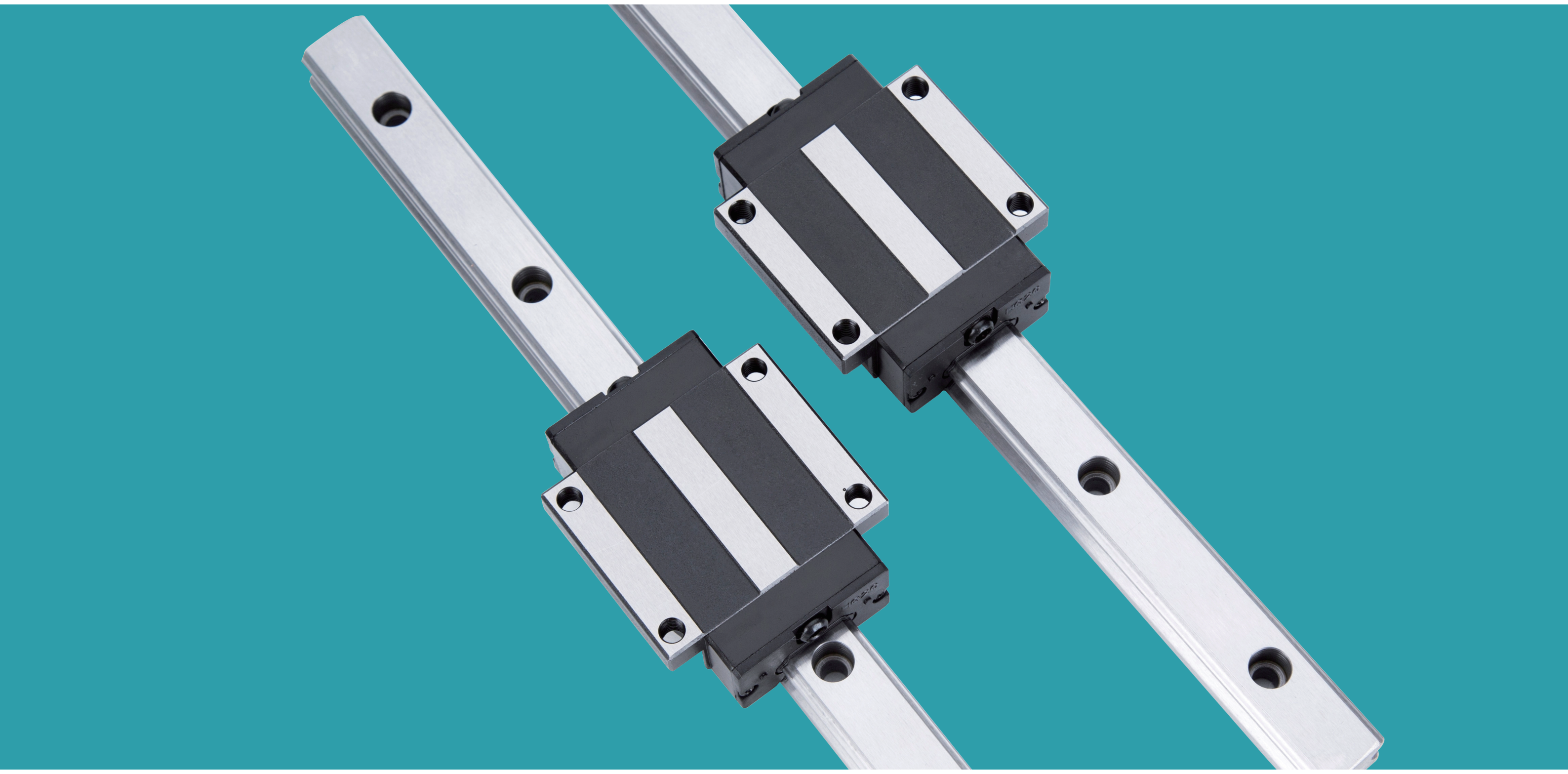
SIMTACH



Linear Guideway

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Ball Screw

KK Module

Preface

A linear guideway allows a type of linear motion that utilizes rolling elements such as balls or rollers. By using re-circulating rolling elements between the rail and the block, a linear guideway can achieve high precision linear motion. Compared to a traditional slide, the coefficient of friction for a linear guideway is only 1/50. Because of the restraint effect between the rails and the blocks, linear guideways can take up loads in both the up/down and the left/right directions. With these features, linear guideways can greatly enhance moving accuracy, especially, when accompanied with precise ball screws.

1. General Information

1-1 Advantages and Features of Linear Guideways

(1) High positional accuracy
When a load is driven by a linear motion guideway, the frictional contact between the load and the bed desk is rolling contact. The coefficient of friction is only 1/50 of traditional contact, and the difference between the dynamic and the static coefficient of friction is small. Therefore, there would be no slippage while the load is moving.

(2) Long life with high motion accuracy
With a traditional slide, errors in accuracy are caused by the counter flow of the oil film. Insufficient lubrication causes wear between the contact surfaces, which become increasingly inaccurate. In contrast, rolling contact has little wear; therefore, machines can achieve a long life with highly accurate motion.

(3) High speed motion is possible with a low driving force
Because linear guideways have little friction resistance, only a small driving force is needed to move a load. This results in greater power savings, especially in the moving parts of a system. This is especially true for the reciprocating parts.

(4) Equal loading capacity in all directions
With this special design, these linear guideways can take loads in either the vertical or horizontal directions. Conventional linear slides can only take small loads in the direction parallel to the contact surface. They are also more likely to become inaccurate when they are subjected to these loads.

(5) Easy installation
Installing a linear guideway is fairly easy. Grinding or milling the machine surface, following the recommended installation procedure, and tightening the bolts to their specified torque can achieve highly accurate linear motion.

(6) Easy lubrication
With a traditional sliding system, insufficient lubrication causes wear on the contact surfaces. Also, it can be quite difficult to supply sufficient lubrication to the contact surfaces because finding an appropriate lubrication point is not very easy. With a linear motion guideway, grease can be easily supplied through the grease nipple on the linear guideway block. It is also possible to utilize a centralized oil lubrication system by piping the lubrication oil to the piping joint.

(7) Interchangeability
Compared with traditional boxways or v-groove slides, linear guideways can be easily replaced should any damage occur. For high precision grades consider ordering a matched, non-interchangeable, assembly of a block and rail.

1-2 Selecting Linear Guideways

Identify the condition

- Type of equipment
- Space limitations
- Accuracy
- Stiffness
- Travel length
- Magnitude and direction of loads
- Moving speed, acceleration
- Duty cycle
- Service life
- Environment

Selection of series

- HG/CG series - Grinding, milling, and drilling machine, lathe, machine center
- EG series - Automatic equipment, high speed transfer device, semiconductor equipment, wood cutting machine, precision measure equipment
- QE/QH series - precision measure equipment, semiconductor equipment, Automatic equipment, laser marking machine, can be widely applied in high-tech industry required high speed, low noise, low dust generation.
- WE/QW series - Automatic device, transportation device, precision measure equipment, semiconductor equipment, blow moulding machine, single axis robot-robotics.
- MG series - Miniature device, semiconductor equipment, medical equipment
- RG/QR series - CNC machining centers, heavy duty cutting machines, CNC grinding machines, injection molding machines, electric discharge machines, wire cutting machines, plano millers

Selection of accuracy

- Classes : C, H,P, SP, UP depends on the accuracy of equipment

Determines the size & the number of blocks

- Dynamic load condition
- If accompanied with a ballscrew, the size should be similar to the diameter of ballscrew. For example, if the diameter of the ballscrew is 35mm, then the model size of linear guideway should be HG35

Calculate the max. load of block

- Make reference to load calculation examples, and calculate the max load.
- Be sure that the static safety factor of selected guideway is larger than the rated static safety factor

Choosing preload

- Depends on the stiffness requirement and accuracy of mounting surface

Identify stiffness

- Calculate the deformation by using the table of stiffness values, choosing heavier preload and larger size linear guideways to enhance the stiffness

Calculating service life

- Calculate the life time requirement by using the moving speed and frequency.
- Make reference to the life calculation example

Selection of lubrication

- Grease supplied by grease nipple
- Oil supplied by piping joint

Completion of selection

1-3 Basic Load Ratings of Linear Guideways

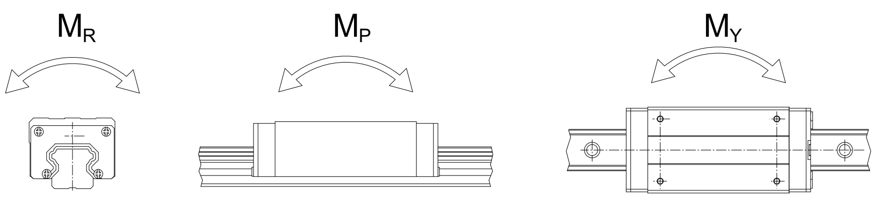
1-3-1 Basic Static Load

(1) Static load rating (C_0)

Localized permanent deformation will be caused between the raceway surface and the rolling elements when a linear guideway is subjected to an excessively large load or an impact load while either at rest or in motion. If the amount of this permanent deformation exceeds a certain limit, it becomes an obstacle to the smooth operation of the linear guideway. Generally, the definition of the basic static load rating is a static load of constant magnitude and direction resulting in a total permanent deformation of 0.0001 times the diameter of the rolling element and the raceway at the contact point subjected to the largest stress. The value is described in the dimension tables for each linear guideway. A designer can select a suitable linear guideway by referring to these tables. The maximum static load applied to a linear guideway must not exceed the basic static load rating.

(2) Static permissible moment (M_0)

The static permissible moment refers to a moment in a given direction and magnitude when the largest stress of the rolling elements in an applied system equals the stress induced by the Static Load Rating. The static permissible moment in linear motion systems is defined for three directions: M_R, M_P and M_Y.



(3) Static safety factor

This condition applys when the guideway system is static or under low speed motion. The static safety factor, which depends on environmental and operating conditions, must be taken into consideration. A larger safety factor is especially important for guideways subject to impact loads (See Table 1-1). The static load can be obtained by using Eq. 1.1

Table 1-1 **Static Safety Factor**

Load Condition	f_{SL} , f_{SM} (Min.)
Normal Load	1.0~3.0
With impacts/vibrations	3.0~5.0

$$f_{SL}=\frac{C_0}{P} \text{ or } f_{SM}=\frac{M_0}{M} \qquad \text{Eq.1.1}$$

f_{SL} : Static safety factor for simple load
f_{SM} : Static safety factor for moment
C_0 : Static load rating (kN)
M_0 : Static permissible moment (kN •mm)
P : Calculated working load (kN)
M : Calculated appling moment (kN•mm)

1-3-2 Basic Dynamic Load

(1) Dynamic load rating (C)

The basic dynamic load rating is an important factor used for calculation of service life of linear guideway. It is defined as the maximum load when the load that does not change in direction or magnitude and results in a nominal life of 50km of operation for a ball type linear guideway and 100km for a roller type linear guideway. The values for the basic dynamic load rating of each guideway are shown in dimension tables. They can be used to predict the service life for a selected linear guideway.

1-4 Service Life of Linear Guideways

1-4-1 Service Life

When the raceway and the rolling elements of a linear guideway are continuously subjected to repeated stresses, the raceway surface shows fatigue. Flaking will eventually occur. This is called fatigue flaking. The life of a linear guideway is defined as the total distance traveled until fatigue flaking appears on the surface of the raceway or rolling elements.

1-4-2 Nominal Life (L)

The service life varies greatly even when the linear motion guideways are manufactured in the same way or operated under the same motion conditions. For this reason, nominal life is used as the criteria for predicting the service life of a linear motion guideway. The nominal life is the total distance that 90% of a group of identical linear motion guideways, operated under identical conditions, can travel without flaking. When the basic dynamic rated load is applied to a linear motion guideway, the nominal life is 50km.

1-4-3 Calculation of Nominal Life

The acting load will affect the nominal life of a linear guideway. Based on the selected basic dynamic rated load and the actual load. The nominal life of ball type and roller type linear guideway can be calculated by Eq.1.2 and Eq. 1.3 respectively.

Ball type: $$L=\left(\frac{C}{P}\right)^{3}\cdot 50km=\left(\frac{C}{P}\right)^{3}\cdot 31mile \qquad \text{Eq.1.2}$$

Roller type: $$L=\left(\frac{C}{P}\right)^{\frac{10}{3}}\cdot 100km=\left(\frac{C}{P}\right)^{\frac{10}{3}}\cdot 62mile \qquad \text{Eq.1.3}$$

L : Nominal life
C : Basic dynamic load rating
P : Actual load

If the environmental factors are taken into consideration, the nominal life is influenced greatly by the motion conditions, the hardness of the raceway, and the temperature of the linear guideway. The relationship between these factors is expressed in Eq.1.4 and Eq. 1.5.

Ball type: $$L=\left(\frac{f_h\cdot f_t\cdot C}{f_w\cdot P_c}\right)^{3}\cdot 50km=\left(\frac{f_h\cdot f_t\cdot C}{f_w\cdot P_c}\right)^{3}\cdot 31mile \qquad \text{Eq.1.4}$$

Roller type: $$L=\left(\frac{f_h\cdot f_t\cdot C}{f_w\cdot P_c}\right)^{\frac{10}{3}}\cdot 100km=\left(\frac{f_h\cdot f_t\cdot C}{f_w\cdot P_c}\right)^{\frac{10}{3}}\cdot 62mile \qquad \text{Eq.1.5}$$

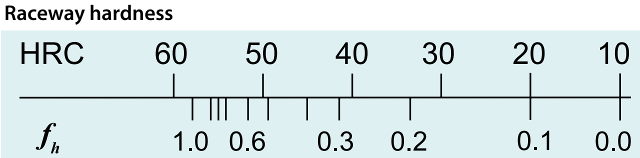
L : Nominal life
f_h : Hardness factor
C : Basic dynamic load rating
f_t : Temperature factor
P_c : Calculated load
f_w : Load factor

1-4-4 Factors of Normal Life

(1) Hardness factor (f_h)

In general, the raceway surface in contact with the rolling elements must have the hardness of HRC 58~62 to an appropriate depth. When the specified hardness is not obtained, the permissible load is reduced and the nominal life is decreased. In this situation, the basic dynamic load rating and the basic static load rating must be multiplied by the hardness factor for calculation.

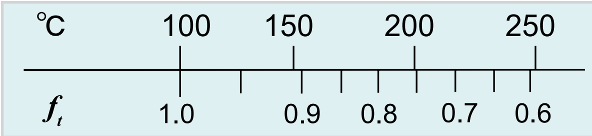
Raceway hardness



(2) Temperature factor (f_t)

Due to the temperature will affect the material of linear guide, therefore the permissible load will be reduced and the nominal service life will be decreased when over 100℃. Therefore, the basic dynamic and static load rating must be multiplied by the temperature factor. As some accessories are plastic which can't resist high temperature, the working enviornment is recommended to be lower than 100℃.

Temperature



(3) Load factor (f_w)

The loads acting on a linear guideway include the weight of slide, the inertia load at the times of start and stop, and the moment loads caused by overhanging. These load factors are especially difficult to estimate because of mechanical vibrations and impacts. Therefore, the load on a linear guideway should be divided by the empircal factor.

Table 1-2 **Load factor**

Loading Condition	Service Speed	f_w
No impacts & vibration	V ≦ 15 m/min	1 ~ 1.2
Small impacts	15 m/min ＜V ≦ 60 m/min	1.2 ~ 1.5
Normal load	60m/min ＜ V ≦ 120 m/min	1.5 ~ 2.0
With impacts & vibration	V ＞120 m/min	2.0 ~ 3.5

1-4-5 Calculation of Service Life (L_h)

Transform the nominal life into the service life time by using speed and frequency.

Ball type: $$L_h = \frac{L \cdot 10^3}{V_e \cdot 60} = \frac{\left(\frac{C}{P}\right)^3 \cdot 50 \cdot 10^3}{V_e \cdot 60} \text{ hr} \quad \text{Eq.1.6}$$

Roller type: $$L_h = \frac{L \cdot 10^3}{V_e \cdot 60} = \frac{\left(\frac{C}{P}\right)^{\frac{10}{3}} \cdot 100 \cdot 10^3}{V_e \cdot 60} \text{ hr} \quad \text{Eq.1.7}$$

L_h : Service life (hr)
L : Nominal life (km)
V_e : Speed (m/min)
C/P : Load factor

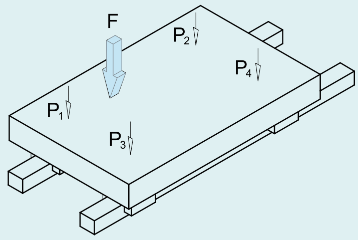
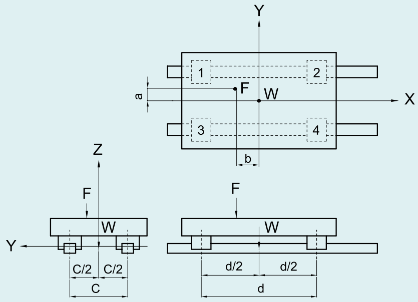
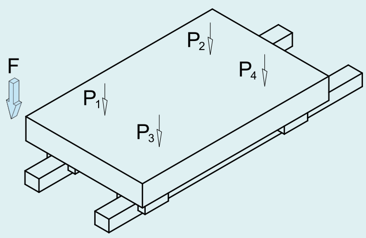
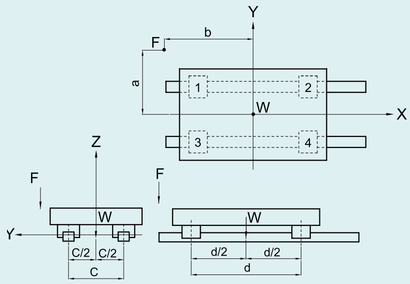
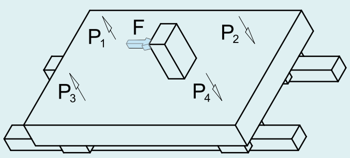
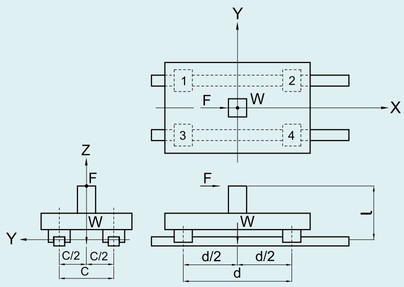
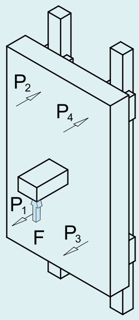
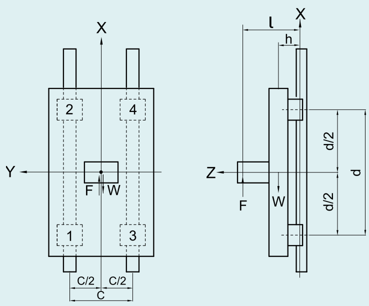
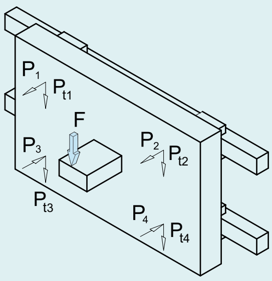
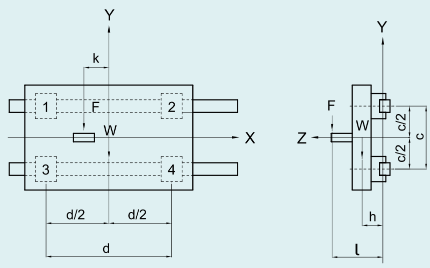
1-5 Applied Loads

1-5-1 Calculation of Load

Several factors affect the calculation of loads acting on a linear guideway (such as the position of the object's center of gravity, the thrust position, and the inertial forces at the time of start and stop). To obtain the correct load value, each load condition should be carefully considered.

(1) Load on one block

Table 1-3 **Calculation example of loads on block**

Patterns	Loads layout	Load on one block
		$P_1=\frac{W}{4}+\frac{F}{4}+\frac{F\cdot a}{2c}+\frac{F\cdot b}{2d}$ $P_2=\frac{W}{4}+\frac{F}{4}+\frac{F\cdot a}{2c}-\frac{F\cdot b}{2d}$ $P_3=\frac{W}{4}+\frac{F}{4}-\frac{F\cdot a}{2c}+\frac{F\cdot b}{2d}$ $P_4=\frac{W}{4}+\frac{F}{4}-\frac{F\cdot a}{2c}-\frac{F\cdot b}{2d}$
		$P_1=\frac{W}{4}+\frac{F}{4}+\frac{F\cdot a}{2c}+\frac{F\cdot b}{2d}$ $P_2=\frac{W}{4}+\frac{F}{4}+\frac{F\cdot a}{2c}-\frac{F\cdot b}{2d}$ $P_3=\frac{W}{4}+\frac{F}{4}-\frac{F\cdot a}{2c}+\frac{F\cdot b}{2d}$ $P_4=\frac{W}{4}+\frac{F}{4}-\frac{F\cdot a}{2c}-\frac{F\cdot b}{2d}$
		$P_1=P_3=\frac{W}{4}-\frac{F\cdot l}{2d}$ $P_2=P_4=\frac{W}{4}+\frac{F\cdot l}{2d}$
		$P_1\sim P_4=-\frac{W\cdot h}{2d}+\frac{F\cdot l}{2d}$
		$P_1\sim P_4=-\frac{W\cdot h}{2c}-\frac{F\cdot l}{2c}$ $P_{t1}=P_{t3}=\frac{W}{4}+\frac{F}{4}+\frac{F\cdot k}{2d}$ $P_{t2}=P_{t4}=\frac{W}{4}+\frac{F}{4}-\frac{F\cdot k}{2d}$

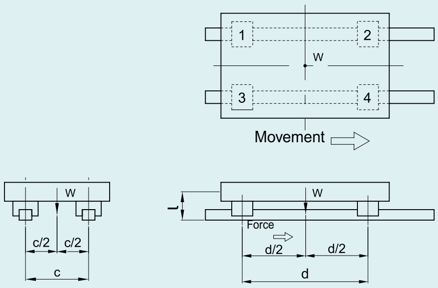
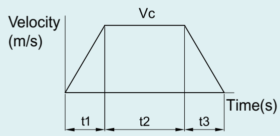
W: Applied weight
l: Distance from external force to driver
c: Rail spacing

P_n: Load (radial, reverse radial), n=1~4
F: External force
d: Block spacing

a,b,k: Distance from external force to geometric center
P_{tn}: Load (lateral), n=1~4
h: Distance from center of gravity to driver

(2) Loads with inertia forces

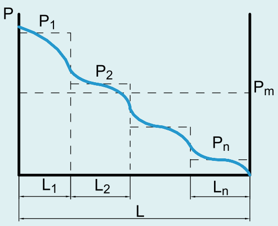
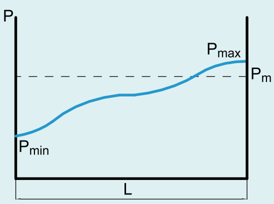
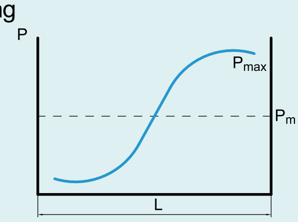
Table 1-4 **Calculation Examples for Loads with Inertia Forces**

Considering the acceleration and deceleration	Load on one block
  W: Weight of object (N) g: Gravitational acceleration (9.8m/sec^2) P_n: Load (radial, reverse radial) (N), n=1~4 V_c: Maximum speed (m/sec) t1(t3): Acceleration (deceleration) time (s) t2: Constant speed time (s) c: Rail spacing (m) d: Block spacing (m) l: Distance from center of gravity to driver (m)	**o** Constant velocity $P_1 \sim P_4 = \frac{W}{4}$ **o** Acceleration $P_1 = P_3 = \frac{W}{4} + \frac{1}{2} \cdot \frac{W}{g} \cdot \frac{V_c}{t1} \cdot \frac{l}{d}$ $P_2 = P_4 = \frac{W}{4} - \frac{1}{2} \cdot \frac{W}{g} \cdot \frac{V_c}{t1} \cdot \frac{l}{d}$ **o** Deceleration $P_1 = P_3 = \frac{W}{4} - \frac{1}{2} \cdot \frac{W}{g} \cdot \frac{V_c}{t3} \cdot \frac{l}{d}$ $P_2 = P_4 = \frac{W}{4} + \frac{1}{2} \cdot \frac{W}{g} \cdot \frac{V_c}{t3} \cdot \frac{l}{d}$

1-5-2 Calculation of The Mean Load for Variable Loading

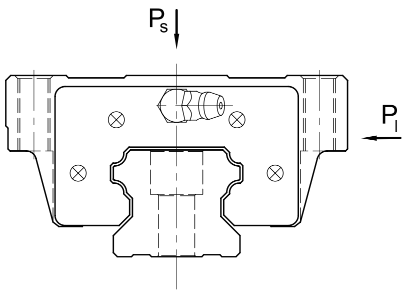
When the load on a linear guideway fluctuates greatly, the variable load condition must be considered in the life calculation. The definition of the mean load is the load equal to the bearing fatigue load under the variable loading conditions. It can be calculated by using table 1-5.

Table 1-5 **Calculation Examples for Mean Load (P_m)**

Operation Condition	Mean load
Step load  	$P_m = \sqrt[3]{1/L(P_1^3 \cdot L_1 + P_2^3 \cdot L_2 + ... + P_n^3 \cdot L_n)}$ P_m: Mean load P_n : Stepping L : Total running distance L_n : Running distance under load P_n
Linear variation  	$P_m = 1/3\,(P_{min} + 2 \cdot P_{max})$ P_m : Mean load P_{min} : Min. Load P_{max} : Max. Load
Sinusoidal loading  	$P_m = 0.65 \cdot P_{max}$ P_m : Mean load P_{max} : Max. Load

1-5-3 Calculation for Bidirectional Equivalent Loads

SIMTACH linear guideways can accept loads in several directions simultaneously. To calculate the service life of the guideway when the loads appear in multiple directions, calculate the equivalent load (P_e) by using the equations below.



HG/EG/WE/QH/QE/QW/RG/QR Series

$$P_e = P_s + P_l \quad \text{Eq.1.8}$$

MG Series

when $P_s > P_l$ $\quad P_e = P_s + 0.5 \cdot P_l \quad$ Eq.1.9

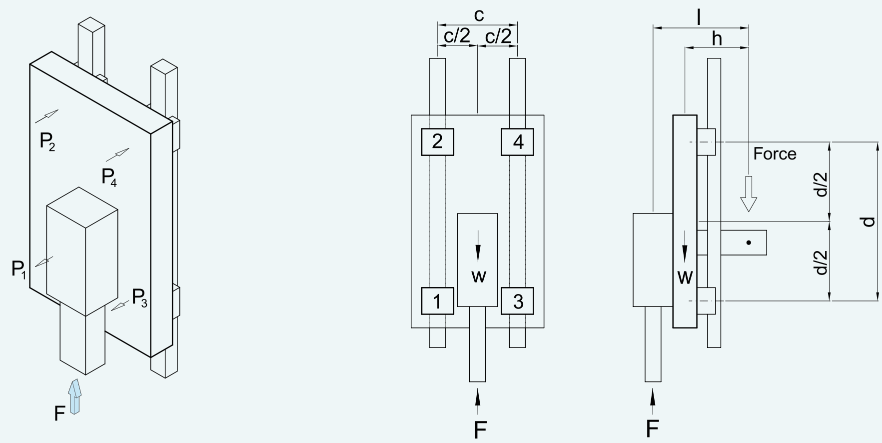
when $P_l > P_s$ $\quad P_e = P_l + 0.5 \cdot P_s \quad$ Eq.1.10

1-5-4 Calculation Example for Service Life

A suitable linear guideway should be selected based on the acting load. The service life is calculated from the ratio of the working load and the basic dynamic load rating.

Table 1-6 Calculation Example for Service Life

Type of Linear Guideway	Dimension of device	Operating condition
Type: HGH 30 CA	d : 600 mm	Weight (W) : 15 kN
C : 38.74 kN	c : 400 mm	Acting force (F) : 1 kN
C_0 : 52.19 kN	h : 200 mm	Temperature: normal temperature
Preload: Z0	l : 250 mm	Load status: normal load



- Calculation of acting loads

$$P_1 \sim P_4 = + \frac{W \times h}{2d} - \frac{F \times l}{2d} = + \frac{15 \times 200}{2 \times 600} - \frac{1 \times 250}{2 \times 600} = 2.29(kN)$$

$$P_{max} = |P_1 \sim P_4| = 2.29(kN)$$

- Because preload is Z0, $P_c = P_{max} = 2.29(kN)$

Note: The larger preload (ZA, AB) will increase the rigidity, but decrease the nominal life of guideway.

- Calculation for life L

$$L = \left(\frac{f_h \times f_t \times C}{f_w \times P_c}\right)^3 \times 50 = \left(\frac{1 \times 1 \times 38.74}{2 \times 2.29}\right)^3 \times 50 = 30,258\ (km)$$

1-6 Friction

As mentioned in the preface, a linear guideway allows a type of rolling motion, which is achieved by using balls or rollers. The coefficient of friction for a linear guideway can be as little as 1/50 of a traditional slide. Generally, the coefficient of friction of ball type linear guideway is about 0.004 and roller type is about 0.003 .

When a load is 10% or less than the basic static load rate, the most of the resistance comes from the grease viscosity and frictional resistance between balls. In contrast, if the load is more than the basic static load rating, the resistance will mainly come from the load.

$$F = \mu \cdot W + S \quad \text{Eq.1.11}$$

F : Friction (kN)
S : Friction resistance (kN)
μ : Coefficient of friction
W : Normal loads (kN)

1-7 Lubrication

Supplying insufficient lubrication to the guideway will greatly reduce the service life due to an increase in rolling friction. The lubricant provides the following functions;

- Reduces the rolling friction between the contact surfaces to avoid abrasion and surface burning of the guideway.
- Generates a lubricant film between the rolling surfaces and decreases fatigue.
- Anti-corrosion .

1-7-1 Grease

Linear guideway must be lubricated with the lithium soap based grease before installation. After the linear guideway is installed, we recommend that the guideway be re-lubricated every 100 km. It is possible to carry out the lubrication through the grease nipple. Generally, grease is applied for speeds that do not exceed 60 m/min faster speeds will require high-viscosity oil as a lubricant.

$$T=\frac{100\cdot 1000}{V_e\cdot 60}\,hr \qquad \text{Eq.1.12}$$

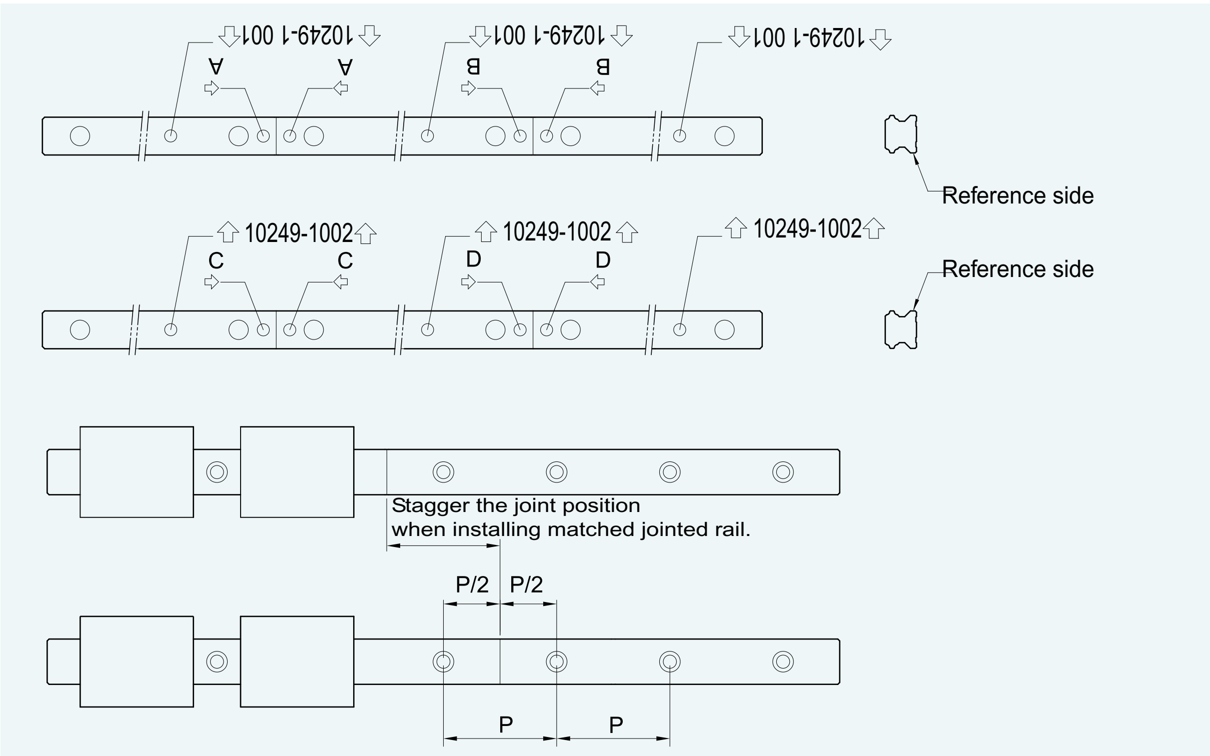
T : Feeding frequency of oil (hour)
V_e : speed (m/min)

1-7-2 Oil

The recommended viscosity of oil is about 32~150c St. The standard grease nipple may be replaced by an oil piping joint for oil lubrication. Since oil evaporates quicker than grease, the recommended oil feed rate is approximate 0.3cm^3/hr.

1-8 Jointed Rail

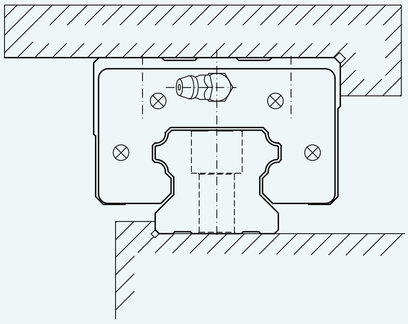
Jointed rail should be installed by following the arrow sign and ordinal number which is marked on the surface of each rail.
For matched pair, jointed rails, the jointed positions should be staggered. This will avoid accuracy problems due to discrepancies between the 2 rails (see figure).



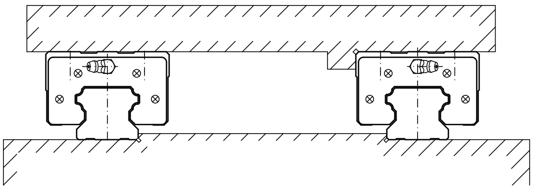
1-9 Mounting Configurations

Linear guideways have equal load ratings in the radial, reverse radial and lateral directions.
The application depends on the machine requirements and load directions.
Typical layouts for linear guideways are shown below:

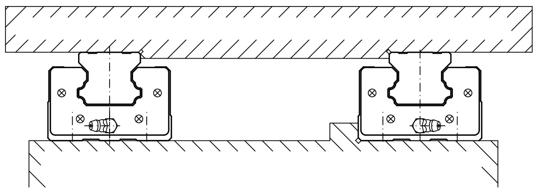
Use of one rail and mounting reference side



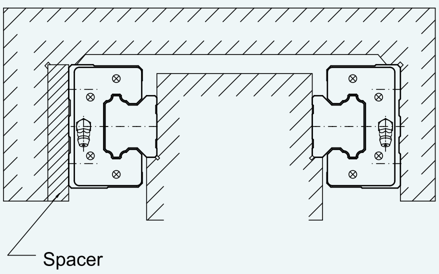
use of two rails(block movement)



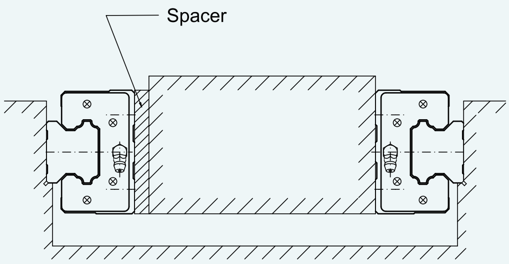
use of two rails(block fixed)



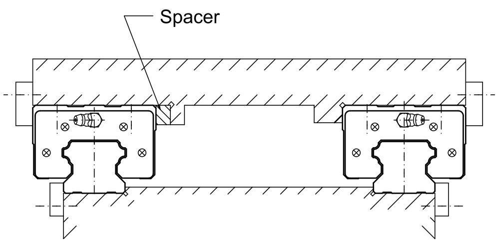
use of two external rails



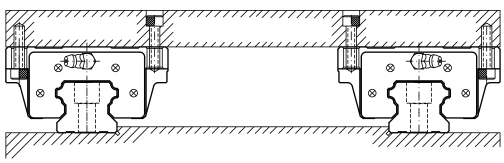
use of two internal rails



total surface fixed installation



HGW type block with mounting holes in different directions.

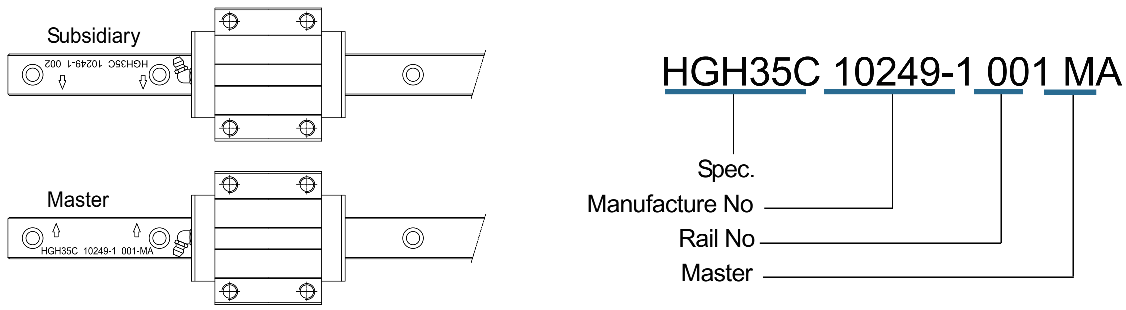


1-10 Mounting Procedures

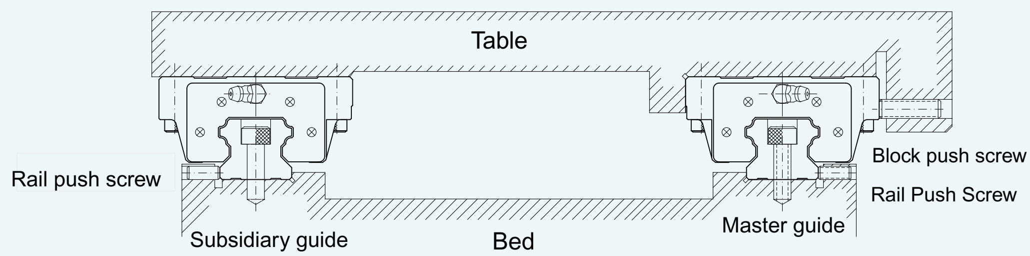
Three installation methods are recommended based on the required running accuracy and the degree of impacts and vibrations.

1-10-1 Master and Subsidiary Guide

For non-interchangeable type Linear Guideways, there are some differences between the master guide and subsidiary guide. The accuracy of the master guide's datum plane is better than the subsidiary's and it can be a reference side for installation. There is a mark "MA" printed on the rail, as shown in the figure below.



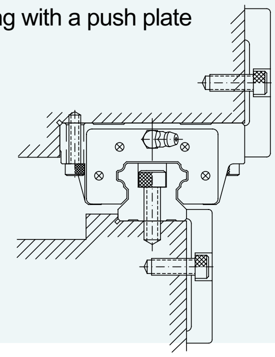
1-10-2 Installation to Achieve High Accuracy and Rigidity



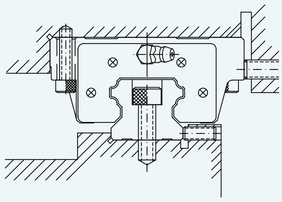
(1) Mounting methods

It is possible that the rails and the blocks will be displaced when the machine is subjected to vibrations and impacts. To eliminate these difficulties and achieve high running accuracy, the following four methods are recommended for fixing.

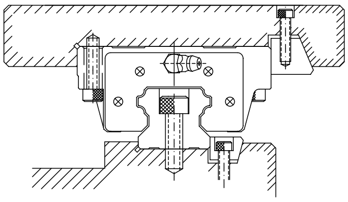
Mounting with a push plate



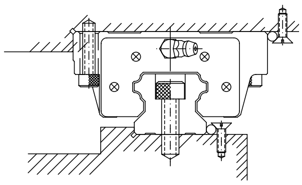
Mounting with push screws



Mounting with taper gib

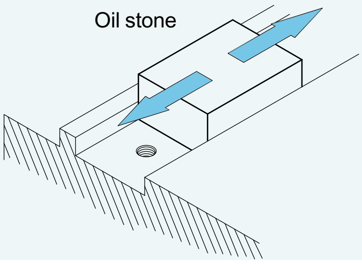


Mounting with needle roller

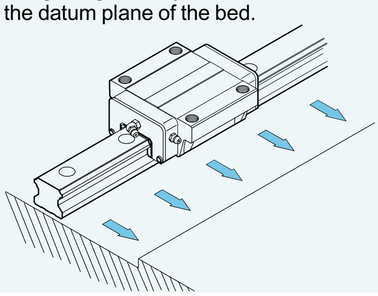


(2) Procedure of rail installation

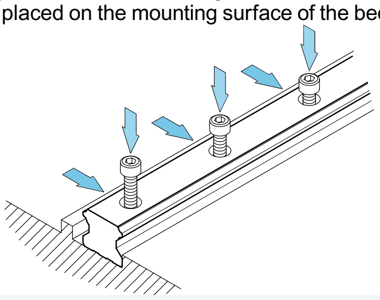
1 Before starting, remove all dirt from the mounting surface of the machine.



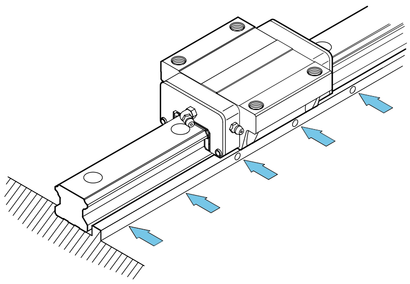
2 Place the linear guideway gently on the bed. Bring the guideway into close contact with the datum plane of the bed.



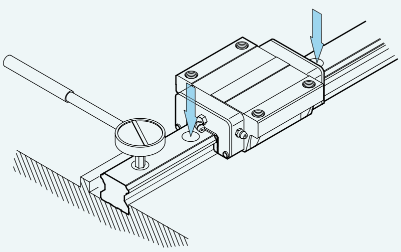
3 Check for correct thread engagement when inserting a bolt into the mounting hole while the rail is being placed on the mounting surface of the bed.



4 Tighten the push screws sequentially to ensure close contact between the rail and the side datum plane.

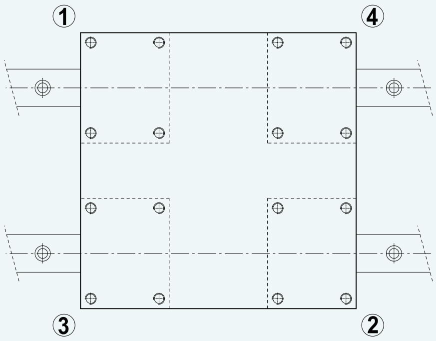


5 Tighten the mounting bolts with a torque wrench to the specified torque.



6 Install the remaining linear guideway in the same way.

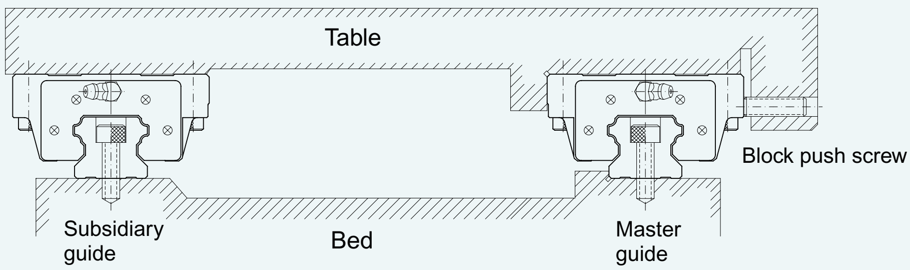
(3) Procedure of block installation



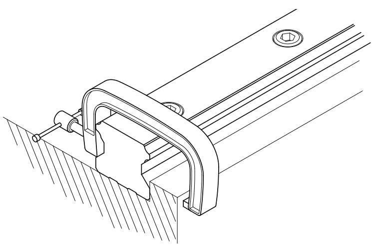
- Place the table gently on the blocks. Next, tighten the block mounting bolts temporarily.
- Push the blocks against the datum plane of the table and position the table by tightening the push screws.
- The table can be fixed uniformly by tightening the mounting bolts on master guide side and subsidiary side in 1 to 4 sequences.

1-10-3 Installation of the Master Guide without Push Screws

To ensure parallelism between the subsidiary guide and the master guide without push screws, the following rail installation methods are recommended. The block installation is the same as mentioned previously.

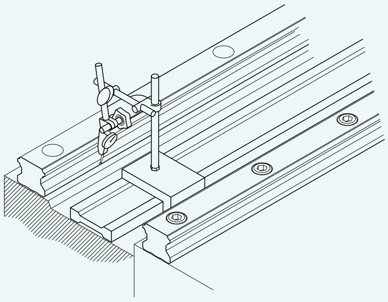


(1) Installation of the rail on the subsidiary guide side

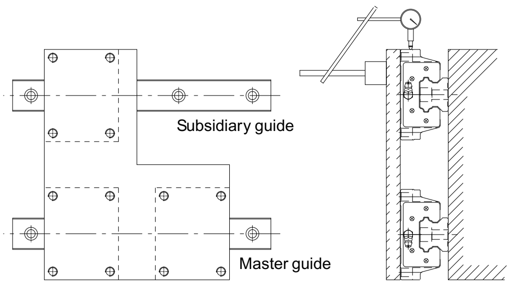


- Using a vice
  Place the rail into the mounting plane of the bed. Tighten the mounting bolts temporarily; then use a vice to push the rail against the side datum plane of the bed. Tighten the mounting bolts in sequence to the specified torque.

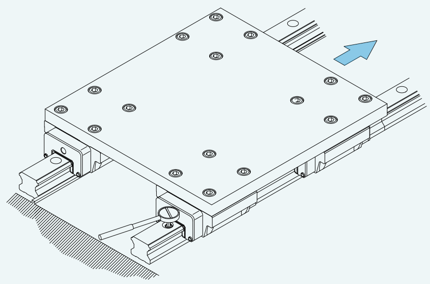
(2) Installation of the rail on the subsidiary guide side



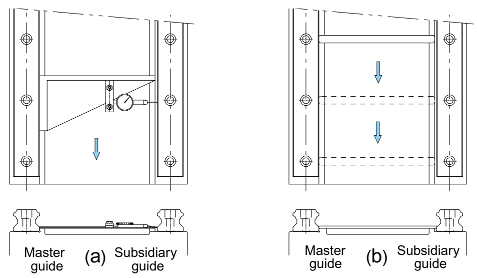
- **Method with use of a straight edge**
  Set a straight edge between the rails parallel to the side datum plane of the rail on the master guide side by using a dial gauge. Use the dial gauge to obtain the straight alignment of the rail on the subsidiary guide side. When the rail on the subsidiary guide side is parallel to the master side, tighten the mounting bolts in sequence from one end of the rail to the other.



- **Method with use of a table**
  Fix two blocks on the master guide side to the table. Temporarily fix the rail and one block on the subsidiary guide side to the bed and the table. Fix a dial gauge stand on the table surface and bring it into contact with the side of the block on the subsidiary guide side. Move the table from one end of the rail to the other. While aligning the rail on the subsidiary side parallel to the rail on the master guide side, tighten the bolts in sequence.



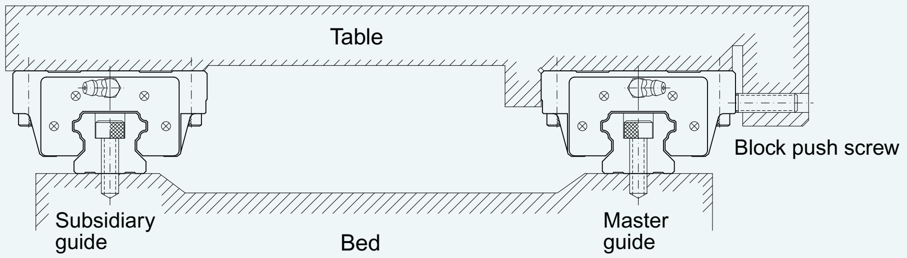
- **Method following the master guide side**
  When a rail on the master guide side is correctly tightened, fix both blocks on the master guide side and one of the two blocks on the subsidiary guide side completely to the table.
  When moving the table from one end of the rail, tighten the mounting bolts on the subsidiary guide side completely.



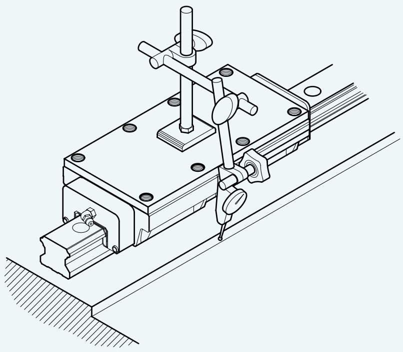
- **Method with use of a jig**
  Use a special jig to ensure the rail position on the subsidiary guide side. Tighten the mounting bolts to the specified torque in sequence.

1-10-4 When There Is No Side Surface of The Bed On The Master Guide Side

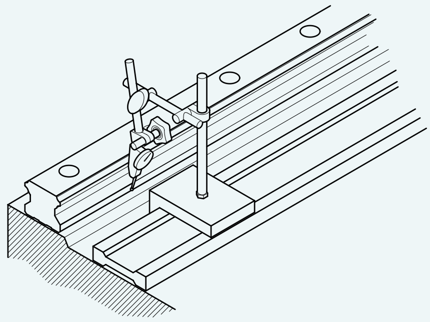
To ensure parallelism between the subsidiary guide and the master guide when there is no side surface, the following rail installation method is recommended. The installation of the blocks is the same as mentioned previously.



(1) Installation of the rail on the master guide side



- Using a provisional datum plane
  Two blocks are fixed in close contact by the measuring plate. A datum plane provided on the bed is used for straight alignment of the rail from one end to the other. Move the blocks and tighten the mounting bolts to the specified torque in sequence.



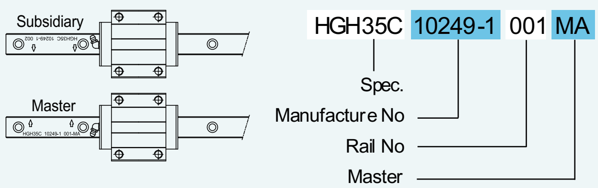
- Method with use of a straight edge
  Use a dial gauge and a straight edge to confirm the straightness of the side datum plane of the rail from one end to the other. Make sure the mounting bolts are tightened securely in sequence.

(2) Installation of the rail on the subsidiary guide side
The method of installation for the rail on the subsidiary guide side is the same as the case without push screws.

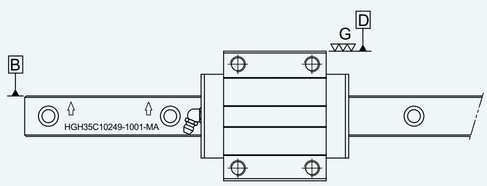
1-10-5 Linear Guideway Mounting Instructions

1. SIMTACH guideways are supplied with a coating of anti-corrosion oil before being shipped. Please clean the oil before moving or running the blocks.

2. Recognition of master and subsidiary rails: For non-interchangeable type linear guideways, there are some differences between the master rail and subsidiary rail. The accuracy of the master rail's datum plane is better than the subsidiary's and it can be a reference side for installation. There is a mark "MA" printed on the rail. Check for the correct order before starting the installation. The rail number of master is an odd number and the rail number of subsidiary is an even number. Please install the rails according to the indication and carry on the installation according to the order for multi-rails installment (e.g.: 001 pairs 002 ; 003 pairs 004 etc.)
3. Recognition of datum plane: The datum plane (B) of rail is the side indicated by the arrow, which is marked on the top surface of the rail. The datum plane of block is smooth ground surface which shows as D inFigure 2.

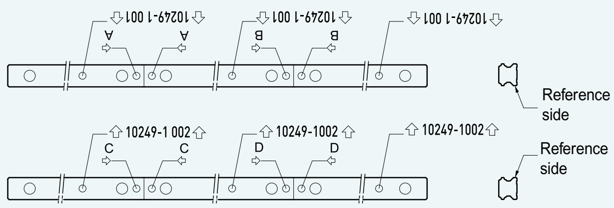


(Figure 1)

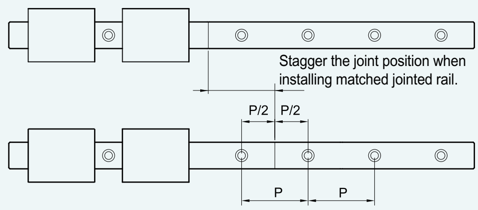


(Figure 2)

4. Butt-joint rail: Butt-joint rail should be installed by following the arrow sign and ordinal number which is marked on the surface of each rail as shown in the figure 3. To avoid accuracy problems due to discrepancies between the 2 rails such as for matched pair, butt-joint rails, the jointed positions should be staggered as shown in figure 4.

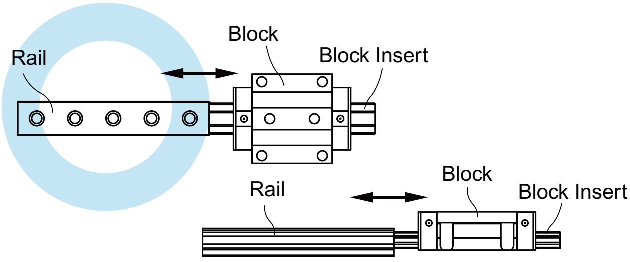


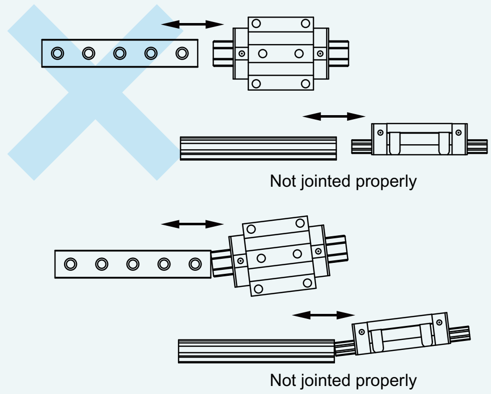
(Figure 3)



(Figure 4)

5. Do not remove blocks from rails when assembling the guideways in machines as far as possible. Please use block inserts (please see Figure 5) if it is necessary to remove/ mount block from/ onto rail.





(Figure 5)

6. Please do not randomly mix block units and rails for non interchangeable type to avoid any installation problem.
7. To ensure the straightness of rail, please tighten the mounting bolts sequentially with a torque wrench to the specified torque. (Refer to SIMTACH Technical Information).

1-10-6 Linear Guideway Usage Instructions

1. Lubricate the blocks after assembling the guideways in machines. Use a lithium soap-base grease or oil.
2. The guideways are packaged with anti-corrosion oil before delivery. If the rails were cleaned before installation, remember to lubricate the rails after assembling the guideways in machine.(Please confirm the compatibility between lubricant & anti rust rail)
3. The blocks are composed of various plastic parts, please avoid prolonged exposure of these parts with any organic solvent when cleaning the blocks to prevent possible damage.
4. Try to avoid any foreign objects from getting into the block as this could result in damage to the product.
5. Please do not disassemble the parts, the incautious actions of disassembly may bring foreign objects into the block and diminish the precision of the guideways or cause possible damage.
6. When handling the guideways please hold them horizontally. Improper handling can cause the blocks to fall off the rail.
7. Please avoid the inappropriate falling or clash on the blocks, which will damage the function of guideways.
8. For special application conditions, please apply the appropriate surface treatment or refer to the Linear Guideway Technical Information catalog for more detailed instructions.
9. The operating temperature range of the E2 type (Self lubricant kit) is -10 ˚C~ 60˚C. For Q1 types (Quiet linear guideway), the range is -10˚C~80˚C The maximum service temperature of the SE type (Metallic end cap) is 150˚C and for other standard types it is 100˚C.
10. Please refer to the Linear Guideway Technical Information catalog for more detailed instructions. Please do not hesitate to contact SIMTACH if there are further questions related to the application.

2. SIMTACH Linear Guideway Product Series

In an effort to meet customer's requirement and service needs SIMTACH offers several different types of guides. We supply the HG series which is suitable for CNC machineries, the EG series for automation industries,the RG series for high rigidity applications, and the miniature series, MGN/MGW, for medical devices and semiconductor equipment.

(1) Types & series

Table 2-1 Types & Series

Series	Assembly Height	Load	Square Tap hole	Flange Combination
HG	High	Heavy Load	HGH-CA	HGW-CC
		Super Heavy Load	HGH-HA	HGW-HC
	Low	Heavy Load	HGL-CA	-
		Super Heavy Load	HGL-HA	-
EG	Low	Medium Load	EGH-SA	-
		Heavy Load	EGH -CA	-
MGN	-	Standard	MGN-C	-
		Long	MGN-H	-
MGW	-	Standard	MGW-C	-
		Long	MGW-H	-
RG	High	Heavy Load	RGH-CA	RGW-CC
		Super Heavy Load	RGH-HA	RGW-HC
	Low	Heavy Load	RGL-CA	-
		Super Heavy Load	RGL-HA	-

(2) Accuracy classes

Table 2-2 **Accuracy Classes**

Series	Assembly Type					Interchangeable Type		
	Normal (C)	High (H)	Precision (P)	Super Precision (SP)	Ultra Precision (UP)	Normal (C)	High (H)	Precision (P)
HG	●	●	●	●	●	●	●	●
EG	●	●	●	●	●	●	●	●
MGN	●	●	●	-	_	●	●	●
MGW	●	●	●	-	-	●	●	●
RG	-	●	●	●	●	-	●	●

(3) Classification of preload

Table 2-3 **Preload**

Series	Non-interchangeable Type			Interchangeable Type	
	Light preload (Z0)	Medium Preload (ZA)	Heavy Preload (ZB)	Light Preload (Z0)	Medium Preload (ZA)
HG	●	●	●	●	●
EG	●	●	●	●	●

Series	Non-interchangeable Type			Interchangeable Type	
	Very Light Preload (Z0)	Medium Preload (ZA)	Heavy Preloa (ZB)	Very Light Preload (Z0)	Light Preload (ZA)
RG	●	●	●	●	●

Series	Non-interchangeable Type			Interchangeable Type		
	Light Clearance (ZF)	Very Ligh Preload (Z0)	Light Preload (Z1)	Light Clearance (ZF)	Very Ligh Preload (Z0)	Light Preload (Z1)
MGN	●	●	●	●	●	●
MGW	●	●	●	●	●	●

HG Series
Heavy Load Ball Type

2-1 HG Series - Heavy Load Ball Type Linear Guideway

HG series linear guideways are designed with load capacity and rigidity higher than other similar products with circular-arc groove and structure optimization. It features equal load ratings in the radial, reverse radial and lateral directions, and self-aligning to absorb installation-error. Thus, SIMTACH HG series linear guideways can achieve a long life with high speed, high accuracy and smooth linear motion.

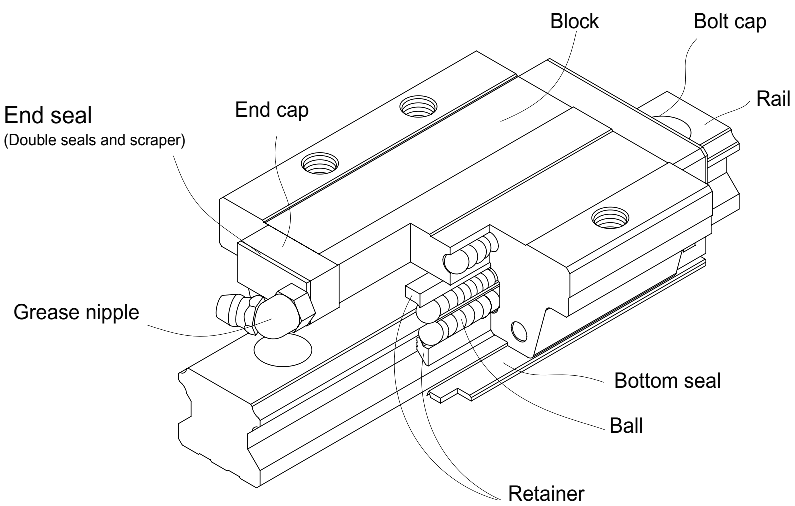
2-1-1 Features of HG Series

(1) Self-aligning capability
By design, the circular-arc groove has contact points at 45 degrees. HG series can absorb most installation errors due to surface irregularities and provide smooth linear motion through the elastic deformation of rolling elements and the shift of contact points. Self-aligning capability, high accuracy and smooth operation can be obtained with an easy installation.

(2) Interchangeability
Because of precision dimensional control, the dimensional tolerance of HG series can be kept in a reasonable range, which means that any blocks and any rails in a specific series can be used together while maintaining dimensional tolerance. And a retainer is added to prevent the balls from falling out when the blocks are removed from the rail.

(3) High rigidity in all four directions
Because of the four-row design, the HG series linear guideway has equal load ratings in the radial, reverse radial and lateral directions. Furthermore, the circular-arc groove provides a wide-contact width between the balls and the groove raceway allowing large permissible loads and high rigidity.

2-1-2 Construction of HG Series



- Rolling circulation system: Block, Rail, End Cap and Retainer
- Lubrication system: Grease Nipple and Piping Joint
- Dust protection system: End seal, Bottom Seal, Bolt Cap, Double Seals and Scraper

2-1-3 Model Number of HG Series

HG series guideways can be classified into non-interchangeable and interchangeable types. The sizes are identical. The only difference between the two types is that the interchangeable type of blocks and rails can be freely exchanged, and their accuracy can reach up to P class. The model number of HG series contains the size, type, accuracy class, preload class, etc..

(1) Non-interchangeable type

HG W 25 C A E 2 R 1600 E ZA P II + DD/E2/RC

- HG Series
- Block Type
  - W : Flange Type
  - H : Square Type
  - L : Square Type (Low)[3]
- Model size
  - 15, 20, 25, 30, 35, 45, 55, 65
- Load Type
  - C : Heavy Load
  - H : Super Heavy Load
- Block Mounting
  - A : Mounting From Top
  - B : Bottom
  - C : Top or Bottom
- E: Special Block
  None: Standard Block
- No. of Blocks per Rail
- Rail Mounting Type
  - R : Mounting From Top
  - T : Bottom
- Rail Length (mm)
- E: Special Rail
  None: Standard Rail
- Preload Code: Z0, ZA, ZB
- Precision Code:
  C, H,P, SP, UP
- No.of rails per axis set [1]
- Dust Protection [2]
- E2: Self-Lubricant
  SE: Metallic End Cap
- RC:Reinforced Cap

Note: 1. The roman numerals express a matched set of rails.
2. No symbol indicates standard protection (end seal and bottom seal).
ZZ : End seal, bottom seal and scraper
KK: Double seals, bottom seal and scraper.
DD: Double seals and bottom seal
3. Block type HGL is the low profile design of HGH (square type), the assembled height is same as HGW (flange type) in same size.

(2) Interchangeable type

○ Model Number of HG Block

HG W 25 C A E ZA P + ZZ/E2

- HG Series
- Block Type
  - W : Flange Type
  - H : Square Type
  - L : Square Type[3]
- Model size
  - 15, 20, 25, 30, 35, 45, 55, 65
- Load Type
  - C : Heavy Load
  - H : Super Heavy Load
- Block Mounting Type
  - A : Mounting From Top
  - B : Bottom, C : Top or Bottom
- E: Special Block
  None: Standard Block
- Preload Code : Z0, ZA
- Precision Code : C, H,P
- Dust Protection [2]
- E2: Self-Lubricant
  SE: Metallic End Cap

○ Model Number of HG Rail

HG R 25 R 1200 E P + RC

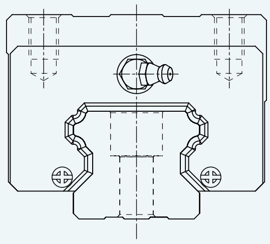
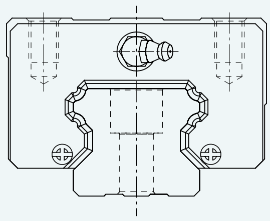
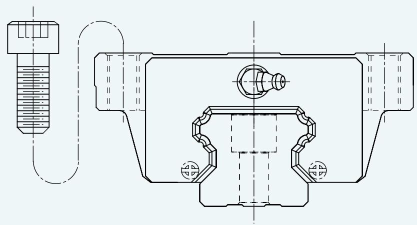
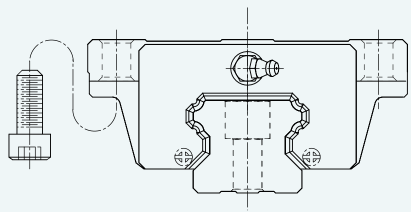
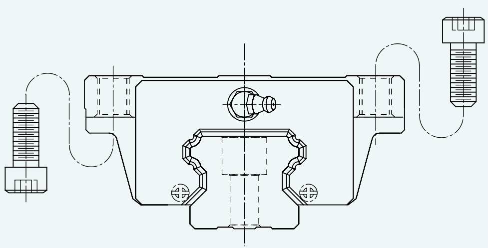
- HG Series
- Interchangeable Rail
- Model size
  - 15, 20, 25, 30, 35, 45, 55, 65
- Rail Mounting Type
  - R : Mounting From Top
  - T : Bottom
- Rail Length (mm)
- E: Special Rail,
  None: Standard Rail
- Precision Code : C, H,P
- RC:Reinforced Cap

2-1-4 Types

(1) Block types

There're two types of blocks:flange and square. The flange type is suitable for heavy moment load application because of the lower assembly height and wider mounting surface.

Table 2-1-1 **Block Types**

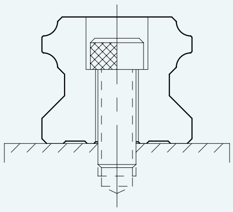
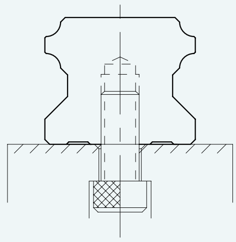
Type	Model	Shape	Height (mm)	Rail Length (mm)	Main Application
Square	HGH-CA HGH-HA		28 ↓ 90	100 ↓ 4000	Machine Centers NC Lathes Grinding Machines Precision Machining Machines Heavy Cutting Machines Automation Devices Transportation Equipment Measuring Equipment Devices Requiring High Positional Accuracy
Square	HGL-CA HGL-HA		24 ↓ 70	100 ↓ 4000	
Flange	HGW-CA HGW-HA		24 ↓ 90	100 ↓ 4000	
Flange	HGW-CB HGW-HB		24 ↓ 90	100 ↓ 4000	
Flange	HGW-CC HGW-HC		24 ↓ 90	100 ↓ 4000	

*Please refer to the chapter 2-1-13 for the dimensional detail.

(2) Rail types

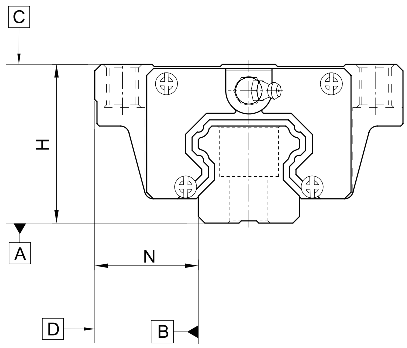
Besides the standard top mounting type, the bottom mounting type is also available.

Table 2-1-2 **Rail Types**

Mounting from Top	Mounting from bottom
	

2-1-5 Accuracy Classes

The accuracy of HG series can be classified into normal (C), high (H), precision (P), super precision (SP), ultra precision (UP), five classes. Please choose the class by referring the accuracy of applied equipment.



(1) Accuracy of non-interchangeable guideways

Table 2-1-3 **Accuracy Standards**

Unit: mm

Item	HG - 15, 20				
Accuracy Classes	Normal (C)	High (H)	Precision (P)	Super Precision (SP)	Ultra Precision (UP)
Dimensional tolerance of height H	± 0.1	± 0.03	0 - 0.03	0 - 0.015	0 - 0.008
Dimensional tolerance of width N	± 0.1	± 0.03	0 - 0.03	0 - 0.015	0 - 0.008
Variation of height H	0.02	0.01	0.006	0.004	0.003
Variation of width N	0.02	0.01	0.006	0.004	0.003
Running parallelism of block surface C to surface A	See Table 2-1-11				
Running parallelism of block surface D to surface B	See Table 2-1-11				

Table 2-1-4 **Accuracy Standards**

Unit: mm

Item	HG - 25, 30, 35				
Accuracy Classes	Normal (C)	High (H)	Precision (P)	Super Precision (SP)	Ultra Precision (UP)
Dimensional tolerance of height H	± 0.1	± 0.04	0 - 0.04	0 - 0.02	0 - 0.01
Dimensional tolerance of width N	± 0.1	± 0.04	0 - 0.04	0 - 0.02	0 - 0.01
Variation of height H	0.02	0.015	0.007	0.005	0.003
Variation of width N	0.03	0.015	0.007	0.005	0.003
Running parallelism of block surface C to surface A	See Table 2-1-11				
Running parallelism of block surface D to surface B	See Table 2-1-11				

Table 2-1-5 **Accuracy Standards** Unit: mm

Item	HG - 45, 55				
Accuracy Classes	Normal (C)	High (H)	Precision (P)	Super Precision (SP)	Ultra Precision (UP)
Dimensional tolerance of height H	± 0.1	± 0.05	0 - 0.05	0 - 0.03	0 - 0.02
Dimensional tolerance of width N	± 0.1	± 0.05	0 - 0.05	0 - 0.03	0 - 0.02
Variation of height H	0.03	0.015	0.007	0.005	0.003
Variation of width N	0.03	0.02	0.01	0.007	0.005
Running parallelism of block surface C to surface A	See Table 2-1-11				
Running parallelism of block surface D to surface B	See Table 2-1-11				

Table 2-1-6 **Accuracy Standards** Unit: mm

Item	HG - 65				
Accuracy Classes	Normal (C)	High (H)	Precision (P)	Super Precision (SP)	Ultra Precision (UP)
Dimensional tolerance of height H	± 0.1	± 0.07	0 - 0.07	0 - 0.05	0 - 0.03
Dimensional tolerance of width N	± 0.1	± 0.07	0 - 0.07	0 - 0.05	0 - 0.03
Variation of height H	0.03	0.02	0.01	0.007	0.005
Variation of width N	0.03	0.025	0.015	0.01	0.007
Running parallelism of block surface C to surface A	See Table 2-1-11				
Running parallelism of block surface D to surface B	See Table 2-1-11				

(2) Accuracy of interchangeable guideways

Table 2-1-7 **Accuracy Standards** Unit: mm

Item	HG - 15, 20		
Accuracy Classes	Normal (C)	High (H)	Precision (P)
Dimensional tolerance of height H	± 0.1	± 0.03	± 0.015
Dimensional tolerance of width N	± 0.1	± 0.03	± 0.015
Variation of height H	0.02	0.01	0.006
Variation of width N	0.02	0.01	0.006
Running parallelism of block surface C to surface A	See Table 2-1-11		
Running parallelism of block surface D to surface B	See Table 2-1-11		

Table 2-1-8 **Accuracy Standards** Unit: mm

Item	HG - 25, 30, 35		
Accuracy Classes	Normal (C)	High (H)	Precision (P)
Dimensional tolerance of height H	± 0.1	± 0.04	± 0.02
Dimensional tolerance of width N	± 0.1	± 0.04	± 0.02
Variation of height H	0.02	0.015	0.007
Variation of width N	0.03	0.015	0.007
Running parallelism of block surface C to surface A	See Table 2-1-11		
Running parallelism of block surface D to surface B	See Table 2-1-11		

Table 2-1-9 **Accuracy Standards** Unit: mm

Item	HG - 45, 55		
Accuracy Classes	Normal (C)	High (H)	Precision (P)
Dimensional tolerance of height H	± 0.1	± 0.05	± 0.025
Dimensional tolerance of width N	± 0.1	± 0.05	± 0.025
Variation of height H	0.03	0.015	0.007
Variation of width N	0.03	0.02	0.01
Running parallelism of block surface C to surface A	See Table 2-1-11		
Running parallelism of block surface D to surface B	See Table 2-1-11		

Table 2-1-10 **Accuracy Standards** Unit: mm

Item	HG - 65		
Accuracy Classes	Normal (C)	High (H)	Precision (P)
Dimensional tolerance of height H	± 0.1	± 0.07	± 0.035
Dimensional tolerance of width N	± 0.1	± 0.07	± 0.035
Variation of height H	0.03	0.02	0.01
Variation of width N	0.03	0.025	0.015
Running parallelism of block surface C to surface A	See Table 2-1-11		
Running parallelism of block surface D to surface B	See Table 2-1-11		

(3) Accuracy of running parallelism

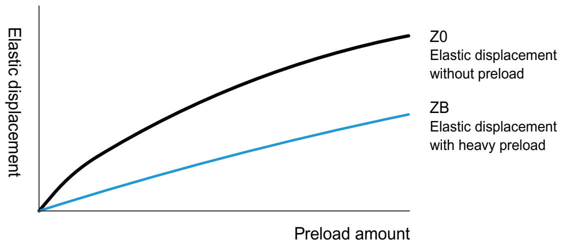
Table 2-1-11 **Accuracy of Running Parallelism**

Rail Length (mm)	Accuracy (μm)				
	C	H	P	SP	UP
~ 100	12	7	3	2	2
100 ~ 200	14	9	4	2	2
200 ~ 300	15	10	5	3	2
300 ~ 500	17	12	6	3	2
500 ~ 700	20	13	7	4	2
700 ~ 900	22	15	8	5	3
900 ~ 1,100	24	16	9	6	3
1,100 ~ 1,500	26	18	11	7	4
1,500 ~ 1,900	28	20	13	8	4
1,900 ~ 2,500	31	22	15	10	5
2,500 ~ 3,100	33	25	18	11	6
3,100 ~ 3,600	36	27	20	14	7
3,600 ~ 4,000	37	28	21	15	7

2-1-6 Preload

(1) Definition

A preload can be applied to each guideway. Oversized balls are used. Generally, a linear motion guideway has a negative clearance between groove and balls in order to improve stiffness and maintain high precision. The figure shows the load is multiplied by the preload, the rigidity is doubled and the deflection is reduced by one half. The preload no larger than ZA would be recommended for the model size under HG20 to avoid an over-preload affecting the guideway's life.



(2) Preload classes

SIMTACH offers three classes of standard preload for various applications and conditions.

Table 2-1-12 **Preload Classes**

Class	Code	Preload	Condition	Examples of Application
Light Preload	Z0	0~ 0.02C	Certain load direction,low impact, low precision required	Transportation devices, auto-packing machines, X-Y axis for general industrial machines, welding machines, welders
Medium Preload	ZA	0.05C~0.07C	High precision required	Machining centers, Z axis for general industrial, machines, EDM, NC lathes,Precision X-Y tables, measuring equipment
Heavy Preload	ZB	0.10C~ 0.12C	High rigidity required, with vibration and impact	Machining centers, grinding machines, NC lathes, horizontal and vertical milling machines, Z axis of machine tools, Heavy cutting machines

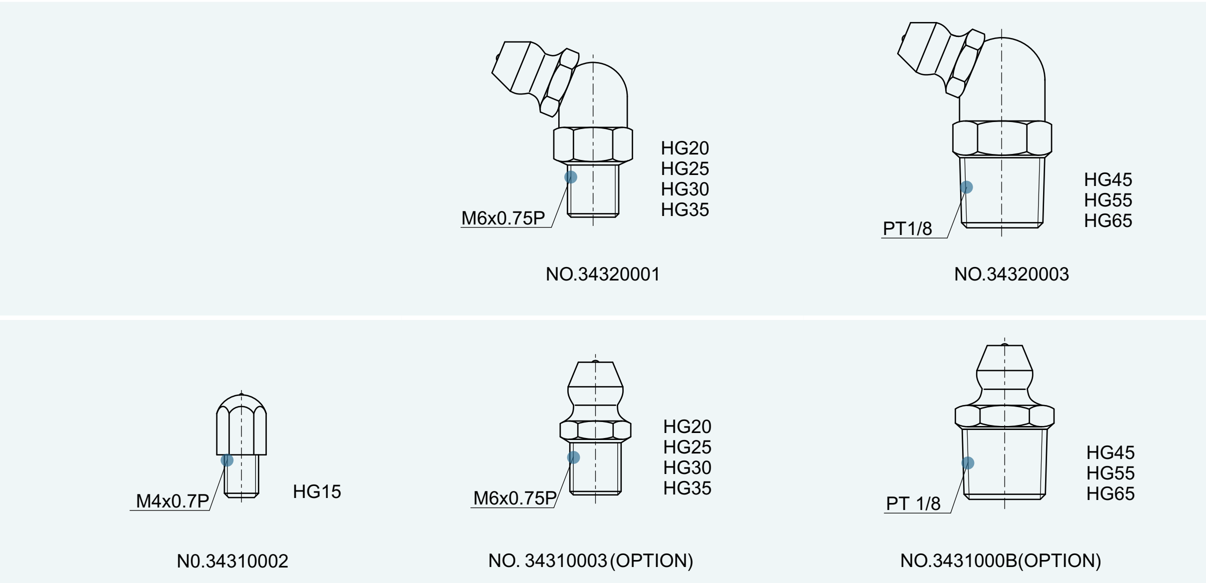
Class	Interchangeable Guideway	Non-Interchangeable Guideway
Preload classes	Z0, ZA	Z0, ZA, ZB

Note: The "C" in the preload column denotes basic dynamic load rating.

2-1-7 Lubrication

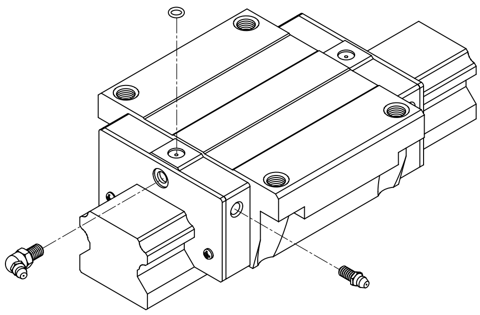
(1) Grease

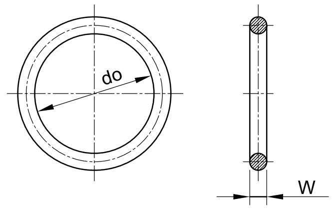
- Grease nipple



Mounting location

The standard location of the grease fitting 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.

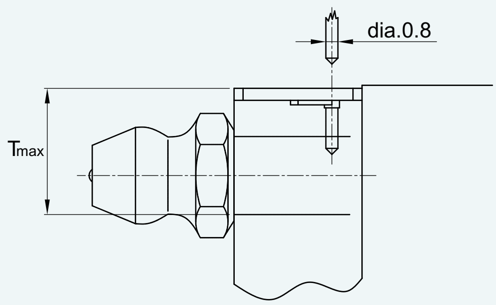




O Ring

Table 2-1-13 **O-Ring size and max. permissible depth for piercing**

Size	O-Ring		Lube hole at top: max. permissible depth for piercing
	do (mm)	W (mm)	T_{max} (mm)
HG15	2.5±0.15	1.5±0.15	3.75
HG20	4.5±0.15	1.5±0.15	5.7
HG25	4.5±0.15	1.5±0.15	5.8
HG30	4.5±0.15	1.5±0.15	6.3
HG35	4.5±0.15	1.5±0.15	8.8
HG45	4.5±0.15	1.5±0.15	8.2
HG55	4.5±0.15	1.5±0.15	11.8
HG65	4.5±0.15	1.5±0.15	10.8



The lubricant amount for a block filled with grease

Table 2-1-14 **The lubricant Amount for a Block Filled with Grease**

Size	Heavy load (cm³)	Super heavy load (cm³)	Size	Heavy load (cm³)	Super heavy load (cm³)
HG15	1	-	HG35	10	12
HG20	2	3	HG45	17	21
HG25	5	6	HG55	26	33
HG30	7	8	HG65	50	61

Frequency of replenishment

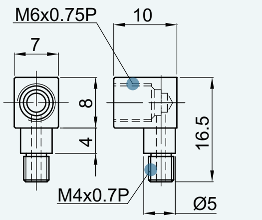
Check the grease every 100 km, or every 3-6 months.

(2) Oil

The recommended viscosity of oil is about 30~150c St. If customers need to use oil-type lubrication, please inform us.

Types of oil piping joint

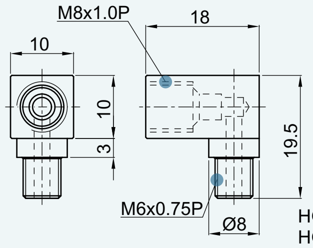
LF-64



HG15

NO.97000EA1

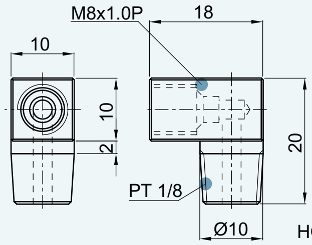
LF-76



HG20
HG25
HG30
HG35

NO.970002A1

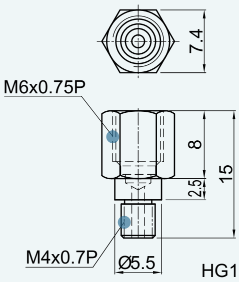
LF-78



HG45
HG55
HG65

NO.970006A1

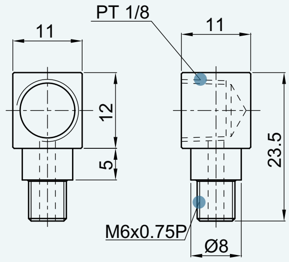
SF-64



HG15

NO.97001TA1

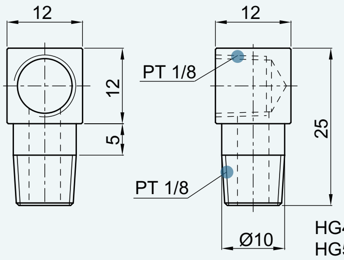
LF-86



HG20
HG25
HG30
HG35

NO.970004A1

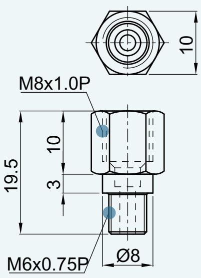
LF-88



HG45
HG55
HG65

NO.970008A1

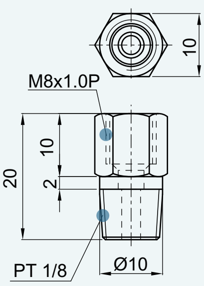
SF-76



HG20
HG25
HG30
HG35

NO.970001A1

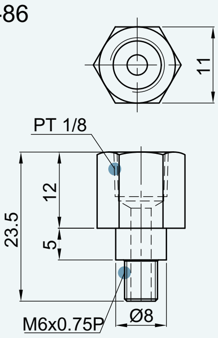
SF-78



HG45
HG55
HG65

NO.970005A1

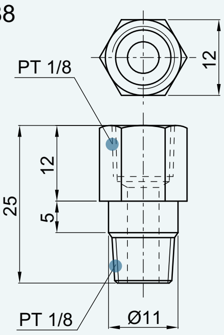
SF-86



HG20
HG25
HG30
HG35

NO.970003A1

SF-88



HG45
HG55
HG65

NO.970007A1

Oil refilling rate

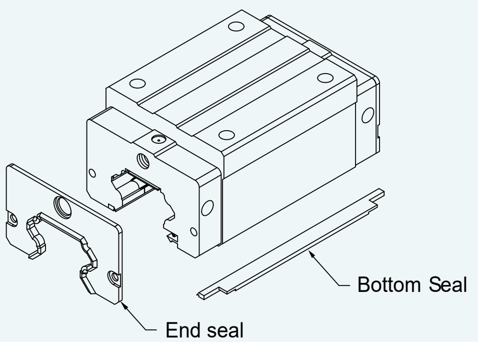
Table 2-1-15

Size	Refilling rate (cm³/hr)	Size	Refilling rate (cm³/hr)
HG15	0.2	HG35	0.3
HG20	0.2	HG45	0.4
HG25	0.3	HG55	0.5
HG30	0.3	HG65	0.6

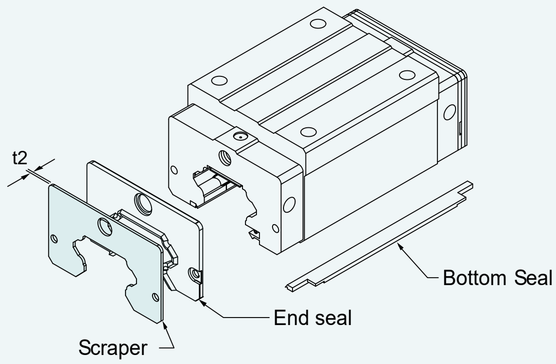
2-1-8 Dust Proof Accessories

(1) Codes of standard dust proof accessories

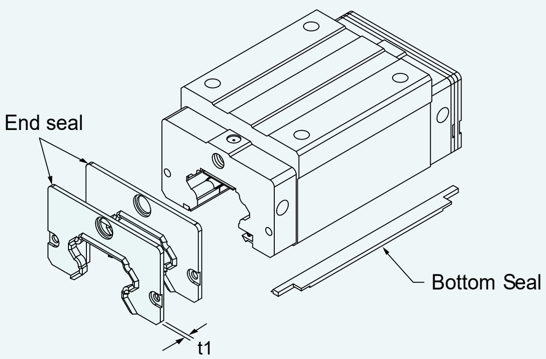
If the following accessories are needed, please add the code followed by the model number.



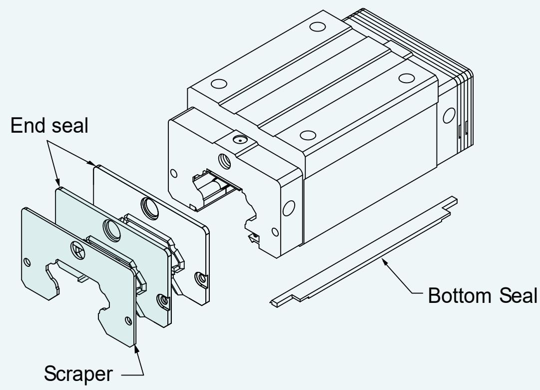
No symbol: Standard Protection (End seal + Bottom Seal)



ZZ (End seal + BottomSeal + Scraper)



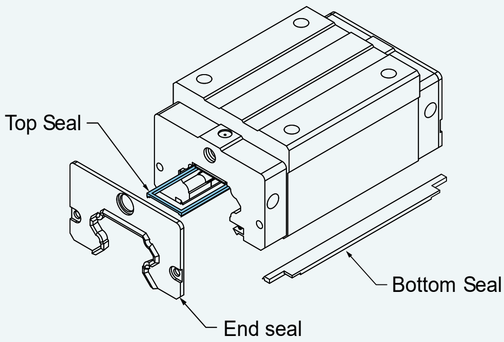
DD (Double seals + BottomSeal)



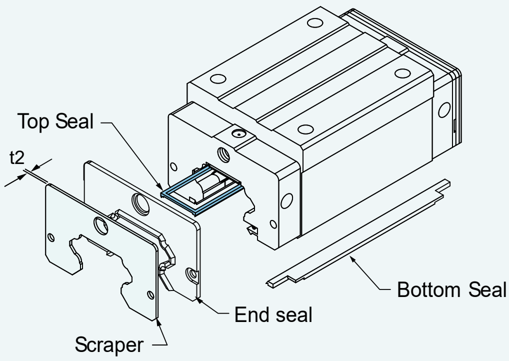
KK (Double seals + BottomSeal + Scraper)

(2) Codes of high-dust proof accessories

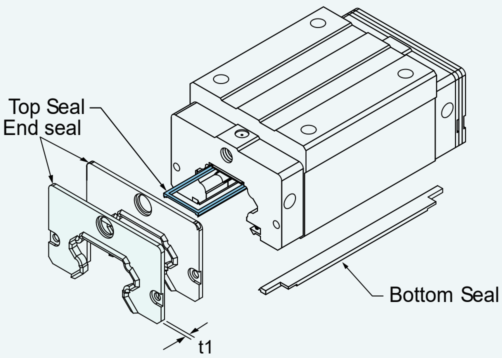
SIMTACH develops many kinds of dust proof accessories for different application and working environment to avoid dust or debris. If the following accessories are needed, please add the code followed by the model number.



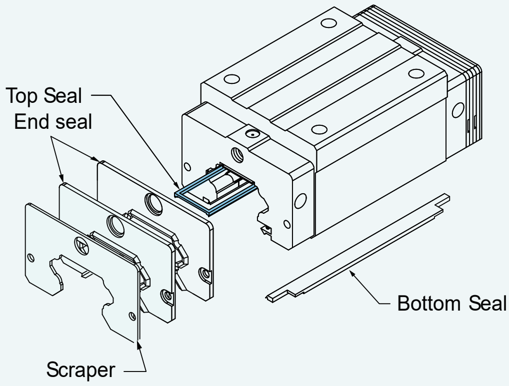
SH{End Seal (High-Dust Proof)
+ Bottom Seal (High Dust Proof) + Top Seal}



ZH{End Seal (High-Dust Proof)
+Bottom Seal (High Dust Proof) + Top Seal + Scraper}



DH{Double End Seal (High Dust Proof)
+Bottom Seal (High Dust Proof) + Top Seal}

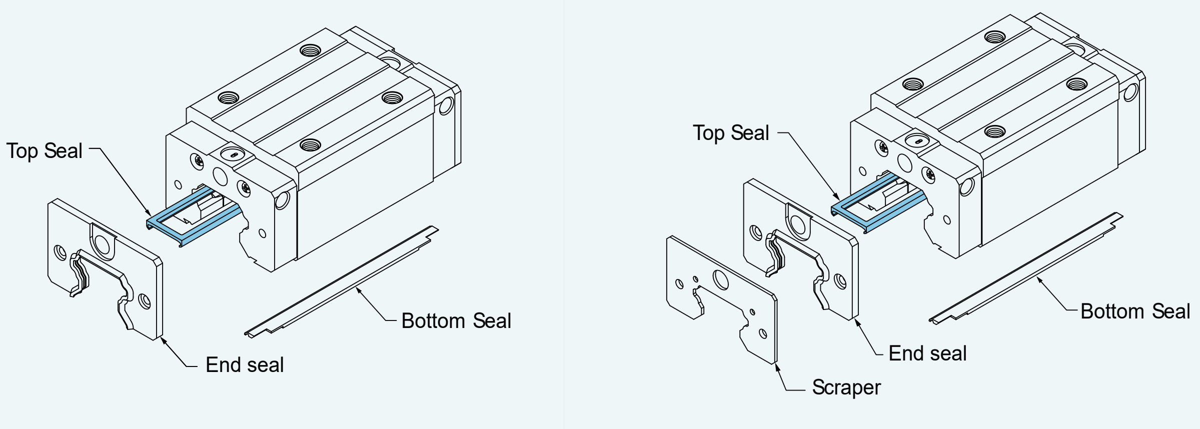


KH {Double End Seal (High Dust Proof)
+ Bottom Seal (High Dust Proof) +Top Seal +Scraper}

Note: 1. The available size for high dust proof accessories are HG20(C/H), 25(C/H), 30(C/H), 35(C/H) and 45C.
2. The value of fricton force will increase 0.6~1.2 kgf.

(3) Codes of ultra-high dust proof accessories

SIMTACH has developed high dust proof accessories which is used for environment that is full of dust and particle, such as wood working machinery and glass/stone machining equipment. These accessories show high performance of dust proof. If accessories are needed, please add the code followed by the model number.



SW (End Seal(Ultra-high dustproof) +Bottom Seal(Ultra-high dustproof) +Top Seal)

ZW (End Seal(Ultra-high dustproof) +Bottom Seal(Ultra-high dustproof) +Top Seal+Scraper)

Note : 1. The available size for high dust proof accessories are HG15C, HG20(C/H), HG30(C/H), HG35(C/H), HG45(C/H).
2. The value of fricton force will increase 1.5~4.0 kgf.

(4) Fuction of dust proof accessories

End seal and bottom seal

To prevent life reduction caused by iron chips or dust entering the block.

Double seals

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

Table 2-1-16 **Dimensions of end seal**

Size	Thickness (t1) (mm)	Size	Thickness (t1) (mm)
HG15 ES	3	HG35 ES	3.2
HG20 ES	3.5	HG45 ES	4.5
HG25 ES	3.5	HG55 ES	4.5
HG30 ES	3.2	HG65 ES	6

Scraper

The scraper removes high-temperature iron chips and larger foreign objects.

Table 2-1-17 **Dimensions of scraper**

Size	Thickness (t2) (mm)	Size	Thickness (t2) (mm)
HG15 SC	1.5	HG35 SC	1.5
HG20 SC	1.5	HG45 SC	1.5
HG25 SC	1.5	HG55 SC	1.5
HG30 SC	1.5	HG65 SC	1.5

Top Seal

Top seal can efficiently avoid dust from the surface of rail or tapping hole getting inside the block.

Bolt caps for rail mounting holes

Caps are used to cover the mounting holes to prevent chips or other foreign objects from collecting in the holes. The caps will be enclosed in each rail package.

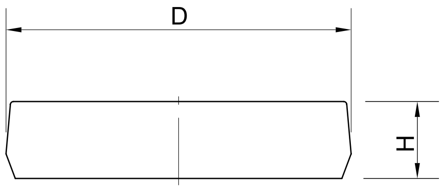
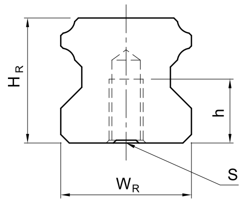
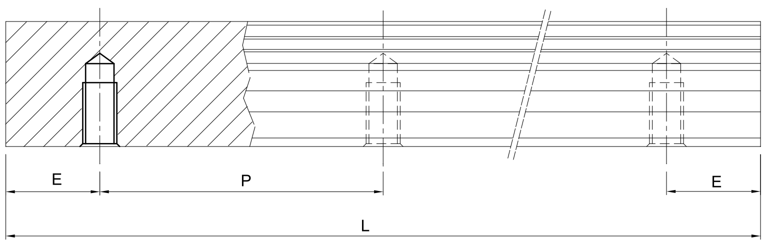


Table 2-1-18 **Dimensions of Bolt Caps for Rail Mounting Holes**

Rail size	Bolt size	Diameter(D) (mm)	Thickness(H) (mm)	Rail size	Bolt size	Diameter(D) (mm)	Thickness(H) (mm)
HGR15	M4	7.65	1.1	HGR35	M8	14.20	3.5
HGR20	M5	9.65	2.5	HGR45	M12	20.25	4.5
HGR25	M6	11.15	2.5	HGR55	M14	23.25	5.0
HGR30	M8	14.20	3.5	HGR65	M16	26.35	5.0

(5) Dimesions for HGR-T (Rail Mounting from Bottom)





Model No.	Dimensions of Rail (mm)						Weight
	W_R	H_R	S	h	P	E	(kg/m)
HGR15T	15	15	M5 x 0.8P	8	60	20	1.48
HGR20T	20	17.5	M6 x 1P	10	60	20	2.29
HGR25T	23	22	M6 x 1P	12	60	20	3.35
HGR30T	28	26	M8 x 1.25P	15	80	20	4.67
HGR35T	34	29	M8x1.25P	17	80	20	6.51
HGR45T	45	38	M12 x 1.75P	24	105	22.5	10.87
HGR55T	53	44	M14 x 2P	24	120	30	15.67
HGR65T	63	53	M20 x 2.5P	30	150	35	21.73

2-1-9 Friction

The maximum value of resistance per end seal are as shown in the table.

Table 2-1-20 **Seal Resistance**

Size	Resistance N (kgf)	Size	Resistance N (kgf)
HG15	1.18 (0.12)	HG35	3.04 (0.31)
HG20	1.57 (0.16)	HG45	3.83 (0.39)
HG25	1.96 (0.2)	HG55	4.61 (0.47)
HG30	2.65 (0.27)	HG65	5.79 (0.59)

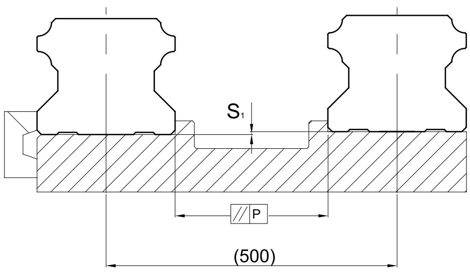
Note:1kgf=9.81N

2-1-10 The Accuracy Tole rance of Mounting Surface

(1) The accuracy tolerance of rail-mounting surface

Because of the Circular-arc contact design, the HG linear guideway can compensate for some surface-error on installation and still maintain smooth linear motion.

As long as the accuracy requirements for the mounting surface are followed, high accuracy and rigidity of linear motion of the guideway can be obtained without any difficulty. In order to satisfy the needs of fast installation and smooth movement, SIMTACH offers the normal clearance type of preload to customers of its high absorption ability of the deviation in mounting surface accuracy.



(2) The parallelism tolerance of reference surface (P)

Table 2-1-21 **Max. Parallelism Tolerance (P)**

unit: μm

Size	Preload classes		
	Z0	ZA	ZB
HG15	25	18	13
HG20	25	20	18
HG25	30	22	20
HG30	40	30	27
HG35	50	35	30
HG45	60	40	35
HG55	70	50	45
HG65	80	60	55

(3) The accuracy tolerance of reference surface height

Table 2-1-22 **Max. Tolerance of Reference Surface Height (S_1)**

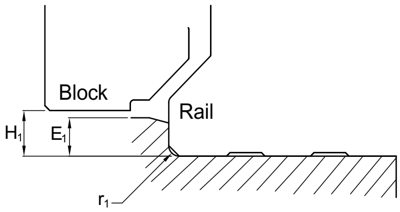
unit: μm

Size	Preload classes		
	Z0	ZA	ZB
HG15	130	85	35
HG20	130	85	50
HG25	130	85	70
HG30	170	110	90
HG35	210	150	120
HG45	250	170	140
HG55	300	210	170
HG65	350	250	200

2-1-11 Cautions for Installation

(1) Shoulder heights and fillets

Improper shoulder heights and fillets of mounting surfaces will cause a deviation in accuracy and the interference with the chamfered part of the rail or block. As long as the recommended shoulder heights and fillets are followed, installation inaccuracies should be eliminated.



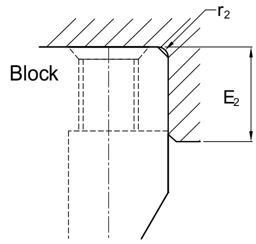


Table 2-1-23 **Shoulder Heights and Fillets**

Size	Max. radius of fillets r_1 (mm)	Max. radius of fillets r_2 (mm)	Shoulder height of the rail E_1 (mm)	Shoulder height of the block E_2 (mm)	Clearance under block H_1 (mm)
HG15	0.5	0.5	3	4	4.3
HG20	0.5	0.5	3.5	5	4.6
HG25	1.0	1	5	5	5.5
HG30	1.0	1	5	5	6
HG35	1.0	1	6	6	7.5
HG45	1.0	1	8	8	9.5
HG55	1.5	1.5	10	10	13
HG65	1.5	1.5	10	10	15

(2) Tightening To rque of Bolts for Installation

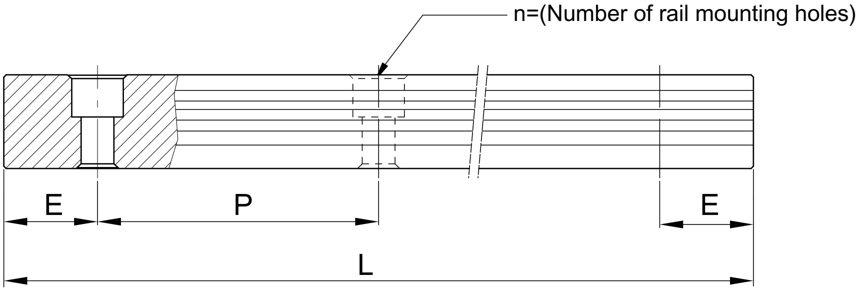
Improper tightening of bolts will seriously influence the accuracy of Linear Guideway installation. The following tightening torques for different sizes of bolts are recommended.

Table 2-1-24 **Mounting Torque**

Size	Bolt size	Torque N-cm (kgf-cm)		
		Iron	Casting	Aluminum
HG15	M4×0.7P×16L	392 (40)	274 (28)	206 (21)
HG20	M5×0.8P×16L	883 (90)	588 (60)	441 (45)
HG25	M6×1P×20L	1373 (140)	921 (94)	686 (70)
HG30	M8×1.25P×25L	3041 (310)	2010 (205)	1470 (150)
HG35	M8×1.25P×25L	3041 (310)	2010 (205)	1470 (150)
HG45	M12×1.75P×35L	11772 (1200)	7840 (800)	5880 (600)
HG55	M14×2P×45L	15696 (1600)	10500 (1100)	7840 (800)
HG65	M16×2P×50L	19620 (2000)	13100 (1350)	9800 (1000)

2-1-12 Standard and Maximum Lengths of Rail

SIMTACH offers standard rail lengths for customer needs. For non-standard E-values, the recommended dimension should no greater than 1/2 of the pitch (P) dimension. This will prevent an unstable rail end.



$$L = (n-1) \times P + 2 \times E \quad \text{Eq.2.1}$$

L : Total length of rail (mm)
n : Number of mounting holes
P : Distance between any two holes (mm)
E : Distance from the center of the last hole to the edge (mm)

Table 2-1-25 **Rail Standard Length and Max. Length**

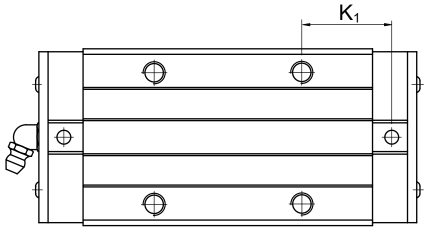
unit: mm

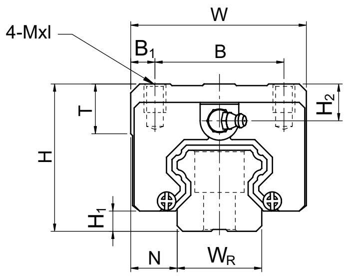
Item	HG15	HG20	HG25	HG30	HG35	HG45	HG55	HG65
Standard Length L(n)	160 (3)	220 (4)	220 (4)	280 (4)	280 (4)	570 (6)	780 (7)	1,270 (9)
	220 (4)	280 (5)	280 (5)	440 (6)	440 (6)	885 (9)	1,020 (9)	1,570 (11)
	280 (5)	340 (6)	340 (6)	600 (8)	600 (8)	1,200 (12)	1,260 (11)	2,020 (14)
	340 (6)	460 (8)	460 (8)	760 (10)	760 (10)	1,620 (16)	1,500 (13)	2,620 (18)
	460 (8)	640 (11)	640 (11)	1,000 (13)	1,000 (13)	2,040 (20)	1,980 (17)	
	640 (11)	820 (14)	820 (14)	1,640 (21)	1,640 (21)	2,460 (24)	2,580 (22)	
	820 (14)	1,000 (17)	1,000 (17)	2,040 (26)	2,040 (26)	2,985 (29)	2,940 (25)	
		1,240 (21)	1,240 (21)	2,520 (32)	2,520 (32)			
			1,600 (27)	3,000 (38)	3,000 (38)			
Pitch (P)	60	60	60	80	80	105	120	150
Distance to End $(E)_s$	20	20	20	20	20	22.5	30	35
Max. Standard Length	4,000(67)	4,000 (67)	4,000 (67)	3,960 (50)	3,960 (50)	3,930 (38)	3,900 (33)	3,970 (27)
Max. Length	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000

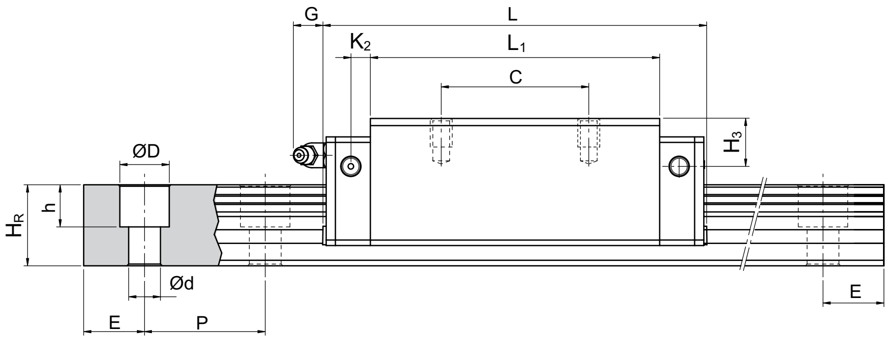
Note : 1. Tolerance of E value for standard rail is 0.5~-0.5 mm. Tolerance of E value for jointed rail is 0~-0.3 mm.
2. Maximum standard length means the max. rail length with standard E value on both sides.
3. If different E value is needed, please contact SIMTACH.

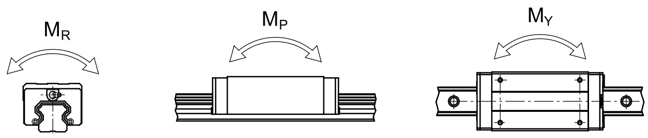
2-1-13 Dimensions for HG Series

(1) HGH-CA / HGH-HA





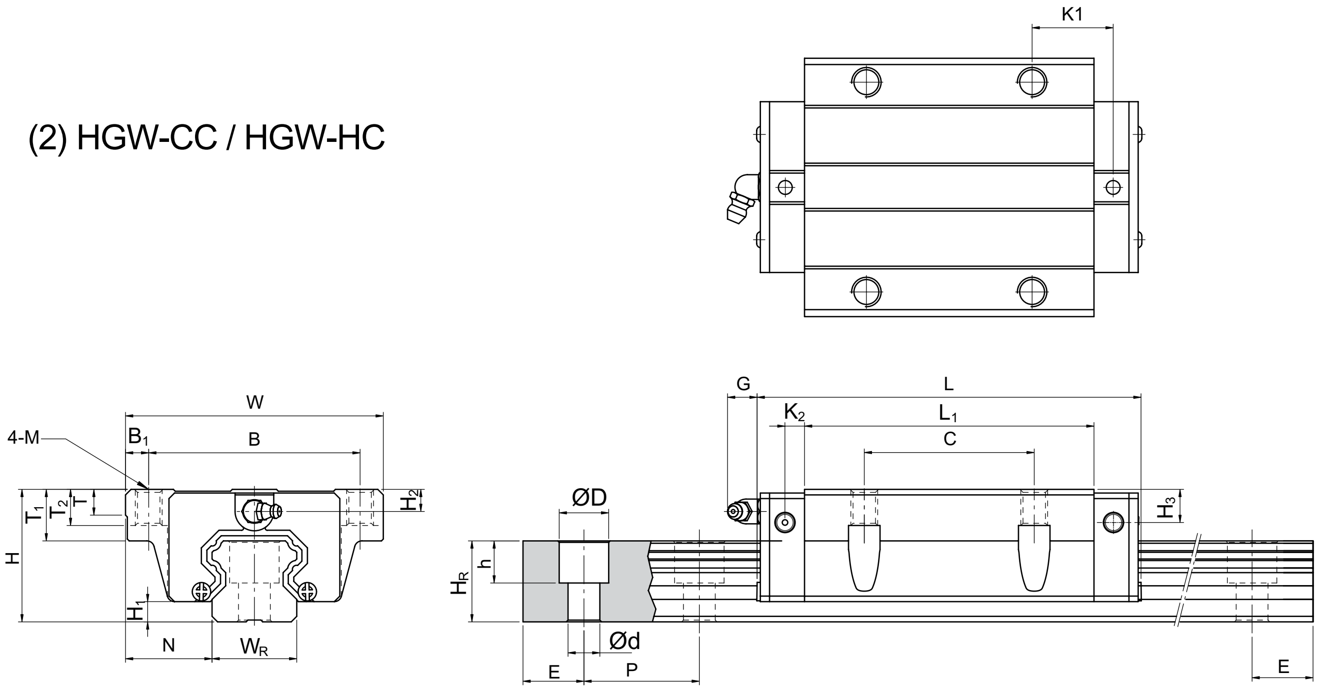


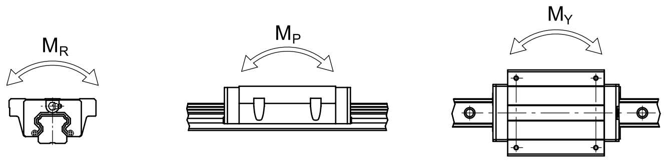


Model No.	Dimensions of Assembly (mm)			Dimensions of Block (mm)													Dimensions of Rail (mm)							Mounting Bolt for Rail	Basic Dynamic Load Rating	Basic Static Load Rating	Static Rated Moment			Weight	
	H	H_1	N	W	B	B_1	C	L_1	L	K_1	K_2	G	MxI	T	H_2	H_3	W_R	H_R	D	h	d	P	E	(mm)	C(kN)	C_0 (kN)	M_R kN-m	M_P kN-m	M_Y kN-m	Block kg	Rail kg/m
HGH15CA	28	4.3	9.5	34	26	4	26	39.4	61.4	10	4.85	5.3	M4x5	6	7.95	7.7	15	15	7.5	5.3	4.5	60	20	M4x16	14.7	23.47	0.12	0.10	0.10	0.18	1.45
HGH20CA	30	4.6	12	44	32	6	36	50.5	77.5	12.25	6	12	M5x6	8	6	6	20	17.5	9.5	8.5	6	60	20	M5x16	27.1	36.68	0.27	0.20	0.20	0.30	2.21
HGH20HA							50	65.2	92.2	12.6															32.7	47.96	0.35	0.35	0.35	0.39	
HGH25CA	40	5.5	12.5	48	35	6.5	35	58	84	15.7	6	12	M6x8	8	10	9	23	22	11	9	7	60	20	M6x20	34.9	52.82	0.42	0.33	0.33	0.51	3.21
HGH25HA							50	78.6	104.6	18.5															42.2	69.07	0.56	0.57	0.57	0.69	
HGH30CA	45	6	16	60	40	10	40	70	97.4	20.25	6	12	M8x10	8.5	9.5	13.8	28	26	14	12	9	80	20	M8x25	48.5	71.87	0.66	0.53	0.53	0.88	4.47
HGH30HA							60	93	120.4	21.75															58.6	93.99	0.88	0.92	0.92	1.16	
HGH35CA	55	7.5	18	70	50	10	50	80	112.4	20.6	7	12	M8x12	10.2	16	19.6	34	29	14	12	9	80	20	M8x25	64.6	93.88	1.16	0.81	0.81	1.45	6.30
HGH35HA							72	105.8	138.2	22.5															77.9	122.77	1.54	1.40	1.40	1.92	
HGH45CA	70	9.5	20.5	86	60	13	60	97	139.4	23	10	12.9	M10x17	16	18.5	30.5	45	38	20	17	14	105	22.5	M12x35	103.8	146.71	1.98	1.55	1.55	2.73	10.41
HGH45HA							80	128.8	171.2	28.9															125.3	191.85	2.63	2.68	2.68	3.61	
HGH55CA	80	13	23.5	100	75	12.5	75	117.7	166.7	27.35	11	12.9	M12x18	17.5	22	29	53	44	23	20	16	120	30	M14x45	153.2	211.23	3.69	2.64	2.64	4.17	15.08
HGH55HA							95	155.8	204.8	36.4															184.9	276.23	4.88	4.57	4.57	5.49	
HGH65CA	90	15	31.5	126	76	25	70	144.2	200.2	43.1	14	12.9	M16x20	25	15	15	63	53	26	22	18	150	35	M16x50	213.2	287.48	6.65	4.27	4.27	7.00	21.18
HGH65HA							120	203.6	259.6	47.8															277.8	420.17	9.38	7.38	7.38	9.82	

Note : 1 kgf = 9.81 N

(2) HGW-CC / HGW-HC

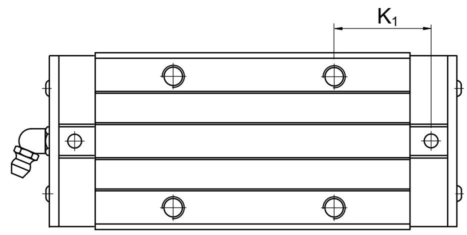


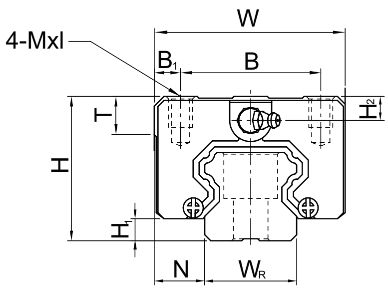


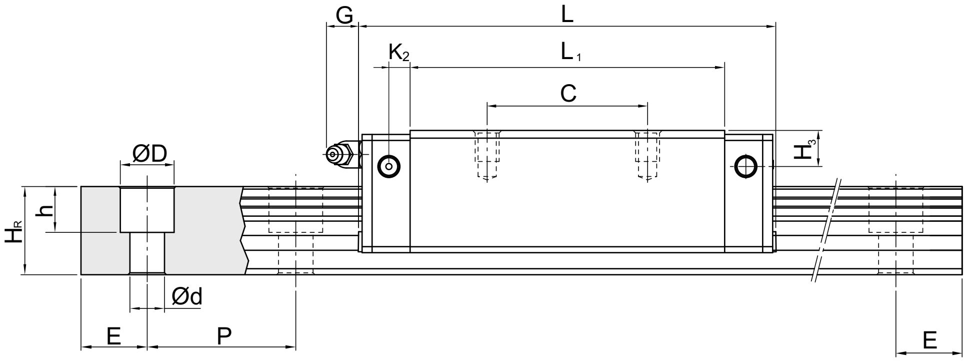
Model No.	Dimensions of Assembly (mm)			Dimensions of Block (mm)																Dimensions of Rail (mm)							Mounting Bolt for Rail	Basic Dynamic Load Rating	Basic Static Load Rating	Static Rated Moment			Weight	
																														M_R	M_P	M_Y	Block	Rail
	H	H_1	N	W	B	B_1	C	L_1	L	K_1	K_2	G	M	T	T_1	T_2	H_2	H_3	W_R	H_R	D	h	d	P	E	(mm)	C(kN)	C_0 (kN)	kN-m	kN-m	kN-m	kg	kg/m
HGW15CC	24	4.3	16	47	38	4.5	30	39.4	61.4	8	4.85	5.3	M5	6	8.9	6.95	3.95	3.7	15	15	7.5	5.3	4.5	60	20	M4x16	14.7	23.47	0.12	0.10	0.10	0.17	1.45
HGW20CC	30	4.6	21.5	63	53	5	40	50.5	77.5	10.25	6	12	M6	8	10	9.5	6	6	20	17.5	9.5	8.5	6	60	20	M5x16	27.1	36.68	0.27	0.20	0.20	0.40	2.21
HGW20HC								65.2	92.2	17.6																	32.7	47.96	0.35	0.35	0.35	0.52	
HGW25CC	36	5.5	23.5	70	57	6.5	45	58	84	10.7	6	12	M8	8	14	10	6	5	23	22	11	9	7	60	20	M6x20	34.9	52.82	0.42	0.33	0.33	0.59	3.21
HGW25HC								78.6	104.6	21																	42.2	69.07	0.56	0.57	0.57	0.80	
HGW30CC	42	6	31	90	72	9	52	70	97.4	14.25	6	12	M10	8.5	16	10	6.5	10.8	28	26	14	12	9	80	20	M8x25	48.5	71.87	0.66	0.53	0.53	1.09	4.47
HGW30HC								93	120.4	25.75																	58.6	93.99	0.88	0.92	0.92	1.44	
HGW35CC	48	7.5	33	100	82	9	62	80	112.4	14.6	7	12	M10	10.1	18	13	9	12.6	34	29	14	12	9	80	20	M8x25	64.6	93.88	1.16	0.81	0.81	1.56	6.30
HGW35HC								105.8	138.2	27.5																	77.9	122.77	1.54	1.40	1.40	2.06	
HGW45CC	60	9.5	37.5	120	100	10	80	97	139.4	13	10	12.9	M12	15.1	22	15	8.5	20.5	45	38	20	17	14	105	22.5	M12x35	103.8	146.71	1.98	1.55	1.55	2.79	10.41
HGW45HC								128.8	171.2	28.9																	125.3	191.85	2.63	2.68	2.68	3.69	
HGW55CC	70	13	43.5	140	116	12	95	117.7	166.7	17.35	11	12.9	M14	17.5	26.5	17	12	19	53	44	23	20	16	120	30	M14x45	153.2	211.23	3.69	2.64	2.64	4.52	15.08
HGW55HC								155.8	204.8	36.4																	184.9	276.23	4.88	4.57	4.57	5.96	
HGW65CC	90	15	53.5	170	142	14	110	144.2	200.2	23.1	14	12.9	M16	25	37.5	23	15	15	63	53	26	22	18	150	35	M16x50	213.2	287.48	6.65	4.27	4.27	9.17	21.18
HGW65HC								203.6	259.6	52.8																	277.8	420.17	9.38	7.38	7.38	12.89	

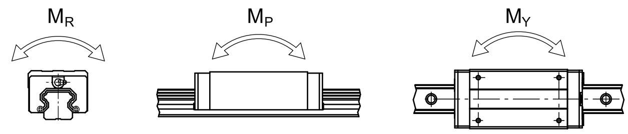
Note : 1 kgf = 9.81 N

(3) HGL-CA / HGL-HA









Model No.	Dimensions of Assembly (mm)			Dimensions of Block (mm)												Dimensions of Rail (mm)							Mounting Bolt for Rail	Basic Dynamic Load Rating	Basic Static Load Rating	Static Rated Moment			Weight	
																										M_R	M_P	M_Y	Block	Rail
	H	H_1	N	W	B	B_1	C	L_1	L	K_1	K_2	G	Mxl	T	H_2	H_3	W_R	H_R	D	h	d	P	E	(mm)	C(kN)	C_0 (kN)	kN-m	kN-m	kN-m	kg	kg/m
HGL15CA	24	4.3	9.5	34	26	4	26	39.4	61.4	10	4.85	5.3	M4x4	6	3.95	3.7	15	15	7.5	5.3	4.5	60	20	M4x16	14.7	23.47	0.12	0.10	0.10	0.14	1.45
HGL25CA	36	5.5	12.5	48	35	6.5	35	58	84	15.7	6	12	M6x6	8	6	5	23	22	11	9	7	60	20	M6x20	34.9	52.82	0.42	0.33	0.33	0.42	3.21
HGL25HA							50	78.6	104.6	18.5															42.2	69.07	0.56	0.57	0.57	0.57	
HGL30CA	42	6	16	60	40	10	40	70	97.4	20.25	6	12	M8x10	8.5	6.5	10.8	28	26	14	12	9	80	20	M8x25	48.5	71.87	0.66	0.53	0.53	0.78	4.47
HGL30HA							60	93	120.4	21.75															58.6	93.99	0.88	0.92	0.92	1.03	
HGL35CA	48	7.5	18	70	50	10	50	80	112.4	20.6	7	12	M8x12	10.2	9	12.6	34	29	14	12	9	80	20	M8x25	64.6	93.88	1.16	0.81	0.81	1.14	6.30
HGL35HA							72	105.8	138.2	22.5															77.9	122.77	1.54	1.40	1.40	1.52	
HGL45CA	60	9.5	20.5	86	60	13	60	97	139.4	23	10	12.9	M10x17	16	8.5	20.5	45	38	20	17	14	105	22.5	M12x35	103.8	146.71	1.98	1.55	1.55	2.08	10.41
HGL45HA							80	128.8	171.2	28.9															125.3	191.85	2.63	2.68	2.68	2.75	
HGL55CA	70	13	23.5	100	75	12.5	75	117.7	166.7	27.35	11	12.9	M12x18	17.5	12	19	53	44	23	20	16	120	30	M14x45	153.2	211.23	3.69	2.64	2.64	3.25	15.08
HGL55HA							95	155.8	204.8	36.4															184.9	276.23	4.88	4.57	4.57	4.27	

Note : 1 kgf = 9.81 N

EG Series

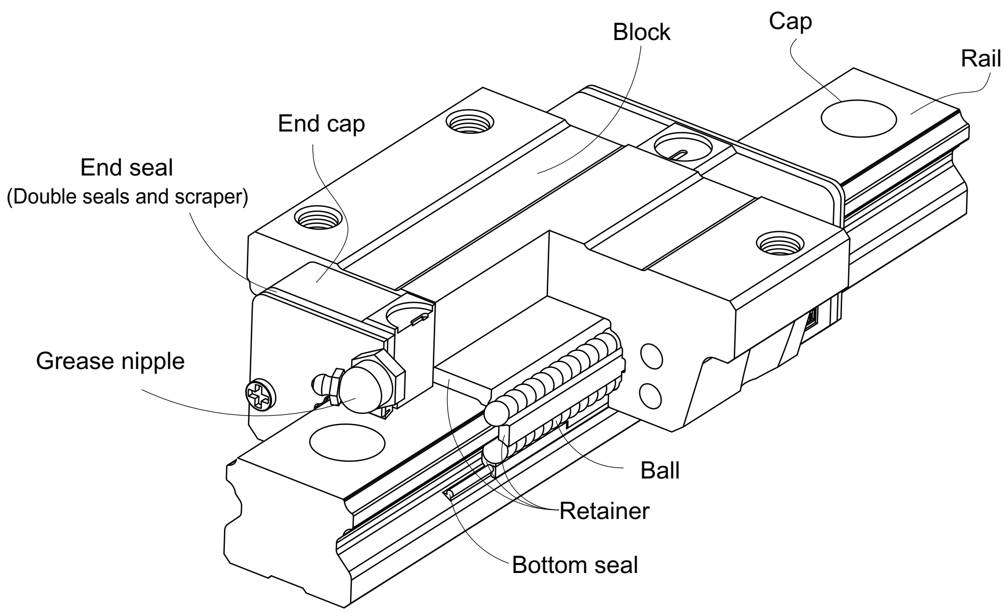
Low Profile Ball Type

2-2 EG Series - Low Profile Ball Type Linear Guideway

2-2-1 Features of the EG Series Linear Guideway

The design of the EG series offers a low profile, high load capacity, and high rigidity. It also features an equal load rating in all four directions and self-aligning capability to absorb installation-error, allowing for higher accuracies. Additionally, the lower assembly height and the shorter length make the EG series more suitable for high-speed, automation machines and applications where space is limited.
The retainer is designed to hold the balls in the block even when it is removed from the rail.

2-2-2 Construction of EG Series



- Rolling circulation system: Block, rail, end cap and retainer
- Lubrication system: Grease nipple and piping Joint
- Dust protection system: End seal, bottom seal, cap and scraper

2-2-3 Model Number of EG Series

EG series linear guideways are classified into non-interchangeable and interchangeable types. The sizes of these two types are the same as one another. The main difference is that the interchangeable type of blocks and rails can be freely exchanged and they can maintain P-class accuracy. Because of strict dimensional control, the interchangeable type linear guideways are a wise choice for customers when rails do not need to be matched for an axis. The model number of the EG series identifies the size, type, accuracy class, preload class, etc.

(1) Non-interchangeable type

EG	W	25	C	A	E	2	R	1600	E	ZA	P	II	+	KK/E2/RC

- EGSeries
- Block Type
  W : Flange Type
  H : Square Type
- Model size
  15, 20, 25, 30, 35
- Load Type
  C : Heavy Load
  S: Medium Load
- Block Mounting Type
  A : Mounting from Top
  B : Bottom
- E: Special Block
  None: Standard Block
- No. of Blocks per Rail
- Rail Mounting Type
  R/U: Mounting From Top
  T : Bottom
- Rail Length (mm)
- E: Special Rail
  None: Standard rail
- Preload Code: Z0, ZA, ZB
- Precision Code:
  C, H,P, SP, UP
- No.of Rails per Axis set[1]
- Dust Protection[2]
- E2: Self-Lubrication
  SE: Metallic End Cap
- RC:Reinforced Cap

Note: 1. The roman numerals are used to express the number of matched rails used in one axis. When a single rail is used in an axis, no symbol is indicated.
2. No symbol indicates standard protection (end seal and bottom seal).
ZZ : End seal, bottom seal and scraper
KK: Double seals, bottom seal and scraper.
DD: Double seals and bottom seal

(2) Interchangeable type

- Model Number of EG Block

EG	W	25	C	A	E	ZA	P	+	ZZ/E2

- EGSeries
- Block Type
  W : Flange Type
  H : Square Type
- Model size
  15, 20, 25, 30, 35
- Load Type
  C : Heavy Load
  S: Medium Load
- Block Mounting Type
  A : Mounting From Top
  B : Bottom
- E: Special Block
  None: Standard block
- Preload Code : Z0, ZA
- Precision Code : C, H,P
- Dust Protection[2]
- E2: Self-Lubricant
  SE: Metallic End Cap

- Model Number of EG Rail

EG	R	25	R	1240	E	P	+	RC

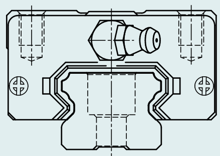
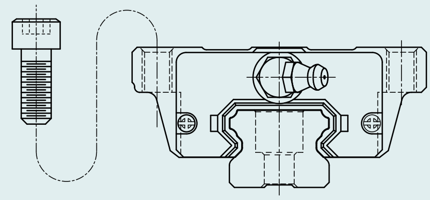
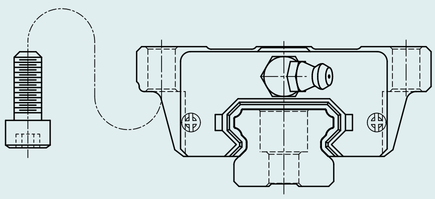
- EGSeries
- Interchangeable Rail
- Model size
  15, 20, 25, 30, 35
- Rail Mounting Type
  R/U : Mounting From Top
  T : Bottom
- Rail Length (mm)
- E: Special Rail,
  None: Standard Rail
- Precision Code : C, H,P
- RC:Reinforced Cap

2-2-4 Types

(1) Block types

SIMTACH offers two types of linear guideways, flange and square types.

Table 2-2-1 **Block Types**

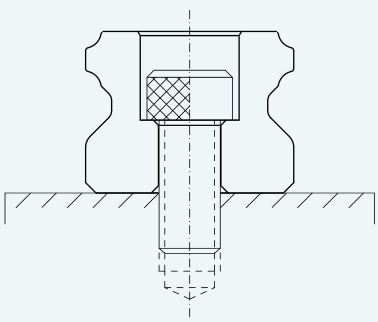
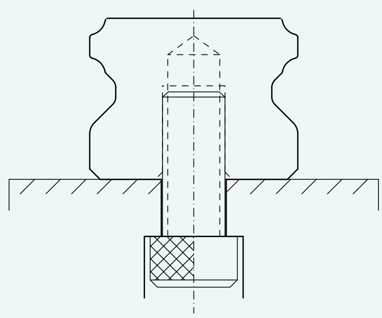
Type	Model	Shape	Height (mm)	Rail Length (mm)	Main Applications
Square	QEH-SA QEH-CA		24 ↓ 48	100 ↓ 4000	○ Automation devices ○ High-speed transportation equipment ○ Precision measuring equipment ○ Semiconductor manufacturing equipment
Flange	QEW-SA QEW-CA		24 ↓ 48	100 ↓ 4000	
	QEW-SB QEW-CB		24 ↓ 48	100 ↓ 4000	

*Please refer to the chapter 2-2-13 for the dimensional detail.

(2) Rail types

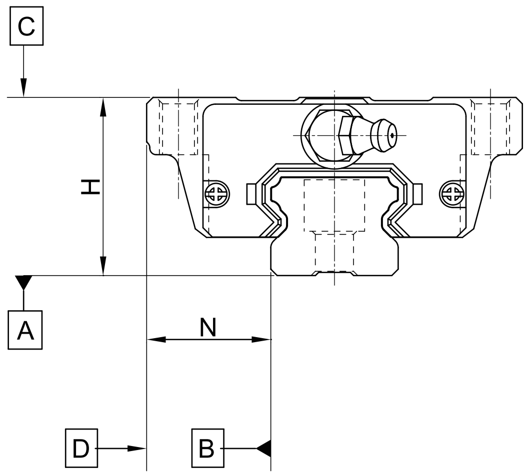
Besides the standard top mounting type, SIMTACH also offers bottom mounting type rails.

Table 2-2-2 **Rail Types**

Mounting from Top	Mounting from Bottom
	

2-2-5 Accuracy

The accuracy of the EG series can be classified into 5 classes: normal(C), high(H), precision(P), super precision(SP), and ultra precision(UP). Choose the class by referencing the accuracy of selected equipment.



(1) Accuracy of non-interchangeable guideways

Table 2-2-3 **Accuracy Standards** Unit: mm

Item	EG - 15, 20				
Accuracy Classes	Normal (C)	High (H)	Precision (P)	Super Precision (SP)	Ultra Precision (UP)
Dimensional tolerance of height H	± 0.1	± 0.03	0 - 0.03	0 - 0.015	0 - 0.008
Dimensional tolerance of width N	± 0.1	± 0.03	0 - 0.03	0 - 0.015	0 - 0.008
Variation of height H	0.02	0.01	0.006	0.004	0.003
Variation of width N	0.02	0.01	0.006	0.004	0.003
Running parallelism of block surface C to surface A	See Table 2-2-7				
Running parallelism of block surface D to surface B	See Table 2-2-7				

Table 2-2-4 **Accuracy Standards** Unit: mm

Item	EG - 25, 30, 35				
Accuracy Classes	Normal (C)	High (H)	Precision (P)	Super Precision (SP)	Ultra Precision (UP)
Dimensional tolerance of height H	± 0.1	± 0.04	0 - 0.04	0 - 0.02	0 - 0.01
Dimensional tolerance of width N	± 0.1	± 0.04	0 - 0.04	0 - 0.02	0 - 0.01
Variation of height H	0.02	0.015	0.007	0.005	0.003
Variation of width N	0.03	0.015	0.007	0.005	0.003
Running parallelism of block surface C to surface A	See Table 2-2-7				
Running parallelism of block surface D to surface B	See Table 2-2-7				

(2) Accuracy of interchangeable guideways

Table 2-2-5 **Accuracy Standards**

Unit: mm

Item	EG - 15, 20		
Accuracy Classes	Normal (C)	High (H)	Precision (P)
Dimensional tolerance of height H	± 0.1	± 0.03	± 0.015
Dimensional tolerance of width N	± 0.1	± 0.03	± 0.015
Variation of height H	0.02	0.01	0.006
Variation of width N	0.02	0.01	0.006
Running parallelism of block surface C to surface A	See Table 2-2-7		
Running parallelism of block surface D to surface B	See Table 2-2-7		

Table 2-2-6 **Accuracy Standards**

Unit: mm

Item	EG - 25, 30, 35		
Accuracy Classes	Normal (C)	High (H)	Precision (P)
Dimensional tolerance of height H	± 0.1	± 0.04	± 0.02
Dimensional tolerance of width N	± 0.1	± 0.04	± 0.02
Variation of height H	0.02	0.015	0.007
Variation of width N	0.03	0.015	0.007
Running parallelism of block surface C to surface A	See Table 2-2-7		
Running parallelism of block surface D to surface B	See Table 2-2-7		

(3) Accuracy of running parallelism

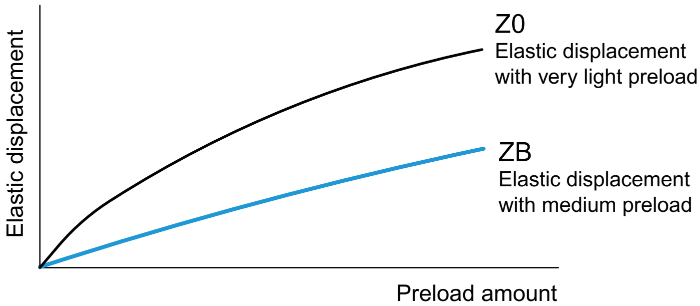
Table 2-2-7 **Accuracy of Running Parallelism**

Rail Length (mm)	Accuracy (μm)				
	C	H	P	SP	UP
~ 100	12	7	3	2	2
100 ~ 200	14	9	4	2	2
200 ~ 300	15	10	5	3	2
300 ~ 500	17	12	6	3	2
500 ~ 700	20	13	7	4	2
700 ~ 900	22	15	8	5	3
900 ~ 1,100	24	16	9	6	3
1,100 ~ 1,500	26	18	11	7	4
1,500 ~ 1,900	28	20	13	8	4
1,900 ~ 2,500	31	22	15	10	5
2,500 ~ 3,100	33	25	18	11	6
3,100 ~ 3,600	36	27	20	14	7
3,600 ~ 4,000	37	28	21	15	7

2-2-6 Preload

(1) Definition

A preload can be applied to each guideway. Generally, a linear motion guideway has a negative clearance between the groove and balls in order to improve stiffness and maintain high precision. The figure shows that adding a preload can improve stiffness of the linear guideway. A preload no greater than ZA would be recommended for model sizes smaller than EG20. This will avoid an over-loaded condition that would affect guideway life.



(2) Preload classes
SIMTACH offers three standard preloads for various applications and conditions.

Table 2-2-8 **Preload Classes**

Class	Code	Preload	Condition
Very Light Preload	Z0	0~ 0.02C	Certain load direction,low impact, low precision required
Light Preload	ZA	0.03C~0.05C	low load and high precision required
Medium Preload	ZB	0.06C~ 0.08C	High rigidity required, with vibration and impact

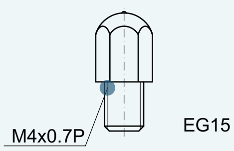
Class	Interchangeable Guideway	Non-Interchangeable Guideway
Preload classes	Z0, ZA	Z0, ZA, ZB

Note: The “C” in the preload column denotes basic dynamic load rating.

2-2-7 Lubrication

(1) Grease

○ Grease nipple



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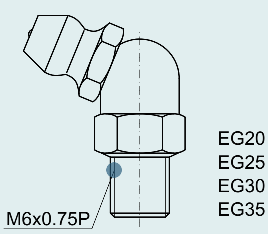

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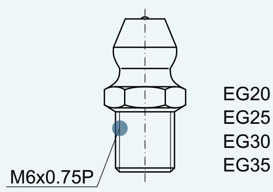
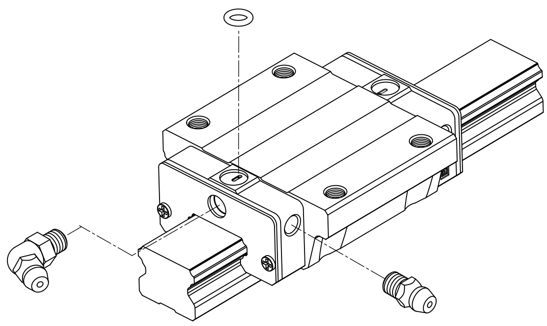
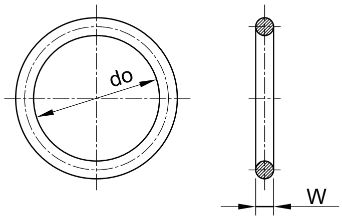


NO.34310003(OPTION)

Mounting location

The standard location of the grease fitting is at both ends of the block, the nipple may be mounted in the side or top of the block. For lateral installation, we recommend that the nipple be mounted to the non-reference side, otherwise please contact us. When lubricating from above, in the recess for the O-ring, a smaller, preformed recess can be found. Preheat the 0.8 mm diameter metal tip. Carefully open the small recess with the metal tip and pierce through it. Insert a round sealing ring into the recess. (The round sealing ring is not supplied with the block) Do not open the small recess with a drill bit this may introduce the danger of contamination. It is possible to carry out the lubrication by using the oil-piping joint.

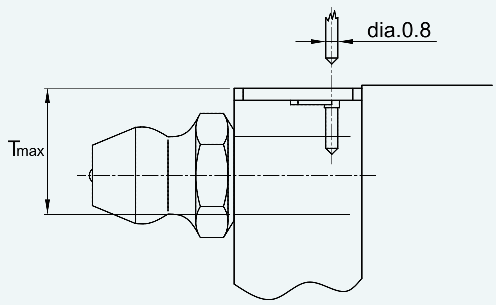




O Ring

Table 2-2-9 **O-Ring size and max. permissible depth for piercing**

Size	O-Ring		Lube hole at top: max. permissible depth for piercing
	do(mm)	W (mm)	T_{max}(mm)
EG15	2.5 ± 0.15	1.5 ± 0.15	6.9
EG20	4.5 ± 0.15	1.5 ± 0.15	8.4
EG25	4.5 ± 0.15	1.5 ± 0.15	10.4
EG30	4.5 ± 0.15	1.5 ± 0.15	10.4
EG35	4.5 ± 0.15	1.5 ± 0.15	10.8



The oil amount for a block filled with grease

Table 2-2-10 **The oil amount for a block filled with grease**

Size	Medium Load (cm^3)	Heavy Load (cm^3)
EG15	0.8	1.4
EG20	1.5	2.4
EG25	2.8	4.6
EG30	3.7	6.3
EG35	5.6	6.6

Frequency of replenishment

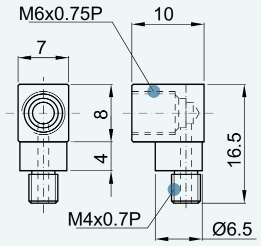
Check the grease every 100 km, or every 3-6 months.

(2) Oil

The recommended viscosity of oil is about 32~150c St. If you need to use oil-type lubrication, please inform us.

Types of oil piping joint

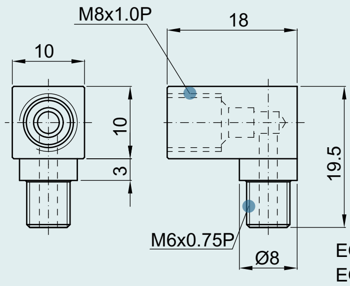
LF-64



NO.97000EA1

EG15

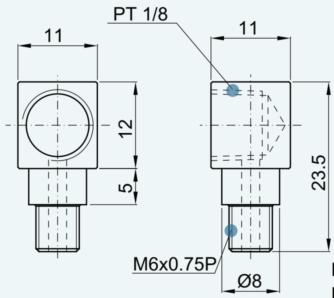
LF-76



EG20
EG25
EG30
EG35

NO.970002A1

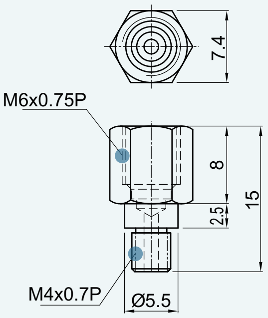
LF-86



EG20
EG25
EG30
EG35

NO.970004A1

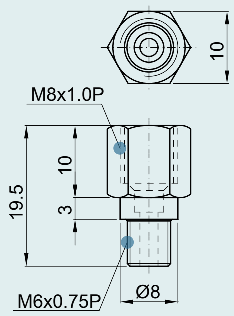
SF-64



EG15

NO.97001TA1

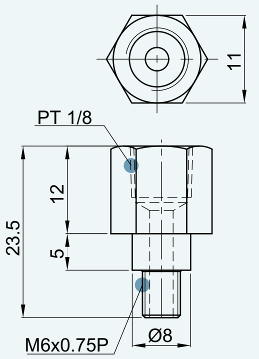
SF-76



EG20
EG25
EG30
EG35

NO.970001A1

SF-86



EG20
EG25
EG30
EG35

NO.970003A1

Oil feeding rate

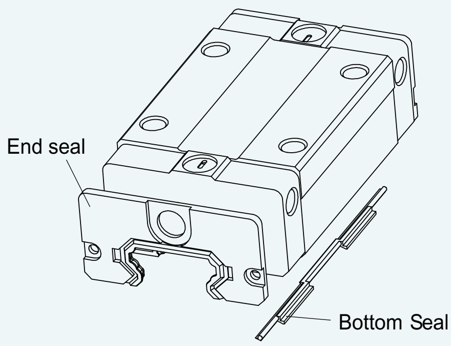
Table 2-2-11 **oil feed rate**

Size	feed rate (cm^3/hr)
EG15	0.1
EG20	0.133
EG25	0.167
EG30	0.2
EG35	0.233

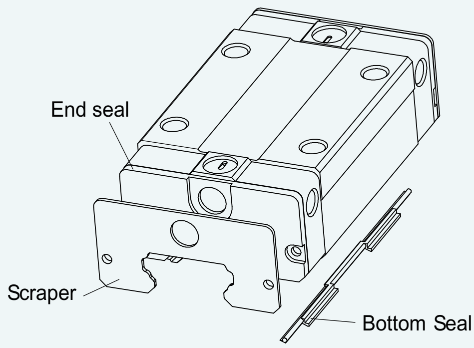
2-2-8 Dust Protection Equipment

(1) Codes of equipment

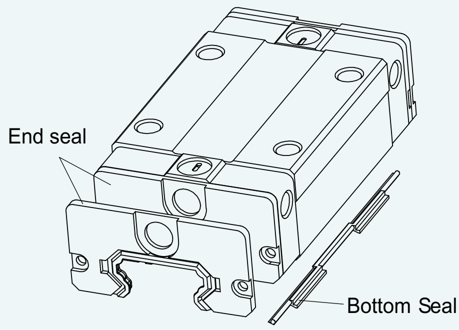
If the following equipment is needed, please indicate the code followed by the model number.



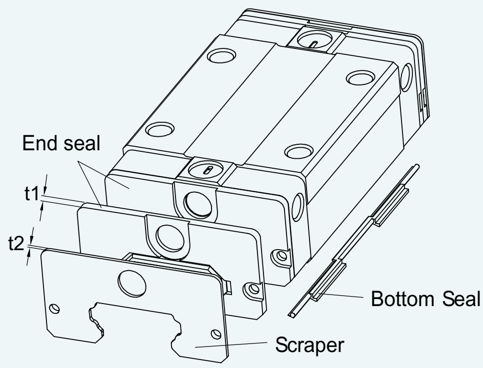
No symbol: Standard Protection
(End seal + Bottom seal)



ZZ(End seal + Bottom seal +Scraper)



DD (Double seals + Bottom Seal)



KK (Double seals + Bottom Seal + Scraper)

(2) End seal and bottom seal

Protects against contaminants entering the block. Reduces potential for groove damage resulting in a reduction of life ratings.

(3) Double seals

Removing foreign matters from the rail to prevent contaminants from entering the block.

Table 2-2-12 **Dimensions of end seal**

Size	Thickness (t1) (mm)
EG15 ES	2
EG20 ES	2
EG25 ES	2
EG30 ES	2
EG35 ES	2

(4) Scraper

Clears larger contaminants, such as weld spatter and metal cuttings, from the rail. Metal scraper protects end seals from excessive damage.

Table 2-2-13 **Dimensions of Scraper**

Size	Thickness (t2) (mm)
EG15 SC	0.8
EG20 SC	0.8
EG25 SC	1
EG30 SC	1
EG35 SC	1.5

(5) Bolt caps for rail mounting holes

Rail mounting hole caps prevent foreign matter from accumulating in the mounting holes. Caps are included with the rail package.

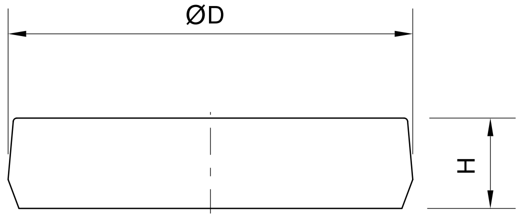
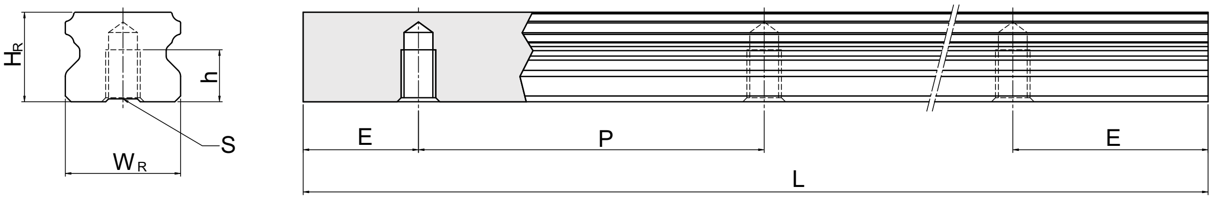


Table 2-2-14 **Dimensions of Bolt Caps for Rail Mounting Holes**

Rail size	Bolt size	Diameter(D) (mm)	Thickness(H) (mm)
EGR15R	M3	6.15	1.2
EGR20R	M5	9.65	2.5
EGR25R	M6	11.15	2.5
EGR30R	M6	11.15	2.5
EGR35R	M8	14.20	3.5

(6) Dimensions for EGR-T (rail mounting from bottom)



Model No.	Dimensions of Rail (mm)						Weight
	W_R	H_R	S	h	P	E	(kg/m)
EGR15T	15	12.5	M5 x 0.8P	7	60	20	1.26
EGR20T	20	15.5	M6 x 1P	9	60	20	2.15
EGR25T	23	18	M6 x 1P	10	60	20	2.79
EGR30T	28	23	M8 x 1.25P	14	80	20	4.42
EGR35T	34	27.5	M8 x 1.25P	17	80	20	6.34

2-2-9 Friction

The maximum value of resistance per end seal are as shown in the table.

Table 2-2-16 **Seal Resistance**

Size	Resistance N (kgf)
EG15	0.98 (0.1)
EG20	0.98 (0.1)
EG25	0.98 (0.1)
EG30	1.47 (0.15)
EG35	1.96 (0.2)

Note:1kgf=9.81N

2-2-10 Mounting Surface Accuracy Tolerance

Because of the circular-arc contact design, the EG linear guideway can withstand surface-error installation and deliver smooth linear motion. When the mounting surface meets the accuracy requirements of the installation, the high accuracy and rigidity of the guideway will be obtained without any difficulty. For faster installation and smoother movement, SIMTACH offers a preload with normal clearance because of its ability to absorb higher deviations in mounting surface inaccuracies.

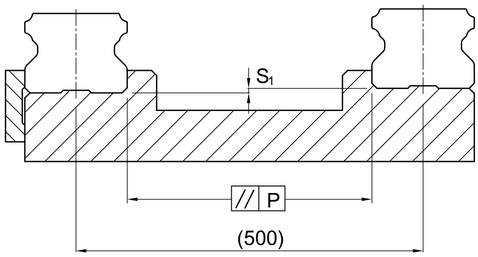


Table 2-2-17 **Max. Parallelism Tolerance (P)**

unit: μm

Size	Preload classes		
	Z0	ZA	ZB
EG15	25	18	-
EG20	25	20	18
EG25	30	22	20
EG30	40	30	27
EG35	50	35	30

Table 2-2-18 **Max. Tolerance of Reference Surface Height (S_1)**

unit: μm

Size	Preload classes		
	Z0	ZA	ZB
EG15	130	85	-
EG20	130	85	50
EG25	130	85	70
EG30	170	110	90
EG35	210	150	120

2-2-11 Cautions for Installation

(1) 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.

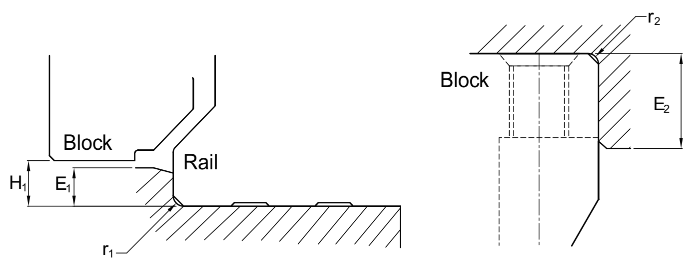


Table 2-2-19 **Shoulder Heights and Chamfers**

unit: mm

Size	Max. radius of fillets r_1 (mm)	Max. radius of fillets r_2 (mm)	Shoulder height of the rail E_1 (mm)	Shoulder height of the block E_2 (mm)	Clearance under block H_1 (mm)
EG15	0.5	0.5	2.7	5.0	4.5
EG20	0.5	0.5	5.0	7.0	6.0
EG25	1.0	1.0	5.0	7.5	7.0
EG30	1.0	1.0	7.0	7.0	10.0
EG35	1.0	1.0	7.5	9.5	11.0

(2) Tightening To rque of Bolts for Installation

Improperly tightened mounting bolts will seriously affect the accuracy of linear guide installations. The following tightening torques for different sizes of bolts are recommended.

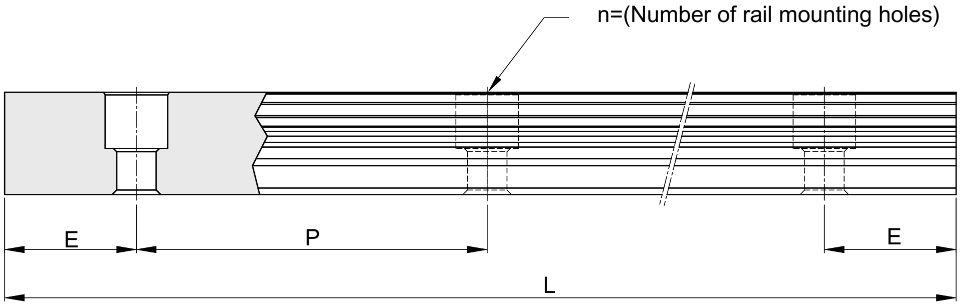
Table 2-2-20 **Tightening Torque**

Size	Bolt size	Torque N-cm(kgf-cm)		
		Iron	Casting	Aluminum
EG 15	M3×0.5P×16L	186 (19)	127 (13)	98 (10)
EG 20	M5×0.8P×16L	883 (90)	588 (60)	441 (45)
EG 25	M6×1P×20L	1373 (140)	921 (94)	686 (70)
EG 30	M6×1P×25L	1373 (140)	921 (94)	686 (70)
EG 35	M8×1.25P×25L	3041 (310)	2010 (205)	1470 (150)

Note: 1 kgf = 9.81 N

2-2-12 Standard and Maximum Lengths of Rail

SIMTACH offers a number of standard rail lengths. Standard rail lengths feature end mounting hole placements set to predetermined values (E). For non-standard rail lengths, be sure to specify the E-value to be no greater than 1/2 the pitch (P) dimension. An E-value greater than this will result in unstable rail ends.



$$L = (n-1) \times P + 2 \times E \quad \text{Eq.2.2}$$

L : Total length of rail (mm)
n : Number of mounting holes
P : Distance between any two holes (mm)
E : Distance from the center of the last hole to the edge (mm)

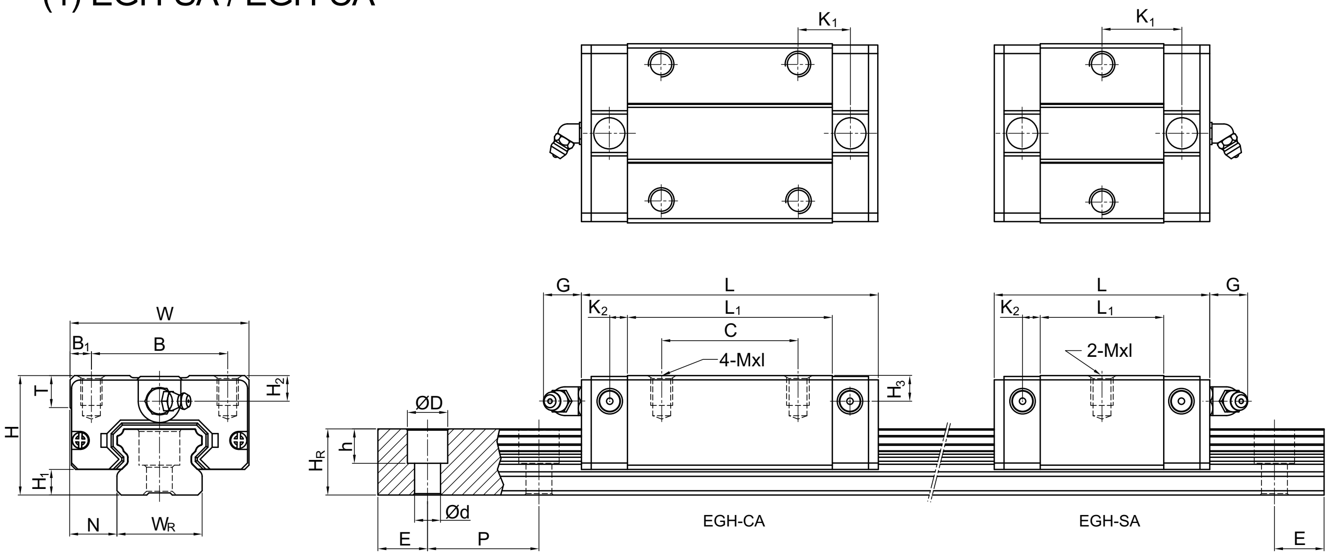
Table 2-2-21 **Rail Standard Length and Max. Length** unit: mm

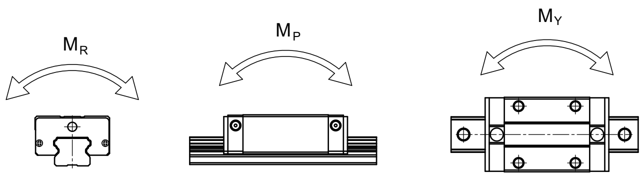
Item	EGR15	EGR20	EGR25	EGR30	EGR35
Standard Length L(n)	160 (3)	220 (4)	220 (4)	280 (4)	280 (4)
	220 (4)	280 (5)	280 (5)	440 (6)	440 (6)
	280 (5)	340 (6)	340 (6)	600 (8)	600 (8)
	340 (6)	460 (8)	460 (8)	760 (10)	760 (10)
	460 (8)	640 (11)	640 (11)	1,000 (13)	1,000 (13)
	640 (11)	820 (14)	820 (14)	1,640 (21)	1,640 (21)
	820 (14)	1,000 (17)	1,000 (17)	2,040 (26)	2,040 (26)
		1,240 (21)	1,240 (21)	2,520 (32)	2,520 (32)
		1,600 (27)	1,600 (27)	3,000 (38)	3,000 (38)
Pitch (P)	60	60	60	80	80
Distance to End $(E)_s$	20	20	20	20	20
Max. Standard Length	4,000(67)	4,000 (67)	4,000 (67)	3,960 (50)	3,960 (50)
Max. Length	4,000	4,000	4,000	4,000	4,000

Note : 1. Tolerance of E value for standard rail is 0.5~-0.5 mm. Tolerance of E value for jointed rail is 0~-0.3 mm.
2. Maximum standard length means the max. rail length with standard E value on both sides.
3. If different E value is needed, please contact SIMTACH.

2-2-13 Dimensions for EG Series

(1) EGH-SA / EGH-CA

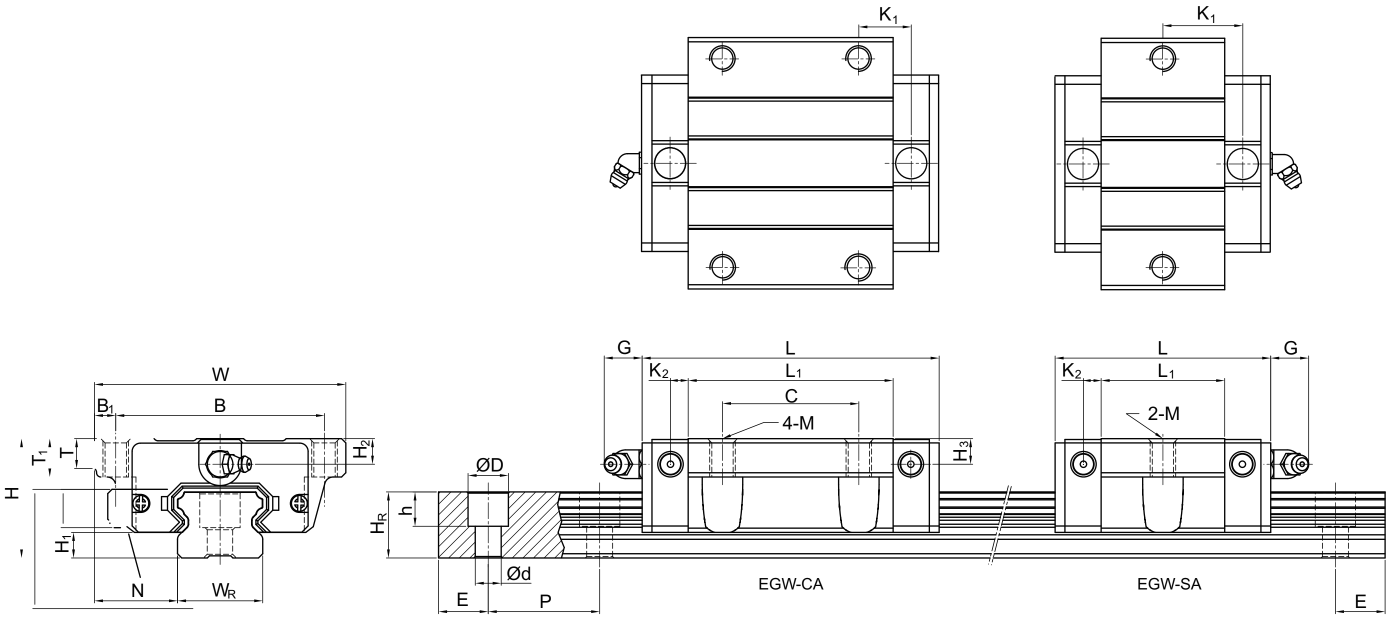


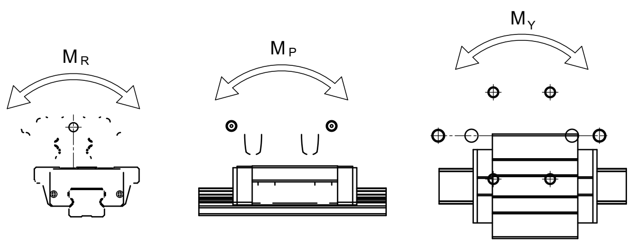


Model No.	Dimensions of Assembly (mm)			Dimensions of Block (mm)													Dimensions of Rail (mm)							Mounting Bolt for Rail	Basic Dynamic Load Rating	Basic Static Load Rating	Static Rated Moment			Weight	
																											M_R	M_P	M_Y	Block	Rail
	H	H_1	N	W	B	B_1	C	L_1	L	K_1	K_2	G	Mxl	T	H_2	H_3	W_R	H_R	D	h	d	P	E	(mm)	C(kN)	C_0 (kN)	kN-m	kN-m	kN-m	kg	kg/m
EGH15SA	24	4.5	9.5	34	26	4	-	23.1	40.1	14.8	3.5	5.7	M4x6	6	5.5	6	15	12.5	6	4.5	3.5	60	20	M3x16	5.35	9.40	0.08	0.04	0.04	0.09	1.25
EGH15CA							26	39.8	56.8	10.15															7.83	16.19	0.13	0.10	0.10	0.15	
EGH20SA	28	6	11	42	32	5	-	29	50	18.75	4.15	12	M5x7	7.5	6	6	20	15.5	9.5	8.5	6	60	20	M5x16	7.23	12.74	0.13	0.06	0.06	0.15	2.08
EGH20CA							32	48.1	69.1	12.3															10.31	21.13	0.22	0.16	0.16	0.24	
EGH25SA	33	7	12.5	48	35	6.5	-	35.5	59.1	21.9	4.55	12	M6x9	8	8	8	23	18	11	9	7	60	20	M6x20	11.40	19.50	0.23	0.12	0.12	0.25	2.67
EGH25CA							35	59	82.6	16.15															16.27	32.40	0.38	0.32	0.32	0.41	
EGH30SA	42	10	16	60	40	10	-	41.5	69.5	26.75	6	12	M8x12	9	8	9	28	23	11	9	7	80	20	M6x25	16.42	28.10	0.40	0.21	0.21	0.45	4.35
EGH30CA							40	70.1	98.1	21.05															23.70	47.46	0.68	0.55	0.55	0.76	
EGH35SA	48	11	18	70	50	10	-	45	75	28.5	7	12	M8x12	10	8.5	8.5	34	27.5	14	12	9	80	20	M8x25	22.66	37.38	0.56	0.31	0.31	0.66	6.14
EGH35CA							50	78	108	20															33.35	64.84	0.98	0.69	0.69	1.13	

Note : 1 kgf = 9.81 N

(2) EGW-CA / EGW-CC





Model No.	Dimensions of Assembly (mm)			Dimensions of Block (mm)													Dimensions of Rail (mm)							Mounting Bolt for Rail	Basic Dynamic Load Rating	Basic Static Load Rating	Static Rated Moment			Weight	
	H	H_1	N	W	B	B_1	C	L_1	L	K_1	K_2	G	M	T	T_1	H_2	H_3	W_R	H_R	D	h	d	P	E	(mm)	C(kN)	C_0 (kN)	M_R kN-m	M_P kN-m	M_Y kN-m	Block kg	Rail kg/m
EGW15SC	24	4.5	18.5	52	41	5.5	-	23.1	40.1	14.8	3.5	5.7	M5	5	7	5.5	6	15	12.5	6	4.5	3.5	60	20	M3x16	5.35	9.40	0.08	0.04	0.04	0.12	1.25
EGW15CC							26	39.8	56.8	10.15																7.83	16.19	0.13	0.10	0.10	0.21	
EGW20SC	28	6	19.5	59	49	5	-	29	50	18.75	4.15	12	M6	7	9	6	6	20	15.5	9.5	8.5	6	60	20	M5x16	7.23	12.74	0.13	0.06	0.06	0.19	2.08
EGW20CC							32	48.1	69.1	12.3																10.31	21.13	0.22	0.16	0.16	0.32	
EGW25SC	33	7	25	73	60	6.5	-	35.5	59.1	21.9	4.55	12	M8	7.5	10	8	8	23	18	11	9	7	60	20	M6x20	11.40	19.50	0.23	0.12	0.12	0.35	2.67
EGW25CC							35	59	82.6	16.15																16.27	32.40	0.38	0.32	0.32	0.59	
EGW30SC	42	10	31	90	72	9	-	41.5	69.5	26.75	6	12	M10	7	10	8	9	28	23	11	9	7	80	20	M6x25	16.42	28.10	0.40	0.21	0.21	0.62	4.35
EGW30CC							40	70.1	98.1	21.05																23.70	47.46	0.68	0.55	0.55	1.04	
EGW35SC	48	11	33	100	82	9	-	45	75	28.5	7	12	M10	10	13	8.5	8.5	34	27.5	14	12	9	80	20	M8x25	22.66	37.38	0.56	0.31	0.31	0.84	6.14
EGW35CC							50	78	108	20																33.35	64.84	0.98	0.69	0.69	1.45	

Note : 1 kgf = 9.81 N

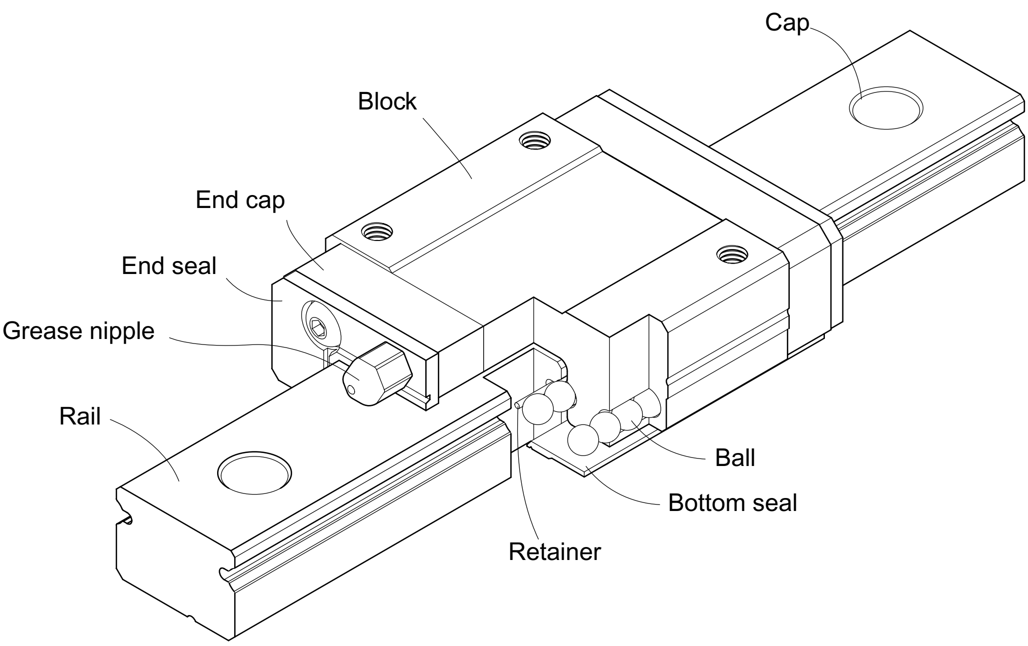
MG Series
Miniature Type

2-3 MG Series - Miniature Linear Guideway

2-3-1 Features of MGN Series

Design features of narrow type miniature guideways- MGN:
1. Tiny and light weight, suitable for miniature equipment.
2. Gothic arch contact design can sustain loads from all directions and offer high rigidity and high accuracy.
3. Steel balls are held by a miniature retainer to avoid balls from falling out, even when the blocks are removed from the rail.
4. Interchangeable types are available in certain precision grades.

2-3-2 Construction of MGN Series



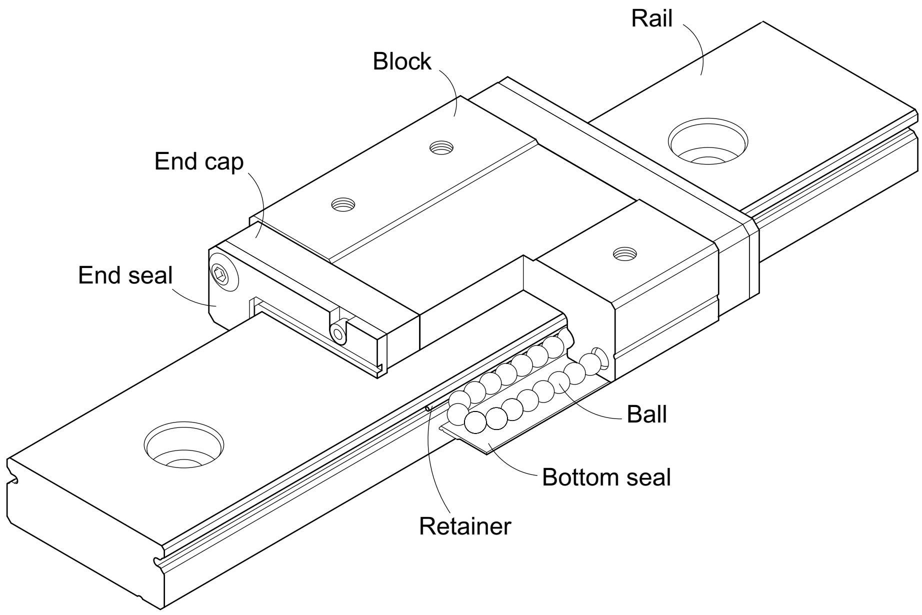
- Rolling circulation system: Block, rail, ball, end cap and retainer
- Lubrication system:Grease nipple is available for MGN15, lubricated by grease gun. MGN7, 9, 12 are lubricated by the hole at the side of the end cap.
- Dust protection system: End seal, bottom seal (optional size 9,12,15), cap (size12,15)

2-3-3 Features of MGW Series

Design features of wide type miniature guideways- MGW:

1. The enlarged width design increases the capacity of moment loading.
2. Gothic arch contact design has high rigidity characteristic in all directions.
3. Steel balls are held by a miniature retainer to avoid balls from falling out, even when the blocks are removed from the rail.

2-3-4 Construction of MGW Series



- Rolling circulation system: Block, rail, ball, end cap and retainer
- Lubrication system:Grease nipple is available for MGW15, lubricated by grease gun.
- Dust protection system: End seal, bottom seal (optional size 9,12,15), cap (size12,15)

(1) Non-interchangeable type

MGN 12 C E 2 R1600 E Z1 P M II + U/RC/-O

- MGN / MGW Series
- Model Size : 5, 7, 9, 12, 15
- Block Type
  C : Standard
  H : Long
- E : Special Block
  None : Standard Block
- No. of Blocks per Rail
- Rail Length (mm)
- E : Special Rail
  None : Standard Rail
- Preload Code : ZF, Z0, Z1
- Precision Code : C, H,P
- Material[3]: No symbol, M, HC, NC
- No. of Rails per Axis[1]
- Bottom Seal Option[2]
- RC:Reinforced Cap (Optional For MGN12,15)
- O:Outer Recirculation Module

Note: 1. Symbol for No. of rails used on the same plane.
No symbol indicates single rail in a axis.
2. The bottom seal is available for MGN & MGW 9, 12, 15.
3. No symbol: Carbon Steel
M: Stainless Steel
HC: Carbon Steel+Hard Chrome Treatment
NC: Carbon Steel+Chemical Black Chrome Treatment
4. MG5 is only supplied with outer recirculation module.

(2) Interchangeable type

○ Interchangeable Block

MGN 12 C E Z1 P M + U/-O

- MGN / MGW Series
- Model Size : 5, 7, 9, 12, 15
- Block Type
  C : Standard
  H : Long
- E: Special Block
  None: Standard Block
- Preload Code : ZF, Z0, Z1
- Precision Code : C, H,P
- No symbol: Carbon Steel
  M: Stainless Steel
- Bottom Seal Option[1]
- O:Outer Recirculation Module

Note: 1.The bottom seal is available for MGN & MGW9, 12, 15.
2.MG5 is only supplied with outer recirculation module.

○ Interchangeable Rail

MGN R 12 R1000 E P M + RC

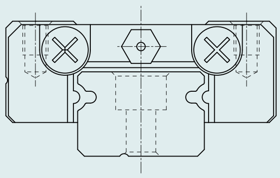
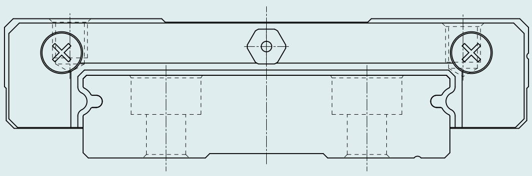
- MGN / MGW Series
- Interchangeable Rail
- Model Size : 5, 7, 9, 12, 15
- Rail Length (mm)
- Rail Special Option
- Precision Code : C, H,P
- Material:
  No symbol (Carbon Steel)
  M (Stainless Steel)
  HC (CarbonSteel+Hard Chrome Treatment)
  NC (CarbonSteel+Chemical Black Chrome Treatment)
- RC:Reinforced Cap (Optional For MGN12,15)

2-3-5 Types

(1) Block types

SIMTACH offers two types of linear guideways, flange and square types.

Table 2-4-1 Block Types

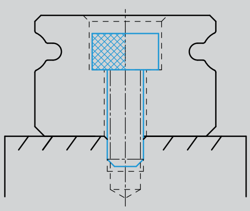
Type	Model	Shape	Height (mm)	Rail Length (mm)	Main Applications
Square	MGN-C MGN-H		8 ↓ 16	100 ↓ 2000	Printer Robotics Precision measure equipment Semiconductor equipment
Flange	MGW-C MGW-H		9 ↓ 16	100 ↓ 2000	

*Please refer to the chapter 2-4-14 for the dimensional detail.

(2) Rail types

SIMTACH offers standard top mounting type.

Table 2-4-2 Rail Types

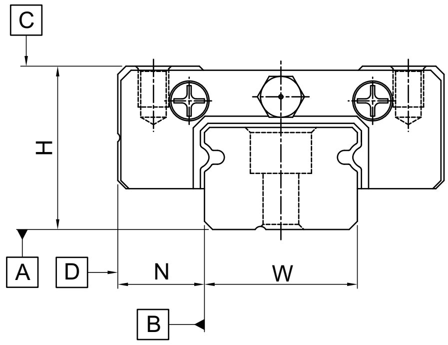
Mounting from Top


MG Series

Miniature Type

2-3-6 Accuracy Classes

The accuracy of MGN/MGW series can be classified into three classes: normal (C), high (H), precision (P). Choices for different accuracy classes are available according to various requirements.



(1) Accuracy of non-interchangeable guideways

Table 2-4-3 Accuracy Standard of Non-interchangeable Type

Unit: mm

Accuracy Classes	Normal (C)	High (H)	Precision (P)
Dimensional tolerance of height H	± 0.04	± 0.02	± 0.01
Dimensional tolerance of width N	± 0.04	± 0.025	± 0.015
Pair Variation of height H	0.03	0.015	0.007
Pair Variation of width N (Master Rail)	0.03	0.02	0.01
Running parallelism of block surface C to surface A	See Table 2-4-5		
Running parallelism of block surface D to surface B	See Table 2-4-5		

(2) Accuracy of interchangeable guideways

Table 2-4-4 Accuracy Standard of Interchangeable Type

Unit: mm

Accuracy Classes		Normal (C)	High (H)	Precision (P)
Dimensional tolerance of height H		± 0.04	± 0.02	± 0.01
Dimensional tolerance of width N		± 0.04	± 0.025	± 0.015
One Set	Pair Variation of height H	0.03	0.015	0.007
	Pair Variation of width N	0.03	0.02	0.01
Pair Variation of width N (Master Rail)		0.07	0.04	0.02
Running parallelism of block surface C to surface A		See Table 2-4-5		
Running parallelism of block surface D to surface B		See Table 2-4-5		

(3) Accuracy of running parallelism

The running parallelism C to A and D to B are related to the rail length.

Table 2-4-5 **Accuracy of Running Parallelism**

Rail Length	Accuracy (μm)			Rail Length	Accuracy (μm)		
(mm)	(C)	(H)	(P)	(mm)	(C)	(H)	(P)
~ 50	12	6	2	1,000 ~ 1,200	25	18	11
50 ~ 80	13	7	3	1,200 ~ 1,300	25	18	11
80 ~ 125	14	8	3.5	1,300 ~ 1,400	26	19	12
125 ~ 200	15	9	4	1,400 ~ 1,500	27	19	12
200 ~ 250	16	10	5	1,500 ~ 1,600	28	20	13
250 ~ 315	17	11	5	1,600 ~ 1,700	29	20	14
315 ~ 400	18	11	6	1,700 ~ 1,800	30	21	14
400 ~ 500	19	12	6	1,800 ~ 1,900	30	21	15
500 ~ 630	20	13	7	1,900 ~ 2,000	31	22	15
630 ~ 800	22	14	8	2,000 ~	31	22	16
800 ~ 1,000	23	16	9				

2-3-7 Preload

MGN/MGW series provides three different preload levels for various applications.

Table 2-4-6 **Preload Classes**

Class	Code	Preload	Accuracy
Light Clearance	ZF	Clearance 4~10μm	C
Very Light Preload	Z0	0	C~P
Light Preload	Z1	0.02C	C~P

Note: "C" in column preload means basic dynamic load rating.

2-3-8 Dust Proof Accessories

End seals and standard accessories fixed on both sides of the block can prevent dust from entering the block, so the accuracy and service life of a linear guideway can be maintained. Bottom seals are fixed under the skirt portion of the block to prevent dust from entering. Customers can order bottom seals by adding the mark "+U" followed by the model number. Sizes 9, 12 and 15 provide bottom seals as an option, but size 5, 7 do not offer the option due to the space limit of H_1. Note that "H1" would reduced if bottom seals are attached, be aware of possible interference between block and mounting surface.

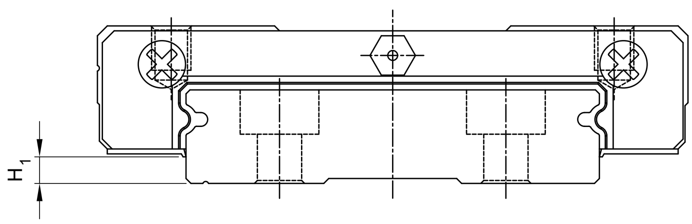


Table 2-4-7

Size	Bottom seal	H_1 mm	Size	Bottom seal	H_1 mm
MGN5	-	-	MGW5	-	-
MGN7	-	-	MGW7	-	-
MGN9	●	1	MGW9	●	1.9
MGN12	●	2	MGW12	●	2.4
MGN15	●	3	MGW15	●	2.4

2-3-9 Mounting Surface Accuracy Tolerance

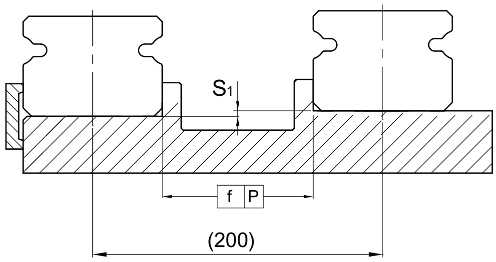


Table 2-4-8 **Max. Parallelism Tolerance (P)**

unit: μm

Size	Preload classes		
	ZF	Z0	Z1
MG5	2	2	2
MG7	3	3	3
MG9	4	4	3
MG12	9	9	5
MG15	10	10	6

Table 2-4-9 **Max. Tolerance of Reference Surface Height (S_1)**

unit: μm

Size	Preload classes		
	ZF	Z0	Z1
MG5	20	20	2
MG7	25	25	3
MG9	35	35	6
MG12	50	50	12
MG15	60	60	20

Table 2-4-10 **Permissible Error of Mounting Surface**

unit: mm

Size	Flatness of the Mounting Surface
MG5	0.015/200
MG7	0.025/200
MG9	0.035/200
MG12	0.050/200
MG15	0.060/200

Note: The values above are suitable for preload of Z F/Z0. For preload of Z1 or using two(or more) rails on the same plane, 50% or less of the values above are recommended.

2-3-10 Cautions for Installation

Shoulder heights and fillets

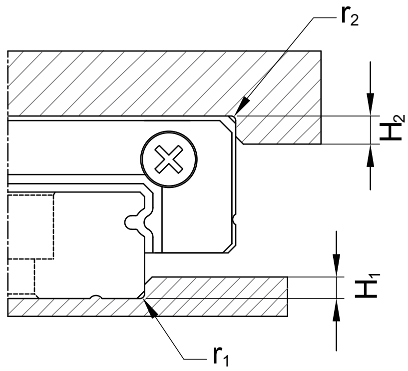


Table 2-4-11 **Shoulder Heights and Fillets**

Size	Max. radius of fillets r_1 (mm)	Max. radius of fillets r_2 (mm)	Shoulder height H_1 (mm)	Shoulder height H_2 (mm)
MGN5	0.1	0.2	1.2	2
MGN 7	0.2	0.2	1.2	3
MGN 9	0.2	0.3	1.7	3
MGN 12	0.3	0.4	1.7	4
MGN 15	0.5	0.5	2.5	5
MGW5	0.1	0.2	1.2	2
MGW 7	0.2	0.2	1.7	3
MGW 9	0.3	0.3	2.5	3
MGW 12	0.4	0.4	3	4
MGW 15	0.4	0.8	3	5

Tightening torque of bolts for installation

Improper tightening of rail mounting bolts will seriously affect the accuracy of the linear guideway. The following table lists the recommended tightening torque for the specific bolt sizes.

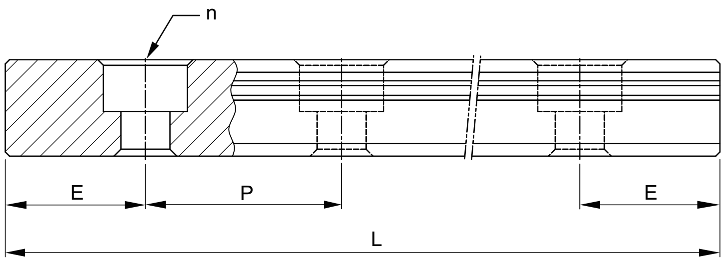
Table 2-4-12 **Tightening Torque**

Size	Bolt size	Torque, N-cm (kgf-cm)		
		Iron	Casting	Aluminum
MGN5	M2×0.4P×6L	57(5.9)	39.2(4)	29.4(3)
MGN7	M2×0.4P×6L	57(5.9)	39.2(4)	29.4(3)
MGN9	M3×0.5P×8L	186(19)	127(13)	98(10)
MGN12	M3×0.5P×8L	186(19)	127(13)	98(10)
MGN15	M3×0.5P×10L	186(19)	127(13)	98(10)
MGW5	M2.5×0.45P×7L	118(12)	78.4(8)	58.8(6)
MGW7	M3×0.5P×6L	186(19)	127(13)	98(10)
MGW9	M3×0.5P×8L	186(19)	127(13)	98(10)
MGW12	M4×0.7P×8L	392(40)	274(28)	206(21)
MGW15	M4×0.7P×10L	392(40)	274(28)	206(21)

Note : 1 kgf = 9.81 N

2-3-11 Standard and Maximum Lengths of Rail

SIMTACH offers standard lengths of rail for instant requirements. For non-standard rail lengths, it's recommended that the E value is no greater than 1/2 of the pitch(P) to prevent instability at the end of the rail, and the E value should be no less than Emin to avoid a broken mounting hole.



$$L = (n-1) \times P + 2 \times E \quad \text{Eq.2.4}$$

L : Total length of rail (mm)
n : Number of mounting holes
P : Distance between any two holes (mm)
E : Distance from the center of the last hole to the edge (mm)

Table 2-4-13

unit: mm

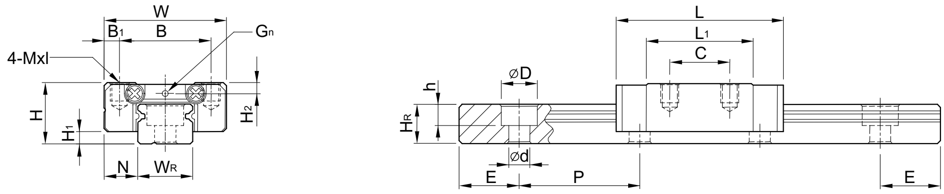
Item	MGNR5	MGNR7	MGNR9	MGNR12	MGNR15	MGWR5	MGWR7	MGWR9	MGWR12	MGWR15
Standard Length L (n)	40(3)	40(3)	55(3)	70(3)	70(2)	50(3)	80(3)	80(3)	110(3)	110(3)
	55(4)	55(4)	75(4)	95(4)	110(3)	70(4)	110(4)	110(4)	150(4)	150(4)
	70(5)	70(5)	95(5)	120(5)	150(4)	90(5)	140(5)	140(5)	190(5)	190(5)
	100(7)	85(6)	115(6)	145(6)	190(5)	110(6)	170(6)	170(6)	230(6)	230(6)
	130(9)	100(7)	135(7)	170(7)	230(6)	130(7)	200(7)	200(7)	270(7)	270(7)
	160(11)	130(9)	155(8)	195(8)	270(7)	150(8)	260(9)	230(8)	310(8)	310(8)
			175(9)	220(9)	310(8)	170(9)		260(9)	350(9)	350(9)
			195(10)	245(10)	350(9)			290(10)	390(10)	390(10)
			275(14)	270(11)	390(10)			350(14)	430(11)	430(11)
			375(19)	320(13)	430(11)			500(19)	510(13)	510(13)
				370(15)	470(12)			710(24)	590(15)	590(15)
				470(19)	550(14)			860(29)	750(19)	750(19)
				570(23)	670(17)				910(23)	910(23)
				695(28)	870(22)				1070(27)	1070(27)
Pitch (P)	15	15	20	25	40	20	30	30	40	40
Distance to End $(E)_s$	5	5	7.5	10	15	5	10	10	15	15
Max. Standard Length	250(17)	595(40)	1195(60)	1995(80)	1990(50)	250(13)	590(20)	1970(66)	1990(50)	1990(50)
Max. Length	250[4]	600	1200[5]	2000	2000	250[4]	600[6]	2000	2000	2000

Note:
1. Tolerance of E value for standard rail is 0.5~-0.5 mm. Tolerance of E value for jointed rail is 0~-0.3 mm.
2. Maximum standard length indicates the max. rail length with standard E value on both sides.
3. If smaller E value is needed, please contact SIMTACH.
4. MGNR5, MGWR5 are only supplied with stainless steel.
5. MGNR9 of stainless steel is supplied with the maximum length of 1200mm; MGNR9 of carbon steel is supplied with the maximum length of 1000mm.
6. MGWR7 of stainless steel is supplied with the maximum length of 600mm; MGWR7 of carbon steel is supplied with the maximum length of 2000mm .

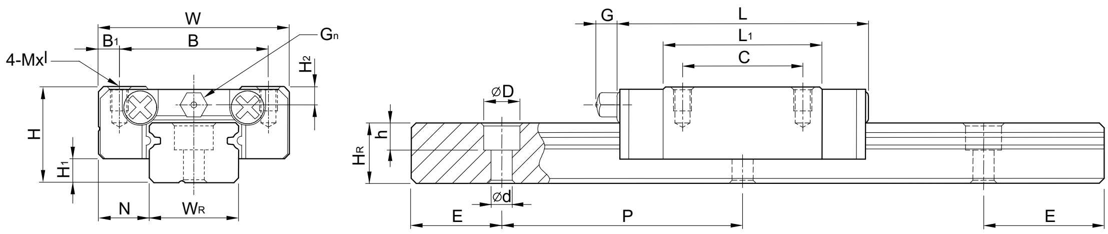
2-3-12 Dimensions for MGN/MGW Series

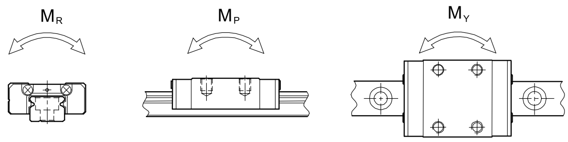
(1) MGN-C / MGN-H

MGN7, MGN9, MGN12



MGN15



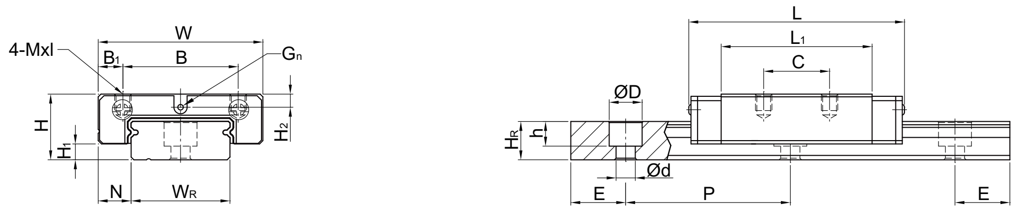


Model No.	Dimensions of Assembly (mm)			Dimensions of Block (mm)										Dimensions of Rail (mm)							Mounting Bolt for Rail	Basic Dynamic Load Rating	Basic Static Load Rating	Static Rated Moment			Weight	
																								M_R	M_P	M_Y	Block	Rail
	H	H_1	N	W	B	B_1	C	L_1	L	G	G_n	MxI	H_2	W_R	H_R	D	h	d	P	E	(mm)	C(kN)	C_0 (kN)	N-m	N-m	N-m	kg	kg/m
MGN7C	8	1.5	5	17	12	2.5	8	13.5	22.5	-	Ø1.2	M2x2.5	1.5	7	4.8	4.2	2.3	2.4	15	5	M2x6	0.98	1.24	4.70	2.84	2.84	0.010	0.22
MGN7H							13	21.8	30.8													1.37	1.96	7.64	4.80	4.80	0.015	
MGN 9C	10	2	5.5	20	15	2.5	10	18.9	28.9	-	Ø1.4	M3x3	1.8	9	6.5	6	3.5	3.5	20	7.5	M3x8	1.86	2.55	11.76	7.35	7.35	0.016	0.38
MGN9H							16	29.9	39.9													2.55	4.02	19.60	18.62	18.62	0.026	
MGN 12C	13	3	7.5	27	20	3.5	15	21.7	34.7	-	Ø2	M3x3.5	2.5	12	8	6	4.5	3.5	25	10	M3x8	2.84	3.92	25.48	13.72	13.72	0.034	0.65
MGN 12H							20	32.4	45.4													3.72	5.88	38.22	36.26	36.26	0.054	
MGN 15C	16	4	8.5	32	25	3.5	20	26.7	42.1	4.5	M3	M3x4	3	15	10	6	4.5	3.5	40	15	M3x10	4.61	5.59	45.08	21.56	21.56	0.059	1.06
MGN 15H							25	43.4	58.8													6.37	9.11	73.50	57.82	57.82	0.092	

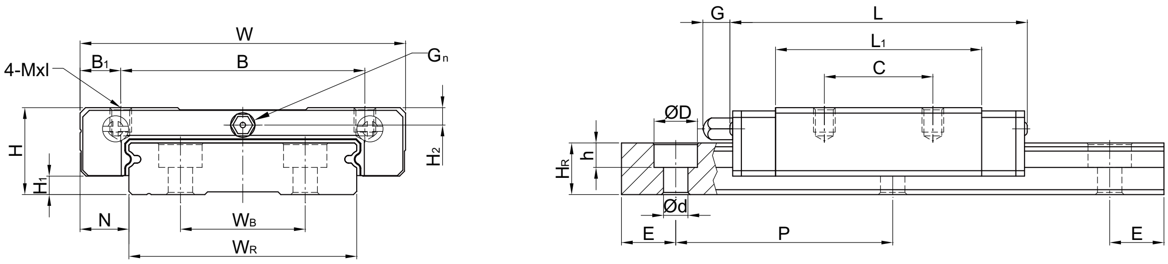
Note : 1 kgf = 9.81 N

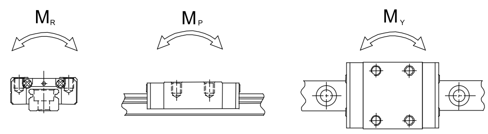
(2) MGW-C / MGW-H

MGW7, MGW9, MGW12



MGW15





Model No.	Dimensions of Assembly (mm)			Dimensions of Block (mm)									Dimensions of Rail (mm)									Mounting Bolt for Rail	Basic Dynamic Load Rating	Basic Static Load Rating	Static Rated Moment			Weight	
																									M_R	M_P	M_Y	Block	Rail
	H	H_1	N	W	B	B_1	C	L_1	L	G	G_n	Mxl	H_2	W_R	W_B	H_R	D	h	d	P	E	(mm)	C(kN)	C_0 (kN)	N-m	N-m	N-m	kg	kg/m
MGW7C	9	1.9	5.5	25	19	3	10	21	31.2	-	Ø1.2	M3x3	1.85	14	-	5.2	6	3.2	3.5	30	10	M3x6	1.37	2.06	15.70	7.14	7.14	0.020	0.51
MGW7H							19	30.8	41														1.77	3.14	23.45	15.53	15.53	0.029	
MGW9C	12	2.9	6	30	21	4.5	12	27.5	39.3	-	Ø1.2	M3x3	2.4	18	-	7	6	4.5	3.5	30	10	M3x8	2.75	4.12	40.12	18.96	18.96	0.040	0.91
MGW9H					23	3.5	24	38.5	50.7														3.43	5.89	54.54	34.00	34.00	0.057	
MGW12C	14	3.4	8	40	28	6	15	31.3	46.1	-	Ø1.2	M3x3.6	2.8	24	-	8.5	8	4.5	4.5	40	15	M4x8	3.92	5.59	70.34	27.80	27.80	0.071	1.49
MGW12H							28	45.6	60.4														5.10	8.24	102.70	57.37	57.37	0.103	
MGW15C	16	3.4	9	60	45	7.5	20	38	54.8	5.2	M3	M4x4.2	3.2	42	23	9.5	8	4.5	4.5	40	15	M4x10	6.77	9.22	199.34	56.66	56.66	0.143	2.86
MGW15H							35	57	73.8														8.93	13.38	299.01	122.60	122.60	0.215	

Note : 1 kgf = 9.81 N

RG Series

High Rigidity Roller Type

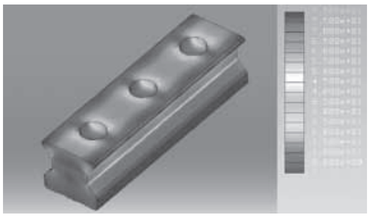
2-4 RG Series – High Rigidity Roller Type Linear Guideway

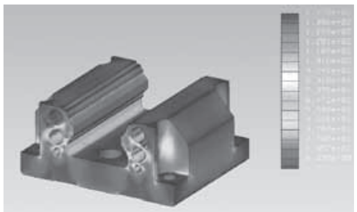
2-4-1 Advantages and features

The new RG series from SIMTACH features a roller as the rolling element instead of steel balls. The roller series offers super high rigidity and very high load capacities. The RG series is designed with a 45-degree angle of contact. Elastic deformation of the linear contact surface, during load, is greatly reduced thereby offering greater rigidity and higher load capacities in all 4 load directions.The RG series linear guideway offers high performance for high-precision manufacturing and achieving longer service life.

(1) Optimal design

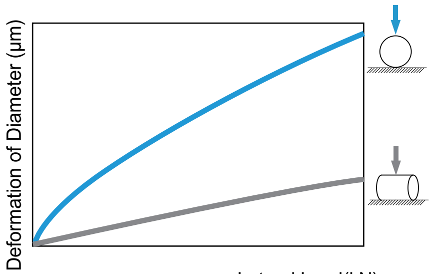
FEM analysis was performed to determine the optimal structure of the block and the rail. The unique design of the circulation path allows the RG series linear guideway to offer smoother linear motion.





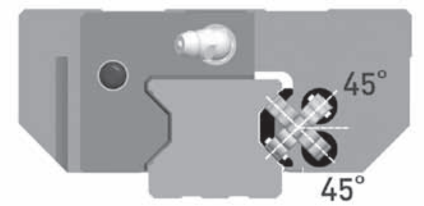
(2) Super high rigidity

The RG series is a type of linear guideway that uses rollers as the rolling elements. Rollers have a greater contact area than balls so that the roller guideway features higher load capacity and greater rigidity. The figure shows the rigidity of a roller and a ball with equal volume.



(3) Super high load capacity

With the four rows of rollers arranged at a contact angle of 45-degrees, the RG series linear guideway has equal load ratings in the radial, reverse radial and lateral directions. The RG series has a higher load capacity in a smaller size than conventional, ball-type linear guideways.



(4) Operating life increased

Compare with the ball element, the contact pressure of rolling element is distributed on the line region. Therefore, stress concentration was reduced siginificantly and the RG series offers longer running life. The nominal life of RG series can be calculated by using Eq.

The acting load will affect the nominal life of a linear guideway. Based on the selected basic dynamic rated load and the actual load. The nominal life of ball type and roller type linear guideway can be calculated by Eq.2.5 respectively.

$$L=\left(\frac{C}{P}\right)^{\frac{10}{3}}\cdot 100km=\left(\frac{C}{P}\right)^{\frac{10}{3}}\cdot 62mile \quad \text{Eq. 2.5}$$

If the environmental factors are taken into consideration, the nominal life is influenced greatly by the motion conditions, the hardness of the raceway, and the temperature of the linear guideway. The relationship between these factors is expressed in Eq.2.6.

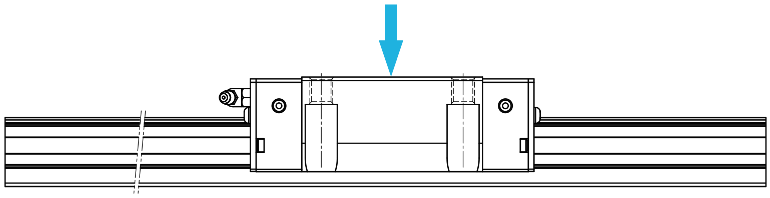
$$L=\left(\frac{f_h\cdot f_t\cdot C}{f_w\cdot P}\right)^{\frac{10}{3}}\cdot 100km=\left(\frac{f_h\cdot f_t\cdot C}{f_w\cdot P}\right)^{\frac{10}{3}}\cdot 62mile \quad \text{Eq. 2.6}$$

L : Nominal life
C : Basic dynamic load rating
P : Actual load

f_h : Hardness factor
f_t : Temperature factor
f_W : Load factor

(5) Test Data

1. Nominal life test

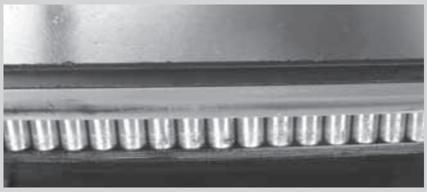


Model of the test system

Table 2-9-1

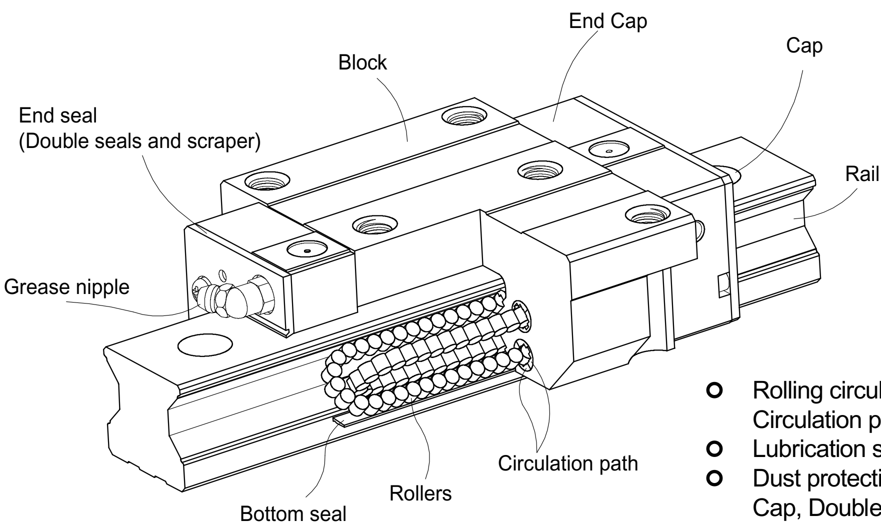
Tested model 1: RGH35CA Preload: ZA class Max. Speed: 60m/min Acceleration: 1G Stroke: 0.55m Lubrication: grease held every 100km External load: 15kN Traveling distance: 1135km	Test results: The nominal life of RGH35CA is 1000km. After traveling 1135km, fatigue flaking did not appear on the surface of the raceway or rollers. 

2. Durability Test

Tested model 2: RGW35CC Preload: ZA class Max. Speed: 120m/min Acceleration: 1G Stroke: 2m Lubrication: oil feed rate: 0.3cm ^{3}/hr External load: 0kN Traveling distance: 15000km	Test results: Fatigue flaking did not appear on the surface of the raceway or rollers after traveling 15000km. 

Note: The data listed are from samples.

2-4-2 Construction of RG Series



- Rolling circulation system: Block, Rail, End cap, Circulation path, rollers
- Lubrication system: Grease nipple and piping joint
- Dust protection system: End seal, Bottom seal, Cap, Double seals and Scraper

RG Series

High Rigidity Roller Type

2-4-3 Model Number of RG series

RG series linear guideways are classified into non-interchangeable and interchangeable types. The sizes of these two types are the same as one another. The main difference is that the interchangeable type of blocks and rails can be freely exchanged and they can maintainP-class accuracy. Because of strict dimensional control, the interchangeable type linear guideways are a wise choice for customers when rails do not need to be matched for an axis. The model number of the RG series identifies the size, type, accuracy class, preload class, etc.

(1) Non-interchangeable type

RG W 35 C C E 2 R 1640 E ZA P II + KK/E2/RC

- RG: RGSeries
- W: Block Type
  - W : Flange Type
  - H : Square Type
  - L : Square Type (Low)[3]
- 35: Model size
  - 15,20,25, 30, 35, 45, 55, 65
- C: Load Type
  - C : Heavy Load
  - H : Super Heavy Load
- C: Block Mounting
  - A : Mounting From Top
  - C : Top or Bottom
- E: E: Special Block / None: Standard Block
- 2: No. of Blocks per Rail
- R: Rail Mounting Type
  - R : Mounting From Top
  - T : Bottom
- 1640: Rail Length (mm)
- E: E: Special Rail / None: Standard Rail
- ZA: Preload Code: Z0, ZA, ZB
- P: Precision Code: H,P, SP, UP
- II: No. of Rails per matched set[1]
- KK: Dust Protection[2]
- E2: Self-Lubricant
- RC: Reinforced Cap

Note: 1. The roman numerals express a matched set of rails.
2. No symbol indicates standard protection (end seal and bottom seal).
ZZ : End seal, bottom seal and scraper
KK: Double seals, bottom seal and scraper.
DD: Double seals and bottom seal
3. Block type RGL is the low profile design of RGH (square type), the assembled height is same as RGW (flange type) in same size.

(2) Interchangeable type

Model Number of RG Block

RG W 25 C A E ZA P + ZZ/E2

- RG: RGSeries
- W: Block Type
  - W : Flange Type
  - H : Square Type
  - L : Square Type (Low)[3]
- 25: Model size
  - 15,20,25, 30, 35, 45, 55, 65
- C: Load Type
  - C : Heavy Load
  - H : Super Heavy Load
- A: Block Mounting Type
  - A : Mounting From Top
  - C : Top or Bottom
- E: E: Special Block / None: Standard block
- ZA: Preload Code : Z0, ZA
- P: Precision Code : H,P
- ZZ: Dust Protection[2]
- E2: Self-Lubricant

Model Number of RG Rail

RG R 25 R 1240 E P + RC

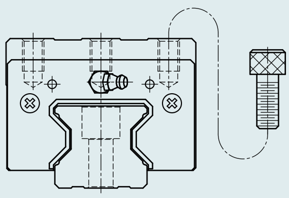
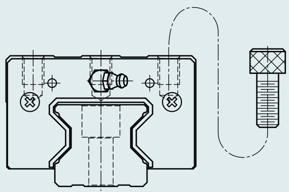
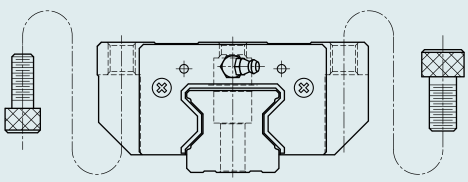
- RG: RGSeries
- R: Interchangeable Rail
- 25: Model size
  - 15,20,25, 30, 35, 45, 55, 65
- R: Rail Mounting Type
  - R : Mounting From Top
  - T : Bottom
- 1240: Rail Length (mm)
- E: E: Special Rail, / None: Standard Rail
- P: Precision Code : H,P
- RC: RC:Reinforced Cap

2-4-4 Types

(1) Block types

SIMTACH offers two types of guide blocks, flange and square type. Because of the low assembly height and large mounting surface, the flange type is excellent for heavy moment load applications.

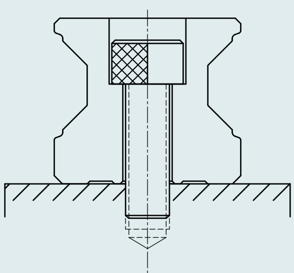
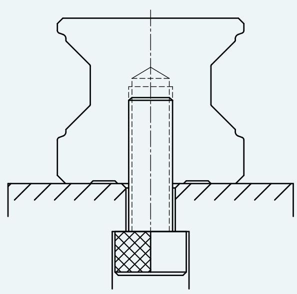
Table 2-9-2 **Block Types**

Type	Model	Shape	Height (mm)	Rail Length (mm)	Main Applications
Square	RGH-CA RGH-HA		28 ↓ 90	100 ↓ 4000	○ Automation Systems ○ Transportation equipment ○ CNC machining centers ○ Heavy duty cutting machines ○ CNC grinding machines ○ Injection molding machines ○ Plano millers ○ Devices requiring high rigidity ○ Devices requiring high load capacity ○ Electric discharge machines
Square	RGL-CA RGL-HA		24 ↓ 70	100 ↓ 4000	
Flange	RGW-CC RGW-HC		24 ↓ 90	100 ↓ 4000	

(2) Rail types

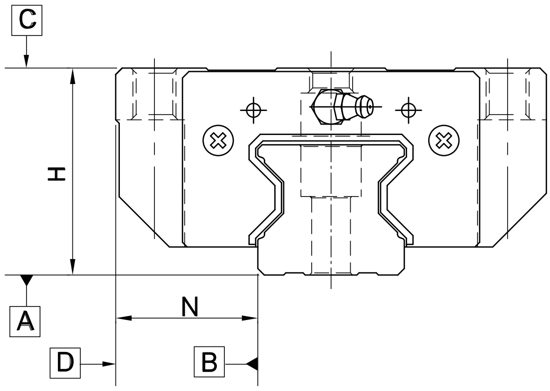
In addition to the standard top mounting type, SIMTACH also offers the bottom mounting type of rails.

Table 2-9-3 **Rail Types**

Mounting from Top	Mounting from Bottom
	

2-4-5 Accuracy Classes

The accuracy of the RG series can be classified into four classes: high (H), precision (P), super precision (SP) and ultra precision (UP). Customers may choose the class by referencing the accuracy requirements of the applied equipment.



(1) Accuracy of non-interchangeable

Table 2-9-4 **Accuracy Standards**

Unit: mm

Item	RG - 15, 20			
Accuracy Classes	High (H)	Precision (P)	Super Precision (SP)	Ultra Precision (UP)
Dimensional tolerance of height H	± 0.03	0 - 0.03	0 - 0.015	0 - 0.008
Dimensional tolerance of width N	± 0.03	0 - 0.03	0 - 0.015	0 - 0.008
Variation of height H	0.01	0.006	0.004	0.003
Variation of width N	0.01	0.006	0.004	0.003
Running parallelism of block surface C to surface A	See Table 2-9-12			
Running parallelism of block surface D to surface B	See Table 2-9-12			

Table 2-9-5 **Accuracy Standards**

Unit: mm

Item	RG - 25, 30, 35			
Accuracy Classes	High (H)	Precision (P)	Super Precision (SP)	Ultra Precision (UP)
Dimensional tolerance of height H	± 0.04	0 - 0.04	0 - 0.02	0 - 0.01
Dimensional tolerance of width N	± 0.04	0 - 0.04	0 - 0.02	0 - 0.01
Variation of height H	0.015	0.007	0.005	0.003
Variation of width N	0.015	0.007	0.005	0.003
Running parallelism of block surface C to surface A	See Table 2-9-12			
Running parallelism of block surface D to surface B	See Table 2-9-12			

Table 2-9-6 **Accuracy Standards**

Unit: mm

Item	RG - 45, 55			
Accuracy Classes	High (H)	Precision (P)	Super Precision (SP)	Ultra Precision (UP)
Dimensional tolerance of height H	± 0.05	0 - 0.05	0 - 0.03	0 - 0.02
Dimensional tolerance of width N	± 0.05	0 - 0.05	0 - 0.03	0 - 0.02
Variation of height H	0.015	0.007	0.005	0.003
Variation of width N	0.02	0.01	0.007	0.005
Running parallelism of block surface C to surface A	See Table 2-9-12			
Running parallelism of block surface D to surface B	See Table 2-9-12			

Table 2-9-7 **Accuracy Standards**

Unit: mm

Item	RG - 65			
Accuracy Classes	High (H)	Precision (P)	Super Precision (SP)	Ultra Precision (UP)
Dimensional tolerance of height H	± 0.07	0 - 0.07	0 - 0.05	0 - 0.03
Dimensional tolerance of width N	± 0.07	0 - 0.07	0 - 0.05	0 - 0.03
Variation of height H	0.02	0.01	0.007	0.005
Variation of width N	0.025	0.015	0.01	0.007
Running parallelism of block surface C to surface A	See Table 2-9-12			
Running parallelism of block surface D to surface B	See Table 2-9-12			

(2) Accuracy of interchangeable

Table 2-9-8 **Accuracy Standards**

Unit: mm

Item	RG - 15, 20	
Accuracy Classes	High (H)	Precision (P)
Dimensional tolerance of height H	± 0.03	± 0.015
Dimensional tolerance of width N	± 0.03	± 0.015
Variation of height H	0.01	0.006
Variation of width N	0.01	0.006
Running parallelism of block surface C to surface A	See Table 2-9-12	
Running parallelism of block surface D to surface B	See Table 2-9-12	

Table 2-9-9 **Accuracy Standards**

Unit: mm

Item	RG - 25, 30, 35	
Accuracy Classes	High (H)	Precision (P)
Dimensional tolerance of height H	± 0.04	± 0.02
Dimensional tolerance of width N	± 0.04	± 0.02
Variation of height H	0.015	0.007
Variation of width N	0.015	0.007
Running parallelism of block surface C to surface A	See Table 2-9-12	
Running parallelism of block surface D to surface B	See Table 2-9-12	

Table 2-9-10 **Accuracy Standards**

Unit: mm

Item	RG - 45, 55	
Accuracy Classes	High (H)	Precision (P)
Dimensional tolerance of height H	± 0.05	± 0.025
Dimensional tolerance of width N	± 0.05	± 0.025
Variation of height H	0.015	0.007
Variation of width N	0.02	0.01
Running parallelism of block surface C to surface A	See Table 2-9-12	
Running parallelism of block surface D to surface B	See Table 2-9-12	

Table 2-9-11 **Accuracy Standards**

Unit: mm

Item	RG - 65	
Accuracy Classes	High (H)	Precision (P)
Dimensional tolerance of height H	± 0.07	± 0.035
Dimensional tolerance of width N	± 0.07	± 0.035
Variation of height H	0.02	0.01
Variation of width N	0.025	0.015
Running parallelism of block surface C to surface A	See Table 2-9-12	
Running parallelism of block surface D to surface B	See Table 2-9-12	

(3) Accuracy of running parallelism

Table 2-9-12 **Accuracy of Running Parallelism**

Rail Length (mm)	Accuracy (μm)			
	H	P	SP	UP
~ 100	7	3	2	2
100 ~ 200	9	4	2	2
200 ~ 300	10	5	3	2
300 ~ 500	12	6	3	2
500 ~ 700	13	7	4	2
700 ~ 900	15	8	5	3
900 ~ 1,100	16	9	6	3
1,100 ~ 1,500	18	11	7	4
1,500 ~ 1,900	20	13	8	4
1,900 ~ 2,500	22	15	10	5
2,500 ~ 3,100	25	18	11	6
3,100 ~ 3,600	27	20	14	7
3,600 ~ 4,000	28	21	15	7

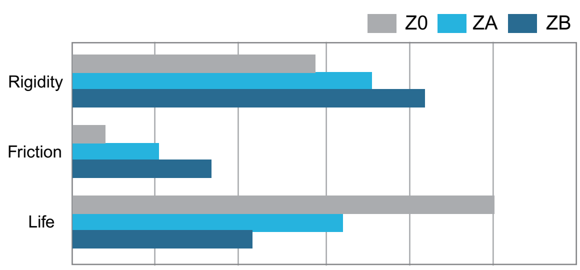
2-4-6 Preload

A preload can be applied to each guideway using oversized rollers. Generally, a linear motion guideway has negative clearance between the raceway and rollers to improve stiffness and maintain high precision. The RG series linear guideway offers three standard preloads for various applications and conditions.

Table 2-9-13

Class	Code	Preload	Condition
Light Preload	Z0	0.02C~ 0.04C	Certain load direction, low impact, low precision required
Medium Preload	ZA	0.07C~0.09C	High rigidity required, high precision required
HeavyPreload	ZB	0.12C~ 0.14C	Super high rigidity required, with vibration and impact

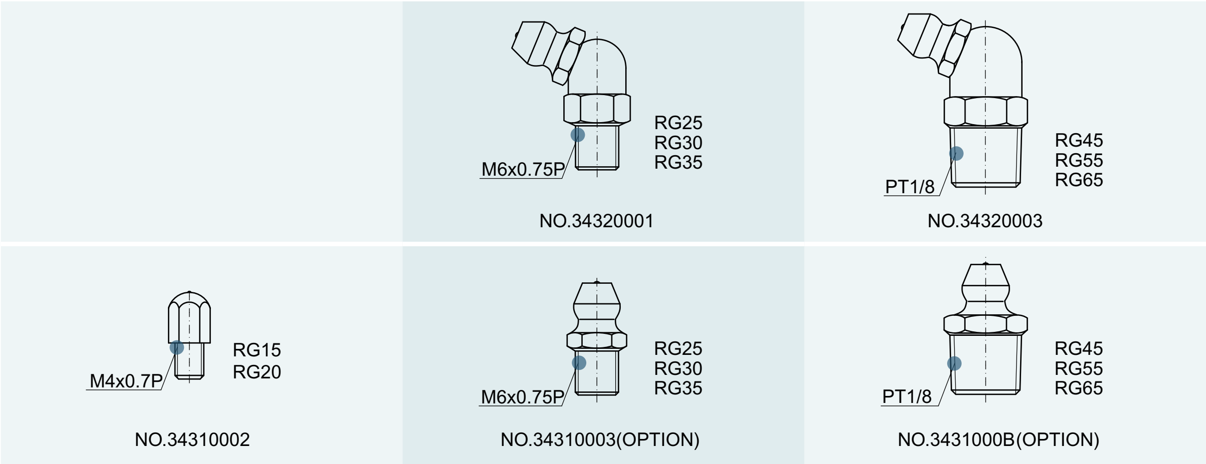
The figure shows the relationship between the rigidity, friction and nominal life. A preload no larger than ZA would be recommended for smaller model sizes to avoid over-preload affecting the life of the guideway.



2-4-7 Lubrication

(1) Grease

Grease nipple



Mounting location

The standard location of the grease fitting is at both ends of the block, but the nipple can be mounted in the side or the top 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 carry out the lubrication by using an oil-piping joint. The figure shows the locations of the grease fitting.

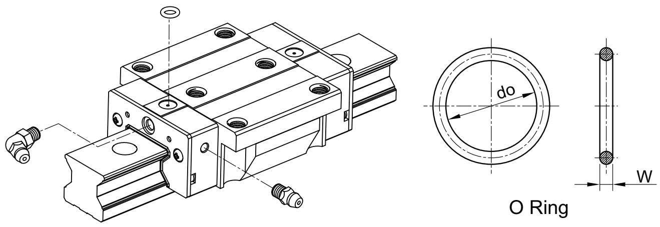
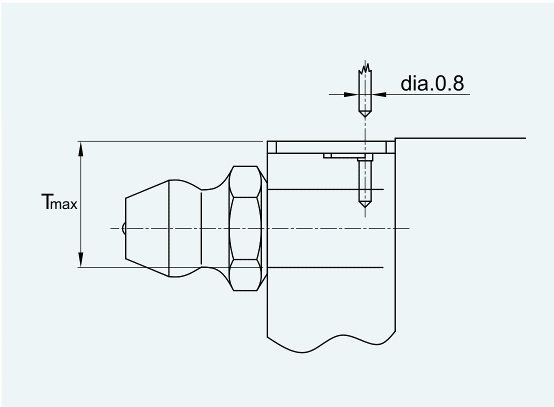


Table 2-9-14 **O-Ring size and max. permissible depth for piercing**

Size	O-Ring		Lube hole at top: max. permissible depth for piercing
	do (mm)	W (mm)	T_{max} (mm)
RG15	2.5±0.15	1.5±0.15	3.45
RG20	2.5±0.15	1.5±0.15	4
RG25	7.5±0.15	1.5±0.15	5.8
RG30	7.5±0.15	1.5±0.15	6.2
RG35	7.5±0.15	1.5±0.15	8.65
RG45	7.5±0.15	1.5±0.15	9.5
RG55	7.5±0.15	1.5±0.15	11.6
RG65	7.5±0.15	1.5±0.15	14.5



The oil amount for a block filled with grease

Table 2-9-15 **The oil amount for a block filled with grease**

Size	Heavy Load(cm³)	Super Heavy Load(cm³)	Size	Heavy Load(cm³)	Super Heavy Load(cm³)
RG15	3	-	RG35	12	14
RG20	5	6	RG45	19	23
RG25	7	8	RG55	28	35
RG30	9	10	RG65	52	63

Frequency of replenishment

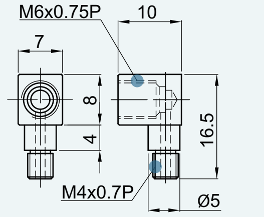
Check the grease every 100 km, or every 3-6 months.

(2) Oil

The recommended viscosity of oil is about 32~150c St. If you need to use oil-type lubrication, please inform us.

- Types of oil piping joint

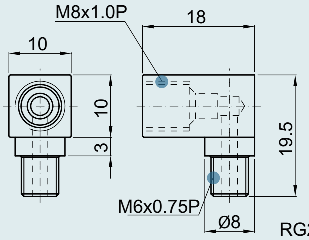
LF-64



RG15
RG20

NO.97000EA1

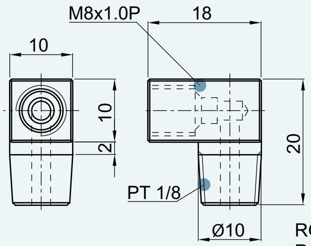
LF-76



RG25
RG30
RG35

NO.970002A1

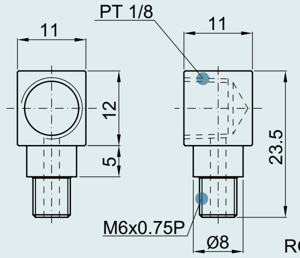
LF-78



RG45
RG55
RG65

NO.970006A1

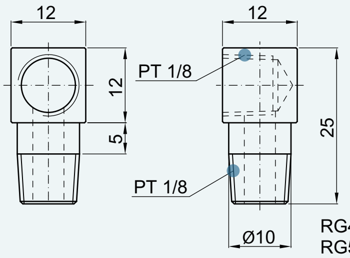
LF-86



RG25
RG30
RG35

NO.970004A1

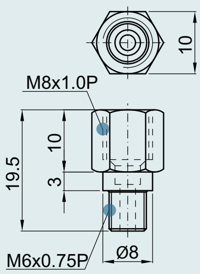
LF-88



RG45
RG55
RG65

NO.970008A1

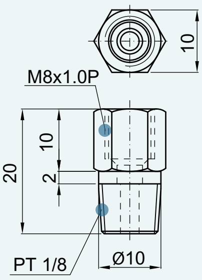
SF-76



RG25
RG30
RG35

NO.970001A1

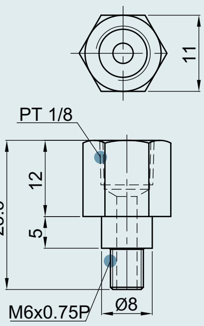
SF-78



RG45
RG55
RG65

NO.970005A1

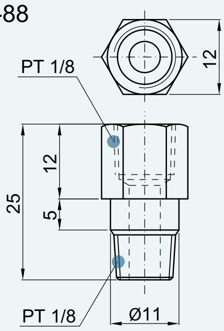
SF-86



RG25
RG30
RG35

NO.970003A1

SF-88



RG45
RG55
RG65

NO.970007A1

Oil feeding rate

Table 2-9-16 **oil feed rate**

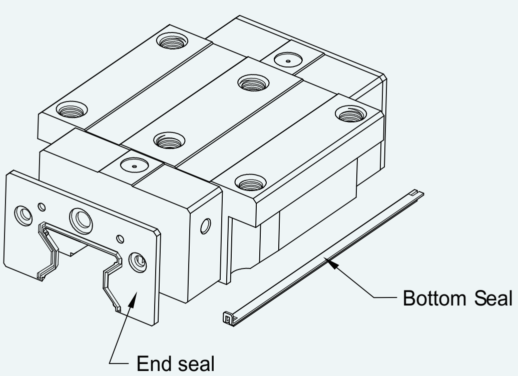
Size	Feed rate (cm³/hr)
RG15	0.14
RG20	0.14
RG25	0.167
RG30	0.2
RG35	0.23
RG45	0.3
RG55	0.367
RG65	0.433

2-4-8 Dust Proof Accessories

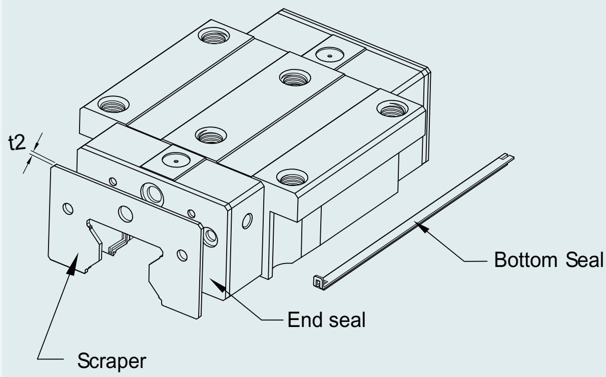
(1) Codes of accessories

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

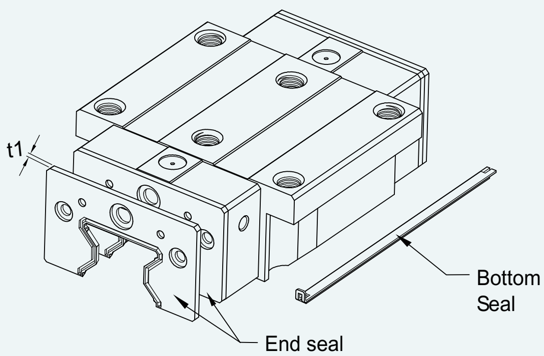
Table 2-9-17



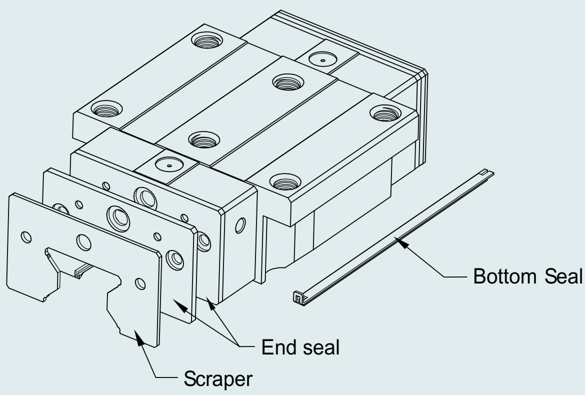
No symbol: Standard Protection (End seal + Bottom Seal)



ZZ (End seal + Bottom Seal + Scraper)



DD (Double seals + Bottom Seal)



KK (Double seals + Bottom Seal + Scraper)

(2) End seal and bottom seal
To prevent life reduction caused by iron chips or dust entering the block.

(3) Double seals
Enhances the wiping effect, foreign matter can be completely wiped off.

Table 2-9-18 **Dimensions of end seal**

Size	Thickness (t1) (mm)	Size	Thickness (t1) (mm)
RG15 ES	2.2	RG35 ES	2.5
RG20 ES	2.2	RG45 ES	3.6
RG25 ES	2.2	RG55 ES	3.6
RG30 ES	2.4	RG65 ES	4.4

(4) Scraper
The scraper removes high-temperature iron chips and larger foreign objects.

Table 2-9-19 **Dimensions of scraper**

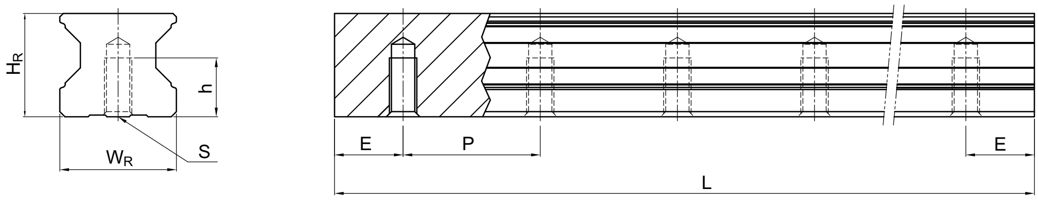
Size	Thickness (t2) (mm)	Size	Thickness (t2) (mm)
RG15 SC	1.0	RG35 SC	1.5
RG20 SC	1.0	RG45 SC	1.5
RG25 SC	1.0	RG55 SC	1.5
RG30 SC	1.5	RG65 SC	1.5

(5) Bolt caps for rail mounting holes
Caps are used to cover the mounting holes to prevent chips or other foreign objects from collecting in the holes. The caps will be enclosed in each rail package.

Table 2-9-20 **Dimensions of Bolt Caps for Rail Mounting Holes**

Rail size	Bolt size	Diameter(D) (mm)	Thickness(H) (mm)	Rail size	Bolt size	Diameter(D) (mm)	Thickness(H) (mm)
RGR15	M4	7.65	1.1	RGR35	M8	14.3	3.3
RGR20	M5	9.65	2.2	RGR45	M12	20.3	4.6
RGR25	M6	11.15	2.5	RGR55	M14	23.5	5.5
RGR30	M8	14.2	3.3	RGR65	M16	26.6	5.5

(4) Dimensions for RGR-T (Rail Mounting from Bottom)



Model No.	Dimensions of Rail (mm)						Weight
	W_R	H_R	S	h	P	E	(kg/m)
RGR15T	15	16.5	M5×0.8P	8	30	20	1.86
RGR20T	20	21	M6×1P	10	30	20	2.76
RGR25T	23	23.6	M6×1P	12	30	20	3.36
RGR30T	28	28	M8×1.25P	15	40	20	4.82
RGR35T	34	30.2	M8×1.25P	17	40	20	6.48
RGR45T	45	38	M12×1.75P	24	52.5	22.5	10.83
RGR55T	53	44	M14×2P	24	60	30	15.15
RGR65T	63	53	M20×2.5P	30	75	35	21.24

2-4-9 Friction

The maximum value of resistance per end seal are as shown in the table.

Table 2-9-22 **Seal Resistance**

Size	Resistance N (kgf)	Size	Resistance N (kgf)
RG15	1.96 (0.2)	RG35	3.53 (0.36)
RG20	2.45 (0.25)	RG45	4.21 (0.43)
RG25	2.74 (0.28)	RG55	5.09 (0.52)
RG30	3.31 (0.31)	RG65	6.66 (0.68)

2-4-10 The Accuracy Tolerance of Mounting Surface

(1) The accuracy tolerance of rail-mounting surface

As long as the accuracy requirements of the mounting surfaces shown in the following tables are met, the high accuracy, high rigidity and long life of the RG series linear guideway will be maintained without any difficulty.

- The parallelism tolerance of reference surface (P)

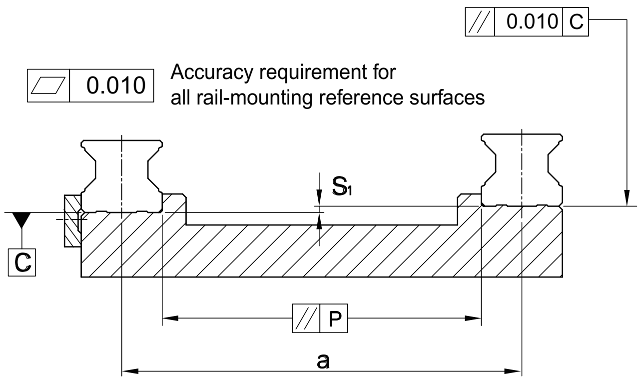


Table 2-9-23 **Max. Parallelism Tolerance (P)**

unit: μm

Size	Preload classes		
	Light Preload (Z0)	Medium Preload (ZA)	Heavy Preload (ZB)
RG15	5	3	3
RG20	8	6	4
RG25	9	7	5
RG30	11	8	6
RG35	14	10	7
RG45	17	13	9
RG55	21	14	11
RG65	27	18	14

- The accuracy tolerance of reference surface height (S_1)

$$S_1 = a \times K$$

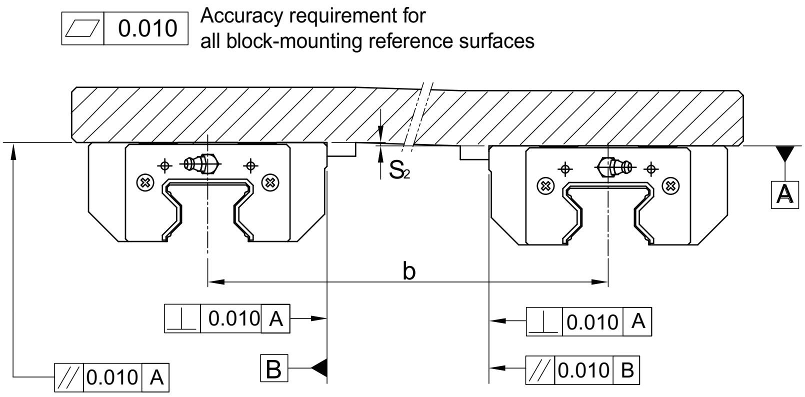
S_1 : Max. tolerance of height
a : Distance between paired rails
K : Coefficient of tolerance of height

Table 2-9-24 **Coefficient of tolerance of height**

Size	Preload classes		
	Light Preload (Z0)	Medium Preload (ZA)	Heavy Preload (ZB)
K	2.2×10^{-4}	1.7×10^{-4}	1.2×10^{-4}

(2) The accuracy tolerance of block-mounting surface

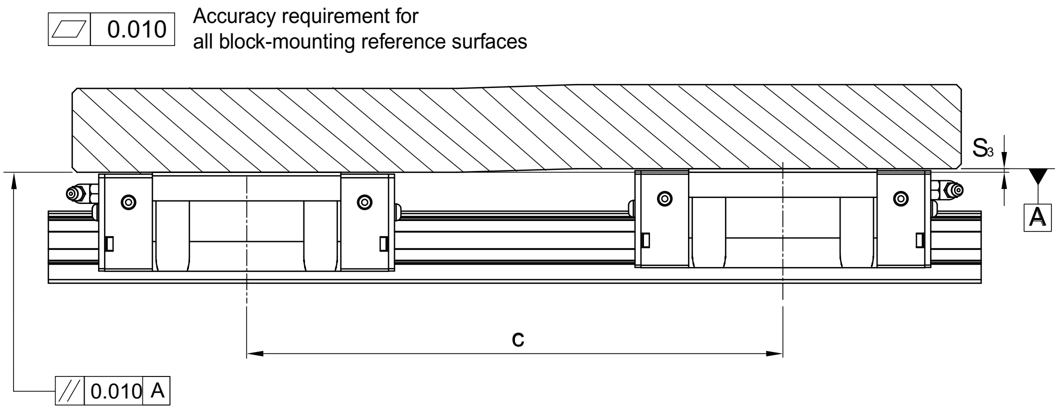
- The tolerance of the height of reference surface when two or more pieces are used in parallel (S_2)



$$S_2 = b \times 4.2 \times 10^{-5}$$

S_2 : Max. tolerance of height
b : Distance between paired blocks

- The tolerance of the height of reference surface when two or more pieces are used in parallel (S_3)



$$S_3 = c \times 4.2 \times 10^{-5}$$

S_3 : Max. tolerance of height
c : Distance between paired blocks

2-4-11 Cautions for Installation

(1) Shoulder heights and fillets

Improper shoulder heights and fillets of mounting surfaces will cause a deviation in accuracy and interference with the chamfered part of the rail or block.

By following the recommended shoulder heights and fillets, accuracy problems in installation can be eliminated.

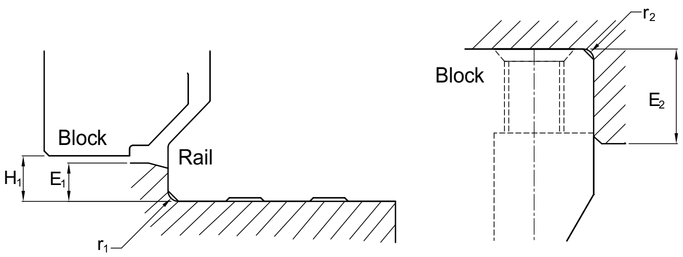


Table 2-9-25

Size	Max. radius of fillets r_1 (mm)	Max. radius of fillets r_2 (mm)	Shoulder height of the rail E_1 (mm)	Shoulder height of the block E_2 (mm)	Clearance under block H_1 (mm)
RG15	0.5	0.5	3	4	4
RG20	0.5	0.5	3.5	5	5
RG25	1.0	1.0	5	5	5.5
RG30	1.0	1.0	5	5	6
RG35	1.0	1.0	6	6	6.5
RG45	1.0	1.0	7	8	8
RG55	1.5	1.5	9	10	10
RG65	1.5	1.5	10	10	12

(2) Tightening To rque of Mounting Bolts

Improper tightening of mounting bolts will seriously influence the accuracy of a linear guideway. The following tightening torque for the different sizes of bolt is recommended.

Table 2-9-26

Size	Bolt size	Torque N-cm(kgf-cm)		
		Iron	Casting	Aluminum
RG15	M4×0.7P×16L	392 (40)	274 (28)	206 (21)
RG20	M5×0.8P×20L	883 (90)	588 (60)	441 (45)
RG25	M6×1P×20L	1373 (140)	921 (94)	686 (70)
RG30	M8×1.25P×25L	3041 (310)	2010 (205)	1470 (150)
RG35	M8×1.25P×25L	3041 (310)	2010 (205)	1470 (150)
RG45	M12×1.75P×35L	11772 (1200)	7840 (800)	5880 (600)
RG55	M14×2P×45L	15696 (1600)	10500 (1100)	7840 (800)
RG65	M16×2P×50L	19620 (2000)	13100 (1350)	9800 (1000)

2-4-12 Standard and Maximum Lengths of Rail

SIMTACH offers a number of standard rail lengths. Standard rail lengths feature end mounting hole placements set to predetermined values (E). For non-standard rail lengths, be sure to specify the E-value to be no greater than 1/2 the pitch (P) dimension. An E-value greater than this will result in unstable rail ends.

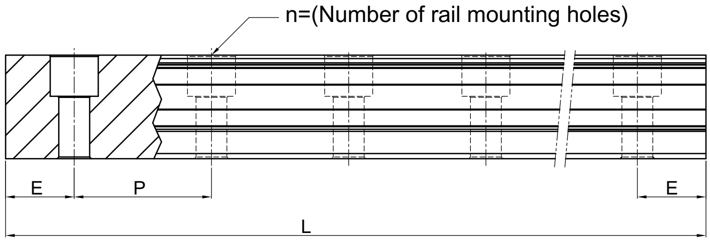


Table 2-9-27

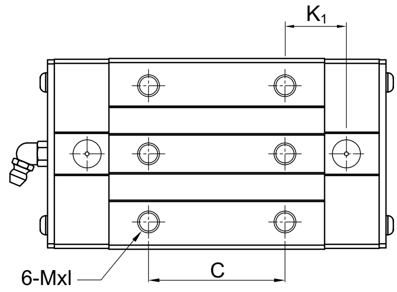
unit: mm

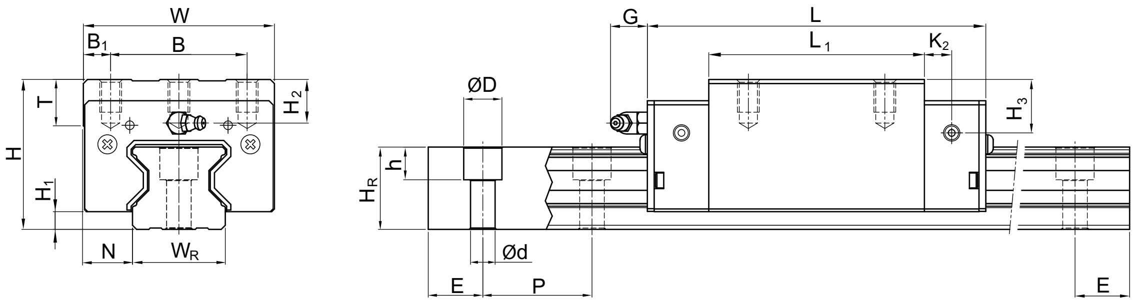
Item	RGR15	RGR20	RGR25	RGR30	RGR35	RGR45	RGR55	RGR65
Standard Length L(n)	160 (5)	220 (7)	220 (7)	280 (7)	280 (7)	570 (11)	780 (13)	1,270 (17)
	220 (7)	280 (9)	280 (9)	440 (11)	440 (11)	885 (17)	1020 (17)	1,570 (21)
	340 (11)	340 (11)	340 (11)	600 (15)	600 (15)	1,200 (23)	1,260 (21)	2,020 (27)
	460 (15)	460 (15)	460 (15)	760 (19)	760 (19)	1,620 (31)	1,500 (25)	2,620 (35)
	580 (19)	640 (21)	640 (21)	1,000 (25)	1,000 (25)	2,040 (39)	1,980 (33)	-
	700 (23)	820 (27)	820 (27)	1,640 (41)	1,640 (41)	2,460 (47)	2,580 (43)	-
	940 (31)	1000 (33)	1,000 (33)	2,040 (51)	2,040 (51)	2,985 (57)	2,940 (49)	
	1120 (37)	1180 (39)	1,240 (41)	2,520 (63)	2,520 (63)	3,090 (59)	3,060 (51)	-
	1360 (45)	1360 (45)	1,600 (53)	3,000 (75)	3,000 (75)	-	-	-
Pitch (P)	30	30	30	40	40	52.5	60	75
Distance to End (E_s)	20	20	20	20	20	22.5	30	35
Max. Standard Length	4,000 (133)	4,000 (133)	4,000 (133)	4,000 (100)	4,000 (100)	3,982.5 (76)	3,960 (66)	3,970 (53)
Max. Length	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000

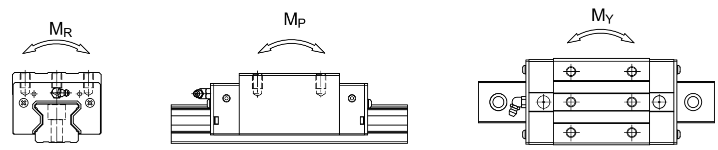
Note : 1. Tolerance of E value for standard rail is 0.5~-0.5 mm. Tolerance of E value for jointed rail is 0~-0.3 mm.
2. Maximum standard length means the max. rail length with standard E value on both sides.
3. If different E value is needed, please contact SIMTACH.

2-4-13 Dimensions for RG series

(1) RGH-CA / RGH-HA





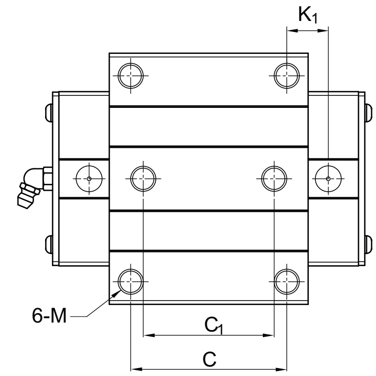


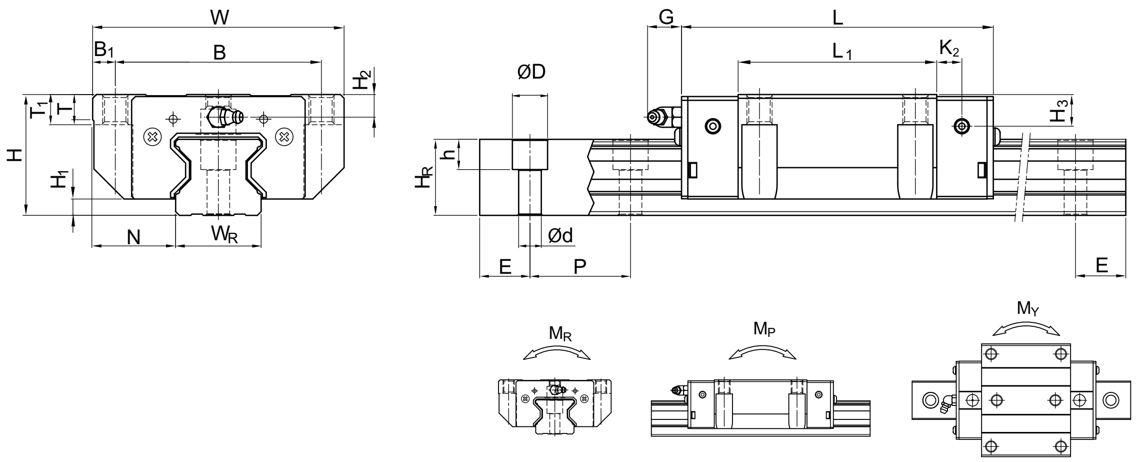
Model No.	Dimensions of Assembly (mm)			Dimensions of Block (mm)												Dimensions of Rail (mm)								Mounting Bolt for Rail	Basic Dynamic Load Rating	Basic Static Load Rating	Static Rated Moment			Weight	
	H	H_1	N	W	B	B_1	C	L_1	L	K_1	K_2	G	MxI	T	H_2	H_3	W_R	H_R	D	h	d	P	E	(mm)	C(kN)	C_0 (kN)	M_R kN-m	M_P kN-m	M_Y kN-m	Block kg	Rail kg/m
RGH15CA	28	4	9.5	34	26	4	26	45	68	13.4	4.7	5.3	M4 x 8	6	7.6	10.1	15	16.5	7.5	5.7	4.5	30	20	M4 x16	11.3	24	0.311	0.173	0.173	0.20	1.8
RGH20CA	34	5	12	44	32	6	36	57.5	86	15.8	6	5.3	M5 x 8	8	8.3	8.3	20	21	9.5	8.5	6	30	20	M5 x20	21.3	46.7	0.647	0.46	0.46	0.40	2.76
RGH20HA							50	77.5	106	18.8															26.9	63	0.872	0.837	0.837	0.53	
RGH25CA	40	5.5	12.5	48	35	6.5	35	64.5	97.9	20.75	7.25	12	M6 x 8	9.5	10.2	10	23	23.6	11	9	7	30	20	M6 x20	27.7	57.1	0.758	0.605	0.605	0.61	3.08
RGH25HA							50	81	114.4	21.5															33.9	73.4	0.975	0.991	0.991	0.75	
RGH30CA	45	6	16	60	40	10	40	71	109.8	23.5	8	12	M8 x10	9.5	9.5	10.3	28	28	14	12	9	40	20	M8 x25	39.1	82.1	1.445	1.06	1.06	0.90	4.41
RGH30HA							60	93	131.8	24.5															48.1	105	1.846	1.712	1.712	1.16	
RGH35CA	55	6.5	18	70	50	10	50	79	124	22.5	10	12	M8 x12	12	16	19.6	34	30.2	14	12	9	40	20	M8 x25	57.9	105.2	2.17	1.44	1.44	1.57	6.06
RGH35HA							72	106.5	151.5	25.25															73.1	142	2.93	2.6	2.6	2.06	
RGH45CA	70	8	20.5	86	60	13	60	106	153.2	31	10	12.9	M10x17	16	20	24	45	38	20	17	14	52.5	22.5	M12 x35	92.6	178.8	4.52	3.05	3.05	3.18	9.97
RGH45HA							80	139.8	187	37.9															116	230.9	6.33	5.47	5.47	4.13	
RGH55CA	80	10	23.5	100	75	12.5	75	125.5	183.7	37.75	12.5	12.9	M12x18	17.5	22	27.5	53	44	23	20	16	60	30	M14 x45	130.5	252	8.01	5.4	5.4	4.89	13.98
RGH55HA							95	173.8	232	51.9															167.8	348	11.15	10.25	10.25	6.68	
RGH65CA	90	12	31.5	126	76	25	70	160	232	60.8	15.8	12.9	M16 x20	25	15	15	63	53	26	22	18	75	35	M16x50	213	411.6	16.20	11.59	11.59	8.89	20.22
RGH65HA							120	223	295	67.3															275.3	572.7	22.55	22.17	22.17	12.13	

Note : 1. 1 kgf = 9.81 N

2. The theoretical dynamic rated load is C_{100R}, if necessary C_{50R} conversion formula is as follows : $C_{50R} = 1.23 \times C_{100R}$

(2) RGW-CC/ RGW-HC



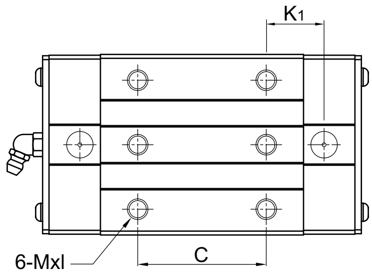


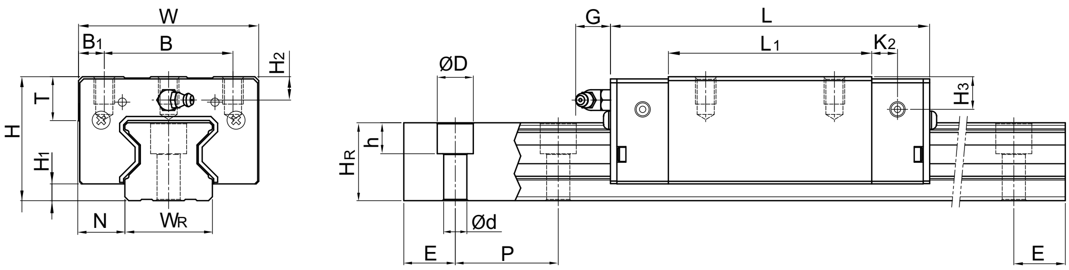
Model No.	Dimensions of Assembly (mm)			Dimensions of Block (mm)															Dimensions of Rail (mm)							Mounting Bolt for Rail	Basic Dynamic Load Rating	Basic Static Load Rating	Static Rated Moment			Weight	
	H	H_1	N	W	B	B_1	C	C_1	L_1	L	K_1	K_2	G	M	T	T_1	H_2	H_3	W_R	H_R	D	h	d	P	E	(mm)	C(kN)	C_0 (kN)	M_R kN-m	M_P kN-m	M_Y kN-m	Block kg	Rail kg/m
RGW15CC	24	4	16	47	38	4.5	30	26	45	68	11.4	4.7	5.3	M5	6	6.95	3.6	6.1	15	16.5	7.5	5.7	4.5	30	20	M4x16	11.3	24	0.311	0.173	0.173	0.22	1.8
RGW20CC	30	5	21.5	63	53	5	40	35	57.5	86	13.8	6	5.3	M6	8	10	4.3	4.3	20	21	9.5	8.5	6	30	20	M5x20	21.3	46.7	0.647	0.46	0.46	0.47	2.76
RGW20HC									77.5	106	23.8																26.9	63	0.872	0.837	0.837	0.63	
RGW25CC	36	5.5	23.5	70	57	6.5	45	40	64.5	97.9	15.75	7.25	12	M8	9.5	10	6.2	6	23	23.6	11	9	7	30	20	M6x20	27.7	57.1	0.758	0.605	0.605	0.72	3.08
RGW25HC									81	114.4	24																33.9	73.4	0.975	0.991	0.991	0.91	
RGW30CC	42	6	31	90	72	9	52	44	71	109.8	17.5	8	12	M10	9.5	10	6.5	7.3	28	28	14	12	9	40	20	M8x25	39.1	82.1	1.445	1.06	1.06	1.16	4.41
RGW30HC									93	131.8	28.5																48.1	105	1.846	1.712	1.712	1.52	
RGW35CC	48	6.5	33	100	82	9	62	52	79	124	16.5	10	12	M10	12	13	9	12.6	34	30.2	14	12	9	40	20	M8x25	57.9	105.2	2.17	1.44	1.44	1.75	6.06
RGW35HC									106.5	151.5	30.25																73.1	142	2.93	2.6	2.6	2.40	
RGW45CC	60	8	37.5	120	100	10	80	60	106	153.2	21	10	12.9	M12	14	15	10	14	45	38	20	17	14	52.5	22.5	M12x35	92.6	178.8	4.52	3.05	3.05	3.43	9.97
RGW45HC									139.8	187	37.9																116	230.9	6.33	5.47	5.47	4.57	
RGW55CC	70	10	43.5	140	116	12	95	70	125.5	183.7	27.75	12.5	12.9	M14	16	17	12	17.5	53	44	23	20	16	60	30	M14x45	130.5	252	8.01	5.4	5.4	5.43	13.98
RGW55HC									173.8	232	51.9																167.8	348	11.15	10.25	10.25	7.61	
RGW65CC	90	12	53.5	170	142	14	110	82	160	232	40.8	15.8	12.9	M16	22	23	15	15	63	53	26	22	18	75	35	M16x50	213	411.6	16.20	11.59	11.59	11.63	20.22
RGW65HC									223	295	72.3																275.3	572.7	22.55	22.17	22.17	16.58	

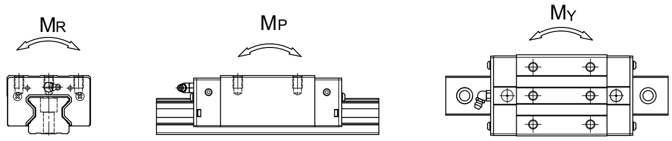
Note : 1. 1 kgf = 9.81 N

2. The theoretical dynamic rated load is C_{100R}, if necessary C_{50R} conversion formula is as follows : $C_{50R} = 1.23 \times C_{100R}$

(3) RGL-CA/ RGL-HA



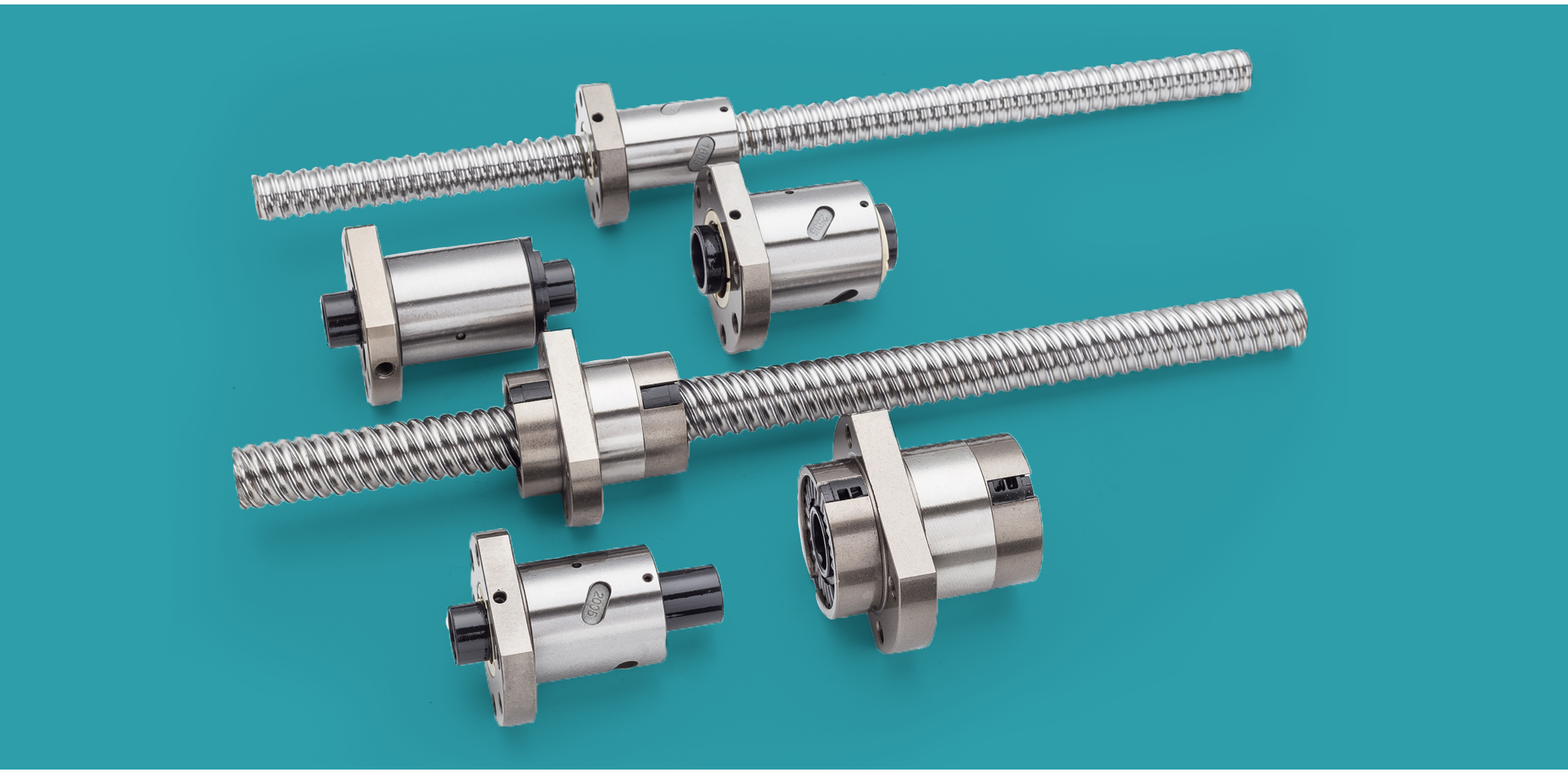




Model No.	Dimensions of Assembly (mm)			Dimensions of Block (mm)													Dimensions of Rail (mm)							Mounting Bolt for Rail	Basic Dynamic Load Rating	Basic Static Load Rating	Static Rated Moment			Weight	
	H	H_1	N	W	B	B_1	C	L_1	L	K_1	K_2	G	MxI	T	H_2	H_3	W_R	H_R	D	h	d	P	E	(mm)	C(kN)	C_0 (kN)	M_R kN-m	M_P kN-m	M_Y kN-m	Block kg	Rai kg/m
RGL15CA	24	4	9.5	34	26	4	26	45	68	13.4	4.7	5.3	M4X5.5	6	3.6	6.1	15	16.5	7.5	5.7	4.5	30	20	M4x16	11.3	24	0.311	0.173	0.173	0.15	1.8
RGL20CA	30	5	12	44	32	6	36	57.5	86	15.8	6	5.3	M5X6	8	4.3	4.3	20	21	9.5	8.5	6	30	20	M5x20	21.3	46.7	0.647	0.46	0.46	0.32	2.76
RGL20HA							50	77.5	106	18.8															26.9	63	0.872	0.837	0.837	0.42	
RGL25CA	36	5.5	12.5	48	35	6.5	35	64.5	97.9	20.75	7.25	12	M6x8	9.5	6.2	6	23	23.6	11	9	7	30	20	M6x20	27.7	57.1	0.758	0.605	0.605	0.51	3.08
RGL25HA							50	81	114.4	21.5															33.9	73.4	0.975	0.991	0.991	0.63	
RGL30CA	42	6	16	60	40	10	40	71	109.8	23.5	8	12	M8x10	9.5	6.5	7.3	28	28	14	12	9	40	20	M8x25	39.1	82.1	1.445	1.06	1.06	0.80	4.41
RGL30HA							60	93	131.8	24.5															48.1	105	1.846	1.712	1.712	1.03	
RGL35CA	48	6.5	18	70	50	10	50	79	124	22.5	10	12	M8x12	12	9	12.6	34	30.2	14	12	9	40	20	M8x25	57.9	105.2	2.17	1.44	1.44	1.27	6.06
RGL35HA							72	106.5	151.5	25.25															73.1	142	2.93	2.6	2.6	1.65	
RGL45CA	60	8	20.5	86	60	13	60	106	153.2	31	10	12.9	M10x17	16	10	14	45	38	20	17	14	52.5	22.5	M12x35	92.6	178.8	4.52	3.05	3.05	2.47	9.97
RGL45HA							80	139.8	187	37.9															116	230.9	6.33	5.47	5.47	3.20	
RGL55CA	70	10	23.5	100	75	12.5	75	125.5	183.7	37.75	12.5	12.9	M12x18	17.5	12	17.5	53	44	23	20	16	60	30	M14x45	130.5	252	8.01	5.4	5.4	3.91	13.98
RGL55HA							95	173.8	232	51.9															167.8	348	11.15	10.25	10.25	5.32	

Note : 1. 1 kgf = 9.81 N

2. The theoretical dynamic rated load is C_{100R}, if necessary C_{50R} conversion formula is as follows : $C_{50R} = 1.23 \times C_{100R}$



BALL SCREW

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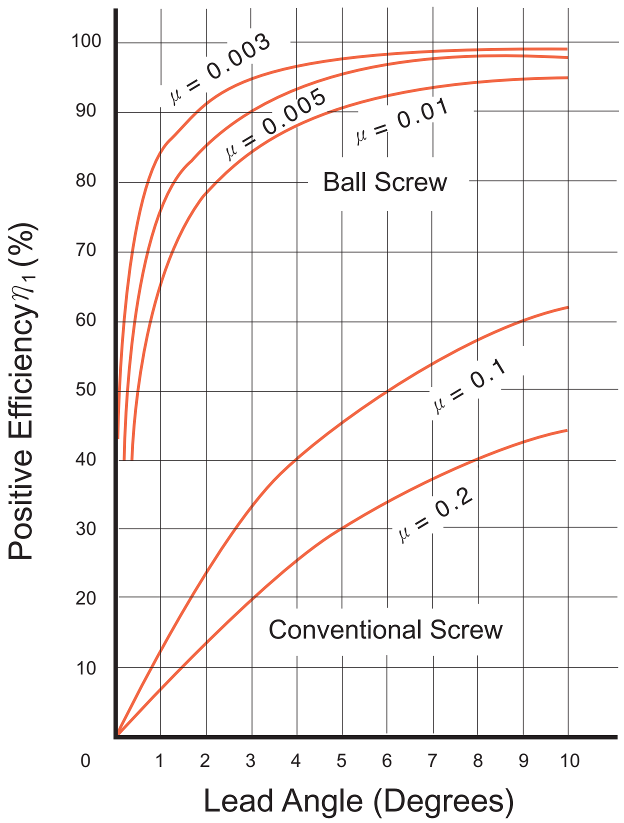
1-1 Features of Ball Screw

(1) High Reliability

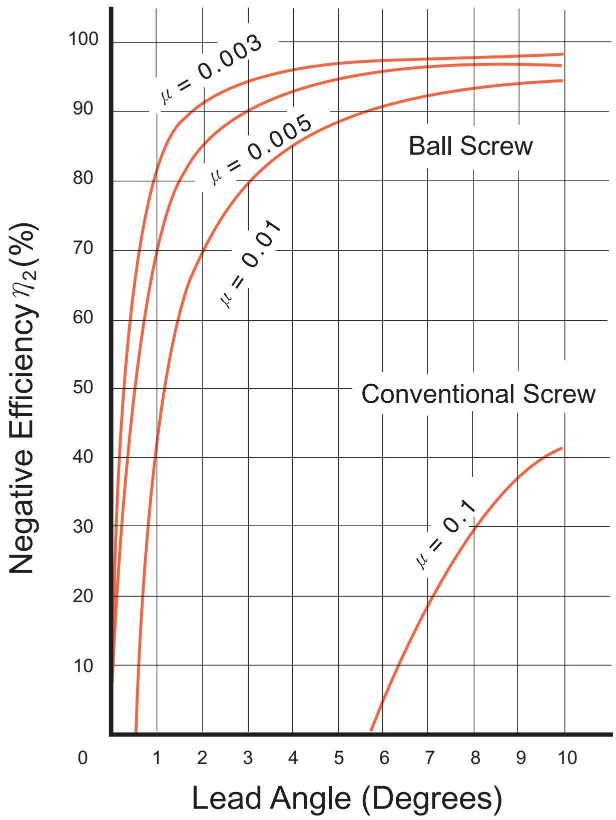
SIMTACH applies stringent quality control standards on every production process. With proper lubrication and use, trouble-free operation for an extended period of time is possible.

(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)

$$P = \frac{2\pi\eta_1 \times T}{\ell}$$

T = Torque kgf· cm
P = Force kgf
l = Lead cm

$$T = \frac{\ell \times {}_{2} \times P}{2\pi}$$

T = Torque kgf· cm
P = Force kgf
l = Lead cm
η2 = Efficiency

Fig 1.1.1 Mechanical Efficiency of Ball Screws

1-1 Features of Ball Screw

(3) High Rigidity and Preload

As figure 1.1.2 shown in below, the ball screw 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.

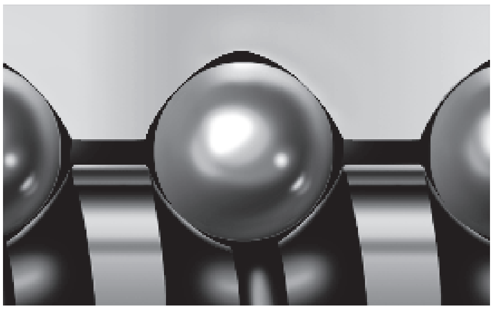


Fig 1.1.2 Groove Shape of Precision Ball Screw

(4)Circulation Method

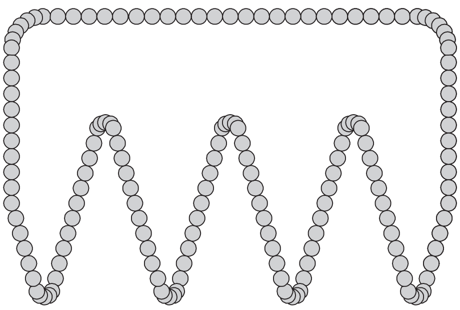


Fig 1.1.3 External Ball Circulation Nuts

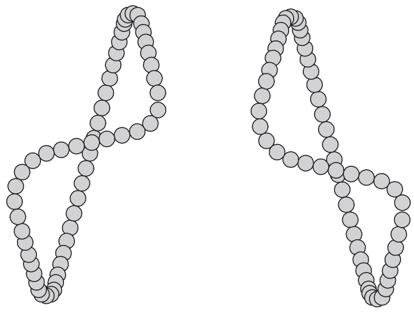


Fig 1.1.4 Internal Ball Circulation Nuts

(5)High Durability

SIMTACH Rigidly selected materials, inten-sive 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°~62°
Nut	Chrome Molybdenum Steel	HRC 58°~62°
Steel Ball	Chrome Molybdenum Steel	HRC 62°UP

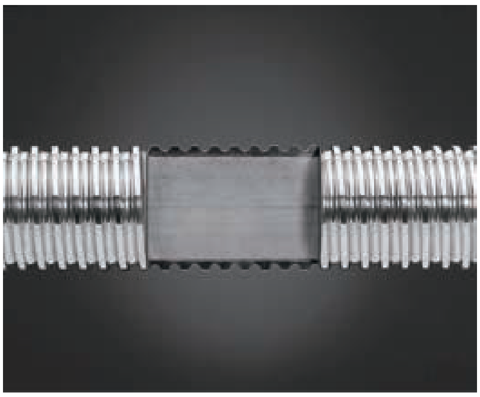
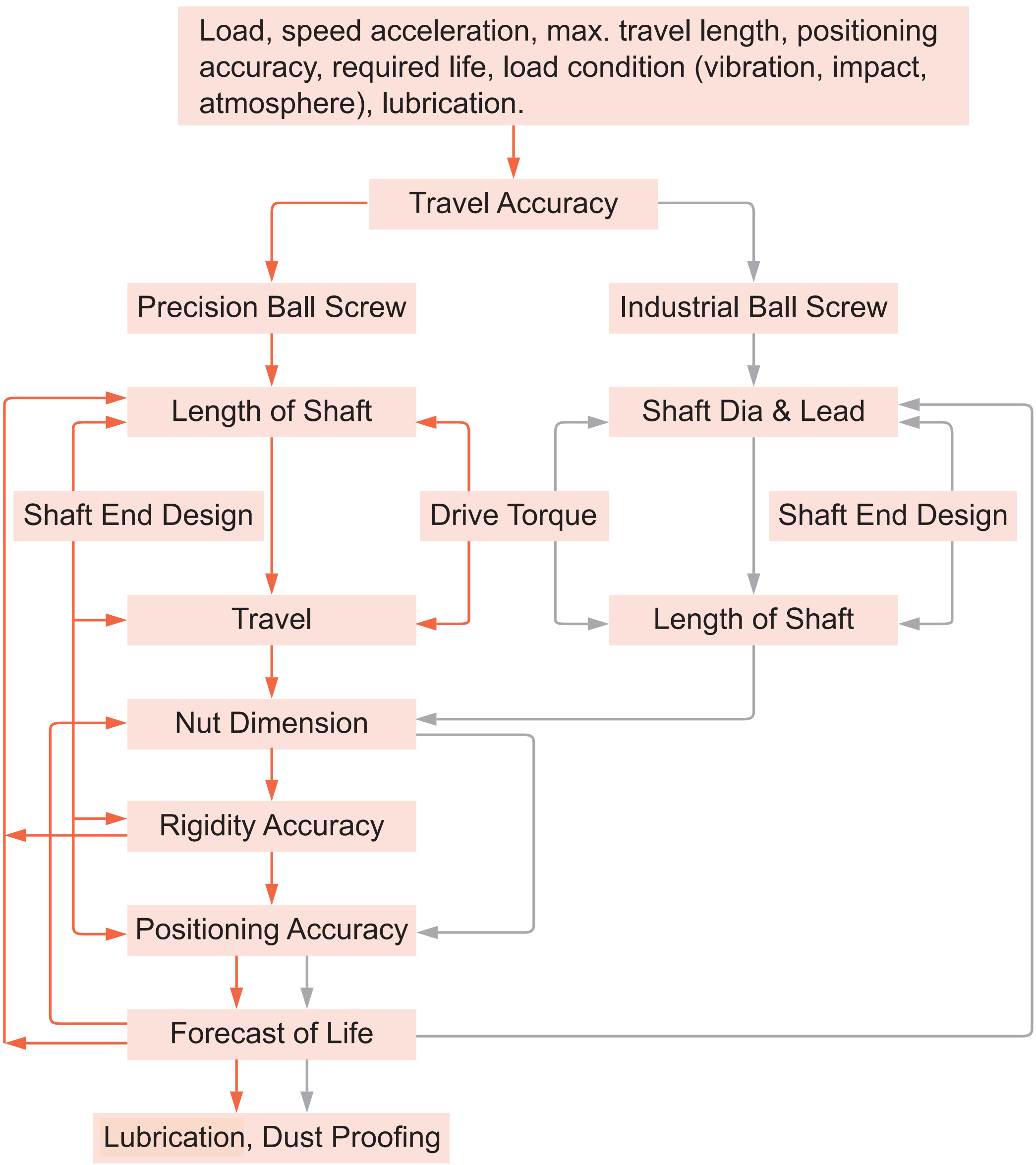


Fig 1.1.5 Heat Treatment

1-2 Ball Screw Selection Precedure



Accuracy (B04)
Screw Shaft Design (B10)
Drive Torque (B16)
Nut Design (B18)

Rigidity (B19)
Positioning Accuracy (B22)
Life Design (B24)
Lubrication and safety design (B30)

1-3 Accuracy

■ 1-3-1 Lead/Travel Accuracy

According to the standard of JIS,we classified our lead accuracy through E, e, e300, and e2π, 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 300mm of useful length and evaluated if it is qualified with the e300 table of 1.3.3.

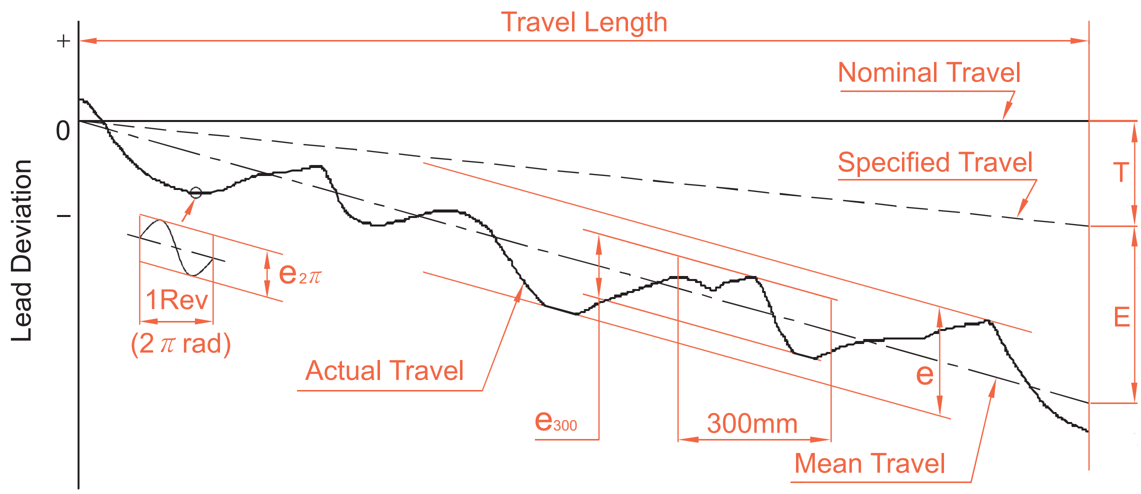


Fig 1.3.1 Diagram of Lead Accuracy

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

1-3 Accuracy

Table 1.3.2 Mean Travel Deviation (±E) and Travel Variation (e) (JIS B 1192)

Grade		C0		C1		C2		C3		C5		C7	C10
Travel Length (mm) Over	Incl.	±E	e	±E	e	±E	e	±E	e	±E	e	e	e
	100	3	3	3.5	5	5	7	8	8	18	18		
100	200	3.5	3	4.5	5	7	7	10	8	20	18		
200	315	4	3.5	6	5	8	7	12	8	23	18		
315	400	5	3.5	7	5	9	7	13	10	25	20		
400	500	6	4	8	5	10	7	15	10	27	20		
500	630	6	4	9	6	11	8	16	12	30	23		
630	800	7	5	10	7	13	9	18	13	35	25		
800	1000	8	6	11	8	15	10	21	15	40	27		
1000	1250	9	6	13	9	18	11	24	16	46	30		
1250	1600	11	7	15	10	21	13	29	18	54	35	±50/300mm	±210/300mm
1600	2000			18	11	25	15	35	21	65	40		
2000	2500			22	13	30	18	41	24	77	46		
2500	3150			26	15	36	21	50	29	93	54		
3150	4000			30	18	44	25	60	35	115	65		
4000	5000					52	30	72	41	140	77		
5000	6300					65	36	90	50	170	93		
6300	8000							110	60	210	115		
8000	10000									260	140		
10000	12500									320	170		

Table 1.3.3 Variation per 300mm (e_{300}) and Wobble Error ($e_{2\pi}$) (JIS B 1192) Unit : μm

Grade	C0	C1	C2	C3	C5	C7	C10
e_{300}	3.5	5	7	8	18	50	210
$e_{2\pi}$	2.5	4	5	6	8		

■ 1-3-2 Axial Play

Axial play of SIMTACH's precision ball screw is shown inn

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

1-3 Accuracy

Excessive preload increases the friction torque and generates heat which will reduce the life expectancy. However, insufficient preload will reduce stiffness and increase the possibility of lost motion. SIMTACH recommends that the preload applied on CNC machine tools should not heavier than 8% of the dynamic load; 5% for industrial automation X-Y table.

Table 1.3.5 The reference spring force of (P2)

Model No.	Spring Force (Kg) Single Nut	Spring Force(Kg) Double Nut
1605	0.1~0.3	0.3~0.6
2005	0.1~0.3	0.3~0.6
2505	0.2~0.5	0.3~0.6
3205	0.2~0.5	0.5~0.8
4005	0.2~0.5	0.5~0.8
2510	0.2~0.5	0.5~0.8
3210	0.3~0.6	0.5~0.8
4010	0.3~0.6	0.5~0.8
5010	0.3~0.6	0.8~1.2
6310	0.6~1.0	0.8~1.2
8010	0.6~1.0	0.8~1.2

Table 1.3.6 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.)
Ø4~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 ball screws are manufactured, inspected and guaranteed to be within specifications.

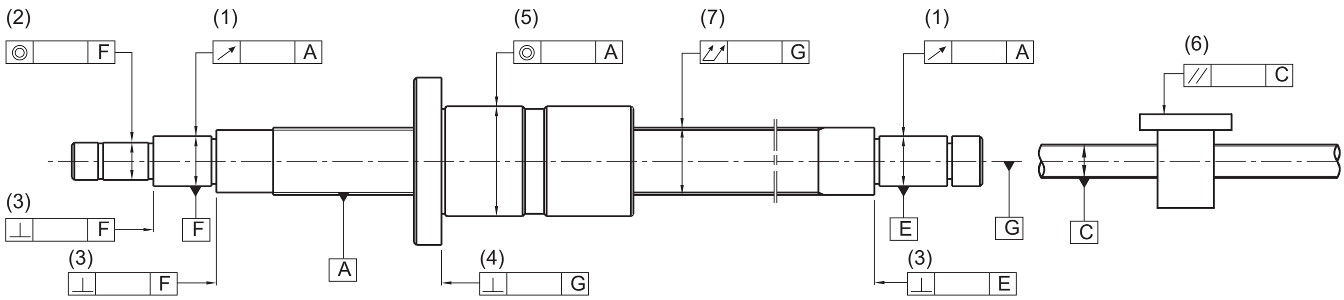


Fig 1.3.2 Mounting Accuracy and Tolerance

1-3 Accuracy

■ 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.

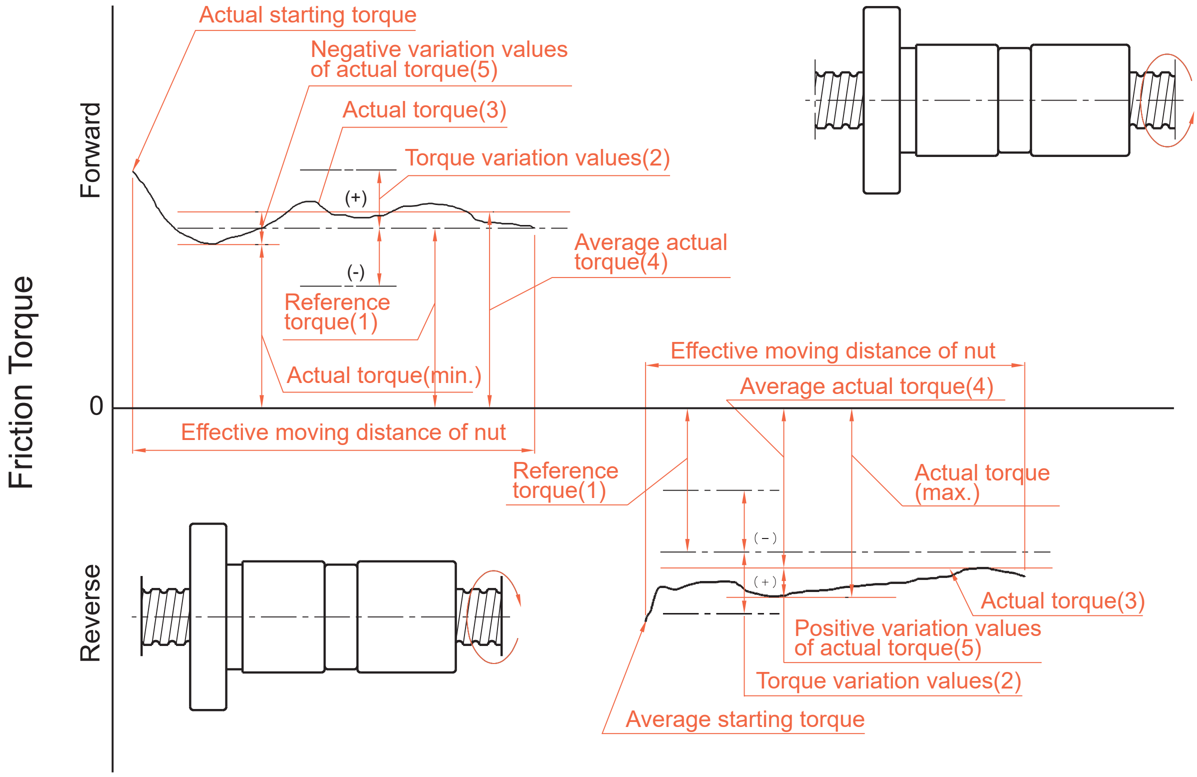


Fig 1.3.3 Descriptions of preload torque

Glossary

(1) Preload
To generate the inner force inside the ball screw todecrease the clearence and increase the rigidity, aset of one gage (approximately 2μ) larger steel-balls is filled inside the nut or two nuts which areexe-cuting mutual displacement in axial direction.

(2) Preload dynamic torque
The dynamic torque required for continuouslyrotating the screws shaft or the nuts under unloadcondition and the preload has applied to the ballscrews.

(3) Reference torque
The targeted preload dynamic torque Fig 1.3.3-(1)

(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 minima-lactual torque values measured when the nuts aredo ing reciprocating movements.

(8)Actual torque variation values
After the nut doing reciprocating movementson the effective length of the thread, the biggestvariation tested will be the actual torque variationvalue, which is covered between the positive andnegative mini-mum value relative to the actualtorque.

(9)Actual torque variation rate
The rate of actual torque variation values in relationof the average actual torque.

1-3 Accuracy

Table 1.3.7 Permissible ranges of toque variation rates

Reference		Effective threading length mm										
										4000~10000		
										-		
		Grade				Grade				Grade		
	Incl		C1		C5		C1		C5		C2, C3	
2	4		±40%		±55%		±45%		±65%		-	
	6		±30%		±45%		±38%		±50%		-	
	10		±25%		±35%		±30%		±40%		±40%	
	25		±20%		±30%		±25%		±35%		±35%	
	63		±15%		±25%		±20%		±30%		±30%	
	100		-		±20%		-		±25%		±25%	

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 kgfcm, SIMTACH specifications will apply.

Calculation of Reference Torque T_p

The equation for computing reference torque of the ball screws is given in following :

$$T_P = 0.05\,(\tan\beta)^{-0.5} \bullet \frac{Fao\ \$,}{2r}$$

Where, Fao = Preload (kgf)

β = Lead angle

, = 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).

$T_p = F \bullet L$

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 JSK2001(industrial lubrication oil viscosity standard), the lubrication oil used should be in complience with IS0 VG68.

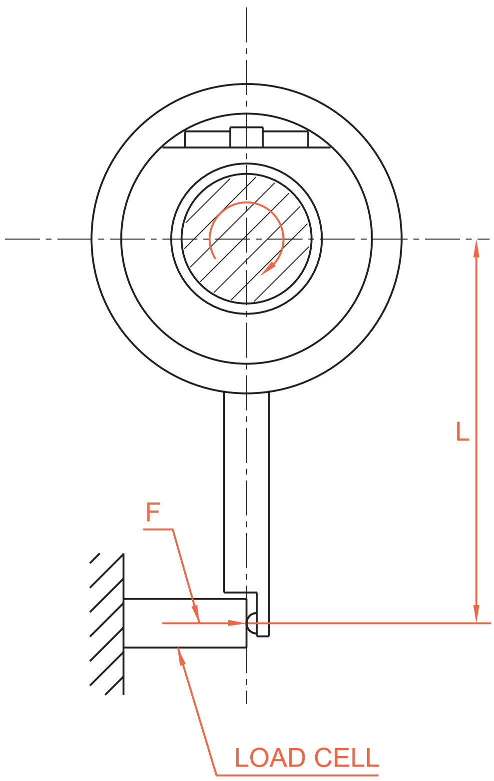


Fig 1.3.4 Preload dynamic torque measuring method

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 SIMTACH.

(Mounting Screw and Nut)

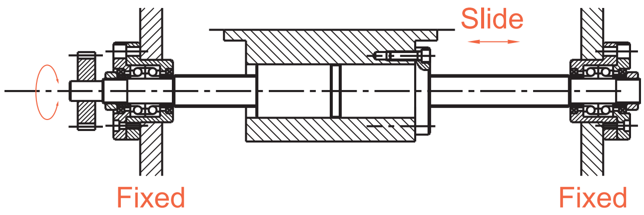


Fig 1.4.1

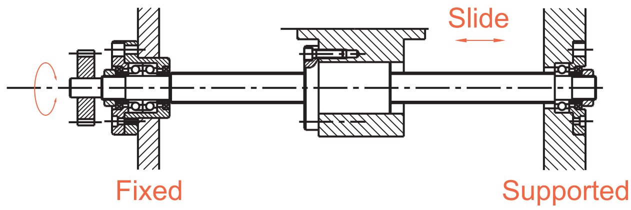


Fig 1.4.5

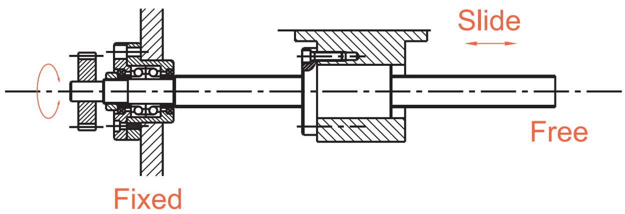


Fig 1.4.2

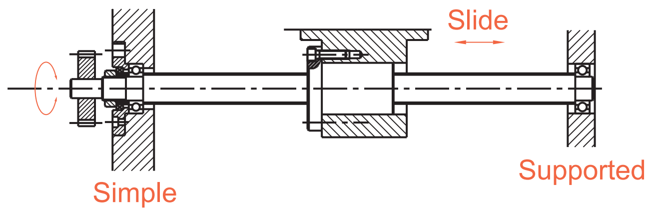


Fig 1.4.6

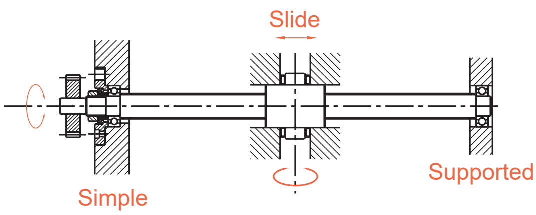
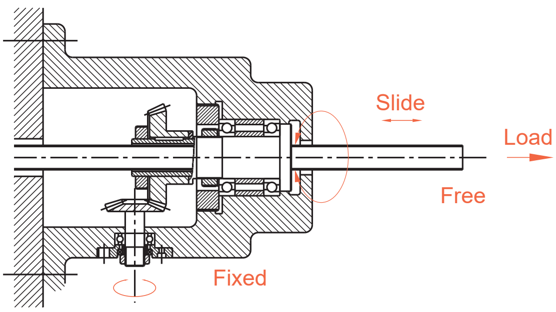


Fig 1.4.3



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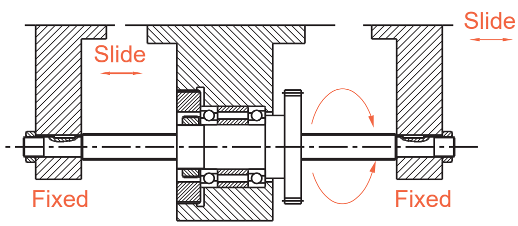


Fig 1.4.4

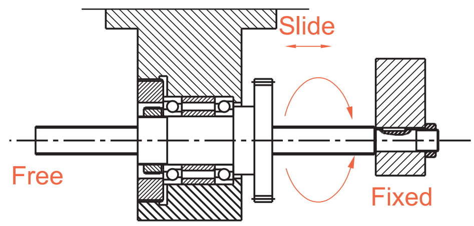


Fig 1.4.8

1-4 Screw Shaft Design

(The mounting method for common types of machinery.)

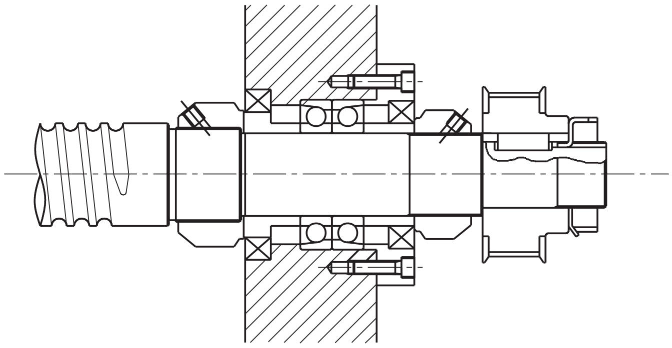


Fig 1.4.9

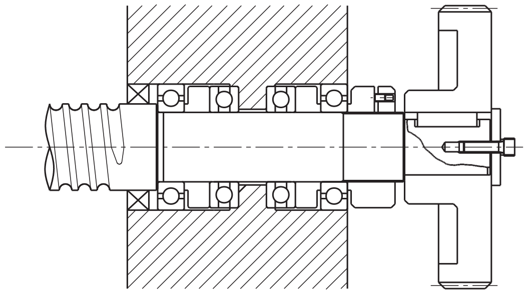


Fig 1.4.11

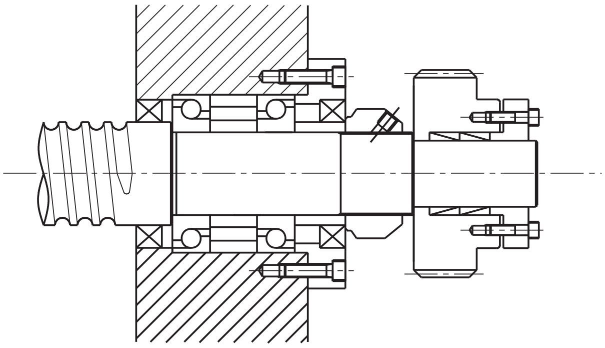


Fig 1.4.10

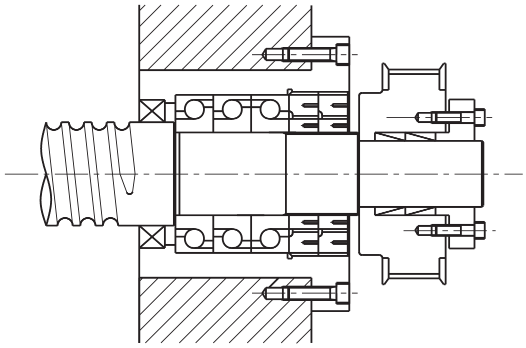


Fig 1.4.12

(The mounting method for bearing in a given pretension.)

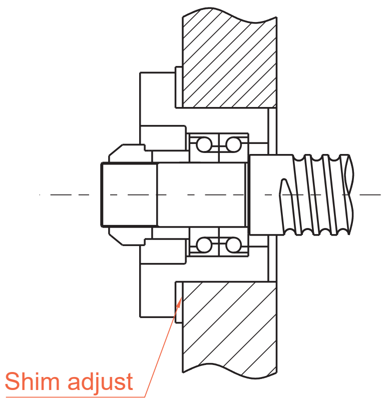


Fig 1.4.13

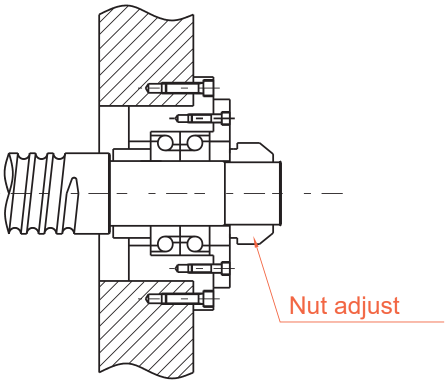


Fig 1.4.14

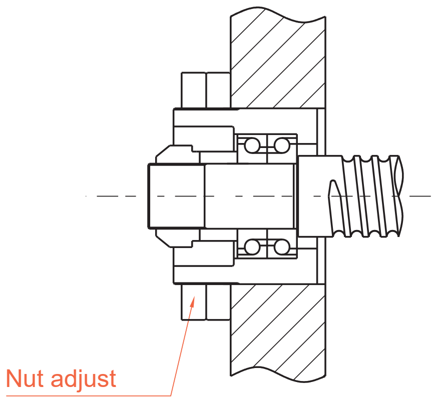


Fig 1.4.15

1-4 Screw Shaft Design

■ 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 125mm.)

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 (a= 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.
1. The allowable tensile / buckling load which equals to the derating stress.
2. Allowable load of the screw's groove.

$$P = \alpha A = 11.8\, dr^2 \text{ (kgf)}$$

Where,
P : Buckling load (kgf)
α: Allowable tensile compressive stress (kgf/mm^2)
A : Sectional a rea of screw sha ft root bottom diameter (mm^2)
dr : Sc rew sha ft root diameter (mm)

1-4 Screw Shaft Design

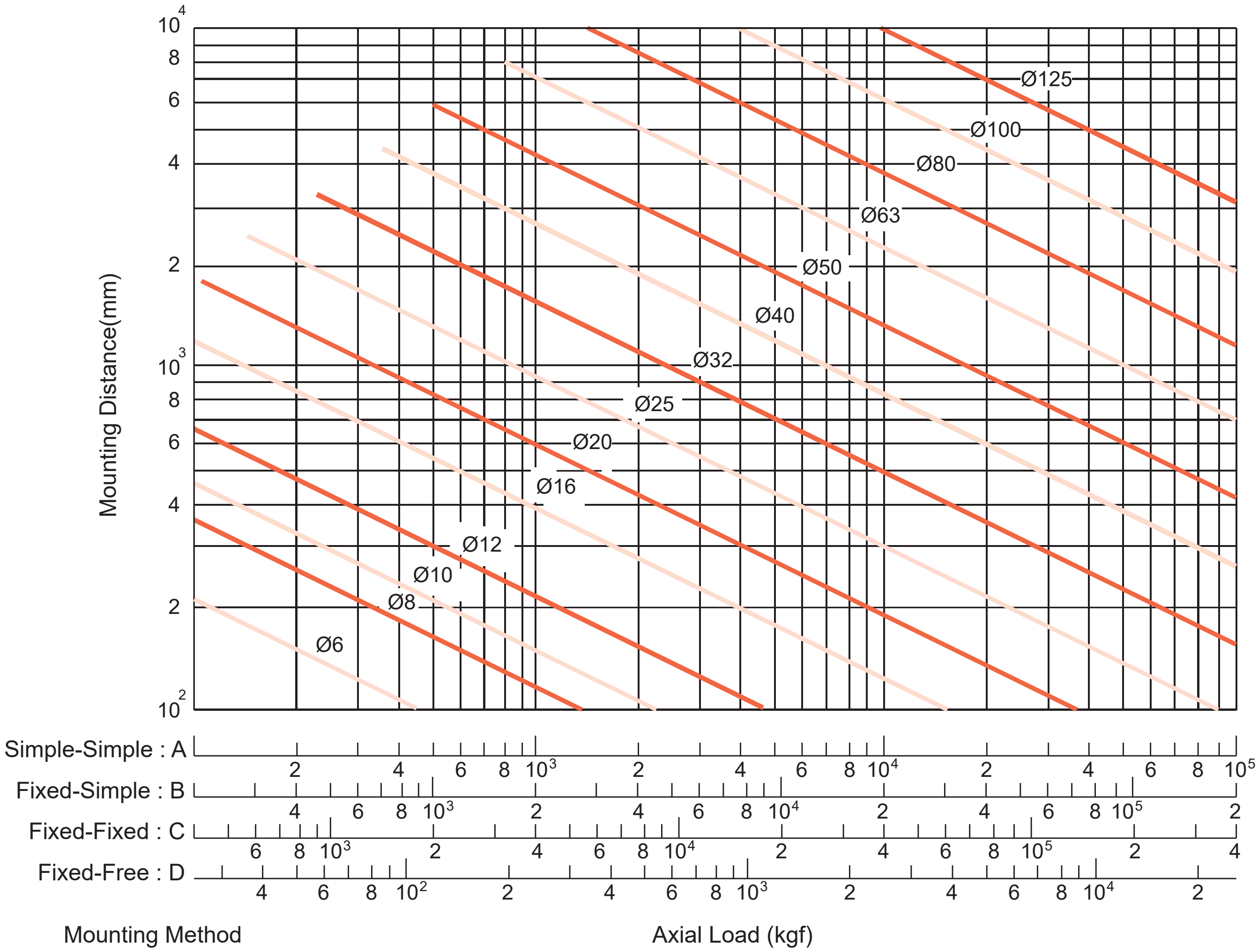


Fig 1.4.16 Buckling Load vs.Nominal Diameter and Length

1-4 Screw Shaft Design

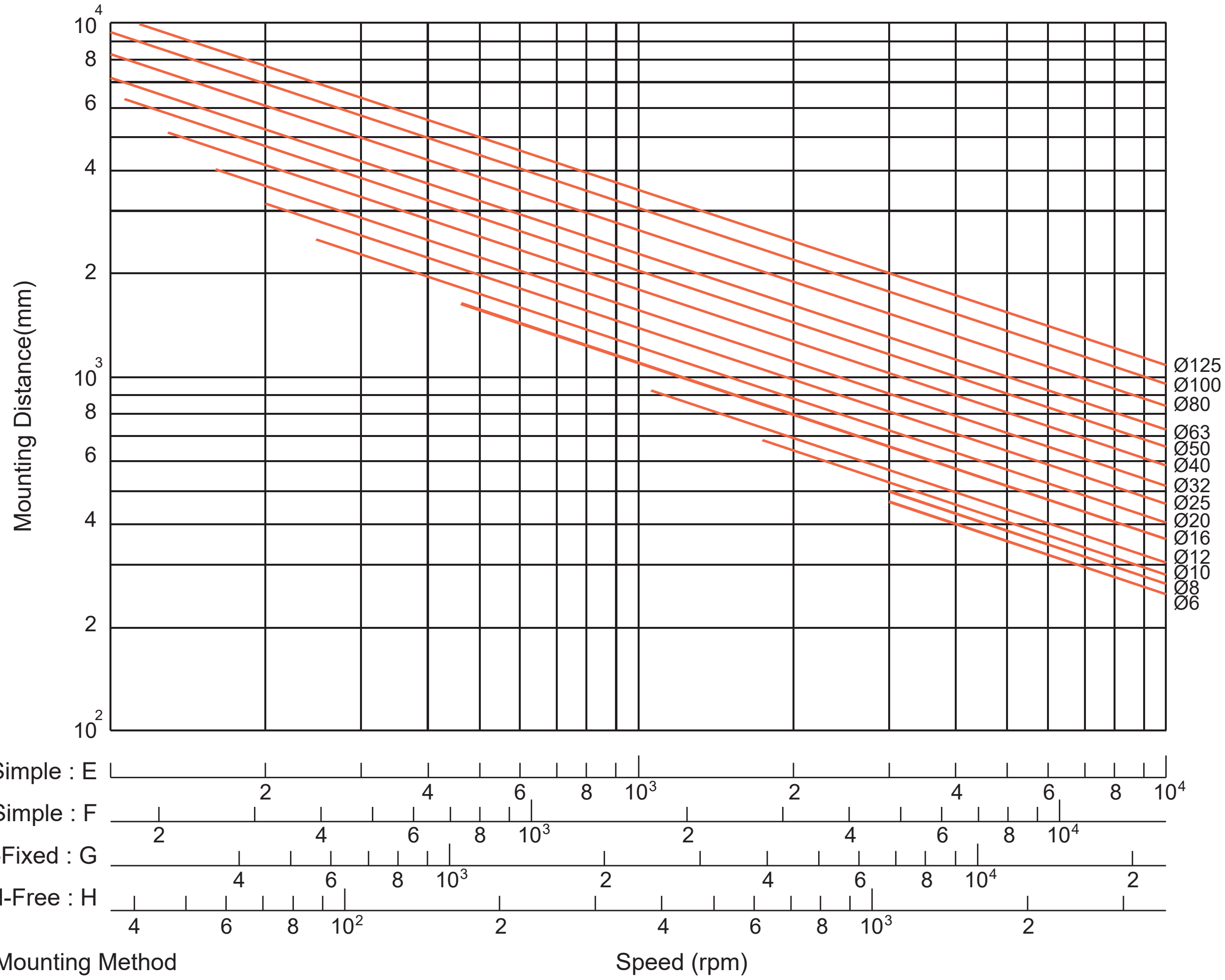


Fig 1.4.17 Critical Speed vs. Nominal Diameter

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.

(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)
Dm×N < 70,000

For general industry (Rolled shaft)
Dm×N < 50,000

If your requirement about the product will exceed the limitation, please contact with SIMTACH to discuss the detailed solution for the ideal product.

※When ε, the ratio of screw length and shaft diameter has exceeded 70, please contact with SIMTACH to arrange the special arrangement for production.

$$n = \alpha \cdot \frac{60m^2}{2r\,L^2}\sqrt{\frac{EIg}{cA}} = f\,\frac{dr}{L^2}\cdot 10^7 (\text{rpm})$$

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 $\gamma = 7.8 \cdot 10^{-6}$ 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)

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)

$\alpha = \frac{2r\,n}{603\,t}$ (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

$T_P = \frac{P \cdot \ell}{2\pi\mu\eta_1}$ (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)

$T_P = \frac{P \cdot \ell\, \eta_2}{2\pi}$ (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

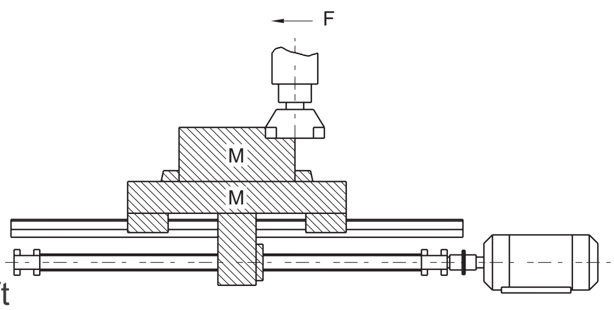


Fig 1.5.1 Moment of inertia of load

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	$\frac{M}{4}\left(\frac{V}{\pi N_M}\right)^2 = \frac{M}{4}\left(\frac{P}{\pi}\right)^2$
Unit	kg . m^2
Moment of inertia during deceleration	$J_M = \left(\frac{J}{N_M}\right)^2 J_\ell$

ρ : Density (kg m^3) ρ=7.8 · 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_ℓ : Rotations in longitudinal moving direction (min^{-1})
J_ℓ : 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 figure 1.6.1.

(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	SFI SFNI SFU SFNU SFK	DFU	●Delicated diameter of screw takes only little space. ●Applicable to those with smaller lead / the outside diameter of the screw
End-caps circulation type	SFY SFH SFA SFE SFS	DFS	●Suitable for high speed positioning

■ 1-6-2 Nut Types

U, I- Type Nut

In these types of nuts, by using the internal circu lator 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 circula tion. As figure 1.6.1 specified, these types of nuts need at least one side which is completely tooth passing, which is applicable for smaller shaft diameter.

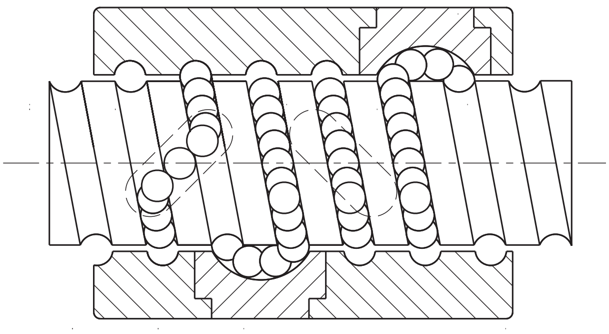


Fig 1.6.1 U, I- Type Nut

Y, S, A,E - Type Nut

By using thin and flexible dust cap on both side, the performance of wiping had been enhanced. Moreover, the enhancement of circulation struc ture increase both the function of high rigidity and speed.

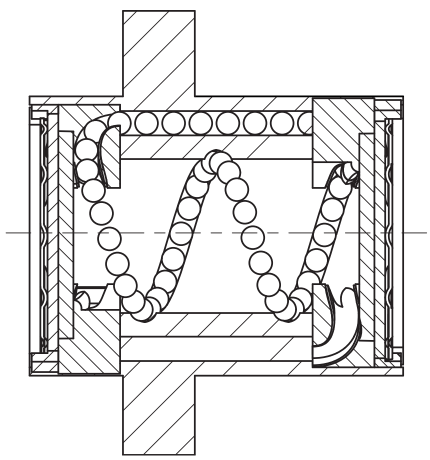


Fig 1.6.4 Y, S, A,E - type nut

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 For places other than Fixed - Fixed installation

$\delta_{SF}=\frac{PL}{4AE}$ (mm)

$\delta_{SS}=\frac{PL_0}{AE}$ (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 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

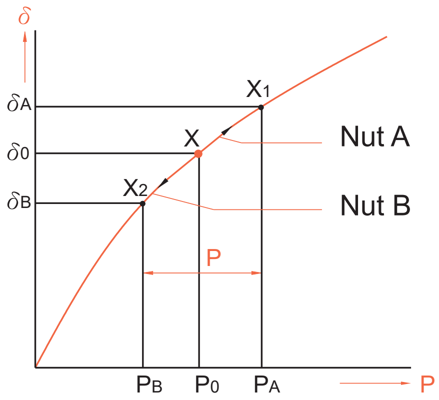


Fig 1.7.1

(b) In case of double nuts

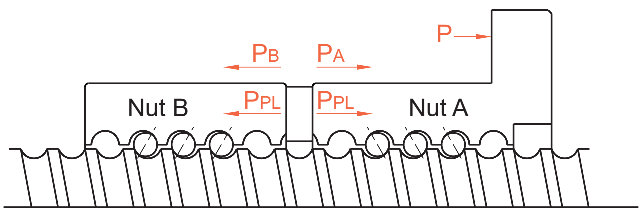


Fig 1.7.2 Preloaded for the double nuts

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.

$$K_N = \frac{P}{\delta_{NW}} = \frac{3P_{PL}}{\delta_{NS/2}} = \frac{6P_{PL}}{\delta_{NS}} \text{ (kgf/mm)}$$

1-7 Rigidity

(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.

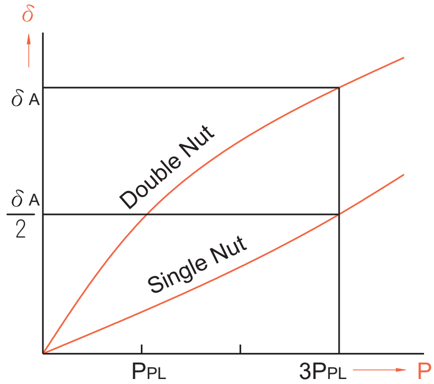


Fig 1.7.3

(3) Axial rigidity K_B and displacement δ_B of support shaft

$K_B = \frac{P}{\delta_B}$ (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 Positioning Accuracy

■ 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 12um per 1m 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_{oa}

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 $L_\alpha = \{\frac{1}{P}\}^3$ 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 equivalen t fatigue life under different load condition changes. (see Table 1.9.1)

$$\left(P_e = \frac{P_1^3 n_1 t_1 + P_2^3 n_2 t_2 + \ldots + P_n^3 n_n t_n}{n_1 t_1 + n_2 t_2 + \ldots + n_n t_n}\right)^{\frac{1}{3}} \text{(kgf)}$$

Axial Load (kgf)	Rotating Speed (min^{-1})	Time(%)
P1	n1	t1
P2	n2	t2
.	.	.
.	.	.
.	.	.
Pn	nn	tn

But, $t_1 + t_2 + t_3 + \ldots + t_n = 100$

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

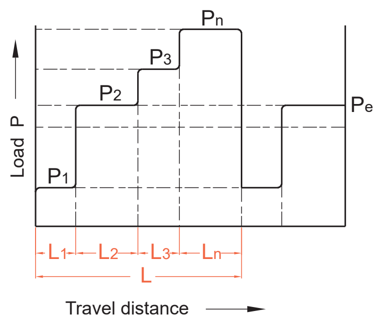


Fig 1.9.1

1-9 Service Life Design

$$P_e = \frac{2P_{max} + P_{min}}{3} \text{ (kgf)}$$

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)

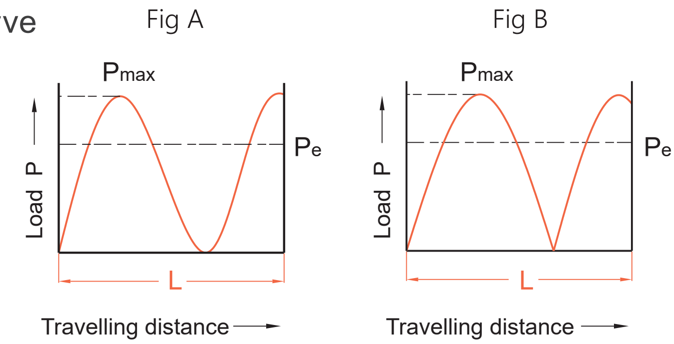


Fig 1.9.2

■ 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 :

$$L = \left\{\frac{C_a}{P_a \cdot f_w}\right\}^3 \cdot 10^6 \qquad L_t = \frac{L}{60n} \qquad L_s = \frac{L \cdot \ell}{10^6}$$

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	f s
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_{oa}
$C_{oa} = P_{max} \cdot f_s$

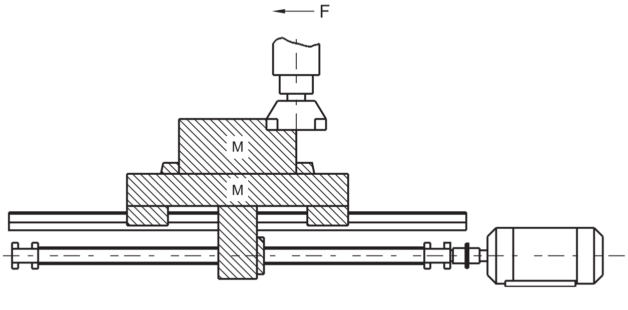
1-9 Life Design

Key Points for Ball Screws Selection	Calculation for Ball Screws Selection

Key Points for Ball Screws Selection

To choose a perfect fit ball screw,users need tounderstand operating requirement,which is thefundamental principal of deciding the design. Besides,the main factors of selection include load weight,stroke, torque, positioning accuracy in a single timeand repeatedly,rigidity, lead and nut's inner diameter.Among all the factors, any single factor's change willcause the change of other factors.Therefore, thebalance between all factors is a must to pay attention to.

Calculation for Ball Screws Selection



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 10um/stroke
6.Driving motor DC motor (MAX 1000 min)
7.Guiding surface friction coefficient (u= 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 reckoning 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 reckoning of H (hr)
H= 12 hr · 250 days · 10 years · 0.6 Running rate
= 18000 hr

(b)Mechanical conditions

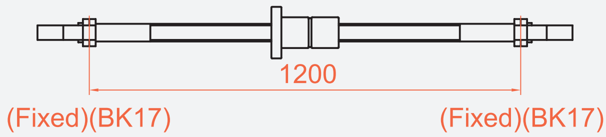
Calculation Items / Different Operations	Speed/ rotations	Cutting resistance	Sliding resistance	Time used
Fast feed	10 m/min/1000 min^{-1}	0 kgf	70 kgf	10 %
Light cutting	6/600	100	70	50
Medium cutting	2/200	200	70	30
Heavy cutting	1/100	300	70	10

Sliding resistance = (300 + 400)·0.1 = 70 kgf

1-9 Service Life Design

Key Points for Ball Screws Selection	Calculation for Ball Screws Selection
2.Ball screw lead ℓ (mm) $\ell=\frac{\text{Feeding speed (m/min)}\cdot 1000}{\text{Max. Rotating speed (min-1) of motor}}$ (mm)	2.Ball screw lead ℓ (mm) $\ell=\frac{10000}{1000}$ =10 (mm) Minimal disassembly= $\frac{10mm}{1000\ stroke}$ = 0.01 mm/stroke
3.Computation of average load Pe (kgf) $P_e=\left(\frac{P_1^3 n_1 t_1+P_2^3 n_2 t_2+...+P_n^3 n_n t_n}{n_1 t_1+n_2 t_2+...+n_n t_n}\right)^{\frac{1}{3}}$ $P_e=\frac{2P_{max}+P_{min}}{3}$ $P_e \fallingdotseq 0.65P_{max}$ $P_e \fallingdotseq 0.75P_{max}$	3.Computation of average load Pe (kgf) $P_e=\left(\frac{70^3\cdot 1000\cdot 10+170^3\cdot 600\cdot 50+270^3\cdot 200\cdot 30+370^3\cdot 100\cdot 10}{1000\cdot 10+600\cdot 50+200\cdot 30+100\cdot 10}\right)^{\frac{1}{3}}$ $=\left[\frac{31.7\cdot 10^{10}}{4.7\cdot 10^4}\right]^{\frac{1}{3}}$ $\fallingdotseq$ 189 kgf
4.Average number of rotations n_m $n_m=\frac{n_1 t_1+n_2 t_2+...+n_n t_n}{100}$	4.Average number of rotations n_m $n_m=\frac{1000\cdot 10+600\cdot 50+200\cdot 30+100\cdot 10}{100}$ $=\frac{4.7\cdot 10^4}{100}$ =470 min^{-1}
5.Calculation of required dynamic rated load Ca Ca = Pe · fs	5.Calculation of required dynamic rated load Ca Ca = 189 · 5 = 945 (kgf)
6.Calculation of required static rated load Coa Coa = Pmax·fs	6.Calculation of required static rated load Coa Coa = 369·5 = 1845 (kgf)
7.Selection of nut type Ca>945 Coa>1845 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 Ca = 2954 (kgf) Coa = 7295 (kgf)

1-9 Life Design

Key Points for Ball Screws Selection	Calculation for Ball Screws Selection
8.Calculation of service life Lt (h) $L_t = \frac{L}{60_n} = \left(\frac{C_a}{P_e \cdot f_w}\right)^3 \cdot 10^6 \cdot \frac{1}{60_n}$	8.Calculation of service life Lt (h) $L_t = \left(\frac{2954}{189 \cdot 2}\right)^3 \cdot 10^6 \cdot \frac{1}{60 \cdot 470} = 42544(h)$
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 $n = \alpha \cdot \frac{60\lambda^2}{2\pi L^2}\sqrt{\frac{EIg}{\gamma A}} = f\,\frac{dr}{L^2} \cdot 10^7 (rpm)$ 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< 50000
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. $\triangle \ell = \alpha \cdot \triangle t \cdot L = 11.7 \cdot 10 \cdot 2 \cdot 700mm$ $\fallingdotseq 0.016mm$ $F_p = \frac{EA \triangle \ell}{L}$ $= \frac{2.06 \cdot 104 \frac{\pi \cdot 21.86^2}{4} \cdot 0.016}{700}$ $\fallingdotseq 177(kgf)$

1-9 Service Life Design

Key Points for Ball Screws Selection	Calculation for Ball Screws Selection
14.Rigidity (1) Axial rigidity Ks and displacement os of screw shaft $Ks = \frac{P}{ds}$ (kgf/mm) P : Axial load (kgf) $\delta_{SF} = \frac{PL}{4AE}$ (mm)......(with reference to page C21) (2) Axial rigidity KN and displacement δ_s of nut $\delta_{NS} = \frac{K}{\sin\beta}\left[\frac{Q^2}{d}\right]^{\frac{1}{3}} \cdot \frac{1}{\zeta}$ (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 Ke and displacement δ_B of bracing shaft $K_B = \frac{P}{d_B}$ (kgf/mm)....(with reference to page C23)	14.Rigidity Deviation can be corrected by estimating the temperature rise per extension of 0.016 mm, and taking into consideration of the pre-tension of 177 kgf. (1) Directional rigidity $\delta_{SF} = \frac{PL}{4AE} = \frac{27 \cdot 1200}{4 \cdot \frac{\pi \cdot 21.86^2}{4} \cdot 2.06 \cdot 10^4}$ = 0.00105 (mm) $Ks = \frac{370}{0.00105} = 3.5 \cdot 10^5$kgf/mm (2) Rigidity of steel ball and nut groove $n = \frac{26.62 \cdot \pi 4}{4.762} = 70$ $Q = \frac{370}{70\sin 45℃} = 10$ $\delta_{NS} = \frac{0.00057}{\sin 45℃}\left(\frac{10^2}{4.762}\right)^{\frac{1}{3}} \cdot \frac{1}{0.7}$ = 3.2· 10 mm = 1.27 · 10^5 kgf/mm $K_N = \frac{370}{3.2 \cdot 10^{-3}}$ =1.27 · 10^5 kgt/mm (3)Rigidity of support bearings Where, nut rigidity 50 kgf/μm $\delta_B = \frac{370}{51 \cdot 2} = 3.6$ μm $K_B = \frac{370}{0.0036} = 1 \cdot 10^5$ kgf/mm ● δ_{TOTAL} =1.05 +3.2 + 3.6 = 7.85μm
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 SIMTACH for further instruction.Do not attempt to reassemble, which might cause permanent damage to the ball screw.)

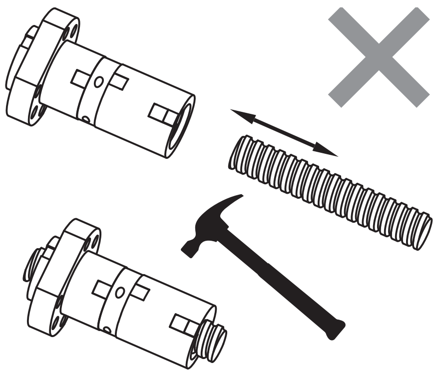


Fig 1.10.1 Error installation

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 5m/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 Cautions About Use of Ball Screws

■ 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.

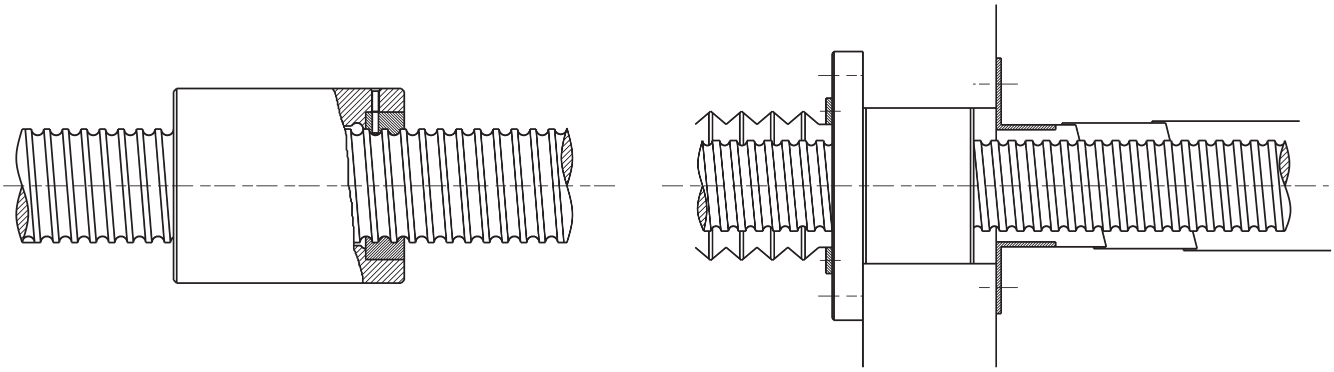


Fig 1.10.2 Dust proof Method by Telescopic Cover and Bellows

■ 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.

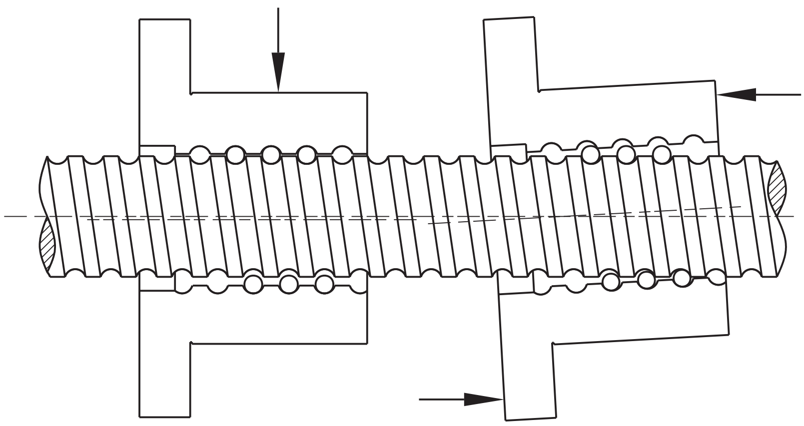


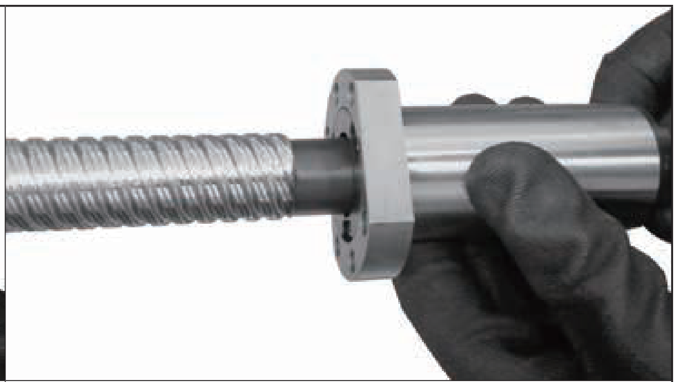
Fig 1.10.3 Offset Load

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 1.10.4 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.

2-1 Rolled Ball Screw Series

■ 2-1-1 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.

■ 2-1-2 The Features of 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.

■ 2-1-3 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

2-1 Rolled Ball Screw Series

Nominal Model Code of Nut

SFU R 025 05 T4 D + N3

① ② ③ ④ ⑤ ⑥ ⑦

①

Nominal Model	
S	S : Single nut
	D : Double nut
F	F : With flange
	C : Without flange
U	NI : NI type nut
	NU : NU type nut
	H : H type nut
	A : A type nut
	NH : NH nut (A solution for slide table)
	Y : Y type nut
	V : V type nut
	U : U type nut
	M : M type nut
	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

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

■ 2-1-4 Preload of Rolled Ball Screw

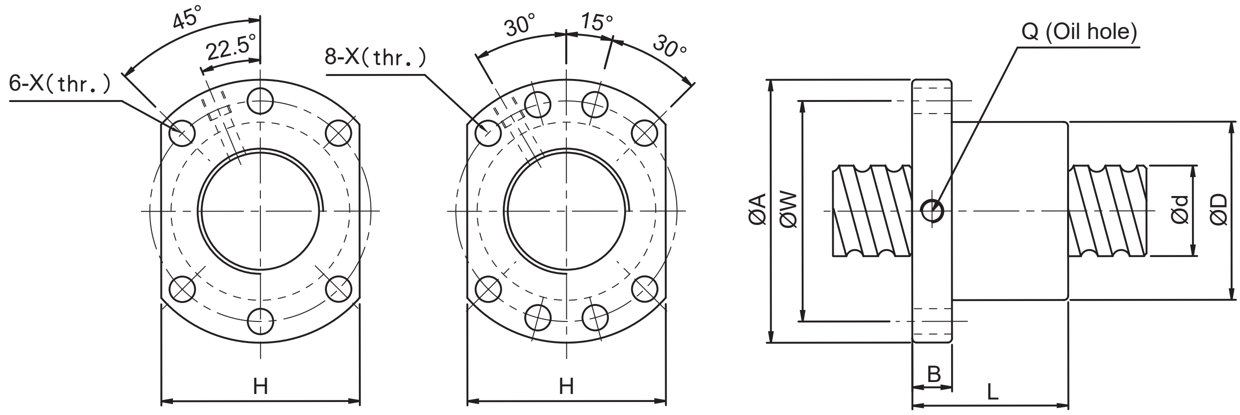
The standard preloading for Rolled Ball Screw is P0. If P1 preloading is required, please contact SIMTACH.

Table2.1.4 Rolled screw accuracy

Unit : μm

Accuracy Grade	C5 (DIN)	C7	C10
e300	23	50	210

SFU Series specifications



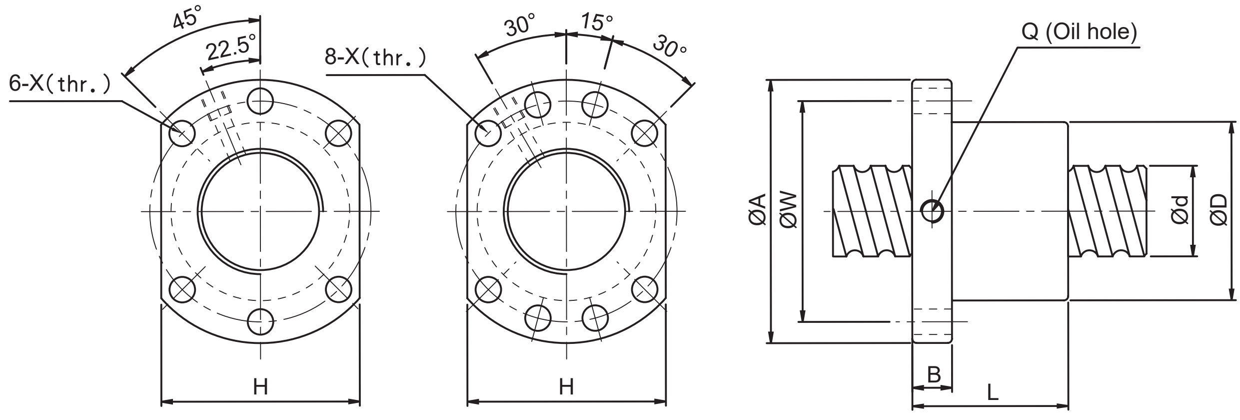
d≦32 d≧40

Unit: mm

Model no.	d	I	Da	Dimensions									Load rating	
				D	A	B	L	W	H	X	Q	n	Ca(kgf)	Coa(kgf)
SFU1204-4 ☆	12	4	2.381	24	40	10	40	32	30	4.5		1x4	593	1129
SFU1604-4	16	4	2.381	28	48	10	40	38	40	5.5	M6x1	1x4	629	1270
SFU1605-3 ☆		5	3.175	28	48	10	42	38	40	5.5	M6x1	1x3	666	1143
SFU1605-4 ☆		5	3.175	28	48	10	50	38	40	5.5	M6x1	1x4	888	1525
SFU1610-3 ☆		10	3.175	28	48	10	57	38	40	5.5	M6x1	1x3	716	1232
SFU2004-4	20	4	2.381	36	58	10	42	47	44	6.6	M6x1	1x4	1066	2987
SFU2005-3 ☆		5	3.175	36	58	10	42	47	44	6.6	M6x1	1x3	749	1495
SFU2005-4 ☆		5	3.175	36	58	10	51	47	44	6.6	M6X1	1x4	999	1994
SFU2504-4	25	4	2.381	40	62	10	42	51	48	6.6	M6x 1	1x4	1180	3795
SFU2505-3 ☆		5	3.175	40	62	10	42	51	48	6.6	M6x1	1x3	839	1935
SFU2505-4 ☆		5	3.175	40	62	10	51	51	48	6.6	M6x1	1x4	1119	2581
SFU2510-4 ☆		10	4.762	40	62	12	85	51	48	6.6	M6x1	1x4	1903	3695
SFU3205-4 ☆	32	5	3.175	50	80	12	52	65	62	9	M6x1	1x4	1264	3402
SFU3210-4 ☆		10	6.35	50	80	12	90	65	62	9	M6x1	1x4	3092	6101
SFU4005-4	40	5	3.175	63	93	14	55	78	70	9	M8x1	1x4	1407	4341
SFU4010-4		10	6.35	63	93	14	93	78	70	9	M8x1	1x4	3480	7779
SFU5010-4	50	10	6.35	75	110	16	93	93	85	11	M8x1	1x4	3898	10325
SFU6310-4	63	10	6.35	90	125	18	98	108	95	11	M8x1	1x4	4401	13611
SFU6320-4		20	9.525	95	135	20	149	115	100	13.5	M8x1	1x4	7404	19008
SFU8010-4	80	10	6.35	105	145	20	98	125	110	13.5	M8x1	1x4	4900	17366
SFU8020-4		20	9.525	125	165	25	154	145	130	13.5	M8x1	1x4	8403	25345

※:with sign ☆ can poduce left helix

DFU Series Specifications

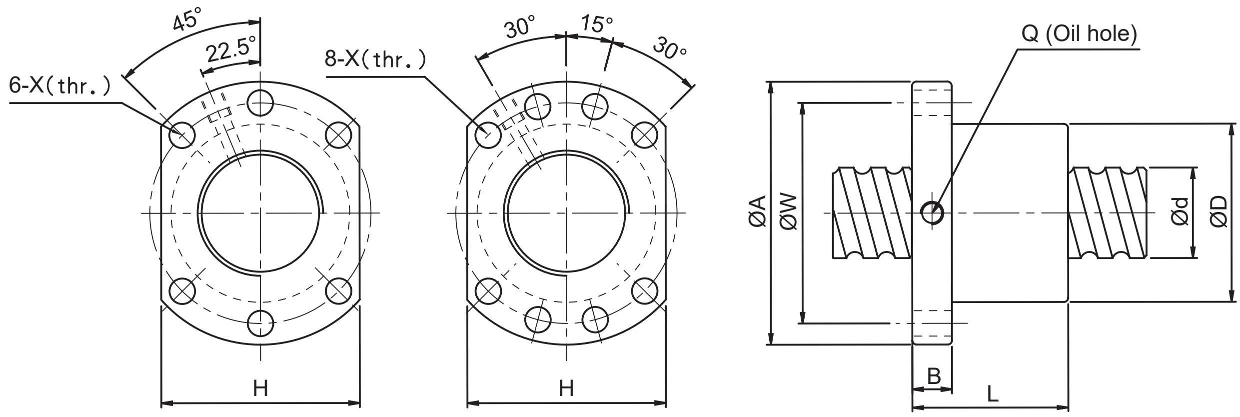


Unit: mm

Model no.	d	l	Da	Dimensions									Load rating	
				D	A	B	L	W	H	X	Q	n	Ca(kgf)	Coa(kgf)
DFU1604-4	16	4	2.381	28	48	10	80	38	40	5	M6x1	1x4	629	1170
DFU1605-4		5	3.175	28	48	10	100	38	40	5	M6x1	1x4	885	1525
DFU1610-3 ☆		10	3.175	28	48	10	118	38	40	5	M6x1	1x3	716	1232
DFU2004-4 ☆	20	4	2.381	36	58	10	80	47	44	6.6	M6x1	1x4	1066	2987
DFU2005-4		5	3.175	36	58	10	101	47	44	6.6	M6x1	1x4	999	1994
DFU2504-4 ☆	25	4	2.381	40	62	10	80	51	48	6.6	M6x1	1x4	1180	3795
DFU2505-4		5	3.175	40	62	10	101	51	48	6.6	M6x1	1x4	1119	2581
DFU2510-4 ☆		10	4.762	40	62	12	145	51	48	6.6	M6x1	1x4	1927	2771
DFU3205-4 ☆	32	5	3.175	50	80	12	102	65	62	9	M6x1	1x4	1264	3402
DFU3210-4 ☆		10	6.35	50	80	12	162	65	62	9	M6x1	1x4	3092	6101
DFU4005-4	40	5	3.175	63	93	14	105	78	70	9	M8x1	1x4	1407	4341
DFU4010-4		10	6.35	63	93	14	165	78	70	9	M8x1	1x4	3480	7979
DFU5010-4	50	10	6.35	75	110	16	171	93	85	11	M8x1	1x4	3898	10325
DFU6310-4	63	10	6.35	90	125	18	182	108	95	11	M8x1	1x4	4401	13611
DFU6320-4		20	9.525	95	135	20	290	115	100	13.5	M8x1	1x4	7404	19008
DFU8010-4	80	10	6.35	105	145	20	182	125	110	13.5	M8x1	1x4	4900	17366
DFU8020-4		20	9.525	125	165	25	295	145	130	13.5	M8x1	1x4	8403	25345

※:with sign ☆ can poduce left helix

SFNU Series Specifications



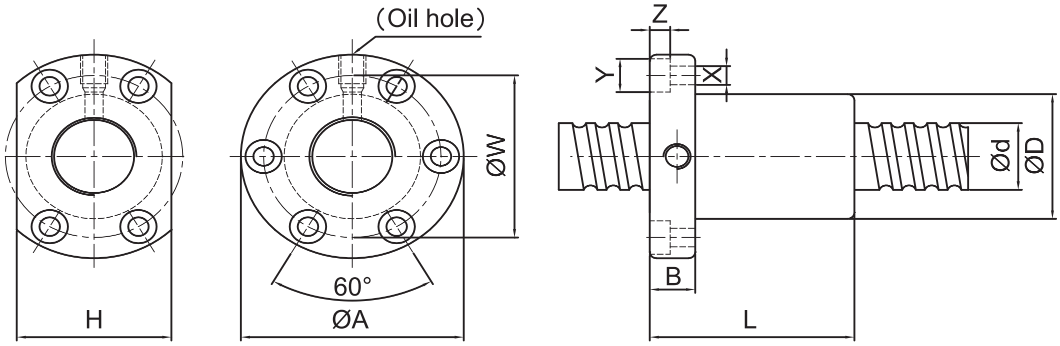
d≦32　　d≧40

Unit: mm

Model no.	d	l	Da	Dimensions									Load rating		K kgf/μm
				D	A	B	L	W	H	X	Q	n	Ca(kgf)	Coa(kgf)	
SFNU1605-4☆	16	5	3.175	28	48	10	45	38	40	5.5	M6	1x4	1380	3052	32
SFNU1610-3		10	3.175	28	48	10	57	38	40	5.5	M6	1x3	1103	2401	26
SFNU2005-4☆	20	5	3.175	36	58	10	51	47	44	6.6	M6	1x4	1551	3875	39
SFNU2505-4☆	25	5	3.175	40	62	10	51	51	48	6.6	M6	1x4	1724	4904	45
SFNU2510-4		10	4.762	40	62	12	80	51	48	6.6	M6	1x4	2954	7295	50
SFNU3205-4☆	32	5	3.175	50	80	12	52	65	62	9	M6	1x4	1922	6343	54
SFNU3210-4☆		10	6.35	50	80	12	85	65	62	9	M6	1x4	4805	12208	61
SFNU4005-4☆	40	5	3.175	63	93	14	55	78	70	9	M8	1x4	2110	7988	63
SFNU4010-4☆		10	6.35	63	93	14	88	78	70	9	M8	1x4	5399	15500	73
SFNU5010-4☆	50	10	6.35	75	110	16	88	93	85	11	M8	1x4	6004	19614	85
SFNU6310-4☆●	63	10	6.35	90	125	18	93	108	95	11	M8	1x4	6719	25358	99
SFNU8010-4●	80	10	6.35	105	145	20	93	125	110	13.5	M8	1x4	7346	31953	109
SFNU1204-4●	12	4	2.5	24	40	10	40	32	30	4.5	M8	1x4	902	1884	26

※ ☆ Left helix available　　※Please contact SIMTACH if the marked types (●) are required.

SFI Series specifications

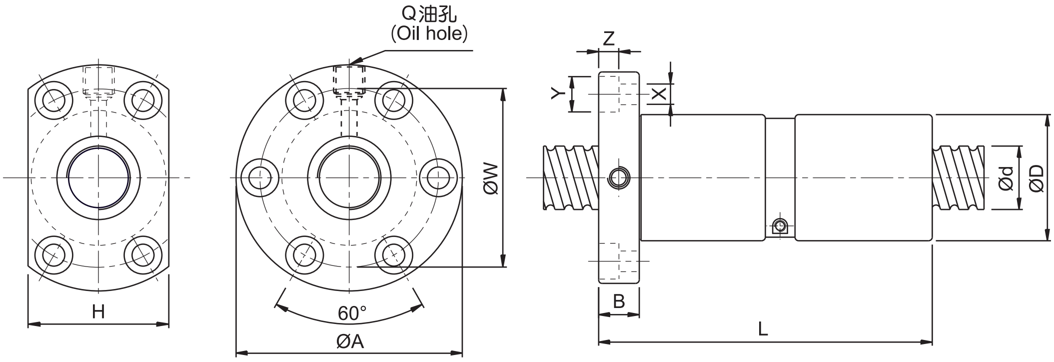


Unit: mm

Model no.	d	I	DA	Dimensions											Load rating	
				D	A	B	L	W	H	X	Y	Z	Q	n	Ca(kgf)	Coa(kgf)
SFI1605-4 ☆	16	5	3.175	30	49	10	50	39	34	4.5	8	4.5	M6x1	1x4	888	1525
SFI1610-3 ☆		10	3.175	34	58	10	57	45	34	5.5	9.5	5.5	M6x1	1x3	716	1232
SFI2005-4 ☆	20	5	3.175	34	57	11	51	45	40	5.5	9.5	5.5	M6x1	1x4	999	1994
SFI2505-4 ☆	25	5	3.175	40	63	11	51	51	46	5.5	9.5	5.	M8x1	1x4	1119	2581
SFI2510-4 ☆		10	4.762	46	72	12	85	58	52	6.5	11	6.5	M8x1	1x4	1903	3695
SFI3205-4 ☆	32	5	3.175	46	72	12	52	58	52	6.5	11	6.5	M8x1	1x4	1264	3402
SFI3210-4		10	6.35	54	88	15	90	70	62	9	14	8.5	M8x1	1x4	3092	6101
SFI4005-4	40	5	3.175	56	90	15	55	72	64	9	14	8.5	M8x1	1x4	1407	4341
SFI4010-4		10	6.35	62	104	18	93	82	70	11	17.5	11	M8x1	1x4	3480	7779
SFI5010-4	50	10	6.35	72	114	18	93	92	82	11	17.5	11	M8x1	1x4	3898	10325
SFI6310-4	63	10	6.35	85	131	22	98	107	95	14	20	13	M8x1	1x4	4401	7779
SFI8010-4	80	10	6.35	105	150	22	98	127	115	14	20	13	M8x1	1x4	4900	10325

※ with sign ☆ can poduce left helix

DFI Series specifications

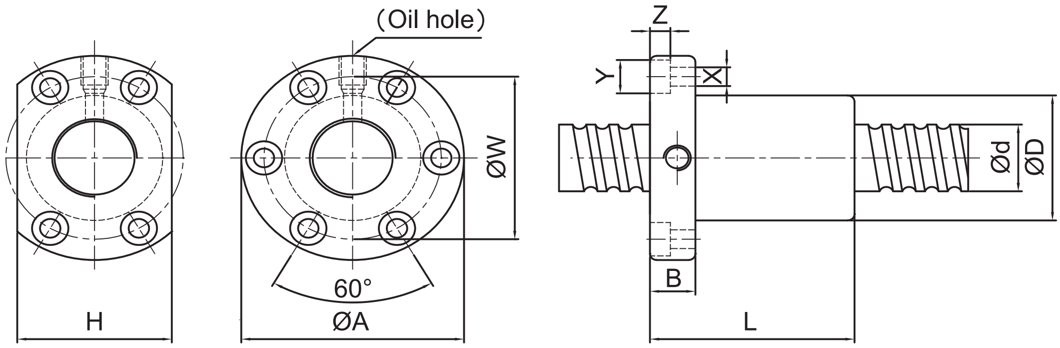


Unit：mm

Model no.	d	I	DA	Dimensions									Load rating	
				D	A	B	L	W	H	X	Q	n	Ca(kgf)	Coa(kgf)
DFI1604-4	16	4	2.381	30	49	10	80	39	34	4.5	M6x1	1x4	973	2406
DFI1605-4 ☆		5	3.175	30	49	10	100	39	34	4.5	M6x1	1x4	1380	3052
DFI2004-4	20	4	2.381	34	57	11	80	45	40	5.5	M6x1	1x4	1066	2987
DFI2005-4 ☆		5	3.175	34	57	11	101	45	40	5.5	M6x1	1x4	1551	3875
DFI2504-4	25	4	2.381	40	63	11	80	51	46	5.5	M6x1	1x4	1180	3795
DFI2505-4 ☆		5	3.175	40	63	11	101	51	46	5.5	M8x1	1x4	1724	4094
DFI2510-4		10	4.762	46	72	12	145	58	52	6.5	M6x1	1x4	2954	7295
DFI3204-4	32	4	2.381	46	72	12	145	58	52	6.5	M6x1	1x4	1296	4838
DFI3205-4 ☆		5	3.175	46	72	12	102	58	52	6.5	M8x1	1x4	1922	6343
DFI3210-4 ☆		10	6.35	54	88	15	162	70	62	9	M8x1	1x4	4805	12208
DFI4005-4 ☆	40	5	3.175	56	90	15	105	72	64	9	M8x1	1x4	2110	7988
DFI4010-4 ☆		10	6.35	62	104	18	165	82	70	11	M8x1	1x4	5399	15500
DFI5010-4 ☆	50	10	6.35	72	114	18	171	92	82	11	M8x1	1x4	6004	19614
DFI6310-4 ☆	63	10	6.35	85	131	22	182	107	95	14	M8x1	1x4	6719	25358
DFI8010-4	80	10	6.35	105	150	22	182	127	115	14	M8x1	1x4	7346	31953

※ with sign ☆ can poduce left helix

SFNI Series specifications

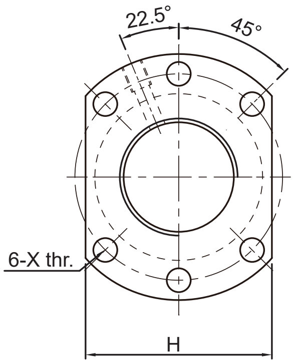


Unit: mm

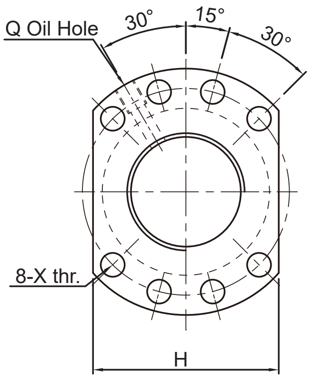
Model no.	d	l	DA	Dimensions											Load rating		K kgf/μm
				D	A	B	L	W	H	X	Y	Z	Q	n	Ca(kgf)	Coa(kgf)	
SFNI1605-4☆	16	5	3.175	30	49	10	45	39	34	4.5	8	4.5	M6	1x4	1380	3052	33
SFNI1610-3		10	3.175	34	58	10	57	45	34	5.5	9.5	5.5	M6	1x3	1103	2401	27
SFNI2005-4☆	20	5	3.175	34	57	11	51	45	40	5.5	9.5	5.5	M6	1x4	1551	3875	39
SFNI2505-4☆	25	5	3.175	40	63	11	51	51	46	5.5	9.5	5.5	M8	1x4	1724	4904	45
SFNI2510-4		10	4.762	46	72	12	80	58	52	6.5	11	6.5	M6	1x4	2954	7295	51
SFNI3205-4☆	32	5	3.175	46	72	12	52	58	52	6.5	11	6.5	M8	1x4	1922	6343	52
SFNI3210-4☆		10	6.35	54	88	15	85	70	62	9	14	8.5	M8	1x4	4805	12208	62
SFNI4005-4☆	40	5	3.175	56	90	15	55	72	64	9	14	8.5	M8	1x4	2110	7988	59
SFNI4010-4☆		10	6.35	62	104	18	88	82	70	11	17.5	11	M8	1x4	5399	15500	72
SFNI5010-4☆	50	10	6.35	72	114	18	88	92	82	11	17.5	11	M8	1x4	6004	19614	83
SFNI6310-4	63	10	6.35	85	131	22	93	107	95	14	20	13	M8	1x4	6719	25358	95
SFNI8010-4	80	10	6.35	105	150	22	93	127	115	14	20	13	M8	1x4	7346	31953	109

※ with sign ☆ can poduce left helix

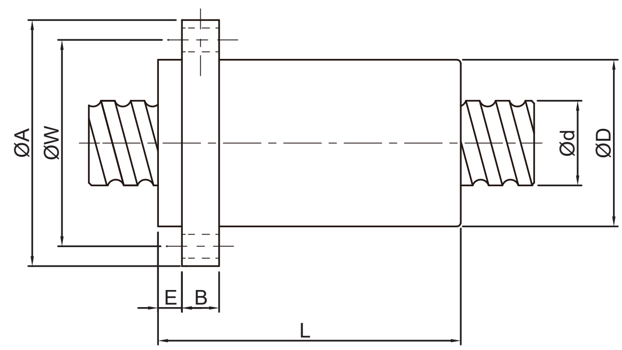
SFA Series specifications



d≦32



d≧40

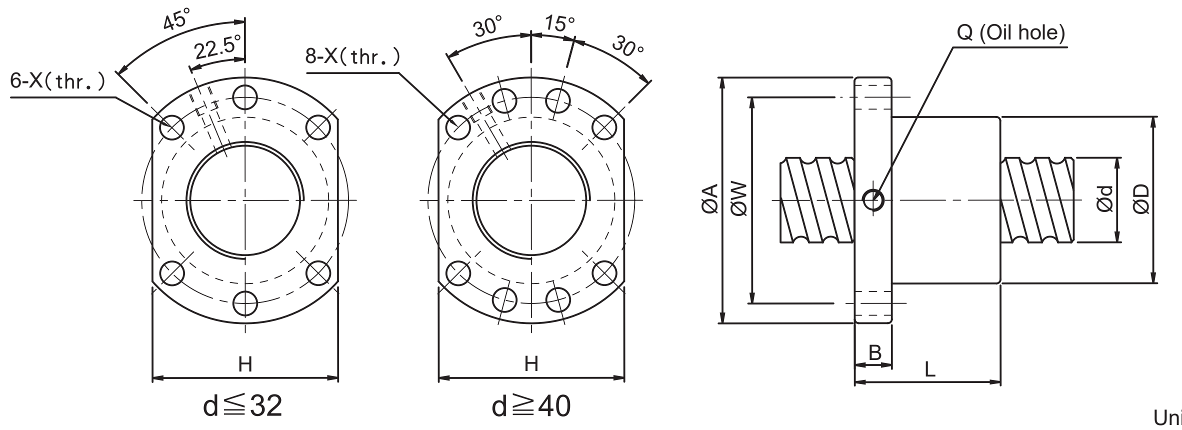


Unit: mm

Model no.	d	l	Da	Dimensions										Load rating		K
				D	A	E	B	L	W	H	X	Q	n	Ca(kgf)	Coa(kgf)	kgf/μm
SFA1205-2.8 ☆	12	5	2.5	24	40	5	10	30	32	30	4.5		2.8×1	661	1316	19
SFA1210-2.8 ☆		10	2.5	24	40	5	10	42	32	30	4.5		2.8×1	642	1287	19
SFA1605-3.8 ☆	15	5	2.778	28	48	5	10	31	38	40	5.5	M6	3.8×1	1112	2507	30
SFA1610-2.8 ☆		10	2.778	28	48	5	10	42	38	40	5.5	M6	2.8×1	839	1821	23
SFA1616-1.8 ☆		16	2.778	28	48	5	10	43	38	40	5.5	M6	1.8×1	552	1137	14
SFA1616-2.8 ☆		16	2.778	28	48	5	10	59	38	40	5.5	M6	2.8×1	808	1769	22
SFA1620-1.8 ☆		20	2.778	28	48	5	10	50	38	40	5.5	M6	1.8×1	554	1170	14
SFA2005-3.8 ☆	20	5	3.175	36	58	7	10	33	47	44	6.6	M6	3.8×1	1484	3681	37
SFA2010-3.8 ☆		10	3.175	36	58	7	10	52	47	44	6.6	M6	3.8×1	1516	3833	40
SFA2020-1.8 ☆		20	3.175	36	58	7	10	52	47	44	6.6	M6	1.8×1	764	1758	19
SFA2020-2.8 ☆		20	3.175	36	58	7	10	72	47	44	6.6	M6	2.8×1	1118	2734	29
SFA2505-3.8 ☆	25	5	3.175	40	62	7	10	33	51	48	6.6	M6	3.8×1	1650	4658	43
SFA2510-3.8 ☆		10	3.175	40	62	7	12	52	51	48	6.6	M6	3.8×1	1638	4633	45
SFA2525-1.8 ☆		25	3.175	40	62	7	12	60	51	48	6.6	M6	1.8×1	843	2199	22
SFA2525-2.8		25	3.175	40	62	7	12	85	51	48	6.6	M6	2.8×1	1232	3421	34
SFA3205-3.8	32	5	3.175	50	80	9	12	35	65	62	9	M6	3.8×1	1839	6026	51
SFA3210-3.8	31	10	3.969	50	80	9	12	53	65	62	9	M6	3.8×1	2460	7255	55
SFA3220-2.8		20	3.969	50	80	9	12	72	65	62	9	M6	2.8×1	1907	5482	43
SFA3232-1.8		32	3.969	50	80	9	12	78	65	62	9	M6	1.8×1	1257	3426	27
SFA3232-2.8		32	3.969	50	80	9	12	110	65	62	9	M6	2.8×1	1838	5329	42
SFA4005-3.8	40	5	3.175	63	93	9	14	39	78	70	9	M8	3.8×1	2018	7589	60
SFA4010-3.8	38	10	6.35	63	93	9	14	57	78	70	9	M8	3.8×1	5035	13943	67
SFA4020-2.8		20	6.35	63	93	9	14	78	78	70	9	M8	2.8×1	3959	10715	54
SFA4040-1.8		40	6.35	63	93	9	14	96	78	70	9	M8	1.8×1	2585	6648	34
SFA4040-2.8		40	6.35	63	93	9	14	136	78	70	9	M8	2.8×1	3780	10341	52
SFA5005-3.8●	50	5	3.175	75	110	10.5	15	42	93	85	11	M8	3.8×1	2207	9542	68
SFA5010-3.8●	48	10	6.35	75	110	10.5	18	57	93	85	11	M8	3.8×1	5638	17852	79
SFA5020-3.8●		20	6.35	75	110	10.5	18	98	93	85	11	M8	3.8×1	5749	18485	87
SFA5050-1.8●		50	6.35	75	110	10.5	18	117	93	85	11	M8	1.8×1	2946	8749	42
SFA5050-2.8●		50	6.35	75	110	10.5	18	167	93	85	11	M8	2.8×1	4308	13610	65

※☆ Actuator type available.
※Please contact SIMTACH if the marked types (●) are required.

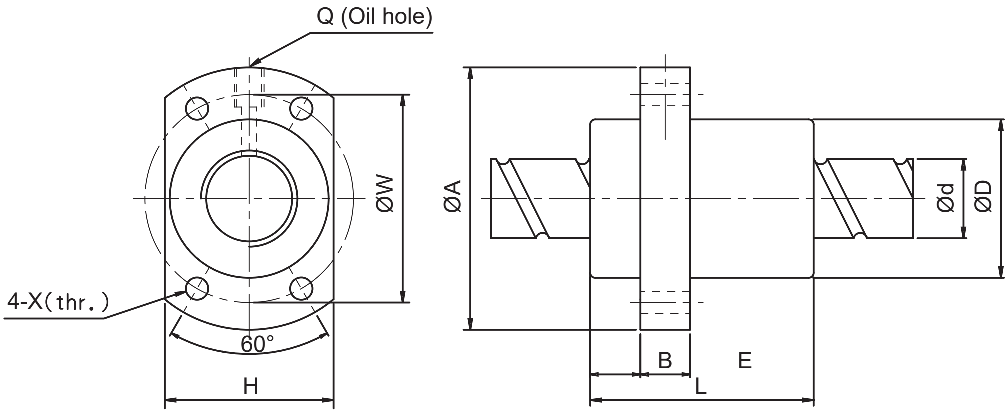
SFS Series specifications



Unit：mm

Model no.	d	l	DA	Dimensions									Load rating	
				D	A	B	L	W	H	X	Q	n	Ca(kgf)	Coa(kgf)
SFS1205-2.8	12	5	2.5	24	40	10	31	32	30	4.5	M6x1	2.8x1	661	1316
SFS1210-2.8		10	2.5	24	40	10	48.5	32	30	4.5	M6x1	2.8x1	642	1287
SFS1605-3.8	15	5	2.778	28	48	10	38	38	40	5.5	M6x1	3.8x1	1112	2507
SFS1610-2.8		10	2.778	28	48	10	47	38	40	5.5	M6x1	2.8x1	839	1821
SFS1616-1.8		16	2.778	28	48	10	45	38	40	5.5	M6x1	1.8x1	552	1137
SFS1616-2.8		16	2.778	28	48	10	61	38	40	5.5	M6x1	2.8x1	808	1769
SFS1620-1.8		20	2.778	28	48	10	57	38	40	5.5	M6x1	1.8x1	554	1170
SFS2005-3.8	20	5	3.175	36	58	10	40	47	44	6.6	M6x1	3.8x1	1484	3681
SFS2010-3.8		10	3.175	36	58	10	60	47	44	6.6	M6x1	3.8x1	1516	3833
SFS2020-1.8		20	3.175	36	58	10	57	47	44	6.6	M6x1	1.8x1	764	1758
SFS2020-2.8		20	3.175	36	58	10	77	47	44	6.6	M6x1	2.8x1	1118	2734
SFS2505-3.8	25	5	3.175	40	62	10	40	51	48	6.6	M6x1	3.8x1	1650	4658
SFS2510-3.8		10	3.175	40	62	12	65	51	48	6.6	M6x1	3.8x1	1638	4633
SFS2520-2.8		20	3.969	40	62	12	72	51	48	6.6	M6x1	2.8x1	1206	2695
SFS2525-1.8		25	3.175	40	62	12	70	51	48	6.6	M6x1	1.8x1	843	2199
SFS2525-2.8		25	3.175	40	62	12	95	51	48	6.6	M6x1	2.8x1	1232	3421
SFS3205-3.8	32	5	3.175	50	80	12	42	65	62	9	M6x1	3.8x1	1839	6026
SFS3210-3.8	31	10	3.969	50	80	13	62	65	62	9	M6x1	3.8x1	2460	7255
SFS3220-2.8		20	3.969	50	80	12	80	65	62	9	M6x1	2.8x1	1907	5482
SFS3232-1.8		32	3.969	50	80	13	84	65	62	9	M6x1	1.8x1	1257	3426
SFS3232-2.8		32	3.969	50	80	13	116	65	62	9	M6x1	2.8x1	1838	2329
SFS4005-3.8	40	5	3.175	63	93	15	45	78	70	9	M8x1	3.8x1	2018	7589
SFS4010-3.8	38	10	6.35	63	93	14	63	78	70	9	M8x1	3.8x1	5035	13943
SFS4020-2.8		20	6.35	63	93	14	82	78	70	9	M8x1	2.8x1	3959	10715
SFS4040-1.8		40	6.35	63	93	15	105	78	70	9	M8x1	1.8x1	2585	6648
SFS4040-2.8		40	6.35	63	93	15	145	78	70	9	M8x1	2.8x1	3780	10341
SFS5005-3.8	50	5	3.175	75	110	15	45	93	85	11	M8x1	3.8x1	2207	9542
SFS5010-3.8	48	10	6.35	75	110	18	68	93	85	11	M8x1	3.8x1	5638	17852
SFS5020-3.8		20	6.35	75	110	18	108	93	85	11	M8x1	2.8x1	5749	18485
SFS5050-1.8		50	6.35	75	110	18	125	93	85	11	M8x1	1.8x1	2946	8749
SFS5050-2.8		50	6.35	75	110	18	175	93	85	11	M8x1	2.8x1	4308	13610

SFY Series specifications



Unit: mm

Model no.	d	I	Da	Dimensions										Load rating		K
				D	A	E	B	L	W	H	X	Q	n	Ca(kgf)	Coa(kgf)	kgf/μm
SFY1616-3.6	16	16	2.778	32	53	10.1	10	45	42	34	4.5	M6	1.8x2	1073	2551	31
SFY2020-3.6	20	20	3.175	39	62	13	10	52	50	41	5.5	M6	1.8x2	1387	3515	37
SFY2525-3.6	25	25	3.969	47	74	15	12	64	60	49	6.6	M6	1.8x2	2074	5494	45
SFY3232-3.6	32	32	4.762	58	92	17	12	78	74	60	9	M6	1.8x2	3021	8690	58
SFY4040-3.6	40	40	6.35	73	114	19.5	15	99	93	75	11	M6	1.8x2	4831	14062	70
SFY5050-3.6 •	50	50	7.938	90	135	21.5	20	117	112	92	14	M6	1.8x2	7220	21974	86
SFY1632-1.6	16	32	2.778	32	53	10.1	10	42.5	42	34	4.5	M6	0.8x2	493	1116	11
SFY2040-1.6	20	40	3.175	39	62	13	10	48	50	41	5.5	M6	0.8x2	653	1597	15
SFY2550-1.6	25	50	3.969	47	74	15	12	58	60	49	6.6	M6	0.8x2	976	2495	19
SFY3264-1.6	32	64	4.762	58	92	17	12	71	74	60	9	M6	0.8x2	1374	3571	22
SFY4080-1.6	40	80	6.35	73	114	19.5	15	90	93	75	11	M6	0.8x2	2273	6387	29
SFY50100-1.6 •	50	100	7.938	90	135	21.5	20	111	112	92	14	M6	0.8x2	3398	9980	35

※Please contact SIMTACH if the marked types (●) are required

2-2 Ball Screw Weight List

Model No.	Weight	
	Ball Nut(kg)	Screw Shaft(kg/m)
SFU/SFNU		
SFU1204-4	0.138	0.87
SFU1604-4	0.190	1.56
SFU1605-4	0.190	1.56
SFU1610-3	0.220	1.56
SFU2005-4	0.316	2.45
SFU2505-4	0.350	3.82
SFU2510-4	0.484	3.81
SFU3205-4	0.588	6.29
SFU3210-4	0.832	6.23
SFU4005-4	0.970	9.84
SFU4010-4	1.246	9.78
SFU5010-4	1.820	15.33
SFU5020-4	2.674	15.31
SFU6310-4	2.576	24.39
SFU6320-4	4.888	24.28
SFU8010-4	3.100	39.38
SFU8020-4	9.016	39.27
SFU10020-4	10.000	61.47
DFU		
DFU1604-4	0.308	1.56
DFU1605-4	0.308	1.56
DFU2005-4	0.480	2.45
DFU2505-4	0.630	3.82
DFU2510-4	0.650	3.81
DFU3205-4	1.040	6.29
DFU3210-4	1.300	6.23
DFU4005-4	1.700	9.84
DFU4010-4	1.700	9.78
DFU5020-4	4.200	15.31
DFU6320-4	8.362	24.28
DFU8020-4	16.660	39.27
DFU10020-4	26.400	61.47

Model No.	Weight	
	Ball Nut(kg)	Screw Shaft(kg/m)
SFI/SFNI		
SFI1605-4	0.220	1.56
SFI1610-3	0.382	1.56
SFI2005-4	0.308	2.45
SFI2505-4	0.396	3.82
SFI2510-4	0.802	3.81
SFI3205-4	0.472	6.29
SFI3210-4	1.140	6.23
SFI4005-4	0.840	9.84
SFI4010-4	1.548	9.78
SFI5010-4	1.924	15.33
SFI6310-4	2.674	24.39
SFI8010-4	3.900	39.38
DFI		
DFI01605-4	0.311	1.56
DFI02005-4	0.446	2.45
DFI02505-4	0.562	3.82
DFI02510-4	0.644	3.81
DFI03205-4	0.690	6.29
DFI03210-4	0.774	6.23

2-2 Ball Screw Weight List

Model No.	Weight	
	Ball Nut(kg)	Screw Shaft(kg/m)
SFA/SFS		
SFA1205-2.8	0.112	0.87
SFA1210-2.8	0.130	0.87
SFA1605-3.8	0.168	1.37
SFA1610-2.8	0.198	1.37
SFA1616-1.8	0.202	1.37
SFA1616-2.8	0.252	1.37
SFA1620-1.8	0.222	1.37
SFA1630-1.8	0.260	1.37
SFA2005-3.8	0.245	2.45
SFA2010-3.8	0.330	2.45
SFA2020-1.8	0.332	2.45
SFA2020-2.8	0.435	2.45
SFA2505-3.8	0.272	3.83
SFA2510-3.8	0.350	3.83
SFA2525-1.8	0.415	3.83
SFA2525-2.8	0.568	3.83
SFA3205-3.8	0.462	6.29
SFA3210-3.8	0.580	5.89
SFA3220-2.8	0.742	5.89
SFA3232-1.8	0.790	5.89
SFA3232-2.8	1.060	5.89
SFA4005-3.8	0.808	9.84
SFA4010-3.8	0.870	8.82
SFA4020-2.8	1.150	8.82
SFA4040-1.8	1.525	8.82
SFA4040-2.8	2.090	8.82
SFA5005-3.8	0.944	15.39
SFA5010-3.8	1.280	14.12
SFA5020-3.8	2.050	14.12
SFA5050-1.8	2.400	14.12
SFA5050-2.8	3.500	14.12
SFA5050-2.8	3.500	14.12

Model No.	Weight	
	Ball Nut(kg)	Screw Shaft(kg/m)
SFY		
SFY1616-3.6	0.238	1.55
SFY1632-1.6	0.222	1.55
SFY2020-3.6	0.380	2.42
SFY2040-1.6	0.348	2.42
SFY2525-3.6	0.652	3.79
SFY2550-1.6	0.596	3.79
SFY3232-3.6	1.168	6.22
SFY3264-1.6	1.066	6.22
SFY4040-3.6	2.288	9.70
SFY4080-1.6	2.096	9.70
SFY5050-3.6	4.120	15.15
SFY50100-1.6	3.818	15.15

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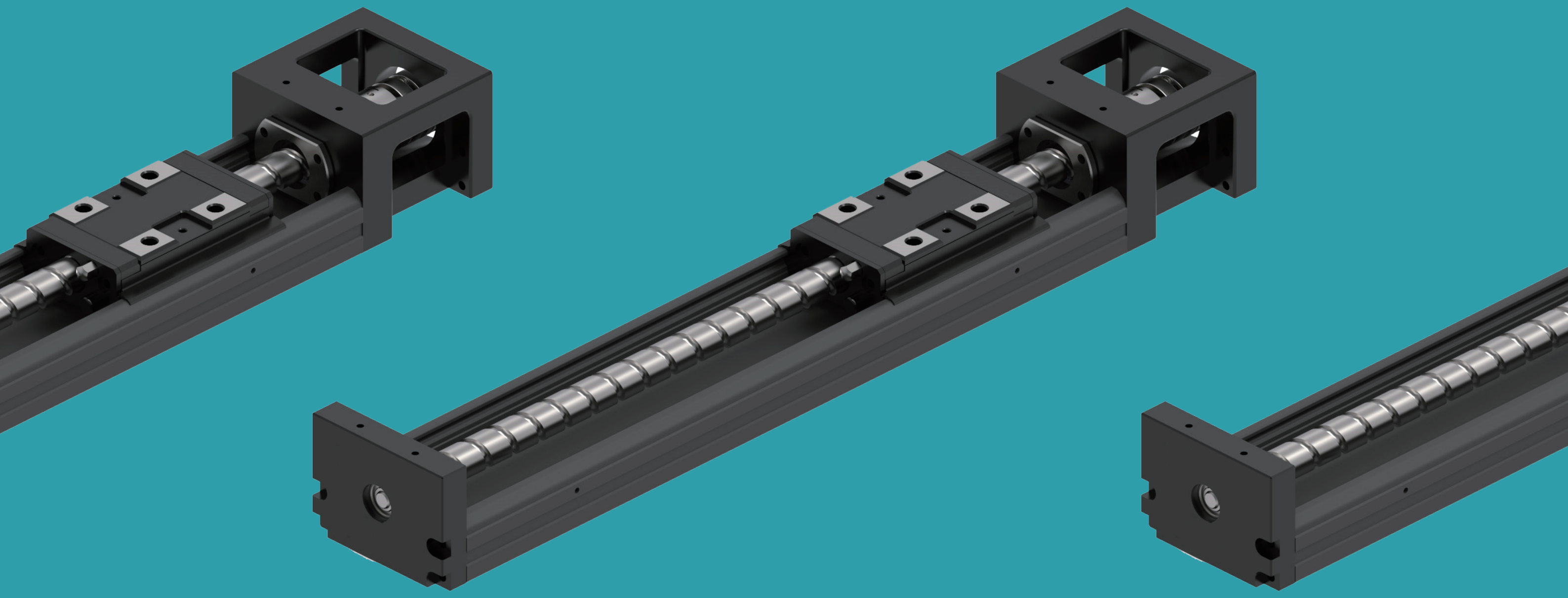

KK MODULE

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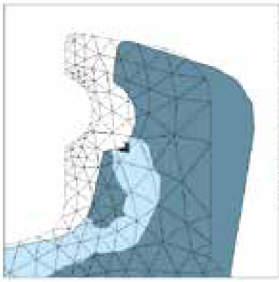
Contents

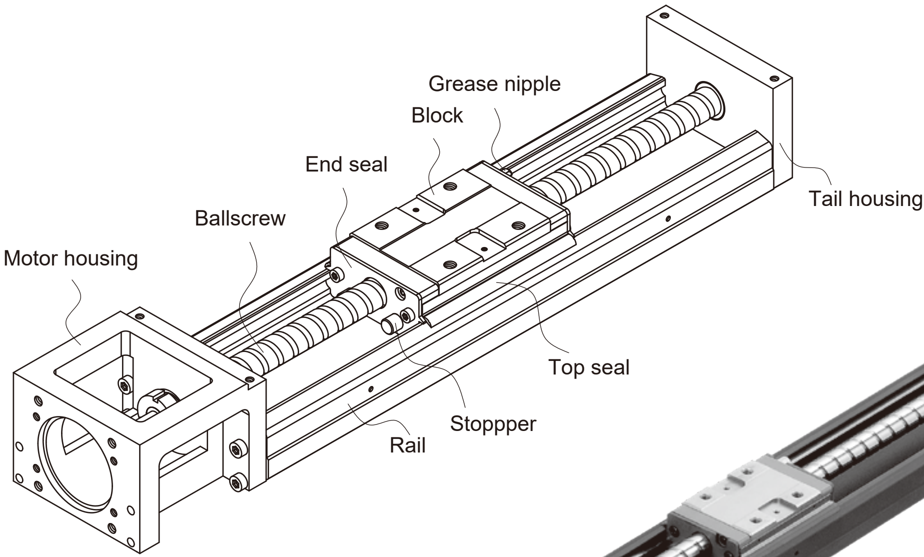
KK Module

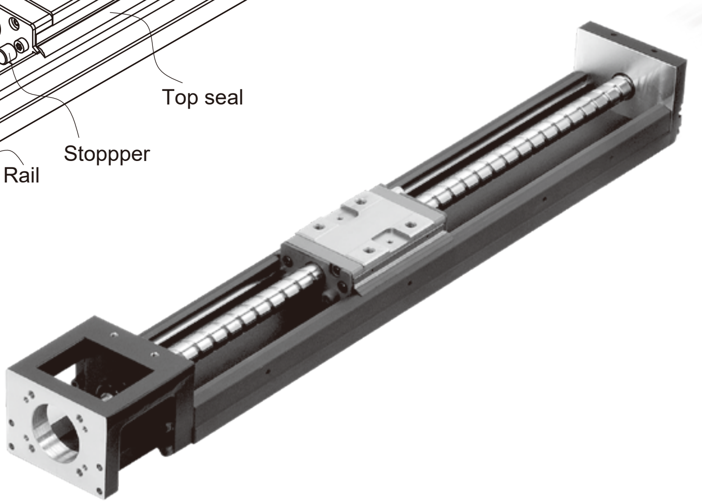
1.1 Features

◎ An integrated system
◎ Easy installation and maintenance
◎ Compact and lightweight
◎ High accuracy
◎ High stiffness
◎ Complete line of accessories

The structure of rail is analyzed by FEA to get the best rigidity and weight. The analysis results are shown as the right figures.

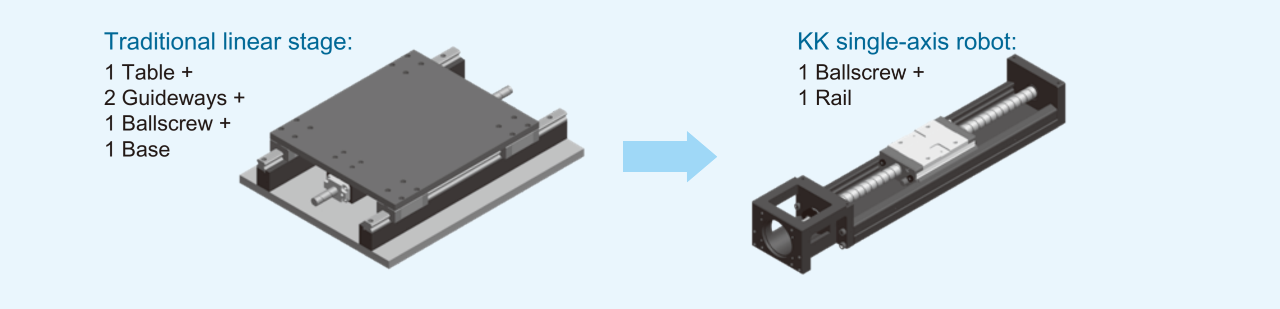






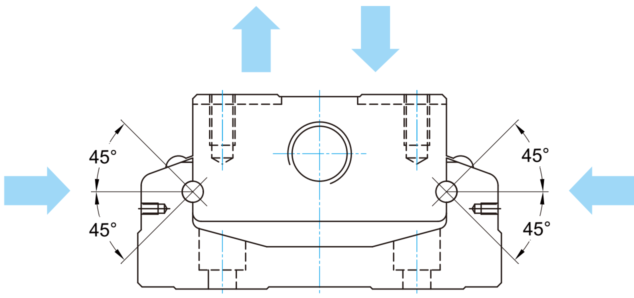
1.1.1 Modulization

The KK single-axis robot integrating a ballscrew and guideway forms a modularized product. The modularized design can help customers save time, cost and system inspection. Therefore, installation efficiency and a space-saving design are also promoted.



1.1.2 Equivalent Load

The gothic arch contact design sustains load from all directions and offers high rigidity and accuracy.

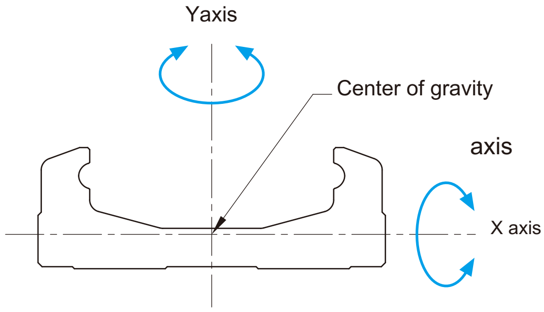


1.1.3 High Stiffness

Using finite element analysis on the U-shaped cross section allows the volume and rigidity to be made balanced, therefore, a high rigidity rail, compact design and a light weight design are also accomplished simultaneously.

Moment of inertia Unit:mm^4

Model no.	I_X	I_Y
KK50	9.6×10^3	1.34×10^5
KK60	2.056×10^4	2.802×10^5
KK86	7.445×10^4	1.134×10^6
KK100	1.296×10^5	2.035×10^6
KK130	2.546×10^5	5.073×10^6

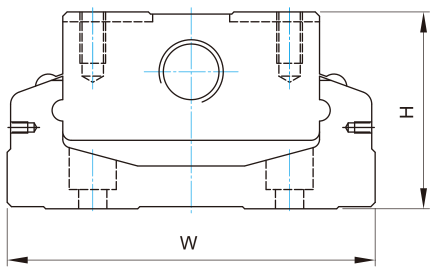


I_X : Moment of inertia computed about X axis
I_Y : Moment of inertia computed about Y axis

1.1.4 Various Specification

KK single-axis robots of various specifications are developed, providing customers with different choices relating to space and loading conditions.

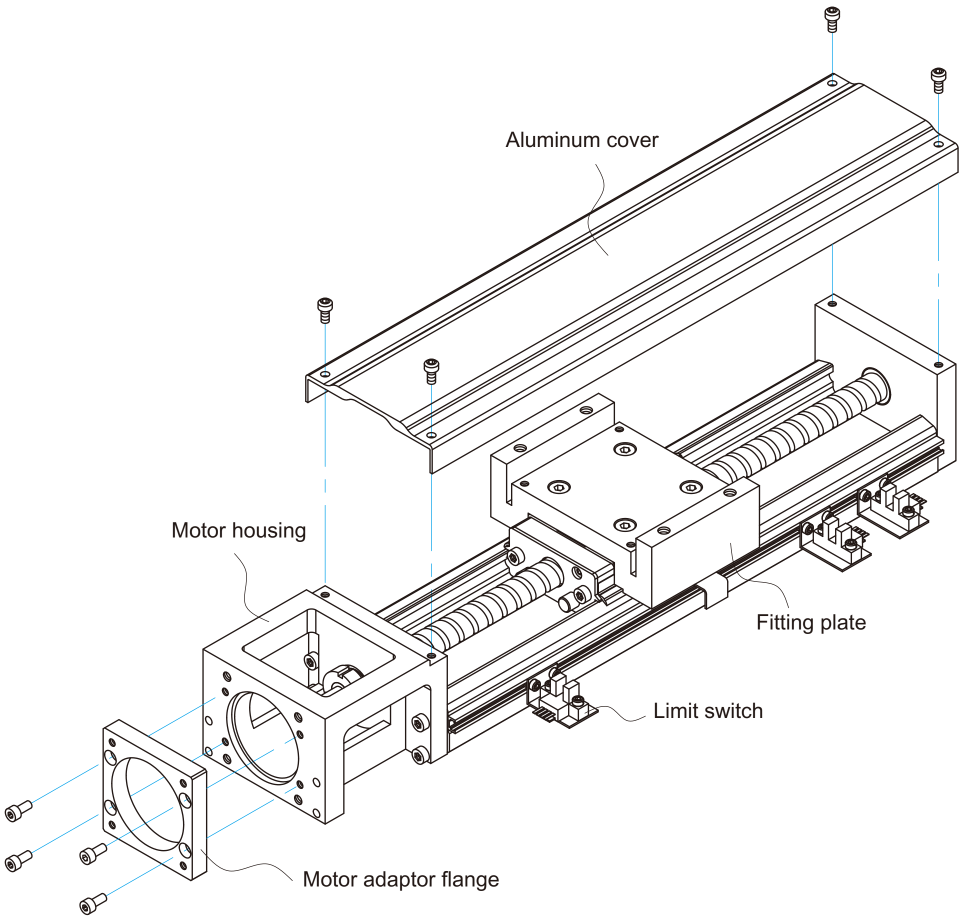
Model no.	W	H
KK50	50	26
KK60	60	33
KK86	86	46
KK100	100	55
KK130	130	65

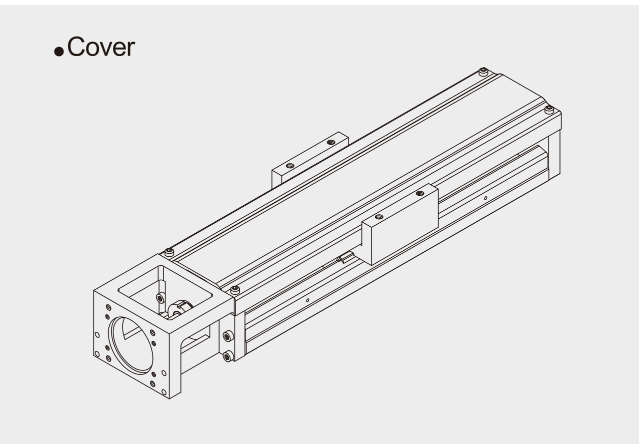


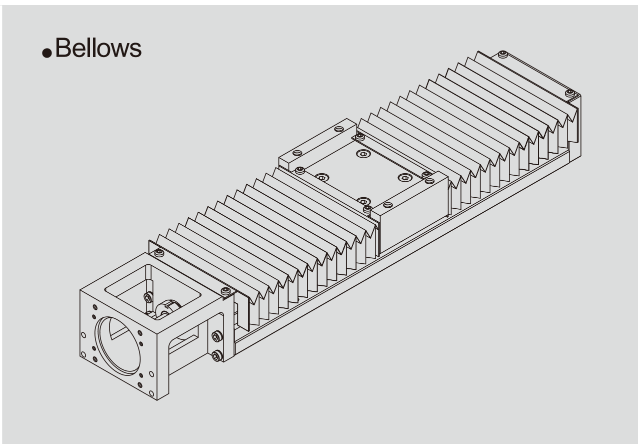
1.2 Accessories

AccessoriesofKKsingle-axisrobotarealsosupportedforspecificdemands,suchasanaluminum cover,bellows,motoradaptorflangeandlimitswitchs.

◎ Aluminum cover and bellow: contamination protection
◎ Motor adaptor flange: connection for different types of motors
◎ Limit switchs: starting point, positioning and other safety matters







KK 60D 10 P E - 400 E A 2 E - FO C S0 M051

KK Series

Nominal Width:
30, 40, 50, 60,
60D, 80, 86, 86D,
100, 130

Ballscrew Lead:
KK30: 1
KK40: 1
KK50: 2
KK60/KK60D: 5, 10
KK80: 10, 20
KK86/KK86D: 10, 20
KK100: 20
KK130: 25

Accuracy Grade:
P: Precision, C: Normal

E: Ballscrew Special Order
None: Normal Type

Rail Length (mm)
KK30: 75, 100, 125, 150, 175, 200
KK40: 100, 150, 200
KK50: 150, 200, 250, 300
KK60/KK60D: 150, 200, 300, 400, 500, 600
KK80: 340, 440, 540, 640, 740, 940
KK86/KK86D: 340, 440, 540, 640, 740, 940
KK100: 980, 1080, 1180, 1280, 1380
KK130: 980, 1180, 1380, 1680

E: Rail Special Order
None: Normal Type

Block Type:
A: Normal
S: Short

Number of Blocks: 1, 2

E: Block Special Order
None: Normal Type

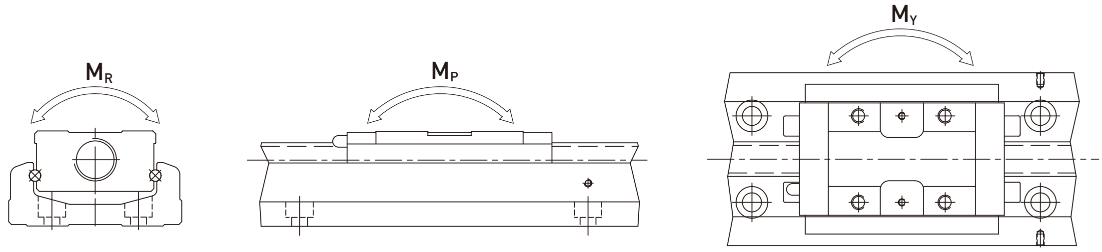
Motor Adaptor Flange:
ref. catalog P.41-45
FE：Flange Special Order

C: Aluminum Cover
B: Bellows (ref. catalog P.46)
None: Normal Type

Limit Switch: ref. catalog P.47-48
S0: Switch Rail Only
S1: Omron EE-SX671
S2: Omron EE-SX674
S3: Panasonic GX-F12A
S4: Panasonic GX-F12A-P
S5: YAMATAKE APM-D3B1-03
(suitable for KK30)
SE: Sensor Special Order
None: No Limit Switch and
Switch Rail

Motor specification:
ref. catalog P.39-40
M: customer specified
None: Without Motor

1.4 Specifications



Model No.		Ballscrew Nominal Diameter (mm)	Ballscrew Lead (mm)	Ballscrew Basic Dynamic Load (N)	Ballscrew Basic Static Load (N)	Guideway Basic Dynamic Load Rating (N) Block A	Guideway Basic Dynamic Load Rating (N) Block S	Guideway Basic Static Load Rating (N) Block A	Guideway Basic Static Load Rating (N) Block S	Allowable Static Moment M_P (N-m) (pitching) Block A1	M_P Block A2	M_P Block S1	M_P Block S2	Allowable Static Moment M_Y (N-m) (yawing) Block A1	M_Y Block A2	M_Y Block S1	M_Y Block S2	Allowable Static Moment M_R(N-m) (rolling) Block A1	M_R Block A2	M_R Block S1	M_R Block S2
KK3001	Precision	6	1	647	1088	2210	-	3510	-	14	73	-	-	14	73	-	-	41	82	-	-
	Normal			618	1079																
KK4001	Precision	8	1	735	1538	3920	-	6468	-	33	182	-	-	33	182	-	-	81	162	-	-
	Normal			676	1284																
KK5002	Precision	8	2	2136	3489	8007	-	12916	-	116	545	-	-	116	545	-	-	222	444	-	-
	Normal			1813	2910																
KK6005	Precision	12	5	3744	6243	13230	7173	21462	11574	152	760	72	367	152	760	72	367	419	838	241	482
	Normal			3377	5625																
KK6010	Precision	12	10	2410	3743	13230	7173	21462	11574	152	760	72	367	152	760	72	367	419	838	241	482
	Normal			2107	3234																
KK8010	Precision	15	10	7144	12642	31458	21051	50764	29475	622	3050	228	1309	622	3050	228	1309	1433	2866	800	1600
	Normal			6429	11387																
KK8020	Precision	15	20	4645	7655	31458	21051	50764	29475	622	3050	228	1309	622	3050	228	1309	1433	2866	800	1600
	Normal			4175	6889																
KK8610	Precision	15	10	7144	12642	31458	21051	50764	29475	622	3050	228	1309	622	3050	228	1309	1507	3014	847	1694
	Normal			6429	11387																
KK8620	Precision	15	20	4645	7655	31458	21051	50764	29475	622	3050	228	1309	622	3050	228	1309	1507	3014	847	1694
	Normal			4175	6889																
KK10020	Precision	20	20	7046	12544	39200	-	63406	-	960	4763	-	-	960	4763	-	-	2205	4410	-	-
	Normal			4782	9163																
KK13025	Precision	25	25	7897	15931	48101	-	84829	-	1536	7350	-	-	1536	7350	-	-	3885	7770	-	-
	Normal			7092	14352																

1.5 Accuracy Grade

Unit : mm

Model	Rail Length	Repeatability		Accuracy		Running Parallelism		Starting Torque(N-cm)	
		Precision	Normal	Precision	Normal	Precision	Normal	Precision	Normal
KK30	75	±0.003	±0.004	0.020	0.040	0.010	0.020	1.2	0.8
	100								
	125								
	150								
	175								
	200								
KK40	100	±0.003	±0.005	0.020	-	0.010	-	1.2	0.8
	150								
	200								
KK50	150	±0.003	±0.005	0.020	-	0.010	-	4	2
	200								
	250								
	300								
KK60	150	±0.003	±0.005	0.020	-	0.010	-	15	7
	200								
	300								
	400								
	500	±0.003	±0.005	0.025	-	0.015	-	15	7
	600								
KK80	340	±0.003	±0.005	0.025	-	0.015	-	15	10
	440								
	540								
	640								
	740	±0.003	±0.005	0.030	-	0.020	-	17	10
	940	±0.003	±0.005	0.040	-	0.030	-	25	10
KK86	340	±0.003	±0.005	0.025	-	0.015	-	15	10
	440								
	540								
	640								
	740	±0.003	±0.005	0.030	-	0.020	-	17	10
	940	±0.003	±0.005	0.040	-	0.030	-	25	10
KK100	980	±0.005	±0.01	0.035	-	0.025	-	17	12
	1080								
	1180	±0.005	±0.01	0.040	-	0.03	-	20	12
	1280	±0.005	±0.01	0.045	-	0.035	-	23	15
	1380			0.05		0.04		25	
KK130	980	±0.005	±0.01	0.035	-	0.025	-	25	15
	1180			0.04		0.03		25	15
	1380								
	1680	±0.007	±0.012	0.05	-	0.04	-	27	18

1.6 Maximum Speed Limit

Model	Ballscrew Lead (mm)	Rail Length L2 (mm)	Speed (mm/sec)	
			Precision	Normal
KK30	01	75	160	160
		100	160	160
		125	160	160
		150	160	160
		175	160	160
		200	160	160
KK40	01	100	190	190
		150	190	190
		200	190	190
KK50	02	150	270	270
		200	270	270
		250	270	270
		300	270	270
KK60	05	150	550	390
		200	550	390
		300	550	390
		400	550	390
		500	550	390
		600	340	340
	10	150	1100	790
		200	1100	790
		300	1100	790
		400	1100	790
		500	1100	790
		600	670	670
KK80	10	340	740	520
		440	740	520
		540	740	520
		640	740	520
		740	740	520
		940	610	430
	20	340	1480	1050
		440	1480	1050
		540	1480	1050
		640	1480	1050
		740	1480	1050
		940	1220	870
KK86	10	340	740	520
		440	740	520
		540	740	520
		640	740	520
		740	740	520
		940	610	430
	20	340	1480	1050
		440	1480	1050
		540	1480	1050
		640	1480	1050
		740	1480	1050
		940	1220	870
KK100	20	980	1120	800
		1080	980	800
		1180	750	750
		1280	630	630
		1380	530	530
KK130	25	980	1120	800
		1180	1120	800
		1380	830	800
		1680	550	550

1.7 Life Calculations

1.7.1 Service Life

Under repeated stress between the raceway and the rolling elements, pitting and flaking will occur as it reaches fatigue failure. The service life of the KK single-axis robot is defined as the distanced traveled before any failure of the raceway or rolling elements appear.

1.7.2 Nominal Life (L)

The service life varies greatly even when the KK units are manufactured in the same way or operated under the same conditions. For this reason, nominal life is used as the criteria for predicting the service life of a KK unit.

1.7.3 Nominal Life Calculation

The calculating formulas are divided into two parts, guideway and ballscrew. The smaller value of the two would be the recommended nominal life of the KK unit.

Nominal life formulas for both the guideway and ballscrew depend on several parameters and are shown below.

◎ Guideway

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

L : Life Rating (km)
f_t : Contact Coefficient (ref. Table 1)
f_w : Loading Coefficient (ref. Table 2)
C : Basic Dynamic Load Rating (N)
P_n : Calculated Loading (N)

Table 1

Block Type	Contact Coefficient f_t
A1, S1	1.0
A2, S2	0.81

Table 2

Operating Condition		Loading Coefficient f_w
Thrust and Vibration	Velocity (V)	
No Thrust	V < 15m/min	1.0 ~ 1.5
Low Vibration	15m/min < V < 60m/min	1.5 ~ 2.0
High Vibration	V > 60m/min	2.0 ~ 3.5

◎ Ballscrew and Bearing

$$L = \left(\frac{1}{f_w} \cdot \frac{C_a}{P_{a,n}} \right)^3 \text{ x } 10^6 \text{ rev}$$

L : Life Rating (rev.)
f_w : Loading Coefficient (ref. Table 2)
C_a : Basic Dynamic Load Rating (N)
$P_{a,n}$: Axial Loading (N)

1.8 Lubrication

Insufficient lubrication of the guideway would lead to a reduction of the service life.

The lubricant provides the following functions:

◎ Reducing rolling friction and avoiding abrasion

◎ Providing a lubricating film and extending the service life

◎ Anti-rusting

1.8.1 Lubricating Grease

Re-lubricating the KK single-axis robot every 100km is recommened. Generally, grease is applied for speeds under 60 m/min. For operating speeds over 60 m/min, a grease with a higher viscosity should be used.

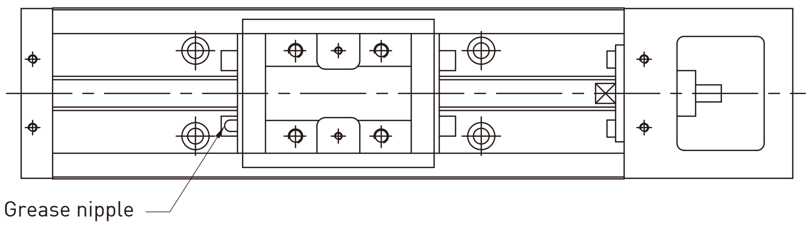
$$T = \frac{100 \times 1000}{V_e \times 60}$$

T : Lubricating frequency (hrs)

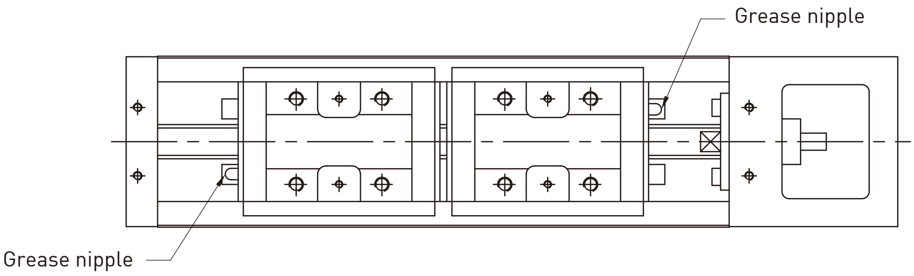
Ve : Speed (m/min)

1.8.2 Grease Nipple

◎ 1 Block

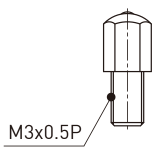


◎ 2 Block



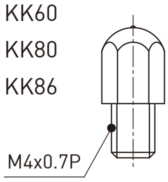
Types of grease nipple

KK40



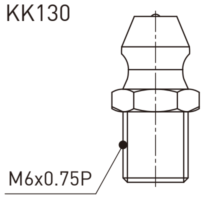
NO. 34310010

KK50
KK60
KK80
KK86



NO. 34310002

KK100
KK130

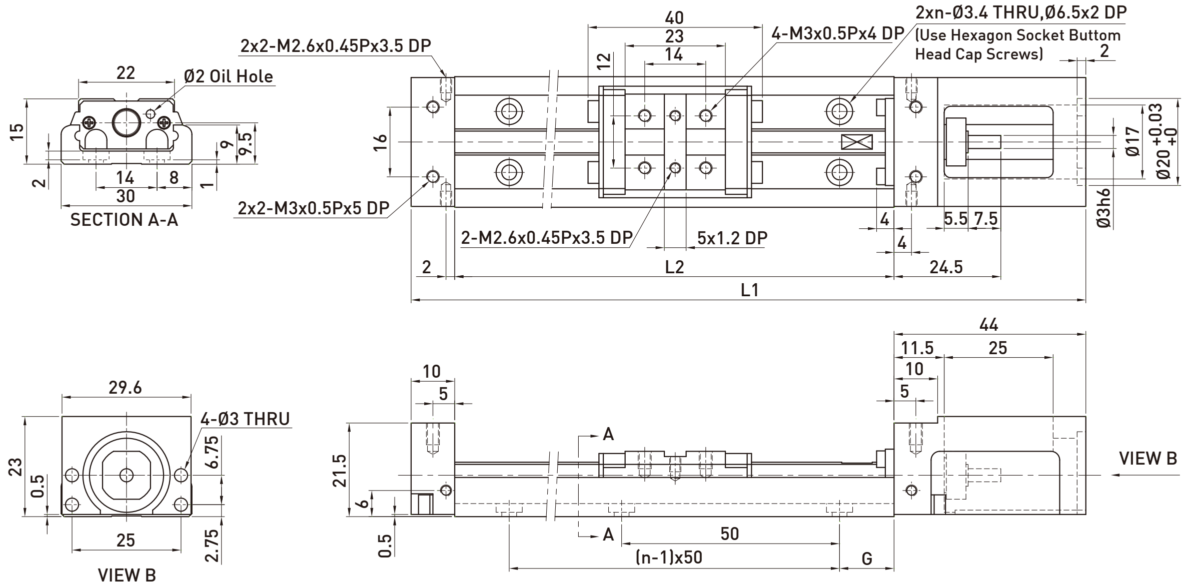


NO. 34310008

1.9 KK Series

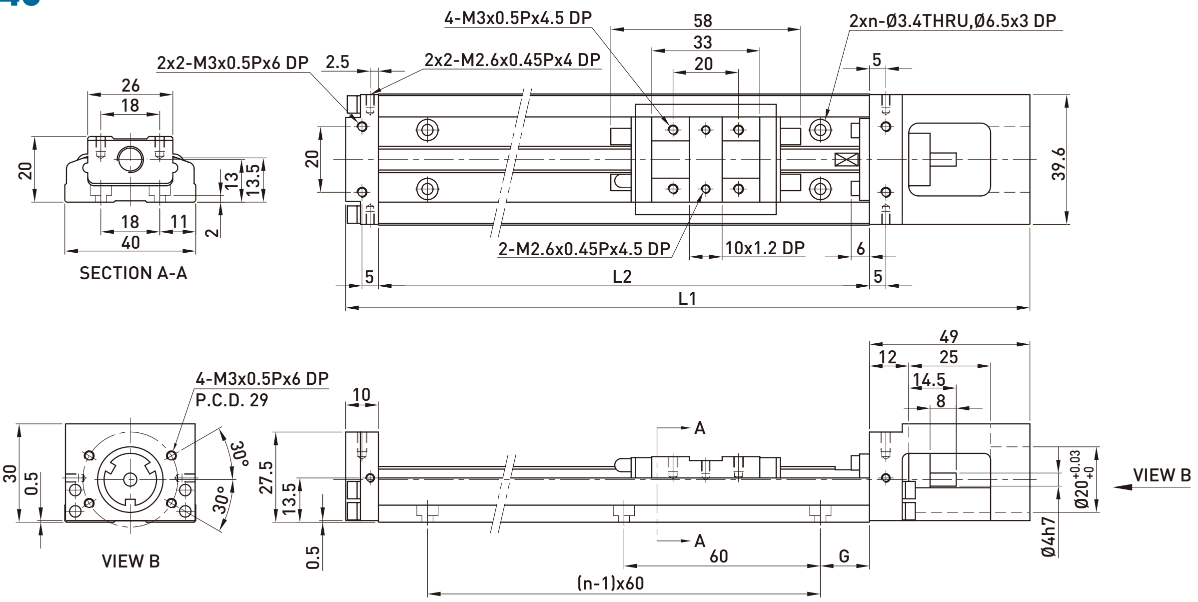
1.9.1 Without cover

KK30



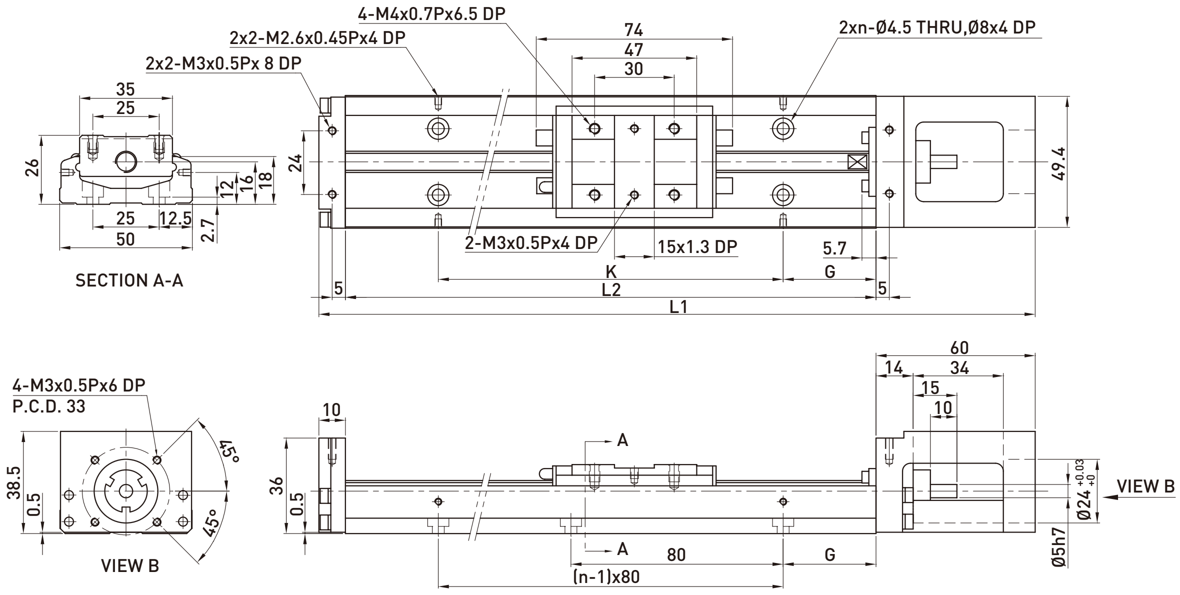
Rail Length L2 (mm)	Total Length L1 (mm)	Maximum Stroke (mm)		G (mm)	n	Mass (kg)	
		A1 Block	A2 Block			A1 Block	A2 Block
75	129	31	-	12.5	2	0.2	-
100	154	56	-	25	2	0.23	-
125	179	81	45	12.5	3	0.26	0.3
150	204	106	70	25	3	0.29	0.33
175	229	131	95	12.5	4	0.32	0.36
200	254	156	120	25	4	0.35	0.39

KK40



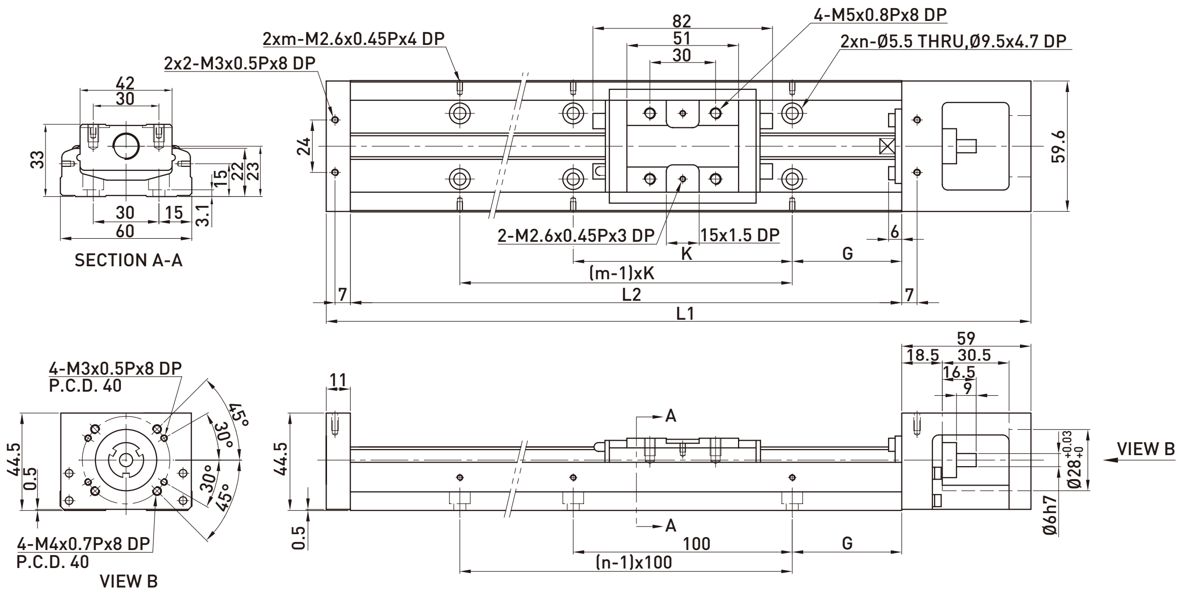
Rail Length L2 (mm)	Total Length L1 (mm)	Maximum Stroke (mm)		G (mm)	n	Mass (kg)	
		A1 Block	A2 Block			A1 Block	A2 Block
100	159	36	-	20	2	0.48	-
150	209	86	34	15	3	0.6	0.67
200	259	136	84	40	3	0.72	0.79

KK50



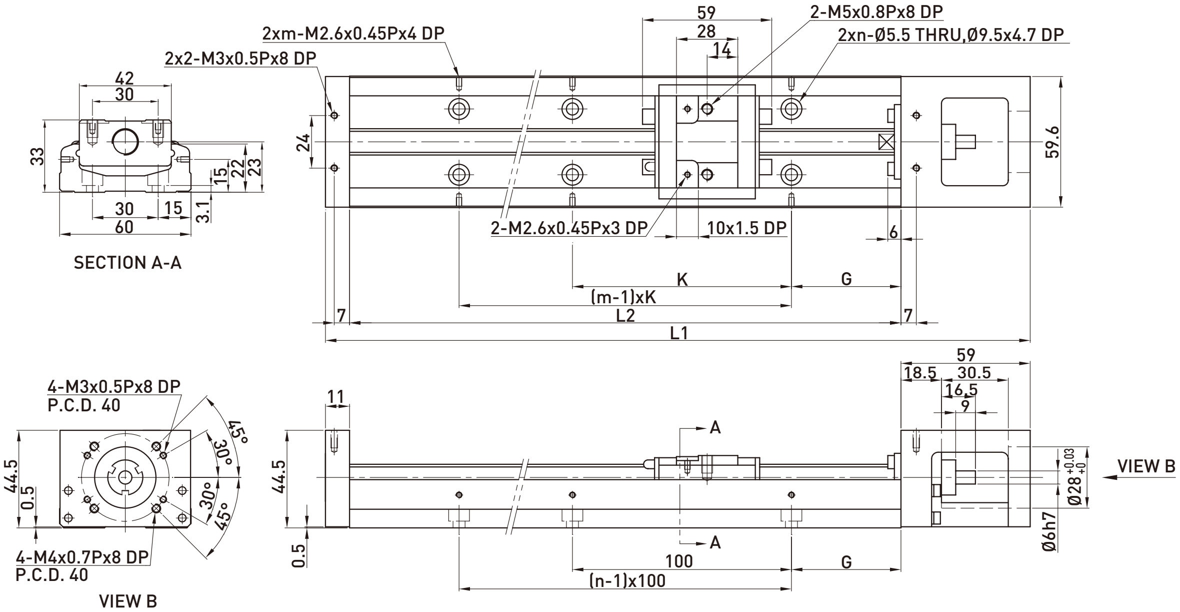
Rail Length L2 (mm)	Total Length L1 (mm)	Maximum Stroke (mm)		G (mm)	K (mm)	n	Mass (kg)	
		A1 Block	A2 Block				A1 Block	A2 Block
150	220	70	-	35	80	2	1	-
200	270	120	55	20	160	3	1.2	1.4
250	320	170	105	45	160	3	1.4	1.6
300	370	220	155	30	240	4	1.6	1.8

KK60



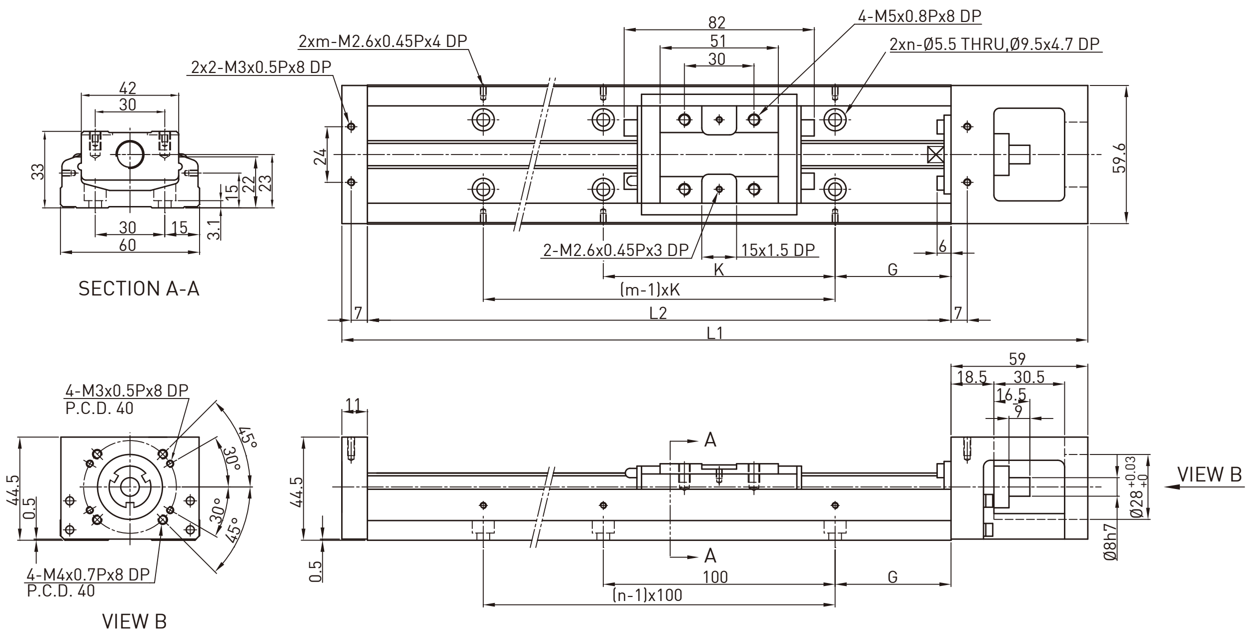
Rail Length L2 (mm)	Total Length L1 (mm)	Maximum Stroke (mm)		G (mm)	K (mm)	n	m	Mass (kg)	
		A1 Block	A2 Block					A1 Block	A2 Block
150	220	60	-	25	100	2	2	1.5	-
200	270	110	-	50	100	2	2	1.8	-
300	370	210	135	50	200	3	2	2.4	2.7
400	470	310	235	50	100	4	4	3	3.3
500	570	410	335	50	200	5	3	3.6	3.9
600	670	510	435	50	100	6	6	4.2	4.6

KK60 (Light Duty)



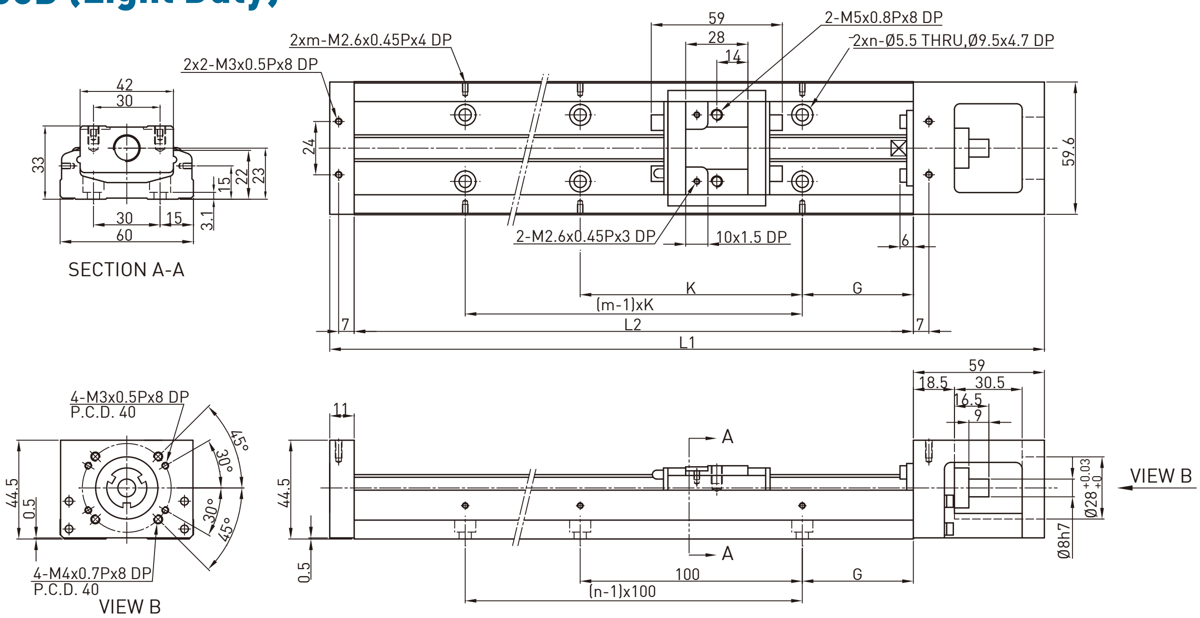
Rail Length L2 (mm)	Total Length L1 (mm)	Maximum Stroke (mm)		G (mm)	K (mm)	n	m	Mass (kg)	
		S1 Block	S2 Block					S1 Block	S2 Block
150	220	85	34	25	100	2	2	1.4	1.6
200	270	135	84	50	100	2	2	1.7	1.9
300	370	235	184	50	200	3	2	2.3	2.5
400	470	335	284	50	100	4	4	2.9	3.1
500	570	435	384	50	200	5	3	3.5	3.7
600	670	535	484	50	100	6	6	4.1	4.3

KK60D



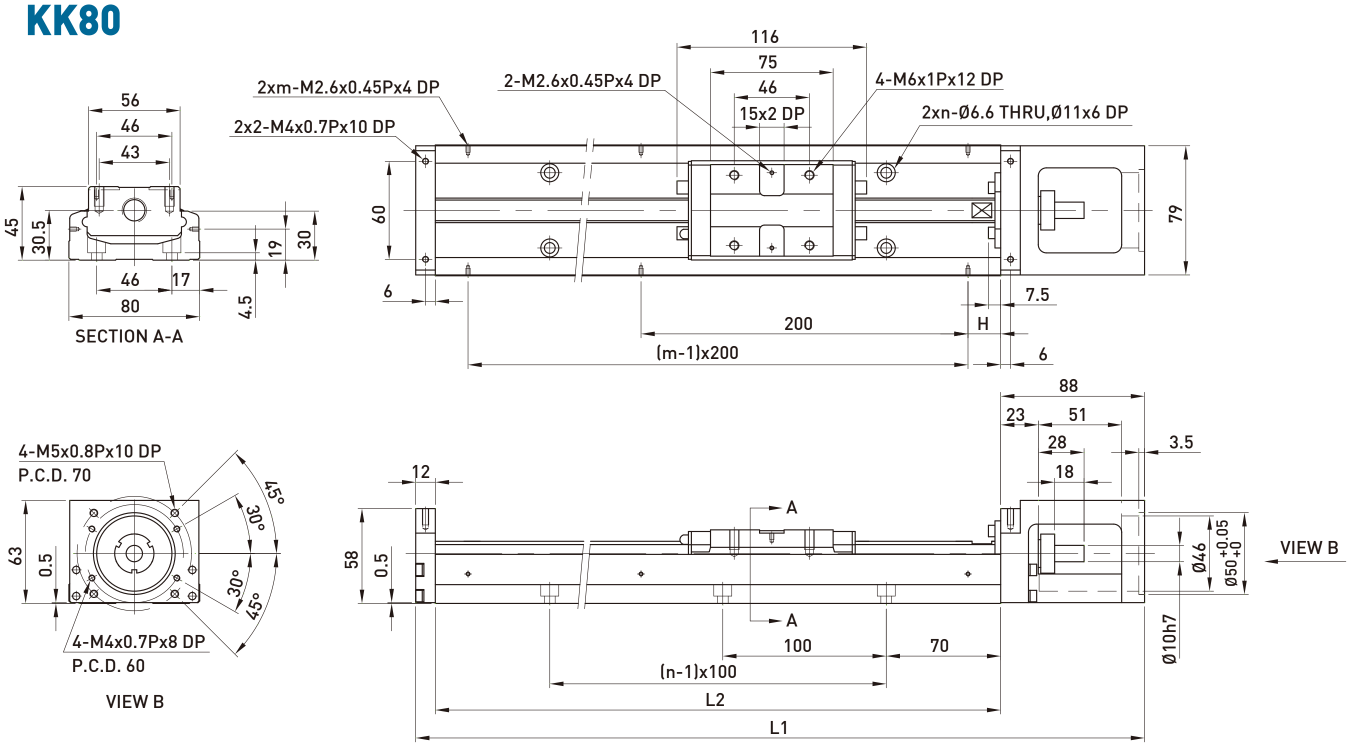
Rail Length L2 (mm)	Total Length L1 (mm)	Maximum Stroke (mm)		G (mm)	K (mm)	n	m	Mass (kg)	
		A1 Block	A2 Block					A1 Block	A2 Block
150	220	60	-	25	100	2	2	1.5	-
200	270	110	-	50	100	2	2	1.8	-
300	370	210	135	50	200	3	2	2.4	2.7
400	470	310	235	50	100	4	4	3	3.3
500	570	410	335	50	200	5	3	3.6	3.9
600	670	510	435	50	100	6	6	4.2	4.6

KK60D (Light Duty)



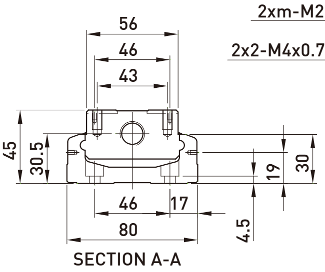
Rail Length L2 (mm)	Total Length L1 (mm)	Maximum Stroke (mm)		G (mm)	K (mm)	n	m	Mass (kg)	
		S1 Block	S2 Block					S1 Block	S2 Block
150	220	85	34	25	100	2	2	1.4	1.6
200	270	135	84	50	100	2	2	1.7	1.9
300	370	235	184	50	200	3	2	2.3	2.5
400	470	335	284	50	100	4	4	2.9	3.1
500	570	435	384	50	200	5	3	3.5	3.7
600	670	535	484	50	100	6	6	4.1	4.3

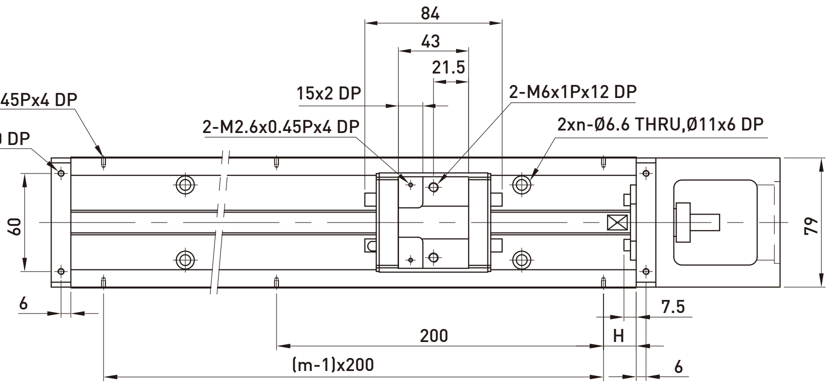
KK80

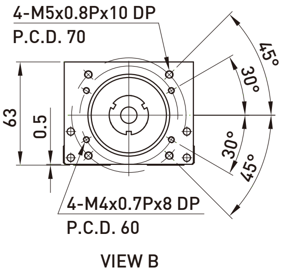


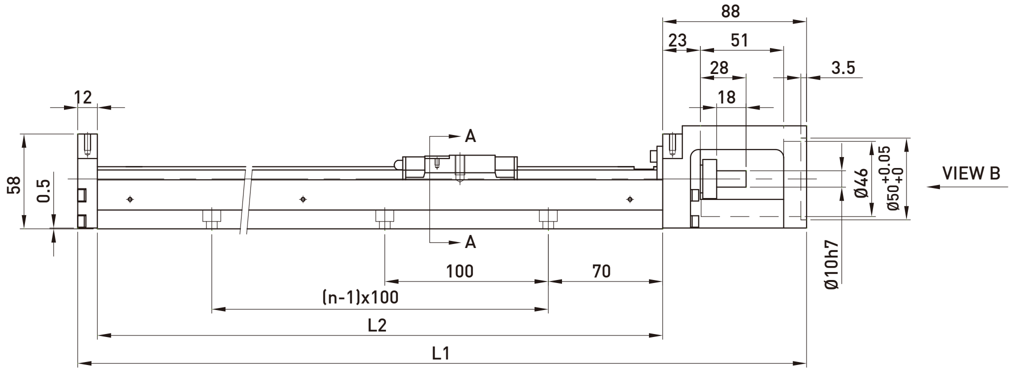
Rail Length L2 (mm)	Total Length L1 (mm)	Maximum Stroke (mm)		H (mm)	n	m	Mass (kg)	
		A1 Block	A2 Block				A1 Block	A2 Block
340	440	216.5	108.5	70	3	2	5.3	6
440	540	316.5	208.5	20	4	3	6.5	7.2
540	640	416.5	308.5	70	5	3	7.6	8.3
640	740	516.5	408.5	20	6	4	8.8	9.5
740	840	616.5	508.5	70	7	4	10	10.7
940	1040	816.5	708.5	70	9	5	12.4	13.1

KK80 (Light Duty)



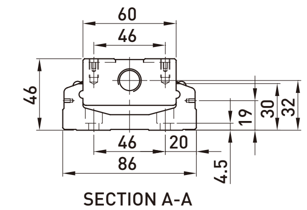


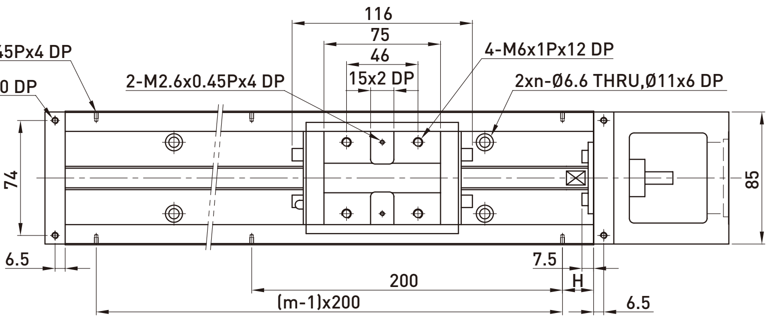


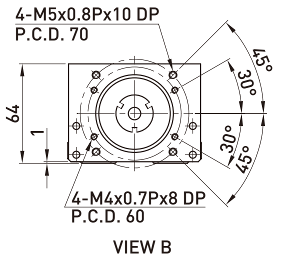


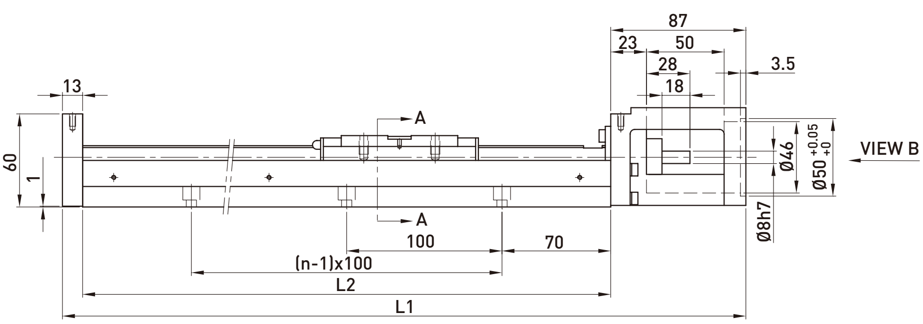
Rail Length L2 (mm)	Total Length L1 (mm)	Maximum Stroke (mm)		H (mm)	n	m	Mass (kg)	
		S1 Block	S2 Block				S1 Block	S2 Block
340	440	248.5	172.5	70	3	2	5	5.4
440	540	348.5	272.5	20	4	3	6.2	6.6
540	640	448.5	372.5	70	5	3	7.3	7.7
640	740	548.5	472.5	20	6	4	8.5	8.9
740	840	648.5	572.5	70	7	4	9.7	10.1
940	1040	848.5	772.5	70	9	5	12.1	12.5

KK86



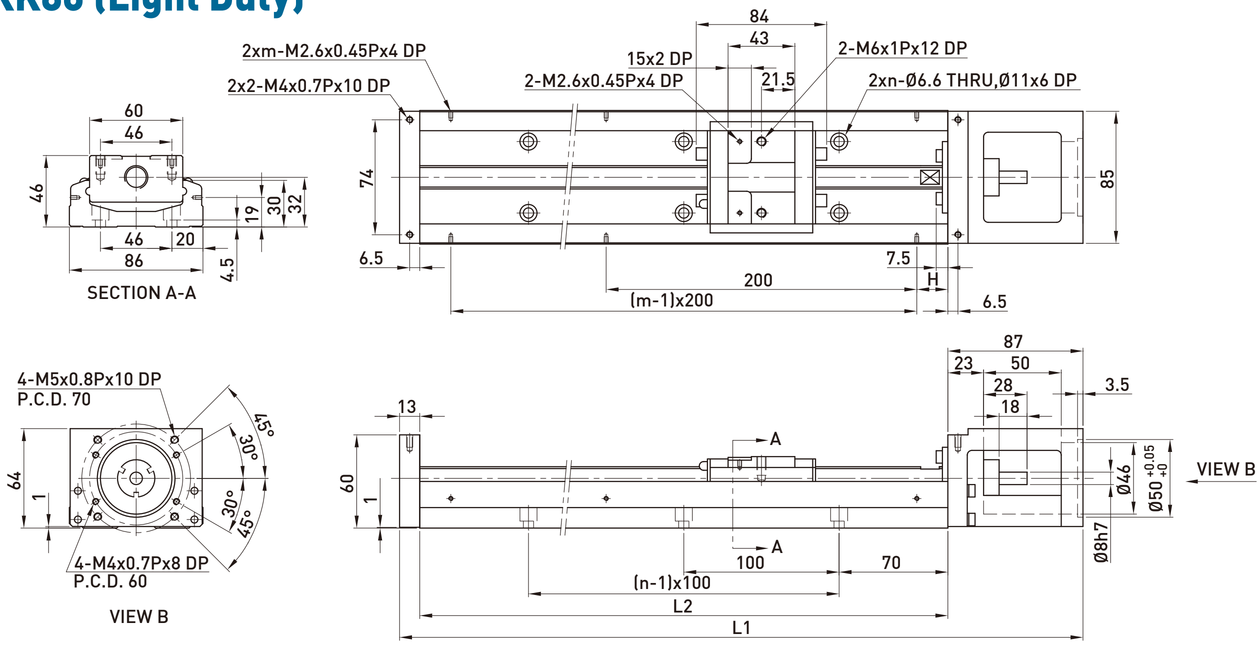






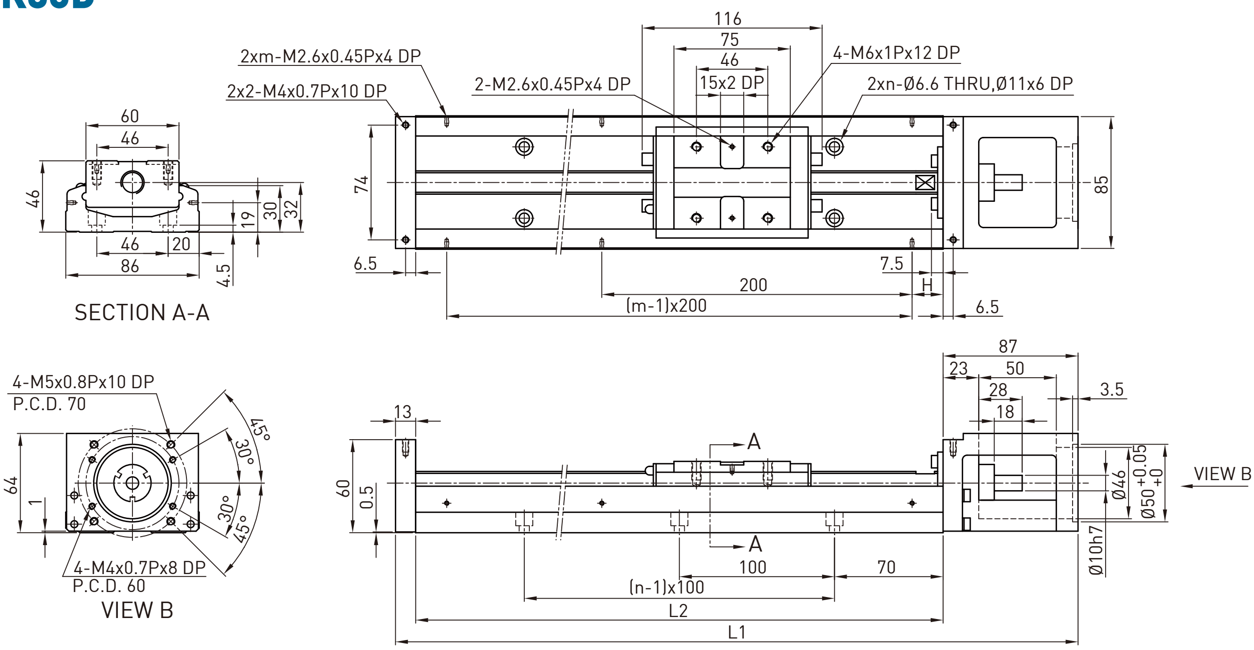
Rail Length L2 (mm)	Total Length L1 (mm)	Maximum Stroke (mm)		H (mm)	n	m	Mass (kg)	
		A1 Block	A2 Block				A1 Block	A2 Block
340	440	216.5	108.5	70	3	2	5.7	6.5
440	540	316.5	208.5	20	4	3	6.9	7.7
540	640	416.5	308.5	70	5	3	8.0	8.8
640	740	516.5	408.5	20	6	4	9.2	10.0
740	840	616.5	508.5	70	7	4	10.4	11.2
940	1040	816.5	708.5	70	9	5	11.6	12.4

KK86 (Light Duty)



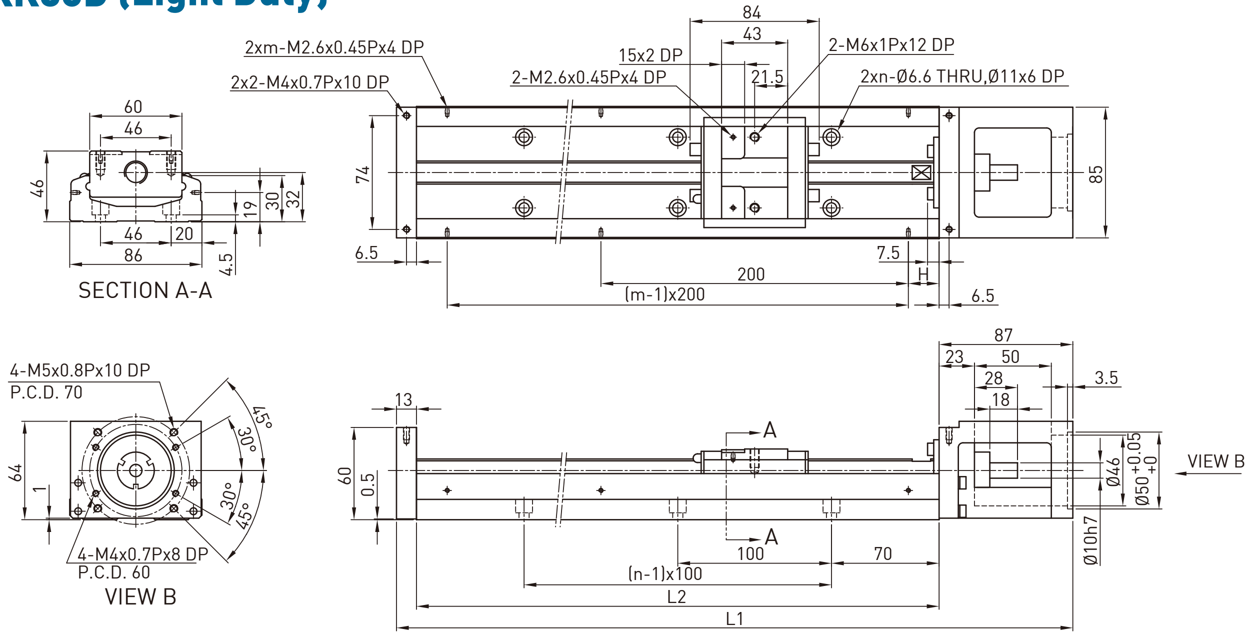
Rail Length L2 (mm)	Total Length L1 (mm)	Maximum Stroke (mm)		H (mm)	n	m	Mass (kg)	
		S1 Block	S2 Block				S1 Block	S2 Block
340	440	248.5	172.5	70	3	2	5.4	5.9
440	540	348.5	272.5	20	4	3	6.6	7.1
540	640	448.5	372.5	70	5	3	7.7	8.2
640	740	548.5	472.5	20	6	4	8.9	9.4
740	840	648.5	572.5	70	7	4	10.1	10.6
940	1040	848.5	772.5	70	9	5	11.3	11.8

KK86D



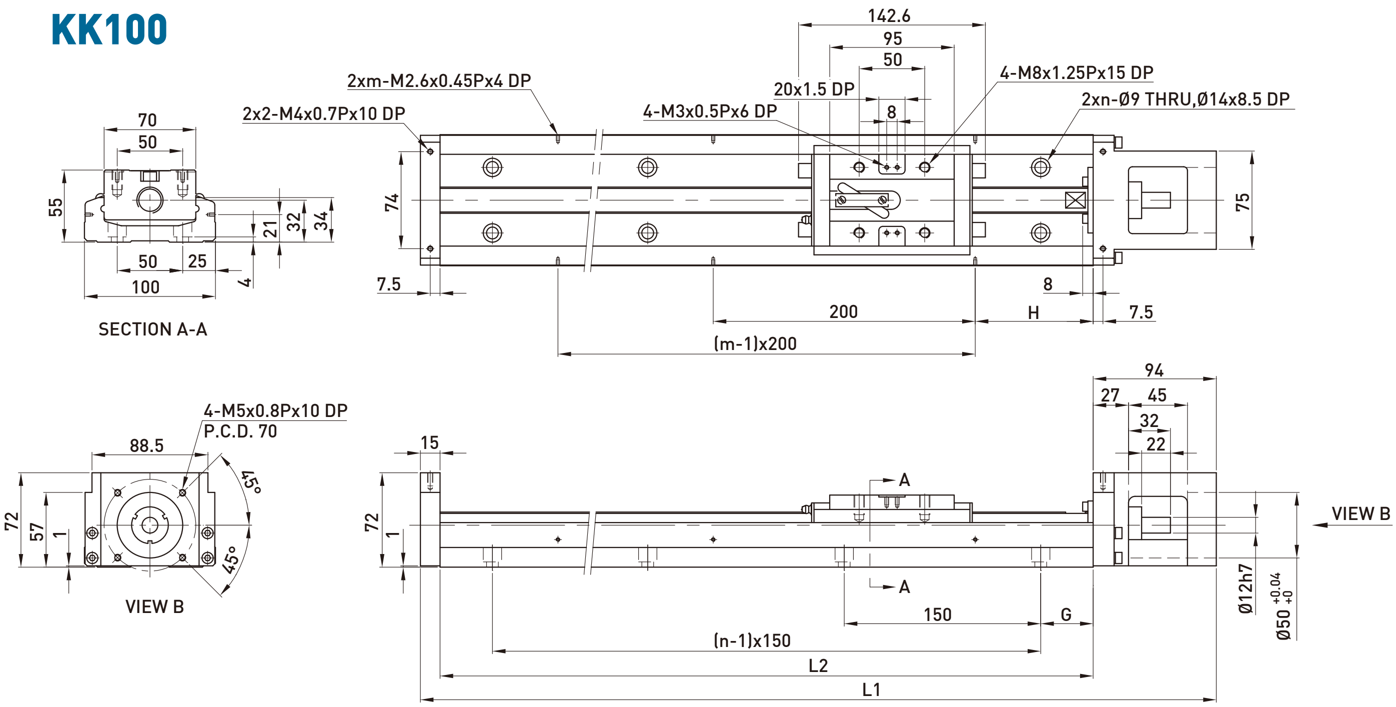
Rail Length L2 (mm)	Total Length L1 (mm)	Maximum Stroke (mm)		H (mm)	n	m	Mass (kg)	
		A1 Block	A2 Block				A1 Block	A2 Block
340	440	216.5	108.5	70	3	2	5.7	6.5
440	540	316.5	208.5	20	4	3	6.9	7.7
540	640	416.5	308.5	70	5	3	8.0	8.8
640	740	516.5	408.5	20	6	4	9.2	10.0
740	840	616.5	508.5	70	7	4	10.4	11.2
940	1040	816.5	708.5	70	9	5	11.6	12.4

KK86D (Light Duty)



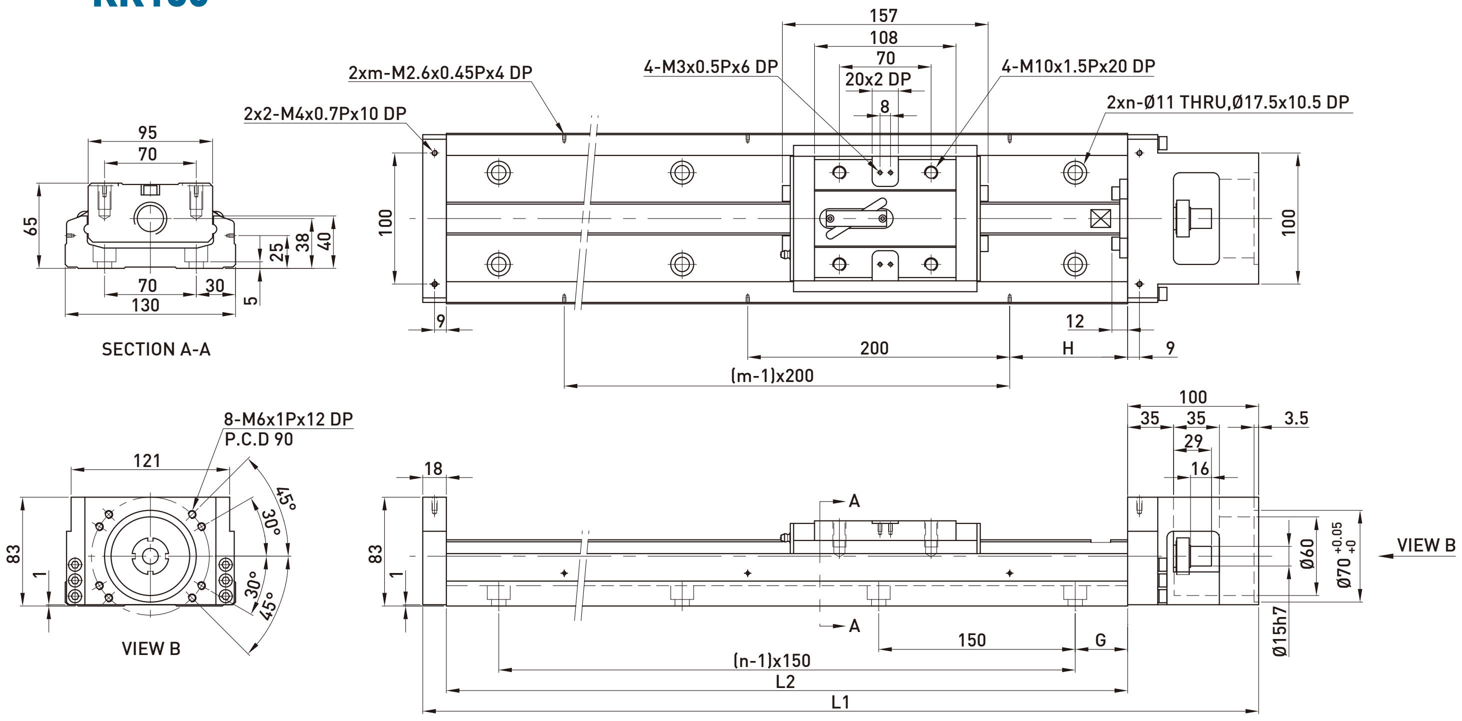
Rail Length L2 (mm)	Total Length L1 (mm)	Maximum Stroke (mm)		H (mm)	n	m	Mass (kg)	
		S1 Block	S2 Block				S1 Block	S2 Block
340	440	248.5	172.5	70	3	2	5.4	5.9
440	540	348.5	272.5	20	4	3	6.6	7.1
540	640	448.5	372.5	70	5	3	7.7	8.2
640	740	548.5	472.5	20	6	4	8.9	9.4
740	840	648.5	572.5	70	7	4	10.1	10.6
940	1040	848.5	772.5	70	9	5	11.3	11.8

KK100



Rail Length L2 (mm)	Total Length L1 (mm)	Maximum Stroke (mm)		G (mm)	H (mm)	n	m	Mass (kg)	
		A1 Block	A2 Block					A1 Block	A2 Block
980	1089	828	700	40	90	7	5	18.6	20.3
1080	1189	928	800	15	40	8	6	20.3	22.0
1180	1289	1028	900	65	90	8	6	22.0	23.7
1280	1389	1128	1000	40	40	9	7	23.6	25.3
1380	1489	1228	1100	15	90	10	7	25.3	27.0

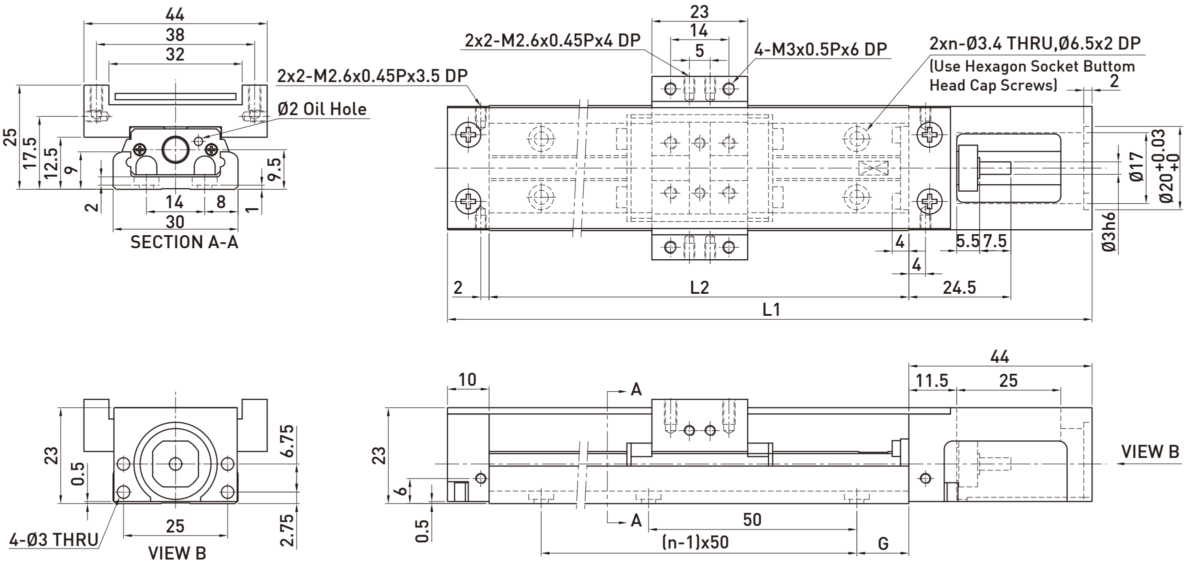
KK130



Rail Length L2 (mm)	Total Length L1 (mm)	Maximum Stroke (mm)		G (mm)	H (mm)	n	m	Mass (kg)	
		A1 Block	A2 Block					A1 Block	A2 Block
980	1098	811	659	40	90	7	5	29.4	32.3
1180	1298	1011	859	65	90	8	6	34.3	37.2
1380	1498	1211	1059	90	90	9	7	39.2	42.1
1680	1798	1511	1359	90	40	11	9	46.5	49.4

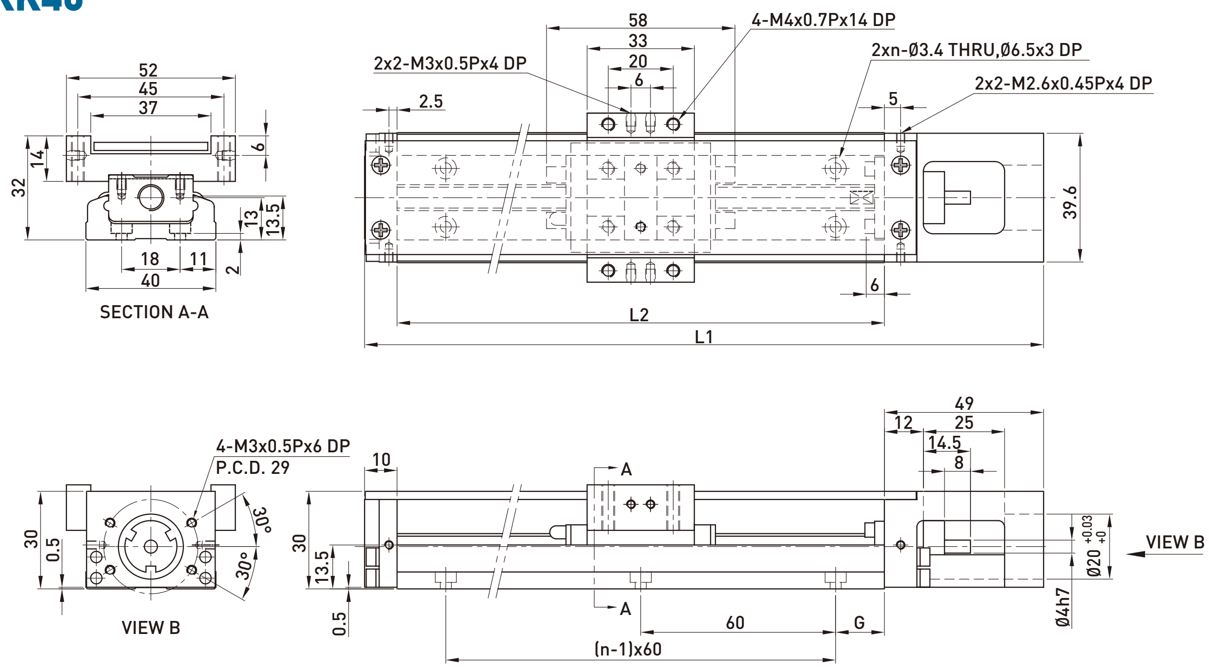
1.9.2 With cover

KK30



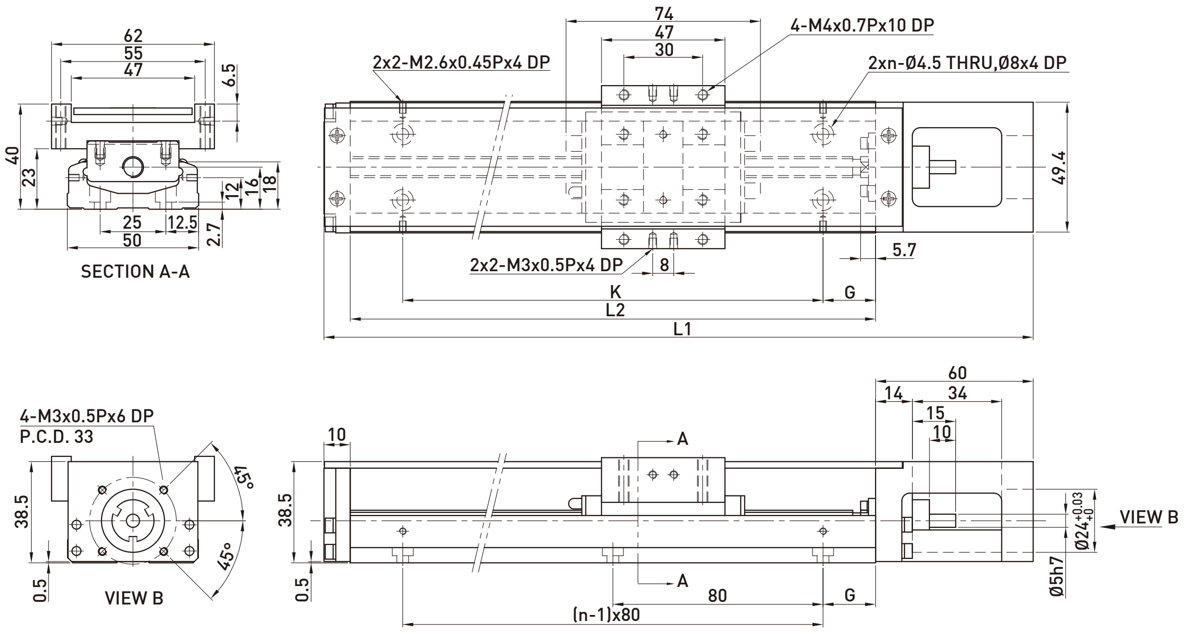
Rail Length L2 (mm)	Total Length L1 (mm)	Maximum Stroke (mm)		G (mm)	n	Mass (kg)	
		A1 Block	A2 Block			A1 Block	A2 Block
75	129	31	-	12.5	2	0.24	-
100	154	56	-	25	2	0.27	-
125	179	81	45	12.5	3	0.3	0.36
150	204	106	70	25	3	0.33	0.39
175	229	131	95	12.5	4	0.37	0.43
200	254	156	120	25	4	0.4	0.46

KK40



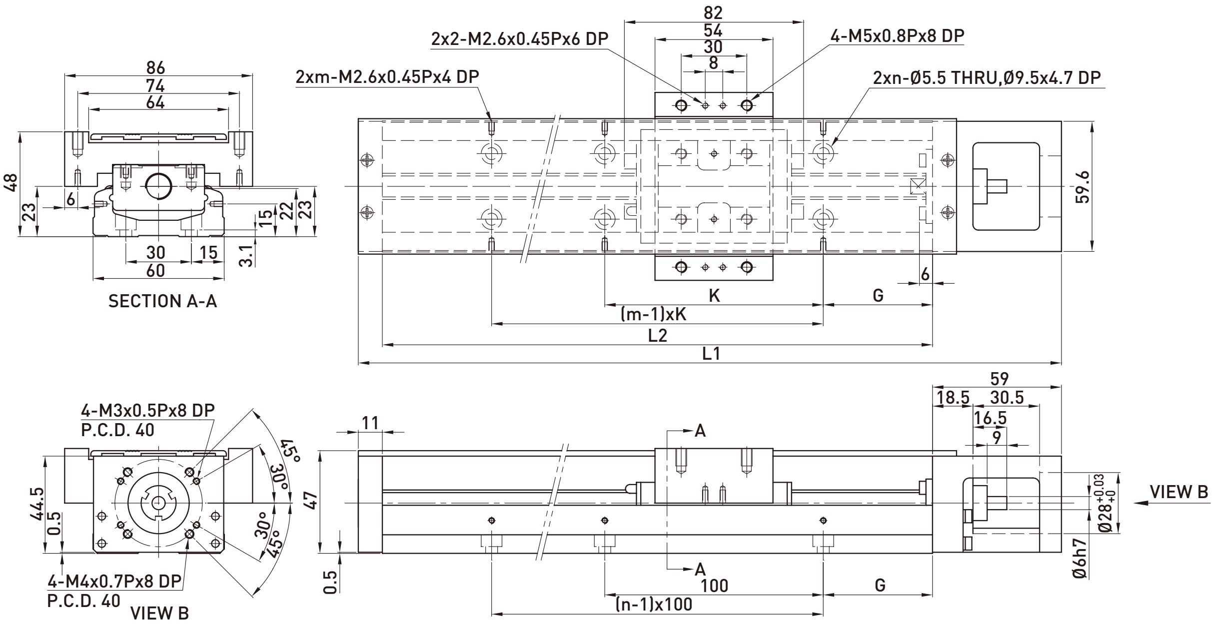
Rail Length L2 (mm)	Total Length L1 (mm)	Maximum Stroke (mm)		G (mm)	n	Mass (kg)	
		A1 Block	A2 Block			A1 Block	A2 Block
100	159	36	-	20	2	0.55	-
150	209	86	34	15	3	0.68	0.76
200	259	136	84	40	3	0.82	0.89

KK50



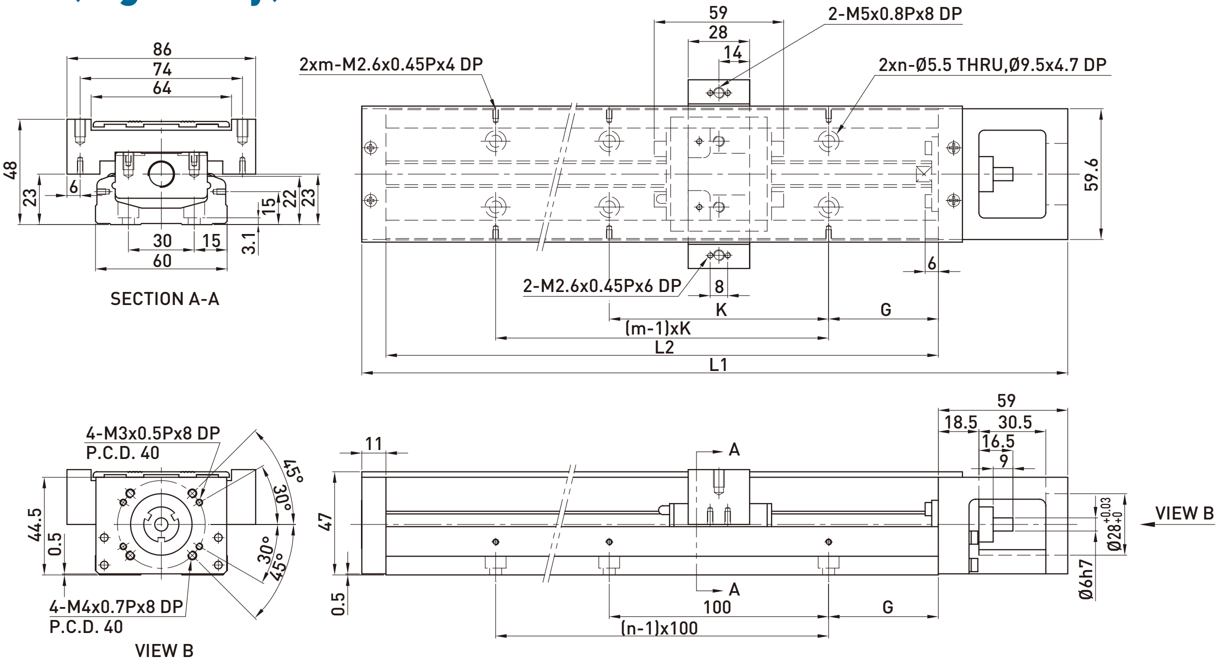
Rail Length L2 (mm)	Total Length L1 (mm)	Maximum Stroke (mm)		G (mm)	K (mm)	n	Mass (kg)	
		A1 Block	A2 Block				A1 Block	A2 Block
150	220	70	-	35	80	2	1.1	-
200	270	120	55	20	160	3	1.3	1.5
250	320	170	105	45	160	3	1.6	1.8
300	370	220	155	30	240	4	1.8	2.0

KK60



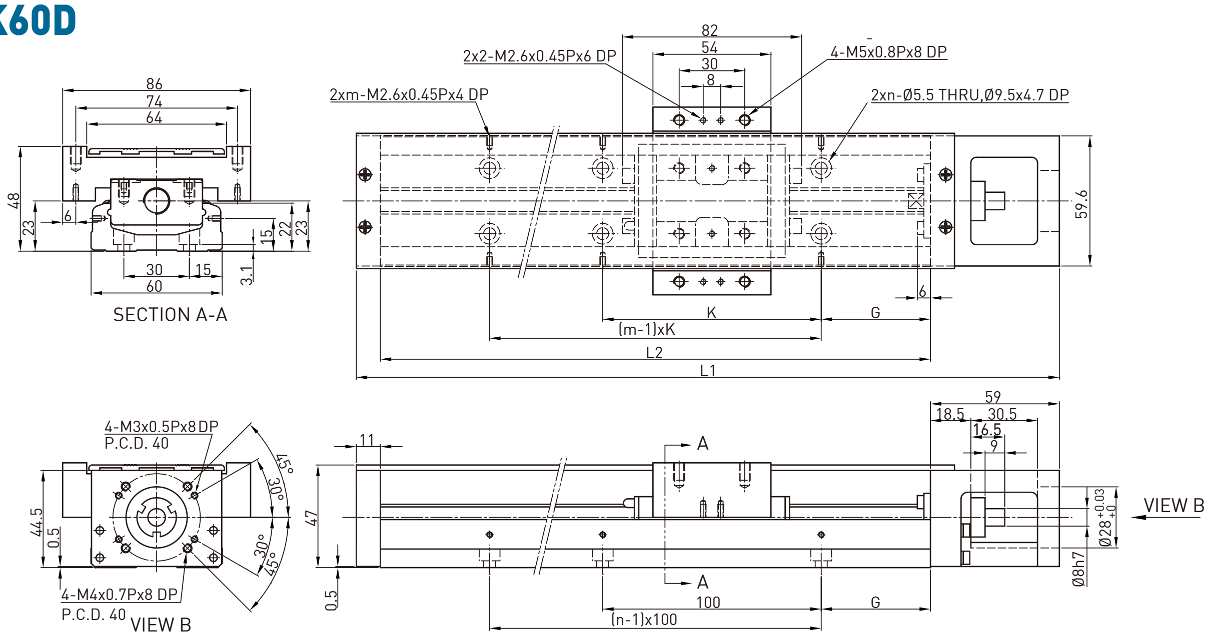
Rail Length L2 (mm)	Total Length L1 (mm)	Maximum Stroke (mm)		G (mm)	K (mm)	n	m	Mass (kg)	
		A1 Block	A2 Block					A1 Block	A2 Block
150	220	60	-	25	100	2	2	1.7	-
200	270	110	-	50	100	2	2	2.1	-
300	370	210	135	50	200	3	2	2.7	3.0
400	470	310	235	50	100	4	4	3.3	3.6
500	570	410	335	50	200	5	3	3.9	4.2
600	670	510	435	50	100	6	6	4.6	5.0

KK60 (Light Duty)



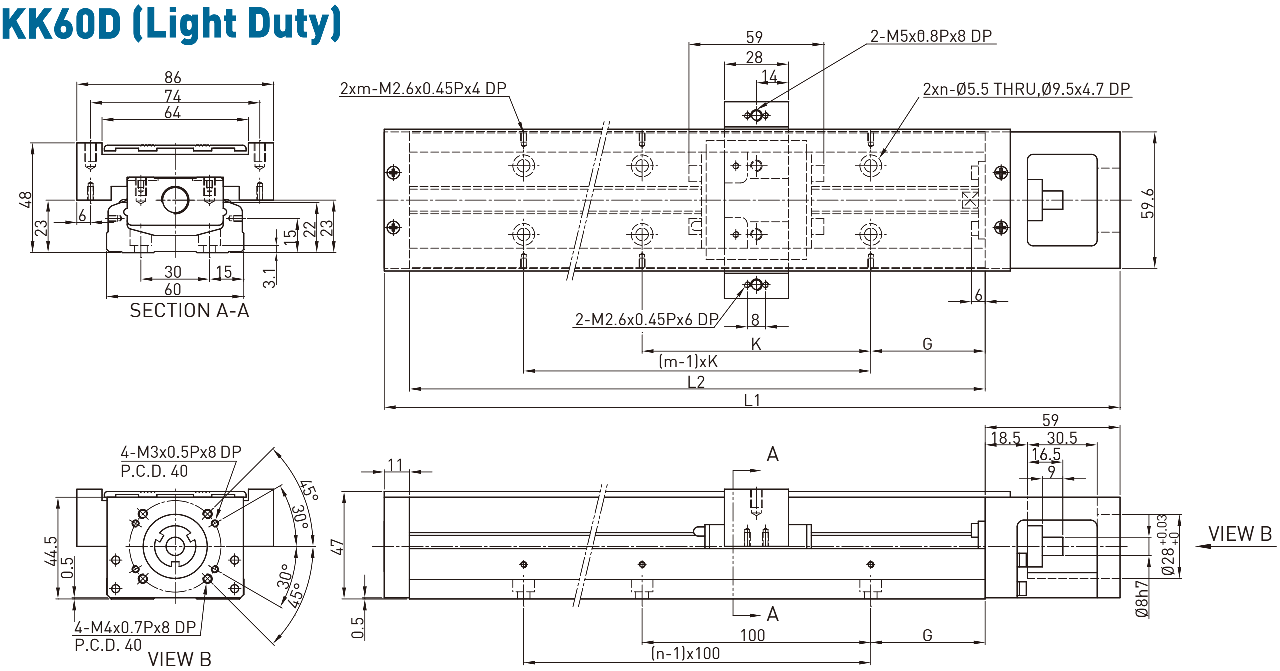
Rail Length L2 (mm)	Total Length L1 (mm)	Maximum Stroke (mm)		G (mm)	K (mm)	n	m	Mass (kg)	
		S1 Block	S2 Block					S1 Block	S2 Block
150	220	85	34	25	100	2	2	1.6	1.8
200	270	135	84	50	100	2	2	1.9	2.1
300	370	235	184	50	200	3	2	2.5	2.7
400	470	335	284	50	100	4	4	3.1	3.3
500	570	435	384	50	200	5	3	3.7	3.9
600	670	535	484	50	100	6	6	4.4	4.6

KK60D



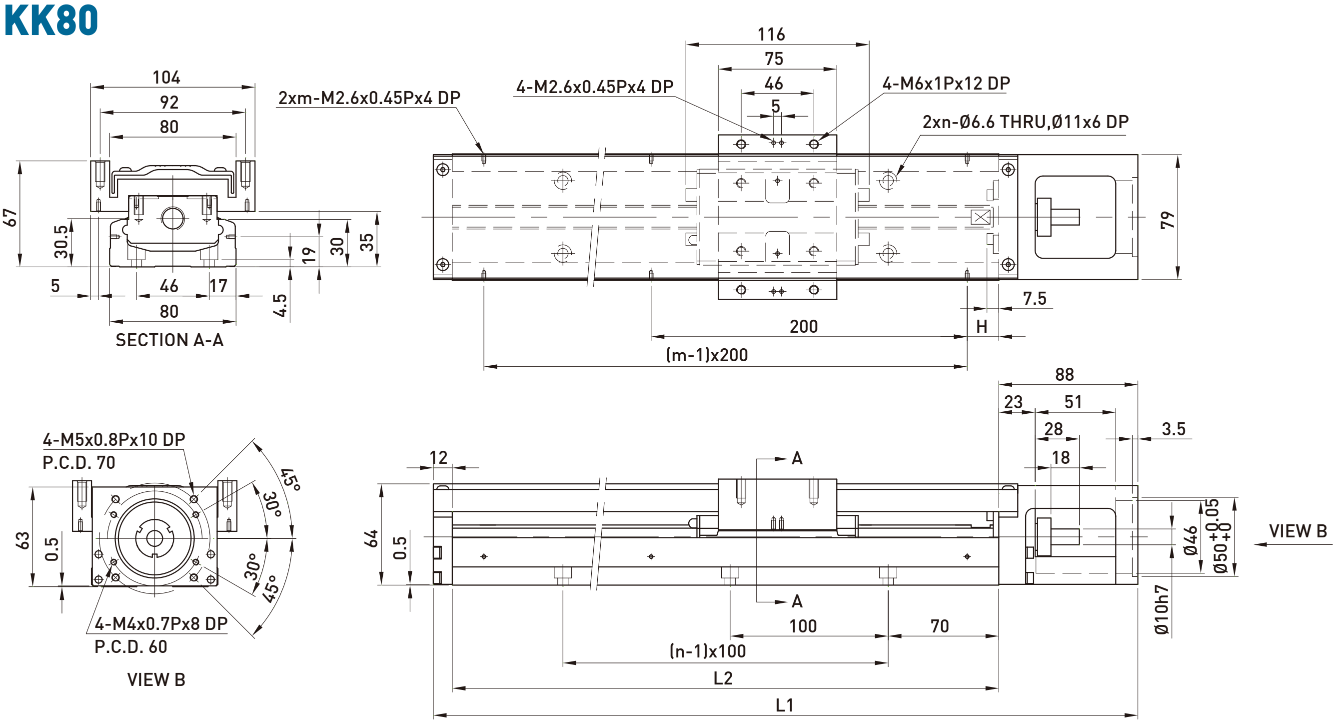
Rail Length L2 (mm)	Total Length L1 (mm)	Maximum Stroke (mm)		G (mm)	K (mm)	n	m	Mass (kg)	
		A1 Block	A2 Block					A1 Block	A2 Block
150	220	60	-	25	100	2	2	1.7	-
200	270	110	-	50	100	2	2	2.1	-
300	370	210	135	50	200	3	2	2.7	3.0
400	470	310	235	50	100	4	4	3.3	3.6
500	570	410	335	50	200	5	3	3.9	4.2
600	670	510	435	50	100	6	6	4.6	5.0

KK60D (Light Duty)



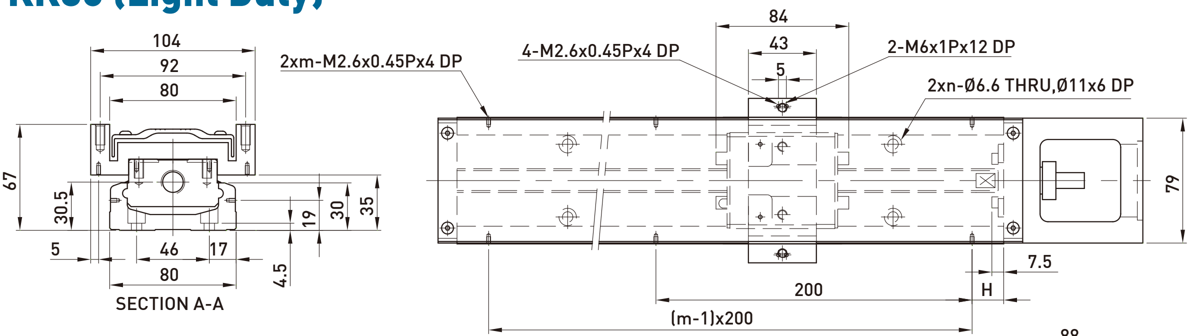
Rail Length L2 (mm)	Total Length L1 (mm)	Maximum Stroke (mm)		G (mm)	K (mm)	n	m	Mass (kg)	
		S1 Block	S2 Block					S1 Block	S2 Block
150	220	85	34	25	100	2	2	1.6	1.8
200	270	135	84	50	100	2	2	1.9	2.1
300	370	235	184	50	200	3	2	2.5	2.7
400	470	335	284	50	100	4	4	3.1	3.3
500	570	435	384	50	200	5	3	3.7	3.9
600	670	535	484	50	100	6	6	4.4	4.6

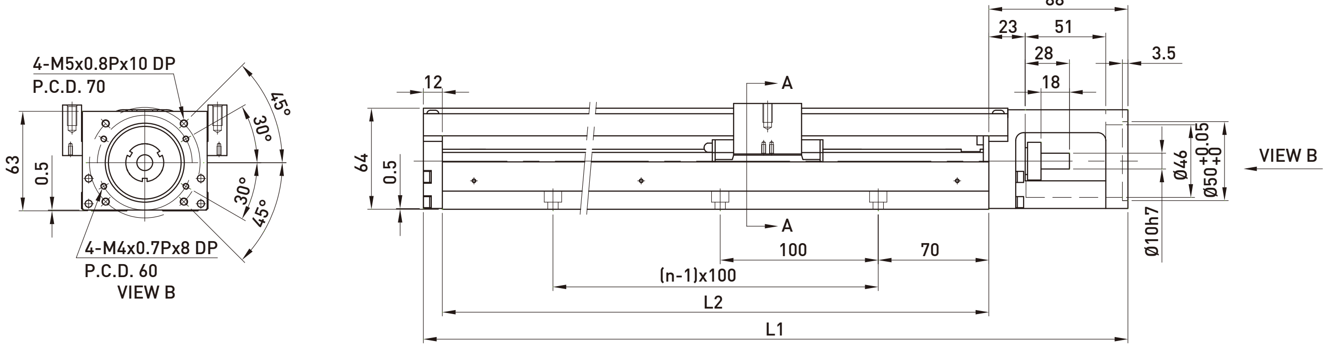
KK80



Rail Length L2 (mm)	Total Length L1 (mm)	Maximum Stroke (mm)		H (mm)	n	m	Mass (kg)	
		A1 Block	A2 Block				A1 Block	A2 Block
340	440	216.5	108.5	70	3	2	6	7.1
440	540	316.5	208.5	20	4	3	7.2	8.3
540	640	416.5	308.5	70	5	3	8.4	9.5
640	740	516.5	408.5	20	6	4	9.7	10.8
740	840	616.5	508.5	70	7	4	10.9	12
940	1040	816.5	708.5	70	9	5	13.5	14.6

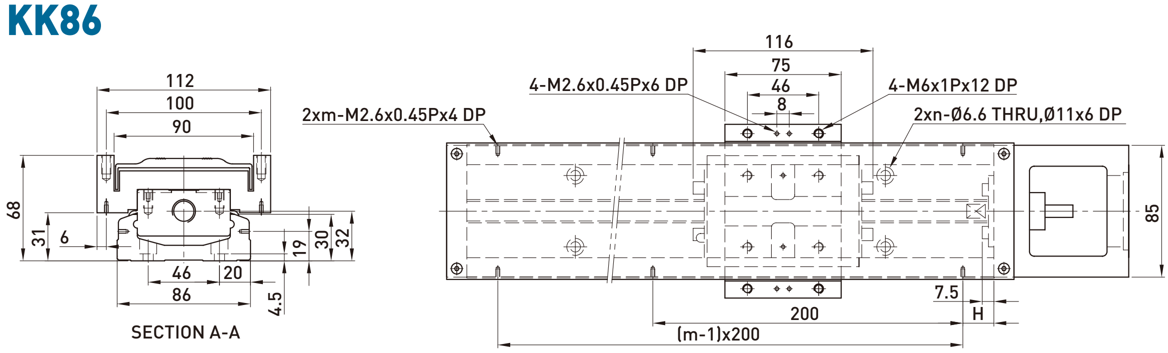
KK80 (Light Duty)

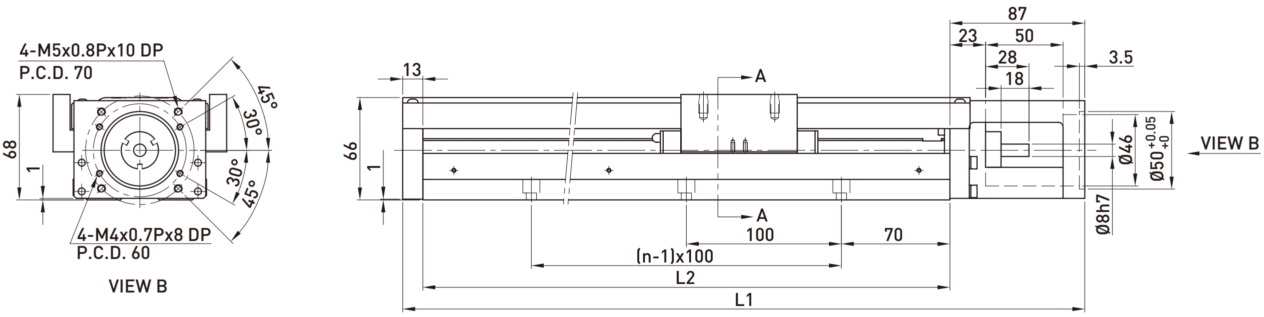




Rail Length L2 (mm)	Total Length L1 (mm)	Maximum Stroke (mm)		H (mm)	n	m	Mass (kg)	
		S1 Block	S2 Block				S1 Block	S2 Block
340	440	248.5	172.5	70	3	2	5.5	6.1
440	540	348.5	272.5	20	4	3	6.8	7.4
540	640	448.5	372.5	70	5	3	7.9	8.5
640	740	548.5	472.5	20	6	4	9.2	9.8
740	840	648.5	572.5	70	7	4	10.5	11.1
940	1040	848.5	772.5	70	9	5	13	13.6

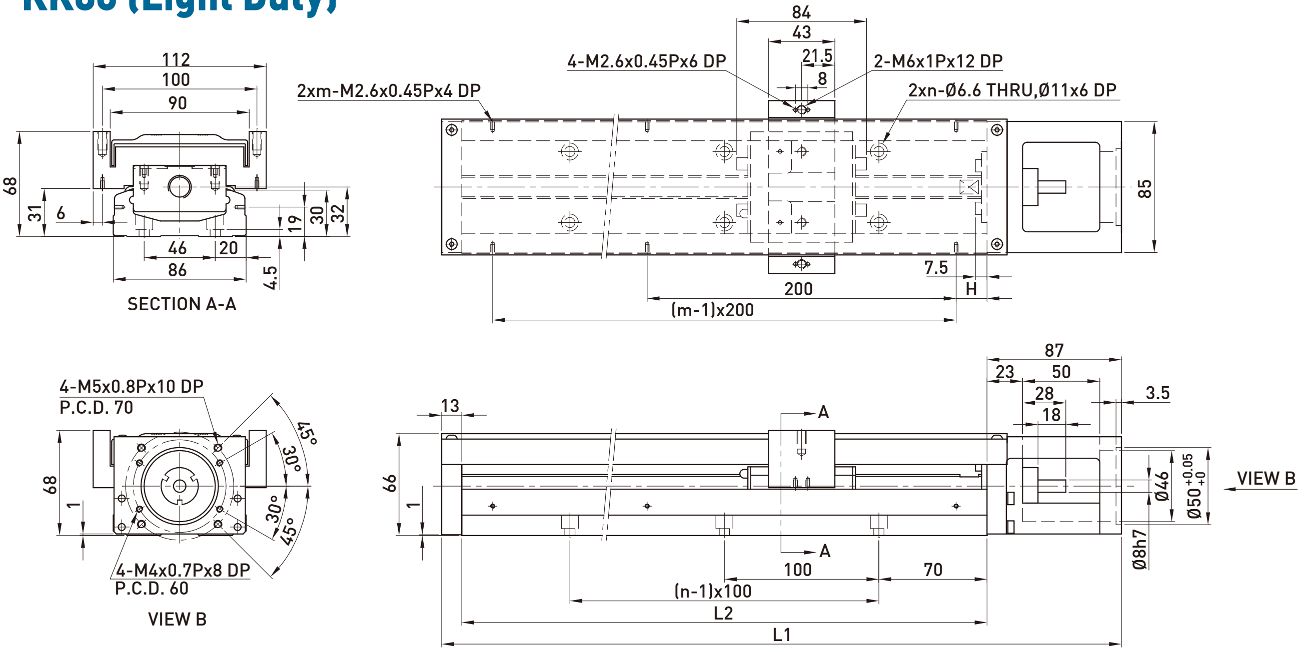
KK86





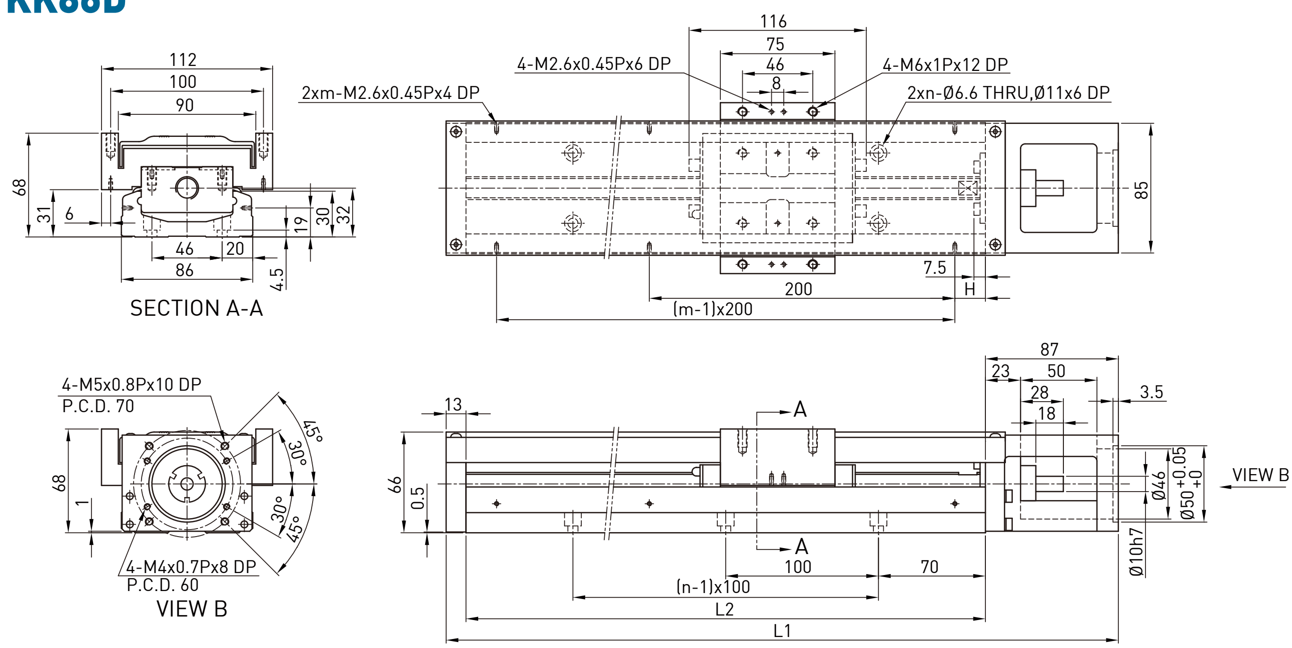
Rail Length L2 (mm)	Total Length L1 (mm)	Maximum Stroke (mm)		H (mm)	n	m	Mass (kg)	
		A1 Block	A2 Block				A1 Block	A2 Block
340	440	216.5	108.5	70	3	2	6.5	7.3
440	540	316.5	208.5	20	4	3	7.8	8.6
540	640	416.5	308.5	70	5	3	9.0	9.8
640	740	516.5	408.5	20	6	4	10.3	11.3
740	840	616.5	508.5	70	7	4	11.6	12.4
940	1040	816.5	708.5	70	9	5	13.0	13.8

KK86 (Light Duty)



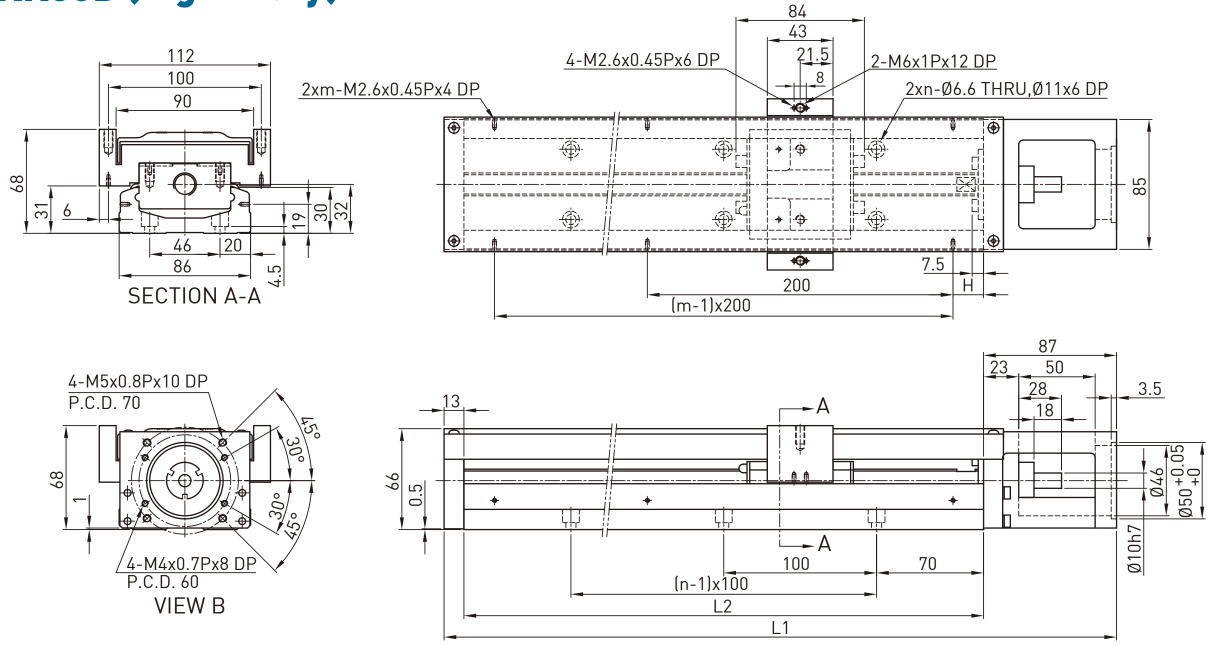
Rail Length L2 (mm)	Total Length L1 (mm)	Maximum Stroke (mm)		H (mm)	n	m	Mass (kg)	
		S1 Block	S2 Block				S1 Block	S2 Block
340	440	248.5	172.5	70	3	2	6.3	7.1
440	540	348.5	272.5	20	4	3	7.6	8.4
540	640	448.5	372.5	70	5	3	8.8	9.6
640	740	548.5	472.5	20	6	4	10.1	11.1
740	840	648.5	572.5	70	7	4	11.4	12.2
940	1040	848.5	772.5	70	9	5	12.8	13.6

KK86D



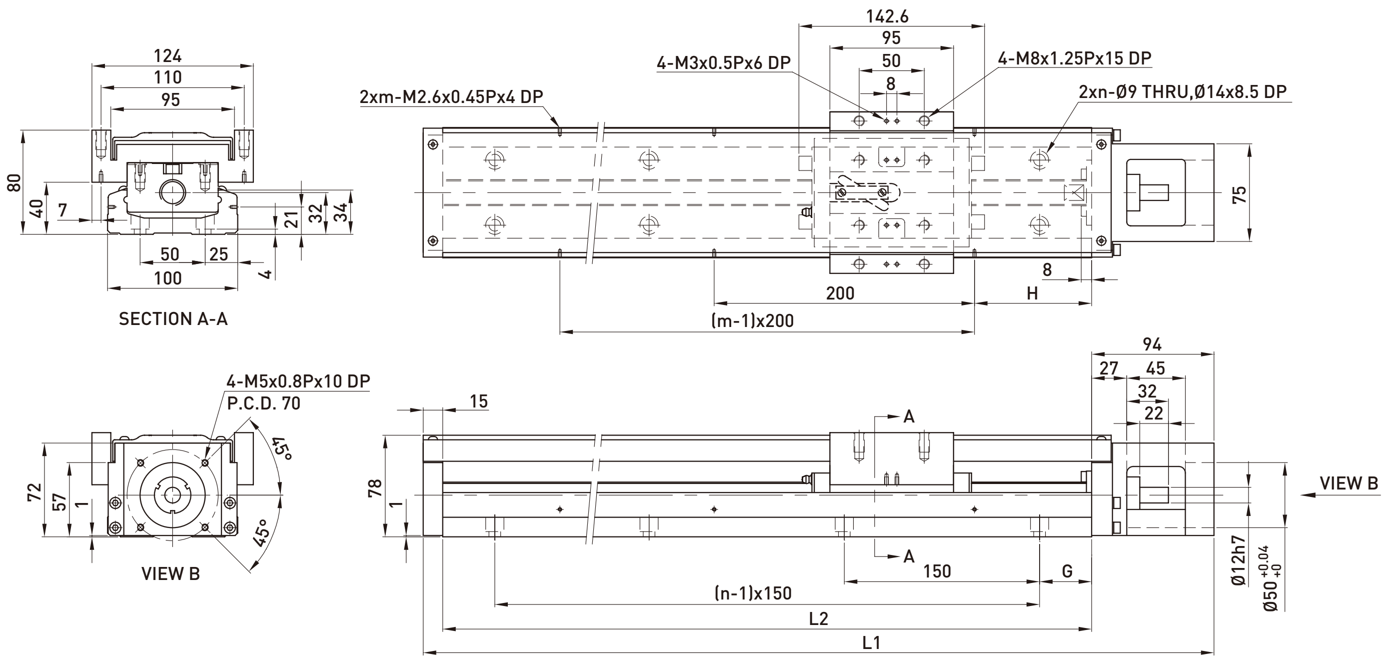
Rail Length L2 (mm)	Total Length L1 (mm)	Maximum Stroke (mm)		H (mm)	n	m	Mass (kg)	
		A1 Block	A2 Block				A1 Block	A2 Block
340	440	216.5	108.5	70	3	2	6.5	7.3
440	540	316.5	208.5	20	4	3	7.8	8.6
540	640	416.5	308.5	70	5	3	9.0	9.8
640	740	516.5	408.5	20	6	4	10.3	11.3
740	840	616.5	508.5	70	7	4	11.6	12.4
940	1040	816.5	708.5	70	9	5	13.0	13.8

KK86D (Light Duty)



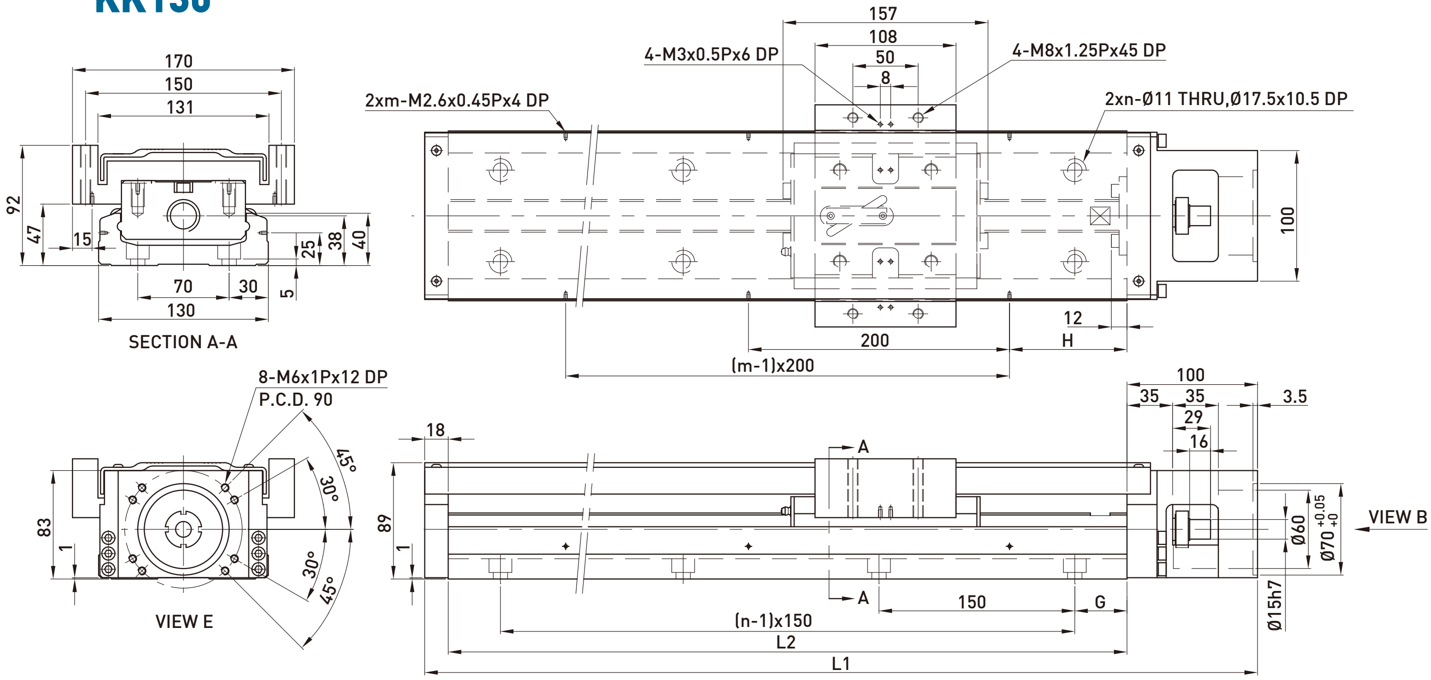
Rail Length L2 (mm)	Total Length L1 (mm)	Maximum Stroke (mm)		H (mm)	n	m	Mass (kg)	
		S1 Block	S2 Block				S1 Block	S2 Block
340	440	248.5	172.5	70	3	2	6.3	7.1
440	540	348.5	272.5	20	4	3	7.6	8.4
540	640	448.5	372.5	70	5	3	8.8	9.6
640	740	548.5	472.5	20	6	4	10.1	11.1
740	840	648.5	572.5	70	7	4	11.4	12.2
940	1040	848.5	772.5	70	9	5	12.8	13.6

KK100



Rail Length L2 (mm)	Total Length L1 (mm)	Maximum Stroke (mm)		G (mm)	H (mm)	n	m	Mass (kg)	
		A1 Block	A2 Block					A1 Block	A2 Block
980	1089	828	700	40	90	7	5	20.4	22.1
1080	1189	928	800	15	40	8	6	22.2	23.9
1180	1289	1028	900	65	90	8	6	24.0	25.7
1280	1389	1128	1000	40	40	9	7	25.7	27.4
1380	1489	1228	1100	15	90	10	7	27.5	29.2

KK130



Rail Length L2 (mm)	Total Length L1 (mm)	Maximum Stroke (mm)		G (mm)	H (mm)	n	m	Mass (kg)	
		A1 Block	A2 Block					A1 Block	A2 Block
980	1098	811	659	40	90	7	5	31.9	35.9
1180	1298	1011	859	65	90	8	6	37.1	41.1
1380	1498	1211	1059	90	90	9	7	42.2	46.2
1680	1798	1511	1359	90	40	11	9	49.9	53.9

1.10 Motor Housing and Motor Adaptor Flange

1.10.1 Motor Selection

SIMTACH AC Servo Motor

Motor Output	Motor	Weight (kg)	Flange Selection								+Brake Weight (kg)	Drive	Weight (kg)	Remarks
			KK30	KK40	KK50	KK60	KK80	KK86	KK100	KK130				
100W	RSM-M04J0330A	0.47	-	F1	F1	F1	F2	F2	-	-	0.56	RS100	1.25	220V
200W	RSMA-M06J0630A	0.88	-	-	-	-	F1	F1	F0	F1	1.3	RS200		220V
400W	RSMA-M06J1330A	1.26	-	-	-	-	F1	F1	F0	F1	1.7	RS400		220V
750W	RSMA-M08J2430A	2.4	-	-	-	-	-	-	F1	F0	3.1	RS750		220V

HIWIN Mikrosystem Servo Motor

Motor Output	Motor	Weight (kg)	Flange Selection								+Brake Weight (kg)	Drive	Weight (kg)	Remarks
			KK30	KK40	KK50	KK60	KK80	KK86	KK100	KK130				
50W	FRLS052□□A4□	0.45	-	F2	F2	F2	F3	F3	-	-	0.58	D2T	1.25	220V
100W	FRLS102□□A4□	0.6	-	F2	F2	F2	F3	F3	-	-	0.76			220V
200W	FRLS202□□06□	1	-	-	-	-	F0	F0	F0	F1	1.5			220V
400W	FRLS402□□06□	1.45	-	-	-	-	F0	F0	F0	F1	1.86			220V
750W	FRMS752□□08□	2.66	-	-	-	-	-	-	F1	F2	3.32			220V

Mitsubishi Servo Motor

Motor Output	Motor	Weight (kg)	Flange Selection								+Brake Weight (kg)	Drive	Weight (kg)	Remarks
			KK30	KK40	KK50	KK60	KK80	KK86	KK100	KK130				
10W	HC-AQ0135D	0.19	F1	-	-	-	-	-	-	-	0.29	M2-JR-03A5	0.2	
20W	HC-AQ0235D	0.22	F1	-	-	-	-	-	-	-	0.32	M2-JR-03A5	0.2	
50W	HF-KP053	0.35	-	F1	F1	F1	F2	F2	-	-	0.75	MR-J3S-10A	0.8	220V
100W	HF-KP13	0.56	-	F1	F1	F1	F2	F2	-	-	0.89	MR-J3S-10A	0.8	220V
200W	HF-KP23	0.94	-	-	-	-	F0	F0	F0	F1	1.6	MR-J3S-20A	0.8	220V
400W	HF-KP43	1.5	-	-	-	-	F0	F0	F0	F1	2.1	MR-J3S-40A	1	220V
750W	HF-KP73	2.9	-	-	-	-	-	-	F1	F2	4	MR-J3S-70A	1.4	220V

Panasonic Servo Motor

Motor Output	Motor	Weight (kg)	Flange Selection								+Brake Weight (kg)	Drive	Weight (kg)	Remarks
			KK30	KK40	KK50	KK60	KK80	KK86	KK100	KK130				
50W	MSMF5A2L1	0.32	-	F2	F2	F2	F3	F3	-	-	0.53	MSMF5A2L1	0.8	110V
50W	MSMF5A2L1	0.32	-	F2	F2	F2	F3	F3	-	-	0.53	MSMF5A2L1	0.8	200V
100W	MSMF011L1	0.47	-	F2	F2	F2	F3	F3	-	-	0.68	MSMF011L1	0.8	110V
100W	MSMF012L1	0.47	-	F2	F2	F2	F3	F3	-	-	0.68	MSMF012L1	0.8	200V
200W	MSMF021L1	0.82	-	-	-	-	F1	F1	-	-	1.3	MSMF021L1	1.1	110V
200W	MSMF022L1	0.82	-	-	-	-	F1	F1	-	-	1.3	MSMF022L1	0.8	200V
400W	MSMF041L1	1.2	-	-	-	-	F1	F1	-	-	1.7	MSMF041L1	1.5	110V
400W	MSMF042L1	1.2	-	-	-	-	F1	F1	-	-	1.7	MSMF042L1	1.1	200V
750W	MSMF082L1	2.3	-	-	-	-	F4	F4	F2	F4	3.1	MSMF082L1	1.5	200V

Yasukawa Servo Motor

Motor Output	Motor	Weight (kg)	Flange Selection								+Brake Weight (kg)	Drive	Weight (kg)	Remarks
			KK30	KK40	KK50	KK60	KK80	KK86	KK100	KK130				
10W	SGMMV-A1A2A21	0.13	F2	-	-	-	-	-	-	-	0.215	SGDV-R90A01A	0.9	220V
20W	SGMMV-A2A2A21	0.17	F2	-	-	-	-	-	-	-	0.27	SGDV-R90A01A	0.9	220V
50W	SGMAV-A5ADA61	0.3	-	F1	F1	F1	F2	F2	-	-		SGDV-R70A01A	0.9	with key
50W	SGMAV-A5ADA2C	0.3	-	F1	F1	F1	F2	F2	-	-		SGDV-R70A01A	0.9	no key
50W	SGMAV-A5ADA21	0.3	-	F1	F1	F1	F2	F2	-	-	0.75	SGDV-R70A01A	0.9	Mid inertia
100W	SGMAV-01ADA64	0.4	-	F1	F1	F1	F2	F2	-	-	0.89	SGDV-R90A01A	0.9	
200W	SGMAV-02ADA65	0.9	-	-	-	-	F0	F0	F0	F1	1.6	SGDV-1R6A01A	0.9	
400W	SGMAV-04ADA66	1.2	-	-	-	-	F0	F0	F0	F1	2.1	SGDV-2R8A01A	1	
750W	SGMAV-08ADA67	2.6	-	-	-	-			F1	F2	4	SGDV-5R5A01A	1.5	

Oriental Step Motor

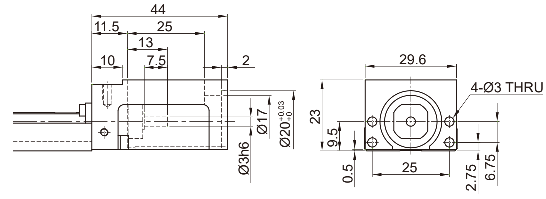
Series	Model	Flange Selection								Built in Motor	Weight (kg)	Built in Drive	Weight (kg)
		KK30	KK40	KK50	KK60	KK80	KK86	KK100	KK130				
CSK 2 phase	CSK243-AP	-	F3	F3	F5	-	-	-	-	PK243-01A	0.21	CSD2109-P	0.12
	CSK244-AP	-	F3	F3	F5	-	-	-	-	PK244-01A	0.27	CSD2112-P	0.12
	CSK245-AP	-	F3	F3	F5	-	-	-	-	PK245-01A	0.35	CSD2112-P	0.12
	CSK264-AP	-	-	-	F4	F6	F6	-	-	PK264-02A	0.45	CSD2120-P	0.12
	CSK266-AP	-	-	-	F4	F6	F6	-	-	PK266-02A	0.7	CSD2120-P	0.12
	CSK268-AP	-	-	-	F4	F6	F6	-	-	PK268-02A	1	CSD2120-P	0.12
	CSK296-AP	-	-	-	-	-	-	F4	F3	PK296-03A	1.7	CSD2145P	0.2
	CSK299-AP	-	-	-	-	-	-	F4	F3	PK299-03A	2.8	CSD2145P	0.2
	CSK2913-AP	-	-	-	-	-	-	F4	F3	PK2913-02A	3.8	CSD2140P	0.2
CSK 2 phase	CSK523-AP	F3	-	-	-	-	-	-	-	PK523A	0.1	SD5103P3	0.04
CFKII 5 phase micro stepping	CFK543AP2	-	F3	F3	F5	-	-	-	-	PK543NAW	0.21	DFC5107P	0.2
	CFK544AP2	-	F3	F3	F5	-	-	-	-	PK544NAW	0.27	DFC5107P	0.2
	CFK545AP2	-	F3	F3	F5	-	-	-	-	PK545NAW	0.35	DFC5107P	0.2
	CFK564AP2	-	-	-	-	F5	F5	-	-	PK564NAW	0.6	DFC5114P	0.2
	CFK566AP2	-	-	-	-	F5	F5	-	-	PK566NAW	0.8	DFC5114P	0.2
	CFK569AP2	-	-	-	-	F5	F5	-	-	PK569NAW	1.3	DFC5114P	0.2
	CFK566HAP2	-	-	-	-	F5	F5	-	-	PK566HNAW	0.8	DFC5128P	0.22
	CKF569HAP2	-	-	-	-	F5	F5	-	-	PK569HNAW	1.3	DFC5128P	0.22
	CFK596HAP2	-	-	-	-	-	-	F3	-	PK596HNAW	1.7	DFC5128P	0.22
	CFK599HAP2	-	-	-	-	-	-	F3	-	PK599HNAW	2.8	DFC5128P	0.22
	CFK5913HAP2	-	-	-	-	-	-	F3	-	PK5913HNAW	3.8	DFC5128P	0.22
UMK 2 phase	UMK243A	-	F3	F3	F5	-	-	-	-	PK243-01	0.21	UDK2109	0.47
	UMK244A	-	F3	F3	F5	-	-	-	-	PK244-01	0.27	UDK2112	0.47
	UMK245A	-	F3	F3	F5	-	-	-	-	PK245-01	0.35	UDK2112	0.47
	UMK264A	-	-	-	F4	F6	F6	-	-	PK264-02	0.45	UDK2120	0.47
	UMK266A	-	-	-	F4	F6	F6	-	-	PK266-02	0.7	UDK2120	0.47
	UMK268A	-	-	-	F4	F6	F6	-	-	PK268-02	1	UDK2120	0.47
RK 5 phase	RK543AA	-	F3	F3	F5	-	-	-	-	PK543W	0.25	RKD507-A	0.4
	RK544AA	-	F3	F3	F5	-	-	-	-	PK544W	0.3	RKD507-A	0.4
	RK545AA	-	F3	F3	F5	-	-	-	-	PK545W	0.4	RKD507-A	0.4
	RK566AA	-	-	-	-	F5	F5	-	-	PK566W	0.8	RKD514L-A	0.85
	RK569AA	-	-	-	-	F5	F5	-	-	PK569W	1.3	RKD514L-A	0.85
	RK596AA	-	-	-	-	-	-	F3	-	PK596W	1.7	RKD514H-A	0.85
	RK599AA	-	-	-	-	-	-	F3	-	PK599W	2.8	RKD514H-A	0.85
	RK5913AA	-	-	-	-	-	-	F3	-	PK5913W	3.8	RKD514H-A	0.85
ASC α-step	ASC34AK	F3	-	-	-	-	-	-	-	ASM34AK	0.15	ASD10A-K	0.25

1.10.3 Motor Housing and Motor Adaptor Flange

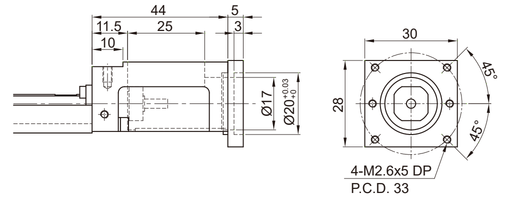
KK30

Motor Housing F0

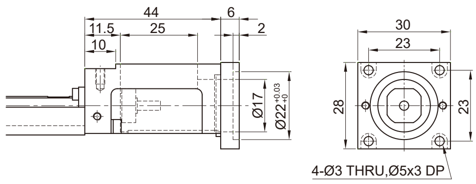
馬達座 F0



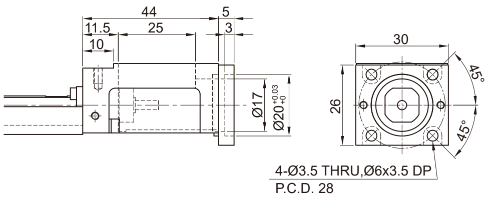
Motor Adaptor Flange F1



Motor Adaptor Flange F3

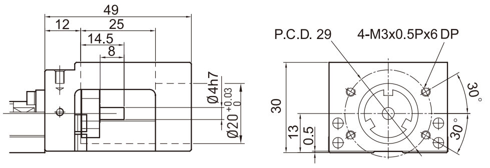


Motor Adaptor Flange F2

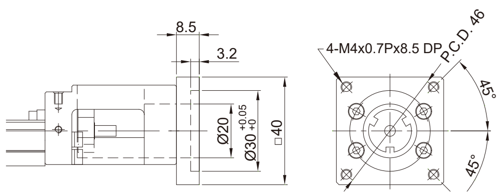


KK40

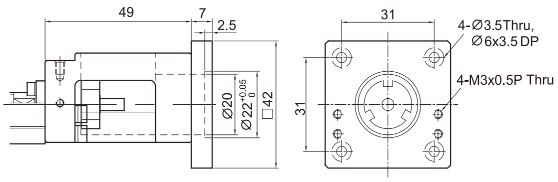
Motor Housing F0



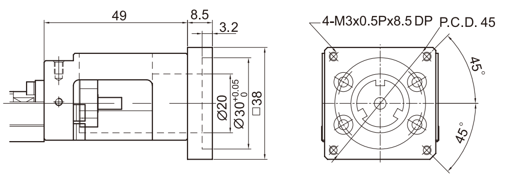
Motor Adaptor Flange F1



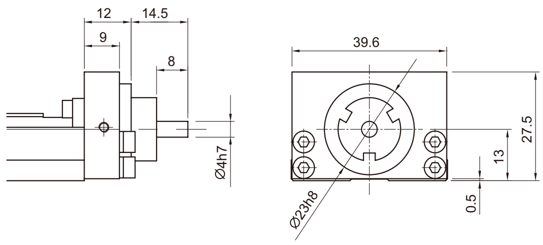
Motor Adaptor Flange F3



Motor Adaptor Flange F2

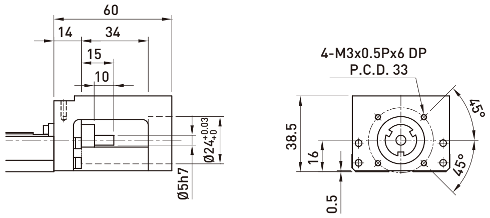


Mount Housing H0

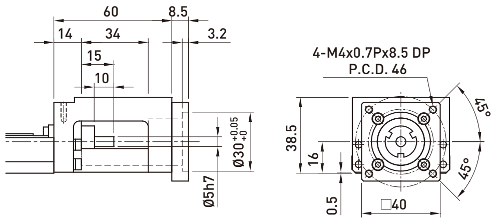


KK50

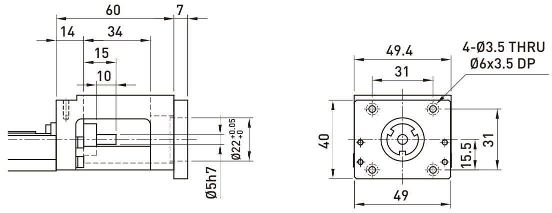
Motor Housing F0



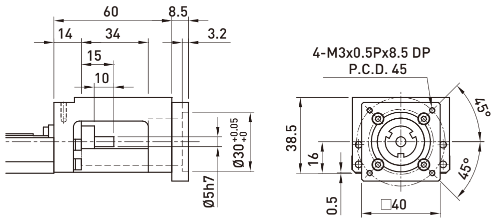
Motor Adaptor Flange F1 馬達連接法蘭 F1



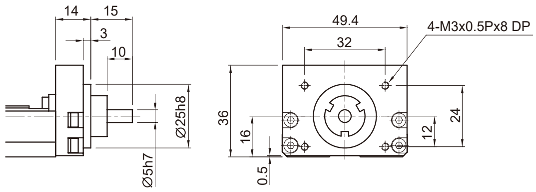
Motor Adaptor Flange F3 馬達連接法蘭 F3



Motor Adaptor Flange F2 馬達連接法蘭 F2

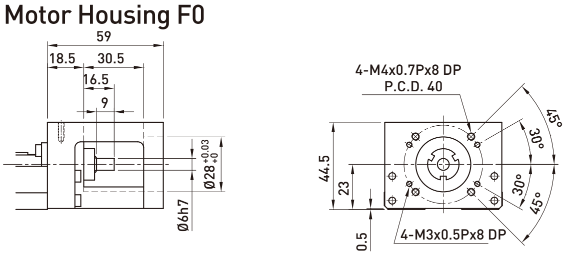


Mount Housing H0

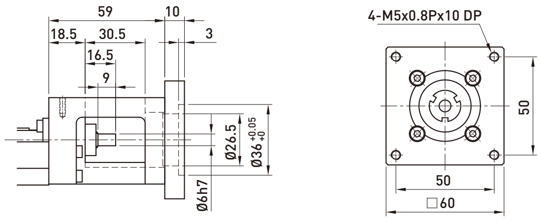


KK60

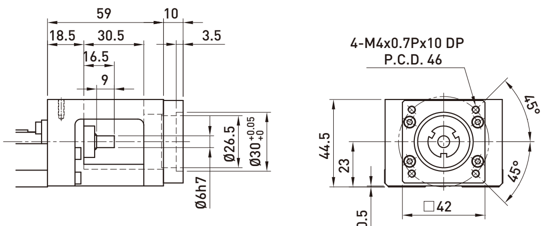
Motor Housing F0



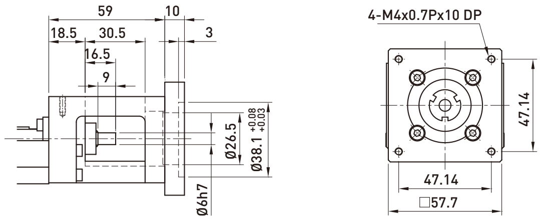
Motor Adaptor Flange F3 馬達連接法蘭 F3



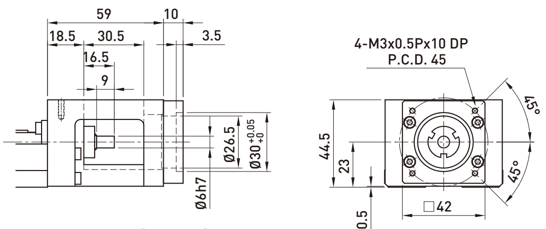
Motor Adaptor Flange F1 馬達連接法蘭 F1



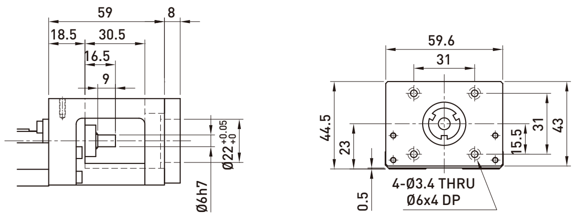
Motor Adaptor Flange F4 馬達連接法蘭 F4



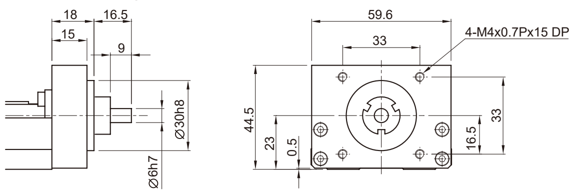
Motor Adaptor Flange F2 馬達連接法蘭 F2



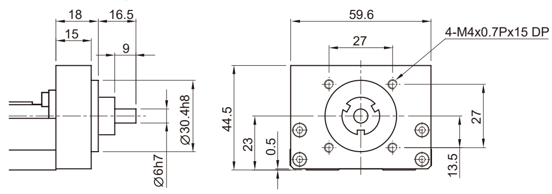
Motor Adaptor Flange F5 馬達連接法蘭 F5



Mount Housing H0

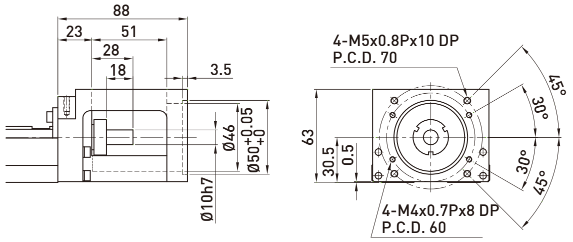


Mount Housing H1

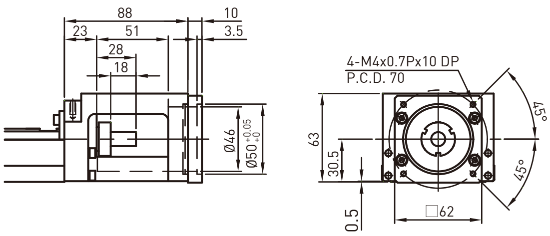


KK80

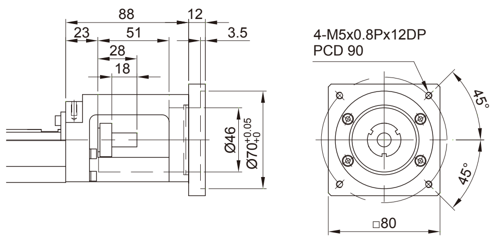
Motor Housing F0



Motor Adaptor Flange F1

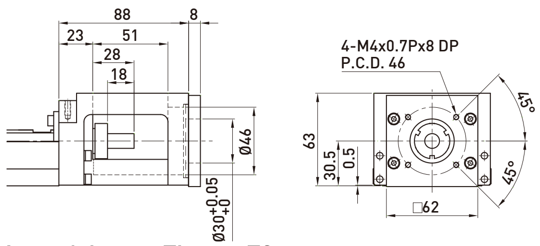


Motor Adaptor Flange F4



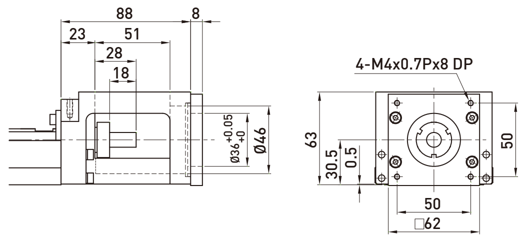
Motor Adaptor Flange F2

Motor adaptor Flange F2



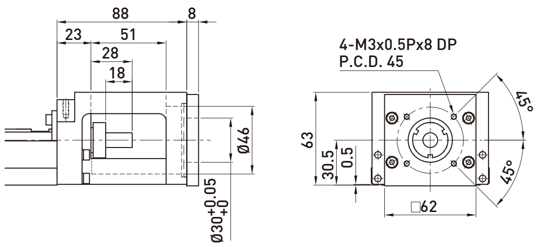
Motor Adaptor Flange F5

Motor adaptor Flange F5

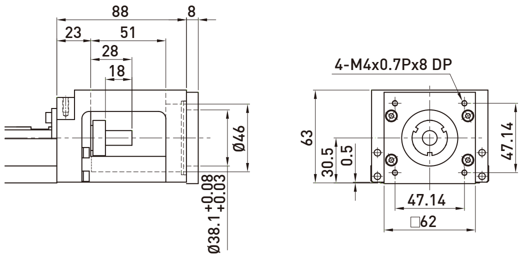


Motor Adaptor Flange F3

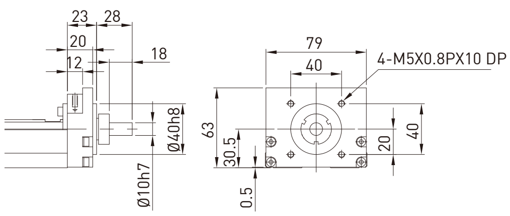
Motor adaptor Flange F3



Motor Adaptor Flange F6

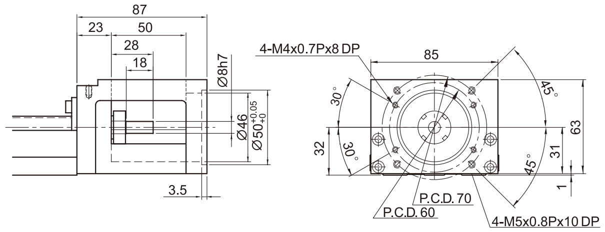


Mount Housing H0

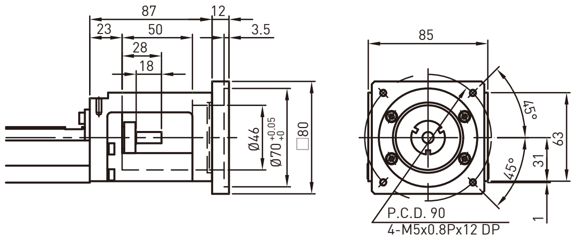


KK86

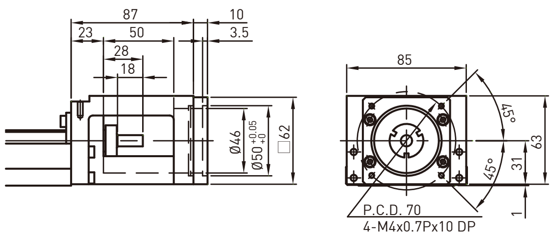
Motor Housing F0



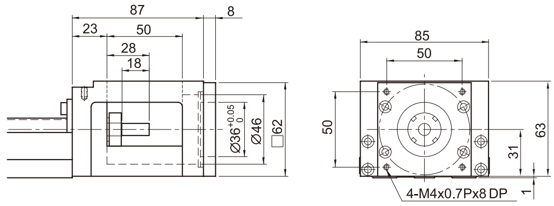
Motor Adaptor Flange F4



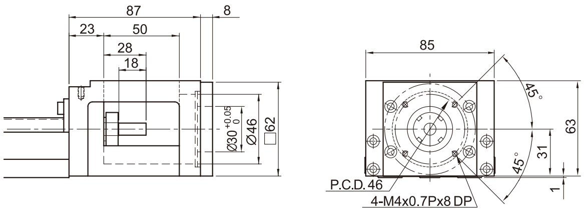
Motor Adaptor Flange F1



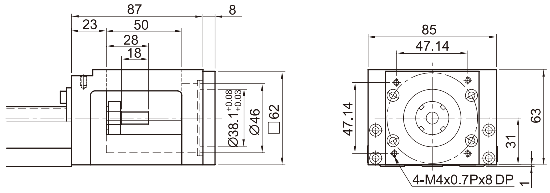
Motor Adaptor Flange F5



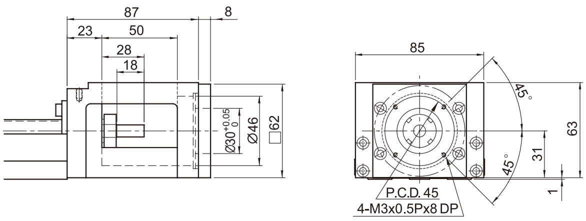
Motor Adaptor Flange F2



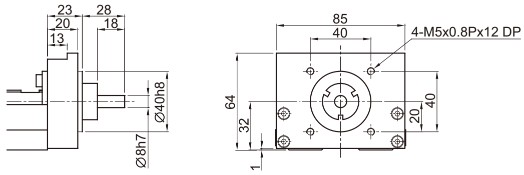
Motor Adaptor Flange F6



Motor Adaptor Flange F3

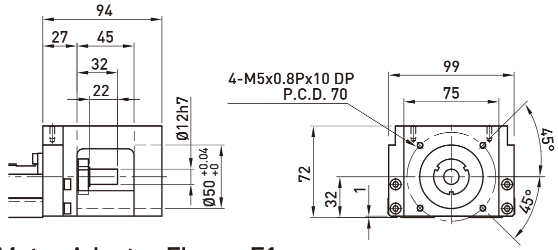


Mount Housing H0

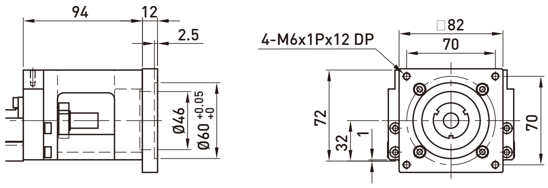


KK100

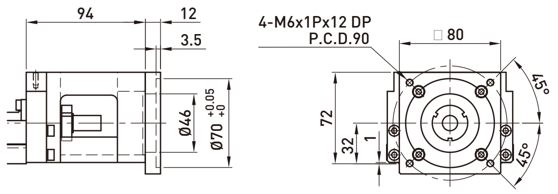
Motor Housing F0



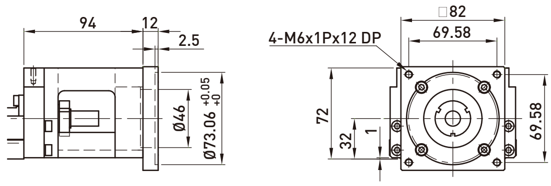
Motor Adaptor Flange F3



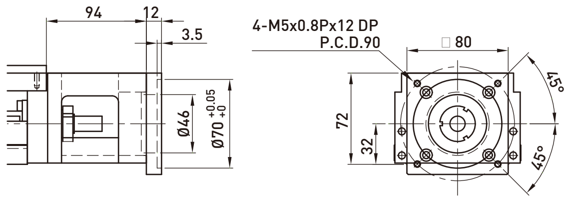
Motor Adaptor Flange F1



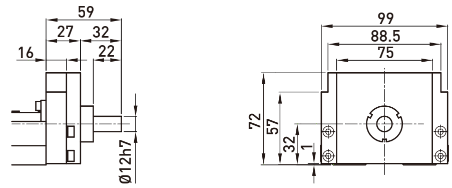
Motor Adaptor Flange F4



MotorAdaptor Flange F2

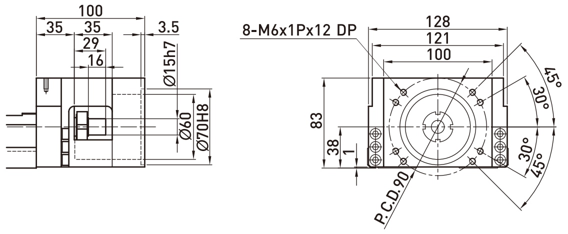


Mount Housing H0

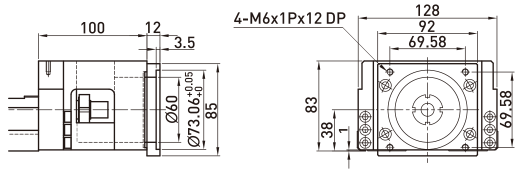


KK130

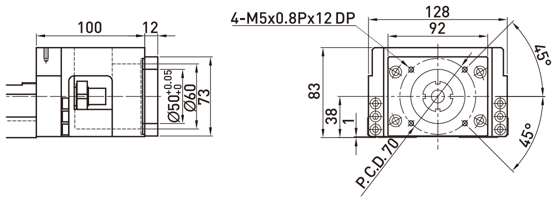
Motor Housing F0



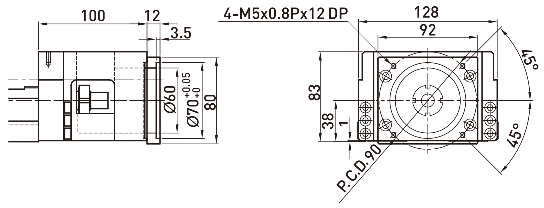
Motor Adaptor Flange F3



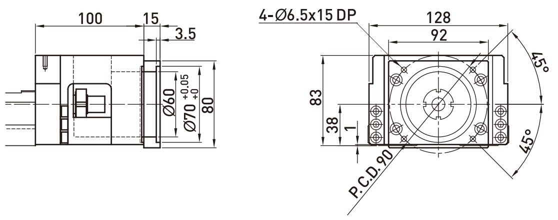
Motor Adaptor Flange F1



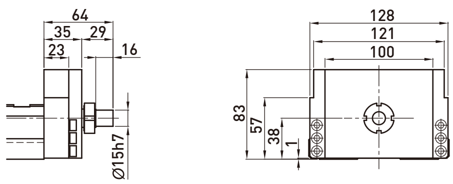
Motor Adaptor Flange F4



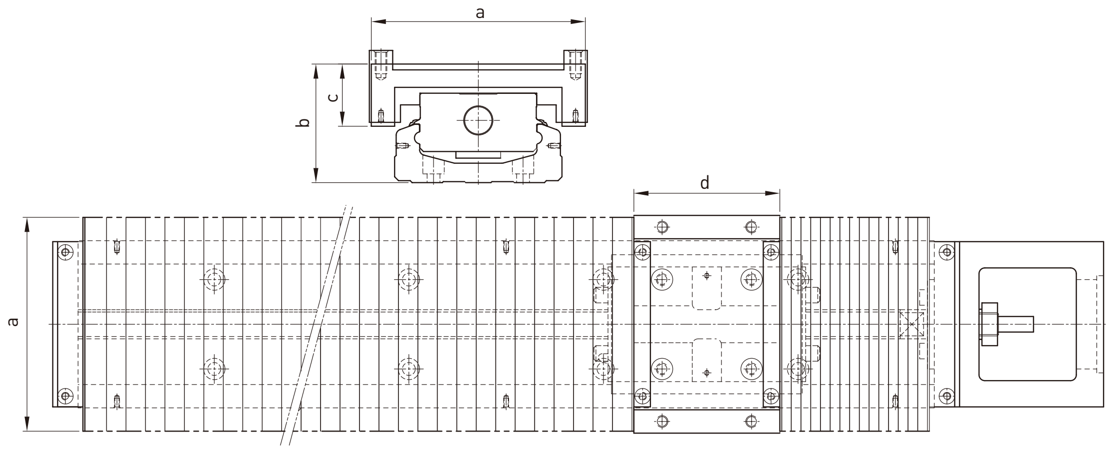
Motor Adaptor Flange F2



Mount Housing H0



1.11 Optional Accessories

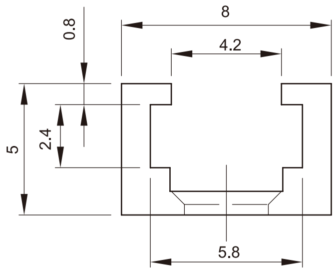


Unit : mm

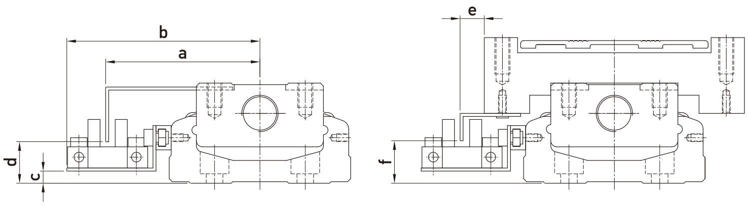
Nominal Width	Rail Length	Stroke	Min.	Max.	a	b	c	d
KK30	75	22	15	37	47	22.5	15.5	23
	100	37	20	57				
	125	52	25	77				
	150	67	30	97				
	175	82	35	117				
	200	97	40	137				
KK40	100	35	16	51	60	29.5	19	33
	150	63	27	90				
	200	93	37	130				
KK50	150	60	21.5	81.5	62	37	19	47
	200	95	29	124				
	250	130	36.5	166.5				
	300	160	46.5	206.5				
KK60	150	56	16	80	84	45.5	24	54
	200	106	20	126				
	300	166	40	206				
	400	234	56	290				
	500	306	70	376				
	600	366	90	456				
KK80	340	181	42	223	106	62.5	34.5	75
	440	257	54	311				
	540	333	66	399				
	640	409	78	487				
	740	485	90	575				
	940	649	108	757				
KK86	340	188	36	224	110	61	32	75
	440	260	50	310				
	540	336	62	398				
	640	408	76	484				
	740	480	90	570				
	940	640	110	750				
KK100	980	769	58	827	150	73	41	95
	1080	855	65	920				
	1180	945	70	1015				
	1280	1029	78	1107				
	1380	1115	85	1200				
KK130	980	748	62	810	180	89	53	108
	1180	916	78	994				
	1380	1084	94	1178				
	1680	1346	113	1459				

1.12 Switch

Switch rail

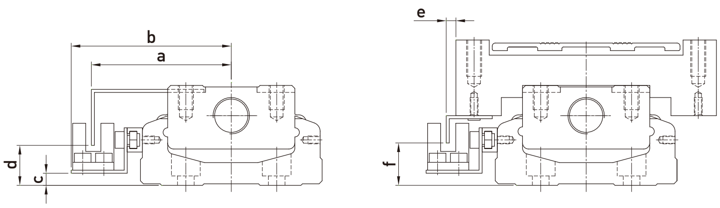


Switch



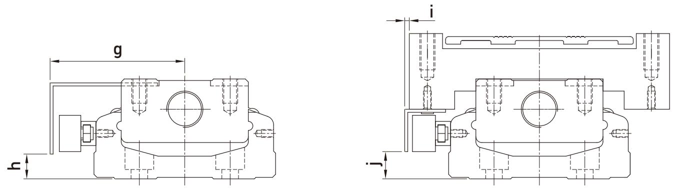
Nominal Width	a	b	c	d	e	f
KK40	41.5	54.1	0.5	10.8	15.3	12
KK50	45.5	59	1	10	15	11
KK60	51	63.8	4	14.5	8	13
KK80	61	74	8	19	9	19
KK86	63.5	76.7	8	18	8	18
KK100	71	84	10	20	9	20
KK130	85.5	98.5	14	24	0.5	23

Switch 1 : Omron EE-SX671



Nominal Width	a	b	c	d	e	f
KK40	36.5	44.3	1	9.8	10.5	12
KK50	41.3	48	1	10.5	10.2	11
KK60	46.2	52.8	4	14	3.2	13
KK80	56	63	8	18	4	18
KK86	59	65.7	8	18	3	18
KK100	66	73	10	20	4.2	20
KK130	80.8	87.5	14	23.5	-4.1	23.5

Switch 2 : Omron EE-SX674



Nominal Width	g	h	i	j
KK40	40	5.5	13.5	5.5
KK50	39.5	5.7	7	19.5
KK60	44.5	9	2	9
KK80	54	12	2	13
KK86	57	13	1	13
KK100	64.5	15	2.5	15
KK130	79	19	-6	19

Switch 3: PANASONIC GX-F12A

Switch 4 : PANASONIC GX-F12A-P

Nominal Width	g	h	i	j
KK30	28	1.8	5.8	1.8

Switch 5 : YAMATAKE APM-D3B1-03

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