



Ballscrews / Linear Guideway / Mono Stage General Catalog

COMPANY INTRODUCTION

PMI GROUP was established in 1990. It's highly involved in manufacturing of ballscrews, linear guideway and mono stage, which is the critical component of precision machinery and mainly applied to Machine Tool, Electric Discharging Machine, Cutting Wire Machine, Plastics Injection Machine, Semi-conductor Equipment, Precision Orientation Equipment and other equipments and machines.

Recent years, **PMI** Group places great emphasis in upgrading not only the manufacturing and quality of products but also the manpower. In addition to comply with requirement of quality management system, **PMI** Group has been actively carried out 『RoHS Green Environmental System』 and environmentally friendly management system to conform to the regulation in order to reach a pollution-free workplace.





Environment Policy

PMI devotes in research & developing and manufacturing of Precision Linear Motion Components. To provide world class levels of service, quality and learning through our innovative business philosophy, that is integral to all *PMI*'s transmission components and services. To protect the environment and personal safety by more actively promoting and implementing the ROHS green system, ESH and energy management systems. To meet or exceed regulatory levels for emission and waste control, within a labor-friendly work environment that utilizes the latest energy reduction technology to make *PMI* a leader in environmental protection. Through the guidance of safety and environmental management systems, energy awareness advocacy and setting up the related regulations, we promise to prevent any pollution, conserve resources, safety as priority, enhance health and energy-saving, with every staff's involvement. In accordance with the spirits of innovations and developments, *PMI* can provide the best mechanical efficiency and quality service to our customers, ensure the personal safety, reduce any harmful factors to every staff in the working place, increase the knowledge of safety and environment, prevent any pollutions, injuries, diseases happened, and effective energy control. Moreover, to be a sustainable development GREEN INDUSTRY, *PMI* will continue to improve the safety, environment activities and energy usage management in order to take the corporation social responsibility to the utmost and reduce any harmful factors and energy consumption during the manufacturing.



We promise and are devoted to implement the following environmental and energy policies:

1. By reducing pollution and continually improving our energy usage performance, *PMI* can simultaneously minimize accidents and sickness whilst achieving regulatory compliance.
2. *PMI* develops GREEN products, strengthen risk and energy management.
3. Purchase energy-saving products, improve the design of the energy performance.
4. Every department participates preserving our environment, energy awareness, and the prevention of injuries, diseases and the reduction of energy consumption.

Based on the above descriptions, *PMI* will continue holding every kind of safety, environment and energy activities, increase our international environmental protection image and industry competition, and let the related organizations understand our ambitions and responsibilities to the environment and energy management that people live in.

Quality Policy

The followings are what the employees expect for the quality policy:

Prompt delivery, sustained improvement, satisfying customer's needs and expectations.



PRODUCT INFORMATION

Precision Ground Series

Internal Ball Circulation Series			
FSIC	A-131	FDIC	A-135
			
End Deflector Series			
FOIC	A-139	FSIC	A-141
			
RDIC	A-143		
			
FSDC	A-146	FDDC	A-150
			

Precision Ground Series

External Ball Circulation Series

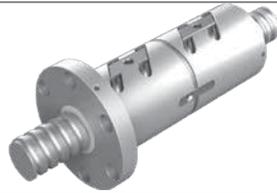
FSWC

A-155



FDWC

A-160



FVC

A-165



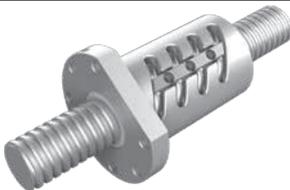
FDVC

A-169



FOWC

A-173



Precision Ground Series

High Lead Series

FSWE

A-176



FDWE

A-180



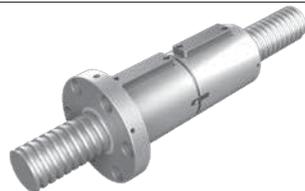
FSVE

A-184



FDVE

A-188



End Cap Series

FSKC

A-192



Heavy Load Series

FSVH

A-197



FSDH

A-199



Rolled Series

External Ball Circulation Series

FSWW

A-252



FSVW

A-255



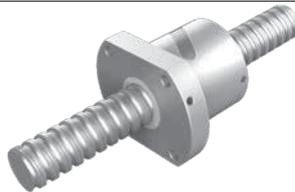
RSVW

A-258



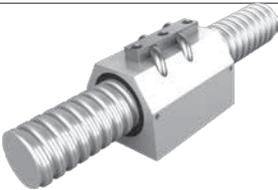
FSBW

A-259



SSVW

A-260



End Cap Series

FSKW

A-261



Rolled Series

internal Ball Circulation Series

FSIW

A-262



FSDW

A-264



FSIN

A-266



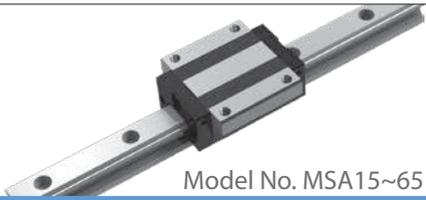
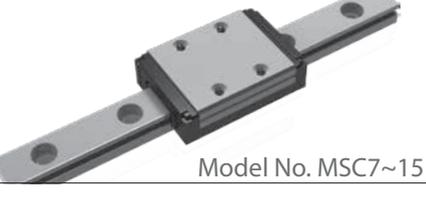
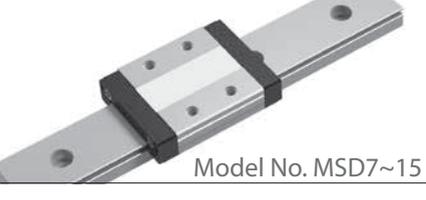
FSDN

A-267



Standard type series

Miniature Series		FA Series	
FSMC	A-200		A-270
			
Blank Shaft End Series			
PPR	A-290	PTR	A-292
			

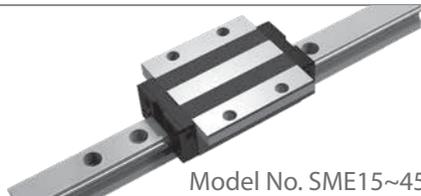
Heavy Load Type		B-39
MSA-A / MSA-LA	MSA-E / MSA-LE	MSA-S / MSA-LS
		
Model No. MSA15~65	Model No. MSA15~65	
Compact Type		B-62
MSB-E	MSB-S	
		
Model No. MSB15~35	Model No. MSB15~35	
Full Roller Type		B-82
MSR-E	MSR-S	
		
Model No. MSR25E~65E	Model No. MSR25S~65S	
Miniature Type		B-102
MSC	MSD	
		
Model No. MSC7~15	Model No. MSD7~15	

Ball Chain Type

B-120

SME-E

SME-S

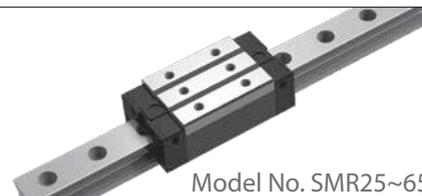
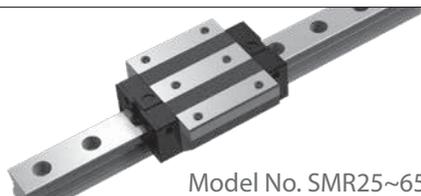


Roller Chain Type

B-146

SMR-E

SMR-S

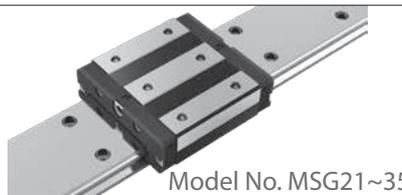
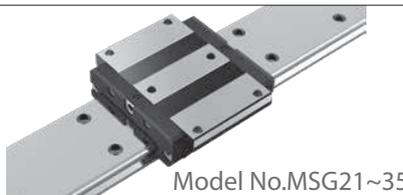


Wide Rail Type

B-166

MSG-E

MSG-S



Mono Stage

C-4

KM



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C. Mono Stage

1. KM Series

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Appendix

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Ball screws



Features of *PMI* Ballscrews

(1) High reliability

PMI has accumulated many years experience in production managing. It covers the whole production sequence, from receiving the order, designing, material preparation, machining, heat treating, grinding, assembling, inspection, packaging and delivery. The systemized managing ensures high reliability of *PMI* Ballscrews.

(2) High accuracy

PMI Ballscrews are machined, ground, assembled and Q.C. inspected under the constant temperature control (20°C) to ensure high precision of Ballscrews. Fig.1.1 accuracy inspection certificate.

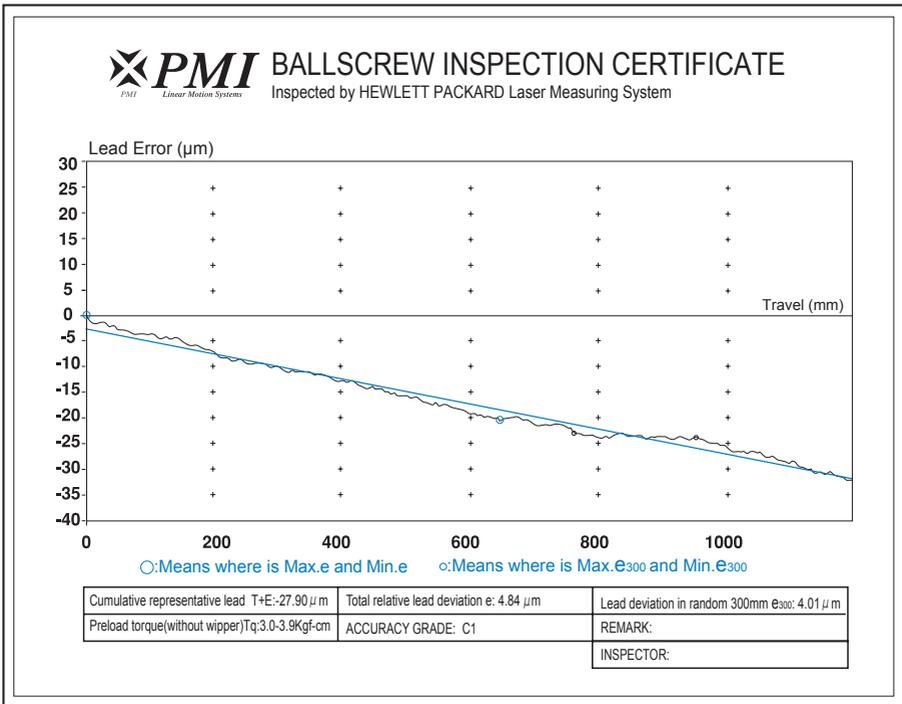


Fig.1.1 Accuracy inspection certificate.

(3) Long durability

PMI Ballscrews are Alloy steels, which are well quenching and tempering treated for good rigidity, along with suitable surface hardening to ensure long durability.

(4) High working efficiency

Balls are rotating inside the Ballscrew nut to offer high working efficiency. Comparing with the traditional ACME screws, which work by friction sliding between the nut and screw, the Ballscrews needs only 1/3 of driving torque. It is easy to transmit linear motion into rotation motion.

(5) No backlash and with high rigidity

The Gothic profile is applied by *PMI* Ballscrews. It offers best contact between balls and the grooves. If suitable preload is exerted on Ballscrew hence to eliminate clearance between the ball nut and screw and to reduce elastic deformation, the ballscrew shall get much better rigidity and accuracy.

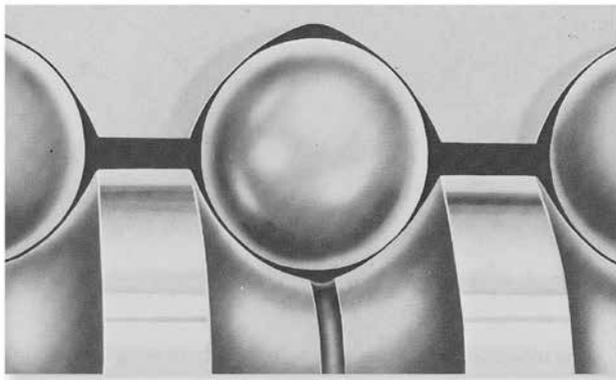
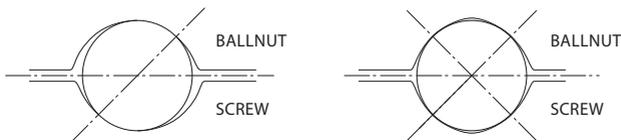


Fig.1.2 Gothic arch thread

2.1 Lead Accuracy

PMI's precision ground Ballscrews are controlled in accordance with JIS B 1192. The permissible values and each part of definitions are shown below.

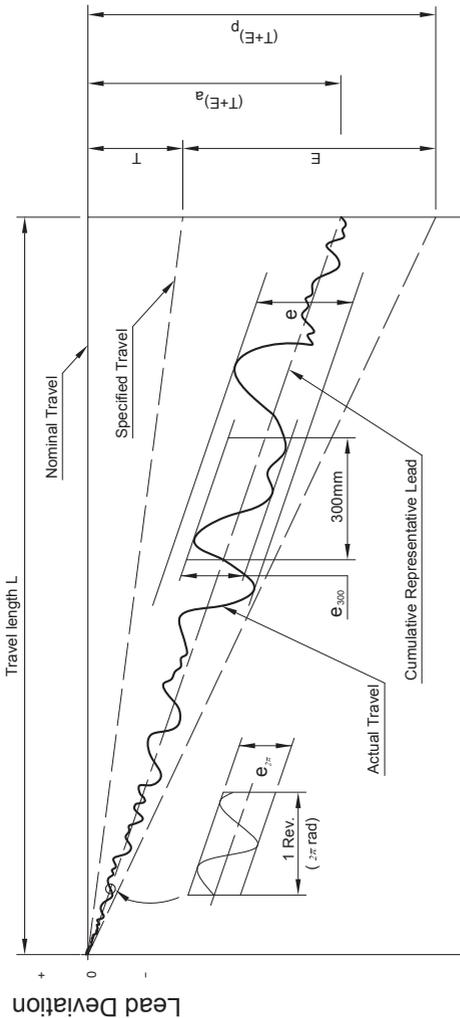


Fig.2.1 Technical Terms Concerning the Lead

Table 2.1 Terms

T+E	<p>Cumulative representative lead. A straight line representing the tendency of the cumulative actual lead. This is obtained by least square method and measured by laser system.</p>
P	<p>Permissible value.</p>
a	<p>Actual value.</p>
T	<p>Specified travel. This value is determined by customer and maker as it depends on different application requirements.</p>
E	<p>Accumulated reference lead deviation. This is allowable deviation of specified travel. It is decided by both of the accuracy grade and effective thread length.</p>
e	<p>Total relative lead variation Maximum width of variation over the travel length.</p>
e₃₀₀	<p>Lead deviation in random 300 mm.</p>
e_{2π}	<p>Lead deviation in random 1 revolution 2π rad.</p>

Table 2.2 Accumulated reference lead deviation ($\pm E$) and total relative variation (e)

Unit: μm

	GRADE		C0		C1		C2		C3		C4		C5	
	OVER	UPTO	E	e	E	e	E	e	E	e	E	e	E	e
	-	315	4	3.5	6	5	8	7	12	8	12	12	23	18
	315	400	5	3.5	7	5	9	7	13	10	14	12	25	20
	400	500	6	4	8	5	10	7	15	10	16	12	27	20
	500	630	6	4	9	6	11	8	16	12	18	14	30	23
	630	800	7	5	10	7	13	9	18	13	20	14	35	25
	800	1000	8	6	11	8	15	10	21	15	22	16	40	27
	1000	1250	9	6	13	9	18	11	24	16	25	18	46	30
	1250	1600	11	7	15	10	21	13	29	18	29	20	54	35
	1600	2000	-	-	18	11	25	15	35	21	35	22	65	40
	2000	2500	-	-	22	13	30	18	41	24	41	25	77	46
	2500	3150	-	-	26	15	36	21	50	29	50	29	93	54
	3150	4000	-	-	32	18	44	25	60	35	62	35	115	65
	4000	5000	-	-	-	-	52	30	72	41	76	41	140	77
	5000	6300	-	-	-	-	65	36	90	50	95	50	170	93
	6300	8000	-	-	-	-	-	-	110	62	120	62	210	115
	8000	10000	-	-	-	-	-	-	137	75	157	75	260	140

Table 2.3 Accuracy grade

Variation in random 300mm (e_{300}) and wobble ($e_{2\pi}$) e_{300} Unit: μm

GRADE	C0	C1	C2	C3	C4	C5	C6	C7	C10
JIS	3.5	5	-	8	-	18	-	50	210
ISO	3.5	6	-	12	-	23	-	52	210
DIN	-	6	-	12	-	23	-	52	210
PMI	3.5	5	7	8	12	18	25	50	210

 $e_{2\pi}$ Unit: μm

GRADE	C0	C1	C2	C3	C4	C5
JIS	3	4	-	6	-	8
ISO	3	4	-	6	-	8
DIN	-	4	-	6	-	8
PMI	3	4	4	6	8	8

Table 2.4 Accuracy grades of ball screw and their application

Application		Name of axis	Accuracy grade								
			C0	C1	C2	C3	C4	C5	C6	C7	C10
NC Machine tools	Lathe	X	•	•	•	•	•	•			
		Z				•	•	•			
	Machining center	X,Y		•	•	•	•	•			
		Z			•	•	•	•			
	Drilling machine	X,Y				•	•	•			
		Z						•	•	•	
	Milling machine Boring machine	X,Y		•	•	•	•	•			
		Z			•	•	•	•			
	Jig boring machine	X,Y	•	•							
		Z	•	•							
	Grinder	X,Y	•	•	•						
		Z		•	•	•					
	Electric discharge machine	X,Y		•	•	•					
		Z			•	•	•	•			
	Wire cutting Electric discharge machine	X,Y		•	•	•					
		Z		•	•	•	•				
	Punch press	X,Y				•	•	•			
	Laser cutting machine	X,Y				•	•	•			
		Z				•	•	•			
	Woodworking machine							•	•	•	•
General industrial machines Machines for specific use					•	•	•	•	•	•	

Application		Name of axis	Accuracy grade								
			C0	C1	C2	C3	C4	C5	C6	C7	C10
Industrial robots	Cartesian type	Assembly			•	•	•	•	•	•	
		other purposes						•	•	•	•
	Articulate type	Assembly				•	•	•	•	•	
		other purposes						•	•	•	
	SCARA type					•	•	•	•	•	
Semiconductor/ associated industrial	Lithographic machine		•	•							
	Chemical processing equipment					•	•	•	•	•	•
	Wire bonder			•	•						
	Prober		•	•	•						
	Printed circuit board drilling machine			•	•	•	•	•			
	Electric component mounted device				•	•	•	•			
Three-dimensional coordinate measuring machine		•	•	•							
Office machine							•	•	•	•	
Image processing machine		•	•								
Plastic injection molding machine									•	•	
Steel mills equipment									•	•	
Nuclear power	Fuel rod control					•	•	•	•	•	
	Mechanical snubber									•	•
Aircraft					•	•	•				

2.2 Preloading Torque

The preloading torque of the Ballscrew is controlled in accordance with JIS B 1192.

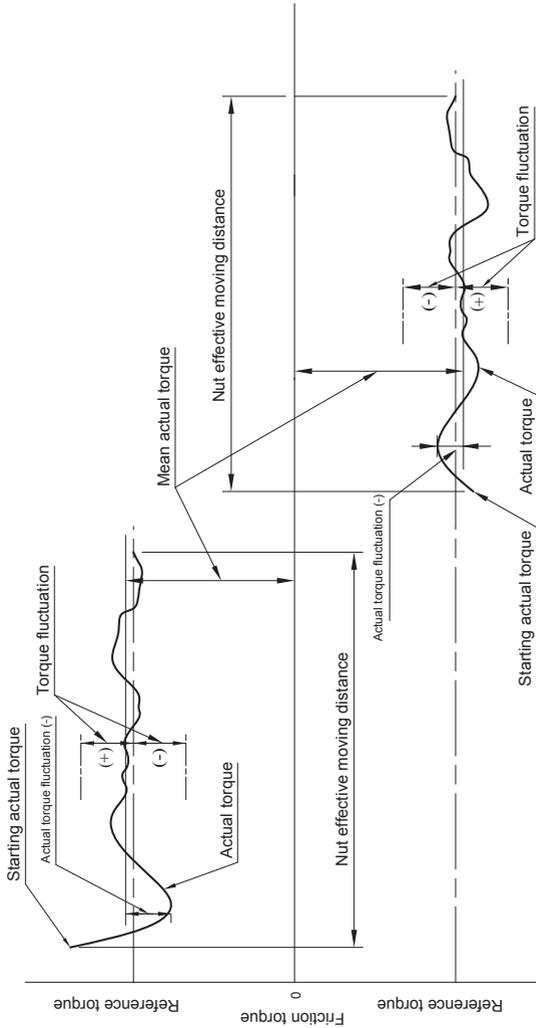


Fig.2.2 Technical terms concerning preload

Preload	The goal in preload is to clear axial play and increase rigidity of Ballscrew. Reference to 5.1.3
Preload torque	Torque needed to continuously turn a Ballscrew with preload with no other load applied to it.
Reference torque	Preload torque set as a goal.
Torque fluctuation	Fluctuation from a goal value of the preload torque. Defined as positive or negative in respect to the reference torque.
Rating of torque fluctuation	Rating on reference torque and torque fluctuation.
Actual torque	Preloaded dynamic torque measured by using an actual value of Ballscrew.
Mean actual torque	In the effective thread length, the net reciprocal to measure the maximum actual torque and minimum actual torque are doing count mean.
Actual torque fluctuation	In the effective thread length, the net reciprocal to measure the maximum fluctuant value.
Rating of Actual torque fluctuation	Rating on mean actual torque and actual torque fluctuation.

Table2.5 Allowable range of preload torque

Reference torque (kgf.cm)		Effective Thread Length (mm)										
		up to and incl. 4000								over 4000 up to and incl. 10000.		
		Slenderness ratio: up to and incl. 40				Slenderness ratio: over 40 up to and incl. 60				Accuracy grade		
		Accuracy grade				Accuracy grade						
OVER	OR LESS	C0	C1	C3	C5	C0	C1	C3	C5	C1	C3	C5
2	4	±30%	±35%	±40%	±50%	±40%	±40%	±50%	±60%	-	-	-
4	6	±25%	±30%	±35%	±40%	±35%	±35%	±40%	±45%	-	-	-
6	10	±20%	±25%	±30%	±35%	±30%	±30%	±35%	±40%	-	±40%	±45%
10	25	±15%	±20%	±25%	±30%	±25%	±25%	±30%	±35%	-	±35%	±40%
25	63	±10%	±15%	±20%	±25%	±20%	±20%	±25%	±30%	-	±30%	±35%
63	100	-	±15%	±15%	±20%	-	-	±20%	±25%	-	±25%	±30%

Reference torque

$$T_P = 0.05 (\tan \beta)^{0.5} \times \frac{F_{ao} \times l}{2\pi} \dots\dots\dots (2.1)$$

Here

- T_P Reference torque (kgf.cm) l Lead(cm)
- F_{ao} Preload (kgf) β Lead angle

2.3 Tolerances on Various Areas of *PMI* Ballscrew

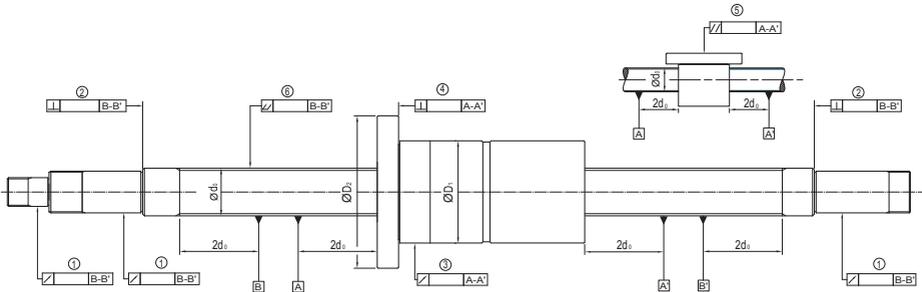


Fig.2.3

Those on above are samples of accuracy of tolerance on various areas of *PMI* Ballscrew.

⊥ : Perpendicularity ↗ : Radial runout // : Parallel ▽_A : Reference

Accuracy on various areas of *PMI* Ballscrew has to measure items:

1. Radial run-out of the circumference of the screw shaft supported portion in respect to the B-B' line.
2. Perpendicularity of the screw shaft supported portion end face to the B-B' line.
3. Radial run-out of the nut circumference in respect to the A-A' line.
4. Perpendicularity of the flange mounting surface to the A-A' line.
5. Parallelism between the nut circumference to the A-A' line.
6. Overall radial run-out to the A-A' line.

Note: 1.The mounting surface of the Ballscrew is finished to the accuracy specified in JIS B 1192:1997
2.Standard tolerance of accuracy measuring from Jan. 1st 2012 on.

2.4 Standard tolerance of accuracy measuring of ballscrew

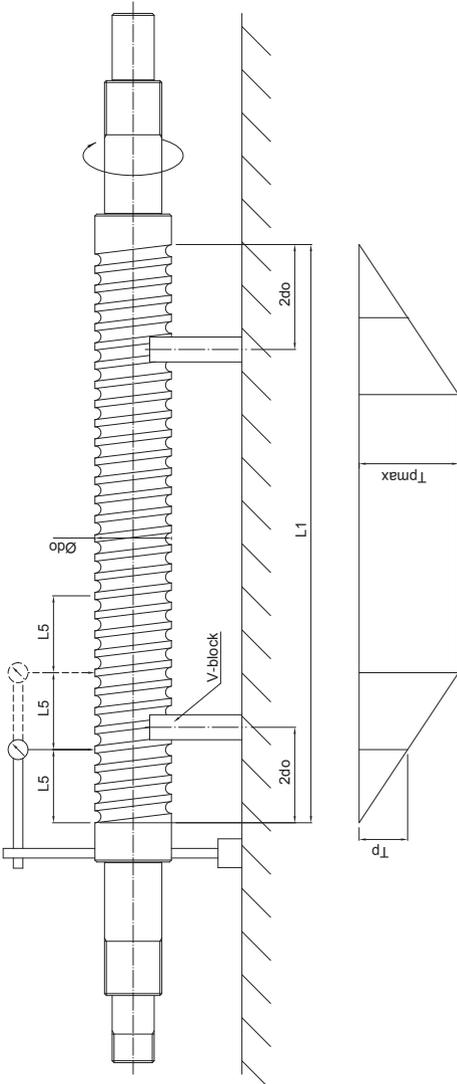


Table 2.6 Total runout in radial direction of outside diameter of screw shaft threaded part in respect to measuring basic length (measuring basic length is according to DIN 69051 and JIS B1192)

Unit: μm

Normal diameter $d_0(\text{mm})$	Measuring basic length L_f	PMI's Grade $T_{p\max}$													
		C0	C1	C2	C3	C4	C5	C6	C7	C10					
above	up to and incl.	-													
6	80														
12	25														
25	50														
50	100	20	20	20	23	25	28	32	40	80					
100	200	1250													
Slenderness ratio $L_f/d_0(\text{mm})$		PMI's Grade ($L_f \geq 4L_5$)													
above	up to and incl	C0	C1	C2	C3	C4	C5	C6	C7	C10					
-	40	40	40	40	45	50	60	64	80	160					
40	60	60	60	60	70	75	85	96	120	240					
60	80	100	100	100	115	125	140	160	200	400					
80	100	160	160	160	180	200	220	256	320	640					

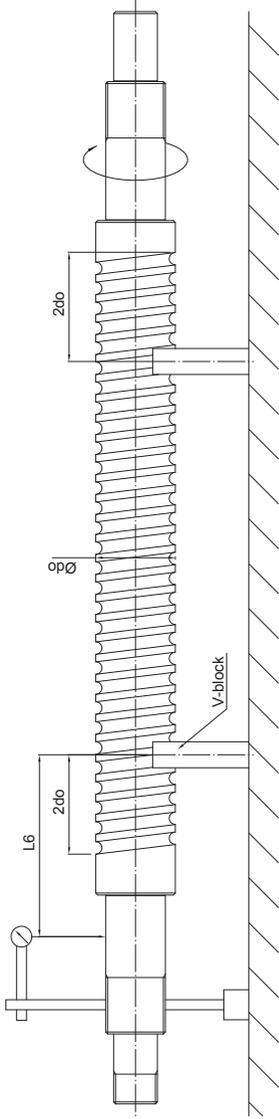


Table 2.7 Circumferential runout in radial direction of outside diameter of mounting part of parts in respect to threaded part axial line of screw shaft (measuring basic length is according to DIN 69051 and JIS B1192)

Unit: μm

Normal diameter d_o (mm)	Measuring basic length L_r	PMI's Grade ($L_6 < L_r$)										
		C0	C1	C2	C3	C4	C5	C6	C7	C10		
above 6	-	6	8	10	11	12	16	20	40	63		
20	80	8	10	12	14	16	20	25	50	80		
50	125	10	12	16	18	20	26	32	63	100		
125	200	-	-	-	20	25	32	40	80	125		

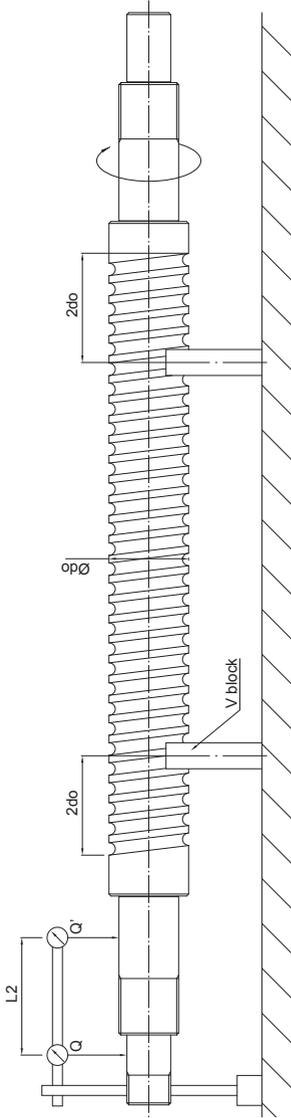


Table 2.8 Perpendicularity on supporting-part end face in respect to the threaded part axial line of screw shaft (measuring basic length is according to DIN 69051 and JIS B1192)(Difference of maximum value within Q and Q')

Unit: μm

Normal diameter $d_o(\text{mm})$		Measuring basic length L_p	PMI's' Grade ($L_2 \leq L_p$)									
above	up to and incl.		C0	C1	C2	C3	C4	C5	C6	C7	C10	
6	20	80	4	5	5	6	6	7	8	12	16	
20	50	125	5	6	6	7	8	9	10	16	20	
50	125	200	6	7	8	9	10	11	12	20	25	
125	200	315	-	-	-	10	12	14	16	25	32	

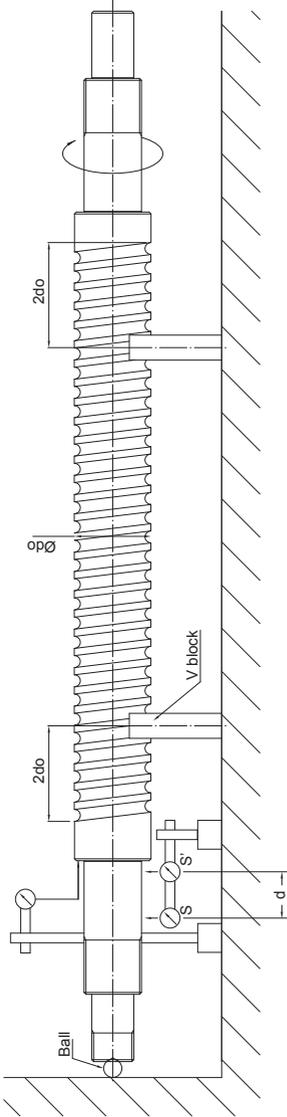


Table 2.9 Perpendicularity on supporting-part end face in respect to the threaded part axial line of screw shaft (measuring basic length is according to DIN 69051 and JIS B1192)(the value of deflection supports two ends' deflection of difference between S and S')

Unit: μm

Normal diameter $d_o(mm)$	PMI's Grade										
	above	up to and incl.	C0	C1	C2	C3	C4	C5	C6	C7	C10
6	63	3	3	3	3	4	4	5	5	6	10
63	125	3	4	4	5	5	5	6	6	8	12
125	200	-	-	-	6	6	6	8	8	10	16

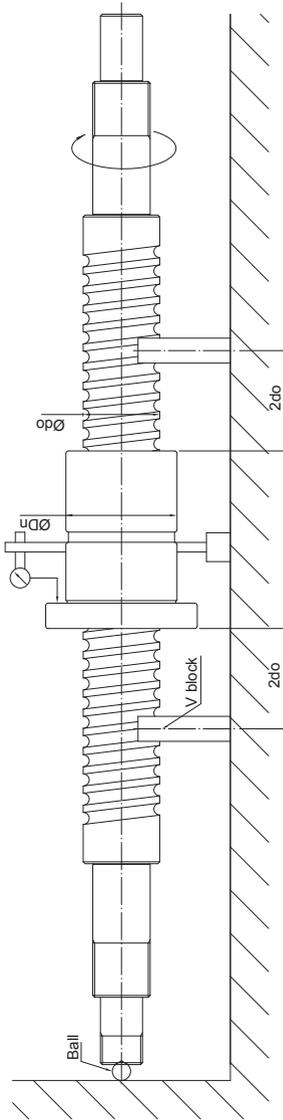


Table2.10 Perpendicularity on mounting face of flange of nut (measuring basic length is according to DIN 69051 and JIS B1192)

Outside diameter of nut D_H	PMI's Grade										Unit: μm
	above	up to and incl.	C0	C1	C2	C3	C4	C5	C6	C7	
-	20	5	6	7	8	9	10	12	14	14	-
20	32	5	6	7	8	9	10	12	14	14	-
32	50	6	7	8	8	10	11	15	18	18	-
50	80	7	8	9	10	12	13	16	18	18	-
80	125	7	9	10	12	14	15	18	20	20	-
125	160	8	10	11	13	15	17	19	20	20	-
160	200	-	11	12	14	16	18	22	25	25	-
200	250	-	12	14	15	18	20	25	30	30	-

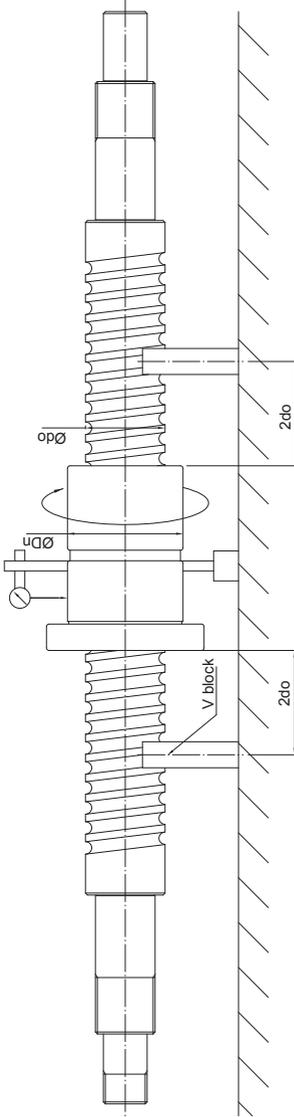


Table 2.11 Circumferential runout in radial direction on outer peripheral face of nut (measuring basic length is according to DIN 69051 and JIS B1192)

Unit: μm

Outside diameter of nut D_h		PMI's Grade												
		C0	C1	C2	C3	C4	C5	C6	C7	C10				
above	up to and incl.													
-	20	5	6	7	9	10	12	16	20	25	30	40	-	-
20	32	6	7	8	10	11	12	15	16	16	20	25	40	-
32	50	7	8	10	12	14	15	19	20	20	25	30	40	-
50	80	8	10	12	15	17	19	25	25	25	30	40	40	-
80	125	9	12	16	20	21	22	28	28	28	32	40	40	-
125	160	10	13	17	22	25	28	32	32	32	40	40	40	-
160	200	-	16	20	22	25	28	32	32	32	40	40	40	-
200	250	-	17	20	22	25	28	32	32	32	40	40	40	-

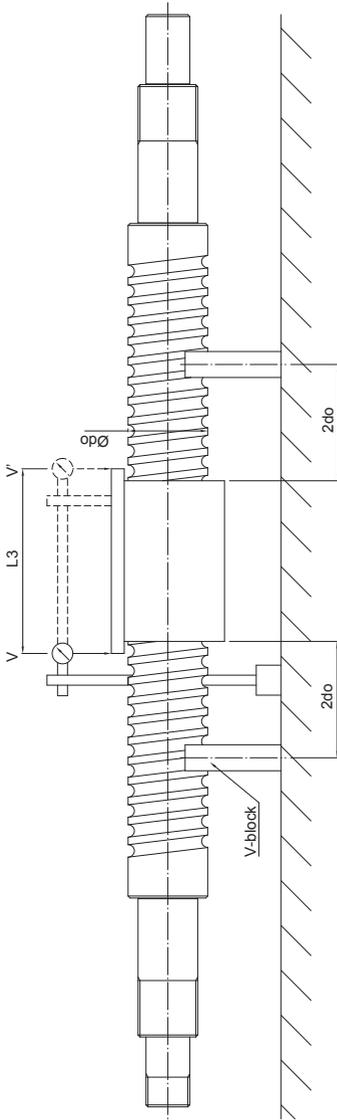


Table2.12 Parallelism on outer peripheral face of nut (V-V)(measuring basic length is according to DIN 69051 and JIS B1192)

Measuring basic length L_3 above	PML's Grade											
	C0	C1	C2	C3	C4	C5	C6	C7	C10			
up to and incl												
-	50	6	7	8	9	10	14	17	-			
50	100	6	8	10	11	12	15	17	-			
100	200	-	10	11	13	15	17	24	30			

Unit: μm

3.1 Production Limit Length of Screw Shaft

Production limit length of precision ground Ballscrew:

When screw shaft O.D. is 4 mm, Limit length of Ballscrew is 150 mm.

When screw shaft O.D. is 120 mm, Limit length of Ballscrew is 10000 mm.

Note: Please contact with our sales people in case a special type is required.

Production limit length of rolled Ballscrew:

When screw shaft O.D. is 12 mm, Limit length of Ballscrew is 1500 mm.

When screw shaft O.D. is 50 mm, Limit length of Ballscrew is 6000 mm.

Note: Please contact with our sales people in case a special type is required.



3.2 Method for Mounting

The permissible axial load and permissible rotational speed vary with the screw-shaft mounting method used, so the mounting method should be determined in accordance with the operating conditions.

Diagrams 3.1~3.3 illustrate a typical method for mounting a screw shaft.

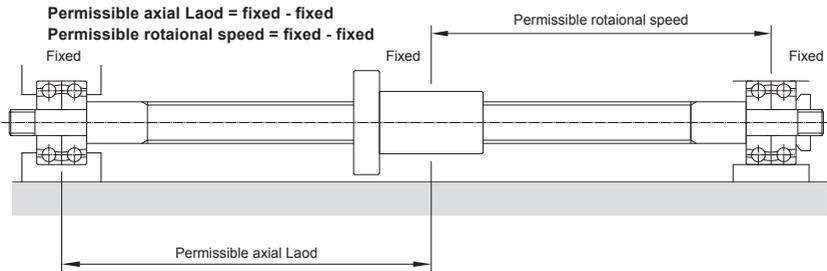


Fig.3.1 Mount method : fixed-fixed

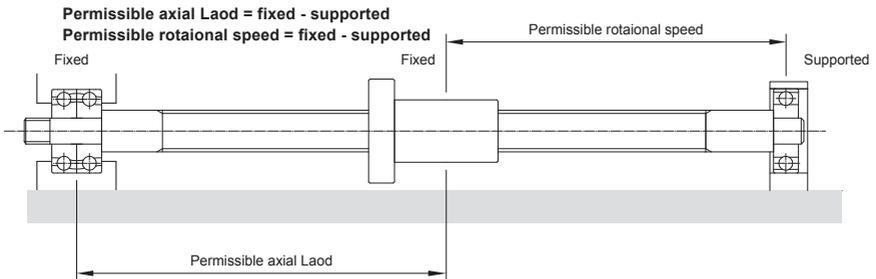


Fig.3.2 Mount method : fixed-supported

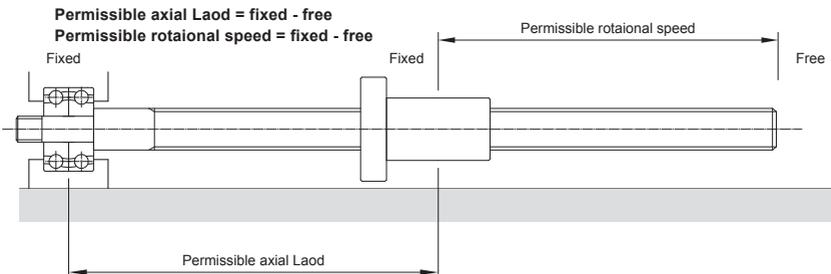


Fig.3.3 Mount method : fixed-free

3.3 Permissible Axial Load

(1) Buckling load :

The Ballscrew to be used should not buckle under the maximum compressive load applied in its axial direction. The buckling load can be calculated by using equation (3.1):

$$P = \alpha \frac{\pi^2 NEI}{L^2} = m \frac{dr^4}{L^2} \times 10^3 \quad (kgf) \dots\dots\dots (3.1)$$

Here:

- α Safety factor ($\alpha=0.5$)
- E Young's modulus ($E=2.1 \times 10^4 \text{ kgf} / \text{mm}^2$)
- I Minimum geometrical moment of inertia of the screw shaft cross section ($I = \pi dr^4 / 64 \text{ mm}^4$)
- dr Screw shaft thread minor diameter (mm)
- L Distance between mounting positions (mm)
- $m \cdot N$ Coefficient depending on the mounting method

supported-supported	$m=5.1$	$(N=1)$
fixed-supported	$m=10.2$	$(N=2)$
fixed-fixed	$m=20.3$	$(N=4)$
fixed-free	$m=1.3$	$(N=1/4)$

(2) Permissible tensile-compressive load of the screw shaft :

Where the axial load is exerted on the Ballscrew, the screw shaft to be used should be determined in consideration of the permissible tensile-compressive load that can exert yielding stress on the screw shaft.

The permissible tensile-compressive load can be calculated using equation (3.2).

a. Permissible tensile-compressive load of yield stress of screw shaft

$$P = \sigma \cdot A = \sigma \cdot \pi \cdot dr^2 / 4 \dots\dots\dots (3.2)$$

Here:

- σ Permissible tensile-compressive stress ($\delta=15 \text{ kgf} / \text{mm}^2$)
- A Cross section area of root diameter of screw shaft (mm^2)
- dr Screw-shaft thread minor diameter (mm)

b. Permissible Load of contact point of ball groove

The maximal axial load must be less then the basic static rate load of the ball screw shaft. For more details please see section 6.3, the permissible load of ball groove. Fig.Value shown(outer diameter of screw shaft-lead)

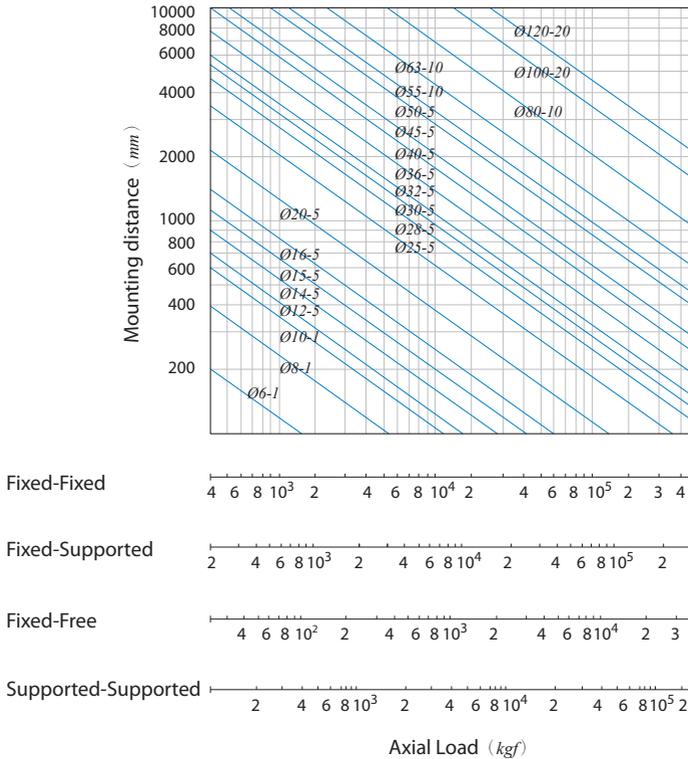


Fig. 3.4 Permissible Axial Load

3.4 Permissible Rotational Speed

(1) Critical rotation speed :

When the rotation speed of driving motor coincides with the natural frequency of feed system (mainly the ballscrew), the resonance of vibration shall be triggered. This rotation speed is then called critical rotation speed. It shall make bad quality machining, since there is wave shape surface on the workpiece. It may also cause damage of machine. Hence it is very important to prevent the resonance of vibration from happening. We choose 80% of critical rotation speed as allowable speed. It is shown as formula (3.3).

It may be required to have additional supports in between the ends bearing supports to make the natural frequency of Ballscrew to be higher and hence to raise the allowable rotation speed.

$$n = \alpha \times \frac{60\lambda^2}{2\pi L^2} \sqrt{\frac{EIg}{\gamma A}} = f \frac{dr}{L^2} \times 10^7 \text{ (rpm)} \dots\dots\dots (3.3)$$

Here:

- n* Permissible rotational speed (rpm)
- α* Safety factor (α=0.8)
- E* Young's modulus (E=2.1×10⁴kgf/mm²)
- I* Minimum geometrical moment of inertia of the screw-shaft cross section (I=πd⁴/64 mm⁴)
- dr* Screw-shaft thread minor diameter (mm)
- A* Screw shaft cross-sectional area (A=πd²/4 mm²)
- L* Distance between mounting positions (mm)
- g* Gravitation acceleration (g =9.8×10³ mm/s²)
- γ* Specific gravity (γ=7.8×10⁻⁶ kgf/mm³)
- f* \ *λ* Coefficient depending on the mounting method

supported-supported	<i>f</i> =9.7	(<i>λ</i> =π)
fixed-supported	<i>f</i> =15.1	(<i>λ</i> =3.927)
fixed-fixed	<i>f</i> =21.9	(<i>λ</i> =4.730)
fixed-free	<i>f</i> =3.4	(<i>λ</i> =1.875)

(2) $dm.n$ Value of Ballscrew:

dm is the BCD (ball circle diameter) of screw shaft, and n is the maximum rotation speed. The $dm.n$ value relates and affects the noise, temperature raise, working life, balls circulation of the ballscrew. In general cases, the $dm.n$ value is limited as follows: (See Note one)

Precision ground : $dm.n \leq 70000$

Rolled : $dm.n \leq 50000$

Rolled ball screw	Allowable $dm.n$ value	Criterion of permissible rotational speed(min^{-1})
Standard specifiction(normal lead)	≤ 50000	1500~2000
High-speed specifiction(large lead)	≤ 70000	2000~2500

Product Specification		Allowable $dm.n$ value		maximum of turning number (standard) [min^{-1}]
		standard	High-speed	
Ground Ballscrew	Inner circulation	≤ 80000		2000
	End Deflector	≤ 220000		3000
	Tube type	≤ 70000		2500
	E-type circuit	$\leq 130000, \leq 140000$ Note 1		3000
	Heavy load	≤ 130000	≤ 160000 Note 2	3000
	Heavy load series of end deflector		≤ 120000	2500
	Cap series circuit	≤ 120000		2500

Note 1:

The $dm.n$ value can be reach 130000 in normal case. For some special cases, for example in a fixed ends case, the $dm.n$ value can be as 140000.

Note 2:

As lead are 10mm, 12mm, 14mm and 16mm, the $dm.n$ value ≤ 120000 . As lead are 20mm and 25mm, the $dm.n$ value ≤ 160000 .

Note 3:

These $dm.n$ values are for reference only. In fact, the $dm.n$ value shall be decided by the ways of end supporting and the distance between them.

Note 4:

Please contact with our sales people in case a very high $dm.n$ value is required.

With better manufacturing technology currently, the $dm.n$ value is no longer limited as above. It is even higher than 100,000.

Fig.Value shown(outer diameter of screw shaft-lead)

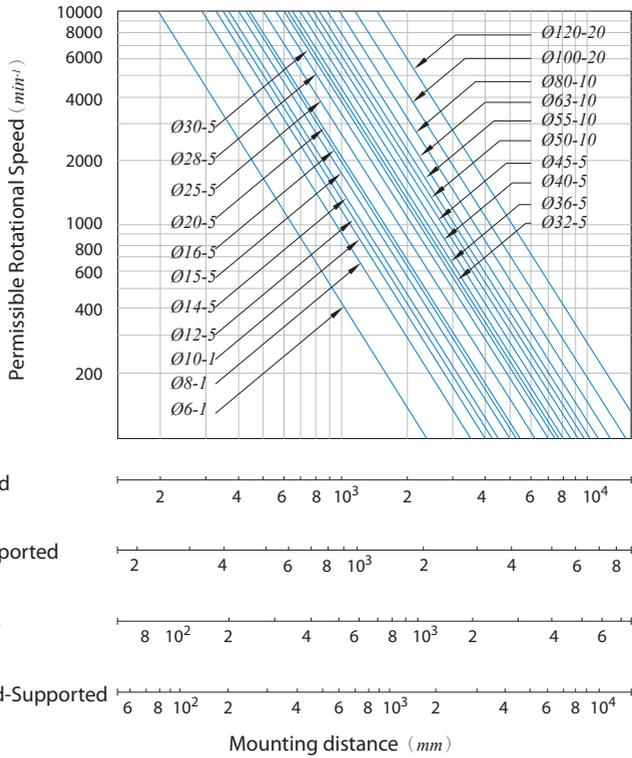


Fig.3.5 Permissible Rotational Speed

3.5 Notes on Screw shaft design

(1) Through end thread:

For the Ballscrews with internal ball circulation Ballnut, it is required to have at least one end with complete thread to the end of Ballscrew for Ballnut assembly to screw shaft. If it is impossible for through end thread, it is required to have at least one end with complete thread and the journal area is with diameter to be $0.2mm$ smaller than the diameter of thread root area.



Fig. 3.6.1 Incomplete thread



Fig. 3.6.2 Through end thread

(2) Machine design for the area of Ballnut and ends area of Ballscrew:

It is very important to check if there is enough space for assembly of Ballscrew onto the machine during machine design. In some cases, there is not enough space for assembly and the Ballnut has to be disassembled from the screw shaft for easier work. It may cause problems, such as the balls falling out from Ballnut, worse accuracy of squareness and roundout of Ballnut, change of preload and damage to external ball circulating tubes. In some more serious cases, the ballscrew may be damaged and not to be used. Please contact with our people if said above disassembling is required.

(3) Not effective hardened area:

The threads on screw shaft are hardened by induction hardening. It shall cause about $15mm$ at both ends of thread area are not hard enough. It is required to pay attention during machine design for the effective thread length of travel.

(4) Extra support unit for long ballscrew:

For a long ballscrew, the bending due to self weight might happen. It may cause radial direction load to ballscrew. The radial direction vibration during rotation might also be more serious. To prevent these problems from happening, it may be required to have extra supports for ballscrew in between the existing supports at both ends. There are two types of supports; one is movable to move along the Ballnut. The other one is fixed type; it is located in a fixed position. The Table must be designed not to hit with this support during moving.

Fixed-Fixed

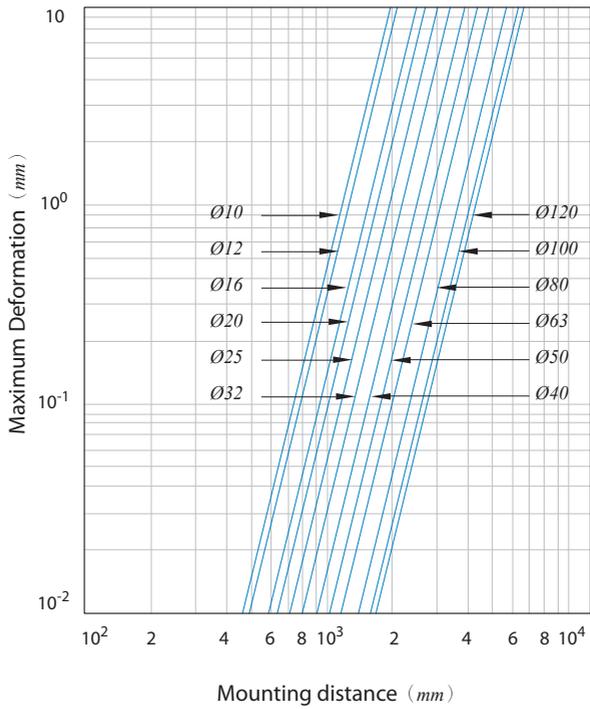
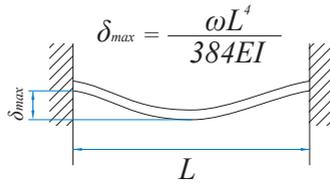


Fig. 3.7.1 Maximum deformation for fixed-fixed

Fixed-Supported

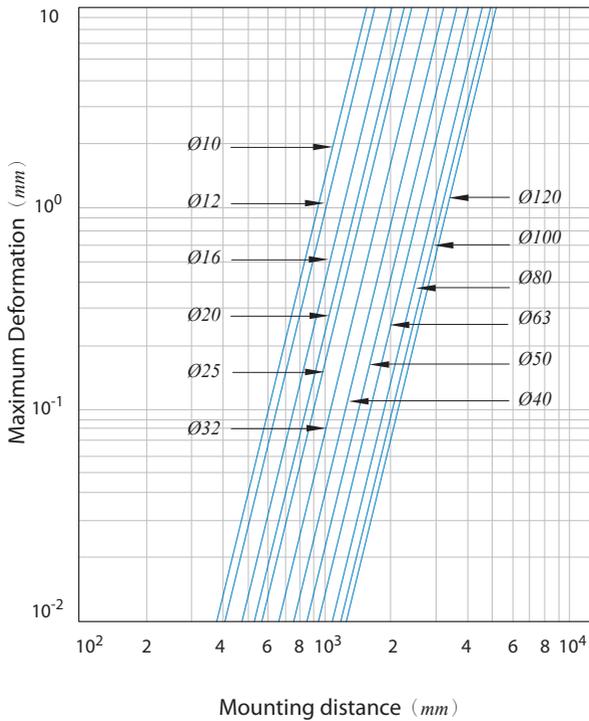
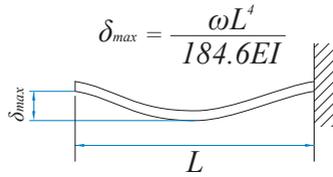


Fig.3.7.2 Maximum deformation for fixed-supported

4.1 Selecting the Type of Nut

(1) Type:

Selecting the type of Nut, please consider the accuracy; dimension (The length of Nut; internal diameter; external diameter), preload and the date of delivery.

(2) Circulation:

a. External ball circulation:

Advantages

- Lower noise due to longer ball circulation paths
- Offers smoother ball running.
- Offers better solution and quality for long lead or large diameter ballscrews.

b. Internal ball circulation:

Advantages:

- Good for limited space of machine.
- Better structure for small lead or small diameter ballscrews.

(3) Effective turns:

Selecting effective turns have to consider required capability; life and rigidity. Refer to the Table 4.1.

(4) Flange:

PMI have three standard type (A type, B type and C type) Please make selection by area space for nut installation. *PMI* can also make special flange as per customers' requests.

(5) Oil hole:

Standard nuts have oil hole. Please dimension in the diagram to manufacture.

Table4.1 The character of effective turns

Character	External ball circulation	Internal ball circulation
Motion	1.5circuit ×2row, 1.5circuit ×3row, 2.5circuit ×1row	1circuit ×3row, 1circuit ×4row
Rigidity	2.5circuit ×2row, 2.5circuit ×3row	1circuit ×6row

4.2 Calculating the Axial Load

4.2.1 Horizontal reciprocating moving mechanism

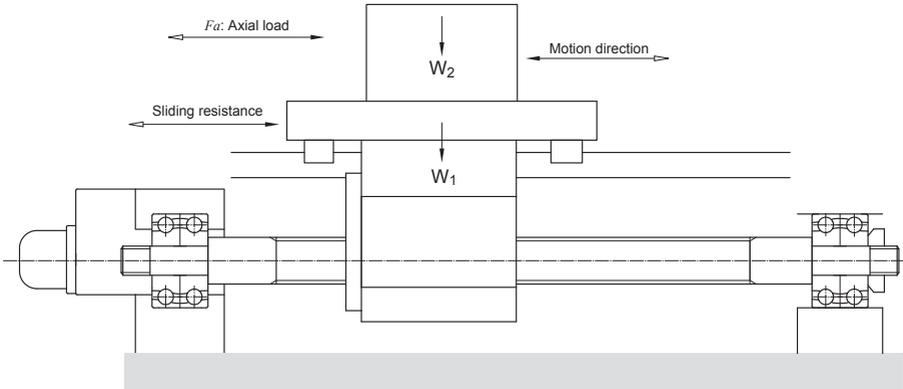


Fig.4.1 Horizontal reciprocating moving mechanism

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

Acceleration (leftward) $F_{a1} = \mu \times mg + f + ma$ (4.1)

Constant speed (leftward) $F_{a2} = \mu \times mg + f$ (4.2)

Deceleration (leftward) $F_{a3} = \mu \times mg + f - ma$ (4.3)

Acceleration (rightward) $F_{a4} = -\mu \times mg - f - ma$ (4.4)

Constant speed (rightward) $F_{a5} = -\mu \times mg - f$ (4.5)

Deceleration (rightward) $F_{a6} = -\mu \times mg - f + ma$ (4.6)

Here:

a Acceleration

$$a = \frac{V_{max}}{t_a} \quad \begin{matrix} V_{max} & \text{Rapid feed speed} \\ t_a & \text{time} \end{matrix}$$

m Total weight (table weight + work piece weight)

μ Friction coefficient of sliding surface

f Non-load resistance

4.2.2 Vertical reciprocating moving mechanism

For reciprocal operation to move work vertically (up and down) in an conveyance system, the axial load (Fa) can be gotten using the following equations:

Acceleration (upward) $Fa_1 = mg + f + ma$ (4.7)

Constant speed (upward) $Fa_2 = mg + f$ (4.8)

Deceleration (upward) $Fa_3 = mg + f - ma$ (4.9)

Acceleration (downward) $Fa_4 = mg - f - ma$ (4.10)

Constant speed (downward) $Fa_5 = mg - f$ (4.11)

Deceleration (downward) $Fa_6 = mg - f + ma$ (4.12)

Here:

a Acceleration

$$a = \frac{V_{max}}{t_a} \quad \begin{matrix} V_{max} & \text{Rapid feed speed} \\ t_a & \text{time} \end{matrix}$$

m Total weight(table weight + work piece weight)

μ Friction coefficient of sliding surface

f Non-load resistance

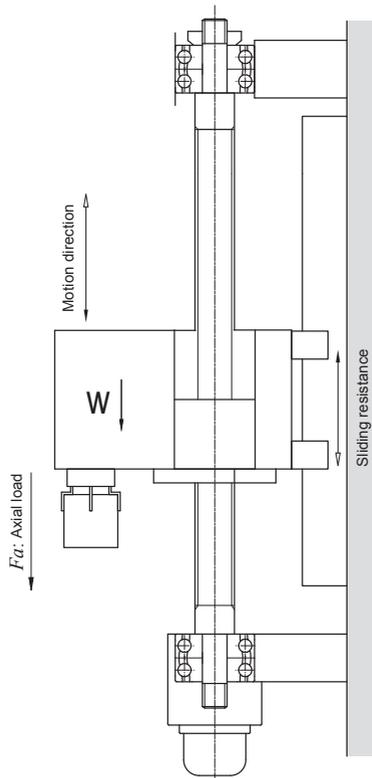


Fig.4.2 Vertical reciprocating moving mechanism

4.3 Notes on Ball Nut Design

Abnormal load: (torsional load or radial load)

When Ballscrew takes only axial load, the best performance of it shall be found; the balls on the groove in between the Ballnut and screw shaft shall evenly take the load and rotate smoothly. In case there is torsional load or radial load on Ballnut, this kind load shall be taken unevenly by some balls only. It shall badly affect Ballscrew performance and even shorten ballscrew life. It is recommended to pay more attention to the mechanism design and Ballscrew assembly.

5.1 Axial Rigidity

"Lost Motion" shall happen due to weakness of rigidity of screw shaft and mating components of it. In order to get good positioning accuracy, it is necessary to consider axial and torsional rigidity of screw shaft and mating components of it.

5.1.1 Axial rigidity of the feed-screw system

Let the axial rigidity of a feed-screw system be K . Then, the elastic displacement in the axial direction can be obtained using equation (5.1)

$$\delta = \frac{F_a}{K_T} \dots \dots \dots (5.1)$$

$$\frac{1}{K_T} = \frac{1}{K_S} + \frac{1}{K_N} + \frac{1}{K_B} + \frac{1}{K_H} \dots \dots \dots (5.2)$$

Here

- δ Feed-screw system elastic displacement in the axial direction (μm)
- F_a Axial load (kgf)
- K_T Axial rigidity of the feed-screw system ($\text{kgf}/\mu\text{m}$)
- K_S Axial rigidity of the screw shaft ($\text{kgf}/\mu\text{m}$)
- K_N Axial rigidity of the Nut ($\text{kgf}/\mu\text{m}$)
- K_B Axial rigidity of the support bearing ($\text{kgf}/\mu\text{m}$)
- K_H Rigidity of the Nut Bracket and support bearing bracket ($\text{kgf}/\mu\text{m}$)

(1) Axial rigidity of Screw shaft: K_s

The axial rigidity of a screw shaft varies depending on the shaft mounting method.

a. fixed - free (Axial direction)

$$K_s = \frac{A \times E}{x} \times 10^{-3} \dots\dots\dots (5.3)$$

Here

- K_s Axial rigidity of Screw shaft ($kgf/\mu m$)
- A Screw shaft cross-sectional area ($A = \pi \cdot dr^2 / 4 \text{ mm}^2$)
- dr Screw shaft thread minor diameter (mm)
- E Young's modulus ($E = 2.1 \times 10^4 \text{ kgf/mm}^2$)
- x Distance between mounting positions (mm)

b. fixed - fixed (Axial direction)

$$K_s = \frac{A \times E \times L}{x(L - x)} \times 10^{-3} \dots\dots\dots (5.4)$$

Here

- K_s Axial rigidity of Screw shaft ($kgf/\mu m$)
- L Distance between mounting positions (mm)

Note: Which $x=L/2$, K_s becomes the minimum and the elastic displacement in the axial direction the maximum.

Fixed-Free

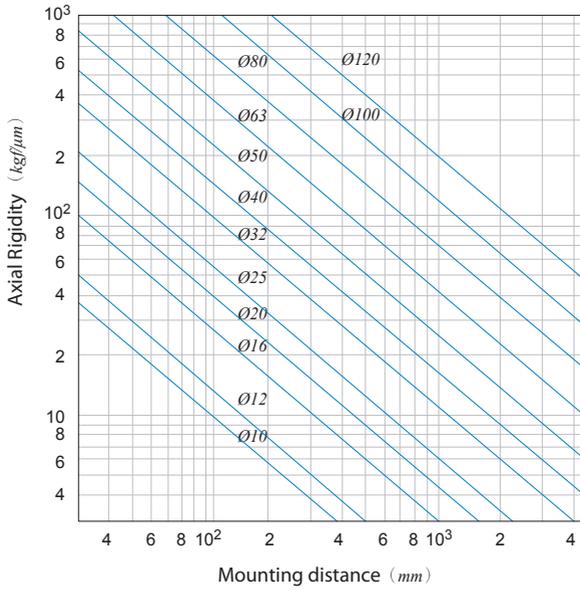
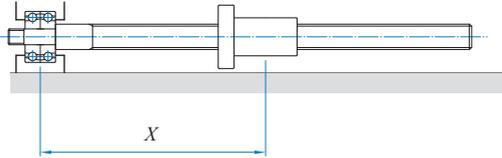


Fig.5.1 Rigidity of ball screw shaft (Fixed-Free)

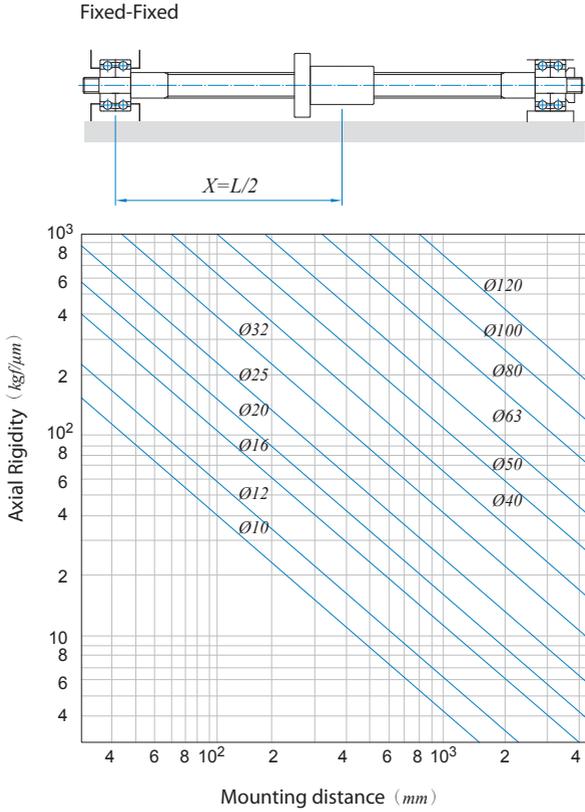


Fig.5.2 Rigidity of ball screw shaft (Fixed-Fixed)

(2) Axial rigidity of Nut: K_N

Computation of the elastic displacement can be using equation (5.5):

$$\delta_a = \frac{C}{\sin \alpha} \left(\frac{Q^2}{D_w} \right)^{1/3} \times \zeta \text{ (}\mu\text{m)} \dots\dots\dots (5.5)$$

Here

- C A constant (reference $C \approx 2.4$)
- α Contact angle of ball and grooved
- D_w Ball diameter (mm)
- Q Load of each balls ($Q = Fa/Z \cdot \sin \alpha$ kgf)
- Z Number of balls
- ζ A coefficient of accuracy and inter conformation

a. Non-preload type

Dimension tables include theoretical axial rigidity values when the axial load with a magnitude of 30% of the basic dynamic load rating (Ca) is exerted on the Nut. These values, don't consider the rigidity of the Nut mounting brackets. Therefore, as a general rule, take 80% of the values given in the table.

When the axial load with a magnitude other than 30% of the basic dynamic load rating (Ca) is exerted on the Nut, rigidity value can be calculated using equation (5.6).

$$K_N = 0.8 \times K \left(\frac{Fa}{0.3Ca} \right)^{1/3} \dots\dots\dots (5.6)$$

here

- K Rigidity value given in the dimension table(kgf/ μ m)
- Fa Axial load (kgf)
- Ca Basic dynamic load rating (kgf)

b. Preloaded type

Dimension tables include theoretical axial rigidity values when the axial load with a magnitude of 10% of the basic dynamic load rating (*Ca*) is exerted on the Nut. These values, don't consider the rigidity of the Nut mounting brackets. Therefore, as a general rule, take 80% of the values given in the table.

When the axial load with a magnitude other than 10% of the basic dynamic load rating (*Ca*) is exerted on the Nut, rigidity value can be calculated using equation (5.7).

$$= 0.8 \times K \left(\frac{F_{ao}}{\epsilon \times Ca} \right)^{1/3} \dots\dots\dots (5.7)$$

here

- K* Rigidity value given in the dimension table (*kgf/μm*)
- F_{ao}* Preload (*kgf*)
- ε* A coefficient of rigidity
ε=0.10(spacer preload and offset preload)
ε=0.05(oversize preload)
- Ca* Basic dynamic load rating (*kgf*)

(3) Axial rigidity of support bearing: *K_B*

The axial rigidity of the support bearings for the Ballscrew varies by bearing type. A typical calculation for determining the axial rigidity of an angular ball bearing can be made using equation (5.8).

$$K_B = \frac{3F_{ao}}{\delta_{ao}} \dots\dots\dots (5.8)$$

here

δ_{ao} Displacement in the axial direction.

$$\left. \begin{aligned} \delta_{ao} &= \frac{0.44}{\sin \alpha} \left(\frac{Q^2}{D_w} \right)^{1/3} \\ Q &= \frac{F_{ao}}{Z \times \sin \alpha} \end{aligned} \right\} \dots\dots\dots (5.9)$$

- F_{ao}* Preload of the suport bearing (*kgf*)
- α* Initial contact angle of the support bearing (°)
- D_w* Ball diameter of the support bearing (*mm*)
- Q* Load of each balls
- Z* Number of balls

(4) Axial rigidity of nut bracket and support bearing bracket : K_H

Take this into consideration in the design of your system. Setting the rigidity as high as possible.

5.1.2 Torsional rigidity of the feed-screw system

The factors of positions error caused by twisting are:

1. Torsional deformation of screw shaft.
2. Torsional deformation of coupling.
3. Torsional deformation of motor.

But above deformations are too small in general machine (non-high speed machine), they are then ignored.

5.1.3 Ballscrew'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.5.3. 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 called "extensive preload".

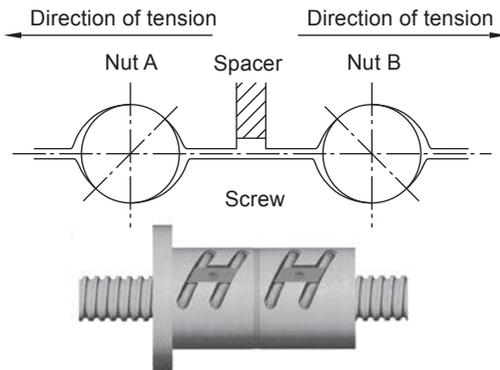


Fig.5.3 Extensive preload

Illustrated in Fig.5.4, is using a thinner spacer. The thickness complies with required magnitude of preload. The spacer is smaller than the gap between Nut A and B, compressing Nut A and B on opposite direction to preload Ballscrews. It's called "compressive preload".

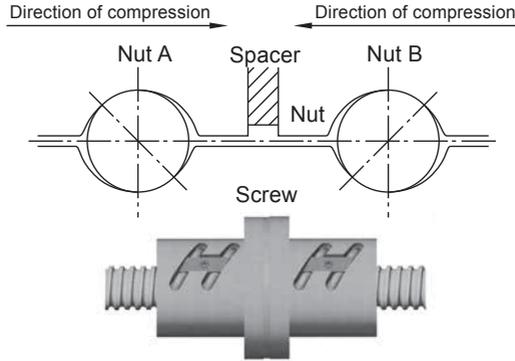


Fig.5.4 Compressive preload

b.Single-nut method:

As that illustrated on Fig. 5.5, 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.

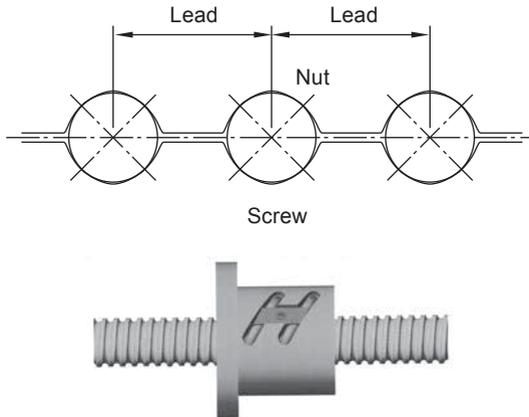


Fig.5.5 Four-point contact preload

There is another way for single nut Ballscrew preloading. That is to shift a very little distance, which complies with required magnitude of preload, on one lead of Ballnut as that illustrated on Fig. 5.6. to preload Ballscrew.

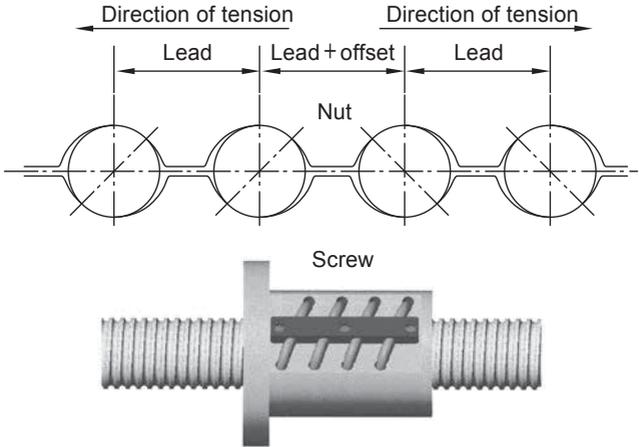


Fig.5.6 Lead offset preload

(2) Relation between preload force and elastic deformation

Fig 5.7, 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 deformation on both Nuts are δ_{a0} . Then there is a external axial force F_a applied to Nut A as shown on Fig 5.6. The deformation of Nut A and B becomes:

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

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

The load in nut A and nut B are:

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

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

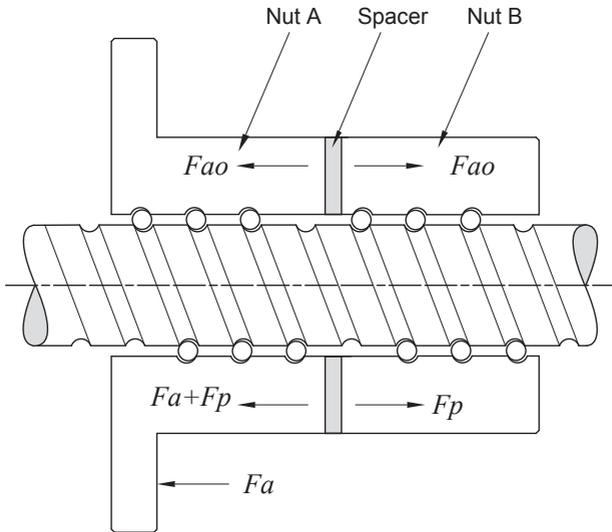


Fig.5.7 Double-nut positioning preload

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:

$$\delta_{a0} = K \times F_{a0}^{2.3} \quad \text{and} \quad 2\delta_{a0} = K \times F_l^{2.3}$$

$$(F_l / F_{a0})^{2.3} = (2\delta_{a0} / \delta_{a0}) = 2$$

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

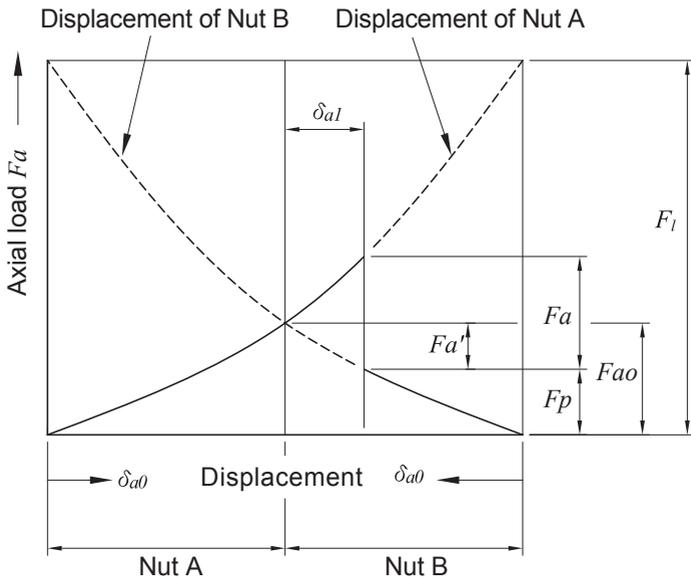


Fig.5.8 Positioning preload diagram

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.5.9, 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.

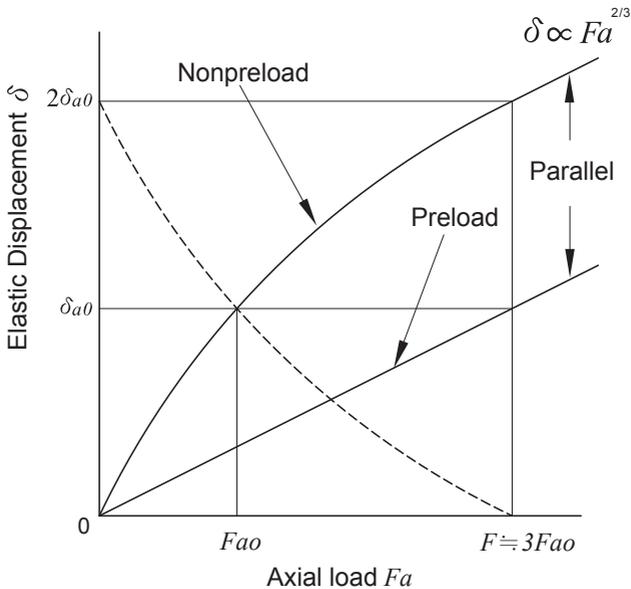


Fig.5.9 Elastic Displacement of the Ballscrew

5.2 Positioning Accuracy

5.2.1 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.

5.2.2 Selecting the lead accuracy

Refer to page A22, the Specified travel line should coincide with the nominal travel line. However, in order to compensate either the elongation caused by the thermal expansion during machine operating or the shortening of length due to external load, the specified travel may be set to be positive or negative to the Nominal travel. Machine designer can show the value of Specified travel on the drawing for our manufacturing, or, we can help to decide it based on our more than ten years experience.

There is another way to compensate thermal effect by "pretension" to Ballscrew. Generally, the pretension force shall elongate the Ballscrew to be equivalent to the thermal expansion at about 2-3°C.

5.2.3 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 (5.10).

$$\Delta L_{\theta} = \rho \cdot \theta \cdot L \dots\dots\dots (5.10)$$

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°C expands the shaft by 12 μm 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.
- Nut cooling system: to reduce temperature of nut by cooling liquid through it.

(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.
- Use the Closed-loop positioning control.

6.1 Life of the Ballscrew

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.

- a. Fatigue life - Time period for surface flaking off happened either on balls or on thread grooves.
- b. 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.

6.2 Fatigue Life

The basic dynamic rate load (C_a) of the Ballscrew is used to calculate its fatigue life when it is operated under a load.

6.2.1 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.

6.2.2 Fatigue life

(1) Calculating life:

There are three ways to show fatigue life:

- a. Total number of revolutions
- b. Total operating time.
- c. Total travel.

$$L = \left(\frac{C_a}{F_a \times f_w} \right)^3 \times 10^6 \dots \dots \dots (6.1)$$

$$L_t = \frac{L}{60 \times n} \dots \dots \dots (6.2)$$

$$L_s = \frac{L \times l}{10^6} \dots \dots \dots (6.3)$$

here

- L* Fatigue life (total number of revolutions)(*rev*)
- L_t* Fatigue life (total operating time)(*hr*)
- L_s* Fatigue life (total travel)(*km*)
- C_a* Basic dynamic rate load(*kgf*)
- F_a* Axial load(*kgf*)
- n* Rotation speed(*rpm*)
- l* Lead(*mm*)
- f_w* Load factor (refer to Table6.1)

Table6.1 Load factor *f_w*

Vibration and impact	Velocity (V)	<i>f_w</i>
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 center20,000 hours
- Production machine.....10,000 hours
- Automatic controller.....15,000 hours
- Surveying instruments.....15,000 hours

(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.Gradiental variation curve (Fig.6.1)

Mean load can be calculated by using equation (6.4):

$$F_m = \left(\frac{F_1^3 \cdot n_1 \cdot t_1 + F_2^3 \cdot n_2 \cdot t_2 + \dots + F_n^3 \cdot n_n \cdot t_n}{n_1 \cdot t_1 + n_2 \cdot t_2 + \dots + n_n \cdot t_n} \right)^{\frac{1}{3}} \dots\dots\dots(6.4)$$

Mean rotational speed can be calculated by using equation (6.5):

$$N_m = \frac{n_1 \cdot t_1 + n_2 \cdot t_2 + \dots + n_n \cdot t_n}{t_1 + t_2 + \dots + t_n} \dots\dots\dots(6.5)$$

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

b.Similar straight line (Fig.6.2)

When mean load variation curve like similar straight line. Mean rotational speed can be calculated using equation (6.6)

$$F_m = 1/3(F_{min} + 2F_{max}) \dots\dots\dots (6.6)$$

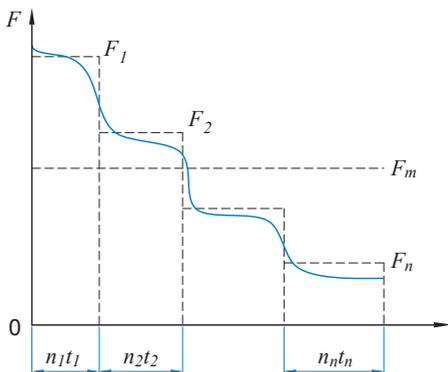


Fig. 6.1 Gradational variation curve's load

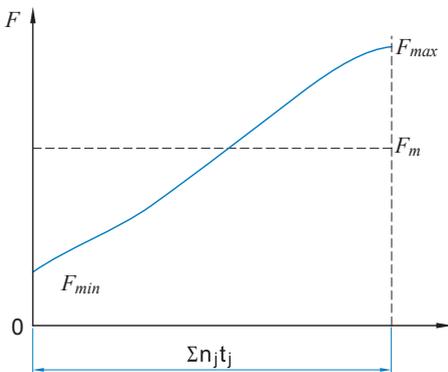


Fig. 6.2 Similar straight line's load

c.Sine curve there are two cases

1. When mean load variation curve shown as the diagram 6.3.1 below. Mean rotational speed can be calculated by using equation (6.7-1):

$$F_m = 0.65F_{max} \dots\dots\dots (6.7-1)$$

2. When mean load variation curve shown as the diagram 6.3.2 below. Mean rotational speed can be calculated by using equation (6.7-2):

$$F_m = 0.75F_{max} \dots\dots\dots (6.7-2)$$

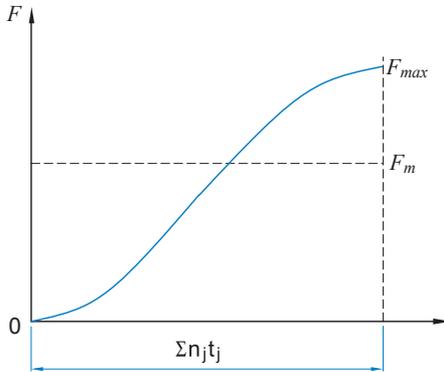


Fig. 6.3.1 Variation like Sine curve's load (1)

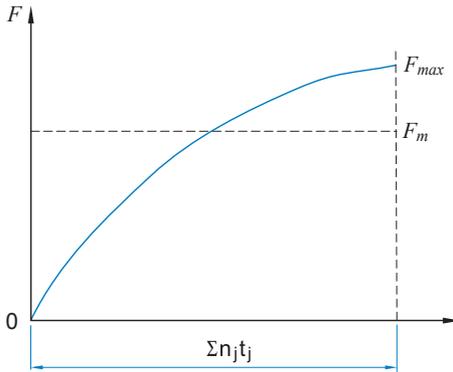


Fig. 6.3.2 Variation like Sine curve's load (2)

6.2.3 Affection of installation errors

When twist load or radial load is applied to Ballscrew, there shall be bad effect on ballscrew operation and its life, It is required to make the feed system (Ballscrew, support bearings, Guideways) to be more rigid. Hence to reduce. installation errors.

Ballscrews must be meticulously installed onto the Yoke (bracket) of machine to achieve precise parallelism and squareness along moving direction of moving parts. It is very important to ensure minimum backlash happens.

Scales of reference calculate for support torque of ball screw, allow fig.6.4

Nut type : R40-10B2-FSWC
specification

shaft diameter : 40 mm

ball diameter : 6.35 mm

effective turns : 2.5 circuit x 2 row

Axial play : 50 μ m

conditions

Axial force $F_a=300$ kgf

Radial displacement:0

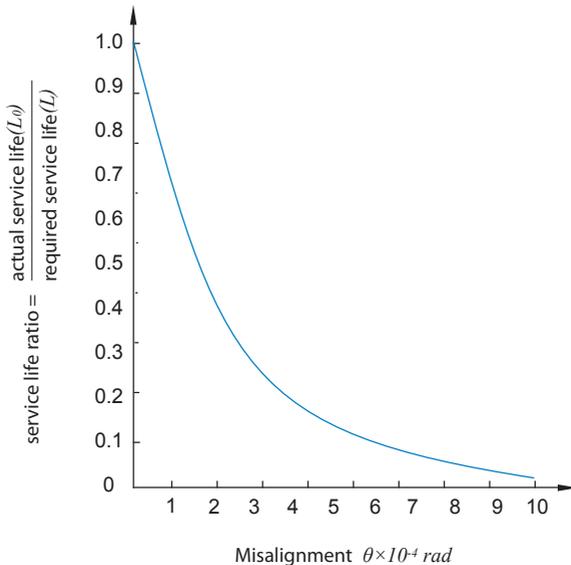


Fig.6.4 The effect on service life of a radial load caused by misalignment

6.3 Permissible Load on Thread Grooves

Even though the Ballscrew is seldom operated and is operated under low velocity, it is required to make the maximum load to be far smaller than its rated basic static load when making selection.

6.3.1 Basic static rate load C_o

The basic static rate load is the static load with a non-varying direction and magnitude that makes the sum of the permanent deformation of the rolling elements and raceway 0.0001 times the rolling element diameter. With the Ballscrew, the basic static rate load is defined in relation to the axial load.

6.3.2 Permissible axial load

$$F_{max} = C_o / f_s$$

here

f_s Static safety factor

General industrial machine..... 1.2~2

Machine tool..... 1.5~3

6.4 Material and Hardness

6.4.1 Material and Hardness of *PMI* Ballscrews

Table 6.2 Material and hardness of Ballscrews

Denomination	Material	Heat treating	Hardness (HRC)
Precision ground	50CrMo4 QT/ Equivalent	Induction hardening	58~62
Rolled	S55C/ Equivalent	Induction hardening	58~62
Nut	SCM420H/ Equivalent	Carburized hardening	58~62

6.4.2 Hardness factor

If used *PMI's* standard materials else one, for a surface hardness of less than HRC58, the basic dynamic rate load (C_a) and the basic static rate load (C_o) must be adjusted. Adjustment is made by the following formula. Show in fig. 6.5

$$C_a' = f_H \times C_a$$

$$C_o' = f_{H'} \times C_o$$

Here

- f_H Hardness coefficient
- $f_{H'}$ Static Hardness coefficient

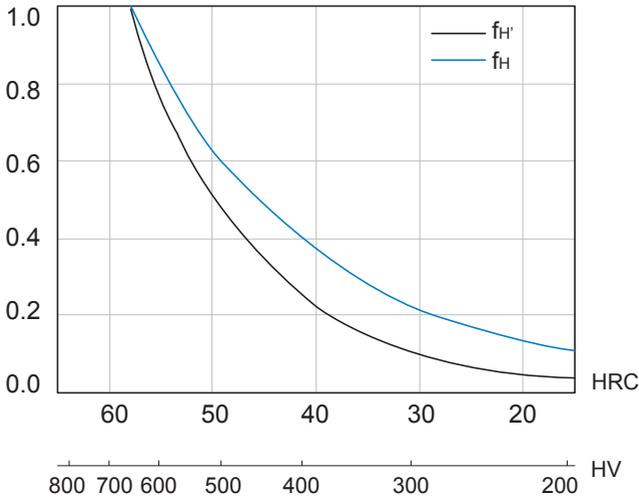


Fig. 6.5 Hardness coefficient

6.5 Heat Treating Inspection Certificate



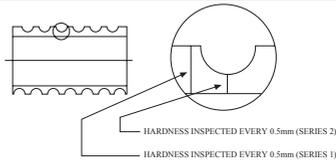
PRECISION MOTION INDUSTRIES, INC.

REPORT FOR HEAT TREATING INSPECTION

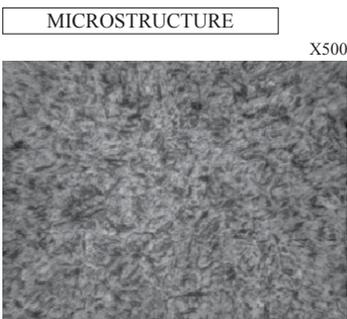


SPECIMEN#	P90227		
CUSTOMER		P.O.NUMBER	SPECIFICATION
PRODUCT	BALLSCREW	03-016030-1	R38-I5B2-FSVC-557-685.8-C4
MATERIAL	50CrMo4QT		
HEATTREAT	INDUCTION SURFACE HARDENING		

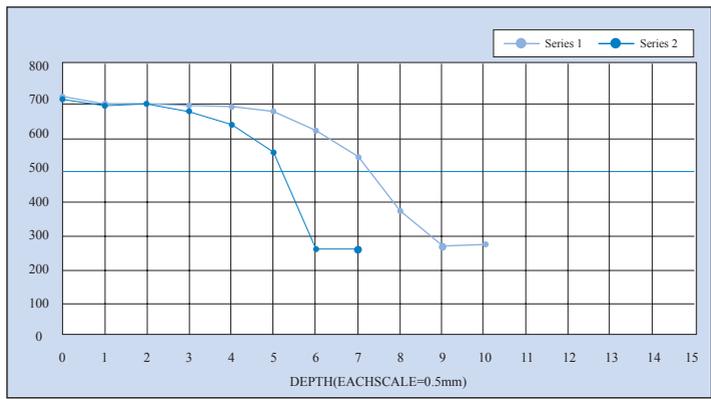
ITEM	INSPECTION DATA	HEATTREATEDARE (SEESKETCH)
HARDNESS	58 - 62 HRC AT SURFACE	
CASEDEPTH	1.5 mm BELOW THREAD ROOT	
MICRO-STRUCTURE	Martensite IN SURFACE AREA Sorbite IN CORE AREA	
TEMPERING	AT 160 DEGREES CELCIUS	



DEPTH	Series1	Series2
0	725	718
1	705	698
2	704	705
3	698	681
4	694	642
5	679	562
6	625	277
7	547	277
8	390	
9	286	
10	288	
11		
12		
13		
14		
15		



HV VS. HRC	
HV	HRC
800	64.0
780	63.3
760	62.5
740	61.8
720	61.0
700	60.1
690	59.7
680	59.2
670	58.8
660	58.3
650	57.8
640	57.3
630	56.8
620	56.3
610	55.7
600	55.2
590	54.7
580	54.1
570	53.6
560	53.0
540	51.7
520	50.5
500	49.1
480	47.7
460	46.1
440	44.5
420	42.7
400	40.8
380	38.8
360	36.6
340	34.4
320	32.2
300	29.8
280	27.1
260	24.0
240	20.3



REMARKS		PASS OR NOT		Q.C.CHIEF		INSPECTOR	
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6.6 Lubrication

Lithium base lubricants are used for Ballscrew lubrication.

Their viscosity are 30~140 cst (40 °C) and ISO grades of 32~100.

Selecting:

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

Table 6.3 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

Table 6.4 calculate of supply lubricate oil

Lubrication method	Principles of inspection and add
oil	<p>Checked and add depending on the tank capacity every week. Oil should be changed when oil is dirty.</p> <p>Calculation of oil Capacity :</p> <p>Capacity of supply oil every 10 min. $Q = \frac{\text{Shaft diameter}(mm)}{90} \text{ c.c.}$</p>

Table 6.5 calculate of supply lubricate grease

Lubrication method	Principles of inspection and add						
grease	<p>Checked every 2~3 months after begin of the operation and see whether foreign matter. Change grease when dirty.</p> <p>Add grease depending on the use condition and operation environment.</p> <p>The add capacity should be the 50% of the internal volume of the nut.</p> <p>Avoid using different brands of grease</p>						
Ball diameter d	Ø1.588	Ø2.0	Ø2.381	Ø2.778	Ø3.175	Ø3.969	Ø4.762
G value	0.8	1.0	1.0	1.5	1.2	1.3	2.0
Ball diameter d	Ø6.350	Ø7.144	Ø7.938	Ø9.525	Ø12.7	Ø15.875	Ø19.05
G value	3.0	3.5	3.9	5.0	6.0	9.6	12

$$Q = \left[\left(\sqrt{(\pi \times dm)^2 + Ld^2} \times \pi d^2 \times \text{effective turns} \right) \times \frac{1}{1000} + \left(\frac{\pi L \times (2DG + G^2)}{4} \right) \right] \times \frac{1}{1100}$$

- Q* Capacity of supply lubricate grease(cm³)
- D* Shaft diameter(mm)
- d* Ball diameter(mm)
- dm* Ball circle diameter(mm)
- G* Size factor of ball
- Ld* Lead(mm)
- L* Length of Nut(mm)

6.7 Dustproof

Same as the rolling bearings, if there is the particles such as chips or water get into the ballscrew, the wearing problem shall be deteriorated. In some serious cases, ballscrew shall then be damaged. In order to prevent these problems from happening, there are wipers assembly at both ends of ballnut and please use the Screw cover or Bellows for better dustproof. Should there be any more information required, please contact us. There is also the "O-Ring" at the wipers to seal the lubrication oil from leaking from ballnut.

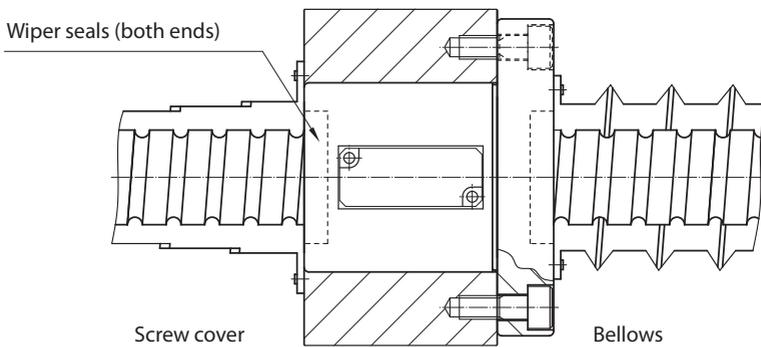


Fig.6.6 Dustproof by screw cover and bellows

7.1 Operating Torque of Ballscrew

(1) Normal Drive

Rotational motion converted to linear motion is called normal drive. The torque required can be obtained by using equation (7.1)

$$T_a = \frac{F_a \times l}{2\pi \times \eta_1} \dots\dots\dots(7.1)$$

here

T_a Normal operation torque
 F_a Axial load
 l Lead
 η Normal efficiency

(2) Reverse operation

Linear motion converted rotational motion is called reverse operation motion. The torque required can be obtained using equation (7.2):

$$T_b = \frac{F_a \times l \times \eta_2}{2\pi} \dots\dots\dots(7.2)$$

here

T_b Reverse operation torque
 η_2 Reverse efficiency

(3) Preload torque

Friction torque due to preload on the Ballscrew, The torque required can be obtained by using equation (7.3):

$$T_p = k \times \frac{F_{ao} \times l}{2\pi} \dots\dots\dots(7.3)$$

here

T_p Preload torque
 F_{ao} Preload
 k Coefficient of preload torque
 see equation(2.1)
 $k=0.05 \times (\tan\beta)^{-0.5}$

7.2 Drive Torque of Motor

(1) Driving torque at constant speed

The torque can counteract load and let Ballscrew to rotate uniformly is called driving torque for constant speed. Driving torque = preloading torque + friction torque for axial load + friction torque for bearing.

$$T_1 = \left(k \times \frac{F_{ao} \cdot l}{2\pi} + \frac{F_a \cdot l}{2\pi \cdot \eta} + T_B \right) \times \frac{N_1}{N_2} \dots\dots\dots (7.4)$$

here

- T_1 Driving torque at constant speed
- F_{a0} Preload
- F_a Axial load
- F Cutting resistance
- μ Guiding surface friction coefficient
- W Total weight (Working table weight + Working object weight)
- T_B Friction torque for bearing
- N_1 Gear one
- N_2 Gear two

In general, driving torque of constant speed motion shall not over than 30% of rated torque of motor.

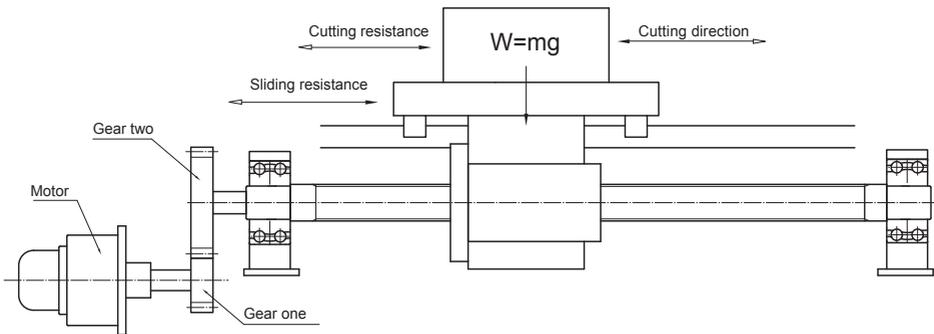


Fig.7.1 Cutting machine diagram

(2) Driving torque at constant acceleration

The torque required to counteract load and to let Ballscrew to rotate at constant acceleration is driving torque at constant acceleration.

$$T_2 = T_1 + J \cdot \dot{\omega} \dots\dots\dots (7.5)$$

$$J = J_M + J_{G1} + \left(\frac{N_1}{N_2}\right)^2 \times [J_{G2} + J_{SH} + J_w + J_C] \dots\dots\dots (7.6)$$

$$J_w = \frac{m}{g} \left(\frac{l}{2\pi}\right)^2 \dots\dots\dots (7.7)$$

Here

- T_2 Driving torque at constant acceleration
- $\dot{\omega}$ Motor's angular acceleration
- J Total inertial
- J_M Inertial of motor
- J_{G1} Inertial of gear one
- J_{G2} Inertial of gear two
- J_{SH} Inertial of screw shaft
- J_w Inertial of moving parts (Ballscrew, Table)
- J_C Inertial of Coupling
- m Total Masses (Working table mass + working piece mass)
- l Lead
- g Gravitational acceleration

- Cylindric inertia (Ballscrew, gear)

$$J = \frac{1}{32} \rho \pi D^4 L \quad (kg \cdot m^2) \dots\dots\dots(7.8)$$

$$= \frac{\pi \gamma}{32g} D^4 L \quad (kg \cdot m^2) \dots\dots\dots(7.9)$$

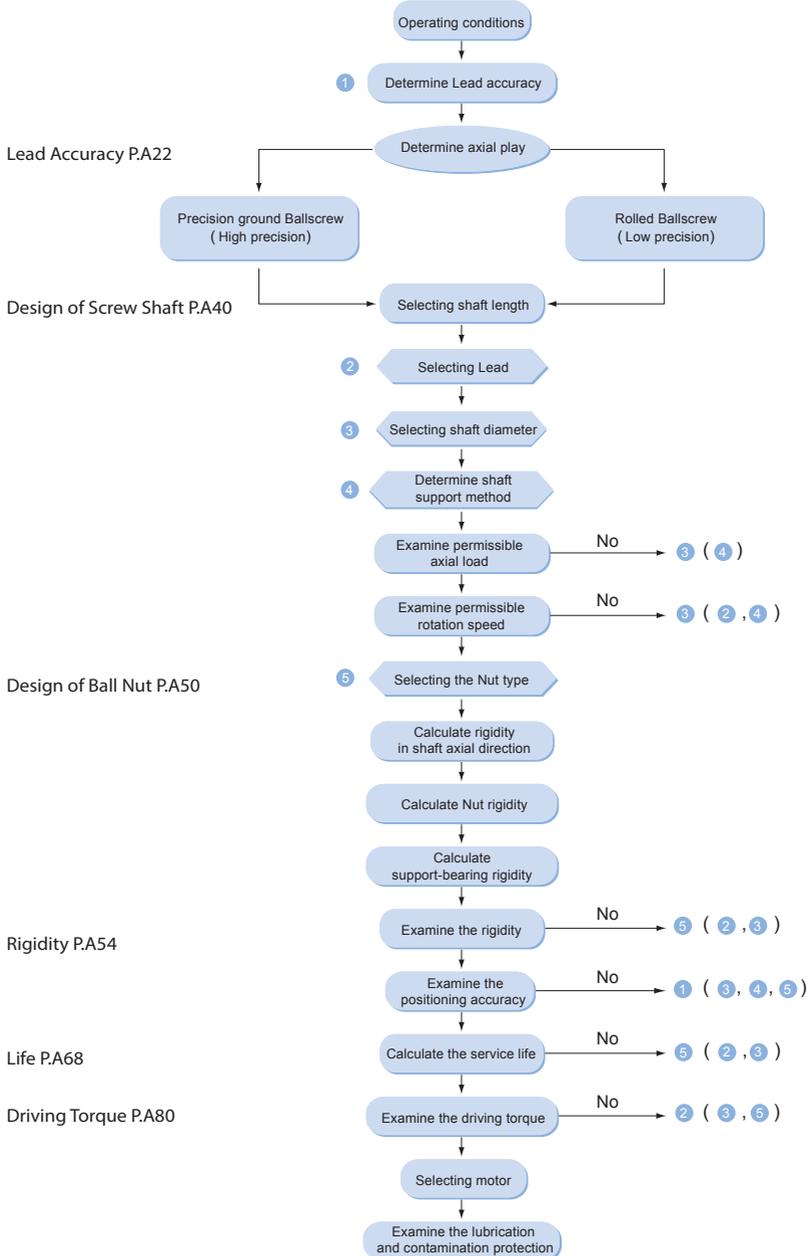
$$= \frac{mD^2}{8} \quad (kg \cdot m^2) \dots\dots\dots(7.10)$$

Here

- ρ Material Density
- γ Specific Gravity
- D Diameter of Cylinder
- L Length of Cylinder
- m Mass of Cylinder

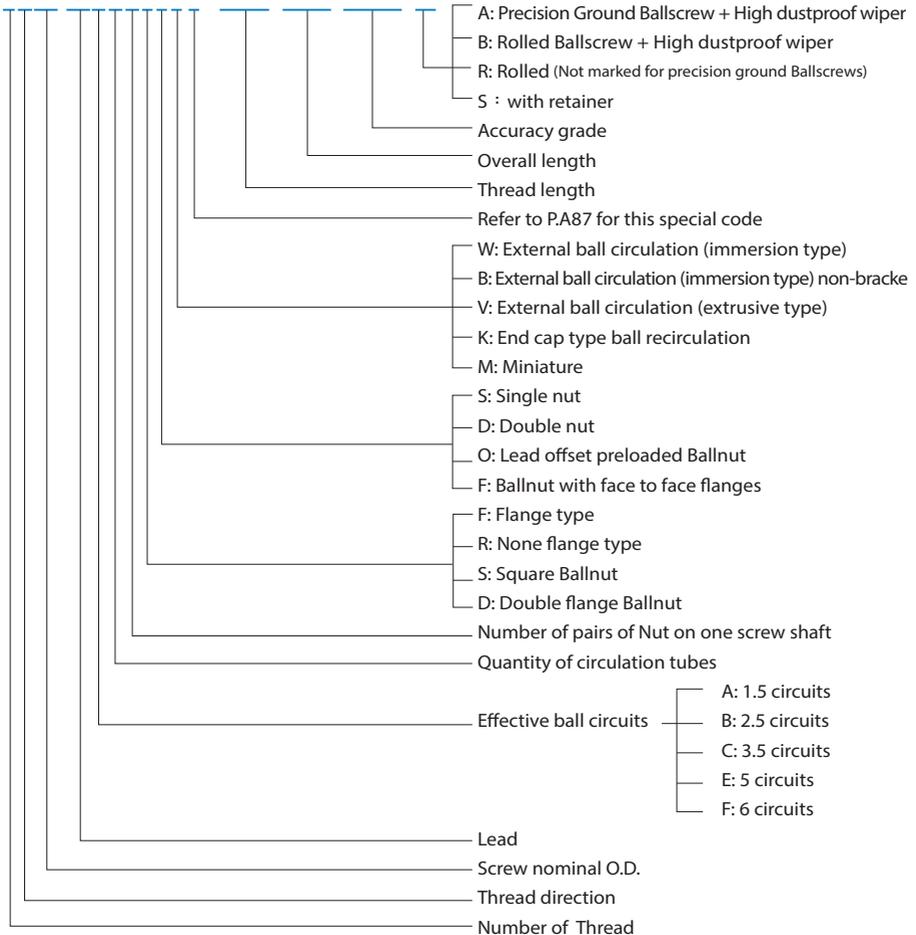
8

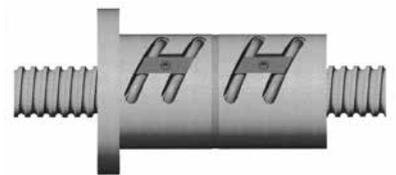
Flow Chart for Selecting Correct Type of Ballscrew



9.1 Nomenclature of External Circulation Ballscrew

4R50-10B2-2FSWC -1000 -1500 -0.018 R





TYPE
FDWC



TYPE
DFWC



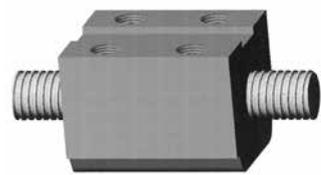
TYPE
FSWC



TYPE
FOWC



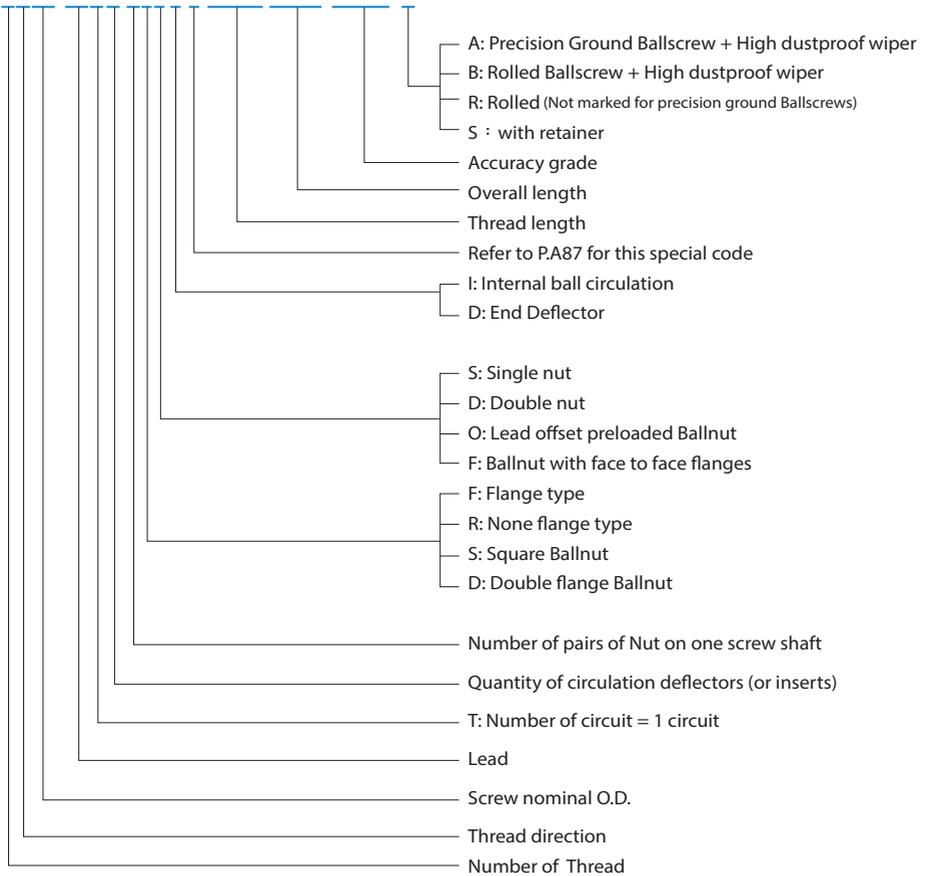
TYPE
RSWC



TYPE
SSWC

9.2 Nomenclature of Internal Circulation Ballscrew

4R50-10T 4-2FS I C -1000 -1500 -0.018 R



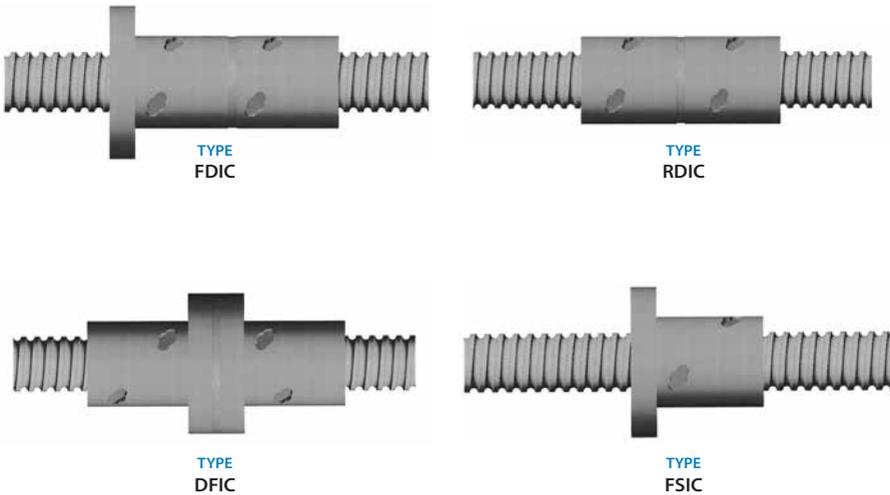


Table 9.1 Special code

C	Precision ground threads
W	Rolled threads
E	E type ball circulation tube (<i>PMT's</i> patent)
Q	Self lubrication
T	Ballnut rotation (Instead of regular screw shaft rotation type Ballscrew)
D	E type tube + Self lubrication
H	Ballscrews For Heavy Load
N	Nut of DIN type
M	Blank Shaft End Type

10.1 Cutting Machine

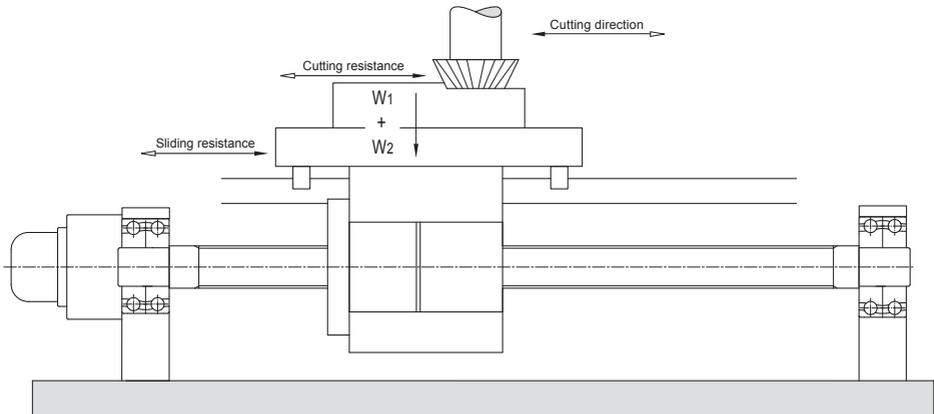


Fig.10.1 Cutting machine

1 \ Design Conditions

Table weight:	$W_1 = 1100 \text{ kg}$
Work piece weight:	$W_2 = 800 \text{ kg}$
Max. travel:	$S_{max} = 1000 \text{ mm}$
Rapid feed speed:	$V_{max} = 14 \text{ m/min}$
Life:	$L_t = 25000 \text{ h}$
Sliding surface friction coefficient:	$\mu = 0.1$
Driving motor:	$N_{max} = 2000 \text{ rpm}$
Positioning accuracy:	$\pm 0.030/1000 \text{ mm}$ (no load)
Repeatability accuracy:	$\pm 0.005 \text{ mm}$ (no load)
Lost Motion:	0.02 mm (no load)

2 \ Mechanical Conditions

Kinds of Operation	Calculation data	Axial load (kgf)		Feed speed	Time
		Cutting resistance	Sliding resistance	mm/min	ratio(%)
Rapid feed		0	190	14000	30
Light cutting		500	190	600	55
Heavy cutting		950	190	120	15

$$\begin{aligned}
 \text{Sliding resistance: } Fa &= \mu (W_1 + W_2) \\
 &= 0.1 \times (1100 + 800) \\
 &= 190 \text{ (kgf)}
 \end{aligned}$$

3 \ Items to Be Decided

1. Screw nominal O.D., Lead, Type of Nut
2. Accuracy grade
3. Thermal displacement
4. Driving motor

1 \ Selecting Screw nominal O.D., Lead, Nut

(1) Lead(l) :

The highest rotation speed of motor

$$l \geq \frac{V_{max}}{N_{max}} = \frac{14000}{2000} = 7 \text{ (mm)}$$

◎Lead have to be 7mm or more.

(As per PMI catalog: select 8 and 10 mm for further analysis)

(2) Basic dynamic rate load (Ca)

Kinds of Operation	Calculation data	Feed speed		Time
	Axial load	$l = 8$	$l = 10$	ratio(%)
Rapid feed	$F_1 = 190$	$N_1 = 1750$	$N_1 = 1400$	$t_1 = 30$
Light cutting	$F_2 = 690$	$N_2 = 75$	$N_2 = 60$	$t_2 = 55$
Heavy cutting	$F_3 = 1140$	$N_3 = 15$	$N_3 = 12$	$t_3 = 15$

Calculation of mean load and mean rotation

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

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

Lead l (mm)	8	10
Mean load F_m (kgf)	330	330
Mean rotation N_m (rpm)	569	455

Calculation of basic dynamic rate load

$$L = \left(\frac{Ca}{Fa \times f_w} \right)^3 \times 10^6 \quad L_t = \frac{L}{60N_m}$$

$$\Rightarrow Ca = (60N_m \times L_t)^{1/3} \times F_m \times f_w \times 10^{-2}$$

As per design Conditions:

$$L_t = 25000 \text{ (hours)}$$

$$f_w = 1.2$$

When $l=8(mm)$ $Ca \geq 3756 \text{ (kgf)}$

If life > 25000 (hours) is needed,

Ca must be > 3756 (kgf)

When $l=10(mm)$ $Ca \geq 3487 \text{ (kgf)}$

If life > 25000 (hours) is needed,

Ca must be > 3487 (kgf)

(3) Selecting the type of nut

In case stiffness is a major concern, lost motion becomes less important, following specifications are to be selected:

- External circulation Ballscrew
- Type: FDWC
- Number of circuit: B×2 or B×3

The value of Ca can be found as per this catalog:

(kgf)

Screw nominal O.D.(mm)	lead 8 (mm)		lead 10 (mm)	
	B×2	B×3	B×2	B×3
32	3210	-	4660	-
36	3265	-	4930	-
40	3410	-	5220	-
45	3650	5175	5480	7760
50	3900	5520	5790	8200

(4) Selecting screw shaft diameter

Ballscrew shaft diameter can be decided by critical rotation speed of high speed feed.

Assume both of the supporting ends are fixed.

So the permissible rotational speed :

$$n = \alpha \times \frac{60\lambda^2}{2\pi L^2} \sqrt{\frac{EIg}{\gamma A}} = f \cdot \frac{dr}{L^2} \times 10^7$$

$$\Rightarrow dr \geq \frac{n \times L^2}{f} \times 10^7$$

L = Max. stroke + Nut length/2 + Unthread area length

= 1000 + 100 + 200 = 1300 (mm)

Screw shaft supported method is fixed-fixed

$$\Rightarrow f = 21.9$$

when $l = 8$ (mm) $dr \geq 13.5$ (mm)

If the highest rotational speed reaches 1750 rpm,

screw shaft diameter at thread root area must be bigger than 14 mm.

© So screw shaft diameter shall be ranged in between 20 and 50 mm.

When $l = 10$ (mm) $dr \geq 10.8$ (mm)

If the highest rotational speed reaches 1400 rpm,

screw shaft diameter at thread root area must be bigger than 11 mm.

© So screw shaft diameter shall be ranged in between 16 and 50 mm.

(5) Considering rigidity

By initial conditions:

Lost motion : 0.02 mm (no load)

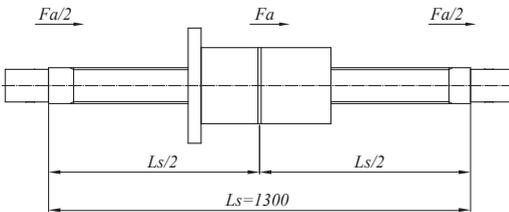
Assume total displacement of components (including screw shaft, ballnut and support bearing) of feed system is 0.016 mm. Thus the unilateral elastic displacement of feed system is

$$\Delta L \leq 8 (\mu m)$$

a. Axial rigidity of the screw shaft: K_s **Elastic displacement of the screw shaft: ΔL_s**

$$K_s = \frac{A \times E \times L}{x(L-x)} \times 10^{-3}$$

The smallest elastic displacement is in the middle of screw shaft.

From following diagram Using $x=L/2$ 

$$\Rightarrow K_s = \frac{\pi \times d^2 \times E}{L_s} \times 10^{-3}$$

$$\Delta L_s = \frac{Fa}{K_s} = \frac{Fa \times L_s}{\pi \times d^2 \times E} \times 10^3$$

Here Fa is sliding resistance of 190 (kgf)

The results are in the table 10.1.

b. Axial rigidity of the nut: K_n **Elastic displacement of the nut: ΔL_n**

Setting the preload to be 1/3 of maximum axial load.

$$F_{ao} = F_{max} / 3 = 1140 / 3 = 380 \text{ (kgf)}$$

$$K_n = 0.8 \times K \left(\frac{F_{ao}}{\varepsilon \times Ca} \right)^{1/3}$$

 $\varepsilon = 0.1$, then

$$\Delta L_n = \frac{Fa}{K_n}$$

The results are in the table 10.1.

Table 10.1

Nut model no.	d_r	Ca	K	Screw		Nut		Total ΔL
				K_s	ΔL_s	K_n	ΔL_n	
32-10B2-FDWC	27.05	4660	125	37.1	5.1	93.0	2.0	7.1
36-10B2-FDWC	31.05	4930	138	48.9	3.9	101.2	1.9	5.8
40-10B2-FDWC	35.05	5220	151	62.3	3.0	108.7	1.7	4.7
45-10B2-FDWC	38.05	5480	167	73.5	2.6	118.3	1.6	4.2
50-10B2-FDWC	42.05	5790	182	89.7	2.1	126.5	1.5	3.6

© With the condition of $\Delta L \leq 8 (\mu m)$

Make following selection by ignoring the bearing rigidity, economical and safety consideration:

Type of Ballscrew : 40-10B2-FDWC
 Screw shaft diameter : 40 (mm)
 Lead : 10 (mm)

(6) Length of Ballscrew

$$\begin{aligned}
 L &= \text{Max. travel} + \text{Nut length} + \text{Unthreaded area length} \\
 &= 1000 + 180 + 100 \quad (\text{including journal ends length}) \\
 &= 1280 \\
 &\approx 1300 \text{ (mm)}
 \end{aligned}$$

(7) Preliminary check

a. Fatigue life

$$\begin{aligned}
 L_t &= \left(\frac{Ca}{F_m \times f_w} \right)^3 \times 10^6 \times \frac{1}{60n} \\
 &= \left(\frac{5220}{330 \times 1.2} \right)^3 \times 10^6 \times \frac{1}{60 \times 455} \\
 &\approx 83900 \text{ (hours)} \geq 25000 \text{ (hours)}
 \end{aligned}$$

b. Permissible rotational speed

$$\begin{aligned} n &= f \times \frac{dr}{L^2} \times 10^7 \\ &= 4540 \text{ (rpm)} \end{aligned}$$

Critical speed of screw shaft is 4540(rpm). It is much bigger than the maximum rotational speed of design. So the Ballscrew selected is safe.

2 \ Selecting lead accuracy

Positioning accuracy required: $\pm 0.030/1000$ mm (Max. travel) Refer to table 2.2, accumulated reference lead deviation ($\pm E$) and total relative variation (e)

Accuracy grades: C4

$E = \pm 0.025/1250$ (mm)

$e = 0.018$ (mm)

3 \ Considering thermal displacement

According to the load capability of support bearings, make the specified travel (T) compensation to be 3°C

1. Thermal displacement: ΔL_θ

$$\begin{aligned} \Delta L_\theta &= \rho \cdot \theta \cdot L \\ &= 12.0 \times 10^{-6} \times 3 \times 1300 \\ &= 0.047 \text{ (mm)} \end{aligned}$$

2. Pretension force: F_θ

$$\begin{aligned} F_\theta &= \Delta L_\theta \times K_S = \frac{\Delta L_\theta \cdot E \cdot \pi dr^2}{4L} \\ &= \frac{0.047 \times 2.1 \times 10^4 \times \pi \times 27.05^2}{4 \times 1300} \\ &= 436 \text{ (kgf)} \end{aligned}$$

Specified Travel (T): -0.047/1300

Pretension force: 436 (kgf)

Stretching: -0.047 (mm)

4 · Selecting driving motor

<Required specifications>

1. The highest rotation speeds is 1500 (*rpm*)
2. Time required to reach highest rotational speed is within 0.15 *sec*.

(1) Inertial

a. Screw shaft:

$$GD_s^2 = \frac{\pi \rho}{8} \times D^4 \times L = \frac{\pi \times 7.8 \times 10^{-3}}{8} \times 4^4 \times 130 = 101.9 \text{ (kgf} \cdot \text{cm}^2)$$

b. Moving parts:

$$GD_w^2 = W \left(\frac{l}{\pi} \right)^2 = (1100 + 800) \times \left(\frac{1.0}{\pi} \right)^2 = 192.5 \text{ (kgf} \cdot \text{cm}^2)$$

c. Coupling:

$$GD_j^2 = 40 \text{ (kgf} \cdot \text{cm}^2)$$

d. Total of inertial:

$$GD_L^2 = GD_s^2 + GD_w^2 + GD_j^2 = 334.4 \text{ (kgf} \cdot \text{cm}^2)$$

(2) Driving torque

In this case, the time sharing of machine working at acceleration condition is limited. Assuming the machine works at constant speed, the torque caused by angular acceleration is then neglected.

a. Preloading torque

$$T_p = k \times \frac{F_{ao} \times l}{2\pi} = 0.18 \times \frac{380 \times 1.0}{2\pi} = 10.8 \text{ (kgf} \cdot \text{cm)}$$

$$k = 0.18$$

$$F_{ao} = F_{max}/3$$

b. Friction torque

Rapid feed:

$$T_a = \frac{F_a \times l}{2\pi \times \eta} = \frac{190 \times 1.0}{2\pi \times 0.9} = 33.6 \text{ (kgf}\cdot\text{cm)}$$

Light cutting:

$$T_b = \frac{690 \times 1.0}{2\pi \times 0.9} = 122.1 \text{ (kgf}\cdot\text{cm)}$$

Heavy cutting:

$$T_c = \frac{1140 \times 1.0}{2\pi \times 0.9} = 201.7 \text{ (kgf}\cdot\text{cm)}$$

The maximum required driving torque is preloading torque plus friction torque of heavy cutting.

$$\begin{aligned} T_L &= T_p + T_c \\ &= 212.5 \text{ (kgf}\cdot\text{cm)} \end{aligned}$$

(3) Selecting driving motor

<Selecting conditions>

a. The highest rotation speed: $N_{max} \geq 1500 \text{ (rpm)}$ b. Rated torque: $T_M > T_L$ c. Rotor inertia: $J_M \geq J_L / 3$

The specifications required for driving motor are then decided as per above conditions.

◎ Motor specifications:

Output	$W_M = 3.6 \text{ (kW)}$
Highest rotation speeds	$N_{max} = 1500 \text{ (rpm)}$
Rated torque	$T_M = 22.6 \text{ (N}\cdot\text{m)}$
Rotor inertia	$GD_M^2 = 750 \text{ (kgf}\cdot\text{cm}^2)$

(4) Check required time period for reaching highest rotation speed

$$t_a = \frac{J}{T'_M T_L} \times \frac{2\pi N}{60} \times f$$

Here

$$J : \text{Total inertia } J = \frac{GD^2}{4g}$$

$$T'_M = 2 \times T_M$$

T_L : Rotation Torque (rapid)

f : Safe factor (choose 1.4 for this case)

$$t_a = \frac{(334.3+750)}{4 \times 980 \times (2 \times 230 - (18.1+33.6))} \times \frac{2\pi \times 1400}{60} \times 1.4 = 0.139 \text{ (sec)} < 0.15 \text{ (sec)}$$

This above motor specifications match design needs.

5 \ Calculating the stress of the Ballscrew

$$\sigma = \frac{F}{A} = \frac{F_{max}}{\pi dr^2/4} = \frac{1140 \times 9.8 \times 4}{\pi \times 35.05^2} = 11.56 \text{ N/mm}^2 = 1.16 \times 10^7 \text{ N/m}^2$$

(dr is screw shaft thread root diameter)

$$dr = 40 + 1.4 - 6.35 = 35.05 \text{ (mm)}$$

$$\tau = \frac{T \times r}{J} = \frac{21540 \times 20}{148167} = 2.91 \text{ N/mm}^2 = 2.91 \times 10^6 \text{ N/m}^2$$

$$T_{max} = T_L = 219.8 \text{ (kgf}\cdot\text{cm)} = 21540 \text{ (N}\cdot\text{mm)}$$

$$J = \frac{\pi dr^4}{32} = \frac{\pi (35.05^4)}{32} = 148167 \text{ (mm}^4\text{)}$$

$$\sigma_{max} = \sqrt{\sigma^2 + \tau^2} \\ = 11.9 \times 10^6 \text{ N/m}^2$$

50CrMo4 steel tension strength is $1.1 \times 10^8 \text{ N/m}^2 > \sigma_{max}$

Yield strength is $0.9 \times 10^8 \text{ N/m}^2 > \sigma_{max}$

◎ So the Ballscrew selected is safe.

6 、 Calculating the buckling load of the screw shaft

$$P = \alpha \frac{\pi^2 nEI}{L^2} = m \frac{d r^4}{L^2} \times 10^3 = 20.3 \times \frac{35.05^4}{1100^2} \times 10^3 = 25300 \text{ (kgf)} > F_{max} \text{ (1140 kgf)}$$

◎ So the Ballscrew selected is safe.

10.2 High Speed Porterage Apparatus (Horizontal application)

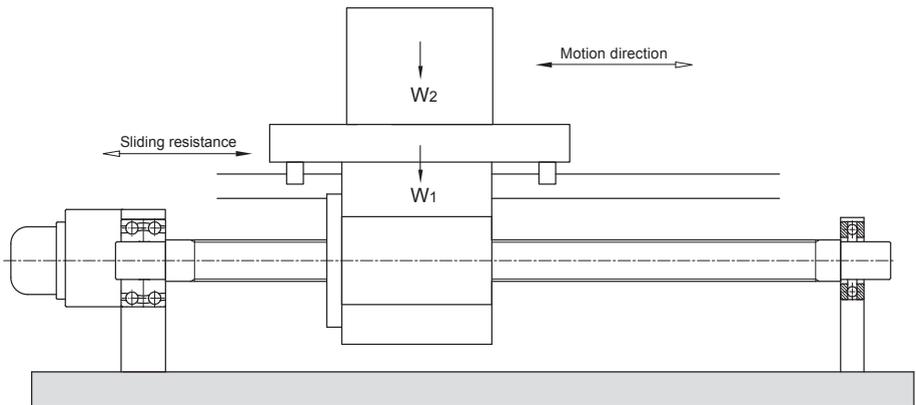


Fig.10.2 High speed porterage apparatus

1 \ Design Conditions:

Table weight:	$W_1 = 50 \text{ kg}$
Work piece weight:	$W_2 = 25 \text{ kg}$
Max. travel:	$S_{max} = 1000 \text{ mm}$
Rapid feed speed:	$V_{max} = 50 \text{ m/min}$
Life:	$L_r = 25000 \text{ hours}$
Guiding surface friction coefficient:	$\mu = 0.01$
Driving motor:	$N_{max} = 3000 \text{ rpm}$
Positioning Accuracy:	$\pm 0.10/\text{at max. travel}$
Repeatability Accuracy:	$\pm 0.01 \text{ mm}$

2 \ Motion Conditions:

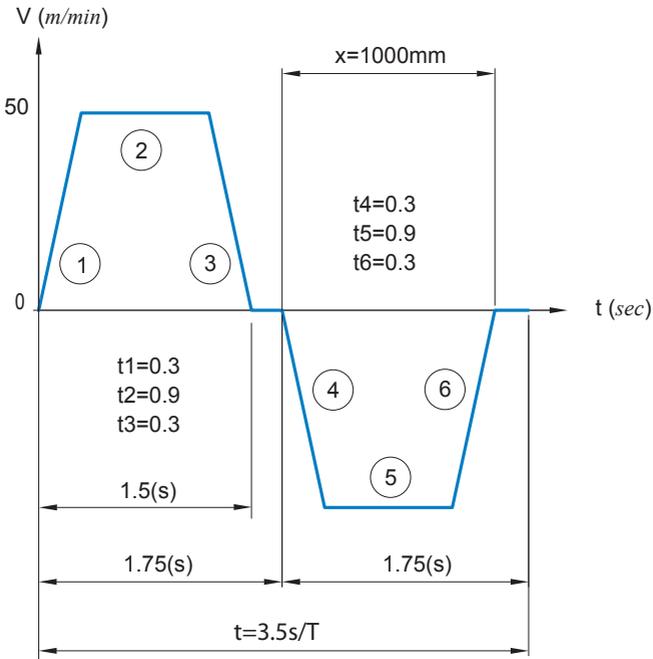


Fig.10.3 Porterage apparatus v-t diagram

3 \ Items to be decided

1. Screw nominal O.D., Lead
2. Accuracy grade
3. Type of nut
4. Driving motor

1 \ Selecting Screw nominal O.D., Lead

(1) Lead (l)

The highest rotation speed of motor

$$l \geq \frac{V_{max}}{N_{max}} = \frac{50000}{3000} \doteq 17 \text{ (mm)}$$

◎Lead have to be 18 mm or more.

(As per *PMI* catalog : select 20 mm for further analysis)

If lead is 20 mm, the highest rapid feed speed 50 m/min shall be reached as long as the motor rotates at 2500 rpm.

(2) Initial selection of screw shaft length

$$\begin{aligned} L &= \text{Max. travel} + \text{Nut length} + \text{Unthreaded area length} \\ &= 1000 + 100 + 100 = 1200 \text{ (mm)} \end{aligned}$$

(3) Selecting screw shaft diameter

Ballscrew shaft diameter can be decided by critical rotation speed of high speed feed.

Assume the supporting ends are fixed-supported.

So the permissible rotational speed :

$$\begin{aligned} n &= \alpha \times \frac{60\lambda^2}{2\pi L^2} \sqrt{\frac{EIg}{\gamma A}} = f \frac{dr}{L^2} \times 10^7 \\ \Rightarrow dr &\geq \frac{n \times L^2}{f} \times 10^{-7} \end{aligned}$$

$$\begin{aligned} L &= \text{Max. travel} + \text{Nut length}/2 + \text{Unthread area length} \\ &= 1000 + 50 + 100 = 1150 \text{ (mm)} \end{aligned}$$

Screw shaft support method is fixed-supported

$$f = 15.1$$

$$d_r \cong 21.9 \text{ (mm)}$$

If the high rotational speed is 2500 *rpm*,

Diameter at thread root area must be bigger than 22 *mm*.

◎ So Screw-shaft diameter shall be ranged in between 25 and 36 *mm*

(4) Considering service life

First to analyze Fig.10.3 (V-t diagram)

The speed line is a straight one, hence it is a constant acceleration, periodically reciprocating motion.

Maximum velocity : $V_{max} = 50 \text{ (m/min)} = 0.83 \text{ (m/s)}$

Acceleration time : $t_1 = 0.3 \text{ (s)}$

Deceleration time : $t_3 = 0.3 \text{ (s)}$

a. Running distance during acceleration

$$\begin{aligned} x_1 &= \left(\frac{V_0 + V}{2} \right) \times t = \left(\frac{0 + 0.83}{2} \right) \times 0.3 \\ &= 0.125 \text{ (m)} = 125 \text{ (mm)} \end{aligned}$$

b. Running distance during constant speed

$$\begin{aligned} x_2 &= V \cdot t = 0.83 \times 0.9 \\ &= 0.75 \text{ (m)} = 750 \text{ (mm)} \end{aligned}$$

c. Running distance from highest speed to stop

$$x_3 = \left(\frac{V_0 + V}{2} \right) \times t = \left(\frac{0.83 + 0}{2} \right) \times 0.3 = 0.125 \text{ (m)} = 125 \text{ (mm)}$$

d. The line segment

$$a_1 = \frac{V_{max}}{t_1} = \frac{0.833}{0.3} = 2.8 \text{ (m/s}^2\text{)}$$

$$F_1 = \mu (W_1 + W_2) \times g + (W_1 + W_2) \times a_1 = 0.01 \times (50 + 25) \times 9.8 + (50 + 25) \times 2.8 = 217 \text{ (N)}$$

$$N_1 = n_{max} / 2 = 2500 / 2 = 1250 \text{ (rpm)}$$

e. The line segment

$$F_2 = f = \mu(W_1 + W_2) \times g = 0.01 \times (50 + 25) \times 9.8 = 7.35 \text{ (N)}$$

$$N_2 = 2500 \text{ (rpm)}$$

f. The line segment

$$F_3 = \mu(W_1 + W_2) \times g + (W_1 + W_2) \times a_3 = 0.01 \times (50 + 25) \times 9.8 + (50 + 25) \times (-2.8) = -203 \text{ (N)}$$

$$N_3 = n_{max} / 2 = 2500 / 2 = 1250 \text{ (rpm)}$$

When the relationship between the applied axial load, running distance, time and mean rotation can be as follows:

Motion	Axial load	Running distance	Time	Mean rotation
Acceleration forward	217	125	0.3	1250
Constant speed forward	7.35	750	0.9	2500
Deceleration forward	-203	125	0.3	1250
Acceleration returning	-217	125	0.3	1250
Constant speed returning	-7.35	750	0.9	2500
Deceleration returning	203	125	0.3	1250

g. Calculation of mean load and mean rotation:

$$F_m = \left(\frac{F_1^3 \cdot n_1 \cdot t_1 + F_2^3 \cdot n_2 \cdot t_2 + \dots + F_n^3 \cdot n_n \cdot t_n}{n_1 \cdot t_1 + n_2 \cdot t_2 + \dots + n_n \cdot t_n} \right)^{\frac{1}{3}} = \left(\frac{217^3 \times 1250 \times 0.6 + 7.35^3 \times 2500 \times 1.8 + 203^3 \times 1250 \times 0.6}{1250 \times 0.6 + 2500 \times 1.8 + 1250 \times 0.6} \right)^{\frac{1}{3}}$$

$$= 132.4 \text{ (N)}$$

$$N_m = \frac{n_1 \cdot t_1 + n_2 \cdot t_2 + \dots + n_n \cdot t_n}{t} = \frac{1250 \times 0.6 + 2500 \times 1.8 + 1250 \times 0.6}{3.5} = 1714 \text{ (rpm)}$$

h. Calculation of life

$$L_t = \left(\frac{Ca}{F_m \times f_w} \right)^3 \times \frac{1}{60 N_m} \times 10^6 = \left(\frac{1170 \times 9.8}{132.4 \times 2.5} \right)^3 \times \frac{1}{60 \times 1714} \times 10^6$$

$$= 404000 \geq 25000 \text{ (hours)}$$

©Above conforms design requirements.

2 \ Selecting accuracy grade

Positioning accuracy of $\pm 0.1/1000$ mm (Max. travel) From P.A24

Accuracy grade: C5

$$E = \pm 0.040/1000$$

$$e = 0.027$$

3 \ Selecting Ballscrew type

Considering operation conditions, effective turns of A1 is selected.

Selecting following type:

R25-20A1-FSWE-1000-1160-0.018

Screw-shaft support method is fixed-supported

4 \ Selecting driving motor

<Required specifications>

1.The highest rotation speed of 3000 (rpm)

2.Time required to reach highest rotational speed is within 0.30 sec

(1) Inertial

a. Screw shaft:

$$J_{SH} = \frac{\pi \rho}{32g} \times D^4 \times L = \frac{\pi \times 7.8 \times 10^{-3}}{32 \times 980} \times 2.5^4 \times 120 = 0.0037 \text{ (kgf} \cdot \text{cm} \cdot \text{sec}^2\text{)}$$

b. Moving parts:

$$J_w = \frac{W}{g} \left(\frac{l}{2\pi} \right)^2 = \frac{25+50}{980} \left(\frac{2}{2\pi} \right)^2 = 0.0078 \text{ (kgf} \cdot \text{cm} \cdot \text{sec}^2\text{)}$$

c. Coupling:

$$J_C = 0.0005 \text{ (kgf} \cdot \text{cm} \cdot \text{sec}^2\text{)}$$

d. Total of Inertial:

$$J_L = J_{sh} + J_w + J_C = 0.012 \text{ (kgf} \cdot \text{cm} \cdot \text{sec}^2\text{)}$$

(2) Driving torque

a. During constant speed:

$$T_l = \frac{F_2 \times l}{2 \times \eta} = \frac{7.35 \times 2}{2 \times 0.9} = 2.6 \approx 3.00 \text{ (N}\cdot\text{cm)}$$
$$\eta = 0.9$$

b. During acceleration

$$T_2 = T_l + J\dot{\omega} = T_l + (J_L + J_M) \times \frac{2\pi n}{60t_1} = 3 + (0.009 + 0.01) \times 9.8 \times \left(\frac{2\pi \times 2500}{60 \times 0.3} \right) = 166 \text{ (N}\cdot\text{cm)}$$

preselect motor, and give the specifications for the rate inertia

$$J_M = 0.01 \text{ (kgf}\cdot\text{cm}\cdot\text{sec}^2)$$

c. During deceleration

$$T_3 = T_l - J\dot{\omega} = T_l - (J_L + J_M) \times \frac{2\pi n}{60t_3} = 3 - (0.009 + 0.01) \times 9.8 \times \left(\frac{2\pi \times 2500}{60 \times 0.3} \right) = -160 \text{ (N}\cdot\text{cm)}$$

(3) Selecting driving motor

<Selecting conditions>

1. The highest rotation speed: $N_{max} \geq 3000 \text{ (rpm)}$
2. Rated torque ----- $T_M > T_L$
3. Rotor inertia ----- $J_M \geq J_L / 3$

The specifications required for driving motor are then decided as per above conditions.

◎ Motor specifications:

Output	$W_M = 400 \text{ (kW)}$
Highest rotation speeds	$N_{max} = 3000 \text{ (rpm)}$
Rated torque	$T_M = 1.27 \text{ (N}\cdot\text{m)}$
Rotor inertia	$J_M = 0.01 \text{ (kgf}\cdot\text{cm}\cdot\text{sec}^2)$

(4) Effective torque:

$$T_{rms} = \sqrt{\frac{T_2^2 \times t_a + T_l^2 \times t_b + T_3^2 \times t_c}{t}} = \sqrt{\frac{166^2 \times 0.6 + 3^2 \times 1.8 + 160^2 \times 0.6}{3.5}} = 95 \text{ (N}\cdot\text{cm)} < 127 \text{ (N}\cdot\text{cm)}$$

◎ It conforms to design requirements.

(5) Time required to reach highest rotational speed.

$$t_a = \frac{J}{T_M - T_L} \times \frac{2\pi n}{60} \times f$$

Here:

J : Total inertia

$T_M' = 2 \times T_M$

T_L : Rotation Torque (rapid)

f : Safe factor (choose 1.4 for this case)

$$t_a = \frac{0.009+0.01}{2 \times 127 \times 3} \times 9.8 \times \frac{2\pi \times 2500}{60} \times 1.4 = 0.27 \text{ (s)} < 0.3 \text{ (s)}$$

◎ It conforms to design requirements.

5 \ Calculating the stress of the Ballscrew

$$\sigma = \frac{F}{A} = \frac{F_{max}}{\pi dr^2/4} = \frac{217 \times 4}{\pi \times 22.425^2} = 0.61 \text{ N/mm}^2 = 6.1 \times 10^5 \text{ N/m}^2$$

$$dr = 25 + 1 - 4.762 = 21.238 \text{ (mm)}$$

(dr is screw shaft thread minor diameter)

$$\tau = \frac{T \times r}{J} = \frac{1660 \times 12.5}{24827} = 0.84 \text{ N/mm}^2 = 8.4 \times 10^5 \text{ N/m}^2$$

$$T_{max} = T_L = 166 \text{ (N}\cdot\text{cm)} = 1660 \text{ (N}\cdot\text{mm)}$$

$$J = \frac{\pi dr^4}{32} = \frac{\pi (22.425^4)}{32} = 24827 \text{ (mm}^4\text{)}$$

$$\sigma_{max} = \sqrt{\sigma^2 + \tau^2} = 0.10 \times 10^8 \text{ N/m}^2$$

50CrMo4 steel tension strength is $1.5 \times 10^8 \text{ N/m}^2$

Yield strength is $0.9 \times 10^8 \text{ N/m}^2$

◎ So the Ballscrew selected is safe.

6 \ Calculating the buckling load of the screw shaft

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

$$= 10.2 \times \frac{22.425^4}{1160^2} \times 10^3$$

$$= 1917 \text{ (kgf)} > F_{max} (22.14 \text{ kgf})$$

◎ So the Ballscrew selected is safe.

10.3 Vertical Porterage Apparatus

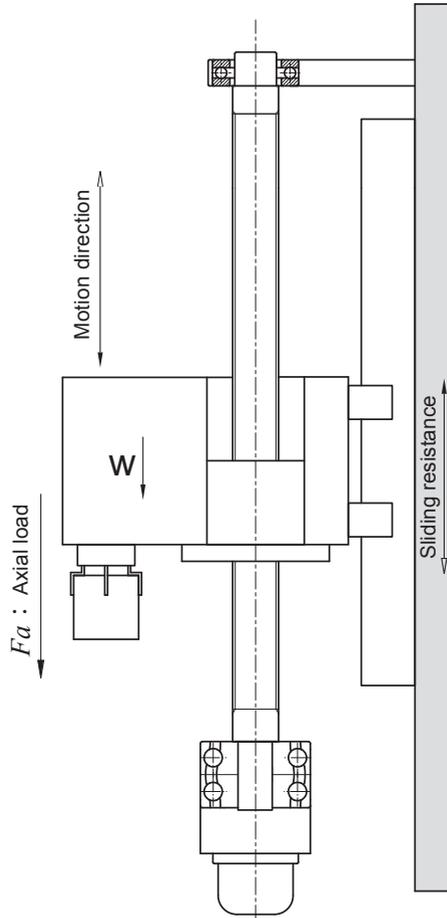


Fig.10.4 Vertical porterage apparatus

1 \ Design Conditions:

Table weight:	$W_1 = 300 \text{ kg}$
Work piece weight:	$W_2 = 50 \text{ kg}$
Max. travel:	$S_{max} = 1500 \text{ mm}$
Rapid feed speed:	$V_{max} = 15 \times 10^3 \text{ mm/min}$
Life:	$Lt = 20000 \text{ hours}$
Guiding surface friction coefficient:	$\mu = 0.01$
Driving motor:	$N_{max} = 1500 \text{ rpm}$
Positioning accuracy:	$\pm 0.8/1500 \text{ mm}$
Repeatability accuracy:	$\pm 0.3 \text{ mm}$

2 \ Motion Conditions:

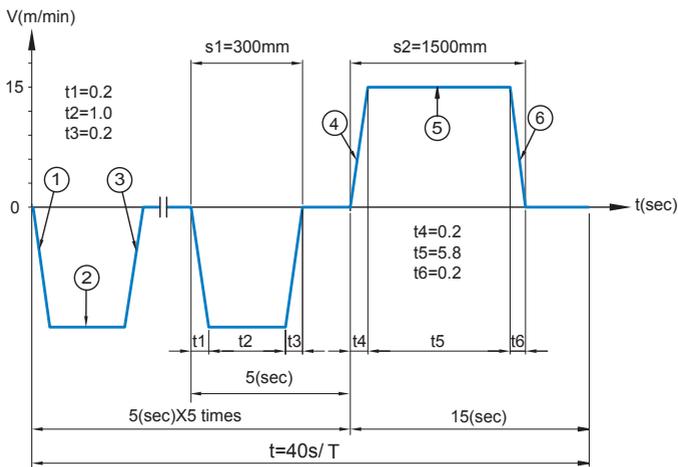


Fig.10.5 Porterage apparatus v-t diagram

3 \ Items to be decided:

1. Accuracy grade
2. Screw nominal O.D., Lead
3. Driving motor

1 \ Selecting accuracy grades

As per design condition: positioning accuracy required: $0.8/1500 \text{ mm}$

$$\frac{\pm 0.8}{1500} = \frac{\pm 0.16}{300}$$

Refer to table 2.2, accumulated reference lead deviation ($\pm E$) and total relative variation (e)

Accuracy grades C7

$$E = \pm 0.05/300 \text{ mm}$$

◎ So the porterage apparatus can use Rolled Ballscrew.

2 \ Selecting screw nominal O.D., Lead

(1) Lead (l) :

The highest rotation speed of motor

$$l \geq \frac{V_{max}}{N_{max}} = \frac{15000}{1500} = 10 \text{ (mm)}$$

◎ Lead have to be 10 mm or more.

(As per *PMI* catalog : select 10 mm for further analysis)

(2) Permissible axial load

Setting up is positive.

a. Force during acceleration (downward)

$$a_l = \frac{V_{max}}{t_l} = \frac{15000}{60 \times 0.2} = 1250 \text{ (mm/s}^2\text{)} = 1.25 \text{ (m/s}^2\text{)}$$

$$f = \mu (W_1 + W_2) \times g = 0.01(300 + 500) \times 9.8 = 35 \text{ (N)} \text{ (Friction)}$$

$$F = ma \rightarrow F_l = (W_1 + W_2) \times g - f - (W_1 + W_2) \times a_l = 2958 \text{ (N)}$$

b. Force during constant speed (downward)

$$F = 0 \rightarrow F_2 = (W_1 + W_2) \times g - f = 3395 \text{ (N)}$$

c. Force during deceleration (downward)

$$F = ma \rightarrow F_3 = (W_1 + W_2) \times g - f + (W_1 + W_2) \times a_3 = 3833 \text{ (N)}$$

d. Force during acceleration (upward)

$$F = ma \rightarrow F_4 = (W_1 + W_2) \times g + f + (W_1 + W_2) \times a_4 = 3903 \text{ (N)}$$

e. Force during constant speed (upward)

$$F = 0 \rightarrow F_5 = (W_1 + W_2) \times g + f = 3465 \text{ (N)}$$

f. Force during deceleration (upward)

$$F = ma \rightarrow F_6 = (W_1 + W_2) \times g + f - (W_1 + W_2) \times a_6 = 3028 \text{ (N)}$$

So

$$F_{a_{max}} = F_4 = 3903 \text{ (N)}$$

(3) Buckling load:

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

$$dr = \left(\frac{P \times L^2}{m} \times 10^{-3} \right)^{1/4} = \left(\frac{3903 \times 1800^2}{9.8 \times 10.2} \times 10^{-3} \right)^{1/4}$$

$$= 19 \text{ (mm)}$$

Screw shaft diameter at thread root area must be bigger than 19 mm.

◎ So screw shaft diameter shall be ranged in between 25 and 50 mm.

(4) The length of screw shaft

L = Max. travel + Nut length + Unthreaded area length

$$= 1500 + 100 + 200 = 1800 \text{ (mm)}$$

Slenderness ratio: 60 or less

$$D \geq \frac{L}{60} = \frac{1800}{60} = 30 \text{ (mm)}$$

◎ So screw shaft diameter shall be ranged in between 32 and 50 mm.

(5) Permissible rotational speed

Assume the supporting ends are fixed-supported

So the permissible rotational speed:

$$n = \alpha \times \frac{60\lambda^2}{2\pi L^2} \sqrt{\frac{EIg}{\gamma A}} = f \frac{dr}{L^2} \times 10^7$$

$$\Rightarrow dr \geq \frac{n \times L^2}{f} \times 10^{-7} \quad (f=15.1, L=1800)$$

$$\geq 30$$

If the highest rotational speed reaches 1500 rpm, screw shaft thread diameter at thread root area must be bigger than 30 mm.

⊙ So screw shaft diameter shall be ranged in between 36 and 50 mm.

(6) Calculating of basic dynamic rate load:

Motion	Axial load (N)	Mean rotation (rpm)	Time (sec)
Acceleration (down)	$F_1=2958$	$n_1=750$	$t_1=1.0$
Constant speed (down)	$F_2=3395$	$n_2=1500$	$t_2=5.0$
Deceleration (down)	$F_3=3833$	$n_3=750$	$t_3=1.0$
Acceleration (up)	$F_4=3903$	$n_4=750$	$t_4=0.2$
Constant speed (up)	$F_5=3465$	$n_5=1500$	$t_5=5.8$
Deceleration (up)	$F_6=3028$	$n_6=750$	$t_6=0.2$

Mean load

$$F_m = \left(\frac{F_1^3 \cdot n_1 \cdot t_1 + F_2^3 \cdot n_2 \cdot t_2 + \dots + F_n^3 \cdot n_n \cdot t_n}{n_1 \cdot t_1 + n_2 \cdot t_2 + \dots + n_n \cdot t_n} \right)^{\frac{1}{3}} = 3436 \text{ (N)}$$

Mean rotation

$$N_m = \frac{n_1 \cdot t_1 + n_2 \cdot t_2 + \dots + n_n \cdot t_n}{t} = 450 \text{ (rpm)}$$

As per design condition:

Life required is 20000 hours, Let $f_w=1.2$

$$L_t = \left(\frac{Ca}{F_m \times f_w} \right)^3 \times \frac{1}{60N_m} \times 10^6$$

$$Ca = (60N_m \times L_t)^{1/3} \times F_m \times f_w \times 10^{-2} = 33576 \text{ (N)} = 3426 \text{ (kgf)}$$

- ◎ If the life required is > 20000 (hours),
 C_a has to be > 3426 (kgf)

(7) Calculating basic static rate load:

$$\begin{aligned} C_o &= F_{max} \times f_s & f_s &= 2.0 \\ &= 7806 \text{ (N)} \\ &= 800 \text{ (kgf)} \\ C_o &\text{ has to be } > 800 \text{ (kgf)} \end{aligned}$$

◎ Selection is made as follows:

Type of the Ballscrew: 40-10B2-FSWW
 Screw shaft diameter: 40 (mm)
 Lead: 10 (mm)
 Basic dynamic rate load: 3520 (kgf)

3 ◦ Selecting driving motor

<Required specifications>

- 1 The highest rotation speeds is 1500 mm/min
- 2 Time required to reach highest rotational speed is within 0.2 sec.

(1) Inertial

a. Screw shaft:

$$GD_s^2 = \frac{\pi \rho}{8} \times D^4 \times L = \frac{\pi \times 7.8 \times 10^{-3}}{8} \times 4^4 \times 180 = 141.1 \text{ (kgf} \cdot \text{cm}^2)$$

b. Moving parts:

$$GD_w^2 = W \left(\frac{l}{\pi} \right)^2 = (300+50) \times \left(\frac{1.0}{\pi} \right)^2 = 192.5 \text{ (kgf} \cdot \text{cm}^2)$$

c. Coupling:

$$GD_j^2 = 1.0 \text{ (kgf} \cdot \text{cm}^2)$$

d. Total of Inertial:

$$GD_L^2 = GD_s^2 + GD_w^2 + GD_j^2 = 178 \text{ (kgf} \cdot \text{cm}^2)$$

(2) Driving torque:

1. Friction torque

a. Acceleration (downward):

$$T_1 = \frac{Fa \times l}{2\pi \times \eta} = \frac{2950 \times 1.0}{2\pi \times 0.9} = 520 \text{ (N}\cdot\text{cm)}$$

b. Constant speed (downward):

$$T_2 = \frac{Fa \times l}{2\pi \times \eta} = \frac{3395 \times 1.0}{2\pi \times 0.9} = 600 \text{ (N}\cdot\text{cm)}$$

c. Deceleration (downward):

$$T_3 = \frac{Fa \times l}{2\pi \times \eta} = \frac{3833 \times 1.0}{2\pi \times 0.9} = 680 \text{ (N}\cdot\text{cm)}$$

d. Acceleration (upward):

$$T_4 = 690 \text{ (N}\cdot\text{cm)}$$

e. Constant speed (upward):

$$T_5 = 610 \text{ (N}\cdot\text{cm)}$$

f. Deceleration (upward):

$$T_6 = 540 \text{ (N}\cdot\text{cm)}$$

2. Preloading torque

$$T_p = k \times \frac{F_{ao} \times l}{2\pi} \quad \therefore F_{ao} = 0 \quad \therefore T_p = 0$$

3. Torque required for acceleration:

$$T_7 = J \cdot \omega$$

$$= (J_L + J_M) \times \frac{2\pi n}{60t_1} = \frac{(178+120)}{4 \times 980} \times \left(\frac{2\pi \times 1500}{60 \times 0.2} \right) = 59.7 \text{ (kgf}\cdot\text{cm)} = 585 \text{ (N}\cdot\text{cm)}$$

$$GD_M = 120 \text{ (kgf}\cdot\text{cm}^2)$$

4. Total torque:

a. Acceleration (downward):

$$T_{k1} = T_1 + T_7 = 520 + 585 = 1105 \text{ (N}\cdot\text{cm)}$$

b. Constant speed (downward):

$$T_{t1} = T_2 = 600 \text{ (N}\cdot\text{cm)}$$

c. Deceleration (downward):

$$T_{g1} = T_3 + T_7 = 680 + 585 = 1265 \text{ (N}\cdot\text{cm)}$$

d. Acceleration (upward):

$$T_{k2} = T_4 + T_7 = 690 + 585 = 1275 \text{ (N}\cdot\text{cm)}$$

e. Constant speed (upward):

$$T_{t2} = T_5 = 610 \text{ (N}\cdot\text{cm)}$$

f. Deceleration (upward):

$$T_{g2} = T_6 + T_7 = 540 + 585 = 1125 \text{ (N}\cdot\text{cm)}$$

The maximum torque takes place at the time of acceleration.

$$T_{max} = T_{k2} = 1275 \text{ (N}\cdot\text{cm)}$$

(3) Selecting driving motor

<Selecting conditions>

a. The highest rotation speeds: $N_{max} \geq 1500$ (rpm)

b. Rated torque: $T_M = T_{rms}$

c. Rotor inertia: $J_M \geq J_L/3$

The specifications required for driving motor are then decided as per above conditions

© Motor specifications:

Output $W_M = 2000$ (W)

Highest rotation speeds $N_{max} = 1500$ (rpm)

Rated torque $T_M = 13$ (N.m)

Rotor inertia $GD_M^2 = 120$ (kgf.cm²)

(4) Effective torque:

$$\begin{aligned} T_{rms} &= \sqrt{\frac{T_{k1}^2 \times t_1 + T_{l1}^2 \times t_2 + T_{g1}^2 \times t_3 + T_{k2}^2 \times t_4 + T_{l2}^2 \times t_5 + T_{g2}^2 \times t_6}{t}} \\ &= \sqrt{\frac{1105^2 \times 1.0 + 600^2 \times 5 + 1265^2 \times 1 + 1275^2 \times 0.2 + 610^2 \times 5.8 + 1125^2 \times 0.2}{20}} \\ &= 606 \text{ (N.cm)} < 1300 \text{ (N.cm)} \end{aligned}$$

© It conforms to design requirements.

4 ․ Calculating the stress of the Ballscrew

$$\begin{aligned}\sigma &= \frac{F}{A} = \frac{F_{max}}{\pi dr^2/4} \\ &= \frac{3903 \times 9.8 \times 4}{\pi \times 35.05^2} \qquad dr = 40 + 1.4 - 6.35 = 35.05 (mm) \\ &= 4.04 \text{ N/mm}^2 \qquad (dr \text{ is screw shaft thread root diameter}) \\ &= 4.04 \times 10^6 \text{ N/m}^2 \\ \tau &= \frac{T \times r}{J} \qquad T_{max} = T_i = 1275 \text{ (N}\cdot\text{cm)} = 12750 \text{ (N}\cdot\text{mm)} \\ &= \frac{12750 \times 20}{148167} \qquad J = \frac{\pi dr^4}{32} = \frac{\pi (35.05^4)}{32} = 148167 \text{ (mm}^4\text{)} \\ &= 1.72 \text{ N/mm}^2 \\ &= 1.72 \times 10^6 \text{ N/m}^2 \\ \sigma_{max} &= \sqrt{\sigma^2 + \tau^2} \\ &= 4.39 \times 10^6 \text{ N/m}^2\end{aligned}$$

50CrMo4 steel tension strength is $1.1 \times 10^8 \text{ N/m}^2 > \sigma_{max}$

Yield strength is $0.9 \times 10^8 \text{ N/m}^2 > \sigma_{max}$

◎ So the Ballscrew selected is safe.

5 ․ Calculating the buckling load of the screw shaft

$$\begin{aligned}P &= \alpha \frac{\pi^2 nEI}{L^2} = m \frac{dr^4}{L^2} \times 10^3 \\ &= 10.2 \times \frac{35.05^4}{1800^2} \times 10^3 \\ &= 4751 \text{ (kgf)} > F_{max} \text{ (398 kgf)}\end{aligned}$$

◎ So the Ballscrew selected is safe.

PMI's design of hollow cooling system is especially good for high speed Ballscrews. It shall well dissipate heat generated by friction between balls and grooves during Ballscrew running, and then to minimize thermal deformation as to ensure positioning accuracy.

11.1 Introduction to Hollow Cooling Screw Shaft

The hollow cooling system is designed by PMI (Fig.11.1) It uses a coolant pipe through the hollow hole of Ballscrew. The hollow hole is through all of the Ballscrew, and one end is clogged with the oil seal by PMI patent. The coolant is pumped into coolant pipe and flow to the end of coolant pipe. Coolant then flow reversely along the hollow hole back into the coolant collector. It can cool down the Ballscrew. The coolant is then sucked back to the cooling unit to drop coolant temperature and pumped again to the coolant pipe to complete circulation.

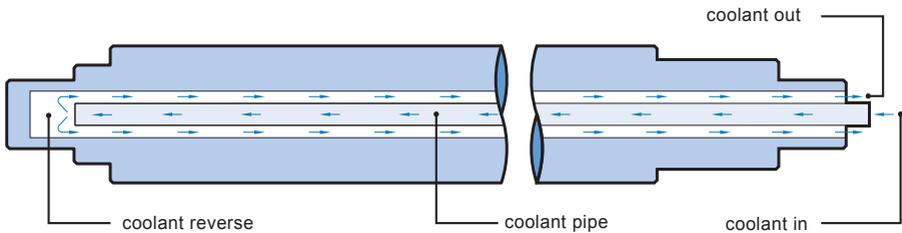


Fig.11.1 Hollow cooling diagram

11.2 Patent of Hollow Cooling Screw Shaft

11.2.1 Hollow cooling system

Features:

- (i) Well and effectively control Ballscrew thermal expansion.
- (ii) Simple design and structure to save cost.



Fig.11.2 Hollow cooling system

11.2.2 Cooling entrance

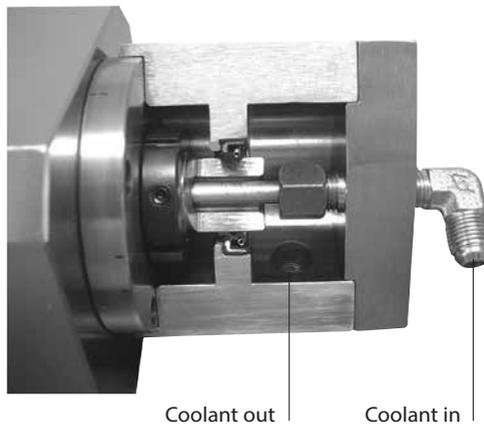


Fig.11.3 Cooling entrance

11.2.3 End sealing

Features: Easy for installing, disassembling and maintenance.

11.2.4 Coolant pipe support installation

Supported the coolant pipe. Let it don't touch Ballscrew.

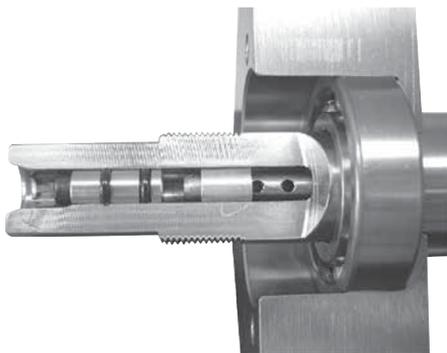


Fig 11.4 End sealing structure

11.2.5 Thermal control system test equipment



Fig.11.5 Thermal control system test equipment

11.3 Thermal control experiment

11.3.1 Test condition

Screw nominal O.D. :	Ø40 mm
Lead:	10 mm
Rotation speed:	1000 rpm
Speed:	10 m/min
Load:	400 kgf
Slideways:	Box ways

11.3.2 The results of experiment

As per the results by experiment, *PMI*'s design of hollow cooling system proves an effective way for controlling the thermal expansion on the Ballscrew. Hence it is a very helpful design to high precision machine tools.

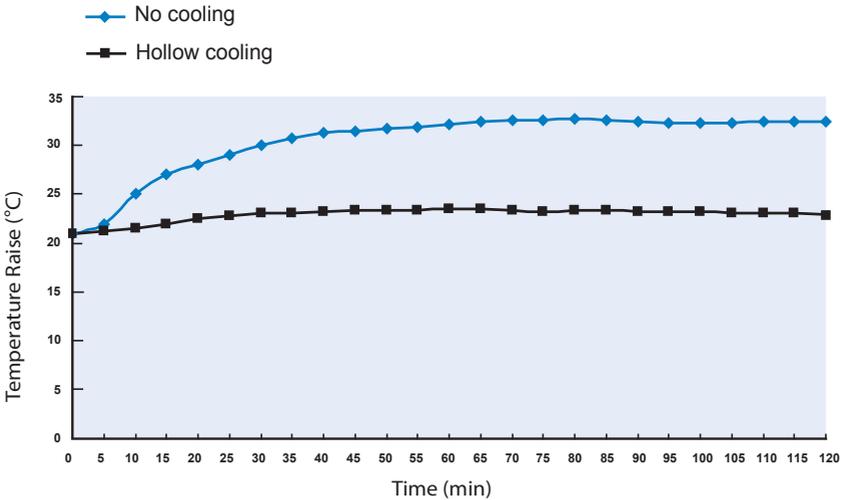


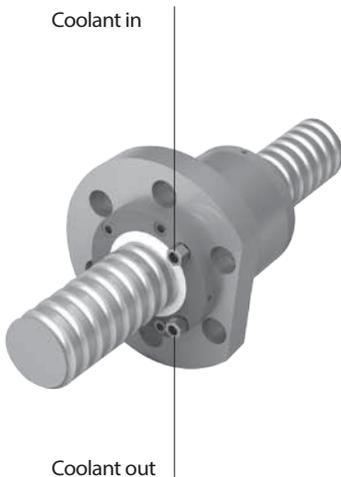
Fig.11.6 The results of experiment

11.4 Nut Cooling

(1) The principle of design

Cool liquid is able to control the heat generation and thermal expansion by creating circulating cooling channel in the nut.

Single Nut Cooling



Double Nut Cooling

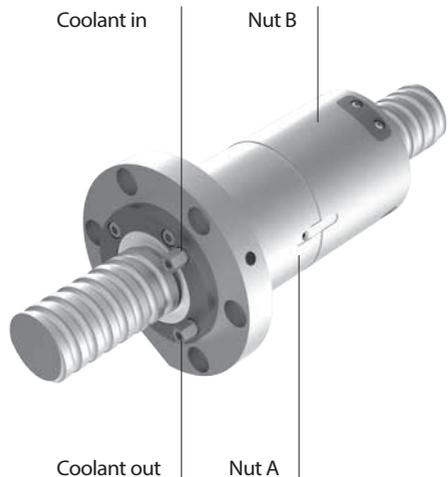


Fig.11.7 Single nut cooling and Double nut cooling diagram

(2) Characteristics:

1. Increase the positioning accuracy and the stability

Control the temperature rise of the ballscrew and reduced the heat deformation. The high velocity and accuracy of the machine will be reached.

2. Decrease the warm-up time of machine

The stable temperature of the ballscrew be quickly, so the warm-up time of the machine could be shortened.

3. Maintain capability of the lubrication oil

When the temperature of the ballscrew is stabilized, it is able to avoid the deterioration of the lubrication caused by high temperature.

Table11.1 Testing Parameters

Model no.	R45-12T5-FDDC-1274-1569-0.018
Operation travel(mm)	690
Feed speed(m/min)	7.2
Mean rotation (rpm)	523.3
Acceleration (m/s ²)	5
Preload (kgf)	392
Table weight (kgf)	200
Mounting method	fixed-supported
Coolant	Mobil Velocite oil no.3 (ISO VG 2)
Coolant flow (L/min)	3.1
Coolant Temperature (°C)	Room temperature ±0.5

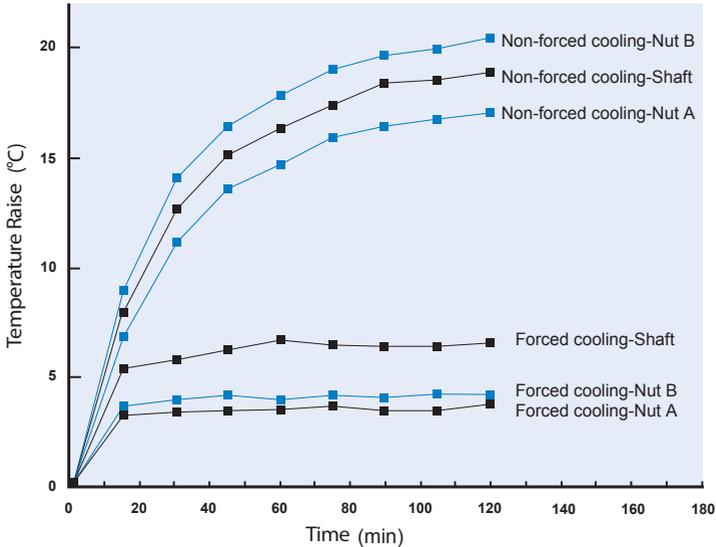


Fig.11.8 The results of experiment

12.1 BallScrew of High Dustproof-Type 1

Design Concept

Scrapers specially developed for ballscrews, with a multi-layered contact structure that ensures effective dust removal.

Features

High Compatibility

High dustproof scrapers can be used with various *PMI* products, including external and internal ball circulation nuts such as the E-type and D-type nuts etc...

Improved Dustproof Capacity

With a reduced mounting surface of the scraper spring, threads are more closely matched, making for a better scraping capacity.

Pioneering Design

Greatly improves dustproof effect

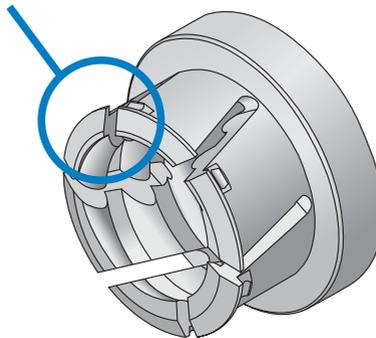


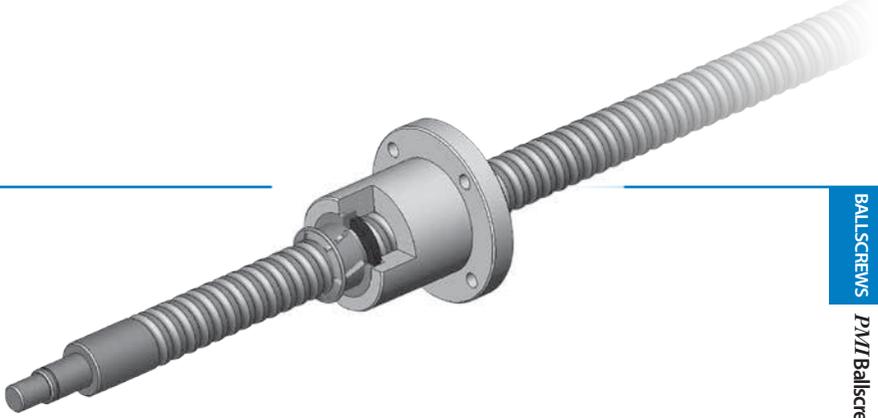
Fig.12.1 High dustproof type1

Long Endurance

The outer ring of the scraper is clamped by a spring. As the scraper gradually wears, the preload of scraper is automatically adjusted.

High Durability

With scrapers that closely fits the threads of the ballscrew and seal pads that match the axial cross section, the inside of the nut is completely safe from dust.



Characteristics

1. Seal Washer

As the ballscrew comes with specially designed grooves, the highly dustproof seal washer inside the scraper perfectly matches the threads, a feature that ensures the removal of scraps as well as insulation against dust.

2. Scraper Design

The thread matching design of the scraper greatly boosts its efficiency. If the length of the nut deviates from average specifications, please contact **PMI** engineers.

3. Shaft End Design

The shaft ends of the ballscrew should not be larger than the root diameter (*dr*). If you have any questions concerning the size of the rest area of the ballscrew, please contact **PMI** engineers.

Fits the Following Types of Nuts

FSWC.FDWC.FSVC.FDVC.FSWE.FDWE.FSVE.FDVE.FSDC.FDDC.FSIC.FDIC.FOWC.FOVC.

(For detailed specifications, please refer to the specification table.)

For other specifications, please contact **PMI** engineers.

Nomenclature

Example: R 32-10 B2-F S V E- 600 – 700 - 0.008 A

A Precision Ground Ballscrew + High dustproof wiper

Applications of High Dustproof Ballscrews

Woodworking machines, laser processing machines, high accuracy transportation equipment, mechanical arms, and other machines that require a dustproof environment.

12.2 BallScrew of High Dustproof-Type 2

Design Concept

Wiper specially developed for ball screws, with a multi-step contact lips structure that ensures effective dust removal.

Features

Long service life time

The contact Gothic arch thread of bulgy shape and the lips interference outside diameter of screw shaft, so the dust can't entry inside of nut.

High compatibility

High dustproof wiper can be used with various *PMI* products.

Nut length unchanging

Install high dustproof of type 2 , the nut length unchanging.

Characteristics

Seal Washer

As the ballscrew comes with specially designed grooves, the highly dustproof seal washer inside the scraper perfectly matches the threads, a feature that ensures the removal of scraps as well as insulation against dust.

No necessary for a complete thread on end of ball screw shaft (see page A47)

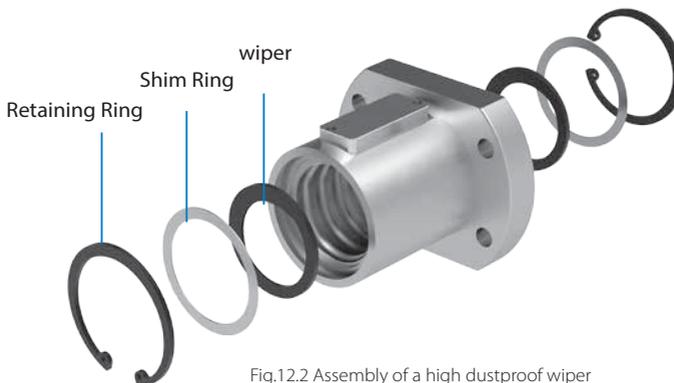


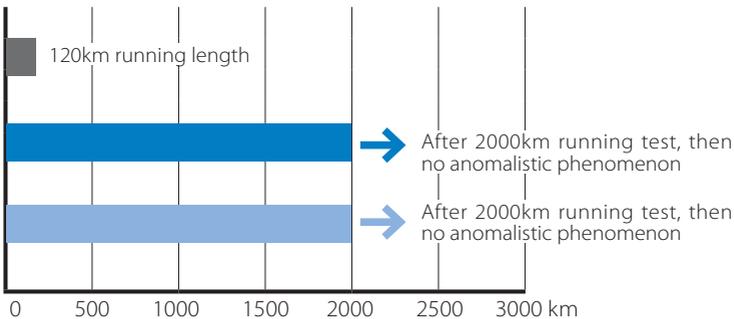
Fig.12.2 Assembly of a high dustproof wiper

Additional Remarks

1. Using the high dustproof scraper may induce an increase in preload. If your machine has a strict requirement on the range of preload, please contact *PMI* engineers.
2. High dustproof seal washers should not be used in an environment where the temperature exceeds 80°C.
3. Due to potential sealing problems with returning tubes, please contact *PMI* engineers if you need to use external ball circulation nuts (such as FSWC and FSVC).

Test Condition

Specifications	R40-10-FSVE
Running Length	300 mm (per cycle)
Motor Speed	150 rpm
Test Environment	Sawdust automatic circulation system
Minimal Size of Dust Particles	below 0.01 mm



- Only standard scraper installed
- High dustproof wiper (type 1)
- High dustproof wiper (type 2)

12.3 BallScrew of High Dustproof-Type 3

Design Concept

The dustproof seals develop focus on general tool machine industrial that doesn't obviously increase of preload torque and temperature rise.

Features

Long service life time

Provide the kind of seals that have better strength, service life and prevent fine dust or metal bit into the nut.

Improved Dustproof Capacity

A special ball screw groove profile together with the grease retaining film seals.

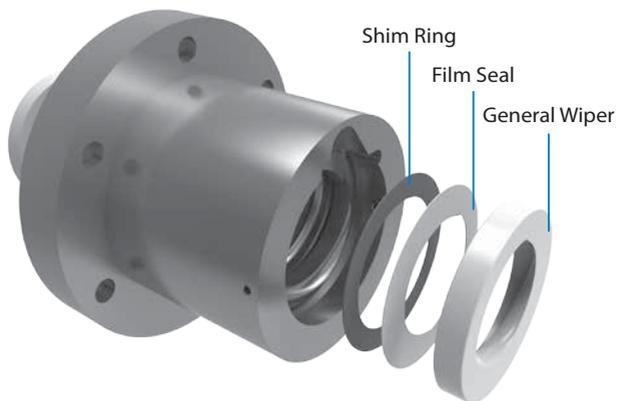
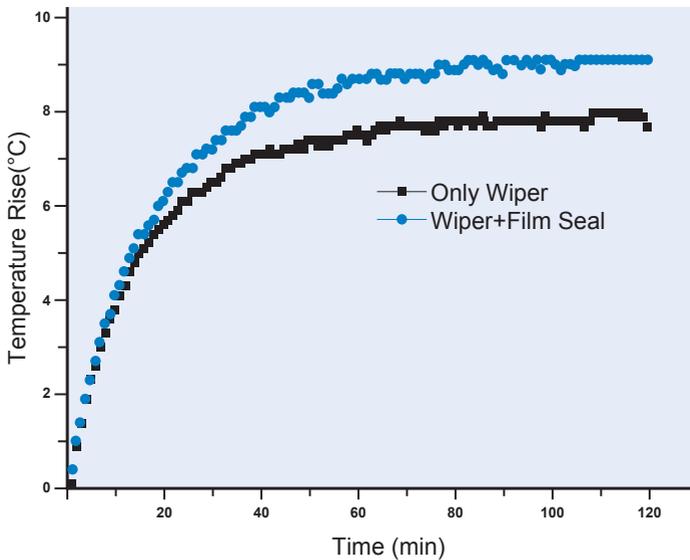


Fig.12.3 Assembly of a Film seal

Heat generate and preload torque

The preload torque increase only 1~2 kgf-cm with film seals for ballscrew. Compare with non-contact wiper, the suppression temperature rise at 1.5~2°C.



PMI Precision Ground BallScrew

13.1 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. Reference A47 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.

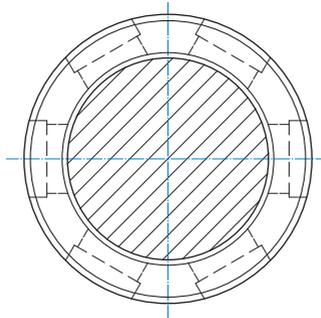
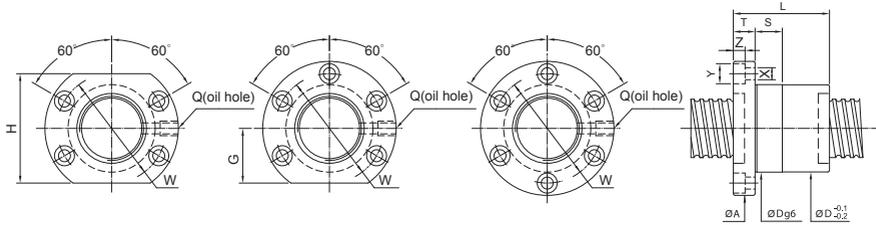


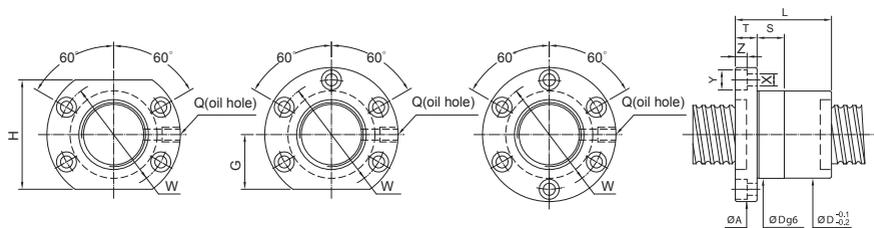
Fig. 13.1 Internal ball circulation's side view



Unit: mm

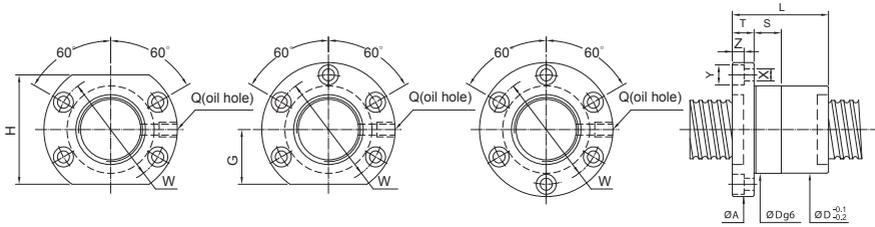
SCREW SIZE	BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD(kgf)		NUT		FLANGE					FIT	BOLT			OIL HOLE Q	STIFFNESS kgf/µm		
			Dynamic (1×10 ⁶ REV.) Ca	Static Co	Dg6	L	A	T	W	G	H		S	X	Y			Z	
O.D.	LEAD																		
14	3	2	3	260	460	26	37	46	10	36	-	-	10	4.5	8	4.5	M6×1P	13	
	4	2.381	3	420	805	26	42	46	10	36	20	40	10	4.5	8	4.5	M6×1P	14	
		2.778	4	840	1870	26	47											21	
16	5	3.175	3	720	1010	26	42	46	10	36	20	40	10	4.5	8	4.5	M6×1P	16	
	4	2.381	3	435	920	28	42	49	10	39	20	40	10	4.5	8	4.5	M6×1P	16	
	5	3.175	3	765	1240	30	42	49	10	39	20	40	10	4.5	8	4.5	M6×1P	18	
20	6	3.175	4	980	1650	30	55	54	12	40	20	40	12	5.5	9.5	5.5	M6×1P	23	
	4	2.381	4	600	1530	34	44	60	12	48	22	44	12	5.5	9.5	5.5	M6×1P	25	
	5	3.175	3	860	1710		47											21	
	6	3.175	4	1100	2280	34	53	57	12	45	20	40	12	5.5	9.5	5.5	M6×1P	28	
	6	3.969	3	1080	2050	34	53	57	12	45	20	40	12	5.5	9.5	5.5	M6×1P	22	
			4	1380	2730	34	61												28
	10	3.175	3	860	1710	36	66	57	12	45	20	40	12	5.5	9.5	5.5	M6×1P	21	
25	4	2.381	3	500	1440	40	40	63	12	51	22	44	15	5.5	9.5	5.5	M8×1P	23	
	5	3.175	3	980	2300		47											26	
			4	1250	3070	40	53	63.5	12	51	22	44	15	5.5	9.5	5.5	M8×1P	33	
			5	1520	3830		57												42
	6	3.969	3	1275	2740	40	53	63.5	12	51	22	44	15	5.5	9.5	5.5	M8×1P	26	
			4	1630	3650	40	61												34
	8	3.969	4	1630	3650	40	69	63.5	12	51	22	44	15	5.5	9.5	5.5	M8×1P	34	
			5	1970	4560	40	77												43
		3.175	3	980	2300	38	70	68	15	55	26	52	15	6.6	11	6.5	M8×1P	26	
			4	1250	3070		81												33
28	6	3.175	3	1030	2630	43	50	68	12	55	26	52	15	6.6	11	6.5	M8×1P	27	
			4	1620	3205		80												35
	10	4.762	4	2070	4270	42	85	68.5	15	55	26	52	15	6.6	11	6.5	M8×1P	37	
			5	2510	5340		91												44
	10	3.175	4	1320	3510	45	77	73	12	60	30	60	15	6.6	11	6.5	M8×1P	28	

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Unit: mm

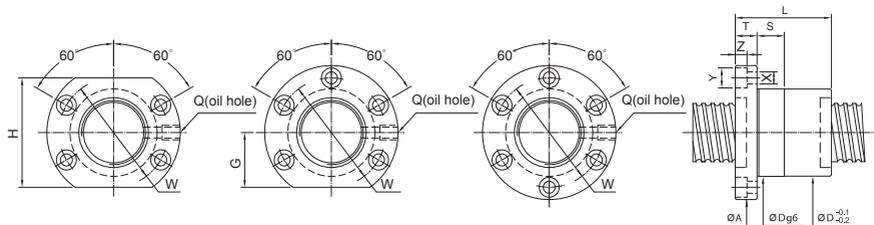
SCREW SIZE	BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD (kgf)		NUT		FLANGE					FIT	BOLT			OIL HOLE	STIFFNESS	
			Dynamic (1×10 ⁶ REV.) Ca	Static Co	Dg6	L	A	T	W	G	H		S	X	Y			Z
O.D.	LEAD																	
32	4	2.381	3	560	1840	43	40	68	15	55	26	52	15	6.6	11	6.5	M8×1P	28
			5	870	3070	49	47											45
	5	3.175	3	1095	3060	47	47	73.5	12	60	30	60	15	6.6	11	6.5	M8×1P	31
			4	1400	4080	53	53											41
	6	3.969	3	1500	3750	53	53	73.5	12	60	30	60	15	6.6	11	6.5	M8×1P	32
			4	1920	5000	61	61											43
	8	4.762	3	1820	4230	50	68	83	16	66	32	64	15	6.6	11	6.5	M8×1P	32
			4	2330	5640	77	77											43
	10	6.35	3	2605	5310	54	80	88	16	70	34	68	15	9	14	8.5	M8×1P	33
			4	3340	7080	90	90											45
12	6.35	3	2605	5310	50	86	88	16	70	34	68	15	9	14	8.5	M8×1P	33	
		4	3340	7080	90	90											45	
36	5	3.175	4	1490	4690	52	56	88	16	70	34	68	15	9	14	8.5	M8×1P	46
			4	2530	6630	55	73											48
	10	6.35	3	2810	6210	58	78	98	18	77	36	72	20	11	17.5	11	M8×1P	37
4			3600	8280	89	89	49											
40	5	3.175	4	1575	5290	56	56	88.5	16	72	29	58	15	9	14	8.5	M8×1P	49
			5	1910	6610	55	61											61
			6	2230	7940	65	65											73
	6	3.969	3	1660	4810	56	56	88.5	16	72	34	68	15	9	14	8.5	M8×1P	39
			4	2130	6410	55	65											51
			6	3020	9620	77	77											75
	8	4.762	3	2120	5720	64	64	93	16	76	36	72	20	9	14	8.5	M8×1P	40
			4	2720	7620	60	77											52
			6	3850	11430	94	94											77
	10	6.35	3	3010	7100	83	83	106	18	84	43	86	20	11	17.5	11	M8×1P	41
			4	3850	9470	64	93											53
			5	4670	11830	99	99											67
12		7.144	3	3010	7100	82	82	110	18	85	45	90	20	11	17.5	11	M8×1P	41
			4	3850	9470	63	100											53
			5	4670	11830	108	108											67
4	5.130	3	4010	9250	70	93	110	18	85	45	90	20	11	17.5	11	M8×1P	43	
		4	5130	12330	103	103											56	



Unit: mm

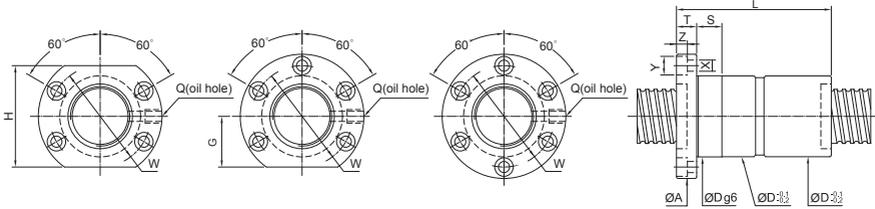
O.D.	SCREW SIZE		EFFECTIVE BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD (kgf)		NUT		FLANGE					FIT			BOLT			OIL HOLE	STIFFNESS kgf/μm
	LEAD	DIA.			Dynamic (1×10 ³ REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	S	X	Y	Z	Q			
45	8	4.762	4	2870	8620	64	72	92	16	75	36	72	15	9	14.5	9	M6×1P	54			
	12	7.144	3	4160	10750	70	86	110	16	90	42	84	20	11	17.5	11	PT1/8"	48			
			4	5330	14330	99													62		
	16	6.35	3	3220	8200	70	102	110	16	90	42	84	20	11	17.5	11	PT1/8"	45			
50			4	1730	6760		55											60			
	5	3.175	5	2100	8450	66	61	98	16	82	36	72	20	9	14	8.5	PT1/8"	74			
			6	2450	10140		65											86			
			4	2380	8250		65											61			
	6	3.969	5	2880	10310	66	64	98	16	82	36	72	20	9	14	8.5	PT1/8"	76			
			6	3370	12380		77											90			
			4	3010	9610		79											63			
	8	4.762	5	3650	12010	70	84	113	18	90	42	84	20	11	17.5	11	PT1/8"	77			
			6	4260	14420		96											92			
			3	3430	9300		83											49			
	10	6.35	4	4390	12400		93											65			
			5	5320	15500	74	99	116	18	94	42	84	20	11	17.5	11	M8×1P	80			
			6	6220	18600		114											95			
			4	5520	16330		104											67			
	12	7.144	5	6690	20410	75	117	121	22	97	47	94	20	14	20	13	PT1/8"	84			
		3	4510	11150		99											50				
		4	5770	14870		111											60				
16	6.35	3	3430	9300	74	104	116	18	94	42	84	20	11	17.5	11	PT1/8"	49				
20	7.938	3	4510	11150	78	146	121	28	97	47	94	20	14	20	13	PT1/8"	50				

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Unit: mm

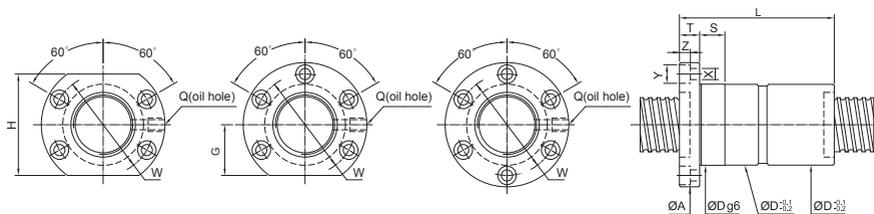
SCREW SIZE	BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD (kgf)		NUT	FLANGE					FIT	BOLT			OIL HOLE	STIFFNESS		
			Dynamic (1x10 ⁶ REV.) Ca	Static Co		Dg6	L	A	T	W		G	H	S			X	Y
O.D.	LEAD																kgf/μm	
63	6	3.969	4	2610	10550	67												73
			6	3700	15830	80	80	122	18	100	45	90	20	11	17.5	11	PT1/8"	107
	8	4.762	4	3375	12200	82	80	124	18	102	46	92	20	11	17.5	11	PT1/8"	76
			6	4780	18300	96	96	136	22	112	52	104	20	14	20	13	PT1/8"	111
	10	6.35	4	5020	16450	85	98	132	22	107	48	96	20	14	20	13	PT1/8"	79
			6	7110	24680	118	118	153	28	123	59	118	20	18	26	17.5	PT1/8"	116
12	7.938	4	6580	19430	111	111	136	22	112	52	104	20	14	20	13	PT1/8"	80	
		6	9320	29150	136	136	153	28	123	59	118	20	18	26	17.5	PT1/8"	111	
20	9.525	3	8490	23610	146	146	153	28	123	59	118	20	18	26	17.5	PT1/8"	79	
		4	10870	31480	156	156	173	28	143	66	132	20	18	26	17.5	PT1/8"	89	
80	10	6.35	4	5510	21200	98												95
			5	6670	26500	105	105	151	22	127	57	114	20	14	20	13	PT1/8"	118
	6	7.938	4	7500	25700	111	111	156	22	132	59	118	20	14	20	13	PT1/8"	140
			6	10620	38550	136	136	173	28	143	66	132	20	18	26	17.5	PT1/8"	143
	20	9.525	3	9770	31700	146	146	173	28	143	66	132	20	18	26	17.5	PT1/8"	97
			4	12510	42270	168	168	188	34	158	76	146	25	20	26	17.5	PT1/8"	127
100	10	6.35	3	4760	20090	84												91
			4	6090	26790	95	95	171	22	147	67	134	25	14	20	13	PT1/8"	120
	5	7.938	4	7380	33490	104	104	171	22	147	67	134	25	14	20	13	PT1/8"	148
			6	8630	40190	115	115	188	34	158	76	146	25	20	26	17.5	PT1/8"	176
	4	9.525	4	14440	54960	140	140	188	34	158	76	146	25	20	26	17.5	PT1/8"	140
			5	17490	68700	135	157	205	28	169	73	146	30	18	26	17.5	PT1/8"	173
6	12.7	4	20460	82440	175	175	205	28	169	73	146	30	18	26	17.5	PT1/8"	205	
		5	24440	97700	190	190	222	34	186	86	164	30	20	26	17.5	PT1/8"	233	
20	9.525	4	14440	54960	159	159	188	34	158	76	146	25	20	26	17.5	PT1/8"	140	
		5	17490	68700	135	180	205	28	169	73	146	30	18	26	17.5	PT1/8"	173	
6	12.7	4	20460	82440	200	200	222	34	186	86	164	30	20	26	17.5	PT1/8"	205	
		5	24440	97700	215	215	240	40	205	99	182	30	22	26	17.5	PT1/8"	233	



Unit: mm

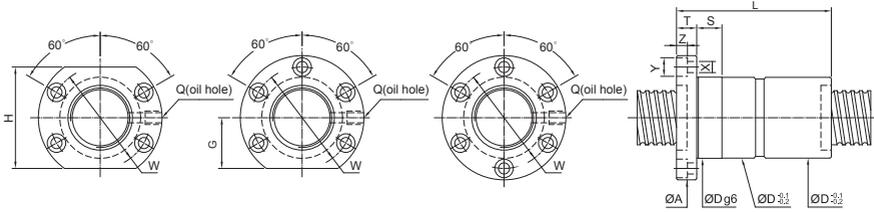
O.D.	SCREW SIZE		EFFECTIVE TURNS	BASIC RATE LOAD(kgf)		NUT		FLANGE					FIT	BOLT			OIL HOLE	STIFFNESS
	LEAD	BALL DIA.		Dynamic (1×10 ⁶ REV.) Ca	Static Co	Dg6	L	A	T	W	G	H		S	X	Y		
16	4	2.381	3	435	920	30	66	46.5	10	39	20	40	10	4.5	8	4.5	M6×1P	31
	5	3.175	3 4	765 980	1240 1650	30	80 89	49	10	39	20	40	10	4.5	8	4.5	M6×1P	35 47
20	5	3.175	3 4	860 1100	1710 2280	34	82 92	57	12	45	20	40	12	5.5	9.5	5.5	M6×1P	43 56
	6	3.969	3 4	1080 1380	2050 2730	34	93 107	57	12	45	20	40	12	5.5	9.5	5.5	M6×1P	43 56
25	5	3.175	3	980	2300	40	82	63.5	12	51	22	44	15	5.5	9.5	5.5	M8×1P	51
			4	1250	3070	92	67											
	6	3.969	3	1275	2740	40	93	63.5	12	51	22	44	15	5.5	9.5	5.5	M8×1P	52
			4	1630	3650	107	68											
10	3.175	3	980	2300	40	129	68	15	55	26	52	15	6.6	11	6.5	M8×1P	51	
			4	1620	3205	140											53	
32	5	3.175	3	1095	3060		82	73.5	12	60	30	60	15	6.6	11	6.5	M8×1P	63
			4	1400	4080	48	92											82
			6	1980	6120	118	122											
	6	3.969	3	1500	3750		93	73.5	12	60	30	60	15	6.6	11	6.5	M8×1P	65
			4	1920	5000	48	109											86
			6	2720	7500	133	125											
	8	4.762	3	1820	4230	50	117	83	16	66	32	64	15	6.6	11	6.5	M8×1P	66
			4	2330	5640	135	86											
	10	6.35	3	2605	5310	50	139	88.5	16	70	34	68	15	9	14	8.5	M8×1P	67
			4	3340	7080	160	89											
36	5	3.175	3	2605	5310	50	153	88	16	70	34	68	15	9	14	8.5	M8×1P	67
			5	4040	8850	203	110											
	8	4.762	4	1490	4690	52	96	88	16	72	34	68	15	9	14	8.5	M8×1P	91
			4	2530	6630	55	138											95
10	6.35	3	2810	6210	58	138	98	18	77	36	72	20	11	17.5	11	M8×1P	75	
		4	3600	8280	159	98												

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Unit: mm

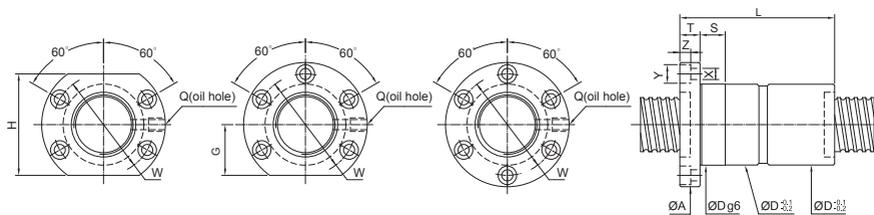
SCREW SIZE	BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD(kgf)		NUT		FLANGE					FIT	BOLT			OIL HOLE	STIFFNESS	
			Dynamic (1×10 ⁶ REV.) Ca	Static Co	Dg6	L	A	T	W	G	H		S	X	Y			Z
O.D.	LEAD																	kgf/μm
40	5	3.175	4	1575	5290	96												100
			5	1910	6610	55	111	88.5	16	72	29	58	15	9	14	8.5	M8×1P	124
			6	2230	7940	122												
	6	3.969	3	1660	4810	97												77
			4	2130	6410	55	113	88.5	16	72	34	68	15	9	14	8.5	M8×1P	103
			6	3020	9620	137												
	8	4.762	3	2120	5720	121												80
			4	2720	7620	60	134	93	16	76	36	72	20	9	14	8.5	M8×1P	105
			6	3850	11430	172												
	10	6.35	3	3010	7100	142												82
			4	3850	9470	64	162	106	18	84	43	86	20	11	17.5	11	M8×1P	107
			5	4670	11830	189												
12	7.144	3	3010	7100	154												82	
		5	4670	11830	63	204	106	18	84	43	86	20	11	17.5	11	M8×1P	133	
		3	4010	9250	70	160	110	18	85	45	90	20	11	17.5	11	M8×1P	86	
45	8	4.762	4	2870	8620	64	136	92	16	75	36	72	15	9	14.5	9	M6×1P	109
			3	4160	10750	158												94
	12	7.144	4	5330	14330	70	183	110	16	90	45	90	20	11	17.5	11	PT1/8"	124
			3	3220	8200	70	198	110	16	90	45	90	20	11	17.5	11	PT1/8"	90



Unit: mm

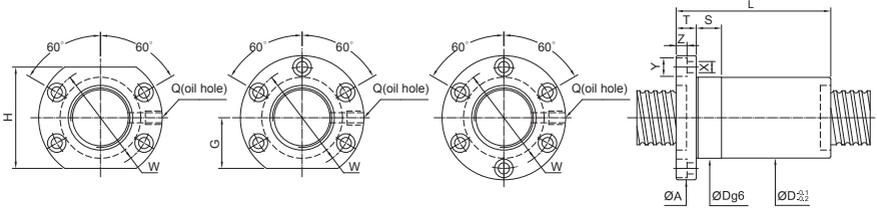
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD (kgf)		NUT		FLANGE					FIT		BOLT			OIL HOLE	STIFFNESS kgf/μm	
O.D.	LEAD			Dynamic (1×10 ⁶ REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	S	X	Y	Z	Q			
50	5	3.175	4	1730	6760	96														119
			5	2100	8450	66	111	98	16	82	36	72	20	9	14	8.5	PT1/8"	148		
			6	2450	10140	122													174	
	6	3.969	4	2380	8250	111														123
			5	2880	10310	66	122	98	16	82	36	72	20	9	14	8.5	PT1/8"	151		
			6	3370	12380	142													181	
	8	4.762	4	3010	9610	136														125
			5	3650	12010	70	157	113	18	90	42	84	20	11	17.5	11.0	PT1/8"	155		
			6	4260	14420	174													185	
	10	6.35	3	3430	9300	143														99
			4	4390	12400	74	162													129
			5	5320	15500	189														161
	12	7.144	6	6220	18600	205														191
			5	6680	20420	75	213	121	22	97	47	94	20	14	20	13	PT1/8"	166		
3			4510	11150	75	171													101	
16	6.35	4	5770	14870	195														132	
		3	3430	9300	74	201	114	18	92	42	84	20	11	17.5	11	PT1/8"	99			
20	7.938	3	4510	11150	78	253	121	28	97	47	94	20	14	20	13	PT1/8"	101			

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Unit: mm

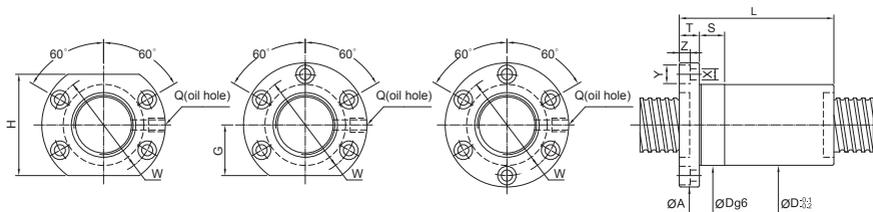
SCREW SIZE	BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD(kgf)		NUT		FLANGE					FIT	BOLT			OIL HOLE Q	STIFFNESS kgf/ μ m	
			Dynamic (1 \times 10 ⁶ REV.) Ca	Static Co	Dg6	L	A	T	W	G	H		S	X	Y			Z
63	6	3.969	4	2610	10550	80	120	122	18	100	45	90	20	11	17.5	11	PT1/8"	146
			6	3700	15830	80	144	122	18	100	45	90	20	11	17.5	11	PT1/8"	217
	8	4.762	4	3375	12200	82	141	124	18	102	46	92	20	11	17.5	11	PT1/8"	151
			6	4780	18300	82	178	124	18	102	46	92	20	11	17.5	11	PT1/8"	222
	10	6.35	4	5020	16450	85	166	132	22	107	48	96	20	14	20	13	PT1/8"	158
			6	7110	24680	85	209	132	22	107	48	96	20	14	20	13	PT1/8"	232
12	7.938	4	6580	19430	90	195	136	22	112	52	104	20	14	20	13	PT1/8"	161	
		6	9320	29150	90	248	136	22	112	52	104	20	14	20	13	PT1/8"	236	
20	9.525	3	8490	23610	95	255	153	28	123	59	118	20	18	26	17.5	PT1/8"	157	
		4	10870	31480	95	296	153	28	123	59	118	20	18	26	17.5	PT1/8"	207	
80	10	6.35	4	5510	21200	105	166	156	22	127	57	114	20	14	20	13	PT1/8"	190
			5	6670	26500	105	185	156	22	127	57	114	20	14	20	13	PT1/8"	235
	6	7.938	4	7500	25700	110	195	156	22	132	59	118	20	14	20	13	PT1/8"	196
			6	10620	38550	110	248	156	22	132	59	118	20	14	20	13	PT1/8"	288
	20	9.525	3	9770	31700	115	254	173	28	143	66	132	20	18	26	17.5	PT1/8"	193
			4	12510	42270	115	297	173	28	143	66	132	20	18	26	17.5	PT1/8"	254
100	10	6.35	3	4760	20090	125	143	171	22	147	67	134	25	14	20	13	PT1/8"	173
			4	6090	26790	125	164	171	22	147	67	134	25	14	20	13	PT1/8"	228
	5	7.938	4	7380	33490	125	184	171	22	147	67	134	25	14	20	13	PT1/8"	281
			6	8630	40190	125	210	171	22	147	67	134	25	14	20	13	PT1/8"	334
	16	9.525	4	14440	54960	135	252	205	28	169	73	146	30	18	26	17.5	PT1/8"	266
			5	17490	68700	135	285	205	28	169	73	146	30	18	26	17.5	PT1/8"	329
6	7.938	4	20460	82440	135	318	205	28	169	73	146	30	18	26	17.5	PT1/8"	391	
		5	20460	82440	135	318	205	28	169	73	146	30	18	26	17.5	PT1/8"	391	
20	9.525	4	14440	54960	135	299	205	28	169	73	146	30	18	26	17.5	PT1/8"	266	
		5	17490	68700	135	340	205	28	169	73	146	30	18	26	17.5	PT1/8"	329	
6	7.938	4	20460	82440	135	381	205	28	169	73	146	30	18	26	17.5	PT1/8"	391	
		5	20460	82440	135	381	205	28	169	73	146	30	18	26	17.5	PT1/8"	391	



Unit: mm

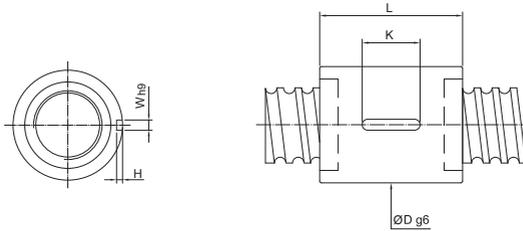
O.D.	SCREW SIZE		EFFECTIVE TURNS	BASIC RATE LOAD(kgf)		NUT		FLANGE					FIT		BOLT			OIL HOLE	STIFFNESS kgf/μm
	LEAD	BALL DIA.		Dynamic (1×10 ⁶ REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	S	X	Y	Z	Q		
20	5	3.175	2×(2)	610	1140	34	53	57	12	45	20	40	12	5.5	9.5	5.5	M6×1P	29	
			3×(2)	860	1710													67	43
	6	3.969	2×(2)	760	1370	34	61	57	12	45	20	40	12	5.5	9.5	5.5	M6×1P	29	
			3×(2)	1080	2050													77	50
25	4	2.381	2×(2)	350	960	40	56	63	12	51	22	44	15	5.5	9.5	5.5	M8×1P	30	
			3×(2)	500	1440													64	46
		5	3.175	2×(2)	690	1530	40	67	63.5	12	51	22	44	15	5.5	9.5	5.5	M8×1P	35
				3×(2)	980	2300													76
		6	3.969	3×(2)	1275	2740	40	77	63.5	12	51	22	44	15	5.5	9.5	5.5	M8×1P	52
				4×(2)	640	1920													64
		8	3.969	3×(2)	1275	2740	40	85	63.5	12	51	22	44	15	5.5	9.5	5.5	M8×1P	52
4×(2)				640	1920	64													59
	10	4.762	2×(2)	1140	2140	42	88	69	15	55	26	52	15	6.6	11	6.5	M8×1P	36	
			3×(2)	1610	3210													102	53
28	6	3.175	3×(2)	1030	2630	43	69	68	12	55	26	52	15	6.6	11	6.5	M8×1P	56	
			4×(2)	1400	4080													77	38
	10	3.175	2×(2)	730	1750	45	77	73	12	60	30	60	15	6.6	11	6.5	M8×1P	38	
			3×(2)	560	1840													56	55
32	4	2.381	3×(2)	560	1840	43	56	68	12	55	26	52	15	6.6	11	6.5	M8×1P	58	
			5×(2)	870	3070													73	89
		5	3.175	3×(2)	1095	3060	48	67	73.5	12	60	30	60	15	6.6	11	6.5	M8×1P	63
				4×(2)	1400	4080													77
		6	3.969	3×(2)	1500	3750	48	77	73.5	12	60	30	60	15	6.6	11	6.5	M8×1P	65
				4×(2)	1920	5000													90
		8	4.762	3×(2)	1820	4230	50	95	83	16	66	32	64	15	6.6	11	6.5	M8×1P	66
4×(2)				2330	5640	112													86
	10	6.35	3×(2)	2605	5310	50	120	88	16	70	34	68	15	9	14	8.5	M8×1P	67	
			3×(2)	2605	5310													50	124
	12	6.35	3×(2)	2605	5310	50	124	88	16	70	34	68	15	9	14	8.5	M8×1P	67	

FOIC



Unit: mm

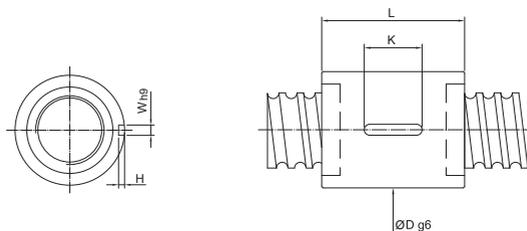
SCREW SIZE	BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD (kgf)		NUT		FLANGE					FIT	BOLT			OIL HOLE	STIFFNESS
			Dynamic (1×10 ⁶ REV.) Ca	Static Co	Dg6	L	A	T	W	G	H		S	X	Y		
40	5	3×(2)	1230	3970	65												75
		4×(2)	1575	5290	55	80	88.5	16	72	29	58	15	9	14	8.5	M8×1P	100
		6×(2)	2230	7940	101												147
	6	4×(2)	2130	6410	55	93	88.5	16	72	34	68	15	9	14	8.5	M8×1P	103
		6×(2)	3020	9620	118												149
		8	4.762	4×(2)	2720	7620	60	116	93	16	76	36	72	20	9	14	8.5
10	6.35	3×(2)	3010	7100	64	123	106	18	84	43	86	20	11	17.5	11	PT1/8"	82
	4×(2)	3850	9470	143												107	
12	6.35	4×(2)	3850	9470	63	160	106	18	84	43	86	20	11	17.5	11	PT1/8"	107
50	5	3×(2)	1350	5070	65												89
		4×(2)	1730	6760	66	80	98	16	82	36	72	20	9	14	8.5	PT1/8"	119
		6×(2)	2450	10140	101												174
	6	4×(2)	2380	8250	66	93	98	16	82	36	72	20	9	14	8.5	PT1/8"	123
		6×(2)	3370	12380	118												181
		8	4.762	4×(2)	3010	9610	70	119	113	18	90	42	84	20	11	17.5	11
10	6.35	3×(2)	3430	9300	74	123	116	18	92	42	84	20	11	17.5	11	M8×1P	99
	4×(2)	4390	12400	143												129	
12	7.144	4×(2)	5530	16330	75	164	121	22	97	47	97	20	14	20	13	PT1/8"	135
	7.938	3×(2)	4510	11150	147											101	
		4×(2)	5770	14870	164											132	
63	6	4×(2)	2610	10550	80	96	122	18	100	45	90	20	11	17.5	11	PT1/8"	146
		6×(2)	3700	15830	121												217
	8	4×(2)	3375	12200	82	119	124	18	102	46	92	20	11	17.5	11	PT1/8"	151
		4×(2)	5020	16450	85	147	132	22	107	48	96	20	14	20	13	PT1/8"	158
	12	7.938	3×(2)	5140	14570	90	147	136	22	112	52	104	20	14	20	13	PT1/8"
4×(2)		6580	19430	171												161	
20	9.525	2×(2)	5990	15740	95	156	153	28	123	59	118	20	18	26	17.5	PT1/8"	107
80	10	2×(2)	3360	13390	95												118
		3×(2)	4760	20090	105	115	171	22	147	67	134	25	14	20	13	PT1/8"	173
	16	9.525	2×(2)	11280	41220	115	175	205	28	169	73	146	30	18	26	17.5	PT1/8"
20	9.525	3×(2)	7960	27480	115	159	205	28	169	73	146	30	18	26	17.5	PT1/8"	137



Unit: mm

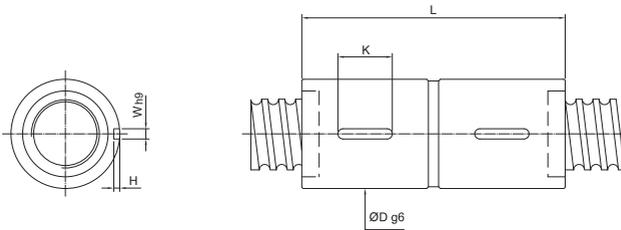
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD(kgf)		NUT		KEYWAY			STIFFNESS
O.D.	LEAD			Dynamic (1×10 ⁶ REV.) Ca	Static Co	Dg6	L	K	W	H	kgf/μm
16	5	3.175	3	765	1240	30	40	20	3	1.8	18
	6	3.175	4	860	1710	34	41	20	3	1.8	21
20	5	3.175	3	1100	2280	34	48	20	3	1.8	28
	6	3.969	4	1080	2050	34	46	20	4	2.5	22
25	5	3.175	3	1380	2730	34	56	25	4	2.5	28
	6	3.175	4	980	2300	40	41	20	4	2.5	26
32	5	3.175	3	1250	3070	40	48	20	4	2.5	33
	6	3.969	4	1275	2740	40	46	20	4	2.5	26
32	5	3.175	3	1630	3650	40	56	25	4	2.5	34
	6	3.175	4	1095	3060	48	41	20	4	2.5	31
32	5	3.175	3	1400	4080	48	48	20	4	2.5	41
	6	3.969	4	1980	6120	50	61	25	5	3.0	60
32	5	3.175	3	1500	3750	50	46	20	5	3.0	32
	6	3.969	4	1920	5000	50	56	25	5	3.0	43
32	5	3.175	3	2720	7500	50	70	32	6	3.5	63
	6	4.762	4	1820	4230	50	59	25	5	3.0	32
32	5	3.175	3	2330	5640	50	70	25	5	3.0	43
	6	6.35	4	2605	5310	50	68	25	6	3.5	33
40	5	3.175	3	3340	7080	50	79	32	6	3.5	45
	6	3.175	4	1575	5290	55	48	20	4	2.5	49
40	5	3.175	4	2230	7940	55	61	25	4	2.5	73
	6	3.969	4	2130	6410	55	56	25	5	3.0	51
40	5	3.969	4	3020	9620	55	70	32	5	3.0	75
	6	4.762	4	2720	7620	60	70	25	5	3.0	52
40	5	4.762	4	3850	11430	60	91	40	5	3.0	77
	6	6.35	3	3010	7100	65	68	25	6	3.5	41
40	5	6.35	4	3850	9470	65	79	32	6	3.5	53

RSIC



Unit: mm

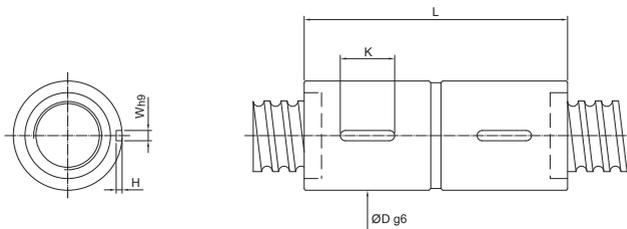
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD(kgf)		NUT		KEYWAY			STIFFNESS
O.D.	LEAD			Dynamic (1×10 ⁶ REV.) Ca	Static Co	Dg6	L	K	W	H	kgf/µm
50	5	3.175	4	1730	6750	66	48	20	4	2.5	60
			6	2450	10130		61	25			86
	6	3.969	4	2380	8250	66	56	25	5	3.0	61
			6	3370	12380		70	32			90
	8	4.762	4	3010	9610	70	70	32	5	3.0	63
			6	4260	14420		91	32			92
10	6.35	3	3430	9300	74	68	32	6	3.5	49	
		4	4390	12400		79				32	65
12	7.938	3	4510	11150	75	82	40	6	3.5	50	
		4	5770	14870		92				40	66
63	6	3.969	4	2610	10550	80	56	25	6	3.5	73
			6	3700	15830		70	32			107
	8	4.762	4	3375	12200	82	70	32	6	3.5	76
			6	4780	18300		91	40			111
10	6.35	4	5020	16450	85	79	32	8	4.0	79	
		6	7110	24680		85	40			116	
12	7.938	4	6580	19430	90	95	40	8	4.0	80	
		6	9320	29150		123	50			118	
80	10	6.35	4	5510	21200	105	79	32	8	4.0	95
			6	7810	31800		102	40			140
	12	7.938	4	7500	25700	110	95	40	8	4.0	98
			6	10620	38550		123	50			143
20	9.525	3	9770	31700	115	126	50	10	5.0	97	
		4	12510	42270		149	63			127	
100	10	6.35	3	4760	20090	125	72	50	10	5	91
			4	6090	26790		82				148
			5	7380	33490		94				
	16	9.525	4	14440	54960	135	128	63	10	5	140
			5	17490	68700		77				205
			6	20460	82440		162				
20	9.525	4	14440	54960	135	144	63	10	5	140	
		5	17490	68700		164				173	
		6	20460	82440		187					



Unit: mm

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD(kgf)		NUT		KEYWAY			STIFFNESS	
O.D.	LEAD			Dynamic (1×10 ⁶ REV.) Ca	Static Co	Dg6	L	K	W	H	kgf/μm	
16	5	3.175	3	765	1240	28	75	20	3	1.8	35	
			4	980	1650		85				47	
20	5	3.175	3	860	1710	34	75	20	3	1.8	43	
			4	1100	2280		85				56	
	6	3.969	3	1080	2050	34	87	20	4	2.5	43	
			4	1380	2730		103				56	
25	5	3.175	3	980	2300	40	75	20	4	2.5	51	
			4	1250	3070		85				67	
	6	3.969	3	1275	2740	40	87	20	4	2.5	52	
			4	1630	3650		103				68	
32	5	3.175	3	1095	3060	48	75	20	4	2.5	63	
			4	1400	4080		85				82	
			6	1980	6120		105				122	
			6	1500	3750		87				65	
	6	3.969	4	3	1920	5000	50	103	25	5	3.0	86
				4	2720	7500		127				125
				6	1820	4230		109				66
				4	2330	5640		127				86
10	6.35	4	3	2605	5310	50	135	25	6	3.5	67	
			4	3340	7080		155				89	
			6	1575	5290		85				100	
			6	2230	7940		105				147	
40	5	3.175	4	2130	6410	55	103	25	5	3.0	103	
			6	3020	9620		127				149	
	8	4.762	6	4	2720	7620	60	127	25	5	3.0	105
				6	3850	11430		161				154
	10	6.35	4	3	3010	7100	65	135	25	6	3.5	82
				4	3850	9470		155				107

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Unit: mm

SCREW SIZE	BALL LEAD	BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD(kgf)		NUT		KEYWAY			STIFFNESS
				Dynamic (1×10 ⁶ REV.) Ca	Static Co	Dg6	L	K	W	H	kgf/μm
50	5	3.175	4	1730	6750	66	85	20	4	2.5	119
			6	2450	10130		105	25			174
	6	3.969	4	2380	8250	66	103	25	5	3.0	123
			6	3370	12380		127	32			181
	8	4.762	4	3010	9610	70	127	32	5	3.0	125
			6	4260	14420		161	32			185
10	6.35	3	3430	9300	74	135	32	6	3.5	99	
		4	4390	12400		155	32			129	
12	7.938	4	6220	18600	75	197	40	6	3.5	191	
		3	4510	11150		161	40			101	
			4	5770	14870		185	40			132
			6	2610	10550		80	106			25
63	6	3.969	4	3700	15830	80	130	32	6	3.5	217
			6	3375	12200		131	32			151
	8	4.762	4	4780	18300	82	165	40	6	3.5	222
			6	5020	16450		160	32			158
	10	6.35	4	7110	24680	85	202	40	8	4.0	232
			6	6580	19430		185	40			161
12	7.938	4	9320	29150	90	238	50	8	4.0	236	
		6	6580	19430		185	40			161	
80	10	6.35	4	5510	21200	105	160	32	8	4.0	190
			6	7810	31800		202	40			280
	12	7.938	4	7500	25700	110	185	40	8	4.0	196
			6	10620	38550		238	50			288
	20	9.525	3	9770	31700	115	245	50	10	5.0	193
			4	12510	42270		289	63			254
100	10	6.35	3	4760	20090	125	132		10	5	173
			4	6090	26790		164	50			228
	4		5	7380	33490		174				281
			6	8630	40190		204				334
	16	9.525	4	14440	54960	135	240		10	5	266
			5	17490	68700		274	63			329
20	9.525	4	20460	82440	135	306		10	5	391	
		5	14440	54960		284				266	
6		5	17490	68700		324	63			329	
		6	20460	82440		366				391	

PMI Precision Ground BallScrew

13.2 End Deflector Series

Features

It is important for a high-lead ballscrew to be with characteristics of high rigidity, low noise and thermal control.

PMI takes its patented design and treatments to achieve the following characteristics:

High DN Value

Max. DN Value: 220,000

Low Noise

The average and accurate ball circle diameter (BCD) through whole threads make the ballscrews to obtain the stable and consistent drag torque as well as to reduce the noise.

The audio frequency is low and downy due to the designed of plastic circulation system.

Space Saving

The ballnut diameter reduces 20%~25% substantially and the length of nut is shorter.

The total space shall be reduced to approximately 50% consequently.

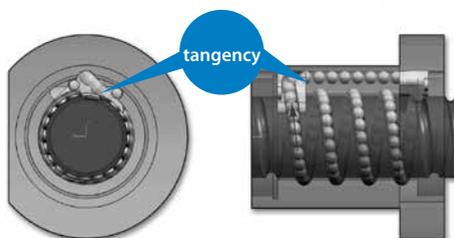
Circulation

The specially designed pathway of the Recirculation System makes a contact with lead angle and also with BCD in the same tangency, improving its smoothness effectively.

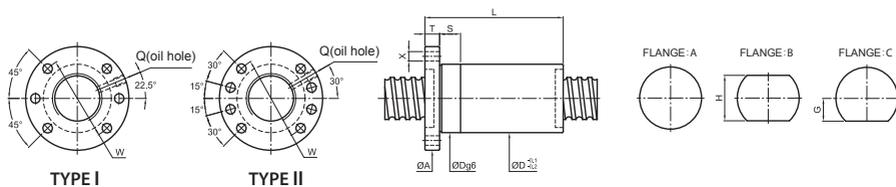
Applications

CNC Machinery / Precision Machinery / High Speed Machinery /
Semi-Conductor Equipment / Medical equipment

Diameter
Reduces
20%~25%



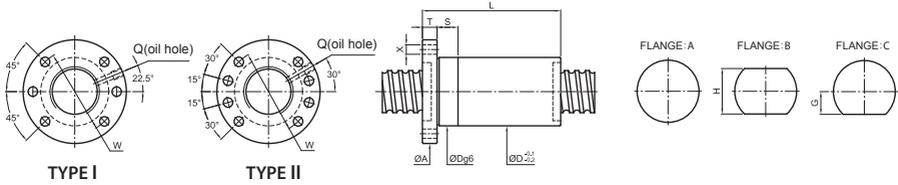
FSDC



Unit: mm

SCREW SIZE	BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD(kgf)		NUT		FLANGE					FIT S	OIL HOLE Q	BOLT X	STIFFNESS kg/μm		
			Dynamic (1×10 ⁶ REV) Ca	Static Co	Dg6	L	A	T	W	G	H					TYPE	
12	4	2.381	3	610	1190	24	28	44	10	34	16	32	I	10	M6×1P	4.5	20
	5		3	610	1190		32										20
	10		3	590	1160		45										20
	20		2	390	770		54										14
14	4	2.381	3	680	1430	26	28	46	10	36	16	32	I	10	M6×1P	4.5	23
	5	3.175	3	820	1520	28	32	49	10	36	16	32	I	10	M6×1P	4.5	25
15	5	3.175	3	850	1640	29	35	51	10	39	19	38	I	10	M6×1P	5.5	26
	10		3	840	1610		47										26
	20		2	560	1050		58										18
16	5	3.175	3	890	1760	29	41	51	10	39	19	38	I	10	M6×1P	5.5	27
	10		3	870	1740	50	27										
	16		2	600	1150	51	19										
20	4	2.381	3	780	2000	32	28	54	12	42	19	38	I	12	M6×1P	5.5	29
	5		4	1300	3030	40	43										
	10	3.175	3	990	2220	36	47	62	12	49	24	48	I	12	M6×1P	6.6	33
	20		2	670	1450	56	23										
	6	3.969	3	1540	3310	37	38	62	12	49	23	46	I	12	M6×1P	6.6	34
	8		3	1540	3300		45										34
10	4.762	4	2560	5530	40	62	62	12	51	24	48	I	15	M6×1P	6.6	47	
25	4	2.381	3	870	2560	36	28	62	12	49	22	44	I	12	M6×1P	6.6	34
	5		4	1440	3840	41	50										
	10	3.175	3	1100	2810	40	50	62	12	51	24	48	I	15	M6×1P	6.6	38
	15		4	1410	3780		81										50
	20	2	2	750	1840	43	60	64	12	51	24	48	I	15	M6×1P	6.6	26
	25		2	730	1810		71										26
	6	3.969	4	2250	5710	43	45	64	12	51	24	48	I	15	M6×1P	6.6	53
	12		4	2240	5660		70										53
	25	4.762	2	1160	2720	45	70	65	15	54	25.5	51	I	15	M6×1P	6.6	28
	8		4	2880	6890		55										55
	10	4.762	4	2880	6870	45	63	65	15	54	25.5	51	I	15	M6×1P	6.6	55
	16		4	2830	6790		85										55
20	6.35	2	1470	3180	51	61	84	16	67	32	64	I	15	M6×1P	9	29	
10		5	5050	11500		78										72	

Coam and Cam are the modified static and dynamic load capacities,calculated according to ISO-3408-5

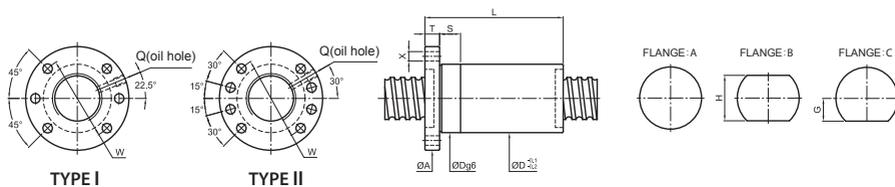


Unit: mm

SCREW SIZE	BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD(kgf)		NUT		FLANGE						FIT S	OIL HOLE Q	BOLT X	STIFFNESS kgf/µm		
			Dynamic (1×10 ⁶ REV) Ca	Static Co	Dg6	L	A	T	W	G	H	TYPE						
O.D.	LEAD																	
28	5	3.175	5	1850	5460	43	48	65	12	51	24	48	I	15	M8×1P	6.6	67	
	6	3.969	5	2880	7980	46	52	66	12	54	26	52	I	15	M8×1P	6.6	70	
	8		3	2350	5720		46										46	
	10	4.762	3	2340	5710	48	52	74	12	60	30	60	I	15	M8×1P	6.6	46	
	16		5	3680	9690		102											73
	12	6.35	5	5280	12530		78											77
			5	5270	12500	54	88	87	16	72	34.5	69	I	15	M8×1P	9	77	
32	5	3.175	4	1610	4970	50	41	87	16	72	34.5	69	I	15	M8×1P	9	61	
	6		5	3050	9140		52											77
	10	3.969	4	2550	7500	53	62	87	16	72	34.5	69	I	15	M8×1P	9	63	
	32		2	1300	3540		90											40
	8		5	3900	10930		67											80
	10		5	3890	10910		77											80
	12	4.762	5	3890	10890		87											80
	15		5	3860	10850	53	116	87	16	72	34.5	69	I	15	M8×1P	9	80	
	20		2	1700	4230		70											34
	32		2	1640	4120		90											34
	10		5	4900	13360		78											84
	12		5	4890	13340		88											84
	16	5.556	5	4860	13280	55	107	87	16	72	34.5	69	I	15	M8×1P	9	79	
	20		3	3140	8110		87											53
	10		5	5720	14490		78											85
	12	6.35	5	5710	14470		88											85
16		4	4520	11100	57	92	87	16	72	34.5	69	I	15	M8×1P	9	69		
20		3	3530	8340		88											54	

Coam and Cam are the modified static and dynamic load capacities,calculated according to ISO-3408-5

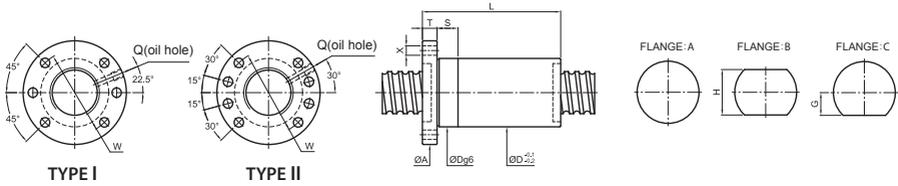
FSDC



Unit: mm

O.D.	LEAD	BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD(kgf)		NUT		FLANGE						FIT S	OIL HOLE Q	BOLT X	STIFFNESS kg/μm		
				Dynamic (1×10 ⁶ REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	TYPE						
36	8	4.762	5	4170	12580	56	63	80	11	68	34	68	I	15	M8×1P	9	86		
	10		5	6050	16460		78												93
	12		5	6080	16430		88												93
	16	6.35	5	6050	16360	61	109	91	18	76	34	68	II	15	M8×1P	9	93		
	20		4	4910	12890		109												76
	36		2	2570	6250		95												41
38	10	6.35	5	6260	17740		80								M8×1P		97		
	12		5	6260	17410	63	88	93	18	78	35	70	II	20		9	97		
	16		5	6220	17350		109											97	
	40		3	3830	10220		142											71	
40	5	3.175	4	1760	6260	58	42	91	18	76	34	68	II	15	M8×1P	9	71		
	6	3.969	5	3420	11810	58	52	91	18	76	34	68	II	15		M8×1P	9	92	
	8	4.762	4	3610	11260	60	56	91	18	76	34	68	II	15	M8×1P		9	77	
	10	6.35	5	6430	18440		78									M8×1P		101	
	12		5	6420	18410		88								9		101		
	15		5	6380	18350		103	95	18	80	36	72	II	20	101				
	16		5	6390	18330	65	108								101				
	20		4	5190	14450										82				
	40		2	2700	6950		110	98	18	83	37	74	II	20	M8×1P		11	43	
	12	7.144	5	7530	20800										M8×1P		103		
16	5		7500	20730	70	110	98	18	83	37	74	II	20	11		103			

Coam and Cam are the modified static and dynamic load capacities,calculated according to ISO-3408-5

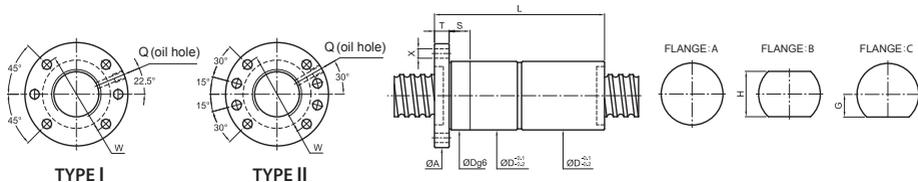


Unit: mm

SCREW SIZE	BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD(kgf)		NUT		FLANGE						FIT	OIL HOLE	BOLT	STIFFNESS	
			Dynamic (1×10 ⁶ REV) Ca	Static Co	Dg6	L	A	T	W	G	H	TYPE					S
45	8	4.762	4	3770	12580	66	55	98	18	83	37	74	II	20	M8×1P	11	84
	10		5	6910	21330		78										110
	12	6.35	5	6910	21310	70	89	105	18	88	40	80	II	20	M8×1P	11	110
	16		5	6880	21250		111										110
	12	7.144	5	7930	23300		88										113
	20		4	6440	18340	73	110	105	18	88	40	80	II	20	M8×1P	11	91
50	5	3.175	5	2360	9950	70	48	105	18	88	40	80	II	20	M8×1P	11	105
	8	4.762	5	4780	17550	70	64	105	18	88	40	80	II	20	M8×1P	11	109
	10		5	7160	23320		78										119
	12	6.35	5	7150	23300		90										119
	16		5	7120	23250	75	109	118	18	100	46	92	II	20	M8×1P	11	119
	20		3	4460	13520		95										74
55	20	7.938	4	7810	22680	80	114	121	18	104	50	100	II	25	M8×1P	11	101
63	12	6.35	5	7340	25280	80	96	118	18	100	46	92	II	20	M8×1P	11	128
	10	6.35	5	7800	29210	88	84	135	22	115	50	110	II	20	M8×1P	11	141
	16	9.525	5	13640	43620	102	116	147	20	127	56	112	II	25	M8×1P	14	167
80	20		5	15350	56760		143										196
	25	9.525	4	12530	44860	118	146	165	25	145	65	130	II	25	M8×1P	14	159
	30		3	9610	32980		134										121

Coam and Cam are the modified static and dynamic load capacities,calculated according to ISO-3408-5

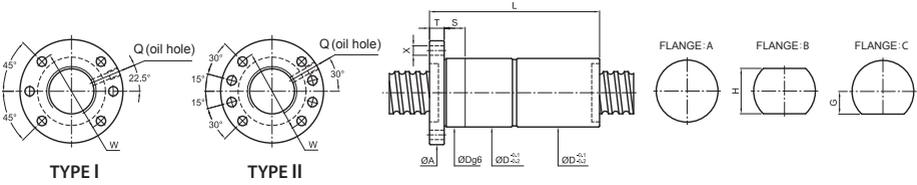
FDDC



Unit: mm

O.D.	SCREW SIZE	LEAD	BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD (kgf)		NUT		FLANGE						FIT	OIL HOLE	BOLT	STIFFNESS		
					Dynamic (1×10 ⁶ REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	TYPE					S	Q
20	4	2.381	2.381	3	780	2000	32	61	54	12	42	19	38	I	12	M6×1P	5.5	44		
	5			4	1300	3030		80											65	
	10	3.175	3.175	3	990	2220	36	97	62	12	49	24	48	I	12	M6×1P	6.6	50		
	20			2	670	1450		116											33	
	6	3.969	3.969	3	1540	3310	37	81	62	12	49	19	38	I	12	M6×1P	6.6	51		
	8			3	1540	3300		93											51	
10	4.762	4	2560	5530	40	107	62	12	51	24	48	I	15	M6×1P	6.6	70				
25	4	2.381	2.381	3	870	2560	36	60	62	12	49	19	38	I	12	M6×1P	6.6	53		
	5			4	1440	3840		81											77	
	10			3	1100	2810		100											58	
	15	3.175	3.175	4	1410	3780	40	166	62	12	51	24	48	I	15	M6×1P	6.6	77		
	20			2	750	1840		120											39	
	25			2	730	1810		146											39	
	6	3.969	3.969	4	2250	5710		87											80	
	12			4	2240	5660	43	142	64	12	51	22	44	I	15	M6×1P	6.6	80		
	25			2	1160	2720		145												41
	8			4	2880	6890		111												83
	10	4.762	4.762	4	2880	6870	45	128	65	15	54	25.5	51	I	15	M6×1P	6.6			83
	16			4	2830	6790		173												83
	20			2	1470	3180		122												42
	10	6.35	5	5050	11500	51	153	84	16	67	32	64	I	15	M6×1P	9	108			

Coam and Cam are the modified static and dynamic load capacities,calculated according to ISO-3408-5

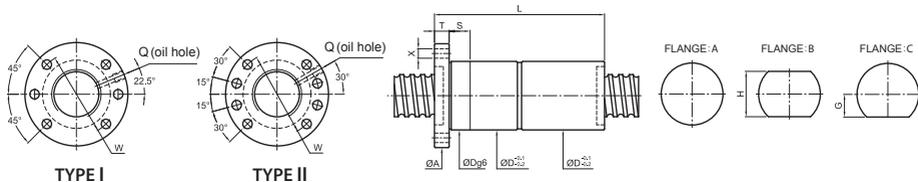


Unit: mm

SCREW SIZE	BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD(kgf)		NUT		FLANGE						FIT S	OIL HOLE Q	BOLT X	STIFFNESS kgf/μm		
			Dynamic (1×10 ⁶ REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	TYPE						
28	5	3.175	5	1850	5460	44	93	65	12	51	24	48	I	M8×1P	6.6	104		
	6	3.969	5	2880	7980	46	106	66	12	50	26	52	I				6.6	108
	8		3	2350	5720		94											
	10	4.762	3	2340	5710	48	102	74	12	60	30	60	I	15	M8×1P	6.6	69	
	16		5	3680	9690		206											112
	10	6.35	5	5280	12530	54	158	87	16	72	34.5	69	I	M8×1P	9	118		
	12		5	5270	12500		172										118	
32	5	3.175	4	1610	4970	50	81	87	16	72	34.5	69	I	15	M8×1P	9	93	
	6		5	3050	9140		106											120
	10	3.969	4	2550	7500	53	126	87	16	72	34.5	69	I	15	M8×1P	9	96	
	32		2	1300	3540		172											60
	8		5	3900	10930		132							124				
	10		5	3890	10910		147								124			
	12	4.762	5	3890	10890	53	171	87	16	72	34.5	69	I	15		M8×1P	9	124
	15		5	3860	10850		221								124			
	20		2	1700	4230		140							51				
	32		2	1640	4120		186								51			
	10		5	4900	13360		153							129				
	12	5.556	5	4890	13340	55	172	87	16	72	34.5	69	I		15	M8×1P	9	129
	16		5	4860	13280		211							121				
	20		3	3140	8110		177							79				
	10		5	5720	14490		153								131			
	12	6.35	5	5710	14470	57	172	87	16	72	34.5	69	I	15		M8×1P	9	131
	16		4	4520	11100		180								105			
	20		3	3530	8340		178							80				

Coam and Cam are the modified static and dynamic load capacities,calculated according to ISO-3408-5

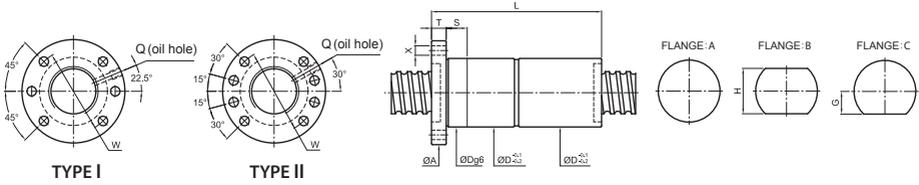
FDDC



Unit: mm

SCREW SIZE	BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD (kgf)		NUT		FLANGE						FIT S	OIL HOLE Q	BOLT X	STIFFNESS kgf/μm		
			Dynamic (1×10 ⁶ REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	TYPE						
36	8	4.762	5	4170	12580	56	127	80	11	68	34	68	II	15	M8×1P	9	133	
	10		5	6050	16460		153											142
	12	5	6080	16430		172											142	
	16	6.35	5	6050	16360	61	213	91	18	76	34	68	II	15	M8×1P	9	142	
	20		4	4910	12890		217											115
	36		2	2570	6250		194											59
38	10	6.35	5	6260	17740		155										149	
	12		5	6260	17410		172										149	
	16		5	6220	17350	63	213	93	18	78	35	70	II	20	M8×1P	9	149	
	40	3	3830	10220		282											106	
40	5	3.175	4	1760	6260	58	87	91	18	76	34	68	II	15	M8×1P	9	111	
	6	3.969	5	3420	11810	58	108	91	18	76	34	68	II	15	M8×1P	9	142	
	8	4.762	4	3610	11260	60	118	91	18	76	34	68	II	15	M8×1P	9	118	
	10	6.35	5	6430	18440		158										155	
	12		5	6420	18410		172											155
	15		5	6380	18350		226	95	18	80	36	72	II	20	M8×1P	9	155	
	16		5	6390	18330	65	212											155
	20		4	5190	14450		220											125
	40	7.144	2	2700	6950		210	98	18	83	37	74	II	20	M8×1P	11	64	
	12		5	7530	20800	70	174	98	18	83	37	74	II	20	M8×1P	11	158	
16	5		7500	20730		212											158	

Coam and Cam are the modified static and dynamic load capacities,calculated according to ISO-3408-5



Unit: mm

SCREW SIZE	LEAD	BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD (kgf)		NUT		FLANGE						FIT S	OIL HOLE Q	BOLT X	STIFFNESS kgf/μm
				Dynamic (1×10 ⁶ REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	TYPE				
45	8	4.762	4	3770	12580	66	114	98	18	83	37	74	II	20	M8×1P	11	130
	10		5	6910	21330		158										170
	12	6.35	5	6910	21310	70	171	105	18	88	40	80	II	20	M8×1P	11	170
	16		5	6880	21250		215										170
	12	7.144	5	7930	23300	73	178										173
	20		4	6440	18340		220	105	18	88	40	80	II	20	M8×1P	11	139
50	5	3.175	5	2360	9950	70	98	105	18	88	40	80	II	20	M8×1P	11	164
	8	4.762	5	4780	17550	70	128	105	18	88	40	80	II	20	M8×1P	11	169
	10		5	7160	23320		158										185
	12	6.35	5	7150	23300	75	174	118	18	100	46	92	II	20	M8×1P	11	185
	16		5	7120	23250		215										185
	20		3	4460	13520	75	185	118	18	100	46	92	II	20	M8×1P	11	112
20	7.938	4	7810	22680	80	220	121		104							154	
55	12	6.35	5	7340	25280	80	174	118	18	100	46	92	II	20	M8×1P	11	198
63	10	6.35	5	7800	29210	88	164	135	22	115	50	100		20	M8×1P	14	220
	16	9.525	5	13640	43620	102	228	147	20	127	56	112		25			257
80	20		5	15350	56760		283										305
	25	9.525	4	12530	44860	118	296	165	25	145	65	130	II	25	M8×1P	14	245
	30		3	9610	32980		254										185

Coam and Cam are the modified static and dynamic load capacities, calculated according to ISO-3408-5

13.3 External Ball Circulation Nuts

Features:

- Lower noise due to longer ball circulation paths.
- Offers smoother ball circulation.
- Offers better solution and quality for high lead or large diameter ballscrews.

Type:

There are two types of Ballnut of the external circulation Ballscrews. They are "immersion type" of Fig.13.2 and "extrusive type" of Fig.13.3. The "immersion type" means the ball circulation tubes are inside the circular surface of Ballnut as shown on specifications of this catalogue are of "immersion type".

In some cases, as per designs on customer's drawings, there are smaller outer diameters ballnuts required. Then the ball circulation tubes shall extrude out of Ballnut circular surface.

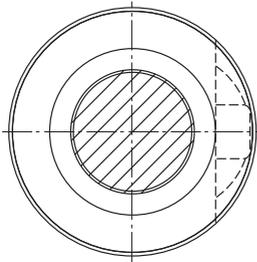


Fig.13.2 Immersion type

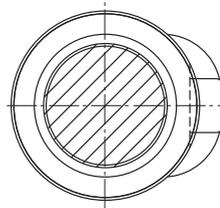
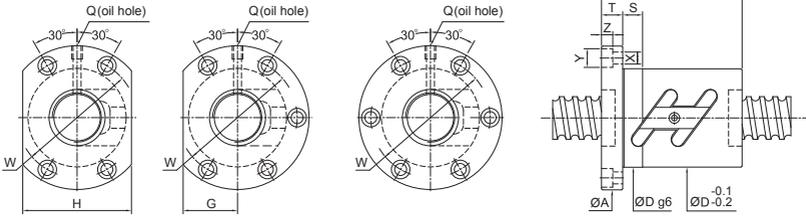


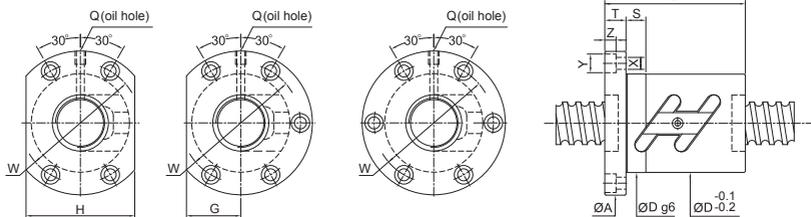
Fig.13.3 Extrusive type



Unit: mm

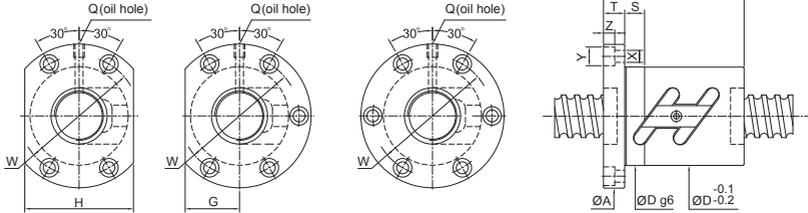
O.D.	SCREW SIZE		EFFECTIVE TURNS circuit × row	BASIC RATE LOAD(kgf)		NUT		FLANGE					FIT	BOLT			OIL HOLE Q	STIFFNESS kgf/μm	
	LEAD	BALL DIA.		Dynamic (1×10 ⁶ REV.) Ca	Static Co	Dg6	L	A	T	W	G	H		S	X	Y			Z
10	3	2.000	2.5×1	250	430	37												9	
	4	2.000	2.5×1	250	430	26	40	46	10	36	14	28	10	4.5	8	4.5	M6×1P	9	
	5	2.000	2.5×1	250	430	42												9	
12	4	2.381	2.5×1	380	640	30	40	50	10	40	16	32	10	4.5	8	4.5	M6×1P	12	
	5	2.381	2.5×1	380	640	42												12	
14	4	2.381	2.5×1	410	750	34	40	57	11	45	17	34	10	4.5	9.5	5.5	M6×1P	14	
	5	3.175	2.5×1	675	1145	42												15	
15	4	2.381	2.5×1	420	800	40												14	
	5	3.175	2.5×1	680	1210	34	42	57	10	45	17	34	10	5.5	9.5	5.5	M6×1P	15	
	10	3.175	2.5×1	680	1210	55												16	
16	4	2.381	1.5×2	490	1010	44												18	
			2.5×1	430	850	34	41	57	11	45	17	34	10	5.5	9.5	5.5	M6×1P	15	
			3.5×1	560	1180	42													21
	5	3.175	1.5×2	805	1525	45													19
			2.5×1	690	1270	41													16
			2.5×2	1250	2540	40	56	63	11	51	21	42	15	5.5	9.5	5.5	M6×1P	31	
			3.5×1	920	1780	46													22
	6	3.175	1.5×2	805	1525	52													19
			2.5×1	690	1270	40	44	63	11	51	21	42	15	5.5	9.5	5.5	M6×1P	16	
			3.5×1	920	1780	52												22	
10	3.175	2.5×1	690	1270	40	56	63	11	51	21	42	15	5.5	9.5	5.5	M6×1P	16		
20	4	2.381	1.5×2	530	1270	44												21	
			2.5×1	480	1060	40	40	63.5	11	51	21	42		5.5	9.5	5.5	M6×1P	18	
			2.5×2	820	2120	50													35
			3.5×1	600	1480	43													25
	5	3.175	1.5×2	965	2070	45													24
			2.5×1	830	1730	44	42	67	11	55	26	52		5.5	9.5	5.5	M6×1P	20	
			2.5×2	1510	3460	56													39
			3.5×1	1110	2420	46													26
	6	3.969	1.5×2	1285	2545	56													24
			2.5×1	1100	2120	48	49	71	11	59	27	54	10	5.5	9.5	5.5	M6×1P	20	
				3.5×1	1470	2970	56												28
	8	3.969	1.5×2	1285	2545	61													24
2.5×1			1100	2120	48	54	75	13	61	27	54	15	6.6	11	6.5	M6×1P	20		
			3.5×1	1470	2970	62												28	

FSWC



Unit: mm

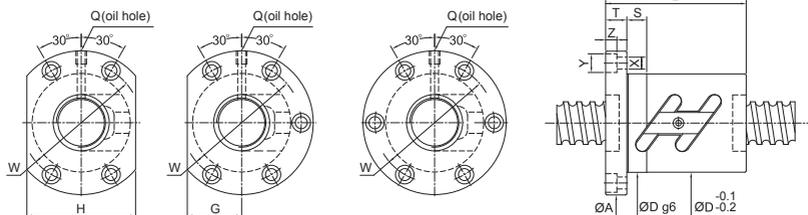
SCREW SIZE	BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD(kgf)		NUT	FLANGE						FIT	BOLT				OIL HOLE	STIFFNESS	
			Dynamic (1×10 ⁶ REV.) Ca	Static Co		Dg6	L	A	T	W	G		H	S	X	Y			Z
O.D.	LEAD																	kgf/μm	
25	4	2.381	1.5×2	600	1630	44													26
			2.5×1	510	1355	46	40												22
			2.5×2	930	2710	49	69	11	57	26	52	15	5.5	9.5	5.5	M6×1P			42
			3.5×1	680	1900	42													30
	5	3.175	1.5×2	1065	2575	45													28
			2.5×1	910	2150	41	73	11	61	28	56	15	5.5	9.5	5.5	M6×1P			24
			2.5×2	1650	4300	50	56												46
			3.5×1	1210	3010	46													33
	6	3.969	1.5×2	1420	3215	56													29
			2.5×1	1210	2680	53	49	76	11	64	29	58	15	5.5	9.5	5.5	M6×1P		24
			2.5×2	2190	5360	62													47
			3.5×1	1610	3750	56													34
8	4.762	1.5×2	1820	3840	61													30	
		2.5×1	1560	3200	58	61	85	13	71	32	64	15	6.6	11	6.5	M6×1P		25	
		3.5×1	2080	4480	66													35	
		1.5×2	1820	3840	71													30	
10	4.762	2.5×1	1560	3200	58	65	85	15	71	32	64	15	6.6	11	6.5	M6×1P		25	
		3.5×1	2080	4480	75													35	
12	3.969	2.5×1	1210	2680	53	60	76	11	64	32	64	15	5.5	9.5	5.5	M6×1P		24	
28	5	3.175	1.5×2	1110	2960	46													31
			2.5×1	950	2470	42													26
			2.5×2	1720	4940	55	56	83	12	69	31	62	15	6.6	11	6.5	M8×1P		50
			3.5×1	1270	3460	47													36
	6	3.969	1.5×2	1480	3605	57													32
			2.5×1	1270	3000	55	50	83	12	69	31	62	15	6.6	11	6.5	M8×1P		26
			2.5×2	2300	6000	63	63												51
			3.5×1	1690	4200	57													37
	8	4.762	1.5×2	1935	4325	65													33
			2.5×1	1650	3600	60	63	93	15	76	36	72	15	9	14	8.5	M8×1P		28
			3.5×1	2200	5040	68													38
			1.5×2	1935	4325	74													33
10	4.762	2.5×1	1650	3600	60	67	93	15	76	36	72	15	9	14	8.5	M8×1P		28	
		3.5×1	2200	5040	77													38	



Unit: mm

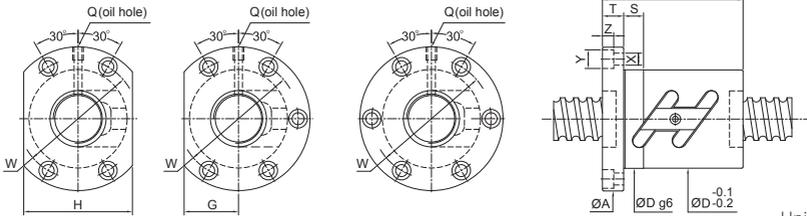
O.D.	LEAD	BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE		NUT	FLANGE						FIT	BOLT			OIL HOLE	STIFFNESS														
				Dynamic (1×10 ⁶ REV.) Ca	Static Co		Dg6	L	A	T	W	G		H	S	X			Y	Z	Q											
32	4	2.381	2.5×1	565	1750	54	40	81	12	67	32	64	15	6.6	11	6.5	M6×1P	26														
			2.5×2	1020	3500		50											50	50													
			1.5×2	1180	3410	47																							34			
	5	3.175	3.175	2.5×1	1010	2840	58	43	85	12	71	32	64	15	6.6	11	6.5	M8×1P	29													
				2.5×2	1830	5680		57											57	57												
				2.5×3	2590	8520	72																							82		
				3.5×1	1350	3980	47																								40	
	6	3.969	3.969	1.5×2	1560	4135	62	57	88	12	75	34	68	15	6.6	11	6.5	M8×1P	35													
				2.5×1	1330	3450		45																							29	
				2.5×2	2410	6900	63																								57	
				3.5×1	1770	4830	57																									40
				1.5×2	2010	5010	64																									36
2.5×1				1720	4180	63																									30	
8	4.762	4.762	2.5×2	3120	8360	66	80	98	15	82	38	76	15	9	14	8.5	M8×1P	59														
			3.5×1	2300	5850		68																							42		
			1.5×2	3000	6530	78																									38	
			2.5×1	2570	5440	74																									32	
			2.5×2	4660	10880	97																										61
			3.5×1	3430	7620	78																										44
12	6.35	6.35	1.5×2	3000	6530	74	88	108	18	90	41	82	15	9	14	8.5	M8×1P	38														
			2.5×1	2570	5440		77																							32		
			2.5×2	4660	10880	110																									62	
			3.5×1	3430	7620	91																										44
			1.5×2	1240	3850	50																										38
			2.5×1	1920	6420	60																										62
36	5	3.175	2.5×2	2720	9630	65	75	98	15	82	38	76	15	9	14	8.5	M8×1P	90														
			3.5×1	1410	4490		50																							44		
			2.5×2	2600	7900	66																									63	
			2.5×3	3680	11850	84																									93	
	10	6.35	6.35	1.5×2	3180	7410	75	81	118	18	98	45	90	15	11	17.5	11	M8×1P	41													
				2.5×1	2720	6180		71																							35	
				2.5×2	4930	12360	103																									68
				3.5×1	3630	8650	81																									48
	12	6.35	6.35	2.5×1	2720	6180	75	77	118	18	98	45	90	15	11	17.5	11	M8×1P	35													
				2.5×2	4930	12360		110																								68
				3.5×1	3630	8650	91																									48

FSWC



Unit: mm

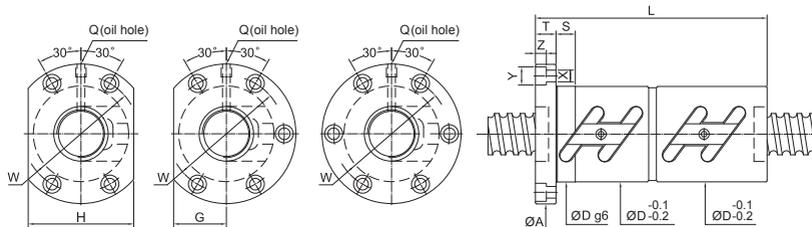
SCREW SIZE	BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD/(kgf)		NUT		FLANGE					FIT	BOLT			OIL HOLE	STIFFNESS	
			Dynamic (1×10 ⁶ REV.) Ca	Static Co	Dg6	L	A	T	W	G	H		S	X	Y			Z
O.D.	LEAD																kgf/μm	
40	5	3.175	1.5×2	1280	4275	50												41
			2.5×1	1090	3560	48												34
			2.5×2	1980	7120	67	60	101	15	83	39	78	15	9	14	8.5	M8×1P	66
			2.5×3	2800	10680	75												98
			3.5×1	1450	4980	50												47
	6	3.969	1.5×2	1750	5300	60												42
			2.5×1	1500	4420	53												35
			2.5×2	2720	8840	70	66	104	15	86	40	80	15	9	14	8.5	PT1/8"	69
			2.5×3	3850	13260	84												101
			3.5×1	2000	6190	60												49
	8	4.762	1.5×2	2220	6320	64												43
			2.5×1	1900	5270	63												36
			2.5×2	3450	10540	74	83	108	15	90	41	82	15	9	14	8.5	PT1/8"	70
			3.5×1	2540	7380	68												50
	10	6.35	1.5×2	3370	8335	81												45
			2.5×1	2880	6950	71												35
			2.5×2	5220	13900	82	103	124	18	102	47	94	20	11	17.5	11	PT1/8"	74
	12	6.35	3.5×1	3840	9730	81												52
			2.5×1	2880	6950	77												38
			2.5×2	5220	13900	86	112	128	18	106	48	96	20	11	17.5	11	PT1/8"	74
45	10	6.35	2.5×2	5480	15700	101											81	
			2.5×3	7760	23550	88	131	132	18	110	50	100	20	11	17.5	11	PT1/8"	119
	12	7.144	2.5×1	3550	8950	84											43	
			2.5×2	6440	17900	90	112	132	18	110	50	100	20	11	17.5	11	PT1/8"	82
			2.5×3	9120	26850	148												121



Unit: mm

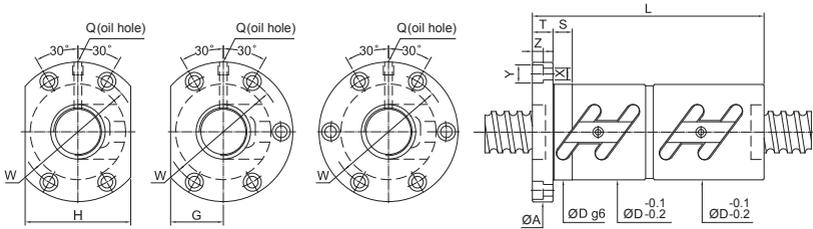
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD(kg/f)		NUT		FLANGE					FIT	BOLT			OIL HOLE	STIFFNESS		
O.D.	LEAD			Dynamic (1×10 ⁶ REV.) Ca	Static Co	Dg6	L	A	T	W	G	H		S	X	Y			Z	Q
50	5	3.175	1.5×2	1410	5305	50												49		
			1.5×3	2000	7960	80	60	114	15	96	43	86	15	9	14	8.5	PT1/8"	72		
			2.5×2	2190	8840	80	60												80	
			3.5×1	1610	6190	50													57	
	6	3.969		1.5×2	1920	6600	60												50	
				2.5×2	2980	11000	84	67	118	15	100	45	90	15	9	14	8.5	PT1/8"	82	
				2.5×3	4220	16500	84	85												121
				3.5×1	2190	7700	60													58
	8	4.762		1.5×2	2515	7810	68												52	
				2.5×2	3900	13020	87	86	128	18	107	49	98	20	11	17.5	11	PT1/8"	85	
				2.5×3	5520	19530	87	109												125
				3.5×1	2870	9110	71													60
10	6.35		1.5×2	3725	10450	81												54		
			2.5×1	3190	8710	71													45	
			2.5×2	5790	17420	93	101	135	18	113	51	102	20	11	17.5	11	PT1/8"	88		
			2.5×3	8200	26130	131													130	
12	7.144		3.5×1	4260	12190	81												63		
			2.5×1	3700	10050	88	146	22	122	55	110	20	14	20	13	PT1/8"	46			
55	10	6.35	2.5×2	6710	20100	116												89		
			2.5×3	6005	19540	101	144	18	122	54	108	20	11	17.5	11	PT1/8"	95			
63	10	6.35	2.5×1	8510	29310	131												140		
			2.5×2	3510	11200	75													55	
			2.5×3	6370	22400	108	105	154	22	130	58	116	20	14	20	13	PT1/8"	106		
			2.5×3	9020	33600	135													156	
12	7.938		2.5×1	4770	13780	88												59		
			2.5×2	8650	27560	115	124	161	22	137	61	122	20	14	20	13	PT1/8"	113		
80	10	6.35	2.5×3	12250	41340	160												167		
			2.5×2	7130	28500	105	176	22	152	66	132	20	14	20	13	PT1/8"	129			
	12	7.938		2.5×3	10100	42750	134											190		
				2.5×2	9710	35560	124	182	22	158	68	136	20	14	20	13	PT1/8"	137		
	16	9.525		2.5×3	13760	53340	160												202	
				2.5×2	16450	59280	160	204	28	172	77	154	30	18	26	17.5	PT1/8"	170		
			2.5×3	23300	88920	208												250		

FDWC



Unit: mm

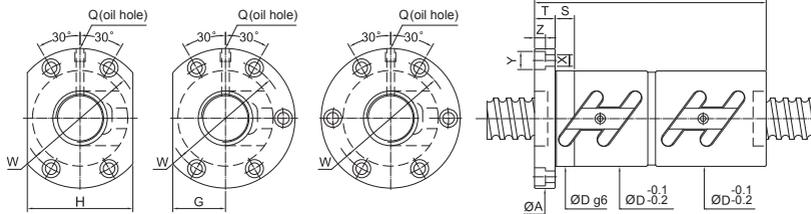
SCREW SIZE	BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD(kgf)		NUT	FLANGE						FIT	BOLT			OIL HOLE	STIFFNESS		
			Dynamic (1×10 ⁶ REV.) Ca	Static Co		Dg6	L	A	T	W	G		H	S	X			Y	Z
O.D.	LEAD																		
16	4	2.381	1.5×2	490	1010	81													36
			2.5×1	430	850	34	70	57	11	45	17	34	15	5.5	9.5	5.5	M6×1P	30	
			3.5×1	560	1180	78													42
	5	3.175	1.5×2	805	1525	90													39
			2.5×1	690	1270	40	77	63	11	51	20	40	15	5.5	9.5	5.5	M6×1P	33	
			2.5×2	1250	2540	105													63
			3.5×1	920	1780	88													45
	6	3.175	1.5×2	805	1525	90													39
			2.5×1	690	1270	40	80	63	11	51	20	40	15	5.5	9.5	5.5	M6×1P	33	
			3.5×1	920	1780	90													45
	20	4	2.381	1.5×2	530	1270	83												42
				2.5×1	480	1060	40	67	63	11	51	24	48	15	5.5	9.5	5.5	M6×1P	36
2.5×2				820	2120	89													69
3.5×1				600	1480	75													49
5		3.175	1.5×2	965	2070	99													47
			2.5×1	830	1730	44	76	67	11	55	26	52	15	5.5	9.5	5.5	M6×1P	40	
			2.5×2	1510	3460	105													77
			3.5×1	1110	2420	80													55
6		3.969	1.5×2	1285	2545	98													49
			2.5×1	1100	2120	48	82	71	11	59	27	54	15	5.5	9.5	5.5	M6×1P	41	
			3.5×1	1470	2970	93													45
8		3.969	1.5×2	1285	2545	108													49
	2.5×2		1100	2120	48	102	75	13	61	28	56	15	6.6	11	6.5	M6×1P	41		
	3.5×1		1470	2970	110													56	



Unit: mm

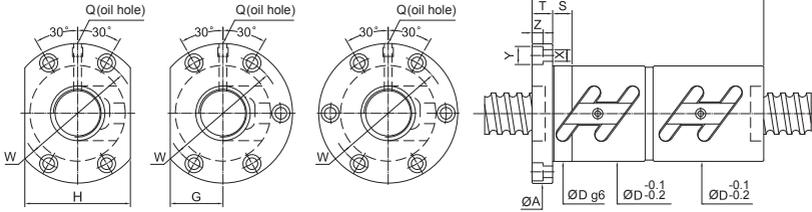
O.D.	LEAD	BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD(kgf)		NUT	FLANGE						FIT	BOLT			OIL HOLE	STIFFNESS		
				Dynamic (1×10 ⁶ REV.) Ca	Static Co		Dg6	L	A	T	W	G		H	S	X			Y	Z
25	4	2.381	1.5×2	600	1630	83													51	
			2.5×1	510	1355	67														43
			2.5×2	930	2710	91	69	11	57	26	52	15	5.5	9.5	5.5	M6×1P				84
			3.5×1	680	1900	75														59
	5	3.175	1.5×2	1065	2575	80													57	
			2.5×1	910	2150	77													48	
			2.5×2	1650	4300	105	73	11	61	28	56	15	5.5	9.5	5.5	M6×1P			92	
			3.5×1	1210	3010	86													65	
	6	3.969	1.5×2	1420	3215	91													58	
			2.5×1	1210	2680	82													49	
			2.5×2	2190	5360	116	76	11	64	29	58	15	5.5	9.5	5.5	M6×1P			94	
			3.5×1	1610	3750	93													67	
8	4.762	1.5×2	1820	3840	111													60		
		2.5×1	1560	3200	95	58	95	85	13	71	32	64	15	6.6	11	6.5	M6×1P	50		
		3.5×1	2080	4480	111													69		
10	4.762	1.5×2	1820	3840	111													60		
		2.5×1	1560	3200	117	58	117	85	15	71	32	64	15	6.6	11	6.5	M6×1P	50		
		3.5×1	2080	4480	138													69		
28	5	3.175	1.5×2	1110	2960	86												62		
			2.5×1	950	2470	78													52	
			2.5×2	1720	4940	106	55	83	12	69	31	62	15	6.6	11	6.5	M8×1P	101		
			3.5×1	1270	3460	86													72	
	6	3.969	1.5×2	1480	3605	98													63	
			2.5×1	1270	3000	89													53	
			2.5×2	2300	6000	117	55	83	12	69	31	62	15	6.6	11	6.5	M8×1P	103		
			3.5×1	1690	4200	94													73	
	8	4.762	1.5×2	1935	4325	113													66	
			2.5×1	1650	3600	97	60	97	93	15	76	36	72	15	9	14	8.5	M8×1P	55	
			3.5×1	2200	5040	113													76	
	10	4.762	1.5×2	1935	4325	113													66	
2.5×1			1635	3600	117	60	117	93	15	76	36	72	15	9	14	8.5	M8×1P	55		
3.5×1			2200	5040	138													76		

FDWC



Unit: mm

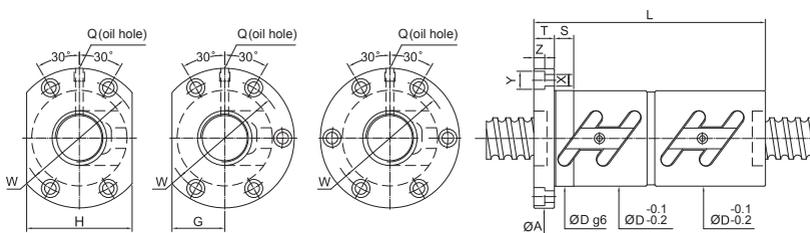
SCREW SIZE	BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD(kgf)		NUT		FLANGE						FIT	BOLT			OIL HOLE Q	STIFFNESS kgf/μm				
			Dynamic (1×10 ⁶ REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	S		X	Y	Z						
O.D.	LEAD																					
32	4	2.381	2.5×1	565	1750	54	68	81	12	67	32	64	15	6.6	11	6.5	M6×1P	52				
			2.5×2	1020	3500	54	90												101			
		5	3.175	1.5×2	1180	3410		82												69		
				2.5×1	1010	2840		78												58		
	5		3.175	2.5×2	1830	5680	58	105	85	12	71	32	64	15	6.6	11	6.5	M8×1P	112			
				2.5×3	2590	8520		136												164		
	6	3.969	3.5×1	1350	3980		82												80			
				1.5×2	1560	4135		100												70		
			6	3.969	2.5×1	1330	3450		87												59	
					2.5×2	2410	6900	62	123	88	12	75	34	68	15	6.6	11	6.5	M8×1P	114		
			6	3.969	3.5×1	1770	4830		100												81	
					1.5×2	2010	5010		113													76
		8	4.762	2.5×1	1720	4180		106													64	
				2.5×2	3120	8360	66	152	98	15	82	38	76	15	9	14	8.5	M8×1P	123			
				3.5×1	2300	5850		113													88	
			10	6.35	1.5×2	3000	6530		138													76
					2.5×1	2570	5440		118													64
					2.5×2	4660	10880	74	177	108	15	90	41	82	15	9	14	8.5	M8×1P	123		
	12	6.35	3.5×1	3430	7620		148													88		
			1.5×2	3000	6530		160													76		
			2.5×1	2570	5440		137													64		
	36	5	3.175	2.5×2	4660	10880	74	208	108	18	90	41	82	15	9	14	8.5	M8×1P	124			
				3.5×1	3430	7620		160													88	
			5	3.175	1.5×2	1240	3850		91												75	
2.5×2					1920	6420		110													123	
6		3.969	2.5×3	2720	9630		139													181		
			3.5×1	1410	4490		90													87		
			2.5×2	2600	7900		123													126		
		6	3.969	2.5×3	3680	11850		159													187	
				2.5×2	3265	9450	70	153	114	18	92	46	92	20	11	17.5	11	M8×1P	129			
		8	4.762	3.5×1	3180	7410		141													83	
2.5×1					2720	6180		131													70	
2.5×2				4930	12360	75	180	118	18	98	45	90	15	11	17.5	11	M8×1P	136				
10			6.35	3.5×1	3630	8650		151													96	
				2.5×1	2720	6180		137													70	
				2.5×2	4930	12360	75	208	118	18	98	45	90	15	11	17.5	11	M8×1P	136			
12		6.35	3.5×1	3630	8650		161													97		



Unit: mm

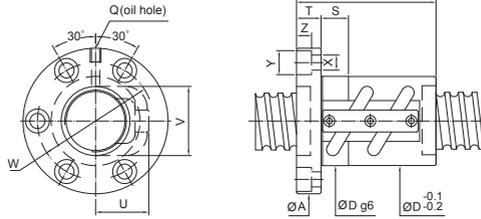
SCREW SIZE	BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD (kgf)		NUT		FLANGE						FIT	BOLT			OIL HOLE	STIFFNESS kgf/μm	
			Dynamic (1×10 ⁶ REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	S	X	Y	Z	Q			
O.D.	LEAD																		
40	5	3.175	1.5×2	1280	4275	88													82
			2.5×1	1090	3560	84													69
			2.5×2	1980	7120	67	108	101	15	83	39	78	15	9	14	8.5	M8×1P		133
			2.5×3	2800	10680	139													196
			3.5×1	1450	4980	88													95
	6	3.969	1.5×2	1750	5300	103													85
			2.5×1	1500	4420	90													71
			2.5×2	2720	8840	70	123	104	15	86	40	80	15	9	14	8.5	PT1/8"		138
			2.5×3	3850	13260	159													202
			3.5×1	2000	6190	103													98
	8	4.762	1.5×2	2220	6320	124													86
			2.5×1	1900	5270	108													73
			2.5×2	3450	10540	74	152	108	15	90	41	82	15	9	14	8.5	PT1/8"		141
			3.5×1	2540	7380	125													100
			2.5×2	3370	8335	141													91
	10	6.35	2.5×1	2880	6950	131													71
			2.5×2	5220	13900	82	180	124	18	102	47	94	20	11	17.5	11	PT1/8"		148
			3.5×1	3840	9730	151													105
			2.5×1	2880	6950	137													76
			2.5×2	5220	13900	86	208	128	18	106	48	96	20	11	17.5	11	PT1/8"		148
12	6.35	3.5×1	3840	9730	161													105	
		2.5×1	2880	6950	137													76	
		2.5×2	5220	13900	86	208	128	18	106	48	96	20	11	17.5	11	PT1/8"		148	
		3.5×1	3840	9730	161													105	
		2.5×2	5220	13900	86	208	128	18	106	48	96	20	11	17.5	11	PT1/8"		148	
45	6	3.969	2.5×2	2850	9870	80	123	114	15	96	48	96	15	9	14	8.5	PT1/8"	151	
			2.5×3	4035	14800	159												222	
	8	4.762	2.5×2	3650	11780	85	158	127	18	105	52	104	20	11	17.5	11	PT1/8"	155	
			2.5×3	5175	17670	206												228	
	10	6.35	2.5×2	5480	15700	88	180	132	18	110	50	100	20	11	17.5	11	PT1/8"	163	
			2.5×3	7760	23550	243												239	
	12	7.144	2.5×1	3550	8950	90	140	132	18	110	50	100	20	11	17.5	11	PT1/8"	85	
			2.5×2	6440	17900	210												165	

FDWC



Unit: mm

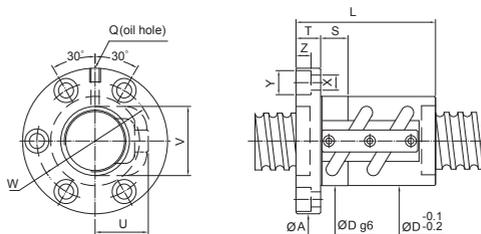
SCREW SIZE	BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD (kgf)		NUT Dg6	FLANGE						FIT S	BOLT			OIL HOLE Q	STIFFNESS kgf/μm			
			Dynamic (1×10 ⁴ REV.) Ca	Static Co		L	A	T	W	G	H		X	Y	Z					
50	5	3.175	1.5×2	1410	5305	108												98		
			1.5×3	2000	7960	80	128	114	15	96	43	86	15	9	14	8.5	PT1/8"	144		
			2.5×2	2190	8840		113												159	
			3.5×1	1610	6190		108												114	
	6	3.969		1.5×2	1920	6600	111												101	
				2.5×2	2980	11000	84	123	118	15	100	45	90	15	9	14	8.5	PT1/8"	164	
				2.5×3	4220	16500		159												242
				3.5×1	2190	7700		107												117
	8	4.762		1.5×2	2515	7810	127												104	
				2.5×2	3900	13020	87	156	128	18	107	49	98	20	11	17.5	11	PT1/8"	170	
				2.5×3	5520	19530		208												250
				3.5×1	2870	9110		127												121
10	6.35		1.5×2	3725	10450	151												108		
			2.5×1	3190	8710		132												91	
			2.5×2	5790	17420	93	180	135	18	113	51	102	20	11	17.5	11	PT1/8"	177		
			2.5×3	8200	26130		243												261	
12	7.144		3.5×1	4260	12190	151												126		
			2.5×1	3700	10050	140	146	18	122	55	110	20	14	20	13	PT1/8"	92			
55	10	6.35	2.5×2	6005	19540	181	144	18	122	54	108	20	11	17.5	11	PT1/8"	191			
			2.5×3	8510	29310	102	243											281		
63	10	6.35	2.5×1	3510	11200	136												110		
			2.5×2	6370	22400	108	189	154	22	130	58	116	20	14	20	13	PT1/8"	213		
	12	7.938		2.5×3	9020	33600	249											313		
				2.5×1	4760	13820	115	144	161	22	137	61	122	20	14	20	13	PT1/8"	112	
16	9.525		2.5×2	8650	27560	214												218		
			2.5×1	8050	23100	122	200	178	28	150	69	138	20	18	26	17.5	PT1/8"	144		
80	10	6.35	2.5×2	7130	28500	200												280		
			2.5×3	10100	42750	130	249	176	22	152	66	132	20	14	20	13	PT1/8"	258		
	12	7.938		2.5×2	9710	35560	220											380		
				2.5×3	13760	53340	136	292	182	22	158	68	136	20	14	20	13	PT1/8"	265	
	16	9.525		2.5×2	16450	59280	290												391	
				2.5×3	23300	88920	143	386	204	28	172	77	154	30	18	26	17.5	PT1/8"	339	
																	500			



Unit: mm

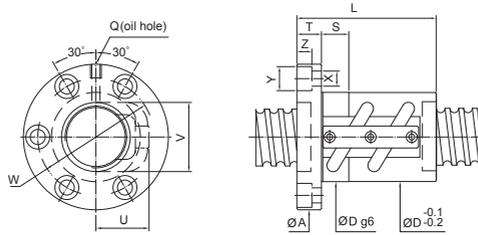
SCREW SIZE	BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD (kgf)		NUT		FLANGE			FIT			BOLT		RETURN TUBE		OIL HOLE	STIFFNESS			
			Dynamic (1×10 ⁶ REV.) Ca	Static Co	Dg6	L	A	T	W	S	X	Y	Z	U	V	Q	kgf/μm				
14	4	2.381	2.5×1	410	750	25	40	45	10	35	10	5.5	9.5	5.5	19	21	M6×1P	14			
	5	3.175	2.5×1	675	1145	25	42	45	10	35	10	5.5	9.5	5.5	19	21	M6×1P	15			
15	4	2.381	2.5×1	420	800	28.5	40	48	10	38	10	5.5	9.5	5.5	17	22	M6×1P	14			
	5	3.175	2.5×1	680	1210	28.5	42	48	10	38	10	5.5	9.5	5.5	17	22	M6×1P	15			
16	5	3.175	1.5×2	805	1525		50												19		
			2.5×1	690	1270	31	45													16	
			2.5×2	1250	2540		60	54	12	41	15	5.5	9.5	5.5	20	23	M6×1P			31	
			3.5×1	920	1780		50														22
20	5	3.175	1.5×2	965	2070		50												24		
			2.5×1	830	1730	35	45													20	
			2.5×2	1510	3460		60	58	12	46	15	5.5	9.5	5.5	22	27	M6×1P			39	
			3.5×1	1110	2420		50														26
6	3.969	1.5×2	1285	2545		66													24		
		2.5×1	1100	2120	36	48	60	12	47	15	5.5	9.5	5.5	23	28	M6×1P			20		
			3.5×1	1470	2970		66												28		
25	6	3.969	1.5×2	1420	3215		65													29	
			2.5×1	1210	2680	42	50														24
			2.5×2	2190	5360		68	68	12	55	15	5.5	9.5	5.5	28	33	M6×1P			47	
			3.5×1	1610	3750		65														34
10	4.762	1.5×2	1820	3840		75													30		
		2.5×1	1560	3200	45	65	72	16	58	15	6.6	11	6.5	29	34	M6×1P			25		
			3.5×1	2080	4480		75												35		
28	5	3.175	1.5×2	1110	2960		50													31	
			2.5×1	950	2470	44	45														26
			2.5×2	1720	4940		60	70	12	56	15	6.6	11	6.5	28	34	M6×1P			50	
			3.5×1	1270	3460		50														36
6	3.969	1.5×2	1480	3605		55														32	
		2.5×1	1270	3000	44	50														26	
		2.5×2	2300	6000		68	70	12	56	15	6.6	11	6.5	28	36	M6×1P			51		
			3.5×1	1690	4200		55												37		

FSVC



Unit: mm

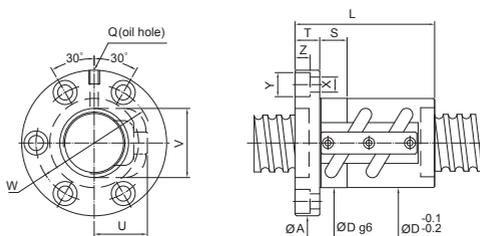
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD(kgf)		NUT		FLANGE			FIT			BOLT		RETURN TUBE		OIL HOLE	STIFFNESS	
O.D.	LEAD			Dynamic (1×10 ⁶ REV.) Ca	Static Co	Dg6	L	A	T	W	S	X	Y	Z	U	V	Q	kgf/μm		
32	5	3.175	1.5×2	1180	3410	50													34	
			2.5×1	1010	2840	45														29
			2.5×2	1830	5680	50	60	76	12	63	15	6.6	11	6.5	30	38	M6×1P			56
			2.5×3	2590	8520	75														82
			3.5×1	1350	3980	50														40
	6	3.969	1.5×2	1560	4135	55														35
			2.5×1	1330	3450	50														29
			2.5×2	2410	6900	52	68	78	12	65	15	6.6	11	6.5	32	39	M6×1P			57
			3.5×1	1770	4830	55														40
			1.5×2	2010	5010	70														36
	8	4.762	2.5×1	1720	4180	62														30
			2.5×2	3120	8360	54	86	88	16	70	15	9	14	8.5	33	40	M6×1P			59
3.5×1			2300	5850	70														42	
1.5×2			3000	6530	78														38	
10	6.35	2.5×1	2570	5440	68														32	
		2.5×2	4660	10880	57	98	91	16	73	15	9	14	8.5	37	44	M8×1P			61	
		3.5×1	3430	7620	78														44	
		1.5×2	3180	7410	82														41	
36	6	3.969	2.5×1	1430	3950	50													33	
			2.5×2	2600	7900	55	68	82	12	68	15	6.6	11	6.5	32	42	M6×1P			63
	10	6.35	1.5×2	3180	7410	82														41
			2.5×1	2720	6180	72														35
			2.5×2	4930	12360	62	102	104	18	82	20	11	17.5	11	40	49	M6×1P			68
			3.5×1	3630	8650	82														48



Unit: mm

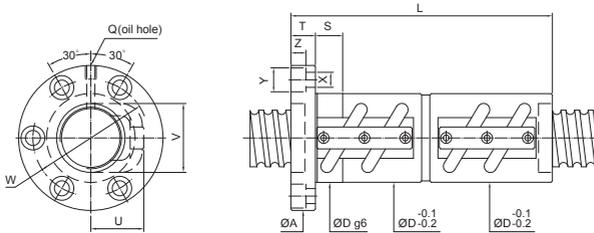
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD(kg f)		NUT		FLANGE			FIT		BOLT		RETURN TUBE		OIL HOLE	STIFFNESS		
O.D.	LEAD			Dynamic (1×10 ⁶ REV.) Ca	Static Co	Dg6	L	A	T	W	S	X	Y	Z	U	V	Q	kg f /μm		
40	5	3.175	1.5×2	1280	4270	55											M8×1P	41		
			2.5×1	1090	3560	50													34	
			2.5×2	1980	7120	58	65	92	16	72	15	9	14	8.5	34	46			66	
			2.5×3	2800	10680	80														98
			3.5×1	1450	4980	55														47
	6	3.969	1.5×2	1750	5300	60													42	
			2.5×1	1500	4420	54														35
			2.5×2	2720	8840	60	72	94	16	76	15	9	14	8.5	36	47		PT1/8"	69	
			2.5×3	3850	13260	90														101
			3.5×1	2000	6190	60														49
	8	4.762	1.5×2	2220	6320	70													43	
			2.5×1	1900	5270	62	62	96	16	78	15	9	14	8.5	38	48		PT1/8"	36	
			2.5×2	3450	10540	86														70
			3.5×1	2540	7380	70														50
	10	6.35	1.5×2	3370	8335	82													45	
2.5×1			2880	6950	72	72	106	18	85	20	11	17.5	11	42	52		PT1/8"	35		
2.5×2			5220	13900	65	102													74	
		3.5×1	3840	9730	82													52		
45	10	6.35	2.5×1	3020	7850	74	74	112	18	90	20	11	17.5	11	48	58	PT1/8"	42		
			2.5×2	5480	15700	70	104												81	
	12	7.144	2.5×1	3550	8950	74	87	122	18	97	20	14	20	13	49	60	PT1/8"	43		
		2.5×2	6440	17900	123	123												82		

FSVC



Unit: mm

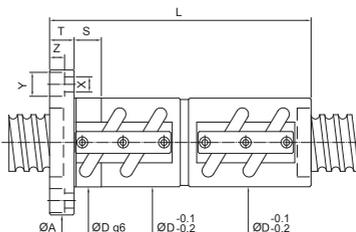
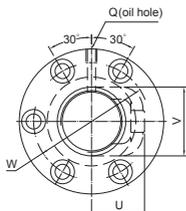
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD(kgf)		NUT		FLANGE			FIT		BOLT		RETURN TUBE		OIL HOLE	STIFFNESS kgf/μm	
O.D.	LEAD			Dynamic (1×10 ⁴ REV.) Ca	Static Co	Dg6	L	A	T	W	S	X	Y	Z	U	V	Q		
50	5	3.175	1.5×2	1410	5305	63												49	
			1.5×3	2000	7960	70	73	104	16	86	15	9	14	8.5	40	56	PT1/8"	72	
			3.5×1	1610	6190	63													57
	6	3.969	2.5×2	2980	11000	72	75	106	16	88	15	9	14	8.5	43	57	PT1/8"	82	
			2.5×3	4220	16500	72	93												121
			2.5×2	3900	13020	75	88	116	18	95	20	11	17.5	11	45	59	PT1/8"	85	
	8	4.762	2.5×3	5520	19530	75	112												125
			1.5×2	3725	10450	84	84												54
			2.5×1	3190	8710	74	74												45
	10	6.35	2.5×2	5790	17420	78	104	119	18	98	20	11	17.5	11	48	62	PT1/8"	88	
			2.5×3	8200	26130	134	134												130
			3.5×1	4260	12190	84	84												63
2.5×1			3700	10050	82	87	128	22	105	20	14	20	13	52	64	PT1/8"	46		
12	7.144	2.5×2	6710	20100	82	123												89	
		2.5×2	6005	19540	84	100	125	18	103	20	11	17.5	11	54	68	PT1/8"	95		
55	10	6.35	2.5×3	8150	29310	84	130											140	
			2.5×1	3510	11200	77	77												55
63	10	6.35	2.5×2	6370	22400	90	107	132	20	110	20	11	17.5	11	53	74	PT1/8"	106	
			2.5×3	9020	33600	137	137												156
			2.5×1	4770	13780	88	88												59
	12	7.938	2.5×2	8650	27560	94	124	142	22	117	20	14	20	13	57	76	PT1/8"	113	
			2.5×3	12250	41340	160	160												167
16	9.525	2.5×1	8050	23100	100	105	150	22	123	20	14	20	13	62	78	PT1/8"	72		
		2.5×2	14600	46200	153	153												140	
80	10	6.35	2.5×2	7130	28500	115	109	163	22	137	20	14	20	13	64	91	PT1/8"	129	
			2.5×3	10100	42750	139	139												190
	12	7.938	2.5×2	9710	35560	125	125	169	22	143	25	14	20	13	67	93	PT1/8"	137	
			2.5×3	13760	53340	159	159												202
	16	9.525	2.5×2	16450	59280	125	156	190	28	154	25	18	26	17.5	70	94	PT1/8"	170	
			2.5×3	23300	88920	204	204												250



Unit: mm

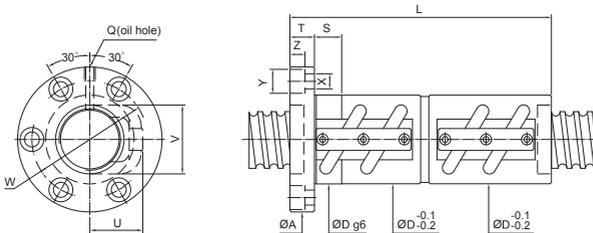
SCREW SIZE	BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD(kgf)		NUT	FLANGE			FIT			BOLT		RETURN TUBE		OIL HOLE	STIFFNESS		
			Dynamic (1×10 ⁶ REV.) Ca	Static Co		Dg6	L	A	T	W	S	X	Y	Z	U			V	Q
O.D.	LEAD																		
16	5	3.175	1.5×2	805	1525	90												39	
			2.5×1	690	1270	31	80												33
			2.5×2	1250	2540		110	54	12	41	15	5.5	9.5	5.5	20	23	M6×1P		63
			3.5×1	920	1780	90													45
20	5	3.175	1.5×2	965	2070	90												47	
			2.5×1	830	1730	35	80												40
			2.5×2	1510	3460		110	58	12	46	15	5.5	9.5	5.5	22	27	M6×1P		77
			3.5×1	1110	2420	90													55
6	3.969	1.5×2	1285	2545	104													49	
		2.5×1	1100	2120	36	92	60	12	47	15	5.5	9.5	5.5	23	28	M6×1P		41	
		3.5×1	1470	2970	104													56	
25	5	3.175	1.5×2	1065	2575	90												57	
			2.5×1	910	2150	40	80												48
			2.5×2	1650	4300		110	64	12	52	15	5.5	9.5	5.5	26	31	M6×1P		92
			3.5×1	1210	3010	90													65
6	3.969	1.5×2	1420	3215	104													58	
		2.5×1	1210	2680	42	92												49	
		2.5×2	2190	5360		128	68	12	55	15	5.5	9.5	5.5	28	33	M6×1P		94	
		3.5×1	1610	3750	104													67	
10	4.762	1.5×2	1820	3840	136													60	
		2.5×1	1560	3200	45	122	72	16	58	15	6.6	11	6.5	29	34	M6×1P		50	
		3.5×1	2080	4480	136													69	
28	5	3.175	1.5×2	1110	2960	90												62	
			2.5×1	950	2470	44	80												52
			2.5×2	1720	4940		110	70	12	56	15	6.6	11	6.5	28	34	M6×1P		101
			3.5×1	1270	3460	90													72
6	3.969	1.5×2	1480	3605	110													63	
		2.5×1	1270	3000	44	98												53	
		2.5×2	2300	6000		134	70	12	56	15	6.6	11	6.5	28	36	M6×1P		103	
		3.5×1	1690	4200	110													73	

FDVC



Unit: mm

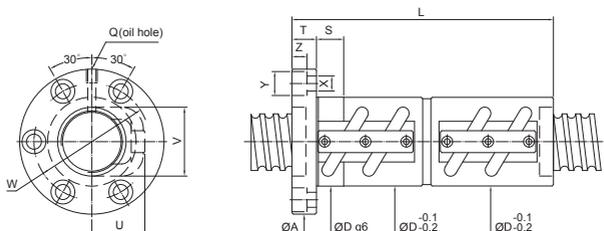
SCREW SIZE	BALL LEAD	BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD (kgf)		NUT Dg6	FLANGE				FIT S	BOLT			RETURN TUBE		OIL HOLE Q	STIFFNESS kgf/μm	
				Dynamic (1×10 ⁶ REV.) Ca	Static Co		A	T	W	X		Y	Z	U	V				
32	5	3.175	1.5×2	1180	3410	90												69	
			2.5×1	1010	2840	80													58
			2.5×2	1830	5680	50	110	76	12	63	15	6.6	11	6.5	30	38	M6×1P		112
			2.5×3	2590	8520	140													164
			3.5×1	1350	3980	90													80
	6	3.969	1.5×2	1560	4135	104													70
			2.5×1	1330	3450	52	92												59
			2.5×2	2410	6900	128	78	12	65	15	6.6	11	6.5	32	39	M6×1P		114	
			3.5×1	1770	4830	104													81
			2.5×2	3120	8360	54	110	88	16	70	15	9	14	8.5	33	40	M6×1P		118
	8	4.762	1.5×2	2010	5010	126													73
			2.5×1	1720	4180	54	158												61
			2.5×2	3120	8360	54	158												118
			3.5×1	2300	5850	126													84
			2.5×2	4660	10880	182	91	16	73	15	9	14	8.5	37	44	M8×1P		123	
10	6.35	1.5×2	3000	6530	142													76	
		2.5×1	2570	5440	57	122												64	
		2.5×2	4660	10880	182	122												123	
		3.5×1	3430	7620	142													88	
		2.5×2	4660	10880	182	122												123	
36	6	3.969	2.5×1	1430	3950	55	92											65	
			2.5×2	2600	7900	128	82	12	68	15	6.6	11	6.5	32	42	M6×1P		126	
	10	6.35	1.5×2	3180	7410	144													83
			2.5×1	2720	6180	62	124												70
			2.5×2	4930	12360	184	104	18	82	20	11	17.5	11	40	49	M6×1P		136	
3.5×1	3630	8650	144														90		



Unit: mm

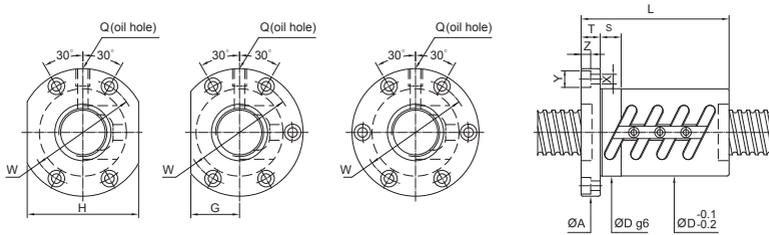
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD (kgf)		NUT Dg6 L	FLANGE			FIT		BOLT		RETURN TUBE		OIL HOLE Q	STIFFNESS kgf/μm		
O.D.	LEAD			Dynamic (1×10 ⁶ REV.) Ca	Static Co		A	T	W	S	X	Y	Z	U	V				
40	5	3.175	1.5×2	1280	4275	94											82		
			2.5×1	1090	3560	84											69		
			2.5×2	1980	7120	58	114	92	16	72	15	9	14	8.5	34	46	M8×1P	133	
			2.5×3	2800	10680	144												196	
			3.5×1	1450	4980	94												95	
	6	3.969		1.5×2	1750	5300	108											85	
				2.5×1	1500	4420	96											71	
				2.5×2	2720	8840	60	132	94	16	76	15	9	14	8.5	36	47	PT1/8"	138
				2.5×3	3850	13260	168												202
				3.5×1	2000	6190	108												98
	8	4.762		1.5×2	2220	6320	126											86	
				2.5×1	1900	5270	110											73	
2.5×2				3450	10540	62	158	96	16	78	15	9	14	8.5	38	48	PT1/8"	141	
3.5×1				2540	7380	126												100	
10	6.35		1.5×2	3370	8335	152											91		
			2.5×1	2880	6950	132											71		
			2.5×2	5220	13900	65	192	106	18	85	20	11	17.5	11	42	52	PT1/8"	148	
			3.5×1	3840	9730	152										105			
45	10	6.35	2.5×1	3020	7850	134											84		
			2.5×2	5480	15700	70	194	112	18	90	20	11	17.5	11	48	58	PT1/8"	163	
12	7.144		2.5×1	3550	8950	158											85		
			2.5×2	6440	17900	74	230	122	18	97	20	14	20	13	49	60	PT1/8"	165	

FDVC



Unit: mm

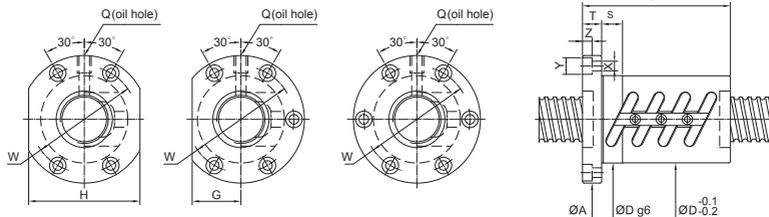
SCREW SIZE	BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD/(kgf)		NUT Dg6	FLANGE				FIT			BOLT		RETURN TUBE		OIL HOLE Q	STIFFNESS kgf/μm	
			Dynamic (1×10 ⁶ REV.) Ca	Static Co		A	T	W	S	X	Y	Z	U	V					
O.D.	LEAD					L													
50	5	3.175	1.5×2	1410	5305		107												98
			1.5×3	2000	7960	70	127	104	16	86	15	9	14	8.5	40	56	PT1/8"	144	
			3.5×1	1610	6190		107												114
	6	3.969	2.5×2	2980	11000	72	134												164
			2.5×3	4220	16500		170	106	16	88	15	9	14	8.5	43	57	PT1/8"	242	
	8	4.762	2.5×2	3900	13020	75	160												170
			2.5×3	5520	19530		208	116	18	95	20	11	17.5	11	45	59	PT1/8"	250	
	10	6.35	1.5×2	3725	10450		154												119
			2.5×1	3190	8710		134												91
			2.5×2	5790	17420	78	194	119	18	98	20	11	17.5	11	48	62	PT1/8"	177	
			2.5×3	8200	26130		254												261
	12	7.144	3.5×1	4260	12190		154												126
2.5×1			3700	10050	82	160	128	22	105	20	14	20	13	52	64	PT1/8"	92		
55	10	6.35	2.5×2	6005	19540		194											191	
			2.5×3	8510	29310	84	254	125	18	103	20	11	17.5	11	54	68	PT1/8"	281	
63	10	6.35	2.5×1	3510	11200		136											110	
			2.5×2	6370	22400	90	196	132	20	110	20	11	17.5	11	53	74	PT1/8"	213	
			2.5×3	9020	33600		256												313
	12	7.938	2.5×1	4760	13820		160												112
			2.5×2	8650	27560	94	232	142	22	117	20	14	20	13	57	76	PT1/8"	218	
16	9.525	2.5×3	12250	41340		304												322	
		2.5×1	8050	23100	100	200	150	22	123	20	14	20	13	62	78	PT1/8"	144		
80	10	6.35	2.5×2	7130	28500		200											258	
			2.5×3	10100	42750	115	260	163	22	137	20	14	20	13	64	91	PT1/8"	380	
12	7.938	9.525	2.5×2	9710	35560		232											265	
			2.5×3	13760	53340	120	302	169	22	143	25	14	20	13	67	93	PT1/8"	391	
			2.5×2	16450	59280	125	302	190	28	154	25	18	26	17.5	70	94	PT1/8"	339	
16	9.525	9.525	2.5×3	23300	88920		398											500	



Unit: mm

SCREW SIZE	BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD (kgf)		NUT		FLANGE					FIT				BOLT	OIL HOLE	STIFFNESS
			Dynamic (1×10 ⁶ REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	S	X	Y	Z			
20	4	2.381	2.5×1×(2)	450	1060	40	50	63.5	11	51	21	42	10	5.5	9.5	5.5	M6×1P	32
			3.5×1×(2)	600	1480	60	49											
	5	3.175	2.5×1×(2)	830	1730	44	56	67	11	55	26	52	15	5.5	9.5	5.5	M6×1P	40
			3.5×1×(2)	1110	2420	65	55											
25	4	2.381	2.5×1×(2)	510	1355	46	50	69	11	57	26	52	15	5.5	9.5	5.5	M6×1P	43
			2.5×2×(2)	930	2710	74	84											
	5	3.175	2.5×1×(2)	910	2150	50	55	73	11	61	28	56	15	5.5	9.5	5.5	M6×1P	48
			2.5×2×(2)	1650	4300	85	92											
	6	3.969	2.5×1×(2)	1210	2680	53	62	76	11	64	29	58	15	5.5	9.5	5.5	M6×1P	49
			2.5×2×(2)	2190	5360	98	94											
8	4.762	2.5×1×(2)	1560	3200	58	77	85	13	71	32	64	15	6.6	11	6.5	M6×1P	50	
		2.5×1×(2)	1560	3200	100	50												
28	5	3.175	2.5×1×(2)	950	2470	55	56	83	12	69	31	62	15	6.6	11	6.5	M8×1P	52
			2.5×2×(2)	1720	4940	86	101											
	6	3.969	2.5×1×(2)	1270	3000	55	63	83	12	69	31	62	15	6.6	11	6.5	M8×1P	53
			2.5×2×(2)	2300	6000	100	103											
10	4.762	1.5×1×(2)	1045	2120	60	74	93	15	76	36	72	15	9	14	8.5	M8×1P	34	
32	4	2.381	2.5×1×(2)	565	1750	54	50	81	12	67	32	64	15	6.6	11	6.5	M6×1P	52
			2.5×2×(2)	1020	3500	76	101											
	5	3.175	2.5×1×(2)	1010	2840	58	57	85	12	71	32	64	15	6.6	11	6.5	M8×1P	58
			2.5×2×(2)	1830	5680	87	112											
	6	3.969	2.5×1×(2)	1330	3450	62	63	88	12	75	34	68	15	6.6	11	6.5	M8×1P	59
			2.5×2×(2)	2410	6900	99	114											
	8	4.762	1.5×1×(2)	1110	2510	66	64	100	15	82	38	76	15	9	14	8.5	M8×1P	37
			2.5×1×(2)	1720	4180	80	61											
10	6.35	1.5×1×(2)	1660	3260	74	78	108	15	90	41	82	15	9	14	8.5	M6×1P	39	
		2.5×1×(2)	2570	5440	97	64												
12	6.35	1.5×1×(2)	1660	3260	74	88	108	18	90	41	82	15	9	14	8.5	M8×1P	39	
		2.5×1×(2)	2570	5440	110	64												

FOWC



Unit: mm

SCREW SIZE	BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD (kgf)		NUT		FLANGE					FIT		BOLT		OIL HOLE	STIFFNESS kgf/μm	
			Dynamic (1×10 ⁶ REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	S	X	Y	Z	Q		
O.D.	LEAD																	
36	5	3.175	2.5×1×(2)	1060	3210	65	60	98	15	82	38	76	15	9	14	8.5	M8×1P	64
			2.5×2×(2)	1920	6420		90											123
	6	3.969	2.5×1×(2)	1430	3950	65	66	98	15	82	38	76	15	9	14	8.5	M8×1P	65
			2.5×2×(2)	2600	7900		102											126
10	6.35	1.5×1×(2)	1750	3710	75	81	118	18	98	45	90	15	11	17.5	11	M8×1P	43	
		2.5×1×(2)	2720	6180		103											70	
40	5	3.175	2.5×1×(2)	1090	3560	67	60	101	15	83	39	78	15	9	14	8.5	M8×1P	69
			2.5×2×(2)	1980	7120		90											133
	6	3.969	2.5×1×(2)	1500	4420	70	66	104	15	86	40	80	15	9	14	8.5	PT1/8"	71
			2.5×2×(2)	2720	8840		102											138
	8	4.762	2.5×1×(2)	1900	5270	74	83	108	15	90	41	82	15	9	14	8.5	PT1/8"	73
			2.5×2×(2)	3450	10540		131											141
10	6.35	2.5×1×(2)	2880	6950	82	103	124	18	102	47	94	20	11	17.5	11	PT1/8"	76	
		3.5×1×(2)	3850	9730		121											105	
12	6.35	2.5×1×(2)	2880	6950	86	112	128	18	106	48	96	20	11	17.5	11	PT1/8"	76	
45	10	6.35	2.5×1×(2)	3020	7850	88	101	132	18	110	50	100	20	11	17.5	11	PT1/8"	84
	12	7.144	2.5×1×(2)	3550	8950	90	112	132	18	110	50	100	20	11	17.5	11	PT1/8"	85
50	5	3.175	2.5×1×(2)	1210	4420	80	60	114	15	96	43	86	15	9	14	8.5	PT1/8"	83
			2.5×2×(2)	2980	11000		84											103
	8	4.762	2.5×2×(2)	3900	13020	87	134	129	18	107	49	98	20	11	17.5	11	PT1/8"	170
			2.5×1×(2)	3190	8710		101											91
	10	6.35	2.5×2×(2)	5790	17420	93	161	135	18	113	51	102	20	11	17.5	11	PT1/8"	177
3.5×1×(2)			4260	12190	121		126											
12	7.144	2.5×1×(2)	3700	10050	100	116	146	22	122	55	110	20	14	20	13	PT1/8"	92	
55	10	6.35	2.5×1×(2)	3310	9770	102	101	144	18	122	54	108	20	11	17.5	11	PT1/8"	98
			2.5×2×(2)	6005	19540		161											191
63	10	6.35	2.5×1×(2)	3510	11200	108	105	154	22	130	58	116	20	14	20	13	PT1/8"	110
			2.5×2×(2)	6370	22400		165											213
	12	7.938	2.5×1×(2)	4770	13780	115	124	161	22	137	61	122	20	14	20	13	PT1/8"	113

13.4 High Lead Ballscrews

High-lead Ballscrews are essential elements and parts for high-speed machine tools of next century.

Features:

It is important for a High-lead Ballscrew to be with characteristics of high rigidity, low noise and thermal control. *PMI*'s 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

PMI's High-speed Ballscrews provide 100 *m/min* and even higher traverse speed for machine tools for high performance cutting.

High Rigidity

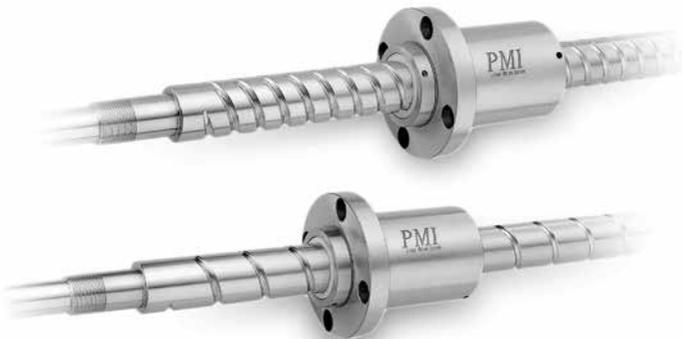
Both the screw and ballnut are surface hardened to a specific hardness and case depth to maintain high rigidity and durability.

Multiple thread starts are available to make more steel balls loaded in the ballnut for higher rigidity and durability.

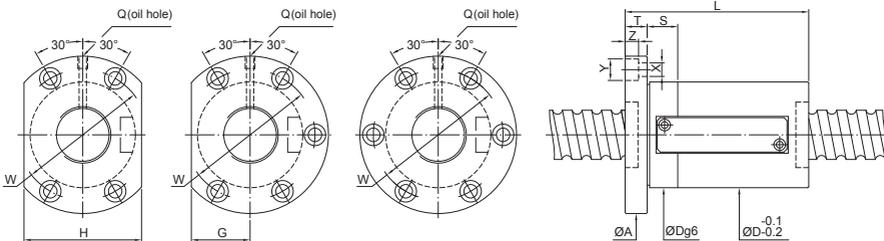
Low Noise

Special design of ball circulation tubes 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.

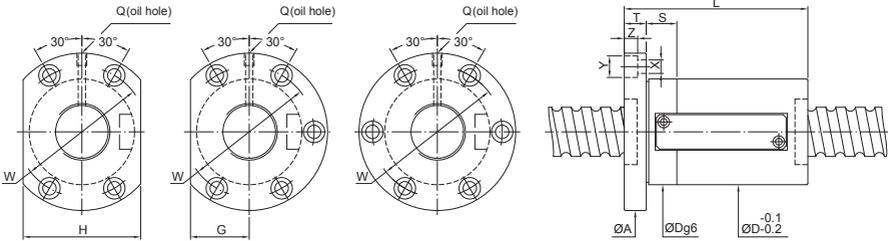


FSWE



Unit: mm

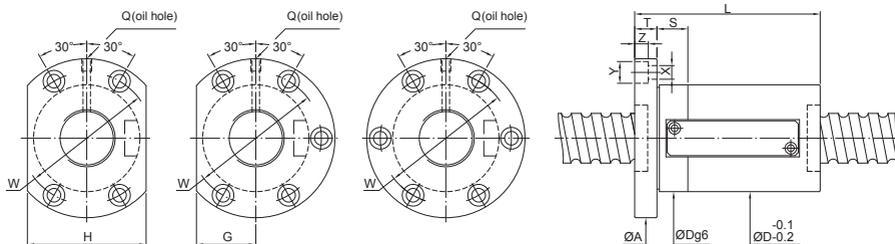
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD/(kgf)		NUT		FLANGE					FIT		BOLT			OIL HOLE	STIFFNESS kgf/μm
O.D.	LEAD			Dynamic (1×10 ⁶ REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	S	X	Y	Z	Q		
12	10	2.381	2.5×1	420	720	30	50	50	10	40	16	32	10	4.5	8	4.4	M6×1P	20	
			3.5×1	1210	2380	46	63	73.5	13	59	25	50	10	5.5	9.5	5.5	M6×1P	34	
	16	3.969	1.5×1	830	1530	46	63	73.5	13	59	25	50	10	5.5	9.5	5.5	M6×1P	24	
			2.5×1	1210	2380	79	79	73.5	13	59	25	50	10	5.5	9.5	5.5	M6×1P	34	
20	16	3.969	1.5×1	920	1930	54	62	76	15	64	32	64	15	6.6	11	6.5	M6×1P	28	
			2.5×1	1340	3000	78	78	76	15	64	32	64	15	6.6	11	6.5	M6×1P	40	
	20	4.762	1.5×1	1170	2300	74	74	85	15	71	32	64	15	6.6	11	6.5	M6×1P	29	
			2.5×1	1710	3580	58	94	85	15	71	32	64	15	6.6	11	6.5	M6×1P	42	
	32	16	3.969	3.5×1	2220	4860	114	114	88	15	75	34	68	15	6.6	11	6.5	M8×1P	55
				5×1	2340	6620	111	111	88	15	75	34	68	15	6.6	11	6.5	M8×1P	77
1.5×1				1010	2480	63	63	88	15	75	34	68	15	6.6	11	6.5	M8×1P	33	
2.5×1				1470	3860	79	79	88	15	75	34	68	15	6.6	11	6.5	M8×1P	48	
20		6.35	3.969	3.5×1	1910	5240	95	95	88	15	75	34	68	15	6.6	11	6.5	M8×1P	63
				5×1	2340	6620	111	111	88	15	75	34	68	15	6.6	11	6.5	M8×1P	77
32	16	6.35	2.5×1	2830	6090	92	92	108	18	90	41	82	15	11	17.5	11	M8×1P	54	
			5×1	4490	10450	124	124	108	18	90	41	82	15	11	17.5	11	M8×1P	85	
	20	3.969	1.5×1	1010	2480	70	70	108	18	90	41	82	15	11	17.5	11	M8×1P	33	
			2.5×1	1470	3860	90	90	108	18	90	41	82	15	11	17.5	11	M8×1P	48	
	20	6.35	3.969	3.5×1	1910	5240	62	110	108	18	90	41	82	15	11	17.5	11	M8×1P	63
				5×1	2350	6610	130	130	108	18	90	41	82	15	11	17.5	11	M8×1P	77
20	6.35	3.969	2.5×1	2830	6090	104	104	108	18	90	41	82	15	11	17.5	11	M8×1P	54	
			5×1	4490	10450	144	144	108	18	90	41	82	15	11	17.5	11	M8×1P	85	



Unit: mm

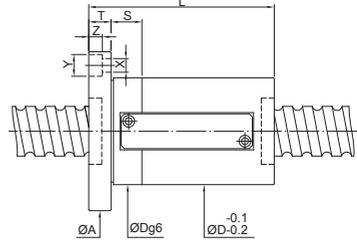
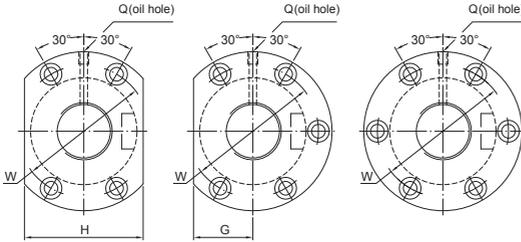
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD/(kgf)		NUT		FLANGE					FIT		BOLT		OIL HOLE	STIFFNESS	
O.D.	LEAD			Dynamic (1×10 ⁶ REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	S	X	Y	Z	Q	kgf/μm	
36	10	6.35	3.5×1	3890	9390	84												76	
			5×1	4750	11860	75	84	118	18	98	45	90	15	11	17.5	11	M8×1P	93	
	12	6.35	2.5×1	2990	6920	85												58	
			3.5×1	3890	9390	75	97	118	18	98	45	90	15	11	17.5	11	M8×1P	76	
	16	6.35	5×1	4750	11860	109												93	
			2.5×1	2990	6920	91													58
	20	6.35	3.5×1	3890	9390	75	107	118	18	98	45	90	15	11	17.5	11	M8×1P	76	
			5×1	4750	11860	123													93
			1.5×1	2050	4450	91													41
	40	10	6.35	2.5×1	2990	6920	111												58
3.5×1				3890	9390	75	131	118	18	98	45	90	15	11	17.5	11	PT1/8"	76	
12		6.35	5×1	4750	11860	151												93	
			2.5×1	2990	6920	91													41
16		6.35	3.5×1	3890	9390	75	131	118	18	98	45	90	15	11	17.5	11	PT1/8"	76	
			5×1	4750	11860	151													93
20		6.35	1.5×1	2050	4450	91													41
			2.5×1	2990	6920	111													58
40		10	6.35	3.5×1	4130	10560	86	86	128	18	106	49	98	15	11	17.5	11	PT1/8"	82
				5×1	5050	13340	96	86	128	18	106	49	98	15	11	17.5	11	PT1/8"	101
	12	6.35	2.5×1	3180	7780	86	86	128	18	106	49	98	15	11	17.5	11	PT1/8"	63	
			3.5×1	4130	10560	86	98	128	18	106	49	98	15	11	17.5	11	PT1/8"	82	
	16	6.35	5×1	5050	13340	110	86	128	18	106	49	98	15	11	17.5	11	PT1/8"	101	
			2.5×1	3180	7780	93	86	128	18	106	49	98	15	11	17.5	11	PT1/8"	63	
	20	6.35	3.5×1	4130	10560	86	109	128	18	106	49	98	15	11	17.5	11	PT1/8"	82	
			5×1	5050	13340	125	86	128	18	106	49	98	15	11	17.5	11	PT1/8"	101	
40	6.35	2.5×1	3740	8790	92	84	128	18	106	49	98	15	11	17.5	11	PT1/8"	65		
		3.5×1	4870	11930	86	104	128	18	106	49	98	15	11	17.5	11	PT1/8"	84		
40	6.35	7.144	5×1	5950	15070	124	84	128	18	106	49	98	15	11	17.5	11	PT1/8"	103	
			1.5×1	2180	5000	84	84	128	18	106	49	98	15	11	17.5	11	PT1/8"	43	
		20	2.5×1	3180	7780	86	104	128	18	106	49	98	15	11	17.5	11	PT1/8"	63	
			3.5×1	4130	10560	86	124	128	18	106	49	98	15	11	17.5	11	PT1/8"	82	
40	6.35	1.5×1	5050	13340	144	84	128	18	106	49	98	15	11	17.5	11	PT1/8"	101		
40	6.35	1.5×1	2180	5000	86	130	128	18	106	49	98	15	11	17.5	11	PT1/8"	43		

FSWE



Unit: mm

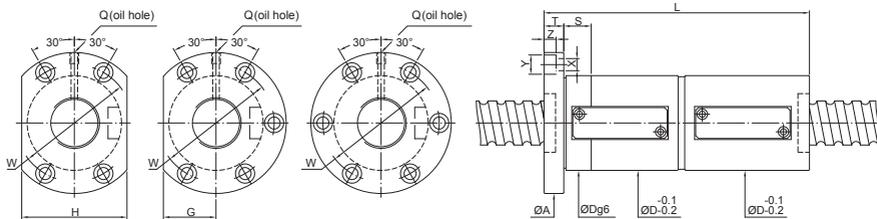
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD (kgf)		NUT		FLANGE				FIT	BOLT			OIL HOLE	STIFFNESS		
O.D.	LEAD			Dynamic (1×10 ⁶ REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	S	X	Y	Z	Q	kgf/μm	
50	10	6.35	3.5×1	4560	13230	93	85	135	18	113	51	102	20	11	17.5	11	PT1/8"	97	
			5×1	5580	16710		95											119	
	12	6.35	2.5×1	3510	9750	93	80	135	18	113	51	102	20	11	17.5	11	PT1/8"	74	
			3.5×1	4560	13230		92											97	
	12	7.144	2.5×1	4080	11260	100	93	105	146	25	122	55	110	20	14	20	13	PT1/8"	75
			3.5×1	5300	15280		92												99
	16	6.35	2.5×1	3510	9750	93	94	110	135	18	113	51	102	20	11	17.5	11	PT1/8"	121
			3.5×1	4560	13230		104												121
	16	7.144	2.5×1	4080	11260	100	100	116	146	25	122	55	110	20	14	20	13	PT1/8"	75
			3.5×1	5300	15280		117												99
	20	7.144	1.5×1	2790	7240	100	98	118	146	25	122	55	110	20	14	20	13	PT1/8"	52
			2.5×1	4080	11260		138												75
20	7.938	3.5×1	5300	15280	105	138	139	152	25	128	58	116	20	14	20	13	PT1/8"	99	
		5×1	6480	19300		158												124	
50	7.938	2.5×1	4750	12090	105	119	157	152	25	128	58	116	20	14	20	13	PT1/8"	78	
		3.5×1	6180	16400		159												101	
			5×1	7550	20720													124	
			1.5×1	3250	7770													53	



Unit: mm

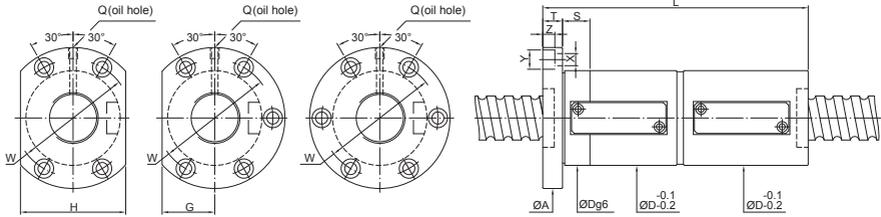
SCREW SIZE	BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD(kgf)		NUT		FLANGE					FIT	BOLT			OIL HOLE	STIFFNESS		
			Dynamic (1×10 ⁶ REV.) Ca	Static Co	Dg6	L	A	T	W	G	H		S	X	Y			Z	Q
O.D.	LEAD																	kgf/μm	
63	10	6.35	3.5×1	5030	17020	108	86	154	22	130	58	116	20	14	20	13	PT1/8"	115	
			5×1	6150	21500		96											141	
	12	6.35	2.5×1	3870	12540	108	84	154	22	130	58	116	20	14	20	13	PT1/8"	87	
			3.5×1	5030	17020		96											115	
	12	7.144	5×1	6150	21500	108	108	154	22	130	58	116	20	14	20	13	PT1/8"	141	
			2.5×1	4540	14460		90											89	
	16	7.144	3.5×1	5900	19620	115	102	161	22	137	61	122	20	14	20	13	PT1/8"	117	
			5×1	7210	24780		114											145	
	16	7.938	2.5×1	4540	14460	115	97	161	22	137	61	122	20	14	20	13	PT1/8"	89	
			3.5×1	5900	19620		113											117	
	20	6.35	5×1	7210	24780	115	129	161	22	137	61	122	20	14	20	13	PT1/8"	145	
			2.5×1	4540	14460		112											91	
20	9.525	3.5×1	5900	19620	122	128	182	28	150	72	144	25	18	26	17.5	PT1/8"	120		
		5×1	7210	24780		144											147		
80	10	6.35	2.5×1	3870	12540	108	104	154	22	130	58	116	20	14	20	13	PT1/8"	87	
			3.5×1	5030	17020		124											115	
	12	7.938	5×1	6150	21500	108	144	154	22	130	58	116	20	14	20	13	PT1/8"	141	
			2.5×1	4540	14460		120											120	
	16	9.525	3.5×1	5900	19620	122	140	204	28	172	77	154	30	18	26	17.5	PT1/8"	136	
			5×1	7210	24780		160											167	
	20	9.525	2.5×1	4540	14460	122	120	204	28	172	77	154	30	18	26	17.5	PT1/8"	124	
			3.5×1	5900	19620		143											162	
	20	9.525	5×1	7210	24780	122	140	204	28	172	77	154	30	18	26	17.5	PT1/8"	201	
			2.5×1	4540	14460		120											124	
	100	16	9.525	3.5×1	5900	19620	143	140	204	28	172	77	154	30	18	26	17.5	PT1/8"	162
				5×1	7210	24780		160											201
20		9.525	2.5×1	4540	14460	143	120	204	28	172	77	154	30	18	26	17.5	PT1/8"	124	
			3.5×1	5900	19620		143											162	
20		9.525	5×1	7210	24780	143	140	204	28	172	77	154	30	18	26	17.5	PT1/8"	201	
			2.5×1	4540	14460		120											124	
20	9.525	3.5×1	5900	19620	143	140	204	28	172	77	154	30	18	26	17.5	PT1/8"	162		
		5×1	7210	24780		160											201		

FDWE



Unit: mm

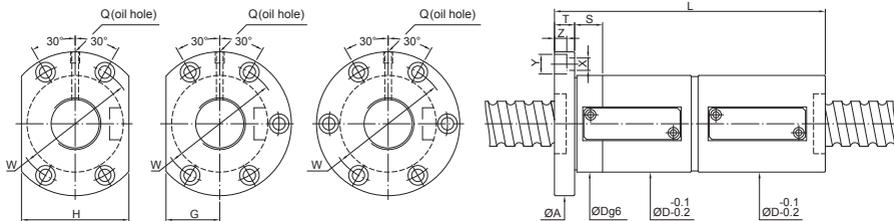
SCREW SIZE	BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE		NUT		FLANGE					FIT		BOLT			OIL HOLE	STIFFNESS	
			Dynamic (1×10 ⁶ REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	S	X	Y	Z	Q			
O.D.	LEAD		LOAD(kgf)															kgf/μm	
12	10	2.381	2.5×1	420	720	30	102	50	10	40	16	32	10	4.5	8	4.4	M6×1P	30	
	10	3.969	2.5×1	1210	2380	46	113	73.5	13	59	25	50	10	5.5	9.5	5.5	M6×1P	51	
			3.5×1	1580	3230													133	68
	16	3.969	1.5×1	830	1530	46	128	73.5	13	59	25	50	10	5.5	9.5	5.5	M6×1P	35	
2.5×1			1210	2380	160													51	
20	16	3.969	1.5×1	830	1530	46	130	73	13	59	25	50	10	5.5	9.5	5.5	M6×1P	35	
	16	3.969	1.5×1	920	1930	54	126	76	15	64	32	64	15	6.6	11	6.5	M6×1P	41	
			2.5×1	1340	3000													158	61
	20	4.762	1.5×1	1170	2300	58	194	85	15	71	32	64	15	6.6	11	6.5	M6×1P	43	
2.5×1			1710	3580	234													63	
32	16	3.969	3.5×1	2220	4860	62	194	88	15	75	34	68	15	6.6	11	6.5	M8×1P	83	
			5×1	2340	6620													226	96
			1.5×1	1010	2480													130	49
			2.5×1	1470	3860													162	73
	16	6.35	2.5×1	2830	6090	74	205	108	18	90	41	82	15	11	17.5	11	M8×1P	120	
			3.5×1	3680	8270													173	105
			5×1	4490	10450													237	131
			1.5×1	1010	2480													93	49
	20	3.969	2.5×1	1470	3860	62	173	88	15	75	34	68	15	6.6	11	6.5	M8×1P	73	
			3.5×1	1910	5240													213	96
			5×1	2350	6610													213	120
			2.5×1	2830	6090													204	80
20	6.35	3.5×1	3680	8270	74	244	108	18	90	41	82	15	11	17.5	11	M8×1P	105		
		5×1	4490	10450													284	131	



Unit: mm

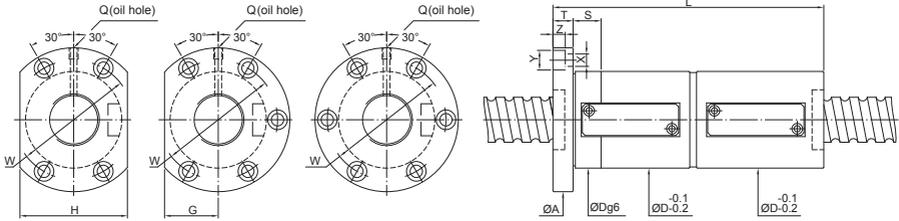
SCREW SIZE	BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE		NUT		FLANGE					FIT		BOLT		OIL HOLE	STIFFNESS	
			LOAD(kgf)	LOAD(kgf)	Dg6	L	A	T	W	G	H	S	X	Y	Z	Q		
O.D.	LEAD		Dynamic (1×10 ⁶ REV.) Ca	Static Co													kgf/μm	
36	10	6.35	3.5×1	3890	9390	155												115
			5×1	4750	11860	75												143
	12	6.35	2.5×1	2990	6920	140												88
			3.5×1	3890	9390	75	164	118	18	98	45	90	15	11	17.5	11	M8×1P	115
	16	6.35	5×1	4750	11860	188												143
			2.5×1	2990	6920	171												88
	20	6.35	3.5×1	3890	9390	75	203	118	18	98	45	90	15	11	17.5	11	M8×1P	115
			5×1	4750	11860	235												143
			1.5×1	2050	4450	164												59
			2.5×1	2990	6920	204												88
40	10	6.35	3.5×1	4130	10560	86	155											125
			5×1	5050	13340	175												155
	12	6.35	2.5×1	3180	7780	141												95
			3.5×1	4130	10560	86	165	128	18	106	49	98	15	11	17.5	11	PT1/8"	125
	16	6.35	5×1	5050	13340	189												155
			2.5×1	3180	7780	173												95
	16	7.144	3.5×1	4130	10560	86	205	128	18	106	49	98	15	11	17.5	11	PT1/8"	125
			5×1	5050	13340	237												155
	20	6.35	2.5×1	3740	8790	173												98
			3.5×1	4870	11930	86	205	128	18	106	49	98	15	11	17.5	11	PT1/8"	128
5×1			5950	15070	237												159	
1.5×1			2180	5000	164												64	
40	6.35	2.5×1	3180	7780	141												95	
		3.5×1	4130	10560	86	204	128	18	106	49	98	15	11	17.5	11	PT1/8"	125	
		5×1	5050	13340	284												155	
40	6.35	1.5×1	2180	5000	86	242	128	18	106	49	98	15	11	17.5	11	PT1/8"	64	

FDWE



Unit: mm

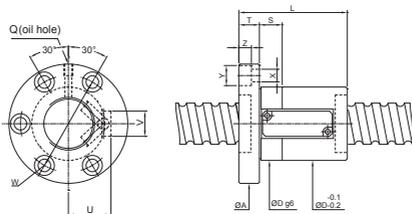
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD(kgf)		NUT		FLANGE					FIT		BOLT			OIL HOLE	STIFFNESS kgf/μm
O.D.	LEAD			Dynamic (1×10 ⁶ REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	S	X	Y	Z	Q		
50	10	6.35	3.5×1	4560	13230	93	155	135	18	113	51	102	20	11	17.5	11	PT1/8"	149	
			5×1	5580	16710	175	185												
	12	6.35	2.5×1	3510	9750	141	165	185	18	113	51	102	20	11	17.5	11	PT1/8"	112	
			3.5×1	4560	13230	93												185	
	12	7.144	2.5×1	4080	11260	161	100	185	25	122	55	110	20	14	20	13	PT1/8"	149	
			5×1	5580	16710	189												209	
	16	6.35	2.5×1	3510	9750	174	206	135	18	113	51	102	20	11	17.5	11	PT1/8"	114	
			3.5×1	4560	13230	93												238	
	16	7.144	2.5×1	4080	11260	180	100	212	146	25	122	55	110	20	14	20	13	PT1/8"	149
			3.5×1	5300	15280	100													244
	20	7.144	1.5×1	2790	7240	179	100	219	146	25	122	55	110	20	14	20	13	PT1/8"	77
			2.5×1	4080	11260	219													259
3.5×1			5300	15280	259	299													
5×1			6480	19300	299	319													
20	7.938	2.5×1	4750	12090	219	105	259	152	25	128	58	116	20	14	20	13	PT1/8"	117	
		3.5×1	6180	16400	259													299	
50	7.938	1.5×1	3250	7770	305	105	305	152	25	128	58	116	20	14	20	13	PT1/8"	154	
		5×1	7550	20720	299													319	



Unit: mm

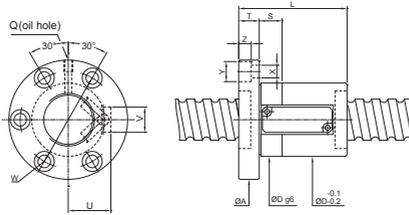
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD/(kgf)		NUT		FLANGE					FIT		BOLT			OIL HOLE	STIFFNESS
O.D.	LEAD			Dynamic (1×10 ⁵ REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	S	X	Y	Z	Q	kgf/μm	
63	10	6.35	3.5×1	5030	17020	108	155	154	22	130	58	116	20	14	20	13	PT1/8"	178	
			5×1	6150	21500	175	220												
	12	6.35	2.5×1	3870	12540	153												134	
			3.5×1	5030	17020	108	177	154	22	130	58	116	20	14	20	13	PT1/8"	178	
	12	7.144	5×1	6150	21500	201												220	
			2.5×1	4540	14460	158													136
	16	7.144	3.5×1	5900	19620	115	182	161	22	137	61	122	20	14	20	13	PT1/8"	180	
			5×1	7210	24780	206													224
	16	7.938	2.5×1	4540	14460	177													136
			3.5×1	5900	19620	115	209	161	22	137	61	122	20	14	20	13	PT1/8"	180	
	20	6.35	5×1	7210	24780	241													224
			2.5×1	5260	15430	207													139
20	9.525	3.5×1	6840	20940	120	239	180	28	150	72	144	25	18	26	17.5	PT1/8"	184		
		5×1	8360	26450	271													228	
80	10	6.35	2.5×1	3870	12540	205												134	
			3.5×1	5030	17020	108	245	154	22	130	58	116	20	14	20	13	PT1/8"	178	
	12	7.938	5×1	6150	21500	285												220	
			2.5×1	8870	25870	219													158
	16	9.525	3.5×1	11530	35110	122	259	182	28	150	72	144	25	18	26	17.5	PT1/8"	208	
			5×1	14090	44350	299													258
	20	6.35	2.5×1	5630	21660	130	159	176	22	152	66	132	20	14	20	13	PT1/8"	207	
			5×1	6880	27360	179													256
	16	9.525	3.5×1	7670	27030	184													222
			5×1	9380	34140	208	182	22	158	68	136	20	14	20	13	PT1/8"	275		
	20	6.35	2.5×1	9900	33200	220													189
			3.5×1	12990	45050	143	220	204	28	172	77	154	30	18	26	17.5	PT1/8"	251	
20	9.525	5×1	15880	56910	252													311	
		2.5×1	9900	33200	220													189	
100	16	9.525	3.5×1	12990	45050	143	260	204	28	172	77	154	30	18	26	17.5	PT1/8"	251	
			5×1	15880	56910	300													311
20	9.525	2.5×1	11320	41820	211													213	
		3.5×1	14720	56750	170	243	243	32	205	91	182	30	22	32	21.5	PT1/8"	283		
20	9.525	5×1	17990	71690	259													351	
		2.5×1	11320	41820	228													213	
20	9.525	3.5×1	14720	56750	170	268	243	32	205	91	182	30	22	32	21.5	PT1/8"	283		
		5×1	17990	71690	308													351	

FSVE



Unit: mm

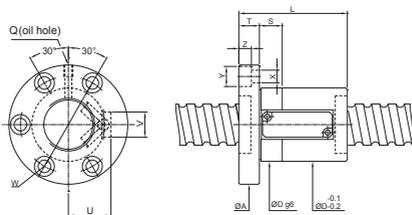
SCREW SIZE	BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD (kgf)		NUT		FLANGE			FIT	BOLT			RETURN TUBE		OIL HOLE	STIFFNESS		
			Dynamic (1×10 ⁶ REV.) Ca	Static Co	Dg6	L	A	T	W		S	X	Y	Z	U			V	Q
12	10	2.381	2.5×1	420	720	25	50	48	10	36	10	4.5	8	4.4	14	12	M6×1P	20	
			3.5×1	1210	2380	38	63	62	13	50	10	5.5	9.5	5.5	23	15	M6×1P	34	
	16	3.969	1.5×1	830	1530	38	63	62	13	50	10	5.5	9.5	5.5	23	15	M6×1P	24	
			2.5×1	1210	2380	79	79	62	13	50	10	5.5	9.5	5.5	23	15	M6×1P	34	
20	16	3.969	1.5×1	830	1530	38	70	62	13	50	10	5.5	9.5	5.5	23	15	M6×1P	24	
			2.5×1	1210	2380	42	62	68	15	55	15	6.6	11	6.6	26	14	M6×1P	28	
	25	4.762	1.5×1	920	1930	42	78	68	15	55	15	6.6	11	6.6	26	14	M6×1P	40	
			2.5×1	1340	3000	74	74	72	15	59	15	6.6	11	6.5	27	16	M6×1P	29	
32	16	3.969	1.5×1	1010	2480		63											33	
			2.5×1	1470	3860	49	79	78	15	63	15	6.6	11	6.6	29	15	M8×1P	48	
			3.5×1	1910	5240	95	95												63
			5×1	2340	6610	111	111												77
	20	6.35	2.5×1	2830	8200		92												54
			3.5×1	3680	11120	57	108	98	18	77	20	11	17.5	11	34	22	M8×1P	69	
			5×1	4490	14050	124	124												85
			1.5×1	1010	2480		70												33
	20	3.969	2.5×1	1470	3860	49	90	78	15	63	15	6.6	11	6.6	29	15	M8×1P	48	
			3.5×1	1910	5240	110	110												63
			5×1	2350	6610	130	130												77
			2.5×1	2830	8200		104												
20	6.35	3.5×1	3680	11120	57	124	98	18	77	20	11	17.5	11	34	22	M8×1P	69		
		5×1	4490	14050	144	144												85	



Unit: mm

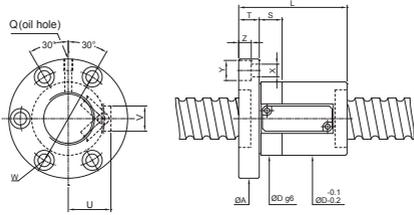
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD (kgf)		NUT		FLANGE			FIT			BOLT		RETURN TUBE		OIL HOLE	STIFFNESS
O.D.	LEAD			Dynamic (1×10 ⁶ REV.) Ca	Static Co	Dg6	L	A	T	W	S	X	Y	Z	U	V	Q	kgf/μm	
36	10	6.35	3.5×1	3890	9390	60	84	100	18	80	20	11	17.5	11	36	22	M8×1P	76	
			5×1	4750	11860		94											93	
	12	6.35	2.5×1	2990	6920	60	85	100	18	80	20	11	17.5	11	36	22	M8×1P	58	
			3.5×1	3890	9390		97											76	
	16	6.35	3.5×1	3890	9390	60	91	107	100	18	80	20	11	17.5	11	36	22	M8×1P	93
			5×1	4750	11860		123												93
	20	6.35	1.5×1	2050	4450	60	91	100	18	80	20	11	17.5	11	36	22	M8×1P	41	
			2.5×1	2990	6920		111											58	
			3.5×1	3890	9390		131											76	
			5×1	4750	11860		151											93	
40	10	6.35	3.5×1	4130	10560	64	84	104	18	84	20	11	17.5	11	38	22	PT1/8"	82	
			5×1	5050	13340		96											101	
	12	6.35	2.5×1	3180	7780	64	86	98	104	18	84	20	11	17.5	11	38	22	PT1/8"	63
			3.5×1	4130	10560		98												82
	16	6.35	2.5×1	3180	7780	64	93	109	104	18	84	20	11	17.5	11	38	22	PT1/8"	101
			3.5×1	4130	10560		125												82
	16	7.144	2.5×1	3740	8790	64	92	108	104	18	84	15	11	17.5	11	38	22	PT1/8"	65
			3.5×1	4870	11930		108												84
			5×1	5950	15070		124												103
	20	6.35	1.5×1	2180	5000	64	84	104	18	84	20	11	17.5	11	38	22	PT1/8"	43	
2.5×1			3180	7780	104		63												
3.5×1			4130	10560	124		82												
5×1			5050	13340	144		101												
40	6.35	1.5×1	2180	5000	64	130	104	18	84	20	11	17.5	11	38	22	PT1/8"	43		

FSVE



Unit: mm

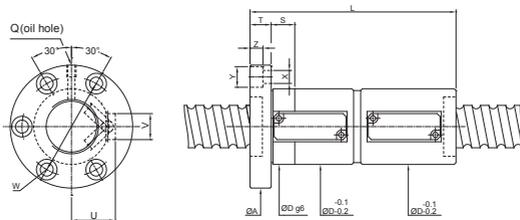
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD/(kgf)		NUT		FLANGE			FIT		BOLT			RETURN TUBE		OIL HOLE	STIFFNESS
O.D.	LEAD			Dynamic (1×10 ⁶ REV.) Ca	Static Co	Dg6	L	A	T	W	S	X	Y	Z	U	V	Q	kgf/μm	
50	10	6.35	3.5×1	4560	13230	73	85	118	18	96	20	11	17.5	11	43	22	PT1/8"	97	
			5×1	5580	16710	95	119												
	12	6.35	2.5×1	3510	9750	82	94	118	18	96	20	11	17.5	11	43	22	PT1/8"	74	
			3.5×1	4560	13230	73												94	97
	12	7.144	2.5×1	4080	11260	93	105	122	20	98	15	14	20	13	44	24	PT1/8"	75	
			3.5×1	5300	15280	75												106	99
	16	6.35	2.5×1	3510	9750	94	110	118	18	96	20	11	17.5	11	43	22	PT1/8"	74	
			3.5×1	4560	13230	73												126	97
	16	7.144	2.5×1	4080	11260	100	116	122	20	98	15	14	20	13	44	24	PT1/8"	75	
			3.5×1	5300	15280	75												132	99
	20	7.144	1.5×1	2790	7240	98	75	118	122	20	98	15	14	20	13	44	20	PT1/8"	52
			2.5×1	4080	11260	118													75
3.5×1			5300	15280	138	99													
5×1			6480	19300	158	121													
20	7.938	2.5×1	4750	12090	119	76	139	123	25	99	20	14	20	13	46	25	PT1/8"	78	
		3.5×1	6180	16400	139													101	
50	7.938	5×1	7550	20720	159	76	157	123	25	99	20	14	20	13	46	25	PT1/8"	124	
		1.5×1	3250	7770	159													53	



Unit: mm

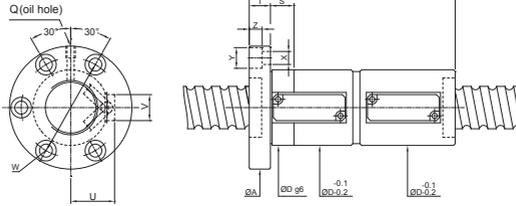
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD (kgf)		NUT		FLANGE				FIT			BOLT		RETURN TUBE		OIL HOLE	STIFFNESS
O.D.	LEAD			Dynamic (1×10 ⁶ REV.) Ca	Static Co	Dg6	L	A	T	W	S	X	Y	Z	U	V	Q	kgf/μm		
63	10	6.35	3.5×1	5030	17020	86	86	133	22	108	20	14	20	13	49	24	PT1/8"	115		
			5×1	6150	21500	86	96												141	
	12	6.35	2.5×1	3870	12540	84													87	
			3.5×1	5030	17020	86	96	133	22	108	20	14	20	13	49	24	PT1/8"	115		
	12	7.144	2.5×1	4540	14460	90													89	
			3.5×1	5900	19620	87	102	134	22	110	20	14	20	13	50	25	PT1/8"	117		
	16	7.144	2.5×1	4540	14460	97													89	
			3.5×1	5900	19620	87	113	134	22	110	20	14	20	13	50	25	PT1/8"	117		
	16	7.938	2.5×1	5260	15430	112													91	
			3.5×1	6840	20940	89	128	148	28	118	25	18	26	17.5	52	25	PT1/8"	120		
	20	6.35	2.5×1	3870	12540	104													87	
			3.5×1	5030	17020	86	124	133	22	108	20	14	20	13	49	24	PT1/8"	115		
20	7.938	2.5×1	5260	15430	120													91		
		3.5×1	6840	20940	89	140	148	28	118	25	18	26	17.5	52	25	PT1/8"	120			
20	9.525	2.5×1	8870	25870	120													105		
		3.5×1	11530	35110	93	140	152	28	122	25	18	26	17.5	54	28	PT1/8"	136			
80	10	6.35	3.5×1	5630	21660	103	90	150	22	126	20	14	20	13	58	25	PT1/8"	133		
			5×1	6880	27360	100													164	
	12	7.938	3.5×1	7670	27030	101												143		
			5×1	9380	34140	123	113	170	22	146	20	14	20	13	66	28	PT1/8"	177		
	16	9.525	2.5×1	9900	33200	108													124	
			3.5×1	12990	45050	126	124	185	28	155	30	18	26	17.5	70	28	PT1/8"	162		
20	9.525	2.5×1	9900	33200	120													124		
		3.5×1	12990	45050	126	140	185	28	155	30	18	26	17.5	70	28	PT1/8"	162			
100	16	9.525	2.5×1	11320	41820	115												139		
			3.5×1	14720	56750	146	131	217	32	181	30	22	32	21.5	82	35	PT1/8"	182		
	20	9.525	2.5×1	17990	71690	147												226		
			3.5×1	11320	41820	128												139		
	20	9.525	2.5×1	14720	56750	146	148	217	32	181	30	22	32	21.5	82	35	PT1/8"	182		
			3.5×1	17990	71690	168												226		

FDVE



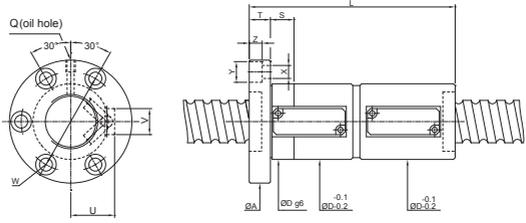
Unit: mm

SCREW SIZE	BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD (kgf)		NUT		FLANGE		FIT		BOLT		RETURN TUBE		OIL HOLE	STIFFNESS			
			Dynamic (1×10 ⁶ REV.) Ca	Static Co	Dg6	L	A	T	W	S	X	Y	Z	U	V		Q		
12	10	2.381	2.5×1	420	720	25	102	48	10	36	10	4.5	8	4.4	14	12	M6×1P	30	
	10	3.969	2.5×1	1210	2380	38	113	62	13	50	10	5.5	9.5	5.5	23	15	M6×1P	51	
			3.5×1	1580	3230													68	
20	16	3.969	1.5×1	830	1530	38	128	62	13	50	10	5.5	9.5	5.5	23	15	M6×1P	35	
			2.5×1	1210	2380													51	
	20	3.969	1.5×1	830	1530	38	130	62	13	50	10	5.5	9.5	5.5	23	15	M6×1P	35	
25	16	3.969	1.5×1	920	1930	42	126	68	15	55	15	6.6	11	6.6	26	14	M6×1P	41	
			2.5×1	1340	3000													61	
	20	4.762	1.5×1	1170	2300	44	154	72	15	59	15	6.6	11	6.5	27	16	M6×1P	43	
32	16	3.969	2.5×1	1710	3580	44	194	72	15	59	15	6.6	11	6.6	29	16	M6×1P	63	
			3.5×1	2220	4860													83	
			1.5×1	1010	2480													130	
			2.5×1	1470	3860													162	
	16	6.35	3.969	3.5×1	1910	5240	49	162	78	15	63	15	6.6	11	6.6	29	15	M8×1P	73
				5×1	2340	6610													194
				2.5×1	2830	8200													173
				3.5×1	3680	11120													205
				5×1	4490	14050													237
				80															
20	3.969	3.969	1.5×1	1010	2480	49	173	78	15	63	15	6.6	11	6.6	29	15	M8×1P	49	
			2.5×1	1470	3860													173	
			3.5×1	1910	5240													213	
			5×1	2350	6610													253	
20	6.35	3.969	2.5×1	2830	8200	57	204	98	18	77	20	11	17.5	11	34	22	M8×1P	80	
			3.5×1	3680	11120													244	
105																			
131																			



Unit: mm

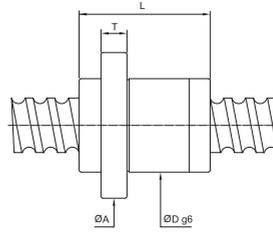
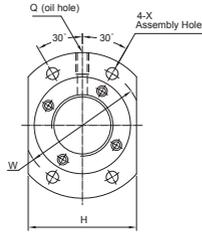
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD (kgf)		NUT		FLANGE			FIT		BOLT		RETURN TUBE		OIL HOLE	STIFFNESS	
O.D.	LEAD			Dynamic (1×10 ⁶ REV.) Ca	Static Co	Dg6	L	A	T	W	S	X	Y	Z	U	V	Q	kgf/μm	
36	10	6.35	3.5×1	3890	9390	60	155	100	18	80	20	11	17.5	11	36	22	M8×1P	115	
			5×1	4750	11860		175											143	
	12	6.35	2.5×1	2990	6920	60	152	100	18	80	20	11	17.5	11	36	22	M8×1P	88	
			3.5×1	3890	9390		176											115	
	16	6.35	2.5×1	2990	6920	60	173	100	18	80	20	11	17.5	11	36	22	M8×1P	88	
			3.5×1	3890	9390		205											115	
	20	6.35	1.5×1	2050	4450	60	164	100	18	80	20	11	17.5	11	36	22	M8×1P	59	
			2.5×1	2990	6920		204											88	
			3.5×1	3890	9390		244											115	
			5×1	4750	11860		284											143	
	40	10	6.35	3.5×1	4130	10560	64	155	104	18	84	20	11	17.5	11	38	22	PT1/8"	125
				5×1	5050	13340		175											155
12		6.35	2.5×1	3180	7780	64	141	165	104	18	84	20	11	17.5	11	38	22	PT1/8"	95
			3.5×1	4130	10560		189												125
16		6.35	2.5×1	3180	7780	64	173	104	18	84	20	11	17.5	11	38	22	PT1/8"	95	
			3.5×1	4130	10560		205											125	
16		7.144	2.5×1	3740	8790	64	173	104	18	84	15	11	17.5	11	38	22	PT1/8"	98	
			3.5×1	4870	11930		205											128	
20		6.35	1.5×1	2180	5000	64	164	104	18	84	20	11	17.5	11	38	22	PT1/8"	64	
			2.5×1	3180	7780		204											95	
20		6.35	3.5×1	4130	10560	64	244	104	18	84	20	11	17.5	11	38	22	PT1/8"	125	
			5×1	5050	13340		284											155	
40	6.35	1.5×1	2180	5000	64	242	104	18	84	20	11	17.5	11	38	22	PT1/8"	64		



Unit: mm

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD(kgf)		NUT		FLANGE			FIT		BOLT		RETURN TUBE		OIL HOLE	STIFFNESS			
O.D.	LEAD			Dynamic (1×10 ⁶ REV.)	Static	Dg6	L	A	T	W	S	X	Y	Z	U	V	Q	kgf/μm			
				Ca	Co																
63	10	6.35	3.5×1	5030	17020	86	155	133	22	108	20	14	20	13	49	24	PT1/8"	178			
			5×1	6150	21500	175	220														
	12	6.35	2.5×1	3870	12540	153														134	
			3.5×1	5030	17020	86	177	133	22	108	20	14	20	13	49	24	PT1/8"	178			
				5×1	6150	21500	201														220
				2.5×1	4540	14460	158														136
	12	7.144	3.5×1	5900	19620	87	182	134	22	110	20	14	20	13	50	25	PT1/8"	180			
			5×1	7210	24780	206														224	
				2.5×1	4540	14460	177														139
				3.5×1	5900	19620	87	209	134	22	110	20	14	20	13	50	25	PT1/8"	184		
				5×1	7210	24780	241														228
				2.5×1	5260	15430	207														134
16	7.144	3.5×1	6840	20940	89	239	148	28	118	25	18	26	17.5	52	25	PT1/8"	178				
		5×1	8360	26450	271														220		
			2.5×1	3870	12540	205														134	
			3.5×1	5030	17020	86	245	133	22	108	20	14	20	13	49	24	PT1/8"	178			
20	6.35	5×1	6150	21500	285														220		
		2.5×1	5260	15430	221														139		
			3.5×1	6840	20940	89	261	148	28	118	25	18	26	17.5	52	25	PT1/8"	184			
			5×1	8360	26450	301														228	
			2.5×1	8870	25870	219														158	
			3.5×1	11530	35110	93	259	152	28	122	25	18	26	17.5	54	28	PT1/8"	208			
20	9.525	5×1	14090	44350	299														258		
		3.5×1	5630	21660	103	159	150	22	126	20	14	20	13	58	25	PT1/8"	207				
5×1	6880	27360	179	179	222																
			3.5×1	7670	27030	184														222	
			5×1	9380	34140	208	170	22	146	20	14	20	13	66	28	PT1/8"	275				
12	7.938	2.5×1	9900	33200	188														189		
		3.5×1	12990	45050	126	220	185	28	155	30	18	26	17.5	70	28	PT1/8"	251				
16	9.525	5×1	15880	56910	252														311		
		2.5×1	9900	33200	220														189		
			3.5×1	12990	45050	126	260	185	28	155	30	18	26	17.5	70	28	PT1/8"	251			
			5×1	15880	56910	300														311	
			2.5×1	11320	41820	211														213	
			3.5×1	14720	56750	146	243	217	32	181	30	22	32	21.5	82	35	PT1/8"	283			
16	9.525	5×1	17990	71690	259														351		
		2.5×1	11320	41820	228														213		
			3.5×1	14720	56750	146	268	217	32	181	30	22	32	21.5	82	35	PT1/8"	283			
			5×1	17990	71690	308														351	

13.5 End Cap Series



Unit: mm

End Cap Series

SCREW SIZE		BALL DIA	EFFECTIVE TURNS circuit × number of thread	BASIC RATE LOAD (kgf)		BALLNUT DIMENSION									
O.D.	LEAD			Dynamic (1×10 ⁶ REV.) Ca	Static Co	NUT		FLANGE				BOLT X	OIL HOLE Q	STIFFNESS kgf/μm	
						Dg6	L	A	T	H	W				
15	10	3.715	2.8×2	1410	2800	34	44	57	10	40	45	5.5	M6×1P	34	
16	16	3.175	1.8×2	700	1400	32	38	53	10	38	42	4.5	M6×1P	18	
20	20	3.175	1.8×2	1100	2500	39	52	62	10	46	50	5.5	M6×1P	29	
25	25	3.969	1.8×2	1650	3900	47	62	74	12	56	60	6.6	M6×1P	35	
			1.8×4	2830	7800										
32	32	4.762	1.8×2	2360	5940	58	70	92	15	68	74	9	M6×1P	44	
			1.8×4	4280	11800										
36	24	7.144	2.8×2	6450	15220	75	94	115	18	86	94	11	M6×1P	77	
40	40	6.35	1.8×2	3860	9900	73	95	114	17	84	93	11	M6×1P	55	
			1.8×4	7000	19880										
50	50	7.938	1.8×2	5800	15800	90	122	135	20	104	112	14	M6×1P	68	
			1.8×4	10520	31600										

13.6 Ballscrews For Heavy Load

Features

Focused on improvements of contact points of balls and thread grooves, ball diameter and circulation system for new type, FSVH. The rated dynamic load has been increased to as two times as that of conventional type, FSVC.

Long Life

Structure of the newly developed circulation system is designed to distribute the load uniformly to the load balls and it also increases the life of ballscrews.

On conventional circulation system, FSVC, the returning tube is inserted into the holes on ballnut perpendicularly which forms an advancing angle. While ball moves into returning tube, it will hit tube end area and then move into returning tube.

New circulation system, FSVH, ball will move into returning tube smoothly by tangent line as the same direction as lead angle. It can increase the life of circulation system structure.

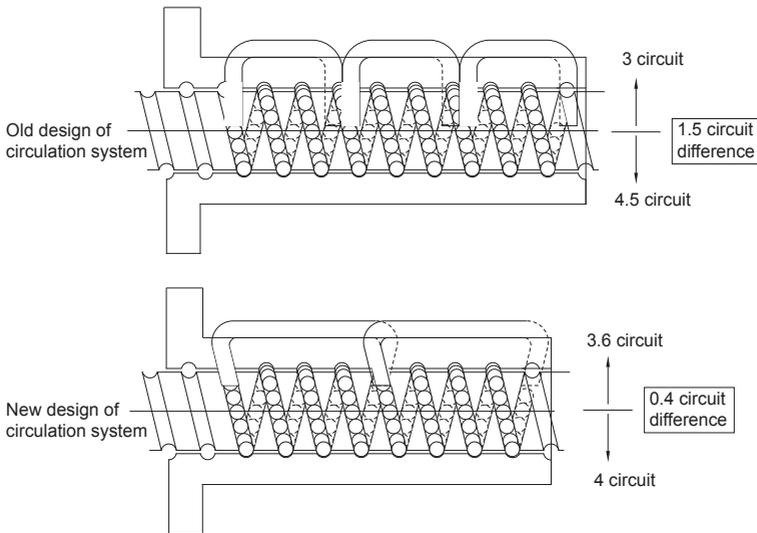


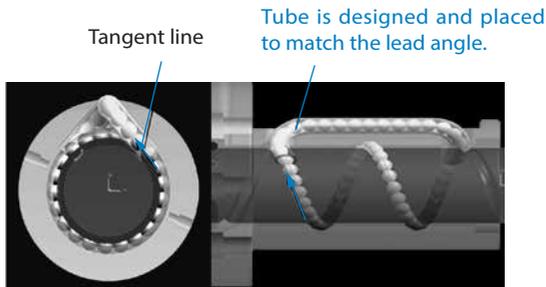
Fig.13.4 Circuit difference for heavy load ballscrew

High DN Value

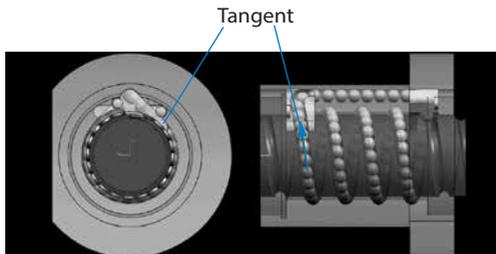
With the newly developed circulation system, ballscrews can meet the demands of high speed running with high DN value.

Low Noise

To use tangential circulation system structure, it can eliminate the noise while balls run into the returning tube.

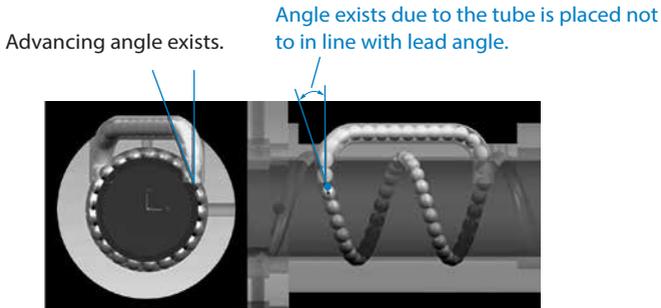


FSVH circulation system structure(NEW)



FSDH circulation system structure (NEW)

Fig.13.5 Circulation system structure for FSVH and FSDH



FSVC circulation system structure

Fig.13.6 Circulation system structure for FSVC

Various Specifications Combination

PMI can supply various ballscrews with diameter 40~120mm and lead 10mm to 60mm (Please contact *PMI* for your specific design requirement)

Recommend mounting direction of heavy load ball screws

In order to support equal load distribution for shaft and nut, recommend mounting direction of ball screws allow fig. 13.7. This mounting direction can avoided vibration as axial load uneven distribution for ball screws, therefore increase service life efficient.

Accuracy Grade and Axial Play

If you have any question about accuracy grade and axial play(e.g. axial play <0), please contact our sales for your specific design requirement.

Unit:mm

Grade \ Axial play	S	N
	0.010 or less	0.030 or less
C6	C6S	C6N

Application

Plastic Injection Machines / Press and Forging Machines
Semi-conductor Equipments / General Machines

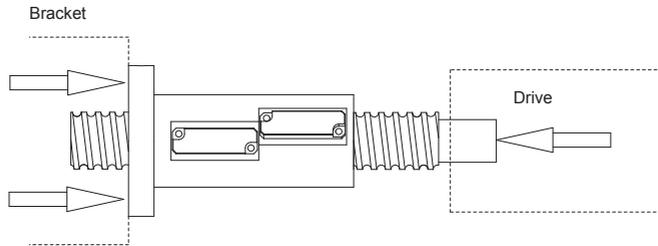


Fig.13.7 Recommend mounting direction of heavy load ballscrew

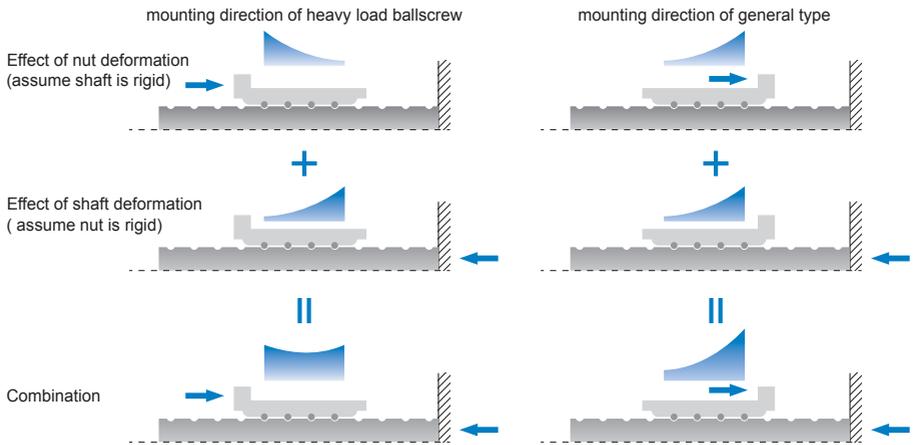
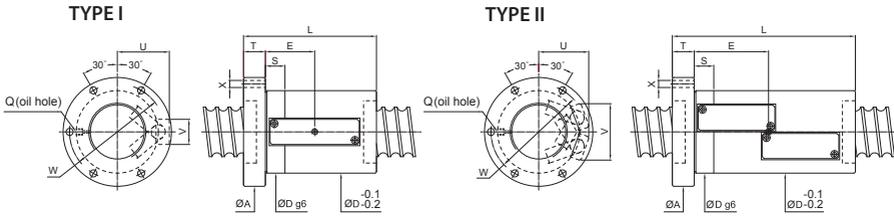


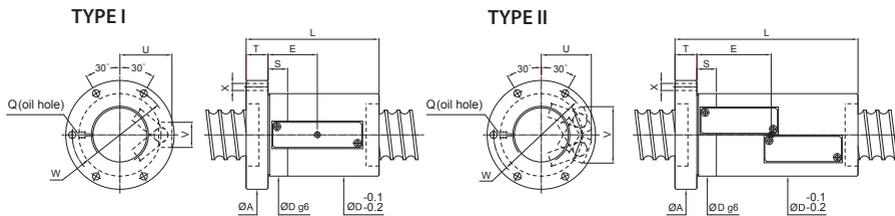
Fig.13.8 Load distribution



Unit: mm

SCREW SIZE	BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD(kgf)		NUT		FLANGE			FIT	OIL HOLE		BOLT		RETURN TUB		Type
			Dynamic (1×10 ⁶ REV.) Ca	Static Co	Dg6	L	A	T	W		S	Q	E	X	V	U	
40	10	7.938	3.5×2	15000	41800	66	124	98	18	83	20	M6x1P	50.75	9	51	43	II
	12	9.525	3.5×2	18600	48200	70	156	103	18	86	20	M6x1P	58	9	55	45	II
45	10	7.938	3.5×2	15900	47300	70	134	104	18	87	20	M6x1P	54.2	9	54	45	II
50	10	7.938	3.5×2	16700	52900	77	133	109	18	92	20	M6x1P	53.7	9	60	48	II
	16	12.7	6×1	24800	63700	95	168	128	28	112	20	PT1/8"	70.5	9	32	60	I
		12.7	3.5×2	31200	83500		200	128	28	112	20		86	9	72	62	II
20	12.7	3.5×2	31200	84800	95	235	128	28	112	20	PT1/8"	97	9	72	62	II	
55	10	7.938	3.5×2	17500	58500	80	153	114	28	97	20	PT1/8"	62.1	9	61	49	II
	16	12.7	6×1	25800	71800	100	168	133	28	115	20	PT1/8"	69.5	9	32	63	I
3.5×2			32600	94000	100	200	133	28	115	20	84.5		9	77	64	II	
63	16	12.7	6×1	27800	81700	105	168	138	28	122	25	PT1/8"	65.25	9	32	66	I
			3.5×2	35000	107000	105	202	138	28	122	25		82.25	9	80	67	II
			6×2	50300	164000	105	266	138	28	122	25		114.25	9	80	67	II
	20	15.875	2.5×2	35900	99300	117	210	157	32	137	25	PT1/8"	96	11	88	74	II
3.5×2	46600	134700	117	246	157	32	137	25	105.5	11	88		74	II			
25	15.875	2.5×2	35900	99300	117	235	157	32	137	25	PT1/8"	91	11	88	75	II	
80	16	12.7	6×1	30900	104400	120	172	158	32	139	25	PT1/8"	66	9	36	73	I
			3.5×2	39000	136700	120	205	158	32	139	25		84	9	89	74	II
			6×2	56000	208700	120	275	158	32	139	25		122	9	89	74	II
	20	15.875	2.5×2	40100	127000	130	210	168	32	150	25	PT1/8"	87.5	11	90	83	II
			3.5×2	52100	172400	130	250	168	32	150	25		107.5	11	90	83	II
			6×2	75000	263200	130	330	168	32	150	30		147.5	11	90	83	II
25	19.05	3.5×2	67700	206100	145	305	188	40	165	25	PT1/8"	119	11	108	94	II	
		6×2	97200	314600	145	402	188	40	165	30		169	11	108	94	II	

FSVH

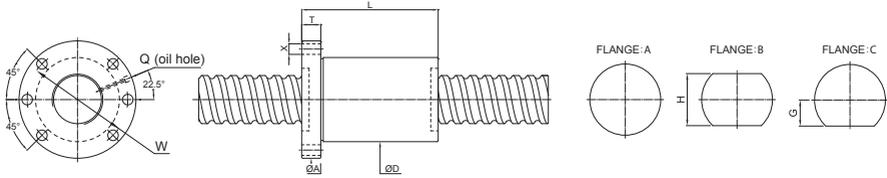


Unit: mm

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD(kgf)		NUT		FLANGE			FIT	OIL HOLE		BOLT X	RETURN TUB		Type
O.D.	LEAD			Dynamic (1×10 ⁴ REV.) Ca	Static Co	Dg6	L	A	T	W		S	Q		E	V	
100	16	12.7	6×1	34200	133200	145	172	185	32	165	25	PT1/8"	63.5	11	38	85	I
			3.5×2	43200	174500	145	205	185	32	165	25		79.5	11	98	85	II
			6×2	62000	266300	145	275	185	32	165	25		117.5	11	98	85	II
	20	15.875	2.5×2	44800	160900	150	205	194	32	172	30	PT1/8"	82	11	107	92	II
			3.5×2	58300	218400	150	245	194	32	172	30		102	11	107	92	II
			6×2	83800	333300	150	330	194	32	172	30		147	11	107	92	II
25	19.05	3.5×2	74900	260200	165	305	218	40	190	30	PT1/8"	122	11	111	102	II	
		6×2	107700	397100	165	410	218	40	190	30		177	11	111	102	II	
120	16	12.7	6×1	34100	130200	173	205	213	40	193	30	PT1/8"	84	11	38	93	I
			3.5×2	43000	170700	173	230	213	40	193	30		101	11	108	94	II
	20	15.875	6×1	46000	160800	173	222	213	40	193	30	PT1/8"	95	11	54	100	I
			3.5×2	58100	210700	173	260	213	40	193	30		116	11	121	104	II
	25	19.0	6×1	59200	194500	183	261	213	40	193	30	PT1/8"	109.5	11	50	106	I
			3.5×2	74700	254800	183	314	213	40	193	30		135.5	11	129	109	II

13.7 Heavy Load Series of End Deflector

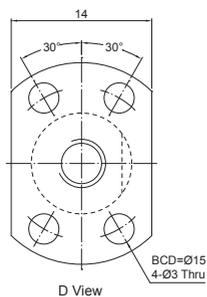
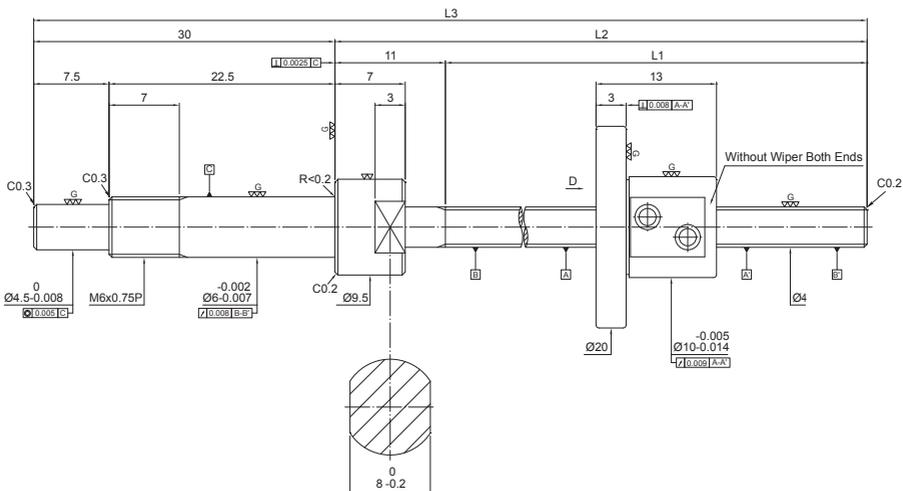
FSDH



Unit: mm

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × number of thread	BASIC RATE LOAD (kgf)		NUT		FLANGE				OIL HOLE	BOLT
O.D.	LEAD			Dynamic (1×10 ⁶ REV.) Ca	Static Co	D6	L	A	T	W	G	Q	X
45	12	9.525	5×1	13600	35400	84	98	128	24	106	57	PT1/8"	14
	16	9.525	5×1	13500	35300	84	122	128	24	106	57	PT1/8"	14
	20	9.525	4×1	11000	27900	84	122	128	24	106	57	PT1/8"	14
50	16	12.7	5×1	21100	53700	102	125	146	28	124	65	PT1/8"	14
	20	12.7	4×1	17200	42400	102	124	146	28	124	65	PT1/8"	14
	40	12.7	3×2	23400	61200	102	163	146	28	124	65	PT1/8"	14
63	32	15.875	4×1	25500	66000	126	176	182	32	154	81	PT1/8"	18
	40	15.875	3×2	35300	96600	126	169	182	32	154	81	PT1/8"	18
80	50	19.05	4×2	66600	204000	155	255	224	40	190	100	PT1/8"	22
100	60	19.05	4×2	73400	251500	175	295	244	40	210	100	PT1/8"	22

13.8 Miniature Series

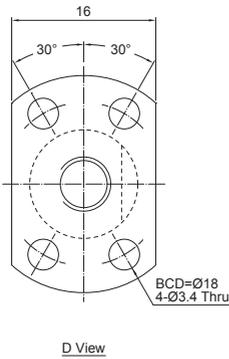
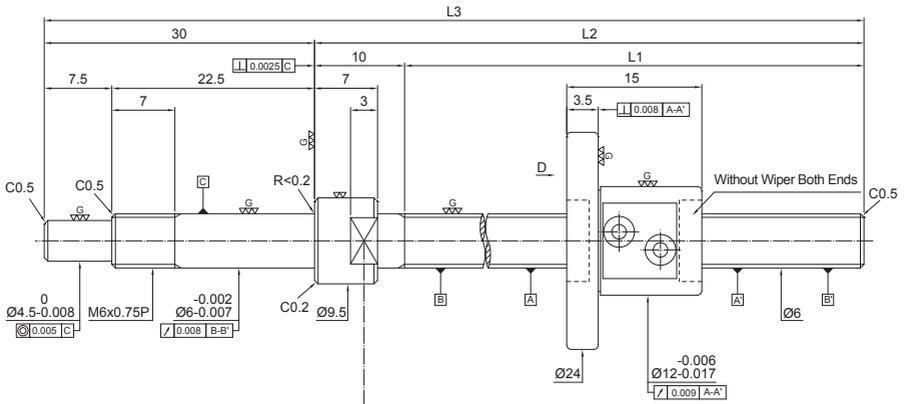


Specification of ball screw

Production Specification	With Preload	Without Preload
Number of Thread / Thread Direction	1/Right	
BCD	4.1	
Lead	1	
Ball Dia.	0.8	
Effective Turns (Circuit × Row)	2.5 × 1	
Lead Angle	4.44	
Dynamic Rate Load Ca (kgf)	49	
Static Rate Load Co (kgf)	70	
Axial Play	0	0.005 or less
Preloading Torque (kgf-cm)	0.01~0.1	0.03 or less

Unit: mm

Model No.	Screw Spindle (Shaft) Length			Accuracy Grade	Lead Accuracy		
	L1	L2	L3		Specified Travel (T)	Accumulated reference lead deviation E	Lead Derivation in random 300mm e_{300}
FSM0401-C3-1R-0085	44	55	85	3	0	0.012	0.008
FSM0401-C3-1R-0105	64	75	105	3	0	0.012	0.008
FSM0401-C3-1R-0135	94	108	138	3	0	0.012	0.008



Specification of ball screw

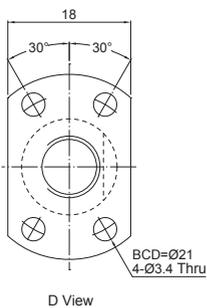
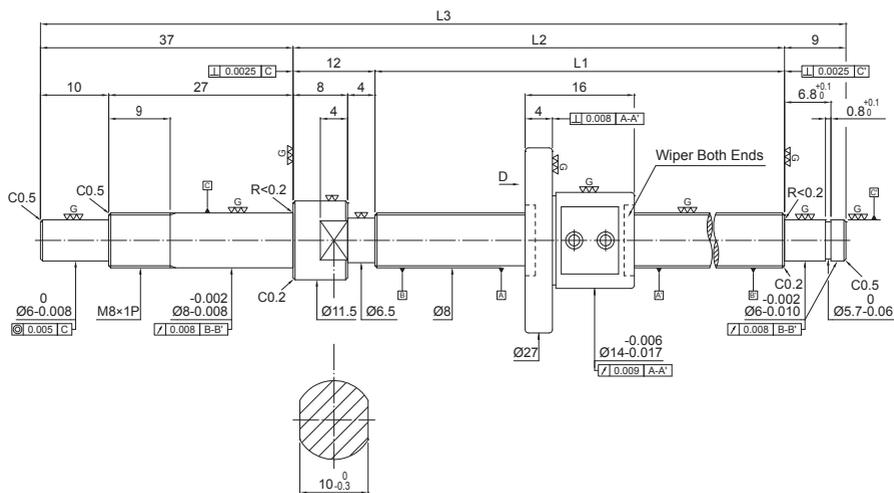
Production Specification	With Preload	Without Preload
Number of Thread / Thread Direction	1/Right	
BCD	6.1	
Lead	1	
Ball Dia.	0.8	
Effective Turns (Circuit \times Row)	2.5 \times 1	
Lead Angle	2.99	
Dynamic Rate Load Ca (kgf)	58	
Static Rate Load Co (kgf)	100	
Axial Play	0	0.005 or less
Preloading Torque (kgf-cm)	0.01~0.15	0.03 or less

Unit: mm

Model No.	Screw Spindle (Shaft) Length			Accuracy Grade	Lead Accuracy		
	L1	L2	L3		Specified Travel (T)	Accumulated reference lead deviation E	Lead Derivation in random 300mm ϵ_{300}
FSM0601-C3-1R-0105	65	75	105	3	0	0.012	0.008
FSM0601-C3-1R-0135	95	105	135	3	0	0.012	0.008
FSM0601-C3-1R-0165	125	135	165	3	0	0.012	0.008

FSMC Miniature Ballscrews

Screw Dia.Ø8 Lead01

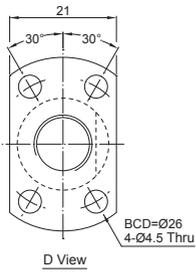
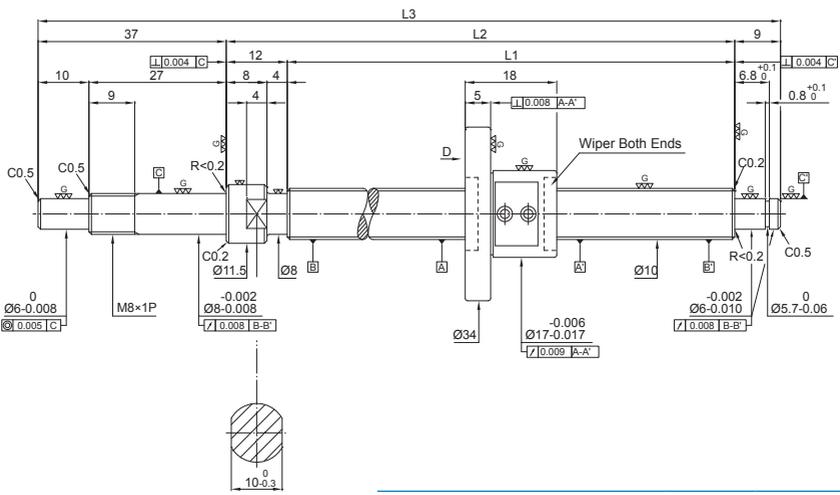


Specification of ball screw

Production Specification	With Preload	Without Preload
Number of Thread / Thread Direction	1/Right	
BCD	8.1	
Lead	1	
Ball Dia.	0.8	
Effective Turns (Circuit × Row)	2.5 × 1	
Lead Angle	2.25	
Dynamic Rate Load Ca (kgf)	66	
Static Rate Load Co (kgf)	140	
Axial Play	0	0.005 or less
Preloading Torque (kgf-cm)	0.01~0.2	0.05 or less

Unit: mm

Model No.	Screw Spindle (Shaft) Length			Accuracy Grade	Lead Accuracy		
	L1	L2	L3		Specified Travel (T)	Accumulated reference lead deviation E	Lead Deriation in random 300mm ϵ_{300}
FSM0801-C3-1R-0138	80	92	138	3	0	0.012	0.008
FSM0801-C3-1R-0168	110	122	168	3	0	0.012	0.008
FSM0801-C3-1R-0198	140	152	198	3	0	0.012	0.008
FSM0801-C3-1R-0248	190	202	248	3	0	0.012	0.008



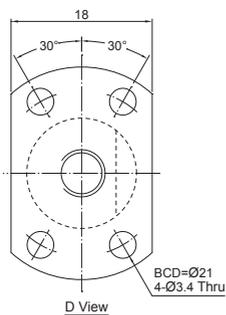
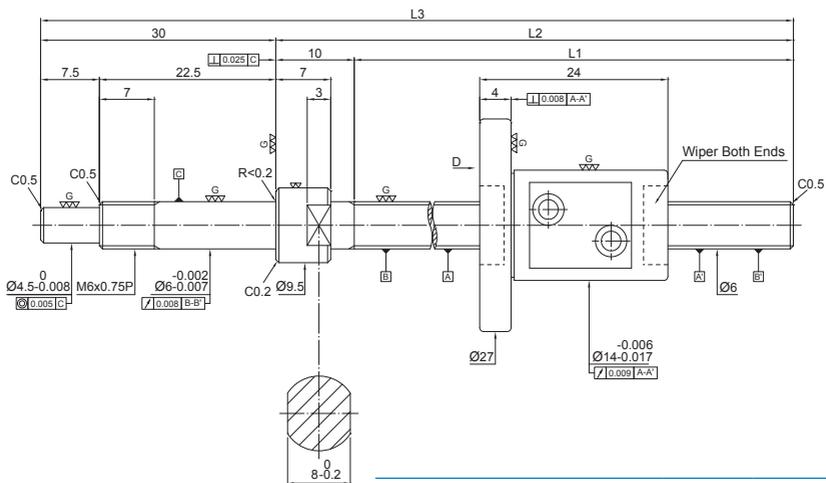
Specification of ball screw		
Production Specification	With Preload	Without Preload
Number of Thread / Thread Direction	1/Right	
BCD	10.1	
Lead	1	
Ball Dia.	0.8	
Effective Turns (Circuit \times Row)	2.5 \times 1	
Lead Angle	1.8	
Dynamic Rate Load Ca (kgf)	73	
Static Rate Load Co (kgf)	180	
Axial Play	0	0.005 or less
Preloading Torque (kgf-cm)	0.01 ~ 0.3	0.05 or less

Unit: mm

Model No.	Screw Spindle (Shaft) Length			Accuracy Grade	Lead Accuracy		
	L1	L2	L3		Specified Travel (T)	Accumulated reference lead deviation E	Lead Deriation in random 300mm ϵ_{300}
FSM1001-C3-1R-0168	110	122	168	3	0	0.012	0.008
FSM1001-C3-1R-0218	160	172	218	3	0	0.012	0.008
FSM1001-C3-1R-0268	210	222	268	3	0	0.012	0.008
FSM1001-C3-1R-0318	260	272	318	3	0	0.012	0.008
FSM1001-C3-1R-0368	310	322	368	3	0	0.013	0.008

FSMC

Miniature Ballscrews
Screw Dia. $\varnothing 6$ Lead 02



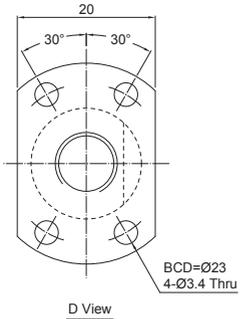
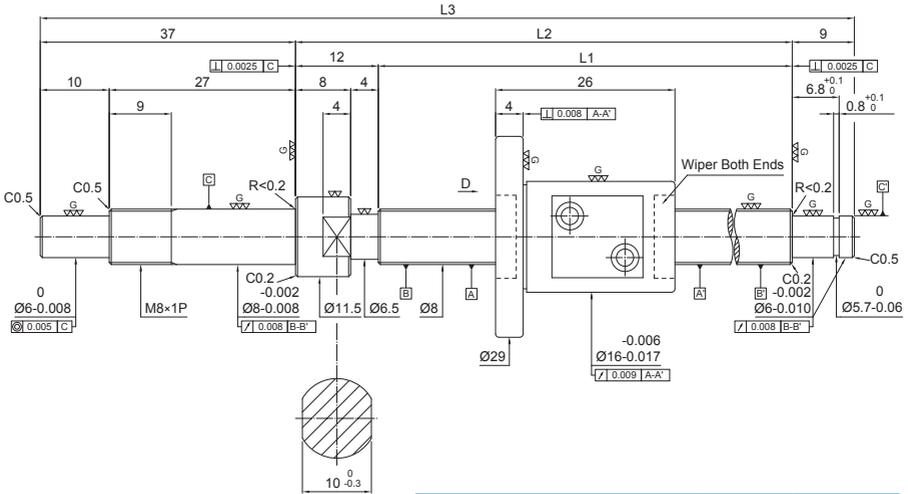
Specification of ball screw

Production Specification	With Preload	Without Preload
Number of Thread / Thread Direction	1/Right	
BCD	6.3	
Lead	2	
Ball Dia.	1.588	
Effective Turns (Circuit \times Row)	2.5 \times 1	
Lead Angle	5.77	
Dynamic Rate Load C_a (kgf)	160	
Static Rate Load C_o (kgf)	210	
Axial Play	0	0.005 or less
Preloading Torque (kgf-cm)	0.01~0.2	0.05 or less

Unit: mm

Model No.	Screw Spindle (Shaft) Length			Accuracy Grade	Lead Accuracy		
	L1	L2	L3		Specified Travel (T)	Accumulated reference lead deviation E	Lead Derivation in random 300mm e_{300}
FSM0602-C3-1R-0105	65	75	105	3	0	0.012	0.008
FSM0602-C3-1R-0135	95	105	135	3	0	0.012	0.008
FSM0602-C3-1R-0165	125	135	165	3	0	0.012	0.008

Miniature Ballscrews
Screw Dia. $\varnothing 08$ Lead 02 **FSMC**



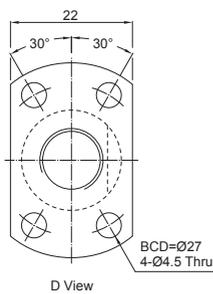
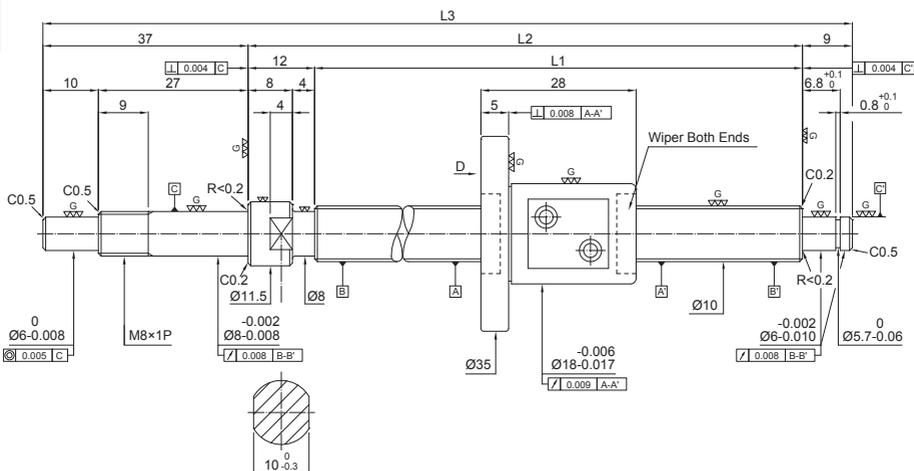
Specification of ball screw		
Production Specification	With Preload	Without Preload
Number of Thread / Thread Direction	1/Right	
BCD	8.3	
Lead	2	
Ball Dia.	1.588	
Effective Turns (Circuit \times Row)	2.5 \times 1	
Lead Angle	4.39	
Dynamic Rate Load Ca (kgf)	190	
Static Rate Load Co (kgf)	290	
Axial Play	0	0.005 or less
Preloading Torque (kgf-cm)	0.01~0.2	0.05 or less

Unit: mm

Model No.	Screw Spindle (Shaft) Length			Accuracy Grade	Lead Accuracy		
	L1	L2	L3		Specified Travel (T)	Accumulated reference lead deviation E	Lead Deriation in random 300mm e_{300}
FSM0802-C3-1R-0138	80	92	138	3	0	0.012	0.008
FSM0802-C3-1R-0168	110	122	168	3	0	0.012	0.008
FSM0802-C3-1R-0198	140	152	198	3	0	0.012	0.008
FSM0802-C3-1R-0248	190	202	248	3	0	0.012	0.008

FSMC Miniature Ballscrews

Screw Dia. $\varnothing 10$ Lead 02

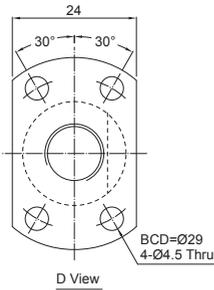
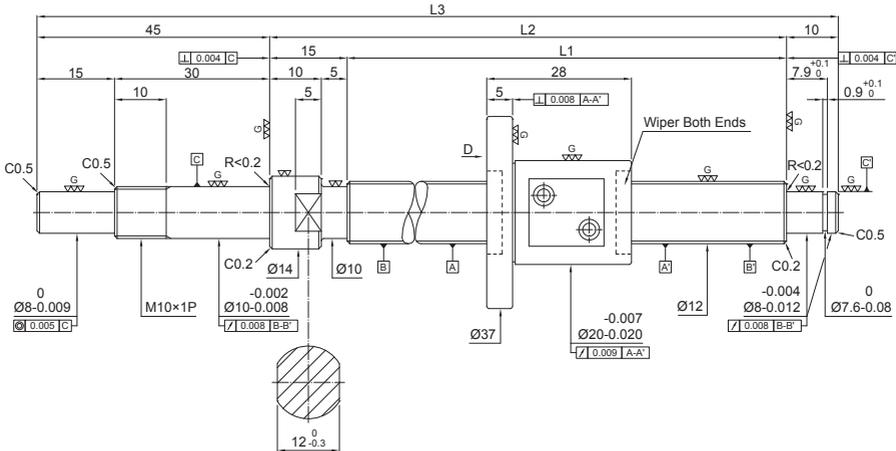


Specification of ball screw

Production Specification	With Preload	Without Preload
Number of Thread / Thread Direction	1/Right	
BCD	10.3	
Lead	2	
Ball Dia.	1.588	
Effective Turns (Circuit \times Row)	2.5 \times 1	
Lead Angle	3.54	
Dynamic Rate Load Ca (kgf)	220	
Static Rate Load Co (kgf)	370	
Axial Play	0	0.005 or less
Preloading Torque (kgf-cm)	0.01~0.3	0.05 or less

Unit: mm

Model No.	Screw Spindle (Shaft) Length			Accuracy Grade	Lead Accuracy		
	L1	L2	L3		Specified Travel (T)	Accumulated reference lead deviation E	Lead Derivation in random 300mm e_{300}
FSM1002-C3-1R-0168	110	122	168	3	0	0.012	0.008
FSM1002-C3-1R-0218	160	172	218	3	0	0.012	0.008
FSM1002-C3-1R-0268	210	222	268	3	0	0.012	0.008
FSM1002-C3-1R-0318	260	272	318	3	0	0.012	0.008
FSM1002-C3-1R-0368	310	322	368	3	0	0.012	0.008



Specification of ball screw

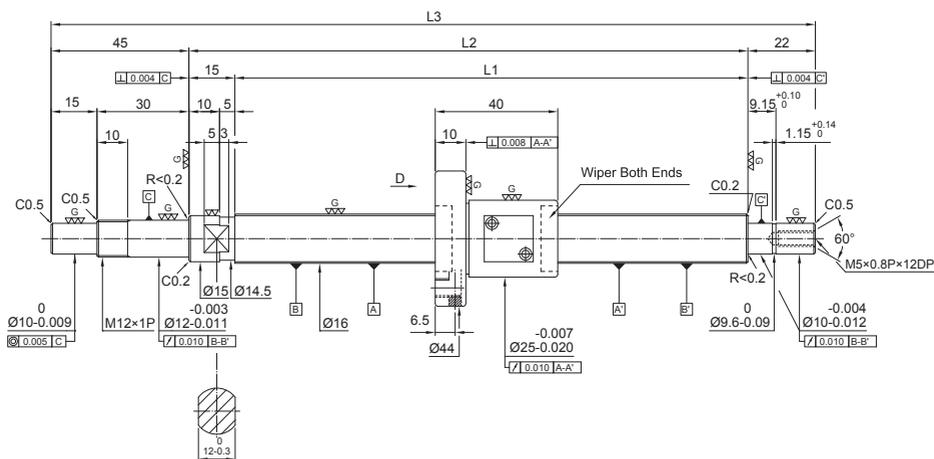
Production Specification	With Preload	Without Preload
Number of Thread / Thread Direction	1/Right	
BCD	12.3	
Lead	2	
Ball Dia.	1.588	
Effective Turns (Circuit × Row)	2.5 × 1	
Lead Angle	2.96	
Dynamic Rate Load Ca (kgf)	240	
Static Rate Load Co (kgf)	450	
Axial Play	0	0.005 or less
Preloading Torque (kgf-cm)	0.04~0.4	0.1 or less

Unit: mm

Model No.	Screw Spindle (Shaft) Length			Accuracy Grade	Lead Accuracy		
	L1	L2	L3		Specified Travel (T)	Accumulated reference lead deviation E	Lead Derivation in random 300mm e_{300}
FSM1202-C3-1R-0180	110	125	180	3	0	0.012	0.008
FSM1202-C3-1R-0230	160	175	230	3	0	0.012	0.008
FSM1202-C3-1R-0280	210	225	280	3	0	0.012	0.008
FSM1202-C3-1R-0330	260	275	330	3	0	0.012	0.008
FSM1202-C3-1R-0380	310	325	380	3	0	0.012	0.008

FSMC Miniature Ballscrews

Screw Dia. Ø16 Lead02



Specification of ball screw

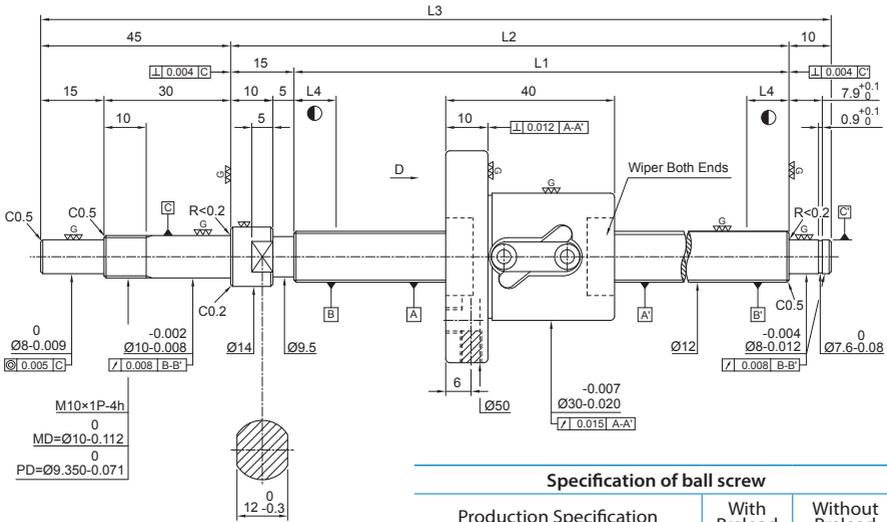
Production Specification	With Preload	Without Preload
Number of Thread / Thread Direction	1/Right	
BCD	16.3	
Lead	2	
Ball Dia.	1.588	
Effective Turns (Circuit x Row)	3.5 x 1	
Lead Angle	2.24	
Dynamic Rate Load Ca (kgf)	360	
Static Rate Load Co (kgf)	850	
Axial Play	0	0.005 or less
Preloading Torque (kgf-cm)	0.05~0.5	0.15 or less

Unit: mm

Model No.	Screw Spindle (Shaft) Length			Accuracy Grade	Lead Accuracy		
	L1	L2	L3		Specified Travel (T)	Accumulated reference lead deviation E	Lead Deriation in random 300mm e ₃₀₀
FSM1602-C3-1R-0221	139	154	221	3	0	0.012	0.008
FSM1602-C3-1R-0271	189	204	271	3	0	0.012	0.008
FSM1602-C3-1R-0321	239	254	321	3	0	0.012	0.008
FSM1602-C3-1R-0371	289	304	371	3	0	0.012	0.008
FSM1602-C3-1R-0471	389	404	471	3	0	0.013	0.008

13.9 Standard Type Series

Standard ballscrews
Screw Dia. $\varnothing 12$ Lead 05 **FSWC**

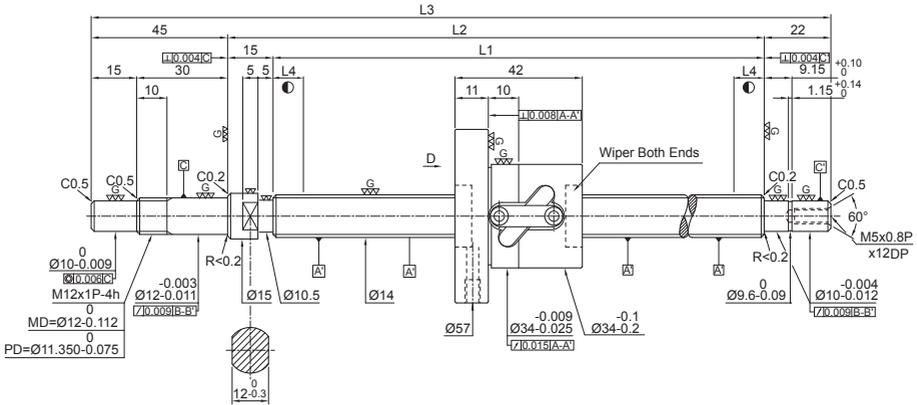


Specification of ball screw

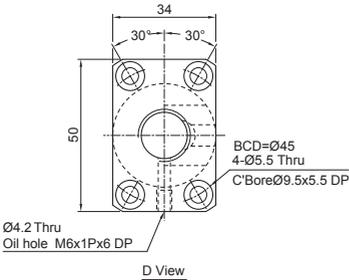
Production Specification	With Preload	Without Preload
Number of Thread / Thread Direction	1/Right	
BCD	12.4	
Lead	5	
Ball Dia.	2.381	
Effective Turns (Circuit × Row)	2.5 × 1	
Lead Angle	7.31	
Dynamic Rate Load Ca (kgf)	380	
Static Rate Load Co (kgf)	640	
Axial Play	0	0.005 or less
Preloading Torque (kgf-cm)	0.01~0.45	0.1 or less

Unit: mm

Model No.	Screw Spindle (Shaft) Length				Accuracy Grade	Lead Accuracy	
	L1	L2	L3	L4		Accumulated reference lead deviation E	Lead Deriation in random 300mm e_{300}
1R12-05B1-FSWC-110-180-0.008	110	125	180	10	3	0.012	0.008
1R12-05B1-FSWC-160-230-0.008	160	175	230	10	3	0.012	0.008
1R12-05B1-FSWC-210-280-0.008	210	225	280	10	3	0.012	0.008
1R12-05B1-FSWC-260-330-0.008	260	275	330	10	3	0.012	0.008
1R12-05B1-FSWC-310-380-0.008	310	325	380	10	3	0.012	0.008
1R12-05B1-FSWC-410-480-0.008	410	425	480	15	3	0.013	0.008
1R12-05B1-FSWC-510-580-0.008	510	525	580	15	3	0.015	0.008



Specification of ball screw		
Production Specification	With Preload	Without Preload
Number of Thread / Thread Direction	1/Right	
BCD	14.6	
Lead	5	
Ball Dia.	3.175	
Effective Turns (Circuit × Row)	2.5 × 1	
Lead Angle	6.22	
Dynamic Rate Load Ca (kgf)	675	
Static Rate Load Co (kgf)	1145	
Axial Play	0	0.005 or less
Preloading Torque (kgf-cm)	0.15~0.7	0.2 or less

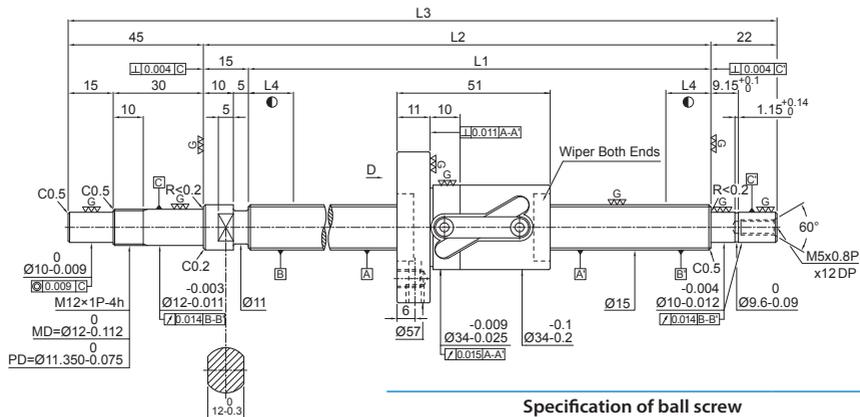


Unit: mm

Model No.	Screw Spindle (Shaft) Length				Accuracy Grade	Lead Accuracy	
	L1	L2	L3	L4		Accumulated reference lead deviation E	Lead Deriation in random 300mm e_{300}
1R14-05B1-F5WC-189-271-0.008	189	204	271	10	3	0.012	0.008
1R14-05B1-F5WC-239-321-0.008	239	254	321	10	3	0.012	0.008
1R14-05B1-F5WC-339-421-0.008	339	954	421	15	3	0.012	0.008
1R14-05B1-F5WC-439-521-0.008	439	454	521	15	3	0.012	0.008
1R14-05B1-F5WC-539-621-0.008	539	554	621	15	3	0.012	0.008
1R14-05B1-F5WC-689-771-0.008	689	704	771	15	3	0.013	0.008

FSWC

Standard ballscrews
Screw Dia. $\varnothing 15$ Lead 10

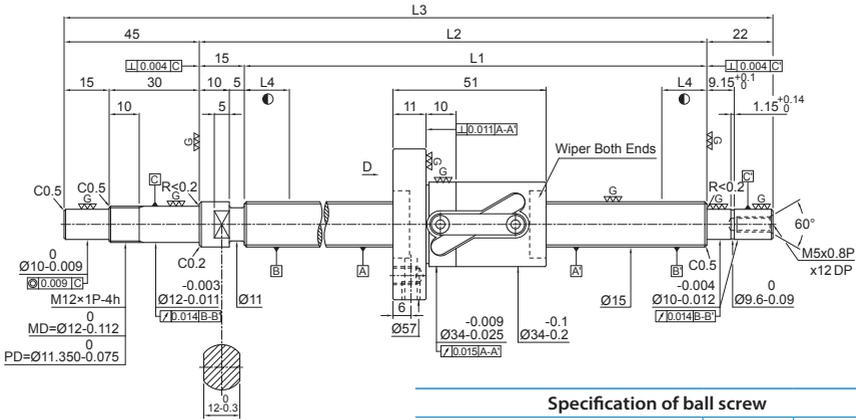


Specification of ball screw

Production Specification	With Preload	Without Preload
Number of Thread / Thread Direction	1/Right	
BCD	15.6	
Lead	10	
Ball Dia.	3.175	
Effective Turns (Circuit \times Row)	2.5 \times 1	
Lead Angle	11.53	
Dynamic Rate Load C_a (kgf)	680	
Static Rate Load C_o (kgf)	1210	
Axial Play	0	0.005 or less
Preloading Torque (kgf-cm)	0.1~0.79	0.24 or less

Unit: mm

Model No.	Screw Spindle (Shaft) Length				Accuracy Grade	Lead Accuracy	
	L1	L2	L3	L4		Accumulated reference lead deviation E	Lead Deriation in random 300mm e_{300}
1R15-10B1-FSWC-189-271-0.018	189	201	271	10	5	0.023	0.018
1R15-10B1-FSWC-239-321-0.018	239	254	321	10	5	0.023	0.018
1R15-10B1-FSWC-289-371-0.018	289	304	371	15	5	0.023	0.018
1R15-10B1-FSWC-339-421-0.018	339	354	421	15	5	0.023	0.018
1R15-10B1-FSWC-389-471-0.018	289	404	471	15	5	0.025	0.018
1R15-10B1-FSWC-439-521-0.018	439	454	521	15	5	0.025	0.018
1R15-10B1-FSWC-489-571-0.018	489	504	571	15	5	0.027	0.018



Specification of ball screw

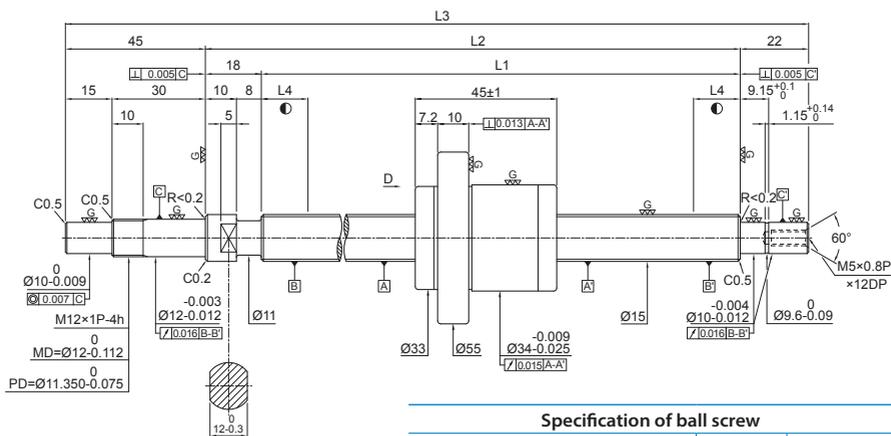
Production Specification	With Preload	Without Preload
Number of Thread / Thread Direction	1/Right	
BCD	15.6	
Lead	10	
Ball Dia.	3.175	
Effective Turns (Circuit \times Row)	2.5 \times 1	
Lead Angle	11.53	
Dynamic Rate Load Ca (kgf)	680	
Static Rate Load Co (kgf)	1210	
Axial Play	0	0.005 or less
Preloading Torque (kgf-cm)	0.1~0.79	0.24 or less

Unit: mm

Model No.	Screw Spindle (Shaft) Length				Accuracy Grade	Lead Accuracy	
	L1	L2	L3	L4		Accumulated reference lead deviation E	Lead Deriation in random 300mm e_{300}
1R15-10B1-FSWC-539-621-0.018	539	554	621	15	5	0.027	0.018
1R15-10B1-FSWC-589-671-0.018	589	604	671	15	5	0.030	0.018
1R15-10B1-FSWC-639-721-0.018	639	654	721	15	5	0.030	0.018
1R15-10B1-FSWC-689-771-0.018	689	704	771	15	5	0.035	0.018
1R15-10B1-FSWC-789-871-0.018	789	804	871	15	5	0.035	0.018
1R15-10B1-FSWC-889-971-0.018	889	904	971	15	5	0.040	0.018
1R15-10B1-FSWC-1089-1171-0.018	1089	1104	1171	15	5	0.046	0.018

FSKC Standard ballscrews

Screw Dia.Ø15 Lead20

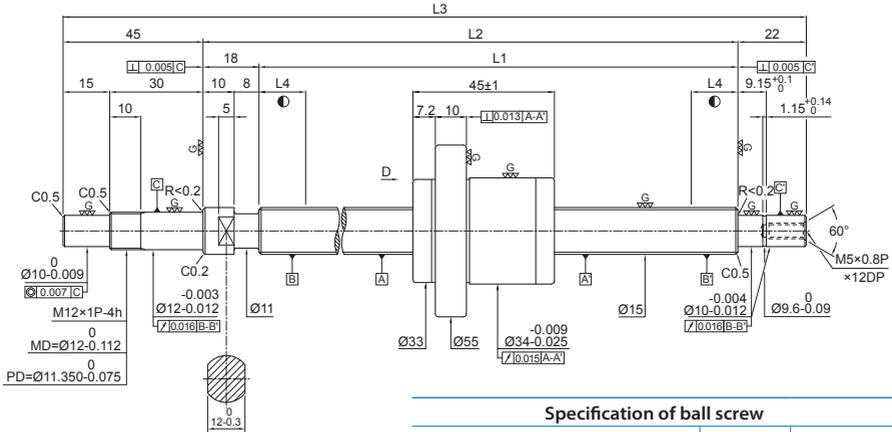


Specification of ball screw

Production Specification	With Preload	Without Preload
Number of Thread / Thread Direction	1/Right	
BCD	15.6	
Lead	20	
Ball Dia.	3.175	
Effective Turns (Circuit × Row)	1.8 × 1	
Lead Angle	22.2	
Dynamic Rate Load Ca (kgf)	780	
Static Rate Load Co (kgf)	1400	
Axial Play	0	0.005 or less
Preloading Torque (kgf-cm)	0.15~0.8	0.24 or less

Unit: mm

Model No.	Screw Spindle (Shaft) Length				Accuracy Grade	Lead Accuracy	
	L1	L2	L3	L4		Accumulated reference lead deviation E	Lead Deriation in random 300mm e_{300}
1R15-20A1-FSKC-186-271-0.018	186	204	271	10	5	0.023	0.018
1R15-20A1-FSKC-236-321-0.018	236	254	321	10	5	0.023	0.018
1R15-20A1-FSKC-286-371-0.018	286	304	371	15	5	0.023	0.018
1R15-20A1-FSKC-336-421-0.018	336	354	421	15	5	0.023	0.018
1R15-20A1-FSKC-386-471-0.018	386	404	471	15	5	0.025	0.018
1R15-20A1-FSKC-436-521-0.018	436	454	521	15	5	0.025	0.018
1R15-20A1-FSKC-486-571-0.018	486	504	571	15	5	0.027	0.018



Specification of ball screw

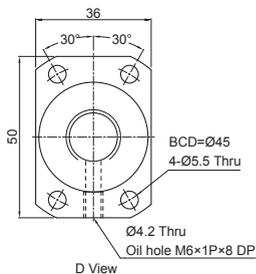
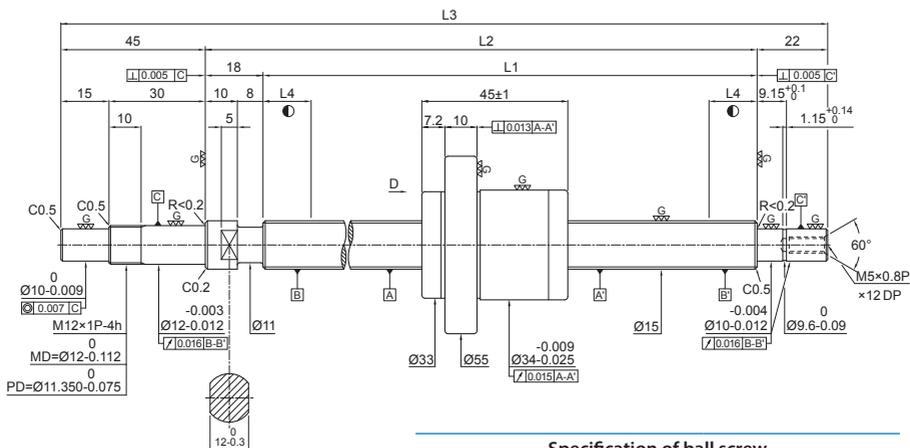
Production Specification	With Preload	Without Preload
Number of Thread / Thread Direction	1/Right	
BCD	15.6	
Lead	20	
Ball Dia.	3.175	
Effective Turns (Circuit × Row)	1.8 × 1	
Lead Angle	22.2	
Dynamic Rate Load Ca (kgf)	780	
Static Rate Load Co (kgf)	1400	
Axial Play	0	0.005 or less
Preloading Torque (kgf-cm)	0.15~0.8	0.24 or less

Unit: mm

Model No.	Screw Spindle (Shaft) Length				Accuracy Grade	Lead Accuracy	
	L1	L2	L3	L4		Accumulated reference lead deviation E	Lead Derivation in random 300mm e_{300}
1R15-20A1-FSKC-536-621-0.018	536	554	621	15	5	0.027	0.018
1R15-20A1-FSKC-586-671-0.018	586	604	671	15	5	0.030	0.018
1R15-20A1-FSKC-636-721-0.018	636	654	721	15	5	0.030	0.018
1R15-20A1-FSKC-686-771-0.018	686	704	771	15	5	0.030	0.018
1R15-20A1-FSKC-786-871-0.018	786	804	871	15	5	0.035	0.018
1R15-20A1-FSKC-886-971-0.018	889	904	971	15	5	0.040	0.018
1R15-20A1-FSKC-1086-1171-0.018	1089	1104	1171	15	5	0.046	0.018

FSKC

Standard ballscrews
Screw Dia. $\varnothing 15$ Lead 20

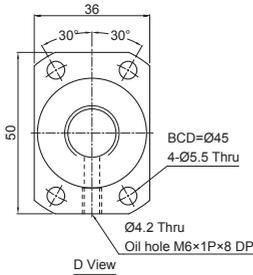
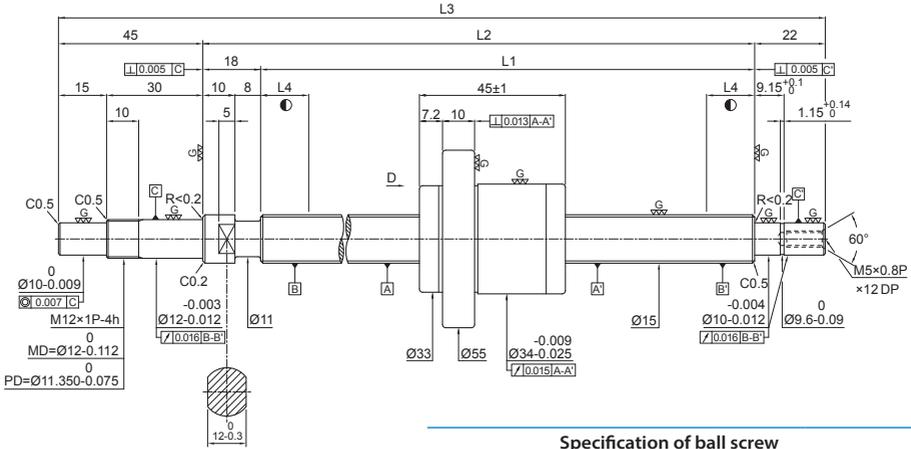


Specification of ball screw

Production Specification	With Preload	Without Preload
Number of Thread / Thread Direction	2/Right	
BCD	15.6	
Lead	20	
Ball Dia.	3.175	
Effective Turns (Circuit \times Row)	1.8 \times 2	
Lead Angle	22.2	
Dynamic Rate Load C_a (kgf)	1400	
Static Rate Load C_o (kgf)	2800	
Axial Play	0	0.005 or less
Preloading Torque (kgf-cm)	0.2~0.9	-

Unit: mm

Model No.	Screw Spindle (Shaft) Length				Accuracy Grade	Lead Accuracy	
	L1	L2	L3	L4		Accumulated reference lead deviation E	Lead Derivation in random 300mm e_{300}
2R15-20A1-FSKC-236-321-0.018	236	254	321	10	5	0.023	0.018
2R15-20A1-FSKC-286-371-0.018	286	304	371	10	5	0.023	0.018
2R15-20A1-FSKC-336-421-0.018	336	354	421	15	5	0.023	0.018
2R15-20A1-FSKC-386-471-0.018	386	404	471	15	5	0.025	0.018
2R15-20A1-FSKC-436-521-0.018	436	454	521	15	5	0.025	0.018
2R15-20A1-FSKC-486-571-0.018	486	504	571	15	5	0.027	0.018



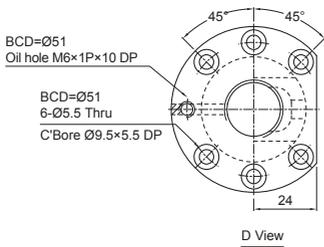
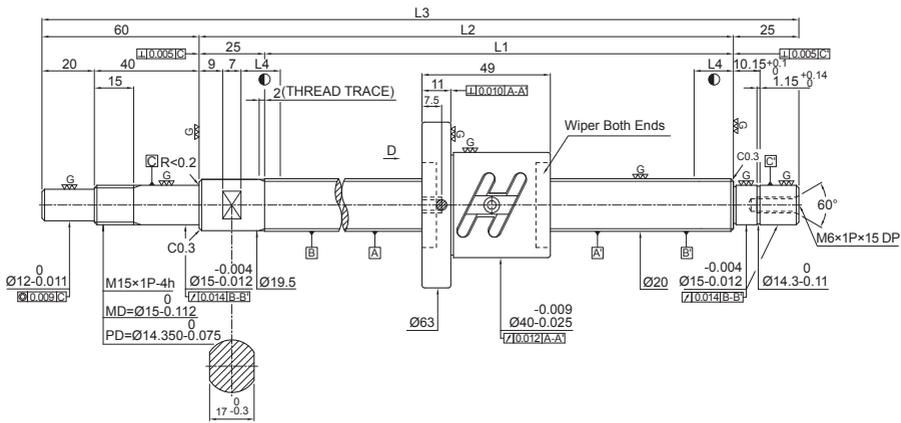
Specification of ball screw

Production Specification	With Preload	Without Preload
Number of Thread / Thread Direction	2/Right	
BCD	15.6	
Lead	20	
Ball Dia.	3.175	
Effective Turns (Circuit × Row)	1.8 × 2	
Lead Angle	22.2	
Dynamic Rate Load Ca (kgf)	1400	
Static Rate Load Co (kgf)	2800	
Axial Play	0	0.005 or less
Preloading Torque (kgf-cm)	0.2~0.9	-

Unit: mm

Model No.	Screw Spindle (Shaft) Length				Accuracy Grade	Lead Accuracy	
	L1	L2	L3	L4		Accumulated reference lead deviation E	Lead Derivation in random 300mm e_{300}
2R15-20A1-FSKC-536-621-0.018	536	554	621	15	5	0.027	0.018
2R15-20A1-FSKC-586-671-0.018	586	604	671	15	5	0.030	0.018
2R15-20A1-FSKC-636-721-0.018	636	654	721	15	5	0.030	0.018
2R15-20A1-FSKC-686-771-0.018	686	704	771	15	5	0.030	0.018
2R15-20A1-FSKC-786-871-0.018	786	804	871	15	5	0.035	0.018
2R15-20A1-FSKC-886-971-0.018	886	904	971	15	5	0.040	0.018

Standard ballscrews
Screw Dia. $\varnothing 20$ Lead 04 **FSWC**



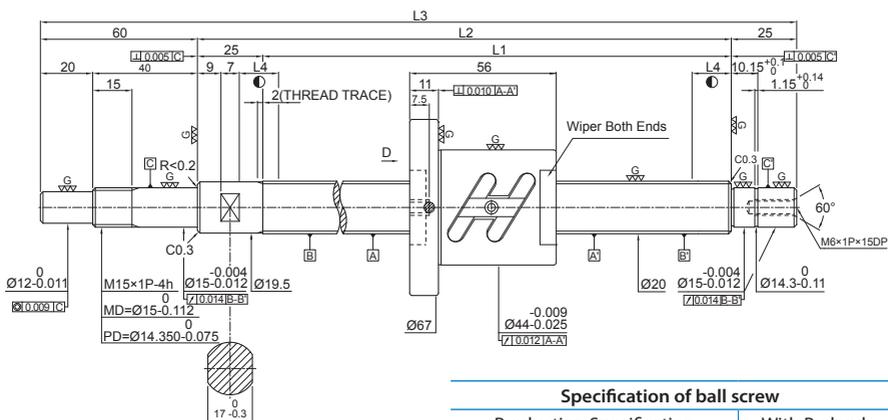
Specification of ball screw	
Production Specification	With Preload
Number of Thread / Thread Direction	1/Right
BCD	20.4
Lead	4
Ball Dia.	2.381
Effective Turns (Circuit x Row)	2.5 x 2
Lead Angle	3.57
Dynamic Rate Load Ca (kgf)	820
Static Rate Load Co (kgf)	2110
Axial Play	0
Preloading Torque (kgf-cm)	0.12~0.68

Unit: mm

Model No.	Screw Spindle (Shaft) Length				Accuracy Grade	Lead Accuracy	
	L1	L2	L3	L4		Accumulated reference lead deviation E	Lead Derivation in random 300mm e_{300}
1R20-04B2-FSWC-225-335-0.018	225	250	335	10	5	0.023	0.018
1R20-04B2-FSWC-275-385-0.018	275	300	385	10	5	0.023	0.018
1R20-04B2-FSWC-375-485-0.018	375	400	485	15	5	0.025	0.018
1R20-04B2-FSWC-475-585-0.018	475	500	585	15	5	0.027	0.018
1R20-04B2-FSWC-575-685-0.018	575	600	685	15	5	0.030	0.018
1R20-04B2-FSWC-675-785-0.018	675	700	785	15	5	0.035	0.018

FSWC Standard ballscrews

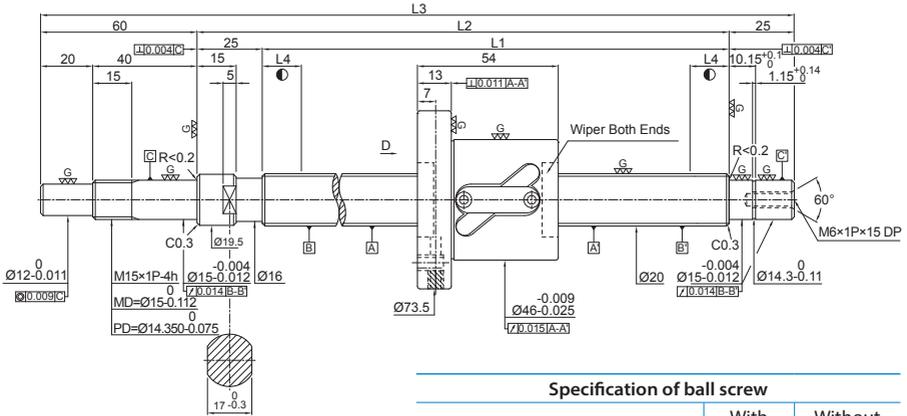
Screw Dia. Ø20 Lead05



Specification of ball screw	
Production Specification	With Preload
Number of Thread / Thread Direction	1/Right
BCD	20.6
Lead	5
Ball Dia.	3.175
Effective Turns (Circuit × Row)	2.5 × 2
Lead Angle	4.42
Dynamic Rate Load Ca (kgf)	1510
Static Rate Load Co (kgf)	3460
Axial Play	0
Preloading Torque (kgf-cm)	0.28~1.32

Unit: mm

Model No.	Screw Spindle (Shaft) Length				Accuracy Grade	Lead Accuracy	
	L1	L2	L3	L4		Accumulated reference lead deviation E	Lead Deriation in random 300mm E ₃₀₀
1R20-05B2-FSWC-225-335-0.018	225	250	335	10	5	0.023	0.018
1R20-05B2-FSWC-275-385-0.018	275	300	385	10	5	0.023	0.018
1R20-05B2-FSWC-375-485-0.018	375	400	485	15	5	0.025	0.018
1R20-05B2-FSWC-475-585-0.018	475	500	585	15	5	0.027	0.018
1R20-05B2-FSWC-575-685-0.018	575	600	685	15	5	0.030	0.018
1R20-05B2-FSWC-775-885-0.018	775	800	885	10	5	0.035	0.018



Specification of ball screw

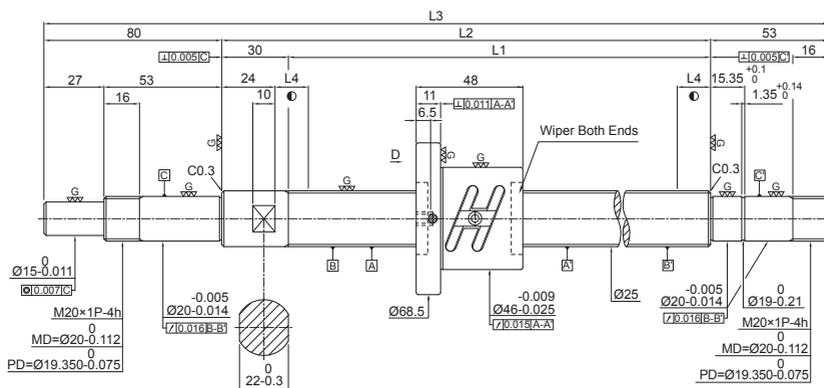
Production Specification	With Preload	Without Preload
Number of Thread / Thread Direction	1/Right	
BCD	20.7	
Lead	10	
Ball Dia.	3.969	
Effective Turns (Circuit × Row)	2.5 × 1	
Lead Angle	8.74	
Dynamic Rate Load Ca (kgf)	1100	
Static Rate Load Co (kgf)	2120	
Axial Play	0	0.005 or less
Preloading Torque (kgf-cm)	0.36~1.44	0.3or less

Unit: mm

Model No.	Screw Spindle (Shaft) Length				Accuracy Grade	Lead Accuracy	
	L1	L2	L3	L4		Accumulated reference lead deviation E	Lead Derivation in random 300mm ϵ_{300}
1R20-10B1-FSWC-289-399-0.018	289	314	399	10	5	0.023	0.018
1R20-10B1-FSWC-389-499-0.018	389	414	499	10	5	0.025	0.018
1R20-10B1-FSWC-489-599-0.018	489	514	599	15	5	0.027	0.018
1R20-10B1-FSWC-589-699-0.018	589	614	699	15	5	0.030	0.018
1R20-10B1-FSWC-689-799-0.018	689	714	799	15	5	0.035	0.018
1R20-10B1-FSWC-789-899-0.018	789	814	899	15	5	0.035	0.018
1R20-10B1-FSWC-889-999-0.018	889	914	999	15	5	0.040	0.018
1R20-10B1-FSWC-989-1099-0.018	989	1014	1099	15	5	0.040	0.018
1R20-10B1-FSWC-1089-1199-0.018	1089	1114	1199	15	5	0.046	0.018
1R20-10B1-FSWC-1189-1299-0.018	1189	1214	1299	15	5	0.046	0.018
1R20-10B1-FSWC-1289-1399-0.018	1289	1314	1399	15	5	0.046	0.018

FSWC

Standard ballscrews
Screw Dia. $\varnothing 25$ Lead 04

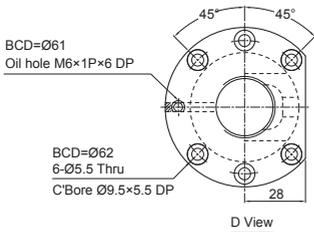
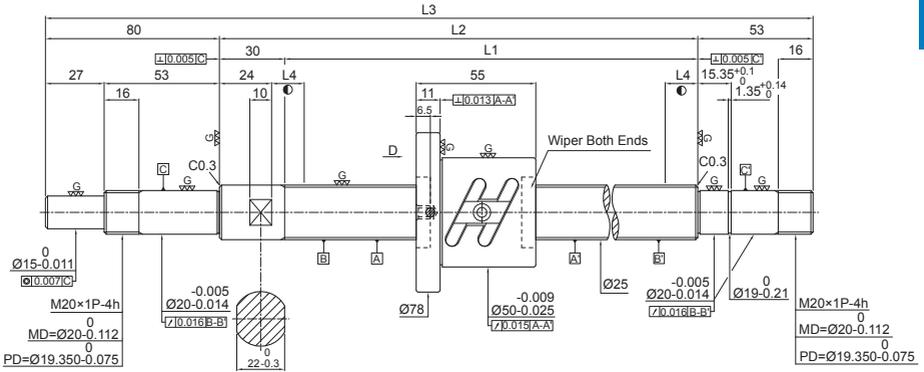


Specification of ball screw

Production Specification	With Preload
Number of Thread / Thread Direction	1/Right
BCD	25.4
Lead	4
Ball Dia.	2.381
Effective Turns (Circuit \times Row)	2.5 \times 2
Lead Angle	2.87
Dynamic Rate Load C_d (kgf)	930
Static Rate Load C_0 (kgf)	2710
Axial Play	0
Preloading Torque (kgf-cm)	0.15~0.85

Unit: mm

Model No.	Screw Spindle (Shaft) Length				Accuracy Grade	Lead Accuracy	
	L1	L2	L3	L4		Accumulated reference lead deviation E	Lead Deriation in random 300mm e_{300}
1R25-04B2-FSWC-220-383-0.018	220	250	383	10	5	0.023	0.018
1R25-04B2-FSWC-270-433-0.018	270	300	433	10	5	0.023	0.018
1R25-04B2-FSWC-370-533-0.018	370	400	533	15	5	0.025	0.018
1R25-04B2-FSWC-470-633-0.018	470	500	633	15	5	0.027	0.018
1R25-04B2-FSWC-570-733-0.018	570	600	733	15	5	0.030	0.018
1R25-04B2-FSWC-770-933-0.018	770	800	933	10	5	0.035	0.018



Specification of ball screw

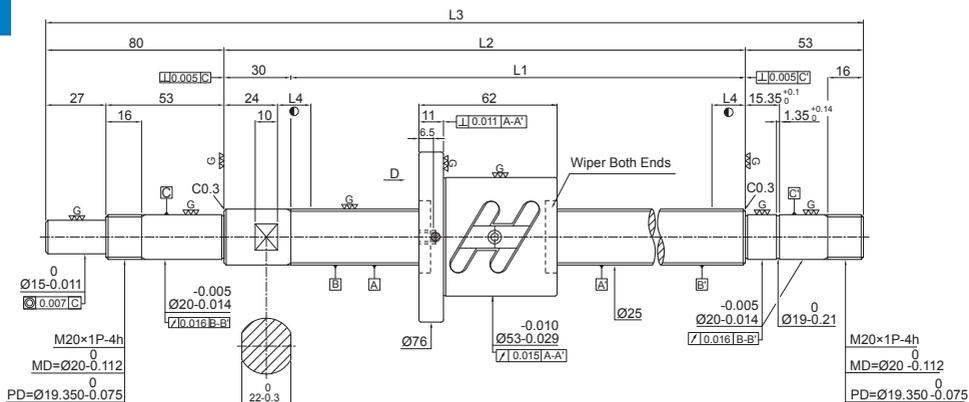
Production Specification	With Preload	Without Preload
Number of Thread / Thread Direction	1/Right	
BCD	25.7	
Lead	5	
Ball Dia.	3.969	
Effective Turns (Circuit × Row)	2.5 × 2	
Lead Angle	3.54	
Dynamic Rate Load Ca (kgf)	1100	
Static Rate Load Co (kgf)	2120	
Axial Play	0	0.005 or less
Preloading Torque (kgf-cm)	0.36~1.44	0.3 or less

Unit: mm

Model No.	Screw Spindle (Shaft) Length				Accuracy Grade	Lead Accuracy	
	L1	L2	L3	L4		Accumulated reference lead deviation E	Lead Deriation in random 300mm E_{300}
1R25-05B2-F5WC-220-383-0.018	220	250	383	10	5	0.023	0.018
1R25-05B2-F5WC-270-433-0.018	270	300	433	10	5	0.023	0.018
1R25-05B2-F5WC-370-533-0.018	370	400	533	15	5	0.025	0.018
1R25-05B2-F5WC-470-633-0.018	470	500	633	15	5	0.027	0.018
1R25-05B2-F5WC-570-733-0.018	570	600	733	15	5	0.030	0.018
1R25-05B2-F5WC-670-833-0.018	670	700	833	15	5	0.030	0.018
1R25-05B2-F5WC-770-933-0.018	770	800	933	15	5	0.035	0.018
1R25-05B2-F5WC-970-1133-0.018	970	1000	1133	15	5	0.040	0.018
1R25-05B2-F5WC-1170-1333-0.018	1170	1200	1333	15	5	0.046	0.018

FSWC

Standard ballscrews
Screw Dia. $\varnothing 25$ Lead 06

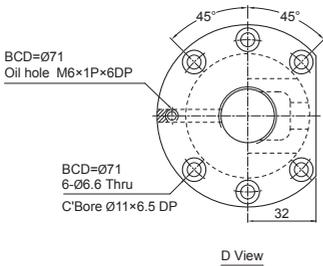
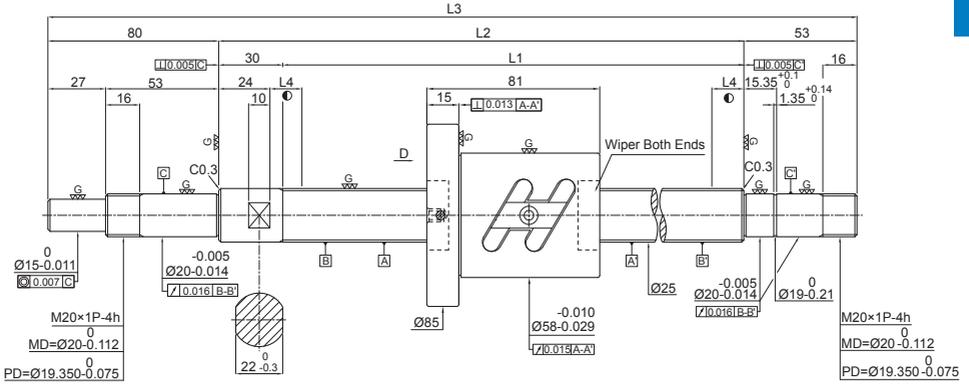


Specification of ball screw

Production Specification	With Preload
Number of Thread / Thread Direction	1/Right
BCD	25.7
Lead	6
Ball Dia.	3.969
Effective Turns (Circuit \times Row)	2.5 \times 2
Lead Angle	4.25
Dynamic Rate Load C_d (kgf)	2190
Static Rate Load C_0 (kgf)	5360
Axial Play	0
Preloading Torque (kgf-cm)	0.42~2.4

Unit: mm

Model No.	Screw Spindle (Shaft) Length				Accuracy Grade	Lead Accuracy	
	L1	L2	L3	L4		Accumulated reference lead deviation E	Lead Deriation in random 300mm e_{300}
1R25-06B2-FSWC-370-533-0.018	370	400	533	15	5	0.025	0.018
1R25-06B2-FSWC-570-733-0.018	570	600	733	15	5	0.030	0.018
1R25-06B2-FSWC-770-933-0.018	770	800	933	15	5	0.035	0.018
1R25-06B2-FSWC-1170-1333-0.018	1170	1200	1333	15	5	0.046	0.018



Specification of ball screw

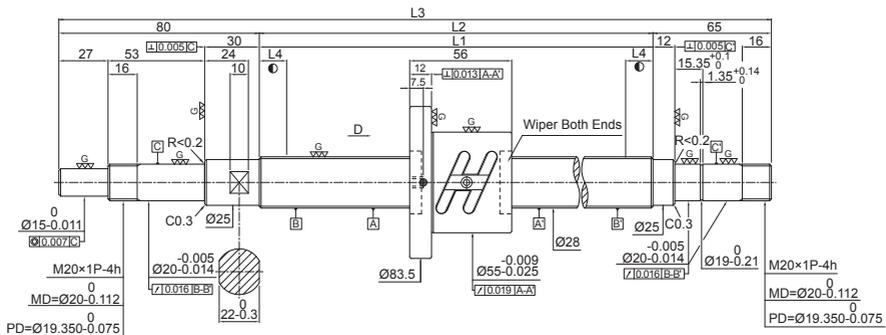
Production Specification	With Preload
Number of Thread / Thread Direction	1/Right
BCD	26
Lead	10
Ball Dia.	4.762
Effective Turns (Circuit × Row)	1.5 × 2
Lead Angle	6.98
Dynamic Rate Load Ca (kgf)	1820
Static Rate Load Co (kgf)	3840
Axial Play	0
Preloading Torque (kgf-cm)	0.42~2.4

Unit: mm

Model No.	Screw Spindle (Shaft) Length				Accuracy Grade	Lead Accuracy	
	L1	L2	L3	L4		Accumulated reference lead deviation E	Lead Derivation in random 300mm e_{300}
1R25-10A2-FSWC-370-533-0.018	370	400	533	10	5	0.025	0.018
1R25-10A2-FSWC-570-733-0.018	570	600	733	10	5	0.030	0.018
1R25-10A2-FSWC-770-933-0.018	770	800	933	15	5	0.035	0.018
1R25-10A2-FSWC-970-1133-0.018	970	1000	1133	15	5	0.040	0.018
1R25-10A2-FSWC-1170-1333-0.018	1170	1200	1333	15	5	0.046	0.018
1R25-10A2-FSWC-1470-1600-0.018	1470	1500	1633	15	5	0.054	0.018

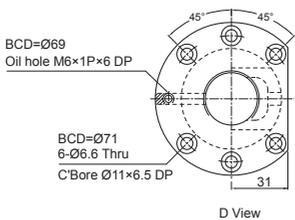
FSWC Standard ballscrews

Screw Dia.Ø28 Lead05



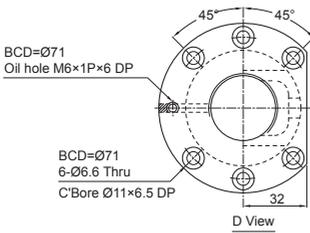
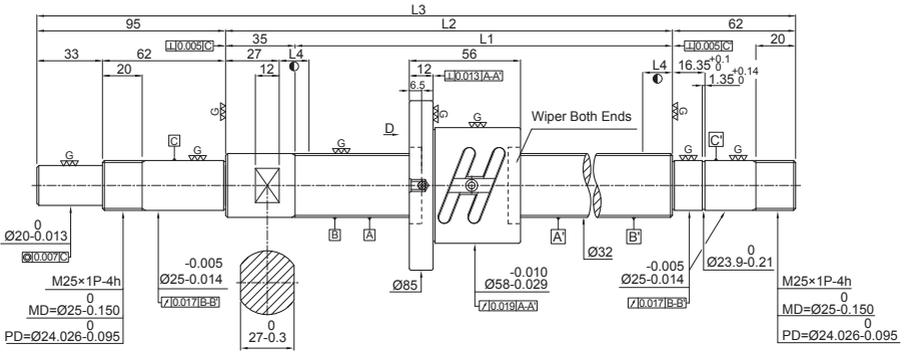
Specification of ball screw

Production Specification	With Preload
Number of Thread /Thread Direction	1/Right
BCD	28.6
Lead	5
Ball Dia.	3.175
Effective Turns (Circuit × Row)	2.5 × 2
Lead Angle	3.19
Dynamic Rate Load Ca (kgf)	1720
Static Rate Load Co (kgf)	4940
Axial Play	0
Preloading Torque (kgf-cm)	0.3~1.7



Unit: mm

Model No.	Screw Spindle (Shaft) Length				Accuracy Grade	Lead Accuracy	
	L1	L2	L3	L4		Accumulated reference lead deviation E	Lead Deriation in random 300mm e_{300}
1R28-05B2-FSWC-270-445-0.018	270	300	445	10	5	0.023	0.018
1R28-05B2-FSWC-370-545-0.018	370	400	545	15	5	0.023	0.018
1R28-05B2-FSWC-470-645-0.018	470	500	645	15	5	0.023	0.018
1R28-05B2-FSWC-558-733-0.018	558	588	733	15	5	0.023	0.018
1R28-05B2-FSWC-758-933-0.018	758	788	933	15	5	0.025	0.018
1R28-05B2-FSWC-958-1133-0.018	958	988	1133	15	5	0.025	0.018
1R28-05B2-FSWC-1158-1333-0.018	1158	1188	1333	15	5	0.027	0.018



Specification of ball screw

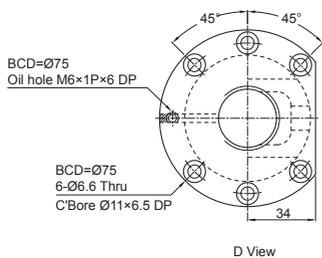
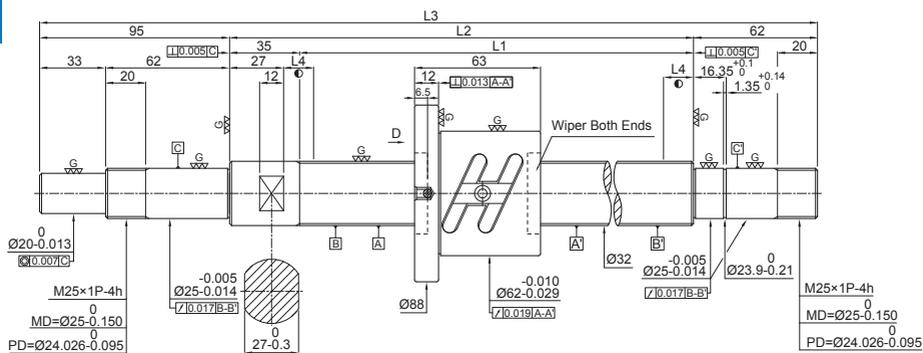
Production Specification	With Preload
Number of Thread / Thread Direction	1/Right
BCD	32.6
Lead	5
Ball Dia.	3.175
Effective Turns (Circuit x Row)	2.5 x 2
Lead Angle	2.79
Dynamic Rate Load Ca (kgf)	1830
Static Rate Load Co (kgf)	5680
Axial Play	0
Preloading Torque (kgf-cm)	0.48~1.92

Unit: mm

Model No.	Screw Spindle (Shaft) Length				Accuracy Grade	Lead Accuracy	
	L1	L2	L3	L4		Accumulated reference lead deviation E	Lead Deriation in random 300mm e_{300}
1R32-05B2-FSWC-265-457-0.018	265	300	457	10	5	0.023	0.018
1R32-05B2-FSWC-365-557-0.018	365	400	557	15	5	0.025	0.018
1R32-05B2-FSWC-465-657-0.018	465	500	657	15	5	0.027	0.018
1R32-05B2-FSWC-565-757-0.018	565	600	757	15	5	0.030	0.018
1R32-05B2-FSWC-665-857-0.018	665	700	857	15	5	0.030	0.018
1R32-05B2-FSWC-765-957-0.018	765	800	957	15	5	0.035	0.018
1R32-05B2-FSWC-965-1157-0.018	965	1000	1157	15	5	0.040	0.018
1R32-05B2-FSWC-1165-1357-0.018	1165	1200	1357	15	5	0.046	0.018
1R32-05B2-FSWC-1465-1657-0.018	1465	1500	1657	15	5	0.054	0.018

FSWC

Standard ballscrews
Screw Dia. Ø32 Lead06

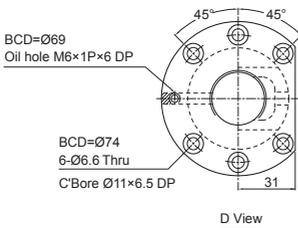
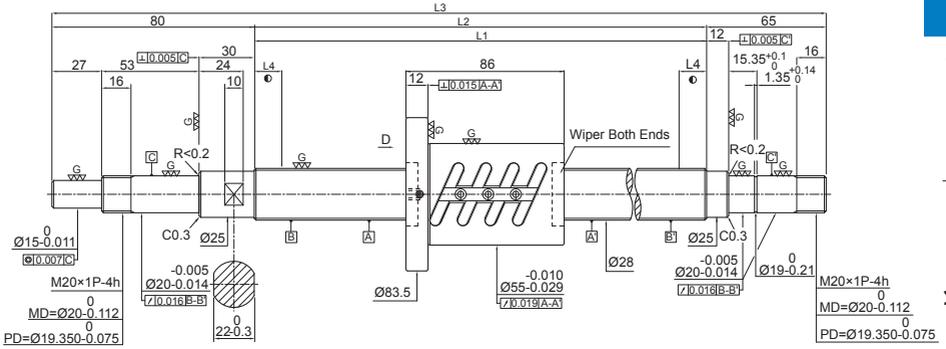


Specification of ball screw

Production Specification	With Preload
Number of Thread / Thread Direction	1/Right
BCD	32.7
Lead	6
Ball Dia.	3.969
Effective Turns (Circuit × Row)	2.5 × 2
Lead Angle	3.34
Dynamic Rate Load Ca (kgf)	2410
Static Rate Load Co (kgf)	6900
Axial Play	0
Preloading Torque (kgf-cm)	0.48~2.72

Unit: mm

Model No.	Screw Spindle (Shaft) Length				Accuracy Grade	Lead Accuracy	
	L1	L2	L3	L4		Accumulated reference lead deviation E	Lead Deriation in random 300mm e_{300}
1R32-06B2-FSWC-365-557-0.018	365	400	557	15	5	0.025	0.018
1R32-06B2-FSWC-565-757-0.018	565	600	757	15	5	0.030	0.018
1R32-06B2-FSWC-765-957-0.018	765	800	957	15	5	0.035	0.018
1R32-06B2-FSWC-965-1157-0.018	965	1000	1157	15	5	0.040	0.018
1R32-06B2-FSWC-1165-1357-0.018	1165	1200	1357	15	5	0.046	0.018
1R32-06B2-FSWC-1465-1657-0.018	1465	1500	1657	15	5	0.054	0.018



Specification of ball screw

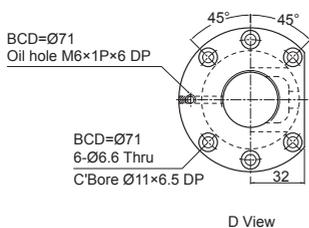
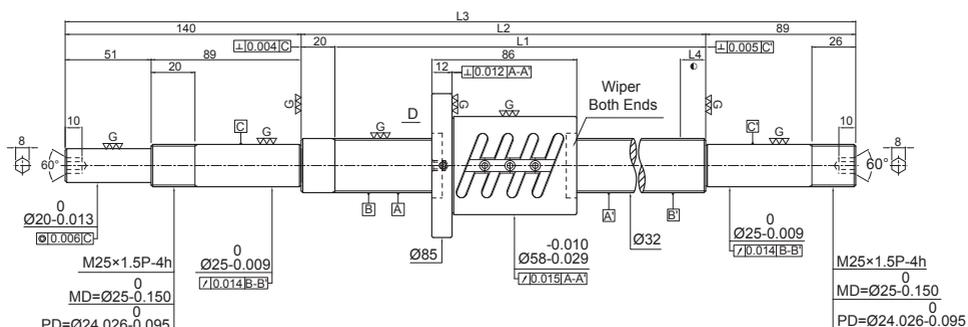
Production Specification	With Preload
Number of Thread / Thread Direction	1/Right
BCD	28.6
Lead	5
Ball Dia.	3.175
Effective Turns (Circuit × Row)	2.5 × 2(2)
Lead Angle	3.19
Dynamic Rate Load Ca (kgf)	1720
Static Rate Load Co (kgf)	4940
Axial Play	0
Preloading Torque (kgf-cm)	1.1~3.3

Unit: mm

Model No.	Screw Spindle (Shaft) Length				Accuracy Grade	Lead Accuracy	
	L1	L2	L3	L4		Accumulated reference lead deviation E	Lead Deriation in random 300mm e_{300}
1R28-05B1-FOWC-270-445-0.018	270	312	445	10	5	0.023	0.018
1R28-05B1-FOWC-370-545-0.018	370	412	545	15	5	0.025	0.018
1R28-05B1-FOWC-470-645-0.018	470	512	645	15	5	0.027	0.018
1R28-05B1-FOWC-558-733-0.018	558	600	733	15	5	0.030	0.018
1R28-05B1-FOWC-758-933-0.018	758	800	933	15	5	0.035	0.018
1R28-05B1-FOWC-958-1133-0.018	958	1000	1133	15	5	0.040	0.018
1R28-05B1-FOWC-1158-1333-0.018	1158	1200	1333	15	5	0.046	0.018

FOWC

Standard ballscrews
Screw Dia. $\varnothing 32$ Lead 05

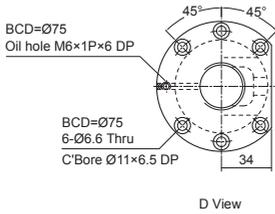
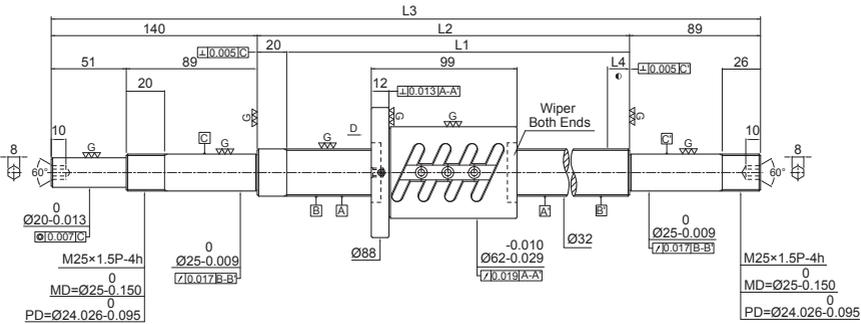


Specification of ball screw

Production Specification	With Preload
Number of Thread / Thread Direction	1/Right
BCD	32.6
Lead	5
Ball Dia.	3.175
Effective Turns (Circuit \times Row)	2.5 \times 2(2)
Lead Angle	2.79
Dynamic Rate Load C_a (kgf)	1830
Static Rate Load C_o (kgf)	5680
Axial Play	0
Preloading Torque (kgf-cm)	1.2~3.6

Unit: mm

Model No.	Screw Spindle (Shaft) Length				Accuracy Grade	Lead Accuracy	
	L1	L2	L3	L4		Accumulated reference lead deviation E	Lead Derivation in random 300mm e_{300}
1R32-05B1-FOWC-280-529-0.018	280	300	529	10	5	0.023	0.018
1R32-05B1-FOWC-380-629-0.018	380	400	629	15	5	0.025	0.018
1R32-05B1-FOWC-480-729-0.018	480	500	729	15	5	0.027	0.018
1R32-05B1-FOWC-580-829-0.018	580	600	829	15	5	0.030	0.018
1R32-05B1-FOWC-680-929-0.018	680	700	929	15	5	0.035	0.018
1R32-05B1-FOWC-780-1029-0.018	780	800	1029	15	5	0.035	0.018
1R32-05B1-FOWC-980-1229-0.018	980	1000	1229	15	5	0.040	0.018
1R32-05B1-FOWC-1180-1429-0.018	1180	1200	1429	15	5	0.046	0.018
1R32-05B1-FOWC-1480-1729-0.018	1480	1500	1729	15	5	0.054	0.018



Specification of ball screw

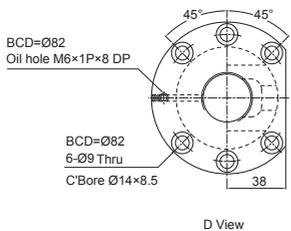
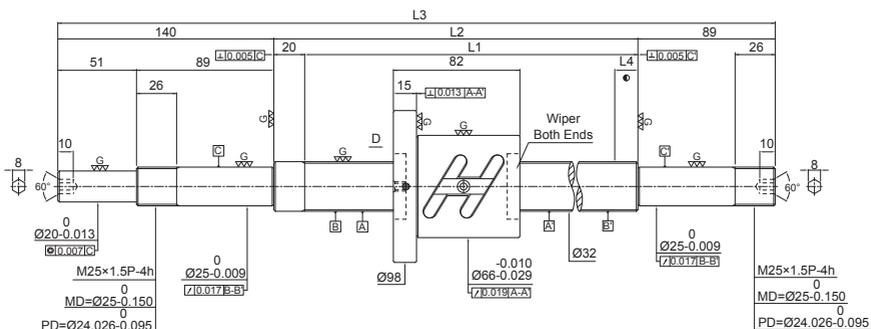
Production Specification	With Preload
Number of Thread / Thread Direction	1/Right
BCD	32.7
Lead	6
Ball Dia.	3.969
Effective Turns (Circuit × Row)	2.5 × 2(2)
Lead Angle	3.34
Dynamic Rate Load Ca (kgf)	2410
Static Rate Load Co (kgf)	6900
Axial Play	0
Preloading Torque (kgf-cm)	2.32~4.82

Unit: mm

Model No.	Screw Spindle (Shaft) Length				Accuracy Grade	Lead Accuracy	
	L1	L2	L3	L4		Accumulated reference lead deviation E	Lead Deriation in random 300mm e ₃₀₀
1R32-06B1-FOWC-380-629-0.018	380	400	629	15	5	0.025	0.018
1R32-06B1-FOWC-580-829-0.018	580	600	829	15	5	0.030	0.018
1R32-06B1-FOWC-780-1029-0.018	780	800	1029	15	5	0.035	0.018
1R32-06B1-FOWC-980-1229-0.018	980	1000	1229	15	5	0.040	0.018
1R32-06B1-FOWC-1180-1429-0.018	1180	1200	1429	15	5	0.046	0.018
1R32-06B1-FOWC-1480-1729-0.018	1480	1500	1729	15	5	0.054	0.018

FOWC Standard ballscrews

Screw Dia. Ø32 Lead08

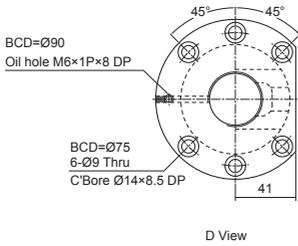
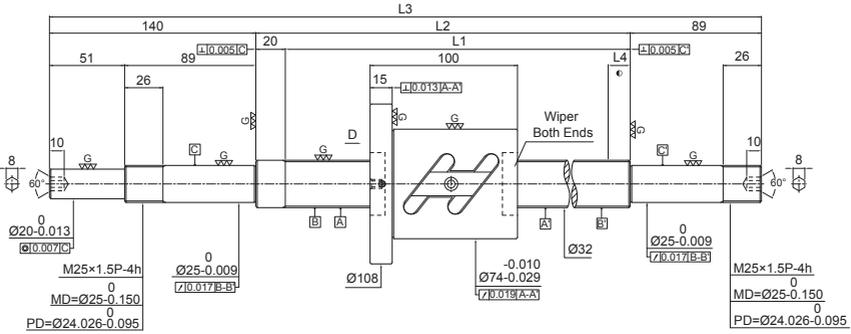


Specification of ball screw

Production Specification	With Preload
Number of Thread / Thread Direction	1/Right
BCD	33
Lead	8
Ball Dia.	4.762
Effective Turns (Circuit × Row)	2.5 × 1(2)
Lead Angle	4.41
Dynamic Rate Load Ca (kgf)	1720
Static Rate Load Co (kgf)	4180
Axial Play	0
Preloading Torque (kgf-cm)	1.26~5.06

Unit: mm

Model No.	Screw Spindle (Shaft) Length				Accuracy Grade	Lead Accuracy	
	L1	L2	L3	L4		Accumulated reference lead deviation E	Lead Deriation in random 300mm e_{300}
1R32-08B1-FOWC-380-629-0.018	380	400	629	15	5	0.025	0.018
1R32-08B1-FOWC-580-829-0.018	580	600	829	15	5	0.030	0.018
1R32-08B1-FOWC-780-1029-0.018	780	800	1029	15	5	0.035	0.018
1R32-08B1-FOWC-980-1229-0.018	980	1000	1229	15	5	0.040	0.018
1R32-08B1-FOWC-1480-1729-0.018	1480	1500	1729	15	5	0.054	0.018



Specification of ball screw

Production Specification	With Preload
Number of Thread / Thread Direction	1/Right
BCD	33.4
Lead	10
Ball Dia.	6.35
Effective Turns (Circuit × Row)	2.5 × 1(2)
Lead Angle	5.44
Dynamic Rate Load Ca (kgf)	2570
Static Rate Load Co (kgf)	5440
Axial Play	0
Preloading Torque (kgf-cm)	3.58~7.44

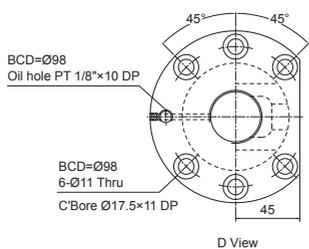
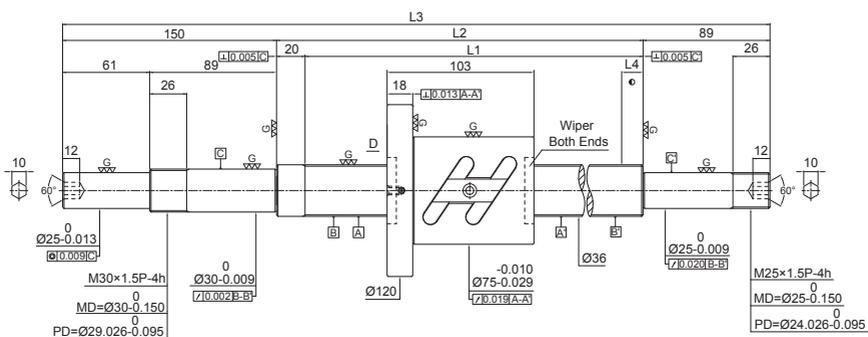
Unit: mm

Model No.	Screw Spindle (Shaft) Length				Accuracy Grade	Lead Accuracy	
	L1	L2	L3	L4		Accumulated reference lead deviation E	Lead Deriation in random 300mm e_{300}
1R32-10B1-FOWC-380-629-0.018	380	400	629	15	5	0.025	0.018
1R32-10B1-FOWC-480-729-0.018	480	500	729	15	5	0.027	0.018
1R32-10B1-FOWC-580-829-0.018	580	600	829	15	5	0.030	0.018
1R32-10B1-FOWC-680-929-0.018	680	700	929	15	5	0.030	0.018
1R32-10B1-FOWC-780-1029-0.018	780	800	1029	15	5	0.035	0.018
1R32-10B1-FOWC-980-1229-0.018	980	1000	1229	15	5	0.040	0.018
1R32-10B1-FOWC-1180-1429-0.018	1180	1200	1429	15	5	0.046	0.018
1R32-10B1-FOWC-1480-1729-0.018	1480	1500	1729	15	5	0.054	0.018
1R32-10B1-FOWC-1780-2029-0.018	1780	1800	2029	15	5	0.065	0.018

FOWC

Standard ballscrews

Screw Dia. Ø36 Lead10

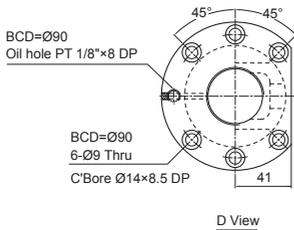
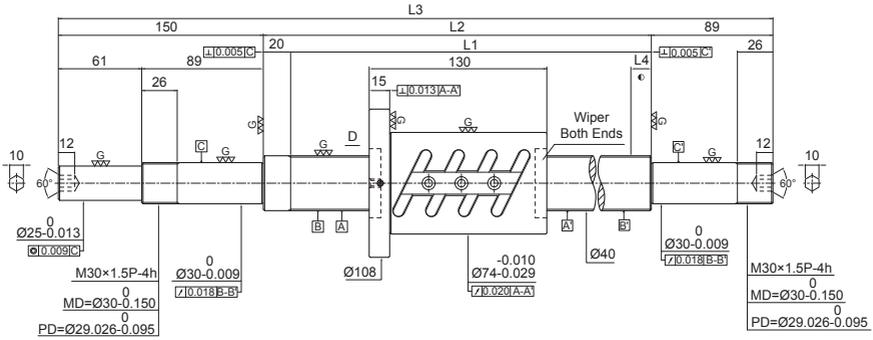


Specification of ball screw

Production Specification	With Preload
Number of Thread / Thread Direction	1/Right
BCD	37.4
Lead	10
Ball Dia.	6.35
Effective Turns (Circuit × Row)	2.5 × 1(2)
Lead Angle	4.86
Dynamic Rate Load Ca (kgf)	2720
Static Rate Load Co (kgf)	6180
Axial Play	0
Preloading Torque (kgf-cm)	3.91~8.13

Unit: mm

Model No.	Screw Spindle (Shaft) Length				Accuracy Grade	Lead Accuracy	
	L1	L2	L3	L4		Accumulated reference lead deviation E	Lead Deriation in random 300mm e_{300}
1R36-10B1-FOWC-480-739-0.018	480	500	739	15	5	0.027	0.018
1R36-10B1-FOWC-680-939-0.018	680	700	939	15	5	0.030	0.018
1R36-10B1-FOWC-980-1239-0.018	980	1000	1239	15	5	0.040	0.018
1R36-10B1-FOWC-1380-1639-0.018	1380	1400	1639	15	5	0.054	0.018
1R36-10B1-FOWC-1780-2039-0.018	1780	1800	2039	15	5	0.065	0.018



Specification of ball screw

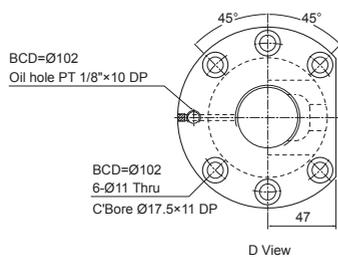
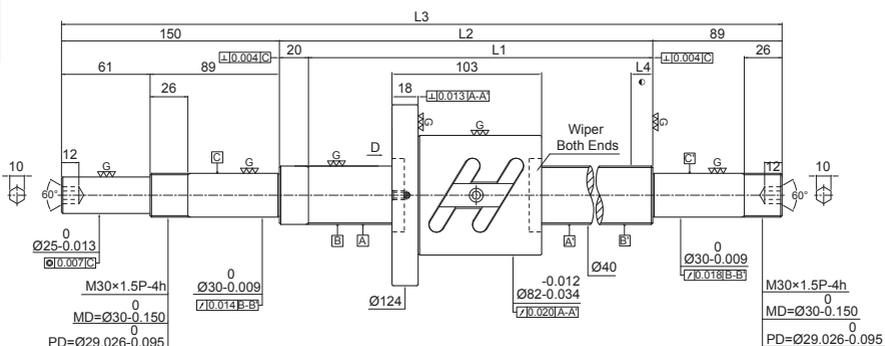
Production Specification	With Preload
Number of Thread / Thread Direction	1/Right
BCD	41
Lead	8
Ball Dia.	4.762
Effective Turns (Circuit × Row)	2.5 × 2(2)
Lead Angle	3.55
Dynamic Rate Load Ca (kgf)	3450
Static Rate Load Co (kgf)	10540
Axial Play	0
Preloading Torque (kgf-cm)	4.24~8.82

Unit: mm

Model No.	Screw Spindle (Shaft) Length				Accuracy Grade	Lead Accuracy	
	L1	L2	L3	L4		Accumulated reference lead deviation E	Lead Deriation in random 300mm e_{300}
1R40-8B2-FOWC-380-639-0.018	380	400	639	15	5	0.025	0.018
1R40-8B2-FOWC-580-839-0.018	580	600	839	15	5	0.030	0.018
1R40-8B2-FOWC-780-1039-0.018	780	800	1039	15	5	0.035	0.018
1R40-8B2-FOWC-980-1239-0.018	980	1000	1239	15	5	0.040	0.018
1R40-8B2-FOWC-1180-1439-0.018	1180	1200	1439	15	5	0.046	0.018
1R40-8B2-FOWC-1580-1839-0.018	1580	1600	1839	15	5	0.054	0.018

FOWC

Standard ballscrews

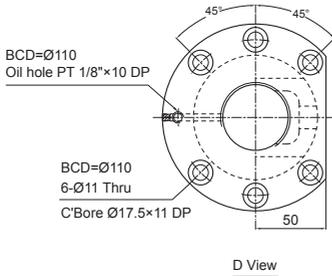
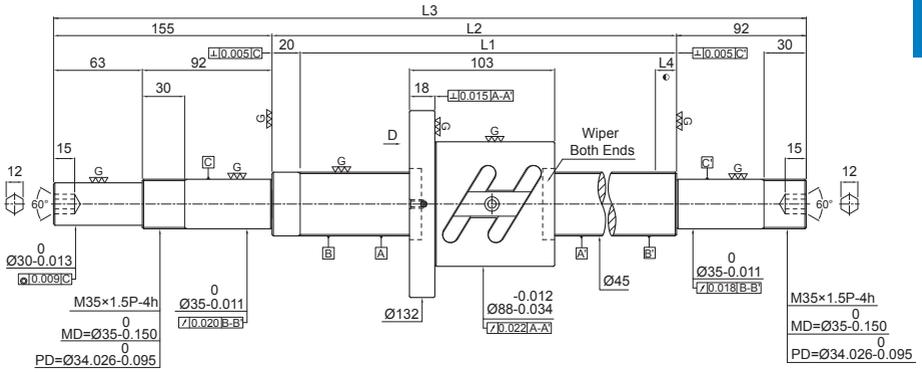
Screw Dia. $\varnothing 40$ Lead 10

Specification of ball screw

Production Specification	With Preload
Number of Thread / Thread Direction	1/Right
BCD	41.4
Lead	10
Ball Dia.	6.35
Effective Turns (Circuit \times Row)	2.5 \times 1(2)
Lead Angle	4.4
Dynamic Rate Load C_a (kgf)	2880
Static Rate Load C_o (kgf)	6950
Axial Play	0
Preloading Torque (kgf-cm)	4.57~8.49

Unit: mm

Model No.	Screw Spindle (Shaft) Length				Accuracy Grade	Lead Accuracy	
	L1	L2	L3	L4		Accumulated reference lead deviation E	Lead Derivation in random 300mm e_{300}
1R40-10B1-FOWC-480-739-0.018	480	500	739	15	5	0.027	0.018
1R40-10B1-FOWC-580-839-0.018	580	600	839	15	5	0.030	0.018
1R40-10B1-FOWC-680-939-0.018	680	700	939	15	5	0.030	0.018
1R40-10B1-FOWC-780-1039-0.018	780	800	1039	15	5	0.035	0.018
1R40-10B1-FOWC-980-1239-0.018	980	1000	1239	15	5	0.040	0.018
1R40-10B1-FOWC-1180-1439-0.018	1180	1200	1439	15	5	0.046	0.018
1R40-10B1-FOWC-1380-1639-0.018	1380	1400	1639	15	5	0.054	0.018
1R40-10B1-FOWC-1580-1839-0.018	1580	1600	1839	15	5	0.054	0.018
1R40-10B1-FOWC-1780-2039-0.018	1780	1800	2039	15	5	0.065	0.018
1R40-10B1-FOWC-2380-2639-0.018	2380	2400	2639	15	5	0.077	0.018



Specification of ball screw

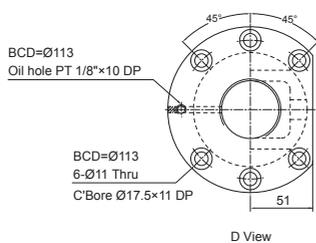
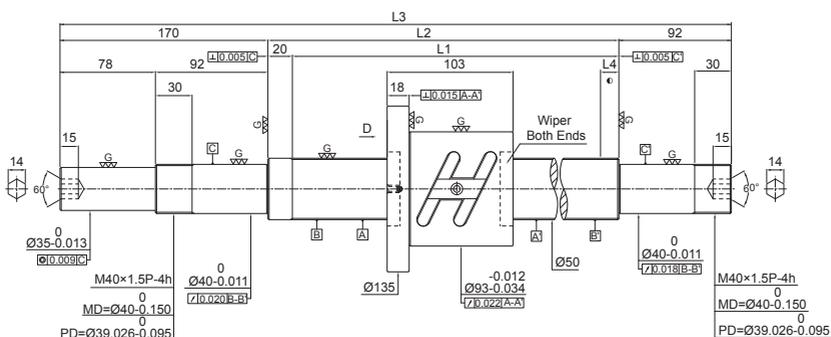
Production Specification	With Preload
Number of Thread / Thread Direction	1/Right
BCD	46.4
Lead	10
Ball Dia.	6.35
Effective Turns (Circuit × Row)	2.5 × 1(2)
Lead Angle	4.4
Dynamic Rate Load Ca (kgf)	3020
Static Rate Load Co (kgf)	7850
Axial Play	0
Preloading Torque (kgf-cm)	4.58~9.5

Unit: mm

Model No.	Screw Spindle (Shaft) Length				Accuracy Grade	Lead Accuracy	
	L1	L2	L3	L4		Accumulated reference lead deviation E	Lead Derivation in random 300mm e_{300}
1R45-10B1-1FOWC-680-947-0.018	680	700	947	15	5	0.035	0.018
1R45-10B1-1FOWC-980-1247-0.018	980	1000	1247	15	5	0.04	0.018
1R45-10B1-1FOWC-1380-1647-0.018	1380	1400	1647	15	5	0.054	0.018
1R45-10B1-1FOWC-1780-2047-0.018	1780	1800	2047	15	5	0.065	0.018
1R45-10B1-1FOWC-2480-2747-0.018	2480	2500	2747	15	5	0.077	0.018

FOWC

Standard ballscrews

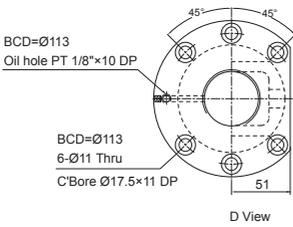
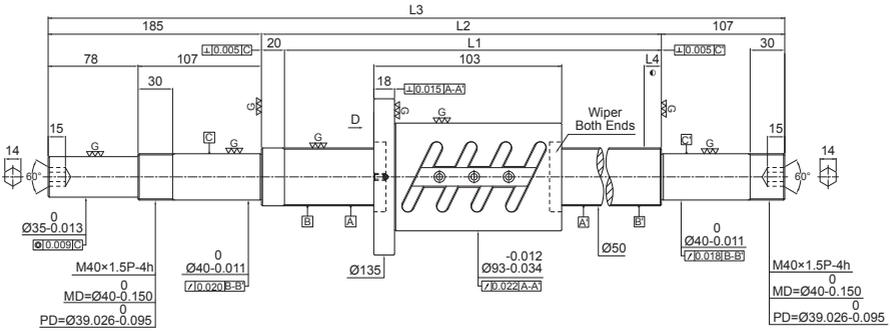
Screw Dia. $\varnothing 50$ Lead 10

Specification of ball screw

Production Specification	With Preload
Number of Thread / Thread Direction	1/Right
BCD	51.4
Lead	10
Ball Dia.	6.35
Effective Turns (Circuit \times Row)	2.5 \times 1(2)
Lead Angle	3.54
Dynamic Rate Load Ca (kgf)	3190
Static Rate Load Co (kgf)	8710
Axial Play	0
Preloading Torque (kgf-cm)	4.84~11.28

Unit: mm

Model No.	Screw Spindle (Shaft) Length				Accuracy Grade	Lead Accuracy	
	L1	L2	L3	L4		Accumulated reference lead deviation E	Lead Deriation in random 300mm e_{300}
1R50-10B1-FOWC-580-892-0.018	580	600	892	15	5	0.030	0.018
1R50-10B1-FOWC-780-1092-0.018	780	800	1092	15	5	0.035	0.018
1R50-10B1-FOWC-980-1292-0.018	980	1000	1292	15	5	0.040	0.018
1R50-10B1-FOWC-1180-1492-0.018	1180	1200	1492	15	5	0.046	0.018
1R50-10B1-FOWC-1480-1792-0.018	1480	1500	1792	15	5	0.054	0.018
1R50-10B1-FOWC-1980-2292-0.018	1980	2000	2292	15	5	0.065	0.018
1R50-10B1-FOWC-2580-2892-0.018	2580	2600	2892	15	5	0.093	0.018



Specification of ball screw

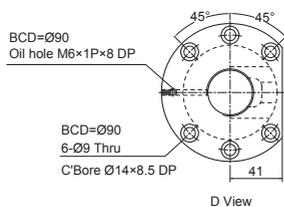
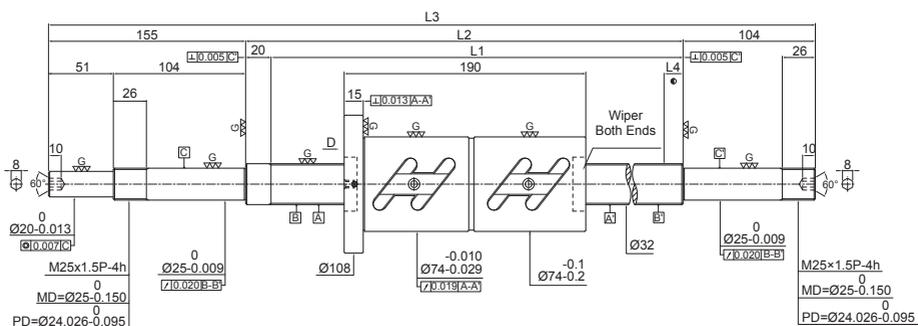
Production Specification	With Preload
Number of Thread / Thread Direction	1/Right
BCD	51.4
Lead	10
Ball Dia.	6.35
Effective Turns (Circuit × Row)	2.5 × 2(2)
Lead Angle	3.54
Dynamic Rate Load Ca (kgf)	5790
Static Rate Load Co (kgf)	17420
Axial Play	0
Preloading Torque (kgf-cm)	10.48~17.48

Unit: mm

Model No.	Screw Spindle (Shaft) Length				Accuracy Grade	Lead Accuracy	
	L1	L2	L3	L4		Accumulated reference lead deviation E	Lead Deriation in random 300mm e_{300}
1R50-10B2-FOWC-580-892-0.018	580	600	892	15	5	0.030	0.018
1R50-10B2-FOWC-780-1092-0.018	780	800	1092	15	5	0.035	0.018
1R50-10B2-FOWC-980-1292-0.018	980	1000	1292	15	5	0.040	0.018
1R50-10B2-FOWC-1180-1492-0.018	1180	1200	1492	15	5	0.046	0.018
1R50-10B2-FOWC-1480-1792-0.018	1480	1500	1792	15	5	0.054	0.018
1R50-10B2-FOWC-1980-2292-0.018	1980	2000	2292	15	5	0.065	0.018
1R50-10B2-FOWC-2580-2892-0.018	2580	2600	2892	15	5	0.093	0.018

FDWC

Standard ballscrews

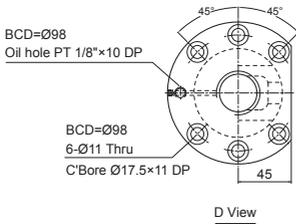
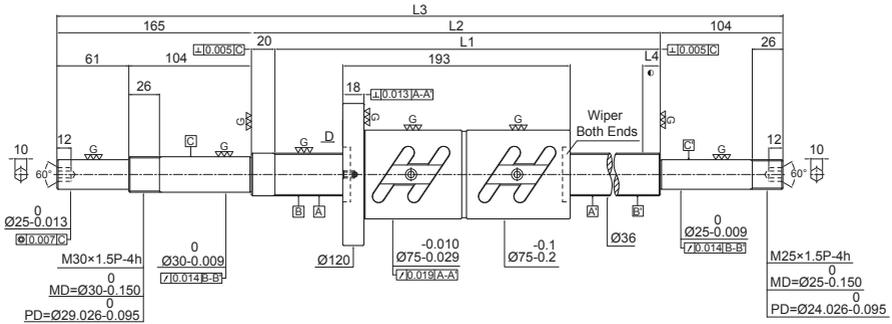
Screw Dia. $\varnothing 32$ Lead 10

Specification of ball screw

Production Specification	With Preload
Number of Thread / Thread Direction	1/Right
BCD	33.4
Lead	10
Ball Dia.	6.35
Effective Turns (Circuit × Row)	2.5 × 2
Lead Angle	5.44
Dynamic Rate Load Ca (kgf)	4660
Static Rate Load Co (kgf)	10880
Axial Play	0
Preloading Torque (kgf-cm)	5.51~11.43

Unit: mm

Model No.	Screw Spindle (Shaft) Length				Accuracy Grade	Lead Accuracy	
	L1	L2	L3	L4		Accumulated reference lead deviation E	Lead Derivation in random 300mm e_{300}
1R32-10B2-FDWC-380-659-0.018	380	400	659	15	5	0.025	0.018
1R32-10B2-FDWC-480-759-0.018	480	500	759	15	5	0.027	0.018
1R32-10B2-FDWC-580-859-0.018	580	600	859	15	5	0.030	0.018
1R32-10B2-FDWC-680-959-0.018	680	700	959	15	5	0.030	0.018
1R32-10B2-FDWC-780-1059-0.018	780	800	1059	15	5	0.035	0.018
1R32-10B2-FDWC-980-1259-0.018	980	1000	1259	15	5	0.040	0.018
1R32-10B2-FDWC-1180-1459-0.018	1180	1200	1459	15	5	0.046	0.018
1R32-10B2-FDWC-1480-1759-0.018	1480	1500	1759	15	5	0.054	0.018
1R32-10B2-FDWC-1780-2059-0.018	1780	1800	2059	15	5	0.065	0.018



Specification of ball screw

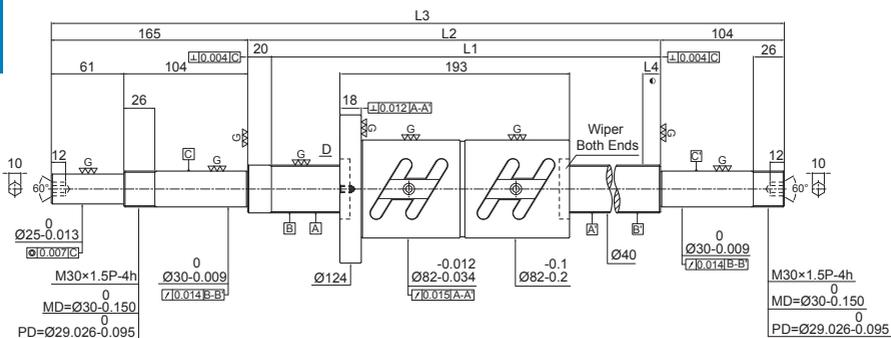
Production Specification	With Preload
Number of Thread / Thread Direction	1/Right
BCD	37.4
Lead	10
Ball Dia.	6.35
Effective Turns (Circuit × Row)	2.5 × 2
Lead Angle	4.86
Dynamic Rate Load Ca (kgf)	4930
Static Rate Load Co (kgf)	12360
Axial Play	0
Preloading Torque (kgf-cm)	6.64~12.34

Unit: mm

Model No.	Screw Spindle (Shaft) Length				Accuracy Grade	Lead Accuracy	
	L1	L2	L3	L4		Accumulated reference lead deviation E	Lead Derivation in random 300mm e ₃₀₀
1R36-10B2-1FDWC-480-769-0.018	480	500	769	15	5	0.027	0.018
1R36-10B2-1FDWC-680-969-0.018	680	700	969	15	5	0.035	0.018
1R36-10B2-1FDWC-980-1269-0.018	980	1000	1269	15	5	0.040	0.018
1R36-10B2-1FDWC-1380-1669-0.018	1380	1400	1669	15	5	0.054	0.018
1R36-10B2-1FDWC-1780-2069-0.018	1780	1800	2069	15	5	0.065	0.018

FDWC

Standard ballscrews
Screw Dia. $\varnothing 40$ Lead 10

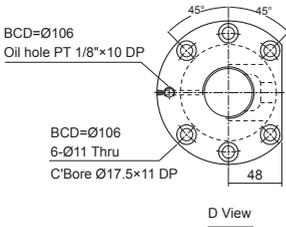
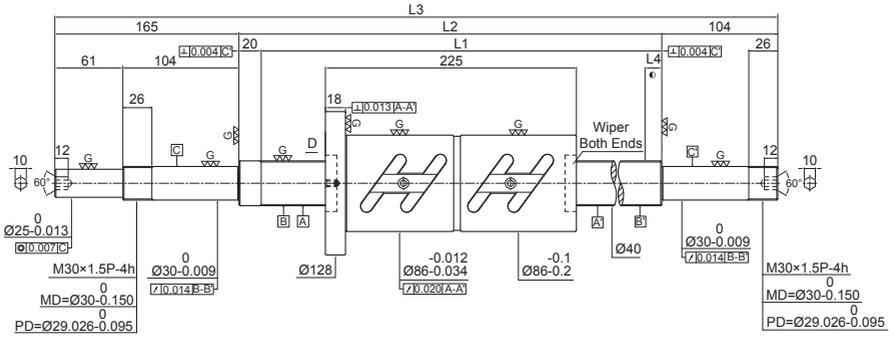


Specification of ball screw

Production Specification	With Preload
Number of Thread / Thread Direction	1/Right
BCD	41.4
Lead	10
Ball Dia.	6.35
Effective Turns (Circuit \times Row)	2.5 \times 2
Lead Angle	4.4
Dynamic Rate Load C_a (kgf)	5220
Static Rate Load C_o (kgf)	13900
Axial Play	0
Preloading Torque (kgf-cm)	8.26~13.78

Unit: mm

Model No.	Screw Spindle (Shaft) Length				Accuracy Grade	Lead Accuracy	
	L1	L2	L3	L4		Accumulated reference lead deviation E	Lead Deriation in random 300mm e_{300}
1R40-10B2-FDWC-480-769-0.018	480	500	769	15	5	0.027	0.018
1R40-10B2-FDWC-580-869-0.018	580	600	869	15	5	0.030	0.018
1R40-10B2-FDWC-680-969-0.018	680	700	969	15	5	0.030	0.018
1R40-10B2-FDWC-780-1069-0.018	780	800	1069	15	5	0.035	0.018
1R40-10B2-FDWC-980-1269-0.018	980	1000	1269	15	5	0.040	0.018
1R40-10B2-FDWC-1180-1469-0.018	1180	1200	1469	15	5	0.046	0.018
1R40-10B2-FDWC-1380-1669-0.018	1380	1400	1669	15	5	0.054	0.018
1R40-10B2-FDWC-1580-1869-0.018	1580	1600	1869	15	5	0.054	0.018
1R40-10B2-FDWC-1780-2069-0.018	1780	1800	2069	15	5	0.065	0.018
1R40-10B2-FDWC-2380-2269-0.018	2380	2400	2269	15	5	0.077	0.018



Specification of ball screw	
Production Specification	With Preload
Number of Thread / Thread Direction	1/Right
BCD	41.5
Lead	12
Ball Dia.	7.144
Effective Turns (Circuit × Row)	2.5 × 2
Lead Angle	5.26
Dynamic Rate Load Ca (kgf)	6170
Static Rate Load Co (kgf)	15700
Axial Play	0
Preloading Torque (kgf-cm)	9.79~18.17

Unit: mm

Model No.	Screw Spindle (Shaft) Length				Accuracy Grade	Lead Accuracy	
	L1	L2	L3	L4		Accumulated reference lead deviation E	Lead Deriation in random 300mm e_{300}
1R40-12B2-FDWC-680-969-0.018	680	700	969	15	5	0.030	0.018
1R40-12B2-FDWC-980-1269-0.018	980	1000	1269	15	5	0.040	0.018
1R40-12B2-FDWC-1380-1669-0.018	1380	1400	1669	15	5	0.054	0.018
1R40-12B2-FDWC-1780-2069-0.018	1780	1800	2069	15	5	0.065	0.018
1R40-12B2-FDWC-2480-2769-0.018	2480	2500	2769	15	5	0.077	0.018

14 *PMI* Rolled BallScrews

14.1 Introduction to Rolled Ballscrew

The production of the *PMI* rolled ballscrews has adopted a manufacturing process and equipment unlike other manufacturers. Combining advanced skills and the Bad Düben digital electric screw thread rolling machine, we adhere to a strict quality control policy at every stage of production, from the selection of ballscrew material and rolled processing to induction hardening heat treatment and post production. We are committed to providing clients with products of the best quality.

The combination of rolled ballscrews and ground nuts has replaced the traditional ACME screws and trapezoidal screws. This makes for a smoother operation while lowering friction and backlash. Moreover, the new technology has the advantage of faster production speed and lower prices.



We employ the most advanced digital electric screw thread rolling machine. During the manufacturing process, the oil cylinders on the two axes of the thread rolling dies employ a servo hydraulic system for the correction of oil pressure and positioning precision.



We employ Germany-imported Bad Düben roller in order to maintain the stability of the thread rolling machine and the quality of the rolled product.

14.2 Features of the *PMI* Rolled Ballscrew

High Precision Rolled Nuts

The manufacturing process of rolled nuts is identical to that of ground nuts. Surface hardening treatment and internal thread grinding ensure durability and smoothness.

Nuts are Interchangeable

Without preload and within the maximum permissible axial play, different types of nuts can be used on the same screw.

14.3 Lead Accuracy of Rolled Screws (e_{300})

According to ISO 3408-3, the definition of lead accuracy for *PMI* rolled ballscrews is as follows: Within the effective thread length, the permissible value of accumulated lead deviation in random 300mm. As shown in table 14.1:

Table 14.1 Lead Accuracy

e_{300} (Within the effective thread length, the permissible value of accumulated lead deviation in random 300mm)

Unit: μm

Grade	C5	C7	C8	C10
ISO, DIN	23	52		210
JIS	18	50		210
<i>PMI</i>	23	50	100	210

ep(Within the effective thread length, the permissible value of accumulated lead deviation)

Unit: μm

Grade	C5	C7	C8	C10
PMI	$ep = \pm(lu/300) \times e_{300}$ lu: Effective thread length (Unit: mm)			

Unit: μm

e ₃₀₀ Measured length	Grade			
	C5	C7	C8	C10
0~100	20	44	84	178
101~200	22	48	92	194
201~315	25	50	100	210

P.S. Please contact us for PMI C5 and C6 requirements.

14.4 Reference Table of the Nominal Outer Diameter and Lead of the PMI's Rolled Screw Shaft

PMI rolled ballscrews offer a variety of specifications, lead accuracies, and maximum rolling length, as shown in table 14.2~14.3:

Table 14.2. Specifications of Rolled Ballscrews

Screw nominal outer diameter \varnothing	Lead										Maximum rolled ballscrew length
	4	5	5.08	6	10	16	20	25	32	40	
12	●	●									1500
14	●	●									3000
15		●			●	●					3000
16	●	●			●	●					3000
20	●	●			●		●				3000
25	●	●/○	●/○		●			●			6000
28		●		●							6000
32		●/○	●/○		●		●		●		6000
36					●						6000
38					●		●			●	6000
40		●			●		●			●	6000
50					●						6000

● : right-hand thread ○ : left-hand thread

P.S. Rolled ballscrews are limited in length and accuracy, please contact us for other requirements.

Table 14.3 Lead Accuracy and Maximum Rolled Length

Screw nominal outer diameter $\varnothing(mm)$	Lead Accuracy Grade (e_{300}) Maximum Rolling Length (mm)			
	C5	C7	C8	C10
12	1500	1500	1500	1500
14	1500	3000	3000	3000
15	2000	3000	3000	3000
16	2000	3000	3000	3000
20	3000	3000	3000	3000
25	3000	6000	6000	6000
28				
32				
36				
38				
40				
50				

14.5 Axial Play

The maximum axial play under normal non-preload condition, as shown in table 14.4

Table 14.4 Maximum Axial Play

Screw O.D. $\varnothing d (mm)$	6~32	36~50
Maximum Axial Play (mm)	0.04	0.07

PMI rolled ballscrews can eliminate axial play by preloading. Please contact our sales representatives if preloading is required.

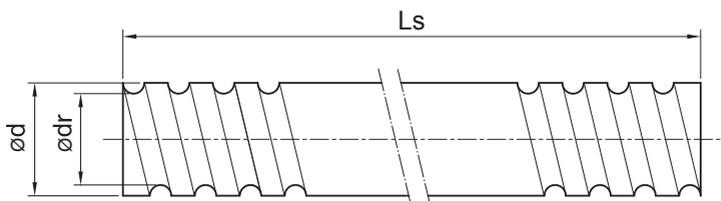
14.6 Materials and Hardness

Standard material and surface hardness for *PMI* rolled screw, as shown in table 14.5

Table 14.5

Denomination	Material	Heat Treatment	Hardness (HRC)
Rolled screw	S55C/Equivalent	Induction hardening	58~62
Nuts	SCM420H/Equivalent	Carburized hardening	58~62

14.7 Types and Dimensions of Rolled Screw Shaft



Unit:mm

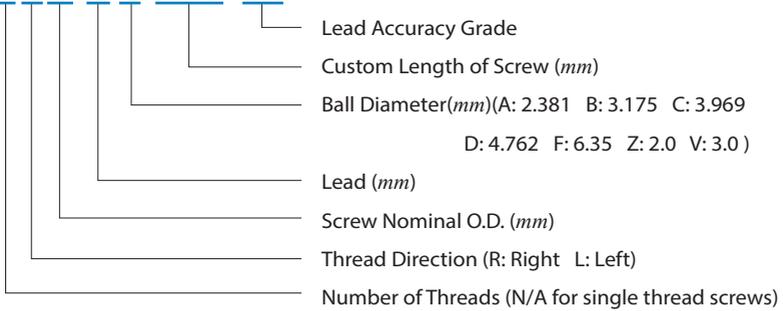
SCREW SIZE			Lead Accuracy Grade	Thread Direction	Number of Threads	Maximum Rolling Length	Screw Number
O.D.	LEAD	BALL DIA.		L: Left / R: Right			
12	4	2.381	C5,C7,C8,C10	R	1	1500	R1204A
	5	2.000		R	1		R1205Z
14	4	2.381		R	1	3000	R1404A
	5	3.175		R	1		R1405B
15	5	3		R	1	3000	R1505V
	10	3		R	2		2R1510V
	10	3.175		R	2		2R1510B
	16	3		R	2		2R1516V
16	4	2.381		R	1	3000	R1604A
	5	3.175		R	1		R1605B
	10	3.175		R	2		2R1610B
	16	3.175		R	2		2R1616B
20	4	2.381		R	1	3000	R2004A
	5	3.175		R	1		R2005B
	10	4.762		R	1		R2010D
	20	3.175		R	2		2R2020B

Unit:mm

SCREW SIZE			Lead Accuracy Grade	Thread Direction	Number of Threads	Maximum Rolling Length	Screw Number
O.D.	LEAD	BALL DIA.		L: Left / R: Right			
25	4	2.381	C5,C7,C8,C10	R	1	6000	R2504A
	5	3.175		R/L	1		R(L)2505B
	5.08	3.175		R/L	1		R(L)2515B
	10	3.175		R	2		2R2510B
	10	4.762		R	1		R2510D
	10	6.350		R	1		R2510F
	25	3.175		R	4		2R2525B
	25	3.969		R	4		4R2525C
28	5	3.175		R	1		R2805B
	6	3.175		R	1		R2806B
32	5	3.175		R/L	1		R(L)3205B
	5.08	3.175		R/L	1		R(L)3215B
	10	3.969		R	1		R3210C
	10	6.350		R	1		R3210F
	20	3.969		R	2		2R3220C
	20	6.350		R	2		2R3220F
	32	3.969		R	4		4R3232C
	32	4.762		R	4		4R3232D
36	10	6.350		R	1		R3610F
38	10	6.350		R	1		R3810F
	20	6.350	R	2	2R3820F		
	40	6.350	R	4	4R3840F		
			R	1	R4005B		
40	10	6.350	R	1	R4010F		
	20	6.350	R	2	2R4020F		
	40	6.350	R	4	4R4040F		
			R	1	R5010F		
50	10	6.350	R	1	R5010F		

Order Code:

4 R 15 10 A -1500 -C7



14.8 Nut Types of Rolled Ballscrew

Standard Models:

FSIN



FSIW



FSDN



FSKW



FSDW



Optional Models :

FSWW



FSVW



RSVW



SSVW

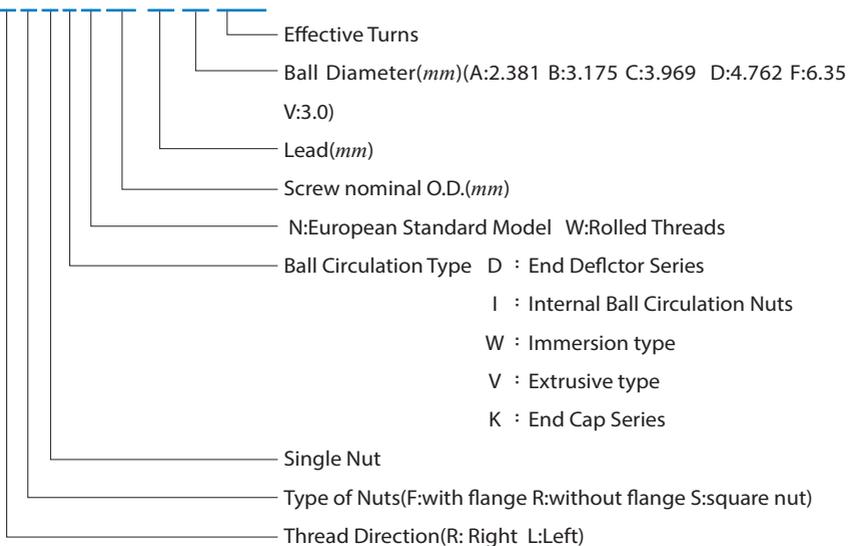


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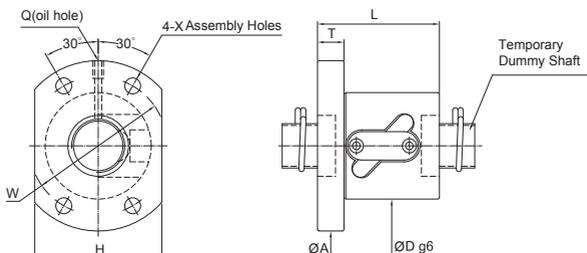


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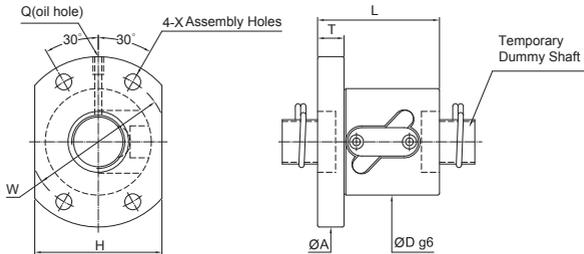


FSWW



Unit: mm

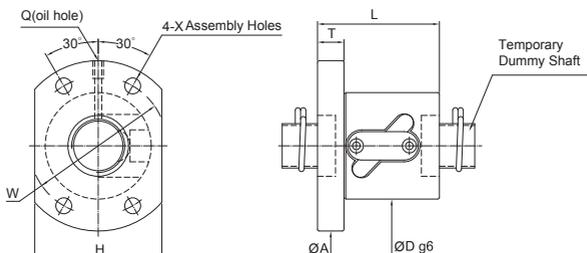
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit x row	BASIC RATE LOAD(kgf)		BALLNUT DIMENSION										
O.D.	LEAD			Dynamic (1x10 ⁶ REV) Ca	Static Co	O.D. D	Length L	Flange			Assembly Hole X	Oil Hole Q	STIFFNESS kgf/µm	Nut Model NO.		
12	4	2.381	2.5x1	285	533	30	40	52	10	40	31	4.5	M6x1P	9	FSWW1204A-2.5P	
	5	2	2.5x1	270	350	26	40	47	10	37	30	4.5	M6x1P	8.2	FSWW1205Z-2.5P	
14	4	2.381	3.5x1	500	1100	35	42	57	10	45	40	4.5	M6x1P	15	FSWW1404A-3.5P	
	5	3.175	2.5x1	515	990	40	40	57	10	45	40	4.5	M6x1P	11	FSWW1405B-2.5P	
15	10	3.175	2.5x1	440	680	34	55	57	10	45	34	5.5	M6x1P	12	FSWW1510B-2.5P	
16	4	2.381	1.5x2	540	1260	34	41	57	11	45	34	5.5	M6x1P	15	FSWW1604A-3.0P	
			2.5x1	460	1050									13	FSWW1604A-2.5P	
			3.5x1	610	1470									17	FSWW1604A-3.5P	
	5	3.175	1.5x2	640	1370	40	41	63	11	51	42	5.5	M6x1P	15	FSWW1605B-3.0P	
			2.5x1	550	1140									13	FSWW1605B-2.5P	
			2.5x2	1000	2280									23	FSWW1605B-5.0P	
3.5x1	730	1600	17	FSWW1605B-3.5P												
10	3.175	2.5x1	550	990	40	56	63	11	51	42	5.5	M6x1P	13	FSWW1610B-2.5P		
20	4	2.381	1.5x2	740	1870	40	42	67	11	55	52	5.5	M6x1P	19	FSWW2004A-3.0P	
			2.5x1	630	1560									16	FSWW2004A-2.5P	
			2.5x2	1140	3120									30	FSWW2004A-5.0P	
			3.5x1	840	2180									22	FSWW2004A-3.5P	
	5	3.175	1.5x2	730	1740	44	42	67	11	55	52	5.5	M6x1P	18	FSWW2005B-3.0P	
			2.5x1	625	1450									15	FSWW2005B-2.5P	
			2.5x2	1130	2900									28	FSWW2005B-5.0P	
			3.5x1	830	2030									20	FSWW2005B-3.5P	
10	4.762	2.5x1	1100	2200	52	61	82	12	67	64	6.6	M6x1P	16	FSWW2010D-2.5P		



Unit: mm

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit x row	BASIC RATE LOAD(kgf)		BALLNUT DIMENSION												
O.D.	LEAD			Dynamic (1x10 ⁶ REV.) Ca	Static Co	O.D. D	Length L	Flange				Assembly Hole X	Oil Hole Q	STIFFNESS kgf/µm	Nut Model NO.			
25	4	2.381	1.5x2	980	2640		44											FSWW2504A-3.0P
			2.5x1	840	2200	46	40	69	11	57	52	5.5	M6x1P	20	FSWW2504A-2.5P			
			2.5x2	1520	4400	49	49							38	FSWW2504A-5.0P			
			3.5x1	1120	3080	42	42							27	FSWW2504A-3.5P			
	5	3.175	1.5x2	840	2200		45											FSWW2505B-3.0P
			2.5x1	720	1830	50	41	73	11	61	56	6.6	M6x1P	18	FSWW2505B-2.5P			
			2.5x2	1120	3710	56	56							37	FSWW2505B-5.0P			
			3.5x1	960	2560	46	46							24	FSWW2505B-3.5P			
	10	4.762	1.5x2	1490	3340		71											FSWW2510D-3.0P
			2.5x1	1270	2780	58	65	85	15	71	64	6.6	M6x1P	20	FSWW2510D-2.5P			
			3.5x1	1700	3890	75	75							27	FSWW2510D-3.5P			
	10	6.35	2.5x1	1720	3590		69											FSWW2510F-2.5P
2.5x2			3200	7170	60	97	96	15	78	72	9	M6x1P	40	FSWW2510F-5.0P				
28	5	3.175	1.5x2	910	2470		46											FSWW2805B-3.0P
			2.5x1	780	2060	55	42	83	12	69	62	6.6	M8x1P	18	FSWW2805B-2.5P			
			2.5x2	1410	4120	56	56							33	FSWW2805B-5.0P			
			3.5x1	1040	2880	47	47							24	FSWW2805B-3.5P			
32	5	3.175	1.5x2	990	2830		47											FSWW3205B-3.0P
			2.5x1	850	2360		43											FSWW3205B-2.5P
			2.5x2	1540	4720	58	57	85	12	71	64	6.6	M8x1P	41	FSWW3205B-5.0P			
			2.5x3	2180	7080	72	72							59	FSWW3205B-7.5P			
	10	6.35	3.5x1	1130	3300		47											FSWW3205B-3.5P
			1.5x2	2260	5620		78											FSWW3210F-3.0P
			2.5x1	1930	4680	67	69	103	15	85	78	9	M6x1P	25	FSWW3210F-2.5P			
			2.5x2	3130	9410	97	97							49	FSWW3210F-5.0P			
			3.5x1	2580	6550		78									FSWW3210F-3.5P		

FSWW

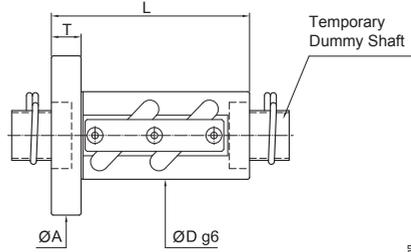
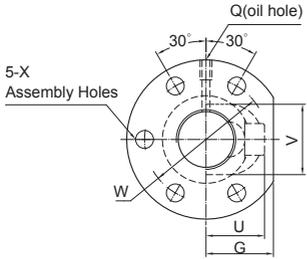


SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD (kgf)		BALLNUT DIMENSION											
O.D.	LEAD			Dynamic (1×10 ⁶ REV.) Ca	Static Co	O.D. D	Length L	Flange				Assembly Hole X	Oil Hole Q	STIFFNESS kgf/μm	Nut Model NO.		
36	10	6.35	1.5x2	2170	6480	81										30	FSWW3610F-3.0P
			2.5x2	3370	10800	70	99	110	17	90	82	11	M6x1P	29	FSWW3610F-5.0P		
			3.5x1	2480	7560	81								35	FSWW3610F-3.5P		
40	5	3.175	1.5x2	1180	3560	54										37	FSWW4005B-3.0P
			2.5x1	1010	2970	48										32	FSWW4005B-2.5P
			2.5x2	1830	5940	67	60	101	15	83	78	9	M8x1P	60	FSWW4005B-5.0P		
			2.5x3	2600	8910	75									87	FSWW4005B-7.5P	
			3.5x1	1350	4160	50									43	FSWW4005B-3.5P	
40	10	6.35	1.5x2	2270	7200	81										39	FSWW4010F-3.0P
			2.5x1	1940	6000	71										34	FSWW4010F-2.5P
			2.5x2	3520	12000	76	100	116	17	96	88	11	M6x1P	59	FSWW4010F-5.0P		
			3.5x1	2590	8400	81									45	FSWW4010F-3.5P	
50	10	6.35	1.5x2	2510	9000	81										31	FSWW5010F-3.0P
			2.5x1	2150	7500	71										39	FSWW5010F-2.5P
			2.5x2	3900	15000	101										72	FSWW5010F-5.0P
			2.5x3	5520	22500	131	128	18	108	100	11	M6x1P	105	FSWW5010F-7.5P			
			3.5x1	2870	10500	81										53	FSWW5010F-3.5P
			3.5x2	4940	21000	126										98	FSWW5010F-7.0P

Note:

Stiffness of nut:

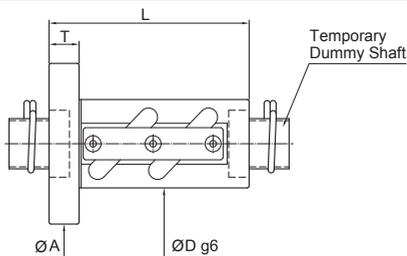
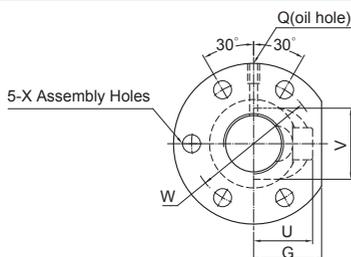
Stiffness values listed above are derived from theoretical formula to the elastic deformation between thread grooves and balls while axial load is 30% dynamic load rating.



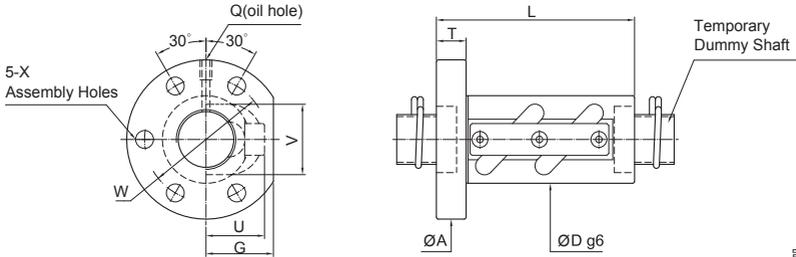
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SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD/(kgf)		BALLNUT DIMENSION												
O.D.	LEAD			Dynamic (1×10 ⁶ REV) Ca	Static Co	O.D. D	Length L	Flange				Return tube		Assembly Hole X	Oil Hole Q	STIFFNESS kgf/μm	Nut Model NO.	
14	4	2.381	3.5x1	500	1100	25	42	55	10	40	19	19	21	4.5	M6x1P	15	FSVW1404A-3.5P	
	5	3.175	2.5x1	515	990	30	43	50	10	40	22	22	21	4.5	M6x1P	11	FSVW1405B-2.5P	
16	5	3.175	1.5x2	540	1260	34	50	54	12	41	24	20	23	5.5	M6x1P	15	FSVW1605B-3.0P	
			2.5x1	550	1140											13	FSVW1605B-2.5P	
			2.5x2	1000	2280											23	FSVW1605B-5.0P	
			3.5x1	730	1600											17	FSVW1605B-3.5P	
20	5	3.175	1.5x2	730	1740	40	50	60	12	50	28	22	27	4.5	M6x1P	18	FSVW2005B-3.0P	
			2.5x1	625	1450											15	FSVW2005B-2.5P	
			2.5x2	1130	2900											28	FSVW2005B-5.0P	
			3.5x1	830	2030											20	FSVW2005B-3.5P	
10	4.762	2.5x1	1100	2200	40	60	67	12	53	30	30	30	6.6	M6x1P	16	FSVW2010-2.5P		
25	5	3.175	2.5x1	720	1830	42	60	71	12	57	28	26	32	6.6	M6x1P	18	FSVW2505B-2.5P	
			2.5x2	1120	3710											37	FSVW2505B-5.0P	
	10	4.762	1.5x2	1480	3340	45	75	72	16	58	34	29	34	6.6	M6x1P	23	FSVW2510D-3.0P	
			2.5x1	1270	2780											20	FSVW2510D-2.5P	
3.5x1	1690	3900	27	FSVW2510D-3.5P														
10	6.35	2.5x1	1720	3590	44	98	79	15	62	34	29	37	9	M6x1P	21	FSVW2510F-2.5P		
		2.5x2	3200	7170											40	FSVW2510F-5.0P		
28	5	3.175	1.5x2	910	2470	44	50	70	12	56	28	28	34	6.6	M6x1P	21	FSVW2805B-3.0P	
			2.5x1	780	2060											18	FSVW2805B-2.5P	
			2.5x2	1410	4120											33	FSVW2805B-5.0P	
			3.5x1	1040	2880											24	FSVW2805B-3.5P	

FSVW



SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD(kgf)		BALLNUT DIMENSION													STIFFNESS kgf/μm	Nut Model NO.
O.D.	LEAD			Dynamic (1×10 ⁶ REV) Ca	Static Co	O.D. D	Length L	Flange				Return tube		Assembly Hole X	Oil Hole Q					
							A	T	W	H	U	V								
32	5	3.175	1.5x2	990	2830	50											26	FSVW3205B-3.0P		
			2.5x1	850	2360	45												22	FSVW3205B-2.5P	
			2.5x2	1540	4720	50	60	76	12	63	36	30	38			6.6	M6x1P	41	FSVW3205B-5.0P	
			2.5x3	2180	7080	75												59	FSVW3205B-7.5P	
			3.5x1	1130	3300	50												29	FSVW3205B-3.5P	
	10	6.35	1.5x2	2260	5620	78											29	FSVW3210F-3.0P		
			2.5x1	1930	4680	72											25	FSVW3210F-2.5P		
			2.5x2	3130	9410	55	101	97	18	75	39	37	44			11	M6x1P	49	FSVW3210F-5.0P	
			3.5x1	2580	6550	78												33	FSVW3210F-3.5P	
			36	10	6.35	1.5x2	2170	6480	82										30	FSVW3610F-3.0P
2.5x1	1860	5400				70											29	FSVW3610F-2.5P		
2.5x2	3370	10800				60	98	105	18	80	42	40	49			11	M6x1P	55	FSVW3610F-5.0P	
3.5x1	2480	7560				82												35	FSVW3610F-3.5P	
40	5	3.175	1.5x2	1180	3560	55										45	FSVW4005B-3.0P			
			2.5x1	1010	2970	50											45	FSVW4005B-2.5P		
			2.5x2	1830	5940	58	65	92	16	72	42	34	46			9	M8x1P	60	FSVW4005B-5.0P	
			2.5x3	2600	8910	80												87	FSVW4005B-7.5P	
			3.5x1	1350	4160	55												43	FSVW4005B-3.5P	
	10	6.35	1.5x2	2270	7200	82											39	FSVW4010F-3.0P		
			2.5x1	1940	6000	72												34	FSVW4010F-2.5P	
			2.5x2	3520	12000	65	102	106	18	85	44	42	52			11	PT1/8"	59	FSVW4010F-5.0P	
			3.5x1	2590	8400	82												45	FSVW4010F-3.5P	
			3.5x2	4450	16800	123	114	114	20	90		44	52			14	M6x1P	81	FSVW4010F-7.0P	



單位:mm

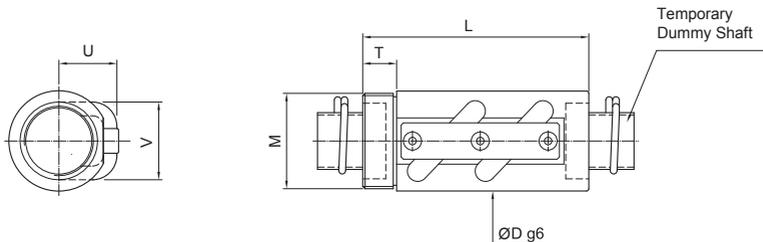
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD/(kgf)		BALLNUT DIMENSION													
O.D.	LEAD			Dynamic (1×10 ⁶ REV.) Ca	Static Co	O.D. D	Length L	Flange A T W H				Return tube U V		Assembly Hole X	Oil Hole Q	STIFFNESS kgf/μm	Nut Model NO.		
50	10	6.35	1.5x2	2510	9000	84											31	FSVW5010F-3.0P	
			2.5x1	2150	7500	74												39	FSVW5010F-2.5P
			2.5x2	3890	15000	78	104	119	18	98	52	48						73	FSVW5010F-5.0P
			2.5x3	5510	22500	134												105	FSVW5010F-7.5P
			3.5x1	2870	10500	84												53	FSVW5010F-3.5P
			3.5x2	4940	21000	80	125	138	22	110	52		18		M6x1P		98	FSVW5010F-7.0P	

Note:

Stiffness of nut:

Stiffness values listed above are derived from theoretical formula to the elastic deformation between thread grooves and balls while axial load is 30% dynamic load rating.

RSVW



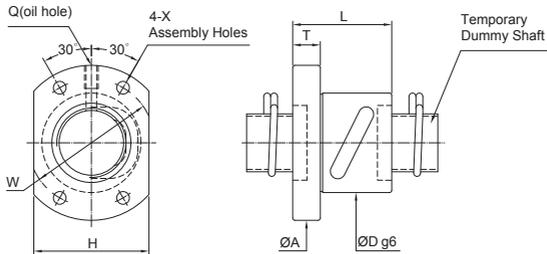
Unit: mm

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD (kgf)		BALLNUT DIMENSION							
O.D.	LEAD			Dynamic (1×10 ⁶ REV.) Ca	Static Co	O.D. D	Length L	Flange M	Return tube T	U	V	STIFFNESS kgf/μm	Nut Model NO.
14	4	2.381	3.5×1	500	1100	25	42	M24×1.0P	10	19	21	15	RSVW1404A-3.5P
	5	3.175	2.5×1	515	990	30	43	M26×1.5P	10	22	21	11	RSVW1405B-2.5P
20	5	3.175	2.5×1	625	1450	40	43	M36×1.5P	12	28	27	15	RSVW2005B-2.5P
25	5	3.175	2.5×1	720	1830	48	63	M40×1.5P	15	28	32	18	RSVW2505B-2.5P
			2.5×2	1120	3710	42	63	M40×1.5P	15	28	32	37	RSVW2505B-5.0P
	10	6.350	2.5×1	1720	3590	68	98	M42×1.5P	15	34	37	21	RSVW2510F-2.5P
			2.5×2	3200	7170	44	98	M42×1.5P	15	34	37	40	RSVW2510F-5.0P
32	10	6.350	2.5×1	1930	4680	72	101	M50×1.5P	18	39	44	25	RSVW3210F-2.5P
			2.5×2	3130	9410	55	101	M50×1.5P	18	39	44	49	RSVW3210F-5.0P
40	10	6.350	3.5×2	4450	16800	65	128	M60×2.0P	25	44	52	81	RSVW4010F-7.0P
50	10	6.350	3.5×2	4940	21000	80	143	M75×2.0P	40	52	62	98	RSVW5010F-7.0P

Note:

Stiffness of nut:

Stiffness values listed above are derived from theoretical formula to the elastic deformation between thread grooves and balls while axial load is 30% dynamic load rating.



Unit: mm

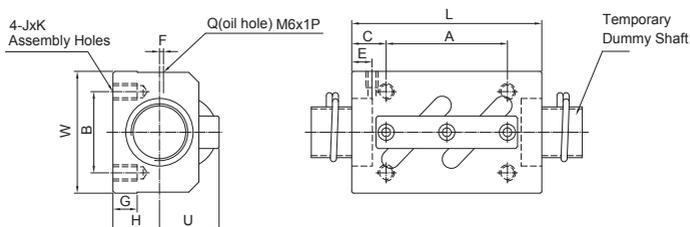
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit X row	BASIC RATE LOAD(kgf)		BALLNUT DIMENSION									
O.D.	LEAD			Dynamic (1x10 ⁶ REV.) Ca	Static Co	O.D. D	Length L	Flange A T W H			Assembly Hole X	Oil Hole Q	STIFFNESS kgf/µm	Nut Model NO.	
12	5	2.000	2.5x1	270	350	26	40	47	10	37	30	4.5	M6x1P	8.2	FSBW1205Z-2.5P
14	4	2.381	3.5x1	500	1100	31	40	50	10	40	37	4.5	M6x1P	15	FSBW1404A-3.5P
	5	3.175	2.5x1	515	990	32	40	50	10	40	38	4.5	M6x1P	11	FSBW1405B-2.5P
16	5	3.175	2.5x1	570	1130	34	40	54	10	44	40	4.5	M6x1P	13	FSBW1605B-2.5P
20	4	2.381	2.5x1	415	850	40	41	59	10	50	46	4.5	M6x1P	14	FSBW2004A-2.5P
	5	3.175	2.5x1	620	1450	40	40	59	10	50	46	4.5	M6x1P	16	FSBW2005B-2.5P
25	4	2.381	2.5x1	450	980	43	41	67	10	55	50	4.5	M6x1P	17	FSBW2504A-2.5P
	5	3.175	2.5x1	720	1830	43	40	67	10	55	50	5.5	M6x1P	18	FSBW2505B-2.5P

Note:

Stiffness of nut:

Stiffness values listed above are derived from theoretical formula to the elastic deformation between thread grooves and balls while axial load is 30% dynamic load rating.

SSVW



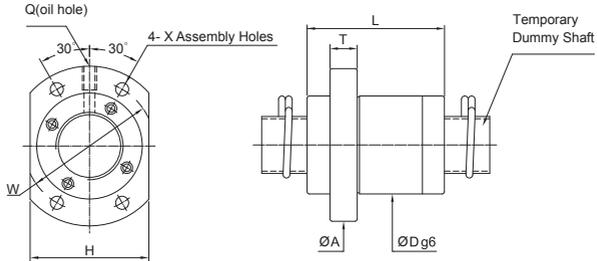
Unit: mm

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit x row	BASIC RATE LOAD (kgf)		BALLNUT DIMENSION												
O.D.	LEAD			Dynamic (1×10 ⁶ REV.) Ca	Static Co	Length L	Width W	Height H	Assembly Hole				Position of Oil Hole		Height from Reference Surface		STIFFNESS kgf/μm	Nut Model NO.
14	4	2.381	3.5×1	500	1110	35	34	13	22	26	6.5	M4×7	6	2	6	18	15	SSVW1404A-3.5P
	5	3.175	2.5×1	515	990	35	34	13	22	26	6.5	M4×7	6	2	6	18	11	SSVW1405B-2.5P
16	5	3.175	2.5×1	590	1210	35	42	16	22	32	6.5	M5×8	6	2	8	21	13	SSVW1605B-2.5P
	5	3.175	2.5×1	625	1450	35	48	17	22	35	6.5	M6×10	6	3	9.15	22	15	SSVW2005B-2.5P
20	10	4.762	2.5×1	1100	2220	58	48	18	35	35	11.5	M6×10	10	2	9.5	25	16	SSVW2010D-2.5P
	5	3.175	2.5×1	720	1830	35	60	20	22	40	6.5	M8×12	7	5	9.5	25	18	SSVW2505B-2.5P
25	10	6.350	2.5×2	3240	7170	94	60	23	60	40	17	M8×12	10	-	10	30	40	SSVW2510F-5.0P
	6	3.175	2.5×2	1380	4140	67	60	22	40	40	13.5	M8×12	8	5	10	27	39	SSVW2806B-5.0P
32	10	6.350	2.5×1	1930	4680	64	70	26	45	50	9.5	M8×12	10	-	12	36	25	SSVW3210F-2.5P
			2.5×2	3130	9410	94			60	17	17							

Note:

Stiffness of nut:

Stiffness values listed above are derived from theoretical formula to the elastic deformation between thread grooves and balls while axial load is 30% dynamic load rating.



Unit: mm

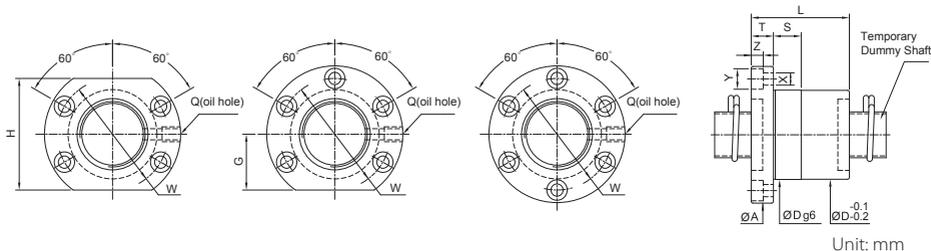
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD(kgf)		BALLNUT DIMENSION									
O.D.	LEAD			Dynamic (1×10 ⁴ REV.) Ca	Static Co	O.D.	Length	Flange				Assembly Hole X	Oil Hole Q	STIFFNESS kgf/μm	Nut Model NO.
						D	L	A	T	W	H				
15	10	3.175	2.8×2	1000	2570	34	44	57	10	45	40	5.5	M6×1P	26	FSKW1510B-5.6P
16	16	3.175	1.8×1	330	640	32	38	53	10	42	38	4.5	M6×1P	9	FSKW1616B-1.8P
20	20	3.175	1.8×2	780	2280	39	52	62	10	50	46	5.5	M6×1P	21	FSKW2020B-3.6P
25	25	3.969	1.8×2	1230	3570	47	62	74	12	60	56	6.6	M6×1P	27	FSKW2525C-3.6P
			1.8×4	2230	7140									52	
32	32	4.762	1.8×2	1760	5500	58	70	92	15	74	68	9	M6×1P	33	FSKW3232D-3.6P
			1.8×4	3200	11000									65	
40	40	6.350	1.8×2	2870	9170	73	95	114	17	93	84	11	M6×1P	42	FSKW4040F-3.6P
			1.8×4	5220	18340									81	

Note:

Stiffness of nut:

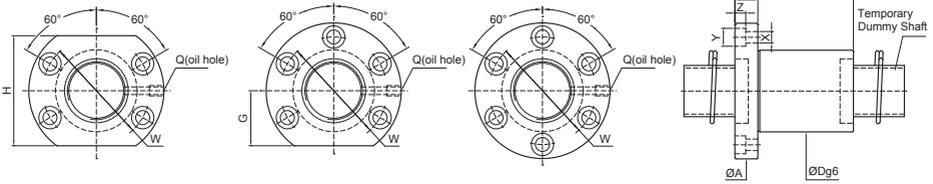
Stiffness values listed above are derived from theoretical formula to the elastic deformation between thread grooves and balls while axial load is 30% dynamic load rating.

FSIW



Unit: mm

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD/(kgf)		BALLNUT DIMENSION														STIFFNESS kgf/µm	Nut Model NO.
O.D.	LEAD			Dynamic (1×10 ⁵ REV.) Ca	Static Co	O.D.	Length	Flange				Assembly Hole			Oil Hole						
						D	L	A	T	W	G	H	X	Y	Z	Q					
14	4	2.381	3	310	670	26	42	46	10	36	20	40	4.5	8	4.5	M6x1P	12	FSIW1404A-3.0P			
			4	400	890		47	48.5	10	39	20	40	4.5	8	4.5	M6x1P	18	FSIW1404A-4.0P			
16	4	2.381	3	320	760	28	42	48.5	10	39	20	40	4.5	8	4.5	M6x1P	13	FSIW1604A-3.0P			
			4	570	1030		42	49	10	39	20	40	4.5	8	4.5	M6x1P	17	FSIW1605B-3.0P			
20	5	3.175	3	730	1370	30	49	49	10	39	20	40	4.5	8	4.5	M6x1P	19	FSIW1605B-4.0P			
			4	450	1270	34	44	60	12	48	22	44	5.5	9.5	5.5	M6x1P	19	FSIW2004A-4.0P			
25	4	2.381	3	650	1420		47	17	48	22	44	5.5	9.5	5.5	M6x1P	17	FSIW2005B-3.0P				
			4	830	1890	34	53	57	12	45	20	40	5.5	9.5	5.5	M6x1P	21	FSIW2005B-4.0P			
28	5	3.175	3	1180	2840		62	63	12	51	22	44	5.5	9.5	5.5	M8x1P	32	FSIW2005B-6.0P			
			4	380	1195	40	40	63	12	51	22	44	5.5	9.5	5.5	M8x1P	17	FSIW2504A-3.0P			
32	4	2.381	3	730	1820		47	68.5	15	55	26	52	6.6	11	6.5	M8x1P	20	FSIW2505B-3.0P			
			4	940	2420	40	53	63.5	12	51	22	44	5.5	9.5	5.5	M8x1P	26	FSIW2505B-4.0P			
36	5	3.175	3	1140	3030		57	68	12	55	26	52	6.6	11	6.5	M8x1P	32	FSIW2505B-5.0P			
			4	1215	2660		80	78	12	55	26	52	6.6	11	6.5	M8x1P	22	FSIW2510D-3.0P			
40	4	2.381	3	1550	3540	42	85	88	16	70	34	68	9	14	8.5	M8x1P	28	FSIW2510D-4.0P			
			4	1880	4430		91	98	18	77	36	72	11	17.5	11	M8x1P	34	FSIW2510D-5.0P			
45	6	3.175	3	770	2180	43	50	98	18	77	36	72	11	17.5	11	M8x1P	22	FSIW2806B-3.0P			
			4	820	2540		47	73.5	12	60	30	60	6.6	11	6.5	M8x1P	24	FSIW2806B-4.0P			
50	5	3.175	3	1050	3390	48	53	73.5	12	60	30	60	6.6	11	6.5	M8x1P	32	FSIW2806B-5.0P			
			4	1490	5090		62	88	16	70	34	68	9	14	8.5	M8x1P	46	FSIW3205B-3.0P			
55	3	2.381	3	1960	4410	50	80	88	16	70	34	68	9	14	8.5	M8x1P	28	FSIW3205B-4.0P			
			4	2510	5880	54	90	98	18	77	36	72	11	17.5	11	M8x1P	34	FSIW3205B-6.0P			
60	10	6.35	3	2010	5150	58	78	98	18	77	36	72	11	17.5	11	M8x1P	28	FSIW3210F-3.0P			
			4	2570	6870		89	98	18	77	36	72	11	17.5	11	M8x1P	34	FSIW3210F-4.0P			
65	3	2.381	3	2010	5150	58	78	98	18	77	36	72	11	17.5	11	M8x1P	30	FSIW3610F-3.0P			
			4	2570	6870		89	98	18	77	36	72	11	17.5	11	M8x1P	39	FSIW3610F-4.0P			



Unit: mm

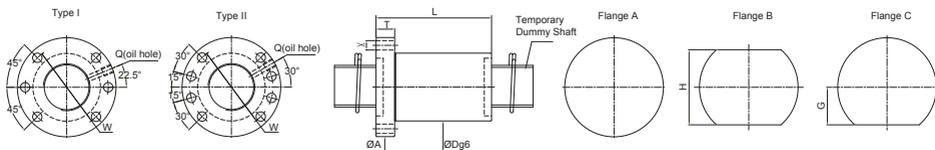
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD/(kgf)		BALLNUT DIMENSION													
O.D.	LEAD			Dynamic (1×10 ⁶ REV.) Ca	Static Co	O.D. D	Length L	Flange				Assembly Hole			Oil Hole Q	STIFFNESS kgf/μm	Nut Model NO.		
							A	T	W	G	H	X	Y	Z					
40	5	3.175	4	1180	4390	56											38	FSIW4005B-4.0P	
			5	1430	5490	55	61	88.5	16	72	29	58	15	9	14	M8x1P	46	FSIW4005B-5.0P	
	10	6.35	6	1670	6590	65											55	FSIW4005B-6.0P	
			3	2050	5900	83												33	FSIW4010F-3.0P
			4	2630	7860	64	93	106	18	84	43	86	11	17.5	11	M8x1P	41	FSIW4010F-4.0P	
50	10	6.35	5	3190	9830	99											52	FSIW4010F-5.0P	
			3	2160	7720	83												39	FSIW5010F-3.0P
			4	2770	10290	74	93	116	18	94	42	84	11	17.5	11	M8x1P	50	FSIW5010F-4.0P	
			5	3360	12860	99												62	FSIW5010F-5.0P
			6	3920	15440	114											73	FSIW5010F-6.0P	

Note:

Stiffness of nut:

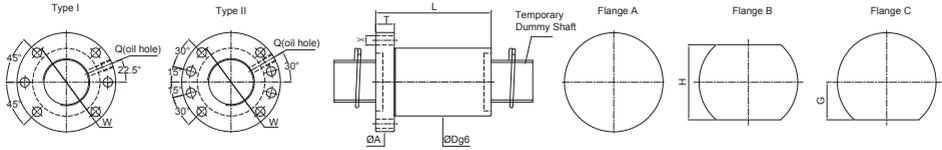
Stiffness values listed above are derived from theoretical formula to the elastic deformation between thread grooves and balls while axial load is 30% dynamic load rating.

FSDW



Unit: mm

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS	MODIFIED LOAD CAPACITY (kgf)		BALLNUT DIMENSION												
O.D.	LEAD			Dynamic (1×10 ⁶ REV.) Cam	Static Coam	O.D. D	Length L	Flange					Oil Hole Q	Assembly Hole X	STIFFNESS kgf/μm	Nut Model NO.		
12	4	2.381	3	410	990	24	28	44	10	34	16	32	I	M6x1P	4.5	13	FSDW1204A-3.0P	
	4	2.381	4	460	1210	26	28	46	10	36	17	34	I	M6x1P	4.5	14	FSDW1404A-3.0P	
14	5	3.175	3	550	1260	29	32	51	10	36	16	32	I	M6x1P	5.5	14	FSDW1405B-3.0P	
	5	3.175	4	590	1610	29	32	51	10	36	16	32	I	M6x1P	5.5	18	FSDW1404A-4.0P	
15	10	3.175	3	560	1340	29	47	51	10	39	19	38	I	M6x1P	5.5	15	FSDW1510B-3.0P	
	5	3.175	3	600	1460	29	35	51	10	39	19	38	I	M6x1P	5.5	16	FSDW1605B-3.0P	
16	10	3.175	3	580	1440	29	50	51	10	39	19	38	I	M6x1P	5.5	15	FSDW1610B-3.0P	
	16	3.175	2	400	950	29	51	51	10	39	19	38	I	M6x1P	5.5	11	FSDW1616B-2.0P	
20	4	2.381	3	520	1660	32	28	54	12	42	19	38	I	M6x1P	4.5	18	FSDW2004A-3.0P	
	5	3.175	3	670	1860	36	35	62	12	49	24	48	I	M6x1P	5.5	19	FSDW2005B-3.0P	
	5	3.175	4	870	2480	36	40	62	12	49	24	48	I	M6x1P	5.5	24	FSDW2005B-4.0P	
	10	4.762	3	1320	3390	40	52	62	12	51	24	48	I	M6x1P	6.6	21	FSDW2010D-3.0P	
25	20	3.175	2	450	1200	36	56	62	12	49	24	48	I	M6x1P	6.6	13	FSDW2020B-2.0P	
	4	2.381	3	580	2120	37	28	62	12	49	22	44	I	M6x1P	6.6	21	FSDW2504A-3.0P	
	5	3.175	3	740	2350	36	35	62	12	49	22	44	I	M6x1P	6.6	21	FSDW2505B-3.0P	
	5	3.175	4	960	3190	40	41	62	12	51	24	48	I	M6x1P	6.6	28	FSDW2505B-4.0P	
	5	3.175	5	1180	4030	46	46	62	12	51	24	48	I	M6x1P	6.6	35	FSDW2505B-5.0P	
	4.762	4	1920	5700	45	63	65	15	54	25.5	51	I	M6x1P	6.6	32	FSDW2510D-4.0P		
	10	3	2130	5570	58	87	16	72	34.5	69	I	M8x1P	9	27	FSDW2510F-3.0P			
	6.35	5	3380	9550	51	78	87	16	72	34.5	69	I	M8x1P	9	42	FSDW2510F-5.0P		
28	25	3.969	2	780	2260	43	71	64	12	51	24	48	I	M6x1P	6.6	16	FSDW2525C-2.0P	
	5	3.175	5	1240	4530	43	48	65	12	51	24	48	I	M8x1P	6.6	38	FSDW2805B-5.0P	
32	5	3.175	4	1080	4130	50	41	87	16	72	34.5	69	I	M8x1P	9	34	FSDW3205B-4.0P	
	10	6.35	3	2410	7020	57	58	87	16	72	34.5	69	I	M8x1P	9	32	FSDW3210F-3.0P	
	5	3.175	5	3820	12030	78	78	87	16	72	34.5	69	I	M8x1P	9	50	FSDW3210F-5.0P	
32	4.762	2	1100	3420	53	90	87	16	72	34.5	69	I	M8x1P	9	20	FSDW3232D-2.0P		



Unit: mm

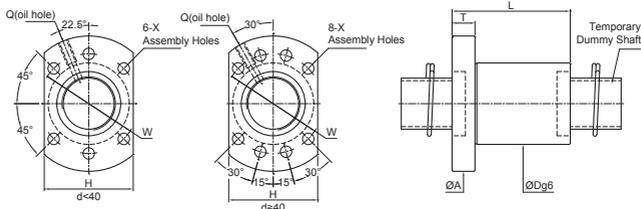
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS	MODIFIED LOAD CAPACITY (kgf)		BALLNUT DIMENSION											
O.D.	LEAD			Dynamic (1×10 ⁶ REV.) Cam	Static Coam	O.D.	Length	Flange						Oil Hole	Assembly Hole	STIFFNESS	Nut Model NO.
						D	L	A	T	W	G	H	TYPE	Q	X	kgf/μm	
36	10	6.35	3	2560	8250	70	58	91	18	76	34	68	I	M6x1P	9	52	FSDW3610F-3.0P
			5	3970	13750	61	78	91	18	76	34	68	II	M6x1P	9	55	FSDW3610F-5.0P
40	10	6.35	5	1180	5200	60	42	91	18	76	34	68	II	M8x1P	9	40	FSDW4005B-4.0P
			4	4290	15290	65	78	95	18	80	36	72	II	M8x1P	9	59	FSDW4010F-5.0P
			2	3480	11990	65	110	98	18	83	37	74	I	M8x1P	11	48	FSDW4020F-4.0P
			4	1810	5770												
50	10	6.35	5	4780	19360	75	78	118	18	100	46	92	II	M8x1P	11	70	FSDW5010F-5.0P

Note:

1. Cam and Coam represent the enhanced dynamic- and static load. Their calculations referred to the standard of ISO-3408-5.
2. Stiffness of nut:

Stiffness values listed above are derived from theoretical formula to the elastic deformation between thread grooves and balls while axial load is 30% dynamic load rating.

FSIN



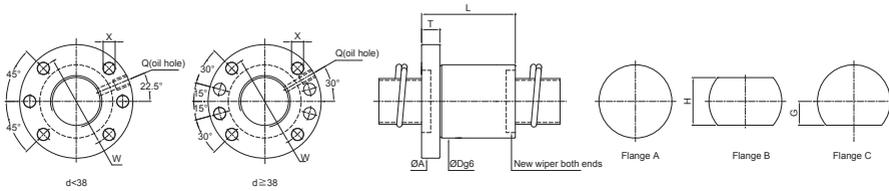
Unit: mm

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS	MODIFIED LOAD CAPACITY (kgf)		BALLNUT DIMENSION										
O.D.	LEAD			Dynamic (1×10 ⁶ REV.) Cam	Static Coam	O.D.	Length	Flange					Oil Hole	Assembly Hole	STIFFNESS	Nut Model NO.
						D	L	A	T	W	G	H	Q	X	kgf/μm	
16	5	3.175	3	1050	2200	28	42	48	10	38	20	40	M6×1P	5.5	17	FSIN1605B-3.0P
20	5	3.175	3	1200	2780	36	44	58	12	47	22	44	M6×1P	6.5	24	FSIN2005B-3.0P
			4	1530	3720											
25	5	3.175	3	1320	3540	40	44	62	12	51	24	48	M6×1P	6.5	28	FSIN2505B-3.0P
			4	1700	4720											
	10	4.762	4	2900	6990		85	62	12	51	24	48	M6×1P	6.5	32	FSIN2510D-4.0P
32	5	3.175	3	1470	4560		47								37	FSIN3205B-3.0P
			4	1900	6090	50	50	80	12	65	31	62	M6×1P	9	50	FSIN3205B-4.0P
			6	2690	9150		66									69
	10	6.35	3	3680	8750		74							39	FSIN3210F-3.0P	
			4	4720	11670	50	80	80	13	65	31	62	M6×1P	9	50	FSIN3210F-4.0P
40	5	3.175	4	2090	7670		54								52	FSIN4005B-4.0P
			6	2940	11510		66								77	FSIN4005B-6.0P
	10	6.35	3	4140	11130	63	74	93	15	78	35	70	M8×1P	9	46	FSIN4010F-3.0P
			4	5310	14850		82								60	FSIN4010F-4.0P
50	10	6.35	3	4610	14090		78								54	FSIN5010F-3.0P
			4	5890	18780	75	88	110	18	93	42.5	85	M8×1P	11	70	FSIN5010F-4.0P
			6	8350	28170		106							103	FSIN5010F-6.0P	

Note:

- Cam and Coam represent the enhanced dynamic- and static load. Their calculations referred to the standard of DIN 69051.
- Stiffness of nut:

Stiffness values listed above are derived from theoretical formula to the elastic deformation between thread grooves and balls while axial load is 30% dynamic load rating.



Unit: mm

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS	MODIFIED LOAD CAPACITY (kgf)		BALLNUT DIMENSION										
O.D.	LEAD			Dynamic (1×10 ⁶ REV) Cam	Static Coam	O.D. D	Length L	Flange					Oil Hole Q	Assembly Hole X	STIFFNESS kgf/μm	Nut Model NO.
15	5	3	4	1210	2130	28	39	48	10	38	20	40	M6×1P	5.5	22	FSDN1605V-4.0P
	10		3	950	1650	28	47	48	10	38	20	40	M6×1P	5.5	17	FSDN1605V-3.0P
	16		3	910	1600	28	64	48	10	38	20	40	M6×1P	5.5	17	FSDN1605V-3.0P
20	5	3.175	4	1570	3270	36	40	58	10	47	22	44	M6×1P	6.6	28	FSDN2005B-4.0P
	20		4	1460	3120	36	58	58	10	47	22	44	M6×1P	6.6	28	FSDN2020B-4.0P
25	5	3.175	5	2130	5230	40	46	62	10	51	24	48	M6×1P	6.6	41	FSDN2505B-5.0P
	10		4	1740	4120	40	60	62	10	51	24	48	M6×1P	6.6	33	FSDN2510B-4.0P
	25		4	1610	3900	40	68	62	10	51	24	48	M6×1P	6.6	33	FSDN2525B-4.0P
32	5	3.175	6	2800	8180	50	53	80	12	65	31	62	M6×1P	9	59	FSDN3205B-6.0P
	10		5	3240	8480	50	73	80	12	65	31	62	M6×1P	9	52	FSDN3210C-5.0P
	20		3.969	4	2600	6630	50	101	80	12	65	31	62	M6×1P	9	42
	32	4	2460	6340	50	84	80	12	65	31	62	M6×1P	9	41	FSDN3232C-4.0P	
38	10	6.35	5	6500	15610	63	78	93	14	78	35	70	M8×1P	9	64	FSDN3810F-5.0P
	20		4	5250	12240	63	107	93	14	78	35	70	M8×1P	9	52	FSDN3820F-4.0P
	40		4	4940	11770	63	104	93	14	78	35	70	M8×1P	9	51	FSDN3840F-4.0P

Note:

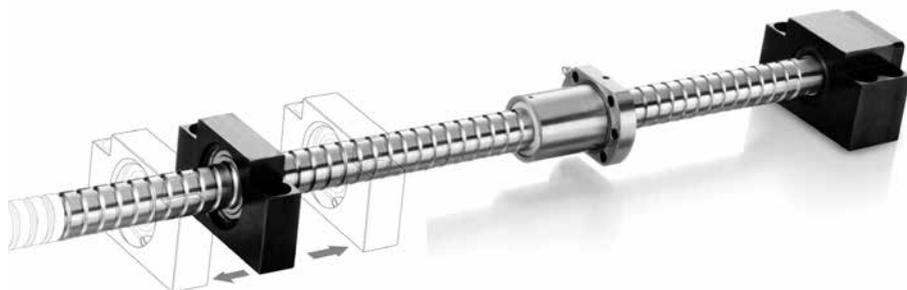
1. Cam and Coam represent the enhanced dynamic- and static load. Their calculations referred to the standard of DIN 69051.

2. Stiffness of nut:

Stiffness values listed above are derived from theoretical formula to the elastic deformation between thread grooves and balls while axial load is 30% dynamic load rating.

15 FA Series

The new circulation design of *PMI* FA series of precision ballscrews carried out the advantages of High Speed, Low Noise, Efficiency, and Standardization for different kinds of application.



Features

Short Delivery

In order to achieve the purpose of standardized stock for short delivery time, the precise outer diameter of screw shaft is used for support bearing seat.

Flexibility of stroke length

Due to the precise outer diameter of screw shaft is used for support bearing seat, the specific length of shaft can be freely cut from standardized screw shaft. Therefore, the flexible stroke length is allowable for simple support end.

High accuracy with reasonable price

The accuracy can be as higher as JIS C5 grade and with axial clearance within $5\ \mu\text{m}$.

Space saving

Comparing with conventional ballscrew, the outer diameter of nut is reduced as 20~25% as much, and the nut length is also shorter than usual. Therefore, the mounting space can be saved from engineering design.

High speed and lower noise

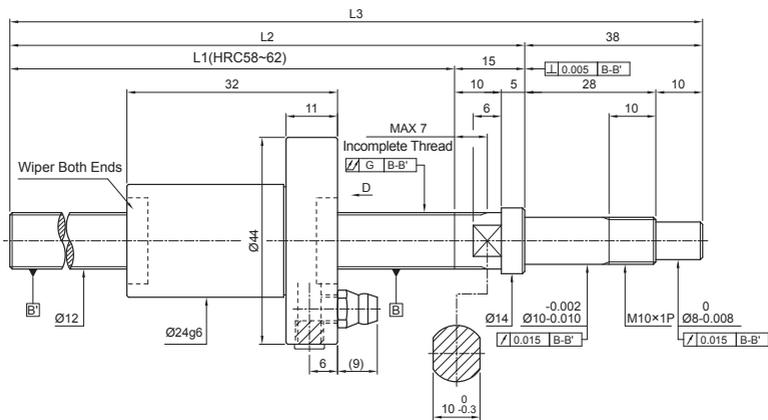
Taking advantage of *PMI* unique technology of high-speed, noise reduction, the rotation speed can be as higher as 5000 *rpm*. Moreover, due to the design of special circulation system, the vibration and noise(6 db less) are much lower than conventional type of ballscrew.

Application range

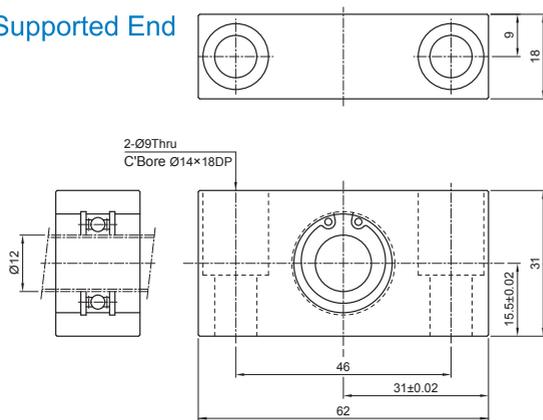
Semiconductor equipments, Measuring devices, Inspection equipments, Medical equipments, Automation, Light load machining, Glue depositing, and other precision motion and positioning applications.

FA Series Ballscrews

Screw Dia. $\varnothing 12$ Lead 05

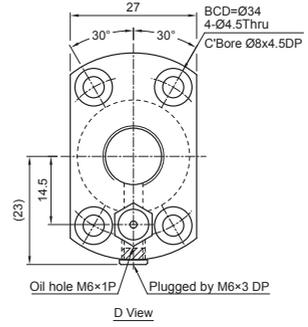


Supported End

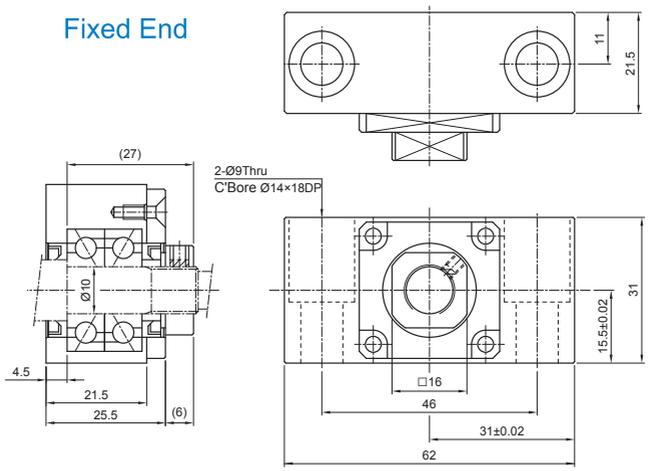


Model No.	Screw Dia.	Lead	Modified Load Capacity(kgf)		Screw Shaft Length			Accuracy Grade
	d	l	Dynamic Cam	Static Coam	L1	L2	L3	
BL012050400+A000	12	05	610	1190	347	362	400	C5
BL012050600+A000	12	05	610	1190	547	562	600	C5
BL012050900+A000	12	05	610	1190	847	862	900	C5

Coam and Cam are the modified static and dynamic load capacities, calculated according to ISO-3408-5



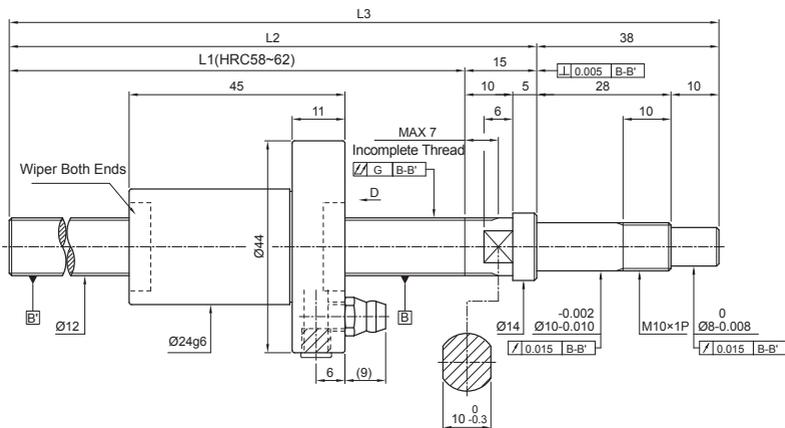
Fixed End



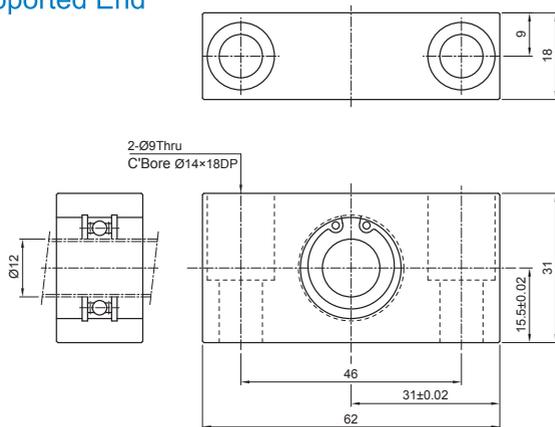
Unit: mm

Axial Play	Lead Accuracy			Tolerances	Fixed End-bearing (kgf)		Supported End-bearing (kgf)	
	Specified Travel (T)	Accumulated reference lead deviation (E)	Lead Deriation in random 300mm (e300)		Overall Radial Runout	Dynamic Ca	Static Co	Dynamic Ca
<0.005	0	0.023	0.018	0.065	546	265	196	106
<0.005	0	0.027	0.018	0.090	546	265	196	106
<0.005	0	0.035	0.018	0.150	546	265	196	106

FA FA Series Ballscrews
Screw Dia. $\varnothing 12$ Lead 10

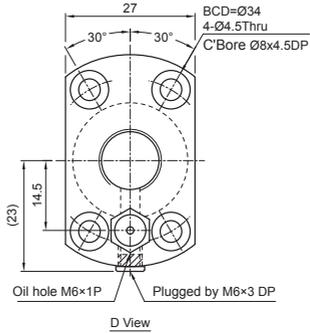


Supported End

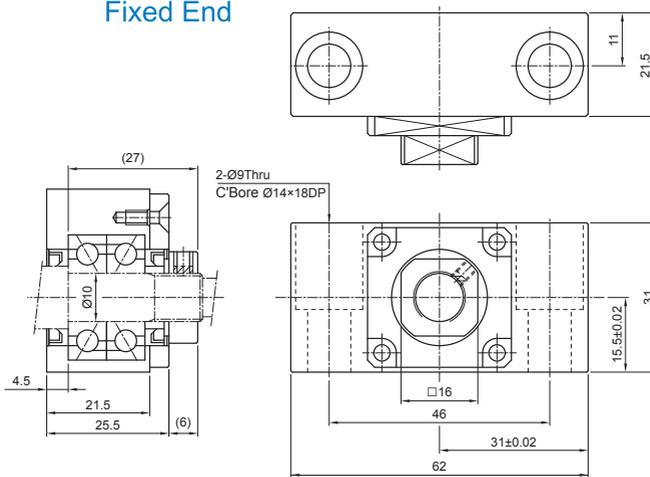


Model No.	Screw Dia.	Lead	Modified Load Capacity(kgf)		Screw Shaft Length			Accuracy Grade
	d	l	Dynamic Cam	Static Coam	L1	L2	L3	
BL012100400+A000	12	10	590	1160	347	362	400	C5
BL012100600+A000	12	10	590	1160	547	562	600	C5
BL012100900+A000	12	10	590	1160	847	862	900	C5

Coam and Cam are the modified static and dynamic load capacities,calculated according to ISO-3408-5



Fixed End

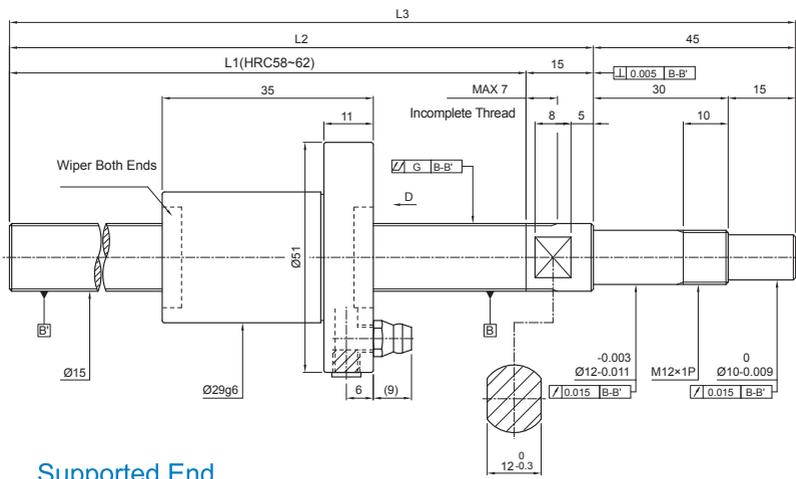


Unit: mm

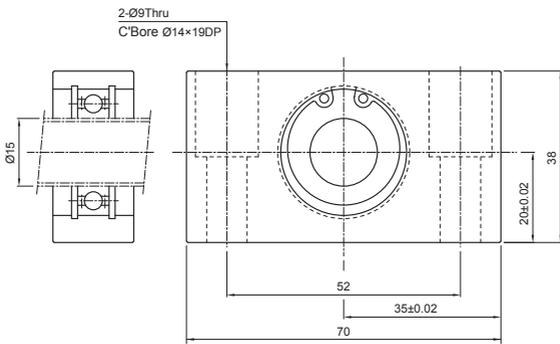
Axial Play	Lead Accuracy			Tolerances	Fixed End-bearing (kgf)		Supported End-bearing (kgf)	
	Specified Travel (T)	Accumulated reference lead deviation (E)	Lead Deriation in random 300mm (e300)		Overall Radial Runout	Dynamic Ca	Static Co	Dynamic Ca
<0.005	0	0.023	0.018	0.065	546	265	196	106
<0.005	0	0.027	0.018	0.090	546	265	196	106
<0.005	0	0.035	0.018	0.150	546	265	196	106

FA Series Ballscrews

Screw Dia. $\varnothing 15$ Lead 05

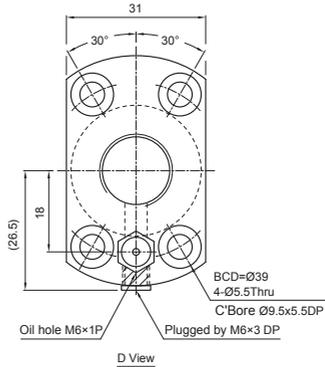


Supported End

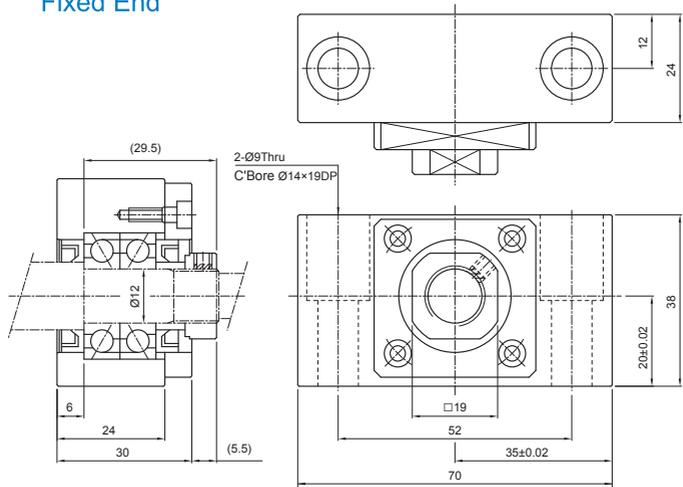


Model No.	Screw Dia.	Lead	Modified Load Capacity(kgf)		Screw Shaft Length			Accuracy Grade
	d	l	Dynamic Cam	Static Coam	L1	L2	L3	
BL015050500+A000	15	05	850	1640	440	455	500	C5
BL015051000+A000	15	05	850	1640	940	955	1000	C5
BL015051450+A000	15	05	850	1640	1390	1405	1450	C5

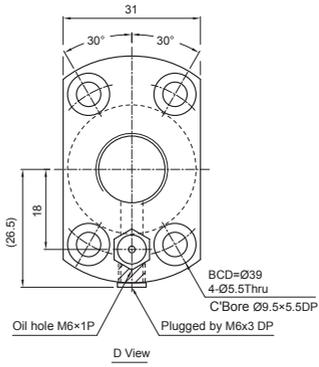
Coam and Cam are the modified static and dynamic load capacities,calculated according to ISO-3408-5



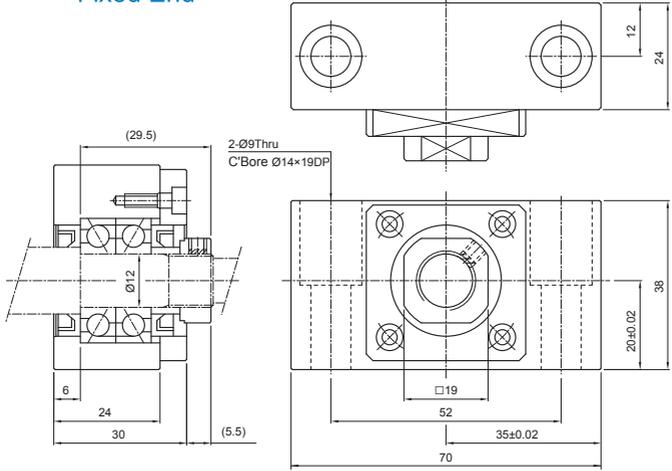
Fixed End



Axial Play	Lead Accuracy			Tolerances	Fixed End-bearing (kgf)		Supported End-bearing (kgf)	
	Specified Travel (T)	Accumulated reference lead deviation (E)	Lead Deriation in random 300mm (e300)		Overall Radial Runout	Dynamic Ca	Static Co	Dynamic Ca
<0.005	0	0.025	0.018	0.060	592	304	372	204
<0.005	0	0.040	0.018	0.120	592	304	372	204
<0.005	0	0.054	0.018	0.190	592	304	372	204



Fixed End

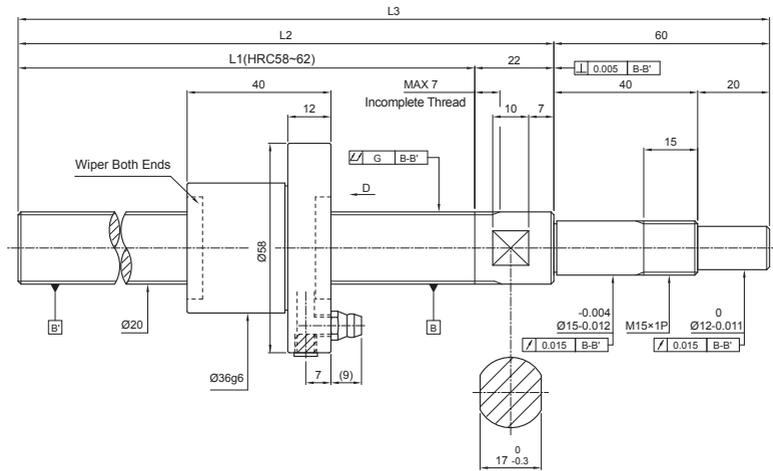


Unit: mm

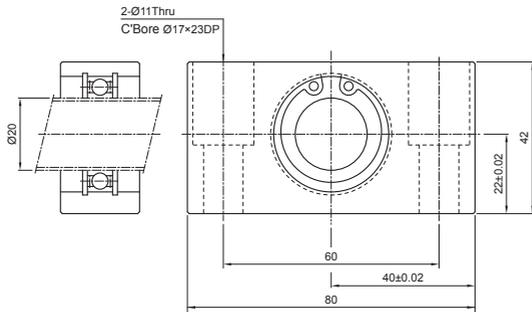
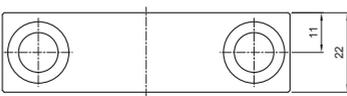
Axial Play	Lead Accuracy			Tolerances	Fixed End-bearing (kgf)		Supported End-bearing (kgf)	
	Specified Travel (T)	Accumulated reference lead deviation (E)	Lead Deriation in random 300mm (e300)		Overall Radial Runout	Dynamic Ca	Static Co	Dynamic Ca
<0.005	0	0.025	0.018	0.060	592	304	372	204
<0.005	0	0.040	0.018	0.120	592	304	372	204
<0.005	0	0.054	0.018	0.190	592	304	372	204

FA Series Ballscrews

Screw Dia. $\varnothing 20$ Lead 05

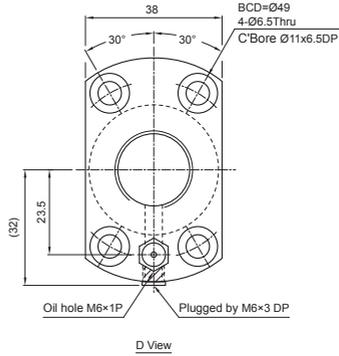


Supported End

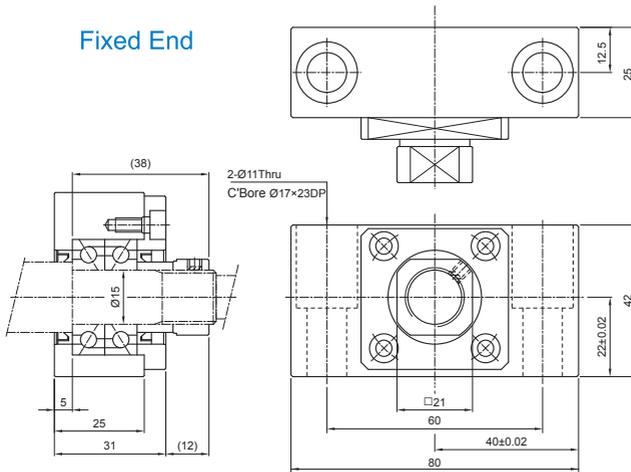


Model No.	Screw Dia.	Lead	Modified Load Capacity(kgf)		Screw Shaft Length			Accuracy Grade
	d	l	Dynamic Cam	Static Coam	L1	L2	L3	
BL020050600+A000	20	05	1300	3030	518	540	600	C5
BL020051000+A000	20	05	1300	3030	918	940	1000	C5
BL020051450+A000	20	05	1300	3030	1368	1390	1450	C5

Coam and Cam are the modified static and dynamic load capacities,calculated according to ISO-3408-5

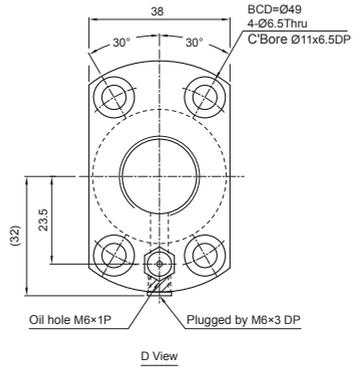


Fixed End

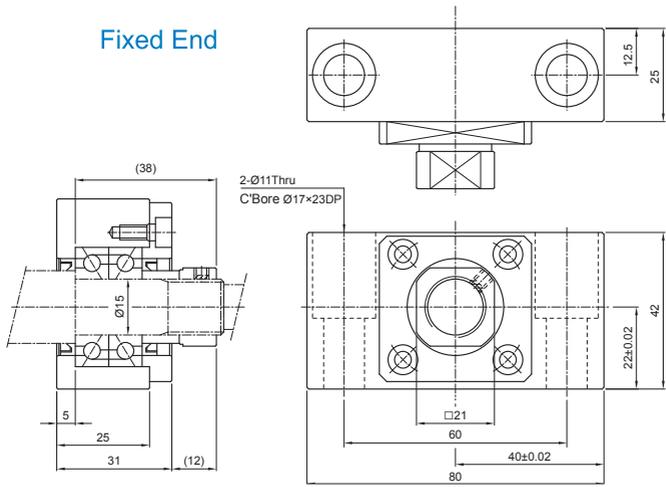


Unit: mm

Axial Play	Lead Accuracy			Tolerances	Fixed End-bearing (kgf)		Supported End-bearing (kgf)	
	Specified Travel (T)	Accumulated reference lead deviation (E)	Lead Deriation in random 300mm (e300)		Overall Radial Runout	Dynamic Ca	Static Co	Dynamic Ca
<0.005	0	0.030	0.018	0.075	622	352	408	252
<0.005	0	0.040	0.018	0.120	622	352	408	252
<0.005	0	0.054	0.018	0.190	622	352	408	252

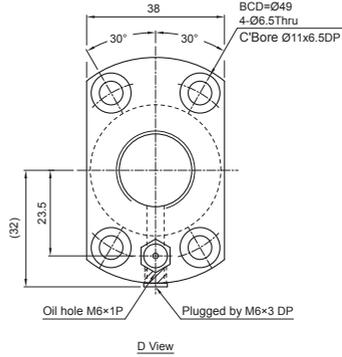


Fixed End

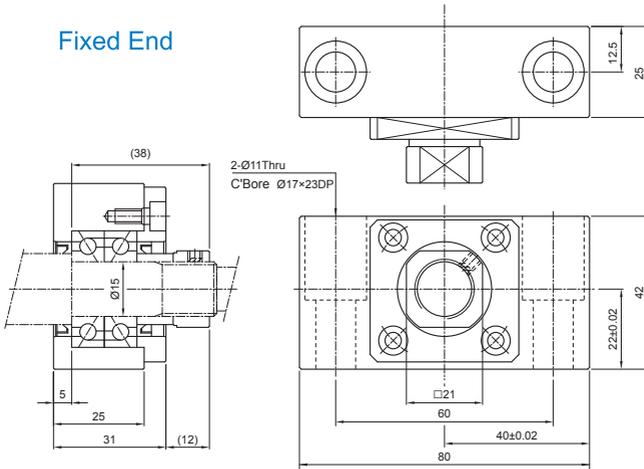


Unit: mm

Axial Play	Lead Accuracy			Tolerances	Fixed End-bearing (kgf)		Supported End-bearing (kgf)	
	Specified Travel (T)	Accumulated reference lead deviation (E)	Lead Deriation in random 300mm (e300)		Overall Radial Runout	Dynamic Ca	Static Co	Dynamic Ca
<0.005	0	0.030	0.018	0.075	622	352	408	252
<0.005	0	0.040	0.018	0.120	622	352	408	252
<0.005	0	0.054	0.018	0.190	622	352	408	252

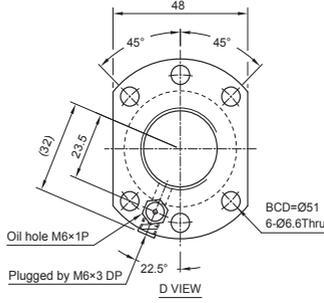


Fixed End

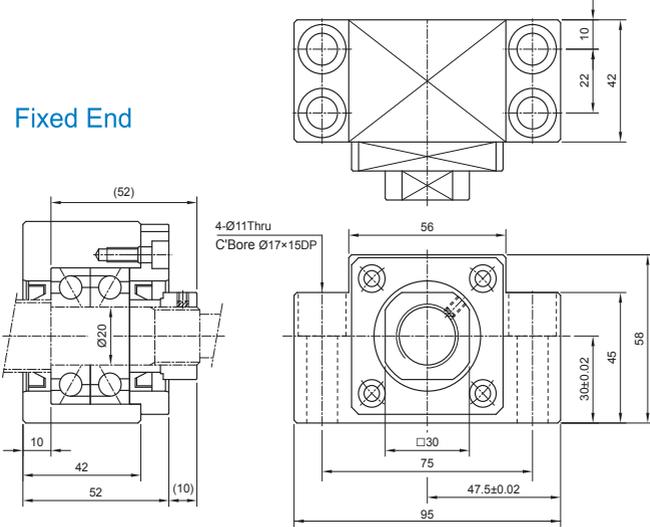


Unit: mm

Axial Play	Lead Accuracy			Tolerances	Fixed End-bearing (kgf)		Supported End-bearing (kgf)	
	Specified Travel (T)	Accumulated reference lead deviation (E)	Lead Deriation in random 300mm (e300)		Overall Radial Runout	Dynamic Ca	Static Co	Dynamic Ca
<0.005	0	0.027	0.018	0.075	622	352	408	252
<0.005	0	0.040	0.018	0.120	622	352	408	252
<0.005	0	0.054	0.018	0.190	622	352	408	252

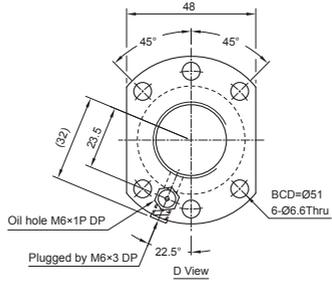


Fixed End

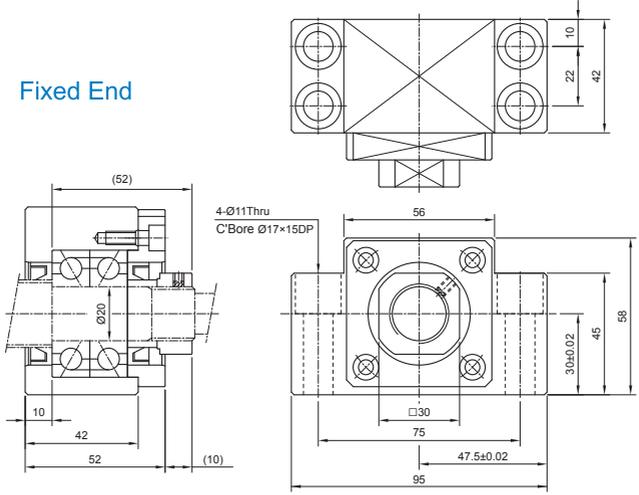


Unit: mm

Axial Play	Lead Accuracy			Tolerances	Fixed End-bearing (kgf)		Supported End-bearing (kgf)	
	Specified Travel (T)	Accumulated reference lead deviation (E)	Lead Deriation in random 300mm (e300)		Overall Radial Runout	Dynamic Ca	Static Co	Dynamic Ca
<0.005	0	0.027	0.018	0.050	1480	847	1030	597
<0.005	0	0.040	0.018	0.085	1480	847	1030	597
<0.005	0	0.054	0.018	0.130	1480	847	1030	597



Fixed End



Unit: mm

Axial Play	Lead Accuracy			Tolerances	Fixed End-bearing (kgf)		Supported End-bearing (kgf)	
	Specified Travel (T)	Accumulated reference lead deviation (E)	Lead Deriation in random 300mm (e300)		Dynamic Ca	Static Co	Dynamic Ca	Static Co
<0.005	0	0.027	0.018	0.050	1480	847	1030	597
<0.005	0	0.040	0.018	0.085	1480	847	1030	597
<0.005	0	0.054	0.018	0.130	1480	847	1030	597
<0.005	0	0.027	0.018	0.050	1480	847	1030	597
<0.005	0	0.040	0.018	0.085	1480	847	1030	597
<0.005	0	0.054	0.018	0.130	1480	847	1030	597
<0.005	0	0.027	0.018	0.050	1480	847	1030	597
<0.005	0	0.040	0.018	0.085	1480	847	1030	597
<0.005	0	0.054	0.018	0.130	1480	847	1030	597

16.1 Product Features

High Applicability Shaft Ends

Without heat treating processes on the shaft ends, the center holes on both side will be reserve. The shaft ends could be easily manufactured to favored size.

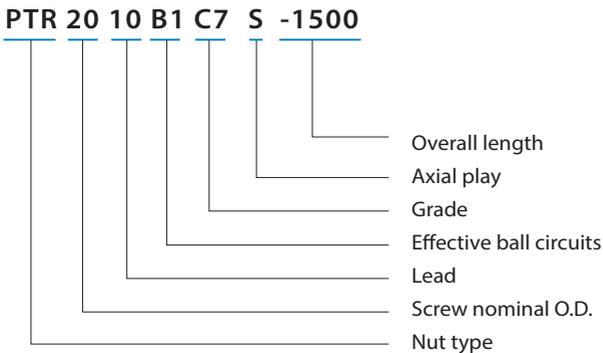
Short Delivery

Standardized stock for general specification's thread length and length of blank shaft ends.

Lower Price

The accuracy can be as good as JIS C5 and C7 grade and with standardized axial clearance for the reason that can be cost down and the price will be cheaper.

PMI Model No.



Nut type:

PPR: FSMM(Miniature Series)

PTR: FSDM (End Deflector Series)

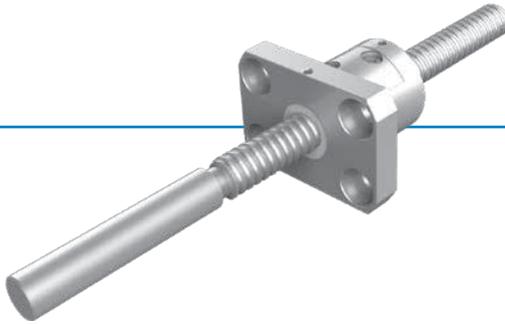
Effective ball circuits:

PPR (Miniature Series)

A1: 1.5×1 circuits / B1: 2.5×1 circuits

PTR (End Deflector Series)

T2: 2 circuits / T3: 3 circuits



Unit:mm

Grade \ Axial play	Z	T	S	N
	0 (Preload)	0.005 or less	0.010 or less	0.030 or less
C5	C5Z	C5T	-	-
C7	-	-	C7S	C7N

16.2 PPR(Miniature Series) - Features

Space Saving

External circulation system, it don't need to have at least one end with complete thread to the end of Ballscrew for Ballnut assembly to screw shaft. And the special design of ballnut, so the size of ballnut is same as internal circulation system of ballnut, Space saving.

Circulation

By way of 3D Spline designed pathway for circulation system, and has enhanced the smooth circulation of ball ,that can reduce the wearing and increase the life of ballscrew.

16.3 PTR(End Deflector Series) - Features

Space Saving

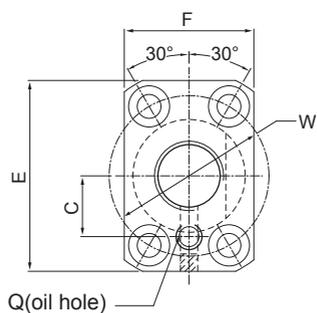
The ballnut diameter reduces 20%~25% substantially and the length of nut is shorter.

Low Noise

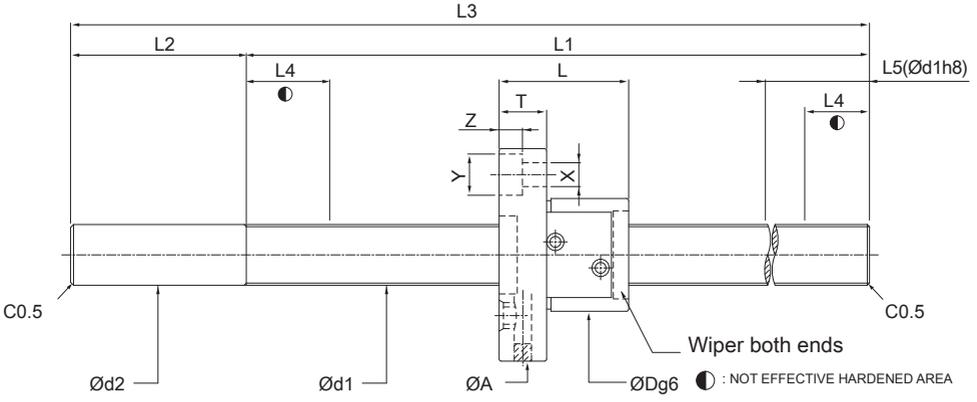
The average and accurate ball circle diameter (BCD) through whole threads make the ballscrews to obtain the stable and consistent drag torque as well as to reduce the noise.

The audio frequency is low and deep due to the designed of plastic circulation system.

PPR

 Miniature nut series
C5


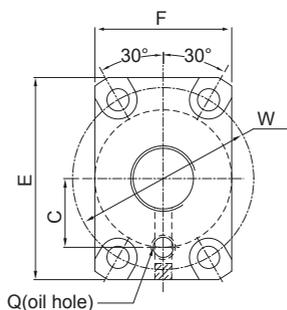
Model No.	SCREW SIZE		EFFECTIVE TURNS	BASIC RATE LOAD(kgf)		SCREW SHAFT LENGTH			
	O.D d1	LEAD		Dynamic (1×10^3 REV.) Ca	Static Co	L1	L2	L3	L4
PPR0802B1C5T-0220	8	2	2.5×1	190	290	160	60	220	10
PPR1202B1C5T-0220	12	2	2.5×1	240	450	160	60	220	10
PPR1202B1C5T-0300						240			



Unit:mm

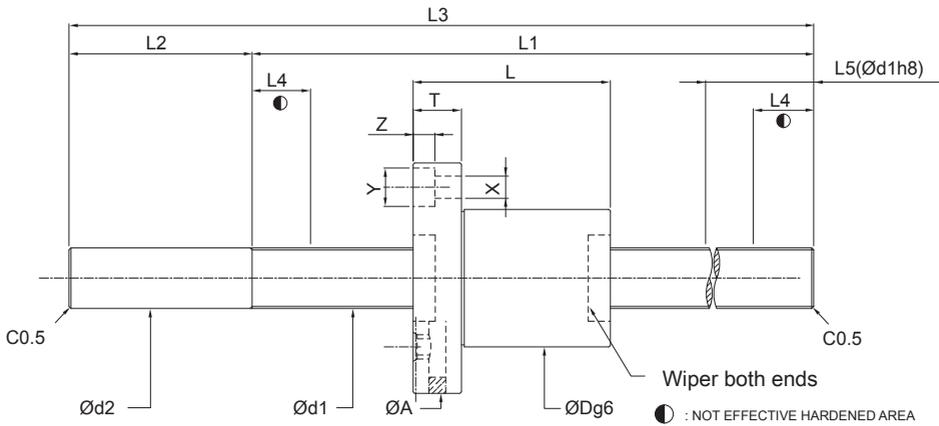
SCREW SHAFT LENGTH		NUT			FLANGE					OIL HOLE		BOLT		
L5	d2	Dg6	L	A	T	W	E	F	C	Q	X	Y	Z	
160	10	20	25	40	6	30	36	25	-	-	4.5	8	4.4	
160 240	12	25	31	45	10	35	41	28	13	M6	4.5	8	4.4	

PTR

 End deflector nut series
C5


Model No.	SCREW SIZE		EFFECTIVE TURNS	MODIFIED LOAD CAPACITY(kgf)		SCREW SHAFT LENGTH			
	O.D d1	LEAD		Dynamic (1×10 ⁶ REV.) Cam	Static Coam	L1	L2	L3	L4
PTR1205T3C5T-0300	12	5	3	610	1190	240	60	300	10
PTR1205T3C5T-0450						390		450	15
PTR1210T3C5T-0300	12	10	3	590	1160	240	60	300	10
PTR1210T3C5T-0450						390		450	15
PTR1220T3C5T-0450	12	20	3	390	770	390	60	450	15
PTR1220T3C5T-0600						540		600	
PTR1505T3C5T-0300	15	5	3	850	1640	240	60	300	10
PTR1505T3C5T-0450						390		450	
PTR1505T3C5T-0600						540		600	15
PTR1505T3C5T-0750						690		750	
PTR1505T3C5T-0900						840		900	
PTR1510T3C5T-0300	15	10	3	840	1610	240	60	300	10
PTR1510T3C5T-0450						390		450	
PTR1510T3C5T-0600						540		600	15
PTR1510T3C5T-0750						690		750	
PTR1510T3C5T-0900						840		900	
PTR1510T3C5T-1100						1040		1100	
PTR1520T2C5T-0450	15	20	2	560	1050	390	60	450	15
PTR1520T2C5T-0600						540		600	
PTR1520T2C5T-0750						690		750	
PTR1520T2C5T-0900						840		900	
PTR1520T2C5T-1000						940		1000	
PTR1520T2C5T-1100						1040		1100	
PTR1520T2C5T-1300						1240		1300	
PTR2005T3C5T-0400	20	5	3	1000	2240	320	80	400	15
PTR2005T3C5T-0600						520		520	
PTR2005T3C5T-0800						720		720	
PTR2005T3C5T-1000						920		920	
PTR2010T3C5T-0600	20	10	3	1530	3280	515	85	600	15
PTR2010T3C5T-0800						715		800	
PTR2010T3C5T-1000						915		1000	
PTR2010T3C5T-1300						1215		1300	
PTR2010T3C5T-1500						1415		1500	

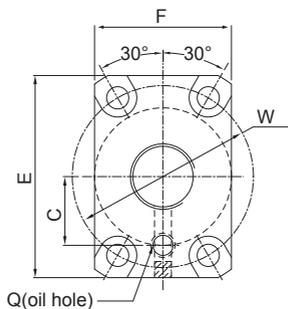
Coam and Cam are the modified static and dynamic load capacities, calculated according to ISO-3408-5



Unit:mm

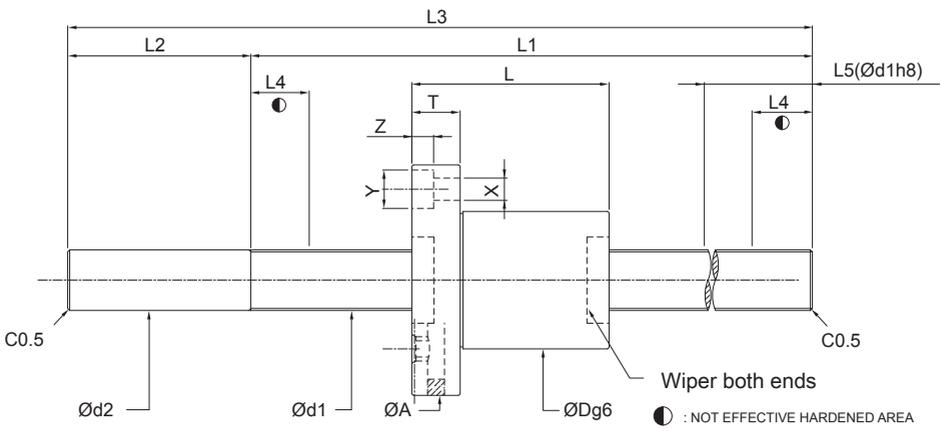
	SCREW SHAFT LENGTH		NUT		FLANGE					OIL HOLE		BOLT		
	L5	d2	Dg6	L	A	T	W	E	F	C	Q	X	Y	Z
	180	12	30	32	50	10	40	45	32	15	M6	4.5	8	4.4
	180	12	30	45	50	10	40	45	32	15	M6	4.5	8	4.4
	180	12	30	54	50	12	40	45	32	15	M6	4.5	8	4.4
	230	15	34	35	57	11	45	50	34	17	M6	5.5	9.5	5.4
	230	15	34	47	57	11	45	50	34	17	M6	5.5	9.5	5.4
	230	15	34	58	57	12	45	50	34	17	M6	5.5	9.5	5.4
	230	20	44	35	67	11	55	60	44	22	M6	5.5	9.5	5.4
	230	20	46	52	74	13	59	66	46	24	M6	6.6	11	6.5

PTR

 End deflector nut series
C7


Model No.	SCREW SIZE		EFFECTIVE TURNS	MODIFIED LOAD CAPACITY(kgf)		SCREW SHAFT LENGTH			
	O.D d1	LEAD		Dynamic (1×10 ⁵ REV.) Cam	Static Coam	L1	L2	L3	L4
PTR1205T3C7S-0450	12	5	3	610	1190	390	60	450	15
PTR1210T3C7S-0600	12	10	3	590	1160	540	60	600	15
PTR1220T2C7S-0600	12	20	2	390	770	540	60	600	15
PTR1505T3C7S-0600	15	5	3	850	1640	540	60	600	15
PTR1510T3C7S-0450	15	10	3	840	1610	390	60	450	15
PTR1510T3C7S-0600						540		600	
PTR1510T3C7S-0750						690		750	
PTR1510T3C7S-0900						840		900	
PTR1510T3C7S-1000						940		1000	
PTR1510T3C7S-1100						1040		1100	
PTR1510T3C7S-1300						1240		1300	
PTR1520T2C7S-0600						15		20	
PTR1520T2C7S-0750	690	750							
PTR1520T2C7S-0900	840	900							
PTR1520T2C7S-1000	940	1000							
PTR1520T2C7S-1100	1040	1100							
PTR1520T2C7S-1300	1240	1300							
PTR2005T3C7S-0600	20	5	3	1000	2240		520		80
PTR2010T3C7S-0600	20	10	3	1530	3280	515	85	600	15
PTR2010T3C7S-1000						915		1000	
PTR2010T3C7S-1500						1415		1500	

Coam and Cam are the modified static and dynamic load capacities,calculated according to ISO-3408-5



Unit:mm

	SCREW SHAFT LENGTH		NUT		FLANGE					OIL HOLE		BOLT		
	L5	d2	Dg6	L	A	T	W	E	F	C	Q	X	Y	Z
	180	12	30	32	50	10	40	45	32	15	M6	4.5	8	4.4
	180	12	30	45	50	10	40	45	32	15	M6	4.5	8	4.4
	180	12	30	54	50	12	40	45	32	15	M6	4.5	8	4.4
	230	15	34	35	57	11	45	50	34	17	M6	5.5	9.5	5.4
	230	15	34	47	57	11	45	50	34	17	M6	5.5	9.5	5.4
	230	15	34	58	57	12	45	50	34	17	M6	5.5	9.5	5.4
	230	20	44	35	67	11	55	60	44	22	M6	5.5	9.5	5.4
	230	20	46	52	74	13	59	66	46	24	M6	6.6	11	6.5

17.1 Preface

In recent years, more and more ballscrews are installed in various machines to meet the requirements of higher accuracy and better performance.

Ballscrews become one of the most widely used power transmission components. In CNC machines, ballscrews help improve their positioning accuracy and elongate their service life. Ballscrews are also increasingly used to replace ACME screws in manually operated machines.

A ballscrew is normally preloaded to minimize the backlash of machine movement. Even a high precision ballscrew will not provide good accuracy and long service life if it is not installed properly. This article discusses primary ballscrew problems and their precautions. Some measuring procedures are also discussed to help users locate the cause of an abnormal backlash.

17.2 The Cause and Precautions of Ballscrew Problems

Three major categories of ballscrew problems and their precautions are discussed as follows

17.2.1 Unsmooth operation

1. Defects from ballscrew manufacturing:

- (1) The return tube is not attached to the ball nut appropriately.
- (2) The track surface of the ballscrew spindle or the ball nut is too rough.
- (3) The roundness of the ball nut or the screw shaft is out of tolerance.
- (4) The lead or the pitch circle diameter of the ball nut / the shaft is out of tolerance.

2. Over-travel:

Over-travel can damage the return tube and cause it to collapse or even break. When this happens, the steel balls will not circulate smoothly. They may break and damage the groove on the ball nut or the screw shaft under severe circumstances. Over-travel may happen during set-up or as the result of a limit switch failure or a machine collision. To prevent further damage, an over-traveled ballscrew should be checked or repaired by the manufacturer before it goes back to service.

3. Misalignment:

Radial load exists if the center line of the ball nut's housing and the screw shaft's bearing support bracket are not aligned properly. The ballscrew unit may bend if this misalignment is too big. An abnormal wear may still happen even if the misalignment is not significant enough to cause a noticeable bending. The accuracy of a ballscrew unit will deteriorate rapidly if it is misaligned. The higher the preload is set in the nut, the more demanding the

alignment accuracy is required in the ballscrew.

4. Foreign objects enter the ball path:

Machined chips get in the ball track. The chips or dust generated during machining processes may be trapped in the ball track if wiper kits are not used to keep them away from the surface of the ballscrew unit. This may cause unsmooth operation, deteriorate accuracy and reduce service life.

5. Damaged return tube:

The return tube may collapse and cause the same problems as mentioned above if it is hit heavily during installation.

6. The ball nut is not mounted properly on the nut housing:

Eccentric load exists when the mounted ball nut is tilted or misaligned. If this is the case, the motor current may fluctuate during rotation.

7. Ballscrew unit is damaged during transportation

- (1) During installation, avoid nuts separating away from screw, otherwise the balls will get out of the nut, that lead to change of the preload and damage of the circulation system and wiper.
- (2) Due to the low friction coefficient, nuts will fall down because of its self weight during vertical deposition; this kind of damage should be avoided, once happened, it should be inspected by manufacturer preventing further damage.

17.2.2 Too much plays

1. No preload or insufficient preload:

The ball nut will rotate and move downward by its self weight when a non-preloaded ballscrew is held vertically with the screw shaft constrained. A significant backlash may exist in a non-preloaded ballscrew unit. Therefore non-preload ballscrews are only used in the machinery, where operation resistance but not positioning accuracy low is the major concern.

PMI can determine the correct amount of preload based on different applications. We can also preset the amount of preload before shipment. Be sure to clearly specify the operation condition of your application when you order a ballscrew unit.

2. Inappropriate bearing selection and installation:

- (1) Angular ball bearings should be used in ballscrew installation. A ball bearing with high pressure angle specially designed for ballscrew installation is even a better choice. A regular deep groove ball bearing will generate a significant amount of axial play when axially loaded. It should not be used in this application.

-
- (2) Two lock nuts and a spring washer should be used in the bearing installation to prevent them from getting loose in operation.
 - (3) The perpendicularity between the bearing seating face and the thread axis of the bearing locknut on the ballscrew, or the parallelism between the opposite faces of the locknut is out of tolerance causing the bearing to tilt. The thread for bearing lock nut and the seating face of a bearing in the ballscrew journal should be machined in one setting to ensure the perpendicularity. It is even better if they can be ground.
 - (4) If the bearing is not attached to the screw shaft properly, it would cause axial play under load. This problem may be caused by the bearing journal of the screw shaft being too long or the non-threaded part of the screw shaft being too short. To solve this problem used the collar.

3. Parallelism or flatness of the housing surface is out of tolerance:

In a machine assembly, a shim bar is frequently located between the housing location surface and the machine body for adjustment purpose. The clearance of table movement may vary at different locations if the parallelism or flatness of any matching component is out of tolerance no matter they are ground or scraped.

4. The ball nut housing or the bearing housing is not rigid enough:

The ball-nut-mounted housing or the bearing-mounted housing may deflect under components' weight or machining load if it is not rigid enough.

5. The ball nut housing or the bearing housing is not mounted properly:

- (1) Ball-nut-seated screws become loose due to vibration and lack of a spring washer.
- (2) Ball-nut-seated screws are not seated firmly because the screws are too long or the thread holes on housing are too short.
- (3) Components may become loose due to vibration or lack of locating pin(s). Solid pins instead of spring pins should be used for locating purpose.
- (4) Not enough locking forces for fixing screw because of too short screws

6. The motor and the ballscrew spindle are not assembled properly:

- (1) There will be a relative rotation between the motor shaft and the ballscrew spindle if the connecting coupling is not installed firmly or the coupling itself is not rigid enough.
- (2) Key is loose in the groove. Any inappropriate match among the hub, key, and key seat may cause these components to generate backlash.
- (3) Driving gears are not engaged properly or driving mechanism is not rigid. A timing belt

should be used to prevent slipping if the ballscrew is to be driven by a belt.

17.2.3 Fracture

1. Broken bearing ball:

Cr-Mo steel is the most commonly used material for bearing balls. It takes about 1,400kg (3,080lb) to 1,600kg (3,520lb) to break a steel ball of 3.175 mm (1/8 in) diameter. The temperature of an under-lubricated or non-lubricated ballscrew raises substantially during operation. This temperature raise could make the bearing balls brittle or break which cause damage to the grooves of the ball nut or the ballscrew spindle consequently.

Therefore, lubricant replenishment should be considered during the design process. If an automatic lubricating system is not available, periodical grease replenishment should be scheduled as part of maintenance program

2. Collapsed or broken return tube:

Over-travel of the ball nut or an impact on the return tube could cause the return tube to collapse or break. This may block the path of bearing balls and cause them to slide instead of rolling and break eventually.

3. Ballscrew shaft end breaks:

(1) Inappropriate design: Sharp corners on the ballscrew spindle should be avoided to reduce local stress concentration.

(2) Bend of screw shaft journal: The seating surface of the bearing of the ballscrew and the thread axis of the bearing's lock nut are not perpendicular to each other or the opposite sides of the lock nut are not parallel to each other. This will cause the end of screw shaft to bend and eventually break. The amount of deflection at the end of the ballscrew shaft before and after the bearing's lock nut being tightened should not exceed 0.01 mm (0.0004 in).

(3) Radial force or fluctuating stress: Misalignment in the ballscrew installation creates abnormal fluctuating shear stress and causes the ballscrew to fail prematurely.

(4) It should be avoided, that the dimension of ball screw shaft end too much different designed from ball screw shaft section area.

4. Influence of temperature raise on ball screw

During the operation of ball screws, the accuracy of machine drive system will influenced by the raise of the temperature, especially for the high speed and high accuracy machines. Following factors affect the temperature raise of ball screws:

(1)Preload (2)Lubrication (3)Preloading torque

(1)The Influence of Preload

Increase the rigidity of ball screw nut in order to avoid the lost motion of the machine drive system, that means increase the preload of the nut to a certain standard. Once the nut being preloaded, the friction torque will be increase, making the temperature raised during operation. *PMI* recommended, that the preload force should be 1/3 of the maximal axial load and is not bigger then 10% of the dynamic load, in order to obtain the optimal life time and lower temperature raise effect.

(2) The Influence of Pretension

The elongation and deformation of ball screws because of heat will deteriorate the position accuracy. The amount of thermal elongation can be calculated by certain formula and compensated by preloading torque. The target value of the Pretension compensation is the negativ T value on the diagram. Too much Pretension will burn the support bearing. Therefor *PMI* recommended, that the pretention should smaller then the Pretension by 5°C; however when the ball screws diameter is over 50mm, it is not suitable for a preloading torque, that means large Pretension forces will be needed when the diameter is large and will burn down the support bearing. *PMI* recommended, that 5°C of temperature raise should be used as standard to compensate the value T (about -0.02~-0.03mm every 1000mm of ball screw)

(3) The Influence of Lubrication

The choice of the lubrication will directly effect the temperature raise of the ball screws. The ball screws of *PMI* should be lubricated by oil or grease. Normaly lubrication oil for bearings will be recommended as ball screw lubrication, and grease from lithium soap will be recommended as lurbrication grease. The choice of viscosity of the lubrication should be according to the operation speed, the working temperature, and the situation of load.

Low viscosity lubrication should be choosed during high speed and low load situation; high viscosity lubrication during low speed and high load situation. Normally, viscosity range of lubrication will be recommended at 32~68cSt (ISO VG 32~68)(DIN51519) during 40°C, high speed; viscosity range of lubrication will be recommended over 90cSt(ISO VG 90) during 40°C, low speed. By application of high speed and heavy load, force cooling must be used in order to reduce the temperature, and using hollow ball screw or cooling oil though nut to meet the cooling consequent.

18

Dimensional Tolerance of Standard Sheet for Shafts and Holes

Unit: μm

Diametional range		Standard Housing Diameter Tolerance																				
above	up to and incl.	e7	e8	e9	f6	f7	f8	g5	g6	h5	h6	h7	h8	h9	js5	js6	js7	k5	k6	m5	m6	n6
-	3	-14	-14	-14	-6	-6	-6	-2	-2	0	0	0	0	0	±2	±3	±5	+4	+6	+6	+8	+10
3	6	-24	-28	-39	-12	-16	-20	-6	-8	-4	-6	-10	-14	-25	±2.5	±4	±6	+6	+9	+9	+12	+16
6	10	-20	-20	-20	-10	-10	-10	-4	-4	-0	0	0	0	0	±2.5	±4	±6	+6	+9	+9	+12	+16
10	14	-32	-38	-50	-18	-22	-28	-9	-12	-5	-8	-12	-18	-30	±3	±4.5	±7	+7	+10	+12	+15	+19
14	18	-40	-47	-61	-22	-28	-35	-11	-14	-6	-9	-15	-22	-36	±3	±4.5	±7	+7	+10	+12	+15	+19
18	24	-32	-32	-32	-16	-16	-16	-6	-6	0	0	0	0	0	±4	±5.5	±9	+9	+12	+15	+18	+23
24	30	-50	-59	-75	-27	-34	-43	-14	-17	-8	-11	-18	-27	-43	±4	±5.5	±9	+9	+12	+15	+18	+23
30	40	-40	-40	-40	-20	-20	-20	-7	-7	0	0	0	0	0	±4.5	±6.5	±10	+11	+15	+17	+21	+28
40	50	-61	-73	-92	-33	-41	-53	-16	-20	-9	-13	-21	-33	-52	±4.5	±6.5	±10	+11	+15	+17	+21	+28
50	65	-50	-50	-50	-25	-25	-25	-9	-9	0	0	0	0	0	±5.5	±8	±12	+13	+18	+20	+25	+33
65	80	-75	-89	-112	-41	-50	-64	-20	-25	-11	-16	-25	-39	-62	±5.5	±8	±12	+13	+18	+20	+25	+33
80	100	-60	-60	-60	-30	-30	-30	-10	-10	0	0	0	0	0	±6.5	±9.5	±15	+15	+21	+24	+30	+39
100	120	-90	-106	-134	-49	-60	-76	-23	-29	-13	-19	-30	-46	-74	±6.5	±9.5	±15	+15	+21	+24	+30	+39
120	140	-72	-72	-72	-36	-36	-36	-12	-12	0	0	0	0	0	±7.5	±11	±17	+18	+25	+28	+35	+45
140	160	-107	-126	-159	-58	-71	-90	-27	-34	-15	-22	-35	-54	-87	±7.5	±11	±17	+18	+25	+28	+35	+45
160	180	-85	-85	-85	-43	-43	-43	-14	-14	0	0	0	0	0	±9	±12.5	±20	+21	+28	+33	+40	+52
180	200	-125	-148	-185	-68	-83	-106	-32	-39	-18	-25	-40	-63	-100	±9	±12.5	±20	+21	+28	+33	+40	+52
200	225	-100	-100	-100	-50	-50	-50	-15	-15	0	0	0	0	0	±10	±14.5	±23	+24	+33	+37	+46	+60
225	250	-146	-172	-215	-79	-96	-122	-35	-44	-20	-29	-46	-72	-115	±10	±14.5	±23	+24	+33	+37	+46	+60

Unit: μm

Diametional range		Standard Spindle Diametion Tolerance																				
above	up to and incl.	E7	E8	E9	F6	F7	F8	G6	G7	H6	H7	H8	H9	H10	JS6	JS7	K6	K7	M6	M7	N5	N7
-	3	+24 +14	+28 +14	+39 +14	+12 +6	+16 +6	+20 +6	+8 +2	+12 +2	+6 0	+10 0	+14 0	+25 +0	+40 0	± 3	± 5	0 -6	0 -10	-2 -8	-2 -12	-4 -10	-4 -14
3	6	+32 +20	+38 +20	+50 +20	+18 +10	+22 +10	+28 +10	+12 +4	+16 +4	+8 0	+12 0	+18 0	+30 0	+48 0	± 4	± 6	+2 -6	+3 -9	-1 -9	0 -12	-5 -13	-4 -16
6	10	+40 +25	+47 +25	+61 +25	+22 +13	+28 +13	+35 +13	+14 +5	+20 +5	+9 0	+15 +0	+22 0	+36 0	+58 0	± 4.5	± 7	+2 -7	+5 -10	-3 -12	0 -15	-7 016	-4 -19
10	14	+50 +32	+59 +32	+75 +32	+27 +16	+34 +16	+43 +16	+17 +6	+24 +6	+11 0	+18 0	+27 0	+43 0	+70 0	± 5.5	± 9	+2 -9	+6 -12	-4 -15	0 -18	-9 -20	-5 -23
18	24	+61 +40	+73 +40	+92 +40	+33 +20	+41 +20	+53 +20	+20 +7	+28 +7	+13 0	+21 0	+33 0	+52 0	+84 0	± 6.5	± 10	+2 -11	+6 -15	-4 -17	0 -21	-11 -24	-7 -28
30	40	+75 +50	+89 +50	+112 +50	+41 +25	+50 +25	+64 +25	+25 +9	+34 +9	+16 0	+25 0	+39 0	+62 0	+100 0	± 8	± 12	+3 -13	+7 -18	-4 -20	0 -25	-12 -28	-8 -33
50	65	+90 +60	+106 +60	+134 +60	+49 +30	+60 +30	+76 +30	+29 +10	+40 +10	+19 0	+30 0	+46 0	+74 0	+120 0	± 9.5	± 15	+4 -15	+9 -21	-5 -24	0 -30	-14 -33	-9 -39
80	100	+107 +72	+126 +72	+159 +72	+58 +36	+71 +36	+90 +36	+34 +12	+47 +12	+22 0	+35 0	+54 0	+87 0	+140 0	± 11	± 17	+4 -18	+10 -25	-6 -28	0 -35	-16 -38	-10 -45
120	140	+125 +85	+148 +85	+185 +85	+68 +43	+83 +43	+106 +43	+39 +14	+54 +14	+25 0	+40 0	+63 0	+100 0	+160 0	± 12.5	± 20	+4 -21	+12 -28	-8 -33	0 -40	-20 -45	-12 -52
180	200	+146 +100	+172 +100	+215 +100	+79 +50	+96 +50	+122 +50	+44 +15	+61 +15	+29 0	+46 0	+72 0	+115 0	+185 0	± 14.5	± 23	+5 -24	+13 -33	-8 -37	0 -46	-22 -51	-14 -60
200	225																					
225	250																					