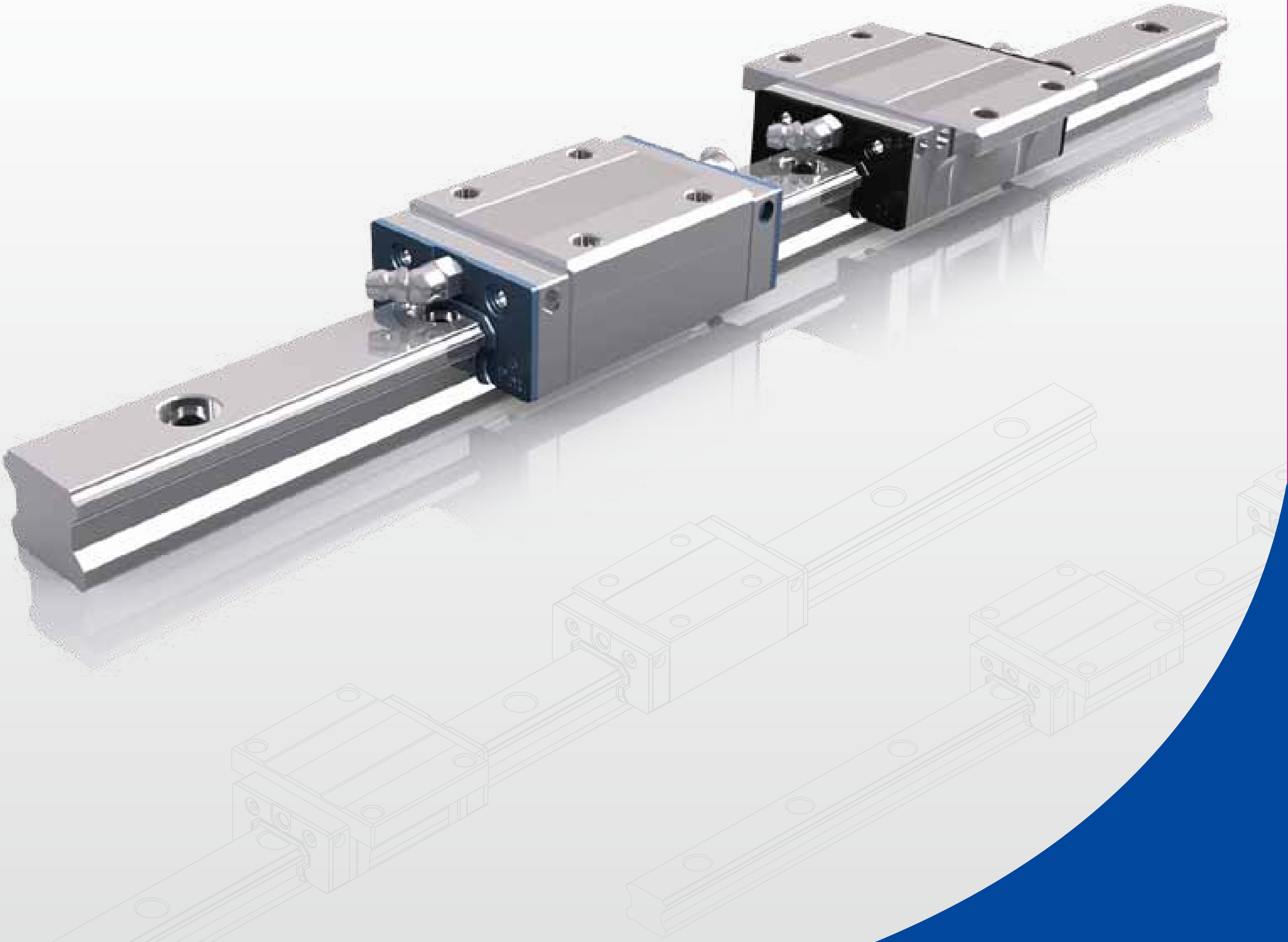
STABILIZED TRANSMISSION AS FORWARDING ®

STAF Linear Guide

STAF Linear Guide Integrated Rail for Non Cage Type and Cage Type



OME Technology Co.,Ltd

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A. Terms of Linear Guide

1-1 Main Factors

a. Lifetime and Load of Linear Guide

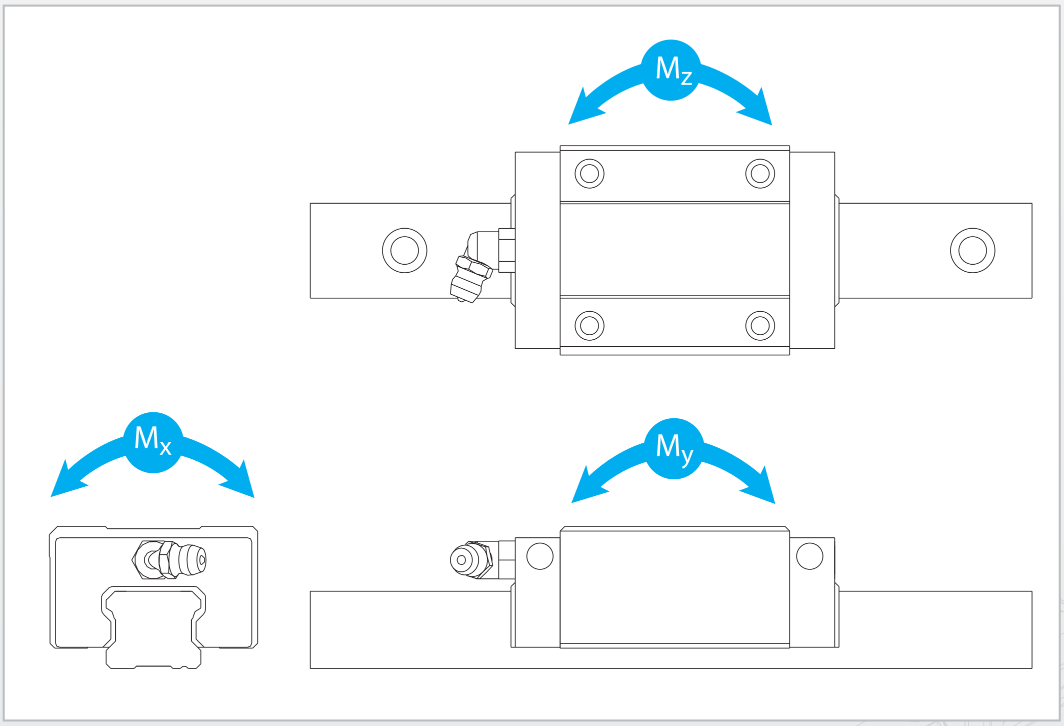
Selection of linear guide has to be made on the static safety factor that is derived by comparing the calculated load of each slide according to its conditions and forces against the factors such as basic static load rating (C_0) or static permissible moment (M_x, M_y, M_z) to judge the reliability of the mechanism. For estimating the lifetime in long term, the basic dynamic load rating (C) has to be considered in calculating the distance durability.

b. Basic Static Load Rating (C_0)

When the linear guide receives excessive load, the grooves and the steel balls will be permanently deformed. The linear guide will no longer operate smoothly when the deformation exceeds limitation. The basic static load rating (C_0) is defined as the static load that will created the deformation of the grooves and steel ball to 1/10,000 of the steel ball diameter.

c. Static Permissible Moment (M_x , M_y , M_z)

When the linear guide receives a moment, the grooves and the steel balls will deform. A moment that causes deformation of the grooves and the steel balls to 1/10,000 of the steel ball diameter is called the static permissible moment. The static permissible moment in the X, Y and Z directions are M_x, M_y and M_z individually.



d. Static Safety Factor (f_S)

The static safety factor (f_s) is determined by the ratio of the load capacity (basic static load rating C_0) of the linear guide to the applied load on the linear guide. This factor reflects the reliability of the linear guide. Applied load is the force applied to the groove. To calculate the applied load, we have to calculate the load applied to the slide both vertical and parallel to the contact face of the groove. In the case of 4 symmetric loads at 45°, the applied load is the sum of the parallel load and the vertical load.

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

f_S	Static safety factor
f_C	Contact factor
C_0	Basic static load rating
M_0	Static permissible moment
P	Calculated load
M	Calculated moment

Static safety factor reference table:

Operation condition	Loading condition	Min. f_S
Standing	Light impact and shift	1.0 ~ 1.3
	Heavy impact and twist	2.0 ~ 3.0
Operation	Light impact and shift	1.0 ~ 1.5
	Heavy impact and twist	2.5 ~ 5.0

e. Life Distance (L)

Linear guide is a mass production product. Even though produced by the same processes and with the same materials, Life of individual linear guide is never the same. Life distance is the total travel distance that 90% linear guides would last before fatigue under certain operation conditions.

f. Basic Dynamic Load Rating (C)

If the life distance of certain linear guide is 50km, and if more than 90% of the linear guides would last for 50km under a of load of constant direction and magnitude that without peeling for fatigue, then the load is defined as the basic dynamic load rating.

1-2 Subsidiary Factors

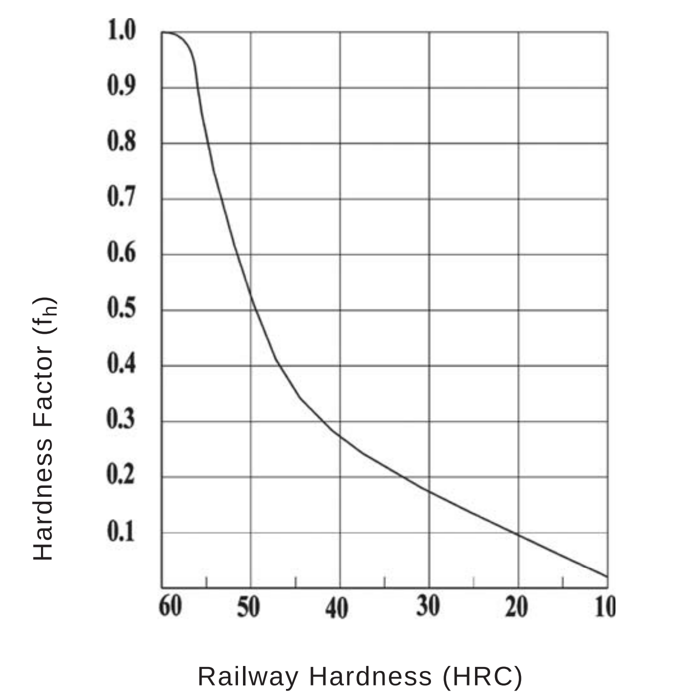
a. Contact Factor (f_c)

It is difficult to get even load distribution when linear guide blocks are closely arranged next to another due to moment load and accuracy of the mounting surface. Hence, in multiple linear guide application, basic static load rating (C) and basic dynamic load rating (C_0) have to be multiplied by contact factor (f_c)

Number of Linear Guides Used	Contact Factor (f_c)
2	0.81
3	0.72
4	0.66
5	0.61
Normal use	1

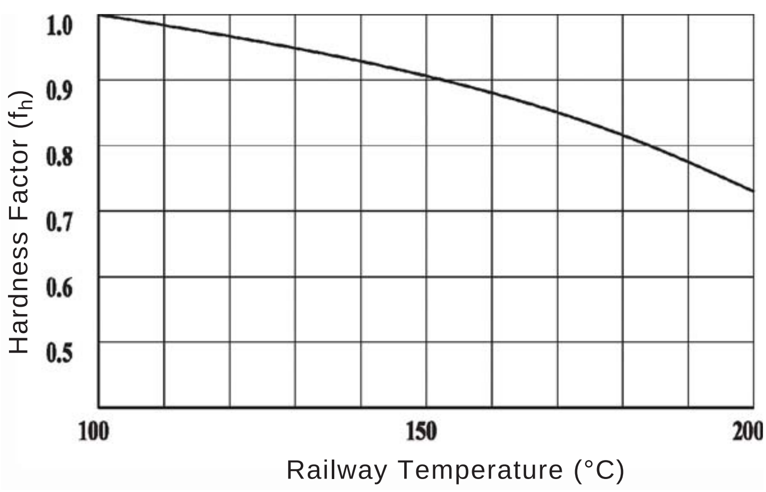
b. Hardness Factor (f_h)

To maximize the load capacity of the linear guide, the hardness of the railways is best at between HRC 58 to 64. If the hardness is lower than HRC 58, the hardness factor (f_h) has to be brought into account for the basic dynamic load rating (C) and the basic static load rating (C_0).



c. Temperature Factor (f_t)

When the ambient temperature exceeds 100℃, the adverse impact of high temperature must be considered, and the temperature factor must be brought into calculation.



Note) If the ambient temperature exceeds 80℃, high-temperature material must be used for the seals and the end plates.

d. Load Factor (f_w)

Reciprocal mechanisms tend to involve vibrations or impact in operation. Particularly, to determine appropriately the load generated by vibration in high-speed operation and the impact of frequent start-stop is very difficult. Hence, when the impact of vibration is significant, the basic dynamic load rating can be divided by the empirical load factors in the table below.

Impact	Speed (V)	Vibration (G)	f_w
Weak	Low V <= 15 m/min	G < = 0.5	1 ~ 1.5
Medium	Moderate 15 < V <= 60 m/min	0.5 < G < = 1.0	1.5 ~ 2.0
Strong	High V > 60 m/min	1.0 < G < = 2.0	2.0 ~ 3.5

1-3 Life Calculation Formula

Life distance of linear guides can be calculated from the basic dynamic load rating (C) and the applied load by the formula below:

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

L: Life distance (km)
Life distance is the total travel distance that 90% of certain type linear guides would last before fatigue in operation under certain conditions individually.

C: Basic dynamic load rating	P : Applied load
f_h: Hardness factor	f_t : Temperature factor
f_c: Contact factor	f_w: Load factor

When the life distance (L) is known, we can calculate the lifetime according to reciprocating stroke and frequency:

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

L_h = Lifetime (hr)
N_1 = Reciprocation frequency (cycles/min)
L_s = Stroke (mm)

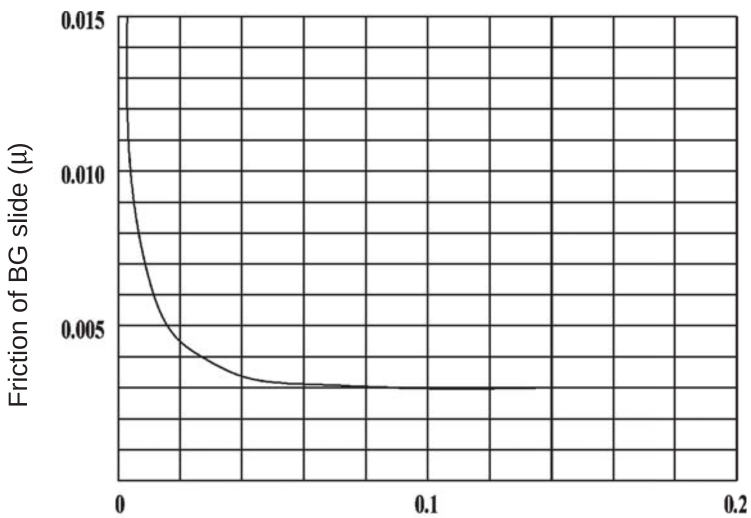
1-4 Friction

Since the linear guide is the integration of the slide, the rail and the rolling elements such as balls or rollers, its movement is carried out by the rolling motion of the rolling elements, the friction can be as minor as 1/40 of the sliding guide. The static friction of linear guide is so small preventing the "stick-slip" so it is applicable to all sorts of accurate movements. The friction of a linear guide varies to the type of the linear guide, the preload, the viscosity of lubricant and the force applied. The friction increases especially when there is moment given or preload applied to increase rigidity. Friction characteristic of the STAF linear guide is shown as in the table below.

Friction can be calculated with the formula below,

$F = \mu \cdot W + f$

F : Friction	
W: Load	
μ : Friction coefficient	
f : Friction of BG slide	

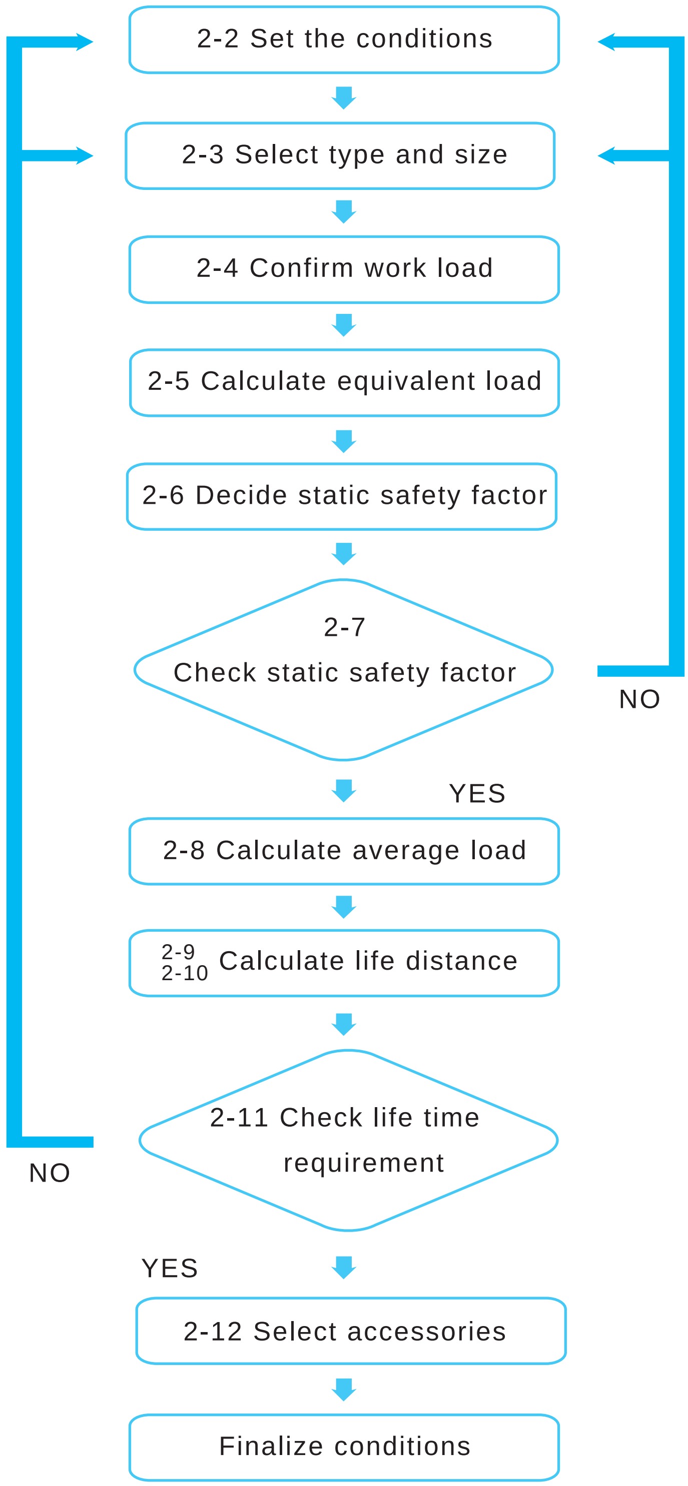


Load ration (P/C)
P: Applied load
C: Basic dynamic load rating

Type	Friction	Type	Friction
BGX 15	0.3	BGC 15	0.45
BGX 20	0.4	BGC 20	0.6
BGX 25	0.45	BGC 25	0.7
BGX 30	0.7	BGC 30	0.9
BGX 35	1.0	BGC 35	1.2
BGX 45	1.2	BGC 45	1.8
BGX 55	1.4	BGC 55	2.0

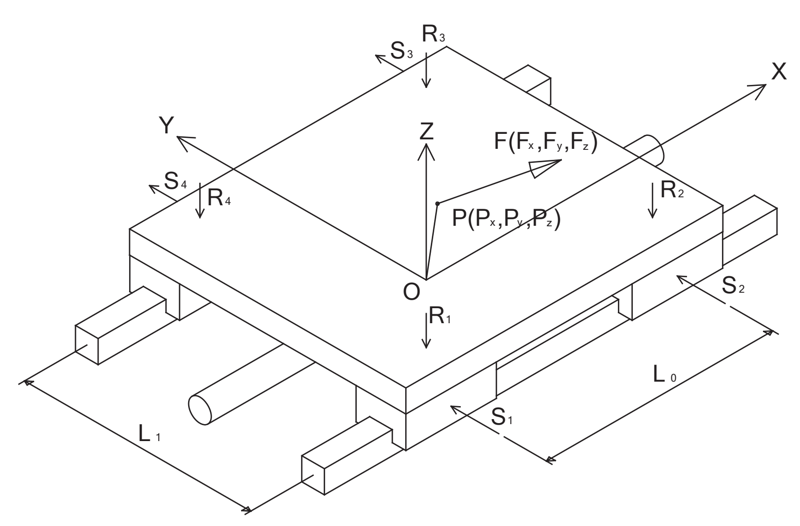
B. How to Select Linear Guide

2-1 Linear Guide Selection Step



2-2 Set the Condition

Selection of linear guide has to be based on calculation. The informations required for such calculation are: A. assembly conditions (span, number of slides and number of rails); B. mounting position (horizontal, vertical, tilt or wall mount); C: applied load (magnitude, direction and position of force, and inertia under acceleration), D: frequency (load cycle).



a. Assembly Conditions

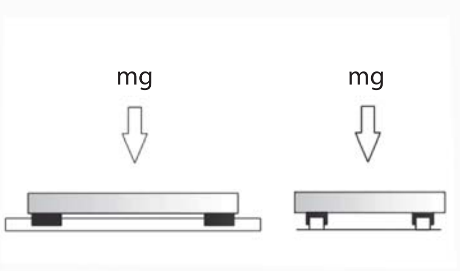
1. Span: distance in between the slides such as L_0 and L_1 in the above figure.
L_0: distance in between the slides on one rail
L_1: distance in between the rails
L_0 and L_1 are crucial to the rigidity and life of the linear motion system.

2. Number of slides: how many slides are mounted on the same rail.
In the above figure, 2 slides are mounted on one rail. Normally, loading capacity and rigidity are increased as the number of slides increase, and so is the life. However, the operation space and the stroke must be brought into consideration.

3. Number of rails: how many rails are used in the system.
In the above figure, 2 rails are used in the system. Normally, moment capacity is increased as the number of slides increase, and so are rigidity and life.

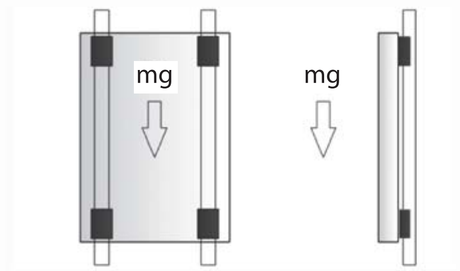
b. Mounting Position

1. Horizontal mount



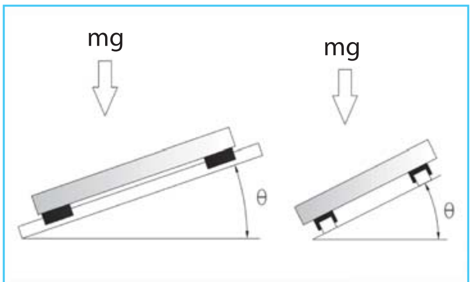
◎ **Horizontal mount (load mg)**
This is the most common way of mounting with the load mg vertical to the slide plane and the sliding direction. It is most persistent to vertical load and is often used in normal positioning and feeding mechanism.

2. Vertical mount



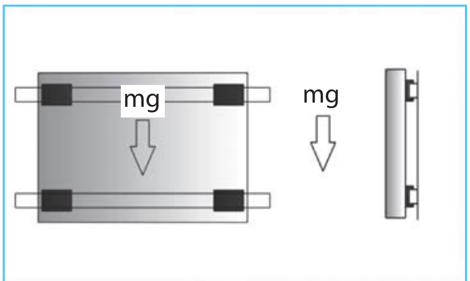
◎ **Vertical mount (load mg)**
In vertical mount, the load mg is parallel to the slides, so the slide span and its moment capacity are crucial. This is often seen in the elevator. Attention should be paid to the suspension of the load. The bigger the suspension is, the bigger the moment is.

3. Tilt mount



◎ **Tilt mount (load mg)**
There are lateral tilted mount and longitudinal tilt mount. The load mg is vertical to the sliding direction in lateral tilt mount and is with an angle θ in longitudinal tilt mount.

4. Wall mount



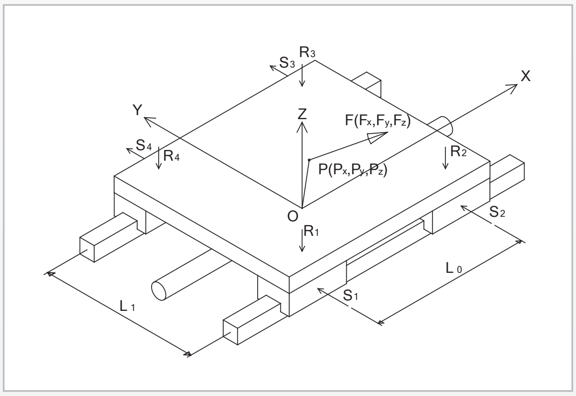
◎ **Wall mount (load mg)**
Moment is crucial for wall mount so the span in between slides affects the load on the slide and must be taken care of.
The load mg is parallel to the slide plane and is vertical to the sliding direction.

c. Work Load

The work load consist 3 elements - Magnitude, direction and position.

1. The workloads on the slide:
   Gravity: The mass of the slide forms the inertia during movement.
   External force: Force from the mechanism. This can be hydraulic, pneumatic or electro-magnetic.
   It will not form inertia during the movement.

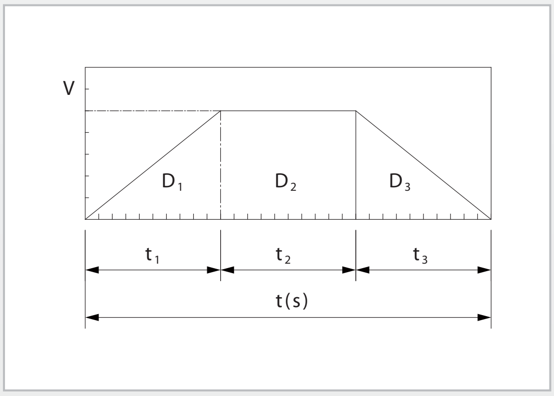
2. Direction of work load:
   The external force can be divided into 3 components, F_x, F_y and F_z as indicated in the right figure.
   F_x is the external force in X-axis.
   F_y is the external force in Y-axis.
   F_z is the external force in Z-axis.



3. Position of work load:
   As shown in the figure, take the slide centre for the origin point.
   The external force can be ball screw, hydraulic cylinder or linear motor.
   The relative position of the external force in X, Y and Z can then be defined.
   P_{fx}: X position of external force in relation to centre.
   P_{fy}: Y position of external force in relation to centre.
   P_{fz}: Z position of external force in relation to centre.

4. Span:
   L_0 and L_1 stand for the distances in between the slides.

5. Velocity diagram:
   Velocity (V):
   Max operation velocity
   Travel distance (D):
   Total travel distance of the mechanism
   Acceleration distance (D_1):
   The distance travelled from start to max velocity
   Uniform distance (D_2):
   The distance travelled in constant velocity
   Deceleration distance (D_3):
   The distance travelled from max. velocity to stop



6. Work load on each slide:
   R_1, R_2, R_3 and R_4 are the vertical loads of each slide.
   S_1, S_2, S_3 and S_4 are the horizontal loads of each slide

d. Work Frequency:

When determining if the life time is satisfactory, the work frequency must be considered. E.g. 1, if the calculated life is 1,000km, and the daily travel is 1km, then the duration is 1,000 days. E.g. 2, if the calculated life is 50,000km, and the daily travel is 500km, then the duration is 100 days.

2-3 Select Type and Size

a. Select the appropriate series (BGX or BGC)
Select the appropriate series of linear guides. Please see our catalogues of BGX and BGC series for relevant information.

b. Select an appropriate size among 15, 20, 25, 30, 35, 45 and 55
Select a size according to mechanical space without considering the load and the life. In the initial selection, it is difficult to judge load and life, and even if the safety factor is sufficient, it does not say that the life is sufficient. Hence, it is recommended to consider the size as the initial selection objective, and then select the bigger type when life or load is insufficient in practice.

2-4 Confirm Work Load

The vertical forces on the slide are:

$$R_1=\frac{-F_z}{4}+\frac{F_z\cdot P_x-F_x\cdot P_z}{2\cdot L_0}+\frac{F_z\cdot P_y-F_y\cdot P_z}{2\cdot L_1}$$

$$R_2=\frac{-F_z}{4}-\frac{F_z\cdot P_x-F_x\cdot P_z}{2\cdot L_0}+\frac{F_z\cdot P_y-F_y\cdot P_z}{2\cdot L_1}$$

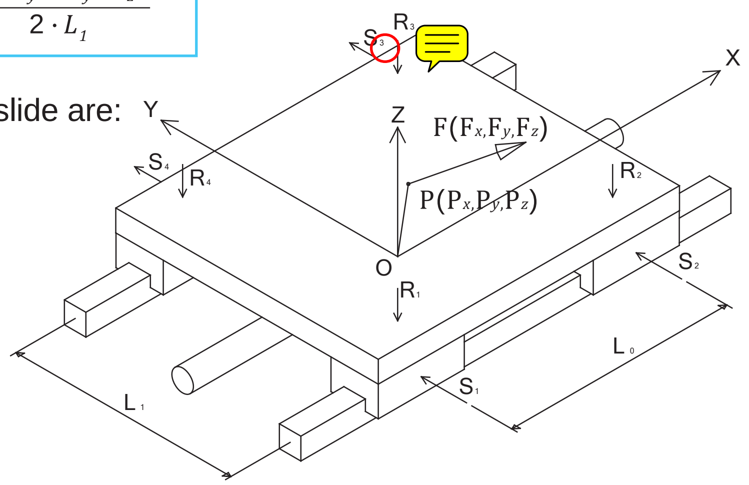
$$R_3=\frac{-F_z}{4}-\frac{F_z\cdot P_x-F_x\cdot P_z}{2\cdot L_0}-\frac{F_z\cdot P_y-F_y\cdot P_z}{2\cdot L_1}$$

$$R_4=\frac{-F_z}{4}+\frac{F_z\cdot P_x-F_x\cdot P_z}{2\cdot L_0}-\frac{F_z\cdot P_y-F_y\cdot P_z}{2\cdot L_1}$$

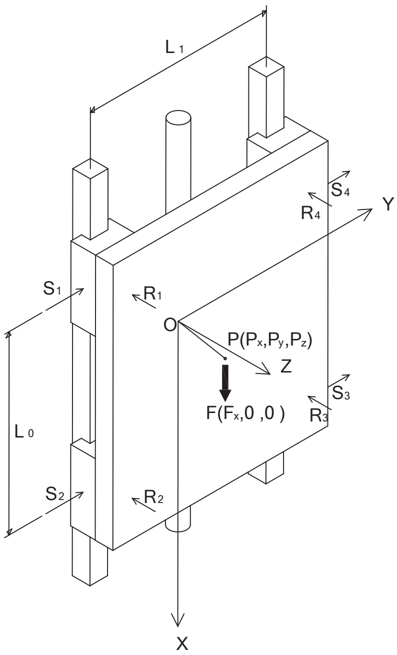
The horizontal forces on the slide are:

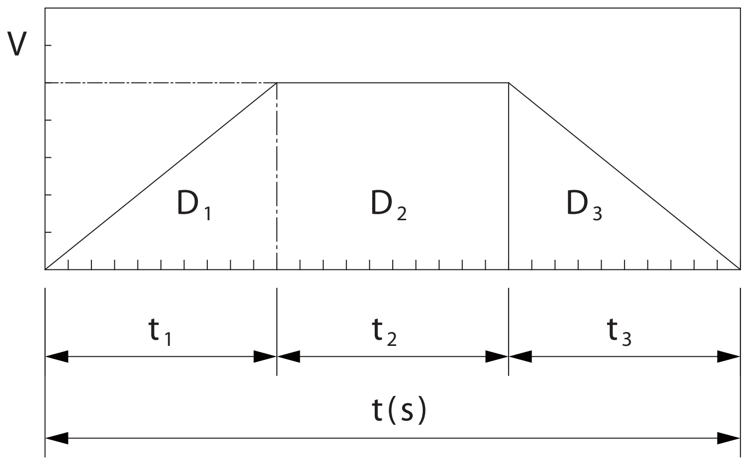
$$S_1=S_4=\frac{F_y}{4}+\frac{F_y\cdot P_x-F_x\cdot P_y}{2\cdot L_0}$$

$$S_2=S_3=\frac{F_y}{4}+\frac{F_y\cdot P_x-F_x\cdot P_y}{2\cdot L_0}$$



Example:





The movement can be divided into 3 sections:

Acceleration section (Section A)
Constant section (Section B)
Deceleration section (Section C)

Take linear guide BGXH20FN2 L4000 NZ0 for example:

Known:

$C = 14.3kN$, $C_0 = 30.5kN$, $V_{max} = 1m/s$

$m = 98kg$, $L_0 = 0.3m$, $L_1 = 0.5m$

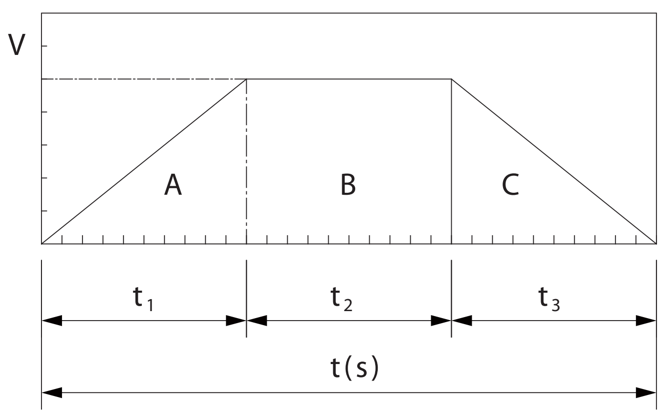
$P_x = 0.08m$, $P_y = 0.25m$, $P_z = 0.28m$

$D_1 = 1m$, $t_1 = 2s$, $a_1 = 0.5m/s$

$D_2 = 2m$, $t_2 = 2s$, $a_2 = 0m/s$

$D_3 = 1m$, $t_3 = 2s$, $a_3 = -0.5m/s$

$F_x = m(g+a)$, $F_y = 0$, $F_z = 0$



Load calculation:

$$R_2(A) = R_3(A) = \frac{-m(g+a_1)\cdot P_z}{2\cdot L_0} = \frac{-98(9.81+0.5)\cdot 0.28}{2\cdot 0.3} = 471.5N$$

Section A

$F_x(A) = m(g+a_1)$, $F_y(A) = 0$, $F_z(A) = 0$

$$R_1(A) = R_4(A) = \frac{-m(g+a_1)\cdot P_z}{2\cdot L_0} = \frac{-98(9.81+0.5)\cdot 0.28}{2\cdot 0.3} = -471.5N$$

$$R_2(A) = R_3(A) = \frac{m(g+a_1)\cdot P_z}{2\cdot L_0} = \frac{98(9.81+0.5)\cdot 0.28}{2\cdot 0.3} = 471.5N$$

$$S_1(A) = S_4(A) = \frac{-m(g+a_1)\cdot P_y}{2\cdot L_0} = \frac{-98(9.81+0.5)\cdot 0.25}{2\cdot 0.3} = -421.0N$$

$$S_2(A) = S_3(A) = \frac{m(g+a_1)\cdot P_y}{2\cdot L_0} = \frac{98(9.81+0.5)\cdot 0.25}{2\cdot 0.3} = 421.0N$$

Section B

$F_x(B) = m(g+a_2)$, $F_y(B) = 0$, $F_z(B) = 0$

$$R_1(B) = R_4(B) = \frac{-m(g+a_2)\cdot P_z}{2\cdot L_0} = \frac{-98(9.81+0)\cdot 0.28}{2\cdot 0.3} = -448.6N$$

$$R_2(B) = R_3(B) = \frac{m(g+a_2)\cdot P_z}{2\cdot L_0} = \frac{98(9.81+0)\cdot 0.28}{2\cdot 0.3} = 448.6N$$

$$S_1(B) = S_4(B) = \frac{-m(g+a_2)\cdot P_y}{2\cdot L_0} = \frac{-98(9.81+0)\cdot 0.25}{2\cdot 0.3} = -400.6N$$

$$S_2(B) = S_3(B) = \frac{m(g+a_2)\cdot P_y}{2\cdot L_0} = \frac{98(9.81+0)\cdot 0.25}{2\cdot 0.3} = 400.6N$$

Section C

$F_x(C) = m(g+a_1)$, $F_y(C) = 0$, $F_z(C) = 0$

$$R_1(C) = R_4(C) = \frac{-m(g+a_3)\cdot P_z}{2\cdot L_0} = \frac{-98(9.81-0.5)\cdot 0.28}{2\cdot 0.3} = -425.8N$$

$$R_2(C) = R_3(C) = \frac{m(g+a_3)\cdot P_z}{2\cdot L_0} = \frac{98(9.81-0.5)\cdot 0.28}{2\cdot 0.3} = 425.8N$$

$$S_1(C) = S_4(C) = \frac{-m(g+a_3)\cdot P_y}{2\cdot L_0} = \frac{-98(9.81-0.5)\cdot 0.25}{2\cdot 0.3} = -380.2N$$

$$S_2(C) = S_3(C) = \frac{m(g+a_3)\cdot P_y}{2\cdot L_0} = \frac{98(9.81-0.5)\cdot 0.25}{2\cdot 0.3} = 380.2N$$

2-5 Calculate Equivalent Load

The vertical and horizontal load capacity depend on the contact angle between the slide and the rail. The equivalent load is different when the contact angle is 90° or 45°. The contact angle in the STAF linear guides are designed 45° so as to get the same magnitudes of vertical and horizontal loads. The equivalent load on the rail (R_e) can be considers as the sum of vertical load magnitude (R_n) and the horizontal load magnitude (S_n).

Vertical load : R_n
Horizontal load : S_n
The equivalent load is : $R_e = |R_n| + |S_n|$

Individual equivalent work load in section A:

$P_1(A) = |R_1(A)| + |S_1(A)| = |-471.5| + |-421.0| = 891.5$ N

$P_2(A) = |R_2(A)| + |S_2(A)| = |471.5| + |421.0| = 891.5$ N

$P_3(A) = |R_3(A)| + |S_3(A)| = |471.5| + |421.0| = 891.5$ N

$P_4(A) = |R_4(A)| + |S_4(A)| = |-471.5| + |-421.0| = 891.5$ N

Individual equivalent work load in section B:

$P_1(B) = |R_1(B)| + |S_1(B)| = |-448.6| + |-400.6| = 849.2$ N

$P_2(B) = |R_2(B)| + |S_2(B)| = |448.6| + |400.6| = 849.2$ N

$P_3(B) = |R_3(B)| + |S_3(B)| = |448.6| + |400.6| = 849.2$ N

$P_4(B) = |R_4(B)| + |S_4(B)| = |-448.6| + |-400.6| = 849.2$ N

Individual equivalent work load in section C:

$P_1(C) = |R_1(C)| + |S_1(C)| = |-425.8| + |-380.2| = 806$ N

$P_2(C) = |R_2(C)| + |S_2(C)| = |425.8| + |380.2| = 806$ N

$P_3(C) = |R_3(C)| + |S_3(C)| = |425.8| + |380.2| = 806$ N

$P_4(C) = |R_4(C)| + |S_4(C)| = |-425.8| + |-380.2| = 806$ N

2-6 Decide Static Safety Factor

Definition of static safety factor:

Static safety factor calculation formula:

$$f_s = \frac{f_c \cdot C_0}{R_e} = \frac{\text{(contact factor)} \cdot \text{(static load rating)}}{\text{max. individual equivalent load}}$$

Static safety factor calculation formula:

$$f_s = \frac{f_c \cdot M_0}{M} = \frac{\text{(contact factor)} \cdot \text{(permissible moment)}}{\text{calculated moment}}$$

Definition of static safety factor:

It is difficult to get even load distribution when linear guide blocks are closely arranged next to another due to moment load and assembly accuracy. Hence, in multiple linear guide application, basic dynamic load rating (C) and basic static load rating (C_0) have to be multiplied by contact factor (f_c).

Number of Linear Guides Used	Contact Factor (f_c)
2	0.81
3	0.72
4	0.66
5	0.61
Normal use	1

Following the previous example:

The max equivalent load (R_e) in the above example is 90.97kgf
In the case of using linear guide BGXH20FN,
The basic dynamic load, C = 1,43kN
The basic static load, C_0 = 30.5kN
Permissible moment in X-axis, Mx = 0.285 kN·m
Permissible moment in Y-axis, My = 0.220 kN·m
Permissible moment in Z-axis, Mz = 0.220 kN·m

fc(normal use)= 1

$$f_s = \frac{f_c \cdot C_0}{P} = \frac{30.5 \cdot 10^3}{891.51} = 34.21 \text{ (safety factor)}$$

2-7 Check Static Safety Factor

The table below are the reference values of static safety factor:

Operation condition	Loading condition	Min. f_S
Standing-still	Light impact and shift	1.0 ~ 1.3
	Heavy impact and twist	2.0 ~ 3.0
Operation	Light impact and shift	1.0 ~ 1.5
	Heavy impact and twist	2.5 ~ 5.0

2-8 Calculate Average Load

Calculation of average load:

There are several formulas of average load calculation according to work load variation pattern in movement.

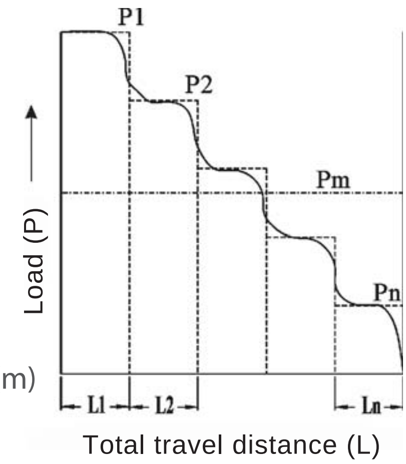
Stepwise load variation:

P_m: Average load (N)

P_n: Varying load (N)

L : Total travel distance (m)

L_n: Corresponding travel distance of each varying load (m)



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

Apply the formula in the example

$$P_{m1} = \left(\frac{P_1(A)^3 \cdot D_1 + P_1(B)^3 \cdot D_2 + P_1(C)^3 \cdot D_3}{D_1+D_2+D_3} \right)^{\frac{1}{3}}$$

$$= \left(\frac{891.5^3 \cdot 1 + 849.2^3 \cdot 2 + 806.0^3 \cdot 1}{1+2+1} \right)^{\frac{1}{3}} = 850.0\text{N}$$

$$P_{m2} = \left(\frac{P_2(A)^3 \cdot D_1 + P_2(B)^3 \cdot D_2 + P_2(C)^3 \cdot D_3}{D_1+D_2+D_3} \right)^{\frac{1}{3}}$$

$$= \left(\frac{891.5^3 \cdot 1 + 849.2^3 \cdot 2 + 806.0^3 \cdot 1}{1+2+1} \right)^{\frac{1}{3}} = 850.0\text{N}$$

$$P_{m3} = \left(\frac{P_3(A)^3 \cdot D_1 + P_3(B)^3 \cdot D_2 + P_3(C)^3 \cdot D_3}{D_1+D_2+D_3} \right)^{\frac{1}{3}}$$

$$= \left(\frac{891.5^3 \cdot 1 + 849.2^3 \cdot 2 + 806.0^3 \cdot 1}{1+2+1} \right)^{\frac{1}{3}} = 850.0\text{N}$$

$$P_{m4} = \left(\frac{P_4(A)^3 \cdot D_1 + P_4(B)^3 \cdot D_2 + P_4(C)^3 \cdot D_3}{D_1+D_2+D_3} \right)^{\frac{1}{3}}$$

$$= \left(\frac{891.5^3 \cdot 1 + 849.2^3 \cdot 2 + 806.0^3 \cdot 1}{1+2+1} \right)^{\frac{1}{3}} = 850.0\text{N}$$

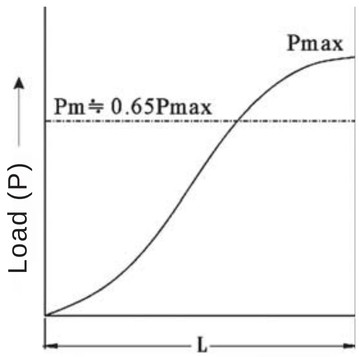
Monotonic load variation:

Monotonic load variation:

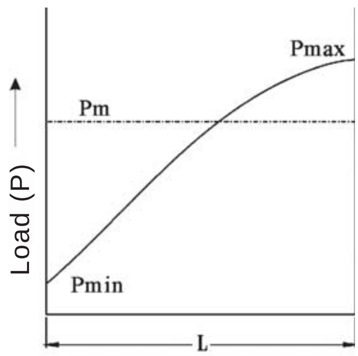
$$P_m \fallingdotseq \left(\frac{P_{min} + 2P_{max}}{3} \right)$$

P_{min} : min load (kgf)

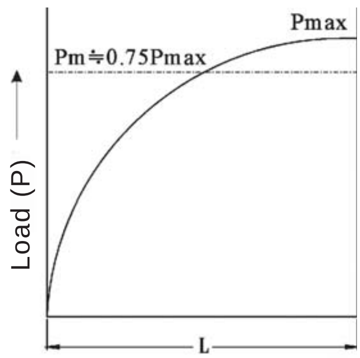
P_{max} : max load (kgf)



Total travel distance (L)



Total travel distance (L)



Total travel distance (L)

2-9 Calculate Life Distance

Formula:

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

L: life distance (km)
C: basic dynamic load rating (kN)
P: average load (kN)
f_c: contact factor
f_h: hardness factor
f_t : temperature factor
f_w: load factor

e.g.: Basic dynamic load rating (C) of BGXH20FN is 14.3kN. Hardness factor (f_h) is 1 if hardness is HRC58. Temperature factor (f_t) is 1 under normal temperature. If contact factor (f_c) is 1, the velocity is 15<V<60m/s, load factor (f_w) is 1.5, and average load (P_m) is 850N.

Then the life distance (L) is:

$$L = \left(\frac{f_h \cdot f_t \cdot f_c}{f_w} \cdot \frac{C}{P} \right)^3 \cdot 50km = \left(\frac{1 \cdot 1 \cdot 1}{1.5} \cdot \frac{14300}{850} \right)^3 \cdot 50km = 71231.5km$$

e.g.: Basic dynamic load rating (C) of BGXH25FN is 20.1kN. Hardness factor (f_h) is 0.8 if hardness is HRC55. Temperature factor (f_t) is 1 under normal temperature. Contact factor (f_c) is 0.81 for 2 slides close together, the velocity (V) is 60m/s, load factor (f_w) is 2, and average load (P_m) is 1530N.

Then the life distance (L) is:

$$L = \left(\frac{f_h \cdot f_t \cdot f_c}{f_w} \cdot \frac{C}{P} \right)^3 \cdot 50km = \left(\frac{0.8 \cdot 1 \cdot 0.81}{2} \cdot \frac{20100}{1530} \right)^3 \cdot 50km = 4353.75km$$

2-10 Calculate Life Time

Formula (A) calculation of hours

L_h: life time by hours
L: life distance (km)
L_s: stroke length (mm)
N_1: reciprocations per minute (min-1)

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

Formula (B) calculation of years

L_y: life time by years
L: life distance (km)
L_s: stroke length (mm)
N_1: reciprocations per minute (min-1)
M: work minutes per hour (min/hr)
H: work hours per day (hr/day)
D: work days per year (day/year)

$$L_y = \frac{L \cdot 10^6}{2 \cdot L_s \cdot N_1 \cdot M \cdot H \cdot D}$$

E.g.1. A machine tool uses linear slides with the estimated life distance 45,000km. What is the life time by hour? Other conditions are as below,
1) Ls (the stroke length) is 3,000mm
2) N1 (the reciprocation) is 4 times per minute

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

E.g.2. A machine tool uses linear slides with the estimated life distance 71,231.5km. What is the life time by year? Other conditions are as below,
1) L_s (the stroke length) is 4,000mm
2) N_1 (the reciprocation) is 5 times per minute
3) The machine operated 60 minutes an hour,
4) 24 hours a day, and
5) 360 days a year

$$L_y = \frac{L \cdot 10^6}{2 \cdot L_s \cdot N_1 \cdot M \cdot H \cdot D} = \frac{70939 \cdot 10^6}{2 \cdot 4000 \cdot 5 \cdot 60 \cdot 24 \cdot 360}$$

2-11 Check Life Time Requirement

If the calculated life time does meet the lifetime requirement, return and start from the beginning steps:

1) Set the conditions, or
2) Select type and size

1) Check the conditions over again:

a. Assembly conditions (span, number of slides and number of rails):
Is it necessary to increase the span? the number of slides? the number of rails?
b. Mounting position (horizontal, vertical, tilt, wall hang or inverse):
Is it necessary to modify the construction?
c. Work load:
Can the load be reduced?
d. Work frequency:
Is it the estimated frequency too big and lead to underestimation of life time?

2) Select type and size:

If the conditions cannot be changed, then another type linear slide has to be selected. It is recommended to keep the size rails, and select a heavier type slide. Selecting a bigger rail will cause the drawbacks below,

a. The weight of the mechanism will get bigger:
The weight increases more when selecting a bigger rails than selecting a bigger slide.
b. Design changes more:
When a bigger rail is selected,
1. The screw hole span is bigger,
2. The screw size is bigger,
3. Contact with the base is bigger,
4. The securing mechanism has to be changed.
When a bigger slide is selected,
1. The screw hole position has to be changed,
2. The length of the slide will depend on the interference,
c. It will take bigger space:
When a bigger rail is selected, there will be the changes below,
1. The total height is increased,
2. The total width is increased,
3. The screw size is bigger,
When a bigger slide is selected, there will be very little change.
d. Design cost will be increased:
The variable cost of the rail is bigger than that of the slide.

2-12 Type Coding System

BGC H 25 BN - 2 - ☐ - L 500 - P - Z1 - II

Slide type:
BGX: non-caged
BGC: caged

Assembly height:
H: high assembly
S: low assembly
X: special assembly

Size:mm

Type and flange:
BN: no flange/standard
BS: no flange/short
BL: no flange/long
BE: no flange/extra long
FN: flange/standard
FS: flange/short
FL: flange/long
FE: flange/extra long

Number of slides

Dust protection category:
☐: bottom & end seals
UU: bottom seals
ZZ: with scrapper
DD: double seals
KK: double seals+ scrapper
SS: top+ bottom+ end seals
E-(SD):top+ bottom+ double seals
G-(GG):top+ bottom+ double seals+ scrapper

Screw hole type:
L: Counterbored
C: Tapped hole

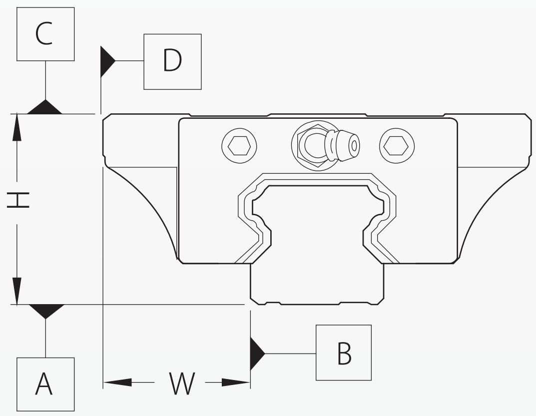
Preload type:
ZF: clearance
Z0: Zero preload
Z1: light preloaded
Z2: medium preloaded
Z3: heavy preloaded

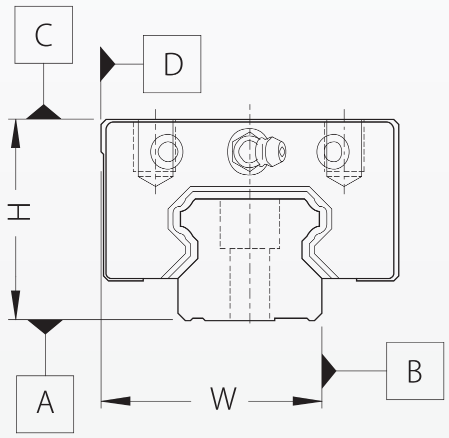
Accuracy Grade:
N: normal
H: high
P: precision
SP:super precision
UP:ultra precision

Rail length

2 rails in parallel

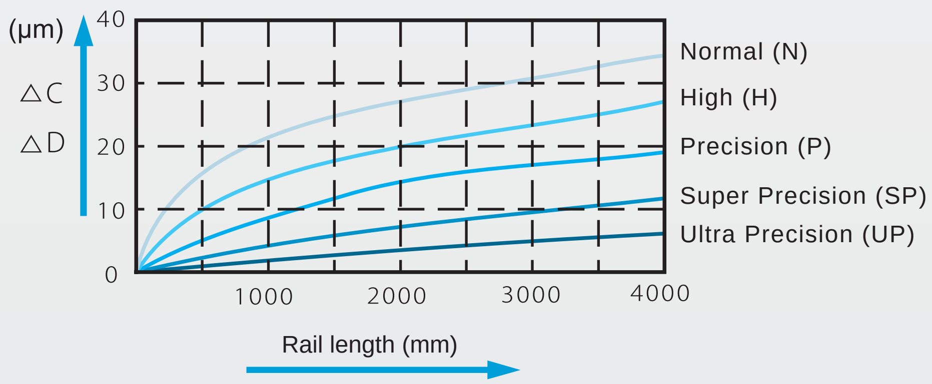
a. Accuracy Category





Unit: mm

Item \ Category	Normal (N)	High (H)	Precision (P)	Super Precision (SP)	Ultra Precision (UP)
Height tolerance (H)	±0.1	±0.04	0 -0.04	0 -0.02	0 -0.01
Width tolerance (W)	±0.1	±0.04	0 -0.04	0 -0.02	0 -0.01
Height difference (△H)	0.03	0.02	0.01	0.005	0.003
Width difference (△W)	0.03	0.02	0.01	0.005	0.003
Deviation of plane C vs. plane A	Please refer to △C in the diagram below for				
Deviation of plane D vs. plane B	Please refer to △D in the diagram below for				



BG accuracy vs. length

b. Preload Selection

What is preload?

When rigidity of a linear guide is not strong enough, clearance will exist in between the elements. Preload is the load preliminarily applied to the rolling elements to eliminate a clearance of a linear guide and to increase its rigidity.

Preload	Clearance/Zero Preload	Light Preload	Medium & Heavy Preload
Conditions	1. weak impact 2. 2 rails in pair 3. low accuracy 4. small resistance 5. small load	1. cantilever 2. single rail 3. light load 4. high accuracy	1. strong impact 2. strong vibration 3. heavy machining
Applications	1. welding machine 2. chopping machine 3. feeding mechanism 4. tool change mechanism 5. ordinary XY table 6. packing machine	1. NC lathe 2. EDM 3. precise XY table 4. ordinary Z-axis 5. industrial robot 6. PCB punching machine	1. machine tool 2. NC lathe and milling machine 3. feeding axis of grinder 4. tool feeding axis

Increase of preload will eliminate the vibration and the inertia impact in a reciprocating mechanism. However, increase of preload will increase the internal load and increase the assembly difficulty. Therefore, selection of linear guide must bring into account the preload and balance between the impact of vibration and of preload to life.

Preload

C: dynamic load rating

Category	Code	Preload
Clearance Free	ZF	0
Zero preload	Z0	0
Light preloaded	Z1	0.02C
Medium preloaded	Z2	0.05C
Heavy preloaded	Z3	0.07C

*In case of even higher preload,please contact STAF/OME representative.

Radial clearance

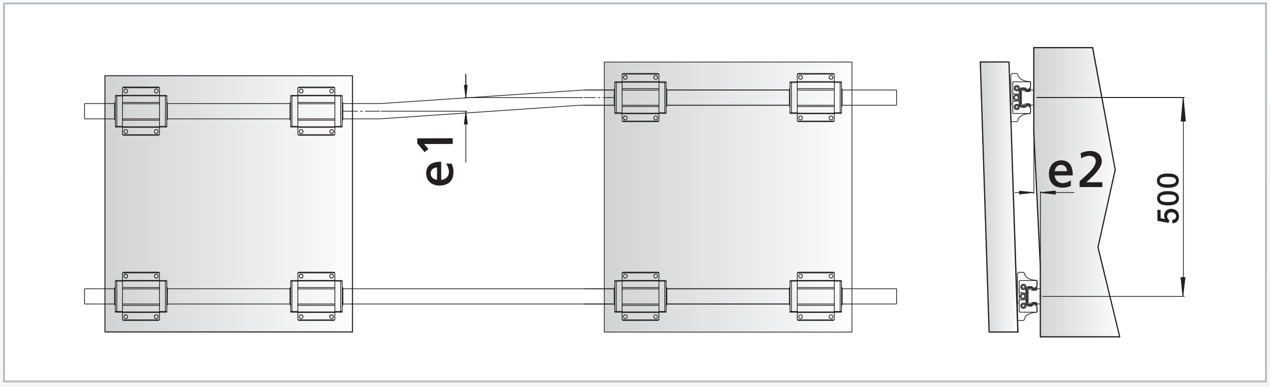
Unit: μm

Preload / Type	ZF	Z0	Z1	Z2	Z3
BG 15	4 ~ 8	-3 ~ 3	4 ~ 8	-13 ~ -9	-18 ~ -14
BG 20	4 ~ 8	-3 ~ 3	4 ~ 8	-14 ~ -9	-19 ~ -14
BG 25	5 ~ 10	-4 ~ 4	5 ~ 10	-17 ~ -11	-23 ~ -18
BG 30	5 ~ 11	-4 ~ 4	5 ~ 11	-18 ~ -12	-25 ~ -19
BG 35	6 ~ 12	-5 ~ 5	6 ~ 12	-20 ~ -13	-27 ~ -20
BG 45	7 ~ 15	-6 ~ 6	7 ~ 15	-23 ~ -15	-32 ~ -24
BG 55	8 ~ 19	-7 ~ 7	8 ~ 19	-29 ~ -20	-38 ~ -30

Interchangeable or non-interchangeable

Accuracy Category	Non-interchangeable (by order)					Interchangeable (stock)	
	UP	SP	P	H	N	H	N
Preload					ZF		
			Z0	Z0	Z0	Z0	Z0
	Z1	Z1	Z1	Z1	Z1	Z1	Z1
	Z2	Z2	Z2	Z2	Z2		
	Z3	Z3	Z3				

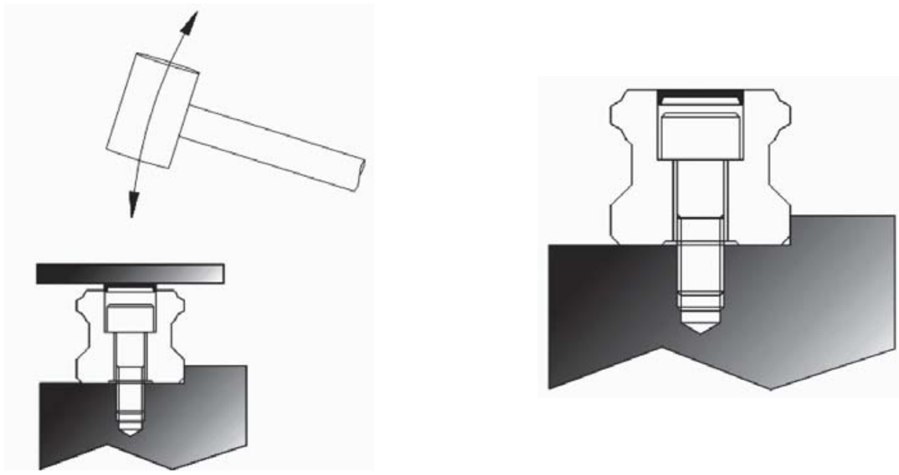
Recommended Mounting Surface Accuracy:



Unit: μm

Type	Allowance of Parallel Deviation (e1)					Allowance of Level Difference (e2)				
	Z3	Z2	Z1	Z0	ZF	Z3	Z2	Z1	Z0	ZF
BG 15			18	25	35			85	130	190
BG 20		18	20	25	35		50	85	130	190
BG 25	15	20	22	30	42	60	70	85	130	195
BG 30	20	27	30	40	55	80	90	110	170	250
BG 35	22	30	35	50	68	100	120	150	210	290
BG 45	25	35	40	60	85	100	140	170	250	350
BG 55	30	45	50	70	95	125	170	210	300	420

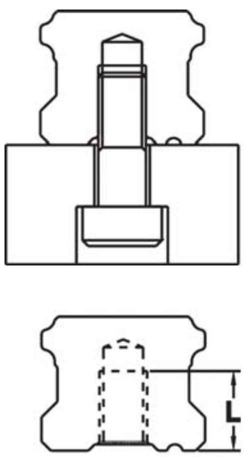
c. Rail Dust Protection



Rail Contamination:
Chips and foreign objects pile up easily in the screw holes that could damage the linear slides. Objects that gets into slide can block the internal circulation and shorten the life of the rails.

Rail Cap:
Most chips and foreign objects that fall on the rails can be wiped away by the seals. Only few will fall into the screw holes and get piled up. The purpose of the rail caps is to block the objects from falling into the screw holes. These caps can be easily mounted with a plastic mallet aligned with hole after the rail is secured.

Tapped Hole Rails:
The tapped hole rails are secured differently from the conventional rails. Since there is no through screw holes, dust and chips simply cannot pile up.

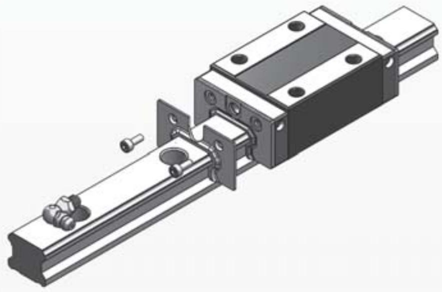


Rail Type	Thread Size	Max Thread Length (L)
BG 15	M5	8mm
BG 20	M6	10 mm
BG 25	M6	12 mm
BG 30	M8	15 mm
BG 35	M8	17 mm
BG 45	M12	20mm
BG 55	M14	24 mm

d. Accessories

Scrapper:

It is good for removing chips or splashes and is recommendable for cutting machines or flame cutters. It protects the end dust proof caps from the chips and splashes and maintains the functionin extreme ambient.

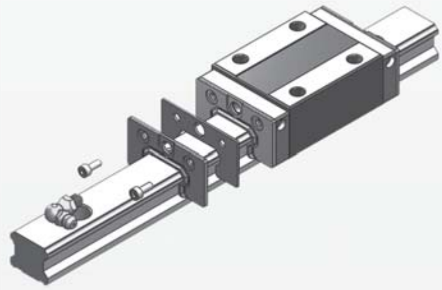


Double end seal:

2 end seals mounted together:

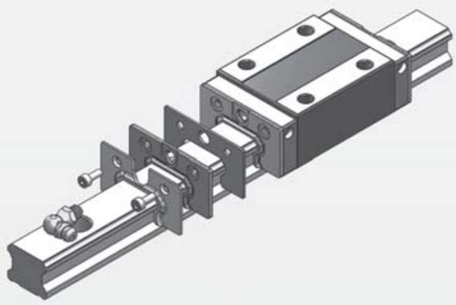
1.The outer cap wipes away most unwanted particles.

2.The inner cap expels the particles not captured by the outer cap.



Scrapper + double end seal:

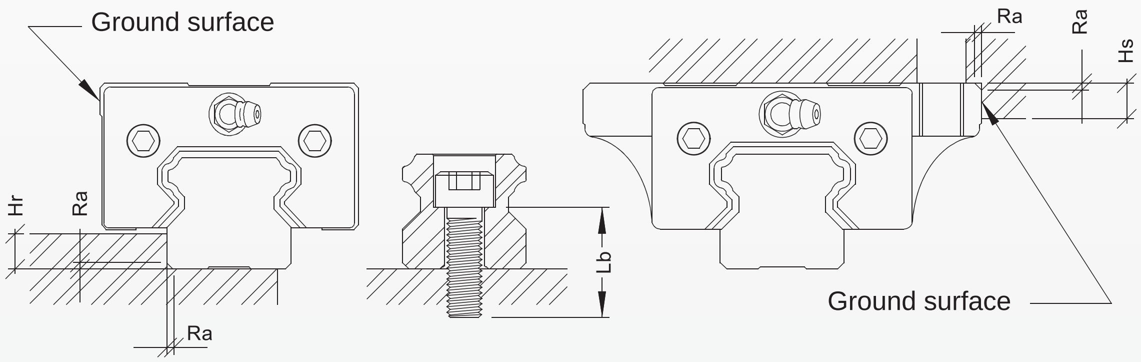
This combination gives both features of the above 2 constructions.



Seal Type	End Seal	Bottom Seal	Top Seal	Double Seal	Scrapper
Not defined	v	v			
UU	v				
ZZ	v	v			v
DD		v		v	
KK		v		v	v
SS	v	v	v		
SD		v	v	v	
GG		v	v	v	v

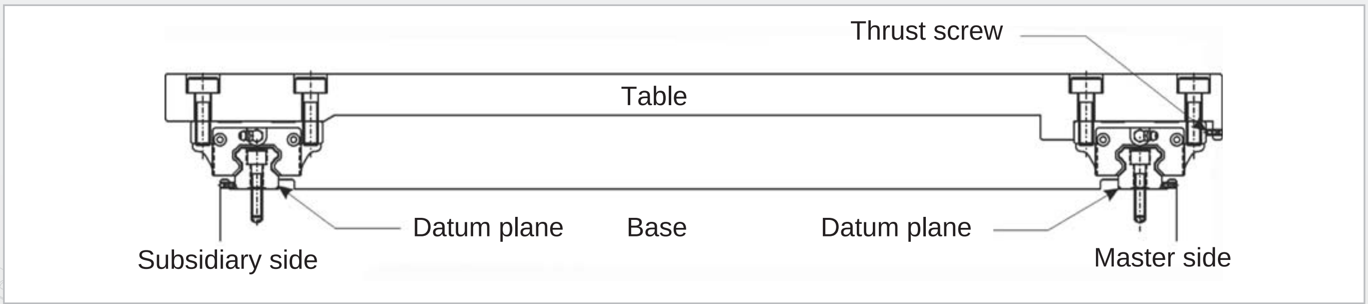
C. How to Mount the Rails

3-1 Mounting Design Concept



Type	Biggest corner radiu of rail side (Ra)	Clear height for rail (Hr)	Clear Height for slide (Hs)	Suggested thread length (Lb)
BG 15	0.6	3.1	5	M4x16
BG 20	0.9	4.3	6	M5x20
BG 25	1.1	5.6	7	M6x25
BG 30	1.4	6.8	8	M8x30
BG 35	1.4	7.3	9	M8x30
BG 45	1.6	8.7	12	M12x35
BG 55	1.6	11.8	17	M14x35

Linear Guide Assembly Steps



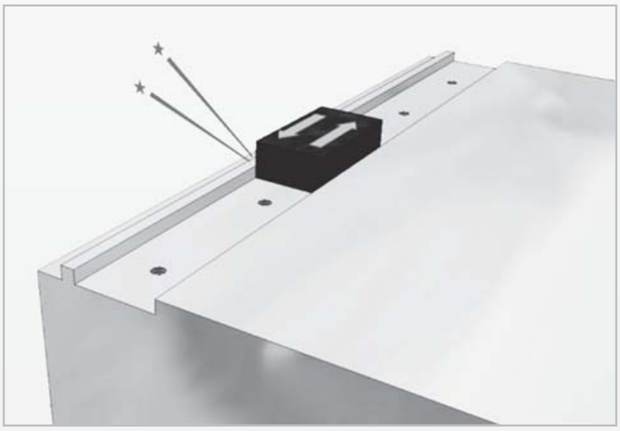
Above figure shows a typical example for rail mounting with the features below,
1. There are 2 datum planes on the base.
2. There is a crosswise datum plane aligned by a thrust screw.
3. The table thrust screw is at the master side.

3-2 Mounting Steps

Step 1:

Clean up all the burrs, contamination objects and marks before mounting.

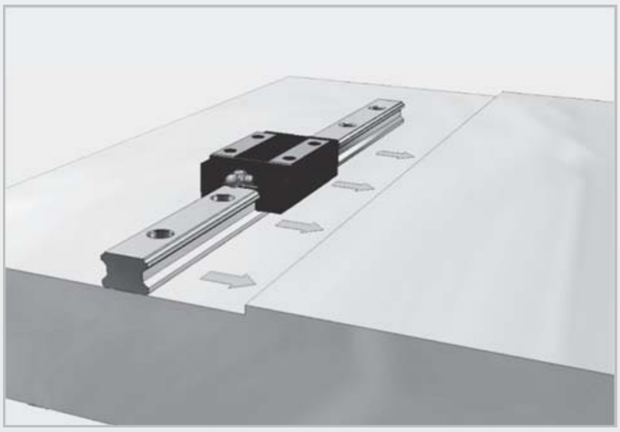
Note: Datum plane is normally covered with antirust. Clean the antirust with detergent beforehand. It is recommended to spray some low viscosity lubricant to protect the datum plane.



Step 2:

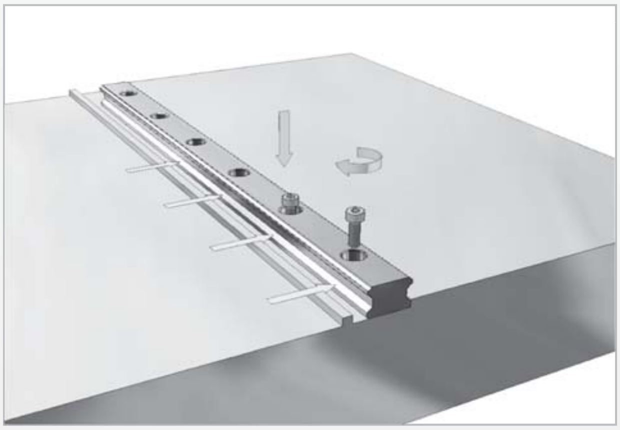
Place the rail gently on the base and secure it with the thrust screw or other fixtures so that it contacts the datum plane nicely.

Note: Check the alignment of the screw holes before securing. Forcing to secure the rail to unaligned screw holes will affect the accuracy and quality due over offset.



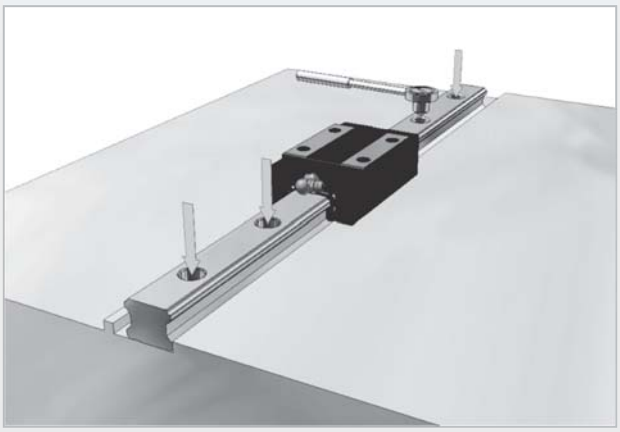
Step 3:

Attach the screws to screw holes in the sequence from centre to both ends. Push the rail gently against the datum plane. Fasten the screws in the sequence from centre to both ends slightly harder to make the rail more stable. Push the rail harder against the datum line to enhance the contact.



Step 4:

Secure the screws with a torque wrench with the appropriate torque selected according to based material.

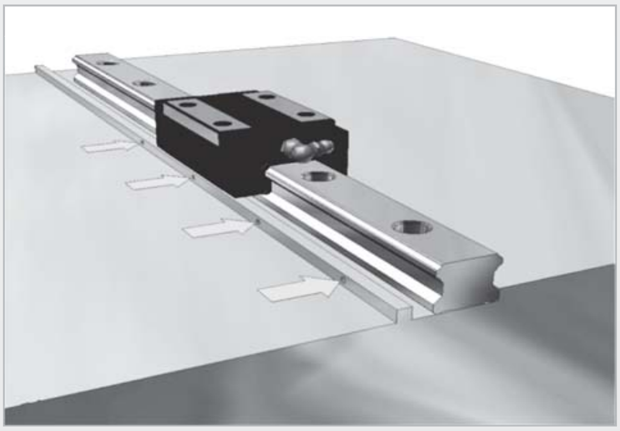


Recommended rail screw fastening torque

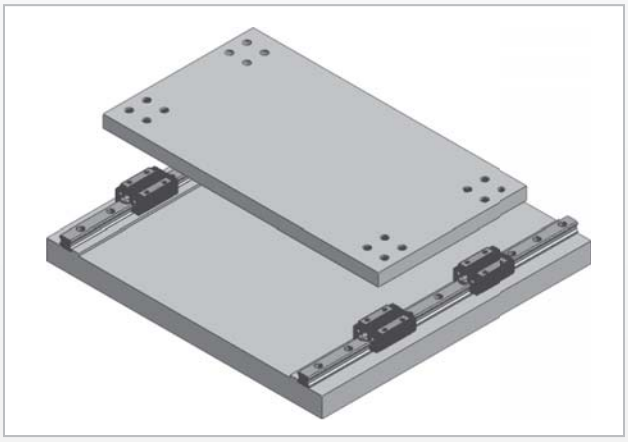
Screw size	Fastening torque (kgf-cm)		
	Steel	Cast Iron	Aluminum alloy
M 2	6.3	4.2	3.1
M 2.3	8.4	5.7	4.2
M 2.6	12.6	8.4	6.3
M 3	21	13.6	10.5
M 4	44.1	29.3	22
M 5	94.5	63	47.2
M 6	146.7	98.6	73.5
M 8	325.7	215.3	157.5
M 10	724.2	483.2	356.7
M 12	1264.2	840	630
M 14	1682.1	1125	840
M 16	2100	1403.5	1050

Step 5:

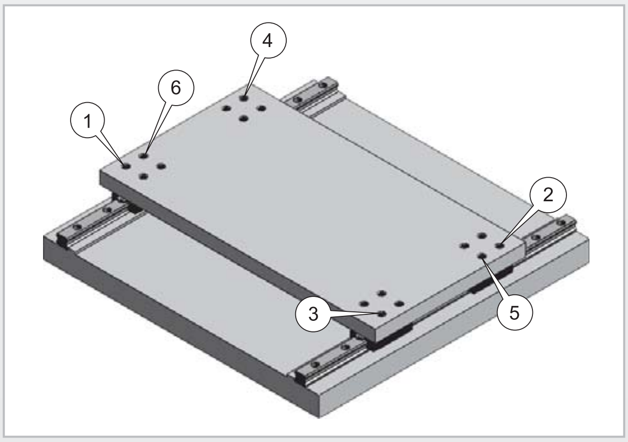
Mount the subsidiary rail with the same steps foresaid, and then mount the slides onto the rails individually. Pay attention to assemble all the accessories, such as grease fitting, oil fitting and seals in this stage otherwise it will be difficult to assemble the assemblies afterwards due to limited space.



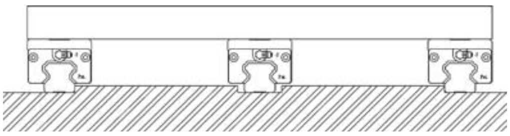
Step 6:
Place the table gently on the slides on both master and subsidiary rails.

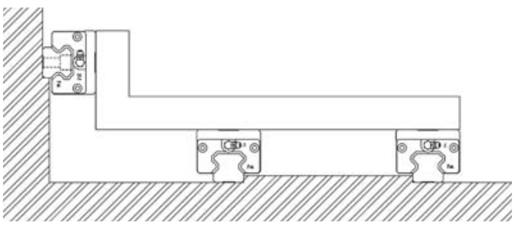


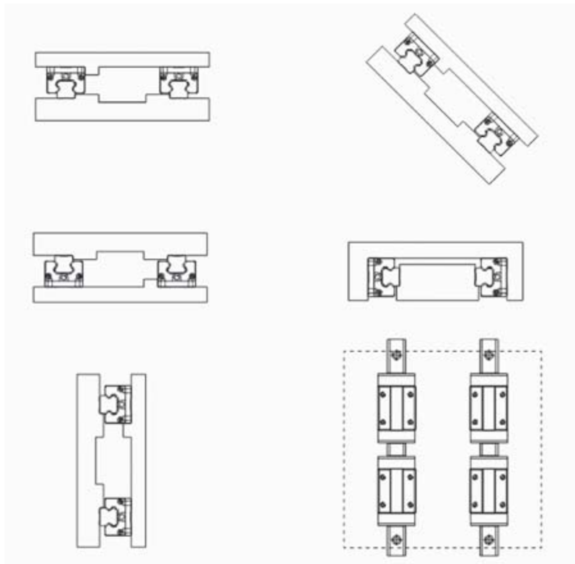
Step 7:
Fasten the crosswise thrust screw to secure the table. Fasten the table screws with the sequence demonstrated in the figure.

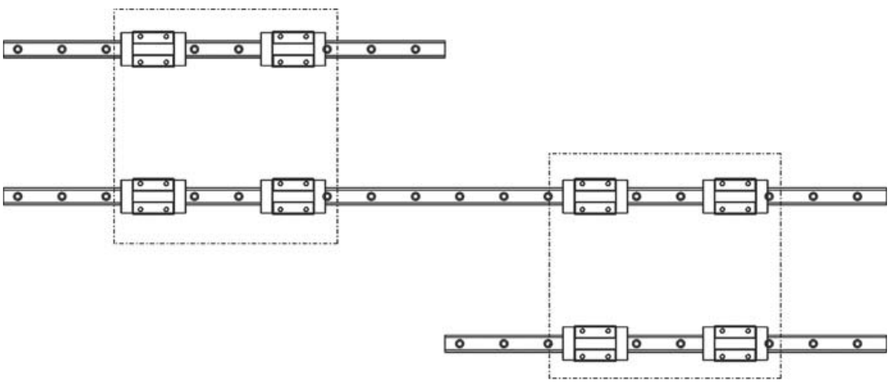


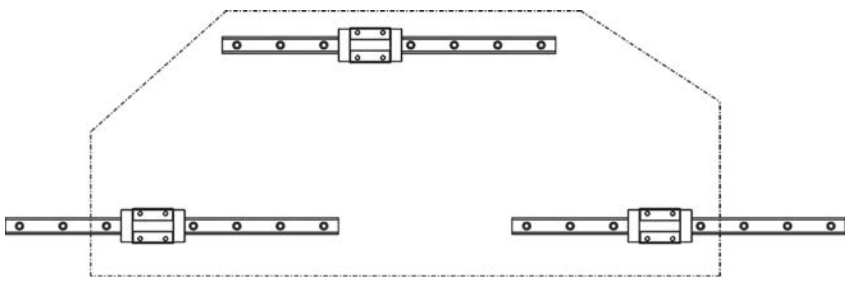
3-3 Common Mounting Styles



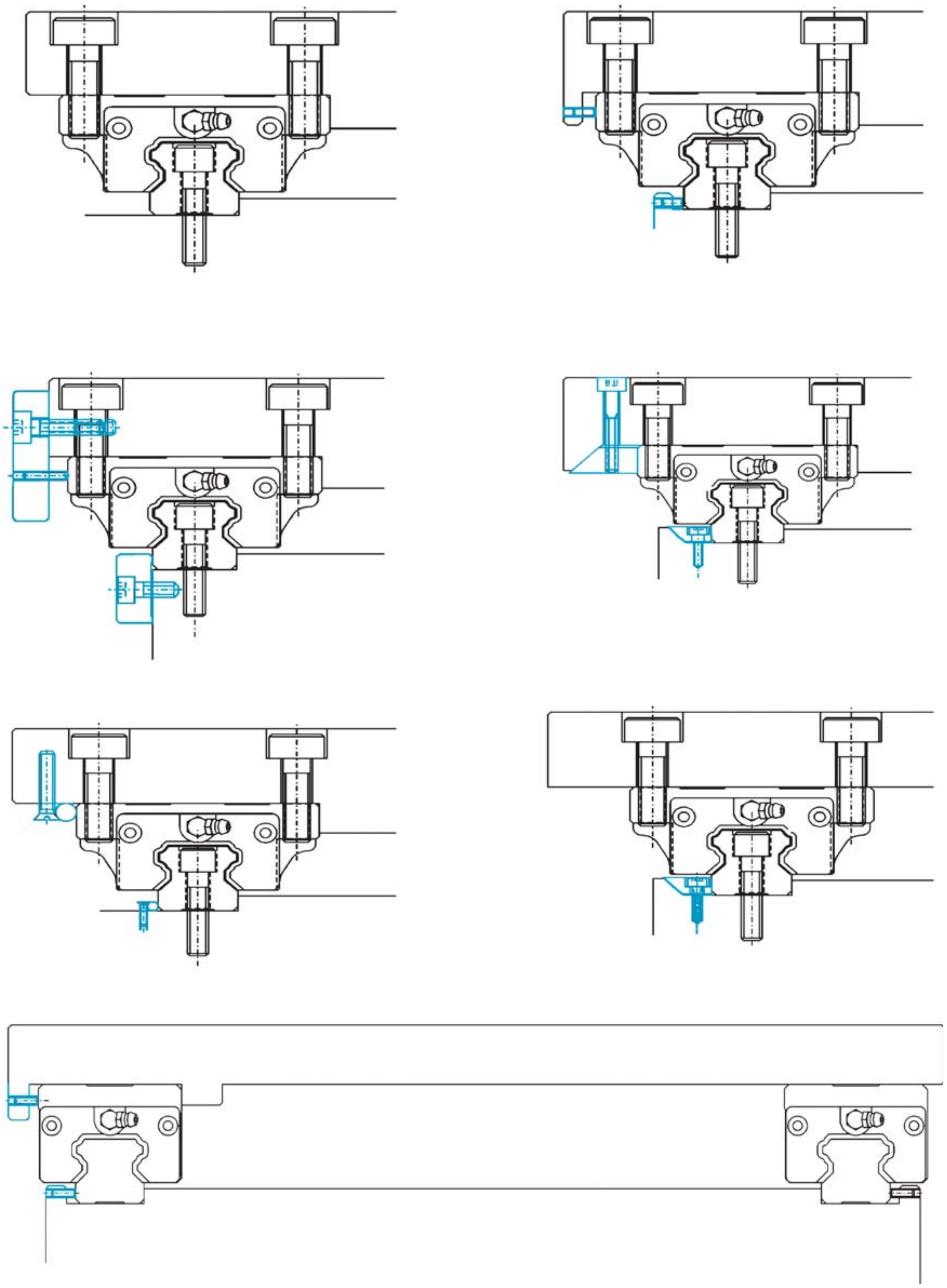




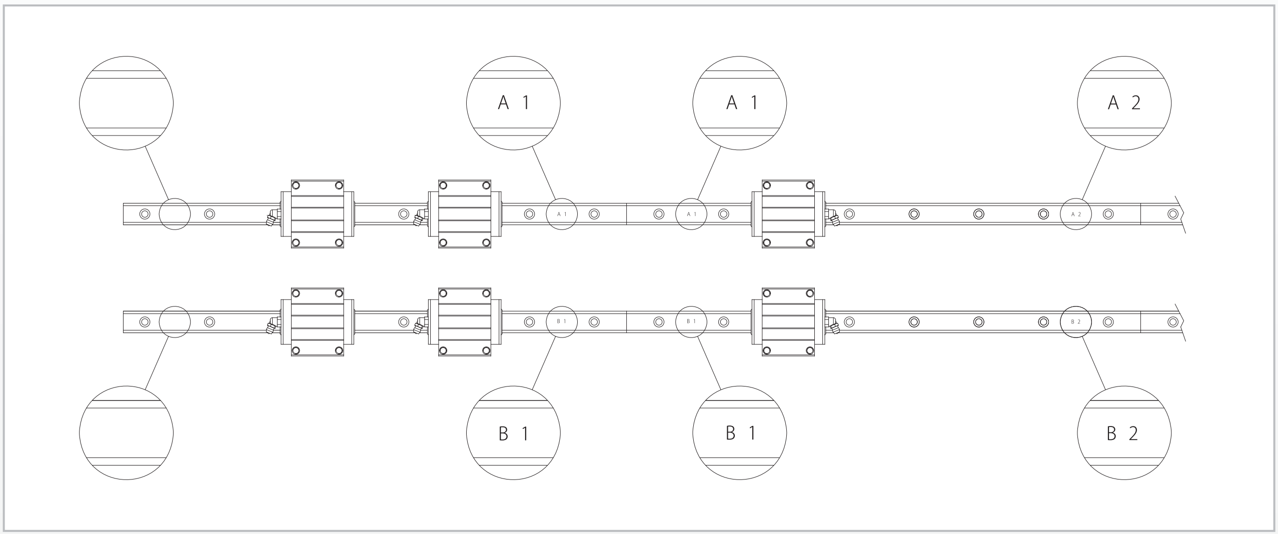




3-4 Common Securing Styles



3-5 Use of Butt- Jointed Rail



When a long rail is ordered, two or more rails can be butt- jointed to the desired length. When jointing rails, be sure to match the marked positions correctly as the above figure. When two or more linear guides with jointed rails are to be arranged parallel to each other, these linear guides will be numbered as the table below:

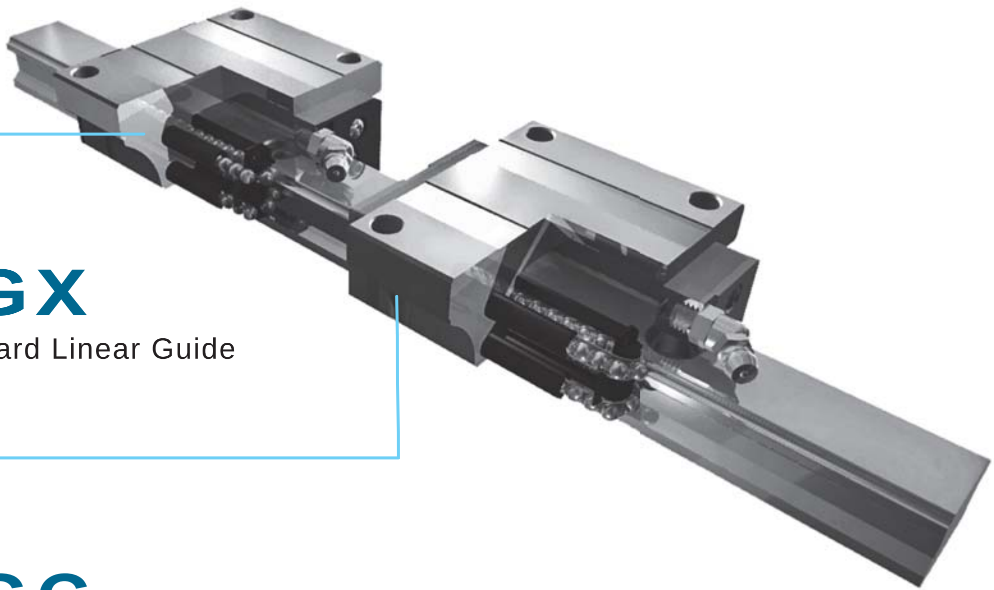
	Jointed rail #1		Jointed rail #2		Jointed rail #3		…		Jointed rail #N	
Parallel axis #01	No mark	A1	A1	A2	A2	A3	A3	…	AN	No mark
Parallel axis #02	No mark	B1	B1	B2	B2	B3	B3	…	BN	No mark
…	⋮		⋮		⋮		⋮		⋮	
Parallel axis #26	No mark	Z1	Z1	Z2	Z2	Z3	Z3	…	ZN	No mark

3-6 Lubrication Volume

Slide No.		Slide Type	Lubrication Grease		Lubrication Oil	
			Initial lubrication (ml)	Regular lubrication (ml)	Initial lubrication (ml)	Hourly lubrication(ml/ hr)
BG-15	N	BN,FN	0.9	0.4	0.2	0.1
	S	BS	0.7	0.3	0.2	0.1
	L	BL,FL	1.0	0.5	0.2	0.1
BC-20	N	BN,FN	1.5	0.8	0.4	0.2
	S	BS	1.1	0.6	0.3	0.1
	L	BL,FL	1.8	0.9	0.4	0.2
BG-25	N	BN,FN	2.3	1.2	0.5	0.2
	S	BS	1.6	0.8	0.4	0.1
	L	BL,FL	2.6	1.4	0.6	0.2
	E	BE,FE	3.1	1.7	0.7	0.3
BG-30	N	BN,FN	3.7	2.0	0.9	0.2
	S	BS	2.8	1.4	0.7	0.2
	L	BL,FL	4.0	2.2	1.0	0.3
	E	BE,FE	5.0	2.8	1.2	0.3
BG-35	N	BN,FN	5.7	3.1	1.4	0.3
	S	BS	3.9	2.0	0.9	0.2
	L	BL,FL	6.3	3.5	1.5	0.3
	E	BE,FE	7.5	4.1	1.8	0.4
BG-45	N	BN,FN	7.0	4.0	2.0	0.5
	L	BL,FL	9.0	4.5	2.3	0.5
	E	BE,FE	10.0	5.0	2.8	0.6
BG-55	N	BN,FN	13.0	6.0	3.5	0.6
	L	BL,FL	17.0	8.0	4.5	0.6
	E	BE,FE	19.0	9.0	5.5	0.7
Remark			Above figures are suggested volumes for initial and regular lubrication. It is recommended to re-lubricate every 100KM.		Above figures are suggested volumes for initial and regular lubrication. It is recommended to re-lubricate every hour.	
			Notice →			
			When travel distance is less than twice slide length, it is suggested to put fittings at both ends. When travel distance is less slide length, it is suggested to move the slide back and forth over twice slide length in addition to putting fittings at both ends to ensure lubrication of the entire circulation loop.			

STAF LINEAR GUIDE

BG SERIES



BGX

Standard Linear Guide

BGC

Caged Linear Guide

BGX

Standard Type

Standard type
without flange

Standard type
with flange

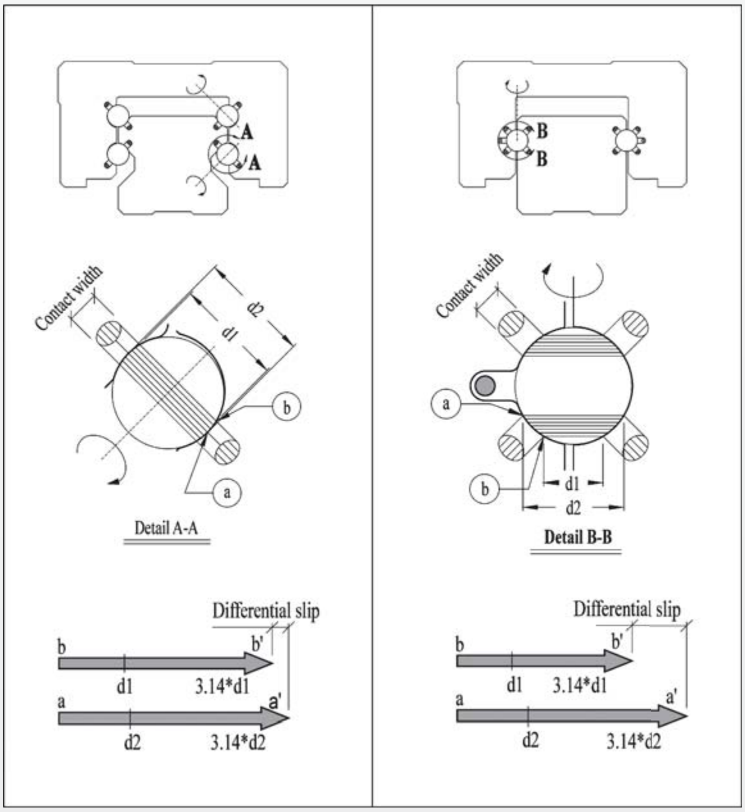
4-1 BGX Conventional Linear Guides

a. BGX 4-Groove Even Load Design

The 4 rows of steel balls forms 45° contact with the grooves at 4 positions will balance the loads from all direction. This design that permits even load capacity in all directions no matter how the rails are mounted is widely adopted in all types of machines. Compared with the 2-groove Gothic design, the 4-groove construction is of better rigidity, accuracy and life. In particular, the auto-adjust capability allows quick accurate linear motions by eliminating the deviation of the mounting plane and the assembly errors.

Comparison table of 4-groove vs. 2-groove

4-groove even load system | 2-groove Gothic system



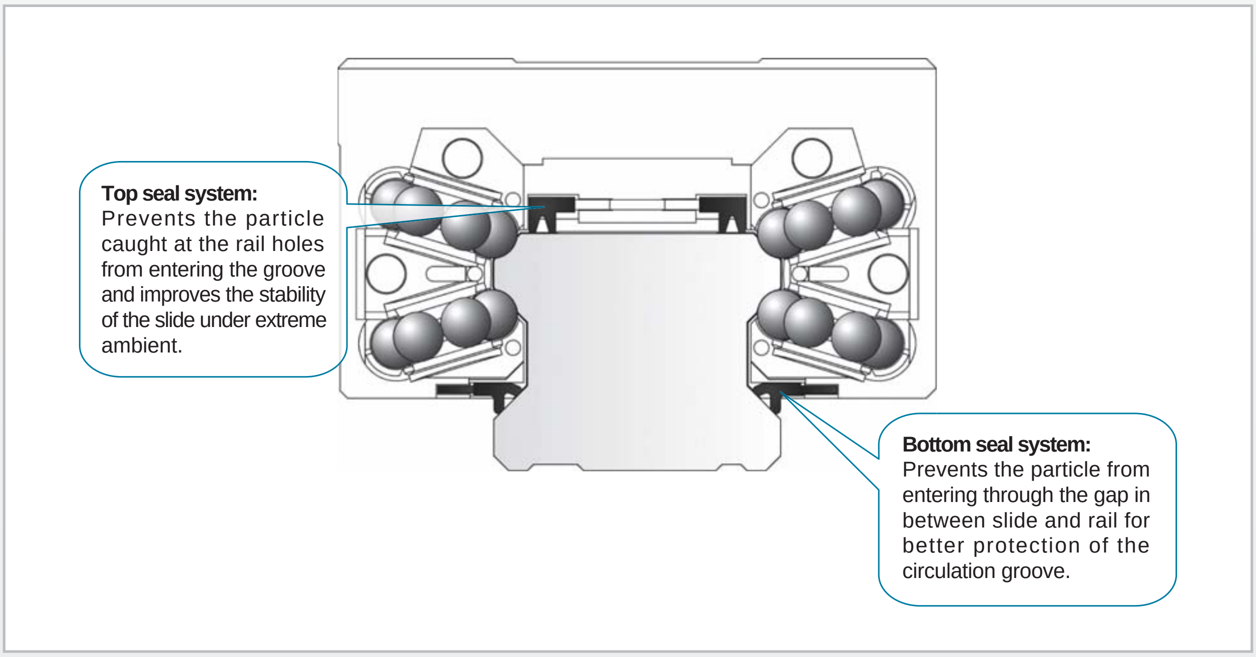
The advantages are:
1. Quick light movements
2. Lower friction
3. Bigger load ratings
4. Higher stability

b. BGX Seal Design

Incursion of foreign objects is normally the major reason of life shortening for rails because the accuracy of linear guides relies very much on circulation of the steel ball between the slide and the rail. Even the incursion of smallest objects can cause skipping and bumping of the slide and lead to permanent damage. Therefore, seal design is the key to linear slide quality. The seal design in BGX linear guides is divided into top and bottom seal systems aiming at the incursion passage of the foreign objects.

Passages of particle incursion:

1. Screw holes: The particles caught at the rail holes get into the circulation groove via vibration cause by machine movements.
2. Gap in between the slide and the rail: This is the closest incursion passage and is normally the passage for bigger particle particularly for the longer rails.

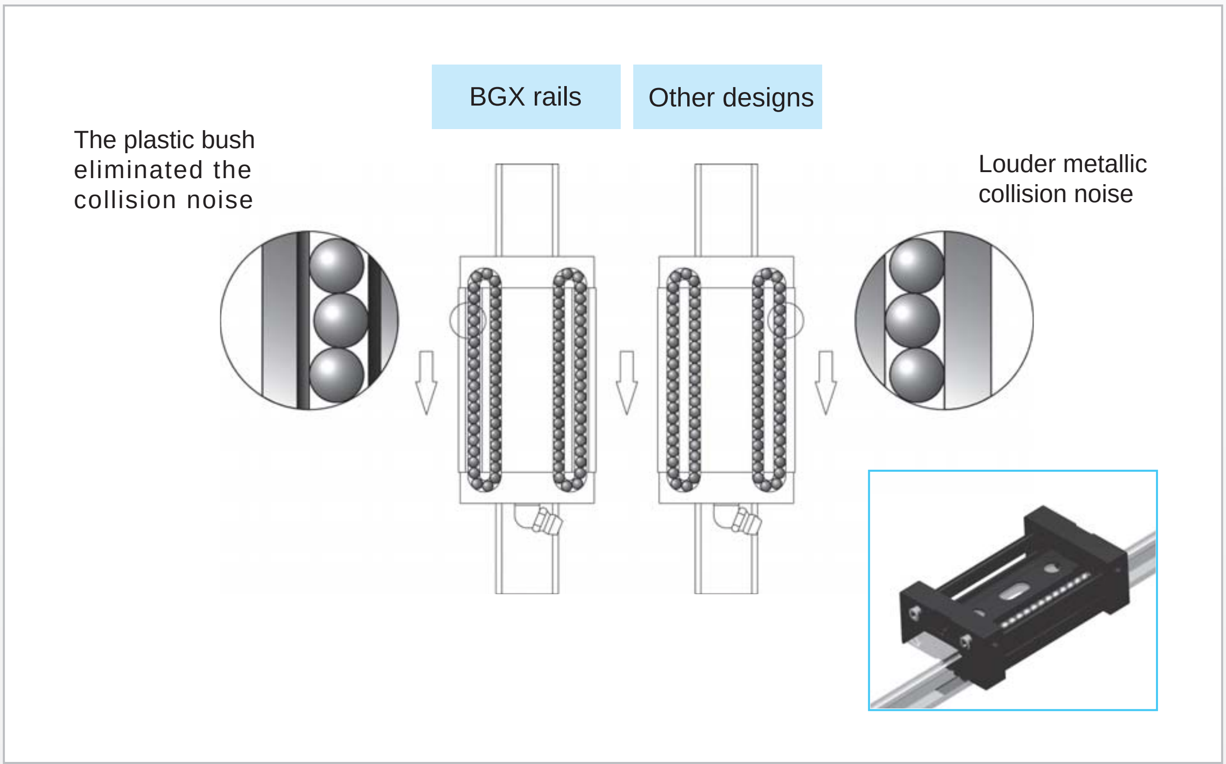


Top seal system:
Prevents the particle caught at the rail holes from entering the groove by covering it with a rubber wiper and protects the upper-row steel balls.

Bottom seal system:
The bottom seal system block the passage between slide and rail with the rubber wiper to secure smooth circulation of the steel balls.

c. BGX Tubular Muffling System

High polymer tube eliminated the collision of steel balls when the slide moves in high speed



The high polymer bush in BGX linear guide improves the lubrication.

Advantages:

1. The slide moves quieter

BGX linear guide use high polymer bush to isolate the circulating steel balls and eliminate the chances of unpleasant noises.

2. Better lubrication

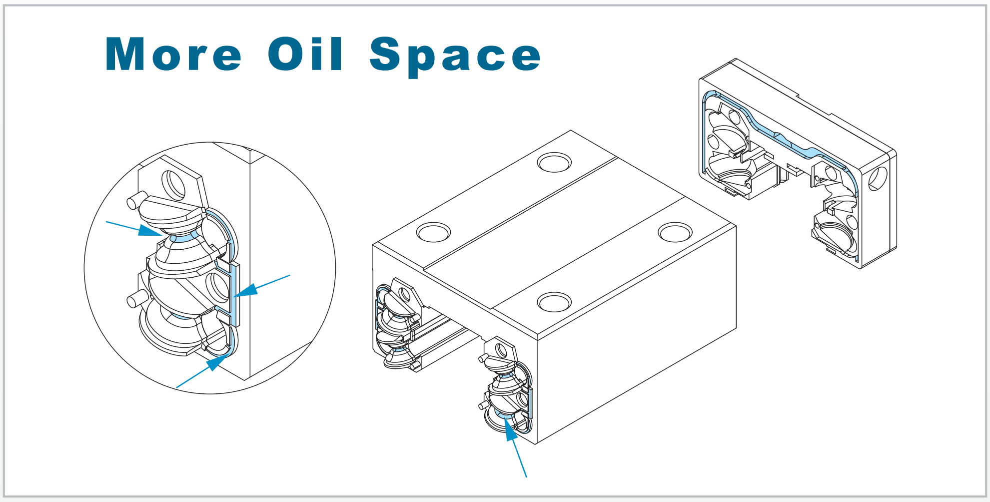
The high polymer bush in BGX linear guide improves the lubrication.

3. Uniform life time

BGX circulation bush guarantees the expected life time of the linear slide for the facts below,

1. No noise of steel ball collision against the metallic tube as the conventional linear slides.
2. Lubrication is better compared to the conventional linear slides.
3. Less friction between the steel balls and the tube in high speed.

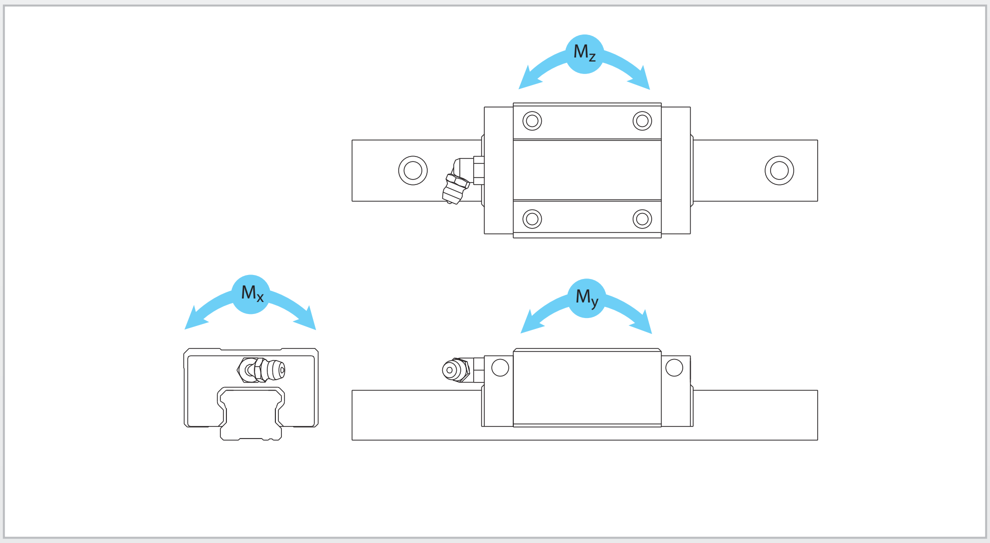
d. BGX Oil Retaining in Circulation System



BGX circulation system reserves a lot of space for retaining oil and is able to keeps a lot more oil. When linear slide moves, the oil inside spreads all over and prolongs the life of the construction due to the inertia. When the slide rests, the lubrication oil will return to the oil retainer in the circulation system without escaping.

e. BGX Permissible Moment

Loads calculation for linear guides differs between single-rail and dual-rail. In the single-rail system, calculating the load must consider the moment given by external force in 3 dimensions, and must calculate the equivalent load permissible moment.



BGC

Caged Type

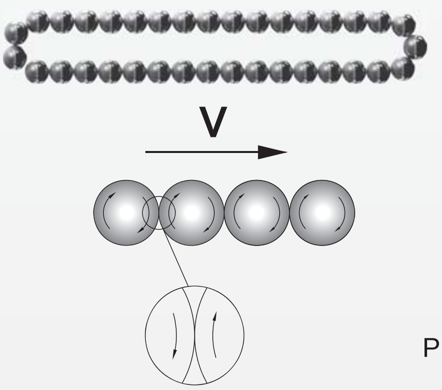
Caged type
without flange

Caged type
with flange

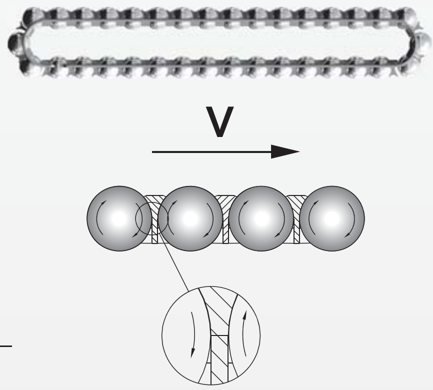
4-2 BGC Caged Liner Guides

a. BGC for High Speed Application

The steel balls rotate between the slide and the rail against each other in the conventional linear guides. Relative speed at the ball contact is 2 times the rotational speed. In addition, since the contact area is extremely small, the pressure is infinite (Please refer to the formula below). This is the major reason of steel ball wearing in conventional linear slides. In BGC linear slides, oil film is retained in between the balls to absorb friction and so is more ideal for high speed.



$$P = \frac{F}{A}$$



P: Contact pressure between neighboring steel balls

F: Interactive force between neighboring steel balls

A: Contact area of neighboring steel balls

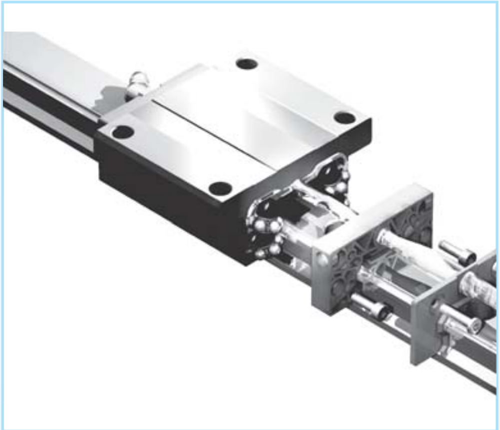
Upper left figure:
The steel balls rotate against each other in the conventional linear guides at the relative speed 2 times the rotational speed and the pressure is infinite because the contact area is extremely small.

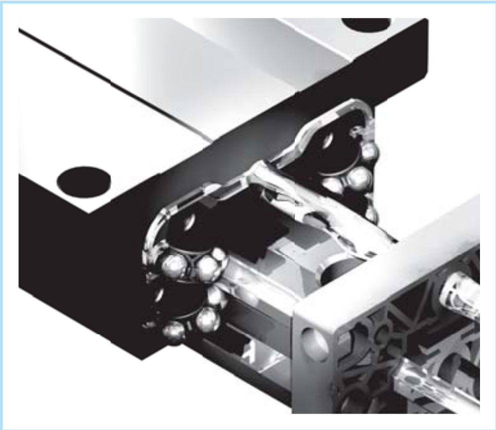
Upper right figure:
In BGC linear guides, the retainer between the steel ball holds the oil and forms the oil film. Friction is absorbed by the oil film. The retainer allows the slide to move in high speed.

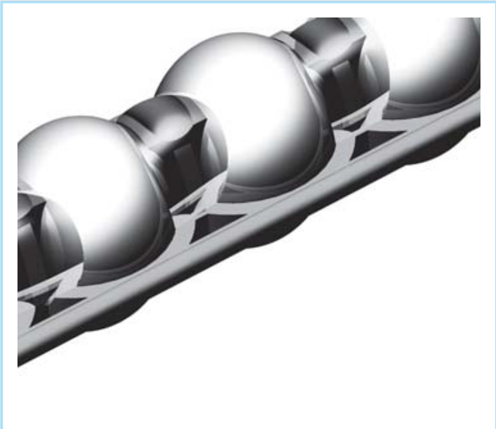
In the BGC linear guides the steel balls are isolated by the oil film. Instead of contacting directly with relative speed twice as the rotational speed as in the conventional linear guides. Hence, the contact pressure of the conventional linear guides is a lot bigger than of the BGC linear guides. In conclusion, contact pressure and relative speed of BGC linear guides is far less than of the conventional ones and so the heat generated is less in the BGC linear guides.

b. BGC Lubrication by Retainer Circulation

The lubrication oil injected from the fittings can be enhanced with the retainer circulation in the BGC linear guides. BGC linear guides surely have a longer life than the conventional, and even other caged type linear guides.







As shown in the figures above, the oil film stays in the steel balls and the retainers. The unique retainer design in the BGC linear guides contains plenty of room to retain the oil. The retainer brings the oil to the circulation surface as it circulates. The retainer even keeps the oil better than the conventional linear guide in rest.

In conventional linear guides, the steel balls contact directly with one another. Therefore, the lubrication flows away easily. Loss of lubrication oil will result in wearing, noise and heating. BGC linear guides provide an overall solution that can improve the performance and life.

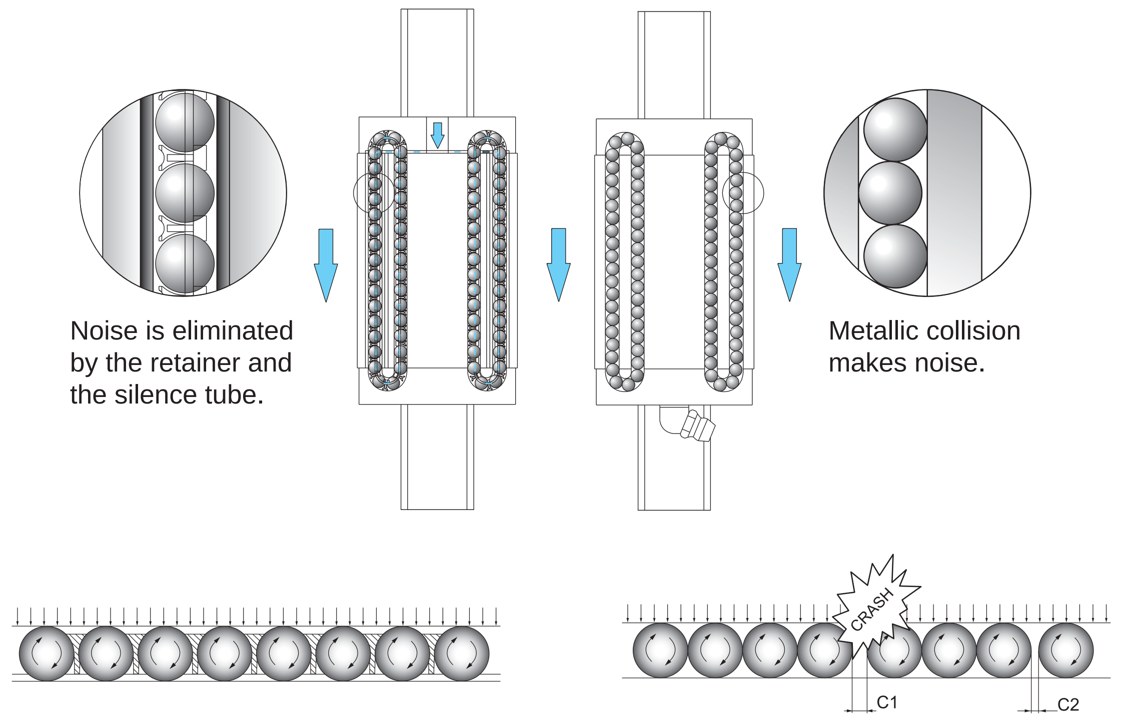
c. BGC Linear Guides Are Less Noisy

The conventional linear guides are noisier because:

1. Relative speed at steel ball contact is twice of that in BGC linear guides.
2. The contact area is extremely small therefore the contact pressure is far larger than that in the BGC linear guides.

Main causes of noises:

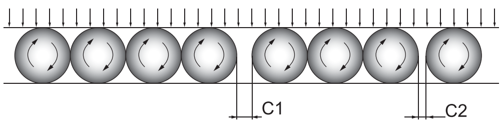
In the conventional linear guides, the steel ball collides with one another and gives sharp noises. In the BGC linear guides, noises are mostly absorbed by the oil film created by the retainer, therefore the noise is far milder than the conventional ones.



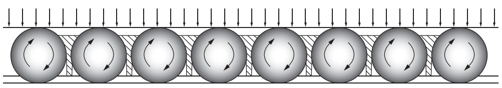
When the steel balls travels in different speeds, the steel balls will catch up the steel ball ahead. In the conventional linear guides, collision happens and creates loud noises. The high polymer retainer in BGC linear guides separates the steel balls and carries oil film. Most of the collisions are absorbed by the elasticity of the retainer and the oil film and so the noises due to collision are suppressed.

d. More Evenly Distributed Load in BGC Linear Guides:

The steel balls in conventional linear guides are not evenly arranged and the clearances between steel balls are not even. Hence the loads on individual steel balls are not even.



As shown in the figure above, steel ball are randomly distributed in the conventional linear guides and unevenly loaded.



As shown in the figure above, steel ball are randomly distributed in the conventional linear guides and unevenly loaded.

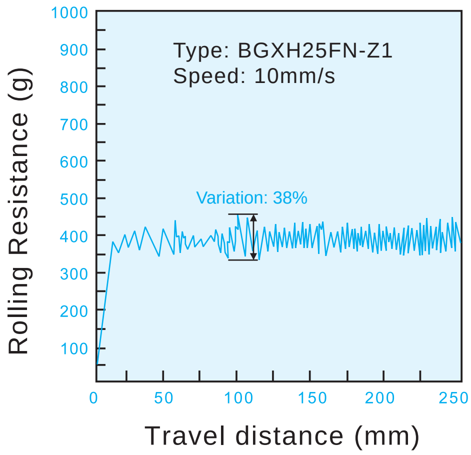
This extra steel ball makes the performance more smooth.

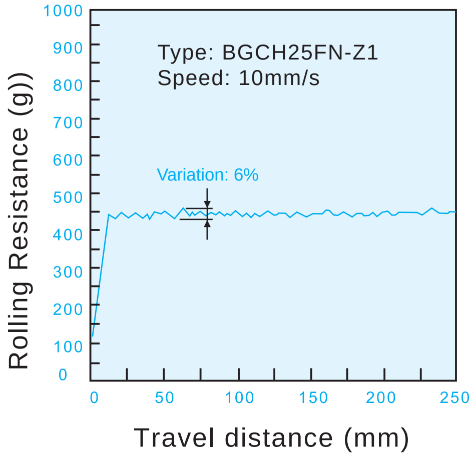
e. BGC Full Retainer Pack

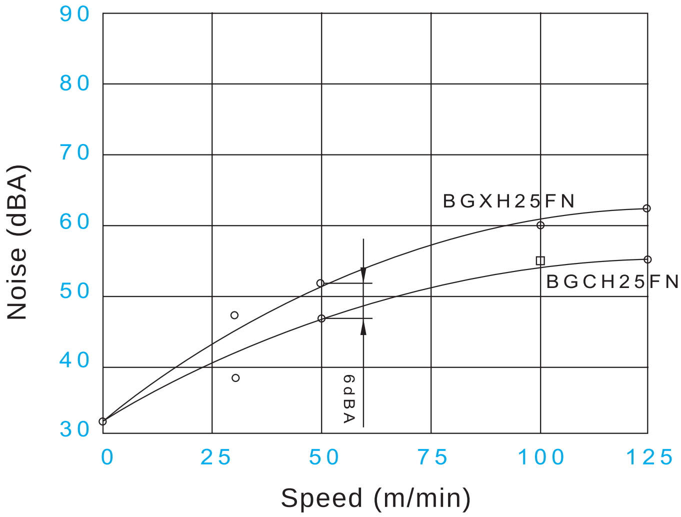
In most designs of linear guides with steel ball spacers, gaps of half to full size of steel balls are often found due to unfilled circulation loop. BGC linear guides provide a solution that fills this gap to arrange the steel balls tightly and distribute the load evenly which results in a uniform life.

Low Noise	Low Vibration

1/6～1/10 Vibration Amplitude in Caged Type Linear Guides



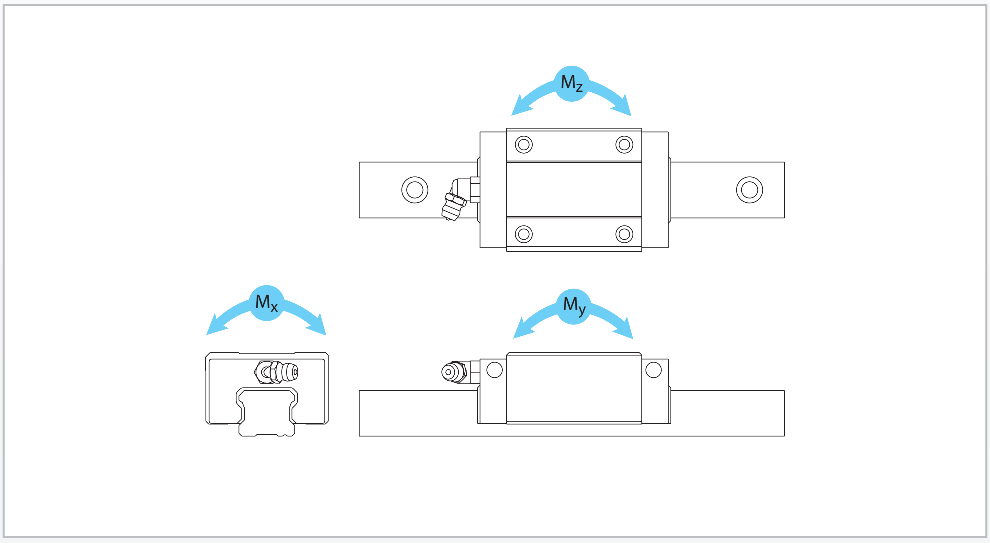




f. BGC vs. Conventional Linear Guides

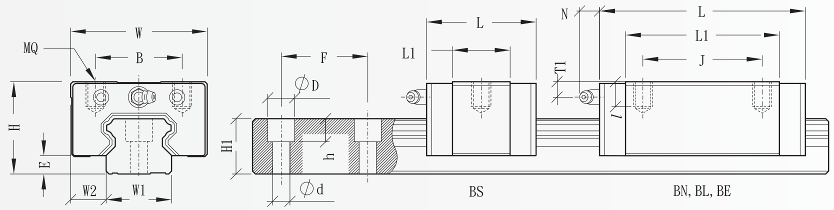
	BGC Linear Guides	Conventional Linear Guides
High Speed	Applicable	Not Applicable
Maintenance	Oil film easy to maintain	Oil film not easy to maintain
Noise	Less Noisy	Noisy
Heating	Low	High
Load	Even	Uneven

g. BGC Permissible Moment



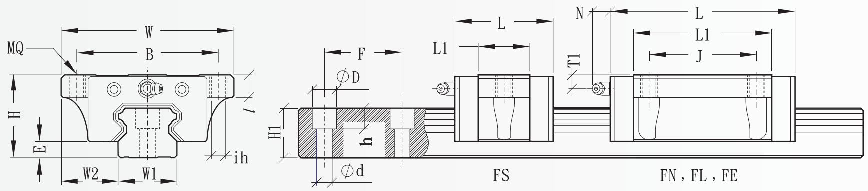
Loads calculation for linear guides differs between single-rail and dual-rail. In the single-rail system, calculating the load must consider the moment given by external force in 3 dimensions, and must calculate the equivalent load permissible moment.

BGX/BGC Specification Table (S-B)



Model	Assembly-mm				Block-mm									Rail-mm						Rating load-kN			Static moment - kN-m			Block	Rail
	H	W	W2	E	L	B	J	MQ	l	L1	Oil H	T1	N	W1	H1	F	d	D	h	C-BGX	C-BGC	C0	M_X	M_Y	M_Z	kg	kg/m
S15BS	24	34	9.5	3.3	40.6	26		M4	4.8	22.2	M4X0.7	5.5	(5)	15	13.0	60	4.5	7.5	6.0	4.6	5.7	9.8	0.068	0.032	0.032	0.10	1.28
S15BN	24	34	9.5	3.3	58.6	26	26	M4	4.8	40.2	M4X0.7	5.5	(5)	15	13.0	60	4.5	7.5	6.0	9.3	11.5	19.6	0.136	0.117	0.117	0.17	1.28
S15BL	24	34	9.5	3.3	66.1	26	26	M4	4.8	47.7	M4X0.7	5.5	(5)	15	13.0	60	4.5	7.5	6.0	11.3	13.9	23.7	0.164	0.169	0.169	0.18	1.28
S15BE	24	34	9.5	3.3	81.1	26	34	M4	4.8	62.7	M4X0.7	5.5	(5)	15	13.0	60	4.5	7.5	6.0	13.7	16.9	31.4	0.217	0.293	0.293	0.22	1.28
S20BS	28	42	11.0	4.5	48.3	32		M5	5.5	27.5	M6X1	5.1	(15.6)	20	16.3	60	6.0	9.5	8.5	7.4	9.1	15.7	0.146	0.064	0.064	0.17	2.15
S20BN	28	42	11.0	4.5	69.3	32	32	M5	5.5	48.5	M6X1	5.1	(15.6)	20	16.3	60	6.0	9.5	8.5	14.3	17.7	30.5	0.285	0.220	0.220	0.26	2.15
S25BS	33	48	12.5	5.8	54.0	35		M6	6.8	32.3	M6X1	7.2	(15.6)	23	19.2	60	7.0	11.0	9.0	10.3	12.7	21.0	0.225	0.101	0.101	0.21	2.88
S25BN	33	48	12.5	5.8	79.2	35	35	M6	6.8	57.5	M6X1	7.2	(15.6)	23	19.2	60	7.0	11.0	9.0	20.1	24.8	41.1	0.440	0.352	0.352	0.38	2.88
X25BN	36	48	12.5	5.8	79.2	35	35	M6	9.0	57.5	M6X1	10.2	(15.6)	23	19.2	60	7.0	11.0	9.0	20.1	24.8	41.1	0.440	0.352	0.352	0.40	2.88
X25BL	36	48	12.5	5.8	93.9	35	35	M6	9.0	72.2	M6X1	10.2	(15.6)	23	19.2	60	7.0	11.0	9.0	25.9	31.9	52.8	0.566	0.568	0.568	0.54	2.88
X25BE	36	48	12.5	5.8	108.6	35	50	M6	9.0	86.9	M6X1	10.2	(15.6)	23	19.2	60	7.0	11.0	9.0	29.2	36.0	63.3	0.679	0.819	0.819	0.67	2.88
S30BS	42	60	16.0	7.0	64.2	40		M8	10.0	37.2	M6X1	10	(15.6)	28	22.8	80	9.0	14.0	12.0	14.7	18.2	27.0	0.350	0.150	0.150	0.50	4.45
S30BN	42	60	16.0	7.0	94.8	40	40	M8	10.0	67.8	M6X1	10	(15.6)	28	22.8	80	9.0	14.0	12.0	29.7	36.7	54.6	0.706	0.551	0.551	0.80	4.45
S30BL	42	60	16.0	7.0	105.0	40	40	M8	10.0	78.0	M6X1	10	(15.6)	28	22.8	80	9.0	14.0	12.0	38.5	47.5	70.7	0.915	0.821	0.821	0.94	4.45
S30BE	42	60	16.0	7.0	130.5	40	60	M8	10.0	103.5	M6X1	10	(15.6)	28	22.8	80	9.0	14.0	12.0	42.9	52.9	86.7	1.122	1.336	1.336	1.16	4.45
S35BS	48	70	18.0	7.5	75.5	50		M8	10.0	44.5	M6X1	11.5	(15.6)	34	26.0	80	9.0	14.0	12.0	21.2	26.2	40.7	0.643	0.269	0.269	0.80	6.25
S35BN	48	70	18.0	7.5	111.5	50	50	M8	10.0	80.5	M6X1	11.5	(15.6)	34	26.0	80	9.0	14.0	12.0	42.4	52.3	81.1	1.282	0.972	0.972	1.20	6.25
S35BL	48	70	18.0	7.5	123.5	50	50	M8	10.0	92.5	M6X1	11.5	(15.6)	34	26.0	80	9.0	14.0	12.0	52.9	65.4	101.4	1.602	1.396	1.396	1.40	6.25
S35BE	48	70	18.0	7.5	153.5	50	72	M8	10.0	122.5	M6X1	11.5	(15.6)	34	26.0	80	9.0	14.0	12.0	58.3	71.9	125.3	1.981	2.286	2.286	1.84	6.25
S45BN	60	86	20.5	8.9	129.0	60	60	M10	15.5	94.0	M8X1.25	14.4	(16)	45	31.1	105	14.0	20.0	17.0	58.0	71.6	108.9	2.300	1.524	1.524	1.64	9.60
S45BL	60	86	20.5	8.9	145.0	60	60	M10	15.5	110.0	M8X1.25	14.4	(16)	45	31.1	105	14.0	20.0	17.0	69.0	85.1	129.5	2.736	2.122	2.122	1.93	9.60
S45BE	60	86	20.5	8.9	174.0	60	80	M10	15.5	139.0	M8X1.25	14.4	(16)	45	31.1	105	14.0	20.0	17.0	79.7	98.4	163.3	3.449	3.379	3.379	2.42	9.60
S55BN	70	100	23.5	12.7	155.0	75	75	M12	18.0	116.0	M8X1.25	14.0	(16)	53	38.0	120	16.0	23.0	20.0	69.8	86.2	133.4	3.303	2.304	2.304	2.67	13.80
S55BL	70	100	23.5	12.7	193.0	75	75	M12	18.0	154.0	M8X1.25	14.0	(16)	53	38.0	120	16.0	23.0	20.0	94.2	116.3	178.9	4.428	4.101	4.101	3.57	13.80
S55BE	70	100	23.5	12.7	210.0	75	95	M12	18.0	171.0	M8X1.25	14.0	(16)	53	38.0	120	16.0	23.0	20.0	127.7	157.7	253.6	6.279	6.458	6.458	3.97	13.80

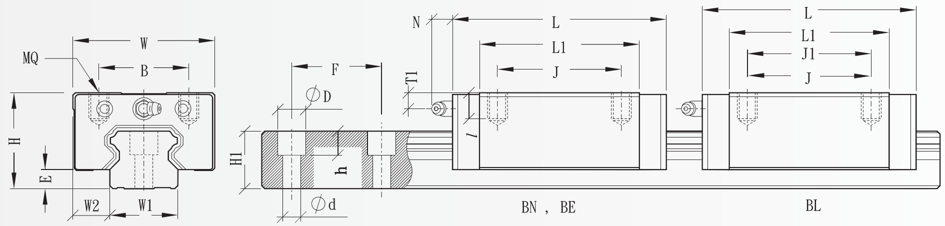
BGX/BGC Specification Table (H-F)(S-F)



◎ PLEASE CONTACT OME/ STAF FOR MORE INFORMATION.

Model	Assembly-mm				Block-mm										Rail-mm						Rating load-kN			Static moment - kN-m			Block	Rail
	H	W	W2	E	L	B	J	MQ	ih	l	L1	Oil H	T1	N	W1	H1	F	d	D	h	C-BGX	C-BGC	C0	M_X	M_Y	M_Z	kg	kg/m
H15FN	24	47	16.0	3.3	58.6	38	30	M5	4.4	8.0	40.2	M4X0.7	5.5	(5)	15	13.0	60	4.5	7.5	6.0	9.3	11.5	19.6	0.136	0.117	0.117	0.21	1.28
H15FL	24	47	16.0	3.3	66.1	38	30	M5	4.4	8.0	47.7	M4X0.7	5.5	(5)	15	13.0	60	4.5	7.5	6.0	11.3	13.9	23.7	0.164	0.169	0.169	0.23	1.28
H15FE	24	47	16.0	3.3	81.1	38	30	M5	4.4	8.0	62.7	M4X0.7	5.5	(5)	15	13.0	60	4.5	7.5	6.0	13.7	16.9	31.4	0.217	0.293	0.293	0.29	1.28
◎ S15FS	24	52	18.5	3.3	40.6	41		M5	4.4	8.0	22.2	M4X0.7	5.5	(5)	15	13.0	60	4.5	7.5	6.0	4.6	5.7	9.8	0.068	0.032	0.032	0.12	1.28
S15FN	24	52	18.5	3.3	58.6	41	26	M5	4.4	8.0	40.2	M4X0.7	5.5	(5)	15	13.0	60	4.5	7.5	6.0	9.3	11.5	19.6	0.136	0.117	0.117	0.19	1.28
H20FN	30	63	21.5	4.5	69.3	53	40	M6	5.4	9.0	48.5	M6X1	7.1	(15.6)	20	16.3	60	6.0	9.5	8.5	14.3	17.7	30.5	0.285	0.220	0.220	0.40	2.15
H20FL	30	63	21.5	4.5	82.1	53	40	M6	5.4	9.0	61.3	M6X1	7.1	(15.6)	20	16.3	60	6.0	9.5	8.5	18.6	23.0	39.5	0.369	0.361	0.361	0.46	2.15
H20FE	30	63	21.5	4.5	97.3	53	40	M6	5.4	9.0	76.5	M6X1	7.1	(15.6)	20	16.3	60	6.0	9.5	8.5	22.1	27.3	48.9	0.456	0.557	0.557	0.61	2.15
◎ S20FS	28	59	19.5	4.5	48.3	49		M6	5.4	7.0	27.5	M6X1	5.1	(15.6)	20	16.3	60	6.0	9.5	8.5	7.4	9.1	15.7	0.225	0.101	0.101	0.18	2.15
S20FN	28	59	19.5	4.5	69.3	49	32	M6	5.4	7.0	48.5	M6X1	5.1	(15.6)	20	16.3	60	6.0	9.5	8.5	14.3	17.7	30.5	0.285	0.220	0.220	0.31	2.15
H25FN	36	70	23.5	5.8	79.2	57	45	M8	7.0	10.0	57.5	M6X1	10.2	(15.6)	23	19.2	60	7.0	11.0	9.0	20.1	24.8	41.1	0.440	0.352	0.352	0.57	2.88
H25FL	36	70	23.5	5.8	93.9	57	45	M8	7.0	10.0	72.2	M6X1	10.2	(15.6)	23	19.2	60	7.0	11.0	9.0	25.9	31.9	52.8	0.566	0.568	0.568	0.72	2.88
H25FE	36	70	23.5	5.8	108.6	57	45	M8	7.0	10.0	86.9	M6X1	10.2	(15.6)	23	19.2	60	7.0	11.0	9.0	29.2	36.0	63.3	0.679	0.819	0.819	0.89	2.88
◎ S25FS	33	73	25.0	5.8	54.0	60		M8	7.0	7.0	32.3	M6X1	7.2	(15.6)	23	19.2	60	7.0	11.0	9.0	10.3	12.7	21.0	0.225	0.101	0.101	0.33	2.88
S25FN	33	73	25.0	5.8	79.2	60	35	M8	7.0	7.0	57.5	M6X1	7.2	(15.6)	23	19.2	60	7.0	11.0	9.0	20.1	24.8	41.1	0.440	0.352	0.352	0.50	2.88
◎ H30FS	42	90	31.0	7.0	64.2	72		M10	8.6	11.0	37.2	M6X1	10	(15.6)	28	22.8	80	9.0	14.0	12.0	14.7	18.2	27.0	0.350	0.150	0.150	0.80	4.45
H30FN	42	90	31.0	7.0	94.8	72	52	M10	8.6	11.0	67.8	M6X1	10	(15.6)	28	22.8	80	9.0	14.0	12.0	29.7	36.7	54.6	0.706	0.551	0.551	1.10	4.45
H30FL	42	90	31.0	7.0	105.0	72	52	M10	8.6	11.0	78.0	M6X1	10	(15.6)	28	22.8	80	9.0	14.0	12.0	38.5	47.5	70.7	0.915	0.821	0.821	1.34	4.45
H30FE	42	90	31.0	7.0	130.5	72	52	M10	8.6	11.0	103.5	M6X1	10	(15.6)	28	22.8	80	9.0	14.0	12.0	42.9	52.9	86.7	1.122	1.336	1.336	1.66	4.45
◎ H35FS	48	100	33.0	7.5	75.5	82		M10	8.6	12.0	44.5	M6X1	11.5	(16)	34	26.0	80	9.0	14.0	12.0	21.2	26.2	40.7	0.643	0.269	0.269	1.00	6.25
H35FN	48	100	33.0	7.5	111.5	82	62	M10	8.6	12.0	80.5	M6X1	11.5	(16)	34	26.0	80	9.0	14.0	12.0	42.4	52.3	81.1	1.282	0.972	0.972	1.50	6.25
H35FL	48	100	33.0	7.5	123.5	82	62	M10	8.6	12.0	92.5	M6X1	11.5	(16)	34	26.0	80	9.0	14.0	12.0	52.9	65.4	101.4	1.602	1.396	1.396	1.90	6.25
H35FE	48	100	33.0	7.5	153.5	82	62	M10	8.6	12.0	122.5	M6X1	11.5	(16)	34	26.0	80	9.0	14.0	12.0	58.3	71.9	125.3	1.981	2.286	2.286	2.54	6.25
H45FN	60	120	37.5	8.9	129.0	100	80	M12	10.6	15.5	94.0	M8X1.25	14.4	(16)	45	31.1	105	14.0	20.0	17.0	58.0	71.6	108.9	2.300	1.524	1.524	2.27	9.60
H45FL	60	120	37.5	8.9	145.0	100	80	M12	10.6	15.5	110.0	M8X1.25	14.4	(16)	45	31.1	105	14.0	20.0	17.0	69.0	85.1	129.5	2.736	2.122	2.122	2.68	9.60
H45FE	60	120	37.5	8.9	174.0	100	80	M12	10.6	15.5	139.0	M8X1.25	14.4	(16)	45	31.1	105	14.0	20.0	17.0	79.7	98.4	163.3	3.449	3.379	3.379	3.42	9.60
H55FN	70	140	43.5	12.7	155.0	116	95	M14	12.6	18.5	116.0	M8X1.25	14.0	(16)	53	38.0	120	16.0	23.0	20.0	69.8	86.2	133.4	3.303	2.304	2.304	3.44	13.80
H55FL	70	140	43.5	12.7	193.0	116	95	M14	12.6	18.5	154.0	M8X1.25	14.0	(16)	53	38.0	120	16.0	23.0	20.0	94.2	116.3	178.9	4.428	4.101	4.101	4.63	13.80
H55FE	70	140	43.5	12.7	210.0	116	95	M14	12.6	18.5	171.0	M8X1.25	14.0	(16)	53	38.0	120	16.0	23.0	20.0	127.7	157.7	253.6	6.279	6.458	6.458	5.16	13.80

BGX/BGC Specification Table (H-B)



◎ BL : BGX → J1 ; BGC → J

	Model	Assembly-mm				Block-mm										Rail-mm						Rating load-kN			Static moment - kN-m			Block	Rail
		H	W	W2	E	L	B	J	J1	MQ	l	L1	Oil H	T1	N	W1	H1	F	d	D	h	C-BGX	C-BGC	C0	M_X	M_Y	M_Z	kg	kg/m
	H15BN	28	34	9.5	3.3	58.6	26	26		M4	6.0	40.2	M4X0.7	9.5	(5)	15	13.0	60	4.5	7.5	6.0	9.3	11.5	19.6	0.136	0.117	0.117	0.19	1.28
	H20BN	30	44	12.0	4.5	69.3	32	36		M5	6.5	48.5	M6X1	7.1	(15.6)	20	16.3	60	6.0	9.5	8.5	14.3	17.7	30.5	0.285	0.220	0.220	0.31	2.15
◎	H20BL	30	44	12.0	4.5	82.1	32	36	50	M5	6.5	61.3	M6X1	7.1	(15.6)	20	16.3	60	6.0	9.5	8.5	18.6	23.0	39.5	0.369	0.361	0.361	0.36	2.15
	H20BE	30	44	12.0	4.5	97.3	32	50		M5	6.5	76.5	M6X1	7.1	(15.6)	20	16.3	60	6.0	9.5	8.5	22.1	27.3	48.9	0.456	0.557	0.557	0.47	2.15
	H25BN	40	48	12.5	5.8	79.2	35	35		M6	9.0	57.5	M6X1	14.2	(15.6)	23	19.2	60	7.0	11.0	9.0	20.1	24.8	41.1	0.440	0.352	0.352	0.45	2.88
◎	H25BL	40	48	12.5	5.8	93.9	35	35	50	M6	9.0	72.2	M6X1	14.2	(15.6)	23	19.2	60	7.0	11.0	9.0	25.9	31.9	52.8	0.566	0.568	0.568	0.66	2.88
	H25BE	40	48	12.5	5.8	108.6	35	50		M6	9.0	86.9	M6X1	14.2	(15.6)	23	19.2	60	7.0	11.0	9.0	29.2	36.0	63.3	0.679	0.819	0.819	0.80	2.88
	H30BN	45	60	16.0	7.0	94.8	40	40		M8	12.0	67.8	M6X1	13	(15.6)	28	22.8	80	9.0	14.0	12.0	29.7	36.7	54.6	0.706	0.551	0.551	0.91	4.45
◎	H30BL	45	60	16.0	7.0	105.0	40	40	60	M8	12.0	78.0	M6X1	13	(15.6)	28	22.8	80	9.0	14.0	12.0	38.5	47.5	70.7	0.915	0.821	0.821	1.04	4.45
	H30BE	45	60	16.0	7.0	130.5	40	60		M8	12.0	103.5	M6X1	13	(15.6)	28	22.8	80	9.0	14.0	12.0	42.9	52.9	86.7	1.122	1.336	1.336	1.36	4.45
	H35BN	55	70	18.0	7.5	111.5	50	50		M8	12.0	80.5	M6X1	18.5	(15.6)	34	26.0	80	9.0	14.0	12.0	42.4	52.3	81.1	1.282	0.972	0.972	1.50	6.25
◎	H35BL	55	70	18.0	7.5	123.5	50	50	72	M8	12.0	92.5	M6X1	18.5	(15.6)	34	26.0	80	9.0	14.0	12.0	52.9	65.4	101.4	1.602	1.396	1.396	1.80	6.25
	H35BE	55	70	18.0	7.5	153.5	50	72		M8	12.0	122.5	M6X1	18.5	(15.6)	34	26.0	80	9.0	14.0	12.0	58.3	71.9	125.3	1.981	2.286	2.286	2.34	6.25
	H45BN	70	86	20.5	8.9	129.0	60	60		M10	18.0	94.0	M8X1.25	24.4	(16)	45	31.1	105	14.0	20.0	17.0	58.0	71.6	108.9	2.300	1.524	1.524	2.28	9.60
◎	H45BL	70	86	20.5	8.9	145.0	60	60	80	M10	18.0	110.0	M8X1.25	24.4	(16)	45	31.1	105	14.0	20.0	17.0	69.0	85.1	129.5	2.736	2.122	2.122	2.67	9.60
	H45BE	70	86	20.5	8.9	174.0	60	80		M10	18.0	139.0	M8X1.25	24.4	(16)	45	31.1	105	14.0	20.0	17.0	79.7	98.4	163.3	3.449	3.379	3.379	3.35	9.60
	H55BN	80	100	23.5	12.7	155.0	75	75		M12	22.0	116.0	M8X1.25	24.0	(16)	53	38.0	120	16.0	23.0	20.0	69.8	86.2	133.4	3.303	2.304	2.304	3.42	13.80
◎	H55BL	80	100	23.5	12.7	193.0	75	75	95	M12	22.0	154.0	M8X1.25	24.0	(16)	53	38.0	120	16.0	23.0	20.0	94.2	116.3	178.9	4.428	4.101	4.101	4.57	13.80
	H55BE	80	100	23.5	12.7	210.0	75	95		M12	22.0	171.0	M8X1.25	24.0	(16)	53	38.0	120	16.0	23.0	20.0	127.7	157.7	253.6	6.279	6.458	6.458	5.08	13.80

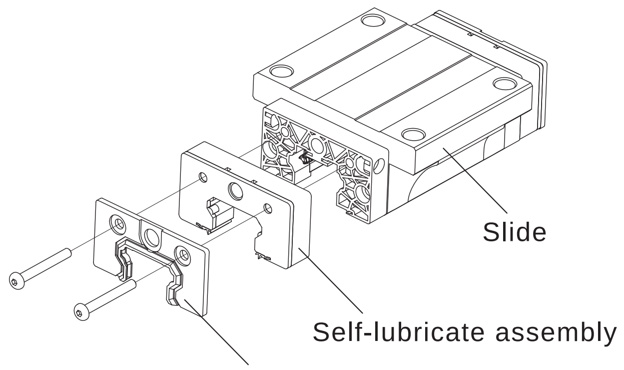
E. STAF Parts & Accessories

5-1 Self-Lubricate Assembly

a. Self-Lubricate Components

Self-lubricate assembly automatically spreads the lubrication oil to form the oil film all over the rail rolling surface to lubricate the rolling elements appropriately. Different from conventional lubrication loop that delivers lubrication oil to the rolling elements, the combination of lubrication loop and self-lubricate assembly provides more reliable lubrication.

◎ Be sure to assemble the self-lubricate assembly cap outward to use the fitting correctly.
◎ Use lubrication oil of viscosity 100~400 to ensure the expected lubrication effect.
◎ If pressure lubrication is used simultaneously, reduce the pressure lubrication adequately.

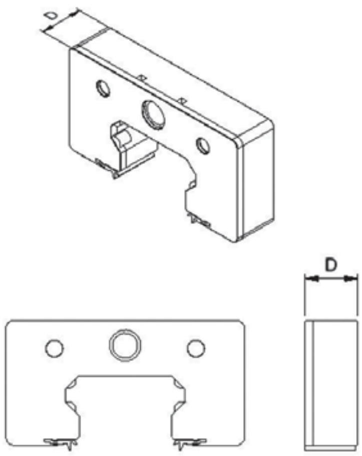


b. Specification of Self-Lubricate Assembly

Self-lubricate assembly automatically spreads the lubrication oil to form the oil film all over the rail rolling surface to lubricate the rolling elements appropriately. Different from conventional lubrication loop that delivers lubrication oil to the rolling elements, the combination of lubrication loop and self-lubricate assembly provides more reliable lubrication.

D: Thickness of single self-lubricate assemble
V: Volume of oil lubrication

Spec	D(mm)	V(cm^3)
15 type	10.3	2.0
20 type	10.3	2.5
25 type	10.3	3.0
30 type	10.3	5.5
35 type	10.7	8.5
45 type	13.0	15.0
55 type	13.0	22.5



c. Self-Lubrication Performance

It has been tested and proved in lab that there was residual oil after 500km of travel if recommended viscosity oil was applied. The self-lubricate assembly uses the same oil fitting as the end cap. There is no need to change the oil fitting. In use, the capillary foam in the assembly collects the excess oil.

d. Assembly Compositions

The self-lubricate assembly are composed of the following components:

Oil retaining foam	x 4
Enclosure cap	x 1
Enclosure housing	x 1
Bottom seal	x 2
Contact felt	x 2

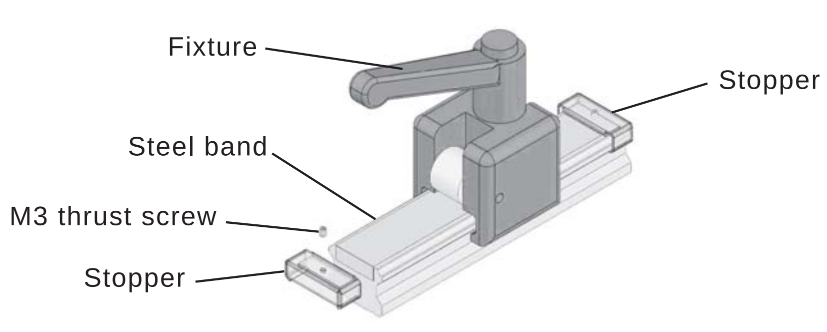
e. Assembly Dimensions

Series		Type	UU	UU+SL assembly	ZZ+SL assembly	DD+SL assembly	KK+SL assembly
BGX 15 BGC	S	40.6	61.2	64.4	66.2	69.4	69.4
	N	58.6	79.2	82.4	84.2	87.4	87.4
	L	66.1	86.7	89.9	91.7	94.9	94.9
BGX 20 BGC	E	81.1	101.7	104.9	106.7	109.9	109.9
	S	48.3	68.9	73.3	74.5	78.9	78.9
	N	69.3	89.9	94.3	95.5	99.9	99.9
	L	82.1	102.7	107.1	108.3	112.7	112.7
BGX 25 BGC	E	97.3	117.9	122.3	123.5	127.9	127.9
	S	54.0	74.6	79.0	80.1	84.5	84.5
	N	79.2	99.8	104.2	105.3	109.7	109.7
	L	93.9	114.5	118.9	120.0	124.4	124.4
BGX BGC 30	E	108.6	129.2	133.6	134.7	139.1	139.1
	S	64.2	84.8	89.8	91.8	96.8	96.8
	N	94.8	115.4	120.4	122.4	127.4	127.4
	L	105.0	125.6	130.6	132.6	137.6	137.6
BGX BGC 35	E	130.5	151.1	156.1	158.1	163.1	163.1
	S	75.5	96.9	101.5	104.9	109.5	109.5
	N	111.5	132.9	137.5	140.9	145.5	145.5
	L	123.5	144.9	149.5	152.9	157.5	157.5
BGX BGC 45	E	153.5	174.9	179.5	182.9	187.5	187.5
	N	129.0	155.0	162.0	164.0	171.0	171.0
	L	145.0	171.0	178.0	180.0	187.0	187.0
	E	174.0	200.0	207.0	209.0	216.0	216.0
BGX 55 BGC	N	155	181	187.6	190	196.6	196.6
	L	193	219	225.6	228	234.6	234.6
	E	210	236	242.6	245	251.6	251.6

5-2 Steel Band Assembly

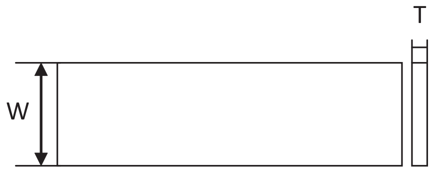
a. Steel Band Purpose

The steel band covers the rail to prevent the slide from being damaged by the dust captured by the height difference between the hole cap and the rail. The steel band consists the components as in the figure below.



b. Steel Band Specifications

Spec	Width (mm)	Thickness (mm)
15 type	10	0.3 (including adhesive)
20 type	11	0.3 (including adhesive)
25 type	13	0.3 (including adhesive)
30 type	16	0.3 (including adhesive)
35 type	18	0.3 (including adhesive)
45 type	27	0.3 (including adhesive)
55 type	29	0.3 (including adhesive)



c. Steel Band Compositions

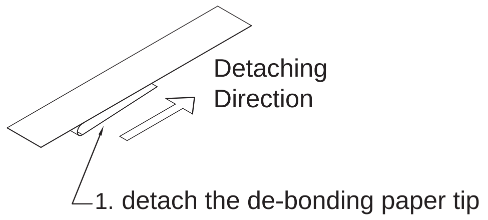
1. Steel band box: All steel band are packed in with the same box, but each type steel band varies in size and so are secured by paper stuff.
2. Steel band fixture: To secure the steel band accurately in the centre of the rail.
3. Stopper: To secure the steel bands extensions at both ends of the rail from falling off.

d. Cautions

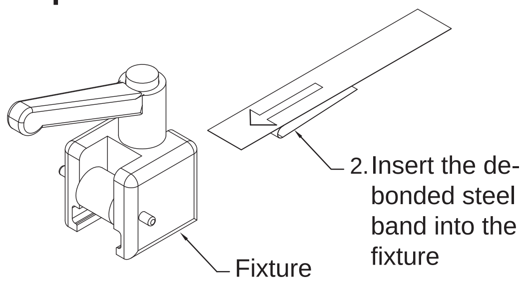
Before attaching the steel band, clean up the rail surface thoroughly with detergent, and be sure there is no more oil left on the rail.
1. Be sure there is no more stains and contamination before attaching the steel band.
2. Use steel band only in temperature 20~40°C, or the effect is not guaranteed.
3. Keep hands off the adhesive to assure the best attaching result.
4. Shelf life of steel band is 6 month.

e. Steel Band Attaching Steps

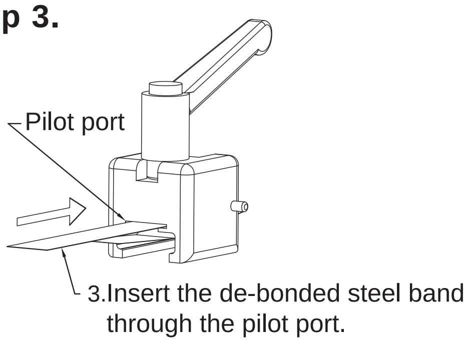
Step 1.



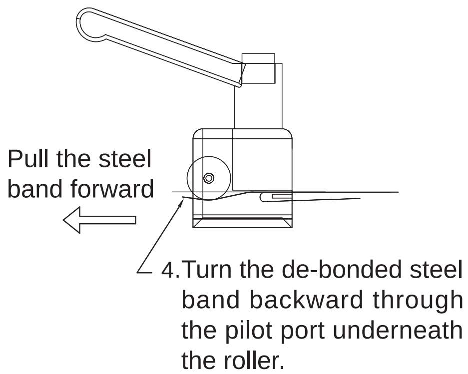
Step 2.



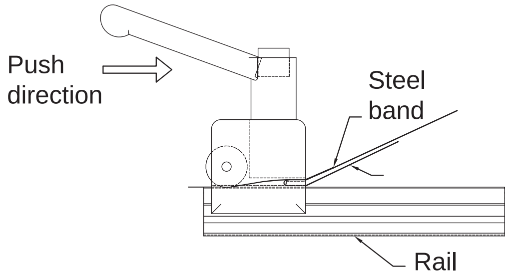
Step 3.



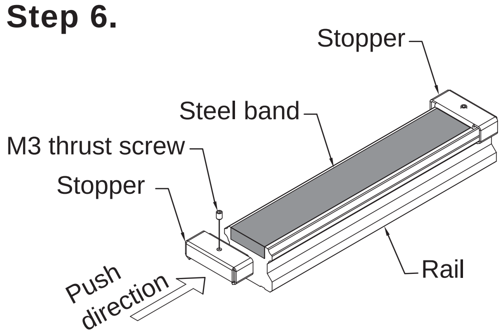
Step 4.



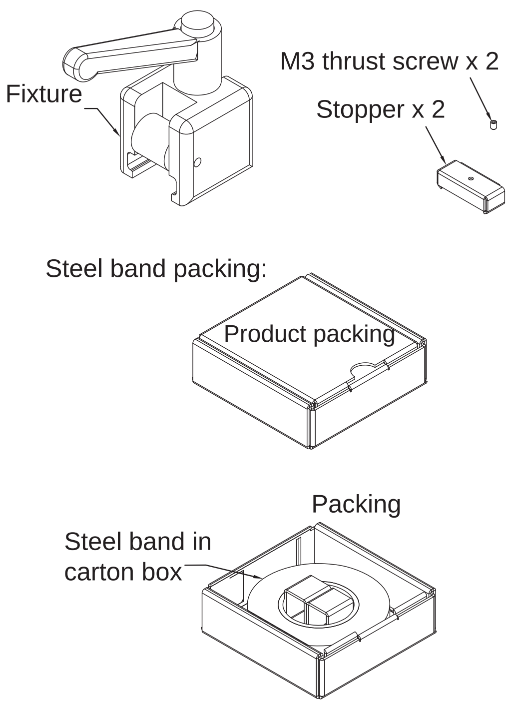
Step 5.



Step 6.



Steel Band Packing Contents



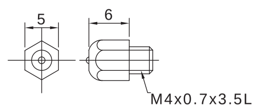
Appendix 1-1: Grease Fitting Specification Table

NGS03

- N G — G Grease Fitting; L Elbow Fitting
- S — S 0; X 67.5; V 90

NGS01

	UU	ZZ	DD	KK	SIDE
15					✓



NGS02

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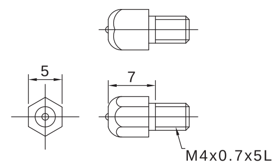
15	✓				



NGS03

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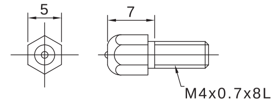
15		✓	✓	✓	



NGS04

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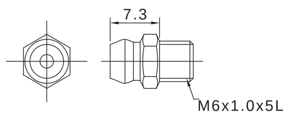
25					✓
30					
35					



NGS05

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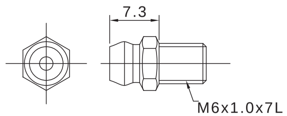
25	✓	✓	✓		
30	✓	✓			✓
35	✓	✓			✓



NGS06

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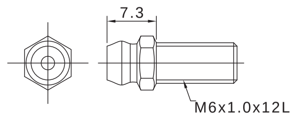
25				✓	
30			✓	✓	
35			✓	✓	



NGS07

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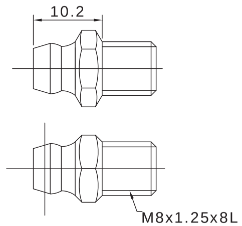
45	✓	✓			✓
55	✓	✓			✓



NGS08

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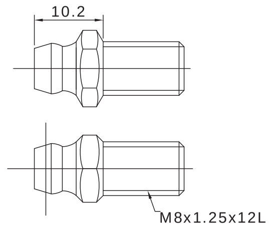
55			✓	✓	



NGX01

	UU	ZZ	DD	KK	SIDE
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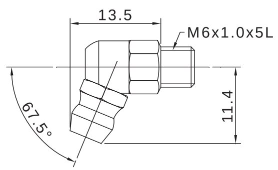
25					✓
30					
35					



NGX02

	UU	ZZ	DD	KK	SIDE
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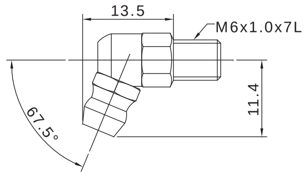
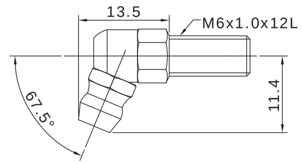
25	✓	✓	✓		
30	✓	✓			✓
35	✓	✓			✓



NGX03

	UU	ZZ	DD	KK	SIDE
20				✓	
25				✓	
30			✓	✓	
35			✓	✓	



NGX04

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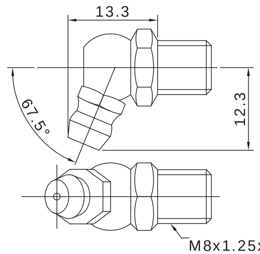
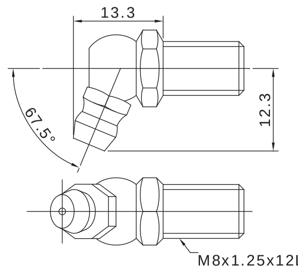
55	✓	✓			✓



NGX05

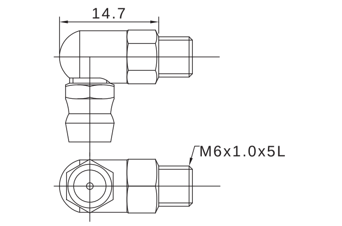
	UU	ZZ	DD	KK	SIDE
45			✓	✓	
55			✓	✓	



Appendix 1-2: Grease Fitting Specification Table

NGV01

	UU	ZZ	DD	KK	SIDE
20					✓
25					✓
30					
35					



NGV02

	UU	ZZ	DD	KK	SIDE
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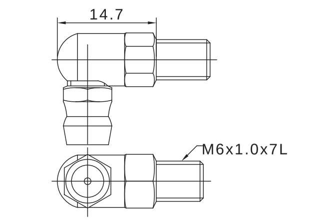
25	✓	✓	✓		
30	✓	✓			✓
35	✓	✓			✓



NGV03

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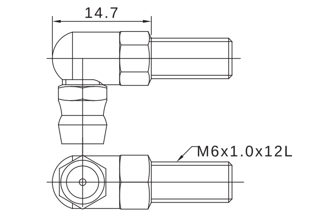
25				✓	
30			✓	✓	
35			✓	✓	



NGV04

	UU	ZZ	DD	KK	SIDE
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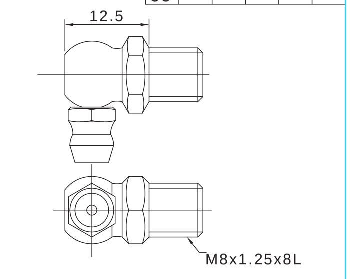
55	✓	✓			✓



NGV05

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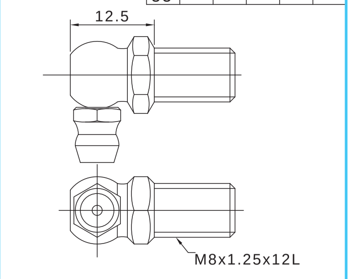
55			✓	✓	



NLS01

	UU	ZZ	DD	KK	SIDE
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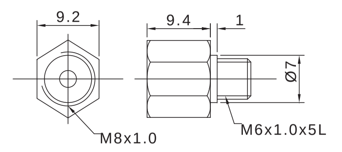
25					✓
30					
35					



NLS02

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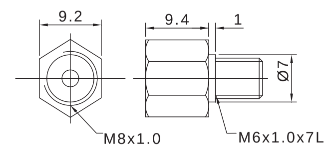
25	✓	✓			
30	✓				✓
35	✓				✓



NLS03

	UU	ZZ	DD	KK	SIDE
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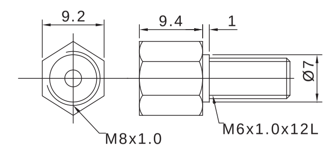
25			✓	✓	
30		✓	✓	✓	
35		✓	✓	✓	



NLS04

	UU	ZZ	DD	KK	SIDE
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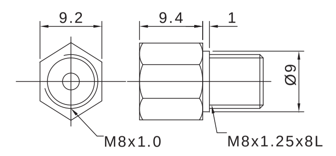
55	✓				✓



NLS05

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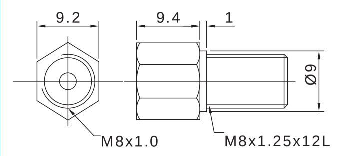
55		✓	✓	✓	



NLV01

	UU	ZZ	DD	KK	SIDE
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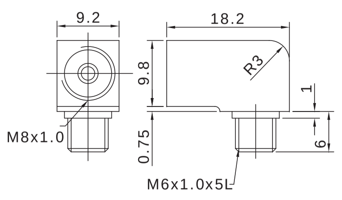
25					✓
30					
35					



NLV02

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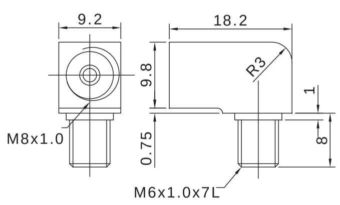
25	✓	✓			
30	✓				✓
35	✓				✓



NLV03

	UU	ZZ	DD	KK	SIDE
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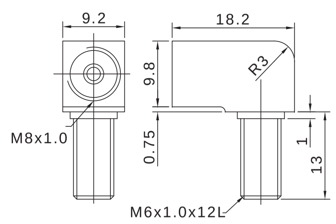
25			✓	✓	
30		✓	✓	✓	
35		✓	✓	✓	



NLV04

	UU	ZZ	DD	KK	SIDE
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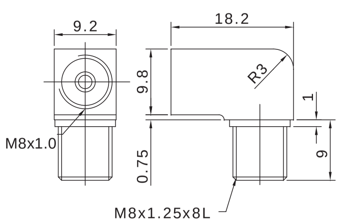
55	✓				✓



NLV05

	UU	ZZ	DD	KK	SIDE
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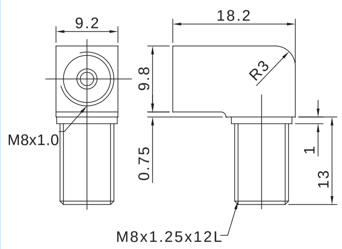

MEMO

MEMO