



Linear Motion Technology



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LINEAR MOTION TECHNOLOGY

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www.abbalinear.com



ABBA Linear Tech Co., Ltd., established in 1999, was the first professional linear guideway manufacturer in Taiwan putting patent self-lubricant and four-row linear guides into mass production. ABBA Linear Tech possessed critical technology, combined R&D achievements with National Taiwan University of Technology and Science, and launched the production successfully in 2000. With several international patents, ABBA is thriving worldwide with its own name and having channels in Taiwan, China, Korea, Japan, Europe, America, etc.

In April 2007, SKF Group acquired ABBA Linear Tech as one of SKF members. SKF, headquartered in Gothenburg in Sweden, is a global bearings and seals manufacturer with some 46,000 employees worldwide. With the addition of ABBA's product range, SKF is reinforcing its position in linear guides. The acquisition is in line with the SKF Group's strategy to strengthen its different technology platforms and to grow in Asia.

Since the beginning ABBA Linear Tech has been making every endeavor on both marketing and product quality, and was recognized by The Creative Innovation Prize, The Rising Star Award, The National Business Start-up Award, and The Taiwan Symbol of Excellence. Besides, ABBA obtained an investment approval in accordance with the encouragement to significant strategic industry from the Industrial Development Bureau of the Ministry of Economic Affairs. What ABBA strived for in the past years has been identified and supported by clients, suppliers, and the academia.

ABBA Linear Tech spirit to offer the best quality and professional service in order to fulfill clients' demands, and become a high-class linear guideway supplier. ABBA Linear Tech also has ambitious plans to expand the product portfolio and sales network.



Award of Creative Innovation Prize



Certificates of Patents



Rising Star Award



National Business Start-up Award

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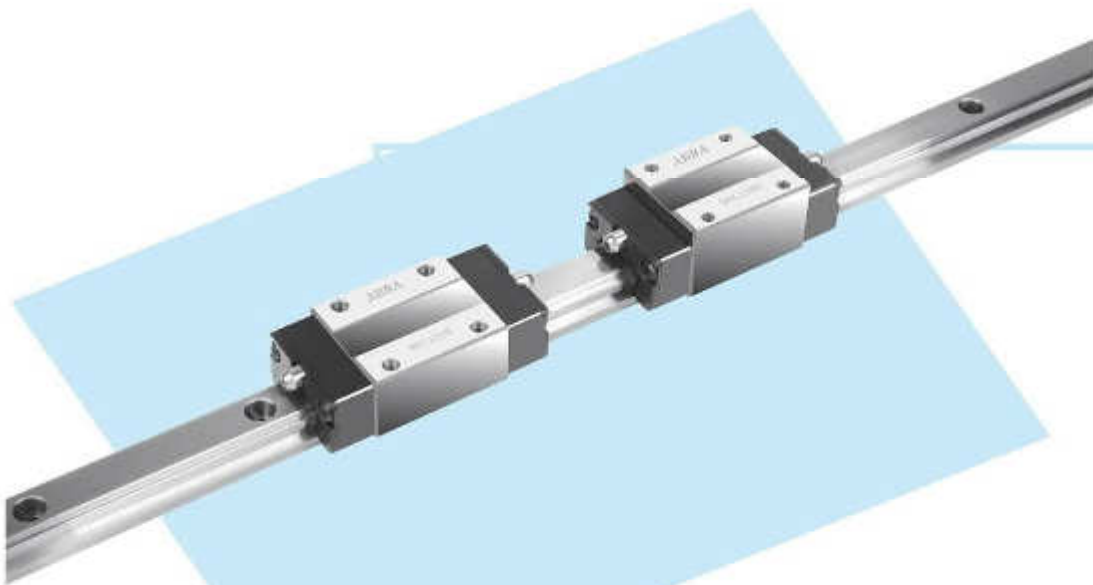
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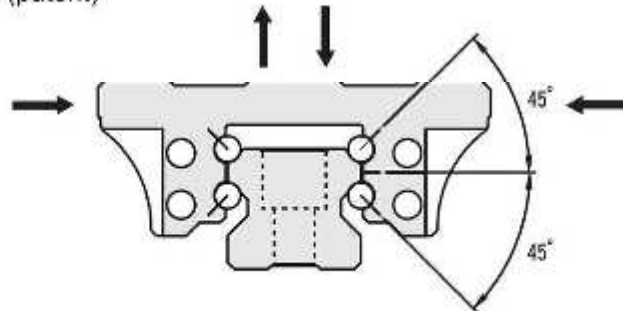
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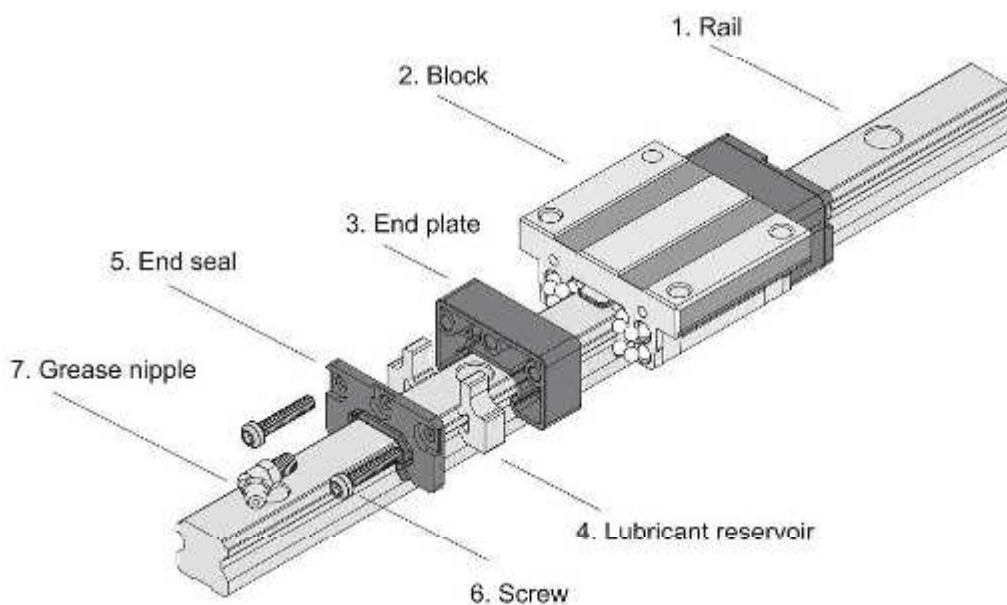
1. Linear Guideway

1.1 Ten Characteristics

- ≡ Built-in long life lubrication (patent)
- ≡ Equivalent loading capacity in four directions
- ≡ Smooth running due to new ball re-circulation (patent)
- ≡ High rigidity : 4-row angular contact
- ≡ International standard dimension
- ≡ High accuracy, low friction, low maintenance
- ≡ High speed, low noise
- ≡ Integral all-round sealing
- ≡ Interchangeability
- ≡ Green production



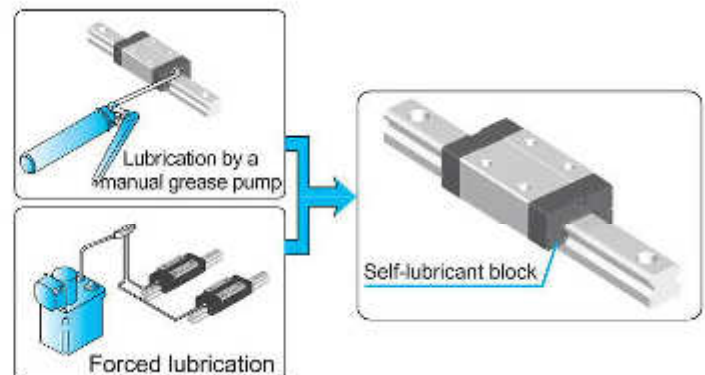
1.2 Construction of Self-Lubricant Linear Guideway



1.3 Four Advantages of Self-Lubricant Block

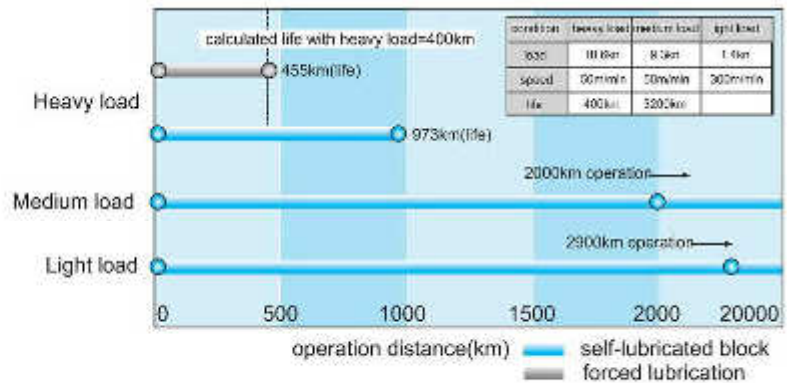
Advantage 1

Maintenance free - No need for frequent periodic lubrication or automatic lubrication systems.



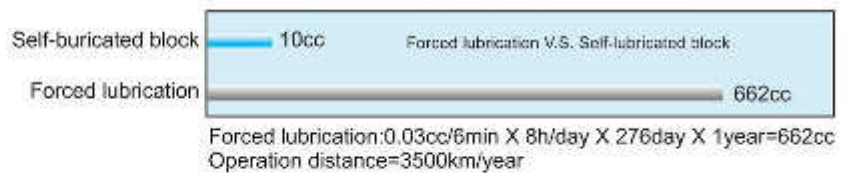
Advantage 2

Extended intervals between maintenance.



Advantage 3

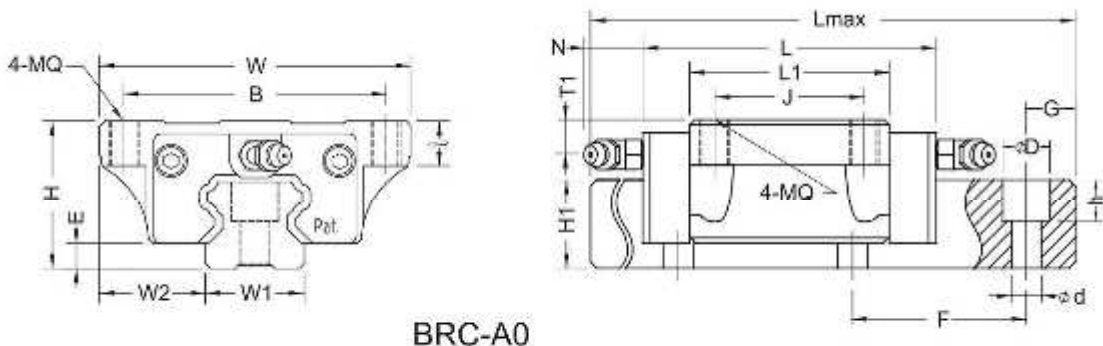
Curtailing lubrication cost.



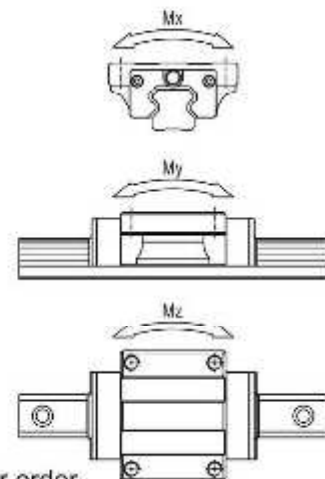
Advantage 4

No oil leakage concern, easy for cleaning.

1.4 Interchangeability Notice



1. Check the mounting height (H)
2. Check the mounting width (W2)
3. Check the block length (L)
4. Check the block's body size (L1)
5. Check the hole diameter and pitches on the block (BxJ)
6. Check the rail width (W1)
7. Check the pitch of the rail (F)
8. Check the hole diameter and rail size (d x D x h)
9. When a specific length is required, please advise the (G) values in your order.



1.5 Accuracy Selection

We have three grades for your selection:
Normal/ High/ Precision

	Application		Accuracy Grade				Application		Accuracy Grade		
	N	H	P	N	H		P				
NC Machine tools	Machining Center				○	Industrial Robots	Orthogonal Type	○	○	○	
	Lathe				○		Multi-joint Type	○	○		
	Milling Machine				○		Semiconductor Machine	Wire Bonder			○
	Boring Machine				○	Prober				○	
	Jig Borer				○	Inserter Machine			○	○	
	Grinding Machine				○	Other Machines	PCB Driller		○	○	
	Electro-discharge Machine				○		Injection Molding Machine	○	○		
	Punching Press Machine		○	○			Measuring Machine			○	
	Laser Cutting Machine		○	○			Business Machine	○	○		
	Wood Working Machine	○	○	○			Transporting Machine	○	○		
	NC Drilling Machine		○	○			X-Y Table		○	○	
	Milling Center		○	○			Painting Machine	○	○		
	Packaging Machine	○					Welding Machine	○	○		
	ATC	○					Medical Equipment	○	○		
	Wire Cut Machine				○		Digitizer		○	○	
	Grinding Wheel Machine				○	Test Equipment			○		

1.6 Accuracy Standard

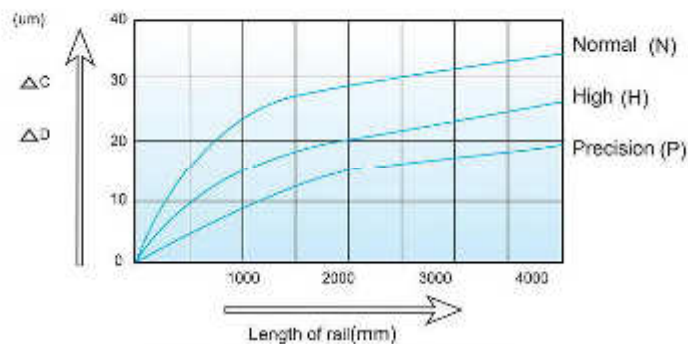
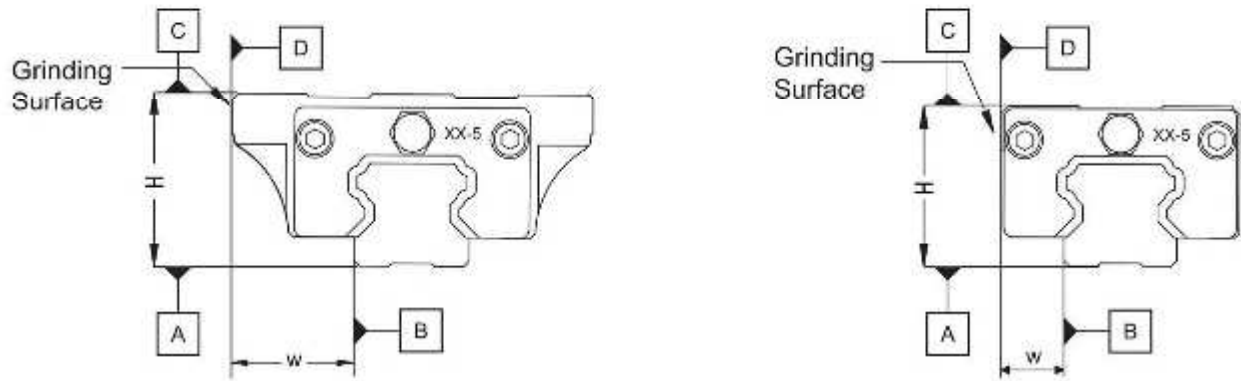


Fig.1.6.1 BR rail length and running parallelism

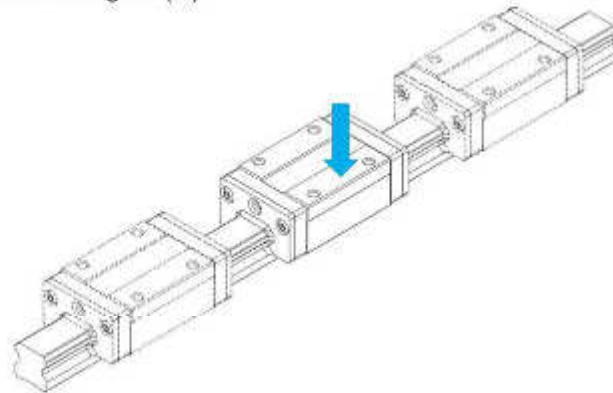
ITEM	GRADE		
	Normal (N)	High (H)	Precision (P)
Tolerance of height (H)	± 0.1	± 0.04	0 -0.04
Tolerance of width (W)	± 0.1	± 0.04	0 -0.04
Difference of heights (ΔH)	0.03	0.02	0.01
Difference of widths (ΔW)	0.03	0.02	0.01
Running parallelism of BR Block between surface A & C	ΔC Refer to Fig.1.6.1		
Running parallelism of BR Block between surface B & D	ΔD Refer to Fig.1.6.1		

Unit : mm

1.6.1 Definitions

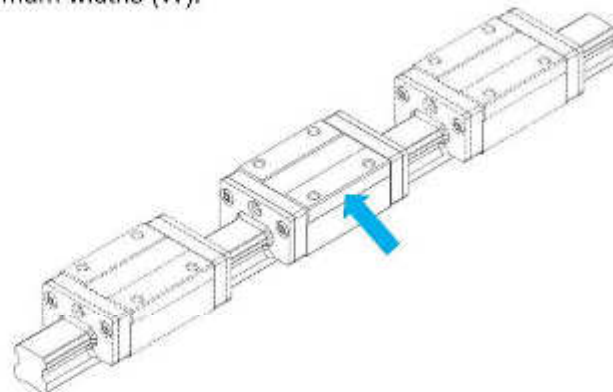
(1) Difference of heights ΔH

The difference is obtained by measuring the different blocks on the same rail position in terms of the difference between the maximum and minimum heights (H).



(2) Difference of widths ΔW

The difference is obtained by measuring the different blocks on the same rail position in terms of the difference between the maximum and minimum widths (W).



(3) Running parallelism

This is refer to the running parallelism tolerance between the two reference planes of rail and block when the block is moved along the entire rail length, the rail being screwed to the reference plane.

1.7 Preload

1.7.1 Preload and rigidity

To adjust a linear guideway to the specific demands of a given application, it is advisable to choose an appropriate preload. This will positively affect the operating behavior of the entire linear guidance system. Preload can enhance the performance of an entire linear guidance system and increase the rigidity of the block under load.

1.7.2 Applying a preload

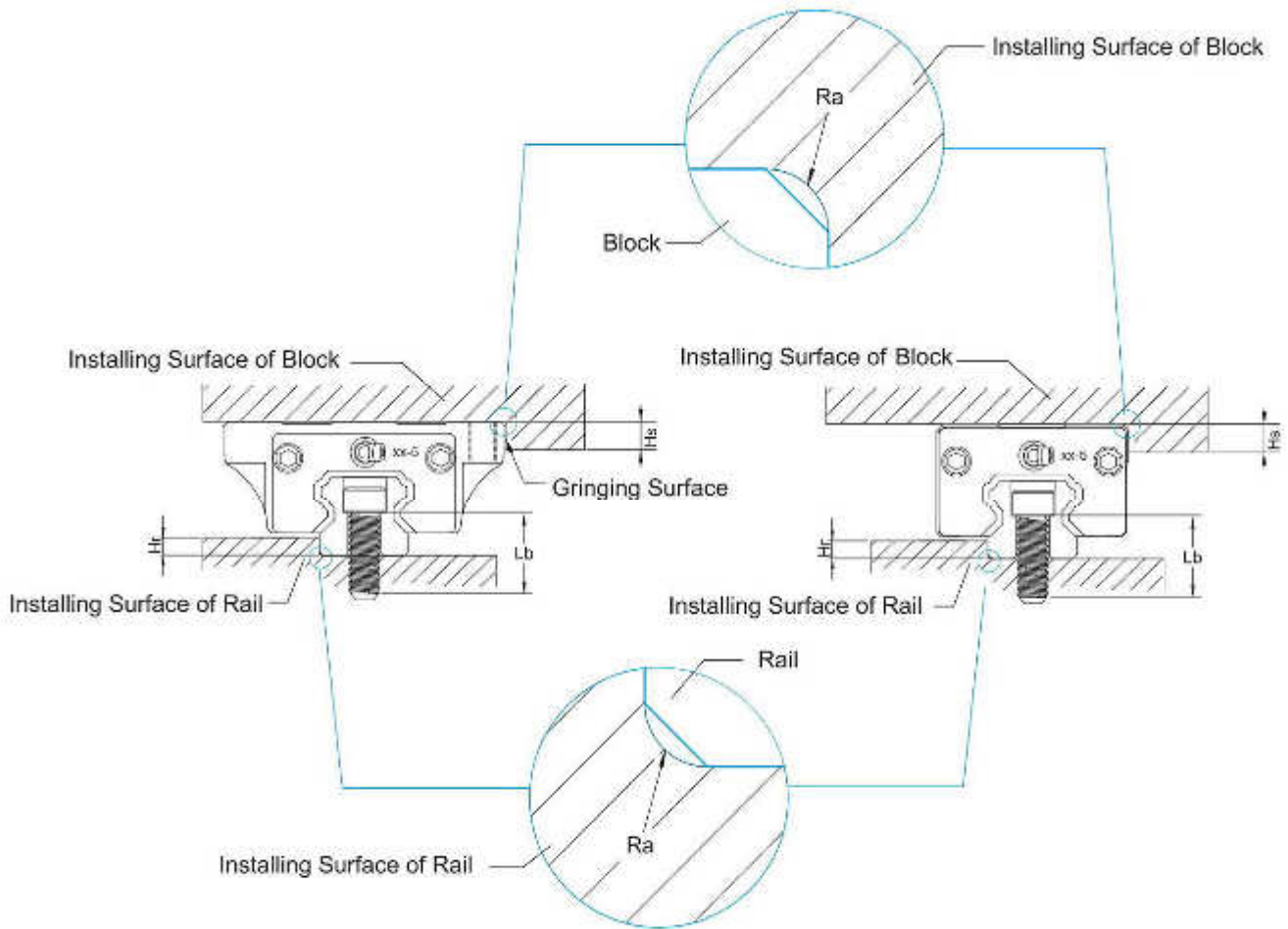
Preload is determined by the diameter of the balls and increases with larger diameter. BR linear guideway are available in five classes. For additional information, refer to table 1.7.1.

Table 1.7.1 Preload class and preload force

Class \ Item	Code	Preload force
Clearance	ZF	0
No Preload	Z0	0
Light Preload	Z1	0~0.02 C
Middle Preload	Z2	0.02C~0.05 C
Heavy Preload	Z3	0.05C~0.07 C

C : Basic dynamic load rating

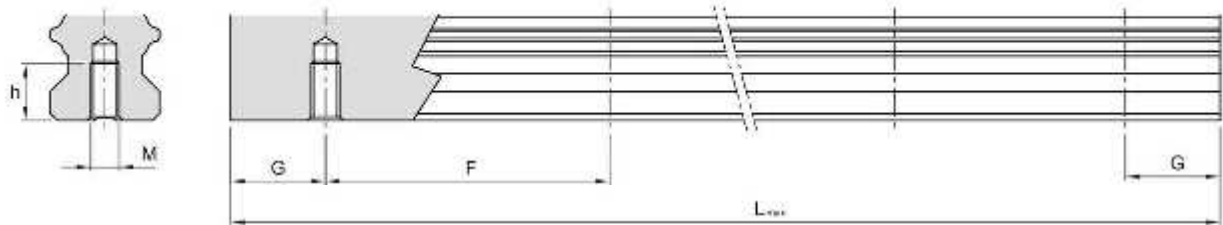
1.8 Suggestion in Assembly



Item	Maximum Fillet (Ra)	Maximum Height (Hr) rail shoulder		Height (Hs) block shoulder		Rail Bolt Length (Lb) suggestion
		Min.	Max.	Min.	Max.	
BR-15	0.8	2.5	3.5	3	4	M4*16
BR-20	0.8	2.5	4	4	5	M5*20
BR-25	1.2	3	5	4	5	M6*25
BR-30	1.2	3	5	4	5	M8*30
BR-35	1.2	3.5	6	5.5	6.5	M8*30
BR-45	1.6	4.5	8	6	8	M12*40

Unit : mm

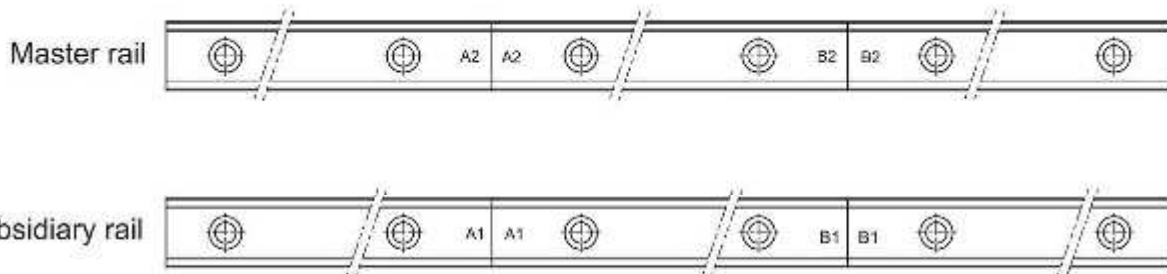
1.9 Dimension of Blind Hole



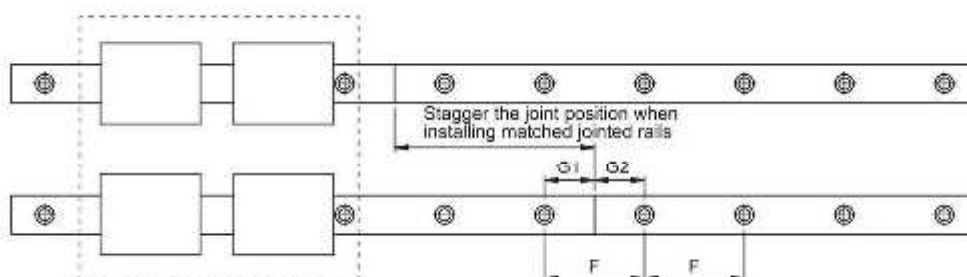
Nominal Size	Screw Size (M)	Screw Thread h (mm)
15	M5	8
20	M6	10
25	M6	12
30	M8	15
35	M8	17
45	M12	24

1.10 Jointed Rail

(1) Jointed rails can be ordered if a rail length is required that exceeds standard and maximum length of rail. Refer to below for markings.



(2) To avoid accuracy problems due to discrepancies between the two rails such as matched pair, butt-joint rails, the jointed positions should be staggered as below.



1.11 Lubrication

The objective of lubrication includes the reduction of friction among the rolling elements as well as between the rolling elements and the raceway, prevention of sintering, reduction of wear, and the prevention of rust by forming a film over the surfaces. To maximize the performance of a linear system, the lubricant type and a lubrication method appropriate for the operating environment should be selected.

1.11.1 Factory pre-lubrication

BR blocks are factory pre-lubricated with Grease No. 2 and the lubricant reservoir is factory pre-lubricated with Grease No. 0. The technical data of grease can be found in table 1.11.2. A preservative is applied to the BR rails and blocks to protect them during transport, storage and mounting. When using the recommended lubricants, it is not necessary to remove this preservative.

1.11.2 Initial lubrication

Initial lubrication is not required, as BR linear guideway is delivered pre-lubricated and ready to install unless specified otherwise. In cases where a different type of grease is required, the blocks should be thoroughly cleaned and regreased prior to mounting. Please refer to table 1.11.1 for appropriate grease quantity.

This initial lubrication has to be applied according to the steps below:

1. Grease each block according to the quantities listed in table 1.11.1.
2. Move the block three times backwards and forwards with stroke = block length.
3. Repeat steps 1 and 2 again, twice.
4. Check if a lubricating film is visible on the rail.

1.11.3 Grease re-lubrication

Re-lubrication intervals recommendation

- Nominal size 30 and below: per 100km; nominal size 35 and above: per 40km
- Make supplementary periodically per 3 months.

1.11.4 Oil re-lubrication

- First time re-lubrication: apply to whole internal block, please refer to table 1.11.1 for appropriate grease amount.
- Re-lubrication amount: $Q=n/150$ (cm³/hrs)
n: Nominal size of rail (mm)
- Recommended lubrication oil spec. ISO VG32-68; ISO VG68-220

Recommended Re-lubrication Amount						unit : ml
Nominal Size	Amount	Nominal Size	Amount	Nominal Size	Amount	
BRC15A0	2~3	BRC25R0	3~4	BRD35A0	6~8	
BRC15R0		BRC25U0	2~3	BRD35R0		
BRC15U0		BRC25SU		BRD35U0		
BRC15SU	1~2	BRC25LA	4~6	BRD35SU	4~6	
BRC20A0	2~3	BRC25LR		BRD35LA	7~10	
BRC20R0		BRC30A0		BRD35LR		
BRC20U0		BRC30R0		BRD45A0	9~14	
BRC20SU		BRC30U0		BRD45R0		
BRC20LA	3~4	BRC30SU	3~5	BRD45U0	11~17	
BRC20LR		BRC30LA	6~8	BRD45LA		
BRC25A0		BRC30LR		BRD45LR		

Table 1.11.1

1.11.5 Grease Lubrication No. and Spec.

NGLI item	No.0	No.2
Drop point (°C)	205	206
Penetration (60worked, 1/10mm)	378	282
Penetration (1000worked, 1/10mm)	382	288
Appearance	Amber	Amber
Oxidation stability (100hrs, Pressure Drop, psi)	4	3
Oxidation stability (500hrs, Pressure Drop, psi)	8	7
Anti-corrosion Test	Pass	Pass
Copper plate corrosion (100°C, 24hrs)	1a	1a
Soap base	Lithium	Lithium
Rinsing water resistance (79.4°C, %)	N/A	2.5
Viscosity of base oil (cSt, @100°C)	164.5	164.5

Table 1.11.2

1.12 Technical Data

1.12.1 Definition of load rating

Basic static load rating: C_0

We define the basic static load rating C_0 as 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 of the diameter of the rolling elements.

Basic dynamic load rating: C

When each 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.

1.12.2 Static safety coefficient : f_s

Static safety factor f_s is the ratio of the basic static load rating C_0 to the load acting on the linear motion system.

$$f_s = (f_c * C_0) / P \quad \text{or} \quad f_s = (f_c * M_0) / M$$

f_s : static safety factor

f_c : contact factor

C_0 : basic static load rating

M_0 : static permissible moment

P : design load

M : design moment

Reference value of static safety factor f_s shown below :

Operating condition	Load condition	Minimum f_s
Normally stationary	Small impact and deflection	1.0 – 1.3
	Impact or twisting load is applied	2.0 – 3.0
Normally moving	Small impact or twisting load is applied	1.0 – 1.5
	Impact or twisting load is applied	2.5 – 5.0

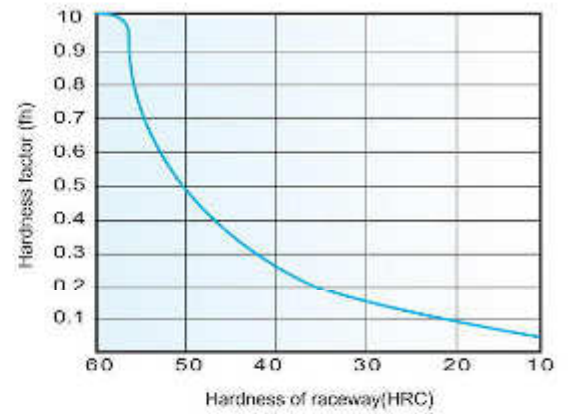
1.12.3 Contact coefficient : f_c

In linear motion system, it is hard to obtain identical load distribution due to moments, errors and other factors on the mounting surfaces. When multiple blocks on a rail are used in close contact, the basic load ratings C and C_0 corresponding with contact coefficients are shown aside.

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

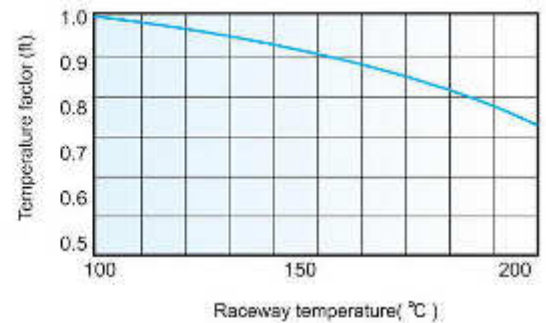
1.12.4 Hardness coefficient : f_h

For linear motion system, its optimum load carrying capacity is HRC 58 to 64 hardness on the raceways. If the hardness is under HRC 58, both the basic dynamic load rating and basic static load rating should be multiplied by hardness coefficient f_h .



1.12.5 Temperature coefficient : f_t

When a linear motion system is subject to temperature above 100°C, the temperature factor should be taken into consideration.



1.12.6 Load coefficient : f_w

Impacts and vibrations	Speed (V)	Measured vibration (G)	f_w
Without external Impacts or Vibrations	At low speed $V \leq 15\text{m/min}$	$G \leq 0.5$	1~1.5
Without significant Impacts or Vibrations	At medium speed $15 < V \leq 60\text{m/min}$	$0.5 < G \leq 1.0$	1.5~2.0
With external Impacts or Vibrations	At high speed $V > 60\text{m/min}$	$1.0 < G \leq 2.0$	2.0~3.5

1.12.7 Formula of nominal life : L

Given the basic dynamic load rating C and the applied load P , the following formula shows the nominal life L of a linear motion system using steel balls.

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

L : Nominal life

C : Basic dynamic load rating

P : Applied load

f_h : Hardness factor

f_t : Temperature factor

f_c : Contact factor

f_w : Load factor

1.13 Friction

$$F = \mu * W + f$$

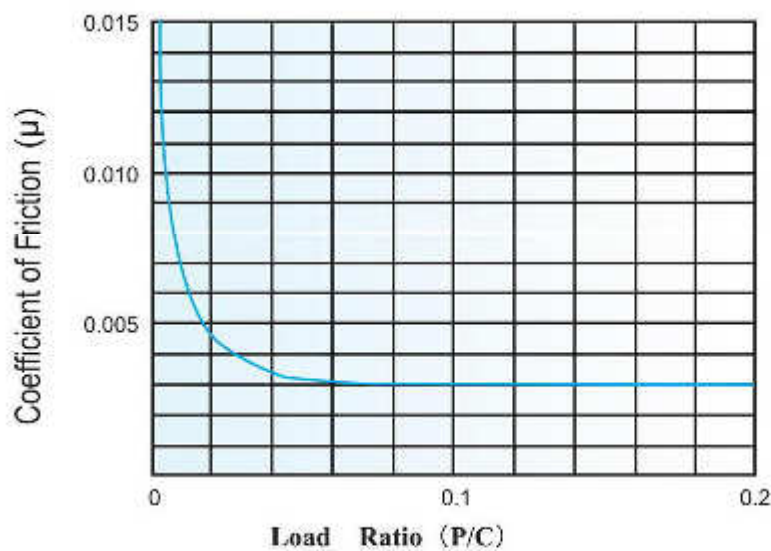
F : Friction (kgf)

W : Normal Loads (kgf)

μ : Coefficient of Friction

f : Friction Resistance of Standard Seal

μ : Coefficient of Friction



P : Load (kgf)

C : Basic Dynamic Load Rating (kgf)

f : Friction Resistance of Standard Seal

Friction Resistance	
Model	Standard Seal
BR15	0.4
BR20	0.5
BR25	0.6
BR30	0.8
BR35	0.95
BR45	1.4

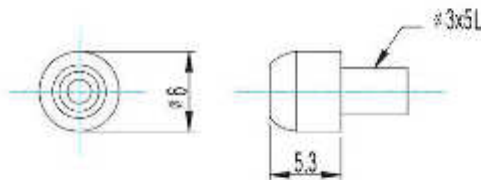
Remark: The value is based on the block with standard seal at both ends and added with Grease No. 2.

1.14 Grease Nipple

1.14.1 Grease Nipple (Standard)

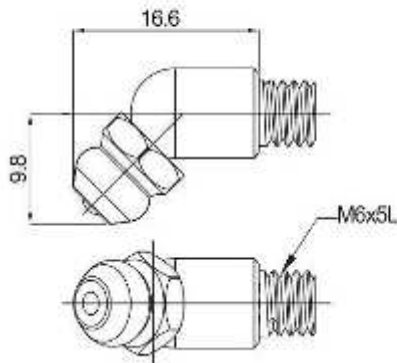
P140129 (NLA01)

Standard block	15	20	25	30	35	45	55
Standard block + U Type Metal Frame Scraper Plate	15	20	25	30	35	45	55



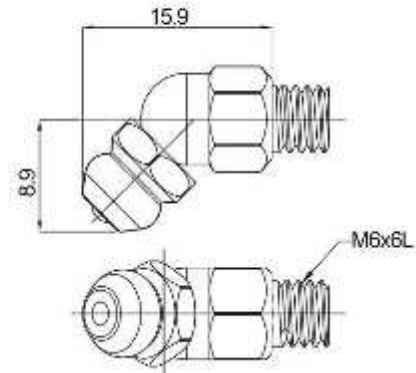
P140880

Standard block	15	20	25	30	35	45	55
Standard block + U Type Metal Frame Scraper Plate	15	20	25	30	35	45	55



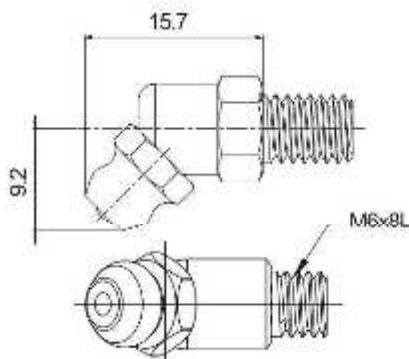
P140135 (NLB02)

Standard block	15	20	25	30	35	45	55
Standard block + U Type Metal Frame Scraper Plate	15	20	25	30	35	45	55



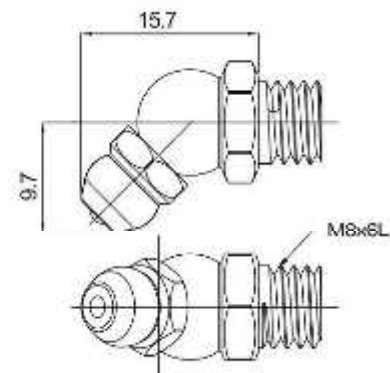
P140137 (NLB03)

Standard block	15	20	25	30	35	45	55
Standard block + U Type Metal Frame Scraper Plate	15	20	25	30	35	45	55



P140138 (NLB04)

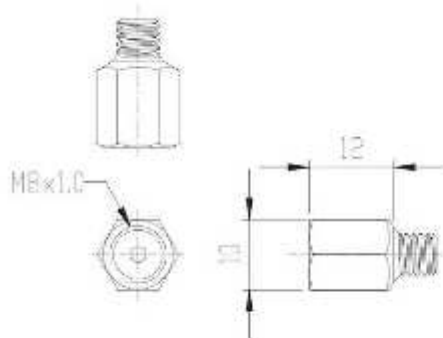
Standard block	15	20	25	30	35	45	55
Standard block + U Type Metal Frame Scraper Plate	15	20	25	30	35	45	55



1.14.2 Plumbing Nipple (VN-PA)

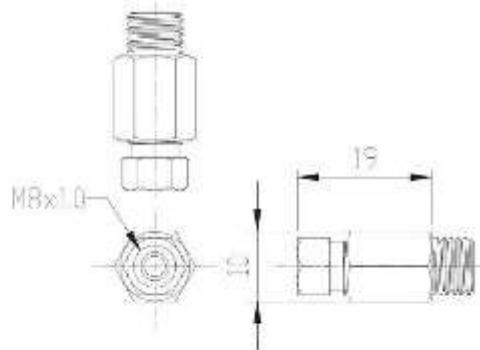
P140142 (NPA01)

Standard block	15	20	25	30	35	45	55
Standard block + U Type Metal Frame Scraper Plate	15	20	25	30	35	45	55



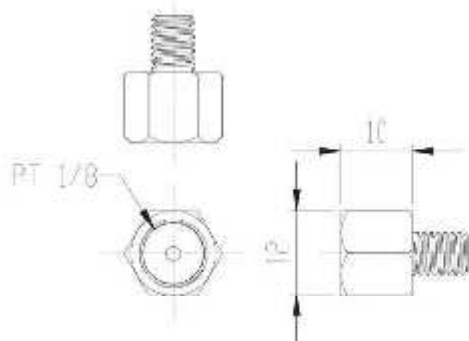
P140143 (NPA02)

Standard block	15	20	25	30	35	45	55
Standard block + U Type Metal Frame Scraper Plate	15	20	25	30	35	45	55



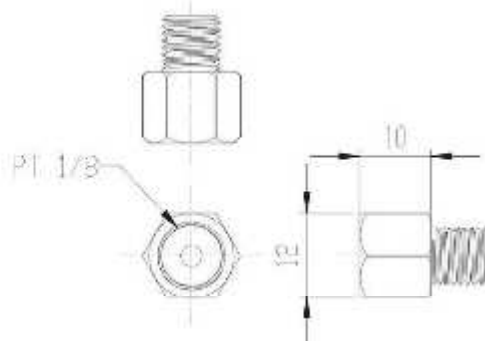
P140144 (NPA03)

Standard block	15	20	25	30	35	45	55
Standard block + U Type Metal Frame Scraper Plate	15	20	25	30	35	45	55



P140145 (NPA01)

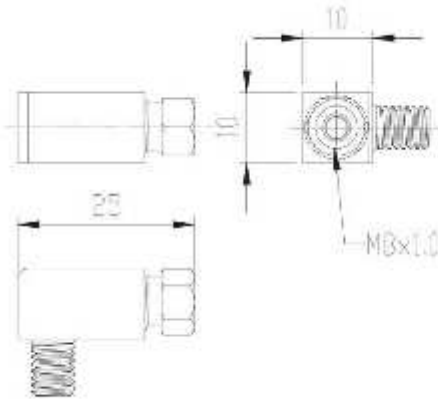
Standard block	15	20	25	30	35	45	55
Standard block + U Type Metal Frame Scraper Plate	15	20	25	30	35	45	55



1.14.3 Plumbing Nipple (VN-PC)

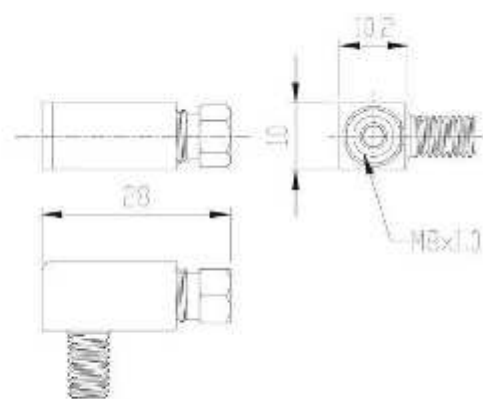
P140147 (NPC02)

Standard block	15	20	25	30	35	45	55
Standard block + U Type Metal Frame Scraper Plate	15	20	25	30	35	45	55



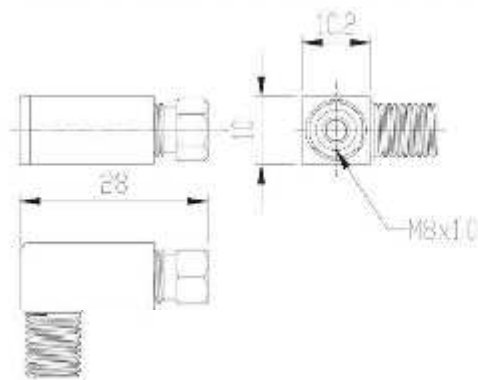
P140148 (NPC03)

Standard block	15	20	25	30	35	45	55
Standard block + U Type Metal Frame Scraper Plate	15	20	25	30	35	45	55



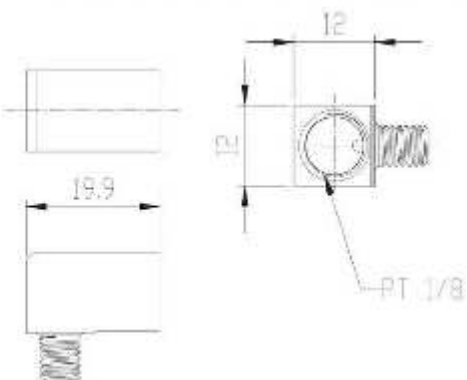
P140150 (NPC05)

Standard block	15	20	25	30	35	45	55
Standard block + U Type Metal Frame Scraper Plate	15	20	25	30	35	45	55



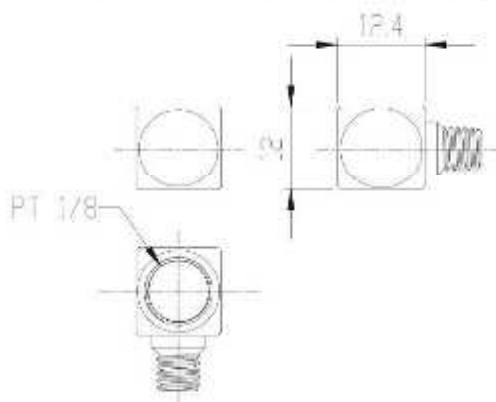
P140153 (NPC08)

Standard block	15	20	25	30	35	45	55
Standard block + U Type Metal Frame Scraper Plate	15	20	25	30	35	45	55



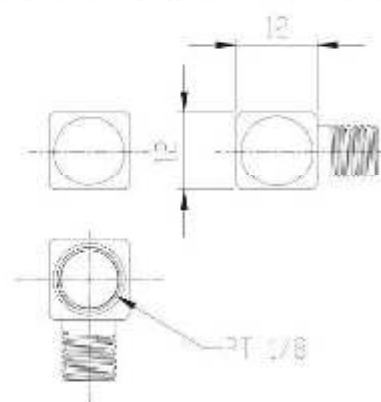
P140146 (NPC01)

Standard block	15	20	25	30	35	45	55
Standard block + U Type Metal Frame Scraper Plate	15	20	25	30	35	45	55



P140152 (NPC07)

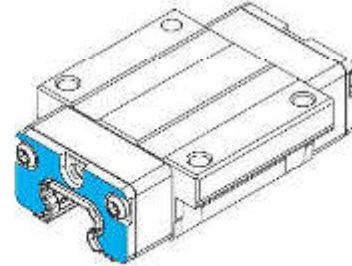
Standard block	15	20	25	30	35	45	55
Standard block + U Type Metal Frame Scraper Plate	15	20	25	30	35	45	55



1.15 Accessories

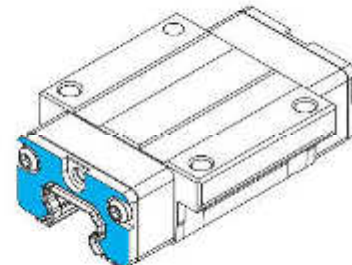
1.15.1 Standard Seal

Standard seal are contact seals that can be attached to the block end faces. Standard seal is suitable for normal environment.



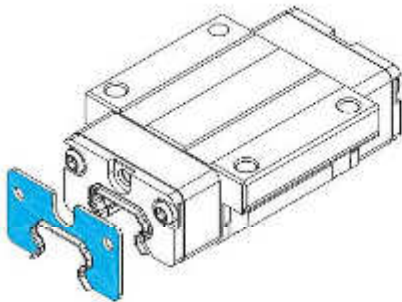
1.15.2 Low Friction Shield

Low friction shields are non-contact seals that can reduce running resistance and replace standard seal. They are suitable for the low pollution environment, for example, cleanroom.



1.15.3 Scraper plate

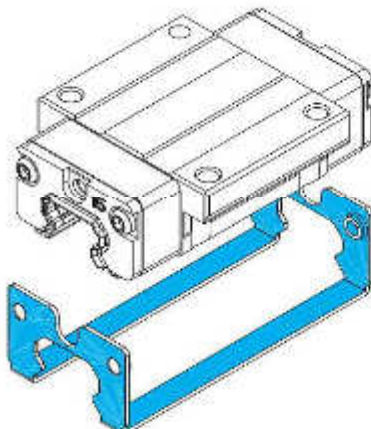
Scraper plates are spring-steel, non-contact components. They protect the standard seal from, for example, coarse contaminants or hot metal chips.



Model	Thickness (mm)
BR15	1
BR20	1
BR25	1.5
BR30	1
BR35	1
BR45	1

1.15.4 U Type Metal Frame

U type metal frames can hold the two side seals and change the block dimension values of L and E as below table. Refer to P38~P41 for definition of L and E.



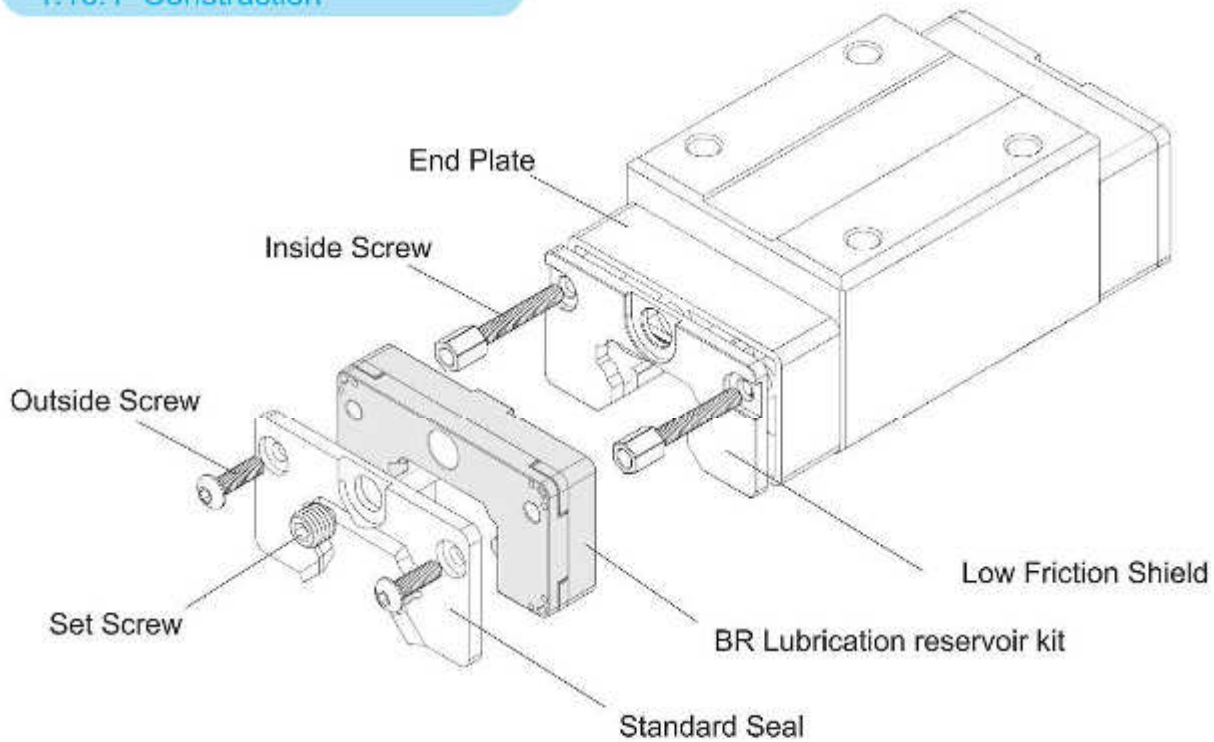
Model	L	E
BR15	68	2.6
BR20	79.8	3
BR25	90	5
BR30	111	7
BR35	111	7.5
BR45	140.2	12

Unit : mm

1.16 BR Lubrication Reservoir Kit

BR lubrication reservoir kit is run by a high oil content of reservoir and optimization of film forming designed to provide adequate and proper amount of lubricant to grooves of rails, thus reaching good effect of environmental protection and extend relubrication intervals.

1.16.1 Construction



1.16.2 Characteristics

(1) Effectively extend the relubrication intervals

- Make supplementary periodically up to 4000km

(2) High reliability and interchangeability

- End-users can install or replace BR lubrication reservoir kit by themselves easily.
- Replace BR lubrication reservoir kit on the rail directly without moving the block out.

(3) Friendly to environment

- Through optimization of the film forming methods to reduce the waste of lubrication oil, thus preventing environmental pollution.

(4) High-performance lubrication oil

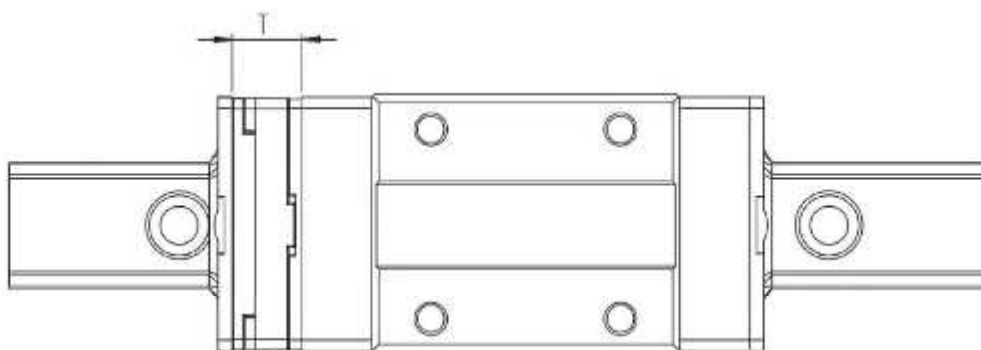
- Using the lubrication oil which is compliance with ISO3448, viscosity grade 680.
 - Perfectly compatible with the lubrication oil of blocks.
- Allowable temperature range: -10~50°C (working continuously) or -10~80°C (working temporarily)

1.16.3 Applicable Scope

- Series : BR Series
- Size : 15/20/25/30
- Block : available for all block types
- End Plate : available for standard end plate only
- Preload : available for all preload classes
- Precision : available for all accuracy classes

1.16.4 Thickness

BR Lubrication reservoir kit will increase the length of block.
Please refer to the below table for thickness T.



Thickness T of BR Lubrication reservoir kit

SIZE	BR lubrication reservoir kit thickness T (mm)
15	13
20	13
25	13
30	10

1.17 Product Overview

BRC-A0
BRD-A0
 Flanged block, standard length,
 standard height



BRC-R0
BRD-R0
 Slim-line block, standard length,
 extended height



BRC-U0
BRD-U0
 Slim-line block, standard length,
 standard height



BRR
 profile rail with blind holes



BRR
 profile rail with standard holes



BRC-LA
BRD-LA
 Flanged block, extended length,
 standard height



BRC-LR
BRD-LR
 Slim-line block, extended length,
 extended height



BRC-SU
BRD-SU
 Slim-line block, short length,
 standard height

1.18 Ordering Key of System

B R S 1 5 - A 0 C 2 Z 1 - 1 0 8 0 0 N D 0 - A 0 S W 2

Size _____
15, 20, 25, 30, 35, 45

Block Type ¹⁾ _____
 AO Flanged block, standard length, standard height
 LA Flanged block, extended length, standard height
 SU Slim-line block, short length, standard height
 UD Slim-line block, standard length, standard height
 RO Slim-line block, standard length, extended height
 LR Slim-line block, extended length, extended height

End Cap Type ²⁾ _____
 C Standard End Cap (for 15, 20, 25, 30)
 D Short End Cap (for 15, 20, 25, 30, 35, 45)

Number of blocks per rail _____
 1-9 1 - 9 blocks per rail
 A-W > 9 blocks per rail (10=A, 11= B, 12=C...)

Preload Class ²⁾ _____
 ZF Clearance
 Z0 No preload
 Z1 Light preload, 0-0.02C
 Z2 Medium preload, 0.02-0.05C
 Z3 Heavy preload, 0.05-0.07C

Rail Length _____
00080-99999 mm [1 mm steps]

Accuracy Class ²⁾ _____
 N Normal
 H High
 P Precision

Rail Hole _____
 D0 Standard hole (Standard hole distance. The distance of the first and last attachment holes is produced equidistantly.)
 F0 Standard hole (Standard hole distance. The distance of the first and last attachment holes is not produced equidistantly.)
 D4 Blind hole (Standard hole distance. The distance of the first and last attachment holes is produced equidistantly.)
 F4 Blind hole (Standard hole distance. The distance of the first and last attachment holes is not produced equidistantly.)
 DX Special machining, customized according to drawing number

Joint Rail Track _____
 A Yes
 O No

Rail Treatment ³⁾ _____
 0 Standard (anti-rust oil)
 B Black oxidation plating
 H Hard chromium plating

Sealing _____
 S Standard seal (only end seal)
 0 Low friction shield
 2 Standard seal + Scraper plate
 U ⁴⁾ Standard seal + Metal frame to hold two side seals
 V Standard seal + BR Lubrication reservoir kit
 W Standard seal + Scraper plate + BR Lubrication reservoir kit

No. of Parallel Rails _____
 00 Single Rail
 W2-W9 Parallel Rails (W2: 2 rails, W3: 3 rails...)

1) Carriage type cross table

● (○) : Block type available

● (○) : Sealing U type, Standard seal + Metal frame to hold two side seals

BRD (Standard End Cap)	AO	LA	SU	UD	RO	LR
15	●		○	●	●	
20	●	○	○	●	●	○
25	●	○	○	●	●	○
30	●	○	○	●	●	○
35						
45						

BRD (Short End Cap)	AO	LA	SU	UD	RO	LR
15	○		○	○	○	
20	○	○	○	○	○	○
25	○	○	○	○	○	○
30	○	○	○	○	○	○
35	●	○	○	●	●	○
45	●	○		●	●	○

2) Refer to following table for limitation

System			
Accuracy	P	H	N
Preload	-	-	ZF
	Z0	Z0	Z0
	Z1	Z1	Z1
	Z2	Z2	Z2

3) Carriage Surface Treatment

- A. Standard: Anti-rust oil
- B. Non-Standard: See Drawing

4) Rippelset screw quantity per block

- A. Size 15, 01-rippel(2 pcs)
- B. Size 20/25/30/35/45: 45°-rippel(1 pcs) + screw(3 pcs)

1.19 Ordering Key of Block

B R C 1 5 - A 0 Z 1 - N 0 S

End Cap Type²⁾

C Standard End Cap (for 15, 20, 25, 30)
D Short End Cap (for 15, 20, 25, 30, 35, 45)

Size

15, 20, 25, 30, 35, 45

Block Type¹⁾

A0 Flanged block, standard length, standard height
LA Flanged block, extended length, standard height
SU Slim-line block, short length, standard height
U0 Slim-line block, standard length, standard height
R0 Slim-line block, standard length, extended height
LR Slim-line block, extended length, extended height

Preload Class

ZF Clearance
ZU No preload
Z1 Light preload, 0~0.02C

Accuracy Class

N Normal

Block Treatment

D Standard (anti-rust oil)
B Black oxidation plating
H Hard chromium plating

Sealing

S Standard seal (only end seal)
0 Low friction shield
1 Standard seal + Scraper plate
U⁴⁾ Standard seal + Metal frame to hold two side seals

1) Block type cross table

●/○ : Block type available

● : Sealing U type, Standard seal + Metal frame to hold two side seals

BRC (Standard End Cap)	A0	LA	SU	U0	R0	LR
15	●		○	●	●	
20	●	○	○	●	●	○
25	●	○	○	●	●	○
30	●	○	○	●	●	○
35						
45						

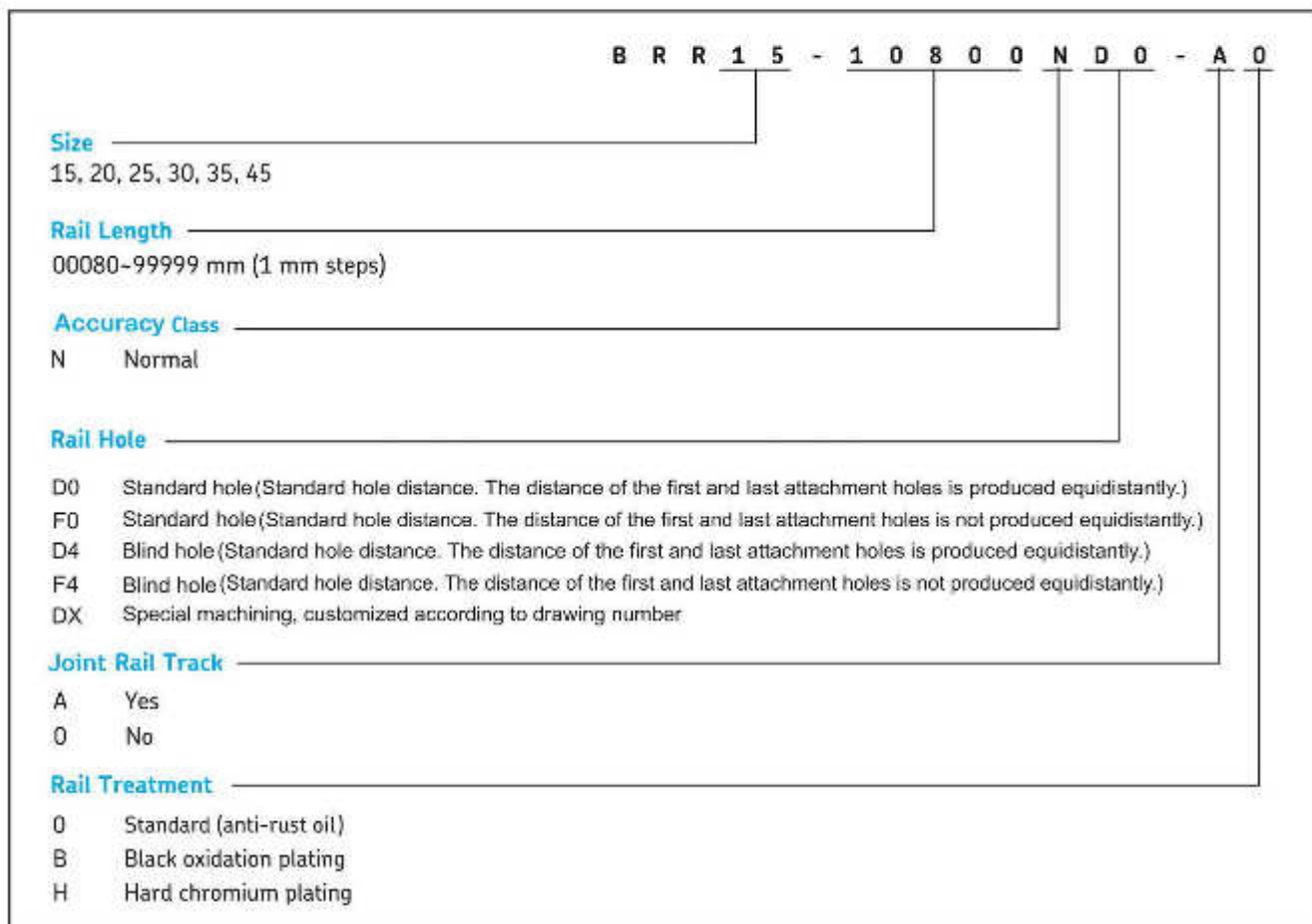
BRD (Short End Cap)	A0	LA	SU	U0	R0	LR
15	○		○	○	○	
20	○	○	○	○	○	○
25	○	○	○	○	○	○
30	○	○	○	○	○	○
35	●	○	○	●	●	○
45	●	○		●	●	○

2) Nipple/set screw quantity per block

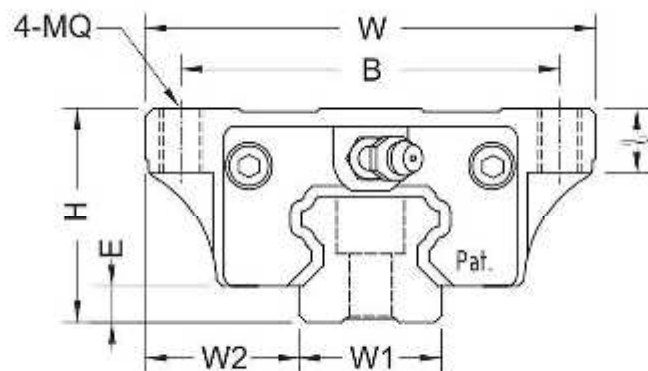
A. Size 15: 0° nipple(2 pcs)

B. Size 20/25/30/35/45: 45° nipple(1 pcs) + screw(1 pcs)

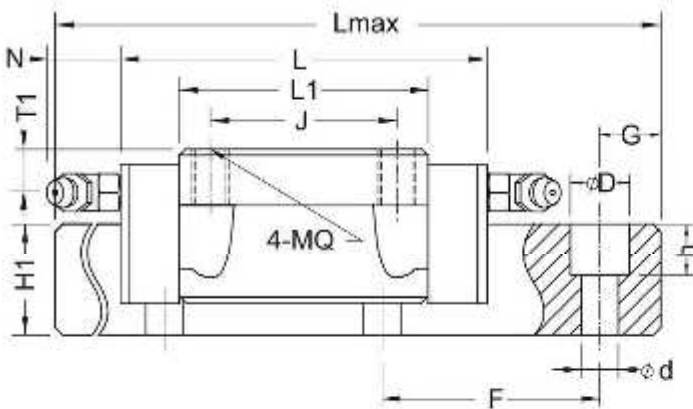
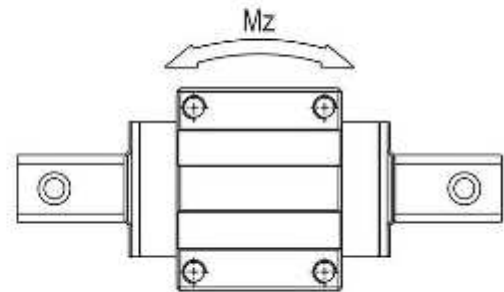
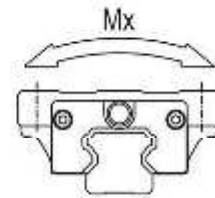
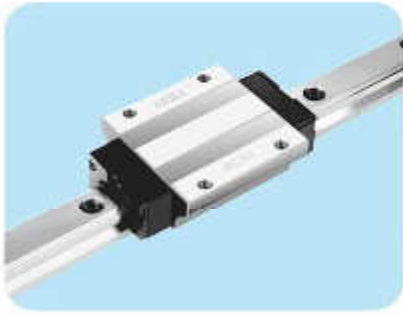
1.20 Ordering Key of Rail



1.21 BRC-A0/LA, BRD-A0/LA



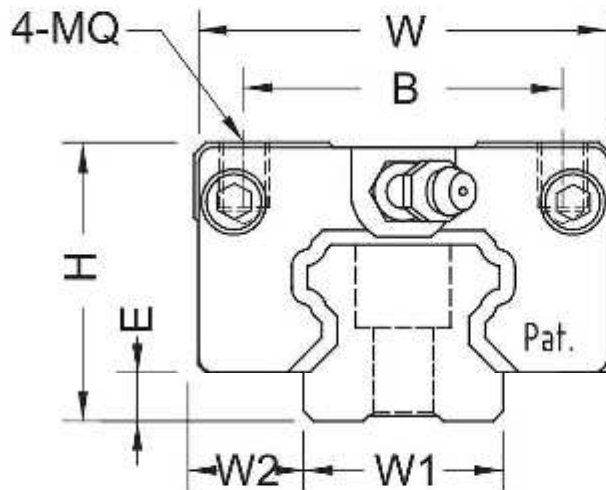
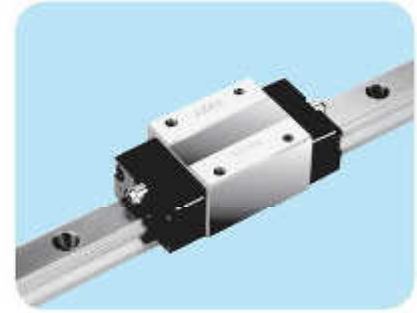
Model No.	Assembly (mm)				BR block (mm)							BR rail (mm)			
	H	W	W2	E	L	BxJ	MQxI	L1	Oil hole	T1	(N)	W1	H1	F	dxDxh
BRC15A0	24	47	16	4.6	66	38x30	M5x8	40	∅ 3	4.3	5	15	14	60	4.5x7.5x5.8
BRD15A0					56										
BRC20A0	30	63	21.5	5	77.8	53x40	M6x9	48.8	M6x1	7	15.6	20	18	60	6x9.5x9.0
BRD20A0					67.8			63.4							
BRC20LA					92.4										
BRD20LA					82.4										
BRC25A0	36	70	23.5	7	88	57x45	M8x12	57	M6x1	7.8	15.6	23	22	60	7x11x9.5
BRD25A0					78			79.1							
BRC25LA					110.1										
BRD25LA					100.1										
BRC30A0	42	90	31	9	109	72x52	M10x12	72	M6x1	7	15.6	28	26	80	9x14x12.5
BRD30A0					99			94.3							
BRC30LA					131.3										
BRD30LA					121.3										
BRD35A0	48	100	33	9.5	109	82x62	M10x13	80	M6x1	8	15.6	34	29	80	9x14x12.5
BRD35LA					134.8			105.8							
BRD45A0	60	120	37.5	14	138.2	100x80	M12x15	105	M8x1	8.5	16	45	38	105	14x20x17.5
BRD45LA					163			129.8							



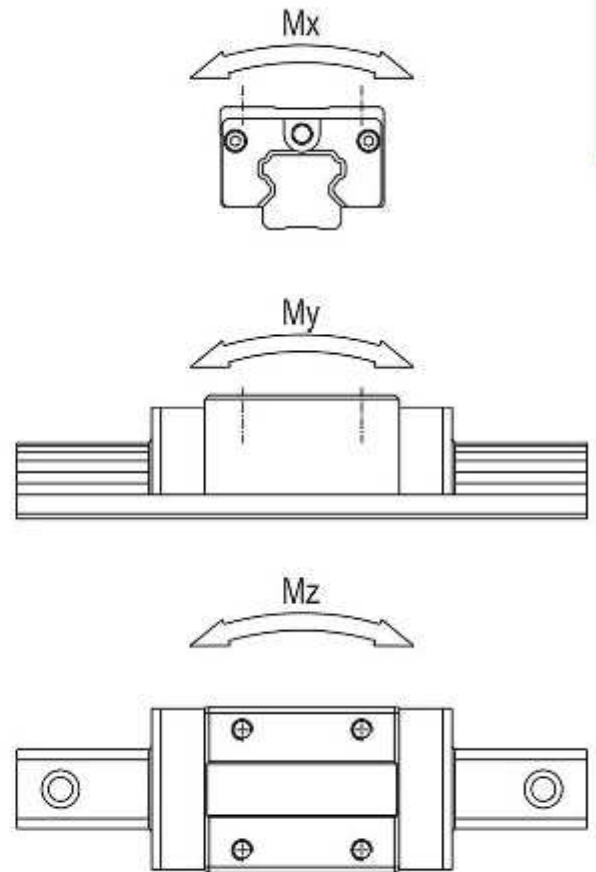
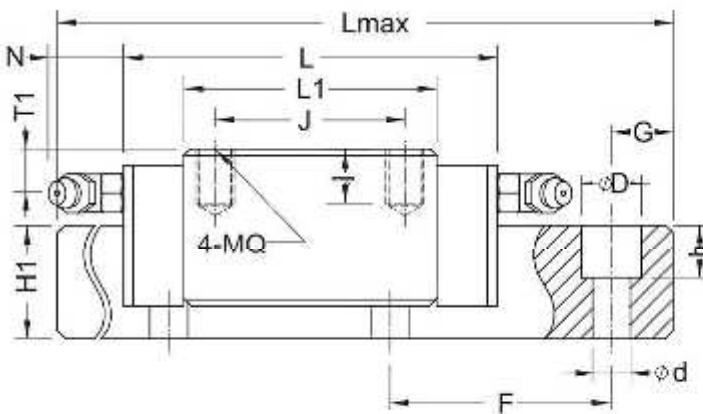
Model No.	Ref. Data (mm)		Basic Load Rating (Kgf)		Static Moment (Kgf·m)			Weight	
	Lmax	G	(C)	(Co)	Mx	My	Mz	Block(Kg)	Rail(Kg/m)
BRC15A0	4000	20	850	1350	10.1	6.8	6.8	0.21	1.4
BRD15A0									
BRC20A0	4000	20	1400	2400	24	14.6	14.6	0.4	2.6
BRD20A0									
BRC20LA			1650	3000	30	23.8	23.8	0.52	
BRD20LA									
BRC25A0	4000	20	1950	3200	36.8	22.8	22.8	0.57	3.6
BRD25A0									
BRC25LA			2600	4600	52.9	45.5	45.5	0.72	
BRD25LA									
BRC30A0	4000	20	2850	4800	67.2	43.2	43.2	1.1	5.2
BRD30A0									
BRC30LA			3600	6400	89.6	75.4	75.4	1.4	
BRD30LA									
BRD35A0	4000	20	3850	6200	105.4	62	62	1.6	7.2
BRD35LA			4800	8300	141.1	109.8	109.8	2	
BRD45A0	4000	22.5	6500	10500	236.3	137.8	137.8	2.7	12.3
BRD45LA			7700	13000	292.5	210.9	210.9	3.6	

Note: BR35 and BR45 are not equipped with self-lubricant parts.

1.22 BRC-R0/LR, BRD-R0/LR



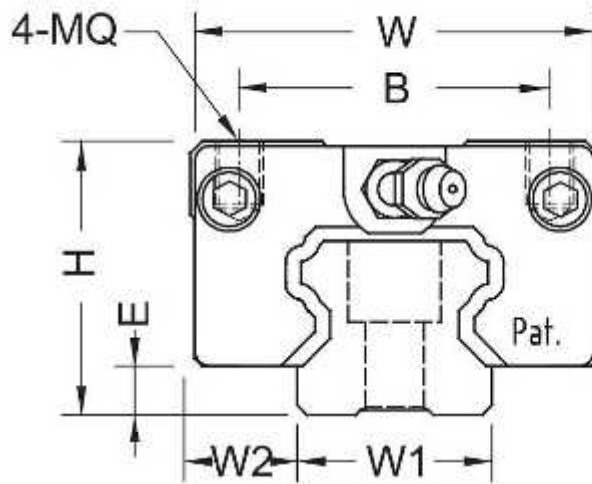
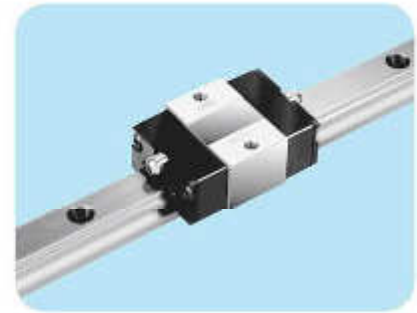
Model No.	Assembly (mm)				BR block (mm)							BR rail (mm)			
	H	W	W2	E	L	BxJ	MQxI	L1	Oil hole	T1	(N)	W1	H1	F	dxDxh
BRC15R0	28	34	9.5	4.6	66	26x26	M4x6	40	∅ 3	8.3	5	15	14	60	4.5x7.5x5.8
BRD15R0					56										
BRC20R0	30	44	12	5	77.8	32x36	M5x8	48.8	M6x1	7	15.6	20	18	60	6x9.5x9.0
BRD20R0					67.8			32x50							
BRC20LR					92.4										
BRD20LR					82.4										
BRC25R0	40	48	12.5	7	88	35x35	M6x10	57	M6x1	11.8	15.6	23	22	60	7x11x9.5
BRD25R0					78			35x50							
BRC25LR					110.1										
BRD25LR					100.1										
BRC30R0	45	60	16	9	109	40x40	M8x13	72	M6x1	10	15.6	28	26	80	9x14x12.5
BRD30R0					99			40x60							
BRC30LR					131.3										
BRD30LR					121.3										
BRD35R0	55	70	18	9.5	109	50x50	M8x13	80	M6x1	15	15.6	34	29	80	9x14x12.5
BRD35LR					134.8	50x72		105.8							
BRD45R0	70	86	20.5	14	138.2	60x60	M10x16.5	105	M8x1	18.5	16	45	38	105	14x20x17.5
BRD45LR					163	60x80		129.8							



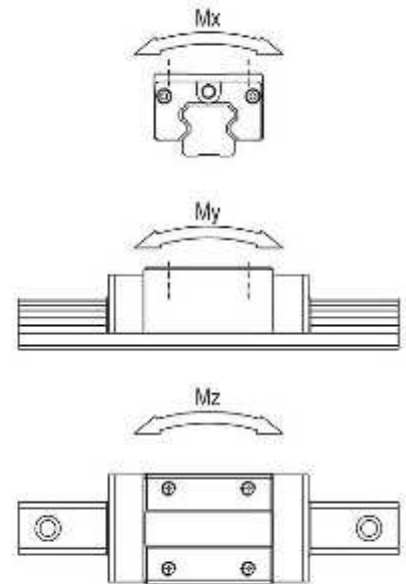
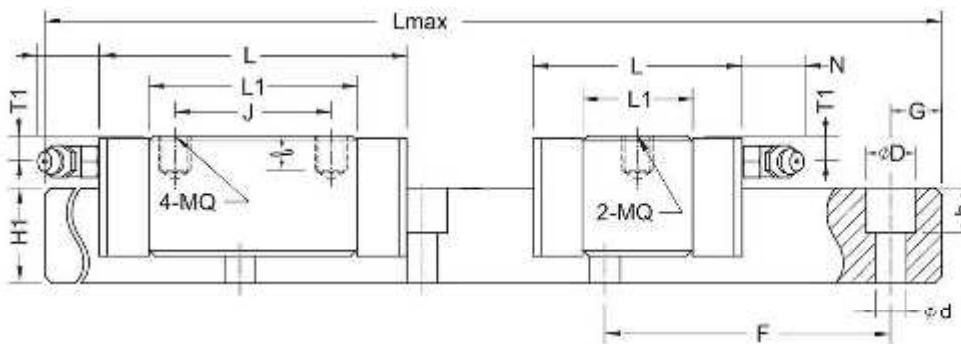
Model No.	Ref. Data (mm)		Basic Load Rating (Kgf)		Static Moment (Kgf*m)			Weight	
	Lmax	G	(C)	(Co)	Mx	My	Mz	Block(Kg)	Rail(Kg/m)
BRC15R0 BRD15R0	4000	20	850	1350	10.1	6.8	6.8	0.19	1.4
BRC20R0 BRD20R0 BRC20LR BRD20LR			1400	2400	24	14.6	14.6		
BRC25R0 BRD25R0 BRC25LR BRD25LR	4000	20	1650	3000	30	23.8	23.8	0.47	3.6
BRC30R0 BRD30R0 BRC30LR BRD30LR			1950	3200	36.8	22.8	22.8	0.45	
BRD35R0 BRD35LR	4000	20	2600	4600	52.9	45.5	45.5	0.56	5.2
BRC30R0 BRD30R0 BRC30LR BRD30LR			2850	4800	67.2	43.2	43.2	0.91	
BRD35R0 BRD35LR	4000	20	3600	6400	89.6	75.4	75.4	1.2	7.2
BRD45R0 BRD45LR			3850	6200	105.4	62	62	1.5	
BRD45R0 BRD45LR	4000	22.5	4800	8300	141.1	109.8	109.8	1.9	12.3
BRD45R0 BRD45LR			6500	10500	236.3	137.8	137.8	2.3	
BRD45R0 BRD45LR	4000	22.5	7700	13000	292.5	210.9	210.9	2.8	12.3

Note: BR35 and BR45 are not equipped with self-lubricant parts.

1.23 BRC-SU/U0, BRD-SU/U0



Model No.	Assembly (mm)				BR block (mm)							BR rail (mm)			
	H	W	W2	E	L	BxJ	MQx _i	L1	Oil hole	T1	(N)	W1	H1	F	dxDxh
BRC15U0	24	34	9.5	4.6	66	26x26	M4x5.6	40	∅3	4.3	5	15	14	60	4.5x7.5x5.8
BRD15U0					56										
BRC15SU					47.6	26x -									
BRD15SU					37.8										
BRC20U0	28	42	11	5	77.8	32x32	M5x6.4	48.8	M6x1	5	15.6	20	18	60	6x9.5x9.0
BRD20U0					67.8										
BRC20SU					57	32x -									
BRD20SU					47										
BRC25U0	33	48	12.5	7	88	35x35	M6x8	57	M6x1	4.8	15.6	23	22	60	7x11x9.5
BRD25U0					78										
BRC25SU					62.5	35x -									
BRD25SU					52.5										
BRC30U0	42	60	16	9	109	40x40	M8x11.5	72	M6x1	7	15.6	28	26	80	9x14x12.5
BRD30U0					99										
BRC30SU					75.6	40x -									
BRD30SU					65.6										
BRD35U0	48	70	18	9.5	109	50x50	M8x11.2	80	M6x1	8	15.6	34	29	80	9x14x12.5
BRD35SU					74.7	50x -		45.7							
BRD45U0	60	86	20.5	14	138.2	60x60	M10x13	105	M8x1	8.5	16	45	38	105	14x20x17.5



Model No.	Ref.Data (mm)		Basic Load Rating (Kgf)		Static Moment (Kgf*m)			Weight	
	Lmax	G	(C)	(Co)	Mx	My	Mz	Block(Kg)	Rail(Kg/m)
BRC15U0	4000	20	850	1350	10.1	6.8	6.8	0.17	1.4
BRD15U0			520	680	5.1	1.8	1.8		
BRC15SU			1400	2400	24	14.6	14.6		
BRD15SU			950	1400	7	4.9	4.9		
BRC20U0	4000	20	1950	3200	36.8	22.8	22.8	0.38	3.6
BRD20U0			1250	1750	17.5	6.9	6.9		
BRC20SU			2850	4800	67.2	43.2	43.2		
BRD20SU			1750	2400	33.6	11.6	11.6		
BRC25U0	4000	20	3850	6200	105.4	62	62	1.2	7.2
BRD25U0			2500	3650	62.1	20.9	20.9		
BRC25SU			2850	4800	67.2	43.2	43.2		
BRD25SU			1750	2400	33.6	11.6	11.6		
BRC30U0	4000	20	6500	10500	236.3	137.8	137.8	2.1	12.3
BRD30U0			2850	4800	67.2	43.2	43.2		
BRC30SU			1750	2400	33.6	11.6	11.6		
BRD30SU			3850	6200	105.4	62	62		
BRD35U0	4000	20	2500	3650	62.1	20.9	20.9	0.8	7.2
BRD45U0	4000	22.5	6500	10500	236.3	137.8	137.8	2.1	12.3

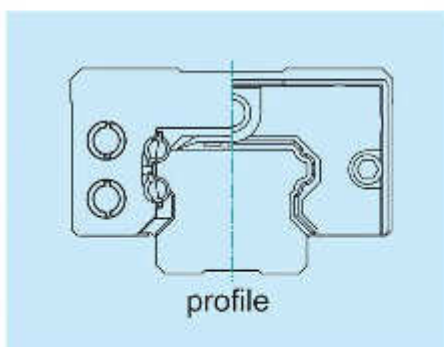
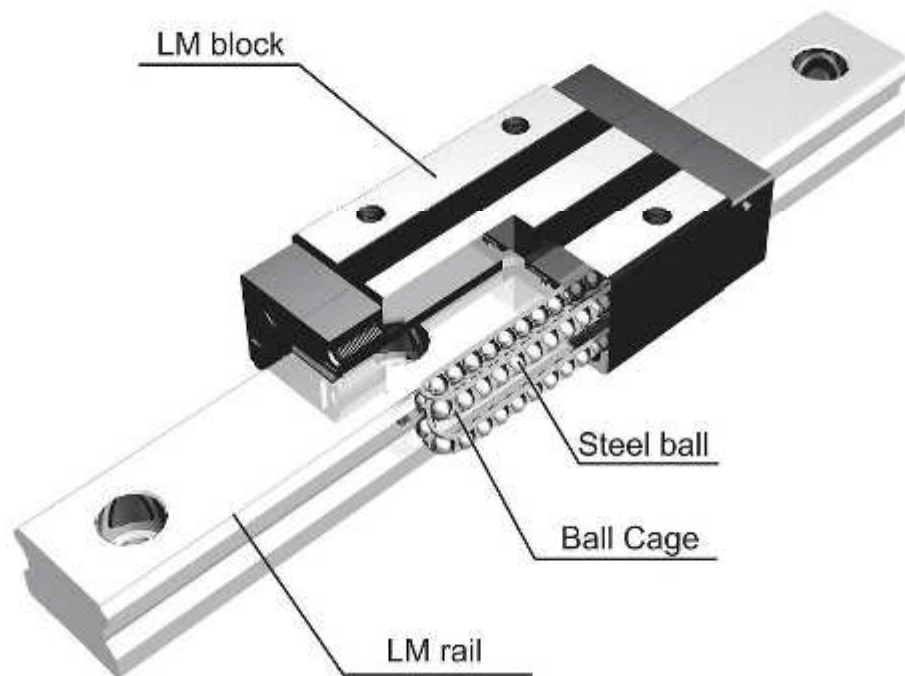
Note: BR35 and BR45 are not equipped with self-lubricant parts.



2.1 Features

- Perfect smoothness, free of maintenance and greasing work.
- Equivalent loading, long service life.
- Equipped with ball cage, lower noise and smoother running.

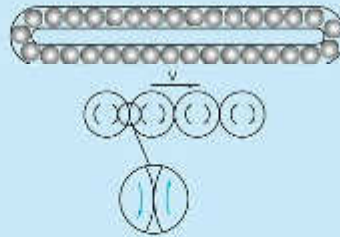
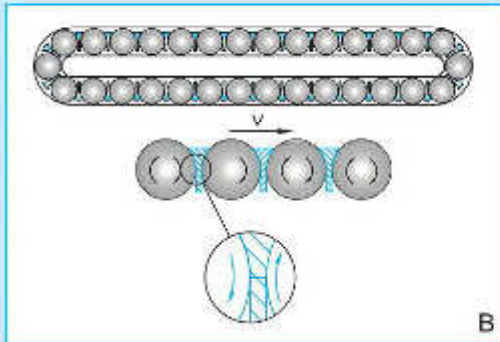
BC Series Component Display



BC series is equipped with **ABBA**'s latest developed Ball Cage, which lowers the noise, and enables high-speed running, longer life time, and outstanding accuracy.

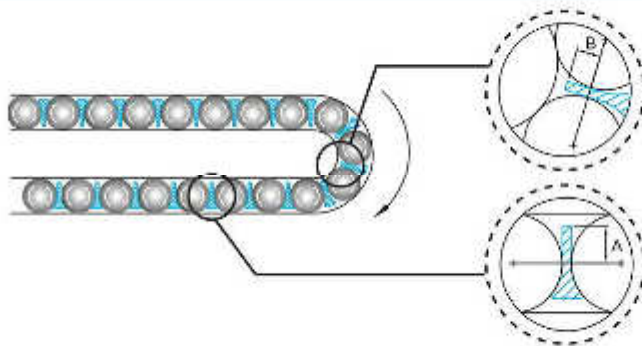
2.2 The Characteristic of BC Series

New (with ball cage)



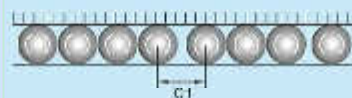
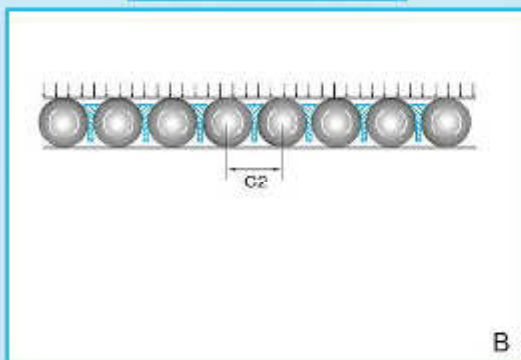
A

1. Steel balls chafe against each other in drawing A, in which the friction is two times larger than in drawing B, so that the life time in B is longer than in A.



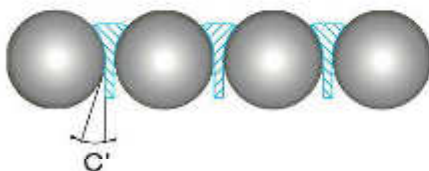
2. The difference between ABBA's ball cage and others' is that there will be no press and intervention from the inner part of the ball cage when it is turning that friction is lowered and life time extends.

New (with ball cage)



A

3. It shows in drawing B that due to the ball cage, steel balls are loaded equivalently that their service life could be longer.



B



Oil membrane adheres easily between the ball cage and steel balls.



A

4. As demonstrated above, the included angle in drawing A(C) is larger than the one in drawing B(C') with ball cage. Therefore, oil membrane adheres easily in the structure of BC series.

2.3 Product Overview

BCC-A0
Flanged block, standard length,
standard height



BCC-R0
Slim-line block, standard length,
extended height



BCR
profile rail with blind holes



BCR
profile rail with standard holes



BCC-LA
Flanged block, extended length,
standard height



BCC-LR
Slim-line block, extended length,
extended height

2.4 Ordering Key of System

B C S 2 0 - A 0 C 2 Z 1 - 1 0 8 0 0 N D 0 - A 0 S W 2

Size _____
20, 25, 30, 35, 45, 55

Block, Type _____
A0 Flanged block, standard length, standard height
LA Flanged block, extended length, standard height
R0 Slim-line block, standard length, extended height
LR Slim-line block, extended length, extended height

End Cap Type _____
C Standard End Cap

Number of carriages per rail _____
1-9 1 ~ 9 blocks per rail
A-W > 9 blocks per rail (10=A, 11=B, 12=C...)

Preload Class ¹⁾ _____
ZF Clearance
Z0 No preload
Z1 Light preload, 0~0.02C

Rail Length _____
00050~99999 mm (1 mm steps)

Accuracy Class ¹⁾ _____
N Normal
H High
P Precision

Rail Hole _____
D0 Standard hole (Standard hole distance. The distance of the first and last attachment holes is produced equidistantly.)
F0 Standard hole (Standard hole distance. The distance of the first and last attachment holes is not produced equidistantly.)
D4 Blind hole (Standard hole distance. The distance of the first and last attachment holes is produced equidistantly.)
F4 Blind hole (Standard hole distance. The distance of the first and last attachment holes is not produced equidistantly.)
DX Special machining, customized according to drawing number

Joint Rail Track _____
A Yes (Refer to drawing for detail)
0 No

Rail Treatment ²⁾ _____
0 Standard (anti-rust oil)

Sealing _____
S Standard seal (only end seal)
1 Standard seal + Scraper plate

No. of Parallel Rails _____
00 Single Rail
W2~W9 Parallel Rails (W2: 2 rails, W3: 3 rails...)

Ball Caged LM

1) Refer to following table for limitation:

System			
Accuracy	P	H	N
Preload	-	-	ZF
	Z0	Z0	Z0
	Z1	Z1	Z1
	Z2	Z2	Z2
	Z3	Z3	Z3

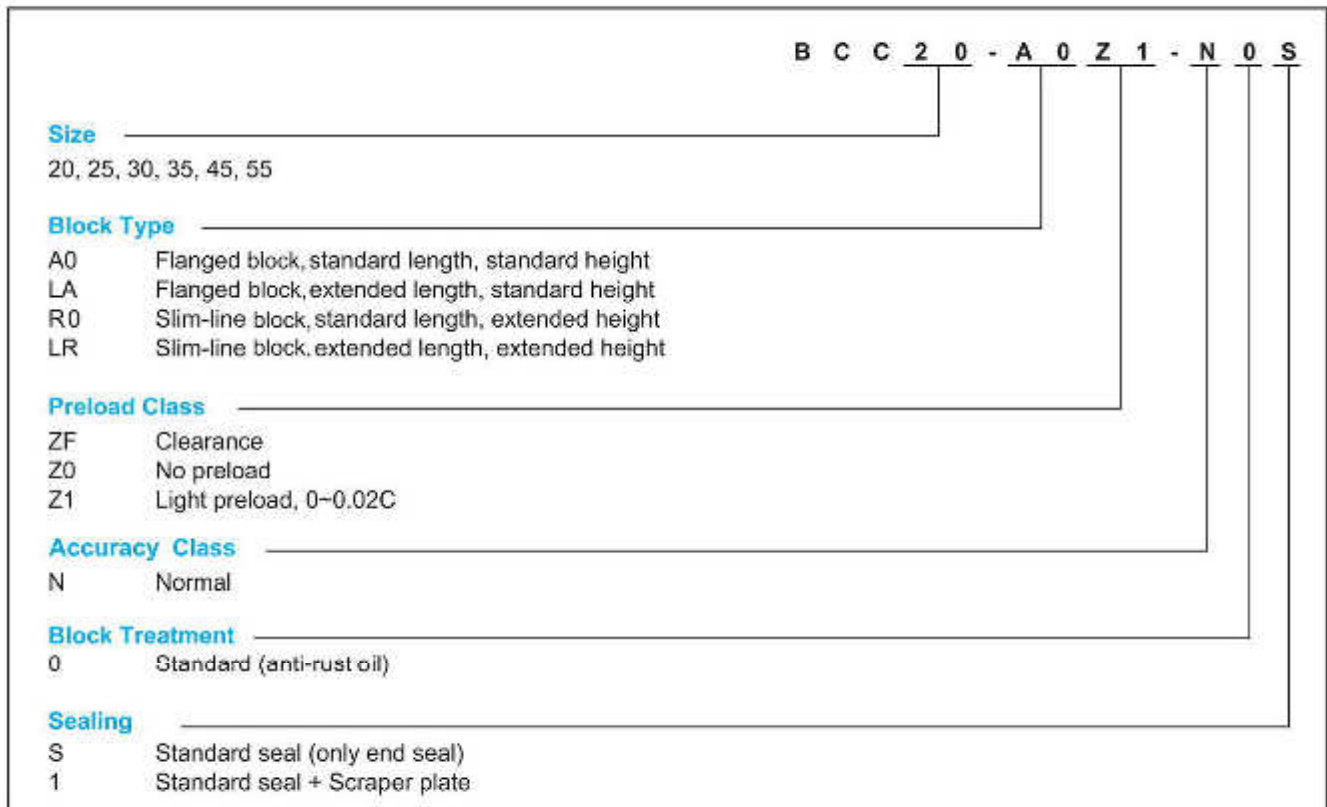
2) Block Surface Treatment

- A. Standard: Anti-rust oil
- B. Non-Standard: See Drawing

3) Nipple/set screw type of Standard type

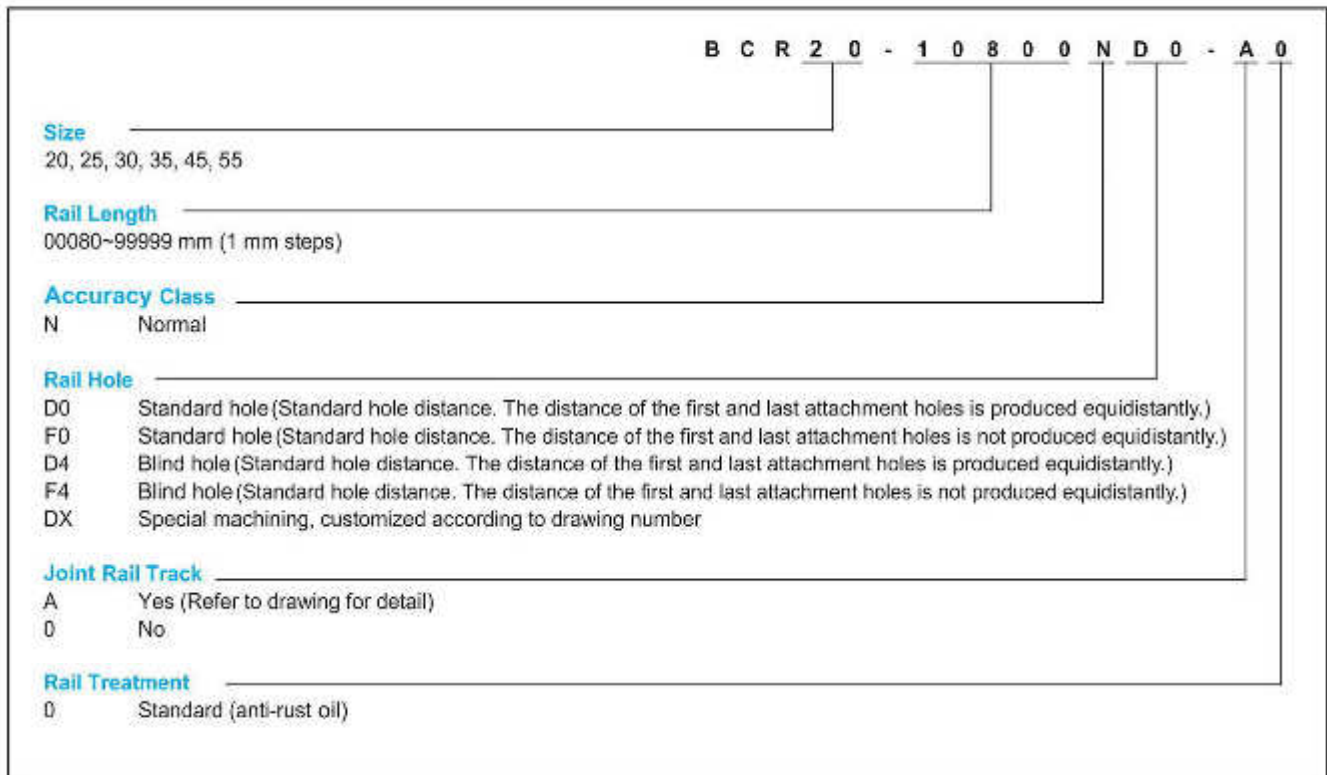
- A. Size 20/25/30/35/45/55: 45° nipple(1 pcs) + screw(1 pcs)

2.5 Ordering Key of Block

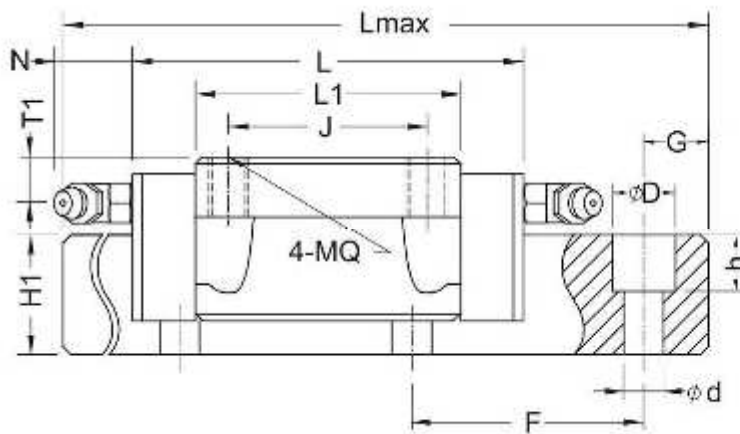


- 1) Nipple/set screw type of Standard type
 A. Size 20/25/30/35/45/55: 45° nipple(1 pcs) + screw(1 pcs)

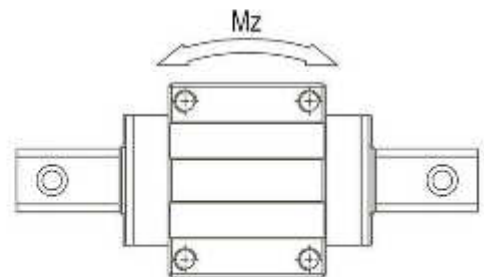
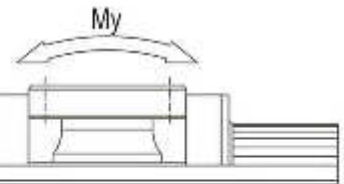
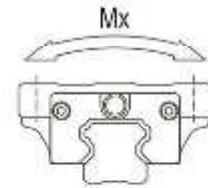
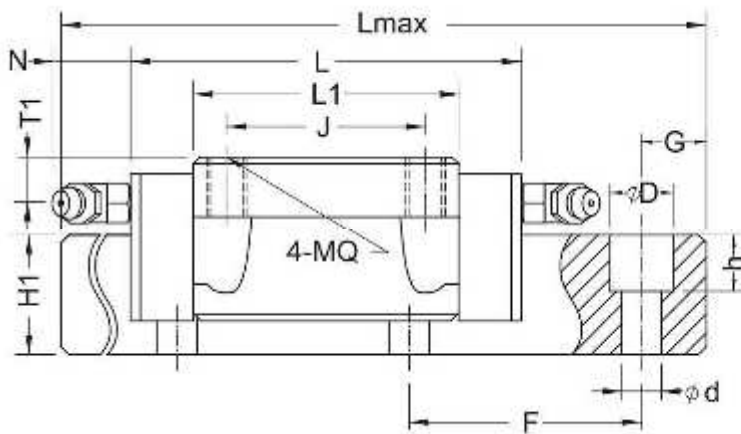
2.6 Ordering Key of Rail



2.7 BCC - A0 / LA

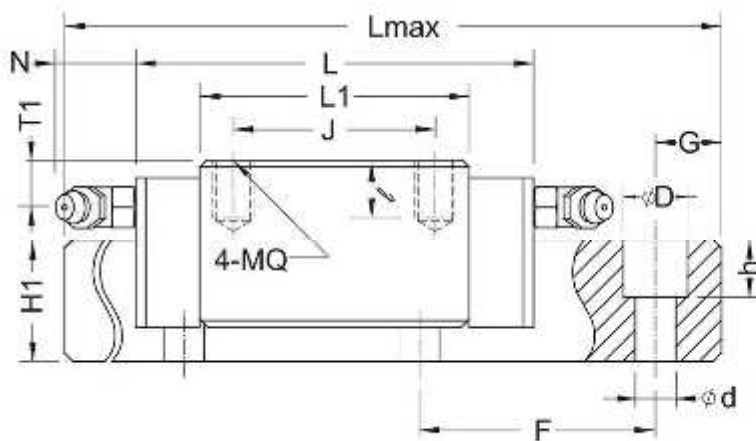
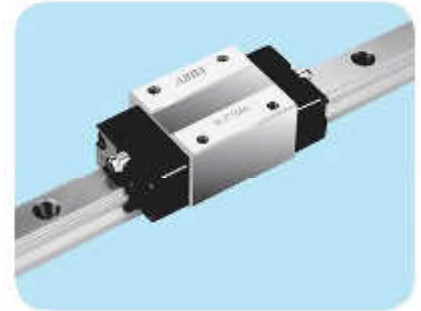


Model No.	Assembly (mm)				BC block (mm)							BC rail (mm)			
	H	W	W2	E	L	BxJ	MQx	L1	Oil hole	T1	(N)	W1	H1	F	dxDxh
BCC20A0	30	63	21.5	6	87	53x40	M6x10	59	M6x1	7.5	15.6	20	16.5	60	6x9.5x9.0
BCC20LA					106			78							
BCC25A0	36	70	23.5	6	102	57x45	M8x12	71	M6x1	10	15.6	23	20	60	7x11x9.5
BCC25LA					119			88							
BCC30A0	42	90	31	7	116	72x52	M10x15	80	M6x1	12	15.6	28	23	80	9x14x12.5
BCC30LA					141			105							
BCC35A0	48	100	33	7.5	132	82x62	M10x17	93	M6x1	12	15.6	34	26	80	9x14x12.5
BCC35LA					162			123							
BCC45A0	60	120	37.5	8.9	150	100x80	M12x17	106	M8x1	16	16	45	32	105	14x20x17.5
BCC45LA					184			140							
BCC55A0	70	140	43.5	12.7	181	116x95	M14x21	131	M8x1	20	16	53	38	120	16x23x20.1
BCC55LA					223			173							



Model No.	Ref. Data (mm)		Basic Load Rating (Kgf)		Static Moment (Kgf*m)			Weight	
	Lmax	G	(C)	(Co)	Mx	My	Mz	Block(Kg)	Rail(Kg/m)
BCC20A0	4000	20	1300	2500	32.9	30.4	30.4	0.45	2.3
BCC20LA			1600	3300	43	52	52	0.62	
BCC25A0	4000	20	1800	3400	51.3	51.8	51.8	0.75	3.2
BCC25LA			2100	4200	63.5	77.2	77.2	0.9	
BCC30A0	4000	20	2500	4600	79	72	72	1.31	4.5
BCC30LA			3100	6100	105	124	124	1.55	
BCC35A0	4000	20	3500	6300	140	126	126	1.9	6.2
BCC35LA			4300	8400	184	214	214	2.55	
BCC45A0	4000	22.5	4700	8200	245	187	187	3.3	10.4
BCC45LA			5800	10900	320	315	315	4.2	
BCC55A0	4000	30	7600	12800	446	355	355	5.4	14.5
BCC55LA			9300	17100	580	600	600	7.1	

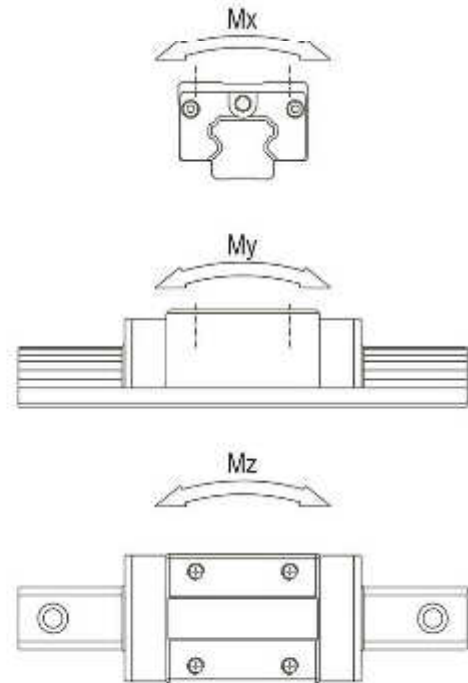
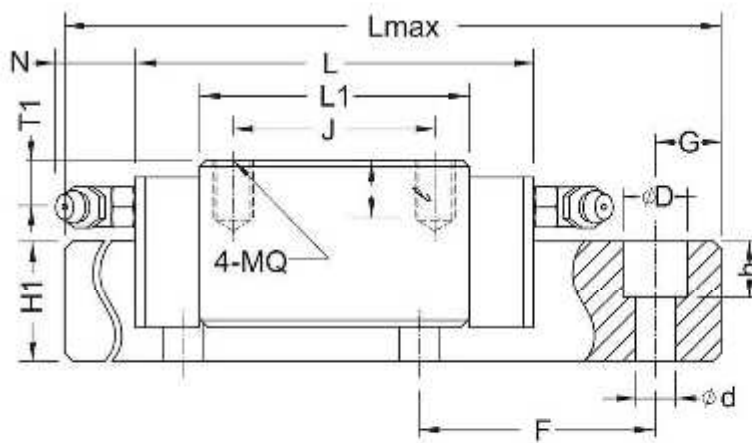
2.8 BCC - R0 / LR



Model No.	Assembly (mm)				BC block (mm)						BC rail (mm)				
	H	W	W2	E	L	BxJ	MQxI	L1	Oil hole	T1	(N)	W1	H1	F	dxDxh
BCC20R0	30	44	12	6	87	32x36	M5x7	59	M6x1	7.5	15.6	20	16.5	60	6x9.5x9.0
BCC20LR					106	32x50		78							
BCC25R0	40	48	12.5	6	102	35x35	M6x10	71	M6x1	14	15.6	23	20	60	7x11x9.5
BCC25LR					119	35x50		88							
BCC30R0	45	60	16	7	116	40x40	M8x12	80	M6x1	15	15.6	28	23	80	9x14x12.5
BCC30LR					141	40x60		105							
BCC35R0	55	70	18	7.5	132	50x50	M8x14	93	M6x1	19	15.6	34	26	80	9x14x12.5
BCC35LR					162	50x72		123							
BCC45R0	70	86	20.5	8.9	150	60x60	M10x16	106	M8x1	26	16	45	32	105	14x20x17.5
BCC45LR					184	60x80		140							
BCC55R0	80	100	23.5	12.7	181	75x75	M12x19	131	M8x1	30	16	53	38	120	16x23x20.1
BCC55LR					223	75x95		173							



Ball Caged LM



Model No.	Ref. Data (mm)		Basic Load Rating (Kgf)		Static Moment (Kgf·m)			Weight	
	Lmax	G	(C)	(Co)	Mx	My	Mz	Block(Kg)	Rail(Kg/m)
BCC20R0	4000	20	1300	2500	32.9	30.4	30.4	0.35	2.3
BCC20LR			1600	3300	43	52	52	0.45	
BCC25R0	4000	20	1800	3400	51.3	51.8	51.8	0.7	3.2
BCC25LR			2100	4200	63.5	77.2	77.2	0.9	
BCC30R0	4000	20	2500	4600	79	72	72	1.1	4.5
BCC30LR			3100	6100	105	124	124	1.4	
BCC35R0	4000	20	3500	6300	140	126	126	1.7	6.2
BCC35LR			4300	8400	184	214	214	2.2	
BCC45R0	4000	22.5	4700	8200	245	187	187	3.1	10.4
BCC45LR			5800	10900	320	315	315	4	
BCC55R0	4000	30	7600	12800	446	355	355	5.2	14.5
BCC55LR			9300	17100	580	600	600	6.7	

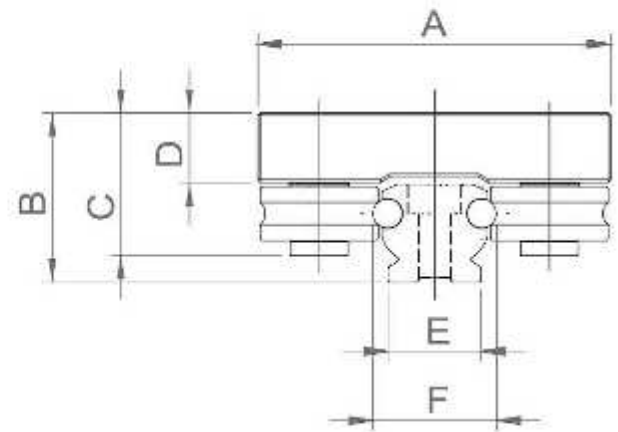
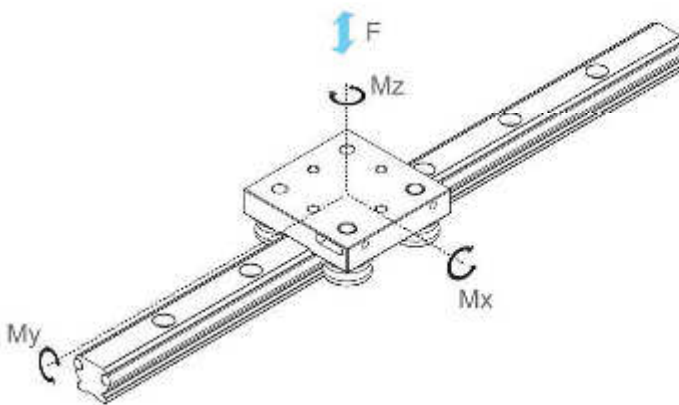


3.1 CRC Standard Type

Ordering Key: **CRC25×0870-B2 (20,10)**

1 **2** **3** **4**

- 1** Block type : CRC
- 2** Guide rail length : 870 mm
- 3** Number of blocks : 2
- 4** End distance of screw hole : 20 · 10
(Evenly spaced on both end if not specific)

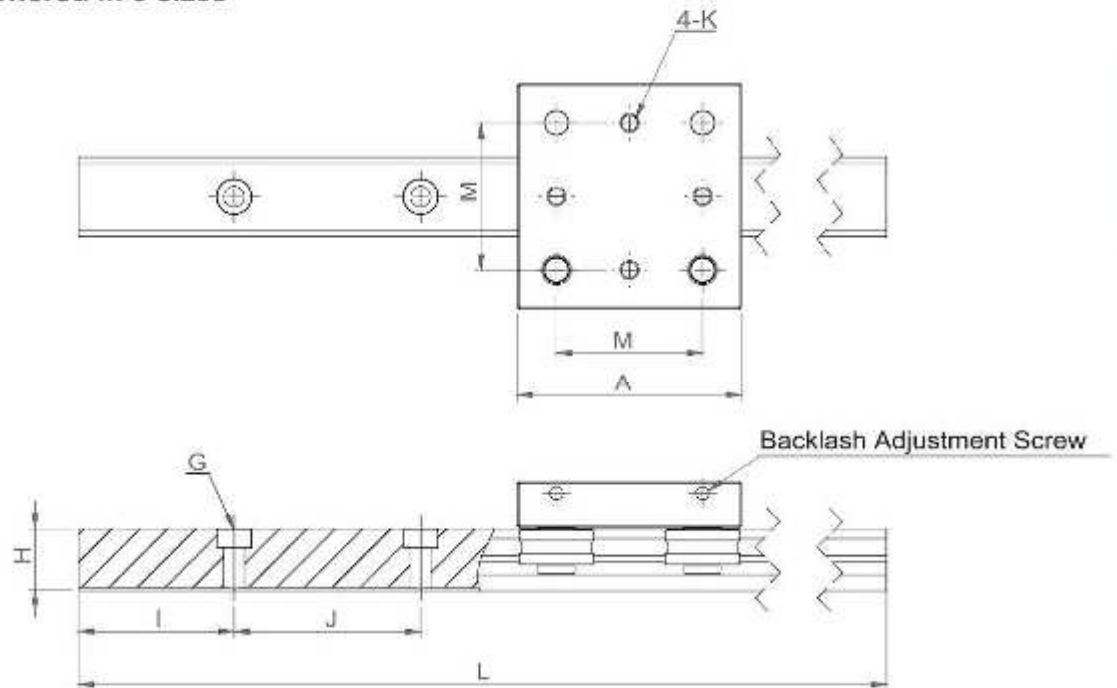


Model No.	Dimensions						Basic Load Rating (kgf)		Static Moment Load (kgf-m)		
	A	B	C	D	E	F	C	C ₀	M _x	M _y	M _z
CRC 20	54	23	20.5	10.8	17	21	72	70	3.6	2.4	3.4
CRC 25	72	34	29.5	14.5	19	25	215	185	17.6	10.8	15.5
CRC 32	80	35	29.5	14.5	25	32	215	185	23	14	19.8
CRC32L	100	46	42	19.2	22	32	410	410	32	20	31.5
CRC 42	110	46	42	19.2	28	42	410	410	45.8	29	45

(mm)

Features

- Block roller clearance pre-adjusted at factory
- Adjustable roller clearance on block
- Low noise
- Lubrication not required
- Rust-Proof guide rail
- CRC series offered in 5 sizes



Model No.	Dimensions						
	C	H	I	J	K	L	M
CRC 20	ø4.5xø8x4.5dp	13.5	1/2J	60	M5	100-4000	36
CRC 25	ø5.7xø10x6.5dp	20	1/2J	60	M6	100-4000	47
CRC 32	ø6.6xø11.5x8dp	20	1/2J	60	M6	100-4000	54
CRC32L	ø6.6xø10.5x8dp	24.8	1/2J	60	M8	100-4000	63
CRC 42	ø9xø14x12dp	24.8	1/2J	80	M8	100-4000	73

Note : I value will be 1/2J or evenly spaced on both end if not specific

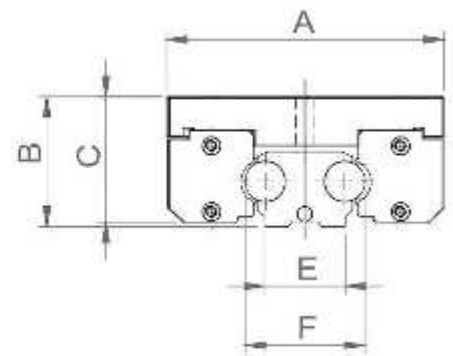
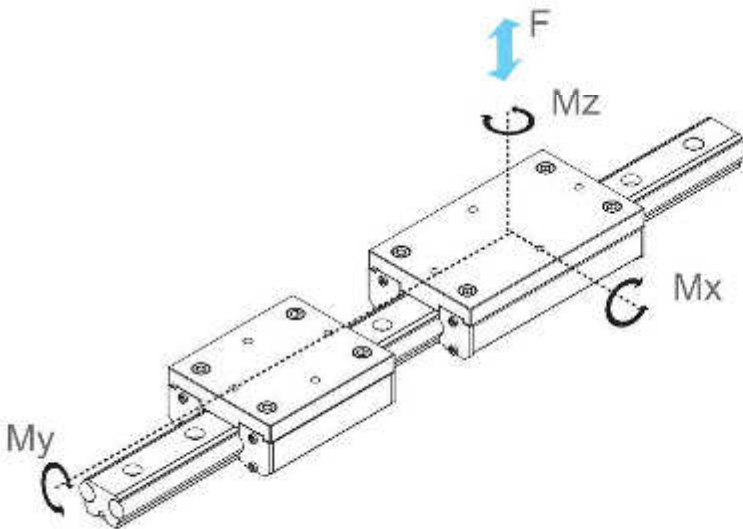
(mm)

3.2 CRD Dust Proof Type

Ordering Key: **CRD12×0880-B2(20,10)**

1 **2** **3** **4**

- 1** Block type :
 CRD12 : Standard Block Type
 CRD12L : Extended Length Block Type
- 2** Guide rail length : 880 mm
- 3** Number of blocks : 2
- 4** End distance of screw hole : 20 · 10
 (Evenly spaced on both end if not specific)

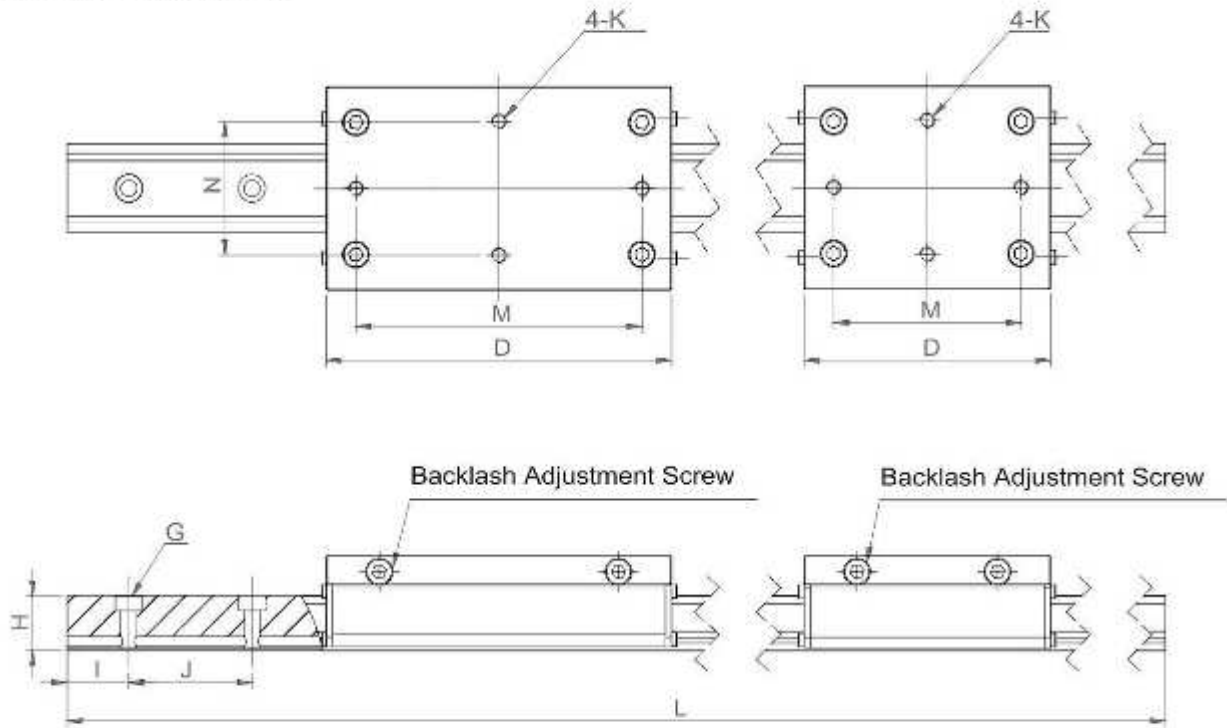


Model No.	Dimensions				
	A	B	C	E	F
CRD12	82	38.5	36.5	24	36
CRD12L	82	38.5	36.5	24	36

(mm)

Features

- Dust-proof block
- Adjustable roller clearance on block
- Low noise
- Lubrication not required
- Easy installation
- Rust-proof guide rail



Model No.	Dimensions								
	D	G	H	I	J	K	L	M	N
CRD12	100	ø7xø10x6	22	1/2J	50	M6	100~4000	76	54
CRD12L	140	ø7xø10x6	22	1/2J	50	M6	100~4000	116	54

Note : I value will be 1/2J or evenly spaced on both end if not specific

Model No.	Basic Load Rating (kgf)		Static Moment Load (Kgf·m)			Weight	
	C	C ₀	M _X	M _Y	M _Z	Carriage (kg)	Guide Rail (kg/m)
CRD12	250	500	4	5.4	4.8	0.6	3
CRD12L	250	500	7.4	5.4	8.8	0.8	3

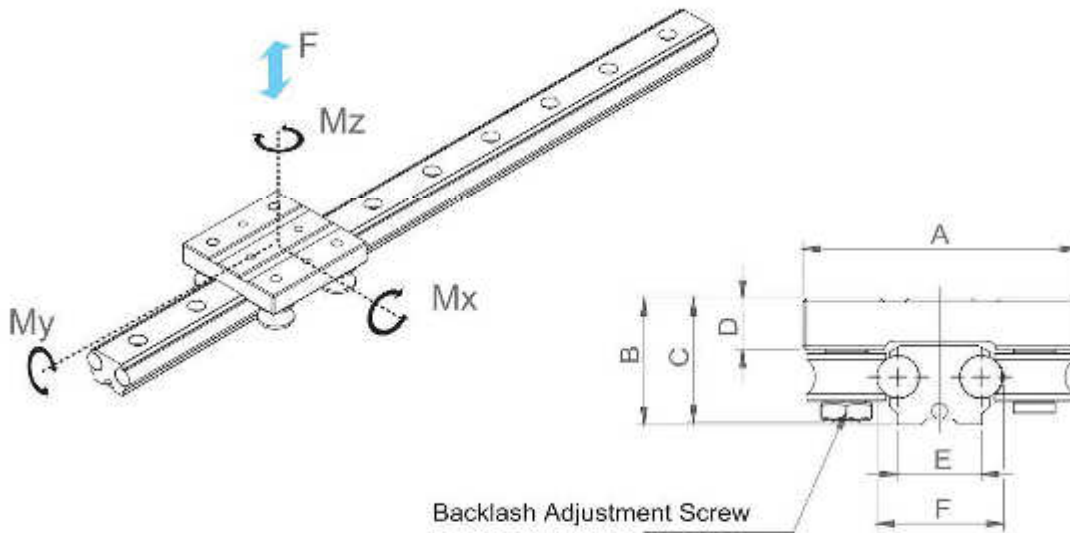
(mm)

3.3 CRE Economic Type

Ordering Key: **CRE12×0880-B2(20,10)**

1 **2** **3** **4**

- 1** Block type :
CRE12 ; Economical Block Type
- 2** Guide rail length : 880 mm
- 3** Number of block : 2
- 4** End distance of screw hole : 20 · 10
(Evenly spaced on both end if not specific)

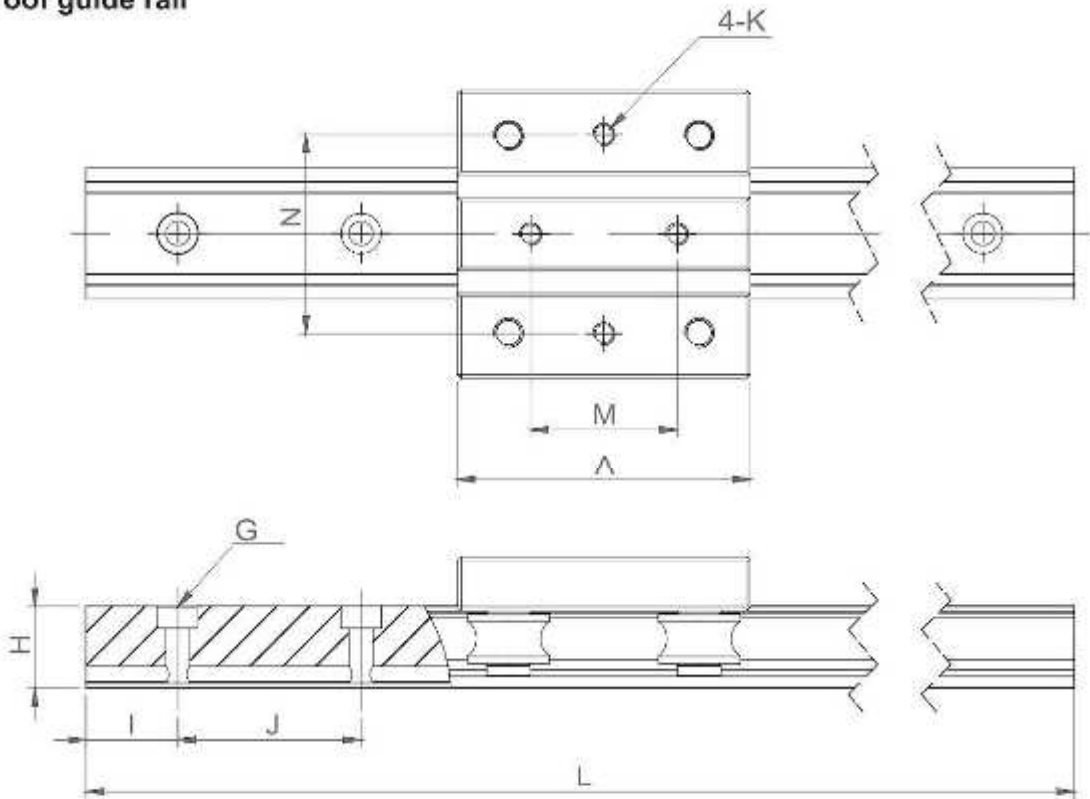


Model No.	Dimensions					
	ABC		DE		F	
CRE12	78	35.5	34	14.5	24	36

(mm)

Features

- Adjustable roller clearance on block
- Low noise
- Lubrication not required
- Easy installation
- Rust-proof guide rail



Cam Roller

Basic Load Rating (kgf)		Static Moment Load (kgf-m)			Weight	
C	C ₀	M _x	M _y	M _z	Carriage (kg)	Guide Rail (kg/m)
200	400	3.6	4.9	4.3	0.35	3

(mm)

Model No.	Dimensions							
	G	H	I	J	K	L	M	N
CRE12	ø7xø10x6	22	1/2J	50	M6	100-4000	40	54

(mm)

Note : I value will be 1/2J or evenly spaced on both end if not specific



Round Shaft

4.1 RLG Standard Type

Ordering Key: **RLG 20 × 0810-B2 (40,20)**

1 **2** **3** **3** **5**

1 Block type :

- RLG : Standard Block Type
- RLG-L : Extended Length Block Type

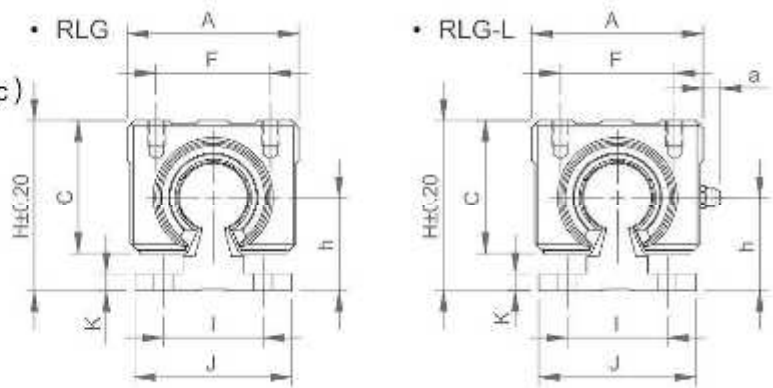
2 Shaft diameter : $\varnothing 20$ mm

3 Guide shaft length : 810 mm

4 Number of block : 2

5 End distance of screw hole : 40,20

(Evenly spaced on both end if not specific)



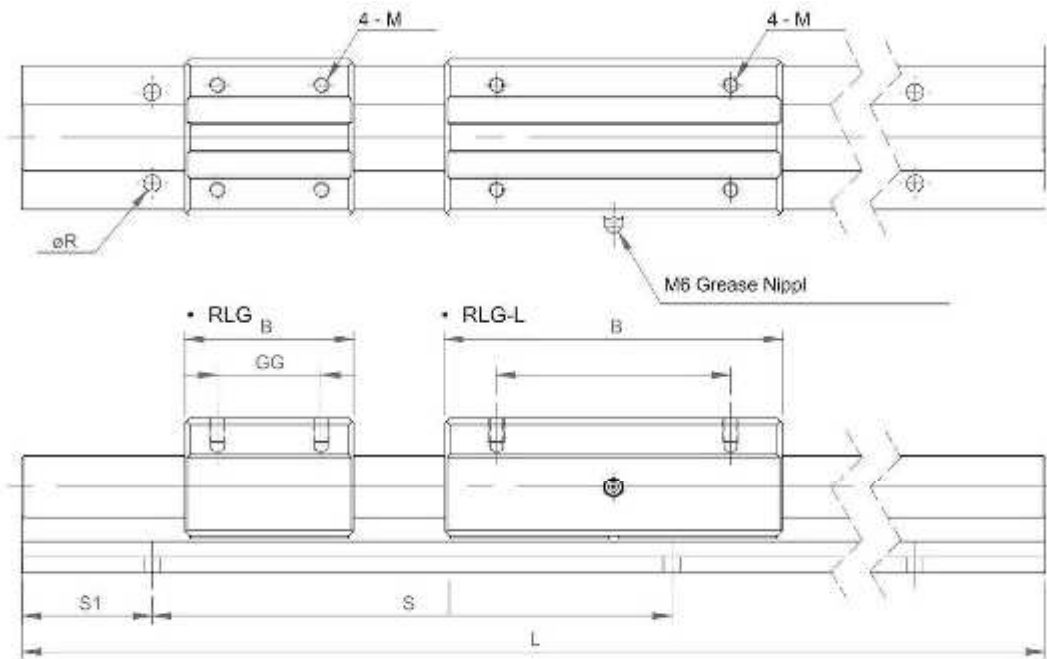
Model No.	Shaft Dia.	Dimensions										
		A	a	B	C	F	G	H	h	I	J	K
RLG10	Ø10	36	7.5	32	24	25	20	33	18	22	32	4
RLG10L				65			40					
RLG12	Ø12	36	7.5	34	24	26	24	34	18.5	23	32	4
RLG12L				68			45					
RLG13	Ø13	40	7.5	39	28	28	26	38	21	25	34	4.5
RLG13L				75			50					
RLG16	Ø16	45	7.5	45	33	32	30	45	25	30	40	5
RLG16L				85			60					
RLG20	Ø20	48	7.5	50	39	35	35	50	27	30	45	5
RLG20L				95			70					
RLG25	Ø25	60	7.5	65	47	40	40	60	33	35	55	6
RLG25L				130			90					
RLG30	Ø30	70	7.5	70	56	50	50	70	37	40	60	7
RLG30L				140			100					
RLG35	Ø35	80		80	63	55	55	80	43	45	65	8
RLG40	Ø40	90		90	72	65	65	90	48	55	75	9
RLG50	Ø50	120		110	92	94	80	115	62	70	95	11

Note : I value will be 1/2J or evenly spaced on both end if not specific

(mm)

Features

- Heat treated and hard chromium plated SUJ2 shaft
- Shaft is fully supported to prevent unwanted shaft deflection in heavy load and long stroke conditions
- Available in Standard, or Extended Length Block Type



Round Shaft

Dimensions					Bearing Model	Basic Load Ratings (kgf)	
L	M	ØR	S	S1*		C	C ₀
200-4000	M5	4.5	100	1/2 S	LM 10-OP	38	56
200-4000	M5	4.5	100		LM12-OP	60	112
200-3000	M5	4.5	100		LM 13-OP	52	80
200-4000	M5	5.5	150		LM 16-OP	83	160
200-6000	M6	5.5	150		LM 20-OP	52	80
300-6000	M6	6.5	200		LM 25-OP	83	160
300-6000	M8	6.5	200		LM 30-OP	79	120
300-6000	M8	9	200		LM 35-OP	125	240
400-6000	M10	9	300		LM 40-OP	90	140
400-6000	M10	11	300		LM 50-OP	142	279
						100	160
						159	320
					160	280	
					253	560	
					170	320	
					220	410	
					389	810	

(mm)

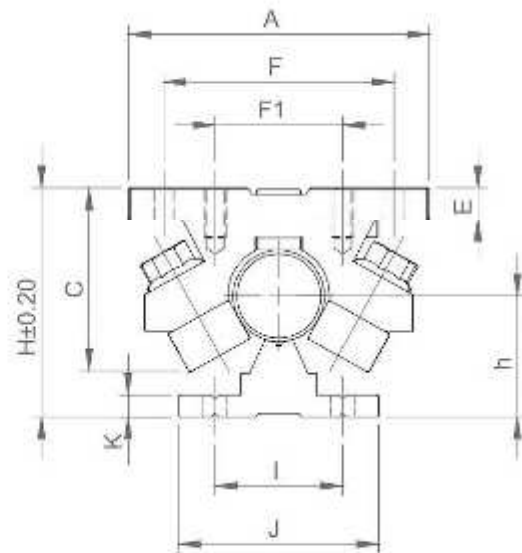
4.2 RLR High Impacts Type

Ordering Key: **RLR** **20** × **0860-B2** (40,20)

1
2
3
3
5



- 1** Block type :
 - RLR : Standard Block Type
 - RLR-L : Extended Length Heavy Duty Type
- 2** Shaft Diameter : $\varnothing 20$ mm
- 3** Guide shaft length : 860 mm
- 4** Number of block : 2
- 5** End distance of screw hole : 40,20
(Evenly spaced on both end if not specific)

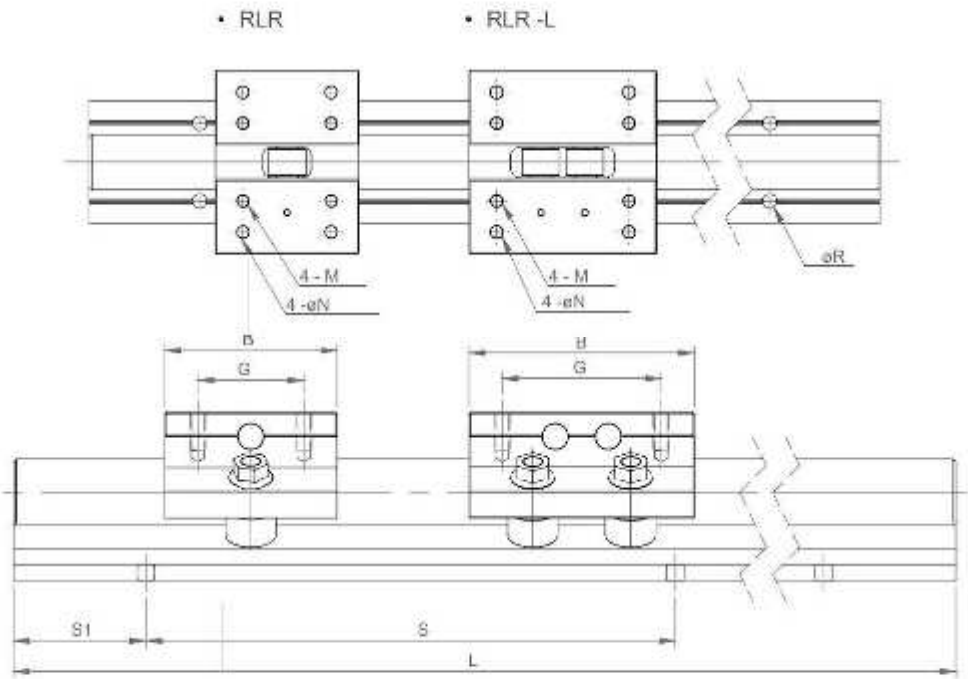


Model No.	Shaft Dia.	Dimensions									
		A	B	C	E	F	F1	G	H	h	I
RLR 20	$\varnothing 20$	70	55	41.6	8	50	27	32	51.6	27	30
RLR 20L			75					46			
RLR 25	$\varnothing 25$	83	65	49.6	9	63	35	40	63	33	35
RLR 25L			85					60			
RLR 30L	$\varnothing 30$	95	100	59.5	12	73	40	73	72	37	40

(mm)

Features

- Heat treated and hard chromium plated SUJ2 shaft
- Shaft is fully supported to prevent unwanted shaft deflection in heavy load and long stroke conditions
- Available in Standard, or Extended Length Carriage Type
- Roller clearance adjustable on block
- RLR series feature in high load capacity, low noise, and high impacts capability



Round Shaft

Dimensions								Basic Load Ratings (kgf)	
J	K	L	M	ØN	ØR	S	S1*	C	C0
45	5	300 - 6000	M5	4.3	5.5	200	1/2 S	230	150
						200		460	300
55	6	300 - 6000	M6	5.5	6.5	200		350	270
						200		700	540
60	7	300 - 6000	M8	6.5	6.5	200	1450	1100	

Note : l value will be 1/2J or evenly spaced on both end if not specific (mm)



5.1 Technological Description of Ball Screws

5.1.1 Lead/Travel Accuracy

Accuracy

- Lead accuracy of **ABBA** ball screws (grade C0~C5) is specified in 4 basic terms ($E, e, e_{300}, e_{2\pi}$). There are defined in Fig.5.1.1.1 Tolerance of deviation ($\pm E$) and variation (e) of accumulated reference travel are shown in Table.5.1.1.1~5.1.1.3
- Accumulated travel deviations for grade C7 and C10 are specified only by the allowable value per 300mm measured within any portion of the thread length. They are 0.05mm for C7 and 0.21mm for C10.

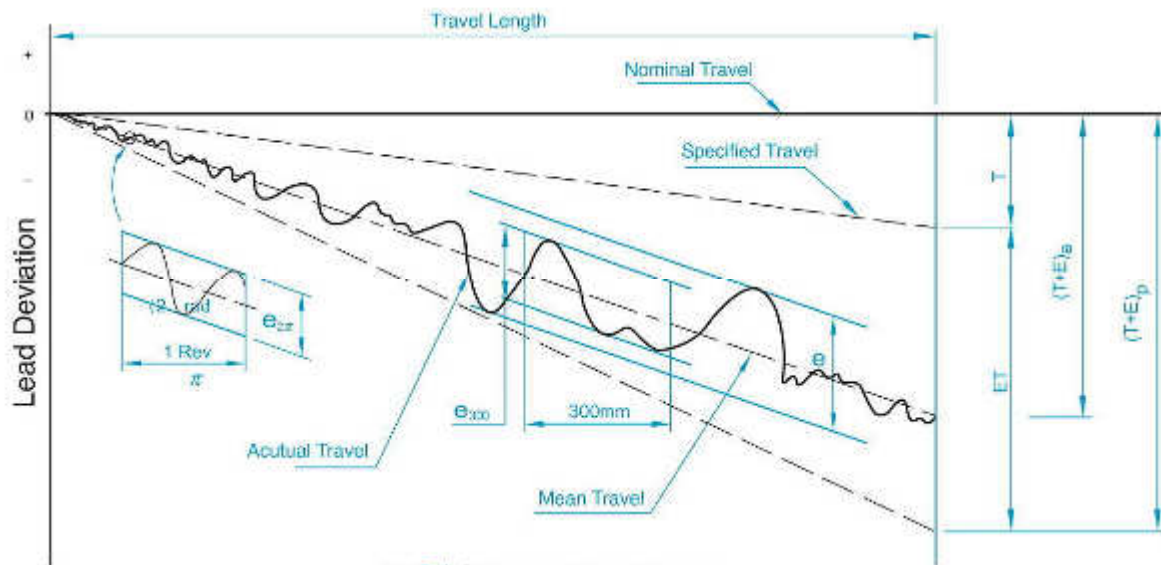


Fig. 5.1.1 Diagram of Lead Accuracy

Table 5.1.1.1 Definition of Terms for Lead Accuracy

Terms	Reference	Definition	Allowable
Travel Compensation	T	Travel compensation is the difference between specified and nominal travel within the useful travel. A slightly smaller value compared to the nominal travel is often selected by the customer to compensate for an expected elongation caused by temperature rise or external load. Therefore "T" is usually a negative value. Note: if no compensation is needed, specified travel is the same as nominal travel.	
Actual Travel		Actual travel is the axial displacement of the nut relative to the screw shaft.	
Mean Travel		Mean travel is the linear best fit line of actual. This could be obtained by the least squares method. This line represents the tendency of actual travel.	
Mean Travel Deviation	E	Mean travel deviation is the difference between mean travel and specified travel within travel length.	Table 5.1.1.2
Travel Variations	e e_{300} $e_{2\pi}$	Travel variations is the band of 2 lines drawn parallel to the mean travel, on the plus and minus side. Maximum width of variation over the travel length. Actual width of variation for the length of 300mm taken anywhere within the travel length. Wobble error, actual width of variation for one revolution (2π radian)	Table 5.1.1.2 Table 5.1.1.3 Table 5.1.1.3

Table 5.1.1.2 Mean Travel Deviation(±E)and Travel Variation(e) (JIS B 1192)

Grade		C0		C1		C2		C3		C5		C7	C10		
Travel Length(mm)	Over	Incl.	±E	e	±E	e	±E	e	±E	e	±E	e	e	e	
		100		3	3	3.5	5	5	7	8	8	18	18		
	100	200	3.5	3	4.5	5	7	7	10	8	20	18			
	200	315	4	3.5	6	5	8	7	12	8	23	18			
	315	400	5	3.5	7	5	9	7	13	10	25	20			
	400	500	6	4	8	5	10	7	15	10	27	20			
	500	630	6	4	9	6	11	8	16	12	30	23			
	630	800	7	5	10	7	13	9	18	13	35	25			
	800	1000	8	6	11	8	15	10	21	15	40	27			
	1000	1250	9	6	13	9	18	11	24	16	46	30			
	1250	1600	11	7	15	10	21	13	29	18	54	35	±50 /300mm	±210 /300mm	
	1600	2000			18	11	25	15	35	21	65	40			
	2000	2500			22	13	30	18	41	24	77	46			
	2500	3150			26	15	36	21	50	29	93	54			
	3150	4000			32	18	44	25	60	35	115	65			
	4000	5000					52	30	72	41	140	77			
	5000	6300					65	36	90	50	170	93			
	6300	8000							110	62	210	115			
	8000	10000									260	140			
	10000	12500									320	170			

Ball Screw

Table 5.1.1.3 Variation per 300mm(e_{300})and Wobble Error($e_{2\pi}$) (JIS B 1192)

Unit : μm

Grade	C0	C1	C2	C3	C5	C7	C10
e_{300}	3.5	5	7	8	18	50	210
$e_{2\pi}$	3	4	4	6	8		

5.1.2 Axial Play

ABBA Axial Direction of Standard Backlash and Preload

Table 5.1.2.1 Clearance in the Axial Direction of Ball Screw (P0)

Clearance in the Axial Direction of Ball Screw			Unit: mm
Screw Shaft OD	Rolled Ball Screw Clearance in the Axial Direction (max.)	Ground Ball Screw Clearance in the Axial Direction (max.)	
4mm~14mm	0.05	0.015	
15mm~50mm	0.08	0.025	
50mm~80mm	0.12	0.05	

Table 5.1.2.2 Clearance in the Axial Direction (P1)

Clearance in the Axial Direction of Ball Screw			Unit: mm
Screw Shaft OD	Rolled Ball Screw Clearance in the Axial Direction (max.)	Ground Ball Screw Clearance in the Axial Direction (max.)	
4mm~80mm	0	0	

Table 5.1.2.3 Spring Force of Internal Circulation

Model No	Spring Force of Internal Circulation (kgf.cm)					
	P2		P3		P4	
	3%Spring Force	TP Reference Torque	8%Spring Force	TP Reference Torque	13%Spring Force	TP Reference Torque
1404-4	0.1	0.13	0.2	0.34	0.3	0.56
1604-3	0.1	0.17	0.3	0.45	0.5	0.73
1604-4	0.1	0.21	0.3	0.57	0.5	0.93
1605-3	0.2	0.29	0.4	0.79	0.7	1.28
1605-4	0.2	0.3	0.4	0.8	0.7	1.3
1610-3	0.2	0.39	0.5	1.04	0.9	1.69
2005-4	0.2	0.47	0.5	1.26	0.9	2.05
2504-4	0.1	0.33	0.3	0.88	0.6	1.43
2505-4	0.2	0.6	0.6	1.6	1.0	2.59
2510-3	0.4	1.11	1.2	2.95	1.9	4.79
2510-4	0.6	1.47	1.2	3.93	2.5	6.38
3205-4	0.2	0.76	0.6	2.02	1.0	3.28
3206-4	0.3	1.14	0.8	3.03	1.3	4.93
3210-3	0.6	2.02	1.7	5.37	2.7	8.73
3210-4	0.8	2.62	2.2	6.99	3.5	11.36
4005-4	0.2	0.95	0.6	2.53	1.1	4.11
4006-4	0.3	1.25	0.9	3.32	1.4	5.4
4010-3	0.8	2.59	2.2	6.91	3.6	11.23
4010-4	0.8	3.31	2.3	8.84	3.7	14.36
5010-3	0.9	3.29	2.3	8.77	3.8	14.26
5010-4	0.9	4.21	2.4	11.23	3.9	18.25
6310-4	1.0	5.42	2.7	14.46	4.4	23.49
6320-3	2.3	13.08	6.1	34.87	9.9	56.66
8010-4	1.1	6.68	2.9	17.82	4.6	28.96
8020-3	2.3	16.87	6.2	44.98	10.1	73.1

Table 5.1.2.4 Spring Force of Plastic Circulation (kgf.cm)

Spring Force of Plastic Circulation (kgf.cm)						
Model No	P2		P3		P4	
	2%Spring Force	TP Reference Torque	5%Spring Force	TP Reference Torque	8%Spring Force	TP Reference Torque
1210-2	0.1	0.12	0.1	0.2	0.2	0.32
1605-4	0.2	0.32	0.4	0.81	0.7	1.29
1610-3	0.1	0.26	0.3	0.65	0.5	1.04
1610-4	0.1	0.33	0.4	0.83	0.6	1.33
1616-3	0.2	0.44	0.6	1.09	0.9	1.75
2005-4	0.2	0.42	0.4	1.04	0.7	1.67
2505-4	0.2	0.52	0.5	1.29	0.8	2.07
2510-4	0.3	0.84	0.8	2.09	1.3	3.34
3205-4	0.2	0.79	0.6	1.98	1.0	3.17
3220-3	0.4	1.45	1.1	3.62	1.8	5.8
4005-4	0.3	1.19	0.8	2.98	1.2	4.77
4020-3	0.8	3.14	2.0	7.85	3.2	12.55
5010-4	0.7	3.47	1.9	8.66	3.0	13.66
5020-5	1.5	6.98	3.8	17.46	6.0	27.93
1616-2	0.2	0.33	0.4	0.83	0.7	1.3
2020-2	0.2	0.45	0.4	1.12	0.7	1.79
2525-2	0.3	0.88	0.7	2.2	1.2	3.52
3232-2	0.4	1.61	1.1	4.04	1.7	6.46
4040-2	0.7	3.3	1.8	8.24	2.8	13.18
5050-2	1.3	7.35	3.3	18.38	5.3	29.41

Table 5.1.2.5 Spring Force of External Circulation (kgf.cm)

Spring Force of External Circulation (kgf.cm)						
Model No	P2		P3		P4	
	3%Spring Force	TP Reference Torque	8%Spring Force	TP Reference Torque	13%Spring Force	TP Reference Torque
082.5-2.5	0.1	0.05	0.1	0.08	0.1	0.13
1003-2.5	0.1	0.06	0.1	0.15	0.2	0.24
1204-3.5	0.1	0.13	0.3	0.34	0.4	0.55
1205-3.5	0.2	0.22	0.5	0.59	0.7	0.95
1605-2.5	0.2	0.28	0.5	0.73	0.7	1.19
1520-1.5	1.5	3.41	4.0	9.08	6.6	14.76
2010-2.5	0.2	0.7	0.6	1.88	1.0	3.05

5.1.3 Definition of Mounting Accuracy and Tolerances on Screw

To use a ball screw properly dimensional accuracy and tolerances are most important.

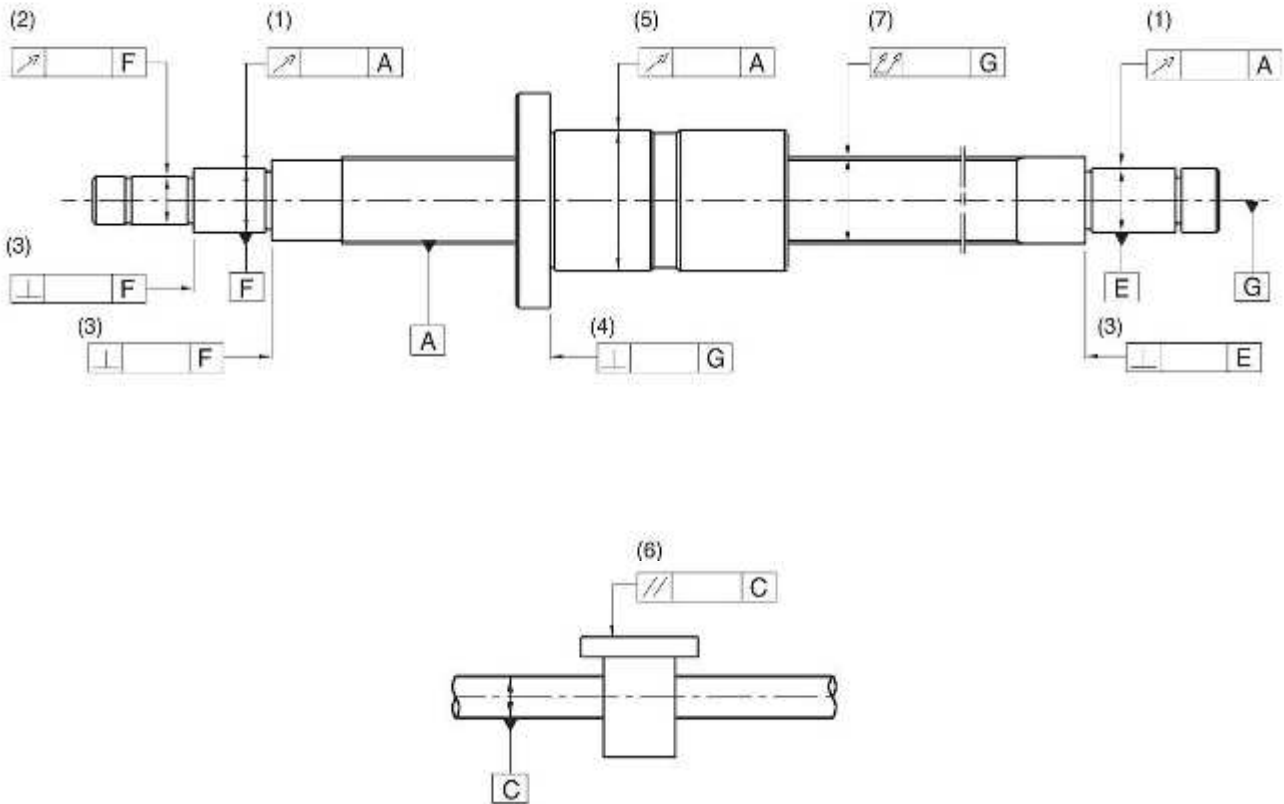
ABBA will help you determine the tolerance factors as they are subject to change according to accuracy grade.

- (1) Periphery run-out of the supporting part of the screw shaft to the screw groove.
- (2) Concentricity of a mounting portion of the shaft to the adjacent ground portion of the screw shaft.
- (3) Perpendicularity of the shoulders to the adjacent ground portion of the screw shaft.

- (4) Perpendicularity of the nut flange to the axis of the screw shaft.
- (5) Concentricity of the ball nut diameter to the screw groove.
- (6) Parallelism of the mounting surface of a ball nut to the screw groove.
- (7) Total run-out of the screw shaft to the axis of the screw shaft.

All **ABBA** ball screws are manufactured, inspected and guaranteed to be within specifications.

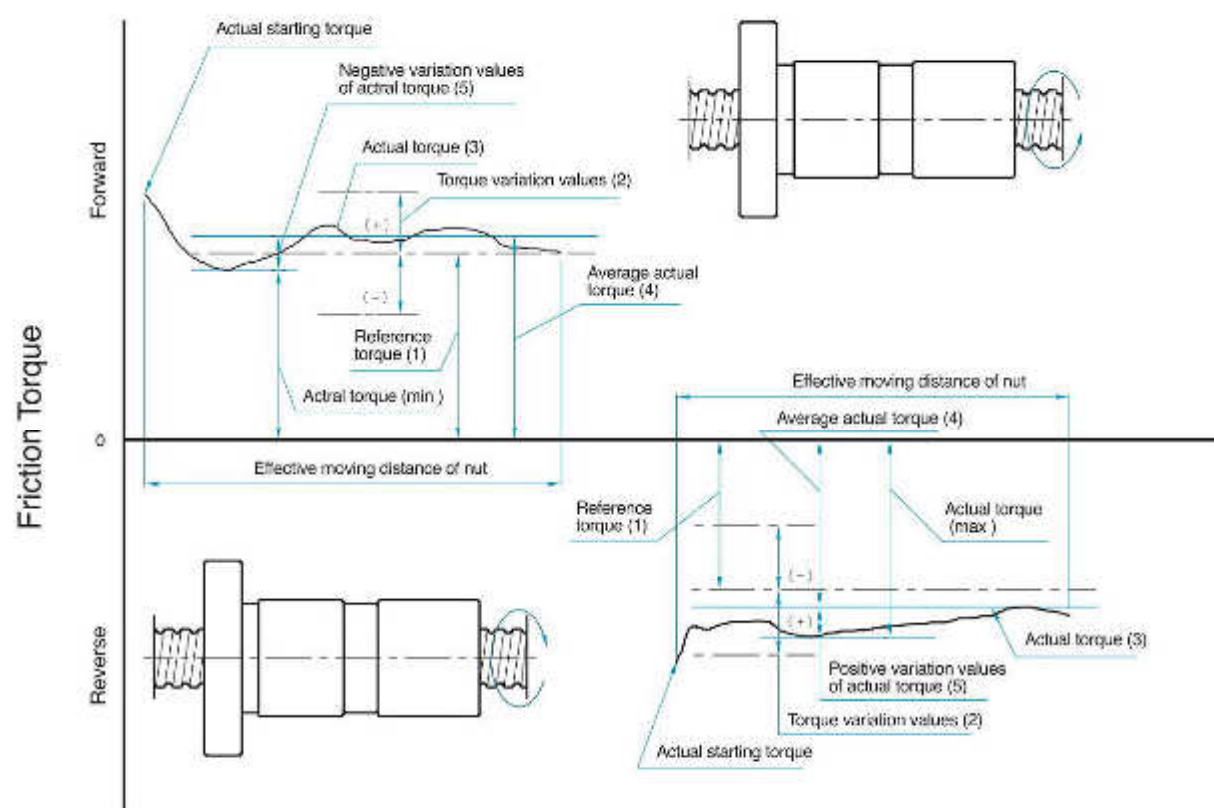
Fig. 5.1.3.1 Mounting Accuracy and Tolerances



5.1.4 Preload Torque

- Terms in relation to the preload torque generated during the rotation of the preload ball screws are shown in 5.1.4.1
- Permissible ranges of torque variation rates is shown in table.5.1.2.3

5.1.4.1 Descriptions of preload torque



Glossary

(1) Preload

The stress generated inside the screws when inserting a set of steel balls of one gage (approximately 2μ) larger into the nut or using them on the 2 nuts which exercise mutual displacements along the screws axis in order to eliminate the gaps of the screw or upgrade the rigidity of the screw.

(2) Preload dynamic torque

The dynamic torque required for continuously rotating the screws shaft or the nuts under unload condition after the specified preload has been applied upon the ball screws.

(3) Reference

The targeted preload dynamic torque [Fig.5.1.3.1]

(4) Torque variation values

The variation values of the targeted preload torque variation rates are specified generally based on JIS Standards as.

(5) Torque variation rate

The rate of variation values in relation to the reference torque.

(6) Actual torque

The actually measured preload dynamic torque of the ball screws.

(7) Average actual torque

The arithmetic average of the maximal and minimal actual torque values measured when the nuts are exercising reciprocating movements.

(8) Actual torque variation values

The maximal variation values measured within the effective length of the threads when the nuts are exercising reciprocating movements, the positive or negative values relative to the actual torque are adopted.

(9) Actual torque variation rate

The rate of actual torque variation values in relation to the average actual torque.

5.1.4.2 Permissible ranges of torque variation rates

Reference torque kgf · cm		Effective threading length (mm)										
		Below 4000								4000~10000		
		Slenderness 1 : below 40				Slenderness 1:40 ~ 1:60				—		
		Grade				Grade				Grade		
Over	Incl.	C0	C1	C2、C3	C5	C0	C1	C2、C3	C5	C1	C2、C3	C5
2	4	±3.0%	±3.5%	±4.0%	±5.0%	±4.0%	±4.0%	±5.0%	±6.0%	—	—	—
4	6	±2.5%	±3.0%	±3.5%	±4.0%	±3.5%	±3.5%	±4.0%	±4.5%	—	—	—
6	10	±2.0%	±2.5%	±3.0%	±3.5%	±3.0%	±3.0%	±3.5%	±4.0%	—	±4.0%	±4.5%
10	25	±1.5%	±2.0%	±2.5%	±3.0%	±2.5%	±2.5%	±3.0%	±3.5%	—	±3.5%	±4.0%
25	63	±1.0%	±1.5%	±2.0%	±2.5%	±2.0%	±2.0%	±2.5%	±3.0%	—	±3.0%	±3.5%
63	100	—	±1.5%	±1.5%	±2.0%	—	—	±2.0%	±2.5%	—	±2.5%	±3.0%

Remarks 1. Slenderness is the value of dividing the screws shaft outside diameter with the screws shaft threading length.

2. For reference torque less than 2 kgf · cm, **ABBA** specifications will apply.

Calculation of reference torque T_p

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

$$T_p = 0.05 (\tan \beta)^{0.5} \cdot \frac{F_{ao} \cdot \ell}{2\pi}$$

Where · F_{ao} : Preload (k f)

β : Lead angle

ℓ : Lead (cm)

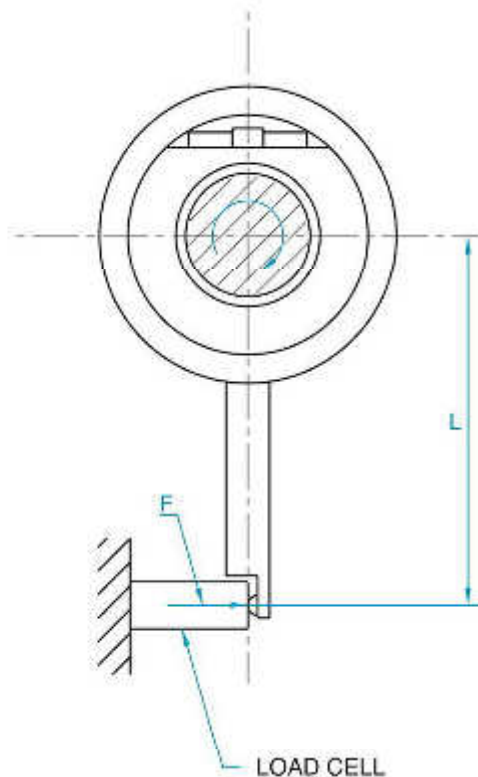
Measurement conditions

The preload dynamic torque T_p is determined first by adopting the following measurement conditions together with the method illustrated in the right diagram for measuring the force F needed to rotate the screws shaft without bringing the nuts to rotate along with the shaft after the screws shaft has started rotating, then multiplying the measured value of F with the arm of force L , the product is T_p .

$$T_p = F \cdot L$$

Measure conditions

- (1) Measurement is executed under the condition of not attaching with scraper.
- (2) The rotating speed during measurement maintains at 100 rpm.
- (3) According to JSK 2001 (industrial lubrication oil viscosity classification standards), the lubrication oil used should be in compliance with ISO VG68.



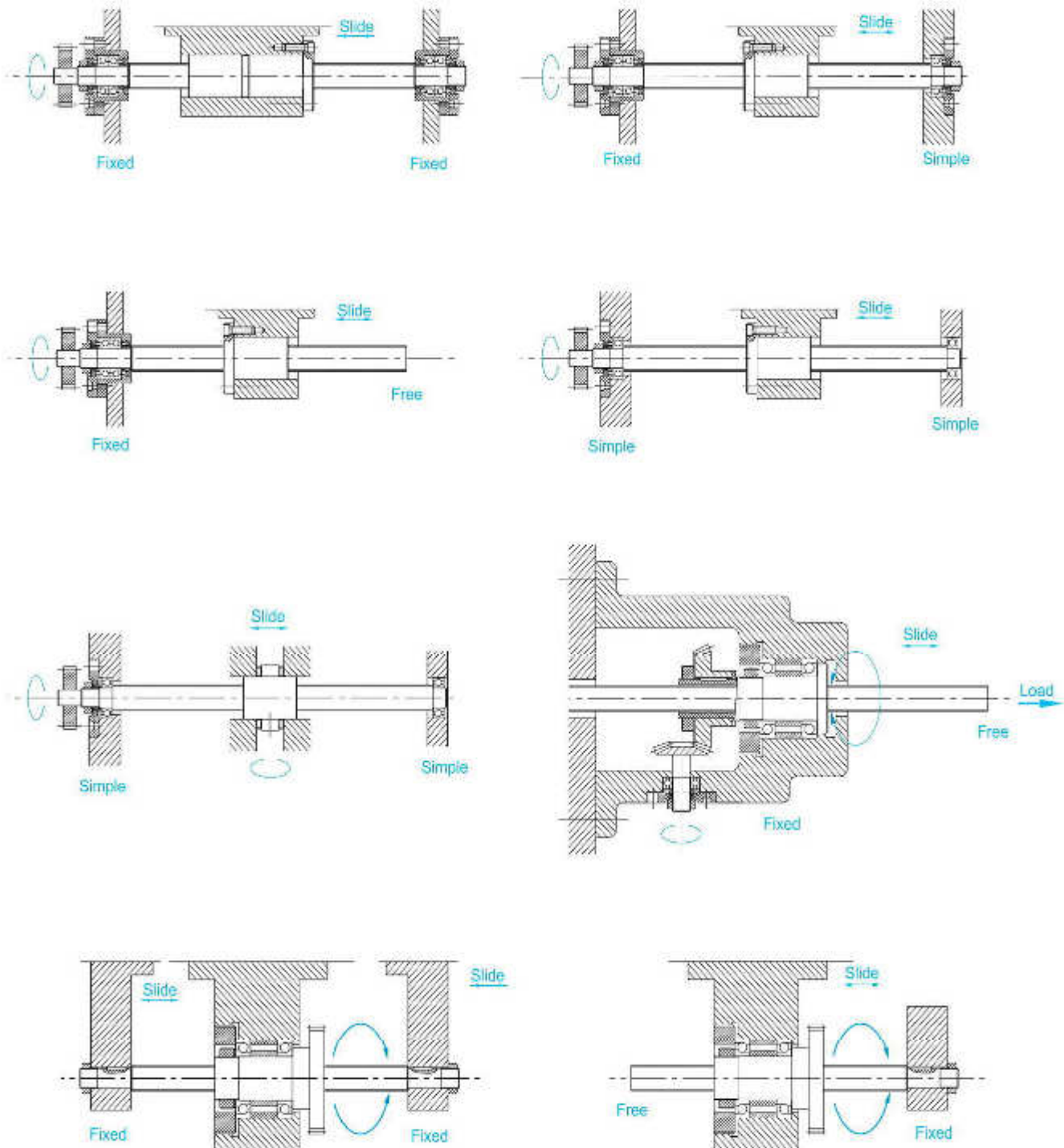
Preload dynamic torque measuring method

5.2 Screw Shaft Design

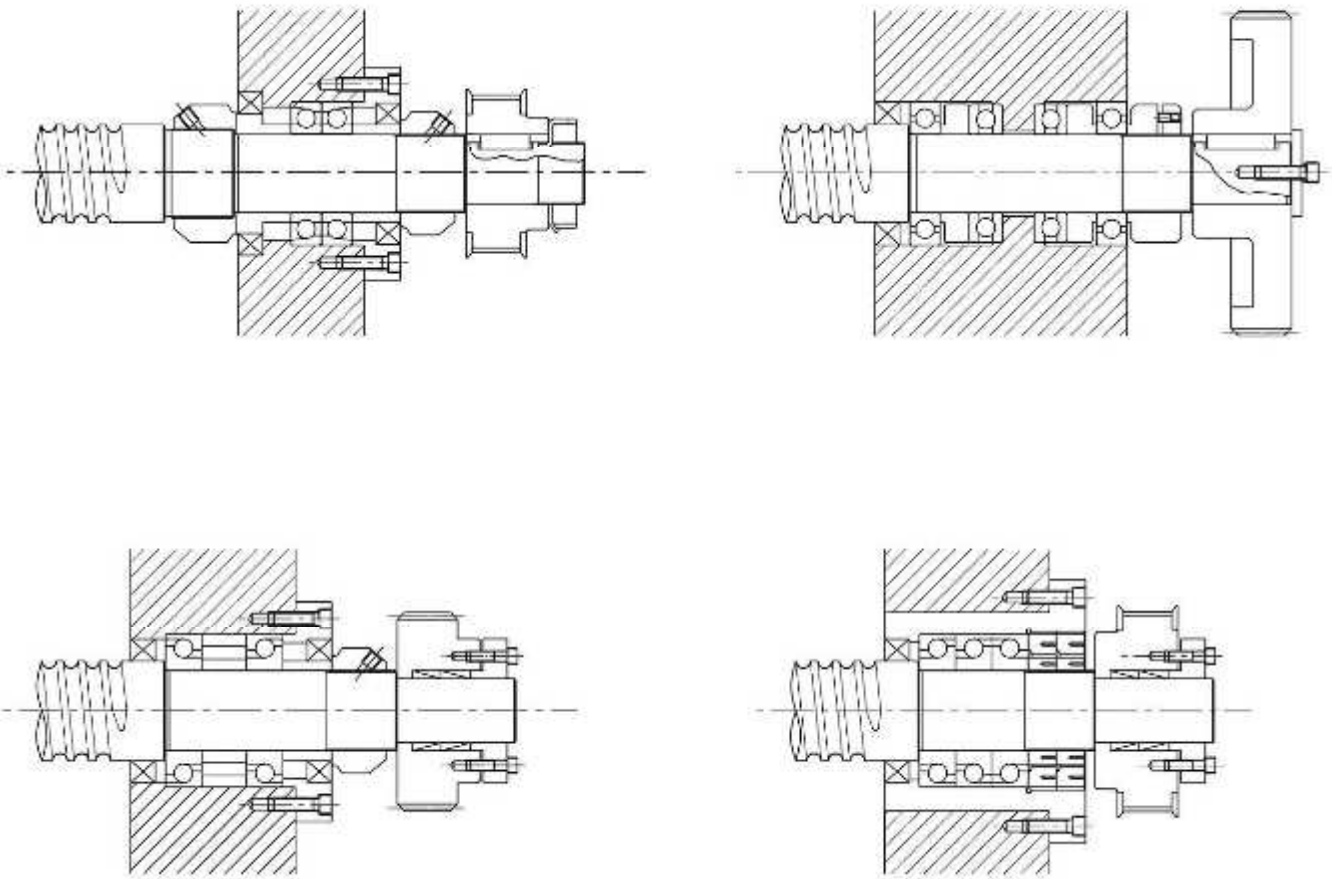
5.2.1 Mounting Methods

- Both the critical speed and column buckling load depend upon the method of mounting and the unsupported length of the shaft, the most common mounting methods for ball screws are shown below.

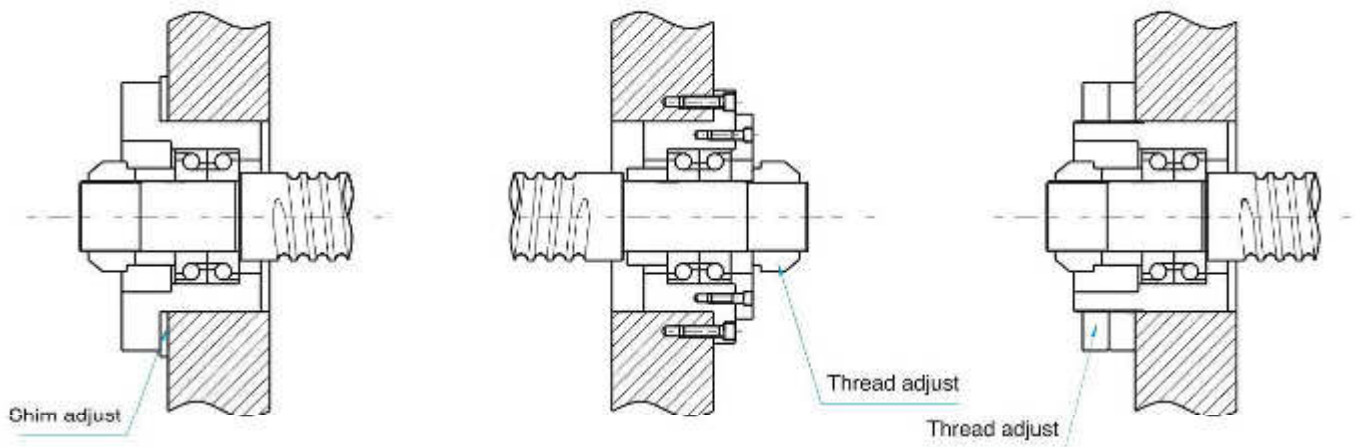
5.2.1.1 Most Common Mounting Methods for Ball Screws



5.2.1.2 Most Machines Mounting Methods for Ball Screws



5.2.1.3 Most Common Mounting Methods for Ball Screws



5.2.2 Buckling Load

The safety of the screw shaft against buckling needs to be checked when the shaft is expected to receive buckling loads. The diagram below summarizes the allowable compressive load for buckling for each nominal outside diameter of screw shaft. (Calculate with the equation shown right when the nominal outside diameter of the screw shaft exceeds 125mm.)

Select the graduation of allowable axial load according to the method of ball screw support.

Remark: Allowable tensile / buckling load

Check the allowable tensile / buckling load (the formula shown below) and allowable load of the ball groove regardless of the mounting method when the mounting distance is short.

$$P = \sigma A = 11.8d^2 \text{ (kgf)}$$

Where,

- σ : Allowable tensile compressive stress (kgf/mm²)
- A : Sectional area (mm²) of screw shaft root bottom diameter
- dr : Screw shaft root diameter (mm)

$$P = \alpha \times \frac{N\pi^2 E}{L^2} = m \frac{dr^4}{L^2} \times 10^3$$

Where,

- α : Safety Factor (0.5)
- E : Vertical elastic modulus (E = 2.1 × 10⁴ kgf/mm²)
- I : Min. secondary moment of screw shaft sectional area

$$I = \frac{\pi}{64} dr^4 \text{ (mm}^4\text{)}$$

dr : Screw shaft root diameter (mm)

L : Mounting distance (mm)

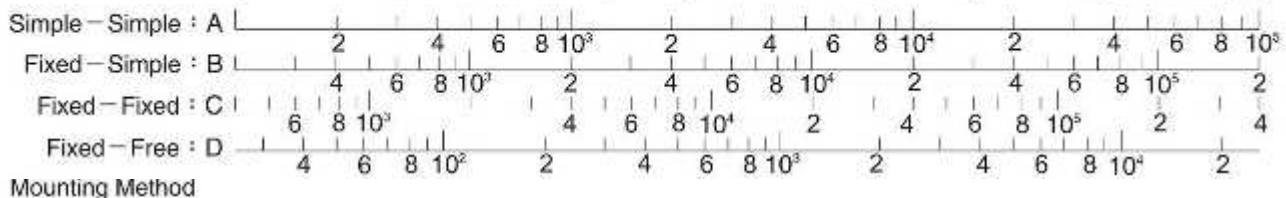
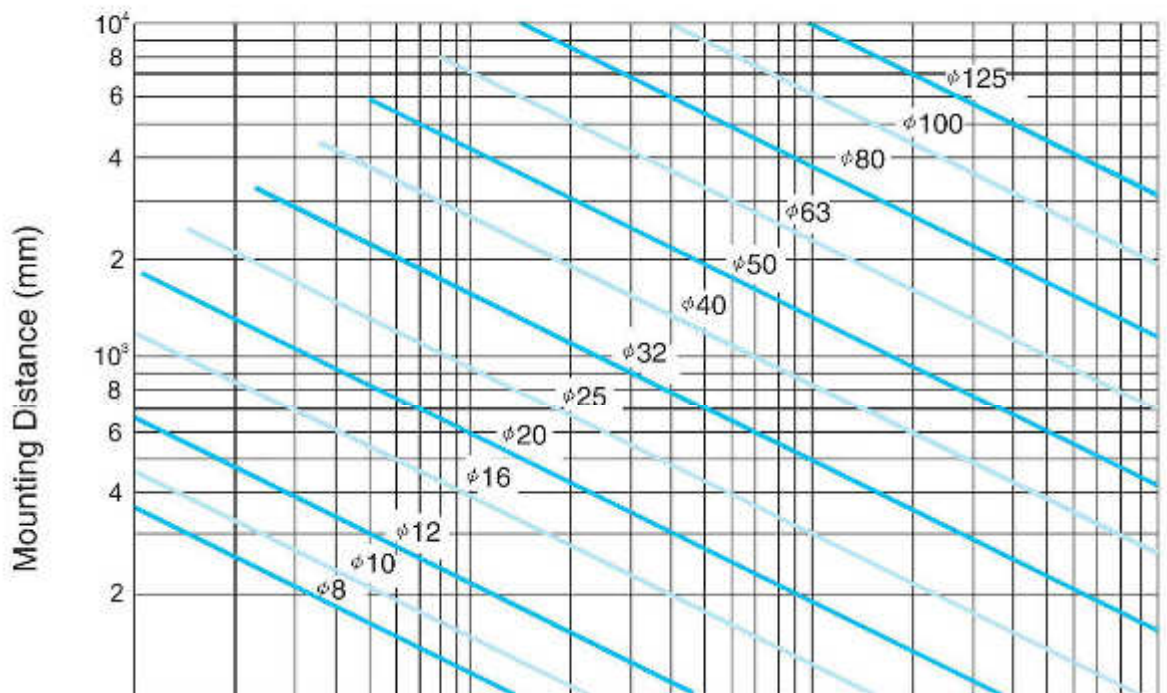
m * N : Coefficient determined from mounting method of ball screw:

Simple - Simple = 5.1 (N=1)

Fixed - Simple = 10.2 (N=2)

Fixed - Fixed = 20.3 (N=4)

Fixed - Free = 1.3 (N=1/4)



Axial Load (kgf)

Buckling Load vs. Shaft Dia. and Length

5.2.3 Critical Speed

It is necessary to check if the ball screw rotation speed is resonant with the natural frequency of the screw shaft.

ABBA has determined 80% or less of this critical speed as an allowable rotation speed. The diagram below summarizes the allowable rotation speed for shaft nominal diameters up to outside diameter of the screw shaft exceeds 125mm.) Select the graduation of allowable rotation speed according to the method of supporting the ball screw.

Where the working rotation speed presents a problem in terms of critical speed, it would be best to provide an intermediate support to increase the natural frequency of the screw shaft.

dm.n value

The allowable rotation speed is regulated also by the $dm \cdot n$ value (dm :diameter of central circle of steel ball , n :Revolution speed , rpm) which expresses the peripheral speed.

Generally;

For precision (accuracy grade C7 to C0)

$$dm \cdot n \leq 70,000$$

For general industry (C10)

$$dm \cdot n \leq 50,000$$

Product exceeding the above limits can be produced, contact **ABBA**.

$$n = \alpha \times \frac{60 \cdot L^2}{2 \cdot \pi \cdot L^2} \sqrt{\frac{E \cdot I \cdot g}{\tau \cdot A}} = f \cdot \frac{dr}{L^2} \times 10^7 \text{ (rpm)}$$

Where,

α : Safety factor ($\alpha = 0.8$)

E : Vertical elastic modulus ($E = 2.1 \times 10^4 \text{ kgf/mm}^2$)

I : Min. secondary moment of screw shaft sectional area

$$I = \frac{\pi}{64} dr^4 \text{ (mm}^4\text{)}$$

dr : Screw shaft root diameter (mm)

g : Acceleration of gravity ($= 9.8 \times 10^3 \text{ mm/s}^2$)

τ : Density ($\tau = 7.8 \times 10^6 \text{ kgf/mm}^3$)

A : Screw shaft sectional area ($A = \pi dr^2/4 \text{ mm}^2$)

L : Mounting distance (mm)

f : λ : Coefficient determined from the ball screw mounting method

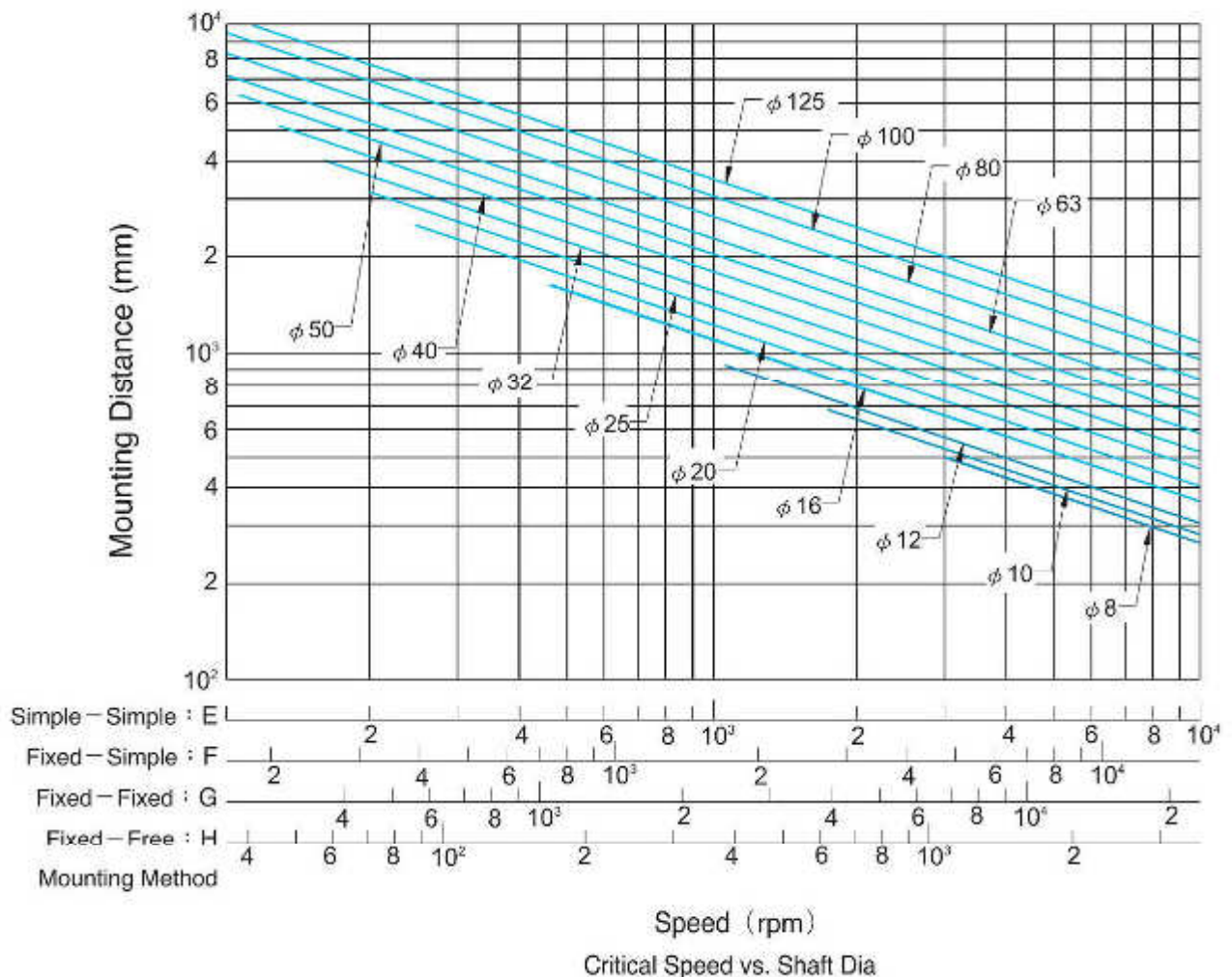
Simple - Simple $f = 9.7$ ($\lambda = \pi$)

Fixed - Simple $f = 15.1$ ($\lambda = 3.927$)

Fixed - Fixed $f = 21.9$ ($\lambda = 4.730$)

Fixed - Free $f = 3.4$ ($\lambda = 1.875$)

(* Particular consideration is necessary for manufacturing when the screw length/shaft dia. Ratio is $\epsilon > 70$. In such an event, contact **ABBA**.)



5.3 Nut Design

5.3.1 Selection of nut

(1) Series

When making selection of series, please take into consideration of demanded accuracy, intended delivery time, dimensions (the outside diameter of the screw, ratio of lead / the outside diameter of the screw), preload load, etc.

(2) Circulation type

Selection of circulation type : Please focus on the economy of space for the nut installation portion.

(a) External circulation type

- Economy
- Suitable for mass production
- Applicable to those with larger lead / the outside diameter of the screw

(b) Internal circulation type

- With nuts of finely crafted outside diameter (occupying small space)
- Applicable to those with smaller lead / the outside diameter of the screw

(c) End-caps circulation type

- Suitable for high speed positioning

(3) Number of loop circuits

Performance and life of service should be considered when selecting number of loop circuits

(4) Shape of flanges

Please make selection based on the available space for the installation of nuts.

(5) Oil hole

Oil holes are provided for the precision ball screws, please use them during machine assembling and regular furnishing.

5.3.1.1 External Ball Circulation Nuts

Features:

- Offers smoother ball running.
- Offers better solution and quality for long lead or large diameter ballscrews.

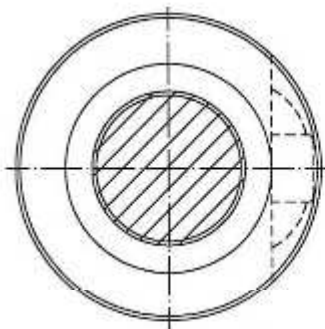


Fig. 5.3.1.1 Immersion type

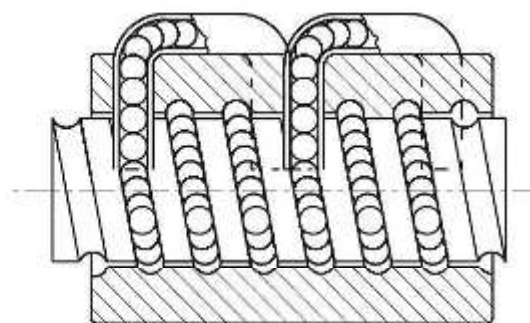


Fig. 5.3.1.2 External ball circulation's nut

5.3.1.2 Internal Ball Circulation Nuts

Features:

The advantage of internal ball circulation nut is that the outer diameter is smaller than that of external ball circulation nut. Hence it is suitable for the machine with limit space for Ballscrew installation.

It is strictly required that there is at least one end of screw shaft with complete threads. Also the rest area next to this complete thread must be with smaller diameter than the nominal diameter of the screw shaft. Above are required for easy assembling the ballnut onto the screw shaft.

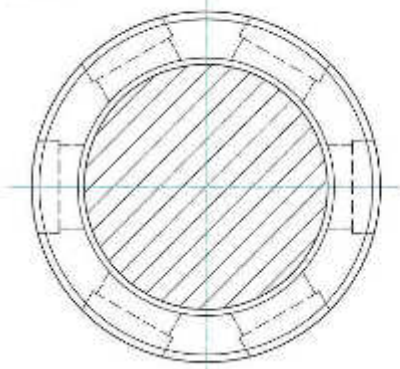


Fig.5.3.1.3 Internal ball circulation's side view

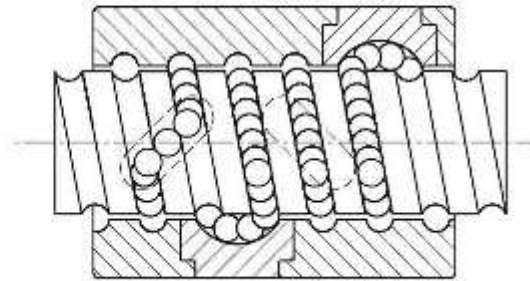


Fig.5.3.1.4 Internal ball circulation's nut

5.3.1.3 High Lead Ballscrews

Features:

- It is important for a High-lead Ballscrew to be with characteristics of high rigidity, low noise and thermal control. ABBA designs and treatments are taken for following:

High DN Value

- The DN value can be 130,000 in normal case. For some special cases, for example in a fixed ends case, the DN value can be as high as 140,000. Please contact our engineers for this special application.

High Speed

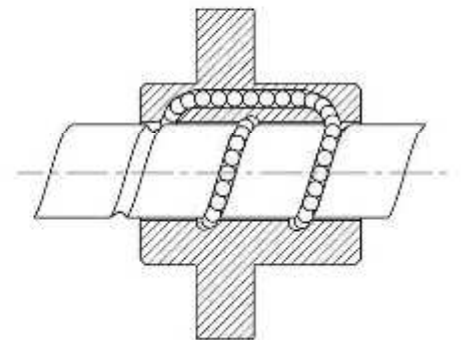
- ABBA High-speed Ball screws provide 100 m/min and even higher traverse speed for machine tools for high performance cutting.

High Rigidity

- Both the screw and ballnut are surface hardened to a specific hardness and case depth to maintain high rigidity and durability. Multiple thread starts are available to make more steel balls loaded in the ballnut for higher rigidity and durability.

Low Noise

- Special design of ball circulation tubes (patent pending) offer smooth ball circulation inside the ballnut. It also makes safe ball fast running into the tubes without damaging the tubes.
- Accurate ball circle diameter (BCD) through whole threads for consistent drag torque and low noise.



Low noise circulation's nut

5.3.2 Axial Rigidity

Excessively weak rigidity of the screw's peripheral structure is one of the primary causes that result in lost motion. Therefore in order to achieve excellent positioning accuracy for the precision machines such as NC working machines, etc., axial rigidity balance as well as torsional rigidity for the parts at various portions of the transmission screw have to be taken into consideration at time of designing.

Static Rigidity K

The axial elastic deformation and rigidity of the transmission screw system can be determined from the formula below.

$$K = \frac{P}{e} \quad (\text{kgf/mm})$$

P : Axial load (kgf) borne by the transmission screw system
e : Axial flexural displacement (mm)

$$\frac{1}{K} = \frac{1}{K_s} + \frac{1}{K_n} + \frac{1}{K_a} + \frac{1}{K_H} \quad (\text{mm/kgf})$$

K_s : Axial rigidity of screw shaft (1)
 K_n : Axial rigidity of nut (2)
 K_a : Axial rigidity of bracing shaft (3)
 K_H : Axial rigidity of installation portions of nuts and bearings (4)

(1) Axial rigidity K_s and displacement δ_s of screw shaft

$$K_s = \frac{P}{\delta_s} \quad (\text{kgf/mm})$$

P : Axial load (kgf)

For places of Fixed - Fixed installation

$$\delta_{sr} = \frac{PL}{4AE} \quad (\text{mm})$$

For places other than Fixed - Fixed installation

$$\delta_{ss} = \frac{PL_0}{4AE} \quad (\text{mm})$$

$$\delta_{ss} = 4\delta_{sr}$$

δ_{sr} : Directional displacement at places of fixed-fixed installation

δ_{ss} : Directional displacement at places other than fixed-fixed installation

A : Cross-sectional area of the screw shaft tooth root diameter (mm²)

E : Longitudinal elastic modulus (2.1×10^4 kgf/mm²)

L : Distance between installations (mm)

L_0 : Distance between load applying points (mm)

(2) Axial rigidity K_n and displacement δ_n of nut

$$K_n = \frac{P}{\delta_n} \quad (\text{kgf/mm})$$

(a) In case of single nut

$$\delta_{ns} = \frac{K}{\sin\beta} \left(\frac{Q}{d} \right)^{1/3} \times \frac{1}{\xi} \quad (\text{mm})$$

$$Q = \frac{P}{n \cdot \sin\beta} \quad (\text{kgf})$$

$$n = \frac{D_o \cdot m}{d} \quad (\text{each})$$

Q : Load of one steel ball (kgf)

n : Number of steel ball

k : Constant determined based on material, shape, dimensions $k \approx 5.7 \times 10^4$

β : Angle of contact (45°)

P : Axial load (kgf)

d : Steel ball diameter (mm)

ξ : Accuracy, internal structure coefficient

m : Effective number of balls

D_o : Steel ball center diameter (mm)

$$D_o = \frac{\ell}{\tan\alpha \cdot \pi}$$

ℓ : Lead (mm)

α : Lead angle

(b) In case of double nuts

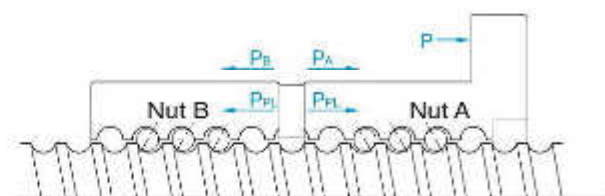


Fig.5.3.2.1 Preloaded for the double nuts

When an axial load P of approximately 3 times of the preload load P_{PL} is exerted, for the purpose of eliminating the preload P_{PL} on nut B, please set the preload load P_{PL} at no more than 1/3 of the maximal axial load (0.25Ca should be taken as the standard maximal preload load). With respect to the displacement value, it should be of 1/2 of the single nut displacement when axial load is 3 times of the preload.

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

δ_{NS} : Displacement of single nut (mm)

δ_{NW} : Displacement of double nuts (mm)

(Explanation of the rigidity of double nuts)

As shown in Diagram Fig.5.3.2.1 and 5.3.2.2, when a preload P_{PL} is applied on the 2 nuts A,B, both nuts A & B would produce flexural deformations that will reach point X. If an external force P is exerted from here, nut A would move from point X to point X1, while nut B would move from X to X2.

Then, based on the computing formula for displacement δ_{NS} of the single nut, we can obtain:

$$\delta_{NS} = aP_{PL}^{0.5}$$

while displacements of nuts A & B are

$$\delta_A = aP_A^{0.5}$$

since displacements of nuts A & B generated due to exertion of external force P are equal, therefore

$$\delta_A - \delta_B = \delta_A - \delta_A$$

or if P is the only external force P that exerts on nuts A,B, if P_A increases

$$P_A - P_B = P$$

$$\delta_B = 0$$

for preventing the external force applied on nut B being absorbed by nut A thus decreasing, so

$$\text{when } \delta_B = 0$$

$$aP_A^{0.5} - aP_B^{0.5} = aP_{PL}^{0.5}$$

$$P_A^{0.5} = 2P_{PL}^{0.5}$$

$$P_A = \sqrt{8} P_{PL} = 3P_{PL}$$

or based on $\delta_A - \delta_B = \delta_B$

$$\delta_B = \frac{\delta_A}{2}$$

thus it can also be judged from Fig.5.3.2.3 that, when axial load is 3 times of preload load, for a single nut with 1/2 displacement, the rigidity is 2 times as high.

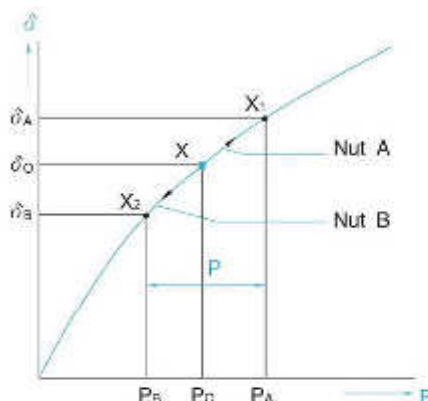


Fig.5.3.2.2

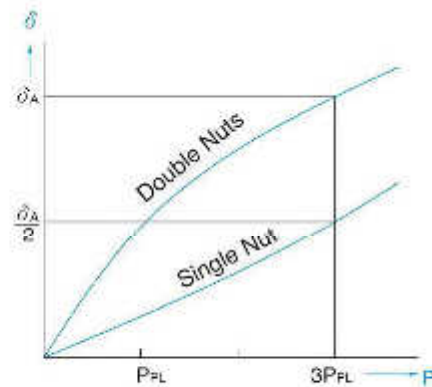


Fig.5.3.2.3

- (3) Axial rigidity K_B and displacement δ_B of bracing shaft

$$K_B = \frac{P}{\delta_B} \text{ (kgf/mm)}$$

The rigidity of the assembled diagonal thrust ball bearing that is used as the bracing bearing for the ball screw and is widely utilized in the field of precision machines can be found from the following formula.

$$\delta_B = \frac{2}{\sin\beta} \left(\frac{Q^2}{d} \right)^{1/3}$$

$$Q = \frac{P}{n \sin\beta} \text{ (kgf)}$$

Q : Load of one steel ball (kgf)

β : Angle of contact (45°)

d : Steel ball diameter (mm)

P : Axial load (kgf)

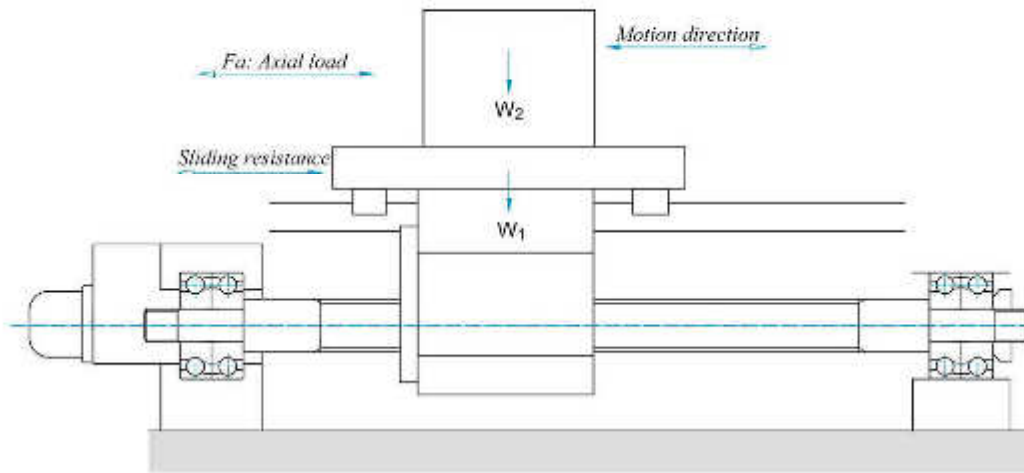
n : Number of steel balls

- (4) Axial rigidity K_{-} and displacement δ_{-} of installation portions of nuts and bearings.

In early stage of machine development, special attentions should be paid to the requirement of high rigidity for the installation portion.

$$K_{-} = \frac{P}{\delta_{-}} \text{ (kgf/mm)}$$

5.3.2.1 Horizontal reciprocating moving mechanism



Horizontal reciprocating moving mechanism

For reciprocal operation to move work horizontally (back and forth) in a conveyance system, the axial load (F_a) can be gotten using the following equations:

Acceleration (leftward) $F_{a1} = \mu \times mg + f + ma$

Constant speed (leftward) $F_{a2} = \mu \times mg + f$

Deceleration (leftward) $F_{a3} = \mu \times mg + f - ma$

Acceleration (rightward) $F_{a4} = -\mu \times mg - f - ma$

Constant speed (rightward) $F_{a5} = -\mu \times mg - f$

Deceleration (rightward) $F_{a6} = -\mu \times mg - f + ma$

Here:

a : Acceleration

$$a = \frac{V_{\max}}{t} \quad V_{\max} : \text{Rapid feed speed}$$

t : time

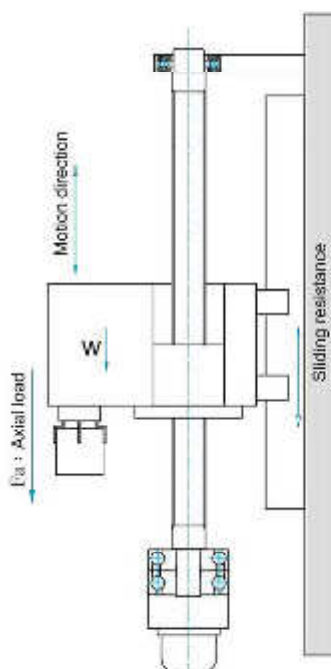
m : Total weight

(table weight + work piece weight)

μ : Sliding surface friction coefficient

f : Non-load resistance

5.3.2.2 Vertical reciprocating moving mechanism



Vertical reciprocating moving mechanism

5.4 Preload and Effect

5.4.1 Ball Screw's Preload and Effect

In order to get high positioning accuracy, there are two ways to reach it. One is commonly known as to clear axial play to zero. The other one is to increase Ballscrew rigidity to reduce elastic deformation while taking axial load. Both two ways are done by preloading.

(1) Methods of preloading

a. Double-nut method:

A spacer inserted between two nuts exerts a preload. There are two ways for it.

One is illustrated in Fig.5.4.1.1 That is to use a spacer with thickness complies with required magnitude of preload. The spacer makes the gap between Nut A and B to be bigger, hence to produce a tension force on Nut A and B. It is

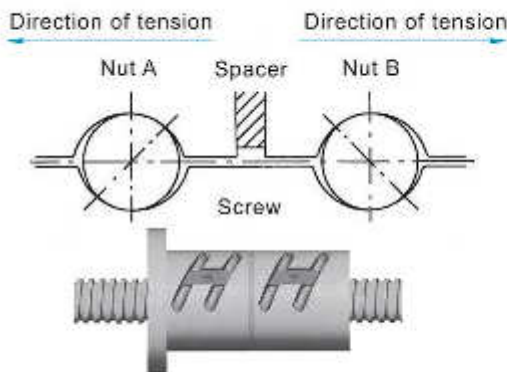


Fig.5.4.1.1 Extensive preload

b. Single-nut method:

As that illustrated on Fig.5.4.1.2 using oversize balls onto the space between Ballnut and screw to get required preload. The balls shall make four-point contact with grooves of Ballnut and screw.

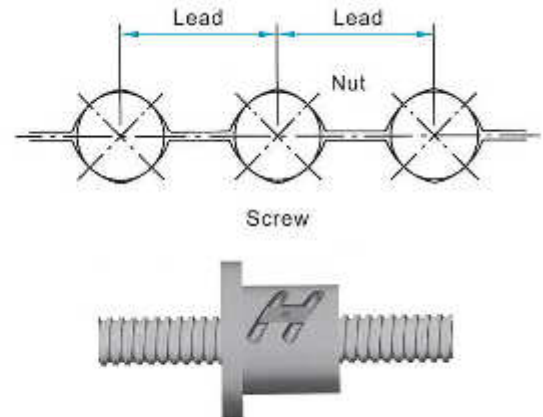


Fig.5.4.1.2 Four-point contact preload

(2) Relation between preload force and elastic deformation

Fig.5.4.1.3 Nuts A and B are assembled with preloading spacer. The preload forces on Nut A and B are F_{a0} , but with reversed direction. The elastic in Fig.5.4.1.4 deformation on both Nuts are δ_{a0}

$$\delta_A = \delta_{a0} + \delta_{a1}$$

$$\delta_B = \delta_{a0} - \delta_{a1}$$

The load in nut A and nut B are:

$$F_A = F_{a0} + F_a - F_{a'} = F_a + F_p$$

$$F_B = F_{a0} - F_{a'} = F_p$$

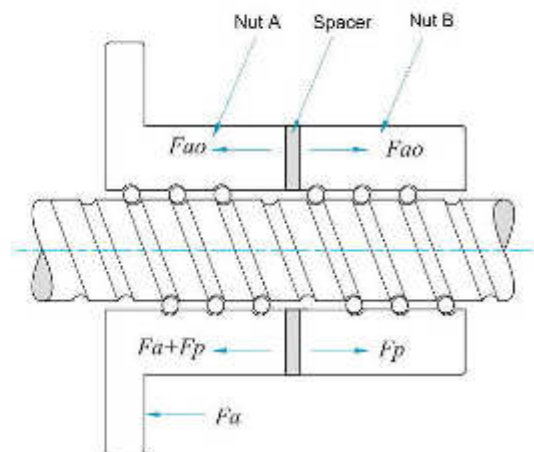


Fig.5.4.1.3 Double-nut positioning preload

It means F_a is offset with an amount F_a' because of the deformation of Nut B decreases. As a result, the elastic deformation of Nut A is reduced. This effect shall be continued until the deformation of Nut B becomes zero, that is, until the elastic deformation δ_{a1} caused by the external axial force equals δ_{a0} , and the preload force applied to Nut B is completely released. The formula related the external axial force and elastic deformation is shown as below:

$$\delta_{a0} = K \times F_{a0}^{2/3} \text{ and } 2\delta_{a0} = K \times F_1^{2/3}$$

$$(F_1 / F_{a0})^{2/3} = (2\delta_{a0} / \delta_{a0}) = 2$$

$$F_1 = 2.8F_{a0} \approx 3F_{a0}$$

Therefore, the preload amount of a ballscrew is recommended to set as 1/3 of its axial load. Too much preload for a Ballscrew shall cause temperature raise and badly affect its life. However, taking the life and efficiency into consideration, the maximum preload amount of a Ballscrew is commonly set to be 10% of its rated basic dynamic load.

Shown on Fig. 5.4.1.5 with the axial load to be three times as the preload, the elastic displacement for the non-preloaded ball Nut is two times as that of the preloaded Nut.

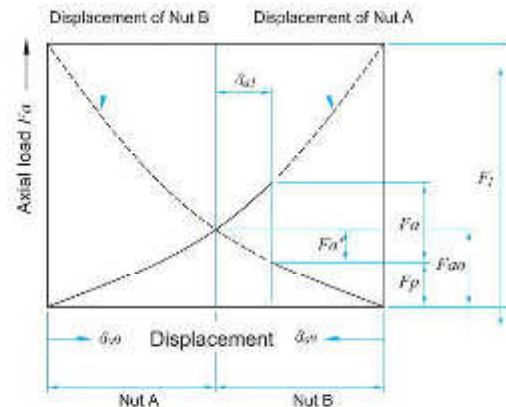


Fig. 5.4.1.4 Positioning preload diagram

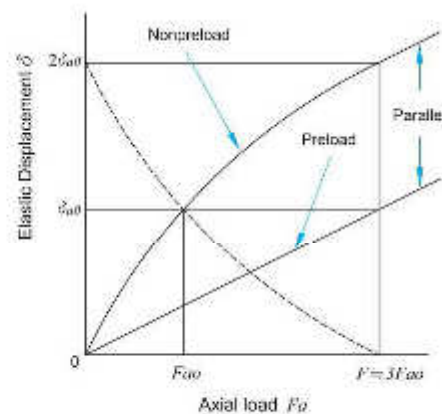


Fig. 5.4.1.5 Elastic Displacement of the Ball Screw

5.4.2 Positioning Accuracy

5.4.2.1 Causes of error in positioning accuracy

Lead error and rigidity of feed system are common causes of feed accuracy error. Other causes like thermal deformation and feed system assembly are also playing important roles in feed accuracy.

5.4.2.2 Considering thermal displacement

If the screw-shaft temperature increases during operation, the heat elongates the screw shaft, thereby reducing the positioning accuracy. Expansion and shrinkage of a screw shaft due to heat can be calculated using equation as below.

$$\Delta L_{\theta} = \rho \cdot \theta \cdot L$$

Here

ΔL_{θ} : Thermal displacement (μm)

ρ : Thermal-expansion coefficient ($12 \mu m/m^{\circ}C$)

θ : Screw-shaft temperature change ($^{\circ}C$)

L : Ballscrew length (mm)

That is to say, an increase in the screw shaft temperature of 1 expands the shaft by $12 \mu m$ per meter. The higher the Ballscrew speed, the greater the heat generation. Thus, temperature increases reduce positioning accuracy. Where high accuracy is required, anti-temperature-elevation measures must be provided as follows:

- (1) To control temperature:
 - Selecting appropriate preload.
 - Selecting correct and appropriate lubricant.
 - Selecting larger lead for the Ballscrew and decrease the rotation speed.
- (2) Compulsory cooling:
 - Ballscrew with hollow cooling.
 - Lubrication liquid or cooling air can be used to cool down external surface of Ballscrew.
- (3) To keep off effect upon temperature raise:
 - Set a negative cumulative lead target value for the Ballscrew.
 - Warm up the machine to stable machine's operating temperature.
 - Pretension by using on Ballscrew while installing onto the machine.

Note: refer to Appendix (3) for examples of ball screws classes for different uses.

5.5 Life

5.5.1 Life of the ball screw

Even though the Ballscrew has been used with correct manner, it shall naturally be worn out and can no longer be used for a specified period. Its life is defined by the period from starting use to ending use caused by nature fail.

- Fatigue life - Time period for surface flaking off happened either on balls or on thread grooves.
- Accuracy life - Time period for serious loosing of accuracy caused by wearing happened on thread groove surface, hence to make Ballscrew can no longer be used.

5.5.2 Fatigue Life

The basic dynamic rate load (C_a) of the Ballscrew is used to calculate its fatigue life

5.5.2.1 Basic dynamic rate load C_a

The basic dynamic rate load (C_a) is the revolution of 10^6 that 90% of identical Ballscrew units in a group, when operated independently of one another under the same conditions, can achieve without developing flaking.

5.5.2.2 Fatigue life

(1) Calculating life:

There are three ways to show fatigue life:

- Total number of revolutions.
- Total operating time.
- Total travel.

$$L = \left(\frac{C_a}{F_a \times f_w} \right)^3 \times 10^6$$

$$L_t = \frac{L}{60 \times n}$$

$$L_s = \frac{L \times l}{10^6}$$

Here

- L : Fatigue life (total number of revolutions)
- L_t : Fatigue life (total operating time)
- L_s : Fatigue life (total travel)
- C_a : Basic dynamic rate load
- F_a : Axial load
- n : Rotation speed
- l : Lead
- f_w : Load factor (refer to Table 5.1)

Load factor f_w

Vibration and impact	Velocity(V)	f_w
Light	$V < 15$ (m/min)	1.0~1.2
Medium	$15 < V < 60$ (m/min)	1.2~1.5
Heavy	$V > 60$ (m/min)	1.5~3.0

Too long or too short fatigue life are not suitable for Ballscrew selection. Using longer life make the Ballscrew's dimensions too large. It's an uneconomical result. Following table is a reference of the Ballscrew's fatigue life.

Machine center.....	20,000 hrs
Production machine.....	10,000 hrs
Automatic controller.....	15,000 hrs
Surveying instruments.....	15,000 hrs

(2) Mean load:

When axial load changed constantly. It is required to calculate the mean axial load (F_m) and the mean rotational speed (N_m) for fatigue life. Setting axial load (F_a) as Y-axis; rotational number ($n \cdot t$) as X-axis. Getting three kind curves or lines:

a. Gradational variation curve (Fig. 5.5.2.1)

Mean load can be calculated by using equation):

$$F_m = \left(\frac{F_1^3 \cdot n_1 \cdot t_1 + F_2^3 \cdot n_2 \cdot t_2 + \dots + F_n^3 \cdot n_n \cdot t_n}{n_1 \cdot t_1 + n_2 \cdot t_2 + \dots + n_n \cdot t_n} \right)^{\frac{1}{3}}$$

Mean rotational speed can be calculated by using equation :

$$N_m = \frac{n_1 \cdot t_1 + n_2 \cdot t_2 + \dots + n_n \cdot t_n}{t_1 + t_2 + \dots + t_n}$$

Axial load (kgf)	Rotation speed (rpm)	Time Ratio (Sec)
F_1	n_1	t_1
F_2	n_2	t_2
\vdots	\vdots	\vdots
F_n	n_n	t_n

b. Similar straight line (Fig. 5.5.2.2)

When mean load variation curve like similar straight line.

Mean rotational speed can be calculated using equation

$$F_m = 1/3(F_{min} + F_{max})$$

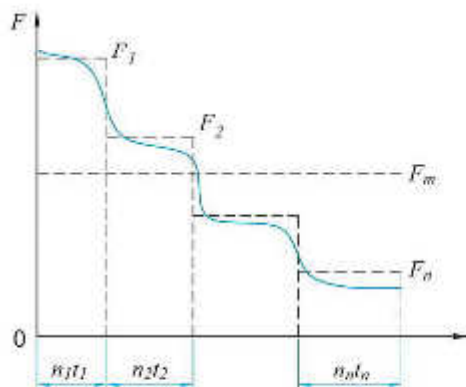


Fig. 5.5.2.1 Gradational variation curve's load

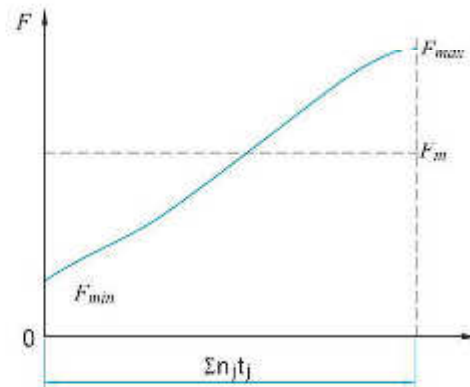


Fig. 5.5.2.2 Similar straight line's load

c. Sine curve there are two cases

1. When mean load variation curve shown as the diagram below.

Mean rotational speed can be calculated by using equation (5.5.2.3) $F_m = 0.65F_{max}$

2. When mean load variation curve shown as the diagram below.

Mean rotational speed can be calculated by using equation (5.5.2.4) $F_m = 0.75F_{max}$

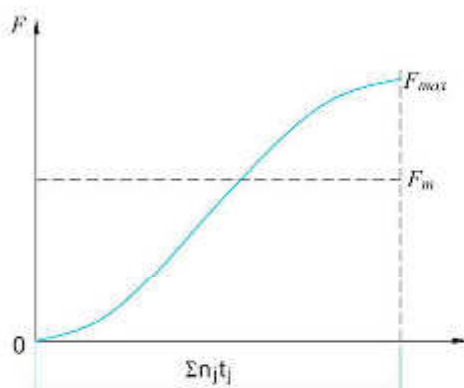


Fig. 5.5.2.3 Variation like Sine curve's load (1)

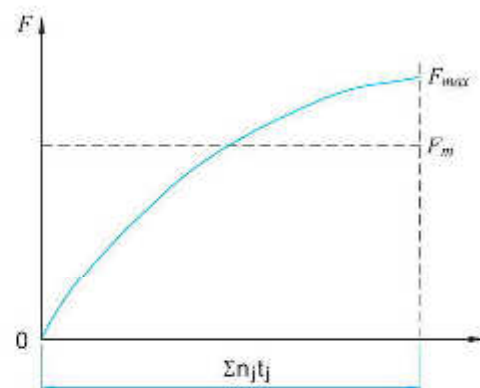


Fig. 5.5.2.4 Variation like Sine curve's load (2)

5.5.3 Material and Hardness

Material and Hardness of ABBA Ball screws

Denomination	Material	Heat treating	Hardness (RHC)
Precision ground	50CrMo4 QT	Induction hardening	58~62
Rolled	S55C	Induction hardening	58~62
Nut	SCM415H	Carburized hardening	58~62

5.5.4 Lubrication

Lithium base lubricants are used for Ball Screw lubrication. Their viscosity are 30~40 cstl (40°C) and ISO grades of 32~100.

Selecting:

1. Low temperature application: Using the lower viscosity lubricant.
2. High temperature, high load and low speed application; Using the higher viscosity lubricant.

Checking and supply interval of lubricant

Manner	Checking interval	Checking item	Supply or replacing interval
Automatic interval oil supply	every week	Oil volume and purity	To supply on each check, its volume depends on oil tank capacity.
Lubricating grease	Within 2-3 months after starting operation of machine	Foreign matter	Normally supply once a year as per the result of check
Oil bath	everyday before operation of machine	Oil surface	To supply as per wasting condition

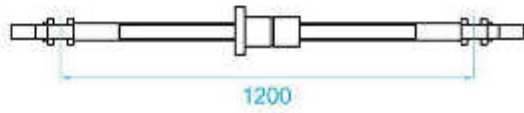
5.5.5 Dustproof

Same as the rolling bearings, if there is the particles such as chips or water get into the ball screw, the wearing problem shall be deteriorated. In some serious cases, ball screw shall then be damaged. In order to prevent these problems from happening, there are wipers assembled at both ends of ball nut to scrape chips and dust. There is also the "O-Ring" at the wipers to seal the lubrication oil from leaking from ball nut.

5.5.6 Key Points for Ball Screws Selection and Calculation

Key points for ball screws selection	Calculation for ball screws selection																																																		
<p>When ball screws are subjected to selection, it is a most fundamental rule that you must first clearly find out what the operation conditions are before going ahead with the final design. Moreover, the elements of your selection include load weight, stroke, torque, position determination accuracy, tracking motion, hardness, lead stroke, nut inside diameter, etc., all elements are mutually related, any change to one of the elements will lead to the changes of other elements, special attention should always be paid to the balance among the elements.</p>	<div style="text-align: center;"> </div> <p>Design conditions</p> <ol style="list-style-type: none"> Working table weight 300 Kg Working object weight 400 Kg Maxima 700 mm Fast feed speed 10 m/min Minimal disassembly ability 10 μm/stroke Driving motor DC motor (MAX 1000 min⁻¹) Guiding surface friction coefficient (μ = 0.05~0.1) Running rate 60 % Accuracy review items Inertia generated during acceleration/deceleration can be neglected because the time periods involved are comparatively small. 																																																		
<p>1. Setting of operation conditions</p> <p>(a) Machine service life time reckoning of H (hr)</p> $H = \text{[]} \times \text{[]} \times \text{[]} \times \text{[]}$ <p style="text-align: center;">hours/day days/ year life years Running</p> <p>(b) Mechanical conditions</p> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th>Calculation Date Distance Distance</th> <th>Speed/rotations</th> <th>Cutting resistance</th> <th>Sliding resistance</th> <th>Time used</th> </tr> </thead> <tbody> <tr> <td>Fast feed</td> <td>m / min / min⁻¹</td> <td>kgf</td> <td>kgf</td> <td>%</td> </tr> <tr> <td>Light cutting</td> <td>/</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Medium cutting</td> <td>/</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Heavy cutting</td> <td>/</td> <td></td> <td></td> <td></td> </tr> </tbody> </table> <p>(c) Position determination accuracy</p> <p>Feed accuracy error factor includes load accuracy and system rigidity. Thermal displacement due to heat generation and positional error of the guide system is also important factors.</p>	Calculation Date Distance Distance	Speed/rotations	Cutting resistance	Sliding resistance	Time used	Fast feed	m / min / min ⁻¹	kgf	kgf	%	Light cutting	/				Medium cutting	/				Heavy cutting	/				<p>1. Setting of operation conditions</p> <p>(a) Machine service life time reckoning of H (hr)</p> $H = 12 \text{ hrs} \times 250 \text{ days} \times 10 \text{ years} \times 0.6 \text{ Running} = 18000\text{hr}$ <p>(b) Mechanical conditions</p> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th>Calculation Date Distance Distance</th> <th>Speed/rotations</th> <th>Cutting resistance</th> <th>Sliding resistance</th> <th>Time used</th> </tr> </thead> <tbody> <tr> <td>Fast feed</td> <td>10m/min/1000min⁻¹</td> <td>0 kgf</td> <td>70 kgf</td> <td>10 %</td> </tr> <tr> <td>Light cutting</td> <td>6 / 600</td> <td>100</td> <td>70</td> <td>50</td> </tr> <tr> <td>Medium cutting</td> <td>2 / 200</td> <td>200</td> <td>70</td> <td>30</td> </tr> <tr> <td>Heavy cutting</td> <td>1 / 100</td> <td>300</td> <td>70</td> <td>10</td> </tr> </tbody> </table> <p>Sliding resistance = (300+400) × 0.1=70 kgf</p>	Calculation Date Distance Distance	Speed/rotations	Cutting resistance	Sliding resistance	Time used	Fast feed	10m/min/1000min ⁻¹	0 kgf	70 kgf	10 %	Light cutting	6 / 600	100	70	50	Medium cutting	2 / 200	200	70	30	Heavy cutting	1 / 100	300	70	10
Calculation Date Distance Distance	Speed/rotations	Cutting resistance	Sliding resistance	Time used																																															
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Key points for ball screws selection	Calculation for ball screws selection
<p>2. Ball screws lead stroke l (mm)</p> $l = \frac{\text{Fast feed stroke (m/min)} \times 1000}{\text{Max. Rotating speed (min}^{-1}\text{) of motor}} \text{ (mm)}$	<p>2. Ball screws lead stroke l (mm)</p> $l = \frac{10000}{1000} = 10 \text{ (mm)}$ <p>Minimal disassembly = $\frac{10\text{mm}}{1000 \text{ stroke}} = 0.01 \text{ mm/stroke}$</p>
<p>3. Computation of average load P_e (kgf)</p> $P_e = \left(\frac{P_1^3 n_1 t_1 + P_2^3 n_2 t_2 + \dots + P_n^3 n_n t_n}{n_1 t_1 + n_2 t_2 + \dots + n_n t_n} \right)^{1/3}$ $P_e = \frac{2P_{\max} + P_{\min}}{3}$ <p>$p_e \approx 0.65 P_{\max}$ $p_e \approx 0.75 P_{\min}$</p>	<p>3. Computation of average load P_e (kgf)</p> $P_e = \left(\frac{70^3 \times 1000 \times 10 + 170^3 \times 600 \times 50 + 270^3 \times 200 \times 30 + 370^3 \times 100 \times 10}{1000 \times 10 + 600 \times 50 + 200 \times 30 + 100 \times 10} \right)^{1/3}$ $= \left(\frac{31.7 \times 10^{18}}{4.7 \times 10^4} \right)^{1/3}$ <p>$\approx 189 \text{ kgf}$</p>
<p>4. Average number of rotations n_m</p> $n_m = \frac{n_1 t_1 + n_2 t_2 + \dots + n_n t_n}{100}$	<p>4. Average number of rotations n_m</p> $n_m = \frac{1000 \times 10 + 600 \times 50 + 200 \times 30 + 100 \times 10}{100}$ $= \frac{4.7 \times 10^4}{100}$ <p>$= 470 \text{ min}^{-1}$</p>
<p>5. Calculation of required dynamic rated load C_a</p> <p>$C_a = P_e \cdot f_s$</p>	<p>5. Calculation of required dynamic rated load C_a</p> <p>$C_a = 189 \times 5 = 945 \text{ (kgf)}$</p>
<p>6. Calculation of required static rated load C_{oa}</p> <p>$C_{oa} = P_{\max} \cdot f_s$</p>	<p>6. Calculation of required static rated load C_{oa}</p> <p>$C_{oa} = 369 \times 5 = 1845 \text{ (kgf)}$</p>
<p>7. Selection of nut type</p> <p>$C_a > 945$ $C_{oa} > 1845$</p> <p>Select the nut types with basic dynamic rated load and basic static rated load as specified above.</p>	<p>7. Selection of nut type</p> <p>Choose SFT 4010 on the catalogue</p> <p>$C_a = 3178 \text{ kgf}$ $C_{oa} = 9480 \text{ kgf}$</p>

Key points for ball screws selection	Calculation for ball screws selection
<p>8. Calculation of life confirmation Lt (h)</p> $L_t = \left(\frac{C_a}{P_e \cdot f_w} \right)^3 \cdot \frac{1}{60n_m} \cdot 10^6$	<p>8. Calculation of life confirmation Lt (h)</p> $L_t = \left(\frac{3178}{189 \cdot 2} \right)^3 \cdot \frac{1}{60 \cdot 470} \cdot 10^6$ $= 20479 \text{ (h)}$
<p>9. Determination of screw length</p> <p>Screw length = Maximal stroke + Nut length + 2 × reserved length at shaft end</p>	<p>9. Determination of screw length</p> <p>Screw length = 700+93+2 × 81 = 874 mm</p>
<p>10. Mounting distance of screw length</p>	<p>10. Mounting distance of screw length(F-F support)</p> 
<p>11. Permissible axial load</p>	<p>11. Permissible axial load</p> <p>Omitted because of F-F support</p>
<p>12. Permissible revolution speed n and dm</p> $n = \alpha \times \frac{60L^2}{2\pi L^2} \sqrt{\frac{E I_E}{\gamma A}} = f \frac{d_r}{L^2} \times 10^7 \text{ (rpm.)}$ <p>dm=Shaft dia. × Maximal speed</p>	<p>12. Permissible revolution speed n and dm</p> $n = \frac{21.9 \times 35.2 \times 10^7}{1200^2}$ $= 5353 \text{ min}^{-1} > n_{\text{max}}$ <p>dm = 40 × 1000 = 40000 < 50000</p>
<p>13. Countermeasure against thermal displacement and rigidity</p>	<p>13. Countermeasure against thermal displacement and rigidity</p> <p>(a) It is estimated there would be a temperature rise of 2–5°C with the ball screws of the general machinery, take temperature rise of 2°C to computer the extension of ball screw.</p> $\Delta \ell = \alpha \cdot t \cdot L$ $= 11.7 \times 10^{-6} \times 2 \times 700 \text{ mm} = 0.016 \text{ mm}$ $F_p = \frac{EA \Delta \ell}{L}$ $= \frac{2.06 \times 10^4 \times \frac{\pi \times 35.2^2}{4} \times 0.016}{700} \approx 458 \text{ kgf}$

Ball Screw

Key points for ball screws selection	Calculation for ball screws selection
<p>(Reference) Force exerted on ball screw when inertia is considered</p> <p>⊙ When used horizontally</p> <p>1. During acceleration</p> $P_{ACC} = M g \times \mu + \frac{M \times V}{60 \times \Delta t}$ <p>2. During deceleration</p> $P_{DEC} = M g \times \mu - \frac{M \times V}{60 \times \Delta t}$ <p>⊙ When used vertically</p> <p>1. During acceleration while descending, during deceleration while ascending</p> $P_U = M g - \frac{M \times V}{60 \times \Delta t}$ <p>2. During acceleration while ascending, during deceleration while descending</p> $P_D = M g + \frac{M \times V}{60 \times \Delta t}$ <p>M : Mass of moving object (kg)</p> <p>g : Acceleration of gravity (9.8m/s²)</p> <p>V : Velocity (m/min)</p> <p>Δt : Acceleration /deceleration time (s)</p> <p>μ : Friction coefficient</p>	<p>Deviation can be corrected by estimating the temperature rise per extension of 0.016mm, and taking into consideration of the pre-tension of 458 kgf.</p> <p>(b) Rigidity</p> <p>(1) Directional rigidity</p> $\delta_{SF} = \frac{PL}{4AE} = \frac{27 \times 1200}{4 \times \frac{\pi \times 35.2^3}{4} \times 2.06 \times 10^4}$ $= 0.00036 \text{ mm}$ $K_S = \frac{370}{0.00036} = 10.3 \times 10^5 \text{ kgf / mm}$ <p>(2) Rigidity of steel ball and nut groove</p> $n = \frac{41.8 \times \pi \times 2.5}{6.35} = 52$ $Q = \frac{370}{52 \sin 45^\circ} = 10$ $\delta_{NS} = \frac{0.00057}{\sin 45^\circ} \left(\frac{10^3}{6.35} \right)^{1/3} \times \frac{1}{0.7}$ $= 2.9 \times 10^{-3} \text{ mm}$ $K_N = \frac{370}{2.9 \times 10^{-3}} = 1.28 \times 10^5 \text{ kgf/mm}$ <p>(3) Rigidity of bracing bearings</p> <p>Where, nut rigidity 50 kgf / mm</p> $\delta_B = \frac{370}{50 \times 2} = 3.7 \mu \text{ m}$ $K_B = \frac{370}{0.0037} = 1 \times 10^5 \text{ kgf/mm}$ <p>⊙ $\delta_{TOTAL} = 0.36 + 2.9 + 3.7 = 6.96 \mu \text{ m}$</p>
<p>14. Confirmation of the ball screw life</p>	<p>14. Confirmation of the ball screw life</p> <p>L = 20479(h) > 18000 (h)</p>

5.6 Driving Torque

Driving torque T_S of the transmission shaft

- $T_S = T_P + T_O + T_F$ (in fixed speed)
 $T_S = T_O + T_P + T_O + T_F$ (when accelerating)
 T_O : Acceleration torque (1)
 T_P : Load torque (2)
 T_O : Preload torque (3)
 T_F : Friction torque (4)

(1) Acceleration T_O

$$T_O = J \alpha \quad (\text{kgf} \cdot \text{cm})$$

$$\alpha = \frac{2\pi n}{60\Delta t} \quad (\text{rad/s}^2)$$

- J : Moment of inertia ($\text{kgf} \cdot \text{cm} \cdot \text{s}^2$)
 α : Angular acceleration (rad/s^2)
 n : Revolutions (min^{-1})
 Δt : Starting time (sec)

(2) Load torque T_P

$$T_P = \frac{P \cdot \ell}{2\pi\eta_1} \quad (\text{kgf} \cdot \text{cm})$$

$$P = F + \mu M$$

- P : Axial load (kgf)
 ℓ : Lead (cm)

η_1 : Positive efficiency

The efficiency when rotating motion is altered to linear motion

F : Cutting force (kgf)

μ : Friction coefficient

M : Mass of moving object (kg)

g : Acceleration of gravity (9.8 m/s^2)

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

η_2 : Reverse efficiency

The efficiency when linear motion returns to rotating motion

(3) Preload torque T_O

$$T_O = \frac{K \cdot P_{Kc} \cdot \ell}{\sqrt{\tan \alpha} \cdot 2\pi} \quad (\text{kgf} \cdot \text{cm})$$

- K : Internal coefficient (0.05 is usually adopted)
 P_{Kc} : Preload (kgf)
 ℓ : Lead (cm)
 α : Lead angle

(4) Friction torque T_F

$$T_F = T_B + T_O + T_J \quad (\text{kgf} \cdot \text{cm})$$

T_B : Friction torque of bracing shaft

T_O : Friction torque of free shaft

T_J : Friction torque motor shaft

The friction torque of the bracing shaft would be affected by the lubrication oil. Or special attention has to be paid to unexpected excessive friction torque which may be generated when oil seal is overly tight, or may result in temperature rise.

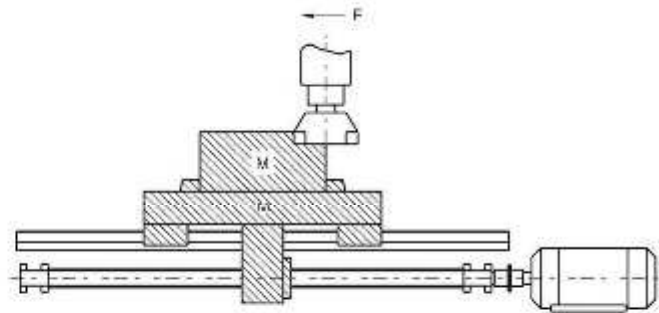


Fig.5.6.1 Moment of inertia of load

【For reference】 Moment of inertia of load

$$J = J_{BS} + J_{CU} + J_W + J_M$$

J_{BS} : Moment of inertia Ball screws shaft

J_{CU} : Moment of inertia Coupler

J_W : Moment of inertia Linear motion part

J_M : Moment of inertia Roller shaft part of motor shaft

Conversion formula for moment of inertia of load

Moment of inertia	Formula	J
Moment of inertia derived from motor shaft		J
Cylinder load		$\frac{\rho \cdot l \cdot D^4}{32}$
Linearly moving object		$\frac{M}{4} \left(\frac{V \ell}{\pi \cdot N v} \right)^2 = \frac{M}{4} \left(\frac{P}{\pi} \right)^2$
Unit		$\text{kg} \cdot \text{m}^2$
Moment of inertia during deceleration		$J_{Mv} \left(\frac{J \ell}{N v} \right)^2 \cdot J \ell$

- ρ : Density (kg/cm^3) $\rho = 7.8 \times 10^{-3}$
 l : Cylinder length (cm)
 D : Cylinder diameter (cm)
 M : Mass of the linear motion part (kg)
 V : Velocity of the linearly moving object (mm/min)
 N : Motor shaft revolutions (min⁻¹)

- P : The moving magnitude of the linearly moving object per every rotation of the motor (mm)
 Nv : Rotations in longitudinal moving direction (min⁻¹)
 $J \ell$: Rotations in longitudinal moving direction (min⁻¹)
 J_{Mv} : Moment of inertia in motor direction

5.7 Selecting Correct Type Ball Screw

Condition

- Accuracy

Load, speed acceleration, max. travel length, positioning accuracy, required life, load condition (vibration, impact), lubrication and atmosphere

- Screw Shaft Design

- Drive Torque

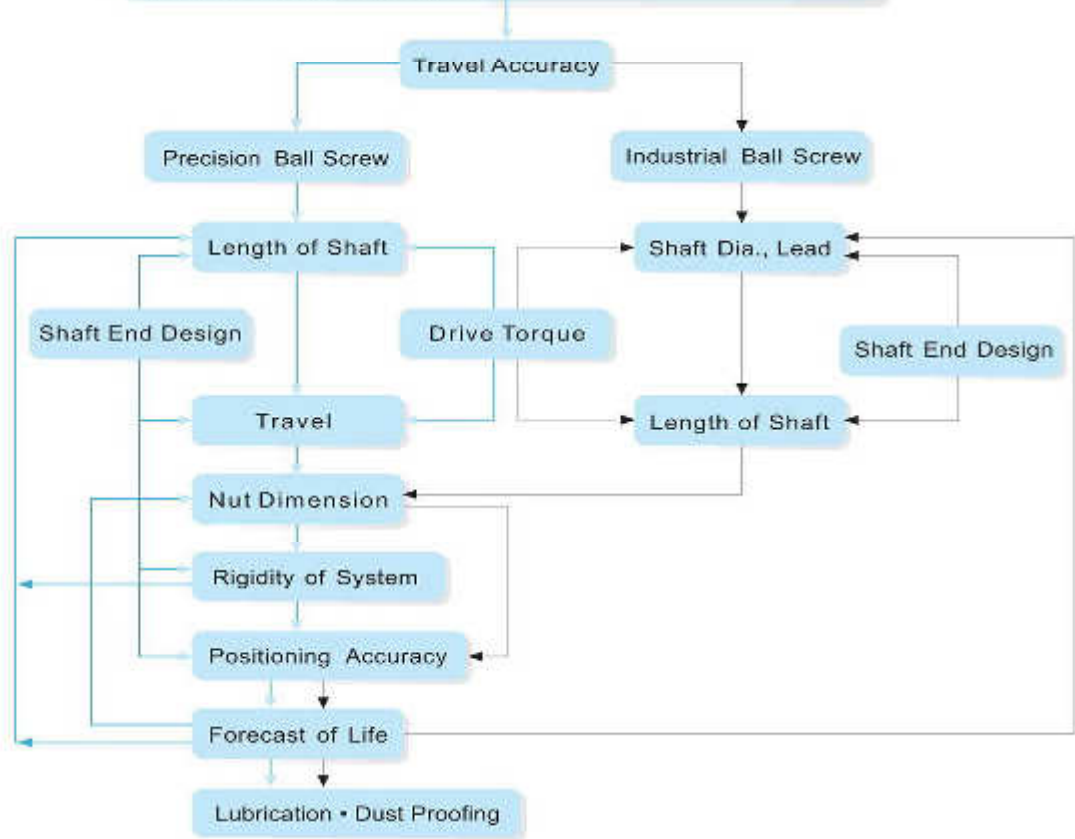
- Nut Design

- Rigidity

- Positioning Accuracy

- Life Design

- Lubrication and safety design

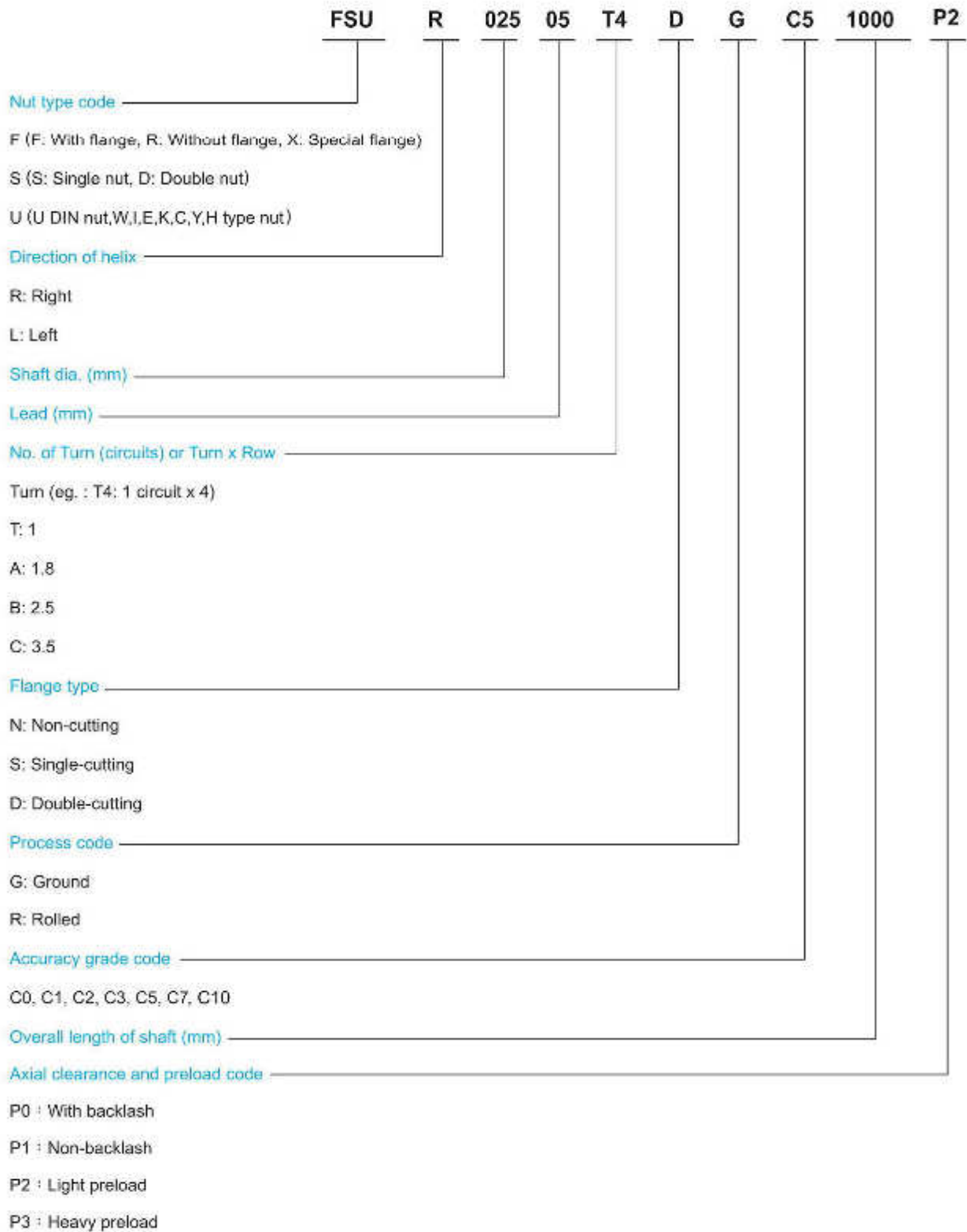


ABBA Ball Screw Size List

Lead \ Dia.	1	2	2.5	3	4	5	5.00	6	10	12.7	16	20	25	32	40	50
6	⊙															
8	⊙	⊙	⊙													
10		⊙		⊙	⊙											
12		⊙			⊙	⊙			⊙	⊙						
14		⊙			⊙	⊙										
15												⊙				
16		⊙			⊙	⊙	⊙		⊙		⊙					
20					○	⊙			⊙			⊙				
25					⊙	⊙			⊙			⊙	⊙			
32					○	⊙		⊙	⊙			⊙		⊙		
40						⊙		⊙	⊙			⊙			⊙	
50						○			⊙			⊙				⊙
63									⊙			⊙			⊙	
80									⊙			⊙				

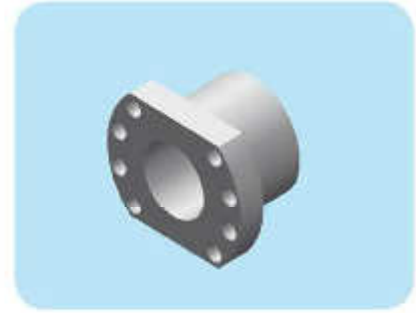
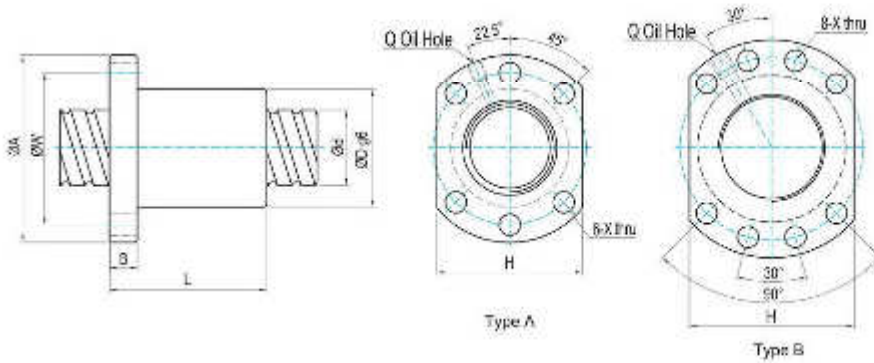
⊙ means rolled ball screw ○ means ground ball screw

5.8 Ordering Key of Ball Screw



5.9 Specification of Ball Screw

5.9.1 FSU (DIN69051)

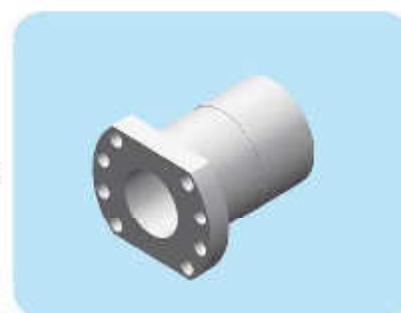
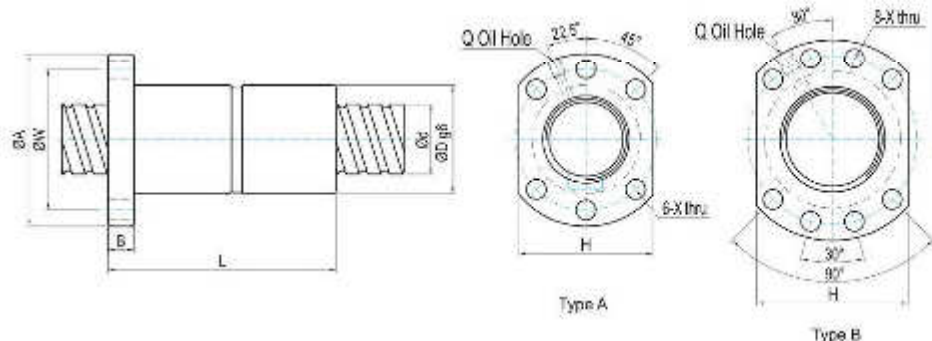


Unit : mm

Model No.	Dimensions														
	d	l	Da	D	A	B	L	W	X	Type	H	Q	n	Ca(Kgf)	Coa(kgf)
1604-4	16	4	2.381	28	48	10	45	38	5.5	A	40	M6	T4	944	1254
★ 1605-3	16	5	3.175	28	48	10	42	38	5.5	A	40	M6	T3	1049	1144
★ 1605-4	16	5	3.175	28	48	10	50	38	5.5	A	40	M6	T4	1344	1525
1610-3	16	10	3.175	28	48	12	65	38	5.5	A	40	M6	T3	1084	1232
2005-3	20	5	3.175	36	58	10	47	47	6.6	A	44	M6	T3	1181	1496
★ 2005-4	20	5	3.175	36	58	10	53	47	6.6	A	44	M6	T4	1512	1995
2006-3	20	6	3.969	36	58	10	52	47	6.6	A	44	M6	T3	1569	1788
2010-3	20	10	3.969	36	58	10	68	47	6.6	A	44	M6	T3	1621	1925
2504-4	25	4	2.381	40	62	11	46	51	6.6	A	48	M6	T4	1178	2046
2505-3	25	5	3.175	40	62	10	47	51	6.6	A	48	M6	T3	1330	1936
★ 2505-4	25	5	3.175	40	62	10	53	51	6.6	A	48	M6	T4	1704	2581
2510-3	25	10	4.762	40	62	12	75	51	6.6	A	48	M6	T3	2250	2772
2510-4	25	10	4.762	40	62	12	85	51	6.6	A	48	M6	T4	2881	3695
★ 3205-4	32	5	3.175	50	80	12	53	65	9	A	62	M6	T4	1924	3403
3206-4	32	6	3.969	50	80	12	58	65	9	A	62	M6	T4	2598	4217
3210-3	32	10	6.35	50	80	16	77.5	65	9	A	62	M6	T3	3775	5877
3210-4	32	10	6.35	50	80	16	90	65	9	A	62	M6	T4	4834	7835
★ 4005-4	40	5	3.175	63	93	16	56	78	9	B	70	M8	T4	2142	4342
4006-4	40	6	3.969	63	93	14	60	78	9	B	70	M6	T4	2877	5318
4010-4	40	10	6.35	63	93	18	93	78	9	B	70	M8	T4	5399	10074
5006-4	50	6	3.969	75	110	15	62	93	11	B	85	M8	T4	3203	6784
5010-4	50	10	6.35	75	110	18	93	93	11	B	85	M8	T4	5933	12313
6310-4	63	10	6.35	90	125	18	98	108	11	B	95	M8	T4	6700	16230
6320-3	63	20	9.525	95	135	20	138	115	13.5	B	100	M8	T3	8957	17945
8010-4	80	10	6.35	105	145	20	98	125	13.5	B	110	M8	T4	7547	21268
8020-3	80	20	9.525	125	165	25	143	145	13.5	B	130	M8	T3	10168	23611

★ Note : with sign ^ can produce left helix

5.9.2 FDU (DIN69051)

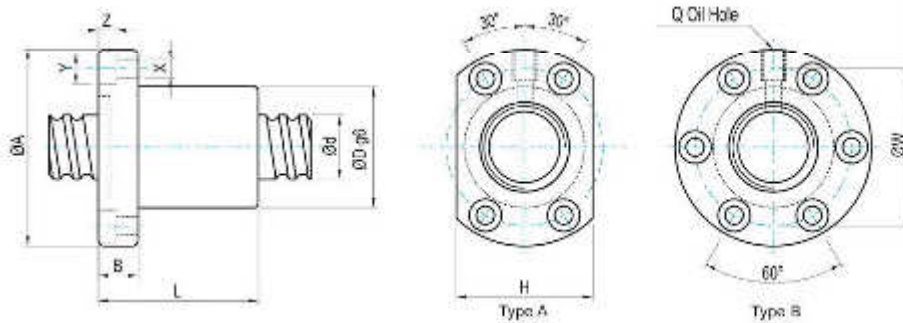


Unit : mm

Model No.	Dimensions														
	d	l	Da	D	A	B	L	W	X	Type	H	Q	n	Ca(Kgf)	Coa(kgf)
★ 1605-3	16	5	3.175	28	48	10	80	38	5.5	A	40	M6	T3	1049	1144
★ 2005-4	20	5	3.175	36	58	12	92	47	6.6	A	44	M6	T4	1512	1995
★ 2505-4	25	5	3.175	40	62	12	92	51	6.6	A	48	M6	T4	1704	2581
2510-4	25	10	4.762	40	62	12	153	51	6.6	A	48	M6	T4	2881	3695
★ 3205-4	32	5	3.175	50	80	12	92	65	9	A	62	M6	T4	1924	3403
3210-4	32	10	6.35	50	80	16	160	65	9	A	62	M6	T4	4834	7835
4005-4	40	5	3.175	63	93	15	96	78	9	B	70	M8	T4	2142	4342
4010-4	40	10	6.35	63	93	18	162	78	9	B	70	M8	T4	5399	10074
5010-4	50	10	6.35	75	110	16	162	93	11	B	85	M8	T4	5933	12313
6310-4	63	10	6.35	90	125	18	182	108	11	B	95	M8	T4	6700	16230
6320-3	63	20	9.525	95	135	20	253	115	13.5	B	100	M8	T3	8957	17945
8010-4	80	10	6.35	105	145	20	182	125	13.5	B	110	M8	T4	7547	21268
8020-3	80	20	9.525	125	165	25	253	145	13.5	B	130	M8	T3	10168	23611

★Note : with sign * can produce left helix

5.9.3 FSI

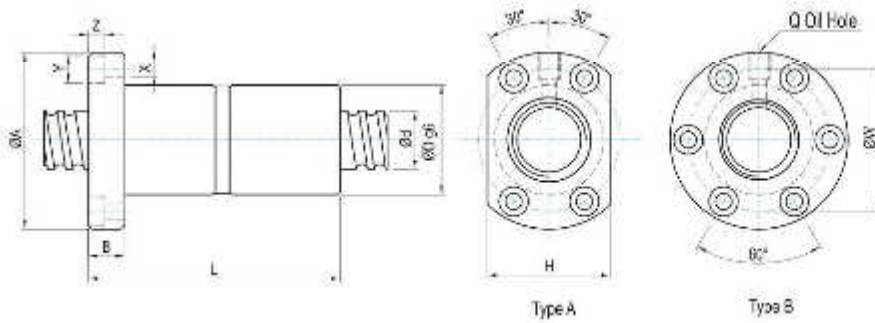


Unit : mm

Model No.	Dimensions																
	d	l	Da	D	A	B	L	W	X	Y	Z	Type	H	Q	n	Ca(Kgf)	Coa(kgf)
1404-4	14	4	2.381	26	46	10	47	36	4.5	8	4.5	A	34	M6	T4	875	1056
1405-3	14	5	3.175	26	46	10	45	36	4.5	8	4.5	A	34	M6	T3	1013	1056
1604-4	16	4	2.381	30	49	10	45	39	4.5	8	4.5	A	34	M6	T4	944	1254
★ 1605-3	16	5	3.175	30	49	10	42	39	4.5	8	4.5	A	34	M6	T3	1049	1144
★ 1605-4	16	5	3.175	30	49	10	50	39	4.5	8	4.5	A	34	M6	T4	1344	1525
1610-3	16	10	3.175	34	58	10	65	45	5.5	9.5	5.5	A	36	M6	T3	1084	1232
★ 2005-4	20	5	3.175	34	57	12	53	45	5.5	9.5	5.5	A	40	M6	T4	1512	1995
2504-4	25	4	2.381	40	63	11	46	51	5.5	9.5	5.5	A	46	M6	T4	1178	2046
★ 2505-4	25	5	3.175	40	63	12	53	51	5.5	9.5	5.5	A	46	M8	T4	1704	2581
2510-4	25	10	4.762	46	72	12	85	58	6.5	11	6.5	A	52	M6	T4	2881	3695
★ 3205-4	32	5	3.175	46	72	12	53	58	6.5	11	6.5	A	52	M8	T4	1924	3403
3206-4	32	6	3.969	62	89	12	63	75	6.5	11	6.5	B	-	M8	T4	2598	4217
3210-4	32	10	6.35	54	88	16	90	70	9	14	8.5	A	62	M8	T4	4834	7835
★ 4005-4	40	5	3.175	56	90	16	56	72	9	14	8.5	A	64	M8	T4	2142	4342
4010-4	40	10	6.35	62	104	18	93	82	11	17.5	11	A	70	M8	T4	5399	10074
5010-4	50	10	6.35	72	114	18	93	92	11	17.5	11	A	82	M8	T4	5933	12313
6310-4	63	10	6.35	85	131	22	100	107	14	20	13	B	-	M8	T4	6700	16230
6320-3	63	20	9.525	95	153	23	130	123	18	26	17.5	B	-	M8	T3	8957	17945
8010-4	80	10	6.35	105	150	22	92	127	14	20	13	B	-	M8	T4	7547	21268
8020-3	80	20	9.525	115	173	23	130	143	18	26	17.5	B	-	M8	T3	10168	23611

★ Note : with sign * can produce left helix

5.9.4 FDI

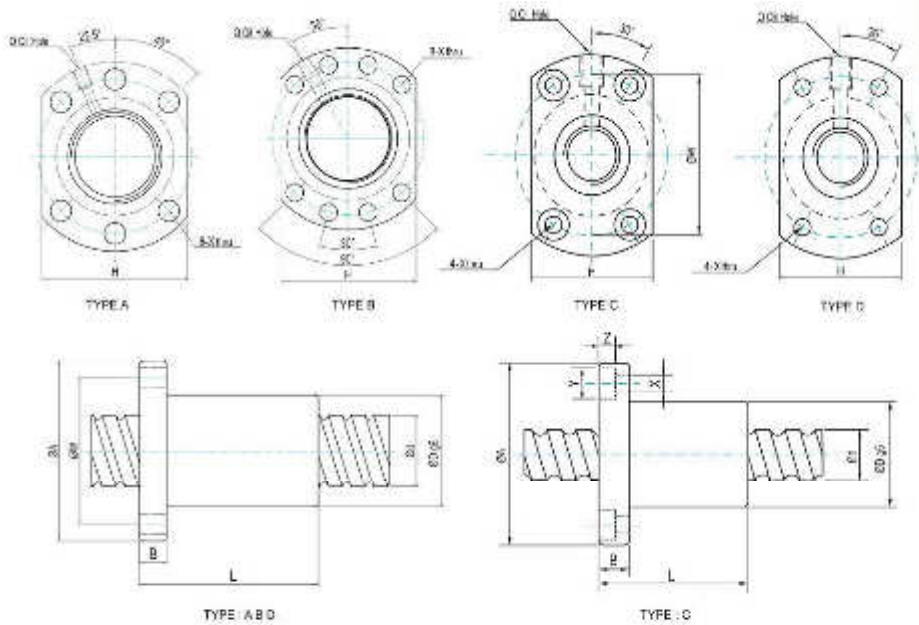
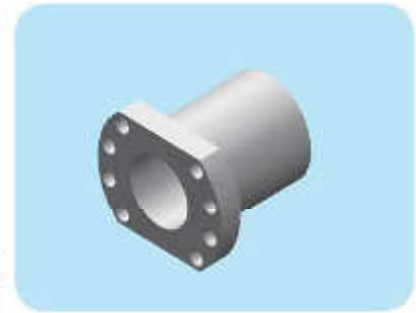


Unit : mm

Model No.	Dimensions																
	d	l	Da	D	A	B	L	W	X	Y	Z	Type	H	Q	n	Ca(Kgf)	Coa(kgf)
★ 1605-3	16	5	3.175	30	49	10	80	39	4.5	8	4.5	A	34	M6	T3	1049	1144
★ 2005-4	20	5	3.175	34	57	12	92	45	5.5	9.5	5.5	A	40	M6	T4	1512	1995
★ 2505-4	25	5	3.175	40	63	12	92	51	5.5	9.5	5.5	A	46	M8	T4	1704	2581
2510-4	25	10	4.762	46	72	12	156	58	6.5	11	6.5	A	52	M6	T4	2881	3695
★ 3205-4	32	5	3.175	46	72	12	92	58	6.5	11	6.5	A	52	M8	T4	1924	3403
3210-4	32	10	6.35	54	88	16	160	70	9	14	8.5	A	62	M8	T4	4834	7835
★ 4005-4	40	5	3.175	56	90	16	96	72	9	14	8.5	A	64	M8	T4	2142	4342
4010-4	40	10	6.35	62	104	18	162	82	11	17.5	11	A	70	M8	T4	5399	10074
5010-4	50	10	6.35	72	114	18	162	92	11	17.5	11	A	82	M8	T4	5933	12313
6310-4	63	10	6.35	85	131	22	182	107	14	20	13	B	-	M8	T4	6700	16230
6320-3	63	20	9.525	95	153	23	253	123	18	26	17.5	B	-	M8	T3	8957	17945
8010-4	80	10	6.35	105	150	22	182	127	14	20	13	B	-	M8	T4	7547	21268
8020-3	80	20	9.525	115	173	23	253	143	18	26	17.5	B	-	M8	T3	10168	23611

★ Note : with sign ^ can produce left helix

5.9.5 FSC

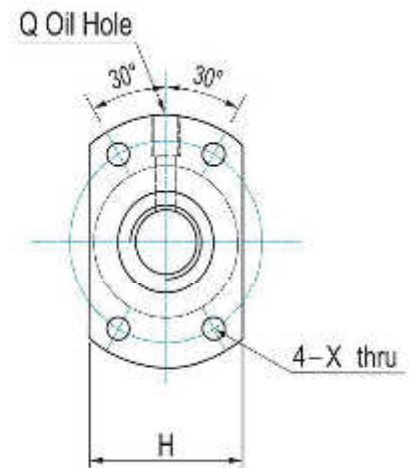
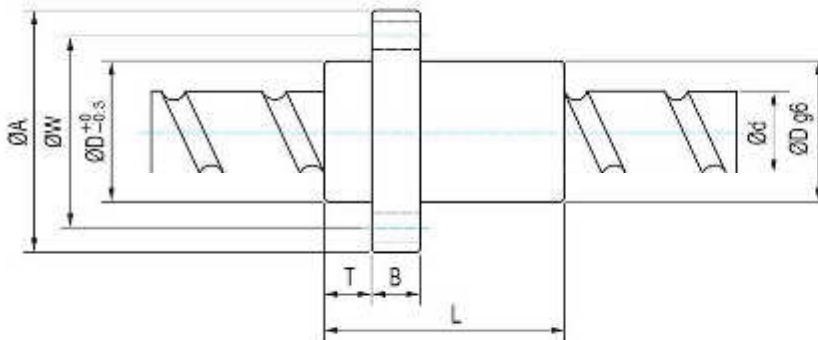


Unit : mm

Model No.	Dimensions																
	d	l	Da	D	A	B	L	W	X	Y	Z	Type	H	Q	n	Ca(Kgf)	Coa(kgf)
1210-2	12	10	2	30	50	10	40	40	4.5	8	4.5	C	32	M6	T2	390	466
1520-2	15	20	3.175	34	55	12	57	45	6	-	-	D	34	M6	T2	833	997
1610-3	16	10	3.175	20	40	12	43	30	5.5	-	-	A	40	M6	T3	1100	1496
1616-3	16	16	3.175	28	48	12	61	38	5.5	-	-	A	40	M6	T3	1180	1496
2010-2	20	10	3.969	46	74	13	54	59	6.6	11	5.5	C	46	M6	T2	1246	1559
2020-4	20	20	3.175	36	58	10	55	47	6.6	-	-	A	44	M6	T4	1659	2464
▲ 2510-4	25	10	3.5	40	62	12	64	51	6.6	-	-	A	48	M6	T4	2067	3280
2525-4	25	25	3.969	47	74	12	67	60	6.6	-	-	A	56	M6	T4	2481	3851
3220-3	32	20	3.969	50	80	13	78	65	9	-	-	A	62	M6	T3	2141	3576
3232-4	32	32	4.762	56	86	16	82	71	9	-	-	A	65	M6	T4	3585	6071
4020-3	40	20	5.556	63	93	15	83	78	9	-	-	B	70	M8	T3	3782	6468
4040-4	40	40	6.35	65	95	18	100	80	9	-	-	B	72	M8	T4	5778	11753
5020-5	50	20	6.35	75	110	18	121	93	11	-	-	B	85	M8	T5	7737	18189

▲ steel balls 3.5mm, please order 3.5mm shaft to meet

5.9.6 FSE

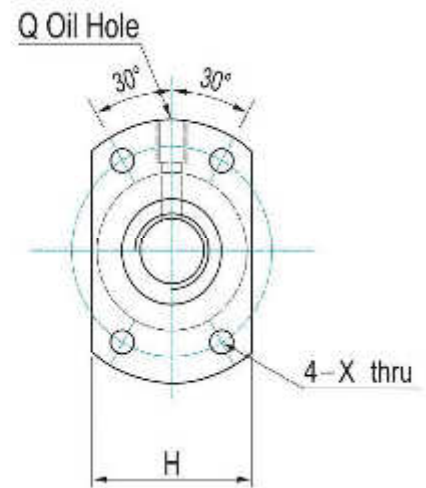
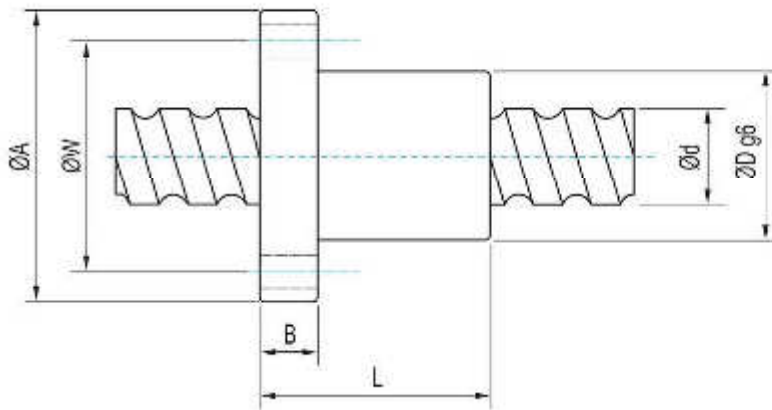
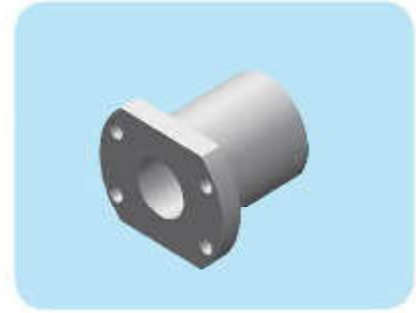


Unit : mm

Model No.	Dimensions														
	d	l	Da	D	A	B	T	L	W	X	H	Q	n	Ca(Kgf)	Coa(kgf)
1616-2	16	16	3.175	32	53	10	10.5	48	42	4.5	38	M6	A2	1512	1995
★ 2020-2	20	20	3.175	39	62	10	10.8	55	50	5.5	46	M6	A2	1659	2464
2520-2	25	20	3.5	47	74	12	11	65	60	6.6	49	M6	A2	2106	3422
2525-2	25	25	3.969	47	74	12	11.2	67	60	6.6	56	M6	A2	2481	3851
3232-2	32	32	4.762	58	92	15	14	82	74	9	68	M6	A2	3585	6071
4040-2	40	40	6.35	73	114	17	17	100	93	11	84	M6	A2	5778	11753
5050-2	50	50	7.938	90	135	20	21.5	125	112	14	92	M6	A2	8819	19241

★ Note : with sign ^ can produce left helix

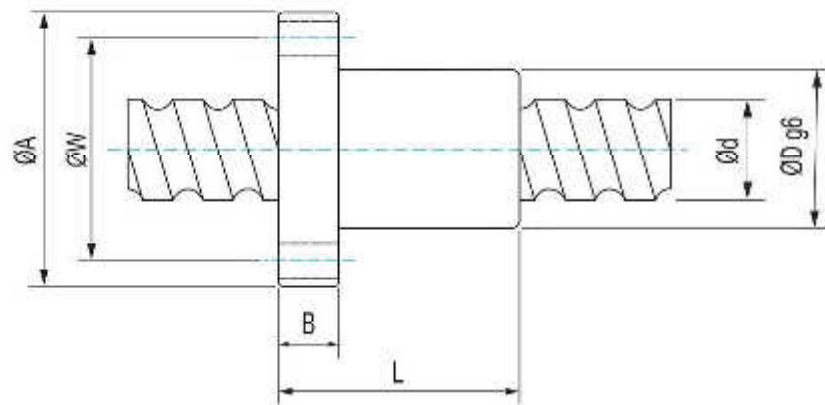
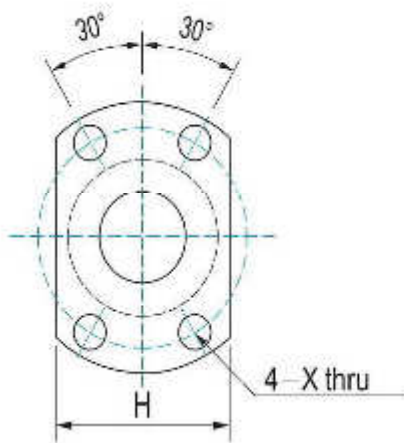
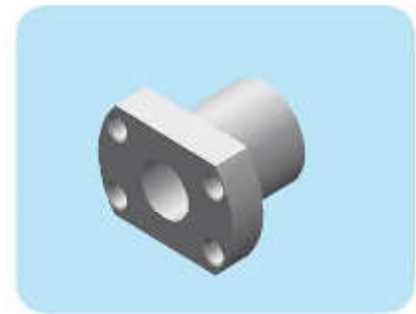
5.9.7 FSB



Unit : mm

Model No.	Dimensions												Ca(Kgf)	Coa(kgf)
	d	l	Da	D	A	B	L	W	X	H	Q	n		
1404-3	14	4	2.381	31	50	10	40	40	4.5	37	M6	T3	684	792
1405-3	14	5	3.175	32	50	10	45	40	4.5	38	M6	T3	1013	1056
1605-3	16	5	3.175	34	54	10	42	44	4.5	40	M6	T3	1049	1144
2005-3	20	5	3.175	40	60	10	47	50	4.5	46	M6	T3	1181	1496
2505-3	25	5	3.175	43	67	10	47	55	5.5	50	M6	T3	1330	1936
2510-3	25	10	4.762	60	96	15	75	78	9	72	M6	T3	2250	2772
2510-4	25	10	4.762	60	96	15	97	78	9	72	M6	T4	2881	3695
3210-3	32	10	6.35	67	103	15	78	85	9	78	M6	T3	3775	5877
3210-4	32	10	6.35	67	103	15	97	85	9	78	M6	T4	4834	7835
4010-4	40	10	6.35	76	116	17	100	96	11	88	M6	T4	5399	10074

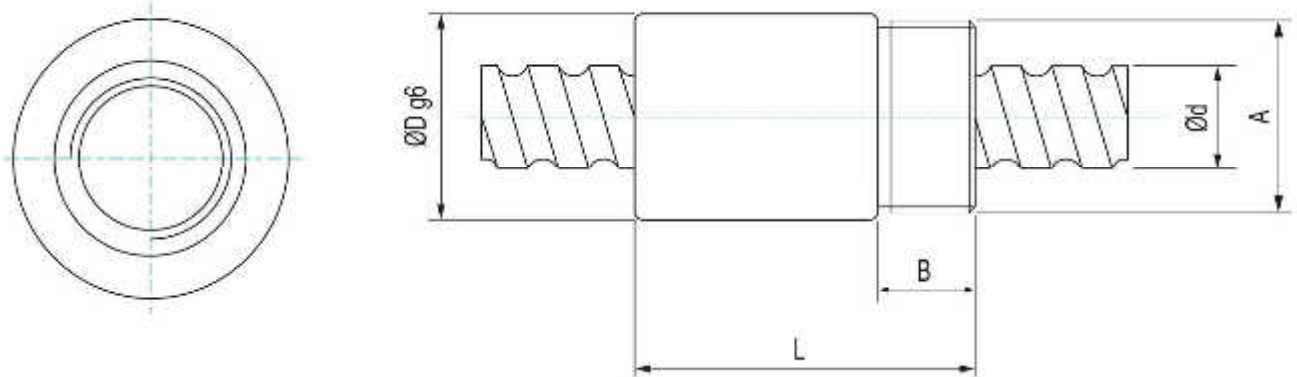
5.9.8 FSK



Unit : mm

Model No.	Dimensions												
	d	l	Da	D	A	B	L	W	X	H	n	Ca(Kgf)	Coa(kgf)
0601-3	6	1	0.8	12	24	3.5	18	18	3.4	16	T3	111	123
0801-3	8	1	0.8	14	27	4	20	21	3.4	18	T3	126	162
0802-3	8	2	1.2	16	29	4	26	23	3.4	20	T3	215	239
0825-3	8	2.5	1.2	16	29	4	26	23	3.4	20	T3	215	239
1002-3	10	2	1.2	18	35	5	28	27	4.5	22	T3	240	302
1004-3	10	4	2	26	46	10	35	36	4.5	28	T3	472	489
1202-3	12	2	1.2	20	37	5	28	29	4.5	24	T3	265	377
1204-3	12	4	2.381	28	48	6	35	39	5.5	30	T3	645	693
1205-3	12	5	2	28	48	6	35	39	5.5	30	T3	514	594
1402-3	14	2	1.2	21	40	6	28	31	5.5	26	T3	283	440
1602-3	16	2	1.2	25	43	10	32	35	5.5	29	T3	300	503

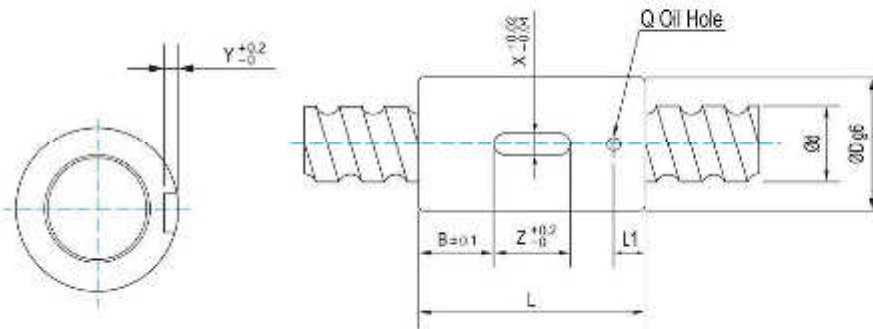
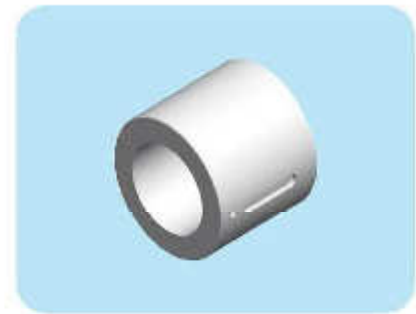
5.9.9 RSK (without wipers)



Unit : mm

Model No.	Dimensions									
	d	l	Da	D	A	B	L	n	Ca(Kgf)	Coa(kgf)
0825-3	8	2.5	1.2	17.5	M15X1P	8	26	T3	215	239
1003-3	10	3	1.8	21	M18X1P	9	29	T3	403	424
1204-3	12	4	2.381	25.5	M20X1P	10	34	T3	645	693
1205-3	12	5	2	25.5	M20X1P	10	39	T3	514	594
1605-3	16	5	3.175	32.5	M26X1.5P	12	42	T3	1049	1144

5.9.10 RSY



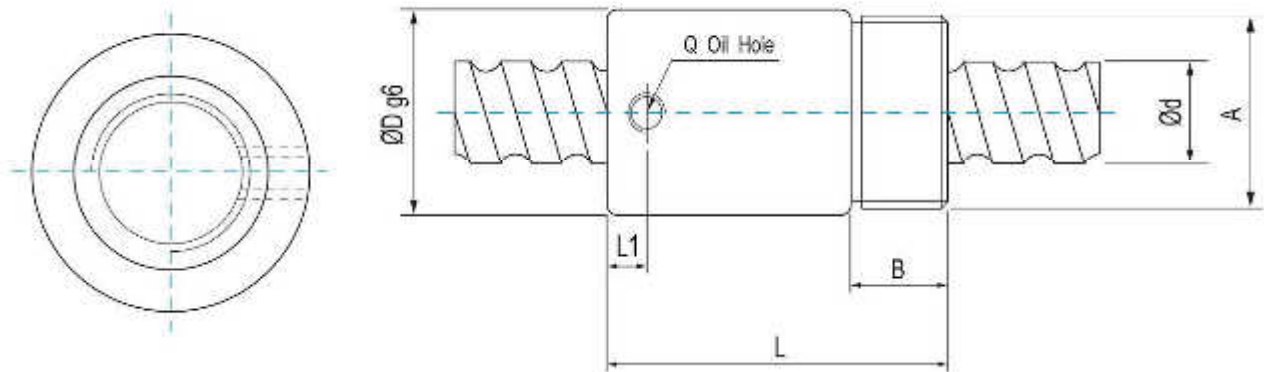
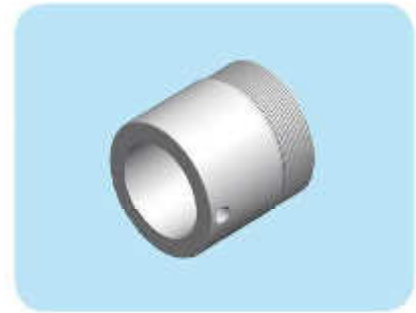
Unit : mm

Model No.	Dimensions													
	d	l	Da	D	L	B	X	Y	Z	Q	L1	n	(Ca Kgf)	(Coa Kgf)
1202-3	12	2	1.2	24	30	9	3	1.5	12	Ø3	4	T3	265	377
1204-3	12	4	2.381	24	35	11.5	3	1.5	12	Ø3	5	T3	645	693
1205-3	12	5	2	24	40	14	3	1.5	12	Ø3	5	T3	514	594
1210-2	12	10	2	24	40	14	3	1.5	12	Ø3	5	T2	390	466
1602-3	16	2	1.2	28	40	10	5	2	20	Ø3	5	T3	300	503
1604-4	16	4	2.381	28	45	12.5	5	2	20	Ø3	7	T4	944	1254
1605-3	16	5	3.175	28	45	12.5	5	2	20	Ø3	7	T3	1049	1144
★ 1605-4	16	5	3.175	28	50	15	5	2	20	Ø3	7	T4	1344	1525
1610-3	16	10	3.175	28	45	12.5	5	2	20	Ø3	7	T3	1181	1496
1616-2	16	16	3.175	28	45	12.5	5	2	20	Ø3	7	T2	833	997
2005-3	20	5	3.175	36	47	13.5	5	2	20	Ø3	7	T3	1181	1496
★ 2005-4	20	5	3.175	36	53	16.5	5	2	20	Ø3	7	T4	1512	1995
2006-3	20	6	3.969	36	53	16.5	5	2	20	Ø3	7	T3	1568	1787
2010-3	20	10	3.969	36	68	24	5	2	20	Ø3	7	T3	1621	1925
2020-4	20	20	3.175	36	55	17.5	5	2	20	Ø3	7	T4	1659	2464
★ 2505-4	25	5	3.175	40	53	16.5	5	2	20	Ø3	7	T4	1704	2581
▲ 2510-3	25	10	3.5	40	54	17	5	2	20	Ø3	7	T3	1614	2460
★ 3205-4	32	5	3.175	50	53	11.5	6	2.5	30	Ø3	7	T4	1924	3403
3210-3	32	10	6.35	50	70	20	6	2.5	30	Ø3	7	T3	3775	5877
3220-3	32	20	3.969	50	78	24	6	2.5	30	Ø3	7	T3	2141	3576
★ 4005-4	40	5	3.175	63	56	13	6	2.5	30	Ø3	7	T4	2142	4342
4010-3	40	10	6.35	63	80	25	6	2.5	30	Ø3	7	T3	4216	7556
4020-3	40	20	5.556	63	83	26.5	6	2.5	30	Ø3	7	T3	3782	6468
5010-3	50	10	6.35	75	82	23	6	2.5	36	Ø3	7	T3	4633	9235
6310-4	63	10	6.35	85	90	29	6	3.5	32	Ø5	14	T4	6700	16230

★Note : with sign * can produce left helix

▲ steel balls 3.5mm, please order 3.5mm shaft to meet

5.9.11 RSU

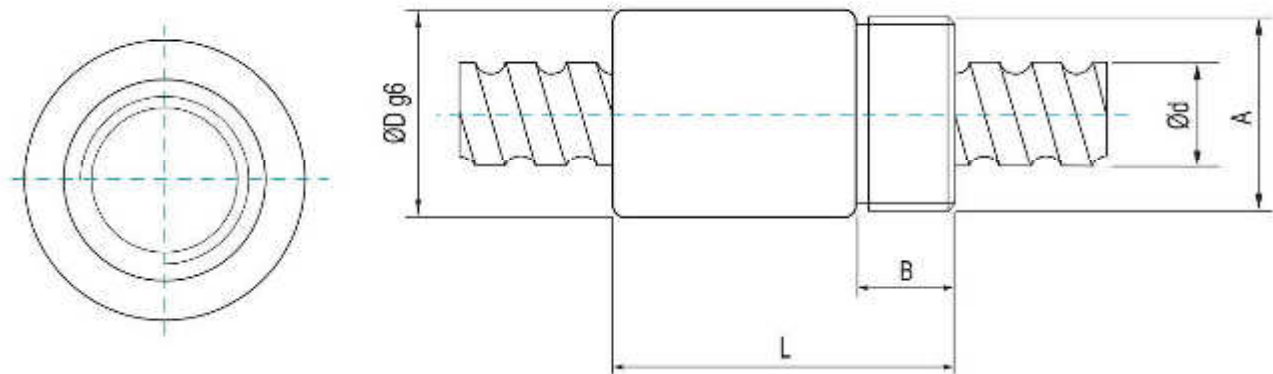


Unit : mm

Model No.	Dimensions											
	d	l	Da	D	A	B	L	Q	L1	n	Ca(Kgf)	Coa(kgf)
▲ 1604-3	16	4	2.381	29	M22X1.5P	8	32	-	-	T3	737	940
1605-4	16	5	3.175	32	M30X1.5P	16	56	M6	6.5	T4	1344	1525
2005-4	20	5	3.175	38	M35X1.5P	16.5	59.5	M6	7	T4	1512	1995
2505-4	25	5	3.175	42	M40X1.5P	17	60	M6	7	T4	1704	2581
2510-4	25	10	4.762	42	M40X1.5P	17	90	M6	10	T4	2881	3695
3205-4	32	5	3.175	52	M48X1.5P	19	60	M6	7	T4	1924	3403
3210-4	32	10	6.35	52	M48X1.5P	19	93	M6	12	T4	4834	7835
4005-4	40	5	3.175	58	M56X1.5P	19	59	M8	6	T4	2142	4342
4010-4	40	10	6.35	65	M60X1.5P	27	102	M8	12	T4	5399	10074
5010-4	50	10	6.35	78	M72X1.5P	29	104	M8	12	T4	5933	12313

▲ without wipers

5.9.12 RSH



Ball Screw

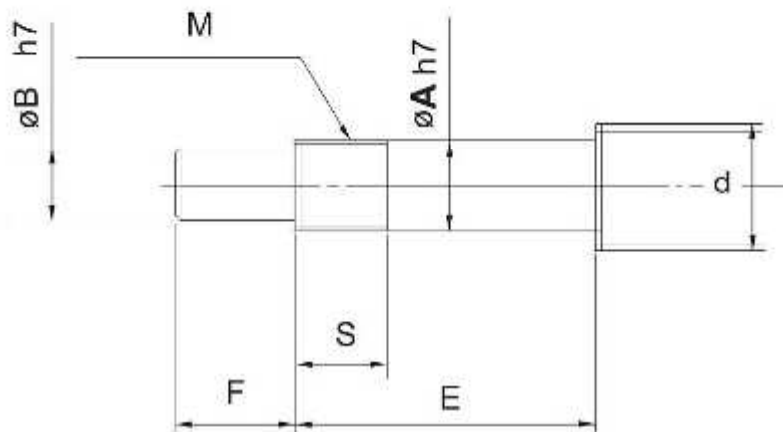
Unit : mm

Model No.	Dimensions									
	d	l	Da	D	A	B	L	n	Ca(Kgf)	Coa(kgf)
12H2-1.5	12	12.7	2.381	29.5	M25x1.5P	12	50	A1	397	445
16H5-3.5	16	5.08	3.175	25.4	15/16"x16un	12.7	43.43	C1	1348	1745



6.1 Recommended Shaft End Shape - BK.FK.EK

For Support Unit Type BK and FK and EK Fixed Side



Unit : mm

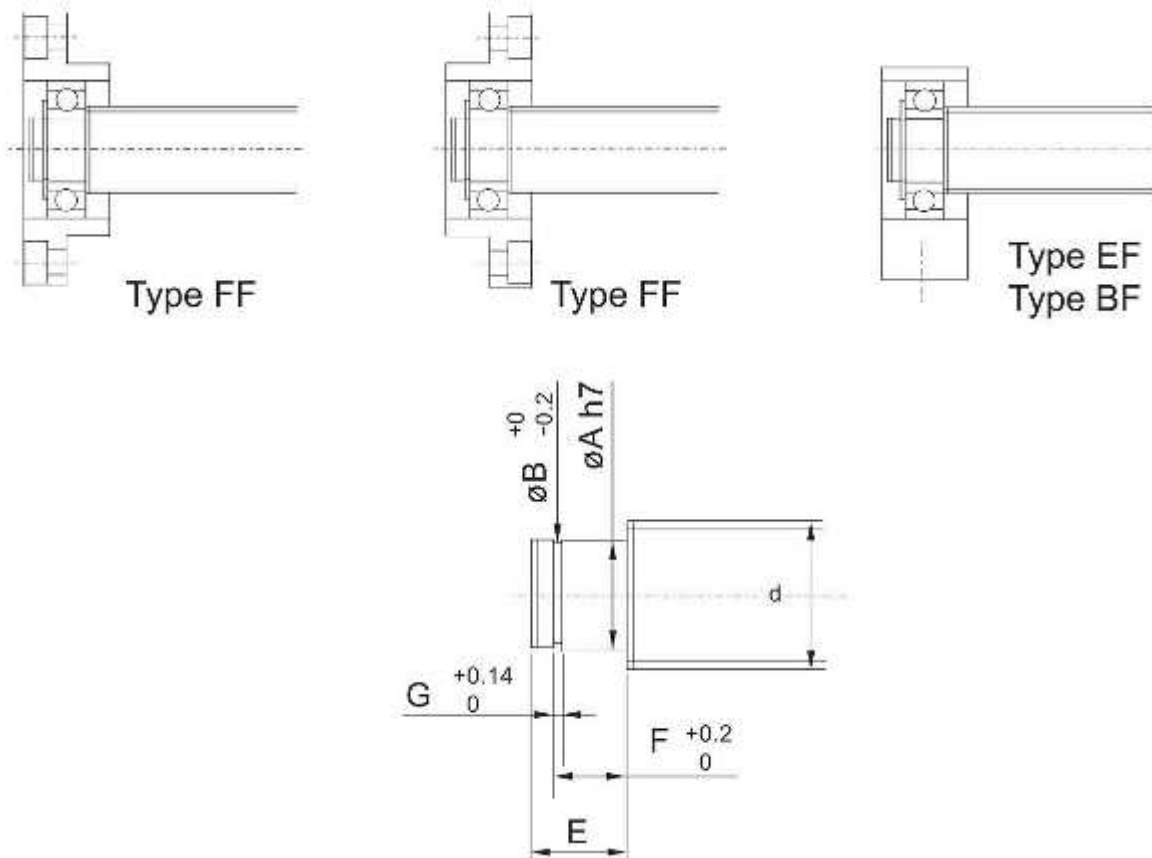
Model No.	Ball Screw shaft OD	Shaft Support Portion OD				Metric screw thread	
BK (Type BK)	d	A	B	E	F	M	S
BK 10	12/14/15	10	8	30	15	M10X1	12
BK 12	14/15/16	12	10	36	15	M12X1	12
BK 15	18/20	15	12	40	20	M15X1	12
BK 17	20/25	17	15	53	23	M17X1	17
BK 20	25/28	20	17	53	25	M20X1	15
BK 25	32/36	25	20	66	30	M25X1.5	20
BK 30	36/40	30	25	73	38	M30X1.5	25
BK 35	45	35	30	82	45	M35X1.5	26
BK 40	50	40	35	94	50	M40X1.5	30

Unit : mm

Model No.		Ball Screw shaft OD	Shaft Support Portion OD				Metric screw thread	
Type FK	Type EK	d	A	B	E	F	M	S
FK 06	EK 06	8	6	4	28	8	M6X0.75	8
FK 08	EK 08	10/12	8	6	32	9	M8X1	10
FK 10	EK 10	12/14/15	10	8	36	15	M10X1	12
FK 12	EK 12	14/15/16	12	10	36	15	M12X1	12
FK 15	EK 15	18/20	15	12	48	20	M15X1	13
FK 17	-	20/25	17	15	59	23	M17X1	17
FK 20	EK 20	25/28/30	20	17	64	25	M20X1	16
FK 25	-	30/32/36	25	20	76	30	M25X1.5	20
FK 30	-	36/40	30	25	73	38	M30X1.5	25

6.2 Recommended Shaft End Shape - FF.EF.BF

For Support Unit Type FF and EF and BF (Floated Side)



Unit : mm

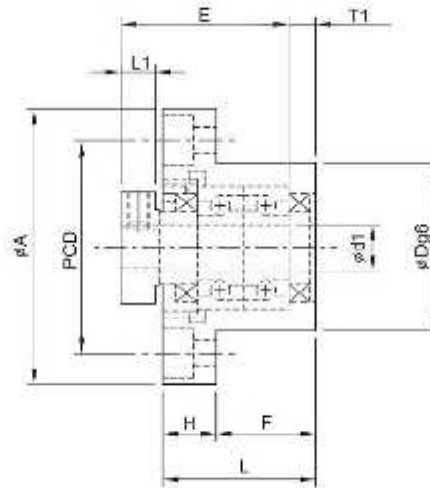
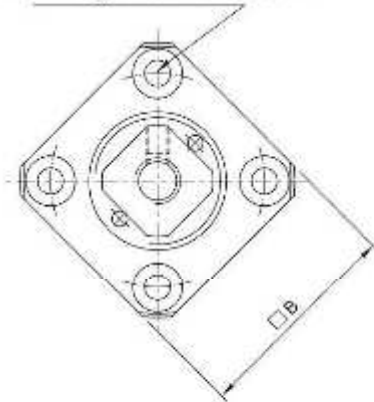
Model No.	Ball Screw shaft OD	Shaft Support Portion OD		Snap-ring Groove		
		A	E	B	F	G
Type: FF/EF/BF	d					
FF/EF06	8	6	9	5.7	6.8	0.8
EF 08	10	6	9	5.7	6.8	0.8
FF/EF/BF10	12/14/15	8	10	7.6	7.9	0.9
FF/EF/BF12	14/15/16	10	11	9.6	9.15	1.15
FF/EF/BF15	18/20	15	13	14.3	10.15	1.15
FF/BF17	20/25	17	16	16.2	13.15	1.15
★FF/EF/BF20	25/28/30	20	19 (16)	19	15.35(13.35)	1.35
FF/BF 25	30/32/36	25	20	23.9	16.35	1.35
FF/BF 30	36/40	30	21	28.6	17.75	1.75
BF 35	40/45	35	22	33	18.75	1.75
BF 40	50	40	23	38	19.95	1.95

Note: () shows the dimension of BF20 which is different from those of type FF20 and EF20. When placing an order, always specify the model number of the Support Unit to be used.

6.3 FK (Fixed Side)



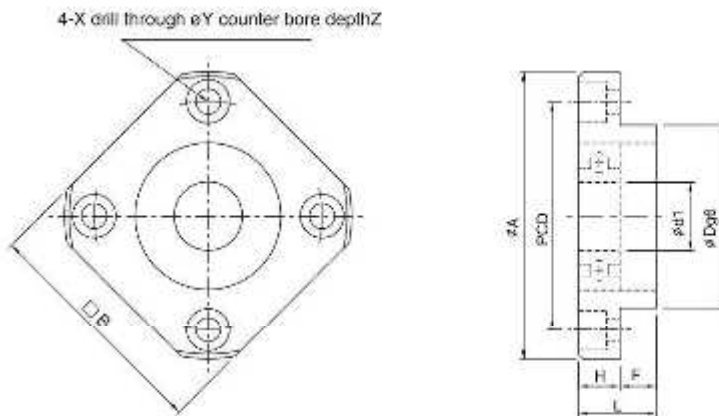
4-X drill through øY counter bore depth Z



Unit : mm

Model No.	d1	L	H	F	E	Dg6	A	PCD	B	L1	T1	L2	T2	X	Y	Z	M	T
FK 5	5	16.5	6	10.5	18.5	20	34	26	26	5.5	3.5	5	3	3.4	6.5	4	M3	11
FK 6	6	20	7	13	22	22	36	28	28	5.5	3.5	6.5	4.5	3.4	6.5	4	M3	12
FK 8	8	23	9	14	26	28	43	35	35	7	4	8	5	3.4	6.5	4	M3	14
FK 10	10	27	10	17	29.5	34	52	42	42	7.5	5	8.5	6	4.5	8	4	M3	16
FK 12	12	27	10	17	29.5	36	54	44	44	7.5	5	8.5	6	4.5	8	4	M4	19
FK 15	15	32	15	17	36	40	63	50	52	10	6	12	8	5.5	9.5	6	M4	22
FK 17	17	45	22	23	47	50	77	62	61	11	9	14	12	6.6	11	10	M4	24
FK 20	20	52	22	30	50	57	85	70	68	8	10	12	14	6.6	11	10	M4	30
FK 25	25	57	27	30	59	63	98	80	79	13	10	20	17	9	15	13	M5	35
FK 30	30	62	30	32	61	75	117	95	93	11	12	17	18	11	17.5	15	M6	40

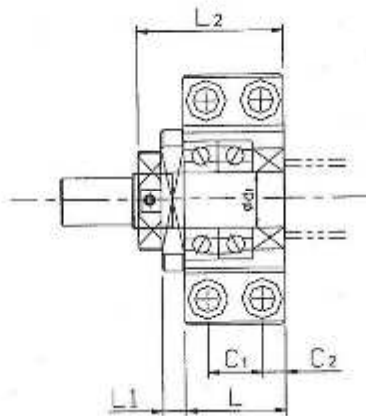
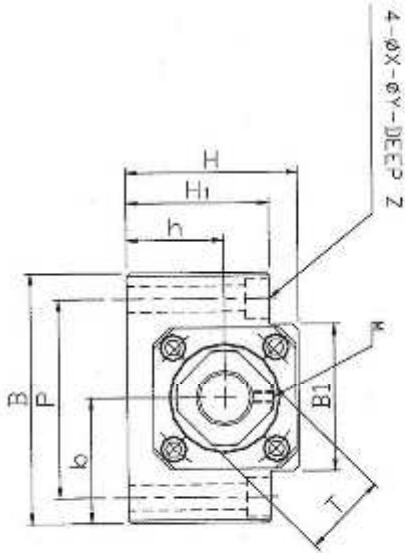
6.4 FF (Floated Side)



Unit : mm

Model No.	d1	L	H	F	Dg6	A	PCD	B	X	Y	Z
FF 06	6	10	64		22	36	28	28	3.46	.5	4
FF 10	8	12	7	5	28	43	35	35	3.4	6.5	4
FF 12	10	15	7	8	34	52	42	42	4.5	8	4
FF 15	15	17	9	8	40	63	50	52	5.5	9.5	5.5
FF 17	17	20	11	9	50	77	62	61	6.6	11	6.5
FF 20	20	20	11	9	57	85	70	68	6.6	11	6.5
FF 25	25	24	14	10	63	98	80	79	9	14	8.5
FF 30	30	27	18	9	75	117	95	93	11	17	11

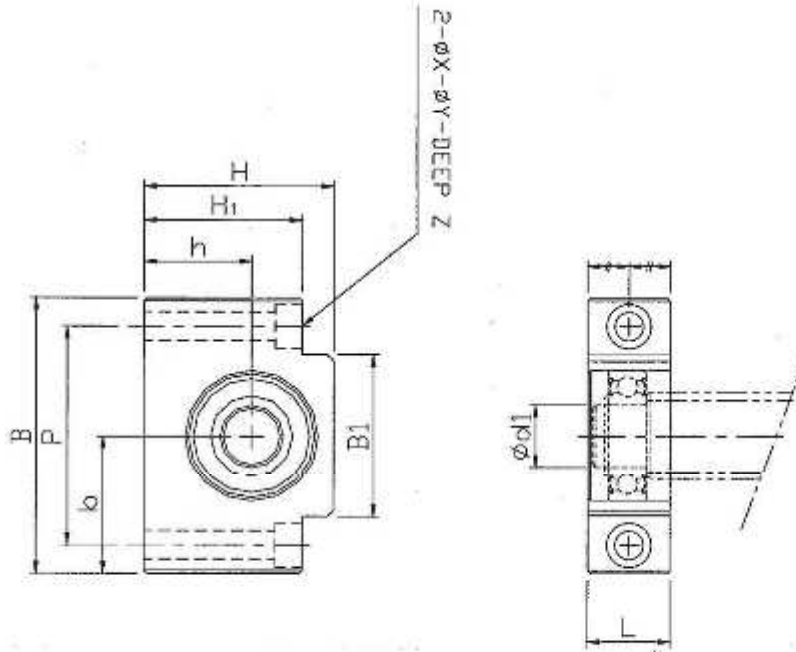
6.5 BK (Fixed Side)



Unit : mm

Model No.	d1	L	L1	L2	L3	C1	C2	B	H	$b_{\pm 0.02}$	$h_{\pm 0.03}$	B1	H1	E	P	d2	X	Y	Z	M	T
BK 10	10	25	5	29.5	5	13	6	60	39	30	22	34	32.5	15	46	5.5	6.6	10.8	5	M4	16
BK 12	12	25	5	29.5	5	13	6	60	43	30	25	34	32.5	18	46	5.5	6.6	10.8	1.5	M4	19
BK 15	15	27	6	32	6	15	6	70	48	35	28	40	38	18	54	5.5	6.6	11	6.5	M3	22
BK 17	17	35	9	44	7	19	8	86	64	43	39	50	55	28	68	6.6	9	14	8.5	M4	24
BK 20	20	35	8	43	8	19	8	88	60	44	34	52	50	22	70	6.6	9	14	8.5	M4	30
BK 25	25	42	12	54	9	22	10	106	80	53	48	64	70	33	85	9	11	17	11	M5	35
BK 30	30	45	14	61	9	23	11	128	89	64	51	76	78	33	102	11	14	20	13	M6	40
BK 35	35	50	14	67	12	26	12	140	96	70	52	88	79	35	114	11	14	20	13	M8	50
BK 40	40	61	18	76	15	33	14	160	110	80	60	100	90	37	130	14	18	26	17.5	M8	50

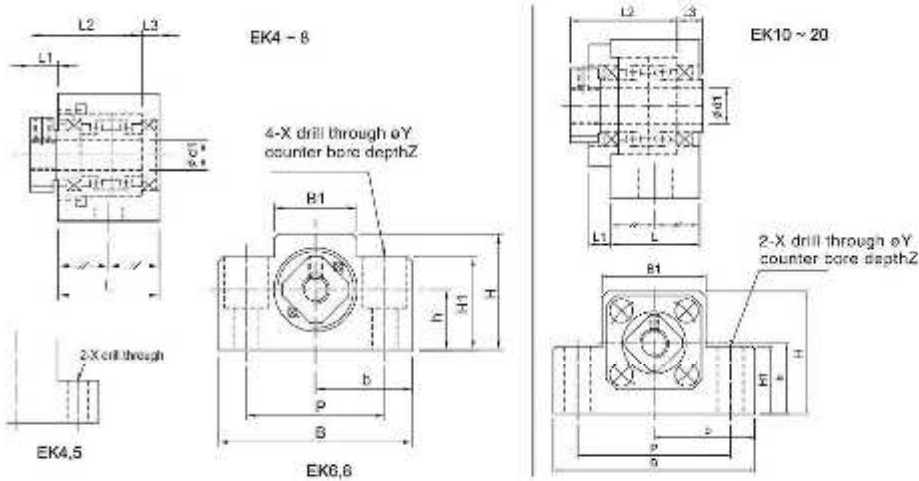
6.6 BF (Floated Side)



Unit : mm

Model No.	d1	L	B	H	b ^{+0.02}	h ^{+0.02}	B1	H1	E	P	d2	X	Y	Z
BF 10	8	20	60	39	30	22	34	32.5	15	46	5.5	6.6	10.8	5
BF 12	10	20	60	43	30	25	34	32.5	18	46	5.5	6.6	10.8	1.5
BF 15	15	20	70	48	35	28	40	38	18	54	5.5	6.6	11	6.5
BF 17	17	23	86	64	43	39	50	55	28	68	6.6	9	14	8.5
BF 20	20	26	88	60	44	34	52	50	22	70	6.6	9	14	8.5
BF 25	25	30	106	80	53	48	64	70	33	85	9	11	17	11
BF 30	30	32	128	89	64	51	76	78	33	102	11	14	20	13
BF 35	35	32	140	96	70	52	88	79	35	114	11	14	20	13
BF 40	40	37	160	110	80	60	100	90	37	130	14	18	26	17.5

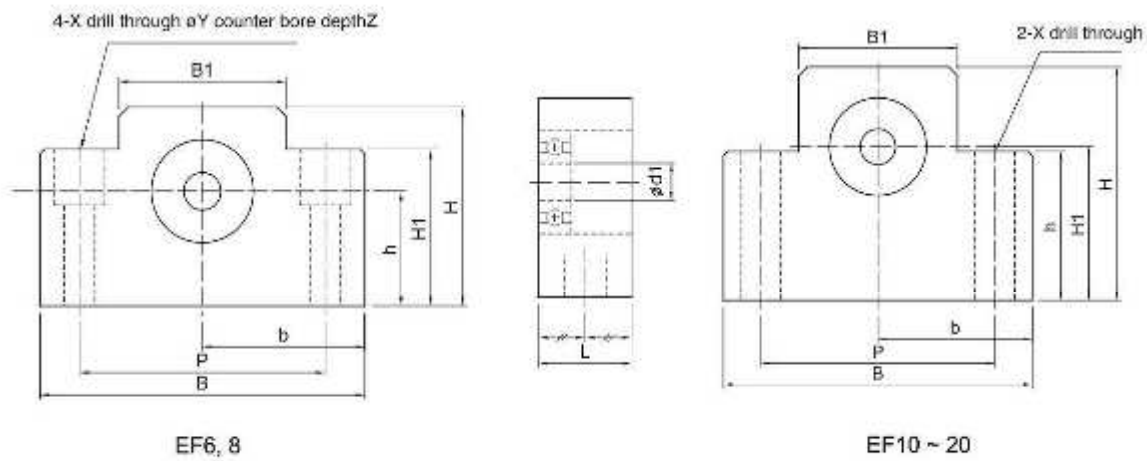
6.7 EK (Fixed Side)



Unit : mm

Model No.	d1	L	L1	L2	L3	B	H	b ^{+0.02}	h ^{+0.02}	B1	H1	P	X	Y	Z	M	T
EK 05	5	16.5	5.5	18.5	3.5	36	21	18	11	20	8	28	4.5	-	-	M3	11
EK 06	6	20	5.5	22	3.5	42	25	21	13	18	20	30	5.5	9.5	11	M3	12
EK 08	8	23	7	26	4	52	32	26	17	25	26	38	6.6	11	12	M3	14
EK 10	10	24	6	29.5	6	70	43	35	25	36	24	52	9	-	-	M3	16
EK 12	12	24	6	29.5	6	70	43	35	25	36	24	52	9	-	-	M4	19
EK 15	15	25	6	36	5	80	49	40	30	41	25	60	11	-	-	M4	22
EK 20	20	42	10	50	10	95	58	47.5	30	56	25	75	11	-	-	M4	30

6.8 EF (Floated Side)



Unit : mm

Model No.	d1	L	B	H	$b^{+0.02}$	$H^{+0.02}$	B1	H1	P	X	Y	Z
EF 06	6	12	42	25	21	13	18	20	30	5.5	9.5	11
EF 08	6	14	52	32	26	17	25	26	38	6.6	11	12
EF 10	8	20	70	43	36	25	36	24	52	9	-	-
EF 12	10	20	70	43	36	25	36	24	52	9	-	-
EF 15	15	20	80	49	40	30	41	25	60	9	-	-
EF 20	20	26	95	58	47.5	30	56	25	75	11	-	-



7.1 Characteristics

(1) Excellent Wear Resistance

Unlike linear ball bearing that requires running on high hardness heat treated shaft (SUJ2), Self-Lubricated Linear Bearing can be used with Hard Chrome Plated Shaft (S45C). Under correct use, the life expectancy is much higher than linear ball bearings.

(2) Interchangeability

Full range of ABBA Self-Lubricated Linear Bearings product line includes Standard, Thin Profile, Profile, and Flanged Type. All Self-Lubricated bearings are interchangeable with our Linear Ball Bearings products.

(3) Multi-Functions

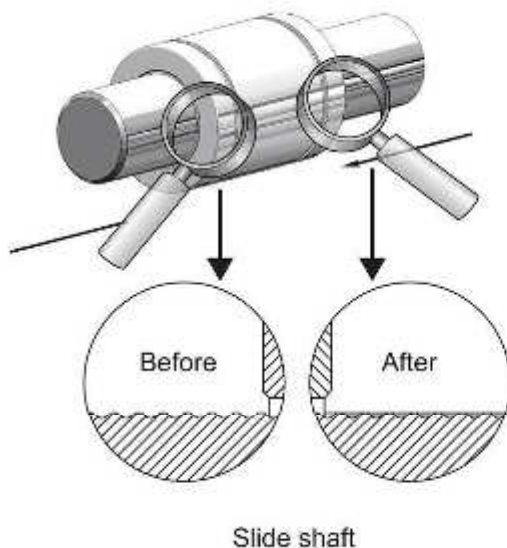
Suitable for either linear, rotary, or combination of both motions.

(4) High Impact Capability

Great capabilities of dampening high impacts, vibrations, and uneven loads while keeping the components from damaging.

(5) Self-Lubricating

Lubrications are not required; however, the use of adequate lubricants can minimize frictions and wear.



(6) High Load Capacity

ABBA Self-Lubricating Linear Bearings can withstand average 3~4 times load capacity over linear ball bearings.

(7) Chemical and Corrosion Resistance

Great resistance to corrosion allows the bearing to be operating or submerging in alcohol, gasoline, water, oil, and stand up to harsh environments.

(8) Reliable

Reliable bearing dimensions due to the liner will not expand to water or oil unlike general industrial use plastic. Thermal expansion effect is also minimal to the bearing, and will not cause binding to the shaft.

(9) Low Friction

Low Coefficient of Friction eliminates oscillating, which is suitable for continuous and intermittent motions.

(10) Substitutability

In the case of the shaft had been scored by linear ball bearing, self-lubricated linear bearing can be installed to the damaged shaft after slight sanding the shaft by sand paper as emergency repair.

(11) Quiet Operation

Quieter operation over linear ball bearing at any operating speed.

(12) Wide Range of Applications

Produces minimum particulates, which is suitable for vacuum and clean rooms applications. Applicable applications include Automation Machines, Transfer Equipment, Vice, Robotic Arms, Robots, Positioning Device, Automotive, Office Equipment, Semi-Conductor Manufacturing, Bio-Chemical Plant, Food Processing Plant, and Fabric Manufacturing related applications.

7.2 Structure Description

1. Anodized aluminum, 6061 T6
2. Water-proof Bonding Agent
3. Frelon thickness : 0.5mm



7.3 Size Selection

Use the formula below to calculate Maximum PV Value (Load x Velocity), then multiply its value by Safety Factor. Cross reference the value to dimension chart in our catalogue page to select bearing size. The size of bearing is proportional to the Load and Velocity.

Formula

- Maximum Load = $L / N \times F$
 - Load x Velocity = $L / N \times V \times F$
 - Axial Driving Force = $\mu \times L$
- L : Total Load Capacity (kgf)
 N : Number of Bearings
 F : Safety Factor 2~3
 V : Velocity (m/sec)
 μ : Coefficient of Friction : 0.15~0.25

Example 1

Assuming a sliding platform has a load of 100kg, uses 4 bearings, and velocity is 0.6 m/sec. Calculation of Bearing Size and required Axial Driving Force is shown below.

Where

- L = 100 kgf, N = 4, assume
 F = 2.5, $\mu = 0.2$, V = 0.6m/sec
- Maximum Load = $L / N \times F = 100 / 4 \times 2.5 = 62.5$ kgf
 - Load x Velocity = $L / N \times V \times F = 100 / 4 \times 0.6 \times 2.5 = 37.5$ kgf · m/sec
 - Required Driving Force = $\mu \times L = 0.2 \times 100 = 20$ kgf

Cross reference the results to dimension chart, known TM 25 Bearing (Max. Load = 1000 kgf, Max. Load x Velocity = 52.8 kgf m/sec) is capable of this application.

Example 2

Assuming all values remains unchanged, except velocity increases to 1.0 m/sec. Calculation of Bearing Size is shown below.

Where

$$\text{Load} \times \text{Velocity} = L / N \times V \times F = 100 / 4 \times 1.0 \times 2.5 = 62.5 \text{ kgf} \cdot \text{m} / \text{sec}$$

According to the dimension chart, TM30 bearing (Max. Load x Velocity = 68.7 kgf·m/sec) is capable of this application.

7.4 Life Calculation

Bearing's Life Calculation is based on Maximum Allowable Amount of Wear. Once this value has been decided, bearing's Life can be calculated by using the formula below. Under constant load and velocity, Bearing's Life is proportional to Bearing Inner Diameter.

Formula

$$T = W / (K \times P \times V) \quad P = L / (A \times l \times N)$$

T : Sliding Time(hour)

W : Amount of Wear (mm)

K : Wearing Rate : 1×10^{-7}

A : Bearing Inner Diameter (cm)

V : Velocity (m/min)

l : Bearing Length (cm)

P : Pressure (kgf/cm²)

L : Total Load (kgf)

N : Number of Bearings

Example 3

To Calculate the life of TM25 Bearing from example1

Where

$$W = 0.05 \text{mm}, K = 1 \times 10^{-7}, A = 2.5$$

From Dimension Chart Known

$$l = 5.9, L = 100 \text{kgf}, V = 0.6 \times 60 = 36 \text{m/min}$$

$$P = L / (A \times l \times N)$$

$$= 100 / (2.5 \times 5.9 \times 4)$$

$$= 1.69 \text{ kgf/cm}^2$$

$$T = W / (K \times P \times V)$$

$$= 0.05 / (1 \times 10^{-7} \times 1.69 \times 36)$$

$$8218 \text{hours}$$

$$\text{Usage per day} = 6 \times 300 \times 8 / 3600 = 4 \text{hours}$$

$$\text{Total Life Time} = 8218 / 4 = 2054 \text{Days}$$

Note

Allowable Amount of Wear is proportional to Bearing's Life. For example, if allowable amount of wear = 0.1mm, Bearing's Life = 4108 Days.

7.5 Cantilevered Loads

In the instance of using cantilever system, binding of the bearing should be taken into account.
 General rule is, Maximum X : Y = 2 : 1

Example

When distance X equals to 100mm, minimum bearing separation Y must be at least 50mm.

Caution

- Binding of the bearing can occur when the ratio exceeds 2 : 1
- Adequate lubrications will help reduce friction and helps increase the 2 : 1 ratio.

In the case of holding more than 2:1 ratio, method of using counter weight could be use to prevent binding. Use the formula shown below.

Formula

$$M \times X = W \times Z$$

M = Mass of Load

X = Distance from Load to the Shaft

W = Mass of Counter weight

Z = 1.5 x (Y)

Example

$$40 \times 200 = W \times Z(1.5 \times 50 = 75)$$

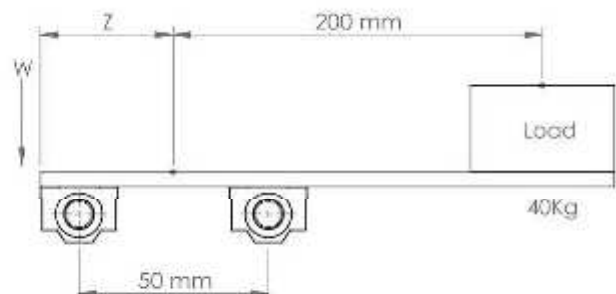
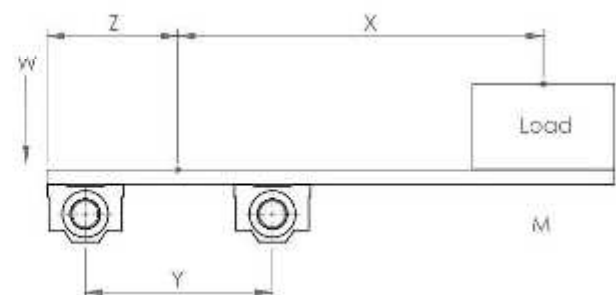
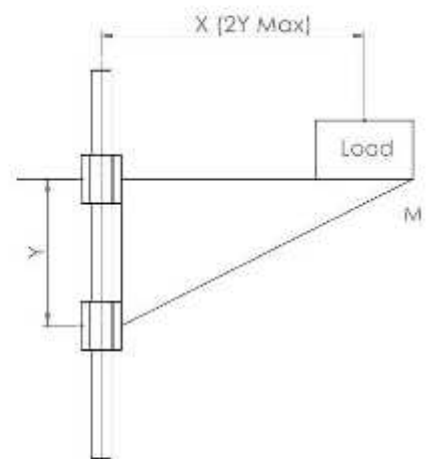
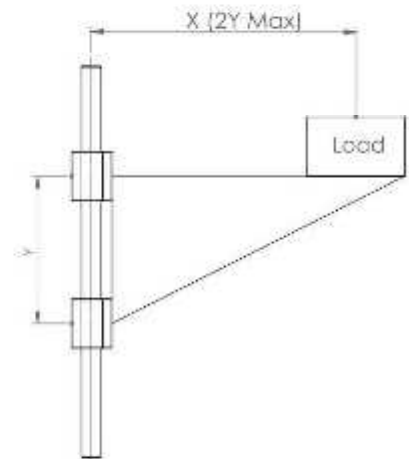
$$W = 40 \times 200 / 75 = 106.7\text{Kg}$$

When W is calculated, load per bearing can be calculated.

$$M + W / \# \text{ of bearings}$$

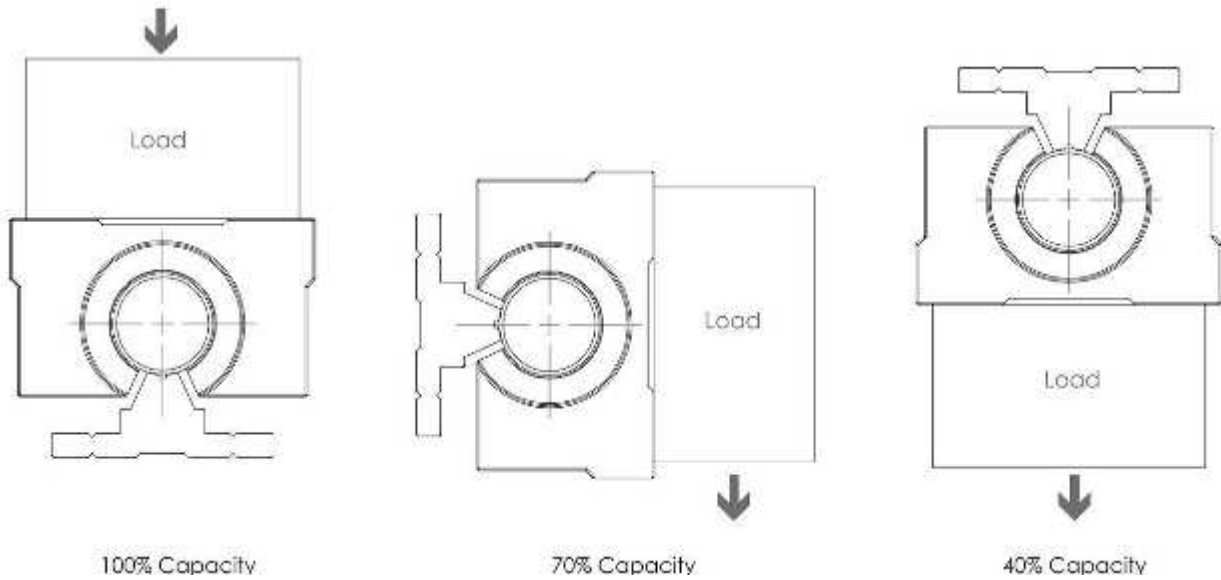
Example

$$40 + 106.7 / 4 = 36.7 \text{ Kg} / \text{ bearing}$$



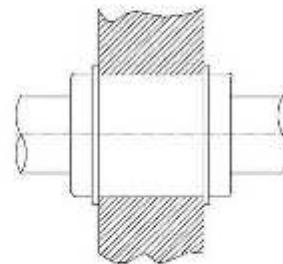
7.6 Open Type Bearing Mounting Configurations

Load capacities on open type self-lubricated linear bearings will vary depending on their mounting configurations.

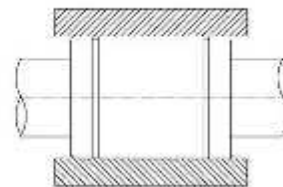


Example

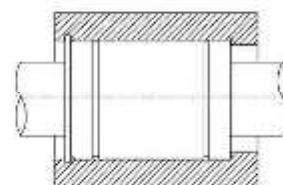
- SM Series bearing installed on the plate, and secured by two retaining rings.



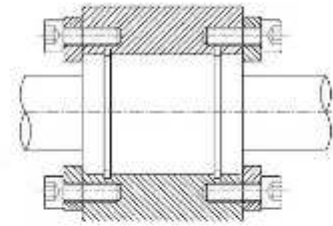
- SM Series bearing installed in the bore, and secured by two retaining rings.



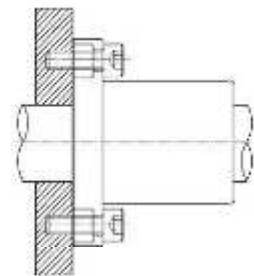
- SM Series bearing installed in the bore, and secured by one retaining ring.



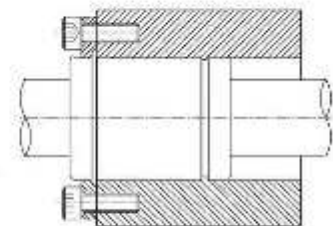
- SM Series bearing secured by two push plates.



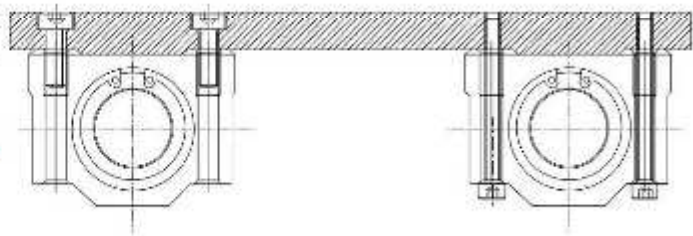
- Flanged type bearing bolted onto the plate; adjust the parallelism to other bearings via lashes given in the bolt hole on the flange.



- SM Series bearing installed by a retaining ring; a push plate is pressed against the ring to secure the bearing.



- When using SCM Series pillow block bearing, bolts can be installed either from top or below.

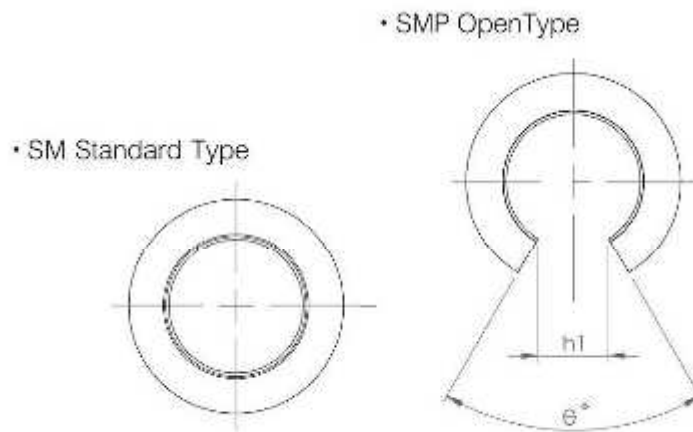


7.7 Round Profile Type

Ordering Key: **SM 20**
1 2

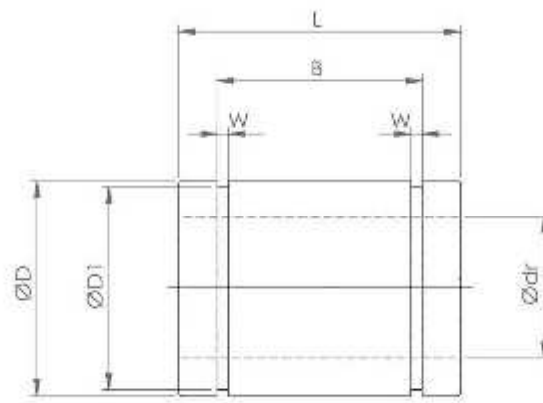
1 SM Standard Type Self-Lubricated Linear Bearing
 SMP Open Type Self-Lubricated Linear Bearing

2 Bearing Inner Diameter



Model No.		Inner Dia.	Dimensions							
Standard Type	Open Type		Ødr (F8)	ØD (h6)	L	B	W	ØD1	h1	θ°
SM 6	—	6	12	19	13.5	1.15	11.5	—	—	—
SM 8	—	8	15	24	17.5	1.15	14.3	—	—	—
SM 10	SMP 10	10	19	29	22.0	1.35	18.0	6.8	80°	80°
SM 12	SMP 12	12	21	30	23.0	1.35	20.0	8	80°	80°
SM 13	SMP 13	13	23	32	23.0	1.35	22.9	9	80°	80°
SM 16	SMP 16	16	28	37	26.5	1.65	26.6	11	80°	80°
SM 20	SMP 20	20	32	42	30.5	1.65	30.3	11	60°	60°
SM 25	SMP 25	25	40	59	41.0	1.90	38.0	12	50°	50°
SM 30	SMP 30	30	45	64	44.5	1.90	42.5	15	50°	50°
SM 35	SMP 35	35	52	70	49.5	2.20	49.0	17	50°	50°
SM 40	SMP 40	40	60	80	60.5	2.20	57.0	20	50°	50°
SM 50	SMP 50	50	80	100	74.0	2.70	76.5	25	50°	50°
SM 60	SMP 60	60	90	110	85.0	3.15	86.5	30	50°	50°

(mm)



Model No.		Max. Static Load (kgf)	Max. PV (kgf * m/sec)	Max. Speed (m / sec)	Weight (g)	
Standard Type	Open Type				SM	SMP
SM 6	—	80	4.1	2	4.4	—
SM 8	—	130	6.9	2	8.3	—
SM 10	SMP 10	200	10.4	2	16.2	12.5
SM 12	SMP 12	250	12.9	2	19	13.9
SM 13	SMP 13	290	14.9	2	24.6	17.9
SM 16	SMP 16	410	21.2	2	41.7	30.0
SM 20	SMP 20	580	30.1	2	56	43.4
SM 25	SMP 25	1000	52.8	2	122.8	99.2
SM 30	SMP 30	1300	68.7	2	153.7	123.5
SM 35	SMP 35	1700	87.7	2	221	177.8
SM 40	SMP 40	2200	115.0	2	341.6	275.6
SM 50	SMP 50	3500	179.0	2	832.7	679.8
SM 60	SMP 60	4600	236.0	2	1057	860.8

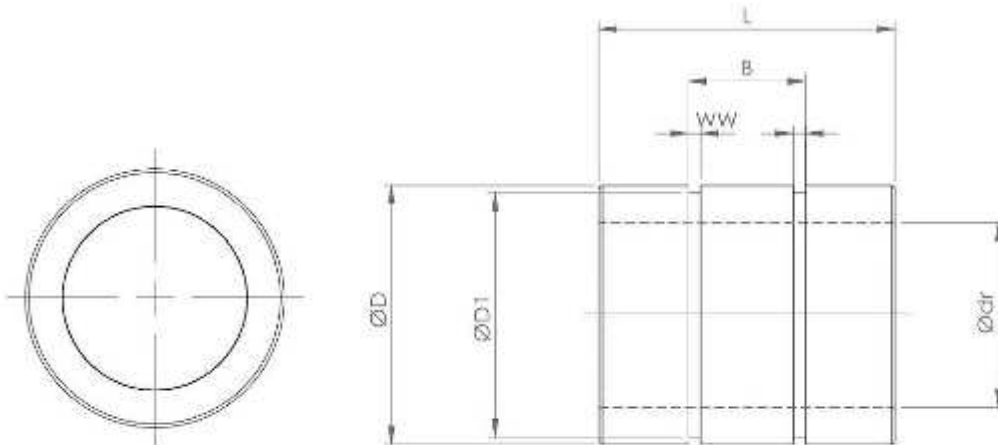
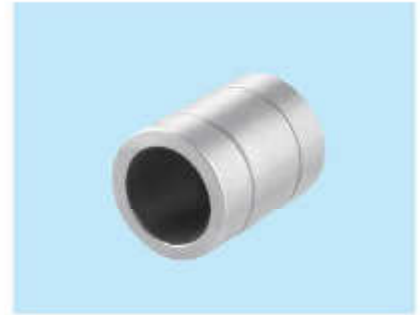
(mm)

7.8 SMT Thin Profile Type

Ordering Key: **SMT 20**
1 2

1 SMT Thin Profile Self-Lubricated Linear Bearing

2 Bearing Inner Diameter



Model No.	Inner Dia.	Dimensions					Max. Static Load	Max. PV	Max. Speed	Weight
	Ødr (F8)	ØD (h6)	L	B	W	ØD1	(kgf)	(kgf * m/sec)	(m / sec)	(g)
SMT10	10	17	26	8.3	1.15	16.20	180	9.3	2	10.49
SMT12	12	19	28	8.7	1.35	18.00	230	12	2	12.97
SMT16	16	24	30	10.7	1.35	22.90	330	17.2	2	20.49
SMT20	20	28	30	13.3	1.65	26.60	420	21.5	2	24.59
SMT25	25	35	40	15.8	1.65	33.00	700	35.8	2	51.23
SMT30	30	40	50	18.8	1.90	38.00	1050	53.7	2	74.71
SMT40	40	52	60	24.4	2.20	49.00	1600	85.9	2	141.4
SMT50	50	62	70	29.4	2.20	59.00	2400	125	2	200.8

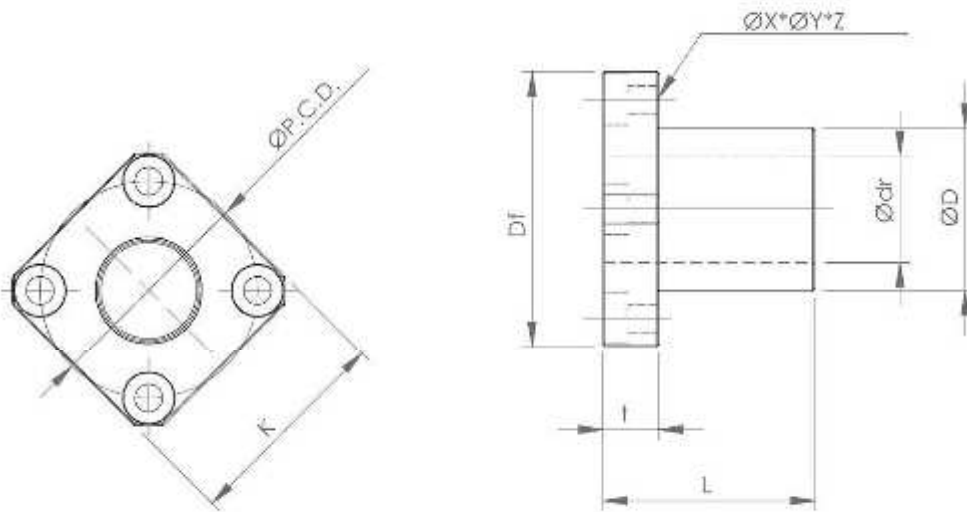
(mm)

7.9 SMK Square Flange Type

Ordering Key: **SMK** **20**
1 2

1 SMK Square Flange Self-Lubricated Bearing

2 Bearing Inner Diameter



Model No.	Inner Dia.		Dimensions							
	Ødr (F8)	ØD (h6)	L	ØDf	K	t	P.C.D.	ØX	ØY	Z
SMK 10	10	19	29	40	30	9	29	4.5	7.5	4.1
SMK 12	12	21	30	42	32	9	32	4.5	7.5	4.1
SMK 13	13	23	32	43	34	9	33	4.5	7.5	4.1
SMK 16	16	28	37	48	37	9	38	4.5	7.5	4.1
SMK 20	20	32	42	54	42	11	43	5.5	9.0	5.1
SMK 25	25	40	59	62	50	11	51	5.5	9.0	5.1
SMK 30	30	45	64	74	58	14	60	6.6	11.0	6.1
SMK 35	35	52	70	82	64	14	67	6.6	11.0	6.1
SMK 40	40	60	80	96	75	18	78	9.0	14.0	8.1
SMK 50	50	80	100	116	92	20	98	9.0	14.0	8.1

(mm)

Model No.	Max. Static Load	Max. PV	Max. Speed	Weight (g)
	(kgf)	(kgf * m/sec)	(m / sec)	(g)
SMK 10	200	10.4	2	33
SMK 12	250	12.9	2	35
SMK 13	290	14.9	2	38
SMK 16	410	21.2	2	56
SMK 20	580	30.1	2	75
SMK 25	1000	52.8	2	149
SMK 30	1300	68.7	2	202
SMK 35	1700	87.7	2	296
SMK 40	2200	115.0	2	450
SMK 50	3500	179.0	2	1000

(mm)

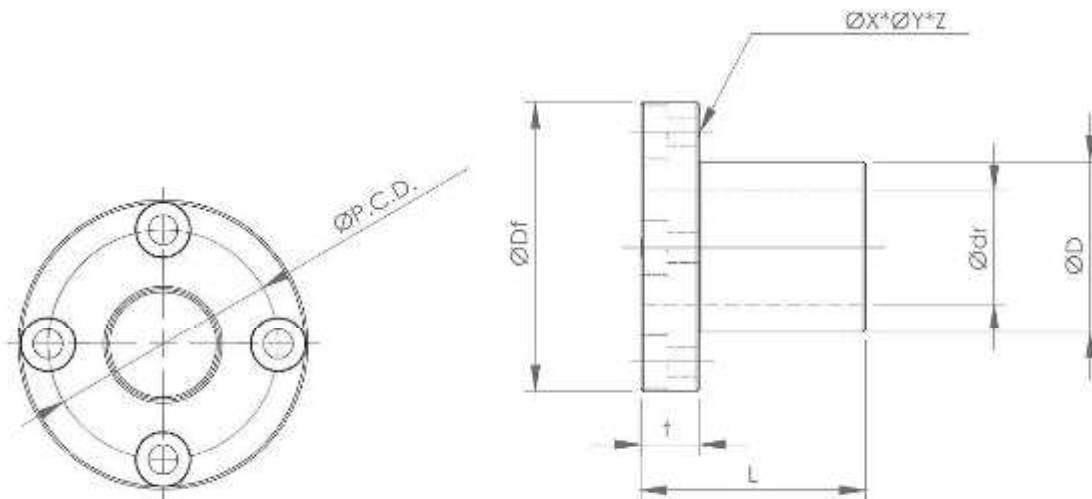
7.10 SMF Round Flange Type

Ordering Key: **SMF 20**

1 **2**

1 SMF Round Flange Self-Lubricated Bearing

2 Bearing Inner Diameter



Model No.	Inner Dia.		Dimensions						
	Ødr (F8)	ØD (h6)	L	ØDf	t	P.C.D.	ØX	ØY	Z
SMF 6	6	12	19	28	8	20	3.5	6.0	3.1
SMF 8	8	15	24	32	8	24	3.5	6.0	3.1
SMF 10	10	19	29	40	9	29	4.5	7.5	4.1
SMF 12	12	21	30	42	9	32	4.5	7.5	4.1
SMF 16	16	28	37	48	9	38	4.5	7.5	4.1
SMF 20	20	32	42	54	11	43	5.5	9.0	5.1
SMF 25	25	40	59	62	11	51	5.5	9.0	5.1
SMF 30	30	45	64	74	14	60	6.6	11.0	6.1

(mm)

Model No.	Max. Static Load	Max. PV	Max. Speed	Weight
	(kgf)	(kgf * m/sec)	(m / sec)	(g)
SMF 6	80	4.1	2	12
SMF 8	130	6.9	2	14
SMF 10	200	10.4	2	36
SMF 12	250	12.9	2	38
SMF 16	410	21.2	2	60
SMF 20	580	30.1	2	80
SMF 25	1000	52.8	2	160
SMF 30	1300	68.7	2	212

(mm)

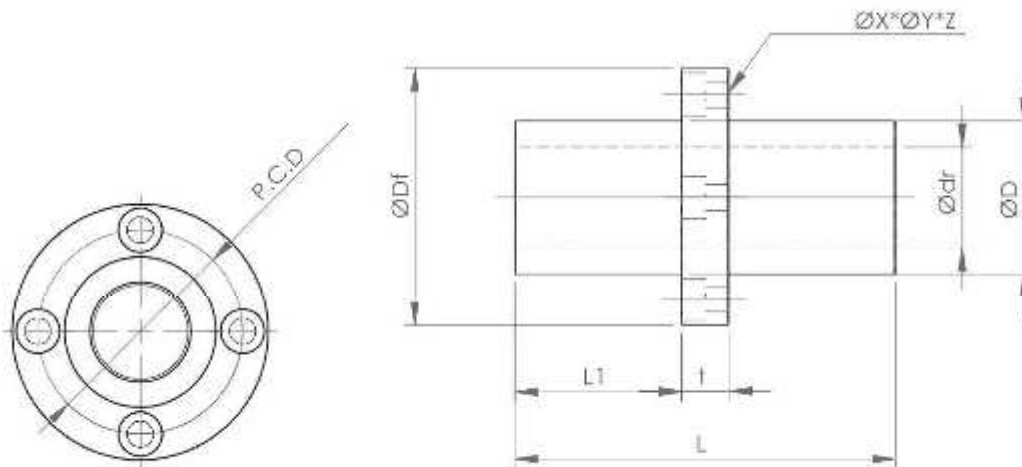
7.11 SMFD Center Flange Type

Ordering Key: **SMFD 20**

1 **2**

1 SMFD Center Flange Self-Lubricated Bearing

2 Bearing Inner Diameter



Model No.	Inner Dia.		Dimensions							
	Ødr (F8)	ØD (h6)	L	L1	ØDf	t	P.C.D	ØX	ØY	Z
SMFD 16	16	28	70	28.5	48	13	38	4.5	7.5	4.1
SMFD 20	20	32	80	32.5	54	15	43	5.5	9.0	5.1
SMFD 25	25	40	112	48.5	62	15	51	5.5	9.0	5.1
SMFD 30	30	45	123	51.5	74	20	60	6.6	11.0	6.1

(mm)

Model No.	Max. Static Load	Max. PV	Max. Speed	Weight
	(kgf)	(kgf * m/sec)	(m / sec)	(g)
SMFD 16	780	38.1	2	113
SMFD 20	1100	54.2	2	150
SMFD 25	1900	95	2	303
SMFD 30	2470	123.7	2	407

(mm)

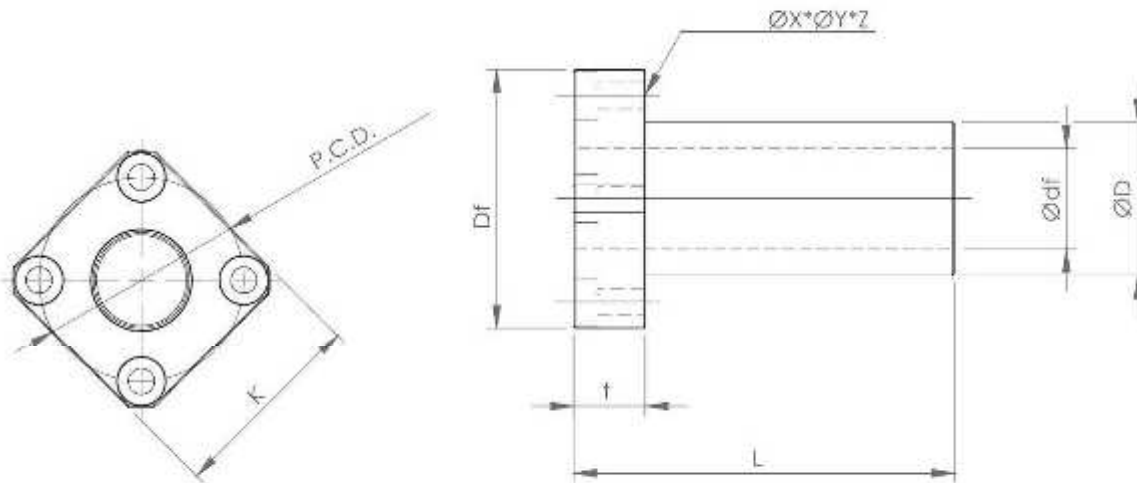
7.12 SMK-L Long Square Flange Type

Ordering Key: **SMK-L 20**

1 **2**

1 SMK-L Long Type Square Flange Self-Lubricated Bearing

2 Bearing Inner Diameter



Model No.	Inner Dia.		Dimensions							
	Ødr (F8)	ØD (h6)	L	ØDf	K	t	P.C.D.	ØX	ØY	Z
SMK10L	10	19	55	40	30	10	20	4.5	7.5	4.1
SMK12L	12	21	57	42	32	13	32	4.5	7.5	4.1
SMK16L	16	28	70	48	37	13	38	4.5	7.5	4.1
SMK20L	20	32	80	54	42	15	43	5.5	9.0	5.1
SMK25L	25	40	112	62	50	15	51	5.5	9.0	5.1
SMK30L	30	45	123	74	58	20	60	6.6	11.0	6.1
SMK35L	35	52	135	82	64	20	67	6.6	11.0	6.1
SMK40L	40	60	151	96	75	22	78	9.0	14.0	8.1

(mm)

Model No.	Max. Static Load	Max. PV	Max. Speed	Weight
	(kgf)	(kgf * m/sec)	(m / sec)	(g)
SMK10L	380	18.7	2	62
SMK12L	475	23.2	2	67
SMK16L	780	38.1	2	106
SMK20L	1100	54.2	2	143
SMK25L	1900	95.0	2	283
SMK30L	2470	123.7	2	388
SMK35L	3230	157.9	2	570
SMK40L	4180	207.0	2	849

(mm)

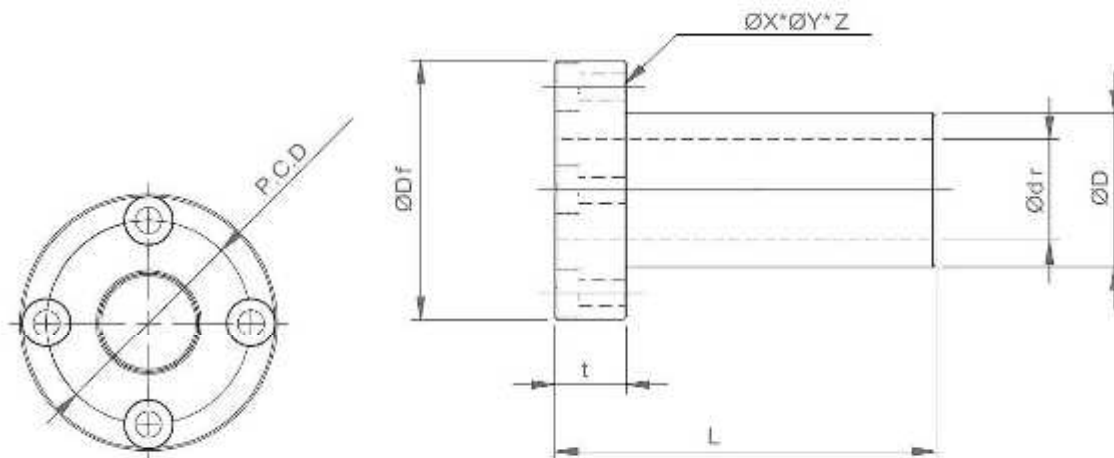
7.13 SMF-L Long Round Flange Type

Ordering Key: **SMF-L 20**

1 **2**

1 SMF-L Long Type Round Flange Self-Lubricated Bearing

2 Bearing Inner Diameter



Model No.	Inner Dia.	Dimensions							
		Ødr (F8)	ØD (h6)	L	ØDf	t	P.C.D.	ØX	ØY
SMF12L	12	21	57	42	13	32	4.5	7.5	4.1
SMF16L	16	28	70	48	13	38	4.5	7.5	4.1
SMF20L	20	32	80	54	15	43	5.5	9.0	5.1
SMF25L	25	40	112	62	15	51	5.5	9.0	5.1
SMF30L	30	45	123	74	20	60	6.6	11.0	6.1

(mm)

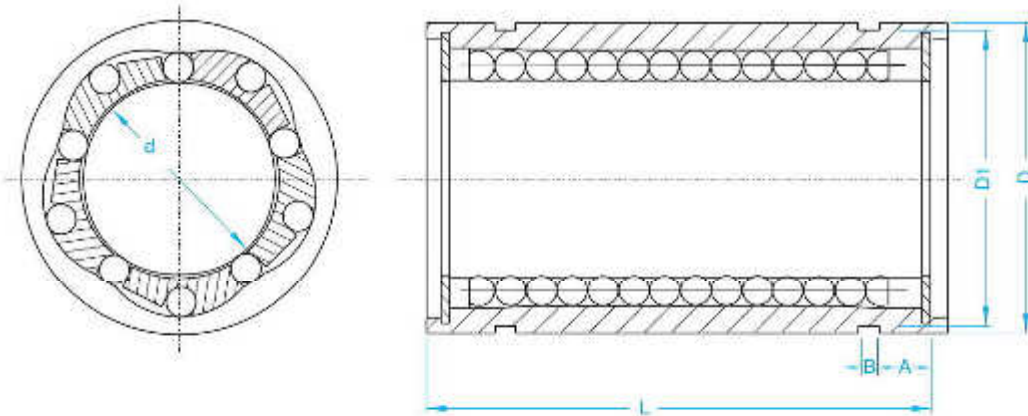
Model No.	Max. Static Load	Max. PV	Max. Speed	Weight
	(kgf)	(kgf * m/sec)	(m / sec)	(g)
SMF12L	475	23.2	2	72
SMF16L	780	38.1	2	113
SMF20L	1100	54.2	2	150
SMF25L	1900	95.0	2	303
SMF30L	2470	123.7	2	407

(mm)



8.Linear Ball Bearing

8.1 LM series (Standard Type)

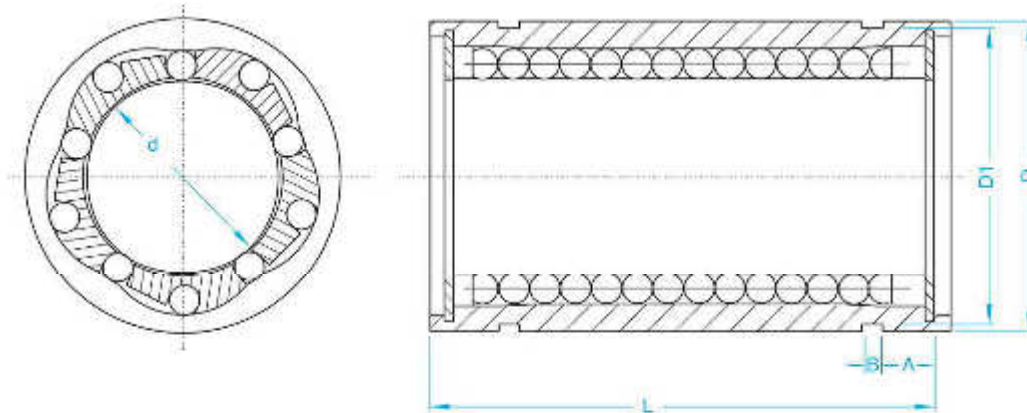


Unit : mm

Model No.	Basic Dimension								Eccentricity (max) μm	Radial Clearance (max) μm	(Kgf) Load		Weight (g)
	d	D	tolerance (μm)	L	tolerance (μm)	B	D1	A			Ca	Coa	
LM4UU	4	8	0	12	0	-	-	0	8	-5	9	13	2
LM6UU	6	12		-11		19	1.1	11.5	2.75	12	-5	20	27
LM8UU	8	15	0	24	-0.2	1.1	14.3	3.25	12	-5	27	41	16
LM10UU	10	19		0		29	1.3	18	3.5	12	-5	38	55
LM12UU	12	21	-13	30	0	1.3	20	3.5	12	-5	42	60	31.5
LM16UU	16	28	0	37		-0.2	1.6	27	5.25	12	-7	78	119
LM20UU	20	32		0	42		1.6	30.5	5.75	15	-9	83	140
LM25UU	25	40	-15	59	0	1.85	38	9	15	-9	100	159	220
LM30UU	30	45	0	64		-0.3	1.85	43	9.75	15	-9	159	279
LM40UU	40	60		0	80		2.1	57	9.75	20	-13	219	409
LM50UU	50	80	-19	100		2.6	76.5	13	20	-13	389	808	1580

Note : UU with oil seals in ends

8.2 LM-L series (Standard - Long Type)

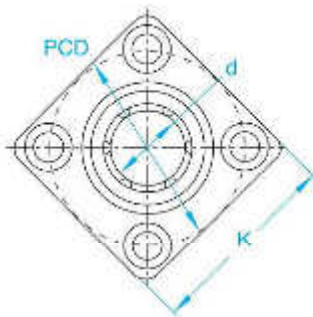


Unit : mm

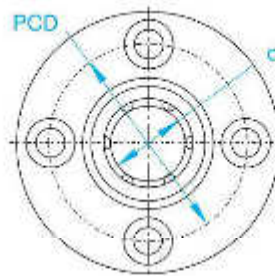
Model No.	Basic Dimension								(Kgf) Load		Weight (g)
	d	D	tolerance (μm)	L	tolerance (μm)	B	A	D1	Ca	Coa	
LM6LUU	6	12	0	35	0	1.1	4	11.5	32	53	16
LM8LUU	8	15	-13	45		1.1	5	14.3	44	80	31
LM10LUU	10	19	0	55		-30	1.1	5.5	18	59	112
LM12LUU	12	21	-16	57	1.3		5.5	20	66	122	80
LM16LUU	16	28		70	1.3		8.5	27	125	240	145
LM20LUU	20	32	0	80	0	1.6	9.5	30.5	143	280	180
LM25LUU	25	40	-19	112		1.85	15	38	159	320	440
LM30LUU	30	45		123		-40	1.85	17	43	254	560
LM40LUU	40	60	0	151	2.1		15	57	350	820	1170
LM50LUU	50	80	-22	192	2.6		22	76.5	620	1622	3100

Note : UU with oil seals in ends

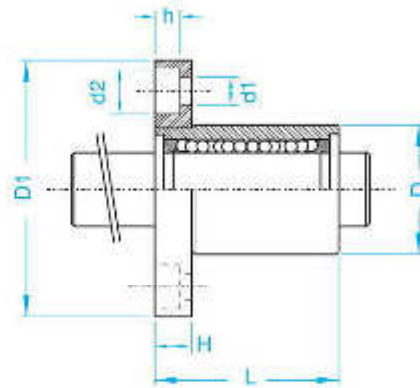
8.3 LF series (Flange Type)



Type : D



Type : N

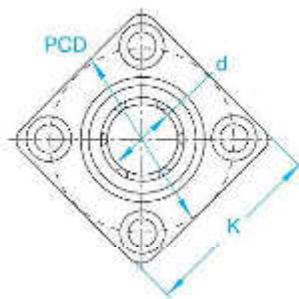


Unit : mm

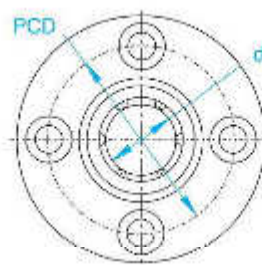
Model No.	Basic Dimension												Eccentricity (max) μm	Radial Clearance (max) μm	(Kgf) Load		Weight (g)	
	d	D	tolerance (μm)	L	tolerance (μm)	D1	tolerance (μm)	H	PCD	K	d1	d2			h	Ca		Coa
LF6UU	6	12	0-11	19		28		5	20	22	3.4	6.5	3.3	12	-5	200	206	26.5
LF8UU	8	15	0	24		32		5	24	25	3.4	6.5	3.3	12	-5	260	400	40
LF10UU	10	19	-13	29		40		6	29	30	4.5	8	4.4	12	-5	370	540	78
LF12UU	12	21		30		42		6	32	32	4.5	8	4.4	12	-5	410	290	76
LF16UU	16	28		37	0	48	0	6	38	37	4.5	8	4.4	12	-7	770	1170	134
LF20UU	20	32	0	42	-20	54	-0.2	8	43	42	5.5	9.5	5.4	15	-9	860	1370	180
LF25UU	25	40	-16	59		62		8	51	50	5.5	9.5	5.4	15	-9	980	1560	340
LF30UU	30	45		64		74		10	60	58	6.6	11	6.5	15	-9	1560	2740	460
LF40UU	40	60	0	80	0	96	0	13	78	75	9	14	8.6	20	-13	2150	4010	1054
LF50UU	50	80	-19	100	-30	116	-0.3	13	98	92	9	14	8.6	20	-13	3820	7830	2200

ote : UU-with oil seals in ends

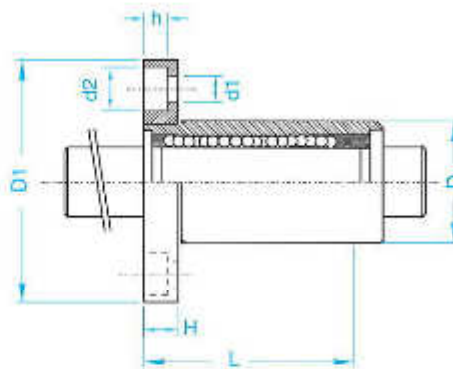
8.4 LF-L series (Flange Long Type)



Type : D



Type : N



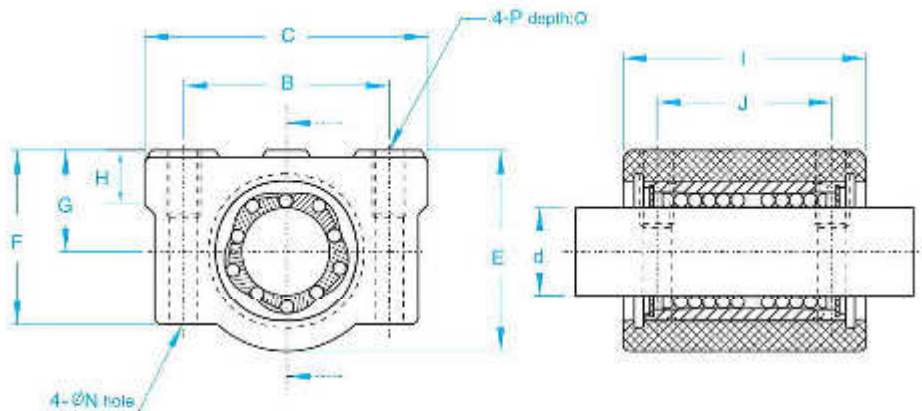
Unit : mm

Model No.	Basic Dimension													Eccentricity (max) μm	Radial Clearance (max) μm	(Kgf) Load		Weight (g)
	d	D	tolerance (μm)	L	tolerance (μm)	D1	tolerance (μm)	H	PCD	K	d1	d2	h			Ca	Coa	
LF6LUU	6	12	0	35		28		5	20	22	3.4	6.5	3.3	12	-5	200	206	26.5
LF8LUU	8	15	-13	45		32		5	24	25	3.4	6.5	3.3	12	-5	260	400	40
LF10LUU	10	19	0	55		40		6	29	30	4.5	8	4.4	12	-5	370	540	78
LF12LUU	12	21	0	57		42		6	32	32	4.5	8	4.4	12	-5	410	290	76
LF16LUU	16	28	-16	70	0	48	0	6	38	37	4.5	8	4.4	12	-7	770	1170	134
LF20LUU	20	32	0	80	-30	54	-0.2	8	43	42	5.5	9.5	5.4	15	-9	860	1370	180
LF25LUU	25	40	0	112		62		8	51	50	5.5	9.5	5.4	15	-9	980	1560	340
LF30LUU	30	45	-19	123		74		10	60	58	6.6	11	6.5	15	-9	1560	2740	460
LF40LUU	40	60	0	151	0	96	0	13	78	75	9	14	8.6	20	-13	2150	4010	1054
LF50LUU	50	80	-22	192	-40	116	-0.3	13	98	92	9	14	8.6	20	-13	3820	7830	2200

Note : UU-with oil seals in ends

8.5 LU/LP series (Housing Type)

LP: No Linear Ball Bearing (Housing Only)
 LU: With Linear Ball Bearing (LP+LM)

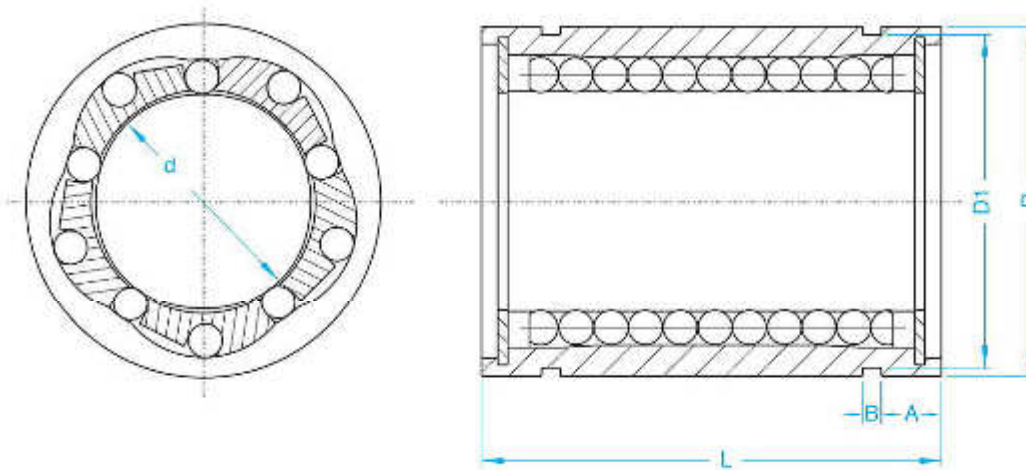


Material: Aluminum Alloy

Unit : mm

Model No.	Basic Dimension												weight (g)
	d	B	C	E	F	G±0.02	H	I	J	N	P	Q	
LU6UU LP6	6	20	30	18	15	9	6	25	15	M3	M4	8	34
LU8UU LP8	8	24	34	22	18	11	6	30	18	M3	M4	8	56
LU10UU LP10	10	28	40	26	21	13	8	35	21	M4	M5	12	90
LU12UU LP12	12	30.5	42	29	25	15	8	36	26	M4	M5	12	112
LU16UU LP16	16	36	50	38.5	35	19	9	44	34	M4	M5	12	189
LU20UU LP20	20	40	54	42	36	21	11	50	40	M5	M6	12	237
LU25UU LP25	25	54	76	51.5	41	26	12	67	50	M6	M8	18	555
LU30UU LP30	30	58	78	59.5	49	30	15	72	58	M6	M8	18	685
LU40UU LP40	40	80	102	78	62	40	20	90	60	M8	M10	25	1600
LU50UU LP50	50	100	122	102	80	52	25	110	80	M8	M10	25	3350

8.6 LME series (European Type)

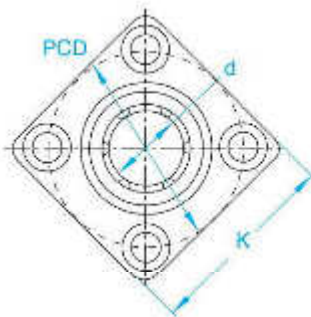


Unit : mm

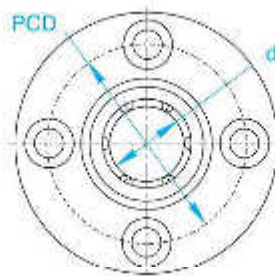
Model No.	Basic Dimension								Eccentricity (max) μm	Radial Clearance (max) μm	(Kgf) Load		Weight (g)
	d	D	tolerance (μm)	L	tolerance (μm)	B	A	D1			Ca	Coa	
LME8UU	8	16	0/-8	25		1.1	4.25	15.2	12	-5	27	41	20
LME12UU	12	22	0	32	0	1.3	4.55	21	12	-7	51	78	41
LME16UU	16	26	-9	36	-20	1.3	5.55	24.9	12	-7	58	91	57
LME20UU	20	32	0	45		1.6	6.75	30.3	15	-9	88	139	91
LME25UU	25	40		58		1.85	6.95	37.5	15	-9	100	159	215
LME30UU	30	47	-11	68	0	1.85	7.95	44.5	15	-9	159	279	325
LME40UU	40	62	0	80	-30	2.15	9.7	59	17	-13	219	409	705
LME50UU	50	75	-13	100		2.65	11.2	72	17	-13	389	808	1130

Note : UU with oil seals in ends

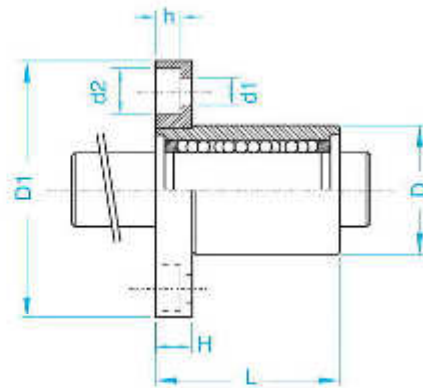
8.7 LFE series (European Flange Type)



Type : D



Type : N



Unit : mm

Model No.	Basic Dimension												Eccentricity (max) μm	Radial Clearance (max) μm	(Kgf) Load		Weight (g)	
	d	D	tolerance (μm)	L	tolerance (μm)	D1	tolerance (μm)	H	PCD	K	d1	d2			h	Ca		Coa
LFE8UU	8	16	0/-8	25		32		5	24	25	3.4	6.5	3.3	12	-5	260	400	44
LFE12UU	12	22	0	32		42		6	32	32	4.5	8	4.4	12	-5	500	770	86
LFE16UU	16	26	-9	36	0	46	0	6	36	35	4.5	8	4.4	12	-7	570	890	120
LFE20UU	20	32	0	45	-20	54	-0.2	8	43	42	5.5	9.5	5.4	15	-9	860	1370	184
LFE25UU	25	40	-11	58		62		8	51	50	5.5	9.5	5.4	15	-9	980	1560	335
LFE30UU	30	47		68		76		10	62	60	6.6	11	6.5	15	-9	1560	2740	545
LFE40UU	40	62	0	80	0	98	0	13	80	75	9	14	8.6	20	-13	2150	4010	1185
LFE50UU	50	75	-13	100	-30	112	-0.3	13	94	88	9	14	8.6	20	-13	3820	7830	1730

Note : UU with oil seals in ends



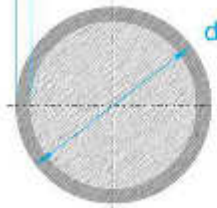
9.Slide Shaft & Slide Shaft Support

9.1 SF/Wv series (Slide Shaft)

SF : Harden and ground

WV: Harden ground and Chromium plated

Hardness Depth (X)



Specification:

1. Material : JIS(S55C)

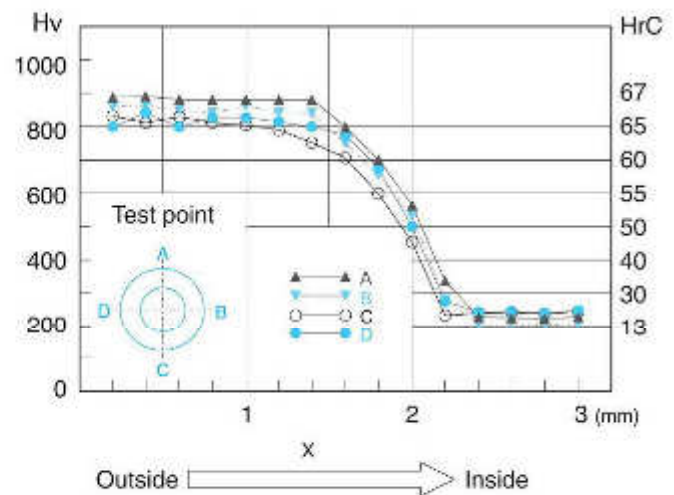
2. Hardness : Hrc62±2.

3. Surface finish : Ra 0.2 - 0.4μm.

4. Shaft straightness : approx. 0.1~0.15 mm/m.

5. Shaft dia. tolerance : h7

If g6 or h6 tolerance is required, please advise.



Unit : mm

Model No.	d	Standard Length				Dia. tolerance h7	Hardness Depth (X)
		1500	2000	2500	3000		
★ SF6	6					0 / -0.012	1.0 ~ 1.5
★ SF8	8					0 / -0.015	1.0 ~ 1.5
★ SF10	10					0 / -0.015	1.0 ~ 1.5
★ SF12	12					0 / -0.018	1.0 ~ 1.5
★ SF16	16					0 / -0.018	1.8 ~ 2.2
★ SF20	20					0 / -0.021	1.8 ~ 2.2
★ SF25	25					0 / -0.021	1.8 ~ 2.2
★ SF30	30					0 / -0.021	1.8 ~ 2.2
★ SF32	32					0 / -0.025	1.8 ~ 2.2
★ SF40	40					0 / -0.025	1.8 ~ 2.2
★ SF50	50					0 / -0.025	1.8 ~ 2.2

Note: 1. With sign ★ can supply Chromium plated slide shaft (Model No:WV)

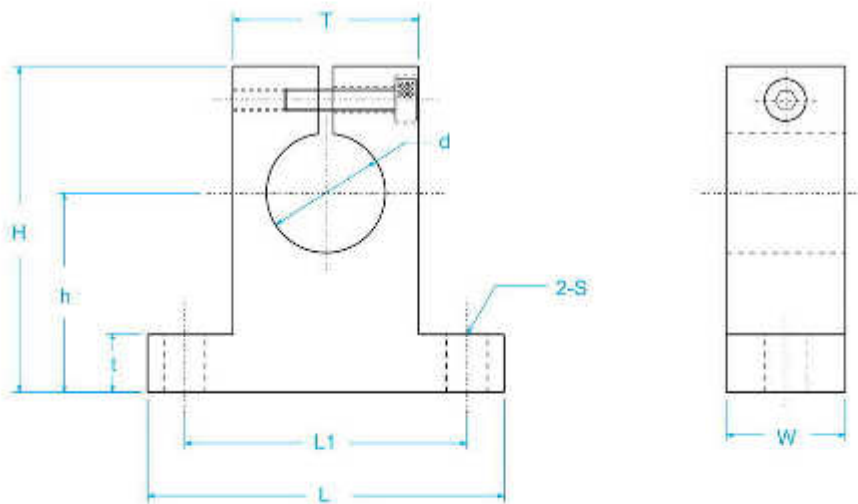
2. Hard Chrome thickness : 20μm.

9.2 SS series (Slide Shaft Support)

Ordering Key: **SS** **20**
1 **2**

1 6061-T6 Aluminum Alloy

2 Shaft Dia.



Unit : mm

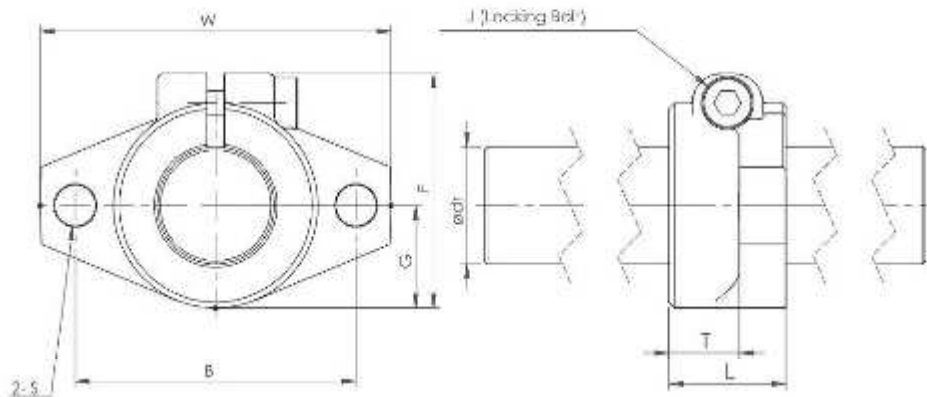
Model No.	Basic Dimension									Weight (g)
	d	h	L	W	H	t	T	L1	S	
SS4	4	20	42	14	32.8	6	18	32	5.5	24
SS6	6	20	42	14	32.8	6	18	32	5.5	24
SS8	8	20	42	14	32.8	6	18	32	5.5	24
SS10	10	20	42	14	32.8	6	18	32	5.5	24
SS12	12	23	42	14	37.5	6	20	32	5.5	30
SS16	16	27	48	16	44	8	25	38	5.5	40
SS20	20	31	60	20	51	10	30	45	6.6	70
SS25	25	35	70	24	60	12	38	56	6.6	130
SS30	30	42	84	28	70	12	44	64	9	180
SS40	40	60	114	36	96	15	60	90	11	420
SS50	50	70	126	40	120	18	74	100	14	750
SS60	60	80	148	45	136	18	90	120	14	1100

9.3 SHF series (Slide Shaft Support)

Ordering Key: **SHF** **20**
1 2

1 S6061-T6 Aluminum Alloy

2 Shaft Dia.



Unit : mm

Model No.	Basic Dimension								
	dr	W	L	T	F	G	B	S	J
SHF 4	4	43	10	5	24	20.0	32	5.5	M4
SHF 5	5	43	10	5	24	20.0	32	5.5	M4
SHF 6	6	43	10	5	24	20.0	32	5.5	M4
SHF 8	8	43	10	5	24	20.0	32	5.5	M4
SHF 10	10	36	10	5	24	10.0	32	5.5	M4
SHF 12	12	47	13	7	28	12.5	36	5.5	M4
SHF 13	13	47	13	7	28	12.5	36	5.5	M4
SHF 16	16	50	16	8	31	14.0	40	5.5	M4
SHF 20	20	60	20	8	37	17.0	48	7.0	M5
SHF 25	25	70	25	10	42	20.0	56	7.0	M5
SHF 30	30	80	30	12	50	23.0	64	9.0	M6
SHF 35	35	92	35	14	58	25.0	72	12.0	M8
SHF 40	40	102	40	16	67	28.0	80	12.0	M10
SHF 50	50	122	50	19	83	35.0	96	14.0	M12
SHF 60	60	140	60	23	95	41.0	112	14.0	M12

Appendix (1)

BR Series Model Code Transition

Block-Standard end cap			Block-Short end cap		
	Old item name	New item name		Old item name	New item name
BR15	BRH15A	BRC15-A0	BR15	BRH15A-S	BRD15-A0
	BRH15B	BRC15-R0		BRH15B-S	BRD15-R0
	BRS15B	BRC15-U0		BRS15B-S	BRD15-U0
	BRS15BS	BRC15-SU		BRS15BS-S	BRD15-SU
BR20	BRH20A	BRC20-A0	BR20	BRH20A-S	BRD20-A0
	BRH20AL	BRC20-LA		BRH20AL-S	BRD20-LA
	BRH20B	BRC20-R0		BRH20B-S	BRD20-R0
	BRH20BL	BRC20-LR		BRH20BL-S	BRD20-LR
	BRS20B	BRC20-U0		BRS20B-S	BRD20-U0
	BRS20BS	BRC20-SU		BRS20BS-S	BRD20-SU
BR25	BRH25A	BRC25-A0	BR25	BRH25A-S	BRD25-A0
	BRH25AL	BRC25-LA		BRH25AL-S	BRD25-LA
	BRH25B	BRC25-R0		BRH25B-S	BRD25-R0
	BRH25BL	BRC25-LR		BRH25BL-S	BRD25-LR
	BRS25B	BRC25-U0		BRS25B-S	BRD25-U0
	BRS25BS	BRC25-SU		BRS25BS-S	BRD25-SU
BR30	BRH30A	BRC30-A0	BR30	BRH30A-S	BRD30-A0
	BRH30AL	BRC30-LA		BRH30AL-S	BRD30-LA
	BRH30B	BRC30-R0		BRH30B-S	BRD30-R0
	BRH30BL	BRC30-LR		BRH30BL-S	BRD30-LR
	BRS30B	BRC30-U0		BRS30B-S	BRD30-U0
	BRS30BS	BRC30-SU		BRS30BS-S	BRD30-SU
BR35			BR35	BRH35A-S	BRD35-A0
				DRI135AL-S	BRD35-LA
				BRH35B-S	BRD35-R0
				BRH35BL-S	BRD35-LR
				BRS35B-S	BRD35-U0
				BRS35BS-S	BRD35-SU
BR45			BR45	BRH45A-S	BRD45-A0
				BRH45AL-S	BRD45-LA
				BRH45B-S	BRD45-R0
				BRH45BL-S	BRD45-LR
				BRS45B-S	BRD45-U0

Rail		
Rail	Old item name	New item name
	BR	BRR

BC Series Model Code Transition

Block-Standard end cap		
	Old item name	New item name
BC20	BCH20A	BCC20-A0
	BCH20AL	BCC20-LA
	BCH20B	BCC20-R0
	BCH20BL	BCC20-LR
BC25	BCH25A	BCC25-A0
	BCH25AL	BCC25-LA
	BCH25B	BCC25-R0
	BCH25BL	BCC25-LR
BC30	BCH30A	BCC30-A0
	BCH30AL	BCC30-LA
	BCH30R	BCC30-R0
	BCH30BL	BCC30-LR
BC35	BCH35A	BCC35-A0
	BCH35AL	BCC35-LA
	BCH35B	BCC35-R0
	BCH35BL	BCC35-LR
BC45	BCH45A	BCC45-A0
	BCH45AL	BCC45-LA
	BCH45B	BCC45-R0
	BCH45BL	BCC45-LR
BC55	BCH55A	BCC55-A0
	BCH55AL	BCC55-LA
	BCH55B	BCC55-R0
	BCH55BL	BCC55-LR

Rail		
	Old item name	New item name
Rail	BC	BCR

Appendix (3)

Examples of ball screws accuracy classes for different uses

Application			Accuracy Grade						
			C0	C1	C2	C3	C5	C7	C10
NC Machine Tools	Lathe	X	○	○	○	○	○	○	
		Z				○	○	○	
	Milling Machine Boring Machine	XY		○	○	○	○	○	
		Z			○	○	○	○	
	Machining Center	XY		○	○	○	○		
		Z			○	○	○		
	Jig Borer	XY	○	○					
		Z	○	○					
	Drilling Machine	XY				○	○	○	
		Z					○	○	
	Grinding Machine	X	○	○	○	○	○	○	
		Z		○	○	○	○	○	
	Electro-discharge Machine (EDM)	XY		○	○	○	○	○	
		(Z)			○	○	○	○	
	Wire Cut(EDM)	XY		○	○	○			
UV			○	○	○	○	○		
Punching Press	XY				○	○	○		
Laser Cutting Machine	XY				○	○			
	Z				○	○			
Wood Working Machine					○	○	○	○	
Machines of General Use and special Use				○	○	○	○	○	
Semiconductor Machines	Explosure Equipments		○	○					
	Chemical Treatment				○	○	○	○	
	Wire Bonder			○	○				
	Prober	○	○	○	○				
	Inserter			○	○	○	○		
	PCB Driller			○	○	○	○		
Industrial Robots	Orthogonal Type	As/sy		○	○	○	○	○	
		Others					○	○	○
	Multi-joints Type	As/sy			○	○	○		
		Others				○	○	○	
SCARA Type			○	○	○	○			
Machines for Steel molding						○	○	○	
Injection Molding Machines						○	○	○	
Three-Dimensional Measuring Machines			○	○	○				
Business Machines						○	○	○	
Pattern Image Macines			○	○					
Nuclear	Rod Control				○	○	○		
	Mechnaical Snubber						○	○	
Aircrafts					○	○			