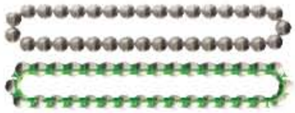
STABILIZED TRANSMISSION AS FORWARDING

STAF LINEAR GUIDE



Cage & Non Cage types on the Same profile rail

OME Technology

About Us

STAF Linear Motion
Professional Linear Motion Manufacturer

OME TECHNOLOGY CO., LTD.

Date of Establishment: Dec. 2007

Founder: K. F. Liao and Louis Wang

Headquarter: Sansia Taipei, Taiwan

Quality Certification: ISO 9001-2000
(CNS 12681)

Business Units

STAF: Linear motion products

OME: X Ray Print Circuit Board Inspection Equipment

STABILIZED
TRANSMISSION
AS
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INDEX

I. Terms of Linear Guide

1-1 Major factors:

a. Load and Life(L)

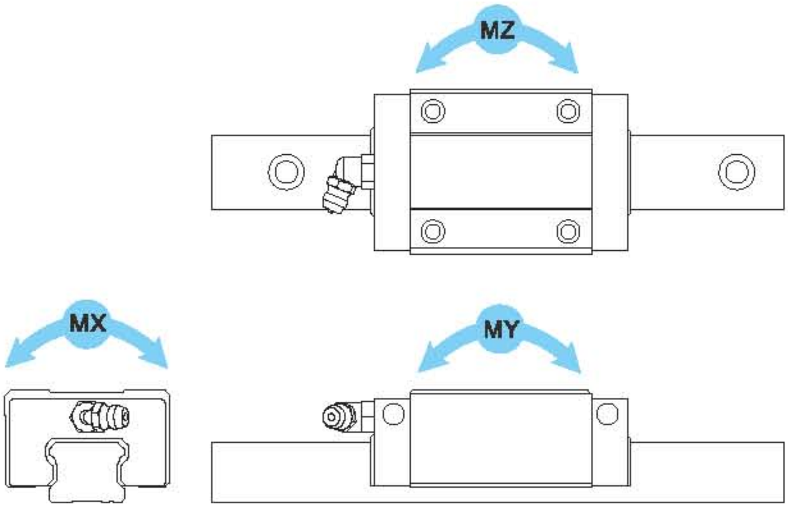
Choosing a linear guide has to consider the following variables to conclude a reliable static safety factor: average applied load on every slide, basic static nominal load(C0) or basic permissible static moment(Mx、My、Mz). In case of calculating life in a long-term consumed environment, it requires basic dynamic nominal load(C) for an approximate result.

b. Basic static load rating(C0)

When a linear motion system in the static state or in motion is subject to an extreme load or impact, a permanent deformation will occur between raceway and rolling elements. If the deformation is excessive, the linear motion system can not travel smoothly. Now, we define the basic static nominal load(C0) is a static load of constant magnitude acting in one direction under which the sum of the permanent deformations of rolling elements and raceway equals 0.0001 times the diameter of the rolling elements.

c. Basic permissible static moment(Mx，My，Mz)

When a linear guide gets a force that makes the balls distorted to 1/10,000 of theirs diameter, we call the force as basic permissible static moment. Values of Mx、My、Mz are shown on the below figure, suggest 3 axes of moment on a linear guide slide.



d. Static safety factor(fs)

The static safety factor indicates the ratio of Basic static nominal load(C0) to the load acting on the linear motion sytem.

$$f_s = \frac{fc \cdot C0}{P} \qquad f_s = \frac{fc \cdot M0}{M}$$

fs : Static safety factor
$C0$: Basic static load rating
P : Design load
fc : Contact factor
$M0$: Permissible static moment
M : Design moment

Reference value of Static safety factor fs shown below:

Operating condition	Load condition	Minimum fs
Normally stationary	Small impact and deflection	1.0 ~ 1.3
	Impact or twisting load are applied	2.0 ~ 3.0
Normally moving	Small impact or twisting load are applied	1.0 ~ 1.5
	Impact or twisting load are applied	2.5 ~ 5.0

e. Nominal life(L)

The nominal life L is the total distance of travel reached without flaking by 90% of a group of identical linear motion system that are operated independently under the same condition.

f. Basic dynamic load rating(C)

When each of a group of identical linear motion system is applied independently under the same condition, basic dynamic load rating C is the load of constant magnitude acting in one direction that results in a nominal life of 50 km for a system using balls.

1-2 Subsidiary factors:

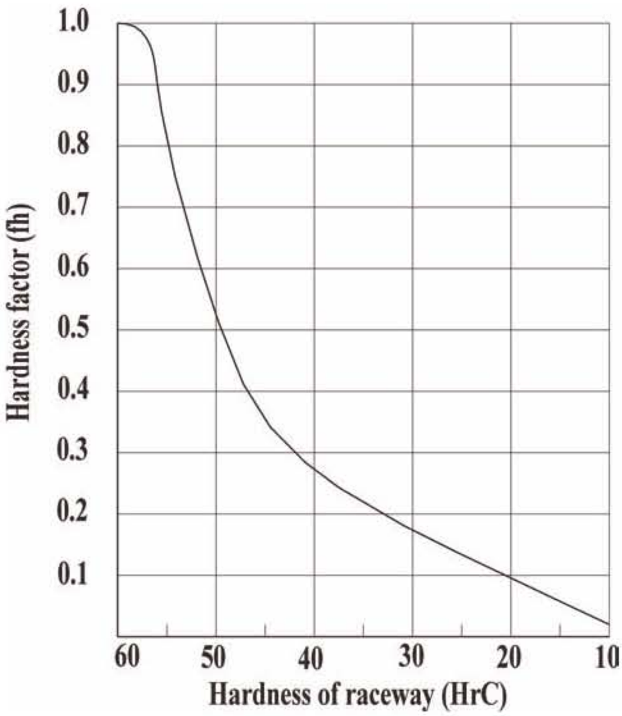
a. Contact factor(fc)

In linear motion system, it is hard to obtain uniform load distribution in close contact installation due to moments, errors on the mounting surfaces and other factors. When two or more blocks in a rail are used in close contact, multiply basic load ratings C and C0 by the contact factors shown below.

Number of blocks in close contact	Contact factor
2	0.81
3	0.72
4	0.66
5	0.61
Normal operation	1

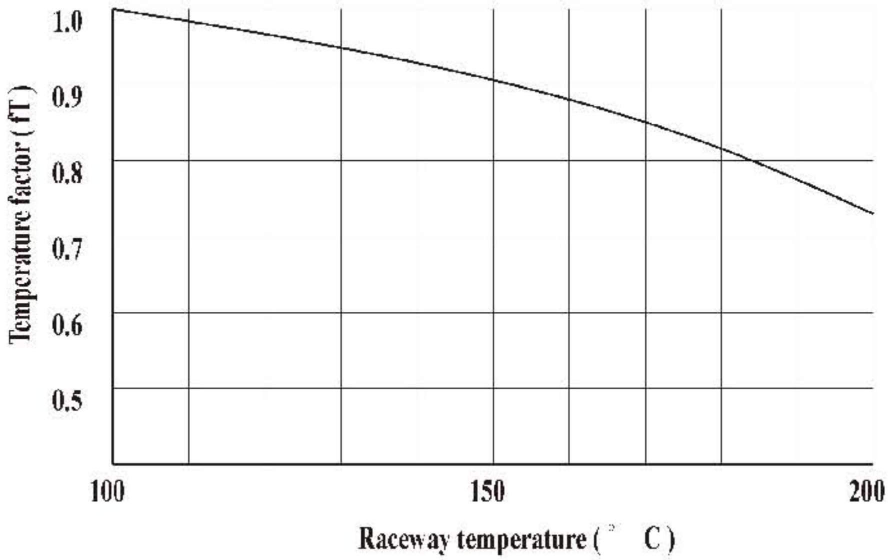
b. Hardness factor(fh)

When working environment temperature exceeds 100 degrees Celsius, ft becomes a key factor.



c. Temperature factor(ft)

When working environment temperature exceeds 100˚C, ft becomes a key factor.



Remark: When working environment temperature exceeds 80 degrees Celsius,the material of seals and cages have to be able to endure the high temperature.

d.Load factor(fw)

Reciprocating motion usually occur vibrations, impacts and variable loads. In general, vibrations occur in high-speed operation, impacts due to repeated starting and stopping and variable loads; therefore, it is difficult to calculate. When above factors affect the loading conditions significantly, divided basic load ratings C and C0 by the experimentally obtained load factors shown below.

Impacts and vibrations	Speed (V)	Measured vibration (G)	fw
Without external Impacts or Vibrations	At low speed V < = 15 m/min	G < = 0.5	1 ~ 1.5
Without significant Impacts or Vibrations	At medium speed 15 < V < = 60 m/min	0.5 < G < = 1.0	1.5 ~ 2.0
With external Impacts or Vibrations	At high speed V > 60 m/min	1.0 < G < = 2.0	2.0 ~ 3.5

1-3 Life calculation:

Giving Basic dynamic load rating C and design load P, to calculate life L by follwing the formula shown below:

$$L=\left(\frac{fh\cdot fT\cdot fc}{fw}\cdot\frac{C}{P}\right)^{3}\cdot 50km$$

L:Nominal life(km)

The nominal life L is the total distance of travel reached without flaking by 90% of a group of identical linear motion system that are operated independently under the same condition.

C: Basic nominal dynamic load	P: Design load
fh: Hardness factor	ft: Temperature factor
fc: Contact factor	fw: Load factor

Life Ln is available after calculated nominal life and stroke and times of travel are given:

$$Ln=\frac{L\cdot 10^{6}}{2\cdot Ls\cdot N1\cdot 60}$$

Ln = Life (hr)
N1 = Times of travel per minute
Ls = Stroke (mm)

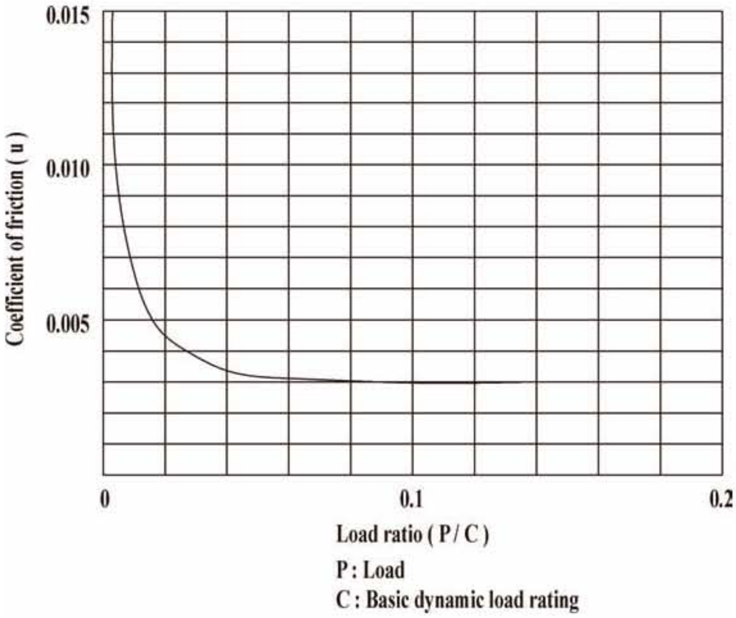
1-4 Friction resistence

A linear motion system is composed by a block, a rail and rolling elements which could be balls or cylinders. Sliding comes from those elements rolling between the rail and the block; as the result, friction resistence fluctuates under different conditions. The below figure shows the reference friction resistence value of STAF linear guide.

Friction can be calculated by:

F = u * W + f

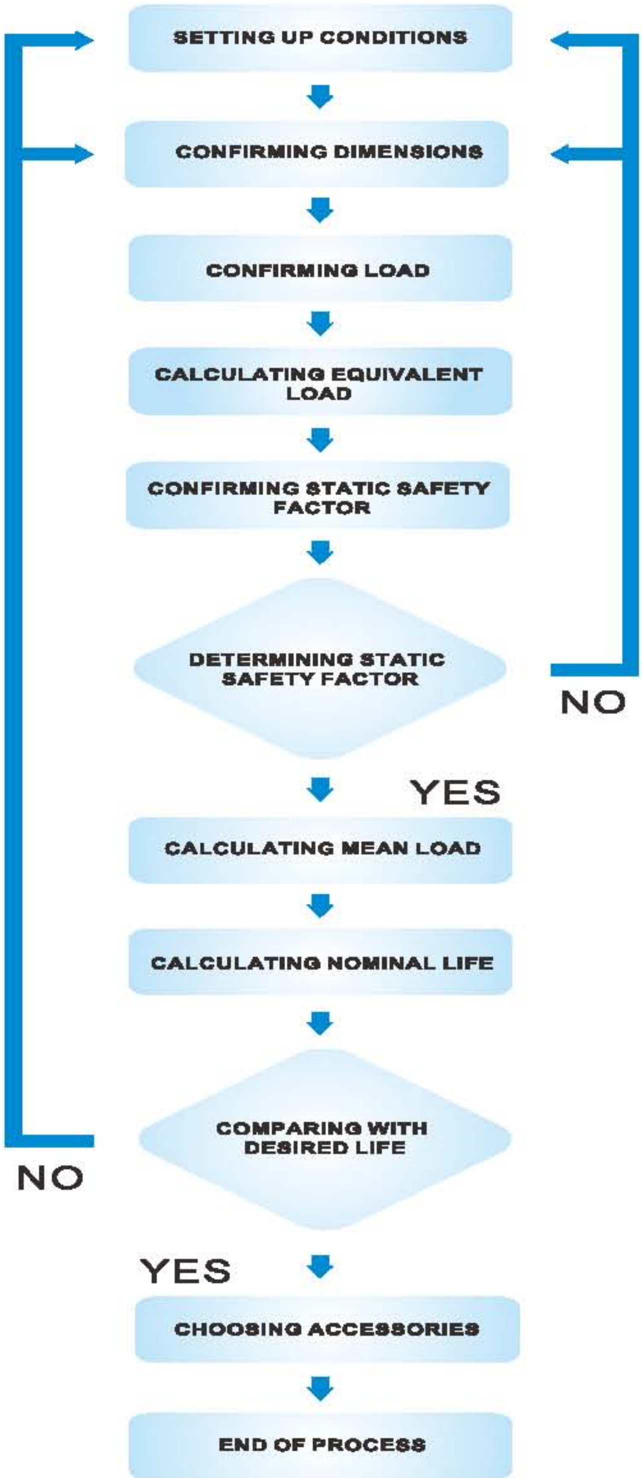
F : Friction resistence
W : Load
u : Coefficient of friction
f : Block seals resistence



Model No.	resistance	Model No.	resistance
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

II. APPLYING STAF LINEAR GUIDE

2-1 Flow Chart of Applying STAF Linear Guide



2-2 Confirming conditions

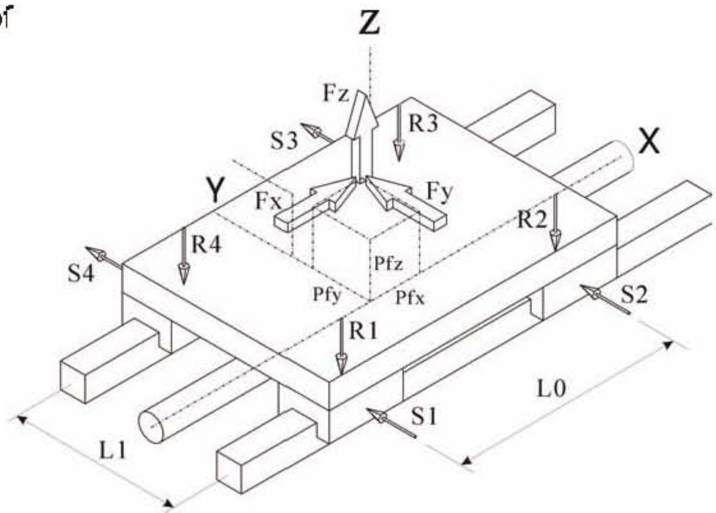
It takes engineering calculation when adapting a linear guide system, and the must knows are:

A. Composition:(distance between 2 blocks / rails number of blocks, number of rails)

B.Mounting:(Horizontal, erect, on a slant, wall installation, or upside down mounting)

C.Applied load

D.Frequency of



a. Composition:

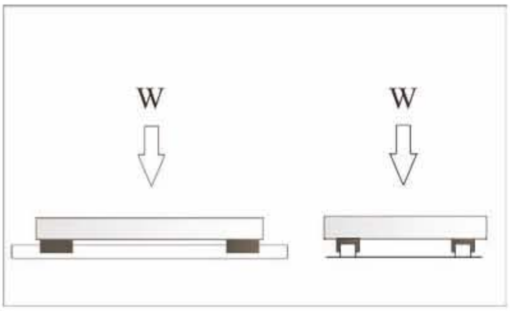
1. Distance between 2 blocks / rails:L0&L1 as shown.
   L0:Distance of two blocks loaded on the same rail(mm)
   L1:Distance between one rail to another(mm)
   The distance of L0 and L1 matters the rigidity and life of the linear guide system itself.

2. Number of blocks: in general cases, the more blocks used on a rail, the better the rigidity and the higher load capacity. However, layout plan and stroke have to be reconsidered.

3. Number of rails: when increasing the quantity of rail, the moment resistance of X axis enhances and so do rigidity and load.

b. Installation:

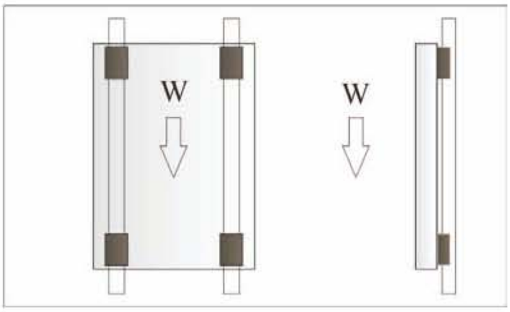
1.Horizontal Installation



◎Horizontal Installation(W:load in direction of compression)

The commonest position of setting a linear guide.
Application: positioning or feeding.
W is vertical to the table mounting on the blocks.
W is vertical to direction of system movement.

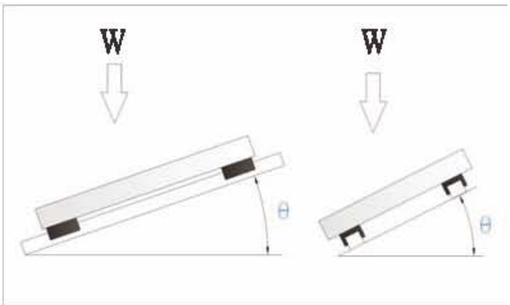
2.Erect Installation



◎Erect Installation(W:load in direction of compression)

Application: elevating device.
W is parallel to working table.
W is parallel to direction of system moving.

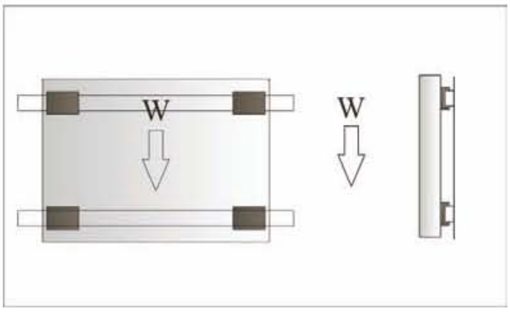
3.Slanting Installation



◎Slanting Installation(W:load in direction of compression)

Side slanting:W is vertical to direction of system moving.
Front slanting:Angleθ between W and direction of movement。

4.Wall Installation



◎Wall Installation(W:load in direction of compression)

Distance between 2 rails ahs to be considered.
W is parallel to working table.
W is vertical to direction of system moving.

c. Applied load

Load contains 3 elements:force, direction of load and object that is loaded.

1.Force:

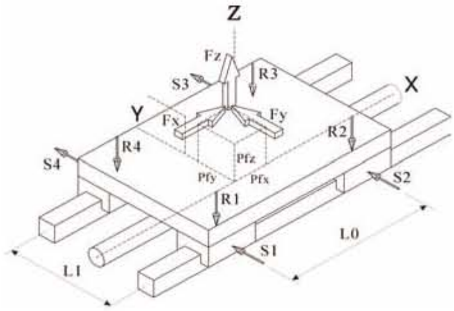
Weight:it produces inertia when it moves.

Outer force: outer force comes from liquid pressure, air pressure and magnetic force. No inertia comes with it.

2.Direction of load:

Can be divided into 3 dimensions.

Shown as Fx, Fy and Fz on fig.



3.Position of load acts:

Pfx, Pfy and Pfz are shown as fig, defined as distance from applied load to center of driving power.

Driving power could be actuated by a ball screw, an oil pneumatic cylinder, a timming belt or a linear motor.

4.Distance between 2 carriages / rails:

L0 & L1:as shown

5.V/D figure:

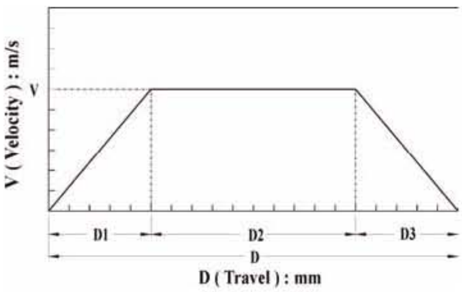
Velocity(V):The highest speed

Distance(D):Distance that the system runs.

(D1):Distance moving from static to the highest speed

(D2):Distance at equivalent speed

(D3):Distance moving from the highest speed to static



6.Forces onto Carriages:

R1、R2、R3、R4 are forces from vertical directions

S1、S2、S3、S4 are forces from horizontal directions

d. Frequency of use:

Frequency of use has to be added into considerations when proving whether the engineering calculation fit the actual application.

Example 1: Suggested that a system with 1000km of calculated life operated 1km per day, it can work for 1000 days.

Example 2: Suggested that a system with 50000km of calculated life operated 500km per day, it can work for 100 days.

2-3 Selecting an optimal model

a.BGX or BGC

Choosing workable size should be based on the type of the machine center. Introductions of BGC and BGX of STAF linear guide are attached in the following content.

b.15、20、25、30、35

Size should be the first point as selecting a linear guide for a new working system because load and exact life are difficult to calculate at the beginning. As the result, when there is a difference between calculated life and actual load, move to a size with larger dynamic load rating.

2-4 Calculating applied load:

Equation of vertical forces onto the block.

$$R_1 = \frac{-F_Z}{4} + \frac{(F_Z \cdot P_{fy} - F_Y \cdot P_{fz})}{2 \cdot L1} - \frac{(F_X \cdot P_{fZ} - F_Z \cdot P_{fX})}{2 \cdot L0}$$

$$R_2 = \frac{-F_Z}{4} + \frac{(F_Z \cdot P_{fy} - F_Y \cdot P_{fz})}{2 \cdot L1} + \frac{(F_X \cdot P_{fZ} - F_Z \cdot P_{fX})}{2 \cdot L0}$$

$$R_3 = \frac{-F_Z}{4} - \frac{(F_Z \cdot P_{fy} - F_Y \cdot P_{fz})}{2 \cdot L1} + \frac{(F_X \cdot P_{fZ} - F_Z \cdot P_{fX})}{2 \cdot L0}$$

$$R_4 = \frac{-F_Z}{4} - \frac{(F_Z \cdot P_{fy} - F_Y \cdot P_{fz})}{2 \cdot L1} - \frac{(F_X \cdot P_{fZ} - F_Z \cdot P_{fX})}{2 \cdot L0}$$

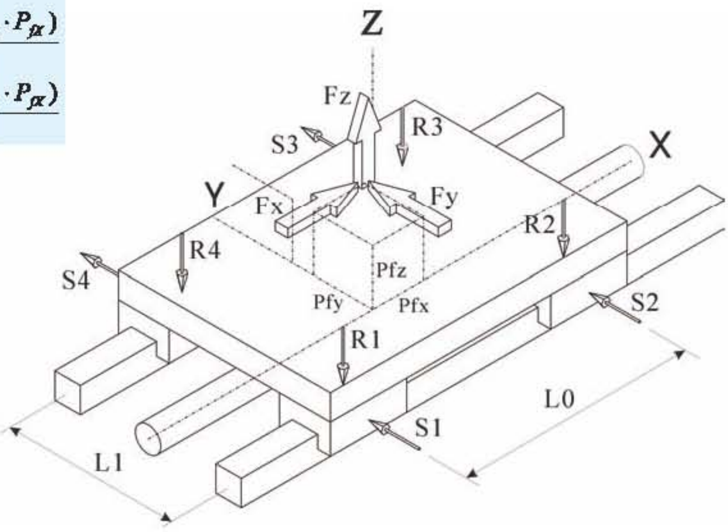
Equation of horizontal forces onto the block.

$$S_1 = \frac{F_Y}{4} + \frac{(F_Y \cdot P_{fX} - F_X \cdot P_{fY})}{2 \cdot L0}$$

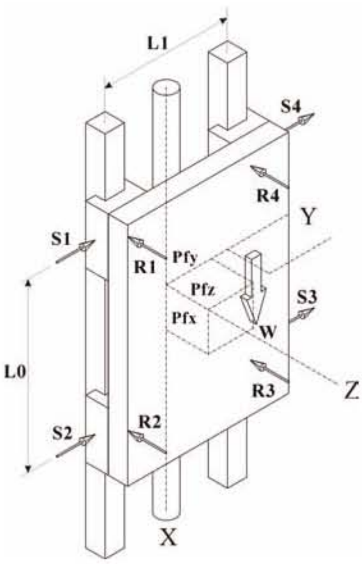
$$S_2 = \frac{F_Y}{4} - \frac{(F_Y \cdot P_{fX} - F_X \cdot P_{fY})}{2 \cdot L0}$$

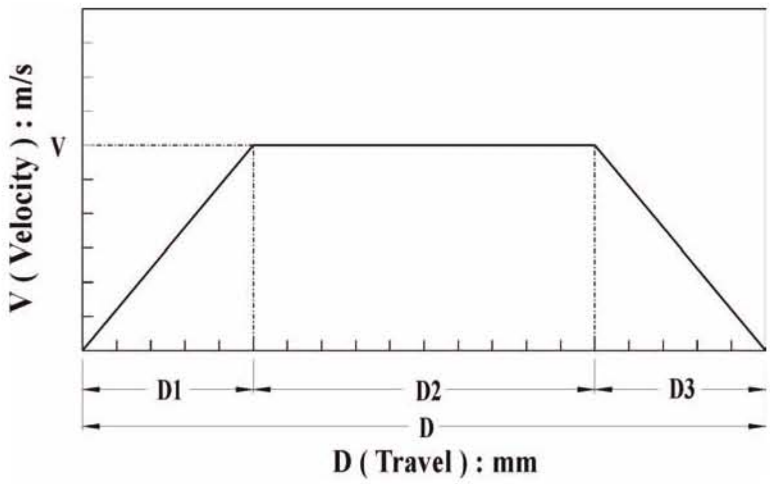
$$S_3 = \frac{F_Y}{4} - \frac{(F_Y \cdot P_{fX} - F_X \cdot P_{fY})}{2 \cdot L0}$$

$$S_4 = \frac{F_Y}{4} + \frac{(F_Y \cdot P_{fX} - F_X \cdot P_{fY})}{2 \cdot L0}$$



Calculation:





the movement can be divided into 3 parts.
acceleration brings load at the first part:Fx(W):(W/g)*(+A)
acceleration brings load at the second part:Fx(W):(W/g)*(0)=0
acceleration brings load at the third part:Fx(W):(W/g)*(-A)

If BGXH20FN2 L4000 NZ0 was taken:

C=1463kgf
C0=3110kgf
D1=1000mm
D2=2000mm
D3=1000mm
V=1m/s V0=0m/s => (A)=0.5m/s^2
V=0m/s V0=1m/s => (-A)= -0.5m/s^2

$$V^2 = V_0^{\,2} + 2a \cdot D1 \Rightarrow a = \frac{V^2 - V_0^{\,2}}{2 \cdot D1}$$

Fx(W)=98kgf ,Fy(W)=0,Fz(W)=0
Fx(A)=98kgf*0.5m/s^2=49N,49N/9.8m/s^2=5kgf ,Fy(A)=0,Fz(A)=0
Fx(-A)=98kgf*-0.5m/s^2= -49N,-49N/9.8m/s^2 = -5kgf ,Fy(-A)=0,Fz(-A)=0
Pfx=80mm Pfy=250mm Pfz=280mm
L0=300mm L1 =500mm fw =1.5

Calculating load

Simply considering acceleration of gravity:

$$R1(W)=\frac{-Fx(W)\cdot Pfz}{2\cdot L0}=-45.73kgf$$

$$S1(W)=\frac{-Fx(W)\cdot Pfy}{2\cdot L0}=-40.83kgf$$

$$R2(W)=\frac{Fx(W)\cdot Pfz}{2\cdot L0}=45.73kgf$$

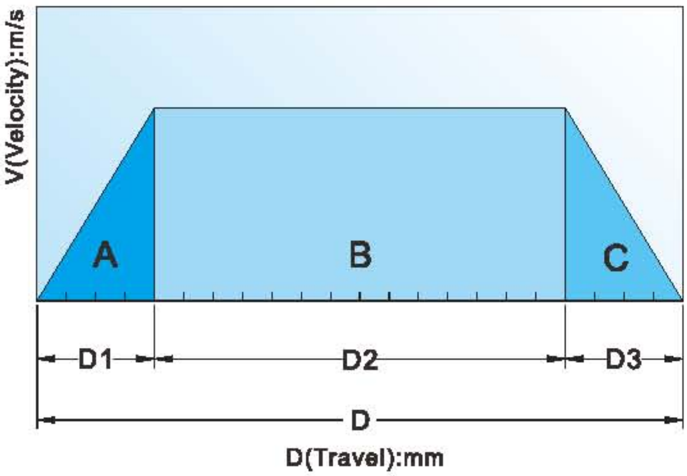
$$S2(W)=\frac{Fx(W)\cdot Pfy}{2\cdot L0}=40.83kgf$$

$$R3(W)=\frac{Fx(W)\cdot Pfz}{2\cdot L0}=45.73kgf$$

$$S3(W)=\frac{Fx(W)\cdot Pfy}{2\cdot L0}=40.83kgf$$

$$R4(W)=\frac{-Fx(W)\cdot Pfz}{2\cdot L0}=-45.73kgf$$

$$R4(W)=\frac{-Fx(W)\cdot Pfy}{2\cdot L0}=-40.83kgf$$



Considering the acceleration when speed increases:

$$R1(A)=\frac{-Fx(A)\cdot Pfz}{2\cdot L0}=-2.33kgf$$

$$S1(A)=\frac{-Fx(A)\cdot Pfy}{2\cdot L0}=-2.08kgf$$

$$R2(A)=\frac{Fx(A)\cdot Pfz}{2\cdot L0}=2.33kgf$$

$$S2(A)=\frac{Fx(A)\cdot Pfy}{2\cdot L0}=2.08kgf$$

$$R3(A)=\frac{Fx(A)\cdot Pfz}{2\cdot L0}=2.33kgf$$

$$S3(A)=\frac{Fx(A)\cdot Pfy}{2\cdot L0}=2.08kgf$$

$$R4(A)=\frac{-Fx(A)\cdot Pfz}{2\cdot L0}=-2.33kgf$$

$$R4(A)=\frac{-Fx(A)\cdot Pfy}{2\cdot L0}=-2.08kgf$$

Considering the acceleration when speed decreases:

$$R1(-A)=\frac{-Fx(-A)\cdot Pfz}{2\cdot L0}=2.33kgf$$

$$S1(-A)=\frac{-Fx(-A)\cdot Pfy}{2\cdot L0}=2.08kgf$$

$$R2(-A)=\frac{Fx(-A)\cdot Pfz}{2\cdot L0}=-2.33kgf$$

$$S2(-A)=\frac{Fx(-A)\cdot Pfy}{2\cdot L0}=-2.08kgf$$

$$R3(-A)=\frac{Fx(-A)\cdot Pfz}{2\cdot L0}=-2.33kgf$$

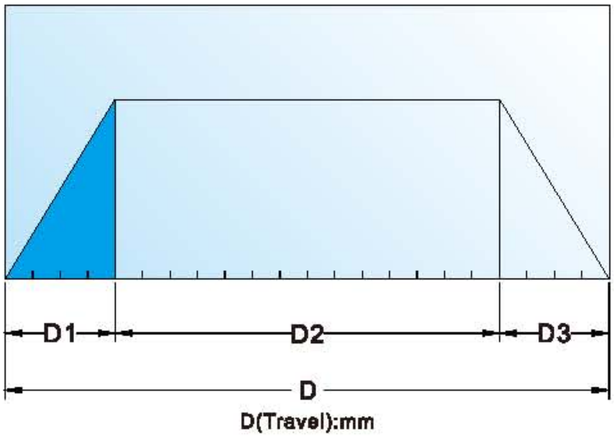
$$S3(-A)=\frac{Fx(-A)\cdot Pfy}{2\cdot L0}=-2.08kgf$$

$$R4(-A)=\frac{-Fx(-A)\cdot Pfz}{2\cdot L0}=2.33kgf$$

$$R4(-A)=\frac{-Fx(-A)\cdot Pfy}{2\cdot L0}=2.08kgf$$

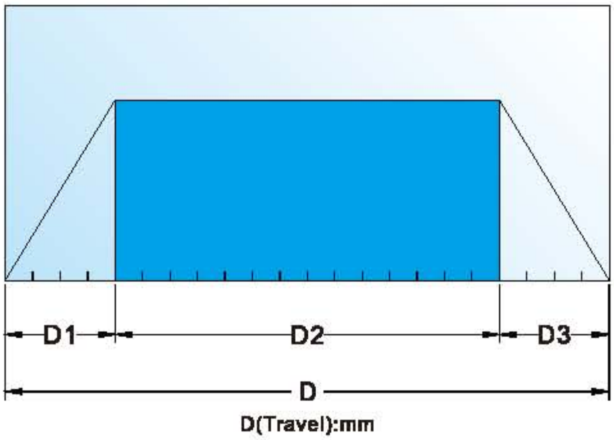
Load of the first stage D1:

$$R1(section1) = R1(W) + R1(A) = -48.06kgf$$
$$R2(section1) = R2(W) + R2(A) = 48.06kgf$$
$$R3(section1) = R3(W) + R3(A) = 48.06kgf$$
$$R4(section1) = R4(W) + R4(A) = -48.06kgf$$
$$S1(section1) = S1(W) + S1(A) = -42.91kgf$$
$$S2(section1) = S2(W) + S2(A) = 42.91kgf$$
$$S3(section1) = S3(W) + S3(A) = 42.91kgf$$
$$S4(section1) = S4(W) + S4(A) = -42.91kgf$$



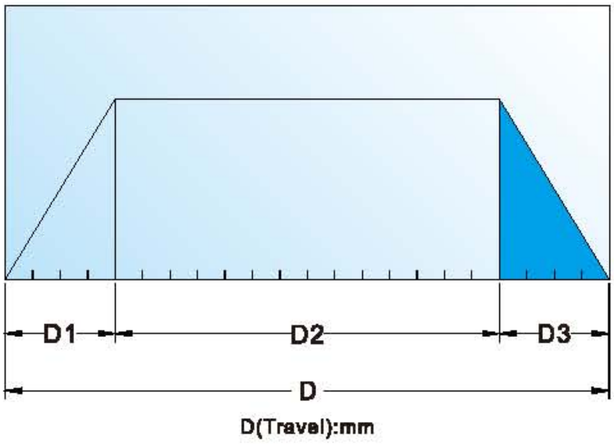
Load of the second stage D2:

$$R1(section2) = R1(W) = -45.73kgf$$
$$R2(section2) = R2(W) = 45.73kgf$$
$$R3(section2) = R3(W) = 45.73kgf$$
$$R4(section2) = R4(W) = -45.73kgf$$
$$S1(section2) = S1(W) = -40.83kgf$$
$$S2(section2) = S2(W) = 40.83kgf$$
$$S3(section2) = S3(W) = 40.83kgf$$
$$S4(section2) = S4(W) = -40.83kgf$$



Load of the final stage D3:

$$R1(section3) = R1(W) + R1(-A) = -43.4kgf$$
$$R2(section3) = R2(W) + R2(-A) = 43.4kgf$$
$$R3(section3) = R3(W) + R3(-A) = 43.4kgf$$
$$R4(section3) = R4(W) + R4(-A) = -43.4kgf$$
$$S1(section3 = S1(W) + S1(-A) = -38.75kgf$$
$$S2(section3) = S2(W) + S2(-A) = 38.75kgf$$
$$S3(section3) = S3(W) + S3(-A) = 38.75kgf$$
$$S4(section3) = S4(W) + S4(-A) = -38.75kgf$$



2-5 Calculation of equivalent load

The contact arc between a rail and a block decides the ratio of those forces from horizontal and vertical directions which happening to the block. Equivalent load means the maximum force that the groove could take. It needs to have the vertical and horizontal forces to calculate the euivalent load, and distribute it by different directions. For instance, the load of 45° design is the absolute value of horizontal force plus the absolute value of vertical force.

Rn: Divided vertically load

Sn: Divided horizontally load

Equivalent load Re comes from:

Re = │Rn│+│Sn│

Value of equivalent load of Zone A:

Re1(section A),Re2(section A),Re3(section A)& Re4(section A)

Re1(section A)=│R1(section A)│+│S1(section A)│=90.97kgf

Re2(section A)=│R2(section A)│+│S2(section A)│=90.97kgf

Re3(section A)=│R3(section A)│+│S3(section A)│=90.97kgf

Re4(section A)=│R4(section A)│+│S4(section A)│=90.97kgf

Value of equivalent load of Zone B:

Re1(section B),Re2(section B),Re3(section B) & Re4(section B)

Re1(section B)=│R1(section B)│+│S1(section B)│=86.56kgf

Re2(section B)=│R2(section B)│+│S2(section B)│=86.56kgf

Re3(section B)=│R3(section B)│+│S3(section B)│=86.56kgf

Re4(section B)=│R4(section B)│+│S4(section B)│=86.56kgf

Value of equivalent load of Zone C:

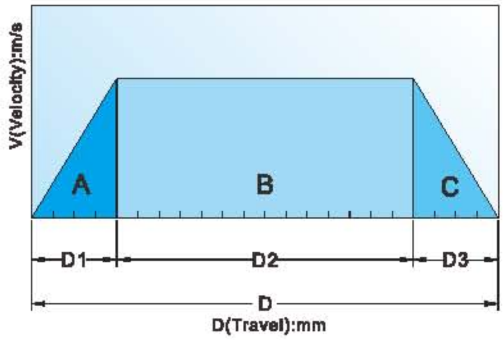
Re1(section C), Re2(section C), Re3(section C) & Re4(section C)

Re1(section C)=│R1(section C)│+│S1(section C)│=82.15kgf

Re2(section C)=│R2(section C)│+│S2(section C)│=82.15kgf

Re3(section C)=│R3(section C)│+│S3(section C)│=82.15kgf

Re4(section C)=│R4(section C)│+│S4(section C)│=82.15kgf



2-6 Confirming static safety factor

definition of safety factor

Calculating fs with static load rating:

$$fs = \frac{fc \cdot C0}{\mathrm{Re}}$$

Calculating fs with permissible static moment:

$$fs = \frac{fc \cdot M0}{M}$$

Contact factor(fc)

In linear motion system, it is hard to obtain uniform load distribution in close contact installation due to moments, errors on the mounting surfaces and other factors. When two or more blocks in a rail are used in close contact, multiply basic load ratings C and C0 by the contact factors shown below.

Number of blocks in close contact	Contact factor
2	0.81
3	0.72
4	0.66
5	0.61
Normal operation	1

For example:

If BGXH20FN was taken ,Re(max) =90.97 kgf
C Basic dynamic load rating = 1463 kgf
C0 Basic static load rating = 3110 kgf
Mx Basic permissible static torque Mx = 31.4 kgf-m
My Basic permissible static torque Mx = 22.5 kgf-m
Mz Basic permissible static torque Mx = 22.5 kgf-m

fc(normal operation) = 1

$$fs = \frac{fc \cdot C0}{\mathrm{Re}} = \frac{1 \cdot 3110}{90.97} = 34.18$$

(Safety factor)

2-7 Reference of static safety factor

Reference value of static safety factor fs shown below:

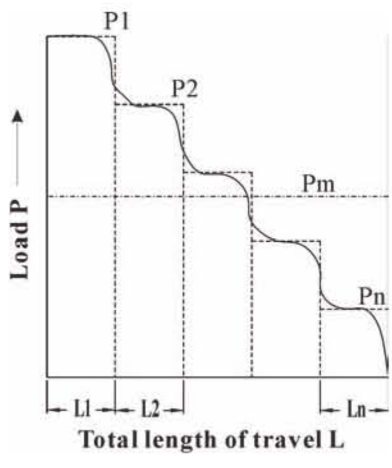
Operating condition	Load condition	Minimum fs
Normally stationary	Small impact and deflection	1.0 ~ 1.3
	Impact or twisting load are applied	2.0 ~ 3.0
Normally moving	Small impact or twisting load are applied	1.0 ~ 1.5
	Impact or twisting load are applied	2.5 ~ 5.0

2-8 Calculating mean load

Calculation of changing mean load can be diversified into the following models:

STEP LOAD:

Pm = [(P1nxL1+P2nxL2..... +PnnxLn)/L] 1/n
Pm:Mean load(kgf)
Pn:Varying load(kgf)
L:Total length of travel(mm)
Ln:Length of travel carrying Pn(mm)
n=3 when the rolling elements are balls.



$$P_m = [\frac{(P1^n \cdot L1 + P2^n \cdot L2.....Pn^n \cdot Ln)}{L}]^{\frac{1}{n}}$$

Calculation

$$P_m1=[\frac{\text{Re1}(section\_A)^3\cdot D1+\text{Re1}(section\_B)^3\cdot D2+\text{Re1}(section\_C)^3\cdot D3}{D1+D2+D3}]^{\frac{1}{n}}$$

$$P_m2=[\frac{\text{Re2}(section\_A)^3\cdot D1+\text{Re2}(section\_B)^3\cdot D2+\text{Re2}(section\_C)^3\cdot D3}{D1+D2+D3}]^{\frac{1}{n}}$$

$$P_m3=[\frac{\text{Re3}(section\_A)^3\cdot D1+\text{Re3}(section\_B)^3\cdot D2+\text{Re3}(section\_C)^3\cdot D3}{D1+D2+D3}]^{\frac{1}{n}}$$

$$P_m4=[\frac{\text{Re4}(section\_A)^3\cdot D1+\text{Re4}(section\_B)^3\cdot D2+\text{Re4}(section\_C)^3\cdot D3}{D1+D2+D3}]^{\frac{1}{n}}$$

$$P_m1=[\frac{90.97^3\cdot 1000+86.56^3\cdot 2000+82.15^3\cdot 1000}{1000+2000+1000}]^{\frac{1}{3}}=86.68kgf$$

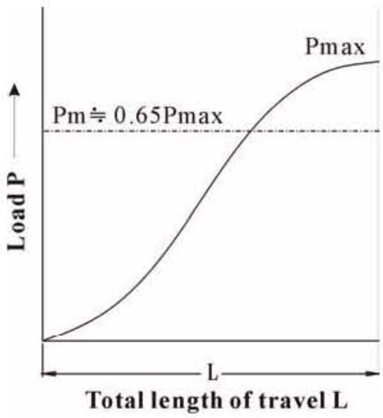
$$P_m2=[\frac{90.97^3\cdot 1000+86.56^3\cdot 2000+82.15^3\cdot 1000}{1000+2000+1000}]^{\frac{1}{3}}=86.68kgf$$

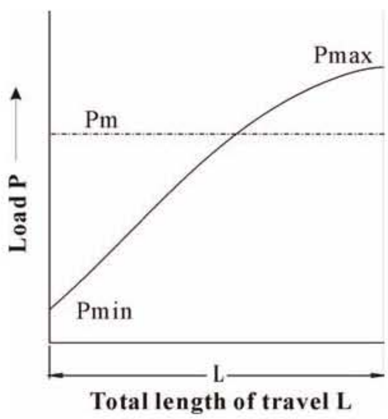
$$P_m3=[\frac{90.97^3\cdot 1000+86.56^3\cdot 2000+82.15^3\cdot 1000}{1000+2000+1000}]^{\frac{1}{3}}=86.68kgf$$

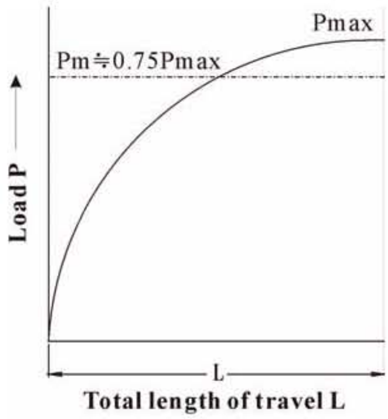
$$P_m4=[\frac{90.97^3\cdot 1000+86.56^3\cdot 2000+82.15^3\cdot 1000}{1000+2000+1000}]^{\frac{1}{3}}=86.68kgf$$

Linear pattern of load

Pm ≒ (Pmin+2xPmax)/3
Pmim:Minimum load(kgf)
Pmax:Maximum load(kgf)







2-9 Calculating nominal life

Equation: $$L=\left(\frac{fh\cdot fT\cdot fc}{fw}\cdot\frac{C}{P}\right)^3\cdot 50km$$

L: Nominal Life(km)
C: Basic dynamic rating load (kgf)
P: Calculated average load (kgf)
fc: Contact factor
fh: Hardness factor
ft: Temperature factor
fw: Load factor

Example:BGXH20FN
Basic dynamic rating load, C = 1463 kgf
Assumed hardness: HRC58°, fh = 1
Assumed temperature: normal, ft = 1
Assumed normal contact, fc = 1
Assumed speed: 15<V<60 m/s, fw = 1.5
Pm = 86.68 kgf

$$L=\left(\frac{fh\cdot fT\cdot fc}{fw}\cdot\frac{C}{P}\right)^3\cdot 50km=\left(\frac{1\cdot 1\cdot 1}{1.5}\cdot\frac{1463}{86.68}\right)^3\cdot 50Km=71231.5km$$

Example: BGXH25FN
Basic dynamic rating load C = 2052 kgf
Assumed hardness: HRC55°, fh = 0.8
Assumed temperature: normal, ft = 1
Assumed 1 block is adjacent to the other, fc = 0.81
Assumed speed: V= 60 m/s, fw = 2
Pm = 150 kgf

$$L=\left(\frac{fh\cdot fT\cdot fc}{fw}\cdot\frac{C}{P}\right)^3\cdot 50km=\left(\frac{0.8\cdot 1\cdot 0.81}{2}\cdot\frac{2052}{150}\right)^3\cdot 50Km=4353.75km$$

2-10 Calculating life time

Formula A: calculating hour

Ln:Lifetime(h)
L:Nominal life(km)
Ls:Distance of travel(mm)
N1:Times of travel per minute(min-1)

Formula A:

$$Ln = \frac{L \cdot 10^6}{2 \cdot Ls \cdot N1 \cdot 60}$$

Formula B: calculating year

Ly:Lifetime(year)
L:Nominal life(km)
Ls:Distance of travel(mm)
N1:Times of travel per minute(min^{-1})
M:Minutes of running per hour(min/hr)
H:Hours of running per day(hr/day)
D:Days of running per year(day/year)

Formula B:

$$Ly = \frac{L \cdot 10^6}{2 \cdot Ls \cdot N1 \cdot M \cdot H \cdot D}$$

Example 1: there is a working station using linear guides with a nominal life 45000 km, how should we calculate its lifetime of use (hr)?

Known:
Ls:Distance of travel= 3000mm (mm)
N1:4 times of travel per minute(min^{-1})

$$Ln = \frac{L \cdot 10^6}{2 \cdot Ls \cdot N1 \cdot 60} = \frac{45000 \cdot 10^6}{2 \cdot 3000 \cdot 4 \cdot 60} = 31250\text{hr}$$

Example 2: there is a working station using linear guides with a nominal life 71231.5 km, how should we calculate its lifetime of use (year)?

Known:
Ls:Distance of travel=4000mm (mm)
N1:5 times of travel per minute(min^{-1})
M:Running 60 mins per hour(min/hr)
H:Running 24 hours per day(hr/day)
D:Running 360 days per year(day/year)

$$Ly = \frac{L \cdot 10^6}{2 \cdot Ls \cdot N1 \cdot M \cdot H \cdot D} = \frac{71231.5 \cdot 10^6}{2 \cdot 4000 \cdot 5 \cdot 60 \cdot 24 \cdot 360} = 3.435 year$$

2-11. Comparing with desired life

If comparing the calculated life and desired life and come up with an unacceptable difference, look back to the flow chart:

1. Confirming conditions
2. Selecting an optimal model

1. Reconfirming the conditions of use:

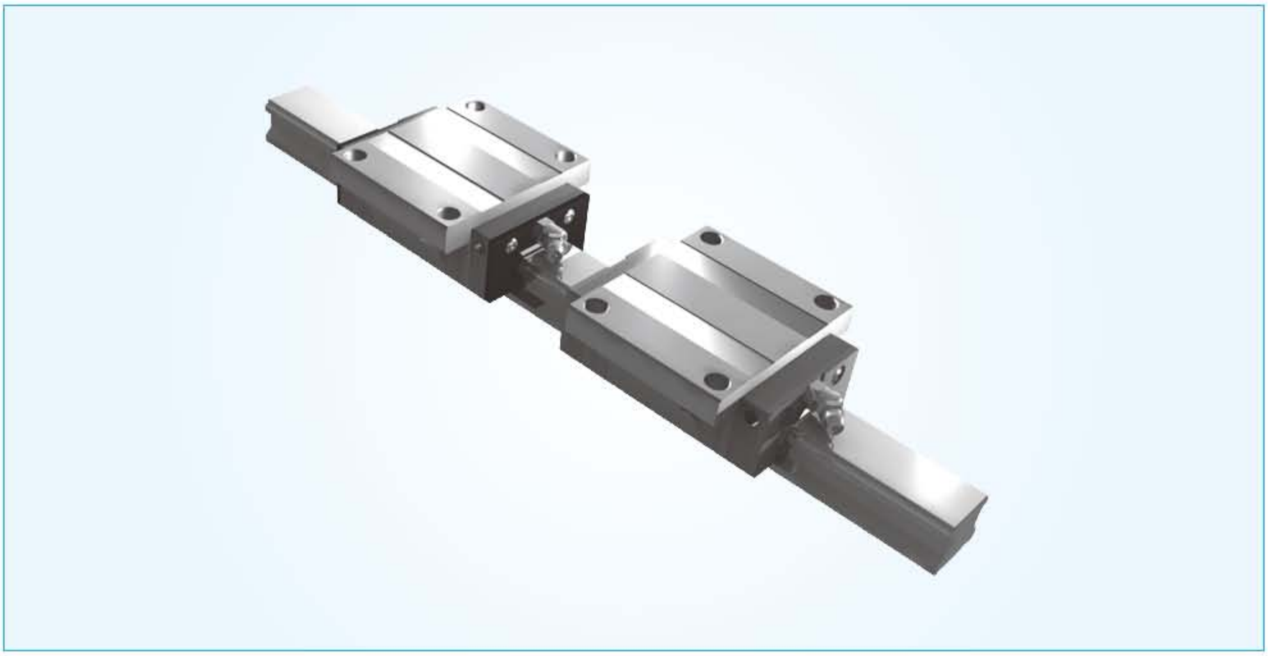
a. Composition?
   i. Distance of each two rails and blocks
   ii. Number of blocks
   iii. Number of rails

b. Mounting: how the rail is mounted onto the system?
c. Load capacity?
d. Frequency of use?

2. Selecting another model:

When conditions of use cannot be changed, select another feasible model is suggested. In addition, choosing another block of the same size with heavier load capacity is firstly recommanded. Replacing the original choice with other sizes, such as size 15 to size 20, would raise the cost and add changes to the design. Contact STAF when technical assistance is required.

2-12 Model Number Coding



BGC H 25 BN - 2 - [ ] - L - 500 - P - Z1 - II

Type Code :
- BGX : Without Cage
- BGC : With Cage

Height Type :
- H : high assembly
- S : low assembly
- X : custom assembly

Size No / mm

Flange & length type :
- BN : Normal Length without Flange
- BS : Short Length without Flange
- BL : Long Length without Flange
- BE : Extra-Long Length without Flange
- FN : Normal Length with Flange
- FS : Short Length with Flange
- FL : Long Length with Flange
- FE : Extra-Long Length with Flange

Two block per rail

Seal Type :
- [ ] : with end & side seals
- UU : just with end seals
- ZZ : with end scrapers
- DD : with double end & side seals
- KK : with double end , side seals & end scrapers
- SS : with an inner seal,side seals & end seals
- SD : with an inner seal,side seals & double end seals

Rail type :
- L : with screw hole
- C : with tapped hole

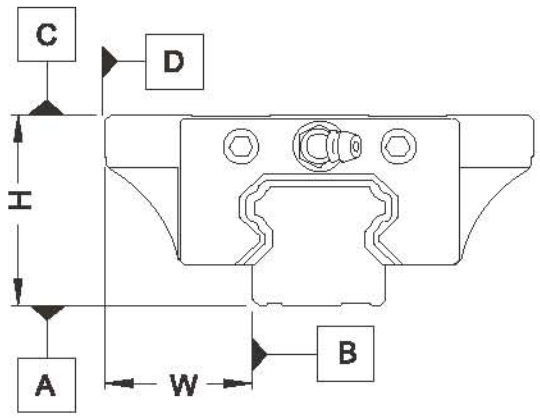
Rail length

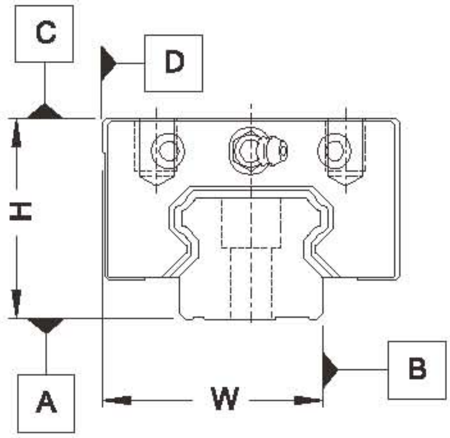
Precision :
- N : Normal
- H : High
- P : Precision
- SP : Super-precision
- UP : Ultra-precision

Preload type :
- ZF : Clearance
- Z0 : No preload
- Z1 : Light preload
- Z2 : Medium preload
- Z3 : Heavy preload

Two sets per axle

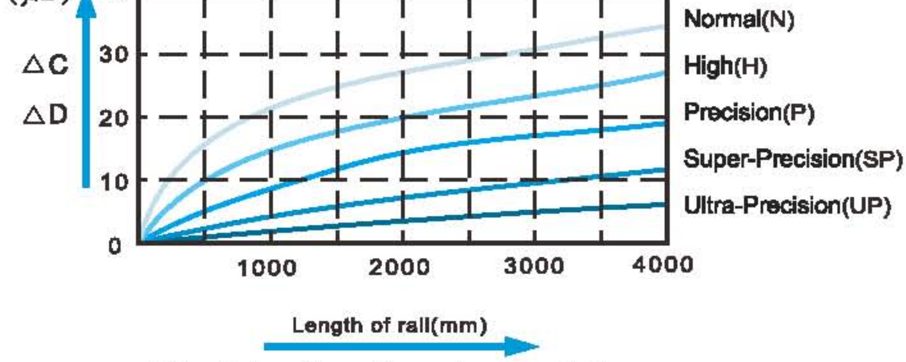
a. Accuracy standard





Unit : mm

ITEM \ GRADE	Normal (N)	High (H)	Precision (P)	Super-Precision (SP)	Ultra-Precision (UP)
Tolerance of height (H)	±0.1	±0.04	0 -0.04	0 -0.02	0 -0.01
Tolerance of width (W)	±0.1	±0.04	0 -0.04	0 -0.02	0 -0.01
Difference of heights (△H)	0.03	0.02	0.01	0.005	0.003
Difference of widths (△W)	0.03	0.02	0.01	0.005	0.003
Running parallelism of BR Block surface C with respect to surface A	△ C Refer to the below Fig. BG rail length and running parallelism				
Running parallelism of BR Block surface D with respect to surface B	△ D Refer to the below Fig. BG rail length and running parallelism				



BG rail length and running parallelism

b. Choosing preload

Replacing larger rolling elements helps strengthening the entire rigidity of the carriage while there exists clearance within ball circulation.

Preload	Slight clearance/ no preload (ZF/ Z0)	Light preload (Z1)	medium/ heavy preload (Z2/ Z3)
Conditions of use	1. Light corrosion 2. 2 parallel axes 3. Low accuracy 4. Low friction 5. Light load	1. Cantilever 2. Mono axis. 3. Light load 4. High accuracy	1. Heavy corrosion 2. Severe vibration 3. Heavy cutting
Application	1. Welding machine 2. Cutting machine 3. Feeder 4. ATC 5. X & Y axis 6. Packaging machine	1. NC Lathe 2. EDN 3. Precision XY table 4. Robotic manipulator 5. Z axis 6. PCB drilling machine	1. Machine center 2. NC Lathe 3. Milling machine 4. Grinding wheel feed shaft

Increasing preload would diminish the vibration and reduce the corrosion caused by running back and forth. However, it would also add the workload within those rolling elements. The greater the preload, the greater the inner workload. As a result, choosing preload has to consider both how vibration and preload would effect life and conclude an optimal choice.

Preload grade

C:Basic dynamic load rating

GRADE \ ITEM	Symbol	Preload force
Clearance	ZF	0
No Preload	Z0	0
Light Preload	Z1	0.02 C
Middle Preload	Z2	0.05 C
Heavy Preload	Z3	0.07 C

Radial clearances

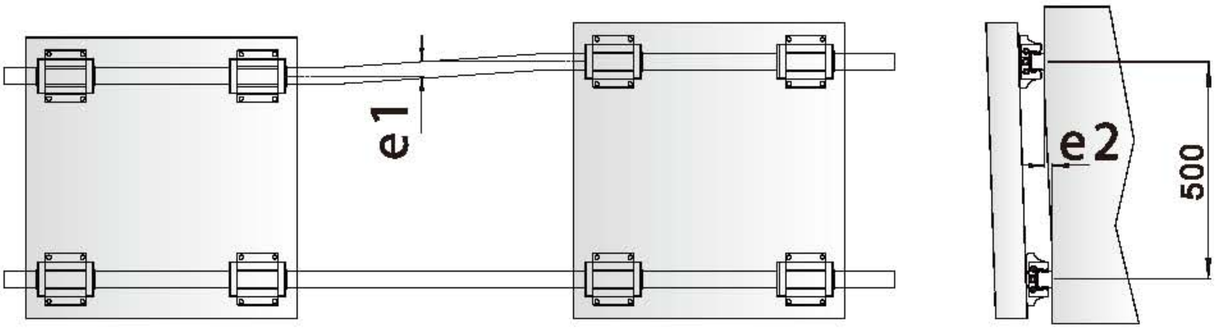
Unit:μm

Type \ Symbol	ZF	Z0	Z1	Z2	Z3
BG 15	5 ~ 12	-4 ~ 4	-12 ~ -5	-20 ~ -13	-28 ~ -21
BG 20	6 ~ 14	-5 ~ 5	-14 ~ -6	-23 ~ -15	-32 ~ -24
BG 25	7 ~ 16	-6 ~ 6	-16 ~ -7	-26 ~ -17	-36 ~ -27
BG 30	8 ~ 18	-7 ~ 7	-18 ~ -8	-29 ~ -19	-40 ~ -30
BG 35	9 ~ 20	-8 ~ 8	-20 ~ -9	-32 ~ -21	-44 ~ -33
BG 45	10 ~ 22	-9 ~ 9	-22 ~ -10	-35 ~ -23	-48 ~ -36

Interchangeability

	Non - interchangeable					Interchangeable	
Accuracy	UP	SP	P	H	N	H	N
Preload	Z1 Z2 Z3	Z1 Z2 Z3	Z0 Z1 Z2 Z3	Z0 Z1 Z2	ZF Z0 Z1 Z2	Z0 Z1	ZF Z0 Z1

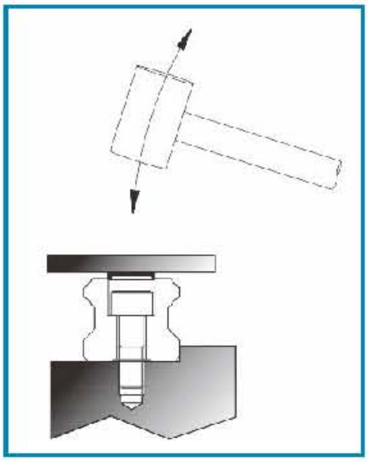
Suggested permissible difference on mounting surfuce:

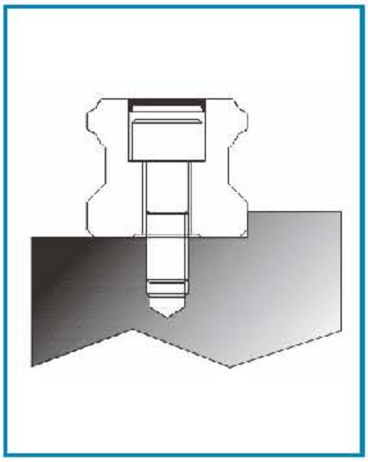


Unit:μm

ITEM	e1					e2				
	Z3	Z2	Z1	Z0	ZF	Z3	Z2	Z1	Z0	ZF
BG 15				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	110	140	170	250	350

c.Sealing for rail



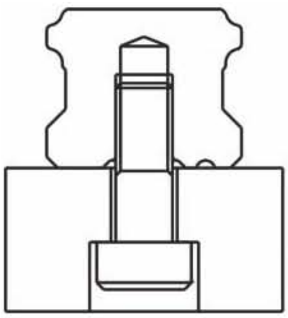


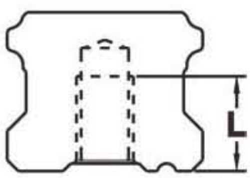
Cap:

Most chippings are blocked by end seals, but some would stay in the screw holes. Caps are accessory that can prevent the entry of chippings.

Rail with tapped holes:

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



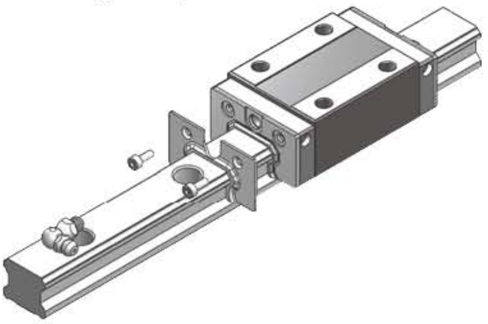


Size	Screw	Length of thread
BG15	M5	8mm
BG20	M6	10mm
BG25	M6	12mm
BG30	M8	15mm
BG35	M8	17mm
BG45	M12	24mm

d. Accessorries of block

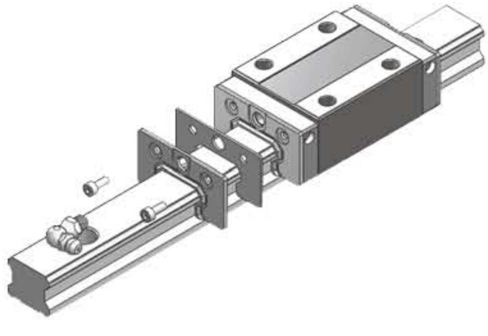
SCRAPERS:

Mainly used in metal cutter or cutting machine to protect the linear guide from iron chippings. Separating the end seal away from the high temp contaminant.



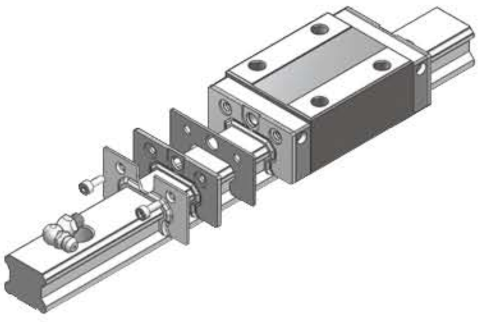
DOUBLE END SEALS:

The outside seal cuts off most of the dust.The inside seal blocks the rest and secures the dust proof system.



SCRAPER + DOUBLE END SEALS:

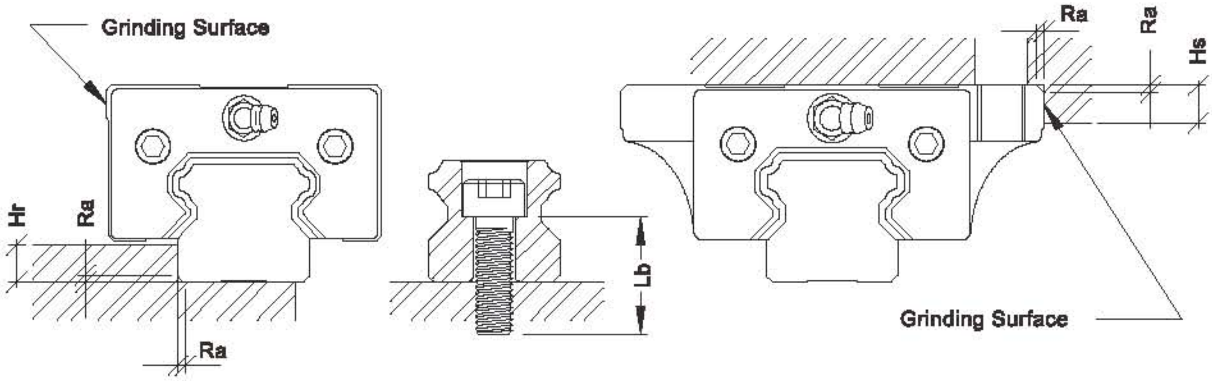
This is the consolidation of the above two.



Coding of seal	end seal	side seal	inner seal (top seal)	double end seal (double front seal)	scraper (metal front shield)
Not specified	V	V			
UU	V				
ZZ	V	V			V
DD		V		V	
KK		V		V	V
SS	V	V	V		
SD		V	V	V	

III. MOUNTING A STAF LINEAR GUIDE

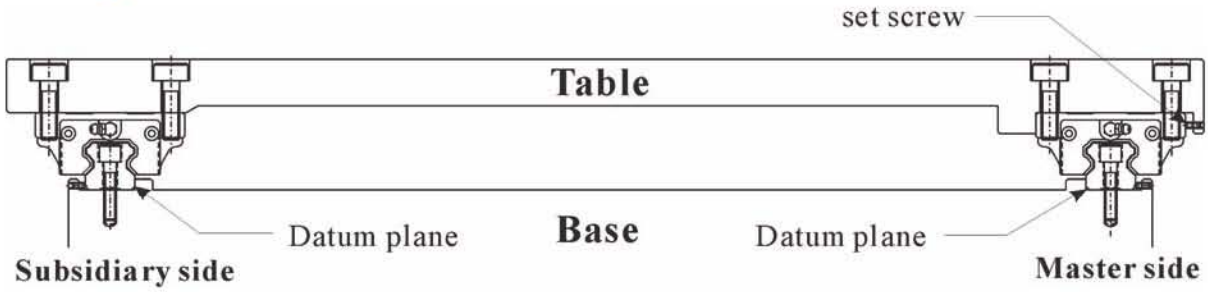
3-1 Dimensions which matter:



Unit : mm

ITEM	Maximum Fillet (Ra)	Maximum Height (Hr) rail shoulder	Maximum Height (Hs) block shoulder	Rail Bolt Length (Lb) suggestion
BG 15	0.6	2.8	5	M4*16
BG 20	0.9	4.3	6	M5*20
BG 25	1.1	5.6	7	M6*25
BG 30	1.4	6.8	8	M8*30
BG 35	1.4	7.3	9	M8*30
BG 45	1.6	8.7	12	M12*35

Mounting procedure



Features of the shown example:

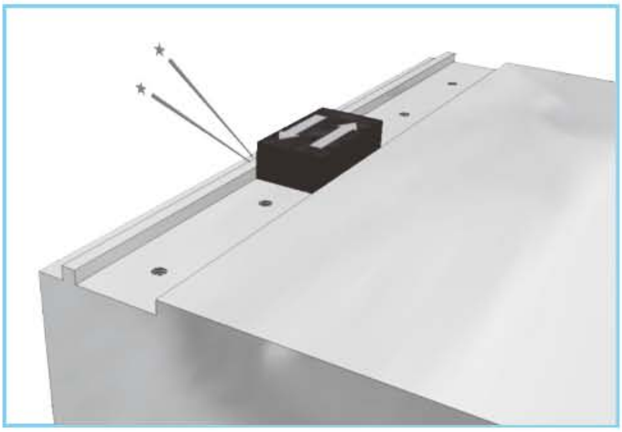
1.Two datum planes on a fixed base.

2.The table has a lateral datum surface and set screws.

3-2 Mounting Procedure

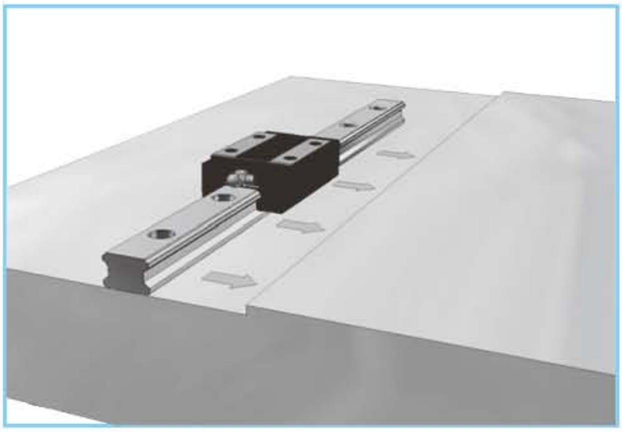
Step 1 Remove dents, burrs and dirt on mounting surfaces.

Attention: Degreasing the rust-proof oil on the platform before installation is suggested; then apply a moderate amount of lubricant with slight viscosity on when installation is done.



Step 2 Place rail against the shoulder of mounting surfaces.
Tighten the mounting bolts lightly.

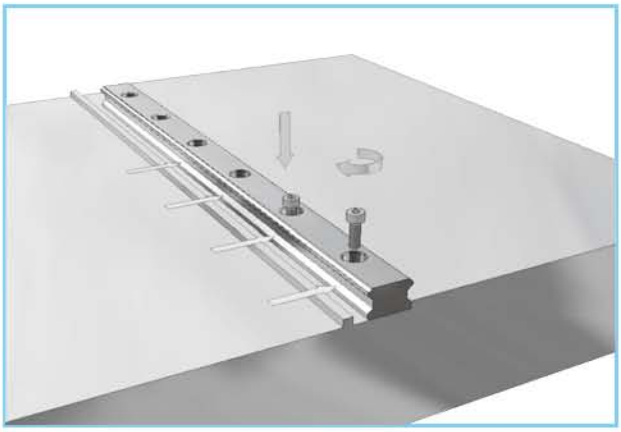
Attention: i. check holes on rail are aligned with the screw holes on mounting surfaces.
ii. do not tighten bolt if the holes are not aligned.



Step 3 Tighten the mounting bolts lightly.

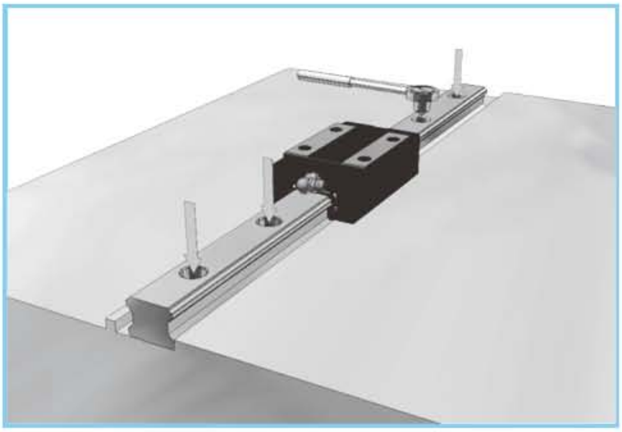
Attention: i. check holes on rail are aligned with the screw holes on mounting surfaces.

ii. do not tighten bolt if the holes are not aligned.



Step 4 Tighten the rail set screws.

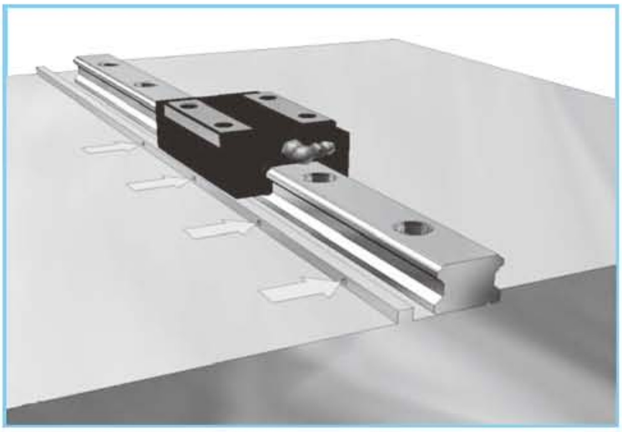
Attention: i. when tightening the mounting bolts, start with the bolt at the longitudinal center of the rail and move towards both rail ends.



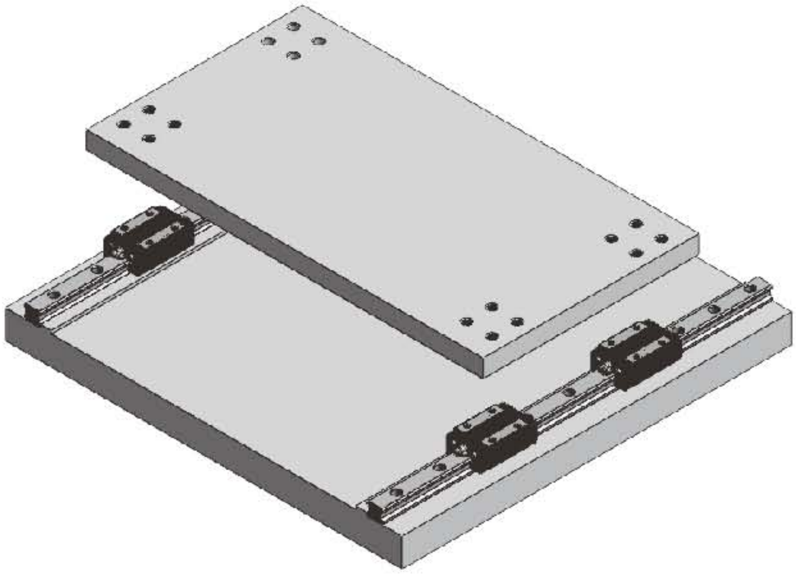
Tightening torque of screw

Screw size	Tightening torque (kgf*cm) – hexagonal socket screw		
	Steel	Cast Iron	Aluminum
M2	6.3	4.2	3.1
M2.3	8.4	5.7	4.2
M2.6	12.6	8.4	6.3
M3	21	13.6	10.5
M4	44.1	29.3	22
M5	94.5	63	47.2
M6	146.7	98.6	73.5
M8	325.7	215.3	157.5
M10	724.2	483.2	356.7
M12	1264.2	840	630
M14	1682.1	1125	840
M16	2100	1403.5	1050

Step 5 Mount the other rail in the same way.

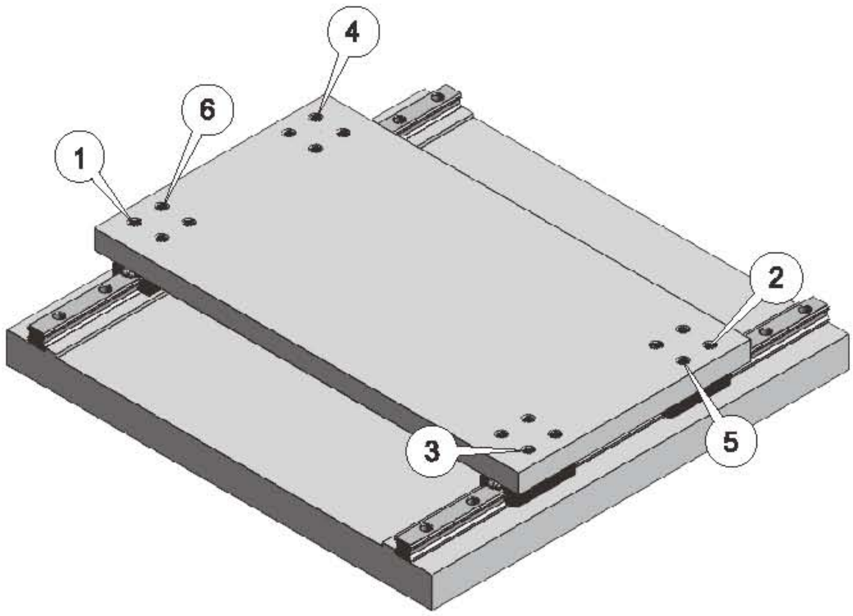


Step 6 **Position the working table onto the master and subsidiary profile rails.**

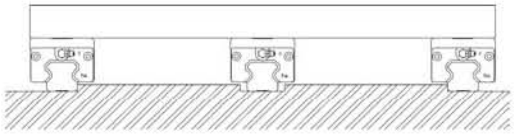


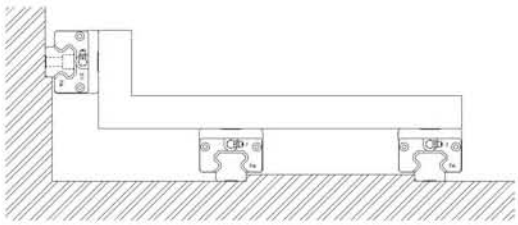
Step 7 **Tighten the mounting bolts on the master and subsidiary blocks.**

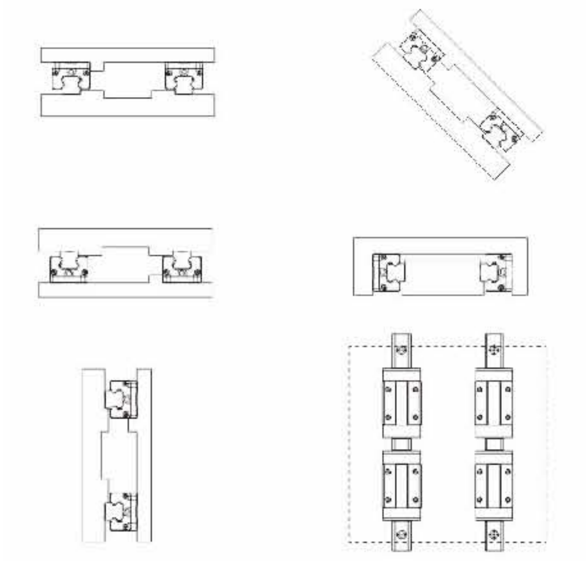
Attention: I. Tighten the mounting bolts in the following sequence.

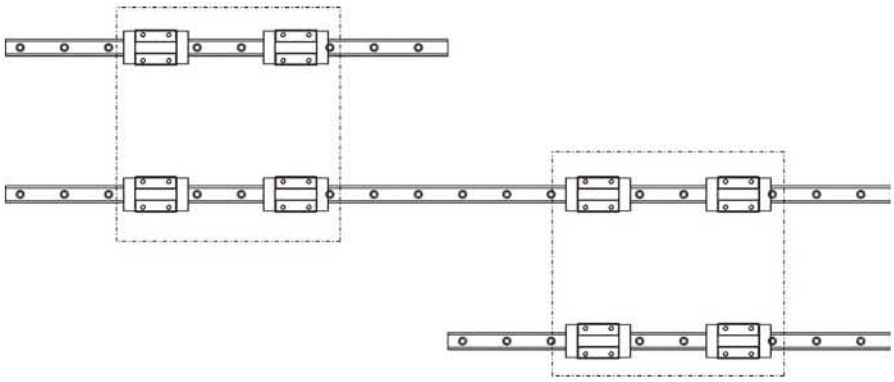


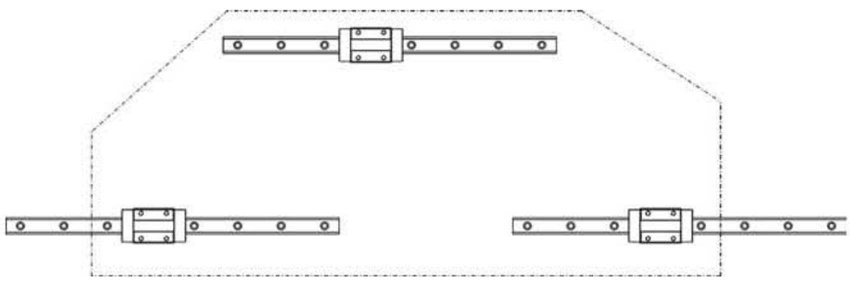
3-3 Common installations



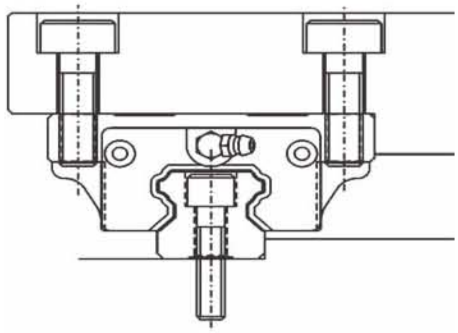


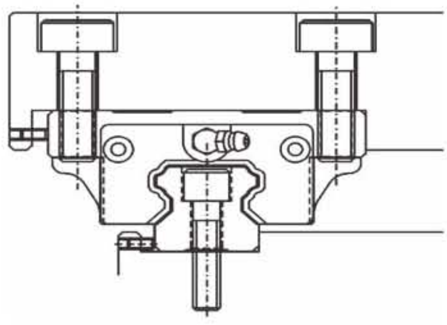


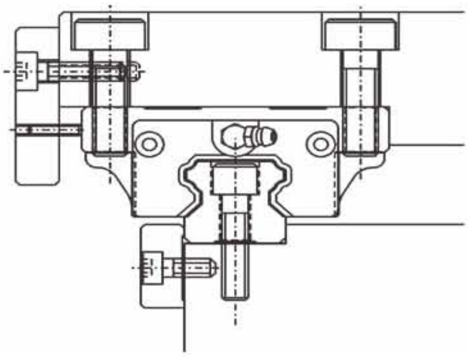


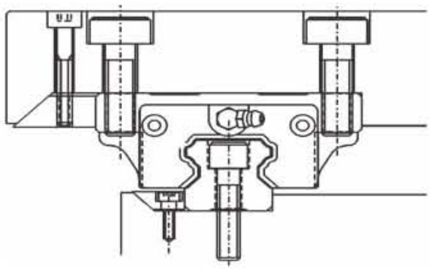


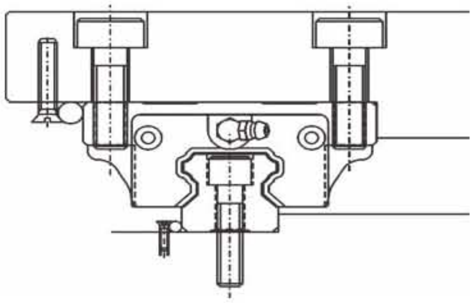
3-4 Common applications to fix carriages

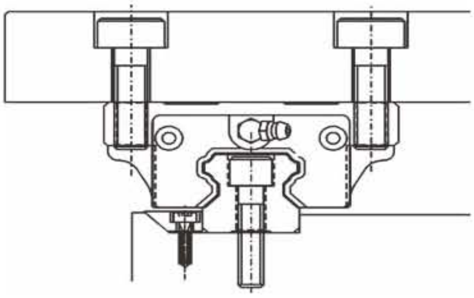


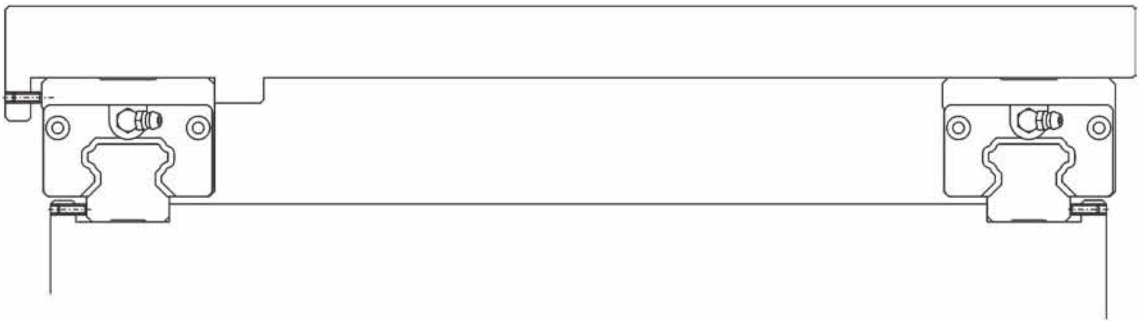






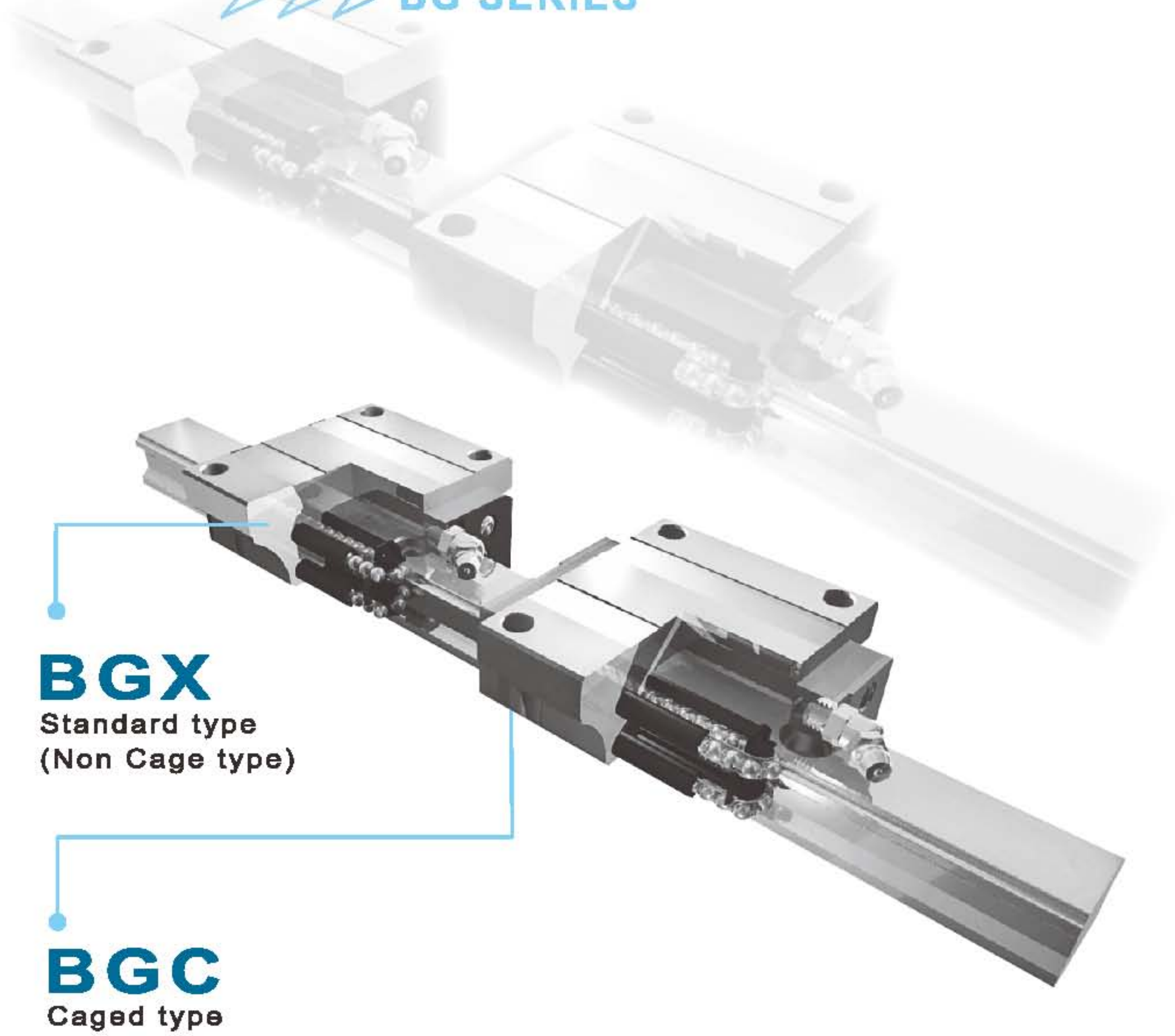






STAF LINEAR GUIDE

BG SERIES



BGX

STANDARD TYPE

Normal Length with Flange

Normal Length without Flange

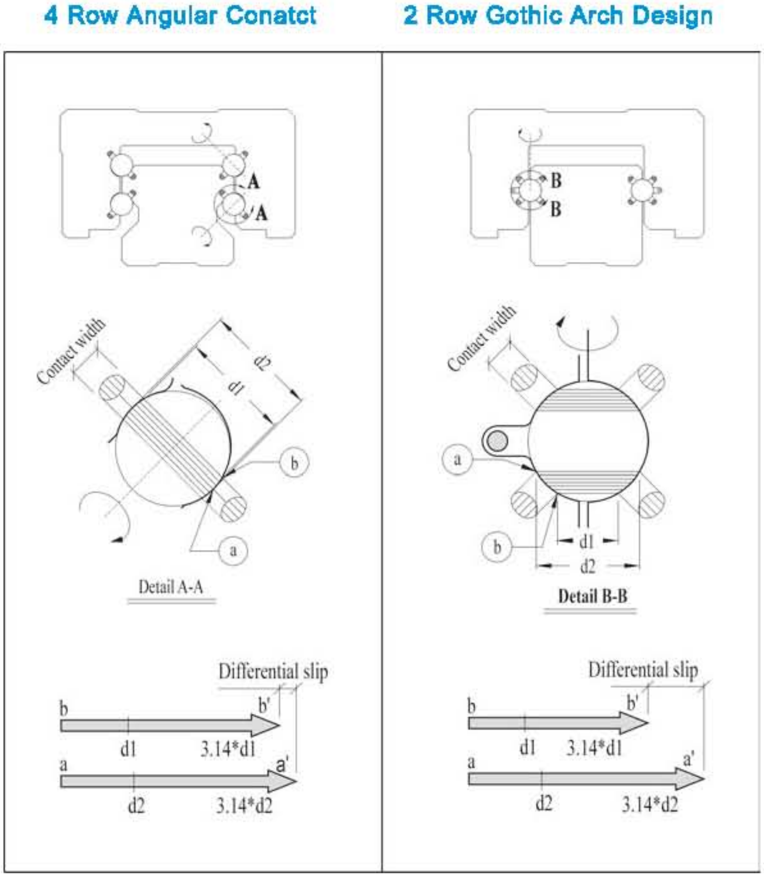
IV. STAF LINEAR GUIDE

4-1. BGX Standard type (Non-caged type)

a.BGX 4 Row angular contact

4 rows of balls make 45° contact between the block and the rail at 4 points which balance the forces from all directions. No matter how a rail is set up, such equivalent-load charicteristic can be widely applied in most type of machines. Comparing with Gothic 2-row design, 4-row structure has better stiffness, higher precision and longer life due to its ability of adjusting self-center, even though a huge difference exists on the working platform or within the assembly itself.

4 Row Angular Conatct V.S. 2 Row Gothic Arch Design



Strenths:

1. Smooth running
2. Low friction
3. Heavy nominal load
4. Good stability

b. BGX Sealing

Particles are the commonest reason that shortens a life of a linear guide system.They cause balls jumping in the circulation system or even a permanent damage. STAF's sealing system divides into upper sealing and bottom sealing to prevent the entry of particles.

Common entry of dust:

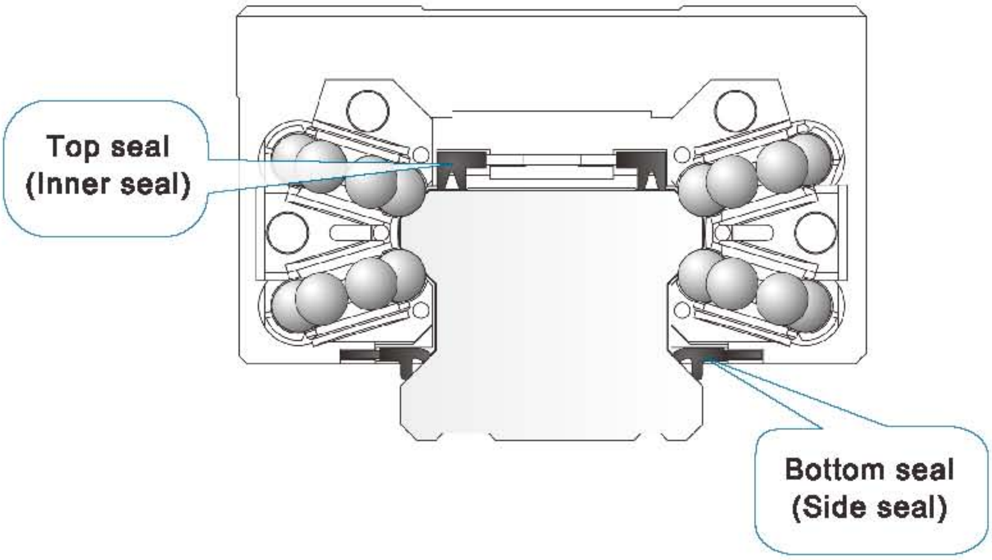
1.Screw hole:

Dust gets in due to vibration or machine movement.

2.Gap between a block and a rail

Gap between a block and a rail: Larger chippings or dusts are easy to enter the circulation system from this position. This happens mostly to long type or extra long type blocks.

To prevent the above two situations from happening, the sealing can be divided into two categories: inner seal (upper seal) and bottom seal (side seal).



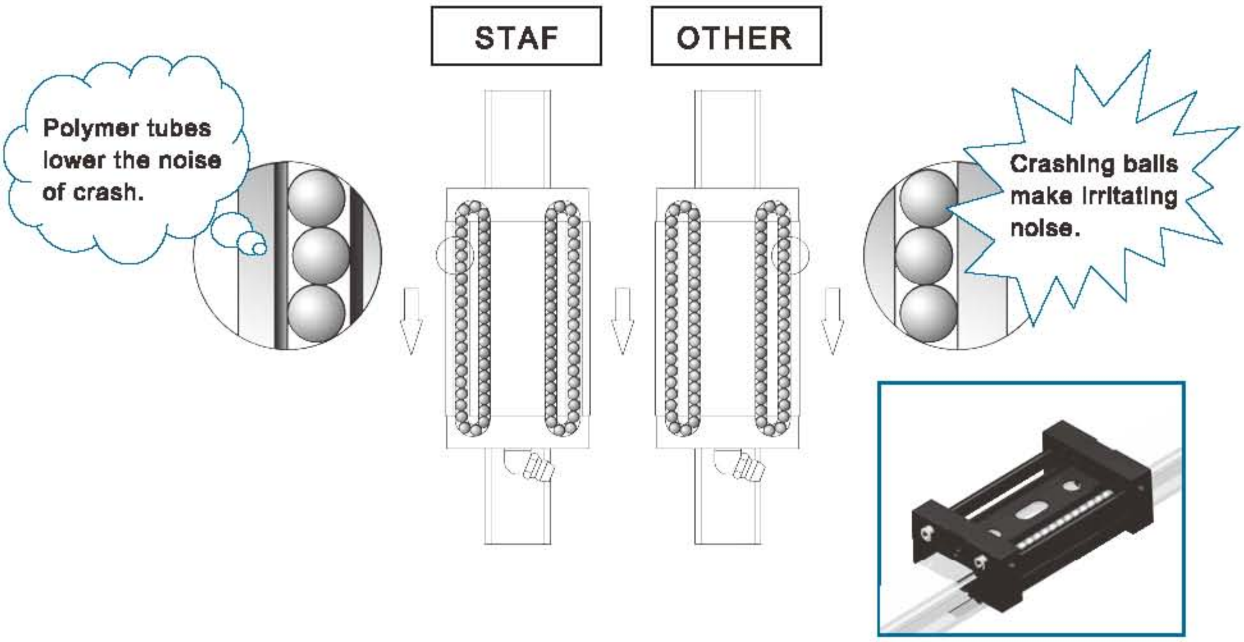
Top seal:

Using rubber scraper to cover the screw holes to prevent the entry of particles.

Bottom seal:

Nitrile rubber made seals cover the gap to secure the ball circulation system.

c. BGX Circulation tube



Polymer tubes lower the noise making from running blocks

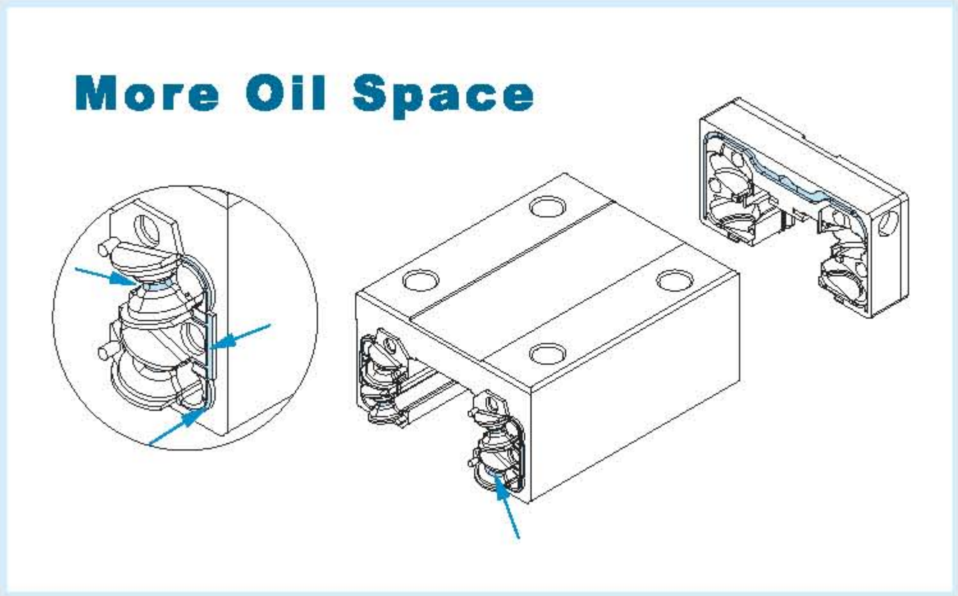
Strenths:

1.Polymer tubes absorb the noise that is from the ball circulation.

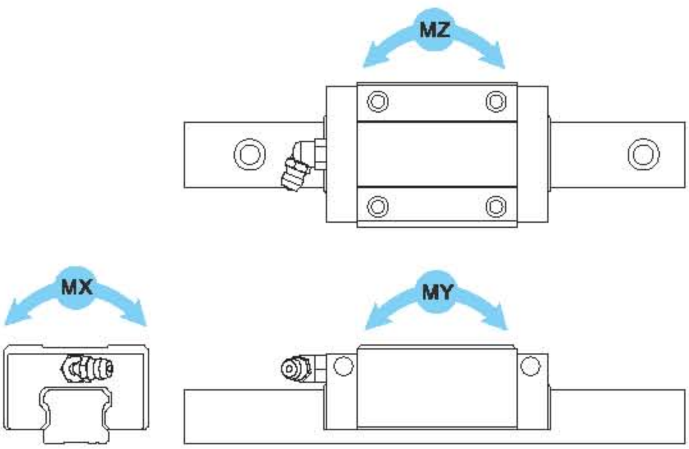
2.Polymer tubes enhance the effectiveness of lubricant.

3.Isolating the contact between balls and metal parts.

d. BGX Oil space design



BGX circulation system preserves more space to contain lubricant. When the circulation starts, lubricant can be brought throughout the system. When the circulation stops, lubricant flow back to the oil space again.



e. BGX Static nominal moment

As far as load is concened, single rail is different from a pair. It takes 3-axis moment to calculate the load applied to one single rail.

BGX Static nominal moment

Unit:Kg-m

Model	Basic permissible static moment		
	MX	MY	MZ
BGXH15BN	13.8	12.0	12.0
BGXH20BN	29.1	22.5	22.5
BGXH20BL	37.7	36.8	36.8
BGXH25BN	44.9	35.9	35.9
BGXH25BL	57.8	57.9	57.9
BGXH25BE	69.3	83.6	83.6
BGXH30BN	72.1	56.2	56.2
BGXH30BL	93.3	83.8	83.8
BGXH30BE	114.5	136.4	136.4
BGXH35BN	130.8	99.2	99.2
BGXH35BL	163.5	142.5	142.5
BGXH35BE	202.1	233.2	233.2
BGXH45BN	234.7	155.5	155.5
BGXH45BL	279.2	216.5	216.5
BGXH45BE	351.9	344.8	344.8
BGXH15FN	13.8	12.0	12.0
BGXH15FL	16.7	17.2	17.2
BGXH20FN	29.1	22.5	22.5
BGXH20FL	37.7	36.8	36.8
BGXH25FN	44.9	35.9	35.9
BGXH25FL	57.8	57.9	57.9
BGXH25FE	69.3	83.6	83.6
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BGXH30FE	114.5	136.4	136.4
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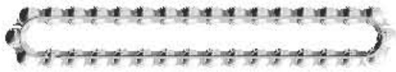
BGXH35FL	163.5	142.5	142.5
BGXH35FE	202.1	233.2	233.2
BGXH45FN	234.7	155.5	155.5
BGXH45FL	279.2	216.5	216.5
BGXH45FE	351.9	344.8	344.8

Model	Basic permissible static moment		
	MX	MY	MX
BGXS15BS	6.9	3.3	3.3
BGXS15BN	13.8	12.0	12.0
BGXS15BL	16.7	17.2	17.2
BGXS20BS	14.9	6.6	6.6
BGXS20BN	29.1	22.5	22.5
BGXS25BS	23.0	10.3	10.3
BGXS25BN	44.9	35.9	35.9
BGXX25BN	44.9	35.9	35.9
BGXX25BL	57.8	57.9	57.9
BGXX25BE	69.3	83.6	83.6
BGXS30BS	35.7	15.3	15.3
BGXS30BN	72.1	56.2	56.2
BGXS30BL	93.3	83.8	83.8
BGXS30BE	114.5	136.4	136.4
BGXS35BS	65.6	27.5	27.5
BGXS35BN	130.8	99.2	99.2
BGXS35BL	163.5	142.5	142.5
BGXS35BE	202.1	233.2	233.2
BGXS45BN	234.7	155.5	155.5
BGXS45BL	279.2	216.5	216.5
BGXS45BE	351.9	344.8	344.8

BGC



CAGED TYPE

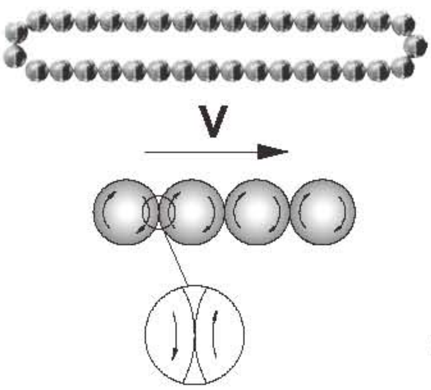
Caged Type with Flange

Caged Type without Flange

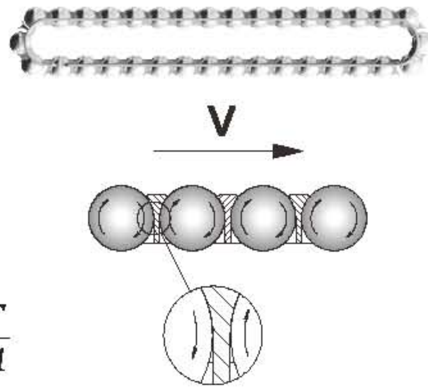
4-2. BGC Caged type

a. BGC High speed feature

In the traditional design of linear guide, the steel balls whirl between the rail and the block. On the contact point of balls, the rotational rate is twice as high as the rate of each ball. In addition, for the traditional type of linear guide, the type of contact for balls is point contact. The contact area A is so small that the contact pressure (P) approaches the infinity (P= Pushing between the steel balls (F)/ the contact area A). Therefore, the balls for the traditional type have worn easily. However, for BGC type, the oil membranes exist in the balls. This type can be used in high speed because the friction of balls is soaked by the oil membranes.



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



P: Contact pressure for the steel balls F: Interaction among the steel balls A: Contact area of the steel balls

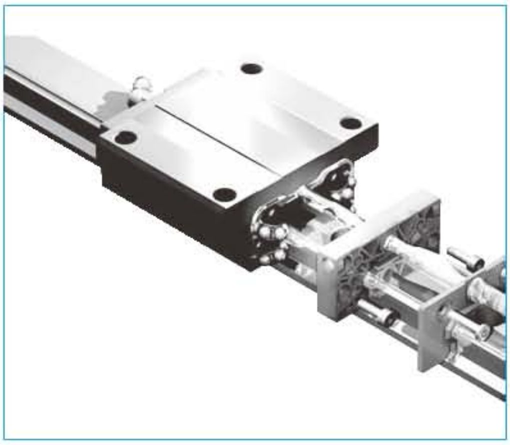
As the drawing in left hand, for the traditional type of linear guide, one steel ball rubs against another one! Among the balls, the rotational rate is twice as high as the moving rate of each ball. Moreover, among them, the type of contact is point contact. Therefore, the contact area of balls is very small, and the contact of balls causes the friction in high speed and under high pressure.

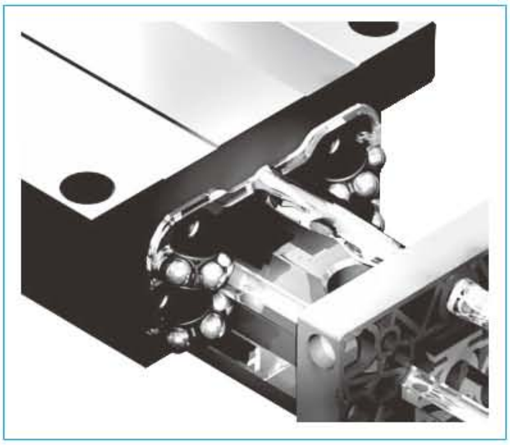
For BGC type, there is a cage among the balls. The cage is facile to keep the oil and to create the oil membranes. In addition, the friction of balls is soaked by the oil membranes. Therefore, the design of the cage makes the blocks of BGC type applicative in high speed.

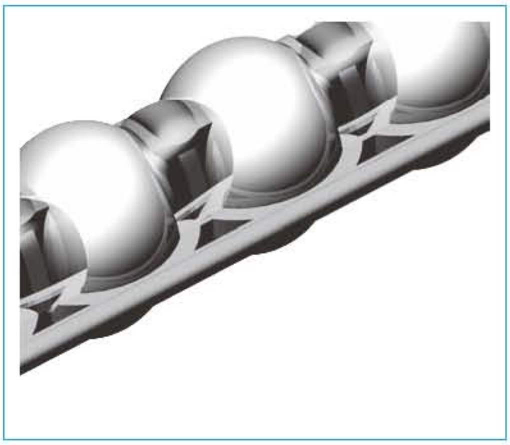
Among the steel balls of BGC type, there is a contact of cage with oil membranes except the rotational contact of balls. The rotational speed of friction in traditional type is twice faster than the one in BGC type. The point contact of balls is for traditional type; the contact of oil membranes for BGC type. Thus, the contact pressure in tradition type is much higher than BGC type. According to the reasons listed as above, the friction speed and the pressure in BGC type are much lower than the ones in traditional type. Therefore, comparing the heating condition, the heat in BGC type is lower than the one in traditional type.

b. BGC Cage drives grease

In the design of BGC type, pouring the grease into the access of injection can enhance the grease effect by the circulation of cage. It is assured that the life time for BGC type is better than the one for the traditional type, even than the other caged types.







As the above drawing, the oil membranes are facile to attach between cage and balls.

The particular design for BGC type is with cage. There is more space for grease. The movement of cage takes the grease which attaches the cage to the surface of the cycle. In the static condition, the lost of oil in BGC type is less than the one in traditional type.

For the traditional type, it is liable to lose the oil in the procedure of operation because of the contact among the balls. Moreover, losing the oil causes the friction, the noise and the heating as well. In BGC type, the development is aimed at this defect. For the entire effect of this type, it promotes the life time and the quality of linear guide.

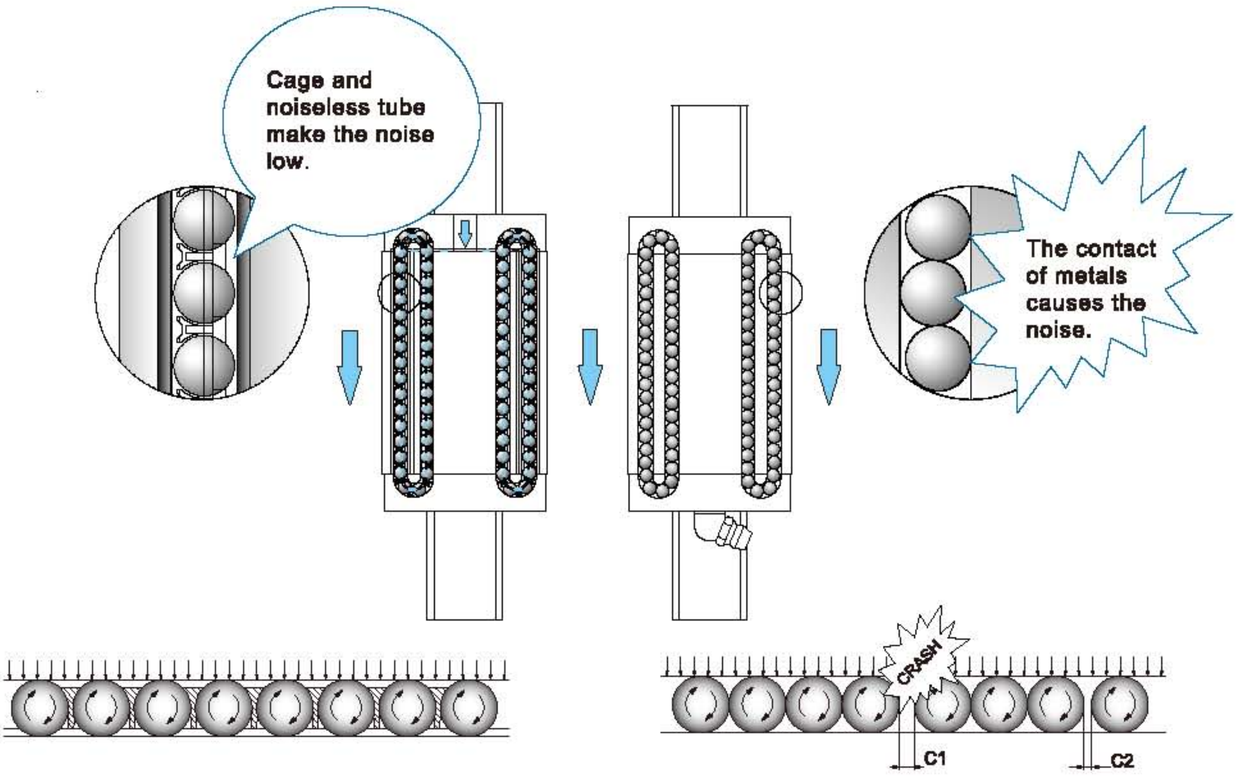
c. BGC Low noise

The factors of causing much noise in traditional type are as below:

1. On the contact point of balls, the rotational speed is twice higher than the one for BGC type.
2. The contact of balls is point contact, and their pressure of contact surface is high. Thus, the friction is more than the one of BGC type.

Key factor which brings the noise:

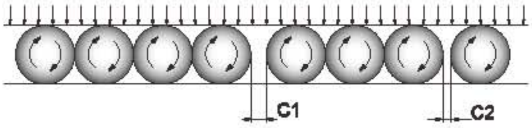
In traditional type, the contact of balls belongs to a direct hit contact and causes the sharp noise. However, for BGC type, the noise is mostly soaked by the cage and the grease. Thus, the noise of BGC type is much lower than the one of traditional type. Tubes lower the noise making from running blocks.



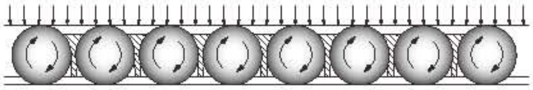
While the rotational speed of balls is different due to their movements in high speed, it will cause a chase effect. In traditional type, the hit of balls causes much noise. Moreover, the cage for BGC type belongs to a macromolecule, and the design of cage includes the oil space. In addition, because of flexibility of cage and grease served as the buffer, the noise is mostly eliminated.

d. BGC Equal load capacities

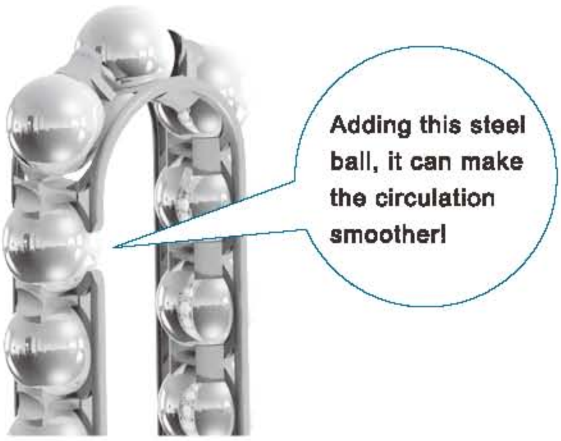
In traditional type, the equal distance of balls cannot be achieved. It is liable to cause an irregular clearance and makes the force unbalanced. The life time of balls that are forced equally in long term is lower. However, in BGC type, the cage is used to set the interval same. Therefore, each ball is forced equally and has a steady life time.



As the above drawing
In traditional type, the distance of balls cannot be equal. It is liable to cause an irregular clearance and an unbalanced force.



As the above drawing
In BGC type, the cage functions as a setter for the equal distance of balls. Regarding the frequency of causing the irregular clearance, the one of BGC type is lower than the one of the traditional type. Thus, for BGC type, the life time is steadier.

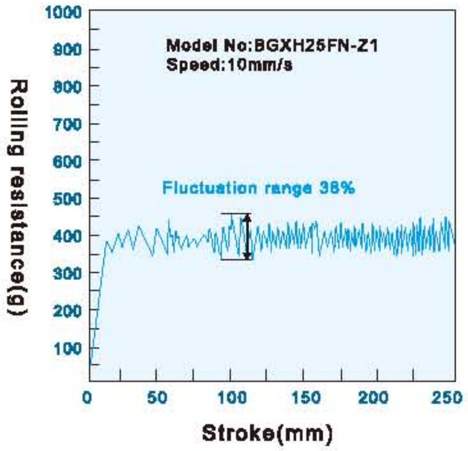


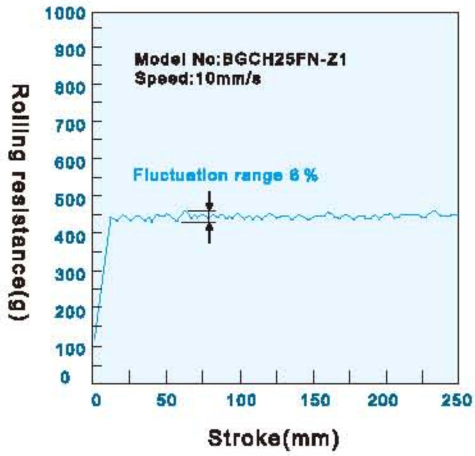
e. BGC Cage

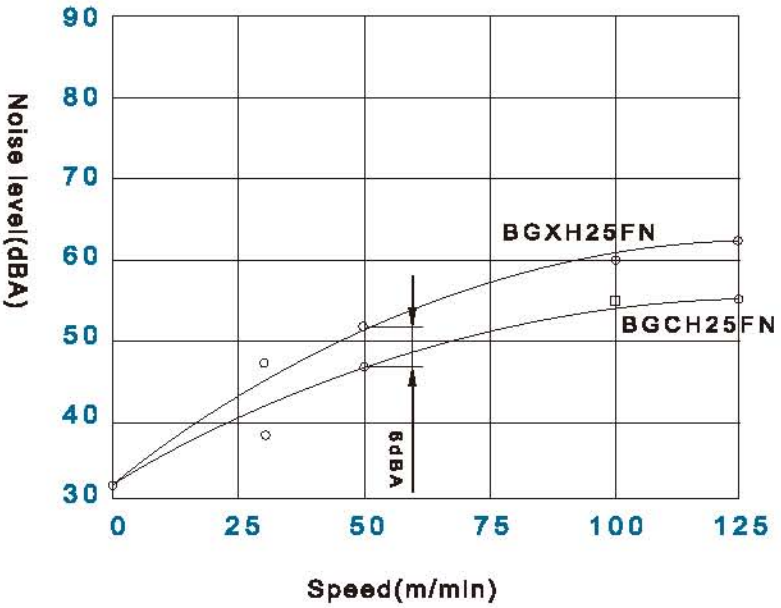
The linear guide is designed with interval chips. Because of the different principals of chip appearance and of chip procedure, it is difficult to distribute the circulation completely. In the end of cycle, it has a left space about one or half ball. However, the design of BGC type overcomes this issue. It not only distributes equally the circulation, makes the force more balanced and smoother, but also makes the lift time of whole product steadier.

Low noise　　Low vibration

Only 1/6～1/10 Fluctuation range for caged blocks



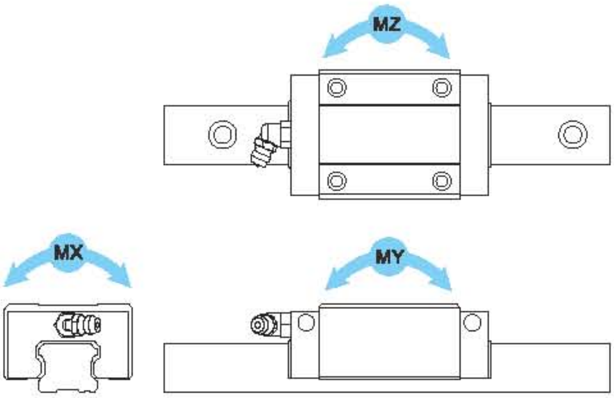




f. BGC Chart of comparison

Applied limit	BGC type	Traditional type
Applied speed	Suitable for high speed	Unsuitable for high speed
Maintenance	Facile to maintain the oil membrane	Hard to maintain the oil membrane
Noise	Hard to cause the noise	Liable to cause the noise
Heating	Hard to heat	Liable to heat
Force	Balanced force	Unbalanced force

g. BGC Static nominal moment:



As far as load is concened, single rail is different from a pair. It takes 3-axis moment to calculate the load applied to one single rail.

Unit:kgf-m

Model	Basic permissible static moment		
	MX	MY	MZ
BGCH15BN	13.8	12.0	12.0
BGCH20BN	29.1	22.5	22.5
BGCH20BL	37.7	36.8	36.8
BGCH25BN	44.9	35.9	35.9
BGCH25BL	57.8	57.9	57.9
BGCH25BE	69.3	83.6	83.6
BGCH30BN	72.1	56.2	56.2
BGCH30BL	93.3	83.8	83.8
BGCH30BE	114.5	136.4	136.4
BGCH35BN	130.8	99.2	99.2
BGCH35BL	163.5	142.5	142.5
BGCH35BE	202.1	233.2	233.2
BGCH45BN	234.7	155.5	155.5
BGCH45BL	279.2	216.5	216.5
BGCH45BE	351.9	344.8	344.8

Model	Basic permissible static moment		
	MX	MY	MZ
BGCH15FN	13.8	12.0	12.0
BGCH15FL	16.7	17.2	17.2
BGCH20FN	29.1	22.5	22.5
BGCH20FL	37.7	36.8	36.8
BGCH25FN	44.9	35.9	35.9
BGCH25FL	57.8	57.9	57.9
BGCH25FE	69.3	83.6	83.6
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BGCH35FL	163.5	142.5	142.5
BGCH35FE	202.1	233.2	233.2
BGCH45FN	234.7	155.5	155.5
BGCH45FL	279.2	216.5	216.5
BGCH45FE	351.9	344.8	344.8
BGCS15BS	6.9	3.3	3.3
BGCS15BN	13.8	12.0	12.0
BGCS15BL	16.7	17.2	17.2
BGCS20BS	14.9	6.6	6.6
BGCS20BN	29.1	22.5	22.5
BGCS25BS	23.0	10.3	10.3
BGCS25BN	44.9	35.9	35.9
BGCX25BN	44.9	35.9	35.9
BGCX25BL	57.8	57.9	57.9
BGCX25BE	69.3	83.6	83.6
BGCS30BS	35.7	15.3	15.3
BGCS30BN	72.1	56.2	56.2
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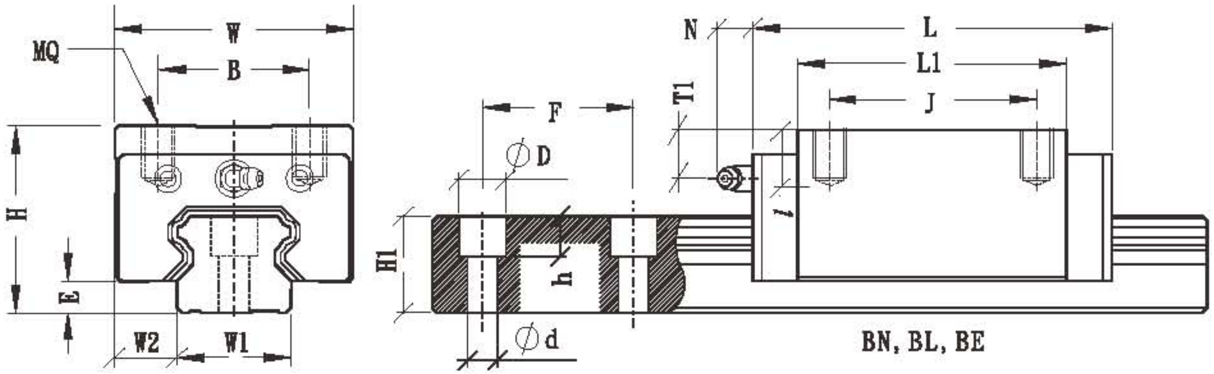
BGCS45BN	234.7	155.5	155.5
BGCS45BL	279.2	216.5	216.5
BGCS45BE	351.9	344.8	344.8

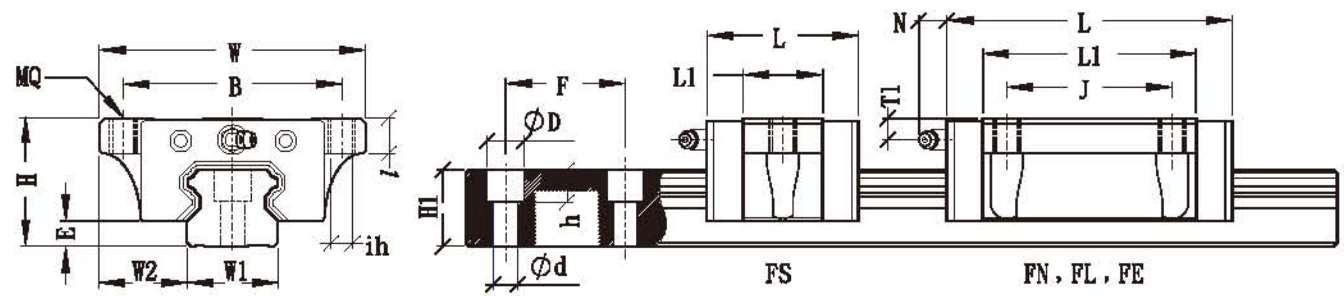
BGX SERIES BGX(H-B)Standard type



◎Please refer to P.22 for detail part number coding or contact us.

Spec. / Model	Assembly-mm				Block-mm									Rail-mm						Rating load-Kgf		Block	Rail
	H	W	W2	E	L	B	J	MQ	l	L1	Oil H	T1	N	W1	H1	F	d	D	h	C	C0	Kgf	Kgf/M
BGXH15BN	28	34	9.5	3.0	58.6	26	26	M4	6.0	40.2	M4X0.7	9.5	(5)	15	13.0	60	4.5	7.5	6.0	951	2001	0.19	1.28
BGXH20BN	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	1463	3110	0.31	2.15
BGXH20BL	30	44	12.0	4.5	82.1	32	50	M5	6.5	61.3	M6X1	7.1	(15.6)	20	16.3	60	6.0	9.5	8.5	1896	4030	0.36	2.15
BGXH25BN	40	48	12.5	5.8	79.7	35	35	M6	9.0	57.5	M6X1	14.2	(15.6)	23	19.2	60	7.0	11.0	9.0	2052	4188	0.45	2.88
BGXH25BL	40	48	12.5	5.8	94.4	35	50	M6	9.0	72.2	M6X1	14.2	(15.6)	23	19.2	60	7.0	11.0	9.0	2638	5383	0.66	2.88
BGXH25BE	40	48	12.5	5.8	109.1	35	50	M6	9.0	86.9	M6X1	14.2	(15.6)	23	19.2	60	7.0	11.0	9.0	2974	6454	0.80	2.88
BGXH30BN	45	60	16.0	7.0	94.8	40	40	M8	12.0	67.8	M6X1	11.0	(15.6)	28	22.8	80	9.0	14.0	12.0	3032	5565	0.91	4.45
BGXH30BL	45	60	16.0	7.0	105.0	40	60	M8	12.0	78.0	M6X1	11.0	(15.6)	28	22.8	80	9.0	14.0	12.0	3927	7207	1.04	4.45
BGXH30BE	45	60	16.0	7.0	130.5	40	60	M8	12.0	103.5	M6X1	11.0	(15.6)	28	22.8	80	9.0	14.0	12.0	4372	8842	1.36	4.45
BGXH35BN	55	70	18.0	7.5	111.5	50	50	M8	12.0	80.5	M6X1	15.0	(15.6)	34	26.0	80	9.0	14.0	12.0	4321	8272	1.50	6.25
BGXH35BL	55	70	18.0	7.5	123.5	50	72	M8	12.0	92.5	M6X1	15.0	(15.6)	34	26.0	80	9.0	14.0	12.0	5399	10336	1.80	6.25
BGXH35BE	55	70	18.0	7.5	153.5	50	72	M8	12.0	122.5	M6X1	15.0	(15.6)	34	26.0	80	9.0	14.0	12.0	5941	12777	2.34	6.25
BGXH45BN	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	5911	11105	2.28	9.60
BGXH45BL	70	86	20.5	8.9	145.0	60	80	M10	18.0	110.0	M8X1.25	24.4	(16)	45	31.1	105	14.0	20.0	17.0	7031	13209	2.67	9.60
BGXH45BE	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	8124	16650	3.35	9.60

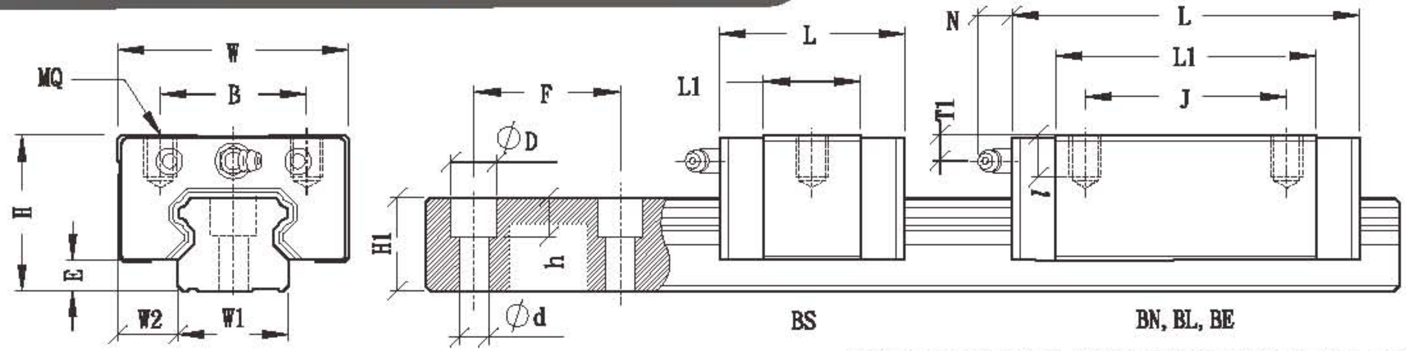
BGX SERIES BGX(H-F)Standard type



◎Please refer to P.22 for detail part number coding or contact us.

Spec. / Model	Assembly-mm				Block-mm										Rail-mm						Rating load-Kgf		Block	Rail
	H	W	W2	E	L	B	J	MQ	ih	l	L1	Oil H	T1	N	W1	H1	F	d	D	h	C	C0	Kgf	Kgf/M
BGXH15FN	24	47	16.0	3.0	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	951	2001	0.21	1.28
BGXH15FL	24	47	16.0	3.0	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	1150	2419	0.23	1.28
BGXH20FN	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	1463	3110	0.40	2.15
BGXH20FL	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	1896	4030	0.46	2.15
BGXH25FN	36	70	23.5	5.8	79.7	57	45	M8	7.0	10.0	57.5	M6X1	10.2	(15.6)	23	19.2	60	7.0	11.0	9.0	2052	4188	0.57	2.88
BGXH25FL	36	70	23.5	5.8	94.4	57	45	M8	7.0	10.0	72.2	M6X1	10.2	(15.6)	23	19.2	60	7.0	11.0	9.0	2638	5383	0.72	2.88
BGXH25FE	36	70	23.5	5.8	109.1	57	45	M8	7.0	10.0	86.9	M6X1	10.2	(15.6)	23	19.2	60	7.0	11.0	9.0	2974	6454	0.89	2.88
BGXH30FN	42	90	31.0	7.0	94.8	72	52	M10	8.6	11.0	67.8	M6X1	8.0	(15.6)	28	22.8	80	9.0	14.0	12.0	3032	5565	1.10	4.45
BGXH30FL	42	90	31.0	7.0	105.0	72	52	M10	8.6	11.0	78.0	M6X1	8.0	(15.6)	28	22.8	80	9.0	14.0	12.0	3927	7207	1.34	4.45
BGXH30FE	42	90	31.0	7.0	130.5	72	52	M10	8.6	11.0	103.5	M6X1	8.0	(15.6)	28	22.8	80	9.0	14.0	12.0	4372	8842	1.66	4.45
BGXH35FN	48	100	33.0	7.5	111.5	82	62	M10	8.6	12.0	80.5	M6X1	8.0	(16)	34	26.0	80	9.0	14.0	12.0	4321	8272	1.50	6.25
BGXH35FL	48	100	33.0	7.5	123.5	82	62	M10	8.6	12.0	92.5	M6X1	8.0	(16)	34	26.0	80	9.0	14.0	12.0	5399	10336	1.90	6.25
BGXH35FE	48	100	33.0	7.5	153.5	82	62	M10	8.6	12.0	122.5	M6X1	8.0	(16)	34	26.0	80	9.0	14.0	12.0	5941	12777	2.54	6.25
BGXH45FN	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	5911	11105	2.27	9.60
BGXH45FL	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	7031	13209	2.68	9.60
BGXH45FE	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	8124	16650	3.42	9.60

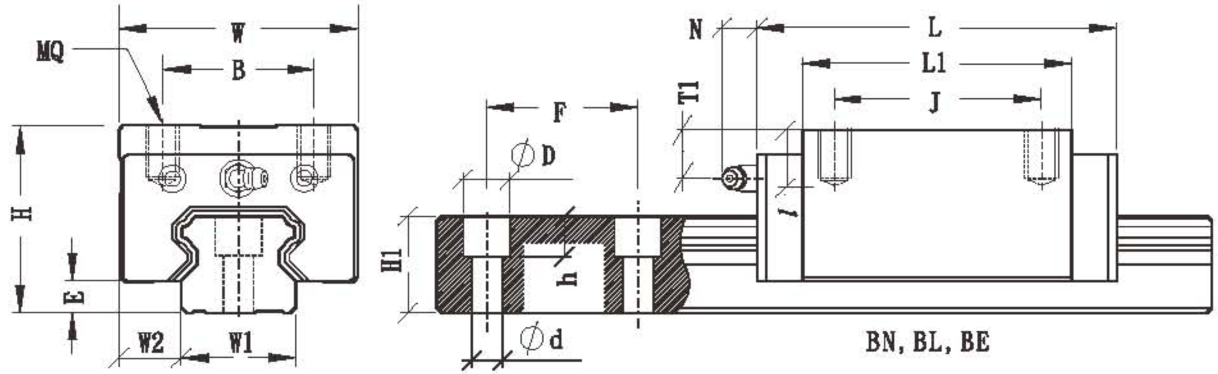
BGX SERIES BGX(S-B)Standard type



◎Please refer to P.22 for detail part number coding or contact us.

Spec. / Model	Assembly-mm				Block-mm									Rail-mm						Rating load-Kgf		Block	Rail
	H	W	W2	E	L	B	J	MQ	l	L1	Oil H	T1	N	W1	H1	F	d	D	h	C	C0	Kgf	Kgf/M
BGXS15BS	24	34	9.5	3.0	40.6	26		M4	4.8	22.2	M4X0.7	5.5	(5)	15	13.0	60	4.5	7.5	6.0	473	996	0.10	1.28
BGXS15BN	24	34	9.5	3.0	58.6	26	26	M4	4.8	40.2	M4X0.7	5.5	(5)	15	13.0	60	4.5	7.5	6.0	951	2001	0.17	1.28
BGXS15BL	24	34	9.5	3.0	66.1	26	26	M4	4.8	47.7	M4X0.7	5.5	(5)	15	13.0	60	4.5	7.5	6.0	1150	2419	0.18	1.28
BGXS20BS	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	753	1600	0.17	2.15
BGXS20BN	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	1463	3110	0.26	2.15
BGXS25BS	33	48	12.5	5.8	54.5	35		M6	6.8	32.3	M6X1	7.2	(15.6)	23	19.2	60	7.0	11.0	9.0	1049	2141	0.21	2.88
BGXS25BN	33	48	12.5	5.8	79.7	35	35	M6	6.8	57.5	M6X1	7.2	(15.6)	23	19.2	60	7.0	11.0	9.0	2052	4188	0.38	2.88
BGXX25BN	36	48	12.5	5.8	79.7	35	35	M6	9.0	57.5	M6X1	10.2	(15.6)	23	19.2	60	7.0	11.0	9.0	2052	4188	0.40	2.88
BGXX25BL	36	48	12.5	5.8	94.4	35	35	M6	9.0	72.2	M6X1	10.2	(15.6)	23	19.2	60	7.0	11.0	9.0	2638	5383	0.54	2.88
BGXX25BE	36	48	12.5	5.8	109.1	35	50	M6	9.0	86.9	M6X1	10.2	(15.6)	23	19.2	60	7.0	11.0	9.0	2974	6454	0.67	2.88
BGXS30BS	42	60	16.0	7.0	64.2	40		M8	10.0	37.2	M6X1	8.0	(15.6)	28	22.8	80	9.0	14.0	12.0	1503	2758	0.50	4.45
BGXS30BN	42	60	16.0	7.0	94.8	40	40	M8	10.0	67.8	M6X1	8.0	(15.6)	28	22.8	80	9.0	14.0	12.0	3032	5565	0.80	4.45
BGXS30BL	42	60	16.0	7.0	105.0	40	40	M8	10.0	78.0	M6X1	8.0	(15.6)	28	22.8	80	9.0	14.0	12.0	3927	7207	0.94	4.45
BGXS30BE	42	60	16.0	7.0	130.5	40	60	M8	10.0	103.5	M6X1	8.0	(15.6)	28	22.8	80	9.0	14.0	12.0	4372	8842	1.16	4.45
BGXS35BS	48	70	18.0	7.5	75.5	50		M8	10.0	44.5	M6X1	8.0	(15.6)	34	26.0	80	9.0	14.0	12.0	2166	4146	0.80	6.25
BGXS35BN	48	70	18.0	7.5	111.5	50	50	M8	10.0	80.5	M6X1	8.0	(15.6)	34	26.0	80	9.0	14.0	12.0	4321	8272	1.20	6.25
BGXS35BL	48	70	18.0	7.5	123.5	50	50	M8	10.0	92.5	M6X1	8.0	(15.6)	34	26.0	80	9.0	14.0	12.0	5399	10336	1.40	6.25
BGXS35BE	48	70	18.0	7.5	153.5	50	72	M8	10.0	122.5	M6X1	8.0	(15.6)	34	26.0	80	9.0	14.0	12.0	5941	12777	1.84	6.25
BGXS45BN	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	5911	11105	1.64	9.60
BGXS45BL	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	7031	13209	1.93	9.60
BGXS45BE	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	8124	16650	2.42	9.60

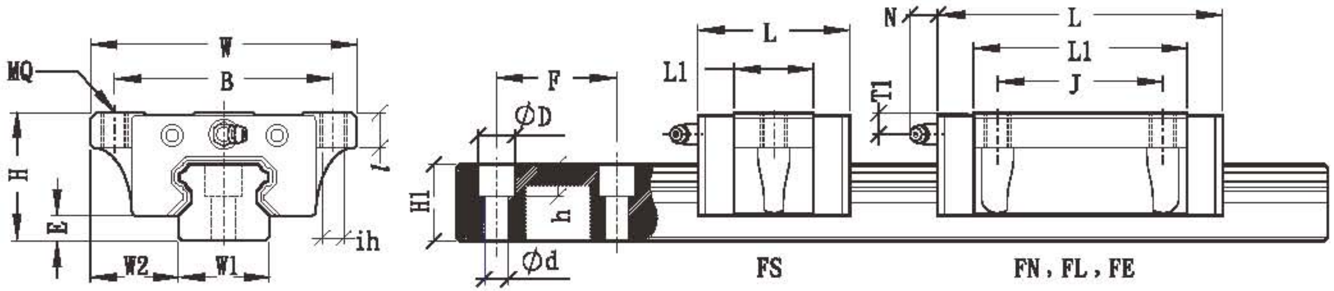
BGC SERIES BGC(H-B)Caged type



◎Please refer to P.22 for detail part number coding or contact us.

Spec. / Model	Assembly-mm				Block-mm									Rail-mm						Rating load-Kgf		Block	Rail
	H	W	W2	E	L	B	J	MQ	l	L1	Oil H	T1	N	W1	H1	F	d	D	h	C	C0	Kgf	Kgf/M
BGCH15BN	28	34	9.5	3.0	58.6	26	26	M4	6.0	40.2	M4X0.7	9.5	(5)	15	13.0	60	4.5	7.5	6.0	1174	2001	0.19	1.28
BGCH20BN	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	1806	3110	0.31	2.15
BGCH20BL	30	44	12.0	4.5	82.1	32	36	M5	6.5	61.3	M6X1	7.1	(15.6)	20	16.3	60	6.0	9.5	8.5	2341	4030	0.36	2.15
BGCH25BN	40	48	12.5	5.8	79.7	35	35	M6	9.0	57.5	M6X1	14.2	(15.6)	23	19.2	60	7.0	11.0	9.0	2534	4188	0.45	2.88
BGCH25BL	40	48	12.5	5.8	94.4	35	35	M6	9.0	72.2	M6X1	14.2	(15.6)	23	19.2	60	7.0	11.0	9.0	3256	5383	0.66	2.88
BGCH25BE	40	48	12.5	5.8	109.1	35	50	M6	9.0	86.9	M6X1	14.2	(15.6)	23	19.2	60	7.0	11.0	9.0	3671	6454	0.80	2.88
BGCH30BN	45	60	16.0	7.0	94.8	40	40	M8	12.0	67.8	M6X1	11.0	(15.6)	28	22.8	80	9.0	14.0	12.0	3743	5565	0.91	4.45
BGCH30BL	45	60	16.0	7.0	105.0	40	40	M8	12.0	78.0	M6X1	11.0	(15.6)	28	22.8	80	9.0	14.0	12.0	4848	7207	1.04	4.45
BGCH30BE	45	60	16.0	7.0	130.5	40	60	M8	12.0	103.5	M6X1	11.0	(15.6)	28	22.8	80	9.0	14.0	12.0	5397	8842	1.36	4.45
BGCH35BN	55	70	18.0	7.5	111.5	50	50	M8	12.0	80.5	M6X1	15.0	(15.6)	34	26.0	80	9.0	14.0	12.0	5335	8272	1.50	6.25
BGCH35BL	55	70	18.0	7.5	123.5	50	50	M8	12.0	92.5	M6X1	15.0	(15.6)	34	26.0	80	9.0	14.0	12.0	6666	10336	1.80	6.25
BGCH35BE	55	70	18.0	7.5	153.5	50	72	M8	12.0	122.5	M6X1	15.0	(15.6)	34	26.0	80	9.0	14.0	12.0	7334	12777	2.34	6.25
BGCH45BN	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	7298	11105	2.28	9.60
BGCH45BL	70	86	20.5	8.9	145.0	60	60	M10	18.0	110.0	M8X1.25	24.4	(16)	45	31.1	105	14.0	20.0	17.0	8680	13209	2.67	9.60
BGCH45BE	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	10030	16650	3.35	9.60

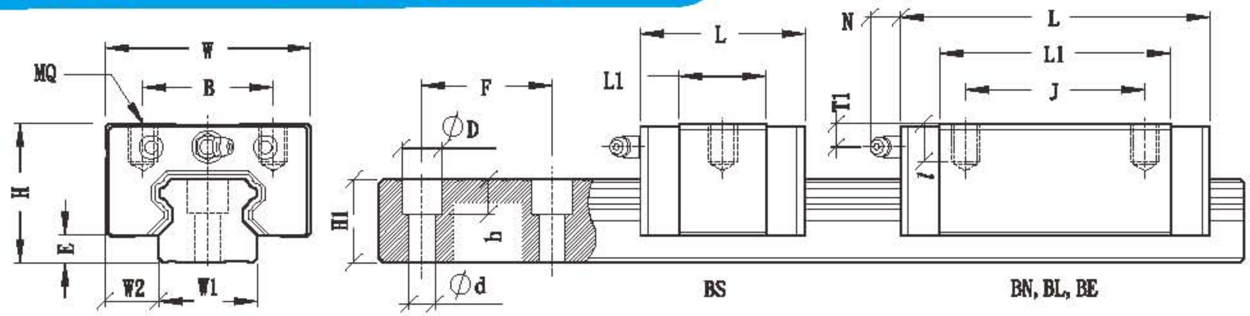
BGC SERIES BGC(H-F)Caged type



◎Please refer to P.22 for detail part number coding or contact us.

Model \ Spec.	Assembly-mm				Block-mm										Rail-mm						Rating load-Kgf		Block	Rail
	H	W	W2	E	L	B	J	MQ	Ih	l	L1	Oil H	T1	N	W1	H1	F	d	D	h	C-BGC	C0	Kgf	Kgf/M
BGCH15FN	24	47	16.0	3.0	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	1174	2001	0.21	1.28
BGCH15FL	24	47	16.0	3.0	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	1420	2419	0.23	1.28
BGCH20FN	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	1806	3110	0.40	2.15
BGCH20FL	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	2341	4030	0.46	2.15
BGCH25FN	36	70	23.5	5.8	79.7	57	45	M8	7.0	10.0	57.5	M6X1	10.2	(15.6)	23	19.2	60	7.0	11.0	9.0	2534	4188	0.57	2.88
BGCH25FL	36	70	23.5	5.8	94.4	57	45	M8	7.0	10.0	72.2	M6X1	10.2	(15.6)	23	19.2	60	7.0	11.0	9.0	3256	5383	0.72	2.88
BGCH25FE	36	70	23.5	5.8	109.1	57	45	M8	7.0	10.0	86.9	M6X1	10.2	(15.6)	23	19.2	60	7.0	11.0	9.0	3671	6454	0.89	2.88
BGCH30FN	42	90	31.0	7.0	94.8	72	52	M10	8.6	11.0	67.8	M6X1	8.0	(15.6)	28	22.8	80	9.0	14.0	12.0	3743	5565	1.10	4.45
BGCH30FL	42	90	31.0	7.0	105.0	72	52	M10	8.6	11.0	78.0	M6X1	8.0	(15.6)	28	22.8	80	9.0	14.0	12.0	4848	7207	1.34	4.45
BGCH30FE	42	90	31.0	7.0	130.5	72	52	M10	8.6	11.0	103.5	M6X1	8.0	(15.6)	28	22.8	80	9.0	14.0	12.0	5397	8842	1.66	4.45
BGCH35FN	48	100	33.0	7.5	111.5	82	62	M10	8.6	12.0	80.5	M6X1	8.0	(16)	34	26.0	80	9.0	14.0	12.0	5335	8272	1.50	6.25
BGCH35FL	48	100	33.0	7.5	123.5	82	62	M10	8.6	12.0	92.5	M6X1	8.0	(16)	34	26.0	80	9.0	14.0	12.0	6666	10336	1.90	6.25
BGCH35FE	48	100	33.0	7.5	153.5	82	62	M10	8.6	12.0	122.5	M6X1	8.0	(16)	34	26.0	80	9.0	14.0	12.0	7334	12777	2.54	6.25
BGCH45FN	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	7298	11105	2.27	9.60
BGCH45FL	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	8680	13209	2.68	9.60
BGCH45FE	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	10030	16650	3.42	9.60

BGC SERIES BGC(S-B)Caged type



◎Please refer to P.22 for detail part number coding or contact us.

Spec. / Model	Assembly-mm				Block-mm									Rail-mm						Rating load-Kgf		Block	Rail
	H	W	W2	E	L	B	J	MQ	l	L1	Oil H	T1	N	W1	H1	F	d	D	h	C	C0	Kgf	Kgf/M
BGCS15BS	24	34	9.5	3.0	40.6	26		M4	4.8	22.2	M4X0.7	5.5	(5)	15	13.0	60	4.5	7.5	6.0	584	996	0.10	1.28
BGCS15BN	24	34	9.5	3.0	58.6	26	26	M4	4.8	40.2	M4X0.7	5.5	(5)	15	13.0	60	4.5	7.5	6.0	1174	2001	0.17	1.28
BGCS15BL	24	34	9.5	3.0	66.1	26	26	M4	4.8	47.7	M4X0.7	5.5	(5)	15	13.0	60	4.5	7.5	6.0	1420	2419	0.18	1.28
BGCS20BS	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	929	1600	0.17	2.15
BGCS20BN	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	1806	3110	0.26	2.15
BGCS25BS	33	48	12.5	5.8	54.5	35		M6	6.8	32.3	M6X1	7.2	(15.6)	23	19.2	60	7.0	11.0	9.0	1295	2141	0.21	2.88
BGCS25BN	33	48	12.5	5.8	79.7	35	35	M6	6.8	57.5	M6X1	7.2	(15.6)	23	19.2	60	7.0	11.0	9.0	2534	4188	0.38	2.88
BGCX25BN	36	48	12.5	5.8	79.7	35	35	M6	9.0	57.5	M6X1	10.2	(15.6)	23	19.2	60	7.0	11.0	9.0	2534	4188	0.40	2.88
BGCX25BL	36	48	12.5	5.8	94.4	35	35	M6	9.0	72.2	M6X1	10.2	(15.6)	23	19.2	60	7.0	11.0	9.0	3256	5383	0.54	2.88
BGCX25BE	36	48	12.5	5.8	109.1	35	50	M6	9.0	86.9	M6X1	10.2	(15.6)	23	19.2	60	7.0	11.0	9.0	3671	6454	0.67	2.88
BGCS30BS	42	60	16.0	7.0	64.2	40		M8	10.0	37.2	M6X1	8.0	(15.6)	28	22.8	80	9.0	14.0	12.0	1855	2758	0.50	4.45
BGCS30BN	42	60	16.0	7.0	94.8	40	40	M8	10.0	67.8	M6X1	8.0	(15.6)	28	22.8	80	9.0	14.0	12.0	3743	5565	0.80	4.45
BGCS30BL	42	60	16.0	7.0	105.0	40	40	M8	10.0	78.0	M6X1	8.0	(15.6)	28	22.8	80	9.0	14.0	12.0	4848	7207	0.94	4.45
BGCS30BE	42	60	16.0	7.0	130.5	40	60	M8	10.0	103.5	M6X1	8.0	(15.6)	28	22.8	80	9.0	14.0	12.0	5397	8842	1.16	4.45
BGCS35BS	48	70	18.0	7.5	75.5	50		M8	10.0	44.5	M6X1	8.0	(15.6)	34	26.0	80	9.0	14.0	12.0	2674	4146	0.80	6.25
BGCS35BN	48	70	18.0	7.5	111.5	50	50	M8	10.0	80.5	M6X1	8.0	(15.6)	34	26.0	80	9.0	14.0	12.0	5335	8272	1.20	6.25
BGCS35BL	48	70	18.0	7.5	123.5	50	50	M8	10.0	92.5	M6X1	8.0	(15.6)	34	26.0	80	9.0	14.0	12.0	6666	10336	1.40	6.25
BGCS35BE	48	70	18.0	7.5	153.5	50	72	M8	10.0	122.5	M6X1	8.0	(15.6)	34	26.0	80	9.0	14.0	12.0	7334	12777	1.84	6.25
BGCS45BN	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	7298	11105	1.64	9.60
BGCS45BL	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	8680	13209	1.93	9.60
BGCS45BE	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	10030	16650	2.42	9.60

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OME Technology Co., Ltd.

No.46, Lane 168, Sanshu Rd., Sansia Township,
Taipei County 237, Taiwan
http://www.staf.com.tw
E-mail:staf@ome.com.tw
Tel:+886-2-26716600 Fax:+886-2-26711400