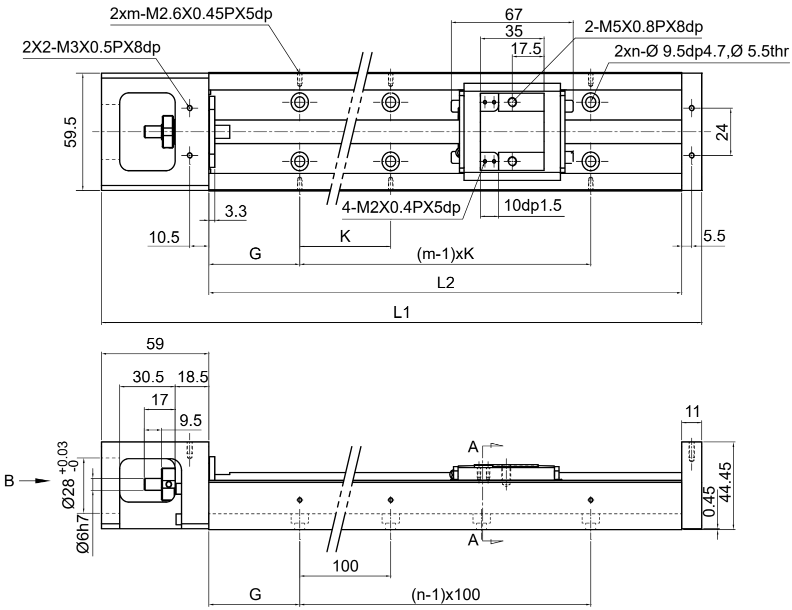
※LS slide base : with one slide base, LD slide base : with two slide bases.

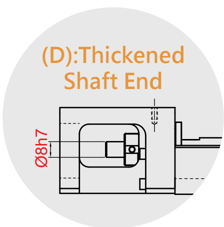
E

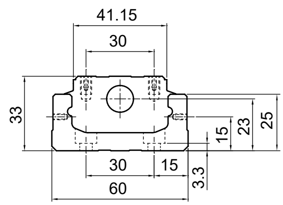
Single Axis Actuator

1-8 KP Product Series

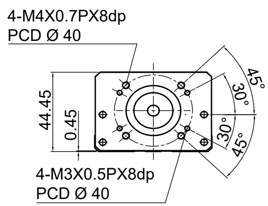
KP33 (Light-Load Type)







SECTION A-A

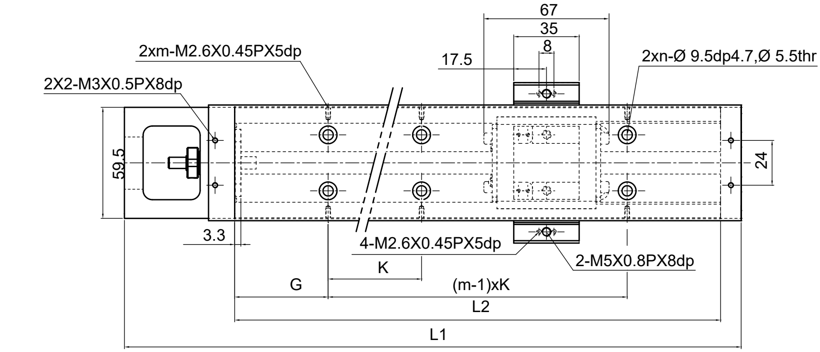


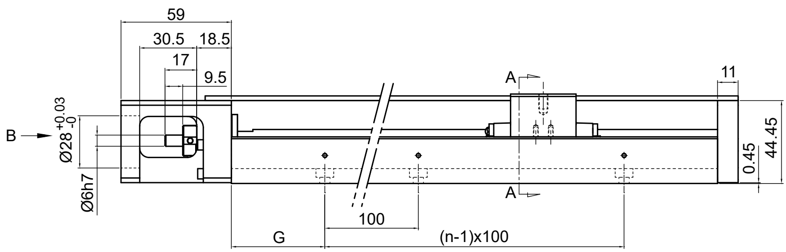
View B

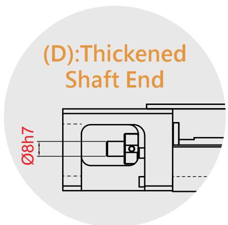
Stroke L2(mm)	Overall length L1(mm)	Max.travel(mm)		G(mm)	K(mm)	n	m	Total weight(kg)	
		NS	ND					NS	ND
150	220	79.5	-	25	100	2	2	1.4	-
200	270	129.5	68.5	50	100	2	2	1.7	1.9
300	370	229.5	168.5	50	200	3	2	2.3	2.5
400	470	329.5	268.5	50	100	4	4	2.9	3.1
500	570	429.5	368.5	50	200	5	3	3.5	3.7
600	670	529.5	468.5	50	100	6	6	4.1	4.3

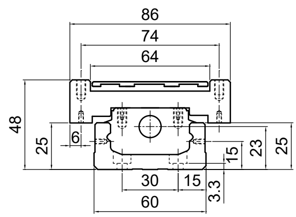
※NS slide base : with one slide base, ND slide base : with two slide bases.

KP33 (Light-Load Type with Protective Cap)

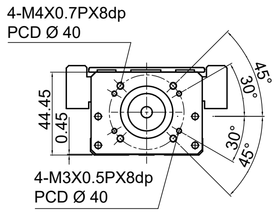








SECTION A-A



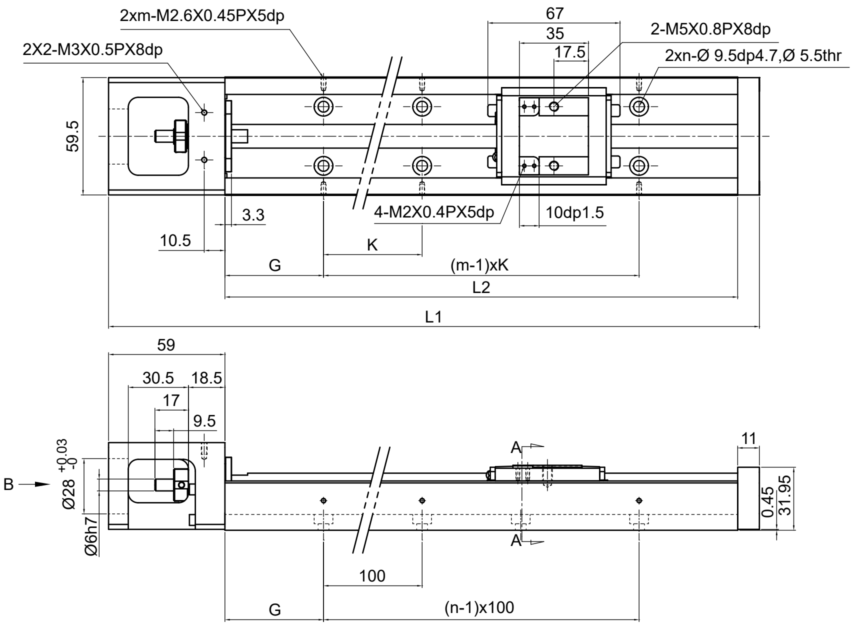
View B

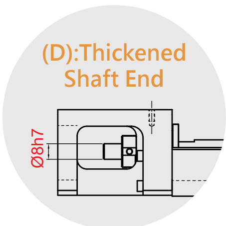
Stroke L2 (mm)	Overall length L1 (mm)	Max. travel (mm)		G(mm)	K(mm)	n	m	Total weight (kg)	
		NS	ND					NS	ND
150	220	79.5	-	25	100	2	2	1.4	-
200	270	129.5	68.5	50	100	2	2	1.7	1.9
300	370	229.5	168.5	50	200	3	2	2.3	2.5
400	470	329.5	268.5	50	100	4	4	2.9	3.1
500	570	429.5	368.5	50	200	5	3	3.5	3.7
600	670	529.5	468.5	50	100	6	6	4.1	4.3

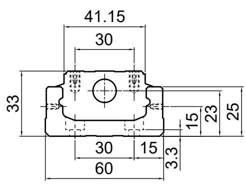
※NS slide base : with one slide base, ND slide base : with two slide bases.

1-8 KP Product Series

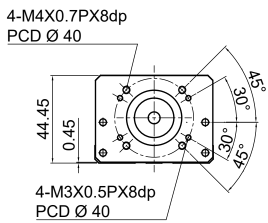
KP33 (Light-Load Type, Low-Assembly)







SECTION A-A

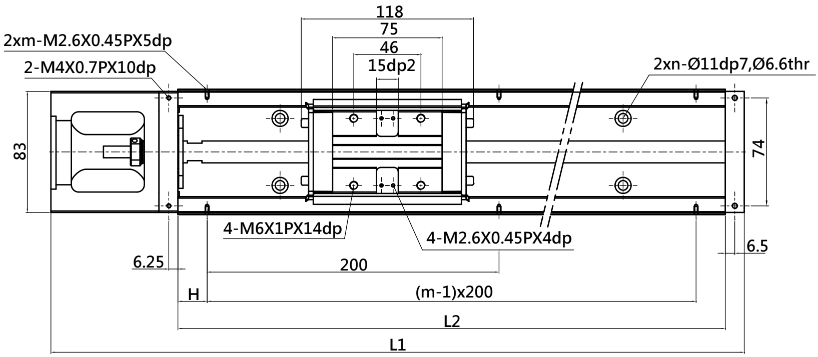


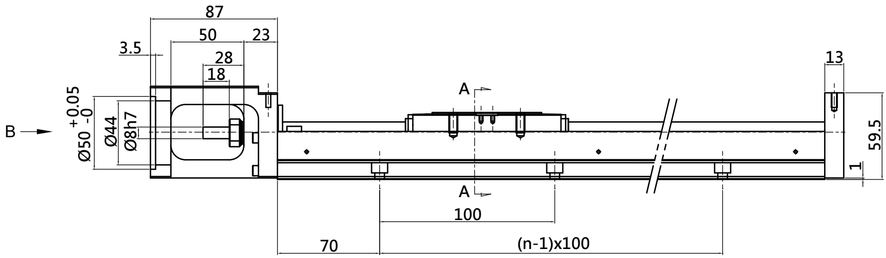
View B

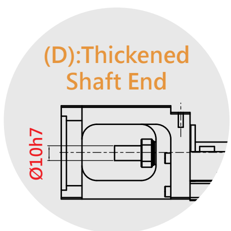
Stroke L2 (mm)	Overall length L1 (mm)	Max. travel (mm)		G(mm)	K(mm)	n	m	Total weight (kg)	
		NS	ND					NS	ND
150	220	79.5	-	25	100	2	2	1.4	-
200	270	129.5	68.5	50	100	2	2	1.7	1.9
300	370	229.5	168.5	50	200	3	2	2.3	2.5
400	470	329.5	268.5	50	100	4	4	2.9	3.1
500	570	429.5	368.5	50	200	5	3	3.5	3.7
600	670	529.5	468.5	50	100	6	6	4.1	4.3

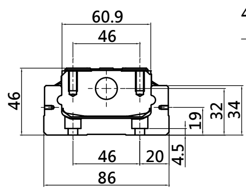
※NS slide base : with one slide base, ND slide base : with two slide bases.

KP46 (Standard Type)

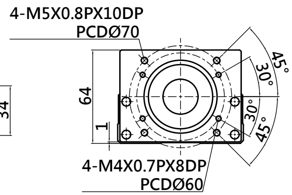








SECTION A-A



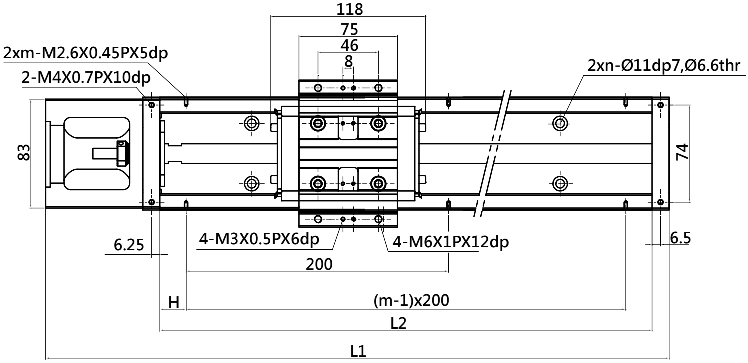
View B

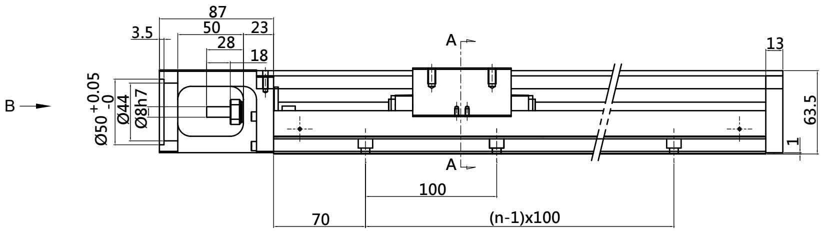
Stroke L2 (mm)	Overall length L1 (mm)	Max. travel (mm)		H(mm)	n	m	Total weight (kg)	
		LS	LD				LS	LD
340	440	218.5	106.5	70	3	2	5.7	6.5
440	540	318.5	206.5	20	4	3	6.9	7.7
540	640	418.5	306.5	70	5	3	8	8.8
640	740	518.5	406.5	20	6	4	9.2	10.1
740	840	618.5	506.5	70	7	4	10.4	11.3
940	1040	818.5	706.5	70	9	5	11.6	12.5

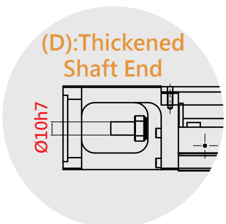
※LS slide base : with one slide base, LD slide base : with two slide bases.

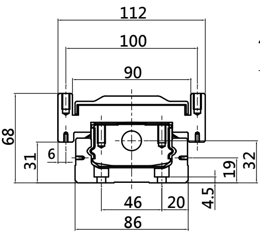
1-8 KP Product Series

KP46 (Standard Type with Protective Cap)

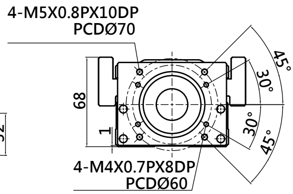








SECTION A-A

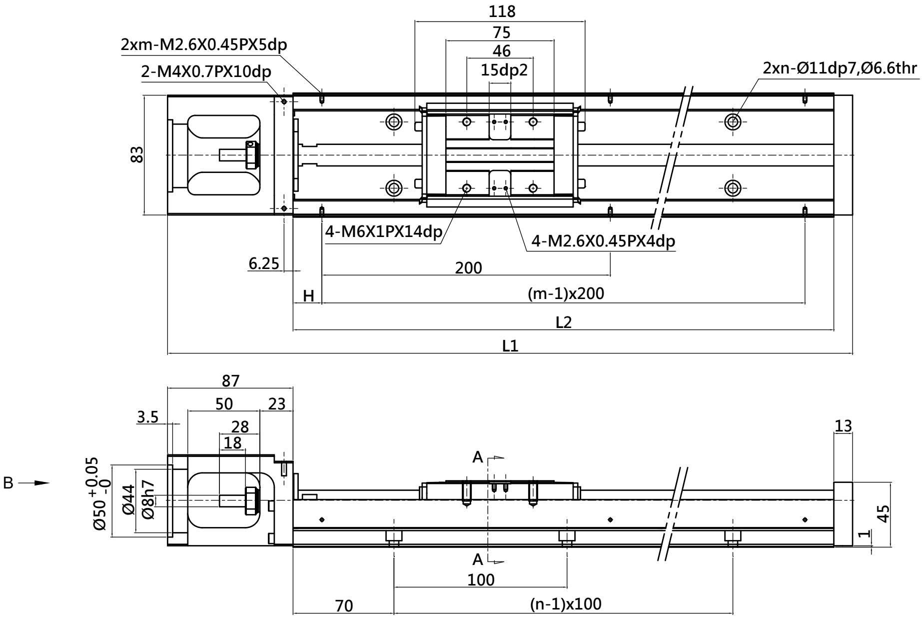


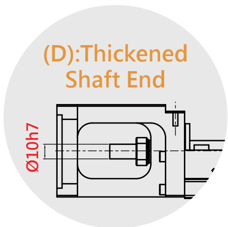
View B

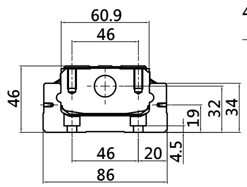
Stroke L2 (mm)	Overall length L1 (mm)	Max. travel (mm)		H(mm)	n	m	Total weight (kg)	
		LS	LD				LS	LD
340	440	218.5	106.5	70	3	2	6.5	7.3
440	540	318.5	206.5	20	4	3	7.8	8.6
540	640	418.5	306.5	70	5	3	9.0	9.8
640	740	518.5	406.5	20	6	4	10.3	11.3
740	840	618.5	506.5	70	7	4	11.6	12.4
940	1040	818.5	706.5	70	9	5	13.0	13.8

※LS slide base : with one slide base, LD slide base : with two slide bases.

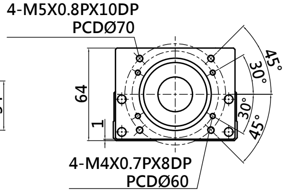
KP46 (Low-Assembly)







SECTION A-A



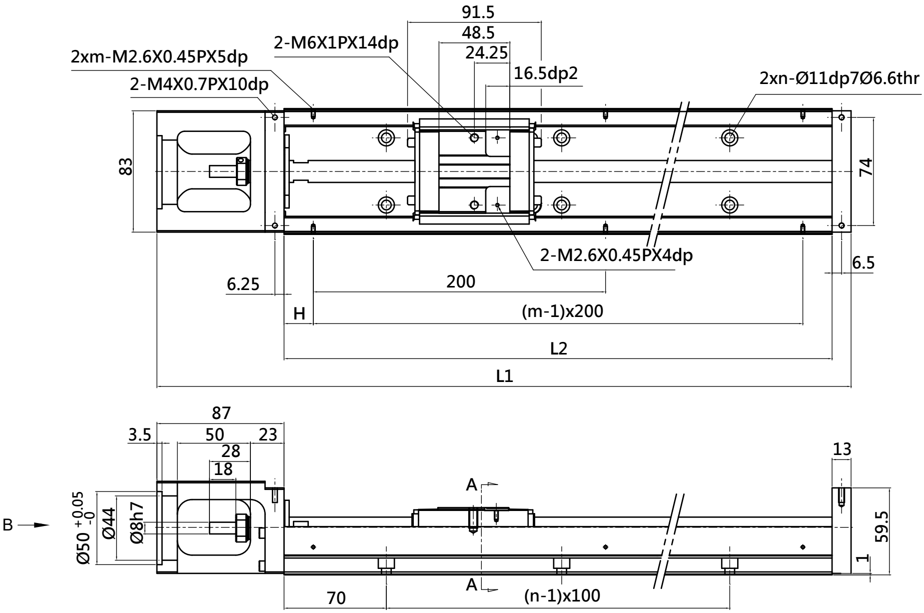
View B

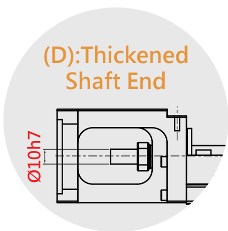
Stroke L2 (mm)	Overall length L1 (mm)	Max. travel (mm)		H(mm)	n	m	Total weight (kg)	
		LS	LD				LS	LD
340	440	218.5	106.5	70	3	2	6.5	7.3
440	540	318.5	206.5	20	4	3	7.8	8.6
540	640	418.5	306.5	70	5	3	9.0	9.8
640	740	518.5	406.5	20	6	4	10.3	11.3
740	840	618.5	506.5	70	7	4	11.6	12.4
940	1040	818.5	706.5	70	9	5	13.0	13.8

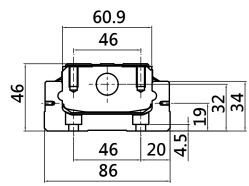
※LS slide base : with one slide base, LD slide base : with two slide bases.

1-8 KP Product Series

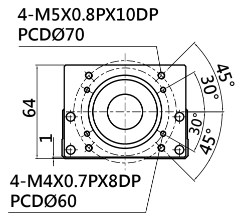
K46 (Light-Load Type)







SECTION A-A

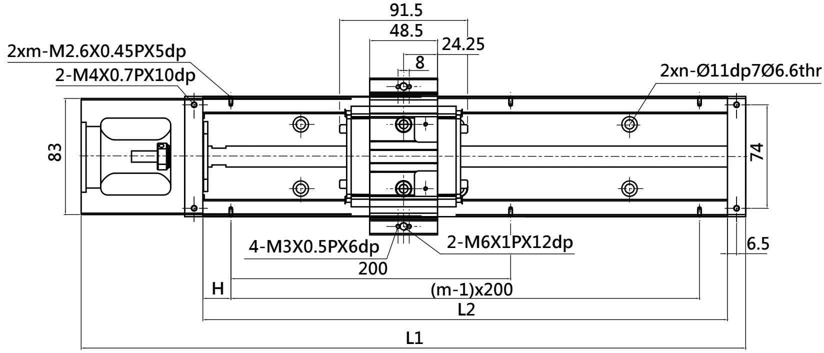


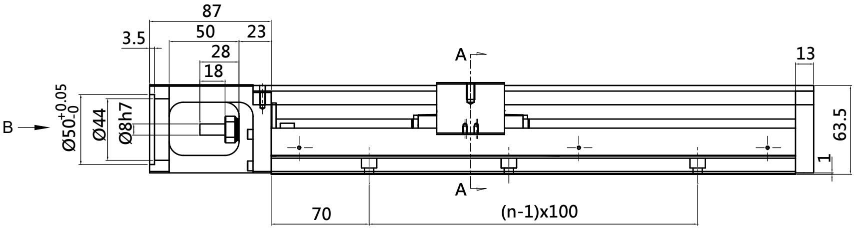
View B

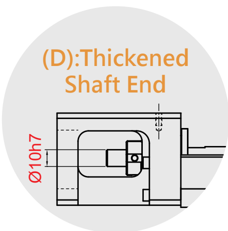
Stroke L2 (mm)	Overall length L1 (mm)	Max. travel (mm)		H(mm)	n	m	Total weight (kg)	
		NS	ND				NS	ND
340	440	245	159.5	70	3	2	5.4	5.9
440	540	345	259.5	20	4	3	6.6	7.1
540	640	445	359.5	70	5	3	7.7	8.2
640	740	545	459.5	20	6	4	8.9	9.4
740	840	645	559.5	70	7	4	10.1	10.6
940	1040	845	759.5	70	9	5	11.3	11.8

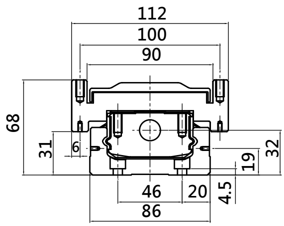
※NS slide base : with one slide base, ND slide base : with two slide bases.

KP46 (Light-Load Type with Protective Cap)

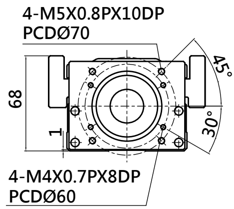








SECTION A-A



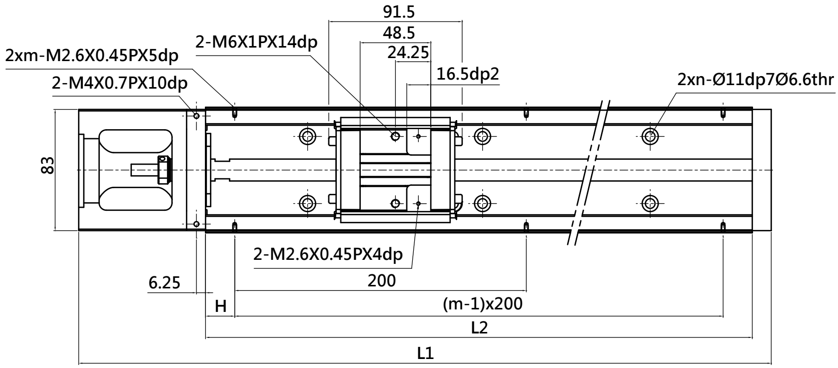
View B

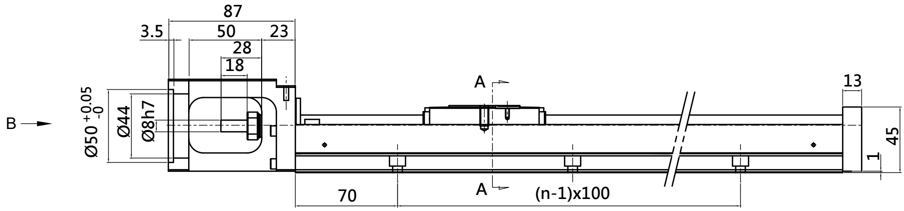
Stroke L2 (mm)	Overall length L1 (mm)	Max. travel (mm)		H(mm)	n	m	Total weight (kg)	
		NS	ND				NS	ND
340	440	245	159.5	70	3	2	6.3	7.1
440	540	345	259.5	20	4	3	7.6	8.4
540	640	445	359.5	70	5	3	8.8	9.6
640	740	545	459.5	20	6	4	10.1	11.1
740	840	645	559.5	70	7	4	11.4	12.2
940	1040	845	759.5	70	9	5	12.8	13.6

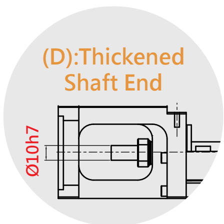
※NS slide base : with one slide base, ND slide base : with two slide bases.

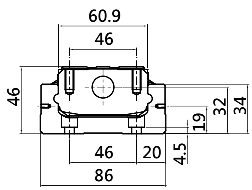
1-8 KP Product Series

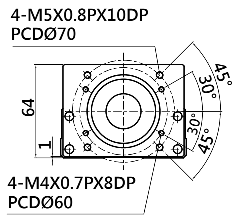
KP46 (Light-Load Type, Low-Assembly)











SECTION A-A

View B

Stroke L2 (mm)	Overall length L1 (mm)	Max. travel (mm)		H(mm)	n	m	Total weight (kg)	
		NS	ND				NS	ND
340	440	245	159.5	70	3	2	6.3	7.1
440	540	345	259.5	20	4	3	7.6	8.4
540	640	445	359.5	70	5	3	8.8	9.6
640	740	545	459.5	20	6	4	10.1	11.1
740	840	645	559.5	70	7	4	11.4	12.2
940	1040	845	759.5	70	9	5	12.8	13.6

※NS slide base : with one slide base, ND slide base : with two slide bases.

1-9 The Adapting Flange of the Motor Base and the Motor

■ 1-9-1 List of Suitable Motors

Table 1.9.1 Mitsubishi Servo Motors

NO.	Power Output	Motor	weight (kg)	Suitable Flange			Brake (kg)	Drive	weight (kg)	Remarks
				KP26	KP33	KP46				
M01	50W	HG-KR053	0.34	F01	F05	F12	-	MR-J4-10A	0.8	220V
M02	50W	HG-KR053K	0.34	F01	F05	F12	-	MR-J4-10A	0.8	220V
M03	100W	HG-KR13	0.54	F01	F05	F12	-	MR-J4-10A	0.8	220V
M04	100W	HG-KR13K	0.54	F01	F05	F12	-	MR-J4-10A	0.8	220V
M05	200W	HG-KR23	0.91	-	-	F10	-	MR-J4-20A	0.8	220V
M06	200W	HG-KR23K	0.91	-	-	F10	-	MR-J4-20A	0.8	220V
M07	400W	HG-KR43	1.4	-	-	F10	-	MR-J4-40A	1	220V
M08	400W	HG-KR43K	1.4	-	-	F10	-	MR-J4-40A	1	220V
M09	750W	HG-KR73	2.8	-	-	-	-	MR-J4-70A	1.4	220V
M10	750W	HG-KR73K	2.8	-	-	-	-	MR-J4-70A	1.4	220V

(1).A Single Axis Actuator includes a servo motor with supply wire, detector connecting wire and servo connector, supply wire and detector connecting wire are 3 meters long. 3m supply wire(3m, MIT) MR-PWS1CBL3M-A2-L-T/ 3m detector connecting wire(3m, MIT)MR-J3ENCBL3M-A2-L-T, servo connector SMR-J3CN1.
(2)Exclude the battery of absolute position detecting system.

Table 1.9.2 Panasonic Servo Motors

NO.	Power Output	Motor	weight (kg)	Suitable Flange			Brake (kg)	Drive	weight (kg)	Remarks
				KP26	KP33	KP46				
M11	50W	MSMF5AZL1U2	0.32	F02	F06	F13	0.53	MADLN01SE	0.8	210V
M12	50W	MSMF5AZL1U2	0.32	F02	F06	F13	0.53	MADLN05SE	0.8	220V
M13	100W	MSMF011L1U2	0.47	F02	F06	F13	0.68	MADLN11SE	0.8	210V
M14	100W	MSMF012L1U2	0.47	F02	F06	F13	0.68	MADLN05SE	0.8	220V
M15	200W	MSMF021L1U2	0.82	-	-	F11	1.3	MBDLN21SE	1	210V
M16	200W	MSMF022L1U2	0.82	-	-	F11	1.3	MADLN15SE	0.8	220V
M17	400W	MSMF041L1U2	1.2	-	-	F11	1.7	MCDLN31SE	1.6	210V
M18	400W	MSMF042L1U2	1.2	-	-	F11	1.7	MBDLN25SE	1	220V
M19	750W	MSMF082L1U2	2.3	-	-	-	3.1	MCDLN35SE	1.6	220V

(1)A single axis actuator includes a servo motor with supply wire, coding wire, I/F adaptor, supply wire and coding wire are 1m, 3m or 5m long, without designation wires would be 3 meters long.
(2) Exclude the battery of absolute position detecting system.

Incremental type	Pulse type	D-Axis	Low-inertia	Medium-inertia	Low-capacity	No Grease Seal	Grease Seal	With Brake	No Brake	Key Way	Key Way, Threaded Hole	Optical Axis

1-9 The Adapting Flange of the Motor Base and the Motor

Table 1.9.3 Yaskawa Servo Motors

NO.	Power Output	Motor	weight (kg)	Suitable Flange			Brake (kg)	Drive	weight (kg)	Remarks
				KP26	KP33	KP46				
M20	50W	SGM7J-A5AF61	0.3	F01	F05	F12	-	SGD7S-R70A00A	0.8	220V
M21	50W	SGM7J-A5AF6C	0.6	F01	F05	F12	0.6	SGD7S-R70A00A	0.8	220V
M22	50W	SGM7J-A5AF6S	0.3	F01	F05	F12	-	SGD7S-R70A00A	0.8	220V
M23	50W	SGM7J-A5AF6E	0.6	F01	F05	F12	0.6	SGD7S-R70A00A	0.8	220V
M24	100W	SGM7J-01AF61	0.4	F01	F05	F12	-	SGD7S-R90A00A	0.8	220V
M25	100W	SGM7J-01AF6C	0.7	F01	F05	F12	0.7	SGD7S-R90A00A	0.8	220V
M26	100W	SGM7J-01AF6S	0.4	F01	F05	F12	-	SGD7S-R90A00A	0.8	220V
M27	100W	SGM7J-01AF6E	0.7	F01	F05	F12	0.7	SGD7S-R90A00A	0.8	220V
M28	200W	SGM7J-02AF61	0.8	-	-	F10	-	SGD7S-1R6A00A	0.8	220V
M29	200W	SGM7J-02AF6C	1.4	-	-	F10	1.4	SGD7S-1R6A00A	0.8	220V
M30	200W	SGM7J-02AF6S	0.8	-	-	F10	-	SGD7S-1R6A00A	0.8	220V
M31	200W	SGM7J-02AF6E	1.4	-	-	F10	1.4	SGD7S-1R6A00A	0.8	220V
M32	400W	SGM7J-04AF61	1.1	-	-	F10	-	SGD7S-2R8A00A	1	220V
M33	400W	SGM7J-04AF6C	1.7	-	-	F10	1.7	SGD7S-2R8A00A	1	220V
M34	400W	SGM7J-04AF6S	1.1	-	-	F10	-	SGD7S-2R8A00A	1	220V
M35	400W	SGM7J-04AF6E	1.7	-	-	F10	1.7	SGD7S-2R8A00A	1	220V
M36	750W	SGM7J-08AF61	2.2	-	-	-	-	SGD7S-5R5A00A	1.6	220V
M37	750W	SGM7J-08AF6C	2.8	-	-	-	2.8	SGD7S-5R5A00A	1.6	220V
M38	750W	SGM7J-08AF6S	2.2	-	-	-	-	SGD7S-5R5A00A	1.6	220V
M39	750W	SGM7J-08AF6E	2.8	-	-	-	2.8	SGD7S-5R5A00A	1.6	220V

(1)A single axis actuator includes a servo motor with supply wire, coding wire and servo connector, supply wire and coding wire are 3 meters long.
3m supply wire(No actuator) JZSP-C7M10F-03-E(50W), JZSP-C7M20F-03-E(100W, 200W, 400W), JZSP-C7M30F-03-E(750W)
3m supply wire(with actuator) JZSP-C7M13F-03-E(50W), JZSP-C7M23F-03-E(100W, 200W, 400W), JZSP-C7M33-03-E-(750W)
coding wire JZSP-C7P10D-03-E CN1 adaptor 3M-MDR(50P)

Incremental type	Pulse type	D-Axis	Low-inertia	Medium-inertia	Low-capacity	No Grease Seal	Grease Seal	With Brake	No Brake	Key Way	Key Way, Threaded Hole	Optical Axis
●	●	●	●	●	●	●	●	●	●	●	●	●

Table 1.9.4 Oriental Step Motors

NO.	Series	Specification	Suitable Flange			Motor	weight (kg)	Drive	weight (kg)	Remarks
			KP26	KP33	KP46					
M40	RK Ⅱ	RKS543AA-3	F03	F09	-	PKE543AC	0.26	RKSD503-A	0.8	110V
M41		RKS544AA-3	F03	F09	-	PKE544AC	0.32	RKSD503-A	0.8	
M42		RKS545AA-3	F03	F09	-	PKE545AC	0.38	RKSD503-A	0.8	
M43		RKS566AA-3	-	-	F15	PKE566AC	0.9	RKSD507-A	0.8	
M44		RKS569AA-3	-	-	F15	PKE569AC	1.4	RKSD507-A	0.8	
M45		RKS596AA-3	-	-	-	PKE596AC	1.9	RKSD507-A	0.8	
M46		RKS599AA-3	-	-	-	PKE599AC	3	RKSD507-A	0.8	
M47		RKS5913AA-3	-	-	-	PKE5913AC	4.1	RKSD507-A	0.8	

※Include 3 meters long supply wire for servo motor.

1-9 The Adapting Flange of the Motor Base and the Motor

Table 1.9.5 Shihlin Motors

NO.	Power Output	Motor	weight (kg)	Suitable Flange			Brake (kg)	Drive	weight (kg)	Remarks
				KP26	KP33	KP46				
M48	100W	SME-L01030SAA	0.45	F01	F05	F12	-	SDE-010A2	1.4	220V
M49	100W	SME-L01030SAB	0.45	F01	F05	F12	-	SDE-010A2	1.4	220V
M50	100W	SME-L01030SBA	0.67	F01	F05	F12	0.67	SDE-010A2	1.4	220V
M51	100W	SME-L01030SBB	0.67	F01	F05	F12	0.67	SDE-010A2	1.4	220V
M52	200W	SME-L02030SAA	0.85	-	-	F10	-	SDE-020A2	1.4	220V
M53	200W	SME-L02030SAB	0.85	-	-	F10	-	SDE-020A2	1.4	220V
M54	200W	SME-L02030SBA	1.23	-	-	F10	1.23	SDE-020A2	1.4	220V
M55	200W	SME-L02030SBB	1.23	-	-	F10	1.23	SDE-020A2	1.4	220V
M56	400W	SME-L04030SAA	1.23	-	-	F10	-	SDE-040A2	1.4	220V
M57	400W	SME-L04030SAB	1.23	-	-	F10	-	SDE-040A2	1.4	220V
M58	400W	SME-L04030SBA	1.59	-	-	F10	1.59	SDE-040A2	1.4	220V
M59	400W	SME-L04030SBB	1.59	-	-	F10	1.59	SDE-040A2	1.4	220V
M60	750W	SME-L07530SAA	2.24	-	-	-	-	SDE-075A2	1.7	220V
M61	750W	SME-L07530SAB	2.24	-	-	-	-	SDE-075A2	1.7	220V
M62	750W	SME-L07530SBA	2.87	-	-	-	2.87	SDE-075A2	1.7	220V
M63	750W	SME-L07530SBB	2.87	-	-	-	2.87	SDE-075A2	1.7	220V

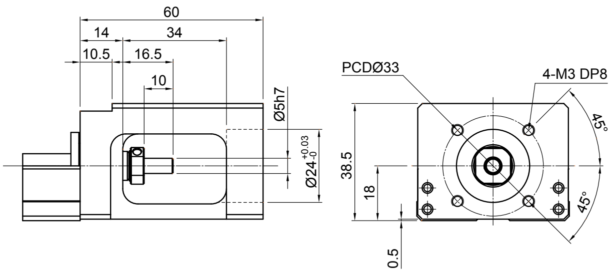
※(1) A single axis actuator includes a servo motor with supply wire, coding wire, I/F adaptor, supply wire and coding wire are mainly 3 meters long.
Supply wire SDA-PWCNL1-3M-L
Supply wire(for brake) SDA-PWCNL2-3M-L
Coding wire SDH-ENL-3M-L

Incremental type	Pulse type	D-Axis	Low-inertia	Medium-inertia	Low-capacity	No Grease Seal	Grease Seal	With Brake	No Brake	Key Way	Key Way, Threaded Hole	Optical Axis

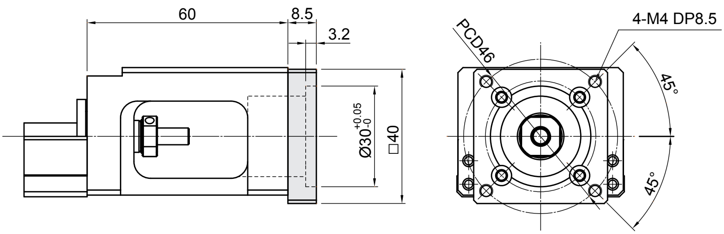
■ 1-9-2 The Adapting Flange of the Motor Base and the Motor

KP26

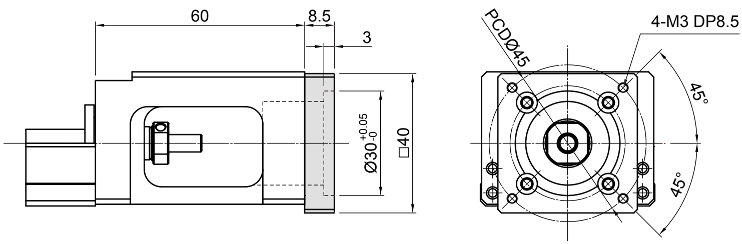
Motor Base F00



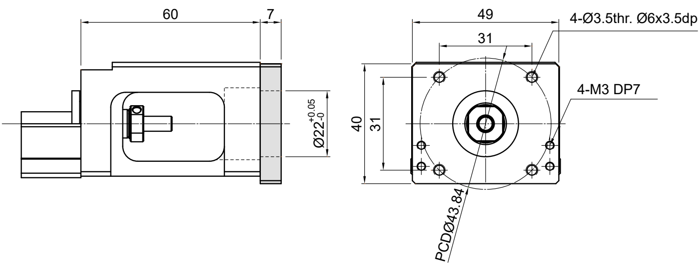
Motor Adapting Flange F01



Motor Adapting Flange F02



Motor Adapting Flange F03



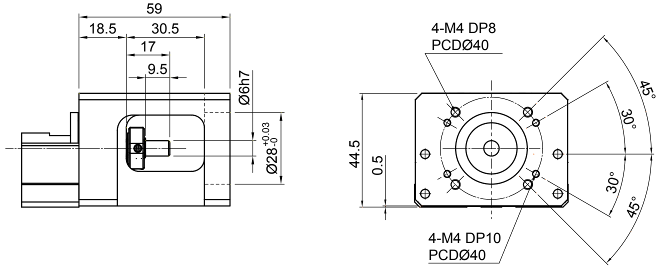
E

Single Axis Actuator

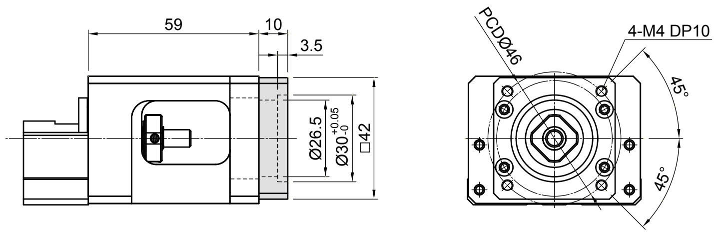
1-9 The Adapting Flange of the Motor Base and the Motor

KP33

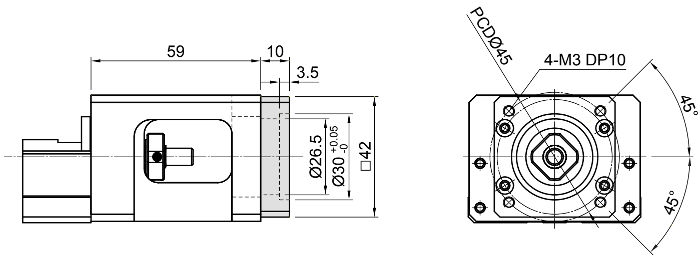
Motor Base F04



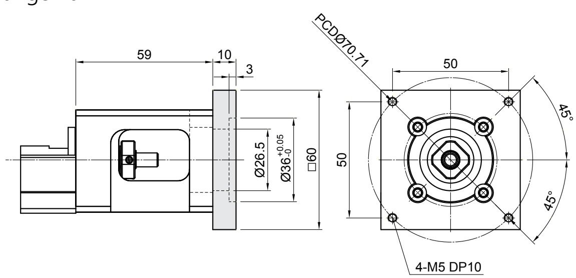
Motor Adapting Flange F05



Motor Adapting Flange F06

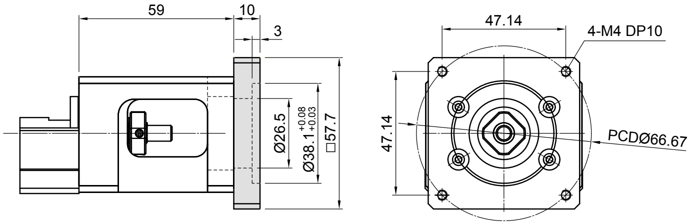


Motor Adapting Flange F07

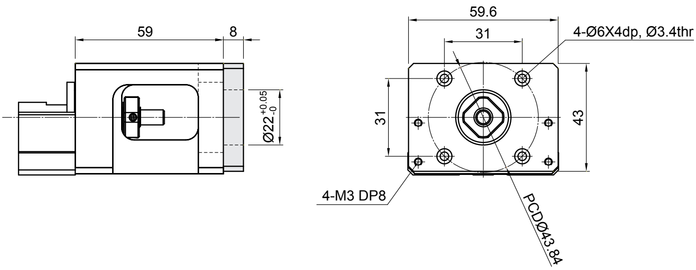


KP33

Motor Adapting Flange F08



Motor Adapting Flange F09

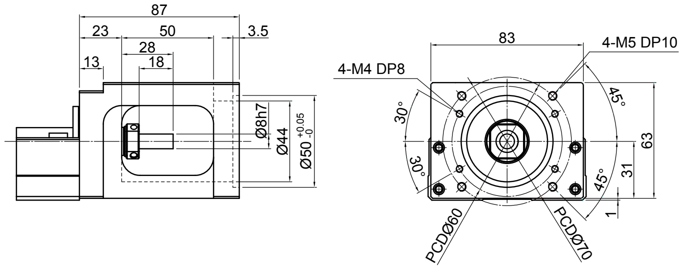


E
Single Axis Actuator

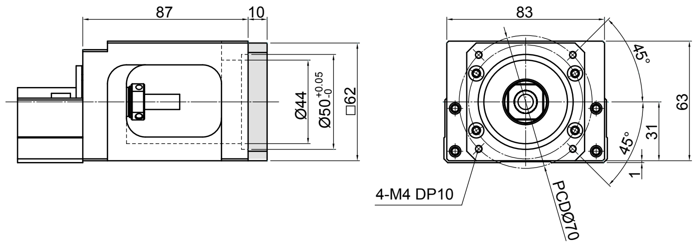
1-9 The Adapting Flange of the Motor Base and the Motor

KP46

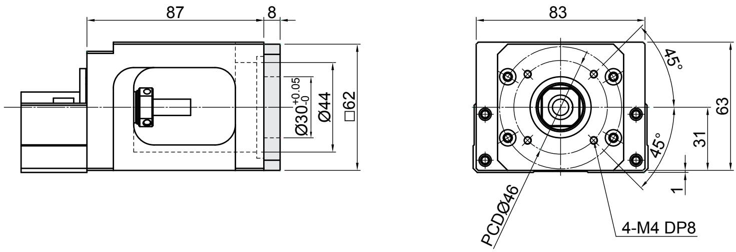
Motor Base F10



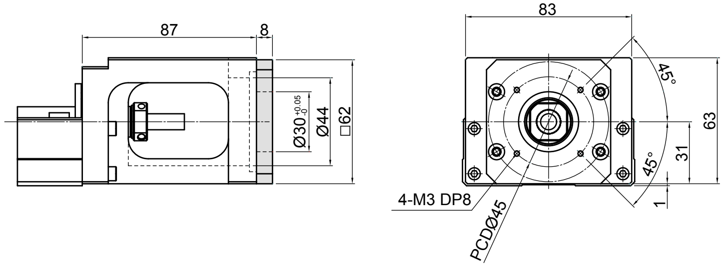
Motor Adapting Flange F11



Motor Adapting Flange F12

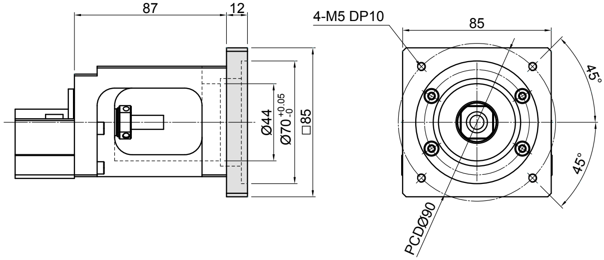


Motor Adapting Flange F13

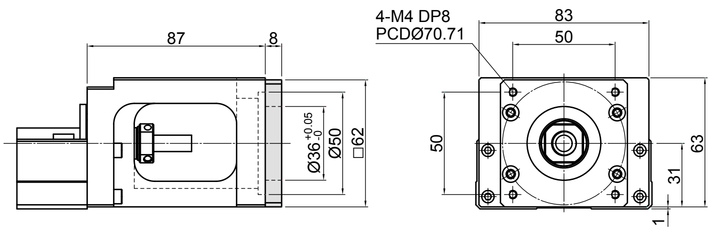


KP46

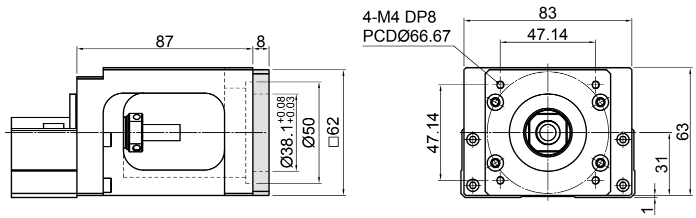
Motor Adapting Flange F14



Motor Adapting Flange F15

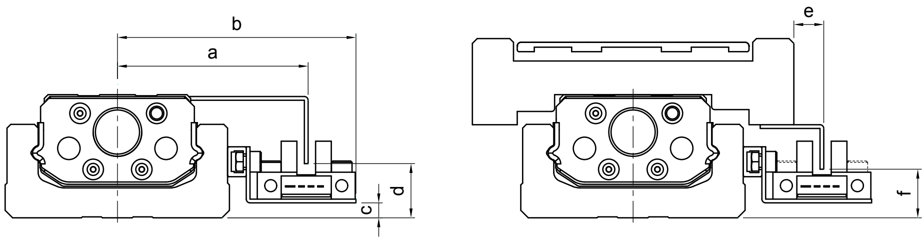


Motor Adapting Flange F16



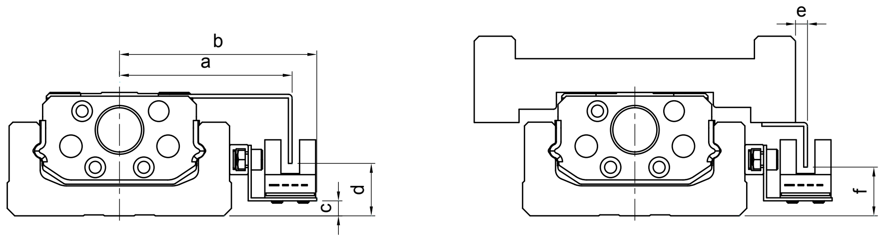
1-9 The Adapting Flange of the Motor Base and the Motor

■ 1-9-3 Sensor



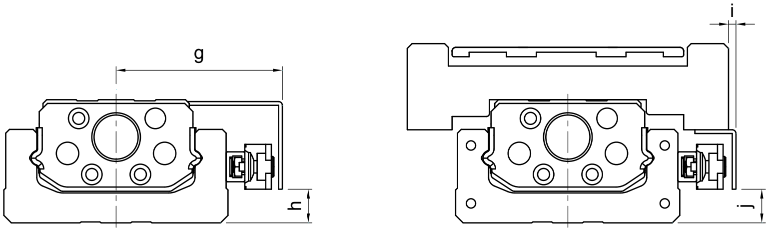
NO.	Nominal Model	a	b	c	d	e	f
S04	KP26	45.5	59	1	10	15	11
S05	KP33	51	63.8	4	14.5	8	13
S06	KP46	63.5	76.7	8	18	8	18

Sensor 1 : Omron EE-SX671.



NO.	Nominal Model	a	b	c	d	e	f
S07	KP26	41.3	48	1	10.5	10.2	11
S08	KP33	46.2	52.8	4	14	3.2	13
S09	KP46	59	65.7	8	18	3	18

Sensor 2 : Omron EE-SX674.



NO.	Nominal Model	g	h	i	j
S10	KP26	39.5	5.7	7	19.5
S11	KP33	44.5	9	2	9
S12	KP46	57	13	1	13

Sensor 3 : SUNX GX-F12A.

NO.	Nominal Model	g	h	i	j
S13	KP26	39.5	5.7	7	19.5
S14	KP33	44.5	9	2	9
S15	KP46	57	13	1	13

Sensor 4 : SUNX GX-F12A-P.

■ 1-9-4 Sensor Track

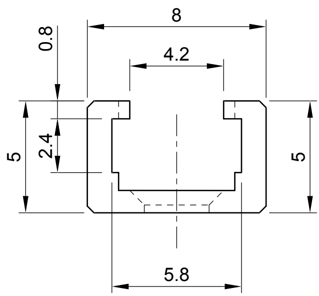
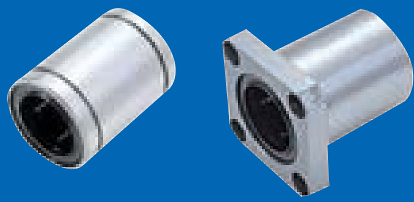


Table 1.9.6 List of Suitable Tracks

NO.	Nominal Model
S01	KP26
S02	KP33
S03	KP46

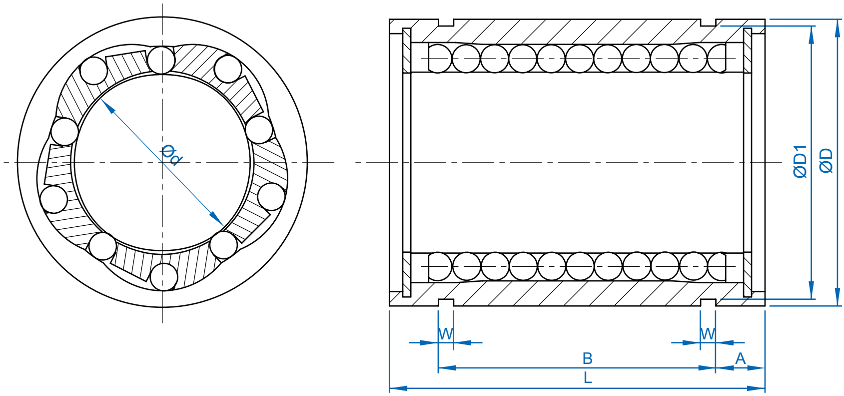
Memo

Linear Ball Bearing



1-1 Linear Ball Bearing

LM Series Specifications (Standard)

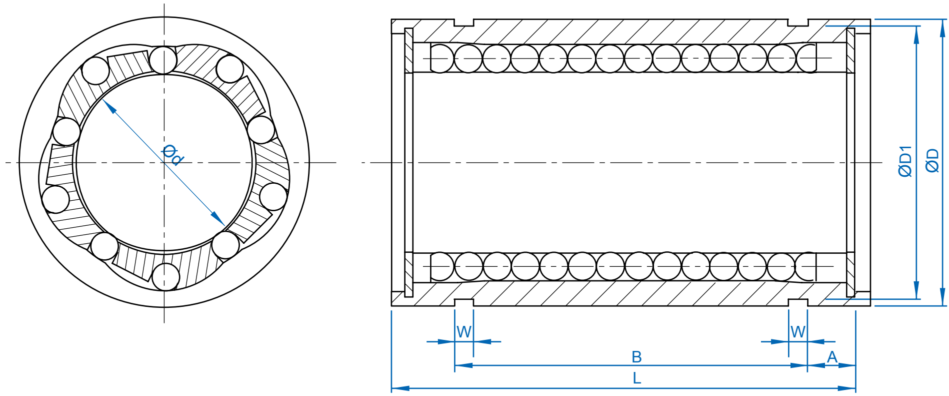


Unit : mm

ModelNo.	Dimension									Ca (kgf)	Coa (kgf)	Weight (g)
	d	D	Tolerance	L	LTolerance	W	D1	B	A			
LM-04UU	4	8	0 -0.011	12	0 -0.20	-	-	-	-	9	13	2
LM-06UU	6	12		19		1.1	11.5	13.5	2.75	21	27	8
LM-08UU	8	15		24		1.1	14.3	17.5	3.25	27	41	16
LM-10UU	10	19	0 -0.013	29		1.3	18	22	3.5	38	56	30
LM-12UU	12	21		30		1.3	20	23	3.5	42	61	31.5
LM-16UU	16	28		37		1.6	27	26.5	5.25	79	120	69
LM-20UU	20	32	0 -0.016	42		1.6	30.5	30.5	5.75	88	140	87
LM-25UU	25	40		59	0 -0.30	1.85	38	41	9	100	159	220
LM-30UU	30	45		64		1.85	43	44.5	9.75	159	279	250
LM-40UU	40	60	0 -0.019	80		2.1	57	60.5	9.75	219	409	585
LM-50UU	50	80		100		2.6	76.5	74	13	389	808	1580

※UU has oil seals at the ends

LM-L Series Specifications (Lengthen)



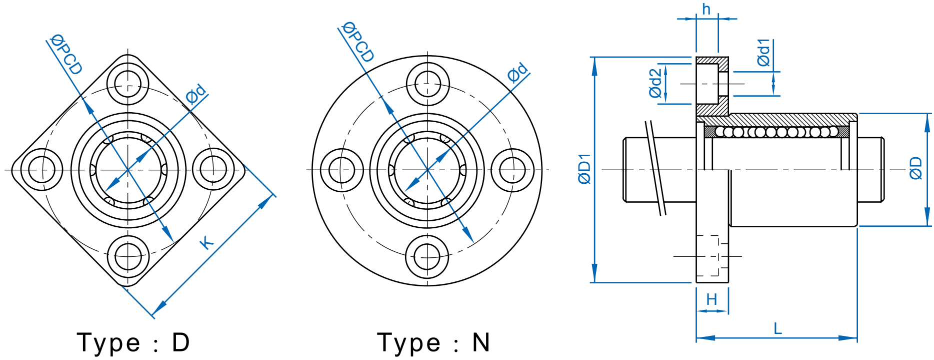
Unit : mm

<table>
<tr><th rowspan="2">Model No.</th><th colspan="9">Dimension</th><th rowspan="2">Ca (kgf)</th><th rowspan="2">Coa (kgf)</th><th rowspan="2">Weight(g)</th></tr>
<tr><th>d</th><th>D</th><th>D Tolerance</th><th>L</th><th>L Tolerance</th><th>W</th><th>D1</th><th>B</th><th>A</th></tr>
<tr><td>LM-06LUU</td><td>6</td><td>12</td><td rowspan="2">0
-0.013</td><td>35</td><td rowspan="6">0
-0.30</td><td>1.1</td><td>11.5</td><td>27</td><td>4</td><td>33</td><td>54</td><td>16</td></tr>
<tr><td>LM-08LUU</td><td>8</td><td>15</td><td>45</td><td>1.1</td><td>14.3</td><td>35</td><td>5</td><td>44</td><td>80</td><td>31</td></tr>
<tr><td>LM-10LUU</td><td>10</td><td>19</td><td rowspan="3">0
-0.016</td><td>55</td><td>1.3</td><td>18</td><td>44</td><td>5.5</td><td>60</td><td>112</td><td>62</td></tr>
<tr><td>LM-12LUU</td><td>12</td><td>21</td><td>57</td><td>1.3</td><td>20</td><td>46</td><td>5.5</td><td>83</td><td>160</td><td>80</td></tr>
<tr><td>LM-16LUU</td><td>16</td><td>28</td><td>70</td><td>1.6</td><td>27</td><td>53</td><td>8.5</td><td>126</td><td>240</td><td>145</td></tr>
<tr><td>LM-20LUU</td><td>20</td><td>32</td><td rowspan="3">0
-0.019</td><td>80</td><td>1.6</td><td>30.5</td><td>61</td><td>9.5</td><td>143</td><td>280</td><td>180</td></tr>
<tr><td>LM-25LUU</td><td>25</td><td>40</td><td>112</td><td rowspan="4">0
-0.40</td><td>1.85</td><td>38</td><td>82</td><td>15</td><td>159</td><td>320</td><td>440</td></tr>
<tr><td>LM-30LUU</td><td>30</td><td>45</td><td>123</td><td>1.85</td><td>43</td><td>89</td><td>17</td><td>254</td><td>560</td><td>580</td></tr>
<tr><td>LM-40LUU</td><td>40</td><td>60</td><td rowspan="2">0
-0.022</td><td>151</td><td>2.1</td><td>57</td><td>121</td><td>15</td><td>350</td><td>820</td><td>1170</td></tr>
<tr><td>LM-50LUU</td><td>50</td><td>80</td><td>192</td><td>2.6</td><td>76.5</td><td>148</td><td>22</td><td>620</td><td>1622</td><td>3100</td></tr>
</table>

※UU has oil seals at the ends

1-1 Linear Ball Bearing

LF Series Specifications (Flange Type)



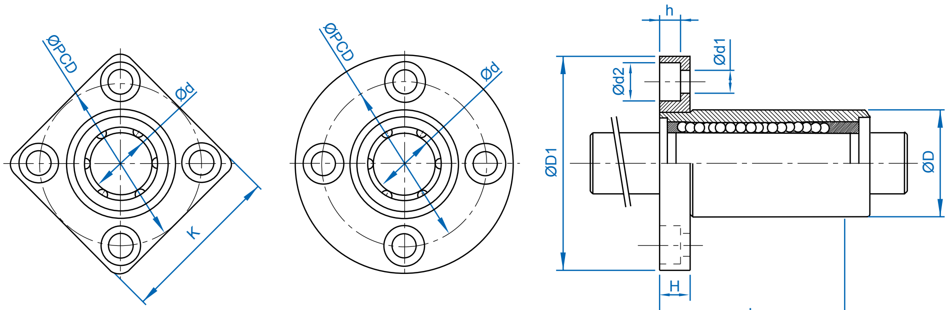
Type : D   Type : N

Unit : mm

Model No.	Dimension												Ca (kgf)	Coa (kgf)	Weight (g)
	d	D	D Tolerance	L	L Tolerance	D1	PCD	H	K	d1	d2	h			
LF-06UU	6	12	0 -0.011	19	0 -0.20	28	20	5	22	3.5	6	3.1	21	27	8
LF-08UU	8	15		24		32	24	5	25	3.5	6	3.1	28	40	16
LF-10UU	10	19	0 -0.013	29		40	29	6	30	4.5	7.5	4.1	38	56	30
LF-12UU	12	21		30		42	32	6	32	4.5	7.5	4.1	52	80	31.5
LF-16UU	16	28		37		48	38	6	37	4.5	7.5	4.1	79	120	69
LF-20UU	20	32	0 -0.016	42		54	43	8	42	5.5	9	5.1	90	140	87
LF-25UU	25	40		59	0 -0.30	62	51	8	50	5.5	9	5.1	100	159	220
LF-30UU	30	45		64		74	60	10	58	6.6	11	6.1	159	279	250
LF-40UU	40	60	0 -0.019	80		96	78	13	75	9	14	8.1	218	409	585
LF-50UU	50	80		100		116	98	13	92	9	14	8.1	389	808	1580

※UU has oil seals at the ends

LF-L Series Specifications (Flange Type with Lengthen Nut)



Type : D Type : N

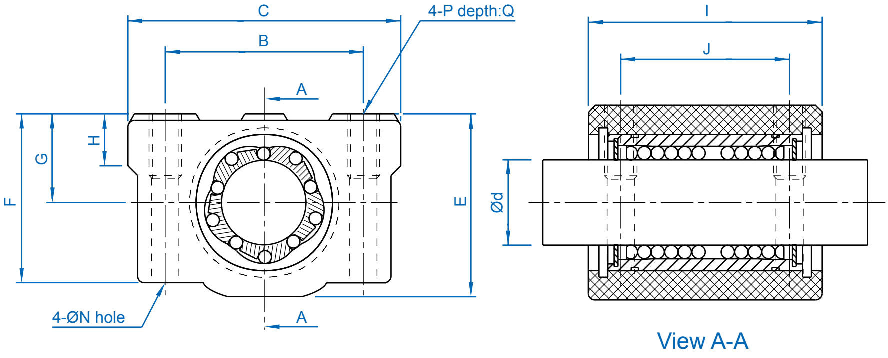
Unit : mm

ModelNo.	Dimension												Ca (kgf)	Coa (kgf)	Weight (g)
	d	D	D Tolerance	L	L Tolerance	D1	PCD	H	K	d1	d2	h			
LF-06LUU	6	12	0 -0.013	35	0 -0.30	28	20	5	22	3.5	6	3.1	33	54	16
LF-08LUU	8	15		45		32	24	5	25	3.5	6	3.1	44	80	31
LF-10LUU	10	19	0 -0.016	55		40	29	6	30	4.5	7.5	4.1	60	112	62
LF-12LUU	12	21		57		42	32	6	32	4.5	7.5	4.1	83	160	80
LF-16LUU	16	28		70		48	38	6	37	4.5	7.5	4.1	126	240	145
LF-20LUU	20	32	0 -0.019	80		54	43	8	42	5.5	9	5.1	143	280	180
LF-25LUU	25	40		112	0 -0.40	62	51	8	50	5.5	9	5.1	159	320	440
LF-30LUU	30	45		123		74	60	10	58	6.6	11	6.1	254	560	580
LF-40LUU	40	60	0 -0.022	151		96	78	13	75	9	14	8.1	350	820	1170
LF-50LUU	50	80		192		116	98	13	92	9	14	8.1	620	1622	3100

※UU has oil seals at the ends

1-1 Linear Ball Bearing

LU/LP Series Specifications (Aluminum Housing Type)

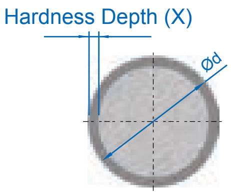


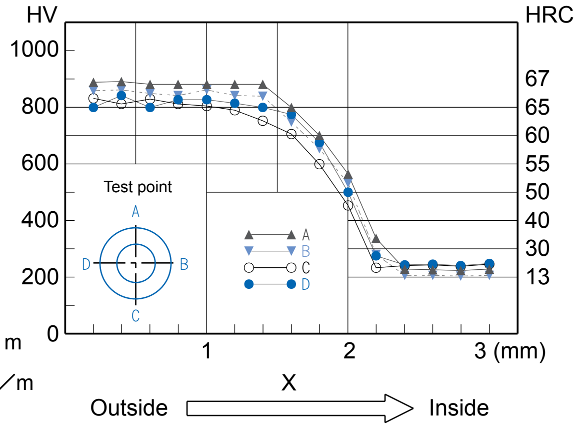
Unit : mm

Model No.	Dimension												Ca (kgf)	Coa (kgf)	Weight (g)
	d	B	C	E	F	G ±0.02	H	I	J	N	P	Q			
LU-08UU LP-08	8	24	34	22	18	11	6	30	18	3.4	M4	8	28	40	52
LU-10UU LP-10	10	28	40	26	21	13	8	35	21	4.3	M5	12	38	56	92
LU-12UU LP-12	12	30.5	42	29	25	15	8	36	26	4.3	M5	12	52	80	102
LU-16UU LP-16	16	36	50	38.5	32.5	19	9	44	34	4.3	M5	12	79	120	200
LU-20UU LP-20	20	40	54	41	35	21	11	50	40	5.2	M6	12	90	140	255
LU-25UU LP-25	25	54	76	51.5	42	26	12	67	50	7	M8	18	100	160	600
LU-30UU LP-30	30	58	78	59.5	49	30	15	72	58	7	M8	18	160	280	735
LU-40UU LP-40	40	80	102	78	62	40	20	90	60	8.7	M10	25	220	410	1590
LU-50UU LP-50	50	100	122	102	80	52	25	110	80	8.7	M10	25	390	810	3340

※LP series does not include Linear ball bearing.

SF/WV Series Specifications (Shaft)





Material：S55C／SUJ2

Hardness：HRC 60 Up

Surface Roughness：Ra 0.15-0.35 μm

Shaft Straightness：approx. 0.1 mm／m

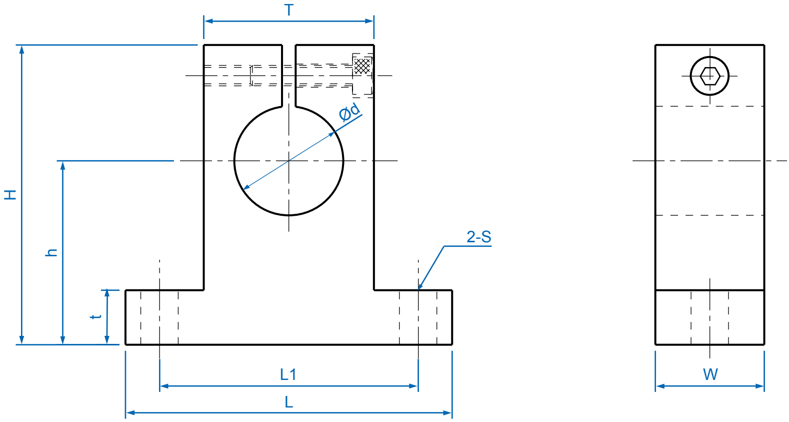
Unit : mm

Model No.	d	Hardness Depth (X)
SF-08★	8	1.0
SF-10★	10	1.0
SF-12★	12	1.6
SF-16★	16	1.6
SF-20★	20	2.2
SF-25★	25	2.2
SF-30★	30	2.2
SF-32★	32	2.2
SF-40★	40	3.5
SF-50★	50	3.5

※With ★ can supply Chromium plated slide shaft (Model No. WV).

1-1 Linear Ball Bearing

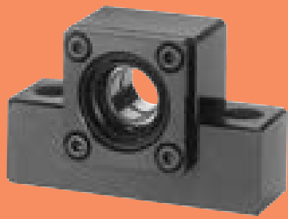
SS Series Specifications (Shaft Support)



Unit : mm

Model No.	Dimension									Weight(g)
	d	h	L	W	H	t	T	L1	S	
SS-08	8	20	42	14	32.8	6	18	32	5.5	24
SS-10	10	20	42	14	32.8	6	18	32	5.5	24
SS-12	12	23	42	14	37.5	6	20	32	5.5	30
SS-16	16	27	48	16	44	8	25	38	5.5	40
SS-20	20	31	60	20	51	10	30	45	6.6	70
SS-25	25	35	70	24	60	12	38	56	6.6	130
SS-30	30	42	84	28	70	12	44	64	9	180
SS-40	40	60	114	36	96	15	60	90	11	420
SS-50	50	70	126	40	120	18	74	100	14	750

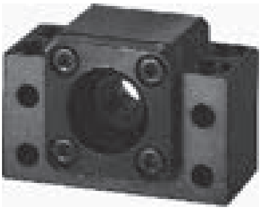
Support Unit of Ball Screw



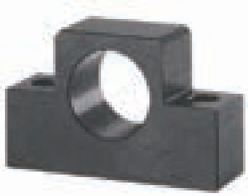
ABOUT SUPPORT UNIT OF BALL

1-1 Category of Support Unit of Ball Screw

BK/EK/FK/BF/EF/FF

Floated End		
Square type 	Convex type 	Flange type 

Surface Treatment : Black Oxidation

Supporting End		
Square type 	Convex type 	Flange type 

Surface Treatment : Black Oxidation

Table 1.1.1 Types of Support and Suggested Diameter of Ball Screw

FixedEndModel			SimpleEndModel			SuggestedDiameter
FlangeType	SquareType		FlangeType	SquareType		
-	EK-6	-	FF-6	EF-6	-	Ø4,Ø6
FK-8	EK-8	-	FF-8	EF-8	-	Ø8,Ø10,Ø12
FK-10	EK-10	BK-10	FF-10	EF-10	BF-10	Ø12,Ø14,Ø15
FK-12	EK-12	BK-12	FF-12	EF-12	BF-12	Ø14,Ø15,Ø16
FK-15	EK-15	BK-15	FF-15	EF-15	BF-15	Ø18,Ø20
-	-	BK-17	-	-	BF-17	Ø20,Ø25
FK-20	EK-20	BK-20	FF-20	EF-20	BF-20	Ø25,Ø28
FK-25	EK-25	BK-25	FF-25	EF-25	BF-25	Ø32,Ø36
FK-30	-	BK-30	FF-30	-	BF-30	Ø36,Ø40
-	-	BK-35	-	-	BF-35	Ø40,Ø45,Ø50
-	-	BK-40	-	-	BF-40	Ø50,Ø55

Table 1.1.2 Function

Fixed End				Simple End			
Support Model	Bearing Model	Axial		Support Model	Bearing Model	Radial	
		Ca (kgf)	K kgf/μm			Ca (kgf)	Coa (kgf)
EK-6	706ATYDF	273	2.9	**EF-6, FF-6**	606ZZ	231	88
EK-8, FK-8	708ATYDF	450	5.4	**EF-8, FF-8**	606ZZ	231	88
BK-10, EK-10, FK-10	7000ATYDF	620	9.6	**BF-10, EF-10, FF-10**	608ZZ	335	142
BK-12, EK-12, FK-12	7001ATYDF	679	10.6	**BF-12, EF-12, FF-12**	6000ZZ	465	200
BK-15, EK-15, FK-15	7002ATYDF	775	11.5	**BF-15, EF-15, FF-15**	6002ZZ	570	289
BK-17	7203ATYDF	1397	12.7	**BF-17**	6203ZZ	979	469
BK-20	7004ATYDF	1295	14.2	**BF-20**	6004ZZ	958	515
EK-20, FK-20	7204ATYDF	1820	15.8	**EF-20, FF-20**	6204ZZ	1300	702
BK-25, EK-25, FK-25	7205ATYDF	2060	19.4	**BF-25, EF-25, FF25**	6205ZZ	1430	800
BK-30, FK-30	7206ATYDF	2856	19.8	**BF-30, FF30**	6206ZZ	1989	1152
BK-35	7207ATYDF	3794	26.0	**BF-35**	6207ZZ	2621	1560
BK-40	7208ATYDF	4498	27.5	**BF-40**	6208ZZ	2968	1815

※When the nominal diameter of ball screw is Ø6 and use EK06 or EF06, ball screw has to be precision ground type.

1-2 Installation of TBI MOTION Support Unit of Ball Screw

■ 1-1 Installing Ball Screw with Support Units

(1) Assemble the fixed end Support Unit with the screw shaft.
※ Do not disassemble the Support Unit.
※ When assembling the screw shaft to the Support Unit, make sure that the dimension between machine ends and bearing are matched.

(2) After inserting the fixed end Support Unit, secure the lock nut by using the fasten set piece and the hexagonal socket-head set screws.
※ Please contact TBI for special condition of mounting methods.

(3) Attach the floated end bearing to the screw shaft and secure the bearing with the C-ring.

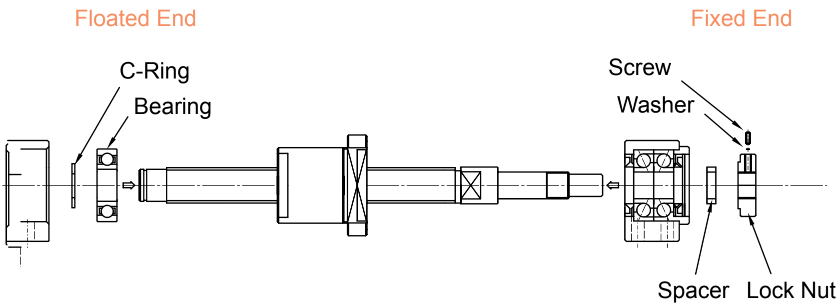


Fig 1.1.1

■ 1-2 Assemble the Nut Bracket

(1) Fix the ball screw to the bracket(temporarily).

(2) Assemble the fixed end Support unit with bearing.

(3) Ensure the parallelism between reference surface(linear guide) and ball screw, then fix both end and floated end.

(4) Move the table toward fixed and floated end to ensure the smoothness of the ball screw then fasten it to the bracket.

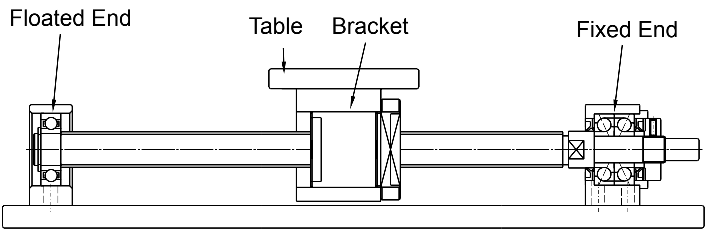


Fig 1.2.1

■ 1-3 Checking Geometric Accuracy

(1) Measure the runout of fixed side support unit and the axial backlash of support side support unit.

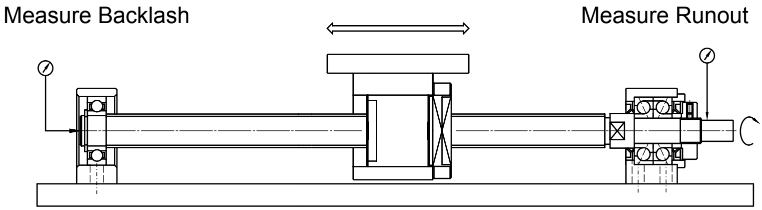


Fig 1.3.1

■ 1-4 Connect Ball Screw Motor

(1) Mount the motor bracket to the base.

(2) Connect the motor and the ball screw with a coupling(Careful with accuracy while mounting)

(3) Completed run test.

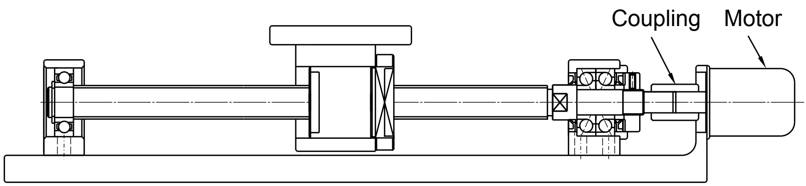
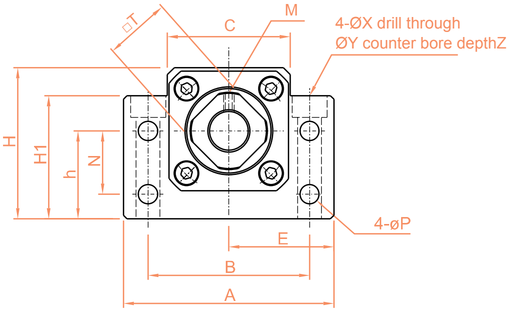


Fig 1.4.1

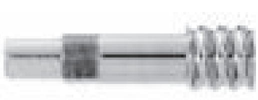
1-3 Nominal Mode Code of Support Unit of Ball Screw

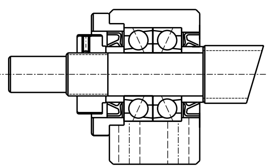
BK Series (Fixed End)

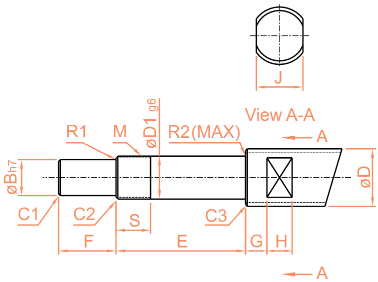


ModelNo.	D1	A	B	C	C1	C2	E ±0.02	H1	h ±0.02	H
BK-10	10	60	46	34	13	6	30	32.5	22	39
BK-12	12	60	46	34	13	6	30	32.5	25	43
BK-15	15	70	54	40	15	6	35	38	28	48
BK-17	17	86	68	50	19	8	43	55	39	64
BK-20	20	88	70	52	19	8	44	50	34	60

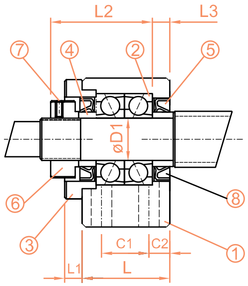
Suggest Dimension of End Machining







ModelNo.	Diameter	D1	B	E	F	M
BK-10	Ø12,Ø14,Ø15	10	8	39	15	M10×1
BK-12	Ø14,Ø15,Ø16,Ø18	12	10	39	15	M12×1
BK-15	Ø18,Ø20	15	12	40	20	M15×1
BK-17	Ø20,Ø25	17	15	53	23	M17×1
BK-20	Ø25,Ø28	20	17	53	25	M20×1

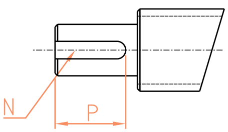


Code	Items	pcs
1	Housing	1PCS
2	Bearing	1SET
3	Lid	1PCS
4	Spacer	2PCS
5	Seal	2PCS
6	Lock Nut	1PCS
7	Screw with Washer	1PCS

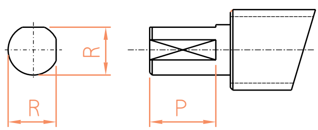
Unit : mm

L	L1	L2	L3	T	P	N	M	X	Y	Z	Bearing Model
25	5	29	5	16	5.5	15	M3	6.6	11	5	7000ATYDFC8P5
25	5	29	5	19	5.5	18	M3	6.6	11	1.5	7001ATYDFC8P5
27	6	32	6	22	5.5	18	M3	6.6	11	6.5	7002ATYDFC8P5
35	9	44	7	24	6.6	28	M4	9	14	8.5	7203ATYDFC8P5
35	8	43	8	30	6.6	22	M4	9	14	8.5	7004ATYDFC8P5

H1 Type



H2 Type



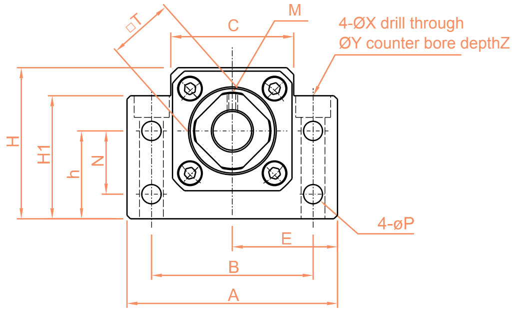
Tolerance

Dimension(mm)		unit h 0.001
Above	Under	h
6	10	-2 -15
10	18	-3 -18
18	24	-3 -21

S	J	G	H	Chamfering			Circular Radius		H1 Keyway(W×D×L)		H2		Model BK
				C1	C2	C3	R1	R2	N	P	R	P	
16	10	5	7	0.5	0.5	0.5	0.3	0.6	2×1.2	11	7.5	11	BK-10
14	13	6	8	0.5	0.5	0.5	0.3	0.6	3×1.8	12	9.5	12	BK-12
12	16	6	9	0.5	0.5	0.5	0.3	0.6	4×2.5	16	11.3	16	BK-15
17	18	7	10	0.5	0.5	0.5	0.3	0.6	5×3.0	21	14.3	21	BK-17
15	21	8	11	0.5	0.5	0.5	0.5	0.6	5×3.0	21	16	21	BK-20

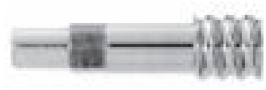
1-3 Nominal Mode Code of Support Unit of Ball Screw

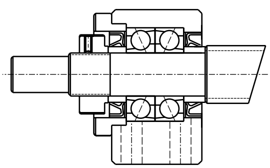
BK Series (Fixed End)

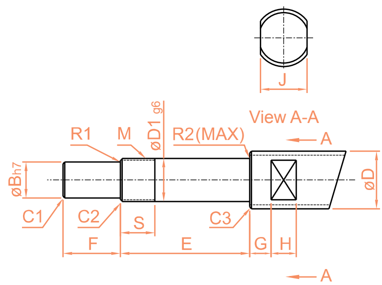


ModelNo.	D1	A	B	C	C1	C2	E ±0.02	H1	h ±0.02	H
BK-25	25	106	85	64	22	10	53	70	48	80
BK-30	30	128	102	76	23	11	64	78	51	89
BK-35	35	140	114	88	26	12	70	79	52	96
BK-40	40	160	130	100	33	14	80	90	60	110

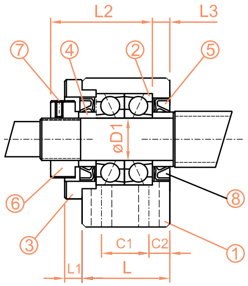
Suggest Dimension of End Machining







ModelNo.	Diameter	D1	B	E	F	M
BK-25	Ø32,Ø36	25	20	65	30	M25×1.5
BK-30	Ø36,Ø40	30	25	72	38	M30×1.5
BK-35	Ø40,Ø45,Ø50	35	30	83	45	M35×1.5
BK-40	Ø50,Ø55	40	35	98	50	M40×1.5

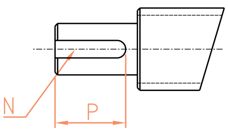


Code	Items	pcs
1	Housing	1PCS
2	Bearing	1SET
3	Lid	1PCS
4	Spacer	2PCS
5	Seal	2PCS
6	Lock Nut	1PCS
7	Screw with Washer	1PCS

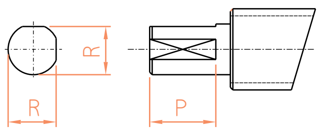
Unit : mm

L	L1	L2	L3	T	P	N	M	X	Y	Z	Bearing Model
42	12	54	9	35	9	33	M5	11	17.5	11	7205ATYDFC8P5
45	14	61	9	40	11	33	M6	14	20	13	7206ATYDFC8P5
50	14	67	12	50	11	35	M8	14	20	13	7207ATYDFC8P5
61	18	76	15	50	14	37	M8	18	26	17.5	7208ATYDFC8P5

H1 Type



H2 Type



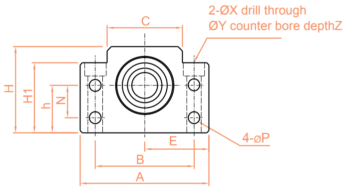
Tolerance

Dimension(mm)		unit h 0.001
Above	Under	h
18	30	-3 -21
30	50	-4 -25

S	J	G	H	Chamfering			Circular Radius		H1 Keyway(W×D×L)		H2		Model BK
				C1	C2	C3	R1	R2	N	P	R	P	
18	27	10	13	0.5	0.7	1.0	0.5	0.6	6×3.5	25	19	25	BK-25
25	32	10	15	0.5	0.7	1.0	0.5	1.0	8×4.0	32	23.5	32	BK-30
28	36	12	15	0.5	1.0	1.0	0.5	1.0	8×4.0	40	28.5	40	BK-35
35	41	14	19	0.5	1.0	1.0	0.5	1.0	10×5.0	45	33	45	BK-40

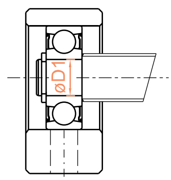
1-3 Nominal Mode Code of Support Unit of Ball Screw

BF Series (Floated End)



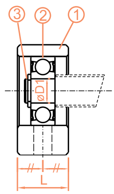
ModelNo.	D1	A	B	C	E ±0.02	H1	h ±0.02	H
BF-10	8	60	46	34	30	32.5	22	39
BF-12	10	60	46	34	30	32.5	25	43
BF-15	15	70	54	40	35	38	28	48
BF-17	17	86	68	50	43	55	39	64
BF-20	20	88	70	52	44	50	34	60
BF-25	25	106	85	64	53	70	48	80
BF-30	30	128	102	76	64	78	51	89
BF-35	35	140	114	88	70	79	52	96
BF-40	40	160	130	100	80	90	60	110

Suggest Dimension of End Machining



ModelNo.	Diameter	D1	E
BF-10	Ø12,Ø14,Ø15	8	10
BF-12	Ø14,Ø15,Ø16	10	11
BF-15	Ø18,Ø20	15	13
BF-17	Ø20,Ø25	17	16
BF-20	Ø25,Ø28	20	16
BF-25	Ø32,Ø36	25	20
BF-30	Ø36,Ø40	30	21
BF-35	Ø40,Ø45,Ø50	35	22
BF-40	Ø50,Ø55	40	23

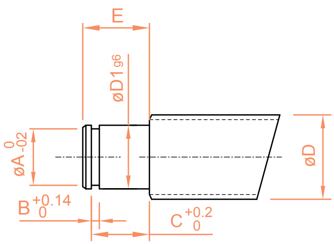
SCREW



Code	Items	pcs
1	Housing	1PCS
2	Bearing	1PCS
3	C-Ring	1PCS

Unit : mm

L	N	P	X	Y	Z	C-Ring	Bearing Model
20	15	5.5	6.6	11	5	C8	608ZZ
20	18	5.5	6.6	11	1.5	C10	6000ZZ
20	18	5.5	6.6	11	6.5	C15	6002ZZ
23	28	6.6	9	14	8.5	C17	6203ZZ
26	22	6.6	9	14	8.5	C20	6004ZZ
30	33	9	11	17.5	11	C25	6205ZZ
32	33	11	14	20	13	C30	6206ZZ
32	35	11	14	20	13	C35	6207ZZ
37	37	14	18	26	17.5	C40	6208ZZ



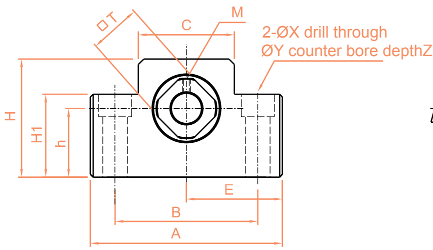
Tolerance

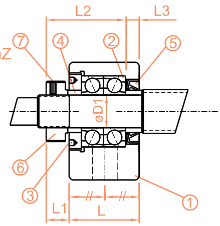
Dimension(mm)		unit $^{h}0.001$
Above	Under	h
6	10	-2 -15
10	18	-3 -18
18	30	-3 -21
30	50	-4 -25

C-Ring			Model BF
A	B	C	
7.6	0.9	7.9	BF-10
9.6	1.15	9.15	BF-12
14.3	1.15	10.15	BF-15
16.2	1.15	13.15	BF-17
19.0	1.35	13.35	BF-20
23.9	1.35	16.35	BF-25
28.6	1.75	17.75	BF-30
33.0	1.75	18.75	BF-35
38.0	1.95	19.95	BF-40

1-3 Nominal Mode Code of Support Unit of Ball Screw

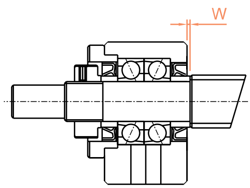
EK Series (Fixed End)

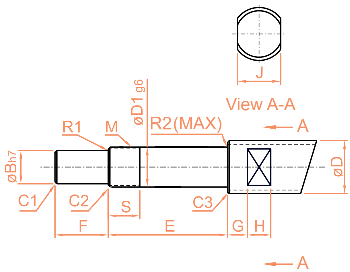




ModelNo.	D1	A	B	C	E	H1	h
					±0.02		±0.02
EK-6	6	42	30	18	21	20	13
EK-8	8	52	38	25	26	26	17
EK-10	10	70	52	36	35	24	25
EK-12	12	70	52	36	35	24	25
EK-15	15	80	60	41	40	25	30

Suggest Dimension of End Machining

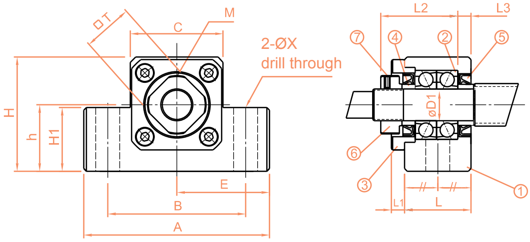




ModelNo.	Diameter	D1	B	E	F	M
EK-6	Ø6,Ø8	6	4	30	8	M6×0.75
EK-8	Ø10,Ø12	8	6	35	9	M8×1
EK-10	Ø12,Ø14,Ø15	10	8	36	15	M10×1
EK-12	Ø14,Ø15,Ø16	12	10	36	15	M12×1
EK-15	Ø18,Ø20	15	12	49	20	M15×1

※When the nominal diameter of ball screw is Ø6 and use EK06 or EF06, ball screw has to be precision ground type.

G
Support Unit of Ball Screw



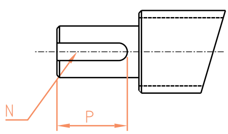
EK10-15

Code	Items	pcs
1	Housing	1PCS
2	Bearing	1SET
3	Lid	1PCS
4	Spacer	2PCS
5	Seal	2PCS
6	Lock Nut	1PCS
7	Screw with Washer	1PCS

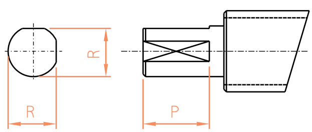
Unit : mm

H	L	L1	L2	L3	M	X	Y	Z	T	Bearing Model
25	20	5.5	22	3.5	M3	5.5	9.5	11	12	706ATYDFC7P5
32	23	7	26	4	M3	6.6	11	12	14	708ATYDFC8P5
43	24	6	29.5	6	M3	9	-	-	16	7000ATYDFC8P5
43	24	6	29.5	6	M3	9	-	-	19	7001ATYDFC8P5
49	25	6	36	5	M3	11	-	-	22	7002ATYDFC8P5

H1 Type



H2 Type



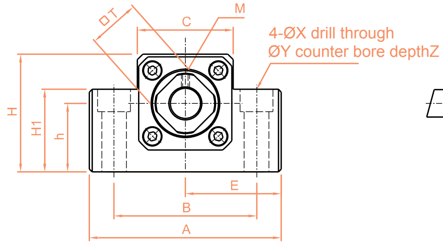
Tolerance

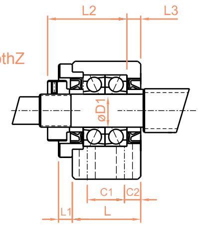
Dimension(mm)		unit h 0.001
Above	Under	h
6	10	-2 -15
10	18	-3 -18
18	24	-3 -21

S	J	G	H	Chamfering			Circular Radius		H1 Keyway(W×D×L)		H2		W	Model EK
				C1	C2	C3	R1	R2	N	P	R	P		
10	5	4	4	0.3	0.3	0.3	0.3	0.6	-	-	3.7	6	1.5	EK-6
10	8	5	5	0.3	0.3	0.3	0.3	0.6	-	-	5.6	7	1.5	EK-8
11	10	5	7	0.5	0.5	0.5	0.3	0.6	2×1.2	11	7.5	11	-0.5	EK-10
11	13	6	8	0.5	0.5	0.5	0.3	0.6	3×1.8	12	9.5	12	-0.5	EK-12
13	16	6	9	0.5	0.5	0.5	0.3	0.6	4×2.5	16	11.3	16	5.0	EK-15

1-3 Nominal Mode Code of Support Unit of Ball Screw

EK Series (Fixed End)

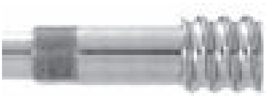


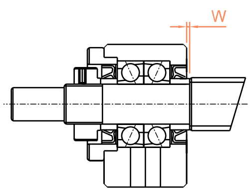


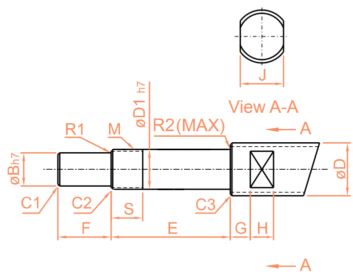
EK-20S

ModelNo.	D1	A	B	C	E	H1	h
					±0.02		±0.02
EK-20	20	95	75	56	47.5	25	30
EK-25	25	105	85	66	52.5	25	35

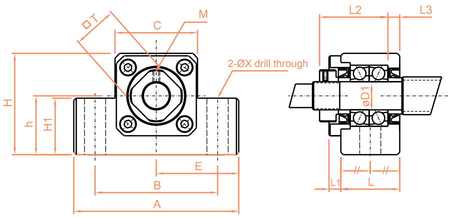
Suggest Dimension of End Machining



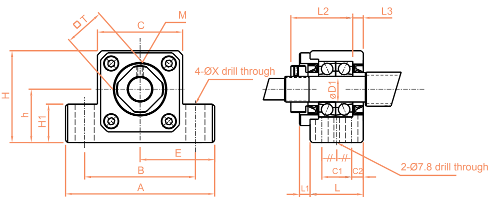




ModelNo.	Diameter	D1	B	E	F	M
EK-20	Ø25,Ø28,Ø32	20	17	64	25	M20×1
EK-25	Ø32,Ø36	25	20	65	30	M25×1.5



EK-20

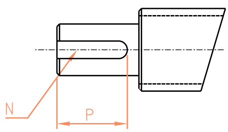


EK-25

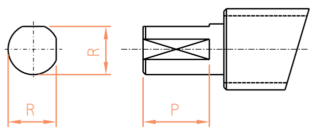
Unit : mm

C2	C1	H	L	L1	L2	L3	M	X	Y	Z	T	Bearing Model
-	-	58	42	10	50	10	M4	11	-	-	30	7204ATYDFC8P5
9	30	68	48	13	60	14	M5	11	-	-	35	7205ATYDFC8P5

H1 Type



H2 Type



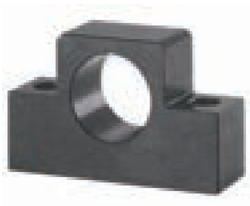
Tolerance

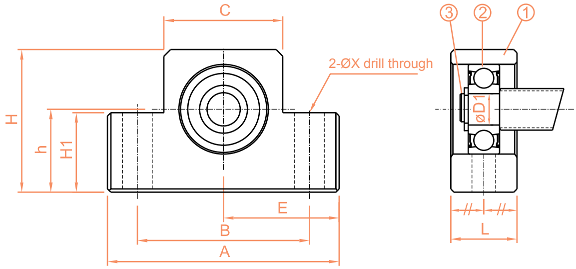
Dimension(mm)		unit h 0.001
Above	Under	h
6	10	-2 -15
10	18	-3 -18
18	24	-3 -21

S	J	G	H	Chamfering			Circular Radius		H1 Keyway(W×D×L)		H2		W	Model EK
				C1	C2	C3	R1	R2	N	P	R	P		
17	21	8	11	0.5	0.5	0.5	0.5	0.6	5×3.0	21	16	21	1.0	EK-20
18	27	10	13	0.5	0.7	1.0	0.5	0.6	6×3.5	25	19	25	1.0	EK-25

1-3 Nominal Mode Code of Support Unit of Ball Screw

EF Series (Floated End)

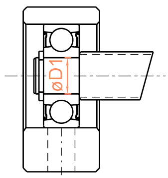




EF10-15 ; EF20-25

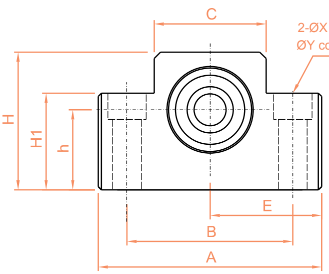
ModelNo.	D1	A	B	C	E ±0.02	H1	h ±0.02
EF-6	6	42	30	18	21	20	13
EF-8	6	52	38	25	26	26	17
EF-10	8	70	52	36	35	24	25
EF-12	10	70	52	36	35	24	25
EF-15	15	80	60	41	40	25	30
EF-20	20	95	75	56	47.5	25	30
EF-25	25	105	85	66	52.5	25	35

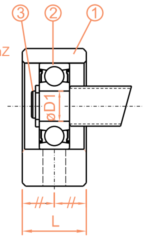
Suggest Dimension of End Machining



ModelNo.	Diameter	D1	E
EF-6	Ø6,Ø8	6	9
EF-8	Ø10,Ø12	6	9
EF-10	Ø12,Ø14,Ø15	8	10
EF-12	Ø14,Ø15,Ø16	10	11
EF-15	Ø18,Ø20	15	13
EF-20	Ø25,Ø28	20	19
EF-25	Ø32,Ø36	25	20

※When the nominal diameter of ball screw is Ø6 and use EK06 or EF06, ball screw has to be precision ground type.



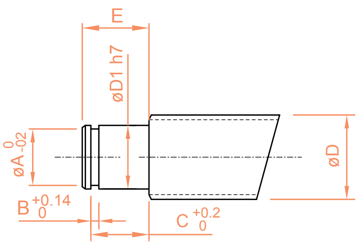


EF6-8

Code	Items	pcs
1	Housing	1PCS
2	Bearing	1PCS
3	C-Ring	1PCS

Unit : mm

H	L	X	Y	Z	C-Ring	Bearing Model
25	12	5.5	9.5	11	C6	606ZZ
32	14	6.6	11	12	C6	606ZZ
43	20	9	-	-	C8	608ZZ
43	20	9	-	-	C10	6000ZZ
49	20	9	-	-	C15	6002ZZ
58	26	11	-	-	C20	6204ZZ
68	30	-	11	-	C25	6205ZZ



Tolerance

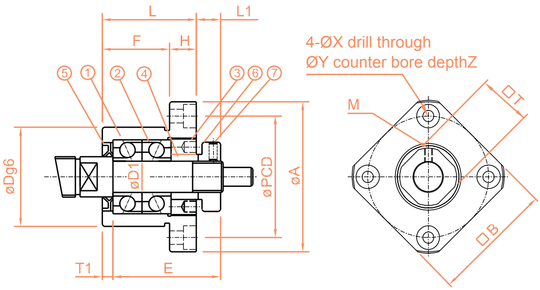
Dimension(mm)		unit h 0.001
Above	Under	h
6	10	-2 -15
10	18	-3 -18
18	24	-3 -21

C-Ring			Model EF
A	B	C	
5.7	0.8	6.8	EF-6
5.7	0.8	6.8	EF-8
7.6	0.9	7.9	EF-10
9.6	1.15	9.15	EF-12
14.3	1.15	10.15	EF-15
19	1.35	15.35	EF-20
23.9	1.35	16.35	EF-25

1-3 Nominal Mode Code of Support Unit of Ball Screw

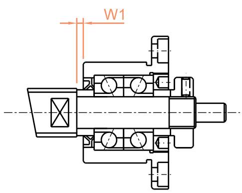
FK Series (Fixed End)

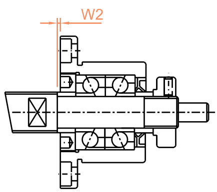

Solution A

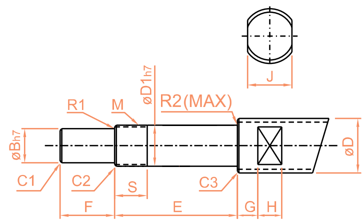


ModelNo.	D1	A	F	L	E	Dg6	H	PCD
FK-6	6	35	13	20	22	22	7	28
FK-8	8	43	14	23	26	28	9	35

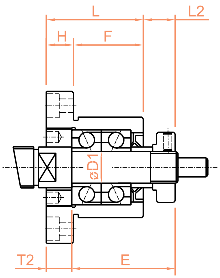
Suggest Dimension of End Machining







ModelNo.	Diameter	D1	B	E	F	M
FK-6	Ø8,Ø10	6	4	30	8	M6x0.75
FK-8	Ø10,Ø12	8	6	35	9	M8×1



Solution B

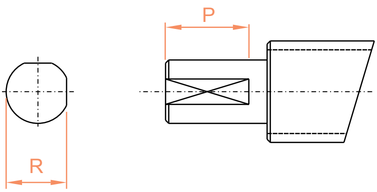
D	g6
22	-0.007 -0.020
28	-0.007 -0.020

Code	Items	pcs
1	Housing	1PCS
2	Bearing	1SET
3	Lid	1PCS
4	Spacer	2PCS
5	Seal	2PCS
6	Lock Nut	1PCS
7	Screw with Washer	1PCS

Unit : mm

M	B	L1	T1	L2	T2	X	Y	Z	T	Bearing Model
M3	28	5.5	3.5	6.5	4.5	2.9	5.5	3.5	12	706ATYDFC8P5
M3	35	7	4	8	5	3.4	6.5	4	14	708ATYDFC8P5

H1 type



Tolerance

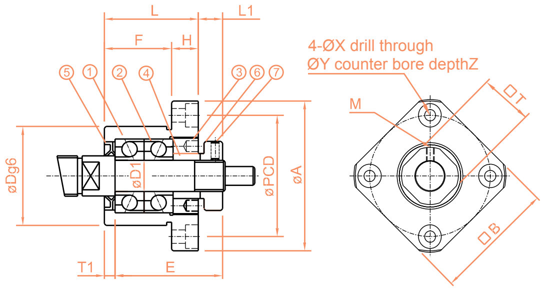
Dimension(mm)		unit h 0.001
Above	Under	h
6	10	-2 -15

S	Chamfering			Circular Radius		H1		W1	W2	Model FK
	C1	C2	C3	R1	R2	R	P			
12	0.3	0.3	0.3	0.3	0.6	3.7	6	1.5	0.5	FK-6
15	0.5	0.5	0.5	0.3	0.6	5.6	7	1.5	0.5	FK-8

1-3 Nominal Mode Code of Support Unit of Ball Screw

FK Series (Fixed End)

Solution B

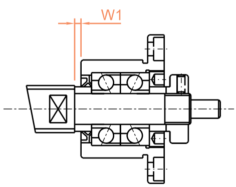


Solution A

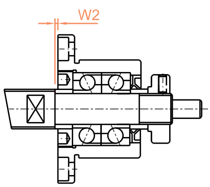
ModelNo.	D1	A	F	L	E	Dg6	H	PCD
FK-10	10	52	17	27	29.5	34	10	42
FK-12	12	54	17	27	29.5	36	10	44
FK-15	15	63	17	32	36	40	15	50
FK-20	20	85	30	52	50	57	22	70
FK-25	25	98	30	57	60	63	27	80
FK-30	30	117	32	62	61	75	30	95

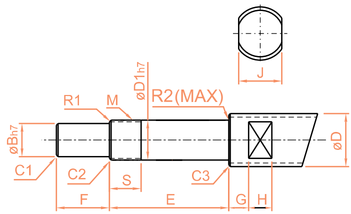
Suggest Dimension of End Machining

H1 Type

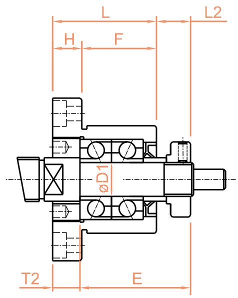


H2 Type





ModelNo.	Diameter	D1	B	E	F	M
FK-10	Ø12,Ø14,Ø15	10	8	36	15	M10×1
FK-12	Ø14,Ø15,Ø16	12	10	36	15	M12×1
FK-15	Ø18,Ø20	15	12	49	20	M15×1
FK-20	Ø25,Ø28	20	17	64	25	M20×1
FK-25	Ø32,Ø36	25	20	76	30	M25×1.5
FK-30	Ø40,Ø50	30	25	72	38	M30×1.5



Solution B

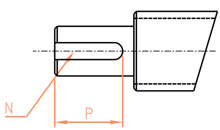
D	g6
34	-0.009 -0.025
36	-0.009 -0.025
40	-0.009 -0.025
57	-0.010 -0.029
63	-0.010 -0.029
75	-0.010 -0.029

Code	Items	pcs
1	Housing	1PCS
2	Bearing	1SET
3	Lid	1PCS
4	Spacer	2PCS
5	Seal	2PCS
6	Lock Nut	1PCS
7	Screw with Washer	1PCS

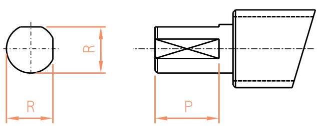
Unit : mm

M	B	L1	T1	L2	T2	X	Y	Z	T	Bearing Model
M3	42	7.5	5	8.5	6	4.5	8	4	16	7000ATYDFC8P5
M3	44	7.5	5	8.5	6	4.5	8	4	19	7001ATYDFC8P5
M3	52	10	6	12	8	5.5	9.5	6	22	7002ATYDFC8P5
M4	68	8	10	12	14	6.6	11	10	30	7204ATYDFC8P5
M5	79	13	10	20	17	9	15	13	35	7205ATYDFC8P5
M6	93	14	12	17	18	11	17.5	15	40	7206ATYDFC8P5

H1 Type



H2 Type



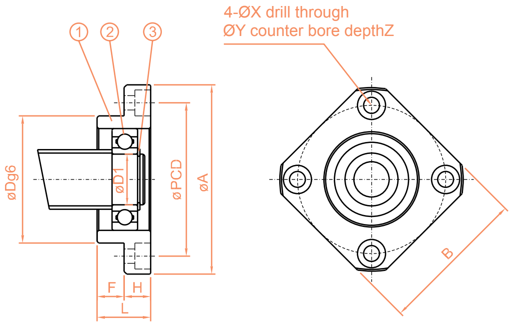
Tolerance

Dimension(mm)		unit h 0.001
Above	Under	h
6	10	-2 -15
10	18	-3 -18
18	30	-3 -21

S	J	G	H	Chamfering			Circular Radius		H1		H2		W1	W2	Model FK
				C1	C2	C3	R1	R2	N	P	R	P			
11	10	5	7	0.5	0.5	0.5	0.3	0.6	2×1.2	11	7.5	11	0.5	0.5	FK-10
11	13	6	8	0.5	0.5	0.5	0.3	0.6	3×1.8	12	9.5	12	0.5	0.5	FK-12
13	16	6	9	0.5	0.5	0.5	0.3	0.6	4×2.5	16	11.6	16	4	2	FK-15
17	21	8	11	0.5	0.5	0.5	0.5	0.6	5×3.0	21	16	21	1	-3	FK-20
20	27	10	13	0.5	0.5	0.5	0.5	0.6	6×3.5	25	19	25	5	-2	FK-25
25	32	10	15	0.5	0.5	0.5	0.5	0.6	8×4	32	23.5	32	-3	-6	FK-30

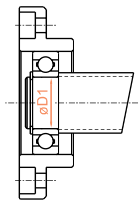
1-3 Nominal Mode Code of Support Unit of Ball Screw

FF Series (Floated End)



ModelNo.	D1	L	H	F	Dg6	A
FF-6	6	10	6	4	22	36
FF-10	8	12	7	5	28	43
FF-12	10	15	7	8	34	52
FF-15	15	17	9	8	40	63
FF-20	20	20	11	9	57	85
FF-25	25	24	14	10	63	98
FF-30	30	27	18	9	75	117

Suggest Dimension of End Machining



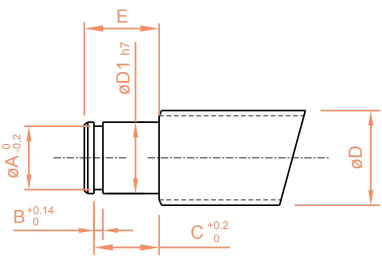
ModelNo.	Diameter	D1	E
FF-6	Ø10,Ø12	6	9
FF-10	Ø12,Ø14,Ø15	8	10
FF-12	Ø14,Ø15,Ø16	10	11
FF-15	Ø18,Ø20	15	13
FF-20	Ø25,Ø28	20	19
FF-25	Ø32,Ø36	25	20
FF-30	Ø40,Ø50	30	21

D	g6
22	-0.007 -0.020
28	-0.007 -0.020
34	-0.009 -0.025
40	-0.009 -0.025
57	-0.010 -0.029
63	-0.010 -0.029
75	-0.010 -0.029

Code	Items	pcs
1	Housing	1PCS
2	Bearing	1PCS
3	C-Ring	1PCS

Unit : mm

PCD	B	X	Y	Z	C-Ring	Bearing Model
28	28	3.4	6.5	4	C6	606ZZ
35	35	3.4	6.5	4	C8	608ZZ
42	42	4.5	8	4	C10	6000ZZ
50	52	5.5	9.5	5.5	C15	6002ZZ
70	68	6.6	11	6.5	C20	6204ZZ
80	79	9	14	8.5	C25	6205ZZ
95	93	11	17.5	11	C30	6206ZZ



Tolerance

Dimension(mm)		unit h 0.001
Above	Under	h
6	10	-2 -15
10	18	-3 -18
18	30	-3 -21

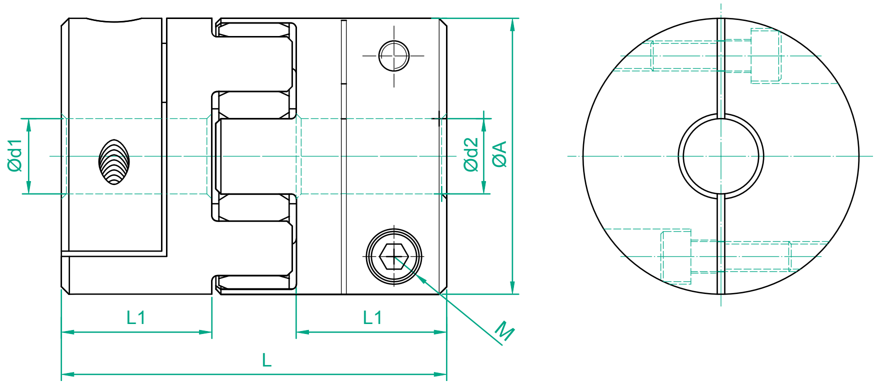
C-Ring			Model FF
A	B	C	
5.7	0.8	6.8	FF-6
7.6	0.9	7.9	FF-10
9.6	1.15	9.15	FF-12
14.3	1.15	10.15	FF-15
19	1.35	15.35	FF-20
23.9	1.35	16.35	FF-25
28.6	1.75	17.75	FF-30

Memo

Coupling

1-1 Nominal Mode Code of Coupling

SRJ Specifications



Unit : mm

ModelNo.	A	L	L1	dmax	(H8)d1xd2		M
					d1	d2	
SRJ-20C	20	30	10	8	5,6,6.35,7,8		M2.5
SRJ-30C	30	35	11	14	6,6.35,8,9,9.5,10,11,12,14		M4
SRJ-40C	40	66	25	20	10,11,12,14,15,16,18,19,20		M5
SRJ-55C	55	78	30	25	15,16,18,19,20,22,24,25		M6
SRJ-65C	65	90	35	35	15,16,18,19,20,22,24,25,28,30,32,35		M8

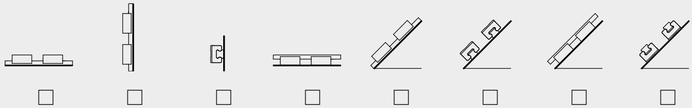
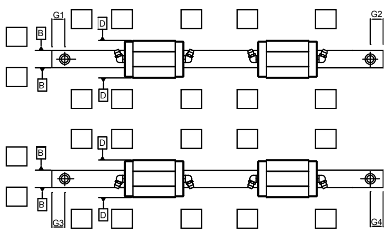
※ Specifications Number：SRJ-AC-d1xd2
※ Material：Aluminum Alloy
※ Buffer Material：Engineering Class Plastic

Function

ModelNo.	RateTorque (N · m)	MaxTorque (N · m)	Max Rotational Spring Rigidity (min-1)	Static Torsion Spring Rigidity (N · m/rad)	Dynamic Torsion Spring Rigidity (N · m/rad)
SRJ-20C	5	10	15200	51.0	151
SRJ-30C	12.5	25	10200	170.9	505
SRJ-40C	17	34	7600	857.5	2571
SRJ-55C	60	120	5600	2060	6163
SRJ-65C	160	320	4700	3430	10291

ModelNo.	Weight (g)		Mass Moment of Inertia J (kg-m^2)		Radial (mm)	Angular (°)	Axial (mm)
	each hub	spider	each hub	spider			
SRJ-20C	8.5	1.7	0.46×10^{-3}	0.073×10^{-3}	0.10	1.0	0.8
SRJ-30C	18	4.2	2.5×10^{-3}	0.45×10^{-3}	0.15	1.0	1
SRJ-40C	64	6.5	20.1×10^{-3}	1.44×10^{-3}	0.15	1.0	1.2
SRJ-55C	130	17.4	50.5×10^{-3}	7.3×10^{-3}	0.2	1.0	1.4
SRJ-65C	250	28.6	200.1×10^{-3}	16.3×10^{-3}	0.2	1.0	1.5

TBI MOTION Linear Guideway Inquiry Form

Customer :		Date :
TEL :	Email :	Confirm By :
Machine Type :		Drawing No. :
Axis	☐ X ☐ Y ☐ Z ☐ Other ( )	
Install Position	 ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐	
Model No.		
No.of Rail Per Axis	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ Other :	
Dust Protection	☐ Standard ☐ U ☐ UZ ☐ UD ☐ XN ☐ UN ☐ ZN ☐ WW ☐ WU ☐ WZ ☐ Other	
Rail Length / Butt joint	☐ Length mm Butt-joint : ☐ NO ☐ YES	
Pitch	G1 : G2 :	
Accessory Code	☐ N (Normal) ☐ H (High) ☐ P (Precision) ☐ SP (Super Precision) ☐ UP (Ultra Precision)	
Preload	☐ ZF (Slight Clearance) ☐ Z0 (No Preload) ☐ Z1 (Light Preload) ☐ Z2 (Medium Preload) ☐ Z3(Heavy Preload)	
Rail Per Axis	☐ 1 ☐ 2 ☐ 3 ☐ Other :	
Rail Mounting	☐ FromTop ☐ K From Bottom ☐ X Railwith Special Maching	
Special Cladding	☐ B (Black Oxidation) ☐ O (Hard Chrome Plating) ☐ P (Phosphating) ☐ N (Nickel Plating) ☐ D (Raydent)	
Lubrication Type	☐ Grease ☐ Oil	
Lubrication Fitting	☐ Grease nipple (Code :) ☐ Oil piping joint (Code :)	
Special Option	☐ Steel end seal ☐ Steel end cap ☐ Cover Strip ☐ Other :	
TBIMOTION Model No.		
Reference surface & Injection Direction		

Memo

Memo

Memo

TBI MOTION

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MB:+1-714-519-3424 M. tbiusa@tbimotion.com

NOTE : The appearance and specification may be changed without prior notice only if the requirement improves performance. 2025.02-EN

SYSTEM CERTIFICATION ISO 45001 SGS
SYSTEM CERTIFICATION ISO 9001 SGS
SYSTEM CERTIFICATION ISO 14001 SGS

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