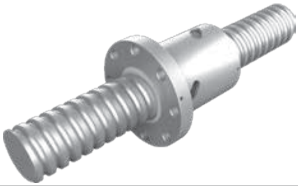
PRODUCT INFORMATION

Precision Ground Series

Internal Ball Circulation Series

FSIC A-131



FDIC A-135

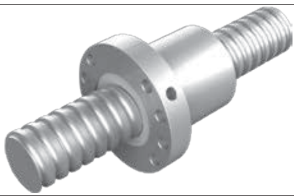
FOIC A-139

RSIC A-141

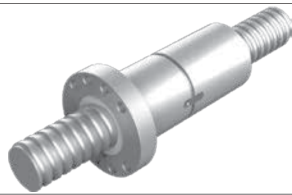
RDIC A-143

End Deflector Series

FSDC A-146



FDDC A-150

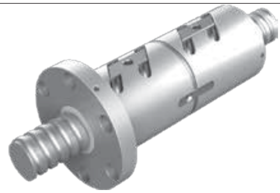


Precision Ground Series

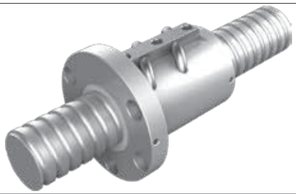
External Ball Circulation Series

FSWC A-155

FDWC A-160



FSVC A-165



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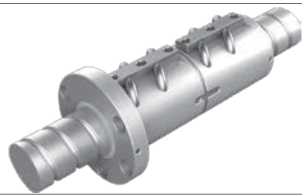
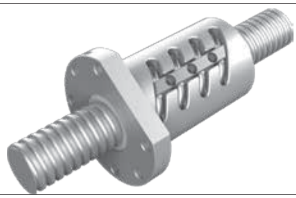


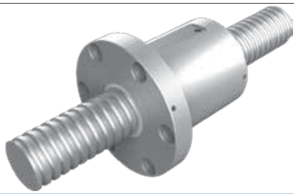
FOWC A-173



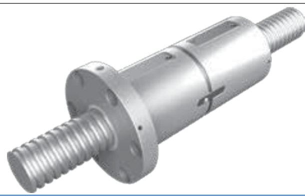
Precision Ground Series

High Lead Series

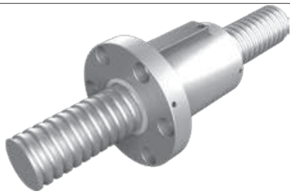
FSWE A-176



FDWE A-180



FSVE A-184



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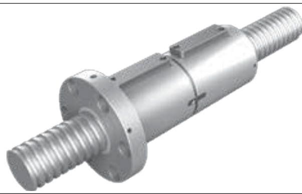
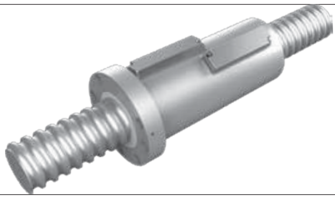


End Cap Series

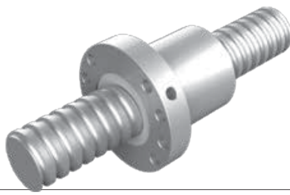
FSKC A-192

Heavy Load Series

FSVH A-197



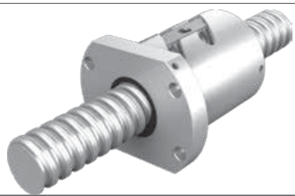
FSDH A-199



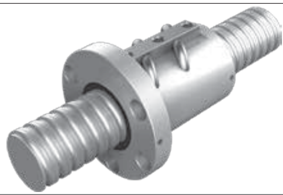
Rolled Series

External Ball Circulation Series

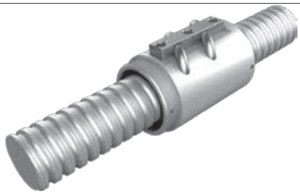
FSWW A-252



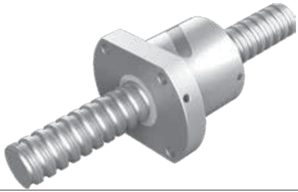
FSVW A-255



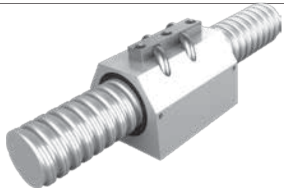
RSVW A-258



FSBW A-259



SSVW A-260

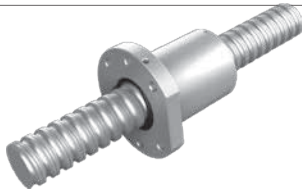
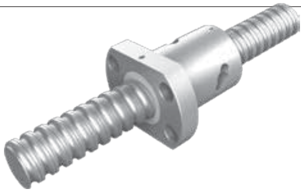
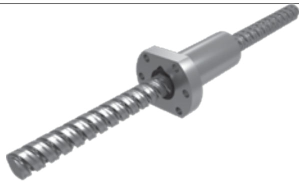


End Cap Series

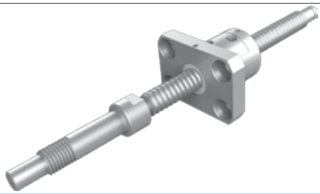
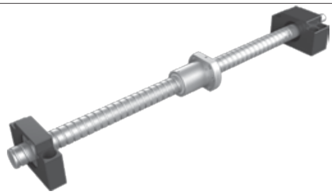
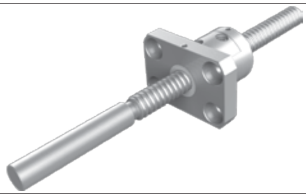
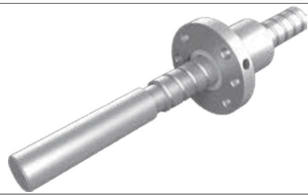
FSKW A-261

Rolled Series

internal Ball Circulation Series

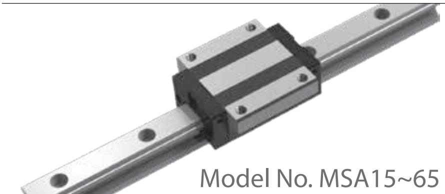
FSIW	A-262	**FSDW**	A-264
			
FSIN	A-266	**FSDN**	A-267
			

Standard type series

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

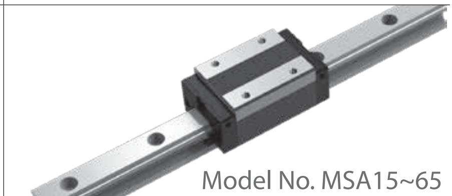
Heavy Load Type B-39

MSA-A / MSA-LA MSA-E / MSA-LE



Model No. MSA15~65

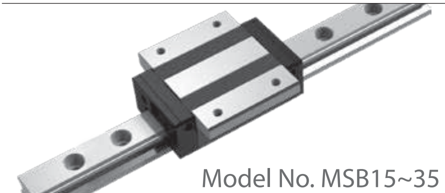
MSA-S / MSA-LS



Model No. MSA15~65

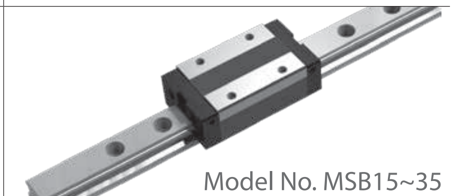
Compact Type B-62

MSB-E



Model No. MSB15~35

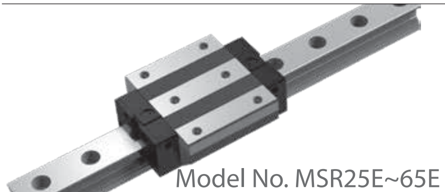
MSB-S



Model No. MSB15~35

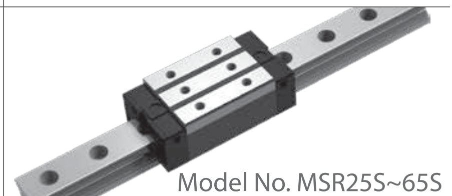
Full Roller Type B-82

MSR-E



Model No. MSR25E~65E

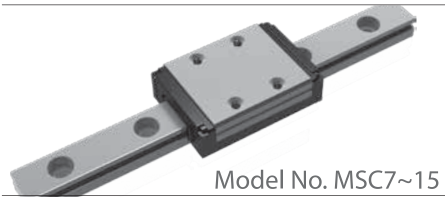
MSR-S



Model No. MSR25S~65S

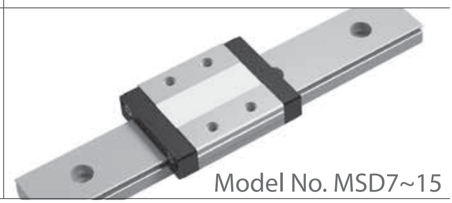
Miniature Type B-102

MSC



Model No. MSC7~15

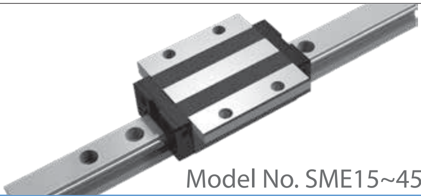
MSD



Model No. MSD7~15

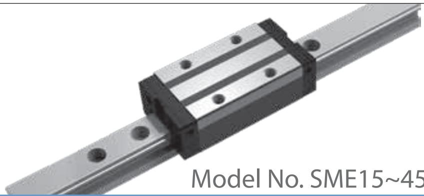
Ball Chain Type B-120

SME-E



Model No. SME15~45

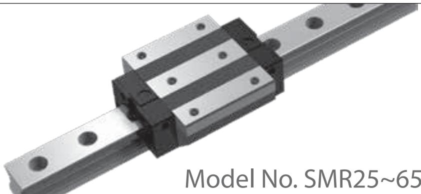
SME-S



Model No. SME15~45

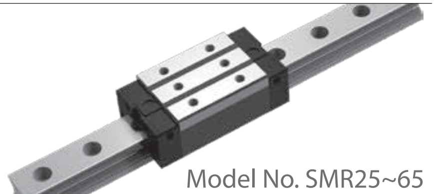
Roller Chain Type B-146

SMR-E



Model No. SMR25~65

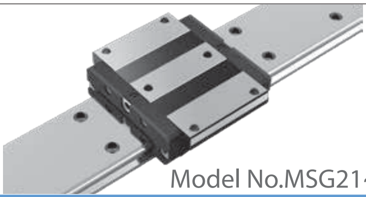
SMR-S



Model No. SMR25~65

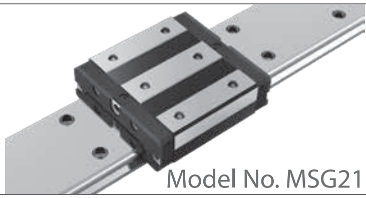
Wide Rail Type B-166

MSG-E



Model No.MSG21~35

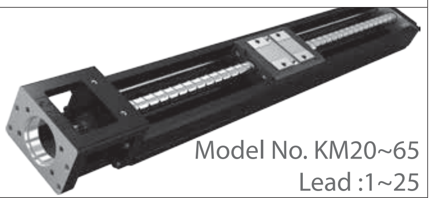
MSG-S



Model No. MSG21~35

Mono Stage C-4

KM



Model No. KM20~65
Lead :1~25

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A. Ballscrews

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B. Linear Guideway

C. Mono Stage

D. Appendix

Ballscrews

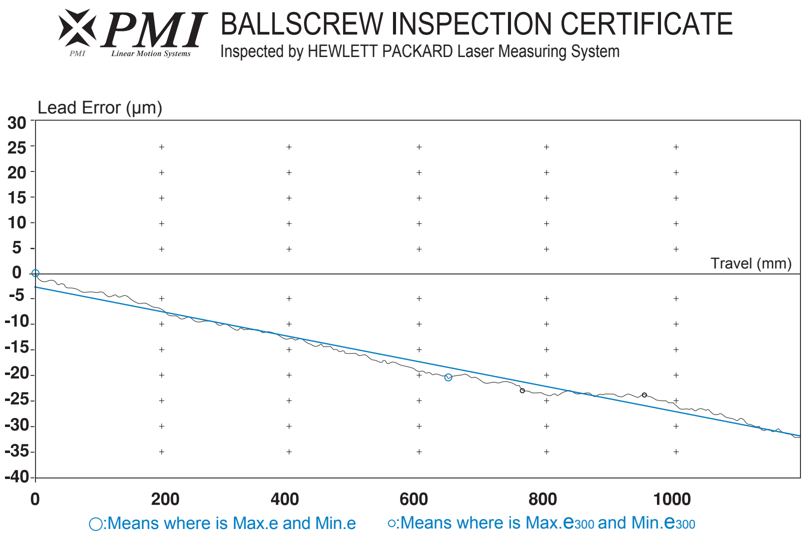
1 Features of *PMI* Ballscrews

(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.



Cumulative representative lead T+E:-27.90 μm	Total relative lead deviation e: 4.84 μm	Lead deviation in random 300mm e300: 4.01 μm
Preload torque(without wipper)Tq:3.0-3.9Kgf-cm	ACCURACY GRADE: C1	REMARK:
		INSPECTOR:

Fig.1.1 Accuracy inspection certificate.

(3) Long durability

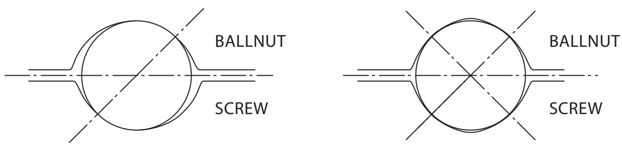
PMI Ballscrews are Alloy steels, which are well quenching and tempering treated for good rigidity, along with suitable surface hardening to ensure long durability.

(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.



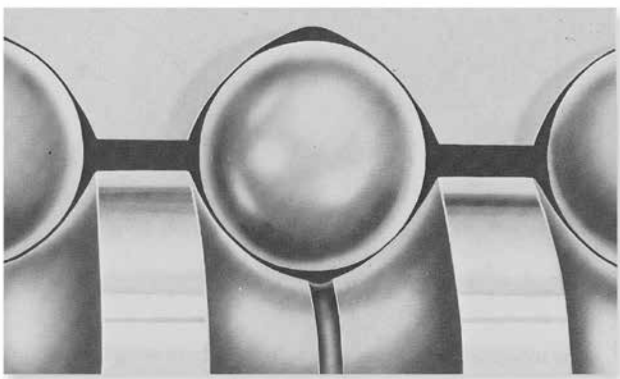


Fig.1.2 Gothic arch thread

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.

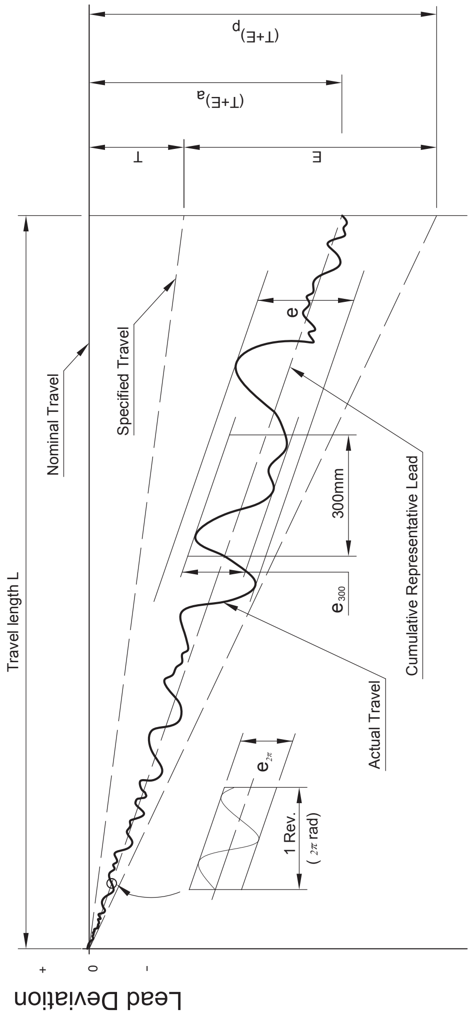


Fig.2.1 Technical Terms Concerning the Lead

Table2.1 Terms

T+E	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	Permissible value.
a	Actual value.
T	Specified travel. This value is determined by customer and maker as it depends on different application requirements.
E	Accumulated reference lead deviation. This is allowable deviation of specified travel. It is decided by both of the accuracy grade and effective thread length.
e	Total relative lead variation Maximum width of variation over the travel length.
e_{300}	Lead deviation in random 300 mm.
$e_{2\pi}$	Lead deviation in random 1 revolution 2π rad.

Table 2.2 Accumulated reference lead deviation (±E) and total relative variation (e)

Unit: μm

Effective thread length (mm)	GRADE		C0		C1		C2		C3		C4		C5	
	OVER	UP TO	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 300*mm* (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.

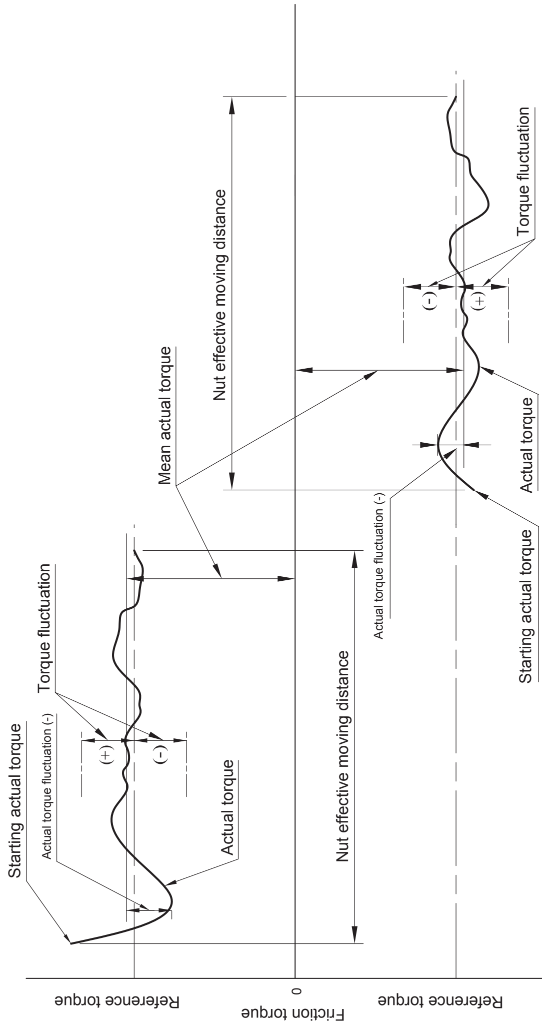


Fig.2.2 Technical terms concerning preload

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 reciprocate to measure the maximum actual torque and minimum actual torque are doing count mean.
Actual torque fluctuation	In the effective thread length, the net reciprocate 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

$$T_P = 0.05(\tan\beta)^{-0.5} \times \frac{Fao \times l}{2\pi} \quad \text{...} \quad (2.1)$$

Here

T_P Reference torque ($kgf \cdot cm$)

Fao Preload (kgf)

l Lead(cm)

β Lead angle

2.3 Tolerances on Various Areas of *PMI* Ballscrew

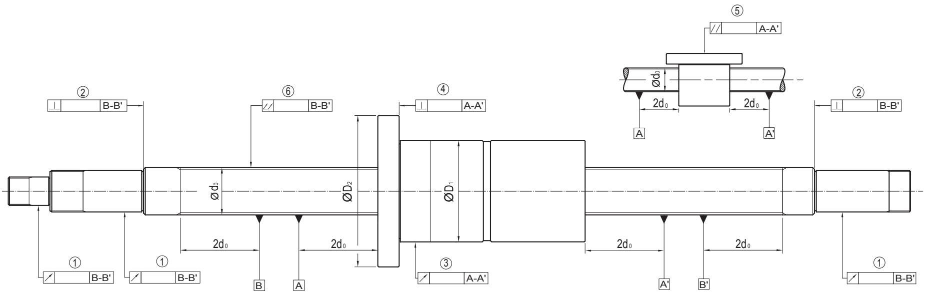


Fig.2.3

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

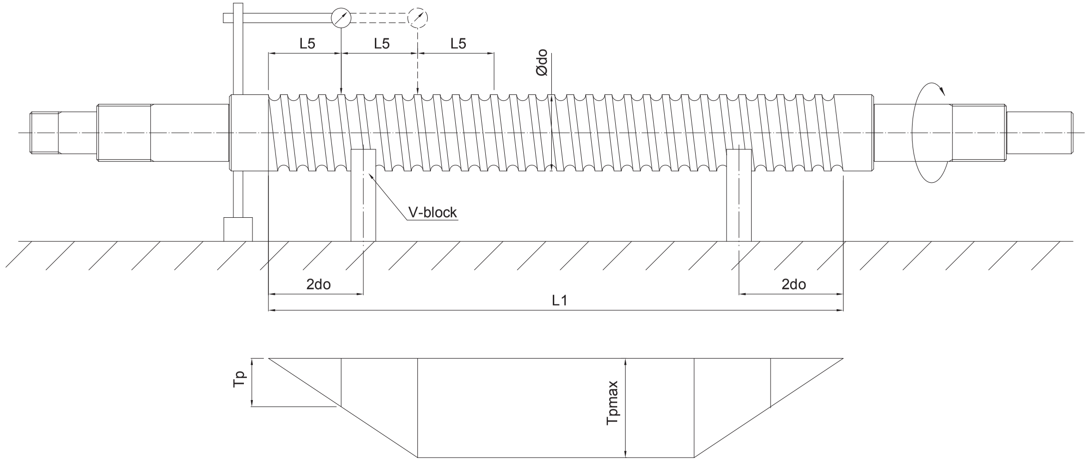


Table2.6 Total runout in radial direction of outside diameter of screw shaft threaded part in respect to measuring basic length
(measuring basic length is accoring to DIN 69051 and JIS B1192)

Unit: μm

Normial diameter *do(mm)*		Measuring basic length L_r	*PMI*s' Grade *Tpmax*								
above	up to and incl.	-	C0	C1	C2	C3	C4	C5	C6	C7	C10
6	12	80	20	20	20	23	25	28	32	40	80
12	25	160									
25	50	315									
50	100	630									
100	200	1250									

Slenderness ratio $L_1/do(mm)$		PMI s' Grade $(L1 \geq 4L5)$								
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

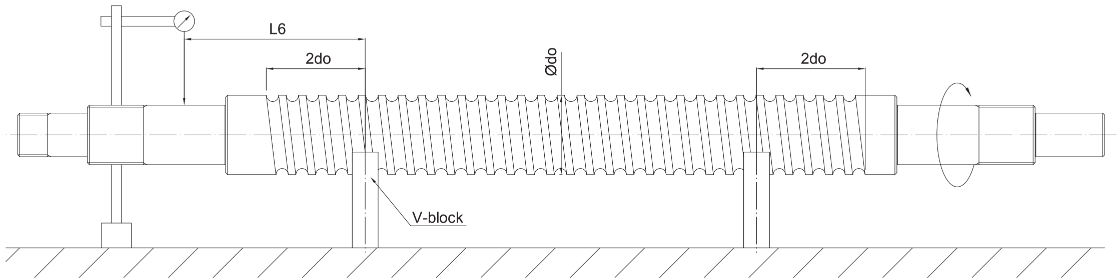


Table2.7 Circumferential runout in radial direction of outside diameter of mounting part of parts in respect to threaded part axial line of screw shaft (measuring basic length is accoring to DIN 69051 and JIS B1192)

Unit: μm

Normial diameter *do(mm)*		Measuring basic length L_r	*PMI* s' Grade(*L6<Lr*)								
above	**up to and incl.**	-	C0	C1	C2	C3	C4	C5	C6	C7	C10
6	**20**	80	6	8	10	11	12	16	20	40	63
20	**50**	125	8	10	12	14	16	20	25	50	80
50	**125**	200	10	12	16	18	20	26	32	63	100
125	**200**	315	-	-	-	20	25	32	40	80	125

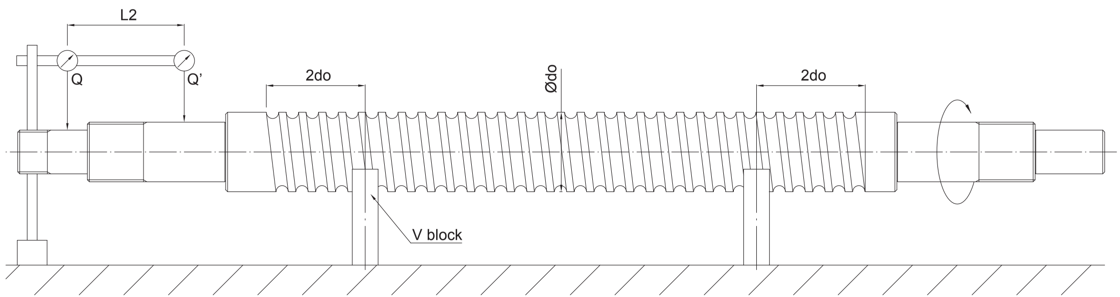


Table2.8 Perpendicularity on supporting-part end face in respect to the threaded part axial line of screw shaf
(measuring basic length is accoring to DIN 69051 and JIS B1192)(Difference of maximum value whinin Q and Q')

Unit: μm

Normial diameter *do(mm)*		Measuring basic length L_r	*PMI* s' Grade($L_2 \leq L_r$)								
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

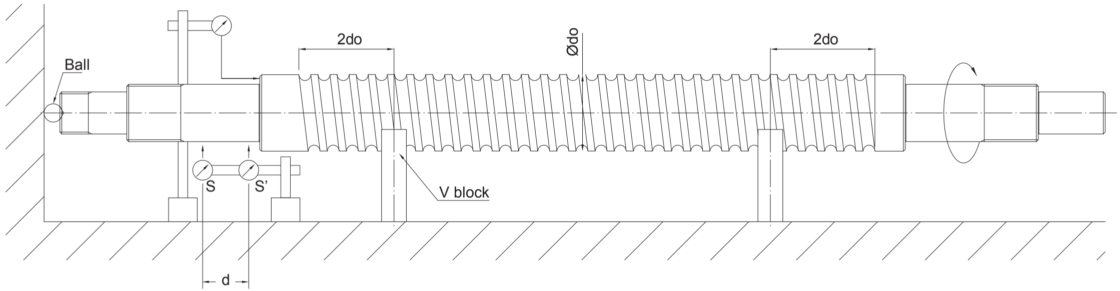


Table2.9 Perpendicularity on supporting-part end face in respect to the threaded part axial line of screw shaf (measuring basic length is accoring to DIN 69051 and JIS B1192)(the value of deflection supports two ends' deflection of difference between S and S')

Unit: μm

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

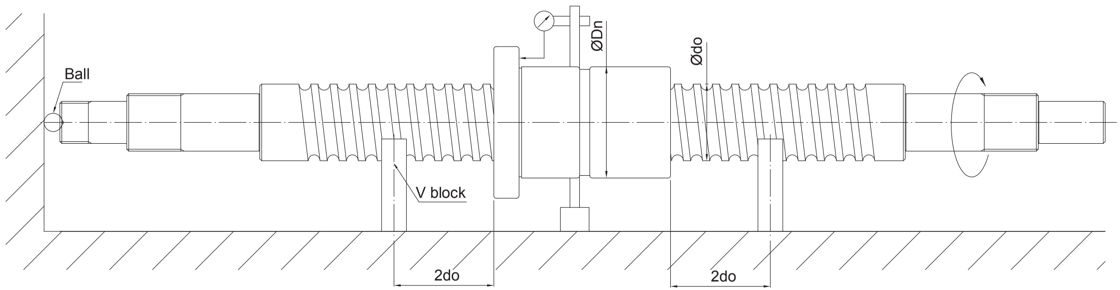


Table2.10 Perpendicularty on mounting face of flang of nut
(measuring basic length is accoring to DIN 69051 and JIS B1192)

Unit: μm

Outside diameter of nut D_n		*PMI* s' Grade								
above	**up to and incl.**	C0	C1	C2	C3	C4	C5	C6	C7	C10
-	**20**	5	6	7	8	9	10	12	14	-
20	**32**	5	6	7	8	9	10	12	14	-
32	**50**	6	7	8	8	10	11	15	18	-
50	**80**	7	8	9	10	12	13	16	18	-
80	**125**	7	9	10	12	14	15	18	20	-
125	**160**	8	10	11	13	15	17	19	20	-
160	**200**	-	11	12	14	16	18	22	25	-
200	**250**	-	12	14	15	18	20	25	30	-

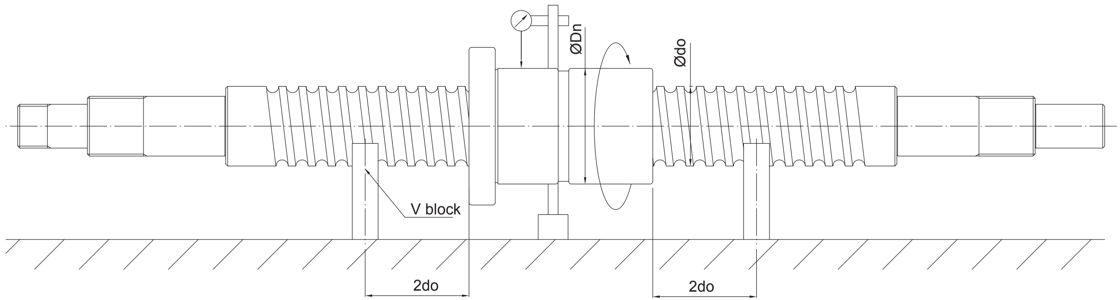


Table2.11Circurmferential runout in radial direction on outer peripheral face of face of nut
(measuring basic length is accoring to DIN 69051 and JIS B1192)

Unit: μm

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

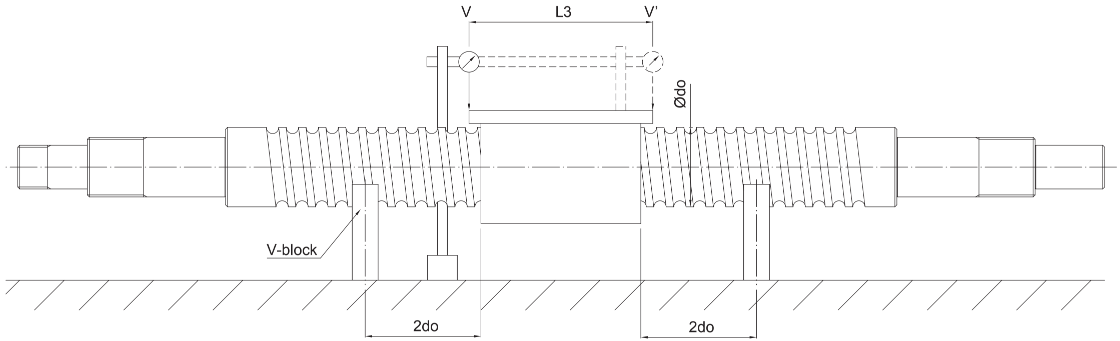


Table2.12 Parallelism on outer peripheral face of nut
(V-V')(measuring basic length is accoring to DIN 69051 and JIS B1192)

Unit: μm

Measuring basic length L_3		*PMI*s' Grade								
above	**up to and incl**	C0	C1	C2	C3	C4	C5	C6	C7	C10
-	**50**	5	6	7	8	9	10	14	17	-
50	**100**	6	7	8	10	11	12	15	17	-
100	**200**	-	10	11	13	15	17	24	30	-

3 Design of Screw Shaft

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.

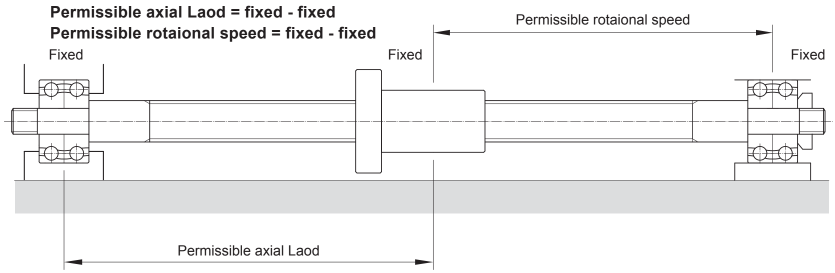


Fig.3.1 Mount method : fixed-fixed

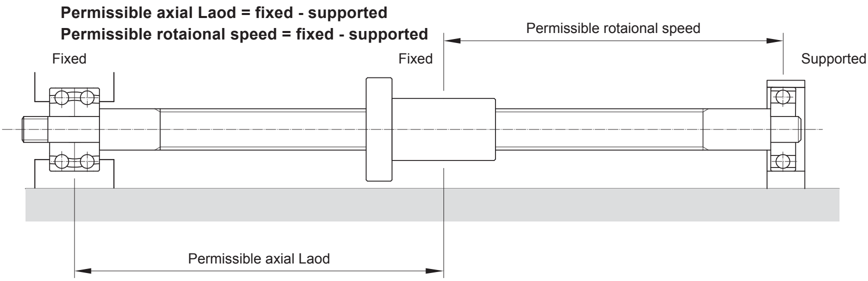


Fig.3.2 Mount method : fixed-supported

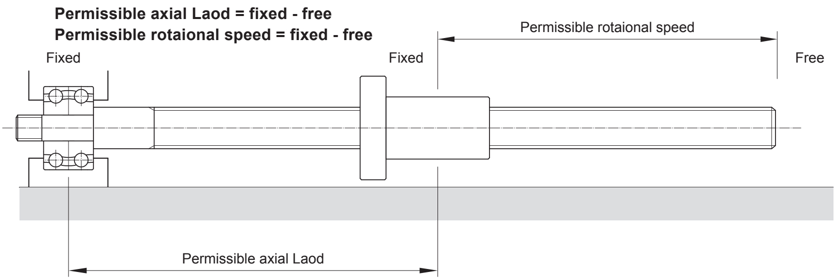


Fig.3.3 Mount method : fixed-free

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):

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

Here:

α	Safety factor (α=0.5)
E	Young's modulus (E=2.1×10^4 kgf/mm^2)
I	Minimum geometrical moment of inertia of the screw shaft cross section ($I=\pi dr^4/64\ mm^4$)
dr	Screw shaft thread minor diameter (mm)
L	Distance between mounting positions (mm)
m 、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

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

Here:

σ	Permissible tensile-compressive stress ($\delta=15\ kgf/mm^2$)
A	Cross section area of root diameter of scrrew 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)

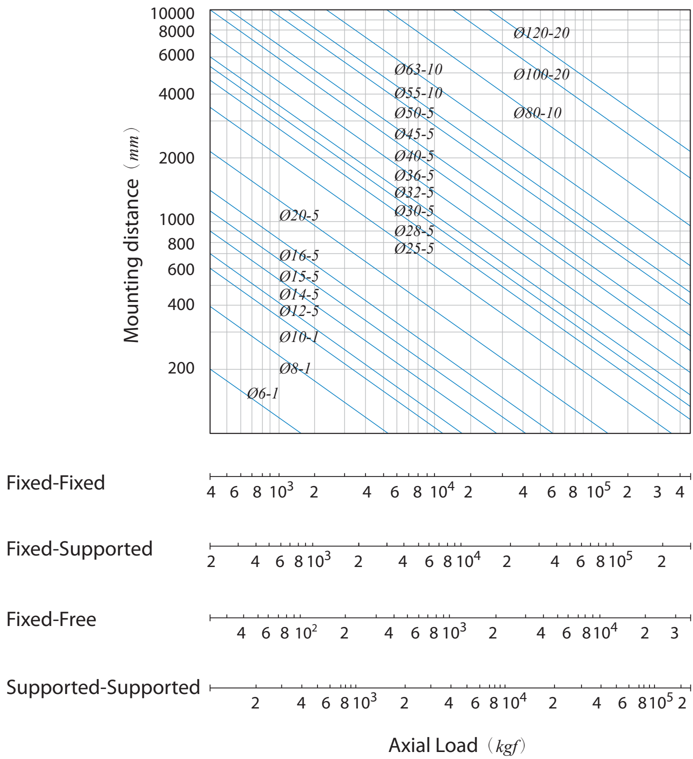


Fig. 3.4 Permissible Axial Load

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.

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

Here:

n	Permissible rational speed (rpm)
α	Safety factor (α=0.8)
E	Young's modulus (E=2.1×10^4kgf/mm^2)
I	Minimum geometrical moment of inertia of the screw-shaft cross section ($I=\pi dr^4/64\ mm^4$)
dr	Screw-shaft thread minor diameter (mm)
A	Screw shaft cross-sectional area ($A=\pi dr^2/4\ mm^2$)
L	Distance between mounting positions (mm)
g	Gravitation acceleration (g =9.8×10^3 mm/s^2)
γ	Specific gravity (γ=7.8×10^{-6} kgf/mm^3)
f、λ	Coefficient depending on the mounting method

supported-supported	f=9.7	($\lambda=\pi$)
fixed-supported	f=15.1	(λ=3.927)
fixed-fixed	f=21.9	(λ=4.730)
fixed-free	f=3.4	(λ=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* ≦ 70000

Rolled ： *dm.n* ≦ 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	≤130000,≤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)

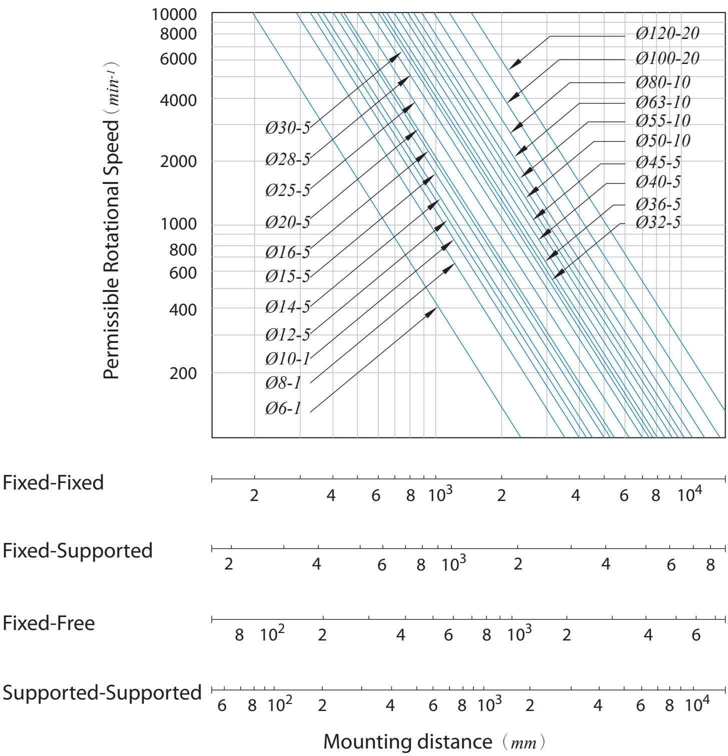


Fig.3.5 Permissible Rotational Speed

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 0.2*mm* 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.

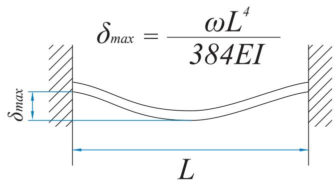
(3) **Not effective hardened area:**

The threads on screw shaft are hardened by induction hardening. It shall cause about 15*mm* 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



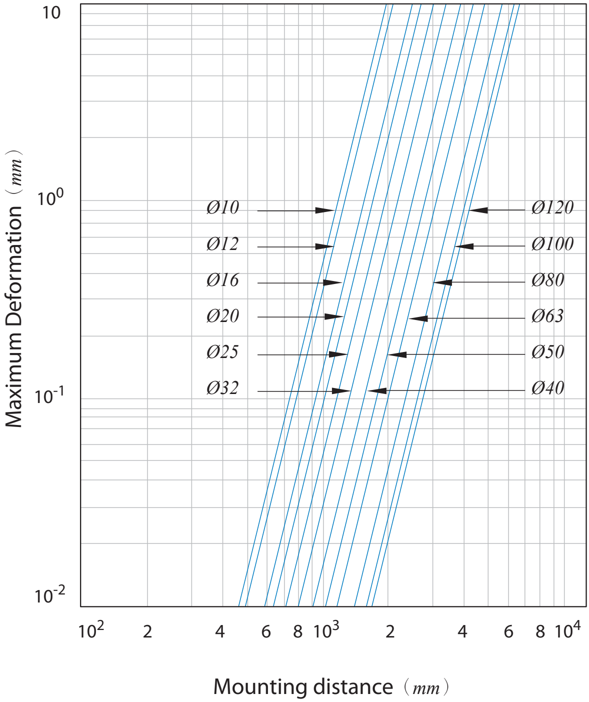
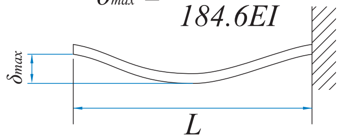


Fig. 3.7.1 Maximun deformation for fixed-fixed

Fixed-Supported

$$\delta_{max} = \frac{\omega L^4}{184.6EI}$$



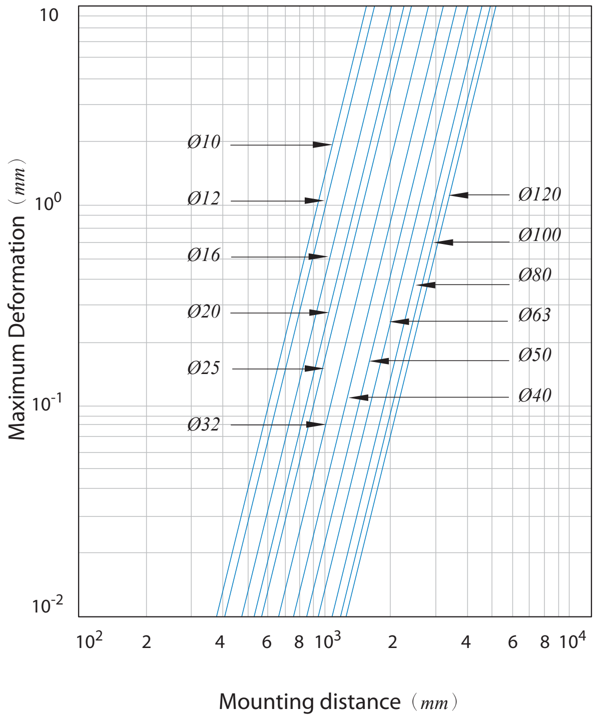


Fig.3.7.2 Maximun deformation for fixed-supported

4 Design of Ball Nut

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

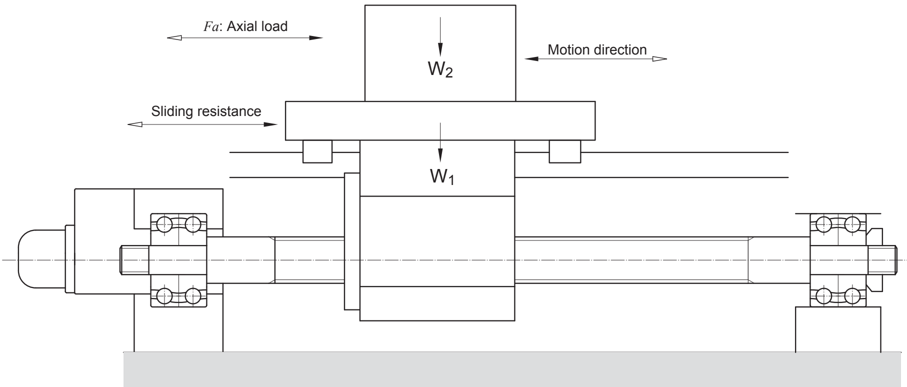


Fig.4.1 Horizontal reciprocating moving mechanism

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

Acceleration (leftward)	$Fa_1 = \mu \times mg + f + ma$ ....(4.1)
Constant speed (leftward)	$Fa_2 = \mu \times mg + f$ ....(4.2)
Deceleration (leftward)	$Fa_3 = \mu \times mg + f - ma$ ....(4.3)
Acceleration (rightward)	$Fa_4 = -\mu \times mg - f - ma$ ....(4.4)
Constant speed (rightward)	$Fa_5 = -\mu \times mg - f$ ....(4.5)
Deceleration (rightward)	$Fa_6 = -\mu \times mg - f + ma$ ....(4.6)

Here:

a Acceleration

$$a = \frac{V_{max}}{t_a}$$

V_{max} Rapid feed speed

t_a time

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

  $$a=\frac{V_{max}}{t_a}$$

  V_{max} Rapid feed speed

  t_a time
- m Total weight(table weight + work piece weight)
- μ Friction coefficient of sliding surface
- f Non-load resistance

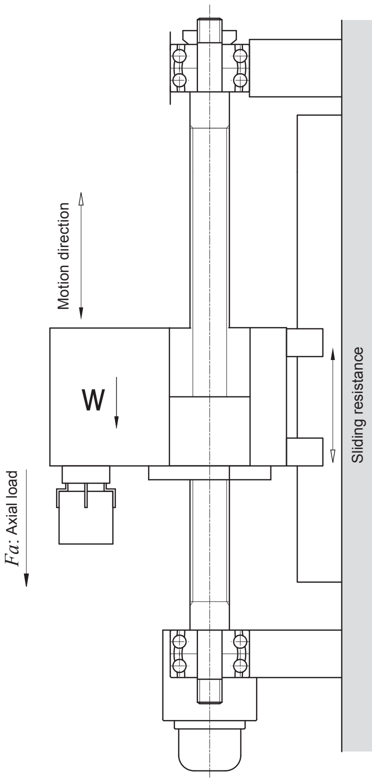


Fig.4.2 Vertical reciprocating moving mechanism

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 Rigidity

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)

$$\delta = \frac{Fa}{K_T} \quad \cdots\cdots\cdots\cdots \quad (5.1)$$

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

Here

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

(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)

$$K_S = \frac{A \times E}{x} \times 10^{-3} \quad \cdots\cdots (5.3)$$

Here

K_S Axial rigidity of Screw shaft ($kgf/\mu m$)

A Screw shaft cross-sectional area ($A=\pi \cdot dr^2/4 \ mm^2$)

dr Screw shaft thread minor diameter (mm)

E Young's modulus (E=2.1×10^4 kgf/mm^2)

x Distance between mounting positions (mm)

b.fixed - fixed (Axial direction)

$$K_S = \frac{A \times E \times L}{x(L - x)} \times 10^{-3} \quad \cdots\cdots (5.4)$$

Here

K_S Axial rigidity of Screw shaft ($kgf/\mu m$)

L Distance between mounting positions (mm)

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

Fixed-Free

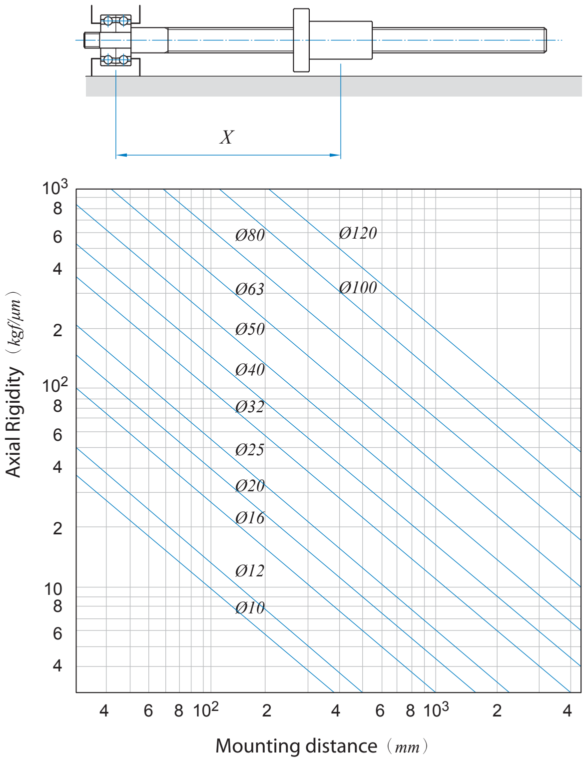
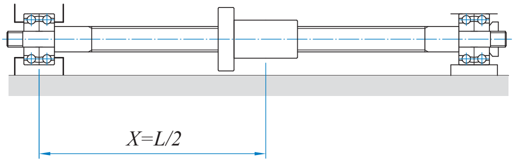


Fig.5.1 Rigidity of ball screw shaft (Fixed-Free)

Fixed-Fixed



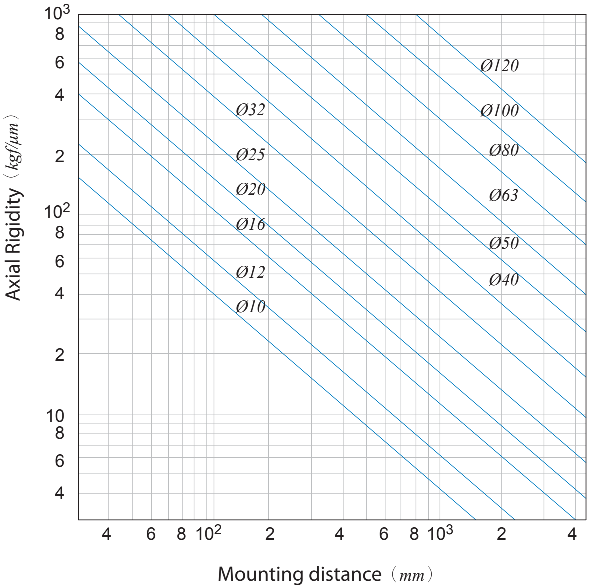


Fig.5.2 Rigidity of ball screw shaft (Fixed-Fixed)

(2) **Axial rigidity of Nut:** K_N

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

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

Here

- C A constant (reference $C \fallingdotseq 2.4$)
- α Contact angle of ball and grooved
- D_ω Ball diameter (mm)
- Q Load of each balls ($Q=Fa/Z \cdot \sin\alpha \ kgf$)
- Z Number of balls
- ξ 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).

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

here

- K Rigidity value given in the dimension table($kgf/\mu m$)
- 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).

$$= 0.8 \times K \left(\frac{Fao}{\varepsilon \times Ca} \right)^{1/3} \quad \cdots\cdots (5.7)$$

here

K	Rigidity value given in the dimension table ($kgf/\mu m$)
Fao	Preload (kgf)
ε	A coefficient of rigidity ε=0.10(spacer prload and offset preload) ε=0.05(oversize prload)
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).

$$K_B = \frac{3Fao}{\delta_{ao}} \quad \cdots\cdots (5.8)$$

here

δao Displacement in the axial direction.

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

Fao	Preload of the suport bearing (kgf)
α	Initial contact angle of the support bearing (°)
D_ω	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".

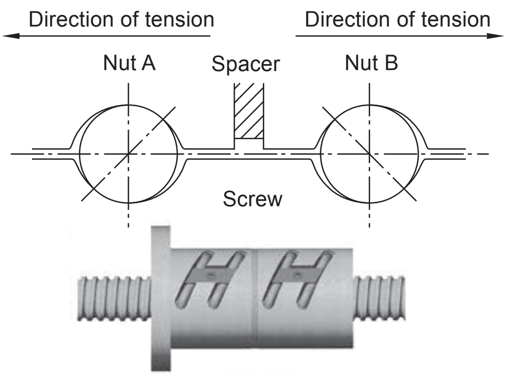


Fig.5.3 Extensive preload

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".

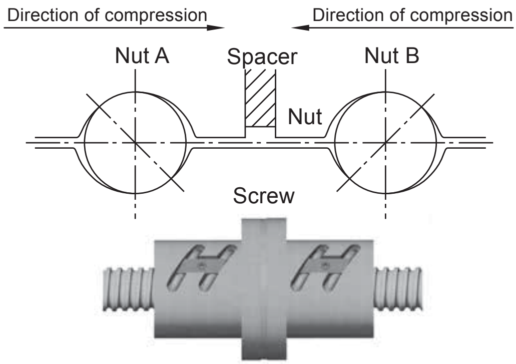


Fig.5.4 Compressive preload

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.

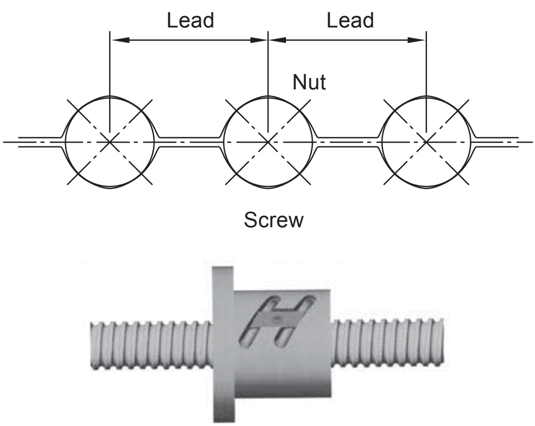


Fig.5.5 Four-point contact preload

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.

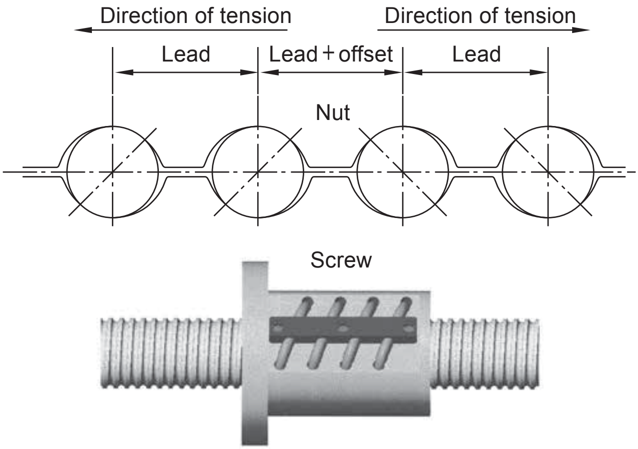


Fig.5.6 Lead offset preload

(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_{ao}, but with reversed direction. The elastic deformation on both Nuts are δ_{ao}.

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:

$$F_A = F_{ao} + F_a - F_a' = F_a + F_p$$
$$F_B = F_{ao} - F_a' = F_p$$

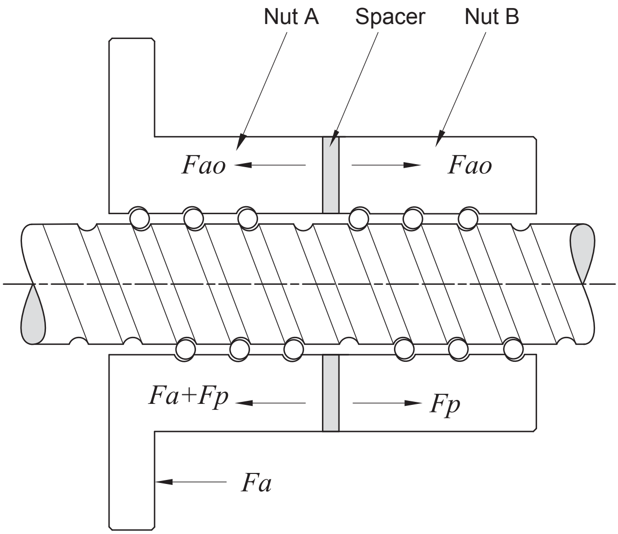


Fig.5.7 Double-nut positioning preload

It means Fa is offset with an amount Fa' 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 $\delta a1$ caused by the external axial force equals δao, 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:

$$\delta_{a0} = K \times Fao^{2/3} \text{ and } 2\delta_{a0} = K \times F_l^{2/3}$$

$$(F_l / Fao)^{2/3} = (2\delta_{a0} / \delta_{a0}) = 2$$

$$F_l = 2.8Fao \fallingdotseq 3Fao$$

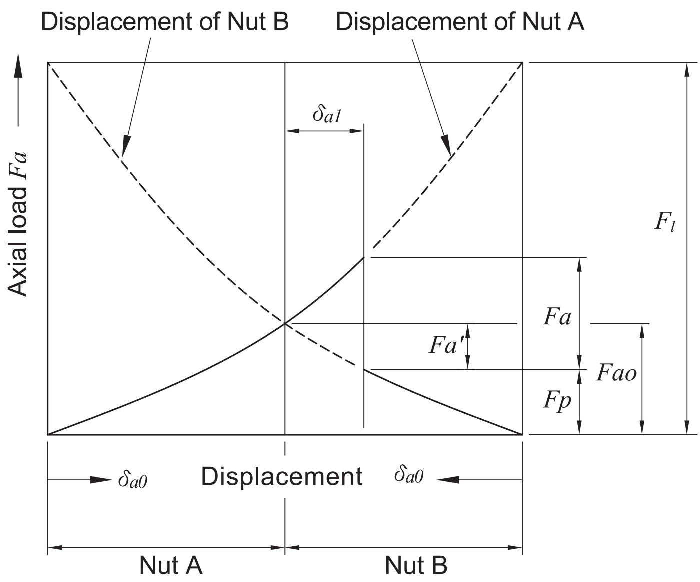


Fig.5.8 Positioning preload diagram

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.

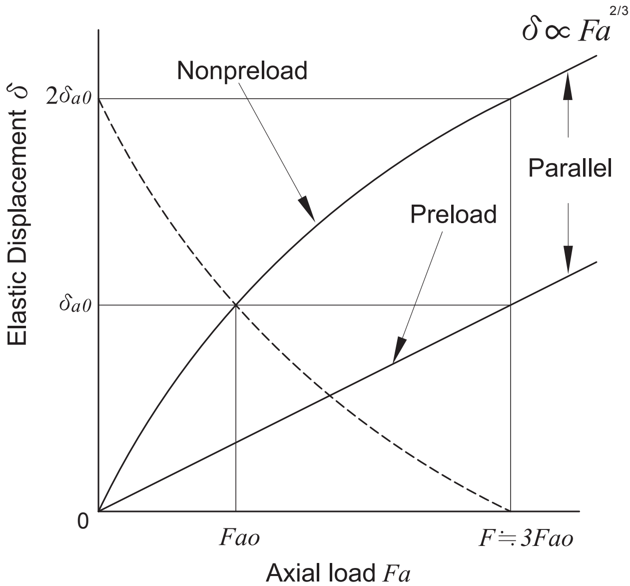


Fig.5.9 Elastic Displacement of the Ballscrew

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).

$$\Delta L_{\theta} = \rho \cdot \theta \cdot L \quad \text{.................................} \quad (5.10)$$

here

- ΔL_{θ} Thermal displacement (μm)
- ρ Thermal-expansion coefficient (12 $\mu m/m$˚C)
- θ Screw-shaft temperature change (˚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 Life

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 Ca

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.

$$L = \left(\frac{Ca}{Fa \times f_W} \right)^3 \times 10^6 \quad \cdots\cdots (6.1)$$

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

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

here

L	Fatigue life (total number of revolutions)(rev)
Lt	Fatigue life (total operating time)(hr)
Ls	Fatigue life (total travel)(km)
Ca	Basic dynamic rate load(kgf)
Fa	Axial load(kgf)
n	Rotation speed(rpm)
l	Lead(mm)
fw	Load factor (refer to Table6.1)

Table6.1 Load factor fw

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

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

Machine center ....20,000 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.Gradational variation curve (Fig.6.1)

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

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

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

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

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)

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

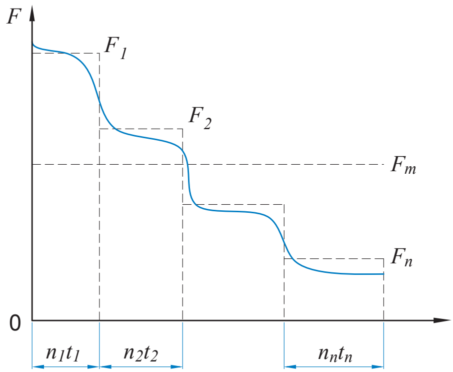


Fig. 6.1 Gradational variation curve's load

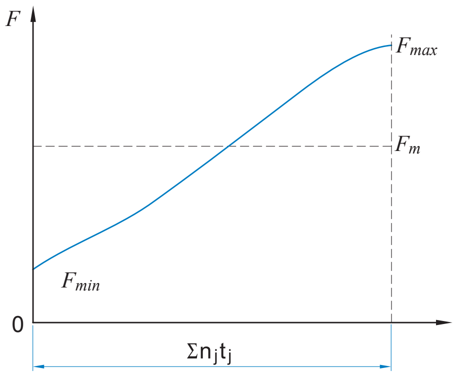


Fig. 6.2 Similar straight line's load

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):

$$F_m = 0.65F_{max} \quad \cdots\cdots \quad (6.7\text{-}1)$$

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):

$$F_m = 0.75F_{max} \quad \cdots\cdots \quad (6.7\text{-}2)$$

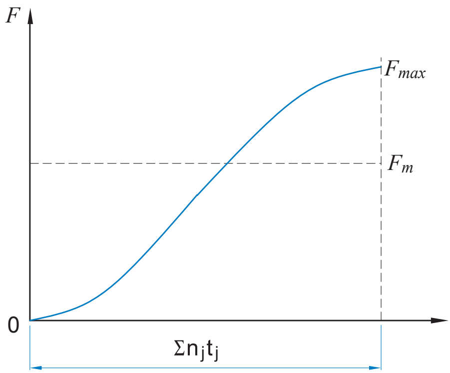


Fig. 6.3.1 Variation like Sine curve's load (1)

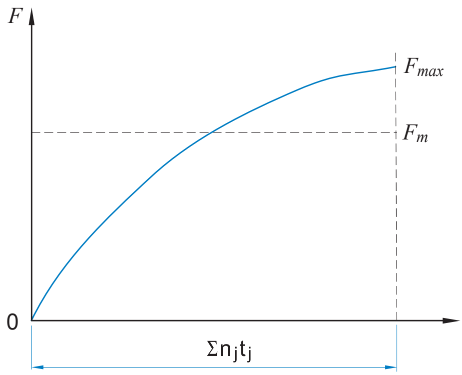


Fig. 6.3.2 Variation like Sine curve's load (2)

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 pallelism 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 μm

conditions
- Axial force Fa=300 kgf
- Radial displacement:0

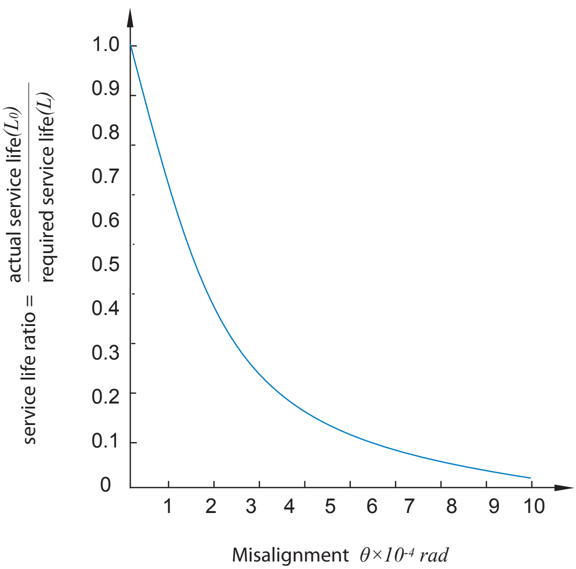


Fig.6.4 The effect on service life of a radial load caused by misalignment

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 Co

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

$$F_{max} = Co / fs$$

here

fs 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 (Ca) and the basic static rate load (Co) 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

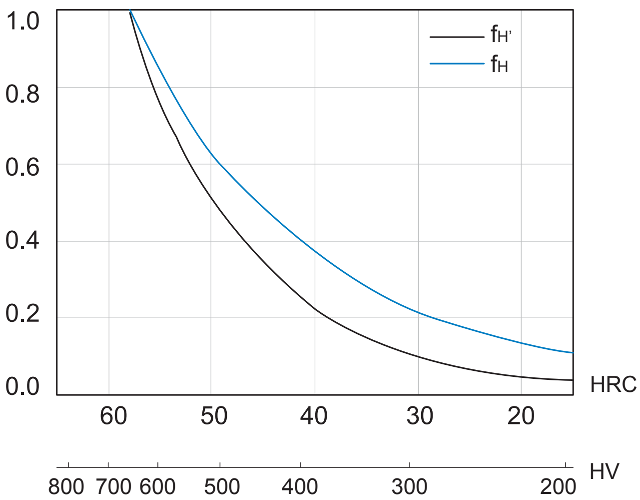


Fig. 6.5 Hardness coefficient

6.5 Heat Treating Inspection Certificate

PMI Linear Motion Systems

PRECISION MOTION INDUSTRIES, INC.

REPORT FOR HEAT TREATING INSPECTION

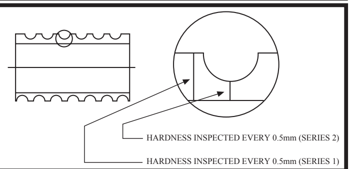
ISO 9001 amtri veritas UKAS QUALITY MANAGEMENT 042

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**
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

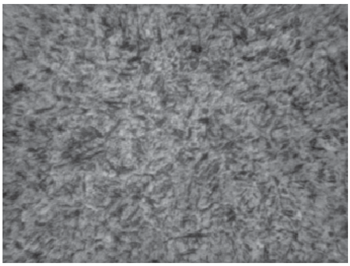
HEATTREATEDARE (SEESKETCH)

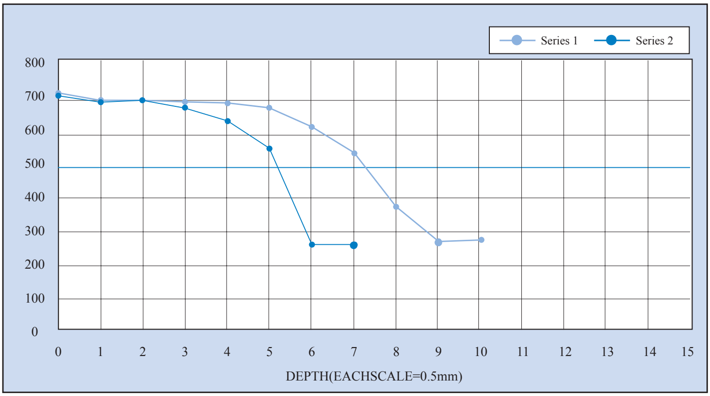


DEPTH	Series1	Series2
0	725	718
1	705	698
2	704	705
3	698	681
4	694	642
5	679	562
6	625	277
7	547	277
8	390	
9	286	
10	288	
11		
12		
13		
14		
15		

MICROSTRUCTURE

X500





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**	

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

Table 6.5 calculate of supply lubricate grease

Lubrication method	Principles of inspection and add
grease	Checked every 2~3 months after begin of the operation and see whether foreign matter. Change grease when dirty. Add grease depending on the use condition and operation environment. The add capacity should be the 50% of the internal volume of the nut. Avoid using different brands of grease

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

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

Q Capacity of supply lubricate grease(cm^3)
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.

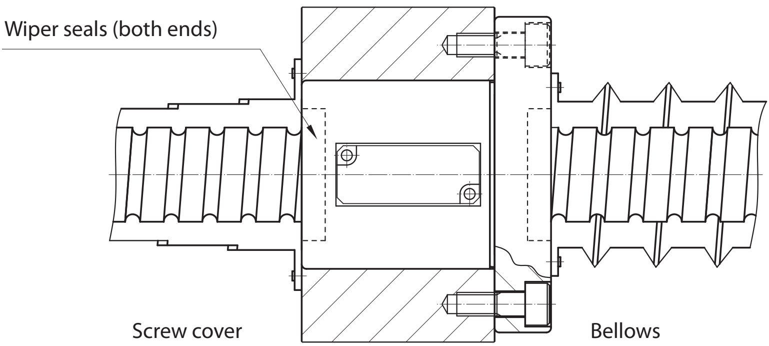


Fig.6.6 Dustproof by screw cover and belows

7 Driving Torque

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)

$$T_a = \frac{Fa \times l}{2\pi \times \eta_1} \quad \cdots\cdots (7.1)$$

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):

$$T_b = \frac{Fa \times l \times \eta_2}{2\pi} \quad \cdots\cdots (7.2)$$

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):

$$T_p = k \times \frac{Fao \times l}{2\pi} \quad \cdots\cdots (7.3)$$

here

T_p Preload torque

Fao 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.

$$T_1 = \left(k \times \frac{Fao \cdot l}{2\pi} + \frac{Fa \cdot l}{2\pi \cdot \eta} + T_B\right) \times \frac{N_1}{N_2} \quad \cdots\cdots (7.4)$$

here

T_1	Driving torque at constant speed
Fao	Preload
Fa	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.

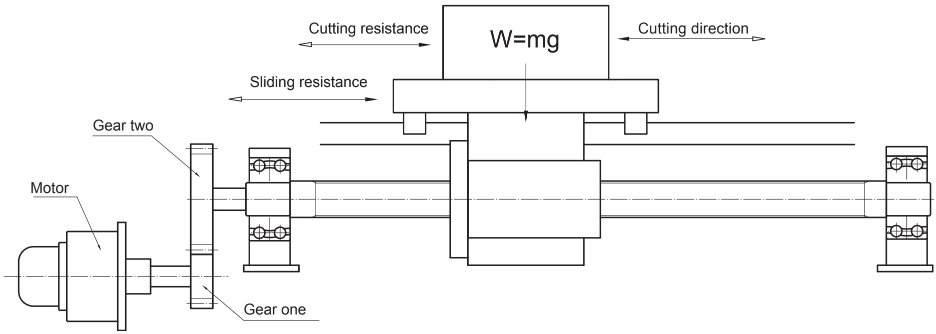


Fig.7.1 Cutting machine diagram

(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.

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

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

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

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)

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

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

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

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

Lead Accuracy P.A22

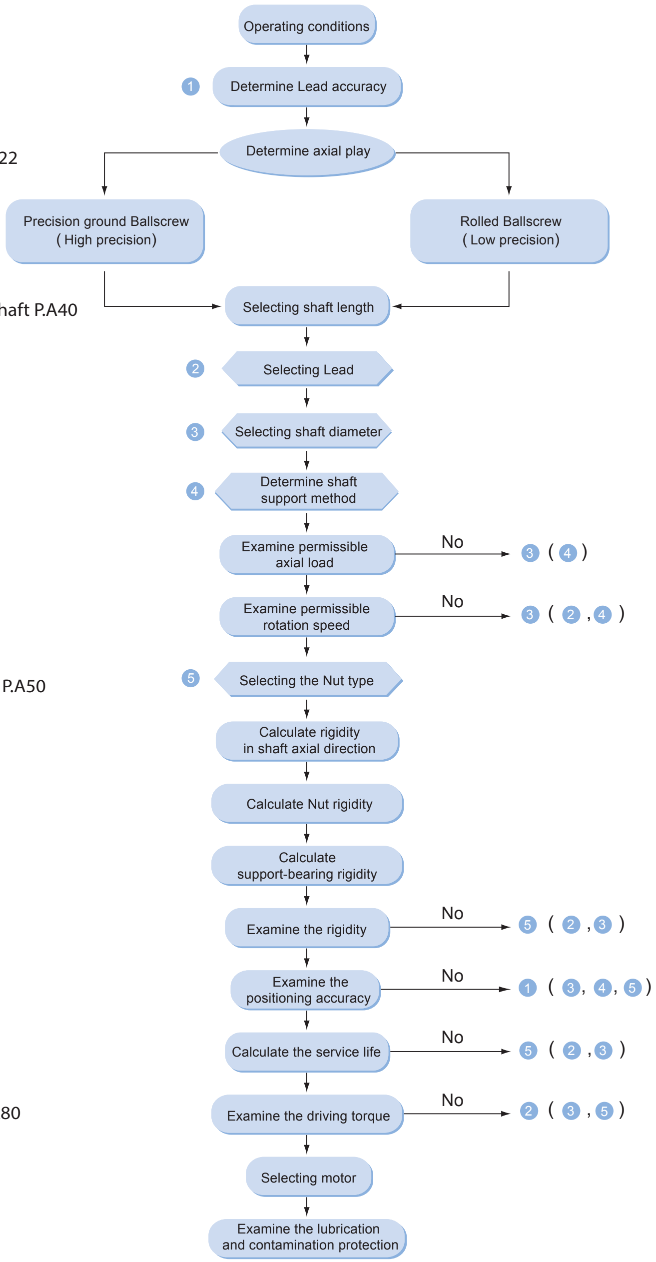
Design of Screw Shaft P.A40

Design of Ball Nut P.A50

Rigidity P.A54

Life P.A68

Driving Torque P.A80

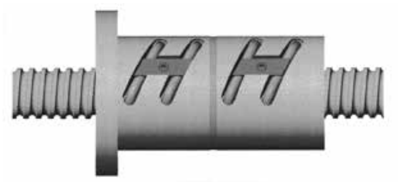


9 Nomenclature of *PMI* Ballscrew

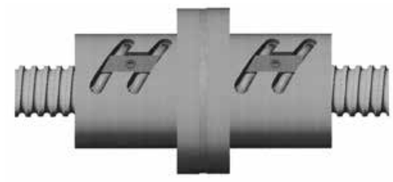
9.1 Nomenclature of External Circulation Ballscrew

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

- R:
  - A: Precision Ground Ballscrew + High dustproof wiper
  - B: Rolled Ballscrew + High dustproof wiper
  - R: Rolled (Not marked for precision ground Ballscrews)
  - S：with retainer
- 0.018: Accuracy grade
- 1500: Overall length
- 1000: Thread length
- C: Refer to P.A87 for this special code
- W:
  - W: External ball circulation (immersion type)
  - B: External ball circulation (immersion type) non-bracke
  - V: External ball circulation (extrusive type)
  - K: End cap type ball recirculation
  - M: Miniature
- S:
  - S: Single nut
  - D: Double nut
  - O: Lead offset preloaded Ballnut
  - F: Ballnut with face to face flanges
- F:
  - F: Flange type
  - R: None flange type
  - S: Square Ballnut
  - D: Double flange Ballnut
- 2: Number of pairs of Nut on one screw shaft
- 2: Quantity of circulation tubes
- B: Effective ball circuits
  - A: 1.5 circuits
  - B: 2.5 circuits
  - C: 3.5 circuits
  - E: 5 circuits
  - F: 6 circuits
- 10: Lead
- 50: Screw nominal O.D.
- R: Thread direction
- 4: Number of Thread

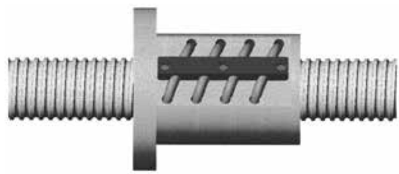


TYPE
FDWC



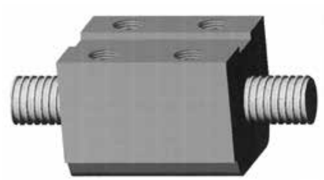
TYPE
DFWC

TYPE
FSWC



TYPE
FOWC

TYPE
RSWC

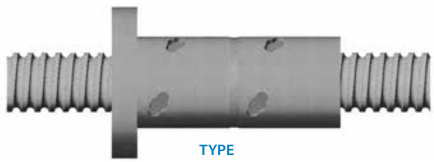


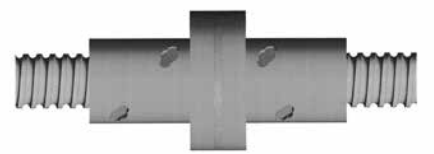
TYPE
SSWC

9.2 Nomenclature of Internal Circulation Ballscrew

4R50-10T4-2FSIC-1000-1500-0.018 R

- R:
  - A: Precision Ground Ballscrew + High dustproof wiper
  - B: Rolled Ballscrew + High dustproof wiper
  - R: Rolled (Not marked for precision ground Ballscrews)
  - S：with retainer
- 0.018: Accuracy grade
- 1500: Overall length
- 1000: Thread length
- C: Refer to P.A87 for this special code
- I:
  - I: Internal ball circulation
  - D: End Deflector
- S:
  - S: Single nut
  - D: Double nut
  - O: Lead offset preloaded Ballnut
  - F: Ballnut with face to face flanges
- F:
  - F: Flange type
  - R: None flange type
  - S: Square Ballnut
  - D: Double flange Ballnut
- 2: Number of pairs of Nut on one screw shaft
- 4: Quantity of circulation deflectors (or inserts)
- T: Number of circuit = 1 circuit
- 10: Lead
- 50: Screw nominal O.D.
- R: Thread direction
- 4: Number of Thread





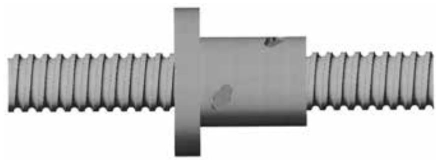


Table 9.1 Special code

C	Precision ground threads
W	Rolled threads
E	E type ball circulation tube (*PMI*'s 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 Sample Process of Selecting The Type of Ballscrew

10.1 Cutting Machine

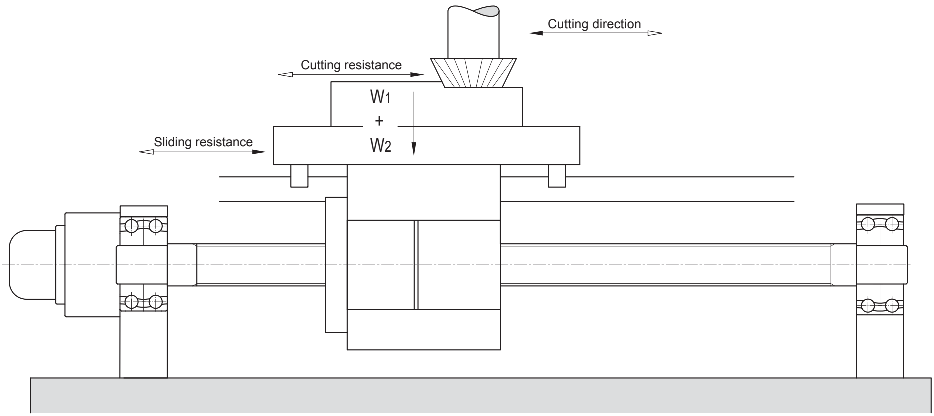


Fig.10.1 Cutting machine

1、Design Conditions

Table weight: $W_1 = 1100\ kg$

Work piece weight: $W_2 = 800\ kg$

Max. travel: $S_{max} = 1000\ mm$

Rapid feed speed: $V_{max} = 14\ m/min$

Life: $L_t = 25000\ h$

Sliding surface friction coefficient: $\mu = 0.1$

Driving motor: $N_{max} = 2000\ rpm$

Positioning accuracy: ±0.030/1000 *mm* (no load)

Repeatability accuracy: ±0.005 *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

Sliding resistance: $Fa = \mu\ (W_1 + W_2)$

$= 0.1 \times (1100 + 800)$

$= 190\ (kgf)$

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

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

◎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)

Calculation data / Kinds of Operation	Axial load	Feed speed		Time
		$l=8$	$l=10$	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

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

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

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

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

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

As per design Conditions:

$L_t = 25000$ ($hours$)

$f_w = 1.2$

When l=8(mm) ....$Ca \geqq 3756$ (kgf)
If life > 25000 ($hours$) is needed,
Ca must be > 3756 (kgf)
When l=10(mm) ....$Ca \geqq 3487$ (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 :

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

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

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) ....$dr \geqq 13.5$ (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) .... $dr \geqq 10.8$ (mm)

If the highest rotational speed reaches 1400 rpm,

screw shaft diameter at thread root area must be biggerthan 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

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

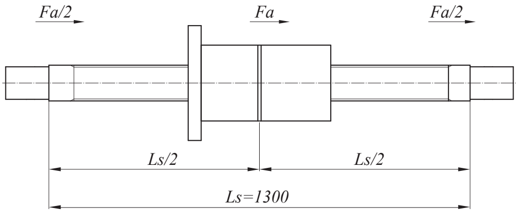
a.Axial rigidity of the screw shaft: Ks

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 $x=L/2$



$$\Rightarrow K_S = \frac{\pi \times dr^2 \times E}{Ls} \times 10^{-3}$$

$$\Delta L_S = \frac{Fa}{K_S} = \frac{Fa \times L_S}{\pi \times dr^2 \times E} \times 10^3$$

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.

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

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

$\varepsilon = 0.1$, then

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

The results are in the table 10.1.

Table10.1

Nut model no.	dr	Ca	K	Screw		Nut		Total
				K_s	ΔL_s	K_n	ΔL_n	ΔL
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 $\Delta L \leqq 8\ (\mu m)$

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

L = Max. travel + Nut length + Unthreaded area length (including journal ends length)

= 1000+180+100

= 1280

≒ 1300 (mm)

(7) Preliminary check

a. Fatigue life

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

$$= \left(\frac{5220}{330 \times 1.2}\right)^3 \times 10^6 \times \frac{1}{60 \times 455}$$

$$\fallingdotseq 83900\ (hours) \geq 25000\ (hours)$$

b. Permissible rotational speed

$$n = f \times \frac{dr}{L^2} \times 10^7$$
$$= 4540\ (rpm)$$

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: ±0.030/1000 mm (Max. travel) Refer to table 2.2, accumulated reference lead deviation (±E) and total relative variation (e)

Accuracy grades: C4

E = ±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

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

2. Pretension force: F_θ

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

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:

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

b.Moving parts:

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

c.Coupling:

$$GD_J^2 = 40\ (kgf \cdot cm^2)$$

d.Total of inertial:

$$GD_L^2 = GD_S^2 + GD_w^2 + GD_J^2 = 334.4\ (kgf \cdot cm^2)$$

(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

$$T_P = k \times \frac{Fao \times l}{2\pi} = 0.18 \times \frac{380 \times 1.0}{2\pi} = 10.8\ (kgf \cdot cm)$$

$k = 0.18$

$Fao = F_{max}/3$

b. Friction torque

Rapid feed:

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

Light cutting:

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

Heavy cutting:

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

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

$$T_L = T_p + T_c$$
$$= 212.5\,(kgf \cdot cm)$$

(3) Selecting driving motor

<Selecting conditions>

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

b.Rated torque: $T_M > T_L$

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

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

◎Motor specifications:

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

(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 : 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)

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

This above motor specifications match design needs.

5、Calculating the stress of the Ballscrew

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

(dr is screw shaft thread root diameter)

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

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

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

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

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

50CrMo4 steel tension strength is $1.1\times10^{8}\ N/m^{2} > \sigma_{max}$

Yield strength is $0.9\times10^{8}\ N/m^{2} > \sigma_{max}$

◎So the Ballscrew selected is safe.

6、Calculating the buckling load of the screw shaft

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

◎So the Ballscrew selected is safe.

10.2 High Speed Porterage Apparatus (Horizontal application)

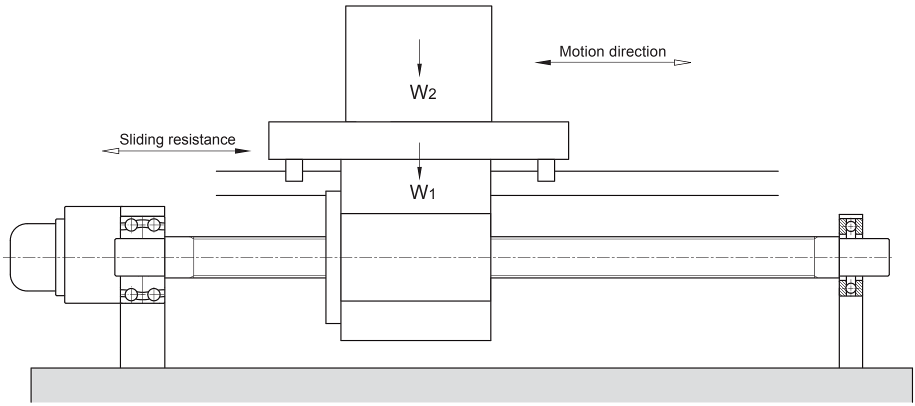


Fig.10.2 High speed porterage apparatus

1 、Design Conditions:

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

2 、Motion Conditions:

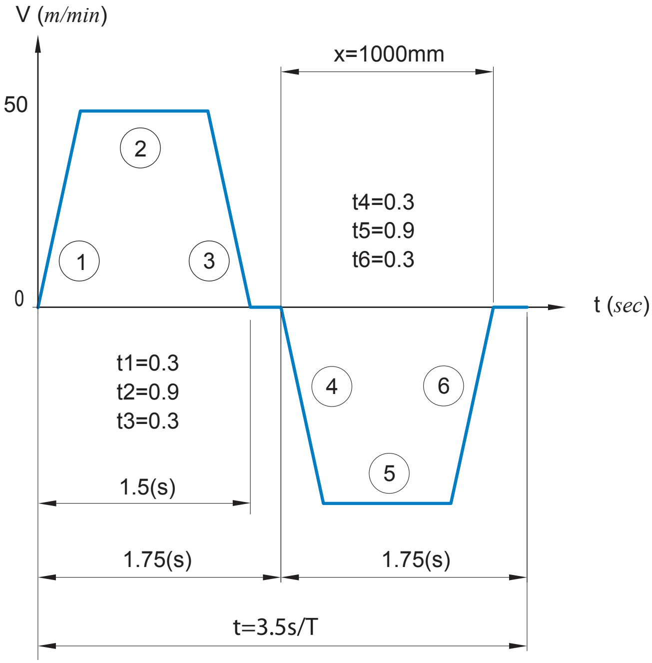


Fig.10.3 Porterage apparatus v-t diagram

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

$$l \geqq \frac{V_{max}}{N_{max}} = \frac{50000}{3000} \fallingdotseq 17\ (mm)$$

◎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

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

= 1000 + 100 + 100 = 1200 (mm)

(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 :

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

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

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

= 1000 + 50 + 100 = 1150 (mm)

Screw shaft support method is fixed-supported

f = 15.1

$dr \geqq 21.9\ (mm)$

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：$V_{max} = 50\ (m/min) = 0.83\ (m/s)$
Acceleration time：$t_1 = 0.3\ (s)$
Deceleration time：$t_3 = 0.3\ (s)$

a.Running distance during acceleration

$$x_1 = \left(\frac{V_0 + V}{2}\right) \times t = \left(\frac{0+0.83}{2}\right) \times 0.3$$

$$= 0.125\ (m) = 125\ (mm)$$

b. Running distance during constant speed

$$x_2 = V \cdot t = 0.83 \times 0.9$$

$$= 0.75\ (\mathrm{m}) = 750\ (mm)$$

c.Running distance from highest speed to stop

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

d. The line segment

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

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

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

e. The line segment

$$F_2 = f = \mu(W_1+W_2)\times g = 0.01\times(50+25)\times 9.8 = 7.35\ (N)$$
$$N_2 = 2500\ (rpm)$$

f. The line segment

$$F_3 = \mu(W_1+W_2)\times g + (W_1+W_2)\times a_3 = 0.01\times(50+25)\times 9.8+(50+25)\times(-2.8) = -203\ (N)$$
$$N_3 = n_{max}/2 = 2500/2 = 1250\ (rpm)$$

Whence 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:

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

$$= 132.4\ (N)$$

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

h. Calculation of life

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

$$= 404000 \geqq 25000\ (hours)$$

◎Above conforms design requirements.

2 、Selecting accuracy grade

Positioning accuracy of ±0.1/1000 *mm* (Max. travel) From P.A24

Accuracy grade: C5
E = ±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:

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

b. Moving parts:

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

c. Coupling:

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

d. Total of Inertial:

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

(2) Driving torque

a. During constant speed:

$$T_1 = \frac{F_2 \times l}{2 \times \eta} = \frac{7.35 \times 2}{2 \times 0.9} = 2.6 \fallingdotseq 3.00\ (N \cdot cm)$$

$\eta = 0.9$

b. During acceleration

$$T_2 = T_1 + J\dot{w} = T_1 + (J_L + J_M) \times \frac{2\pi n}{60 t_1} = 3 + (0.009 + 0.01) \times 9.8 \times \left(\frac{2\pi \times 2500}{60 \times 0.3}\right) = 166\ (N \cdot cm)$$

preselet motor, and give the specifications for the rate inertia

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

c. During deceleration

$$T_3 = T_1 - J\dot{w} = T_1 - (J_L + J_M) \times \frac{2\pi n}{60 t_3} = 3 - (0.009 + 0.01) \times 9.8 \times \left(\frac{2\pi \times 2500}{60 \times 0.3}\right) = -160\ (N \cdot cm)$$

(3) Selecting driving motor

<Selecting conditions>

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

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

◎Motor specifications:

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

(4) Effective torque:

$$T_{rms} = \sqrt{\frac{T_2^2 \times t_a + T_1^2 \times t_b + T_3^2 \times t_c}{t}} = \sqrt{\frac{166^2 \times 0.6 + 3^2 \times 1.8 + 160^2 \times 0.6}{3.5}} = 95\ (N \cdot cm) < 127\ (N \cdot cm)$$

◎ 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)

$$t_a = \frac{0.009+0.01}{2\times127\times3} \times 9.8 \times \frac{2\pi\times2500}{60} \times 1.4 = 0.27\ (s) < 0.3\ (s)$$

◎It conforms to design requirements.

5、Calculating the stress of the Ballscrew

$$\sigma = \frac{F}{A} = \frac{F_{max}}{\pi dr^2/4} = \frac{217\times4}{\pi\times22.425^2} = 0.61\ N/mm^2 = 6.1\times10^5\ N/m^2$$

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

(dr is screw shaft thread minor diameter)

$$\tau = \frac{T\times r}{J} = \frac{1660\times12.5}{24827} = 0.84\ N/mm^2 = 8.4\times10^5\ N/m^2$$

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

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

$$\sigma_{max} = \sqrt{\sigma^2+\tau^2} = 0.10\times10^8\ N/m^2$$

50CrMo4 steel tension strength is $1.5\times10^8\ N/m^2$

Yield strength is $0\ 9\times10^8\ N/m^2$

◎So the Ballscrew selected is safe.

6、Calculating the buckling load of the screw shaft

$$P = \alpha\frac{\pi^2 nEI}{L^2} = m\frac{dr^4}{L^2}\times10^3$$

$$= 10.2\times\frac{22.425^4}{1160^2}\times10^3$$

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

◎So the Ballscrew selected is safe.

10.3 Vertical Porterage Apparatus

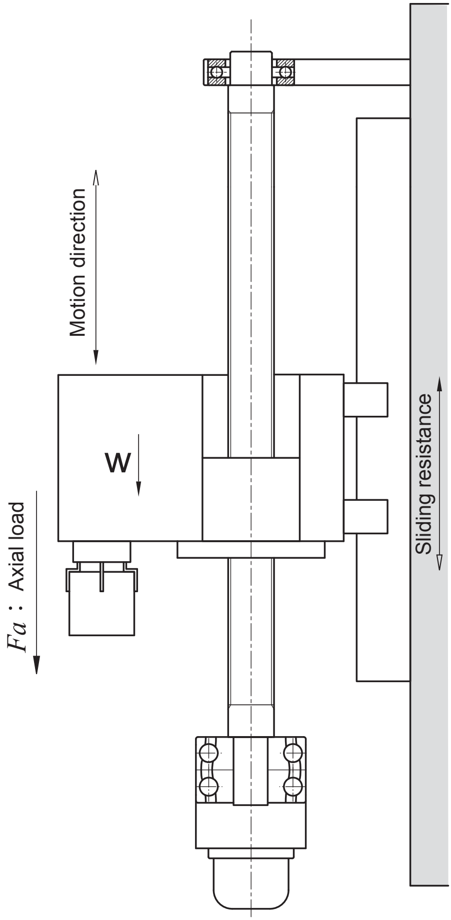


Fig.10.4 Vertical porterage apparatus

1 、Design Conditions:

Table weight:	$W_1 = 300\ kg$
Work piece weight:	$W_2 = 50\ kg$
Max. travel:	$S_{max} = 1500\ mm$
Rapid feed speed:	$V_{max} = 15\times10^3\ mm/min$
Life:	$Lt = 20000\ hours$
Guiding surface friction coefficient:	$\mu = 0.01$
Driving motor:	$N_{max} = 1500\ rpm$
Positioning accuracy:	$\pm0.8/1500\ mm$
Repeatability accuracy:	$\pm0.3\ mm$

2 、Motion Conditions:

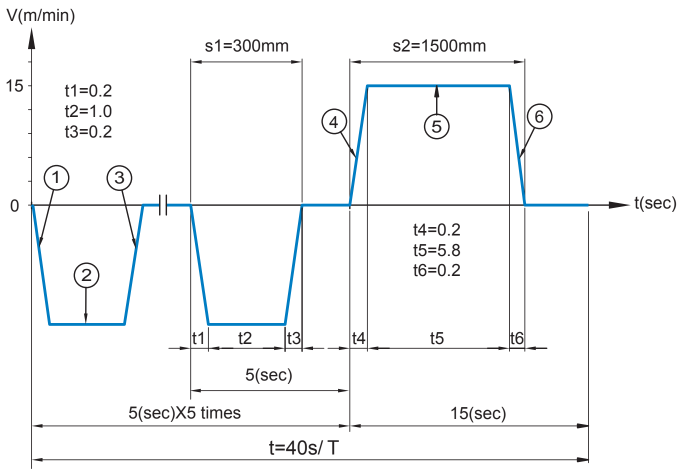


Fig.10.5 Porterage apparatus v-t diagram

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 *mm*

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

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

Accuracy grades C7

E=±0.05/300 *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

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

◎ 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)

$$a_1 = \frac{V_{max}}{t_1} = \frac{15000}{60\times 0.2} = 1250\ (mm/s^2) = 1.25\ (m/s^2)$$

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

$$F=ma \rightarrow F_1=(W_1+W_2)\times g - f - (W_1+W_2)\times a_1 = 2958\ (N)$$

b. Force during constant speed (downward)

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

c. Force during deceleration (downward)

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

d. Force during acceleration (upward)

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

e. Force during constant speed (upward)

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

f. Force during deceleration (upward)

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

So

$$Fa_{max}=F_4 = 3903\ (N)$$

(3) Buckling load:

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

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

$= 19\ (mm)$

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 (*mm*)

Slenderness ratio: 60 or less

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

◎ 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:

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

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

$$\geqq 30$$

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

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

Mean rotation

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

As per design condition:

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

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

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

◎If the life required is > *20000* (*hours*),

Ca has to be > *3426* (*kgf*)

(7) Calculating basic static rate load:

$$Co = F_{max} \times f_S \qquad f_S = 2.0$$
$$= 7806\ (N)$$
$$= 800\ \ (kgf)$$

Co has to be > *800* (*kgf*)

◎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:

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

b. Moving parts:

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

c. Coupling:

$$GD_J^2 = 1.0\ (kgf \cdot cm^2)$$

d. Total of Inertial:

$$GD_L^2 = GD_S^2 + GD_w^2 + GD_J^2 = 178\ (kgf \cdot cm^2)$$

(2) Driving torque:

1.Friction torque

a.Acceleration (downward):

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

b.Constant speed (downward):

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

c.Deceleration (downward):

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

d.Acceleration (upward):

$$T_4 = 690\ (N \cdot cm)$$

e.Constant speed (upward):

$$T_5 = 610\ (N \cdot cm)$$

f.Deceleration (upward):

$$T_6 = 540\ (N \cdot cm)$$

2.Preloading torque

$$T_P = k \times \frac{Fao \times l}{2\pi} \quad \therefore Fao = 0 \quad \because T_P = 0$$

3.Torque required for acceleration:

$$T_7 = J \cdot w$$
$$= (J_L + J_M) \times \frac{2\pi n}{60t_1} = \frac{(178+120)}{4 \times 980} \times \left(\frac{2\pi \times 1500}{60 \times 0.2} \right) = 59.7 \ (kgf \cdot cm) = 585 \ (N \cdot cm)$$

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

4.Total torque:

a.Acceleration (downward):

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

b.Constant speed (downward):

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

c.Deceleration (downward):

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

d.Acceleration (upward):

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

e.Constant speed (upward):

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

f.Deceleration (upward):

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

The maximum torque takes place at the time of acceleration.

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

(3) Selecting driving motor

<Selecting conditions>

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

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

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

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	$GD^2{}_M = 120\ (kgf.cm^2)$

(4) Effective torque:

$$T_{rms} = \sqrt{\frac{T_{k1}^2 \times t_1 + T_{t1}^2 \times t_2 + T_{g1}^2 \times t_3 + T_{k2}^2 \times t_4 + T_{t2}^2 \times t_5 + T_{g2}^2 \times t_6}{t}}$$

$$= \sqrt{\frac{1105^2 \times 1.0 + 600^2 \times 5 + 1265^2 \times 1 + 1275^2 \times 0.2 + 610^2 \times 5.8 + 1125^2 \times 0.2}{20}}$$

$$= 606\ (N \cdot cm) < 1300\ (N \cdot cm)$$

◎It conforms to design requirements.

4、Calculating the stress of the Ballscrew

$$\sigma = \frac{F}{A} = \frac{F_{max}}{\pi dr^2/4}$$

$$= \frac{3903\times 9.8\times 4}{\pi \times 35.05^2}$$

$dr = 40+1.4-6.35=35.05(mm)$

(dr is screw shaft thread root diameter)

$$= 4.04 \ N/mm^2$$

$$= 4.04\times 10^6 \ N/m^2$$

$$\tau = \frac{T\times r}{J}$$

$T_{max}=T_L=1275\ (N\cdot cm)=12750\ (N\cdot mm)$

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

$$= \frac{12750\times 20}{148167}$$

$$= 1.72 \quad N/mm^2$$

$$= 1.72\times 10^6 \ N/m^2$$

$$\sigma_{max} = \sqrt{\sigma^2 + \tau^2}$$

$$= 4.39\times 10^6 \ N/m^2$$

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

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

◎So the Ballscrew selected is safe.

5、Calculating the buckling load of the screw shaft

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

$$= 10.2\times\frac{35.05^4}{1800^2}\times 10^3$$

$$= 4751\ (kgf) > F_{max}\ (398\ kgf)$$

◎So the Ballscrew selected is safe.

11 *PMI* Ballscrew With Hollow Cooling System

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.

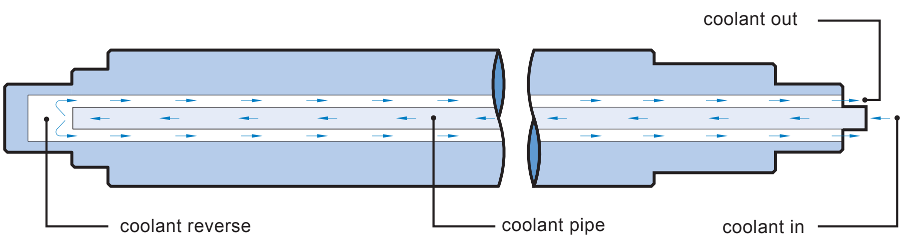


Fig.11.1 Hollow cooling diagram

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

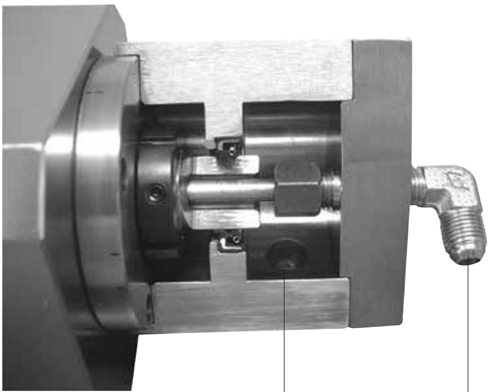


Fig.11.3 Cooling entrance

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.

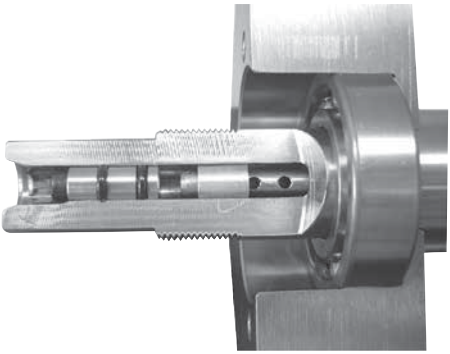


Fig 11.4 End sealing structure

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.

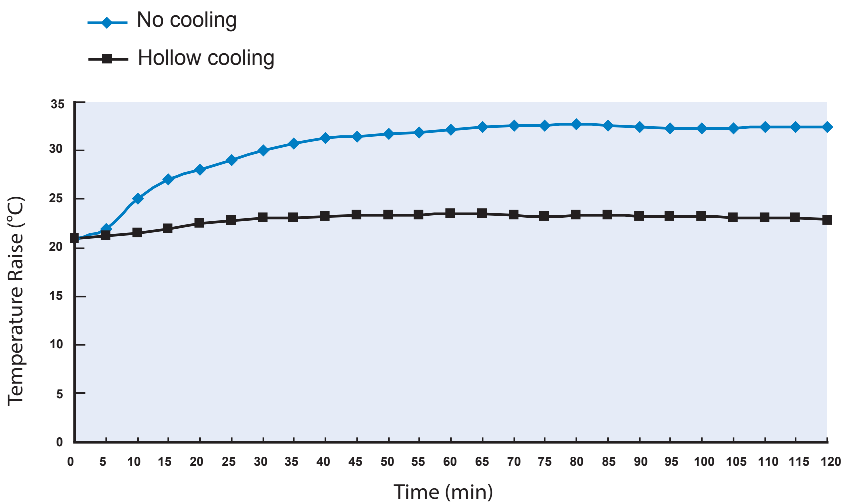


Fig.11.6 The results of experiment

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

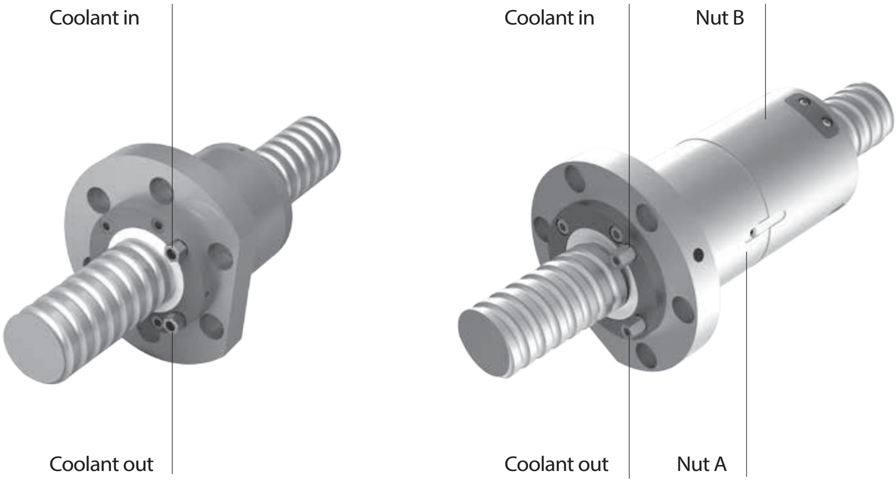


Fig.11.7 Single nut cooling and Double nut cooling diagram

（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/s2)	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 (℃)	Room temperature ±0.5

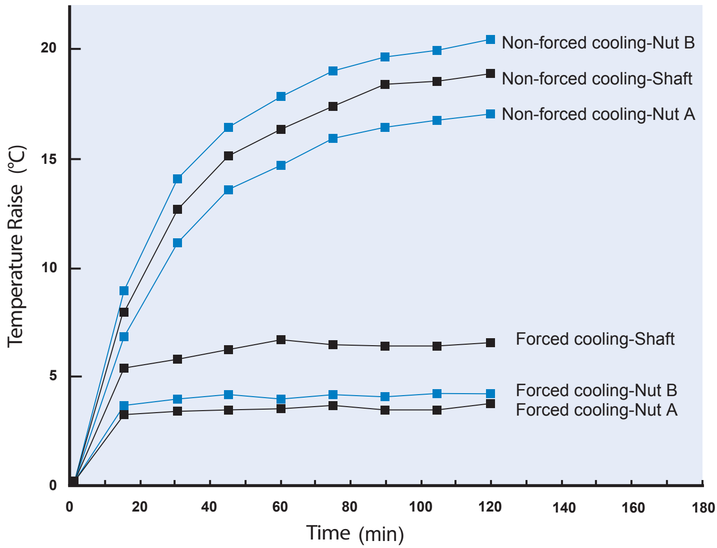


Fig.11.8 The results of experiment

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

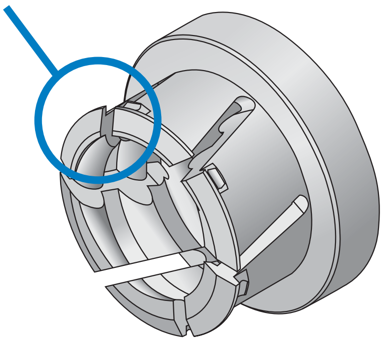


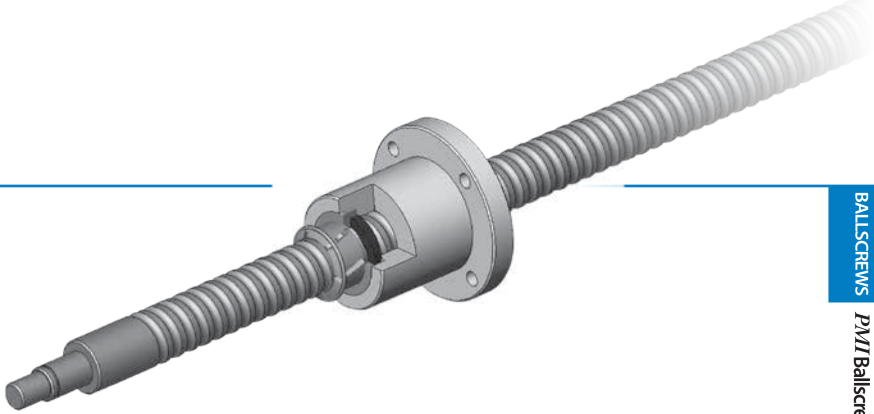
Fig.12.1 High dustproof type1

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)

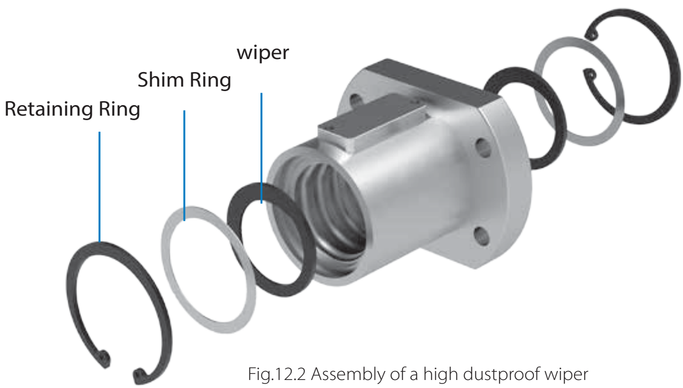


Fig.12.2 Assembly of a high dustproof wiper

Additional Remarks

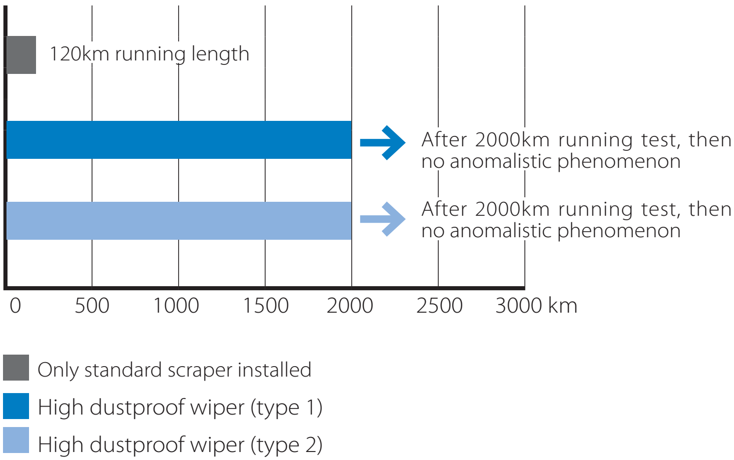
1. Using the high dustproof scraper may induce an increase in preload. If your machine has a strict requirement on the range of preload, please contact ***PMI*** engineers.

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*



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.

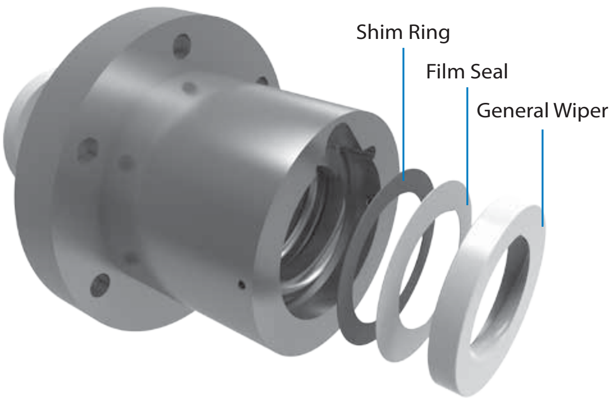
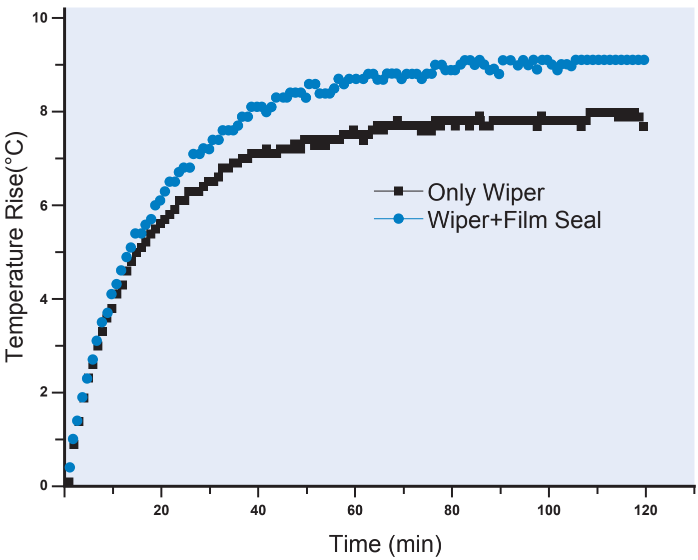


Fig.12.3 Assembly of a Film seal

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℃.



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.

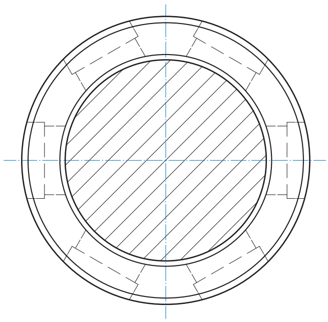
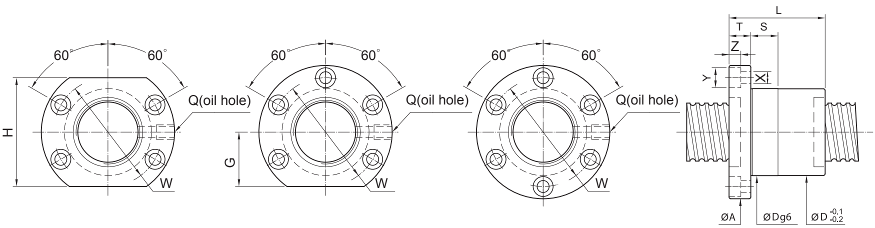


Fig. 13.1 Internal ball circulation's side view

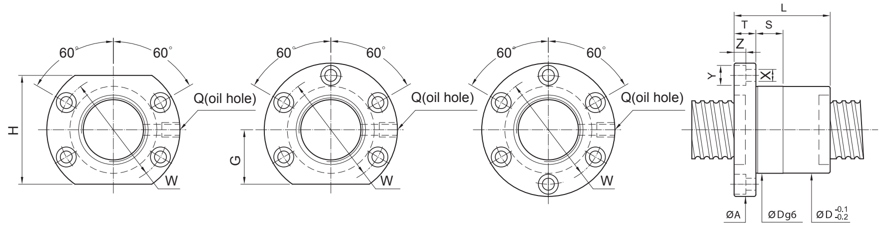
FSIC



Unit: mm

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS	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*
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		47											21
	5	3.175	3	720	1010	26	42	46	10	36	20	40	10	4.5	8	4.5	M6×1P	16
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
			4	980	1650		49	49	10	39	20	40	10	4.5	8	4.5		23
	6	3.175	4	980	1650	30	55	54	12	40	20	40	12	5.5	9.5	5.5	M6×1P	23
20	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	34	47	57	12	45	20	40	12	5.5	9.5	5.5	M6×1P	21
			4	1100	2280		53											28
			6	1560	3420		62											42
	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		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	40	47	63.5	12	51	22	44	15	5.5	9.5	5.5	M8×1P	26
			4	1250	3070		53											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		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		77											43
	10	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
		4.762	3	1620	3205	42	80	68.5	15	55	26	52	15	6.6	11	6.5	M8×1P	27
			4	2070	4270		85											35
			5	2510	5340		91											44
28	6	3.175	3	1030	2630	43	50	68	12	55	26	52	15	6.6	11	6.5	M8×1P	28
	10	3.175	4	1320	3510	45	77	73	12	60	30	60	15	6.6	11	6.5	M8×1P	37

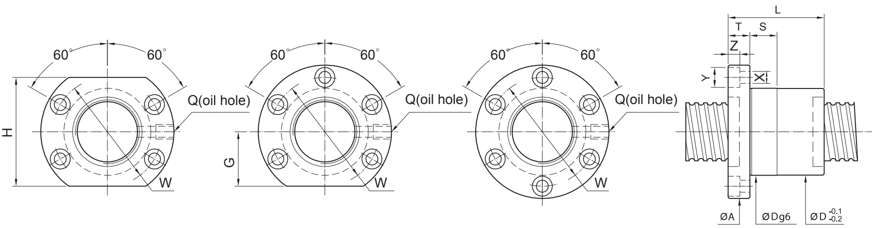
FSIC



Unit: mm

SCREW SIZE O.D.	SCREW SIZE LEAD	BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD(*kgf*) Dynamic (1×10^6 REV.) Ca	BASIC RATE LOAD(*kgf*) Static Co	NUT Dg6	NUT L	FLANGE A	FLANGE T	FLANGE W	FLANGE G	FLANGE H	FIT S	BOLT X	BOLT Y	BOLT Z	OIL HOLE Q	STIFFNESS *kgf/μm*
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											45
	5	3.175	3	1095	3060	48	47	73.5	12	60	30	60	15	6.6	11	6.5	M8×1P	31
			4	1400	4080		53											41
			6	1980	6120		62											60
	6	3.969	3	1500	3750	48	53	73.5	12	60	30	60	15	6.6	11	6.5	M8×1P	32
			4	1920	5000		61											43
			6	2720	7500		73											63
	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											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											45
	12	6.35	3	2605	5310	50	86	88	16	70	34	68	15	9	14	8.5	M8×1P	33
36	5	3.175	4	1490	4690	52	56	88	16	70	34	68	15	9	14	8.5	M8×1P	46
	8	4.762	4	2530	6630	55	73	88	16	72	29	58	15	9	14	8.5	M8×1P	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											49
40	5	3.175	4	1575	5290	55	56	88.5	16	72	29	58	15	9	14	8.5	M8×1P	49
			5	1910	6610		61											61
			6	2230	7940		65											73
	6	3.969	3	1660	4810	55	56	88.5	16	72	34	68	15	9	14	8.5	M8×1P	39
			4	2130	6410		65											51
			6	3020	9620		77											75
	8	4.762	3	2120	5720	60	64	93	16	76	36	72	20	9	14	8.5	M8×1P	40
			4	2720	7620		77											52
			6	3850	11430		94											77
	10	6.35	3	3010	7100	64	83	106	18	84	43	86	20	11	17.5	11	M8×1P	41
			4	3850	9470		93											53
			5	4670	11830		99											67
	12	6.35	3	3010	7100	63	82	106	18	84	43	86	20	11	17.5	11	M8×1P	41
			4	3850	9470		100											53
			5	4670	11830		108											67
		7.144	3	4010	9250	70	93	110	18	85	45	90	20	11	17.5	11	M8×1P	43
			4	5130	12330		103											56

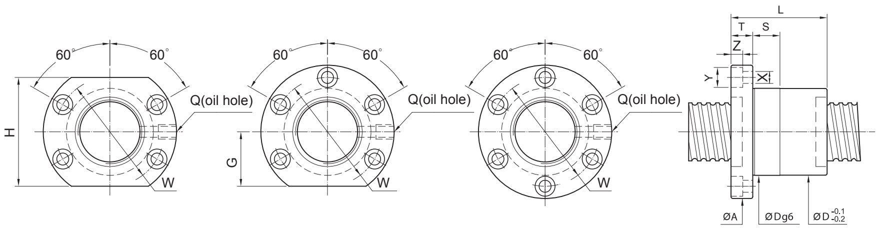
FSIC



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	
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	5	3.175	4	1730	6760	66	55	98	16	82	36	72	20	9	14	8.5	PT1/8"	60
			5	2100	8450		61											74
			6	2450	10140		65											86
	6	3.969	4	2380	8250	66	65	98	16	82	36	72	20	9	14	8.5	PT1/8"	61
			5	2880	10310		64											76
			6	3370	12380		77											90
	8	4.762	4	3010	9610	70	79	113	18	90	42	84	20	11	17.5	11	PT1/8"	63
			5	3650	12010		84											77
			6	4260	14420		96											92
	10	6.35	3	3430	9300	74	83	116	18	94	42	84	20	11	17.5	11	M8×1P	49
			4	4390	12400		93											65
			5	5320	15500		99											80
			6	6220	18600		114											95
	12	7.144	4	5520	16330	75	104	121	22	97	47	94	20	14	20	13	PT1/8"	67
			5	6690	20410		117											84
		7.938	3	4510	11150	75	99	121	22	97	47	94	20	14	20	13	PT1/8"	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

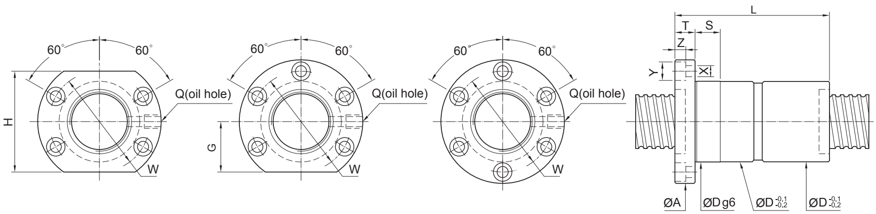
FSIC



Unit: mm

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD(*kgf*)		NUT		FLANGE					FIT	BOLT			OIL HOLE	STIFFNESS
O.D.	LEAD			Dynamic (1×10⁶ REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	S	X	Y	Z	Q	*kgf/μm*
63	6	3.969	4	2610	10550	80	67	122	18	100	45	90	20	11	17.5	11	PT1/8"	73
			6	3700	15830		80											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											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											116
	12	7.938	4	6580	19430	90	111	136	22	112	52	104	20	14	20	13	PT1/8"	80
			6	9320	29150		136											111
	20	9.525	3	8490	23610	95	146	153	28	123	59	118	20	18	26	17.5	PT1/8"	79
			4	10870	31480		156											89
80	10	6.35	4	5510	21200	105	98	151	22	127	57	114	20	14	20	13	PT1/8"	95
			5	6670	26500		105											118
			6	7810	31800		118											140
	12	7.938	4	7500	25700	110	111	156	22	132	59	118	20	14	20	13	PT1/8"	98
			6	10620	38550		136											143
	20	9.525	3	9770	31700	115	146	173	28	143	66	132	20	18	26	17.5	PT1/8"	97
			4	12510	42270		168											127
100	10	6.35	3	4760	20090	125	84	171	22	147	67	134	25	14	20	13	PT1/8"	91
			4	6090	26790		95											120
			5	7380	33490		104											148
			6	8630	40190		115											176
	16	9.525	4	14440	54960	135	140	205	28	169	73	146	30	18	26	17.5	PT1/8"	140
			5	17490	68700		157											173
			6	20460	82440		175											205
	20	9.525	4	14440	54960	135	159	205	28	169	73	146	30	18	26	17.5	PT1/8"	140
			5	17490	68700		180											173
			6	20460	82440		200											205

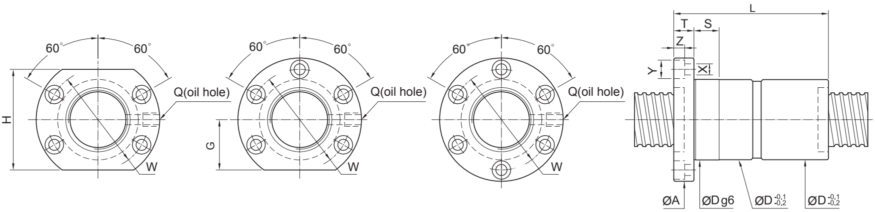
FDIC



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	
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	765	1240	30	80	49	10	39	20	40	10	4.5	8	4.5	M6×1P	35
			4	980	1650		89											47
20	5	3.175	3	860	1710	34	82	57	12	45	20	40	12	5.5	9.5	5.5	M6×1P	43
			4	1100	2280		92											56
	6	3.969	3	1080	2050	34	93	57	12	45	20	40	12	5.5	9.5	5.5	M6×1P	43
			4	1380	2730		107											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
		4.762	3	1620	3205	42	140	68.5	15	55	26	52	15	6.6	11	6.5	M8×1P	53
			4	2070	4270		155											70
32	5	3.175	3	1095	3060	48	82	73.5	12	60	30	60	15	6.6	11	6.5	M8×1P	63
			4	1400	4080		92											82
			6	1980	6120		118											122
	6	3.969	3	1500	3750	48	93	73.5	12	60	30	60	15	6.6	11	6.5	M8×1P	65
			4	1920	5000		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
	12	6.35	3	2605	5310	50	153	88	16	70	34	68	15	9	14	8.5	M8×1P	67
			5	4040	8850		203											110
36	5	3.175	4	1490	4690	52	96	88	16	70	34	68	15	9	14	8.5	M8×1P	91
	8	4.762	4	2530	6630	55	138	88	16	72	34	68	15	9	14	8.5	M8×1P	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

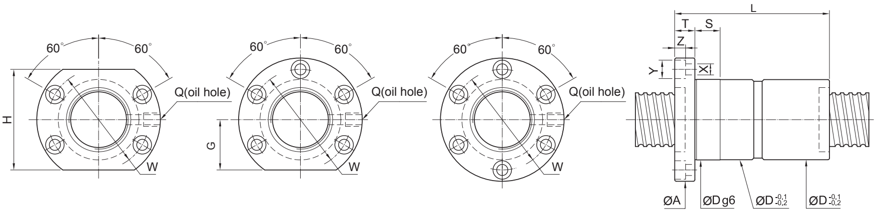
FDIC



Unit: mm

SCREW SIZE O.D.	SCREW SIZE LEAD	BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD (kgf) Dynamic (1×10⁶ REV.) Ca	BASIC RATE LOAD (kgf) Static Co	NUT Dg6	NUT L	FLANGE A	FLANGE T	FLANGE W	FLANGE G	FLANGE H	FIT S	BOLT X	BOLT Y	BOLT Z	OIL HOLE Q	STIFFNESS kgf/μm
40			4	1575	5290		96											100
	5	3.175	5	1910	6610	55	111	88.5	16	72	29	58	15	9	14	8.5	M8×1P	124
			6	2230	7940		122											147
			3	1660	4810		97											77
	6	3.969	4	2130	6410	55	113	88.5	16	72	34	68	15	9	14	8.5	M8×1P	103
			6	3020	9620		137											149
			3	2120	5720		121											80
	8	4.762	4	2720	7620	60	134	93	16	76	36	72	20	9	14	8.5	M8×1P	105
			6	3850	11430		172											154
			3	3010	7100		142											82
	10	6.35	4	3850	9470	64	162	106	18	84	43	86	20	11	17.5	11	M8×1P	107
			5	4670	11830		189											133
	12	6.35	3	3010	7100	63	154	106	18	84	43	86	20	11	17.5	11	M8×1P	82
			5	4670	11830		204											133
		7.144	3	4010	9250	70	160	110	18	85	45	90	20	11	17.5	11	M8×1P	86
			4	5130	12330		185											114
45	8	4.762	4	2870	8620	64	136	92	16	75	36	72	15	9	14.5	9	M6×1P	109
	12	7.144	3	4160	10750	70	158	110	16	90	45	90	20	11	17.5	11	PT1/8"	94
			4	5330	14330		183											124
	16	6.35	3	3220	8200	70	198	110	16	90	45	90	20	11	17.5	11	PT1/8"	90

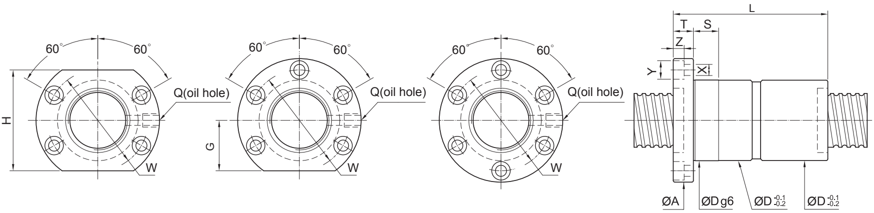
FDIC



Unit: mm

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

FDIC



Unit: mm

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS	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*
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		144											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		178											222
	10	6.35	4	5020	16450	85	166	132	22	107	48	96	20	14	20	13	PT1/8"	158
			6	7110	24680		209											232
	12	7.938	4	6580	19430	90	195	136	22	112	52	104	20	14	20	13	PT1/8"	161
			6	9320	29150		248											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		296											207
80			4	5510	21200		166											190
	10	6.35	5	6670	26500	105	185	151	22	127	57	114	20	14	20	13	PT1/8"	235
			6	7810	31800		209											280
	12	7.938	4	7500	25700	110	195	156	22	132	59	118	20	14	20	13	PT1/8"	196
			6	10620	38550		248											288
			3	9770	31700		254											193
	20	9.525	4	12510	42270	115	297	173	28	143	66	132	20	18	26	17.5	PT1/8"	254
			6	17720	63410		376											373
100			3	4760	20090		143											173
	10	6.35	4	6090	26790	125	164	171	22	147	67	134	25	14	20	13	PT1/8"	228
			5	7380	33490		184											281
			6	8630	40190		210											334
			4	14440	54960		252											266
	16	9.525	5	17490	68700	135	285	205	28	169	73	146	30	18	26	17.5	PT1/8"	329
			6	20460	82440		318											391
			4	14440	54960		299											266
	20	9.525	5	17490	68700	135	340	205	28	169	73	146	30	18	26	17.5	PT1/8"	329
			6	20460	82440		381											391

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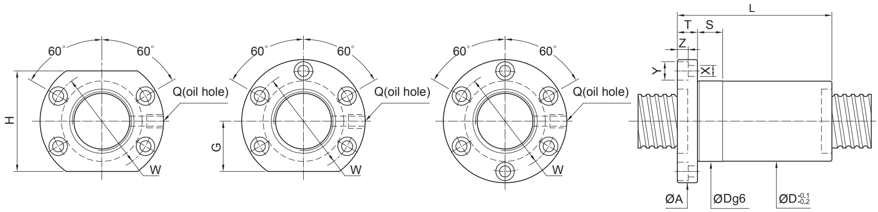
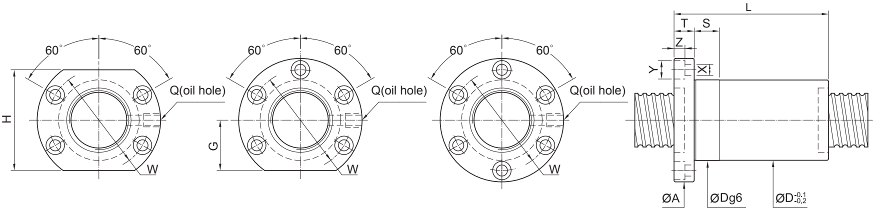


Unit: mm

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	
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	44	63	12	51	22	44	15	5.5	9.5	5.5	M8×1P	30
			3×(2)	500	1440		56											46
			4×(2)	640	1920		64											59
	5	3.175	2×(2)	690	1530	40	53	63.5	12	51	22	44	15	5.5	9.5	5.5	M8×1P	35
			3×(2)	980	2300		67											51
			4×(2)	1250	3070		76											67
	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
	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
	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
	10	3.175	2×(2)	730	1750	45	77	73	12	60	30	60	15	6.6	11	6.5	M8×1P	38
32	4	2.381	3×(2)	560	1840	43	56	68	12	55	26	52	15	6.6	11	6.5	M8×1P	55
			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											82
	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											86
	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
	12	6.35	3×(2)	2605	5310	50	124	88	16	70	34	68	15	9	14	8.5	M8×1P	67

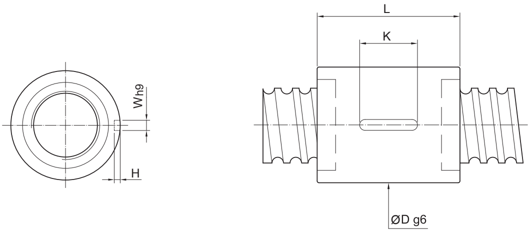
FOIC



Unit: mm

SCREW SIZE O.D.	SCREW SIZE LEAD	BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD(*kgf*) Dynamic (1×10⁶ REV.) Ca	BASIC RATE LOAD(*kgf*) Static Co	NUT Dg6	NUT L	FLANGE A	FLANGE T	FLANGE W	FLANGE G	FLANGE H	FIT S	BOLT X	BOLT Y	BOLT Z	OIL HOLE Q	STIFFNESS *kgf/μm*
40	5	3.175	3×(2)	1230	3970	55	65	88.5	16	72	29	58	15	9	14	8.5	M8×1P	75
			4×(2)	1575	5290		80											100
			6×(2)	2230	7940		101											147
	6	3.969	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	M8×1P	105
	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	3.175	3×(2)	1350	5070	66	65	98	16	82	36	72	20	9	14	8.5	PT1/8"	89
			4×(2)	1730	6760		80											119
			6×(2)	2450	10140		101											174
	6	3.969	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	PT1/8"	125
	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	75	147	121	22	97	47	97	20	14	20	13	PT1/8"	101
			4×(2)	5770	14870		164											132
63	6	3.969	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	4.762	4×(2)	3375	12200	82	119	124	18	102	46	92	20	11	17.5	11	PT1/8"	151
	10	6.35	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"	122
			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	6.35	2×(2)	3360	13390	105	95	171	22	147	67	134	25	14	20	13	PT1/8"	118
			3×(2)	4760	20090		115											173
	16	9.525	2×(2)	11280	41220	115	175	205	28	169	73	146	30	18	26	17.5	PT1/8"	201
	20	9.525	3×(2)	7960	27480	115	159	205	28	169	73	146	30	18	26	17.5	PT1/8"	137

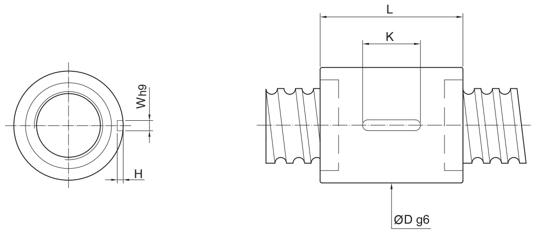
RSIC



Unit: mm

SCREW SIZE O.D.	SCREW SIZE LEAD	BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD*(kgf)* Dynamic (1×10^6 REV.) Ca	BASIC RATE LOAD*(kgf)* Static Co	NUT Dg6	NUT L	KEYWAY K	KEYWAY W	KEYWAY H	STIFFNESS *kgf/μm*
16	5	3.175	3	765	1240	30	40	20	3	1.8	18
20	5	3.175	3	860	1710	34	41	20	3	1.8	21
			4	1100	2280		48				28
	6	3.969	3	1080	2050	34	46	20	4	2.5	22
			4	1380	2730		56	25			28
25	5	3.175	3	980	2300	40	41	20	4	2.5	26
			4	1250	3070		48				33
	6	3.969	3	1275	2740	40	46	20	4	2.5	26
			4	1630	3650		56	25			34
32	5	3.175	3	1095	3060	48	41	20	4	2.5	31
			4	1400	4080		48	20			41
			6	1980	6120		61	25			60
	6	3.969	3	1500	3750	50	46	20	5	3.0	32
			4	1920	5000		56	25			43
			6	2720	7500		70	32			63
	8	4.762	3	1820	4230	50	59	25	5	3.0	32
			4	2330	5640		70				43
	10	6.35	3	2605	5310	50	68	25	6	3.5	33
			4	3340	7080		79	32			45
40	5	3.175	4	1575	5290	55	48	20	4	2.5	49
			6	2230	7940		61	25			73
	6	3.969	4	2130	6410	55	56	25	5	3.0	51
			6	3020	9620		70	32			75
	8	4.762	4	2720	7620	60	70	25	5	3.0	52
			6	3850	11430		91	40			77
	10	6.35	3	3010	7100	65	68	25	6	3.5	41
			4	3850	9470		79	32			53

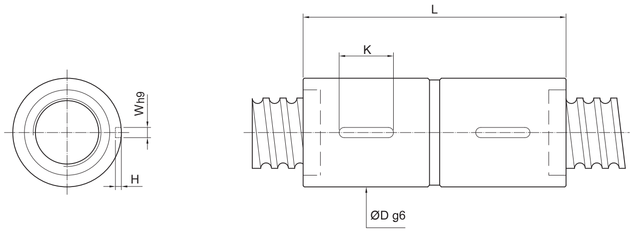
RSIC



Unit: mm

SCREW SIZE		BALL	EFFECTIVE	BASIC RATE LOAD*(kgf)*		NUT		KEYWAY			STIFFNESS
O.D.	LEAD	DIA.	TURNS	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				92
	10	6.35	3	3430	9300	74	68	32	6	3.5	49
			4	4390	12400		79				65
			6	6220	18600		102				95
	12	7.938	3	4510	11150	75	82	40	6	3.5	50
			4	5770	14870		92				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				120
			5	7380	33490		94				148
			6	8630	40190		104				176
	16	9.525	4	14440	54960	135	128	63	10	5	140
			5	17490	68700		77				173
			6	20460	82440		162				205
	20	9.525	4	14440	54960	135	144	63	10	5	140
			5	17490	68700		164				173
			6	20460	82440		187				205

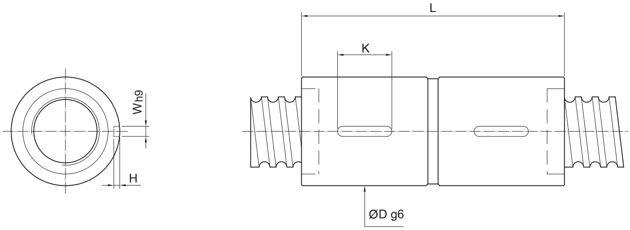
RDIC



Unit: mm

SCREW SIZE		BALL	EFFECTIVE	BASIC RATE LOAD *(kgf)*		NUT		KEYWAY			STIFFNESS
O.D.	LEAD	DIA.	TURNS	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	25			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	25			68
32	5	3.175	3	1095	3060	48	75	20	4	2.5	63
			4	1400	4080		85	20			82
			6	1980	6120		105	25			122
	6	3.969	3	1500	3750	50	87	20	5	3.0	65
			4	1920	5000		103	25			86
			6	2720	7500		127	32			125
	8	4.762	3	1820	4230	50	109	25	5	3.0	66
			4	2330	5640		127				86
	10	6.35	3	2605	5310	50	135	25	6	3.5	67
			4	3340	7080		155	32			89
40	5	3.175	4	1575	5290	55	85	20	4	2.5	100
			6	2230	7940		105	25			147
	6	3.969	4	2130	6410	55	103	25	5	3.0	103
			6	3020	9620		127	32			149
	8	4.762	4	2720	7620	60	127	25	5	3.0	105
			6	3850	11430		161	40			154
	10	6.35	3	3010	7100	65	135	25	6	3.5	82
			4	3850	9470		155	32			107

RDIC



Unit: mm

SCREW SIZE O.D.	SCREW SIZE LEAD	BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD *(kgf)* Dynamic (1×10^6 REV.) Ca	BASIC RATE LOAD *(kgf)* Static Co	NUT Dg6	NUT L	KEYWAY K	KEYWAY W	KEYWAY H	STIFFNESS *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				185
	10	6.35	3	3430	9300	74	135	32	6	3.5	99
			4	4390	12400		155	32			129
			6	6220	18600		197	40			191
	12	7.938	3	4510	11150	75	161	40	6	3.5	101
			4	5770	14870		185				132
63	6	3.969	4	2610	10550	80	106	25	6	3.5	146
			6	3700	15830		130	32			217
	8	4.762	4	3375	12200	82	131	32	6	3.5	151
			6	4780	18300		165	40			222
	10	6.35	4	5020	16450	85	160	32	8	4.0	158
			6	7110	24680		202	40			232
	12	7.938	4	6580	19430	90	185	40	8	4.0	161
			6	9320	29150		238	50			236
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	50	10	5	173
			4	6090	26790		164				228
			5	7380	33490		174				281
			6	8630	40190		204				334
	16	9.525	4	14440	54960	135	240	63	10	5	266
			5	17490	68700		274				329
			6	20460	82440		306				391
	20	9.525	4	14440	54960	135	284	63	10	5	266
			5	17490	68700		324				329
			6	20460	82440		366				391

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

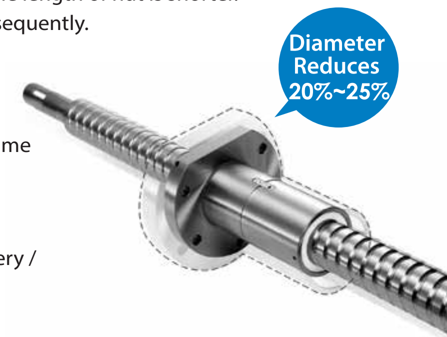
Max. DN Value: 220,000

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.



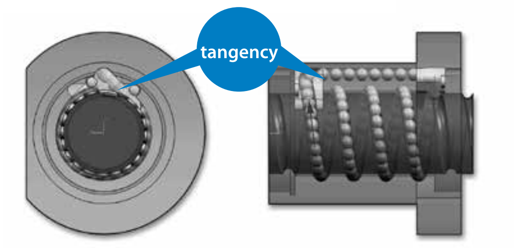
Circulation

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.

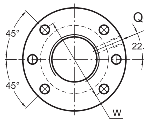
Applications

CNC Machinery / Precision Machinery / High Speed Machinery /

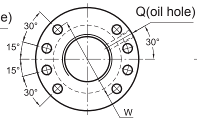
Semi-Conductor Equipment / Medical equipment



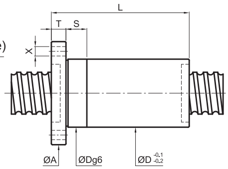
FSDC

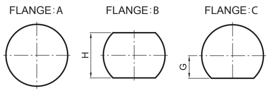


TYPE I



TYPE II



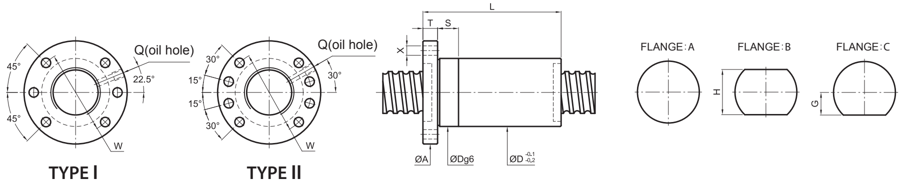


Unit: mm

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD(*kgf*)		NUT		FLANGE						FIT	OIL HOLE	BOLT	STIFFNESS
O.D.	LEAD			Dynamic (1×10^6 REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	TYPE	S	Q	X	*kgf/μm*
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	29	50										27
	16		2	600	1150	29	51										19
20	4	2.381	3	780	2000	32	28	54	12	42	19	38	I	12	M6×1P	5.5	29
	5	3.175	4	1300	3030	36	40	62	12	49	24	48	I	12	M6×1P	6.6	43
	10		3	990	2220		47										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	3.175	4	1440	3840	40	41	62	12	51	24	48	I	15	M6×1P	6.6	50
	10		3	1100	2810		50										38
	15		4	1410	3780		81										50
	20		2	750	1840		60										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		2	1160	2720		70										28
	8	4.762	4	2880	6890	45	55	65	15	54	25.5	51	I	15	M6×1P	6.6	55
	10		4	2880	6870		63										55
	16		4	2830	6790		85										55
	20		2	1470	3180		61										29
	10	6.35	5	5050	11500	51	78	84	16	67	32	64	I	15	M6×1P	9	72

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

FSDC



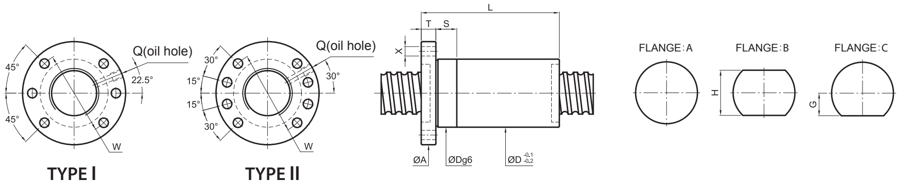
TYPE I　　TYPE II

Unit: mm

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

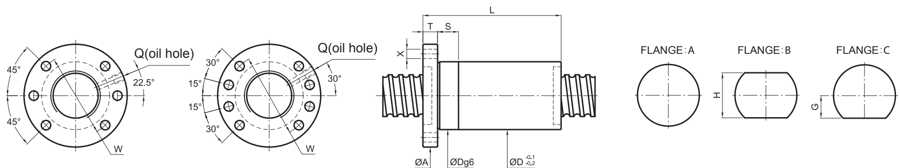


Unit: mm

SCREW SIZE		BALL	EFFECTIVE	BASIC RATE LOAD(kgf)		NUT		FLANGE						FIT	OIL HOLE	BOLT	STIFFNESS
O.D.	LEAD	DIA.	TURNS	Dynamic (1×10⁶ REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	TYPE	S	Q	X	*kgf/μm*
36	8	4.762	5	4170	12580	56	63	80	11	68	34	68	I	15	M8×1P	9	86
	10	6.35	5	6050	16460	61	78	91	18	76	34	68	II	15	M8×1P	9	93
	12		5	6080	16430		88										93
	16		5	6050	16360		109										93
	20		4	4910	12890		109										76
	36		2	2570	6250		95										41
38	10	6.35	5	6260	17740	63	80	93	18	78	35	70	II	20	M8×1P	9	97
	12		5	6260	17410		88										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	65	78	95	18	80	36	72	II	20	M8×1P	9	101
	12		5	6420	18410		88										101
	15		5	6380	18350		103										101
	16		5	6390	18330		108										101
	20		4	5190	14450		110	98	18	83	37	74	II	20	M8×1P	11	82
	40		2	2700	6950												43
	12	7.144	5	7530	20800	70	110	98	18	83	37	74	II	20	M8×1P	11	103
	16		5	7500	20730												103

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

FSDC



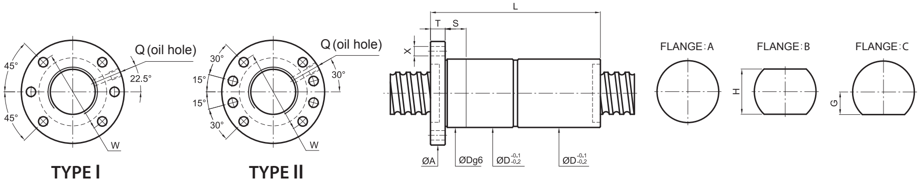
TYPE I   TYPE II

Unit: mm

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD(kgf)		NUT		FLANGE						FIT	OIL HOLE	BOLT	STIFFNESS
O.D.	LEAD			Dynamic (1×10^6 REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	TYPE	S	Q	X	*kgf/μm*
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	73	88	105	18	88	40	80	II	20	M8×1P	11	113
	20		4	6440	18340		110										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	75	90	118	18	100	46	92	II	20	M8×1P	11	119
	16		5	7120	23250		109										119
	20		3	4460	13520		95										74
	20	7.938	4	7810	22680	80	114	121	18	104	50	100	II	25	M8×1P	11	101
55	12	6.35	5	7340	25280	80	96	118	18	100	46	92	II	20	M8×1P	11	128
63	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

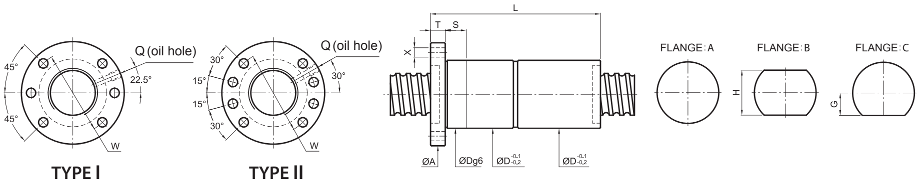


Unit: mm

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

FDDC



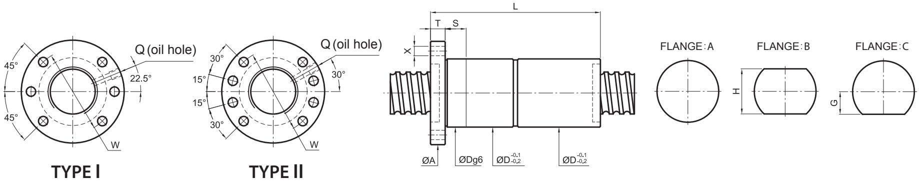
TYPE I TYPE II

Unit: mm

SCREW SIZE O.D.	SCREW SIZE LEAD	BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD(kgf) Dynamic (1×10⁶ REV.) Ca	BASIC RATE LOAD(kgf) Static Co	NUT Dg6	NUT L	FLANGE A	FLANGE T	FLANGE W	FLANGE G	FLANGE H	FLANGE TYPE	FIT S	OIL HOLE Q	BOLT X	STIFFNESS kgf/μm
	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		M8×1P	6.6	108
	8		3	2350	5720		94										69
28	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
	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
32	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



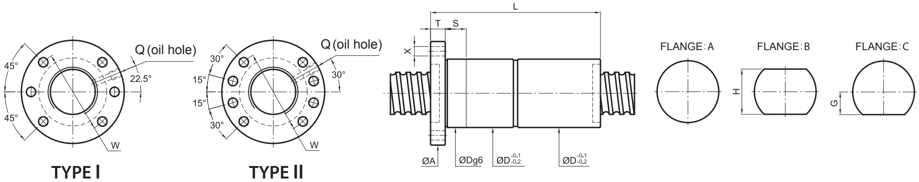
TYPE I TYPE II

Unit: mm

SCREW SIZE O.D.	SCREW SIZE LEAD	BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD*(kgf)* Dynamic (1×10⁶ REV.) Ca	BASIC RATE LOAD*(kgf)* Static Co	NUT Dg6	NUT L	FLANGE A	FLANGE T	FLANGE W	FLANGE G	FLANGE H	FLANGE TYPE	FIT S	OIL HOLE Q	BOLT X	STIFFNESS *kgf/μm*
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		5	6260	17740		155										149
	12	6.35	5	6260	17410	63	172	93	18	78	35	70	II	20	M8×1P	9	149
	16		5	6220	17350		213										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		5	6430	18440		158										155
	12		5	6420	18410		172	95	18	80	36	72	II	20	M8×1P	9	155
	15	6.35	5	6380	18350	65	226										155
	16		5	6390	18330		212										155
	20		4	5190	14450		220	98	18	83	37	74	II	20	M8×1P	11	125
	40		2	2700	6950		210										64
	12	7.144	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

FDDC



Unit: mm

SCREW SIZE		BALL	EFFECTIVE	BASIC RATE LOAD(*kgf*)		NUT		FLANGE						FIT	OIL HOLE	BOLT	STIFFNESS
O.D.	LEAD	DIA.	TURNS	Dynamic (1×10^6 REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	TYPE	S	Q	X	*kgf/μm*
45	8	4.762	4	3770	12580	66	114	98	18	83	37	74	II	20	M8×1P	11	130
	10	6.35	5	6910	21330	70	158	105	18	88	40	80	II	20	M8×1P	11	170
	12		5	6910	21310		171										170
	16		5	6880	21250		215										170
	12	7.144	5	7930	23300	73	178	105	18	88	40	80	II	20	M8×1P	11	173
	20		4	6440	18340		220										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	6.35	5	7160	23320	75	158	118	18	100	46	92	II	20	M8×1P	11	185
	12		5	7150	23300		174										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	II	20	M8×1P	14	220
	16	9.525	5	13640	43620	102	228	147	20	127	56	112		25			257
80	20	9.525	5	15350	56760	118	283	165	25	145	65	130	II	25	M8×1P	14	305
	25		4	12530	44860		296										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.

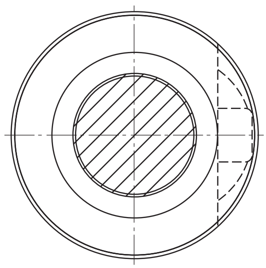


Fig.13.2 Immersion type

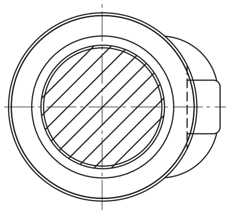
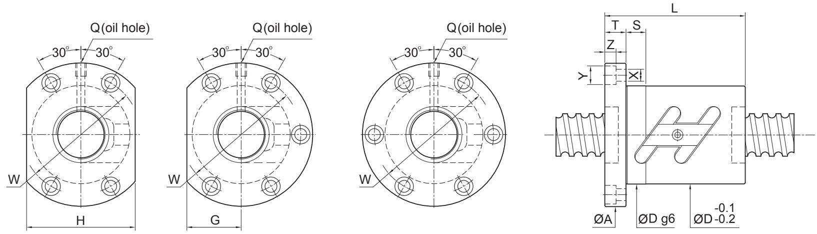


Fig.13.3 Extrusive type

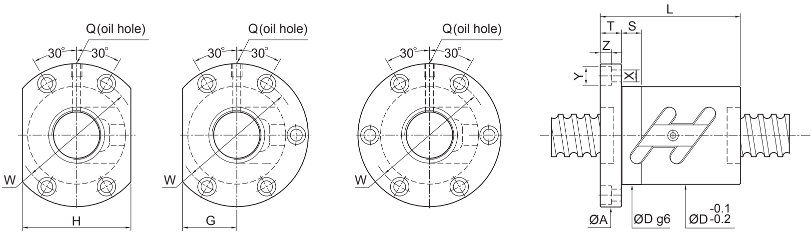
FSWC



Unit: mm

SCREW SIZE O.D.	SCREW SIZE LEAD	BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD(kgf) Dynamic (1×10[6] REV.) Ca	BASIC RATE LOAD(kgf) Static Co	NUT Dg6	NUT L	FLANGE A	FLANGE T	FLANGE W	FLANGE G	FLANGE H	FIT S	BOLT X	BOLT Y	BOLT Z	OIL HOLE Q	STIFFNESS kgf/μm
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	M6x1P	15
	10	3.175	2.5×1	680	1210		55											16
16			1.5×2	490	1010		44											18
	4	2.381	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
			1.5×2	805	1525		45											19
	5	3.175	2.5×1	690	1270	40	41	63	11	51	21	42	15	5.5	9.5	5.5	M6×1P	16
			2.5×2	1250	2540		56											31
			3.5×1	920	1780		46											22
			1.5×2	805	1525		52											19
	6	3.175	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			1.5×2	530	1270		44						10					21
	4	2.381	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						15					35
			3.5×1	600	1480		43						10					25
			1.5×2	965	2070		45						15					24
	5	3.175	2.5×1	830	1730	44	42	67	11	55	26	52	10	5.5	9.5	5.5		20
			2.5×2	1510	3460		56						15				M6×1P	39
			3.5×1	1110	2420		46						15					26
			1.5×2	1285	2545		56						15					24
	6	3.969	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						15					28
			1.5×2	1285	2545		61						15					24
	8	3.969	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						15					28

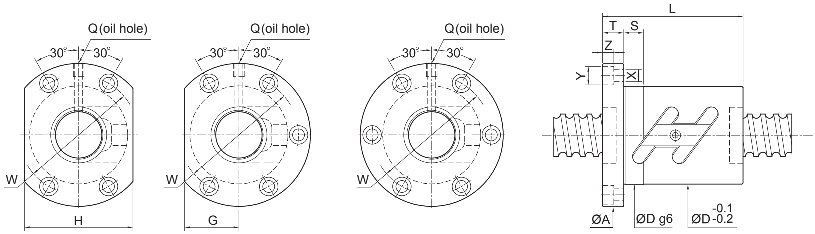
FSWC



Unit: mm

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

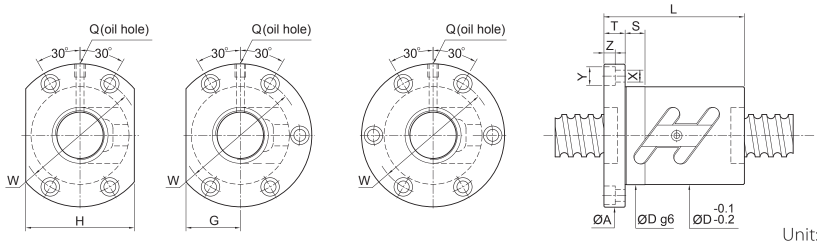
FSWC



Unit: mm

SCREW SIZE O.D.	SCREW SIZE LEAD	BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD(kgf) Dynamic (1×10^6 REV.) Ca	BASIC RATE LOAD(kgf) Static Co	NUT Dg6	NUT L	FLANGE A	FLANGE T	FLANGE W	FLANGE G	FLANGE H	FIT S	BOLT X	BOLT Y	BOLT Z	OIL HOLE Q	STIFFNESS kgf/μm
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
	5	3.175	1.5×2	1180	3410	58	47	85	12	71	32	64	15	6.6	11	6.5	M8×1P	34
			2.5×1	1010	2840		43											29
			2.5×2	1830	5680		57											56
			2.5×3	2590	8520		72											82
			3.5×1	1350	3980		47											40
	6	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
	8	4.762	1.5×2	2010	5010	66	64	98	15	82	38	76	15	9	14	8.5	M8×1P	36
			2.5×1	1720	4180		63											30
			2.5×2	3120	8360		80											59
			3.5×1	2300	5850		68											42
	10	6.35	1.5×2	3000	6530	74	78	108	15	90	41	82	15	9	14	8.5	M8×1P	38
			2.5×1	2570	5440		68											32
			2.5×2	4660	10880		97											61
			3.5×1	3430	7620		78											44
	12	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
36	5	3.175	1.5×2	1240	3850	65	50	98	15	82	38	76	15	9	14	8.5	M8×1P	38
			2.5×2	1920	6420		60											62
			2.5×3	2720	9630		75											90
			3.5×1	1410	4490		50											44
	6	3.969	2.5×2	2600	7900	65	66	98	15	82	38	76	15	9	14	8.5	M8×1P	63
			2.5×3	3680	11850		84											93
	10	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	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

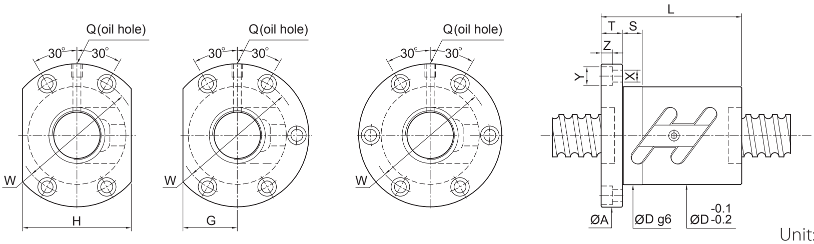
FSWC



Unit: mm

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD(kgf)		NUT		FLANGE					FIT	BOLT			OIL HOLE	STIFFNESS
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
40	5	3.175	1.5×2	1280	4275	67	50	101	15	83	39	78	15	9	14	8.5	M8×1P	41
			2.5×1	1090	3560		48											34
			2.5×2	1980	7120		60											66
			2.5×3	2800	10680		75											98
			3.5×1	1450	4980		50											47
	6	3.969	1.5×2	1750	5300	70	60	104	15	86	40	80	15	9	14	8.5	PT1/8"	42
			2.5×1	1500	4420		53											35
			2.5×2	2720	8840		66											69
			2.5×3	3850	13260		84											101
			3.5×1	2000	6190		60											49
	8	4.762	1.5×2	2220	6320	74	64	108	15	90	41	82	15	9	14	8.5	PT1/8"	43
			2.5×1	1900	5270		63											36
			2.5×2	3450	10540		83											70
			3.5×1	2540	7380		68											50
	10	6.35	1.5×2	3370	8335	82	81	124	18	102	47	94	20	11	17.5	11	PT1/8"	45
			2.5×1	2880	6950		71											35
			2.5×2	5220	13900		103											74
			3.5×1	3840	9730		81											52
	12	6.35	2.5×1	2880	6950	86	77	128	18	106	48	96	20	11	17.5	11	PT1/8"	38
			2.5×2	5220	13900		112											74
			3.5×1	3840	9730		91											52
45	10	6.35	2.5×2	5480	15700	88	101	132	18	110	50	100	20	11	17.5	11	PT1/8"	81
			2.5×3	7760	23550		131											119
	12	7.144	2.5×1	3550	8950	90	84	132	18	110	50	100	20	11	17.5	11	PT1/8"	43
			2.5×2	6440	17900		112											82
			2.5×3	9120	26850		148											121

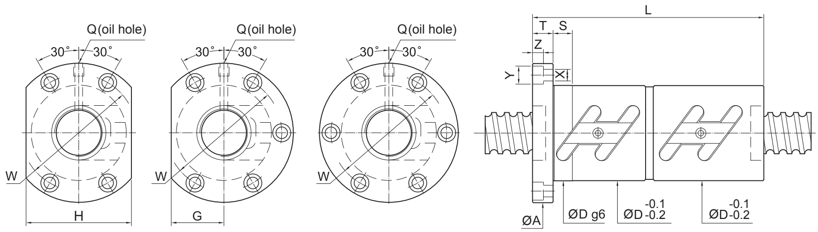
FSWC



Unit: mm

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD(kgf)		NUT		FLANGE					FIT	BOLT			OIL HOLE	STIFFNESS
O.D.	LEAD		circuit × row	Dynamic (1×10^6 REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	S	X	Y	Z	Q	kgf/μm
50	5	3.175	1.5×2	1410	5305	80	50	114	15	96	43	86	15	9	14	8.5	PT1/8"	49
			1.5×3	2000	7960		60											72
			2.5×2	2190	8840		60											80
			3.5×1	1610	6190		50											57
	6	3.969	1.5×2	1920	6600	84	60	118	15	100	45	90	15	9	14	8.5	PT1/8"	50
			2.5×2	2980	11000		67											82
			2.5×3	4220	16500		85											121
			3.5×1	2190	7700		60											58
	8	4.762	1.5×2	2515	7810	87	68	128	18	107	49	98	20	11	17.5	11	PT1/8"	52
			2.5×2	3900	13020		86											85
			2.5×3	5520	19530		109											125
			3.5×1	2870	9110		71											60
	10	6.35	1.5×2	3725	10450	93	81	135	18	113	51	102	20	11	17.5	11	PT1/8"	54
			2.5×1	3190	8710		71											45
			2.5×2	5790	17420		101											88
			2.5×3	8200	26130		131											130
			3.5×1	4260	12190		81											63
	12	7.144	2.5×1	3700	10050	100	88	146	22	122	55	110	20	14	20	13	PT1/8"	46
			2.5×2	6710	20100		116											89
55	10	6.35	2.5×2	6005	19540	102	101	144	18	122	54	108	20	11	17.5	11	PT1/8"	95
			2.5×3	8510	29310		131											140
63	10	6.35	2.5×1	3510	11200	108	75	154	22	130	58	116	20	14	20	13	PT1/8"	55
			2.5×2	6370	22400		105											106
			2.5×3	9020	33600		135											156
	12	7.938	2.5×1	4770	13780	115	88	161	22	137	61	122	20	14	20	13	PT1/8"	59
			2.5×2	8650	27560		124											113
			2.5×3	12250	41340		160											167
80	10	6.35	2.5×2	7130	28500	130	105	176	22	152	66	132	20	14	20	13	PT1/8"	129
			2.5×3	10100	42750		134											190
	12	7.938	2.5×2	9710	35560	136	124	182	22	158	68	136	20	14	20	13	PT1/8"	137
			2.5×3	13760	53340		160											202
	16	9.525	2.5×2	16450	59280	143	160	204	28	172	77	154	30	18	26	17.5	PT1/8"	170
			2.5×3	23300	88920		208											250

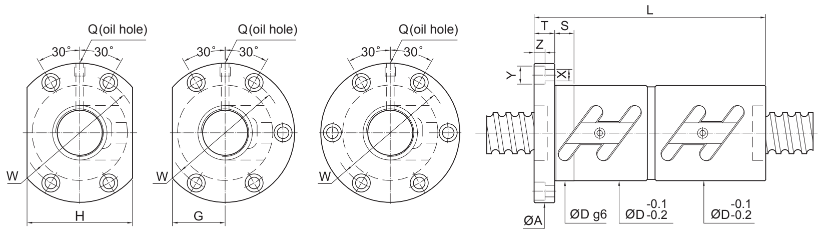
FDWC



Unit: mm

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

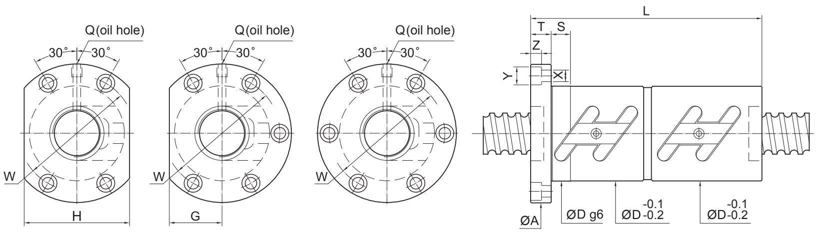
FDWC



Unit: mm

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD(kgf)		NUT		FLANGE					FIT	BOLT			OIL HOLE	STIFFNESS
O.D.	LEAD		circuit × row	Dynamic (1×10⁶ REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	S	X	Y	Z	Q	kgf/μm
25	4	2.381	1.5×2	600	1630	46	83	69	11	57	26	52	15	5.5	9.5	5.5	M6×1P	51
			2.5×1	510	1355		67											43
			2.5×2	930	2710		91											84
			3.5×1	680	1900		75											59
	5	3.175	1.5×2	1065	2575	50	80	73	11	61	28	56	15	5.5	9.5	5.5	M6×1P	57
			2.5×1	910	2150		77											48
			2.5×2	1650	4300		105											92
			3.5×1	1210	3010		86											65
	6	3.969	1.5×2	1420	3215	53	91	76	11	64	29	58	15	5.5	9.5	5.5	M6×1P	58
			2.5×1	1210	2680		82											49
			2.5×2	2190	5360		116											94
			3.5×1	1610	3750		93											67
	8	4.762	1.5×2	1820	3840	58	111	85	13	71	32	64	15	6.6	11	6.5	M6×1P	60
			2.5×1	1560	3200		95											50
			3.5×1	2080	4480		111											69
	10	4.762	1.5×2	1820	3840	58	134	85	15	71	32	64	15	6.6	11	6.5	M6×1P	60
			2.5×1	1560	3200		117											50
			3.5×1	2080	4480		138											69
28	5	3.175	1.5×2	1110	2960	55	86	83	12	69	31	62	15	6.6	11	6.5	M8×1P	62
			2.5×1	950	2470		78											52
			2.5×2	1720	4940		106											101
			3.5×1	1270	3460		86											72
	6	3.969	1.5×2	1480	3605	55	98	83	12	69	31	62	15	6.6	11	6.5	M8×1P	63
			2.5×1	1270	3000		89											53
			2.5×2	2300	6000		117											103
			3.5×1	1690	4200		94											73
	8	4.762	1.5×2	1935	4325	60	113	93	15	76	36	72	15	9	14	8.5	M8×1P	66
			2.5×1	1650	3600		97											55
			3.5×1	2200	5040		113											76
	10	4.762	1.5×2	1935	4325	60	134	93	15	76	36	72	15	9	14	8.5	M8×1P	66
			2.5×1	1635	3600		117											55
			3.5×1	2200	5040		138											76

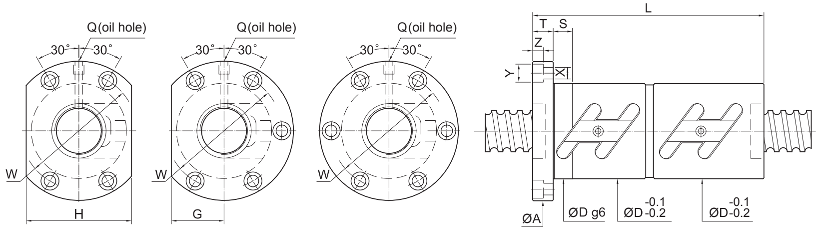
FDWC



Unit: mm

SCREW SIZE O.D.	SCREW SIZE LEAD	BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD(kgf) Dynamic (1×10^6 REV.) Ca	BASIC RATE LOAD(kgf) Static Co	NUT Dg6	NUT L	FLANGE A	FLANGE T	FLANGE W	FLANGE G	FLANGE H	FIT S	BOLT X	BOLT Y	BOLT Z	OIL HOLE Q	STIFFNESS kgf/μm
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		90											101
	5	3.175	1.5×2	1180	3410	58	82	85	12	71	32	64	15	6.6	11	6.5	M8×1P	69
			2.5×1	1010	2840		78											58
			2.5×2	1830	5680		105											112
			2.5×3	2590	8520		136											164
			3.5×1	1350	3980		82											80
	6	3.969	1.5×2	1560	4135	62	100	88	12	75	34	68	15	6.6	11	6.5	M8×1P	70
			2.5×1	1330	3450		87											59
			2.5×2	2410	6900		123											114
			3.5×1	1770	4830		100											81
	8	4.762	1.5×2	2010	5010	66	113	98	15	82	38	76	15	9	14	8.5	M8×1P	76
			2.5×1	1720	4180		106											64
			2.5×2	3120	8360		152											123
			3.5×1	2300	5850		113											88
	10	6.35	1.5×2	3000	6530	74	138	108	15	90	41	82	15	9	14	8.5	M8×1P	76
			2.5×1	2570	5440		118											64
			2.5×2	4660	10880		177											123
			3.5×1	3430	7620		148											88
	12	6.35	1.5×2	3000	6530	74	160	108	18	90	41	82	15	9	14	8.5	M8×1P	76
			2.5×1	2570	5440		137											64
			2.5×2	4660	10880		208											124
			3.5×1	3430	7620		160											88
36	5	3.175	1.5×2	1240	3850	65	91	98	15	82	38	76	15	9	14	8.5	M8×1P	75
			2.5×2	1920	6420		110											123
			2.5×3	2720	9630		139											181
			3.5×1	1410	4490		90											87
	6	3.969	2.5×2	2600	7900	65	123	98	15	82	38	76	15	9	14	8.5	M8×1P	126
			2.5×3	3680	11850		159											187
	8	4.762	2.5×2	3265	9450	70	153	114	18	92	46	92	20	11	17.5	11	M8×1P	129
	10	6.35	1.5×2	3180	7410	75	141	118	18	98	45	90	15	11	17.5	11	M8×1P	83
			2.5×1	2720	6180		131											70
			2.5×2	4930	12360		180											136
			3.5×1	3630	8650		151											96
	12	6.35	2.5×1	2720	6180	75	137	118	18	98	45	90	15	11	17.5	11	M8×1P	70
			2.5×2	4930	12360		208											136
			3.5×1	3630	8650		161											97

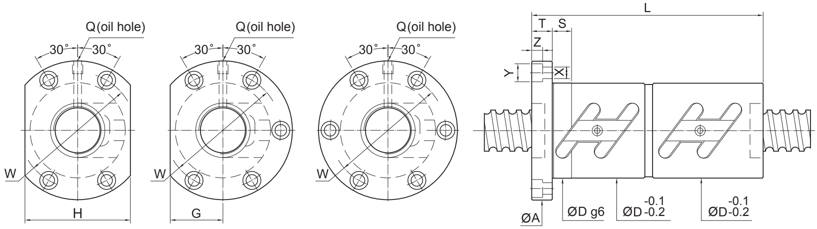
FDWC



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
40	5	3.175	1.5×2	1280	4275	67	88	101	15	83	39	78	15	9	14	8.5	M8×1P	82
			2.5×1	1090	3560		84											69
			2.5×2	1980	7120		108											133
			2.5×3	2800	10680		139											196
			3.5×1	1450	4980		88											95
	6	3.969	1.5×2	1750	5300	70	103	104	15	86	40	80	15	9	14	8.5	PT1/8"	85
			2.5×1	1500	4420		90											71
			2.5×2	2720	8840		123											138
			2.5×3	3850	13260		159											202
			3.5×1	2000	6190		103											98
	8	4.762	1.5×2	2220	6320	74	124	108	15	90	41	82	15	9	14	8.5	PT1/8"	86
			2.5×1	1900	5270		108											73
			2.5×2	3450	10540		152											141
			3.5×1	2540	7380		125											100
	10	6.35	1.5×2	3370	8335	82	141	124	18	102	47	94	20	11	17.5	11	PT1/8"	91
			2.5×1	2880	6950		131											71
			2.5×2	5220	13900		180											148
			3.5×1	3840	9730		151											105
	12	6.35	2.5×1	2880	6950	86	137	128	18	106	48	96	20	11	17.5	11	PT1/8"	76
			2.5×2	5220	13900		208											148
			3.5×1	3840	9730		161											105
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

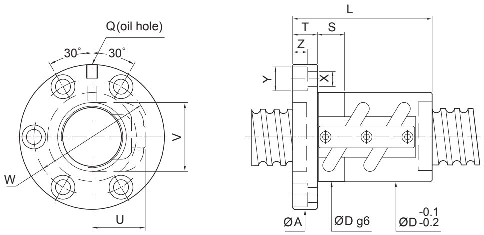
FDWC



Unit: mm

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD(*kgf*)		NUT		FLANGE					FIT	BOLT			OIL HOLE	STIFFNESS
O.D.	LEAD		circuit × row	Dynamic (1×10^6 REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	S	X	Y	Z	Q	*kgf/μm*
50	5	3.175	1.5×2	1410	5305	80	108	114	15	96	43	86	15	9	14	8.5	PT1/8"	98
			1.5×3	2000	7960		128											144
			2.5×2	2190	8840		113											159
			3.5×1	1610	6190		108											114
	6	3.969	1.5×2	1920	6600	84	111	118	15	100	45	90	15	9	14	8.5	PT1/8"	101
			2.5×2	2980	11000		123											164
			2.5×3	4220	16500		159											242
			3.5×1	2190	7700		107											117
	8	4.762	1.5×2	2515	7810	87	127	128	18	107	49	98	20	11	17.5	11	PT1/8"	104
			2.5×2	3900	13020		156											170
			2.5×3	5520	19530		208											250
			3.5×1	2870	9110		127											121
	10	6.35	1.5×2	3725	10450	93	151	135	18	113	51	102	20	11	17.5	11	PT1/8"	108
			2.5×1	3190	8710		132											91
			2.5×2	5790	17420		180											177
			2.5×3	8200	26130		243											261
			3.5×1	4260	12190		151											126
	12	7.144	2.5×1	3700	10050	100	140	146	18	122	55	110	20	14	20	13	PT1/8"	92
			2.5×2	6710	20100		210											179
55	10	6.35	2.5×2	6005	19540	102	181	144	18	122	54	108	20	11	17.5	11	PT1/8"	191
			2.5×3	8510	29310		243											281
63	10	6.35	2.5×1	3510	11200	108	136	154	22	130	58	116	20	14	20	13	PT1/8"	110
			2.5×2	6370	22400		189											213
			2.5×3	9020	33600		249											313
	12	7.938	2.5×1	4760	13820	115	144	161	22	137	61	122	20	14	20	13	PT1/8"	112
			2.5×2	8650	27560		214											218
	16	9.525	2.5×1	8050	23100	122	200	178	28	150	69	138	20	18	26	17.5	PT1/8"	144
			2.5×2	14600	46200		296											280
80	10	6.35	2.5×2	7130	28500	130	189	176	22	152	66	132	20	14	20	13	PT1/8"	258
			2.5×3	10100	42750		249											380
	12	7.938	2.5×2	9710	35560	136	220	182	22	158	68	136	20	14	20	13	PT1/8"	265
			2.5×3	13760	53340		292											391
	16	9.525	2.5×2	16450	59280	143	290	204	28	172	77	154	30	18	26	17.5	PT1/8"	339
			2.5×3	23300	88920		386											500

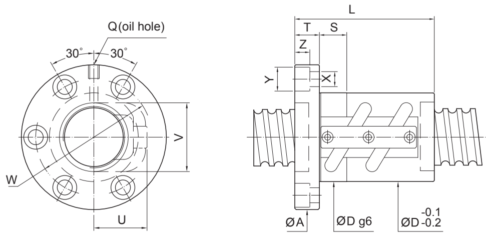
FSVC



Unit: mm

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

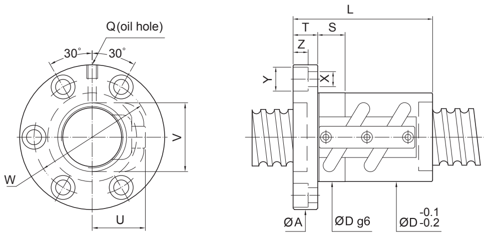
FSVC



Unit: mm

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

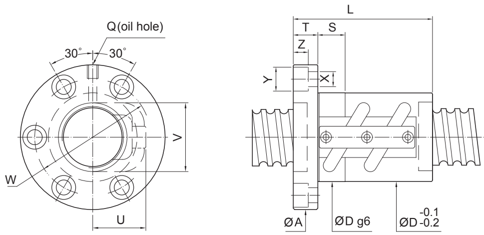
FSVC



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
40	5	3.175	1.5×2	1280	4270	58	55	92	16	72	15	9	14	8.5	34	46	M8×1P	41
			2.5×1	1090	3560		50											34
			2.5×2	1980	7120		65											66
			2.5×3	2800	10680		80											98
			3.5×1	1450	4980		55											47
	6	3.969	1.5×2	1750	5300	60	60	94	16	76	15	9	14	8.5	36	47	PT1/8"	42
			2.5×1	1500	4420		54											35
			2.5×2	2720	8840		72											69
			2.5×3	3850	13260		90											101
			3.5×1	2000	6190		60											49
	8	4.762	1.5×2	2220	6320	62	70	96	16	78	15	9	14	8.5	38	48	PT1/8"	43
			2.5×1	1900	5270		62											36
			2.5×2	3450	10540		86											70
			3.5×1	2540	7380		70											50
	10	6.35	1.5×2	3370	8335	65	82	106	18	85	20	11	17.5	11	42	52	PT1/8"	45
			2.5×1	2880	6950		72											35
			2.5×2	5220	13900		102											74
			3.5×1	3840	9730		82											52
45	10	6.35	2.5×1	3020	7850	70	74	112	18	90	20	11	17.5	11	48	58	PT1/8"	42
			2.5×2	5480	15700		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											82

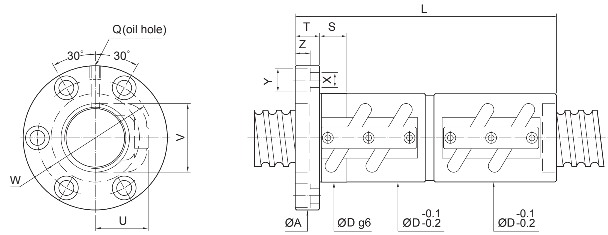
FSVC



Unit: mm

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD(*kgf*)		NUT		FLANGE			FIT	BOLT			RETURN TUBE		OIL HOLE	STIFFNESS
O.D.	LEAD		circuit × row	Dynamic (1×10^6 REV.) Ca	Static Co	Dg6	L	A	T	W	S	X	Y	Z	U	V	Q	*kgf/μm*
50	5	3.175	1.5×2	1410	5305	70	63	104	16	86	15	9	14	8.5	40	56	PT1/8"	49
			1.5×3	2000	7960		73											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		93											121
	8	4.762	2.5×2	3900	13020	75	88	116	18	95	20	11	17.5	11	45	59	PT1/8"	85
			2.5×3	5520	19530		112											125
	10	6.35	1.5×2	3725	10450	78	84	119	18	98	20	11	17.5	11	48	62	PT1/8"	54
			2.5×1	3190	8710		74											45
			2.5×2	5790	17420		104											88
			2.5×3	8200	26130		134											130
			3.5×1	4260	12190		84											63
	12	7.144	2.5×1	3700	10050	82	87	128	22	105	20	14	20	13	52	64	PT1/8"	46
			2.5×2	6710	20100		123											89
55	10	6.35	2.5×2	6005	19540	84	100	125	18	103	20	11	17.5	11	54	68	PT1/8"	95
			2.5×3	8150	29310		130											140
63	10	6.35	2.5×1	3510	11200	90	77	132	20	110	20	11	17.5	11	53	74	PT1/8"	55
			2.5×2	6370	22400		107											106
			2.5×3	9020	33600		137											156
	12	7.938	2.5×1	4770	13780	94	88	142	22	117	20	14	20	13	57	76	PT1/8"	59
			2.5×2	8650	27560		124											113
			2.5×3	12250	41340		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											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											190
	12	7.938	2.5×2	9710	35560	120	125	169	22	143	25	14	20	13	67	93	PT1/8"	137
			2.5×3	13760	53340		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											250

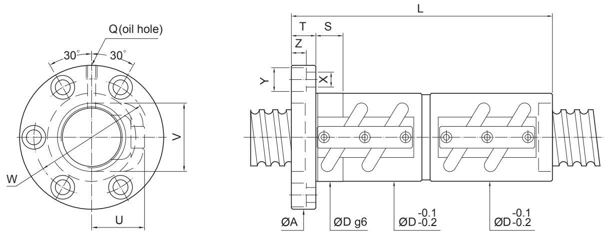
FDVC



Unit: mm

SCREW SIZE O.D.	SCREW SIZE LEAD	BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD (kgf) Dynamic (1×10⁶ REV.) Ca	BASIC RATE LOAD (kgf) Static Co	NUT Dg6	NUT L	FLANGE A	FLANGE T	FLANGE W	FIT S	BOLT X	BOLT Y	BOLT Z	RETURN TUBE U	RETURN TUBE V	OIL HOLE Q	STIFFNESS kgf/μm
16	5	3.175	1.5×2	805	1525	31	90	54	12	41	15	5.5	9.5	5.5	20	23	M6×1P	39
			2.5×1	690	1270		80											33
			2.5×2	1250	2540		110											63
			3.5×1	920	1780		90											45
20	5	3.175	1.5×2	965	2070	35	90	58	12	46	15	5.5	9.5	5.5	22	27	M6×1P	47
			2.5×1	830	1730		80											40
			2.5×2	1510	3460		110											77
			3.5×1	1110	2420		90											55
	6	3.969	1.5×2	1285	2545	36	104	60	12	47	15	5.5	9.5	5.5	23	28	M6×1P	49
			2.5×1	1100	2120		92											41
			3.5×1	1470	2970		104											56
25	5	3.175	1.5×2	1065	2575	40	90	64	12	52	15	5.5	9.5	5.5	26	31	M6×1P	57
			2.5×1	910	2150		80											48
			2.5×2	1650	4300		110											92
			3.5×1	1210	3010		90											65
	6	3.969	1.5×2	1420	3215	42	104	68	12	55	15	5.5	9.5	5.5	28	33	M6×1P	58
			2.5×1	1210	2680		92											49
			2.5×2	2190	5360		128											94
			3.5×1	1610	3750		104											67
	10	4.762	1.5×2	1820	3840	45	136	72	16	58	15	6.6	11	6.5	29	34	M6×1P	60
			2.5×1	1560	3200		122											50
			3.5×1	2080	4480		136											69
28	5	3.175	1.5×2	1110	2960	44	90	70	12	56	15	6.6	11	6.5	28	34	M6×1P	62
			2.5×1	950	2470		80											52
			2.5×2	1720	4940		110											101
			3.5×1	1270	3460		90											72
	6	3.969	1.5×2	1480	3605	44	110	70	12	56	15	6.6	11	6.5	28	36	M6×1P	63
			2.5×1	1270	3000		98											53
			2.5×2	2300	6000		134											103
			3.5×1	1690	4200		110											73

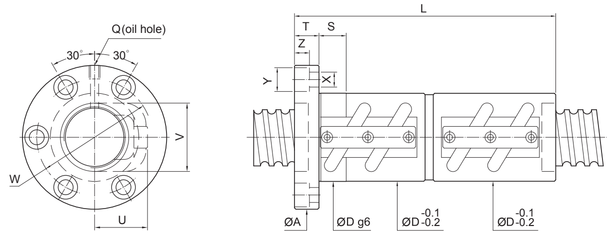
FDVC



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	90	76	12	63	15	6.6	11	6.5	30	38	M6×1P	69
			2.5×1	1010	2840		80											58
			2.5×2	1830	5680		110											112
			2.5×3	2590	8520		140											164
			3.5×1	1350	3980		90											80
	6	3.969	1.5×2	1560	4135	52	104	78	12	65	15	6.6	11	6.5	32	39	M6×1P	70
			2.5×1	1330	3450		92											59
			2.5×2	2410	6900		128											114
			3.5×1	1770	4830		104											81
	8	4.762	1.5×2	2010	5010	54	126	88	16	70	15	9	14	8.5	33	40	M6×1P	73
			2.5×1	1720	4180		110											61
			2.5×2	3120	8360		158											118
			3.5×1	2300	5850		126											84
	10	6.35	1.5×2	3000	6530	57	142	91	16	73	15	9	14	8.5	37	44	M8×1P	76
			2.5×1	2570	5440		122											64
			2.5×2	4660	10880		182											123
			3.5×1	3430	7620		142											88
36	6	3.969	2.5×1	1430	3950	55	92	82	12	68	15	6.6	11	6.5	32	42	M6×1P	65
			2.5×2	2600	7900		128											126
	10	6.35	1.5×2	3180	7410	62	144	104	18	82	20	11	17.5	11	40	49	M6×1P	83
			2.5×1	2720	6180		124											70
			2.5×2	4930	12360		184											136
			3.5×1	3630	8650		144											90

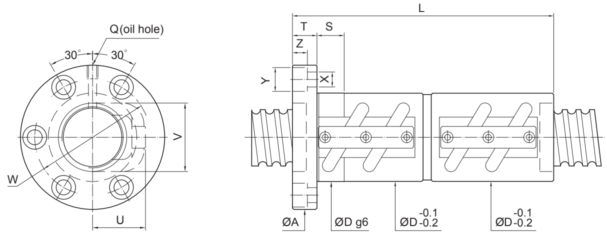
FDVC



Unit: mm

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

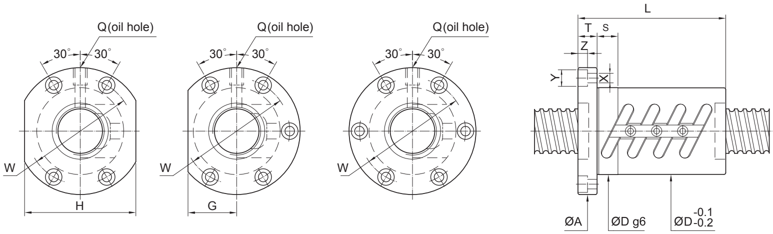
FDVC



Unit: mm

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD(kgf)		NUT		FLANGE			FIT	BOLT			RETURN TUBE		OIL HOLE	STIFFNESS
O.D.	LEAD		circuit × row	Dynamic (1×10⁶ REV.) Ca	Static Co	Dg6	L	A	T	W	S	X	Y	Z	U	V	Q	kgf/μm
50	5	3.175	1.5×2	1410	5305	70	107	104	16	86	15	9	14	8.5	40	56	PT1/8"	98
			1.5×3	2000	7960		127											144
			3.5×1	1610	6190		107											114
	6	3.969	2.5×2	2980	11000	72	134	106	16	88	15	9	14	8.5	43	57	PT1/8"	164
			2.5×3	4220	16500		170											242
	8	4.762	2.5×2	3900	13020	75	160	116	18	95	20	11	17.5	11	45	59	PT1/8"	170
			2.5×3	5520	19530		208											250
	10	6.35	1.5×2	3725	10450	78	154	119	18	98	20	11	17.5	11	48	62	PT1/8"	119
			2.5×1	3190	8710		134											91
			2.5×2	5790	17420		194											177
			2.5×3	8200	26130		254											261
			3.5×1	4260	12190		154											126
	12	7.144	2.5×1	3700	10050	82	160	128	22	105	20	14	20	13	52	64	PT1/8"	92
			2.5×2	6710	20100		232											179
55	10	6.35	2.5×2	6005	19540	84	194	125	18	103	20	11	17.5	11	54	68	PT1/8"	191
			2.5×3	8510	29310		254											281
63	10	6.35	2.5×1	3510	11200	90	136	132	20	110	20	11	17.5	11	53	74	PT1/8"	110
			2.5×2	6370	22400		196											213
			2.5×3	9020	33600		256											313
	12	7.938	2.5×1	4760	13820	94	160	142	22	117	20	14	20	13	57	76	PT1/8"	112
			2.5×2	8650	27560		232											218
			2.5×3	12250	41340		304											322
	16	9.525	2.5×1	8050	23100	100	200	150	22	123	20	14	20	13	62	78	PT1/8"	144
			2.5×2	14600	46200		296											280
80	10	6.35	2.5×2	7130	28500	115	200	163	22	137	20	14	20	13	64	91	PT1/8"	258
			2.5×3	10100	42750		260											380
	12	7.938	2.5×2	9710	35560	120	232	169	22	143	25	14	20	13	67	93	PT1/8"	265
			2.5×3	13760	53340		302											391
	16	9.525	2.5×2	16450	59280	125	302	190	28	154	25	18	26	17.5	70	94	PT1/8"	339
			2.5×3	23300	88920		398											500

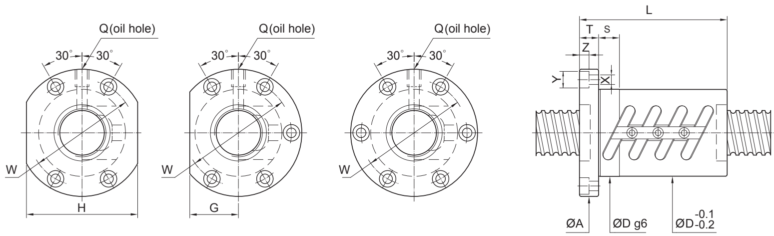
FOWC



Unit: mm

SCREW SIZE O.D.	SCREW SIZE LEAD	BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD(kgf) Dynamic (1×10⁶ REV.) Ca	BASIC RATE LOAD(kgf) Static Co	NUT Dg6	NUT L	FLANGE A	FLANGE T	FLANGE W	FLANGE G	FLANGE H	FIT S	BOLT X	BOLT Y	BOLT Z	OIL HOLE Q	STIFFNESS kgf/μm
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
	6	3.969	2.5×1×(2)	1100	2120	48	67	71	11	59	27	54	15	5.5	9.5	5.5	M6×1P	41
	8	3.969	2.5×1×(2)	1100	2120	48	78	75	13	61	27	54	15	6.6	11	6.5	M6×1P	41
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
	10	4.762	2.5×1×(2)	1560	3200	58	100	85	15	71	32	64	15	6.6	11	6.5	M6×1P	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
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	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
			1.5×1×(2)	1860	4710		81											47
	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
	6	3.969	2.5×2×(2)	2980	11000	84	103	118	15	100	45	90	15	9	14	8.5	PT1/8"	164
	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.

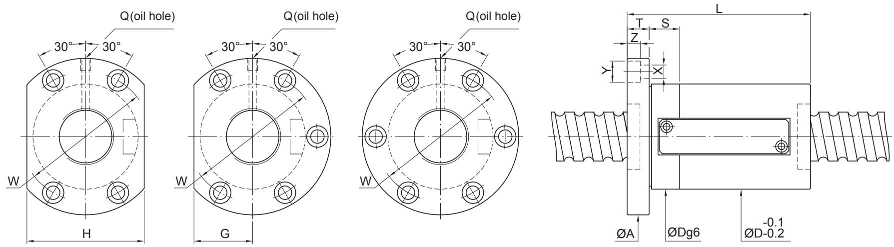
Multiple thread starts are available to make more steel balls loaded in the ballnut for higher rigidity and durability.

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.

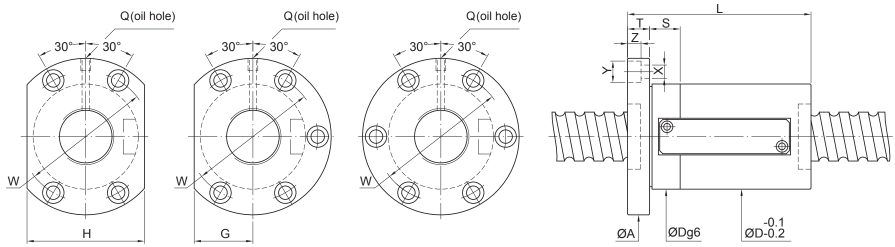
FSWE



Unit: mm

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD(kgf)		NUT		FLANGE					FIT	BOLT			OIL HOLE	STIFFNESS
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
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
20	10	3.969	2.5×1	1210	2380	46	63	73.5	13	59	25	50	10	5.5	9.5	5.5	M6×1P	34
			3.5×1	1580	3230		73											45
	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											34
	20	3.969	1.5×1	830	1530	46	70	73	13	59	25	50	10	5.5	9.5	5.5	M6×1P	24
25	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											40
	20	4.762	1.5×1	1170	2300	58	74	85	15	71	32	64	15	6.6	11	6.5	M6×1P	29
			2.5×1	1710	3580		94											42
			3.5×1	2220	4860		114											55
32	16	3.969	1.5×1	1010	2480	62	63	88	15	75	34	68	15	6.6	11	6.5	M8×1P	33
			2.5×1	1470	3860		79											48
			3.5×1	1910	5240		95											63
			5×1	2340	6620		111											77
	16	6.35	2.5×1	2830	6090	74	92	108	18	90	41	82	15	11	17.5	11	M8×1P	54
			3.5×1	3680	8270		108											69
			5×1	4490	10450		124											85
	20	3.969	1.5×1	1010	2480	62	70	88	15	75	34	68	15	6.6	11	6.5	M8×1P	33
			2.5×1	1470	3860		90											48
			3.5×1	1910	5240		110											63
			5×1	2350	6610		130											77
	20	6.35	2.5×1	2830	6090	74	104	108	18	90	41	82	15	11	17.5	11	M8×1P	54
			3.5×1	3680	8270		124											69
			5×1	4490	10450		144											85

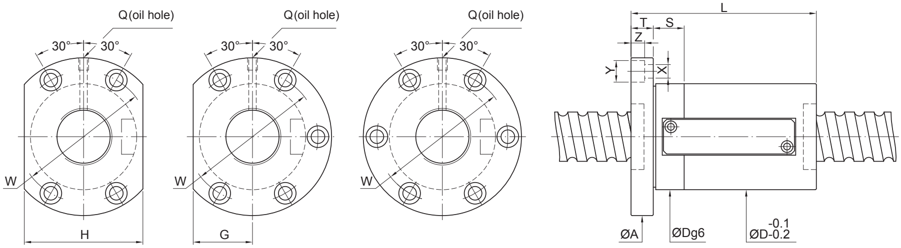
FSWE



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
36	10	6.35	3.5×1	3890	9390	75	84	118	18	98	45	90	15	11	17.5	11	M8×1P	76
			5×1	4750	11860		94											93
	12	6.35	2.5×1	2990	6920	75	85	118	18	98	45	90	15	11	17.5	11	M8×1P	58
			3.5×1	3890	9390		97											76
			5×1	4750	11860		109											93
	16	6.35	2.5×1	2990	6920	75	91	118	18	98	45	90	15	11	17.5	11	M8×1P	58
			3.5×1	3890	9390		107											76
			5×1	4750	11860		123											93
	20	6.35	1.5×1	2050	4450	75	91	118	18	98	45	90	15	11	17.5	11	PT1/8"	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	86	86	128	18	106	49	98	15	11	17.5	11	PT1/8"	82
			5×1	5050	13340		96											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		98											82
			5×1	5050	13340		110											101
	16	6.35	2.5×1	3180	7780	86	93	128	18	106	49	98	15	11	17.5	11	PT1/8"	63
			3.5×1	4130	10560		109											82
			5×1	5050	13340		125											101
	16	7.144	2.5×1	3740	8790	86	92	128	18	106	49	98	15	11	17.5	11	PT1/8"	65
			3.5×1	4870	11930		108											84
			5×1	5950	15070		124											103
	20	6.35	1.5×1	2180	5000	86	84	128	18	106	49	98	15	11	17.5	11	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	86	130	128	18	106	49	98	15	11	17.5	11	PT1/8"	43

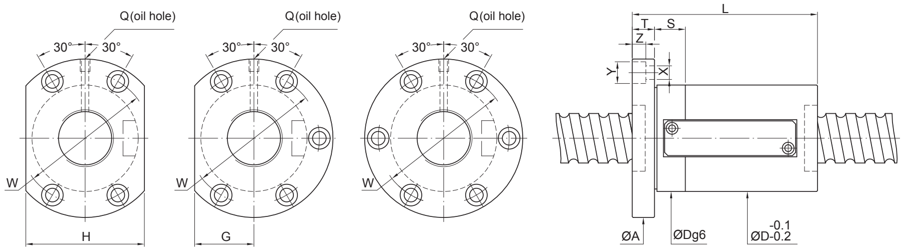
FSWE



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		80											74
			3.5×1	4560	13230	93	92	135	18	113	51	102	20	11	17.5	11	PT1/8"	97
			5×1	5580	16710		104											119
	12	7.144	2.5×1	4080	11260		93											75
			3.5×1	5300	15280	100	105	146	25	122	55	110	20	14	20	13	PT1/8"	99
			5×1	6480	19300		117											121
	16	6.35	2.5×1	3510	9750		94											74
			3.5×1	4560	13230	93	110	135	18	113	51	102	20	11	17.5	11	PT1/8"	97
			5×1	5580	16710		126											119
	16	7.144	2.5×1	4080	11260		100											75
			3.5×1	5300	15280	100	116	146	25	122	55	110	20	14	20	13	PT1/8"	99
			5×1	6480	19300		132											121
	20	7.144	1.5×1	2790	7240		98											52
			2.5×1	4080	11260	100	118	146	25	122	55	110	20	14	20	13	PT1/8"	75
			3.5×1	5300	15280		138											99
			5×1	6480	19300		158											121
	20	7.938	2.5×1	4750	12090		119											78
			3.5×1	6180	16400	105	139	152	25	128	58	116	20	14	20	13	PT1/8"	101
			5×1	7550	20720		159											124
	50	7.938	1.5×1	3250	7770	105	157	152	25	128	58	116	20	14	20	13	PT1/8"	53

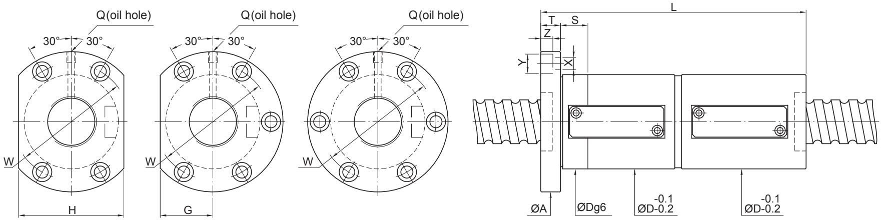
FSWE



Unit: mm

SCREW SIZE O.D.	SCREW SIZE LEAD	BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD(kgf) Dynamic (1×10⁶ REV.) Ca	BASIC RATE LOAD(kgf) Static Co	NUT Dg6	NUT L	FLANGE A	FLANGE T	FLANGE W	FLANGE G	FLANGE H	FIT S	BOLT X	BOLT Y	BOLT Z	OIL HOLE Q	STIFFNESS 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		84											87
			3.5×1	5030	17020	108	96	154	22	130	58	116	20	14	20	13	PT1/8"	115
			5×1	6150	21500		108											141
	12	7.144	2.5×1	4540	14460		90											89
			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	7.144	2.5×1	4540	14460		97											89
			3.5×1	5900	19620	115	113	161	22	137	61	122	20	14	20	13	PT1/8"	117
			5×1	7210	24780		129											145
	16	7.938	2.5×1	5260	15430		112											91
			3.5×1	6840	20940	120	128	180	28	150	72	144	25	18	26	17.5	PT1/8"	120
			5×1	8360	26450		144											147
	20	6.35	2.5×1	3870	12540		104											87
			3.5×1	5030	17020	108	124	154	22	130	58	116	20	14	20	13	PT1/8"	115
			5×1	6150	21500		144											141
	20	9.525	2.5×1	8870	25870		120											105
			3.5×1	11530	35110	122	140	182	28	150	72	144	25	18	26	17.5	PT1/8"	136
			5×1	14090	44350		160											167
80	10	6.35	3.5×1	5630	21660	130	90	176	22	152	66	132	20	14	20	13	PT1/8"	133
			5×1	6880	27360		100											164
	12	7.938	3.5×1	7670	27030	136	101	182	22	158	68	136	20	14	20	13	PT1/8"	143
			5×1	9380	34140		113											177
	16	9.525	2.5×1	9900	33200		108											124
			3.5×1	12990	45050	143	124	204	28	172	77	154	30	18	26	17.5	PT1/8"	162
			5×1	15880	56910		140											201
	20	9.525	2.5×1	9900	33200		120											124
			3.5×1	12990	45050	143	140	204	28	172	77	154	30	18	26	17.5	PT1/8"	162
			5×1	15880	56910		160											201
100	16	9.525	2.5×1	11320	41820		115											139
			3.5×1	14720	56750	170	131	243	32	205	91	182	30	22	32	21.5	PT1/8"	182
			5×1	17990	71690		147											226
	20	9.525	2.5×1	11320	41820		128											139
			3.5×1	14720	56750	170	148	243	32	205	91	182	30	22	32	21.5	PT1/8"	182
			5×1	17990	71690		168											226

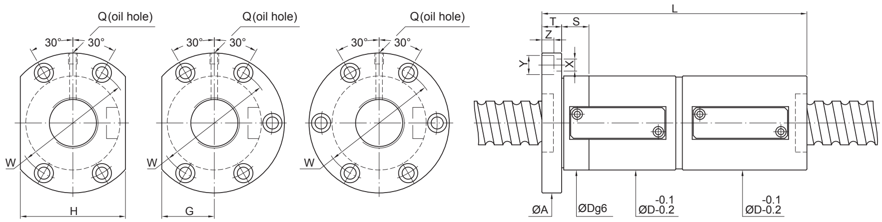
FDWE



Unit: mm

SCREW SIZE O.D.	SCREW SIZE LEAD	BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD(kgf) Dynamic (1×10⁶ REV.) Ca	BASIC RATE LOAD(kgf) Static Co	NUT Dg6	NUT L	FLANGE A	FLANGE T	FLANGE W	FLANGE G	FLANGE H	FIT S	BOLT X	BOLT Y	BOLT Z	OIL HOLE Q	STIFFNESS 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
20	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	3.969	1.5×1	830	1530	46	130	73	13	59	25	50	10	5.5	9.5	5.5	M6×1P	35
25	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	154	85	15	71	32	64	15	6.6	11	6.5	M6×1P	43
			2.5×1	1710	3580		194											63
			3.5×1	2220	4860		234											83
32	16	3.969	1.5×1	1010	2480	62	130	88	15	75	34	68	15	6.6	11	6.5	M8×1P	49
			2.5×1	1470	3860		162											73
			3.5×1	1910	5240		194											96
			5×1	2340	6620		226											120
	16	6.35	2.5×1	2830	6090	74	173	108	18	90	41	82	15	11	17.5	11	M8×1P	80
			3.5×1	3680	8270		205											105
			5×1	4490	10450		237											131
	20	3.969	1.5×1	1010	2480	62	93	88	15	75	34	68	15	6.6	11	6.5	M8×1P	49
			2.5×1	1470	3860		133											73
			3.5×1	1910	5240		173											96
			5×1	2350	6610		213											120
	20	6.35	2.5×1	2830	6090	74	204	108	18	90	41	82	15	11	17.5	11	M8×1P	80
			3.5×1	3680	8270		244											105
			5×1	4490	10450		284											131

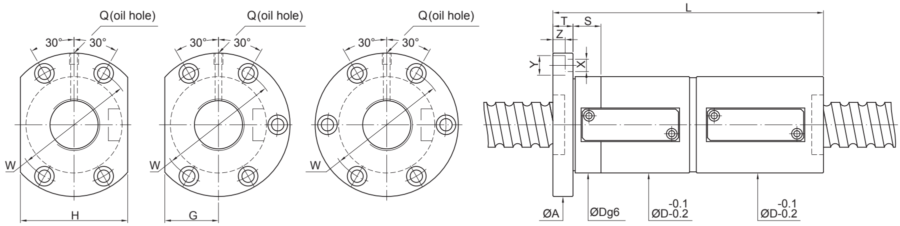
FDWE



Unit: mm

SCREW SIZE O.D.	LEAD	BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD(kgf) Dynamic (1×10^6 REV.) Ca	Static Co	NUT Dg6	L	FLANGE A	T	W	G	H	FIT S	BOLT X	Y	Z	OIL HOLE Q	STIFFNESS kgf/μm
36	10	6.35	3.5×1	3890	9390	75	155	118	18	98	45	90	15	11	17.5	11	M8×1P	115
			5×1	4750	11860		175											143
	12	6.35	2.5×1	2990	6920	75	140	118	18	98	45	90	15	11	17.5	11	M8×1P	88
			3.5×1	3890	9390		164											115
			5×1	4750	11860		188											143
	16	6.35	2.5×1	2990	6920	75	171	118	18	98	45	90	15	11	17.5	11	M8×1P	88
			3.5×1	3890	9390		203											115
			5×1	4750	11860		235											143
	20	6.35	1.5×1	2050	4450	75	164	118	18	98	45	90	15	11	17.5	11	PT1/8"	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	86	155	128	18	106	49	98	15	11	17.5	11	PT1/8"	125
			5×1	5050	13340		175											155
	12	6.35	2.5×1	3180	7780	86	141	128	18	106	49	98	15	11	17.5	11	PT1/8"	95
			3.5×1	4130	10560		165											125
			5×1	5050	13340		189											155
	16	6.35	2.5×1	3180	7780	86	173	128	18	106	49	98	15	11	17.5	11	PT1/8"	95
			3.5×1	4130	10560		205											125
			5×1	5050	13340		237											155
	16	7.144	2.5×1	3740	8790	86	173	128	18	106	49	98	15	11	17.5	11	PT1/8"	98
			3.5×1	4870	11930		205											128
			5×1	5950	15070		237											159
	20	6.35	1.5×1	2180	5000	86	164	128	18	106	49	98	15	11	17.5	11	PT1/8"	64
			2.5×1	3180	7780		204											95
			3.5×1	4130	10560		244											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

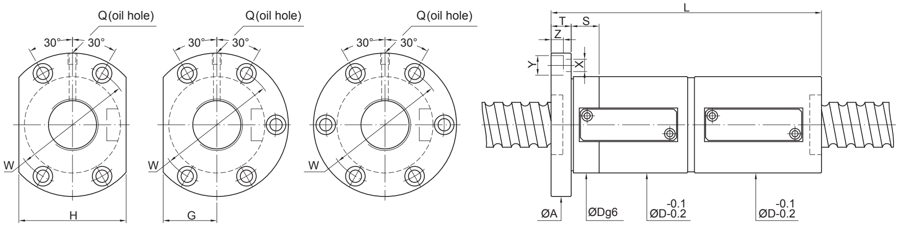
FDWE



Unit: mm

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD(*kgf*)		NUT		FLANGE					FIT	BOLT			OIL HOLE	STIFFNESS
O.D.	LEAD		circuit × row	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	155	135	18	113	51	102	20	11	17.5	11	PT1/8"	149
			5×1	5580	16710		175											185
			2.5×1	3510	9750		141											112
	12	6.35	3.5×1	4560	13230	93	165	135	18	113	51	102	20	11	17.5	11	PT1/8"	149
			5×1	5580	16710		189											185
			2.5×1	4080	11260		161											114
	12	7.144	3.5×1	5300	15280	100	185	146	25	122	55	110	20	14	20	13	PT1/8"	151
			5×1	6480	19300		209											187
			2.5×1	3510	9750		174											112
	16	6.35	3.5×1	4560	13230	93	206	135	18	113	51	102	20	11	17.5	11	PT1/8"	149
			5×1	5580	16710		238											185
			2.5×1	4080	11260		180											114
	16	7.144	3.5×1	5300	15280	100	212	146	25	122	55	110	20	14	20	13	PT1/8"	151
			5×1	6480	19300		244											187
			1.5×1	2790	7240		179											77
	20	7.144	2.5×1	4080	11260	100	219	146	25	122	55	110	20	14	20	13	PT1/8"	114
			3.5×1	5300	15280		259											151
			5×1	6480	19300		299											187
			2.5×1	4750	12090		219											117
	20	7.938	3.5×1	6180	16400	105	259	152	25	128	58	116	20	14	20	13	PT1/8"	154
			5×1	7550	20720		299											191
	50	7.938	1.5×1	3250	7770	105	305	152	25	128	58	116	20	14	20	13	PT1/8"	79

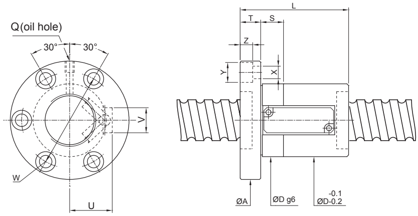
FDWE



Unit: mm

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD(*kgf*)		NUT		FLANGE					FIT	BOLT			OIL HOLE	STIFFNESS
O.D.	LEAD		circuit × row	Dynamic (1×10^6 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 5×1	5030 6150	17020 21500	108	155 175	154	22	130	58	116	20	14	20	13	PT1/8"	178 220
63	12	6.35	2.5×1 3.5×1 5×1	3870 5030 6150	12540 17020 21500	108	153 177 201	154	22	130	58	116	20	14	20	13	PT1/8"	134 178 220
63	12	7.144	2.5×1 3.5×1 5×1	4540 5900 7210	14460 19620 24780	115	158 182 206	161	22	137	61	122	20	14	20	13	PT1/8"	136 180 224
63	16	7.144	2.5×1 3.5×1 5×1	4540 5900 7210	14460 19620 24780	115	177 209 241	161	22	137	61	122	20	14	20	13	PT1/8"	136 180 224
63	16	7.938	2.5×1 3.5×1 5×1	5260 6840 8360	15430 20940 26450	120	207 239 271	180	28	150	72	144	25	18	26	17.5	PT1/8"	139 184 228
63	20	6.35	2.5×1 3.5×1 5×1	3870 5030 6150	12540 17020 21500	108	205 245 285	154	22	130	58	116	20	14	20	13	PT1/8"	134 178 220
63	20	9.525	2.5×1 3.5×1 5×1	8870 11530 14090	25870 35110 44350	122	219 259 299	182	28	150	72	144	25	18	26	17.5	PT1/8"	158 208 258
80	10	6.35	3.5×1 5×1	5630 6880	21660 27360	130	159 179	176	22	152	66	132	20	14	20	13	PT1/8"	207 256
80	12	7.938	3.5×1 5×1	7670 9380	27030 34140	136	184 208	182	22	158	68	136	20	14	20	13	PT1/8"	222 275
80	16	9.525	2.5×1 3.5×1 5×1	9900 12990 15880	33200 45050 56910	143	188 220 252	204	28	172	77	154	30	18	26	17.5	PT1/8"	189 251 311
80	20	9.525	2.5×1 3.5×1 5×1	9900 12990 15880	33200 45050 56910	143	220 260 300	204	28	172	77	154	30	18	26	17.5	PT1/8"	189 251 311
100	16	9.525	2.5×1 3.5×1 5×1	11320 14720 17990	41820 56750 71690	170	211 243 259	243	32	205	91	182	30	22	32	21.5	PT1/8"	213 283 351
100	20	9.525	2.5×1 3.5×1 5×1	11320 14720 17990	41820 56750 71690	170	228 268 308	243	32	205	91	182	30	22	32	21.5	PT1/8"	213 283 351

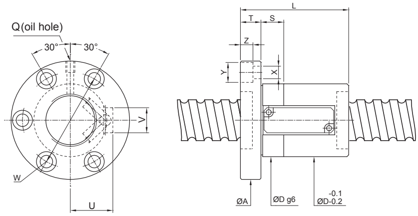
FSVE



Unit: mm

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD(*kgf*)		NUT		FLANGE			FIT	BOLT			RETURN TUBE		OIL HOLE	STIFFNESS
O.D.	LEAD		circuit × row	Dynamic (1×10^6 REV.) Ca	Static Co	Dg6	L	A	T	W	S	X	Y	Z	U	V	Q	*kgf/μm*
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
20	10	3.969	2.5×1	1210	2380	38	63	62	13	50	10	5.5	9.5	5.5	23	15	M6×1P	34
			3.5×1	1580	3230		73											45
	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											34
	20	3.969	1.5×1	830	1530	38	70	62	13	50	10	5.5	9.5	5.5	23	15	M6×1P	24
25	16	3.969	1.5×1	920	1930	42	62	68	15	55	15	6.6	11	6.6	26	14	M6×1P	28
			2.5×1	1340	3000		78											40
			1.5×1	1170	2300		74											29
	20	4.762	2.5×1	1710	3580	44	94	72	15	59	15	6.6	11	6.5	27	16	M6×1P	42
			3.5×1	2220	4860		114											55
32			1.5×1	1010	2480		63											33
	16	3.969	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											63
			5×1	2340	6610		111											77
			2.5×1	2830	8200		92											54
	16	6.35	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											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											63
			5×1	2350	6610		130											77
			2.5×1	2830	8200		104											54
	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											85

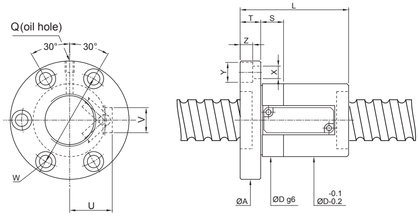
FSVE



Unit: mm

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD(kgf)		NUT		FLANGE			FIT	BOLT				RETURN TUBE		OIL HOLE	STIFFNESS
O.D.	LEAD		circuit × row	Dynamic (1×10⁶ 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
			5×1	4750	11860		109												93
	16	6.35	2.5×1	2990	6920	60	91	100	18	80	20	11	17.5	11		36	22	M8×1P	58
			3.5×1	3890	9390		107												76
			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	104	18	84	20	11	17.5	11		38	22	PT1/8"	63
			3.5×1	4130	10560		98												82
			5×1	5050	13340		110												101
	16	6.35	2.5×1	3180	7780	64	93	104	18	84	20	11	17.5	11		38	22	PT1/8"	63
			3.5×1	4130	10560		109												82
			5×1	5050	13340		125												101
	16	7.144	2.5×1	3740	8790	64	92	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

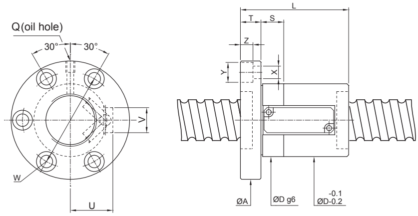
FSVE



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	73	82	118	18	96	20	11	17.5	11	43	22	PT1/8"	74
			3.5×1	4560	13230		94											97
			5×1	5580	16710		106											119
	12	7.144	2.5×1	4080	11260	75	93	122	20	98	15	14	20	13	44	24	PT1/8"	75
			3.5×1	5300	15280		105											99
			5×1	6480	19300		117											121
	16	6.35	2.5×1	3510	9750	73	94	118	18	96	20	11	17.5	11	43	22	PT1/8"	74
			3.5×1	4560	13230		110											97
			5×1	5580	16710		126											119
	16	7.144	2.5×1	4080	11260	75	100	122	20	98	15	14	20	13	44	24	PT1/8"	75
			3.5×1	5300	15280		116											99
			5×1	6480	19300		132											121
	20	7.144	1.5×1	2790	7240	75	98	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	76	119	123	25	99	20	14	20	13	46	25	PT1/8"	78
			3.5×1	6180	16400		139											101
			5×1	7550	20720		159											124
	50	7.938	1.5×1	3250	7770	76	157	123	25	99	20	14	20	13	46	25	PT1/8"	53

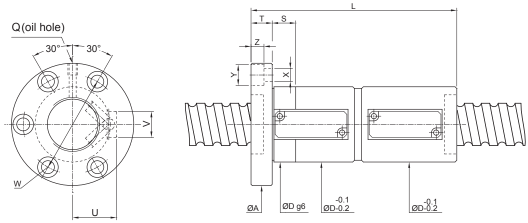
FSVE



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*
63	10	6.35	3.5×1 5×1	5030 6150	17020 21500	86	86 96	133	22	108	20	14	20	13	49	24	PT1/8"	115 141
	12	6.35	2.5×1 3.5×1 5×1	3870 5030 6150	12540 17020 21500	86	84 96 108	133	22	108	20	14	20	13	49	24	PT1/8"	87 115 141
	12	7.144	2.5×1 3.5×1 5×1	4540 5900 7210	14460 19620 24780	87	90 102 114	134	22	110	20	14	20	13	50	25	PT1/8"	89 117 145
	16	7.144	2.5×1 3.5×1 5×1	4540 5900 7210	14460 19620 24780	87	97 113 129	134	22	110	20	14	20	13	50	25	PT1/8"	89 117 145
	16	7.938	2.5×1 3.5×1 5×1	5260 6840 8360	15430 20940 26450	89	112 128 144	148	28	118	25	18	26	17.5	52	25	PT1/8"	91 120 147
	20	6.35	2.5×1 3.5×1 5×1	3870 5030 6150	12540 17020 21500	86	104 124 144	133	22	108	20	14	20	13	49	24	PT1/8"	87 115 141
	20	7.938	2.5×1 3.5×1 5×1	5260 6840 8360	15430 20940 26450	89	120 140 160	148	28	118	25	18	26	17.5	52	25	PT1/8"	91 120 147
	20	9.525	2.5×1 3.5×1 5×1	8870 11530 14090	25870 35110 44350	93	120 140 160	152	28	122	25	18	26	17.5	54	28	PT1/8"	105 136 167
80	10	6.35	3.5×1 5×1	5630 6880	21660 27360	103	90 100	150	22	126	20	14	20	13	58	25	PT1/8"	133 164
	12	7.938	3.5×1 5×1	7670 9380	27030 34140	123	101 113	170	22	146	20	14	20	13	66	28	PT1/8"	143 177
	16	9.525	2.5×1 3.5×1 5×1	9900 12990 15880	33200 45050 56910	126	108 124 140	185	28	155	30	18	26	17.5	70	28	PT1/8"	124 162 201
	20	9.525	2.5×1 3.5×1 5×1	9900 12990 15880	33200 45050 56910	126	120 140 160	185	28	155	30	18	26	17.5	70	28	PT1/8"	124 162 201
100	16	9.525	2.5×1 3.5×1 5×1	11320 14720 17990	41820 56750 71690	146	115 131 147	217	32	181	30	22	32	21.5	82	35	PT1/8"	139 182 226
	20	9.525	2.5×1 3.5×1 5×1	11320 14720 17990	41820 56750 71690	146	128 148 168	217	32	181	30	22	32	21.5	82	35	PT1/8"	139 182 226

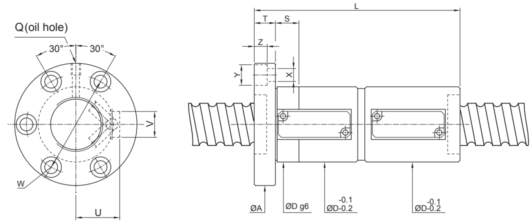
FDVE



Unit: mm

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD*(kgf)*		NUT		FLANGE			FIT	BOLT			RETURN TUBE		OIL HOLE	STIFFNESS
O.D.	LEAD		circuit × row	Dynamic $(1\times10^6$ REV.) Ca	Static Co	Dg6	L	A	T	W	S	X	Y	Z	U	V	Q	*kgf/μm*
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
20	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		133											68
	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		160											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		158											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
			2.5×1	1710	3580		194											63
			3.5×1	2220	4860		234											83
32	16	3.969	1.5×1	1010	2480	49	130	78	15	63	15	6.6	11	6.6	29	15	M8×1P	49
			2.5×1	1470	3860		162											73
			3.5×1	1910	5240		194											96
			5×1	2340	6610		226											120
	16	6.35	2.5×1	2830	8200	57	173	98	18	77	20	11	17.5	11	34	22	M8×1P	80
			3.5×1	3680	11120		205											105
			5×1	4490	14050		237											131
	20	3.969	1.5×1	1010	2480	49	133	78	15	63	15	6.6	11	6.6	29	15	M8×1P	49
			2.5×1	1470	3860		173											73
			3.5×1	1910	5240		213											96
			5×1	2350	6610		253											120
	20	6.35	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
			5×1	4490	14050		284											131

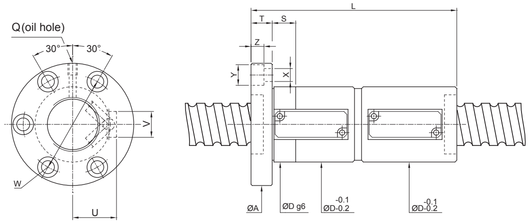
FDVE



Unit: mm

SCREW SIZE O.D.	SCREW SIZE LEAD	BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD (kgf) Dynamic (1×10^6 REV.) Ca	BASIC RATE LOAD (kgf) Static Co	NUT Dg6	NUT L	FLANGE A	FLANGE T	FLANGE W	FIT S	BOLT X	BOLT Y	BOLT Z	RETURN TUBE U	RETURN TUBE V	OIL HOLE Q	STIFFNESS 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
			5×1	4750	11860		200											143
	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
			5×1	4750	11860		237											143
	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	104	18	84	20	11	17.5	11	38	22	PT1/8"	95
			3.5×1	4130	10560		165											125
			5×1	5050	13340		189											155
	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
			5×1	5050	13340		237											155
	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
			5×1	5950	15070		237											159
	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
			3.5×1	4130	10560		244											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

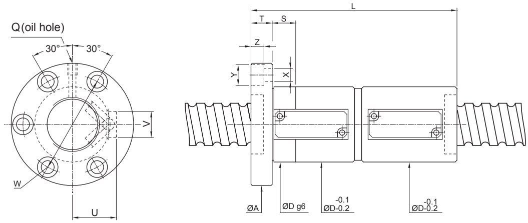
FDVE



Unit: mm

SCREW SIZE O.D.	SCREW SIZE LEAD	BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD *(kgf)* Dynamic (1×10^6 REV.) Ca	BASIC RATE LOAD *(kgf)* Static Co	NUT Dg6	NUT L	FLANGE A	FLANGE T	FLANGE W	FIT S	BOLT X	BOLT Y	BOLT Z	RETURN TUBE U	RETURN TUBE V	OIL HOLE Q	STIFFNESS *kgf/μm*
50	10	6.35	3.5×1	4560	13230	73	155	118	18	96	20	11	17.5	11	43	22	PT1/8"	149
			5×1	5580	16710		175											185
	12	6.35	2.5×1	3510	9750	73	152	118	18	96	20	11	17.5	11	43	22	PT1/8"	112
			3.5×1	4560	13230		176											149
			5×1	5580	16710		200											185
	12	7.144	2.5×1	4080	11260	75	161	122	20	98	15	14	20	13	44	24	PT1/8"	114
			3.5×1	5300	15280		185											151
			5×1	6480	19300		209											187
	16	6.35	2.5×1	3510	9750	73	174	118	18	96	20	11	17.5	11	43	22	PT1/8"	112
			3.5×1	4560	13230		206											149
			5×1	5580	16710		238											185
	16	7.144	2.5×1	4080	11260	75	180	122	20	98	15	14	20	13	44	24	PT1/8"	114
			3.5×1	5300	15280		212											151
			5×1	6480	19300		244											187
	20	7.144	1.5×1	2790	7240	75	179	122	20	98	15	14	20	13	44	20	PT1/8"	77
			2.5×1	4080	11260		219											114
			3.5×1	5300	15280		259											151
			5×1	6480	19300		299											187
	20	7.938	2.5×1	4750	12090	76	219	123	25	99	20	14	20	13	46	25	PT1/8"	117
			3.5×1	6180	16400		259											154
			5×1	7550	20720		299											191
	50	7.938	1.5×1	3250	7770	76	305	123	25	99	20	14	20	13	46	25	PT1/8"	79

FDVE

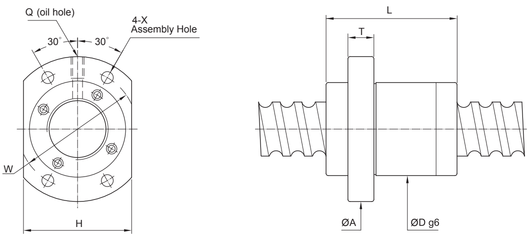


Unit: mm

SCREW SIZE O.D.	SCREW SIZE LEAD	BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD(kgf) Dynamic (1×10⁶ REV.) Ca	BASIC RATE LOAD(kgf) Static Co	NUT Dg6	NUT L	FLANGE A	FLANGE T	FLANGE W	FIT S	BOLT X	BOLT Y	BOLT Z	RETURN TUBE U	RETURN TUBE V	OIL HOLE Q	STIFFNESS kgf/μm
63	10	6.35	3.5×1 5×1	5030 6150	17020 21500	86	155 175	133	22	108	20	14	20	13	49	24	PT1/8"	178 220
	12	6.35	2.5×1 3.5×1 5×1	3870 5030 6150	12540 17020 21500	86	153 177 201	133	22	108	20	14	20	13	49	24	PT1/8"	134 178 220
	12	7.144	2.5×1 3.5×1 5×1	4540 5900 7210	14460 19620 24780	87	158 182 206	134	22	110	20	14	20	13	50	25	PT1/8"	136 180 224
	16	7.144	2.5×1 3.5×1 5×1	4540 5900 7210	14460 19620 24780	87	177 209 241	134	22	110	20	14	20	13	50	25	PT1/8"	139 184 228
	16	7.938	2.5×1 3.5×1 5×1	5260 6840 8360	15430 20940 26450	89	207 239 271	148	28	118	25	18	26	17.5	52	25	PT1/8"	134 178 220
	20	6.35	2.5×1 3.5×1 5×1	3870 5030 6150	12540 17020 21500	86	205 245 285	133	22	108	20	14	20	13	49	24	PT1/8"	134 178 220
	20	7.938	2.5×1 3.5×1 5×1	5260 6840 8360	15430 20940 26450	89	221 261 301	148	28	118	25	18	26	17.5	52	25	PT1/8"	139 184 228
	20	9.525	2.5×1 3.5×1 5×1	8870 11530 14090	25870 35110 44350	93	219 259 299	152	28	122	25	18	26	17.5	54	28	PT1/8"	158 208 258
80	10	6.35	3.5×1 5×1	5630 6880	21660 27360	103	159 179	150	22	126	20	14	20	13	58	25	PT1/8"	207 256
	12	7.938	3.5×1 5×1	7670 9380	27030 34140	123	184 208	170	22	146	20	14	20	13	66	28	PT1/8"	222 275
	16	9.525	2.5×1 3.5×1 5×1	9900 12990 15880	33200 45050 56910	126	188 220 252	185	28	155	30	18	26	17.5	70	28	PT1/8"	189 251 311
	20	9.525	2.5×1 3.5×1 5×1	9900 12990 15880	33200 45050 56910	126	220 260 300	185	28	155	30	18	26	17.5	70	28	PT1/8"	189 251 311
100	16	9.525	2.5×1 3.5×1 5×1	11320 14720 17990	41820 56750 71690	146	211 243 259	217	32	181	30	22	32	21.5	82	35	PT1/8"	213 283 351
	20	9.525	2.5×1 3.5×1 5×1	11320 14720 17990	41820 56750 71690	146	228 268 308	217	32	181	30	22	32	21.5	82	35	PT1/8"	213 283 351

13.5 End Cap Series

FSKC



Unit: mm

SCREW SIZE		BALL	EFFECTIVE TURNS	BASIC RATE LOAD(*kgf*)		BALLNUT DIMENSION								
				Dynamic (1×10^6 REV.)	Static	NUT		FLANGE				BOLT	OIL HOLE	STIFFNESS
O.D.	LEAD	DIA	circuit × number of thread	Ca	Co	Dg6	L	A	T	H	W	X	Q	*kgf/μm*
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									69
32	32	4.762	1.8×2	2360	5940	58	70	92	15	68	74	9	M6×1P	44
			1.8×4	4280	11800									87
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									108
50	50	7.938	1.8×2	5800	15800	90	122	135	20	104	112	14	M6×1P	68
			1.8×4	10520	31600									135

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.

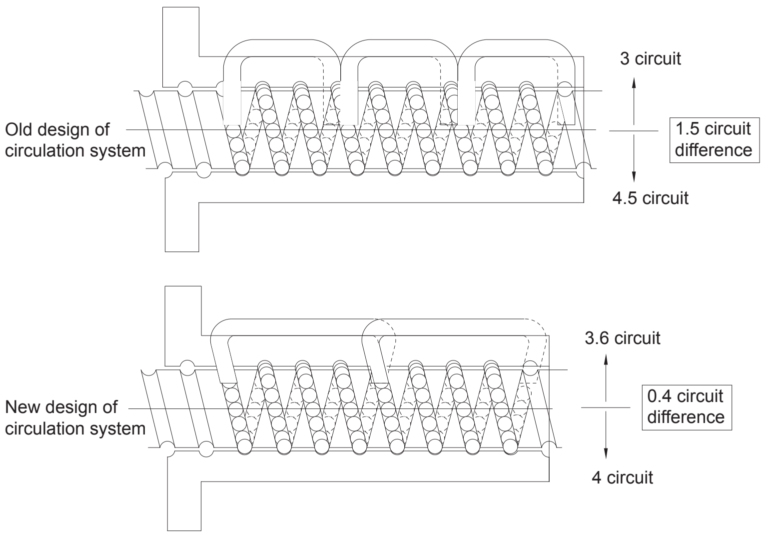


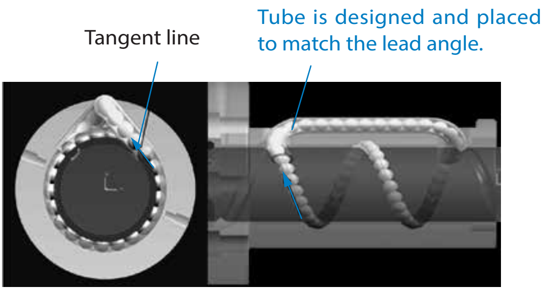
Fig.13.4 Circuit difference for heavy load ballscrew

High DN Value

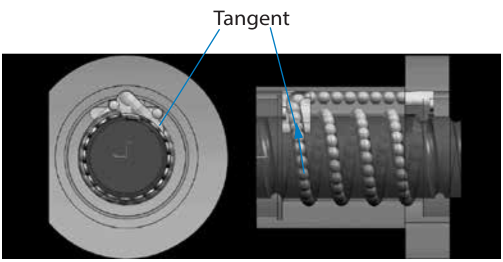
With the newly developed circulation system, ballscrews can meet the demands of high speed running with high DN value.

Low Noise

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

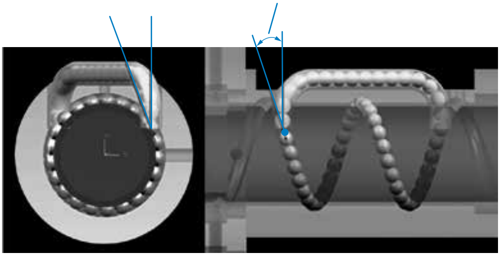


FSVH circulation system structure(NEW)



FSDH circulation system structure (NEW)

Fig.13.5 Circulation system structure for FSVH and FSDH



FSVC circulation system structure

Fig.13.6 Circulation systwm structure for FSVC

Various Specifications Combination

PMI can supply various ballscrews with diameter 40~120*mm* and lead 10*mm* to 60*mm* (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

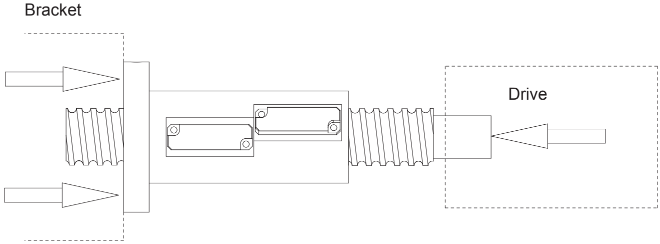


Fig.13.7 Recommend mounting direction of heavy load ballscrew

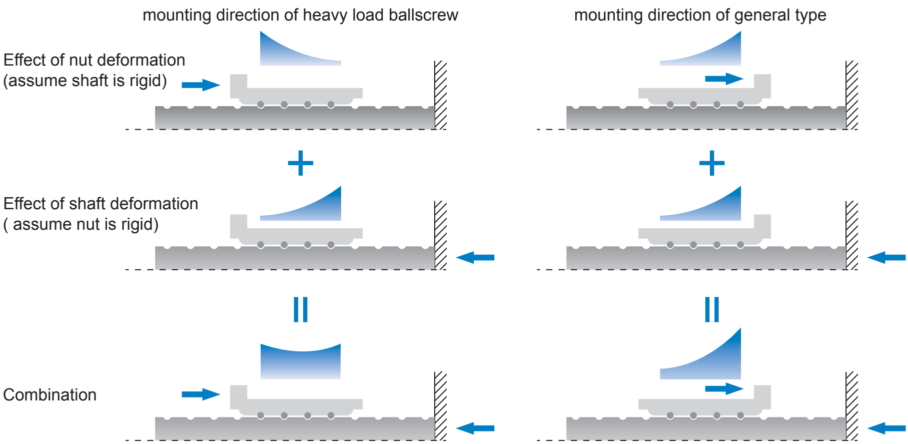
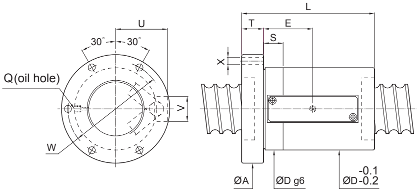
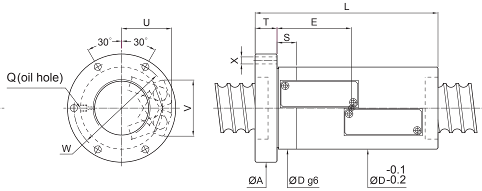


Fig.13.8 Load distribution

FSVH



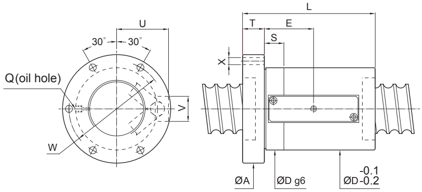


Unit: mm

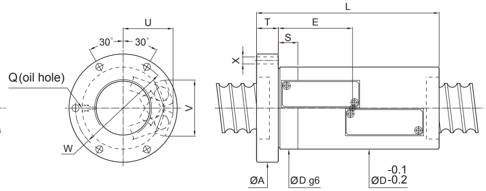
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD *(kgf)*		NUT		FLANGE			FIT	OIL HOLE		BOLT	RETURN TUB		Type
O.D.	LEAD			Dynamic (1×10^6 REV.) Ca	Static Co	Dg6	L	A	T	W	S	Q	E	X	V	U	
40	10	7.938	3.5×2	15000	41800	66	124	98	18	83	20	M6x1P	50.75	9	51	43	II
	12	9.525	3.5×2	18600	48200	70	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

TYPE I



TYPE II

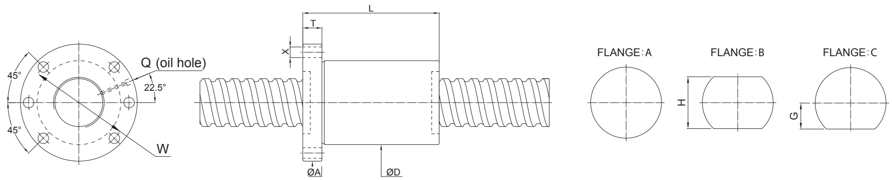


Unit: mm

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD(*kgf*)		NUT		FLANGE			FIT	OIL HOLE		BOLT	RETURN TUB		Type
O.D.	LEAD		circuit × row	Dynamic (1×10^6 REV.) Ca	Static Co	Dg6	L	A	T	W	S	Q	E	X	V	U	
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

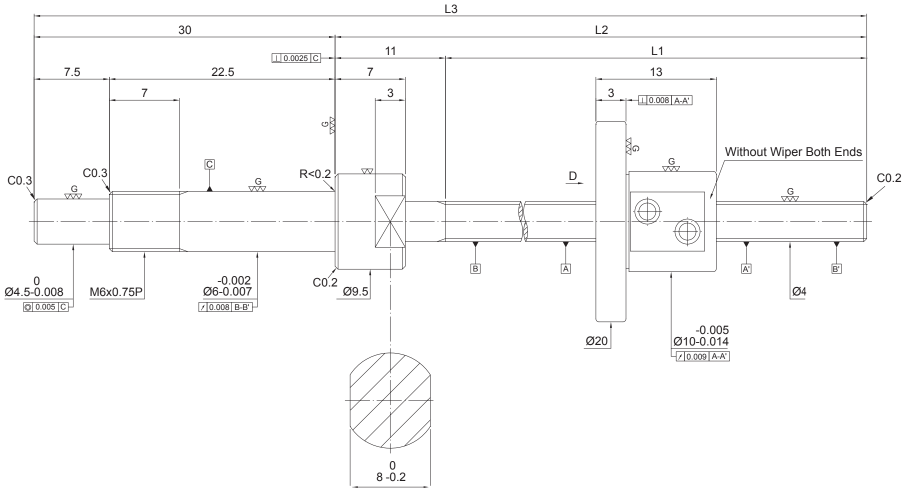
FSDH

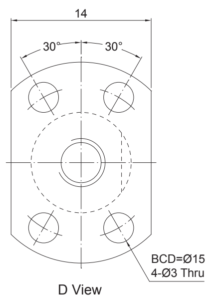


Unit: mm

SCREW SIZE		BALL	EFFECTIVE TURNS	BASIC RATE LOAD*(kgf)*		NUT		FLANGE				OIL HOLE	BOLT
O.D.	LEAD	DIA.	circuit × number of thread	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

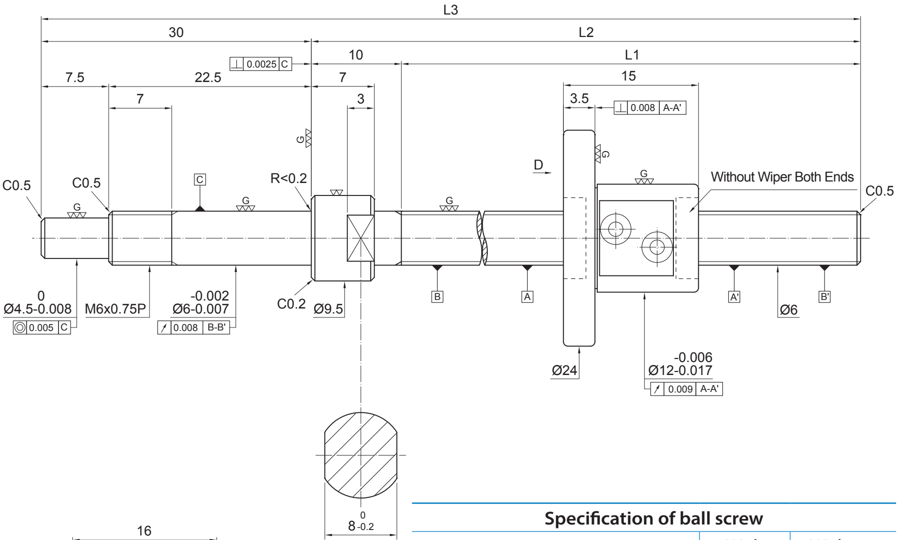


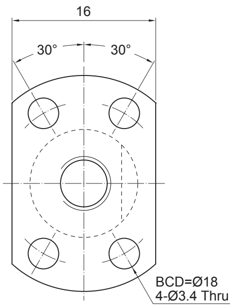


Specification of ball screw		
Production Specification	With Preload	Without Preload
Number of Thread / Thread Direction	1/Right	
BCD	4.1	
Lead	1	
Ball Dia.	0.8	
Effective Turns (Circuit × Row)	2.5 × 1	
Lead Angle	4.44	
Dynamic Rate Load Ca (kgf)	49	
Static Rate Load Co (kgf)	70	
Axial Play	0	0.005 or 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 Deriation 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





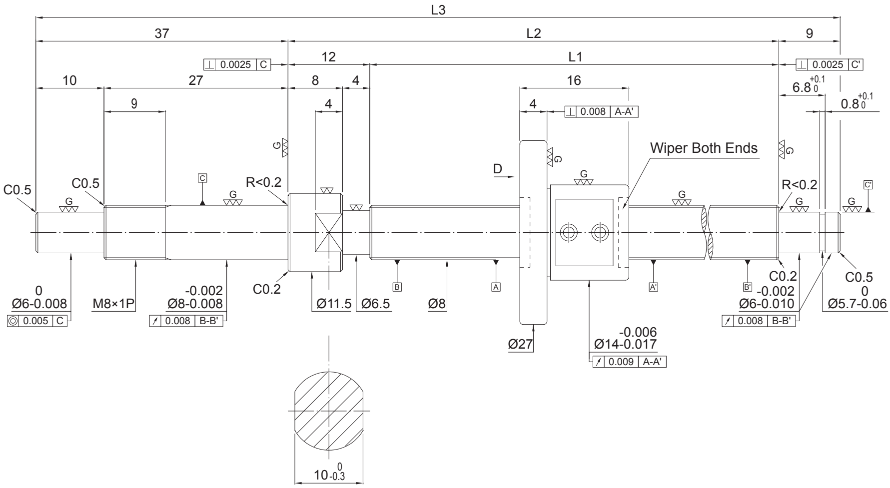
D View

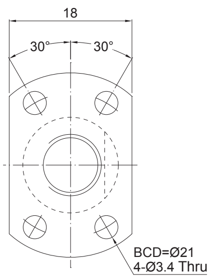
Specification of ball screw		
Production Specification	With Preload	Without Preload
Number of Thread / Thread Direction	1/Right	
BCD	6.1	
Lead	1	
Ball Dia.	0.8	
Effective Turns (Circuit × Row)	2.5 × 1	
Lead Angle	2.99	
Dynamic Rate Load Ca (kgf)	58	
Static Rate Load Co (kgf)	100	
Axial Play	0	0.005 or 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 Deriation in random 300mm e_{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



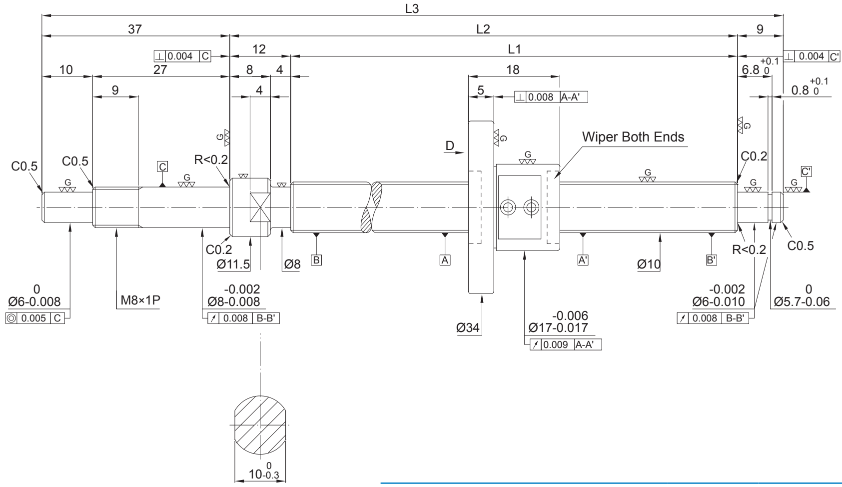


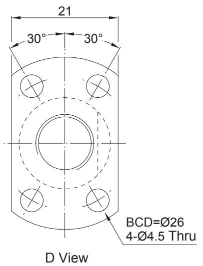
D View

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 e_{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



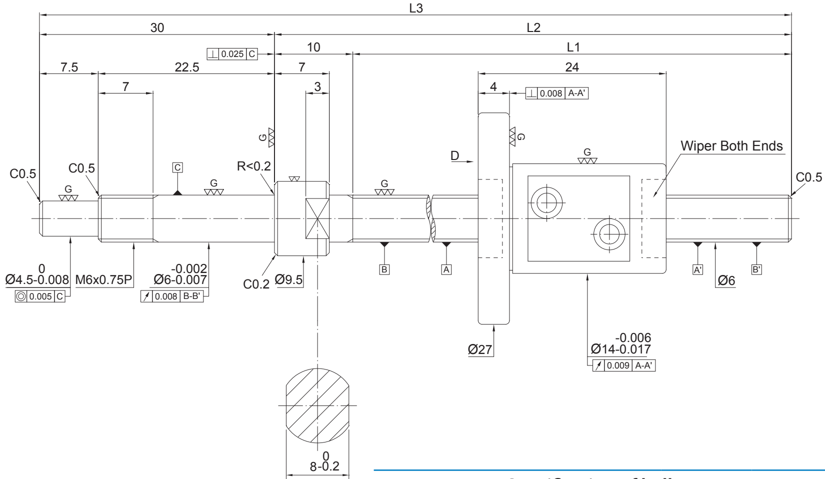


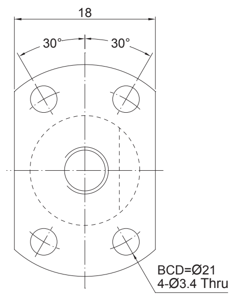
Specification of ball screw		
Production Specification	With Preload	Without Preload
Number of Thread / Thread Direction	1/Right	
BCD	10.1	
Lead	1	
Ball Dia.	0.8	
Effective Turns (Circuit × Row)	2.5 × 1	
Lead Angle	1.8	
Dynamic Rate Load Ca (kgf)	73	
Static Rate Load Co (kgf)	180	
Axial Play	0	0.005 or 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 e_{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.Ø6 Lead02



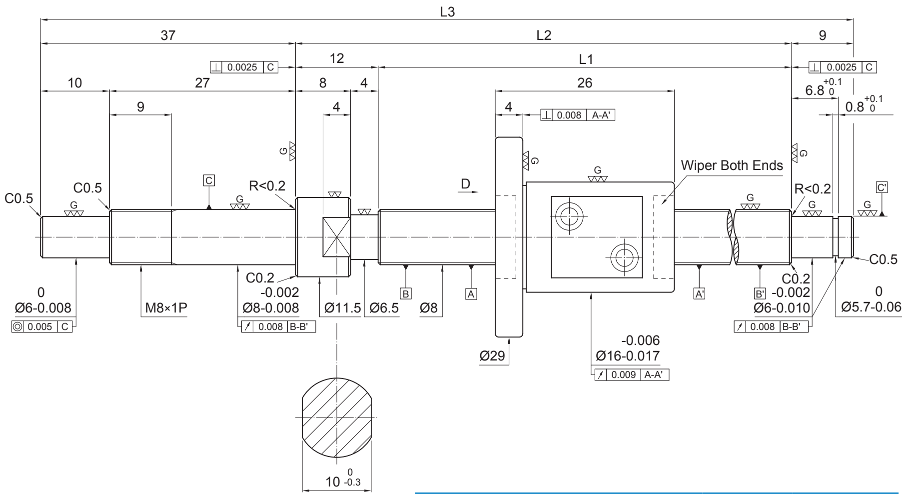


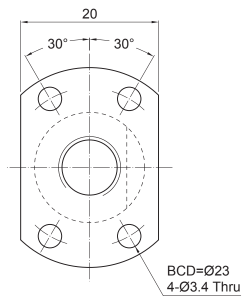
D View

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 × Row)	2.5 × 1	
Lead Angle	5.77	
Dynamic Rate Load Ca (kgf)	160	
Static Rate Load Co (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 Deriation 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





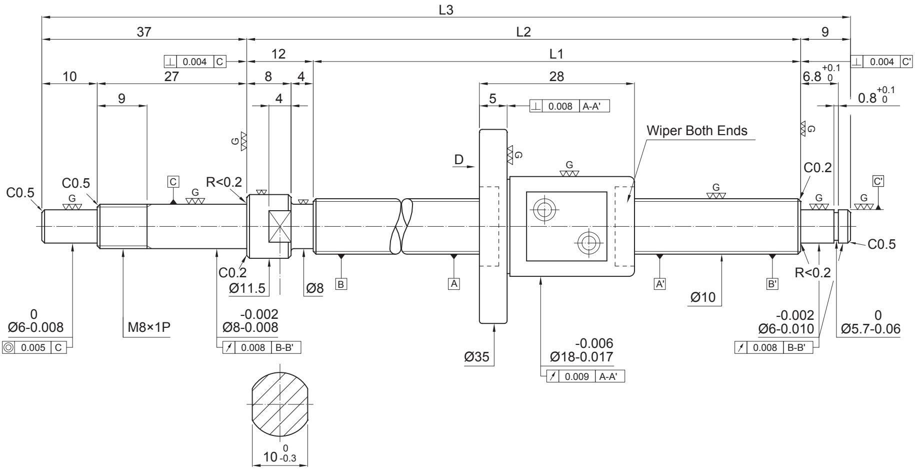
D View

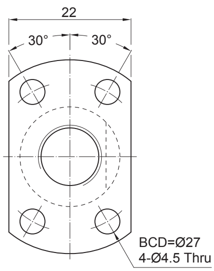
Specification of ball screw		
Production Specification	With Preload	Without Preload
Number of Thread / Thread Direction	1/Right	
BCD	8.3	
Lead	2	
Ball Dia.	1.588	
Effective Turns (Circuit × Row)	2.5 × 1	
Lead Angle	4.39	
Dynamic Rate Load Ca (kgf)	190	
Static Rate Load Co (kgf)	290	
Axial Play	0	0.005 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.Ø10 Lead02



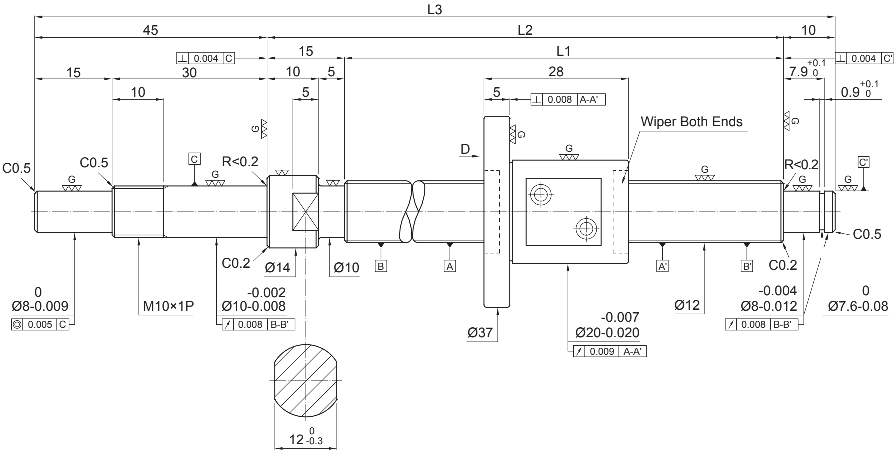


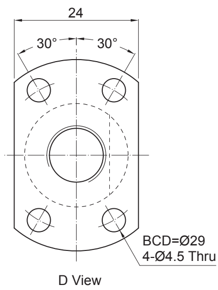
D View

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 × Row)	2.5 × 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 Deriation 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





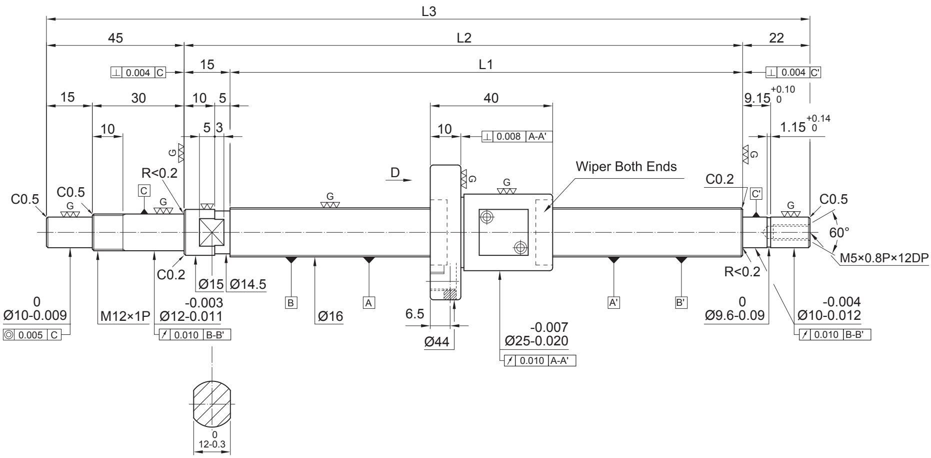
D View

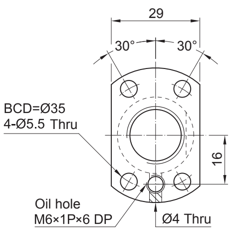
Specification of ball screw		
Production Specification	With Preload	Without Preload
Number of Thread / Thread Direction	1/Right	
BCD	12.3	
Lead	2	
Ball Dia.	1.588	
Effective Turns (Circuit × Row)	2.5 × 1	
Lead Angle	2.96	
Dynamic Rate Load Ca (kgf)	240	
Static Rate Load Co (kgf)	450	
Axial Play	0	0.005 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 Deriation 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





D View

Specification of ball screw

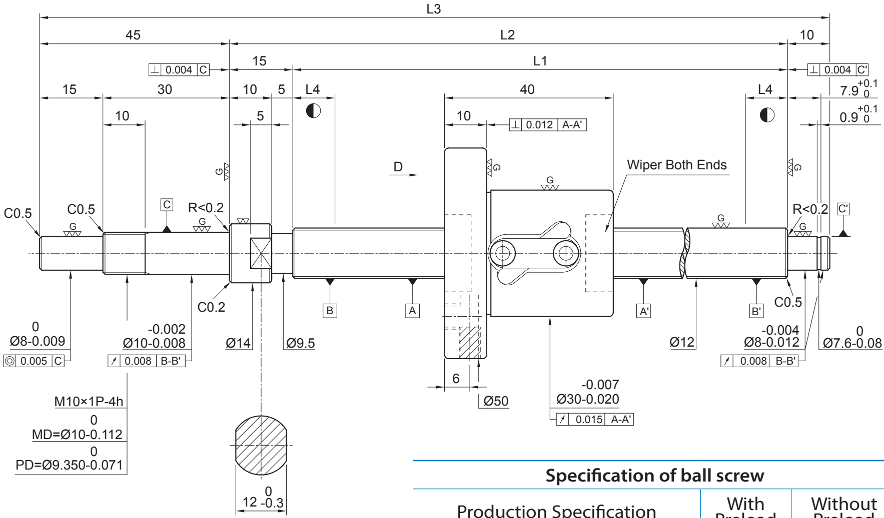
Production Specification	With Preload	Without Preload
Number of Thread / Thread Direction	1/Right	
BCD	16.3	
Lead	2	
Ball Dia.	1.588	
Effective Turns (Circuit × Row)	3.5 × 1	
Lead Angle	2.24	
Dynamic Rate Load Ca (kgf)	360	
Static Rate Load Co (kgf)	850	
Axial Play	0	0.005 or less
Preloading Torque (kgf-cm)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

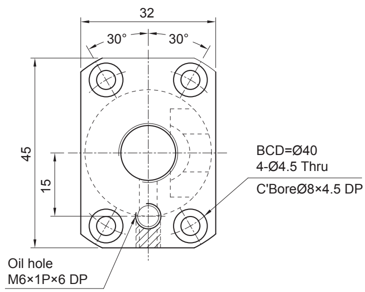
Unit: mm

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.Ø12 Lead05 **FSWC**





D View

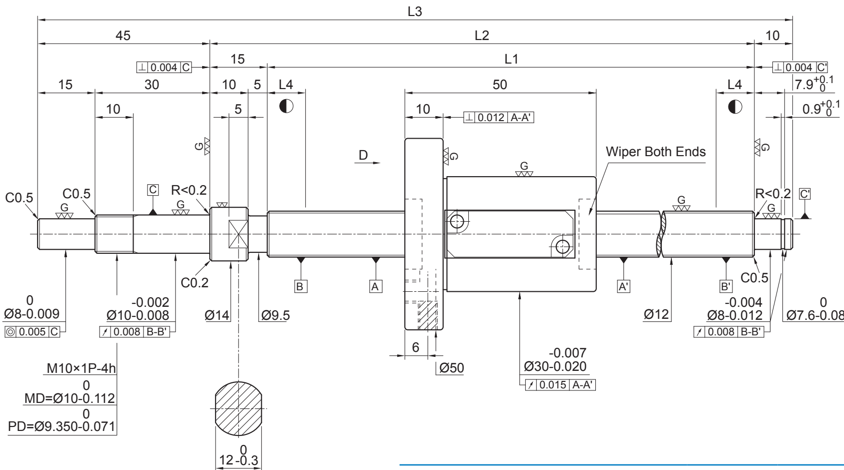
Specification of ball screw

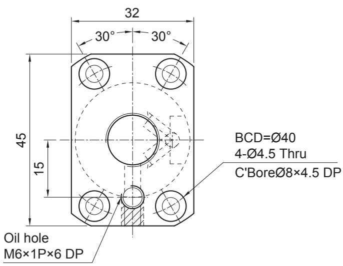
Production Specification	With Preload	Without Preload
Number of Thread / Thread Direction	1/Right	
BCD	12.4	
Lead	5	
Ball Dia.	2.381	
Effective Turns (Circuit × Row)	2.5 × 1	
Lead Angle	7.31	
Dynamic Rate Load Ca (kgf)	380	
Static Rate Load Co (kgf)	640	
Axial Play	0	0.005 or less
Preloading Torque (kgf-cm)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

FSWE Standard ballscrews Screw Dia.Ø12 Lead10





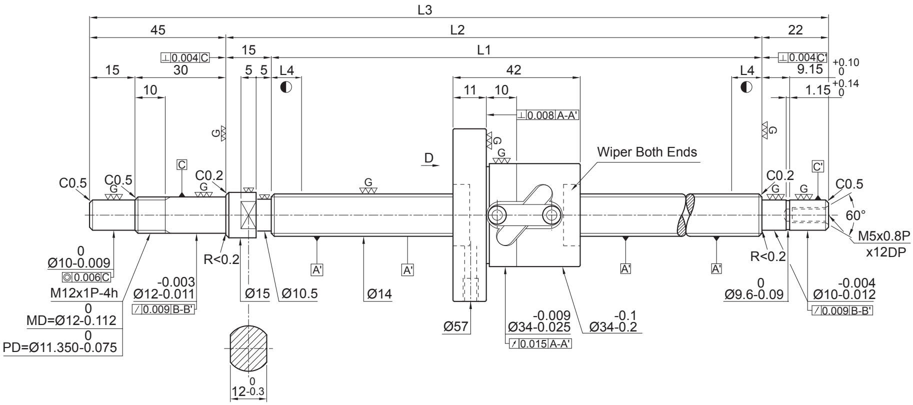
D View

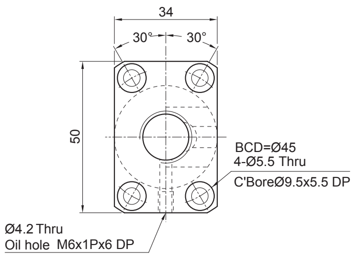
Specification of ball screw		
Production Specification	With Preload	Without Preload
Number of Thread / Thread Direction	1/Right	
BCD	12.4	
Lead	10	
Ball Dia.	2.381	
Effective Turns (Circuit × Row)	2.5 × 1	
Lead Angle	14.4	
Dynamic Rate Load Ca (kgf)	420	
Static Rate Load Co (kgf)	720	
Axial Play	0	0.005 or less
Preloading Torque (kgf-cm)	0.1~0.5	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}
1R12-10B1-FSWE-160-230-0.008	160	175	230	10	3	0.012	0.008
1R12-10B1-FSWE-210-280-0.008	210	225	280	10	3	0.012	0.008
1R12-10B1-FSWE-310-380-0.008	310	325	380	15	3	0.012	0.008
1R12-10B1-FSWE-410-480-0.008	410	425	480	15	3	0.013	0.008
1R12-10B1-FSWE-510-580-0.008	510	525	580	15	3	0.015	0.008

Standard ballscrews
Screw Dia.Ø14 Lead05 **FSWC**





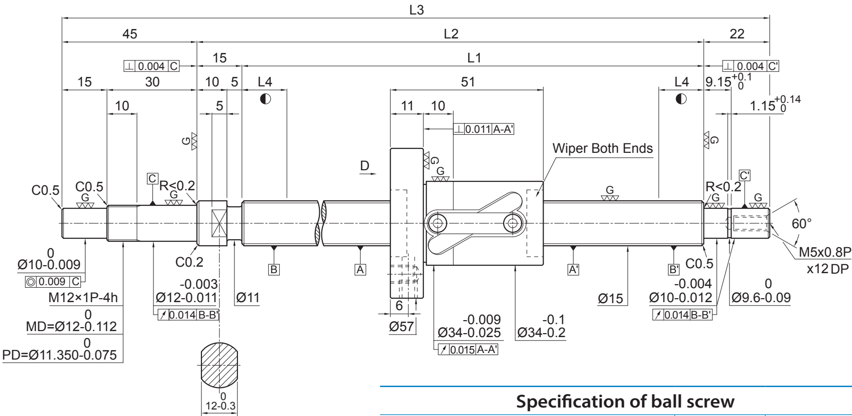
D View

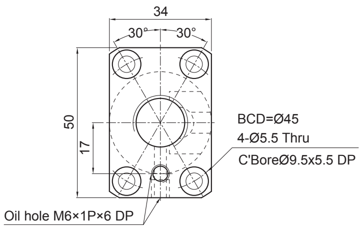
Specification of ball screw		
Production Specification	With Preload	Without Preload
Number of Thread / Thread Direction	1/Right	
BCD	14.6	
Lead	5	
Ball Dia.	3.175	
Effective Turns (Circuit × Row)	2.5 × 1	
Lead Angle	6.22	
Dynamic Rate Load Ca (kgf)	675	
Static Rate Load Co (kgf)	1145	
Axial Play	0	0.005 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-FSWC-189-271-0.008	189	204	271	10	3	0.012	0.008
1R14-05B1-FSWC-239-321-0.008	239	254	321	10	3	0.012	0.008
1R14-05B1-FSWC-339-421-0.008	339	954	421	15	3	0.012	0.008
1R14-05B1-FSWC-439-521-0.008	439	454	521	15	3	0.012	0.008
1R14-05B1-FSWC-539-621-0.008	539	554	621	15	3	0.012	0.008
1R14-05B1-FSWC-689-771-0.008	689	704	771	15	3	0.013	0.008

FSWC Standard ballscrews Screw Dia.Ø15 Lead10



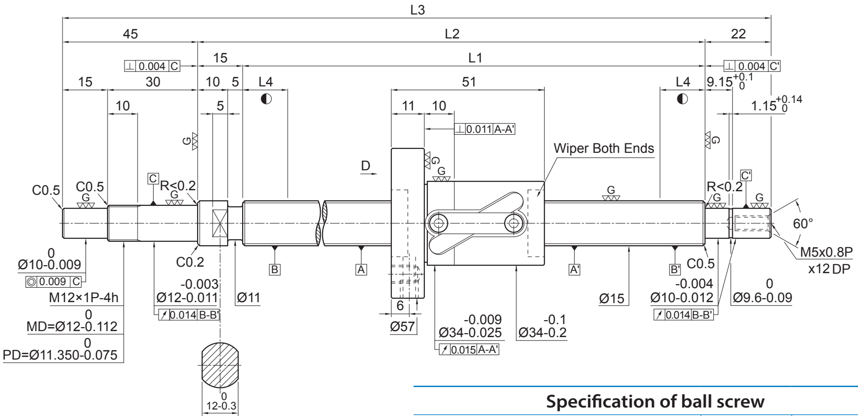


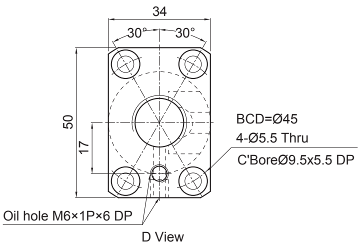
D View

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 × Row)	2.5 × 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-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



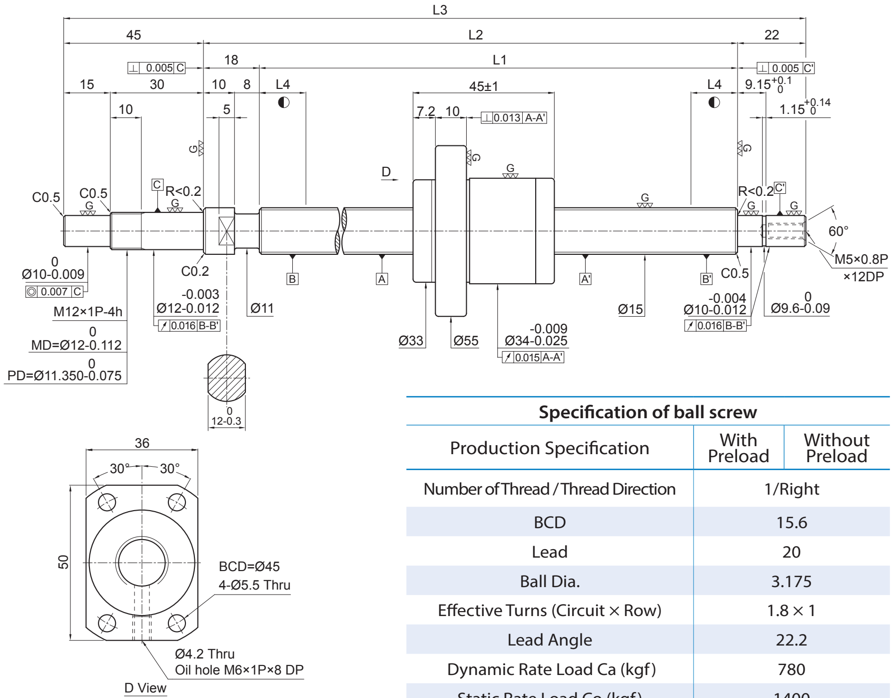


Specification of ball screw		
Production Specification	With Preload	Without Preload
Number of Thread / Thread Direction	1/Right	
BCD	15.6	
Lead	10	
Ball Dia.	3.175	
Effective Turns (Circuit × Row)	2.5 × 1	
Lead Angle	11.53	
Dynamic Rate Load Ca (kgf)	680	
Static Rate Load Co (kgf)	1210	
Axial Play	0	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

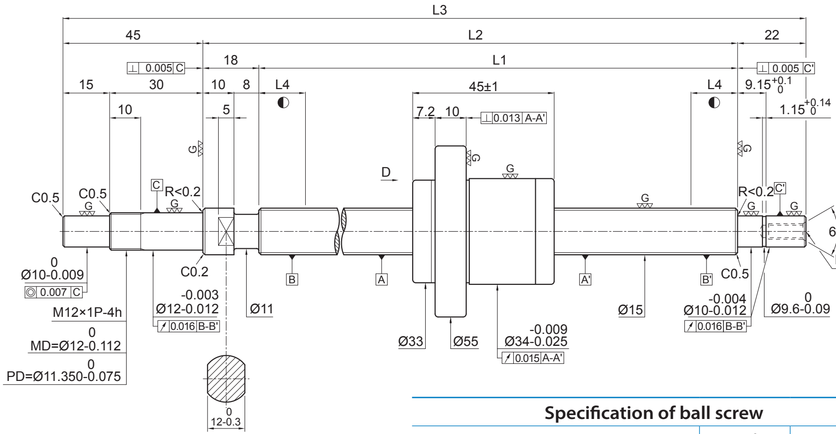
FSKC Standard ballscrews Screw Dia.Ø15 Lead20

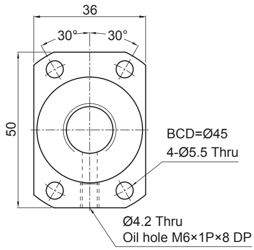


Specification of ball screw		
Production Specification	With Preload	Without Preload
Number of Thread / Thread Direction	1/Right	
BCD	15.6	
Lead	20	
Ball Dia.	3.175	
Effective Turns (Circuit × Row)	1.8 × 1	
Lead Angle	22.2	
Dynamic Rate Load Ca (kgf)	780	
Static Rate Load Co (kgf)	1400	
Axial Play	0	0.005 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





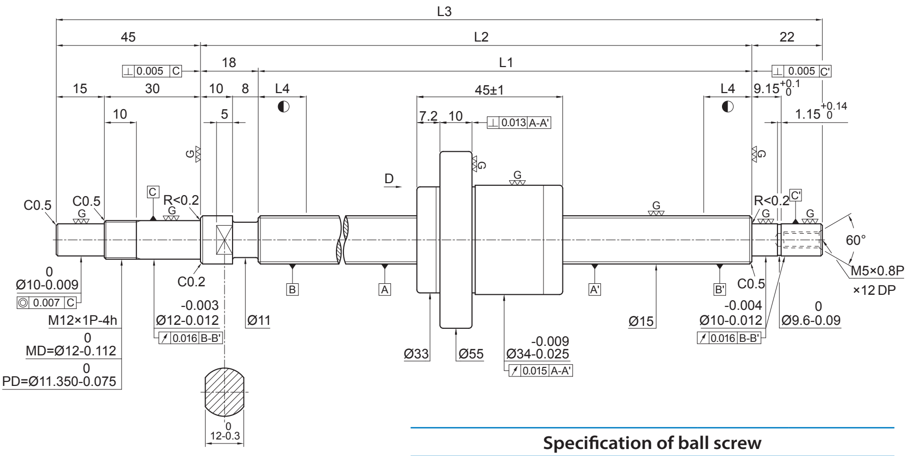
D View

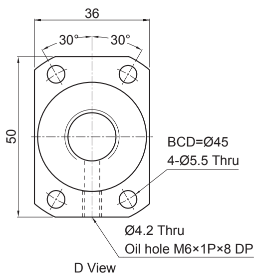
Specification of ball screw		
Production Specification	With Preload	Without Preload
Number of Thread / Thread Direction	1/Right	
BCD	15.6	
Lead	20	
Ball Dia.	3.175	
Effective Turns (Circuit × Row)	1.8 × 1	
Lead Angle	22.2	
Dynamic Rate Load Ca (kgf)	780	
Static Rate Load Co (kgf)	1400	
Axial Play	0	0.005 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-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.Ø15 Lead20

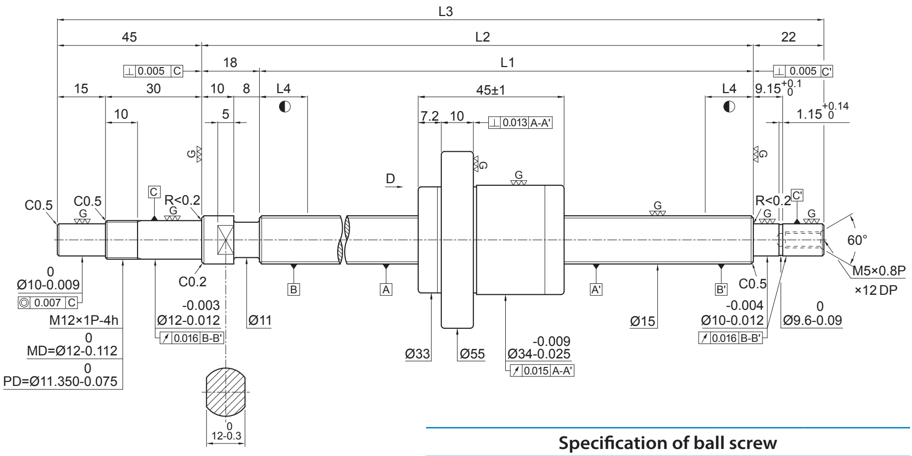


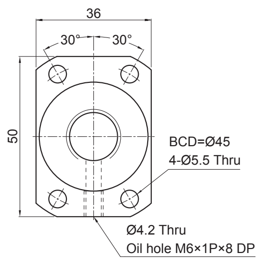


Specification of ball screw		
Production Specification	With Preload	Without Preload
Number of Thread / Thread Direction	2/Right	
BCD	15.6	
Lead	20	
Ball Dia.	3.175	
Effective Turns (Circuit × Row)	1.8 × 2	
Lead Angle	22.2	
Dynamic Rate Load Ca (kgf)	1400	
Static Rate Load Co (kgf)	2800	
Axial Play	0	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 Deriation 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





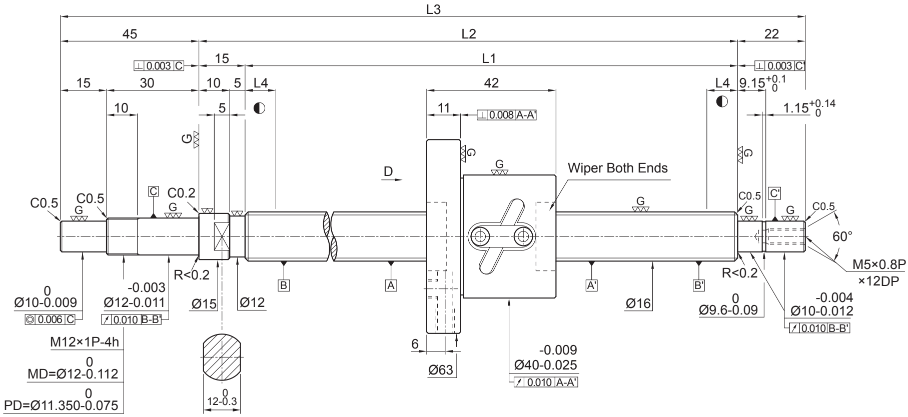
D View

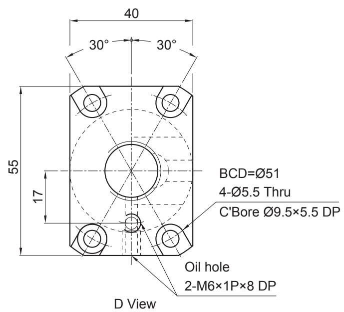
Specification of ball screw		
Production Specification	With Preload	Without Preload
Number of Thread / Thread Direction	2/Right	
BCD	15.6	
Lead	20	
Ball Dia.	3.175	
Effective Turns (Circuit × Row)	1.8 × 2	
Lead Angle	22.2	
Dynamic Rate Load Ca (kgf)	1400	
Static Rate Load Co (kgf)	2800	
Axial Play	0	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 Deriation 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

FSWC Standard ballscrews Screw Dia.Ø16 Lead05



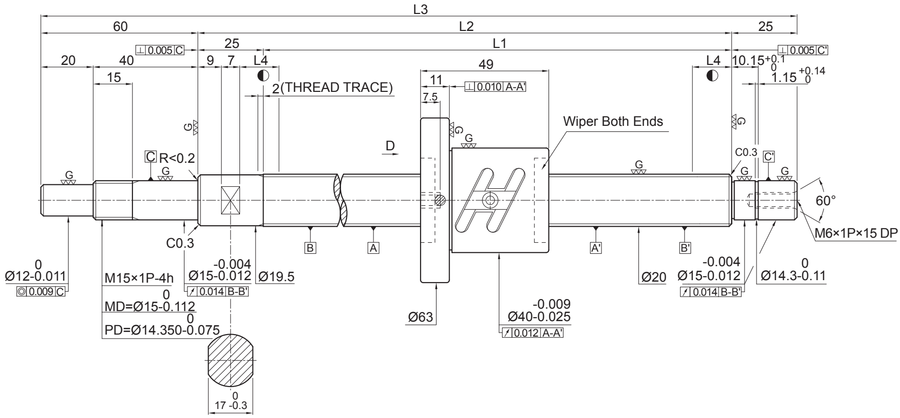


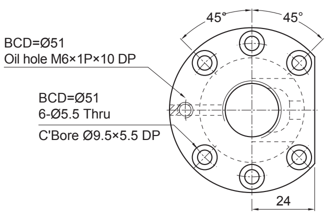
Specification of ball screw

Production Specification	With Preload	Without Preload
Number of Thread / Thread Direction	1/Right	
BCD	16.6	
Lead	5	
Ball Dia.	3.175	
Effective Turns (Circuit × Row)	2.5 × 1	
Lead Angle	5.48	
Dynamic Rate Load Ca (kgf)	690	
Static Rate Load Co (kgf)	1270	
Axial Play	0	0.005 or less
Preloading Torque (kgf-cm)	0.15~0.8	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}
1R16-05B1-FSWC-189-271-0.018	189	204	271	10	5	0.023	0.018
1R16-05B1-FSWC-289-371-0.018	289	304	371	10	5	0.023	0.018
1R16-05B1-FSWC-389-471-0.018	389	404	471	15	5	0.025	0.018
1R16-05B1-FSWC-489-571-0.018	489	504	571	15	5	0.027	0.018
1R16-05B1-FSWC-689-771-0.018	689	704	771	15	5	0.035	0.018
1R16-05B1-FSWC-889-971-0.018	889	904	971	15	5	0.040	0.018





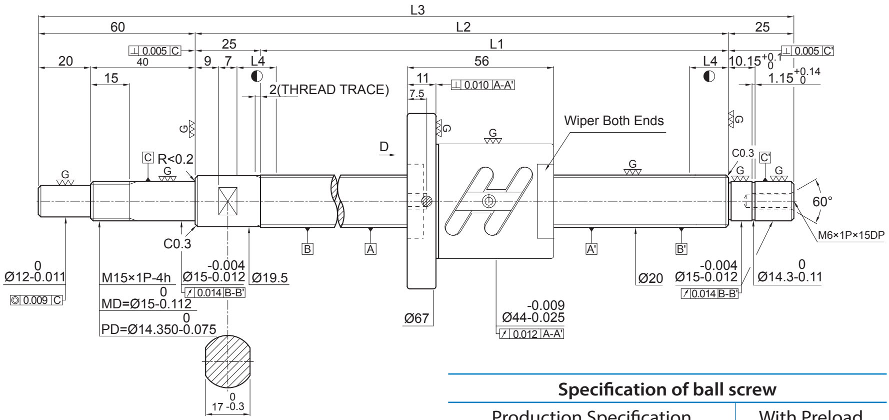
D View

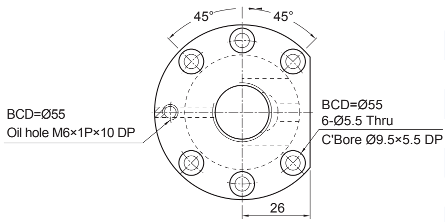
Specification of ball screw	
Production Specification	With Preload
Number of Thread / Thread Direction	1/Right
BCD	20.4
Lead	4
Ball Dia.	2.381
Effective Turns (Circuit × Row)	2.5 × 2
Lead Angle	3.57
Dynamic Rate Load Ca (kgf)	820
Static Rate Load Co (kgf)	2110
Axial Play	0
Preloading Torque (kgf-cm)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





D View

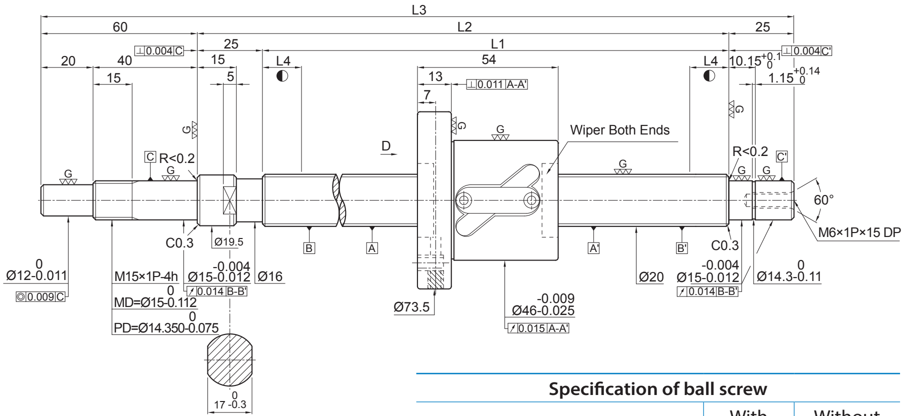
Specification of ball screw	
Production Specification	With Preload
Number of Thread / Thread Direction	1/Right
BCD	20.6
Lead	5
Ball Dia.	3.175
Effective Turns (Circuit × Row)	2.5 × 2
Lead Angle	4.42
Dynamic Rate Load Ca (kgf)	1510
Static Rate Load Co (kgf)	3460
Axial Play	0
Preloading Torque (kgf-cm)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

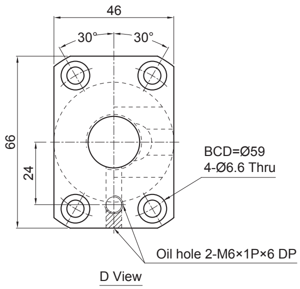
Unit: mm

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

Standard ballscrews
Screw Dia.Ø20 Lead10

FSWC



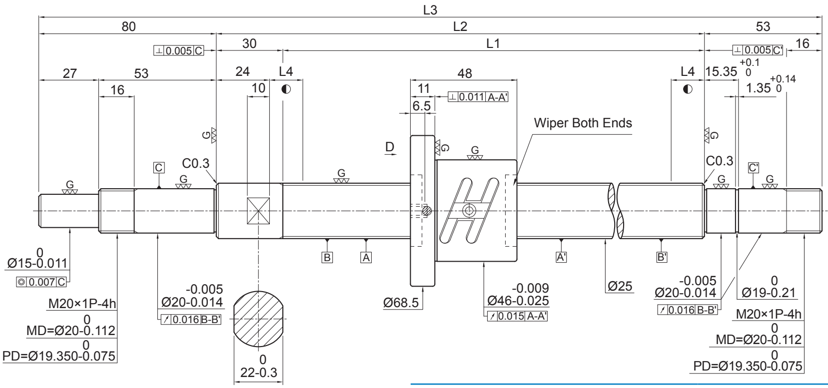


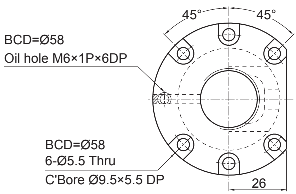
Specification of ball screw		
Production Specification	With Preload	Without Preload
Number of Thread / Thread Direction	1/Right	
BCD	20.7	
Lead	10	
Ball Dia.	3.969	
Effective Turns (Circuit × Row)	2.5 × 1	
Lead Angle	8.74	
Dynamic Rate Load Ca (kgf)	1100	
Static Rate Load Co (kgf)	2120	
Axial Play	0	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 Deriation in random 300mm e_{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.Ø25 Lead04



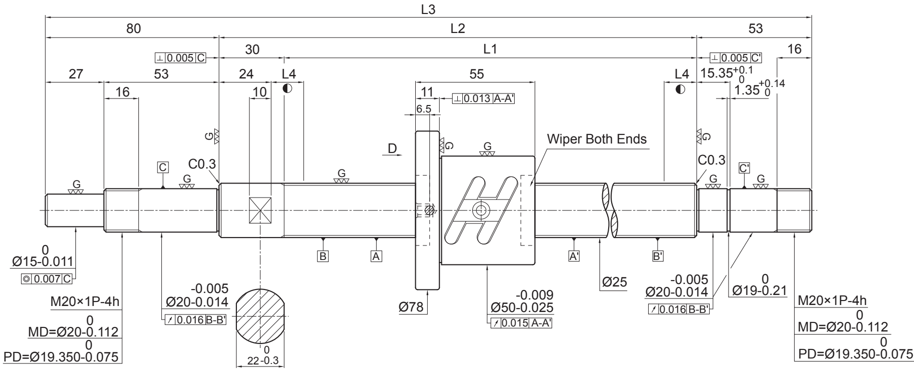


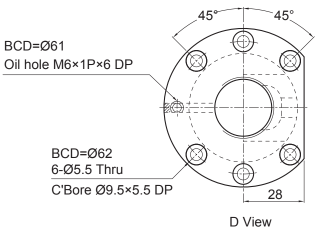
D View

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 × Row)	2.5 × 2
Lead Angle	2.87
Dynamic Rate Load Ca (kgf)	930
Static Rate Load Co (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





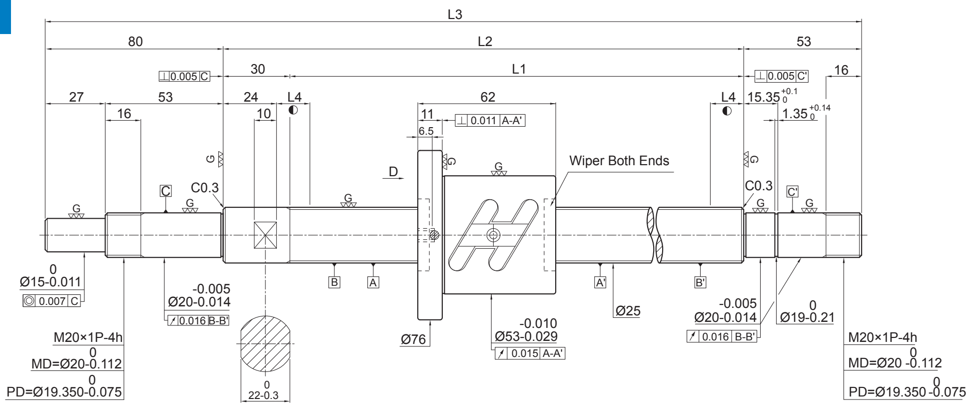
Specification of ball screw

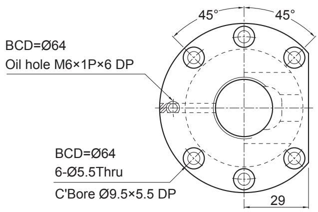
Production Specification	With Preload	Without Preload
Number of Thread / Thread Direction	1/Right	
BCD	25.7	
Lead	5	
Ball Dia.	3.969	
Effective Turns (Circuit × Row)	2.5 × 2	
Lead Angle	3.54	
Dynamic Rate Load Ca (kgf)	1100	
Static Rate Load Co (kgf)	2120	
Axial Play	0	0.005 or less
Preloading Torque (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-FSWC-220-383-0.018	220	250	383	10	5	0.023	0.018
1R25-05B2-FSWC-270-433-0.018	270	300	433	10	5	0.023	0.018
1R25-05B2-FSWC-370-533-0.018	370	400	533	15	5	0.025	0.018
1R25-05B2-FSWC-470-633-0.018	470	500	633	15	5	0.027	0.018
1R25-05B2-FSWC-570-733-0.018	570	600	733	15	5	0.030	0.018
1R25-05B2-FSWC-670-833-0.018	670	700	833	15	5	0.030	0.018
1R25-05B2-FSWC-770-933-0.018	770	800	933	15	5	0.035	0.018
1R25-05B2-FSWC-970-1133-0.018	970	1000	1133	15	5	0.040	0.018
1R25-05B2-FSWC-1170-1333-0.018	1170	1200	1333	15	5	0.046	0.018

FSWC Standard ballscrews Screw Dia.Ø25 Lead06





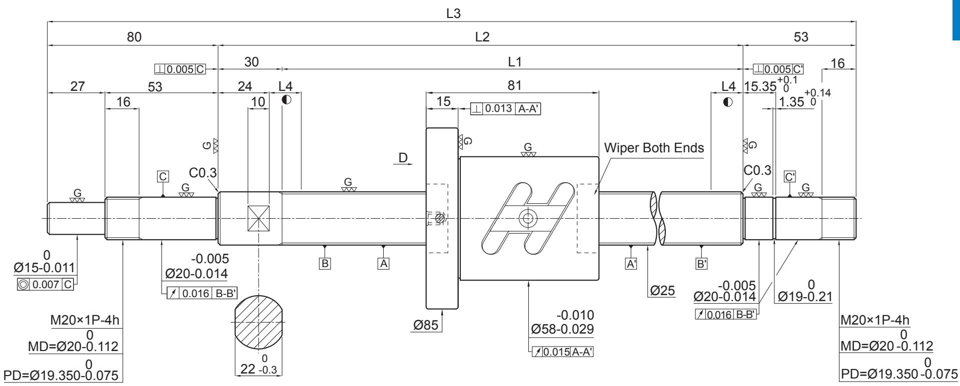
D View

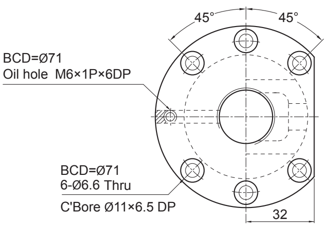
Specification of ball screw	
Production Specification	With Preload
Number of Thread / Thread Direction	1/Right
BCD	25.7
Lead	6
Ball Dia.	3.969
Effective Turns (Circuit × Row)	2.5 × 2
Lead Angle	4.25
Dynamic Rate Load Ca (kgf)	2190
Static Rate Load Co (kgf)	5360
Axial Play	0
Preloading Torque (kgf-cm)	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

Standard ballscrews
Screw Dia.Ø25 Lead10 **FSWC**





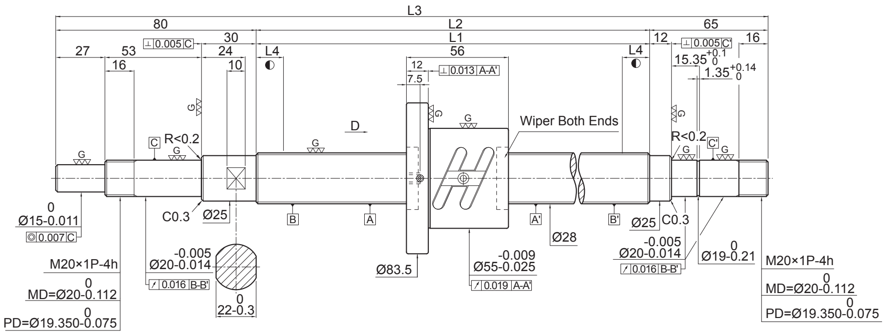
D View

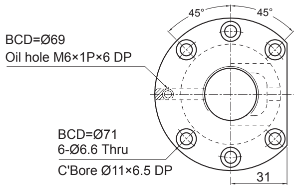
Specification of ball screw	
Production Specification	With Preload
Number of Thread / Thread Direction	1/Right
BCD	26
Lead	10
Ball Dia.	4.762
Effective Turns (Circuit × Row)	1.5 × 2
Lead Angle	6.98
Dynamic Rate Load Ca (kgf)	1820
Static Rate Load Co (kgf)	3840
Axial Play	0
Preloading Torque (kgf-cm)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



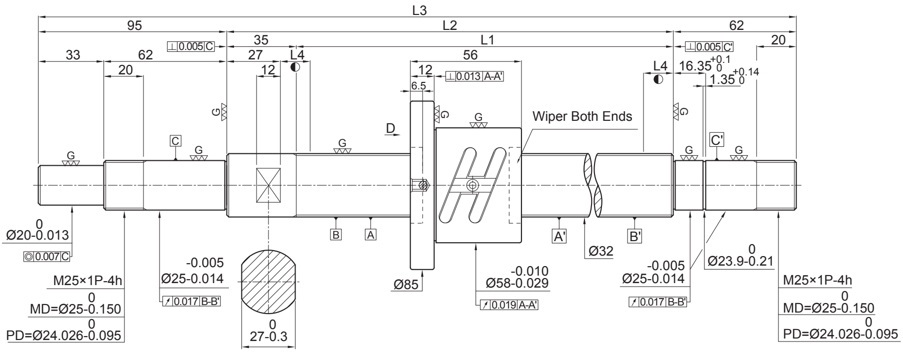


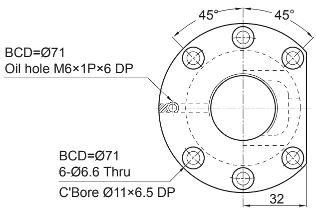
D View

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





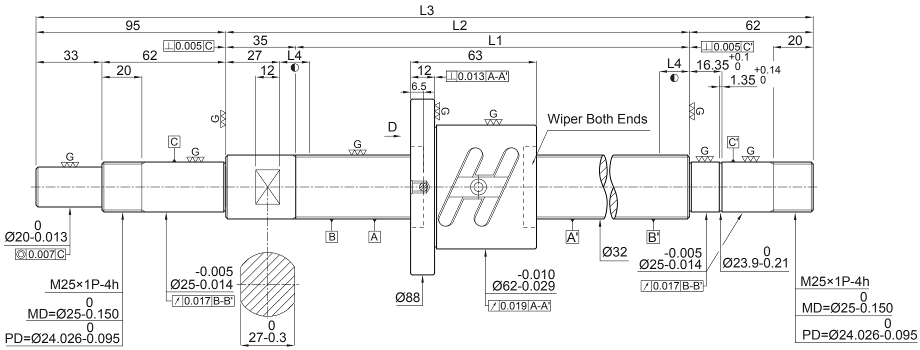
D View

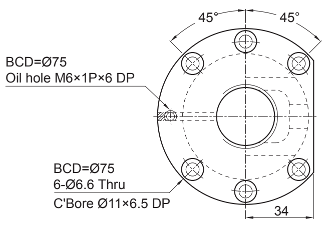
Specification of ball screw	
Production Specification	With Preload
Number of Thread / Thread Direction	1/Right
BCD	32.6
Lead	5
Ball Dia.	3.175
Effective Turns (Circuit × Row)	2.5 × 2
Lead Angle	2.79
Dynamic Rate Load Ca (kgf)	1830
Static Rate Load Co (kgf)	5680
Axial Play	0
Preloading Torque (kgf-cm)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



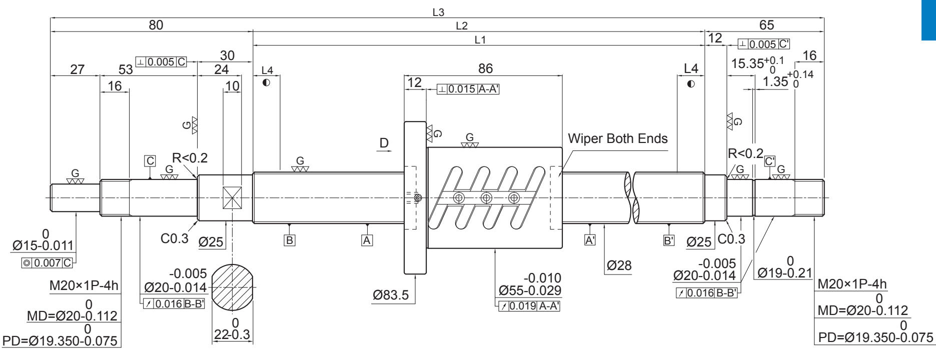


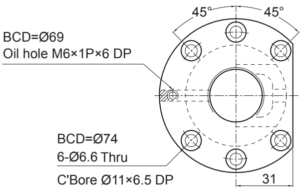
D View

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





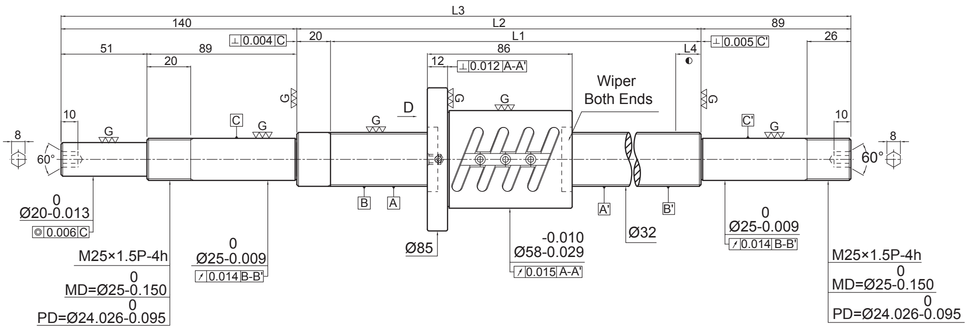
D View

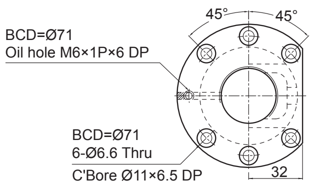
Specification of ball screw	
Production Specification	With Preload
Number of Thread / Thread Direction	1/Right
BCD	28.6
Lead	5
Ball Dia.	3.175
Effective Turns (Circuit × Row)	2.5 × 2(2)
Lead Angle	3.19
Dynamic Rate Load Ca (kgf)	1720
Static Rate Load Co (kgf)	4940
Axial Play	0
Preloading Torque (kgf-cm)	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.Ø32 Lead05



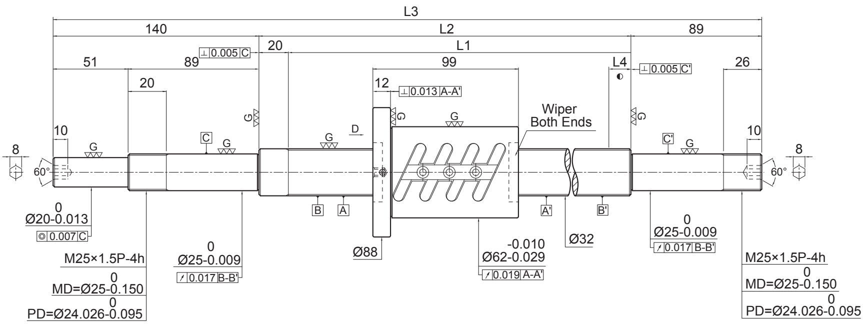


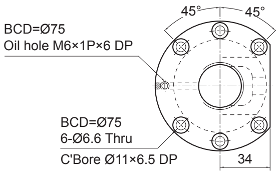
D View

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 × Row)	2.5 × 2(2)
Lead Angle	2.79
Dynamic Rate Load Ca (kgf)	1830
Static Rate Load Co (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 Deriation 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





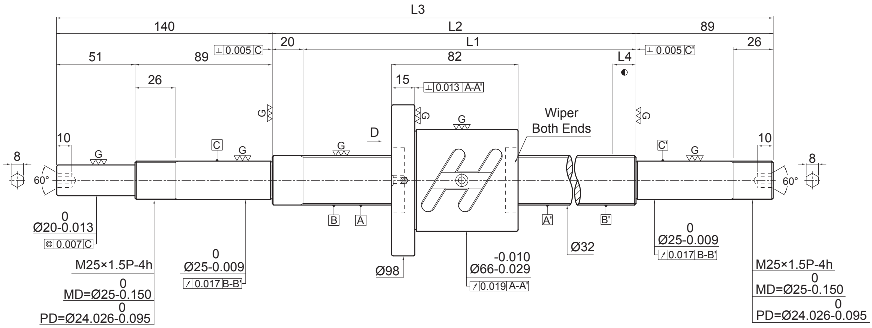
D View

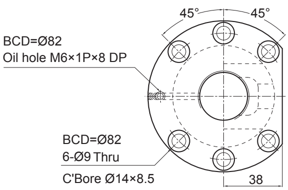
Specification of ball screw	
Production Specification	With Preload
Number of Thread / Thread Direction	1/Right
BCD	32.7
Lead	6
Ball Dia.	3.969
Effective Turns (Circuit × Row)	2.5 × 2(2)
Lead Angle	3.34
Dynamic Rate Load Ca (kgf)	2410
Static Rate Load Co (kgf)	6900
Axial Play	0
Preloading Torque (kgf-cm)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





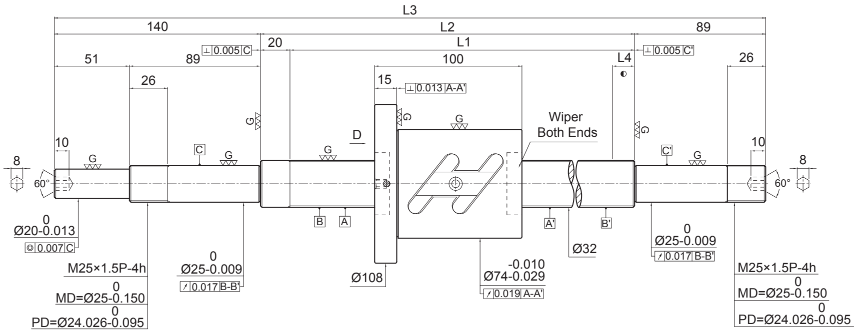
D View

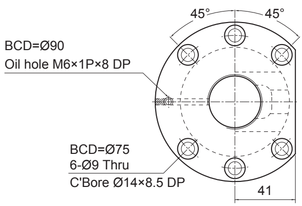
Specification of ball screw	
Production Specification	With Preload
Number of Thread / Thread Direction	1/Right
BCD	33
Lead	8
Ball Dia.	4.762
Effective Turns (Circuit × Row)	2.5 × 1(2)
Lead Angle	4.41
Dynamic Rate Load Ca (kgf)	1720
Static Rate Load Co (kgf)	4180
Axial Play	0
Preloading Torque (kgf-cm)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

Standard ballscrews
Screw Dia.Ø32 Lead10 **FOWC**





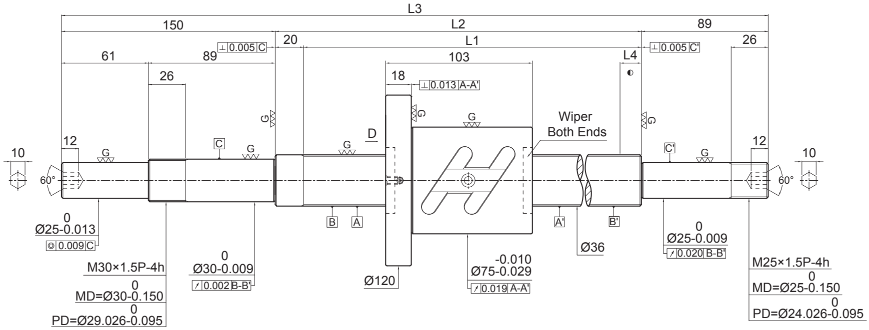
D View

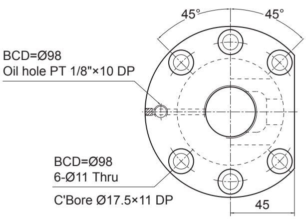
Specification of ball screw	
Production Specification	With Preload
Number of Thread / Thread Direction	1/Right
BCD	33.4
Lead	10
Ball Dia.	6.35
Effective Turns (Circuit × Row)	2.5 × 1(2)
Lead Angle	5.44
Dynamic Rate Load Ca (kgf)	2570
Static Rate Load Co (kgf)	5440
Axial Play	0
Preloading Torque (kgf-cm)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



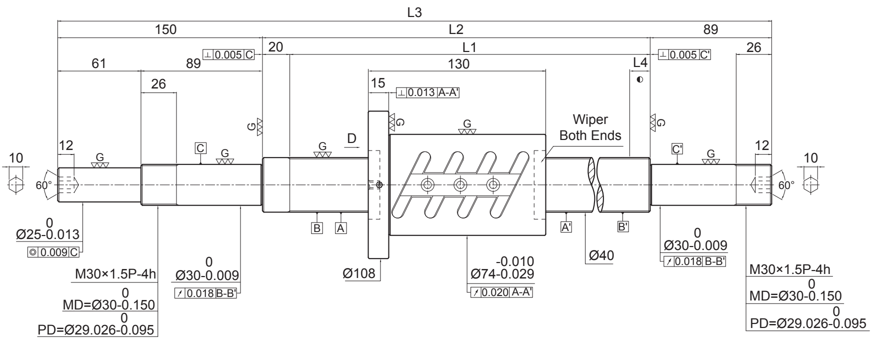


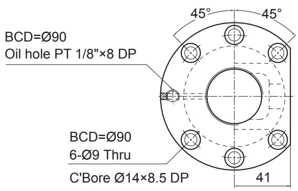
D View

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





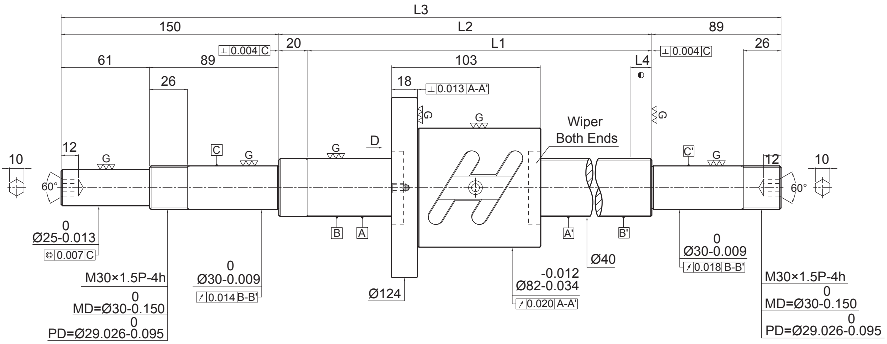
D View

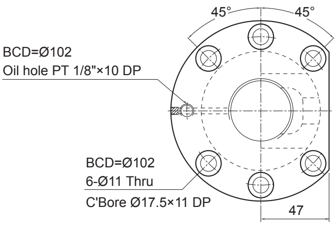
Specification of ball screw	
Production Specification	With Preload
Number of Thread / Thread Direction	1/Right
BCD	41
Lead	8
Ball Dia.	4.762
Effective Turns (Circuit × Row)	2.5 × 2(2)
Lead Angle	3.55
Dynamic Rate Load Ca (kgf)	3450
Static Rate Load Co (kgf)	10540
Axial Play	0
Preloading Torque (kgf-cm)	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.Ø40 Lead10





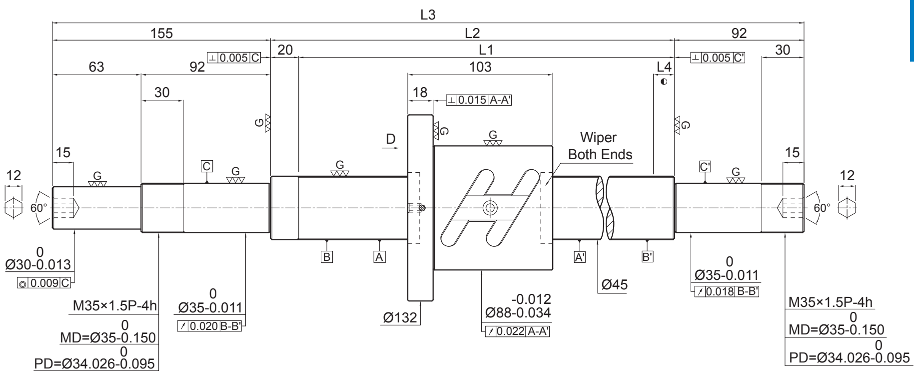
D View

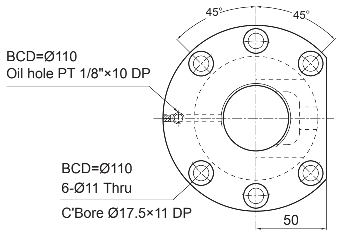
Specification of ball screw	
Production Specification	With Preload
Number of Thread / Thread Direction	1/Right
BCD	41.4
Lead	10
Ball Dia.	6.35
Effective Turns (Circuit × Row)	2.5 × 1(2)
Lead Angle	4.4
Dynamic Rate Load Ca (kgf)	2880
Static Rate Load Co (kgf)	6950
Axial Play	0
Preloading Torque (kgf-cm)	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 Deriation 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

Standard ballscrews
Screw Dia.Ø45 Lead10 **FOWC**





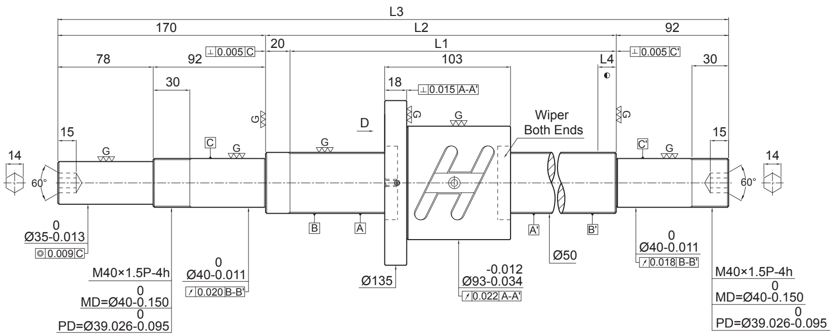
D View

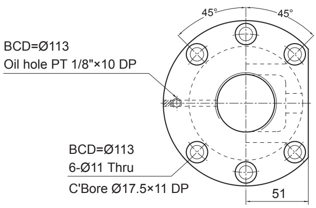
Specification of ball screw	
Production Specification	With Preload
Number of Thread / Thread Direction	1/Right
BCD	46.4
Lead	10
Ball Dia.	6.35
Effective Turns (Circuit × Row)	2.5 × 1(2)
Lead Angle	4.4
Dynamic Rate Load Ca (kgf)	3020
Static Rate Load Co (kgf)	7850
Axial Play	0
Preloading Torque (kgf-cm)	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 Deriation 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.Ø50 Lead10





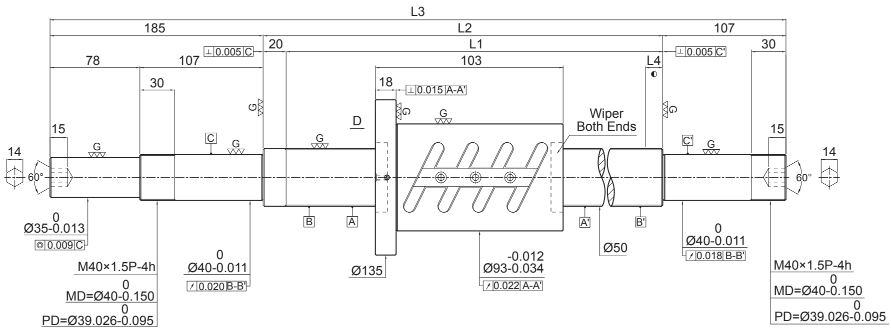
D View

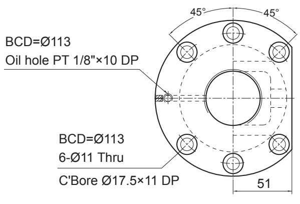
Specification of ball screw	
Production Specification	With Preload
Number of Thread / Thread Direction	1/Right
BCD	51.4
Lead	10
Ball Dia.	6.35
Effective Turns (Circuit × Row)	2.5 × 1(2)
Lead Angle	3.54
Dynamic Rate Load Ca (kgf)	3190
Static Rate Load Co (kgf)	8710
Axial Play	0
Preloading Torque (kgf-cm)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

Standard ballscrews
Screw Dia.Ø50 Lead10 **FOWC**





D View

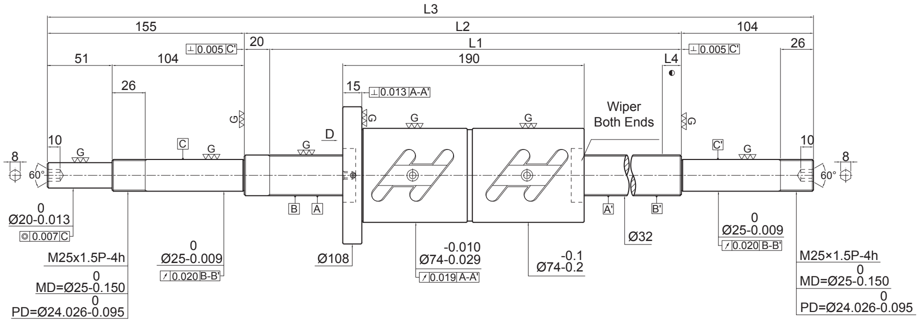
Specification of ball screw	
Production Specification	With Preload
Number of Thread / Thread Direction	1/Right
BCD	51.4
Lead	10
Ball Dia.	6.35
Effective Turns (Circuit × Row)	2.5 × 2(2)
Lead Angle	3.54
Dynamic Rate Load Ca (kgf)	5790
Static Rate Load Co (kgf)	17420
Axial Play	0
Preloading Torque (kgf-cm)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

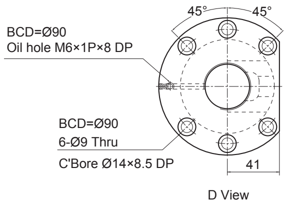
Unit: mm

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.Ø32 Lead10



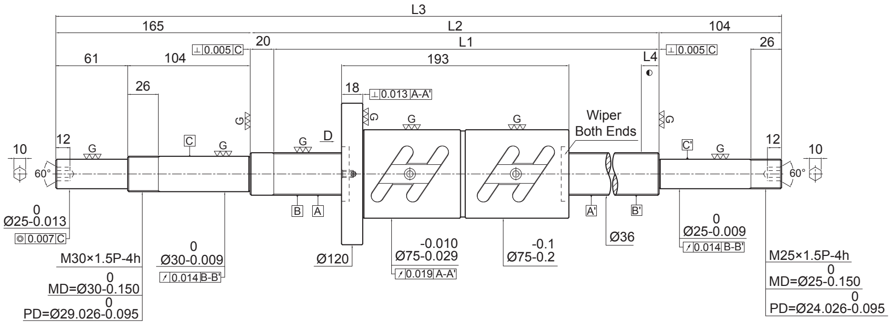


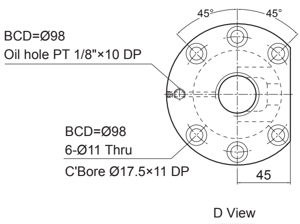
D View

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 Deriation 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





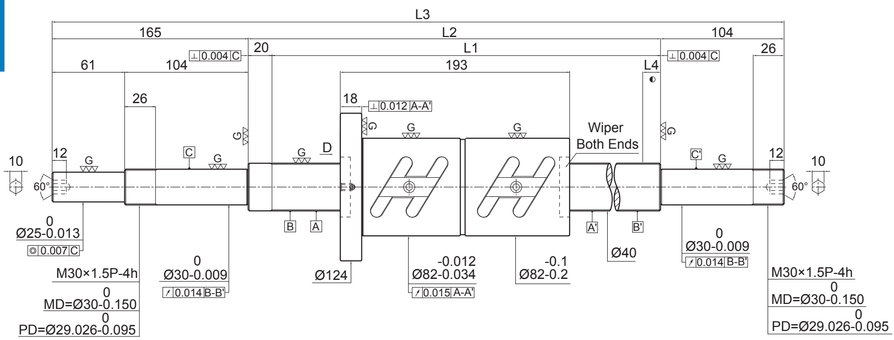
D View

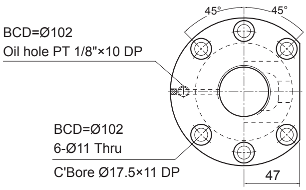
Specification of ball screw	
Production Specification	With Preload
Number of Thread / Thread Direction	1/Right
BCD	37.4
Lead	10
Ball Dia.	6.35
Effective Turns (Circuit × Row)	2.5 × 2
Lead Angle	4.86
Dynamic Rate Load Ca (kgf)	4930
Static Rate Load Co (kgf)	12360
Axial Play	0
Preloading Torque (kgf-cm)	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 Deriation 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.Ø40 Lead10



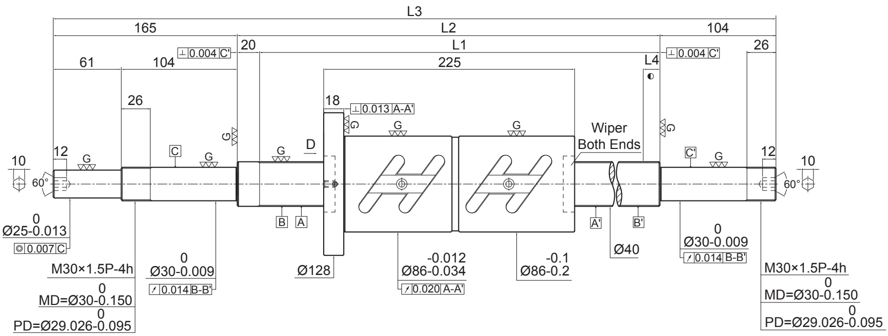


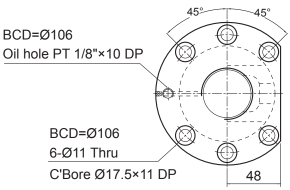
D View

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 × Row)	2.5 × 2
Lead Angle	4.4
Dynamic Rate Load Ca (kgf)	5220
Static Rate Load Co (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





D View

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 300*mm*. 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
PMI	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} Grade / Measured length	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 Ø	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 Ø(*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. Ød (*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.

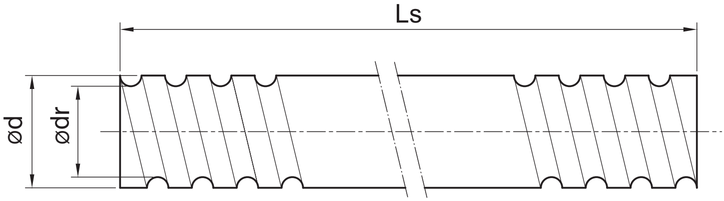
14.6 Materials and Hardness

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)25I5B
	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)32I5B
	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
40	5	3.175		R	1		R4005B
	10	6.350		R	1		R4010F
	20	6.350		R	2		2R4020F
	40	6.350		R	4		4R4040F
50	10	6.350		R	1		R5010F

Order Code:

4 R 15 10 A -1500 -C7

- -C7: Lead Accuracy Grade
- -1500: Custom Length of Screw (*mm*)
- A: Ball Diameter(*mm*)(A: 2.381 B: 3.175 C: 3.969 D: 4.762 F: 6.35 Z: 2.0 V: 3.0)
- 10: Lead (*mm*)
- 15: Screw Nominal O.D. (*mm*)
- R: Thread Direction (R: Right L: Left)
- 4: Number of Threads (N/A for single thread screws)

14.8 Nut Types of Rolled Ballscrew

Standard Models:

FSIN

FSIW

FSDN

FSKW

FSDW

Optional Models：

FSWW

FSVW

RSVW

SSVW

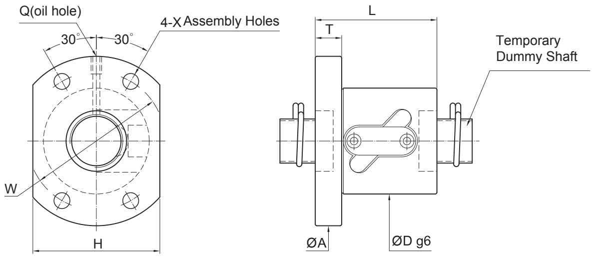
FSBW

Order Code:

R F S D N 25 05 A 4T

- 4T — Effective Turns
- A — Ball Diameter(*mm*)(A:2.381 B:3.175 C:3.969 D:4.762 F:6.35 V:3.0)
- 05 — Lead(*mm*)
- 25 — Screw nominal O.D.(*mm*)
- N — N:European Standard Model W:Rolled Threads
- D — Ball Circulation Type
  - D ：End Deflctor Series
  - I ：Internal Ball Circulation Nuts
  - W ：Immersion type
  - V ：Extrusive type
  - K ：End Cap Series
- S — Single Nut
- F — Type of Nuts(F:with flange R:without flange S:square nut)
- R — Thread Direction(R: Right L:Left)

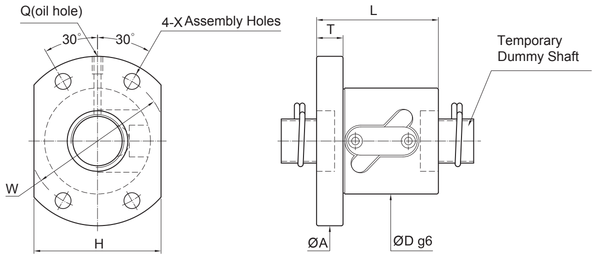
FSWW



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 A	Flange T	Flange W	Flange H	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	44	57	11	45	34	5.5	M6x1P	15	FSWW1604A-3.0P
			2.5x1	460	1050		41							13	FSWW1604A-2.5P
			3.5x1	610	1470		42							17	FSWW1604A-3.5P
	5	3.175	1.5x2	640	1370	40	45	63	11	51	42	5.5	M6x1P	15	FSWW1605B-3.0P
			2.5x1	550	1140		41							13	FSWW1605B-2.5P
			2.5x2	1000	2280		56							23	FSWW1605B-5.0P
			3.5x1	730	1600		46							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	45	67	11	55	52	5.5	M6x1P	19	FSWW2004A-3.0P
			2.5x1	630	1560		42							16	FSWW2004A-2.5P
			2.5x2	1140	3120		56							30	FSWW2004A-5.0P
			3.5x1	840	2180		46							22	FSWW2004A-3.5P
	5	3.175	1.5x2	730	1740	44	45	67	11	55	52	5.5	M6x1P	18	FSWW2005B-3.0P
			2.5x1	625	1450		42							15	FSWW2005B-2.5P
			2.5x2	1130	2900		56							28	FSWW2005B-5.0P
			3.5x1	830	2030		46							20	FSWW2005B-3.5P
	10	4.762	2.5x1	1100	2200	52	61	82	12	67	64	6.6	M6x1P	16	FSWW2010D-2.5P

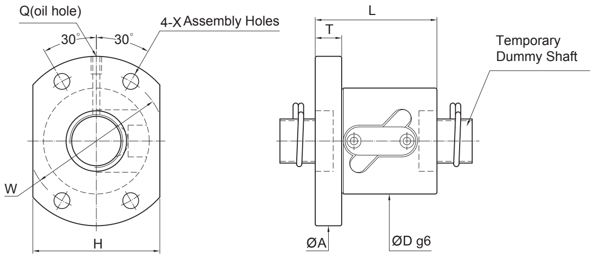
FSWW



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 A	Flange T	Flange W	Flange H	Assembly Hole X	Oil Hole Q	STIFFNESS *kgf/μm*	Nut Model NO.
25	4	2.381	1.5x2	980	2640	46	44	69	11	57	52	5.5	M6x1P	24	FSWW2504A-3.0P
			2.5x1	840	2200		40							20	FSWW2504A-2.5P
			2.5x2	1520	4400		49							38	FSWW2504A-5.0P
			3.5x1	1120	3080		42							27	FSWW2504A-3.5P
	5	3.175	1.5x2	840	2200	50	45	73	11	61	56	6.6	M6x1P	21	FSWW2505B-3.0P
			2.5x1	720	1830		41							18	FSWW2505B-2.5P
			2.5x2	1120	3710		56							37	FSWW2505B-5.0P
			3.5x1	960	2560		46							24	FSWW2505B-3.5P
	10	4.762	1.5x2	1490	3340	58	71	85	15	71	64	6.6	M6x1P	23	FSWW2510D-3.0P
			2.5x1	1270	2780		65							20	FSWW2510D-2.5P
			3.5x1	1700	3890		75							27	FSWW2510D-3.5P
	10	6.35	2.5x1	1720	3590	60	69	96	15	78	72	9	M6x1P	21	FSWW2510F-2.5P
			2.5x2	3200	7170		97							40	FSWW2510F-5.0P
28	5	3.175	1.5x2	910	2470	55	46	83	12	69	62	6.6	M8x1P	21	FSWW2805B-3.0P
			2.5x1	780	2060		42							18	FSWW2805B-2.5P
			2.5x2	1410	4120		56							33	FSWW2805B-5.0P
			3.5x1	1040	2880		47							24	FSWW2805B-3.5P
32	5	3.175	1.5x2	990	2830	58	47	85	12	71	64	6.6	M8x1P	26	FSWW3205B-3.0P
			2.5x1	850	2360		43							22	FSWW3205B-2.5P
			2.5x2	1540	4720		57							41	FSWW3205B-5.0P
			2.5x3	2180	7080		72							59	FSWW3205B-7.5P
			3.5x1	1130	3300		47							29	FSWW3205B-3.5P
	10	6.35	1.5x2	2260	5620	67	78	103	15	85	78	9	M6x1P	29	FSWW3210F-3.0P
			2.5x1	1930	4680		69							25	FSWW3210F-2.5P
			2.5x2	3130	9410		97							49	FSWW3210F-5.0P
			3.5x1	2580	6550		78							33	FSWW3210F-3.5P

FSWW



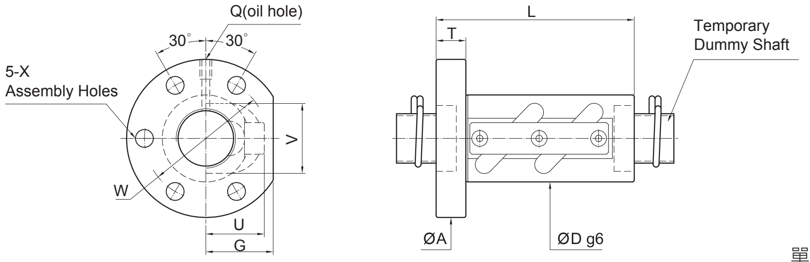
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD(kgf)		BALLNUT DIMENSION									
O.D.	LEAD			Dynamic (1×10^6 REV.) Ca	Static Co	O.D. D	Length L	Flange A	Flange T	Flange W	Flange H	Assembly Hole X	Oil Hole Q	STIFFNESS kgf/μm	Nut Model NO.
36	10	6.35	1.5x2	2170	6480	70	81	110	17	90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

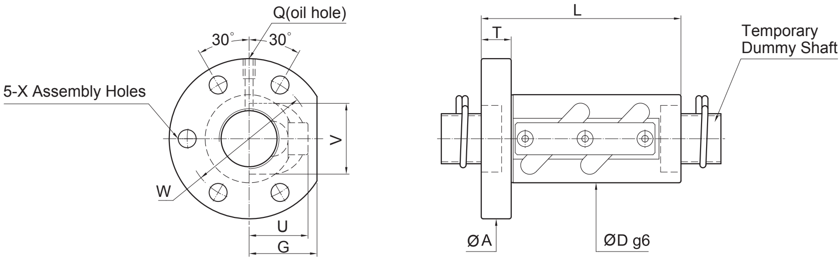
FSVW



單位:mm

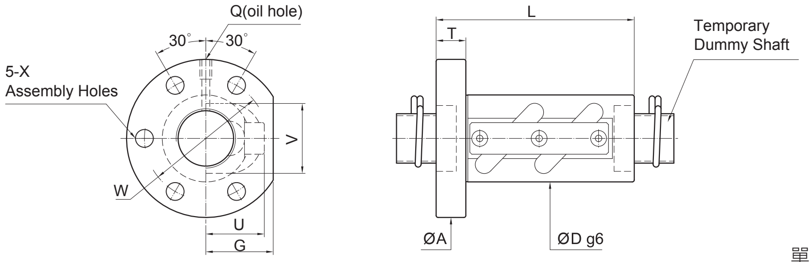
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD(kgf)		BALLNUT DIMENSION											
O.D.	LEAD			Dynamic (1×10⁶ REV.) Ca	Static Co	O.D. D	Length L	Flange A	Flange T	Flange W	Flange H	Return tube U	Return tube V	Assembly Hole X	Oil Hole Q	STIFFNESS kgf/μm	Nut Model NO.
14	4	2.381	3.5x1	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		43									13	FSVW1605B-2.5P
			2.5x2	1000	2280		60									23	FSVW1605B-5.0P
			3.5x1	730	1600		50									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		43									15	FSVW2005B-2.5P
			2.5x2	1130	2900		60									28	FSVW2005B-5.0P
			3.5x1	830	2030		50									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	45	71	12	57	28	26	32	6.6	M6x1P	18	FSVW2505B-2.5P
			2.5x2	1120	3710		60									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		65									20	FSVW2510D-2.5P
			3.5x1	1690	3900		75									27	FSVW2510D-3.5P
	10	6.35	2.5x1	1720	3590	44	68	79	15	62	34	29	37	9	M6x1P	21	FSVW2510F-2.5P
			2.5x2	3200	7170		98									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		45									18	FSVW2805B-2.5P
			2.5x2	1410	4120		60									33	FSVW2805B-5.0P
			3.5x1	1040	2880		50									24	FSVW2805B-3.5P

FSVW



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

FSVW



單位:mm

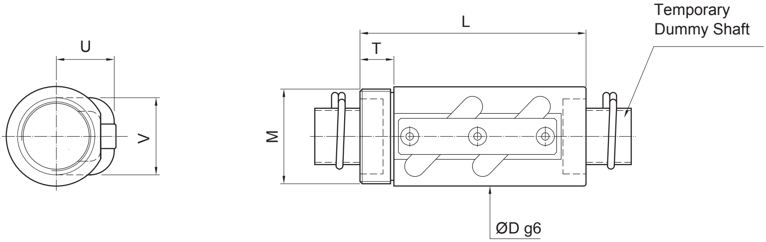
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD(kgf)		BALLNUT DIMENSION											
O.D.	LEAD			Dynamic (1×10^6 REV.) Ca	Static Co	O.D. D	Length L	Flange A	Flange T	Flange W	Flange H	Return tube U	Return tube V	Assembly Hole X	Oil Hole Q	STIFFNESS kgf/μm	Nut Model NO.
			1.5x2	2510	9000		84									31	FSVW5010F-3.0P
			2.5x1	2150	7500		74									39	FSVW5010F-2.5P
50	10	6.35	2.5x2	3890	15000	78	104	119	18	98	52	48	62	11	PT1/8"	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

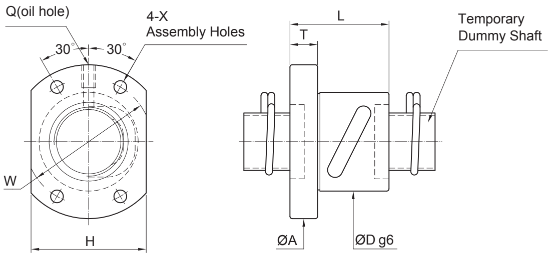
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD *(kgf)*		BALLNUT DIMENSION							
O.D.	LEAD			Dynamic (1×10^6 REV.) Ca	Static Co	O.D. D	Length L	Flange M	T	Return tube U	V	STIFFNESS *kgf/μm*	Nut Model NO.
14	4	2.381	3.5×1	500	1100	25	42	M24×1.0P	10	19	21	15	RSVW1404A-3.5P
	5	3.175	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	42	48	M40×1.5P	15	28	32	18	RSVW2505B-2.5P
			2.5×2	1120	3710		63					37	RSVW2505B-5.0P
	10	6.350	2.5×1	1720	3590	44	68	M42×1.5P	15	34	37	21	RSVW2510F-2.5P
			2.5×2	3200	7170		98					40	RSVW2510F-5.0P
32	10	6.350	2.5×1	1930	4680	55	72	M50×1.5P	18	39	44	25	RSVW3210F-2.5P
			2.5×2	3130	9410		101					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.

FSBW



Unit: mm

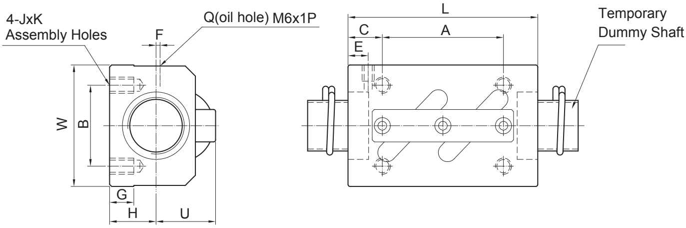
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD*(kgf)*		BALLNUT DIMENSION									
O.D.	LEAD			Dynamic (1×10^6 REV.) Ca	Static Co	O.D. D	Length L	Flange A	Flange T	Flange W	Flange H	Assembly Hole X	Oil Hole Q	STIFFNESS *kgf/μm*	Nut Model NO.
12	5	2.000	2.5×1	270	350	26	40	47	10	37	30	4.5	M6×1P	8.2	FSBW1205Z-2.5P
14	4	2.381	3.5×1	500	1100	31	40	50	10	40	37	4.5	M6×1P	15	FSBW1404A-3.5P
	5	3.175	2.5×1	515	990	32	40	50	10	40	38	4.5	M6×1P	11	FSBW1405B-2.5P
16	5	3.175	2.5×1	570	1130	34	40	54	10	44	40	4.5	M6×1P	13	FSBW1605B-2.5P
20	4	2.381	2.5×1	415	850	40	41	59	10	50	46	4.5	M6×1P	14	FSBW2004A-2.5P
	5	3.175	2.5×1	620	1450	40	40	59	10	50	46	4.5	M6×1P	16	FSBW2005B-2.5P
25	4	2.381	2.5×1	450	980	43	41	67	10	55	50	4.5	M6×1P	17	FSBW2504A-2.5P
	5	3.175	2.5×1	720	1830	43	40	67	10	55	50	5.5	M6×1P	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

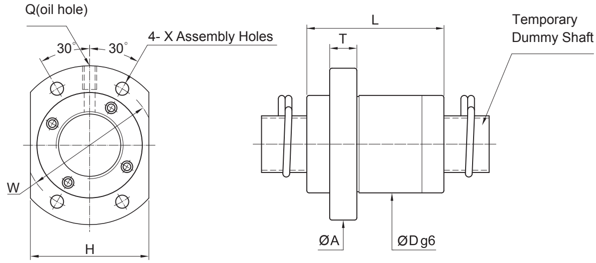
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD(kgf)		BALLNUT DIMENSION												
O.D.	LEAD			Dynamic (1×10^6 REV.) Ca	Static Co	Length L	Width W	Height H	Assembly Hole A	B	C	J×K	Position of Oil Hole E	F	Height from Reference Surface G	U	STIFFNESS kgf/μm	Nut Model NO.
14	4	2.381	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
20	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
	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
25	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
	10	6.350	2.5×2	3240	7170	94	60	23	60	40	17	M8×12	10	-	10	30	40	SSVW2510F-5.0P
28	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						49	SSVW3210F-5.0P

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.

FSKW



Unit: mm

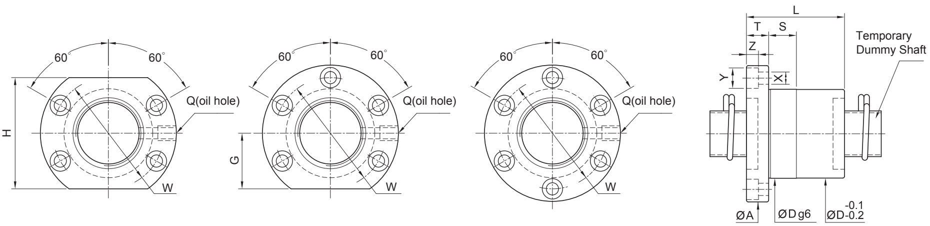
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD(*kgf*)		BALLNUT DIMENSION									
O.D.	LEAD			Dynamic (1×10^6 REV.) Ca	Static Co	O.D. D	Length L	Flange A	T	W	H	Assembly Hole X	Oil Hole Q	STIFFNESS *kgf/μm*	Nut Model NO.
15	10	3.175	2.8×2	1000	2570	34	44	57	10	45	40	5.5	M6×1P	26	FSKW1510B-5.6P
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	FSKW2525C-7.2P
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	FSKW3232D-7.2P
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	FSKW4040F-7.2P

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.

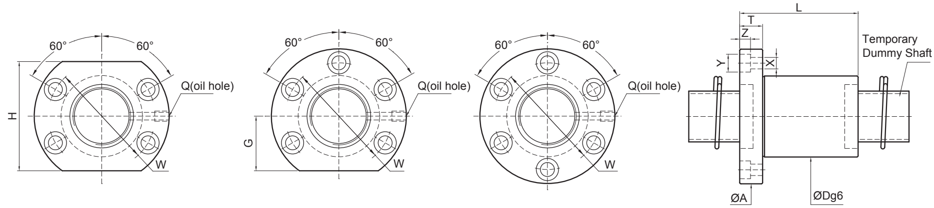
FSIW



Unit: mm

SCREW SIZE O.D.	SCREW SIZE LEAD	BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD(*kgf*) Dynamic (1×10⁶ REV.) Ca	BASIC RATE LOAD(*kgf*) Static Co	O.D. D	Length L	Flange A	Flange T	Flange W	Flange G	Flange H	Assembly Hole X	Assembly Hole Y	Assembly Hole Z	Oil Hole Q	STIFFNESS *kgf/μm*	Nut Model NO.
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										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
	5	3.175	3	570	1030	30	42	49	10	39	20	40	4.5	8	4.5	M6x1P	17	FSIW1605B-3.0P
		3.175	4	730	1370		49										19	FSIW1605B-4.0P
20	4	2.381	4	450	1270	34	44	60	12	48	22	44	5.5	9.5	5.5	M6x1P	19	FSIW2004A-4.0P
	5	3.175	3	650	1420	34	47	57	12	45	20	40	5.5	9.5	5.5	M6x1P	17	FSIW2005B-3.0P
			4	830	1890		53										21	FSIW2005B-4.0P
			6	1180	2840		62										32	FSIW2005B-6.0P
25	4	2.381	3	380	1195	40	40	63	12	51	22	44	5.5	9.5	5.5	M8x1P	17	FSIW2504A-3.0P
	5	3.175	3	730	1820	40	47	63.5	12	51	22	44	5.5	9.5	5.5	M8x1P	20	FSIW2505B-3.0P
			4	940	2420		53										26	FSIW2505B-4.0P
			5	1140	3030		57										32	FSIW2505B-5.0P
	10	4.762	3	1215	2660	42	80	68.5	15	55	26	52	6.6	11	6.5	M8x1P	22	FSIW2510D-3.0P
			4	1550	3540		85										28	FSIW2510D-4.0P
			5	1880	4430		91										34	FSIW2510D-5.0P
28	6	3.175	3	770	2180	43	50	68	12	55	26	52	6.6	11	6.5	M8x1P	22	FSIW2806B-3.0P
32	5	3.175	3	820	2540	48	47	73.5	12	60	30	60	6.6	11	6.5	M8x1P	24	FSIW3205B-3.0P
			4	1050	3390		53										32	FSIW3205B-4.0P
			6	1490	5090		62										46	FSIW3205B-6.0P
	10	6.35	3	1960	4410	50	80	88	16	70	34	68	9	14	8.5	M8x1P	28	FSIW3210F-3.0P
			4	2510	5880	54	90										34	FSIW3210F-4.0P
36	10	6.35	3	2010	5150	58	78	98	18	77	36	72	11	17.5	11	M8x1P	30	FSIW3610F-3.0P
			4	2570	6870		89										39	FSIW3610F-4.0P

FSIW



Unit: mm

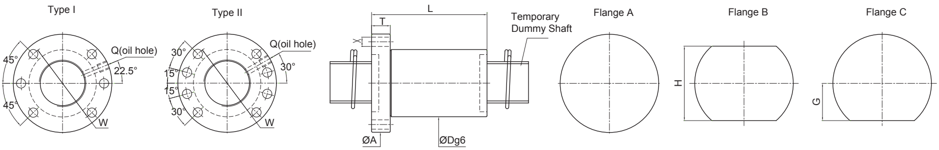
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD*(kgf)*		BALLNUT DIMENSION												
O.D.	LEAD			Dynamic (1×10^6 REV.) Ca	Static Co	O.D. D	Length L	Flange A	T	W	G	H	Assembly Hole X	Y	Z	Oil Hole Q	STIFFNESS *kgf/μm*	Nut Model NO.
40	5	3.175	4	1180	4390	55	56	88.5	16	72	29	58	15	9	14	M8x1P	38	FSIW4005B-4.0P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

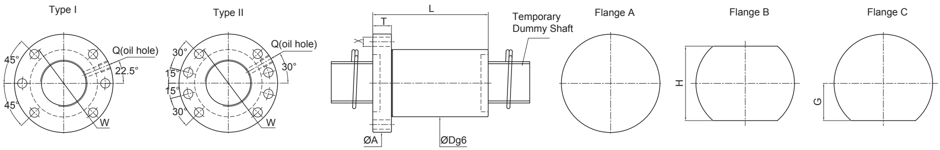
FSDW



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 A	T	W	G	H	TYPE	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
14	4	2.381	3	460	1210	26	28	46	10	36	17	34	I	M6x1P	4.5	14	FSDW1404A-3.0P
			4	590	1610		32	48								18	FSDW1404A-4.0P
	5	3.175	3	550	1260	29	32	51	10	36	16	32	I	M6x1P	5.5	14	FSDW1405B-3.0P
15	10	3.175	3	560	1340	29	47	51	10	39	19	38	I	M6x1P	5.5	15	FSDW1510B-3.0P
16	5	3.175	3	600	1460	29	35	51	10	39	19	38	I	M6x1P	5.5	16	FSDW1605B-3.0P
	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
			4	870	2480		40									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
	20	3.175	2	450	1200	36	56	62	12	49	24	48	I	M6x1P	6.6	13	FSDW2020B-2.0P
25	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	40	36	62	12	51	24	48	I	M6x1P	6.6	21	FSDW2505B-3.0P
			4	960	3190		41									28	FSDW2505B-4.0P
			5	1180	4030		46									35	FSDW2505B-5.0P
	10	4.762	4	1920	5700	45	63	65	15	54	25.5	51	I	M6x1P	6.6	32	FSDW2510D-4.0P
		6.35	3	2130	5570	51	58	87	16	72	34.5	69	I	M8x1P	9	27	FSDW2510F-3.0P
			5	3380	9550		78									42	FSDW2510F-5.0P
	25	3.969	2	780	2260	43	71	64	12	51	24	48	I	M6x1P	6.6	16	FSDW2525C-2.0P
28	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	3820	12030		78									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

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 A	T	W	G	H	TYPE	Oil Hole Q	Assembly Hole X	STIFFNESS *kgf/μm*	Nut Model NO.
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	5	3.175	4	1180	5200	60	42	91	18	76	34	68	II	M8x1P	9	40	FSDW4005B-4.0P
	10	6.35	5	4290	15290	65	78	95	18	80	36	72	II	M8x1P	9	59	FSDW4010F-5.0P
	20	6.35	4	3480	11990	65	110	98	18	83	37	74	I	M8x1P	11	48	FSDW4020F-4.0P
	40		2	1810	5770											25	FSDW4040F-2.0P
50	10	6.35	5	4780	19360	75	78	118	18	100	46	92	II	M8x1P	11	70	FSDW5010F-5.0P

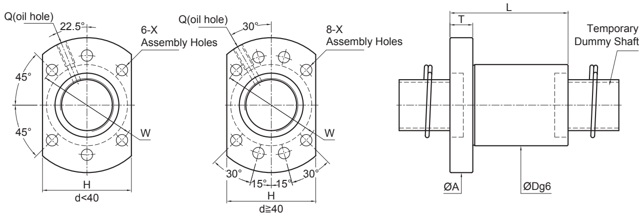
Note:

1.Cam and Coam represent the enhanced dynamic- and static load. Their calcultions 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 O.D.	SCREW SIZE LEAD	BALL DIA.	EFFECTIVE TURNS	MODIFIED LOAD CAPACITY (kgf) Dynamic (1×10^6 REV.) Cam	MODIFIED LOAD CAPACITY (kgf) Static Coam	BALLNUT DIMENSION O.D. D	Length L	Flange A	Flange T	Flange W	Flange G	Flange H	Oil Hole Q	Assembly Hole X	STIFFNESS kgf/μm	Nut Model NO.
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		50								25	FSIN2005B-4.0P
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		50								37	FSIN2505B-4.0P
	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	50	47	80	12	65	31	62	M6×1P	9	37	FSIN3205B-3.0P
			4	1900	6090		50								50	FSIN3205B-4.0P
			6	2690	9150		66								69	FSIN3205B-6.0P
	10	6.35	3	3680	8750	50	74	80	13	65	31	62	M6×1P	9	39	FSIN3210F-3.0P
			4	4720	11670		80								50	FSIN3210F-4.0P
40	5	3.175	4	2090	7670	63	54	93	15	78	35	70	M8×1P	9	52	FSIN4005B-4.0P
			6	2940	11510		66								77	FSIN4005B-6.0P
	10	6.35	3	4140	11130		74								46	FSIN4010F-3.0P
			4	5310	14850		82								60	FSIN4010F-4.0P
50	10	6.35	3	4610	14090	75	78	110	18	93	42.5	85	M8×1P	11	54	FSIN5010F-3.0P
			4	5890	18780		88								70	FSIN5010F-4.0P
			6	8350	28170		106								103	FSIN5010F-6.0P

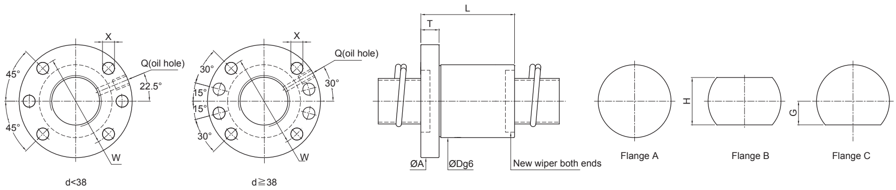
Note:

1.Cam and Coam represent the enhanced dynamic- and static load. Their calcultions 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.

FSDN



Unit: mm

SCREW SIZE O.D.	LEAD	BALL DIA.	EFFECTIVE TURNS	MODIFIED LOAD CAPACITY (kgf) Dynamic (1×10^6 REV.) Cam	Static Coam	O.D. D	Length L	Flange A	T	W	G	H	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	3.969	5	3240	8480	50	73	80	12	65	31	62	M6×1P	9	52	FSDN3210C-5.0P
	20		4	2600	6630	50	101	80	12	65	31	62	M6×1P	9	42	FSDN3220C-4.0P
	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:

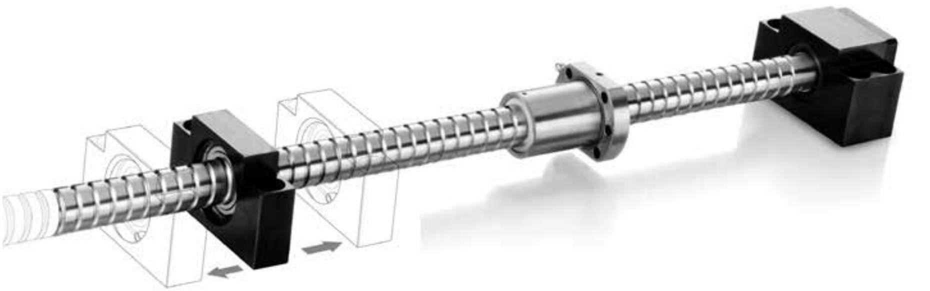
1.Cam and Coam represent the enhanced dynamic- and static load. Their calcultions referred to the standard of DIN 69051.

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 μm.

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.

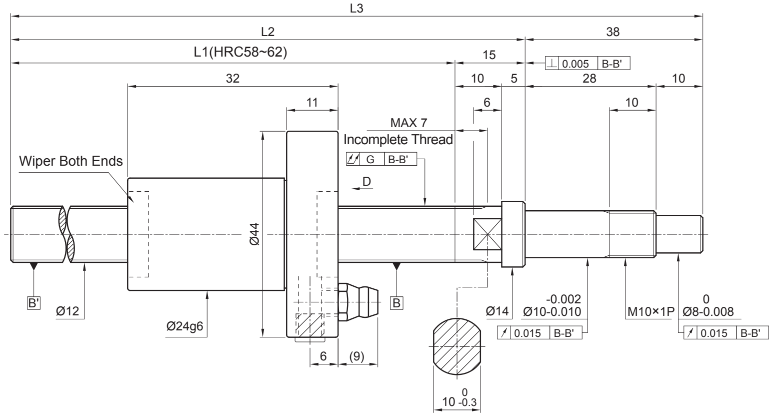
Application range

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

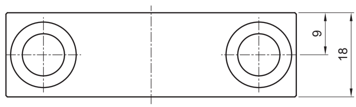
FA

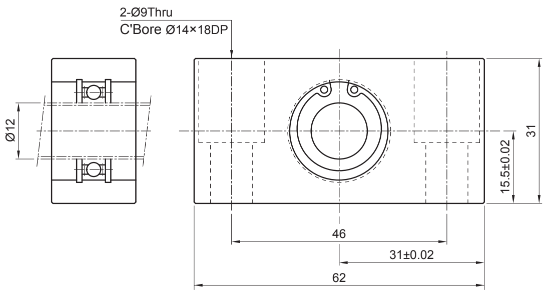
FA Series Ballscrews

Screw Dia.Ø12 Lead05



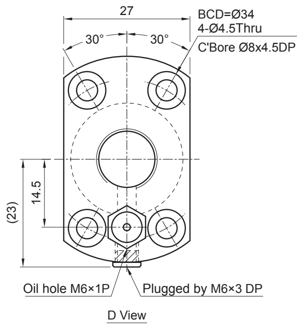
Supported End



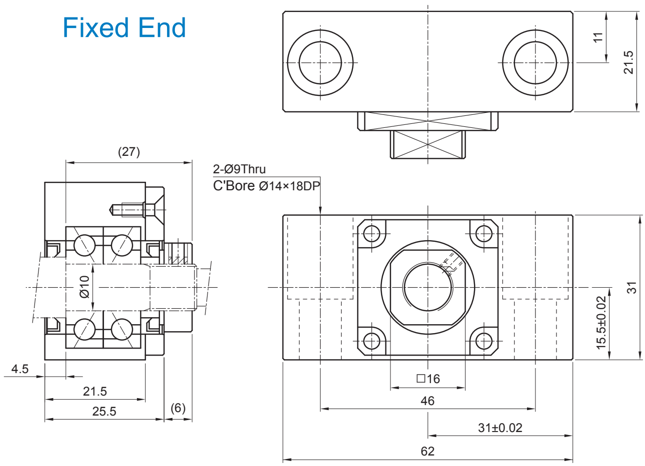


Model No.	Screw Dia.	Lead	Modified Load Capacity(kgf)		Screw Shaft Length			Accuracy Grade
	d	l	Dynamic Cam	Static Coam	L1	L2	L3	
BL012050400+A000	12	05	610	1190	347	362	400	C5
BL012050600+A000	12	05	610	1190	547	562	600	C5
BL012050900+A000	12	05	610	1190	847	862	900	C5

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



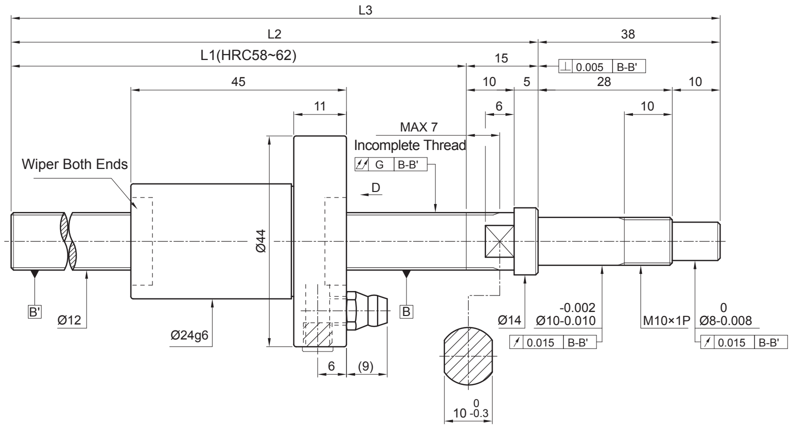
Fixed End



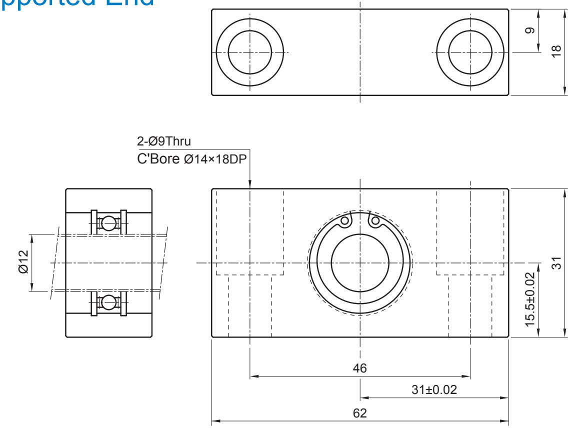
Unit: mm

	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	Static Co
	<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.Ø12 Lead10

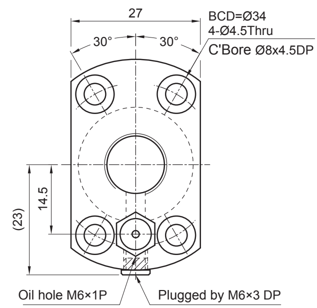


Supported End



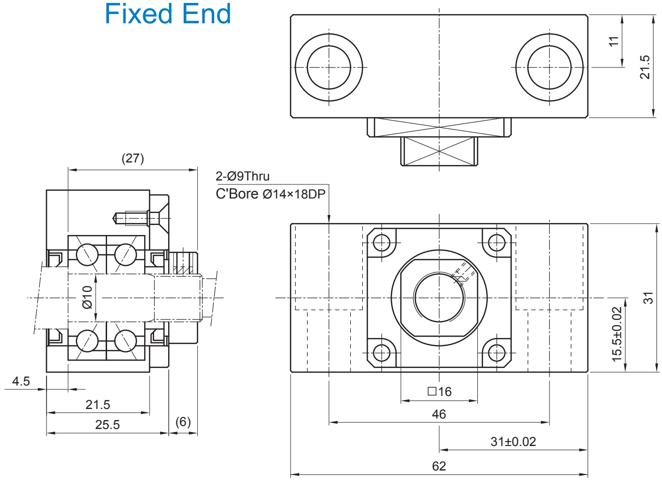
Model No.	Screw Dia.	Lead	Modified Load Capacity(kgf)		Screw Shaft Length			Accuracy Grade
	d	l	Dynamic Cam	Static Coam	L1	L2	L3	
BL012100400+A000	12	10	590	1160	347	362	400	C5
BL012100600+A000	12	10	590	1160	547	562	600	C5
BL012100900+A000	12	10	590	1160	847	862	900	C5

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



D View

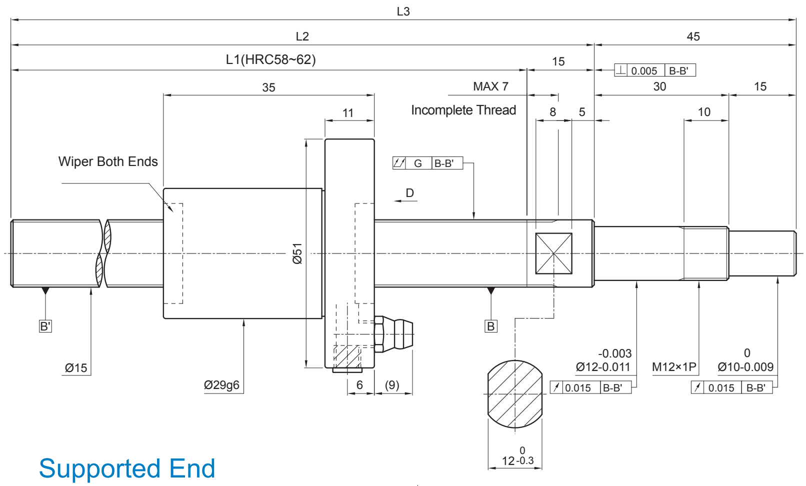
Fixed End



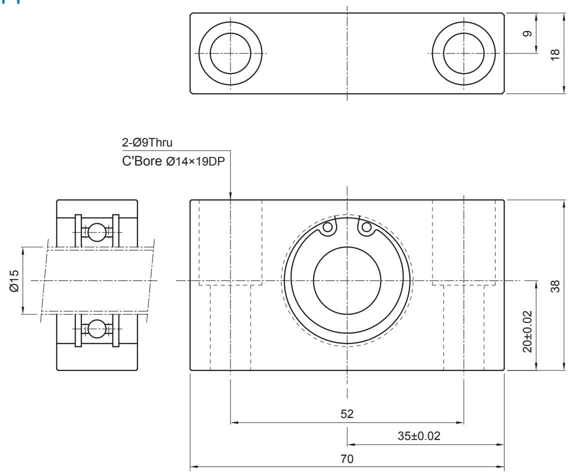
Unit: mm

	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	Static Co
	<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.Ø15 Lead05

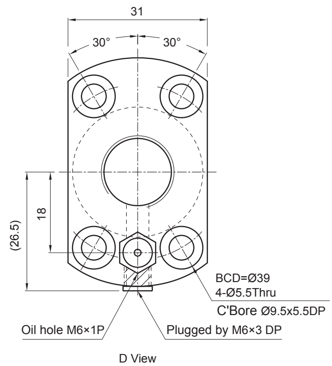


Supported End

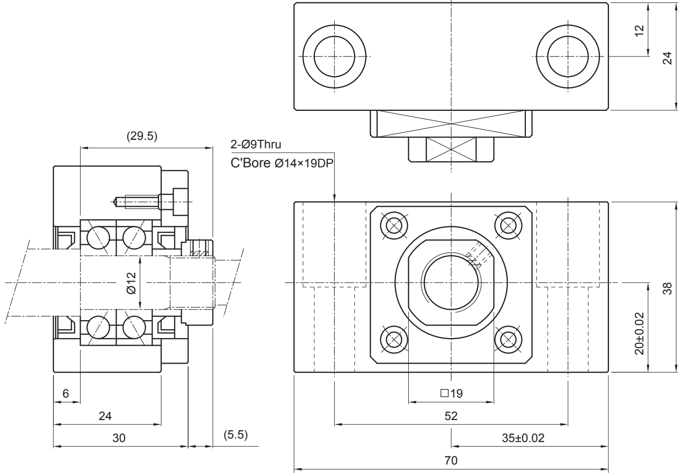


Model No.	Screw Dia.	Lead	Modified Load Capacity(kgf)		Screw Shaft Length			Accuracy Grade
	d	l	Dynamic Cam	Static Coam	L1	L2	L3	
BL015050500+A000	15	05	850	1640	440	455	500	C5
BL015051000+A000	15	05	850	1640	940	955	1000	C5
BL015051450+A000	15	05	850	1640	1390	1405	1450	C5

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



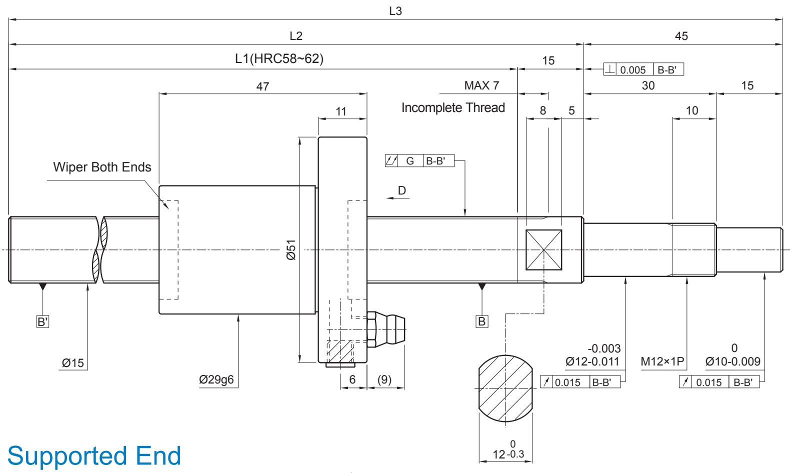
Fixed End



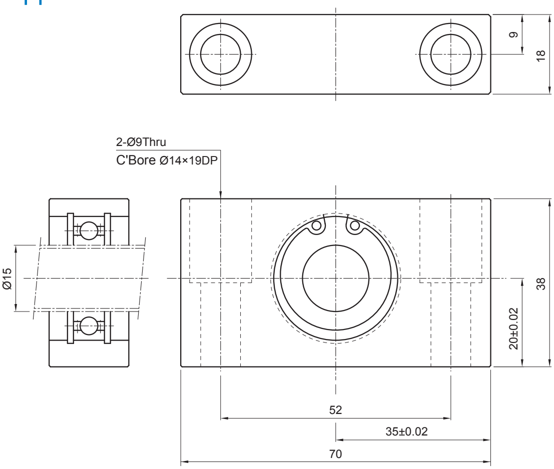
Unit: mm

	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	Static Co
	<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 FA Series Ballscrews
Screw Dia.Ø15 Lead10



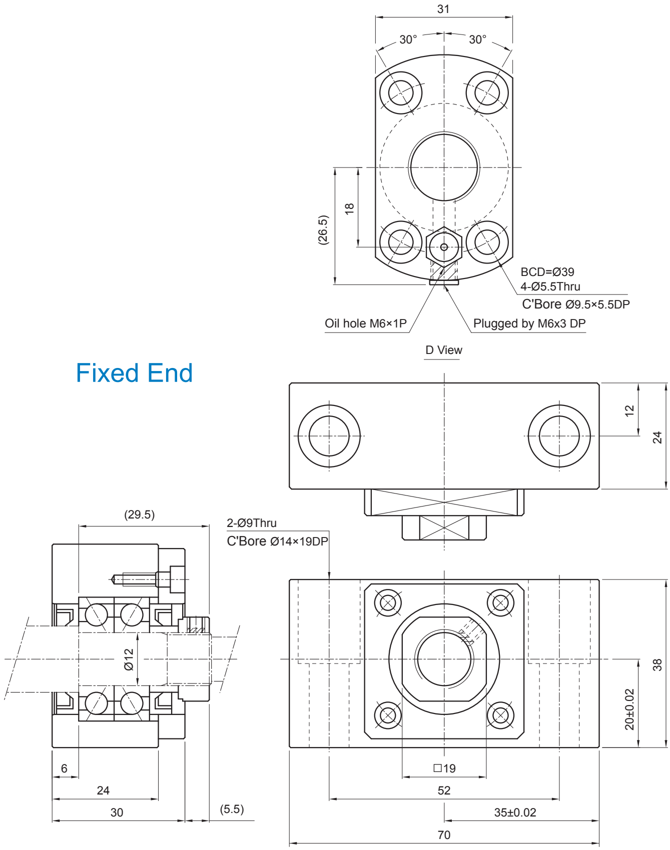
Supported End



Model No.	Screw Dia.	Lead	Modified Load Capacity(kgf)		Screw Shaft Length			Accuracy Grade
	d	l	Dynamic Cam	Static Coam	L1	L2	L3	
BL015100500+A000	15	10	840	1610	440	455	500	C5
BL015101000+A000	15	10	840	1610	940	955	1000	C5
BL015101450+A000	15	10	840	1610	1390	1405	1450	C5

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

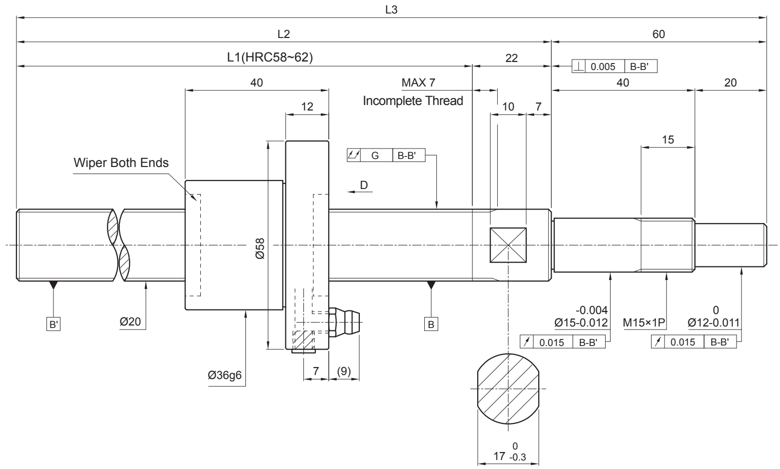
Fixed End



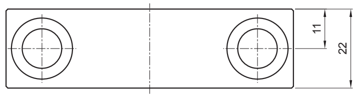
Unit: mm

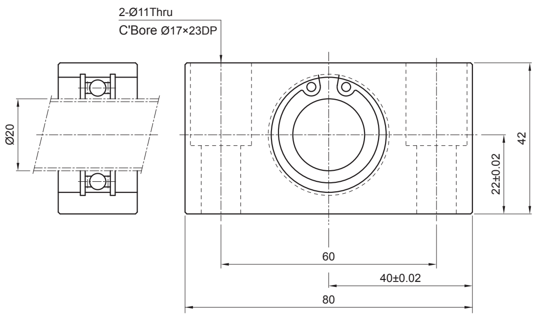
	Axial Play	Lead Accuracy			Tolerances	Fixed End–bearing (kgf)		Supported End–bearing (kgf)	
		Specified Travel (T)	Accumulated reference lead deviation (E)	Lead Deriation in random 300mm (e300)	Overall Radial Runout	Dynamic Ca	Static Co	Dynamic Ca	Static Co
	<0.005	0	0.025	0.018	0.060	592	304	372	204
	<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 FA Series Ballscrews
Screw Dia.Ø20 Lead05



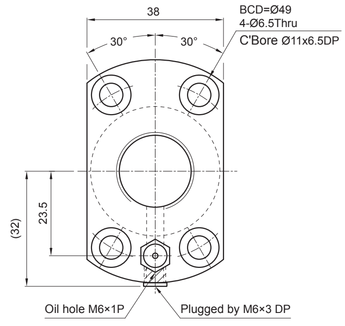
Supported End





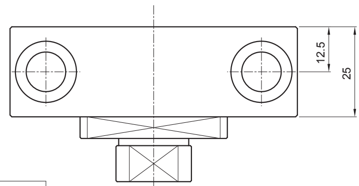
Model No.	Screw Dia.	Lead	Modified Load Capacity(kgf)		Screw Shaft Length			Accuracy Grade
	d	l	Dynamic Cam	Static Coam	L1	L2	L3	
BL020050600+A000	20	05	1300	3030	518	540	600	C5
BL020051000+A000	20	05	1300	3030	918	940	1000	C5
BL020051450+A000	20	05	1300	3030	1368	1390	1450	C5

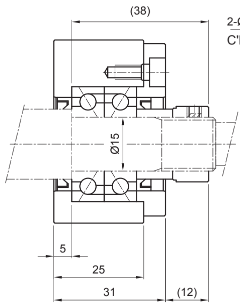
Coam and Cam are the modified static and dynamic load capacities,calculated according to ISO-3408-5

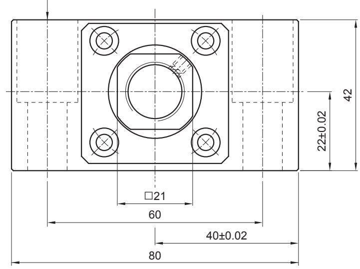


D View

Fixed End



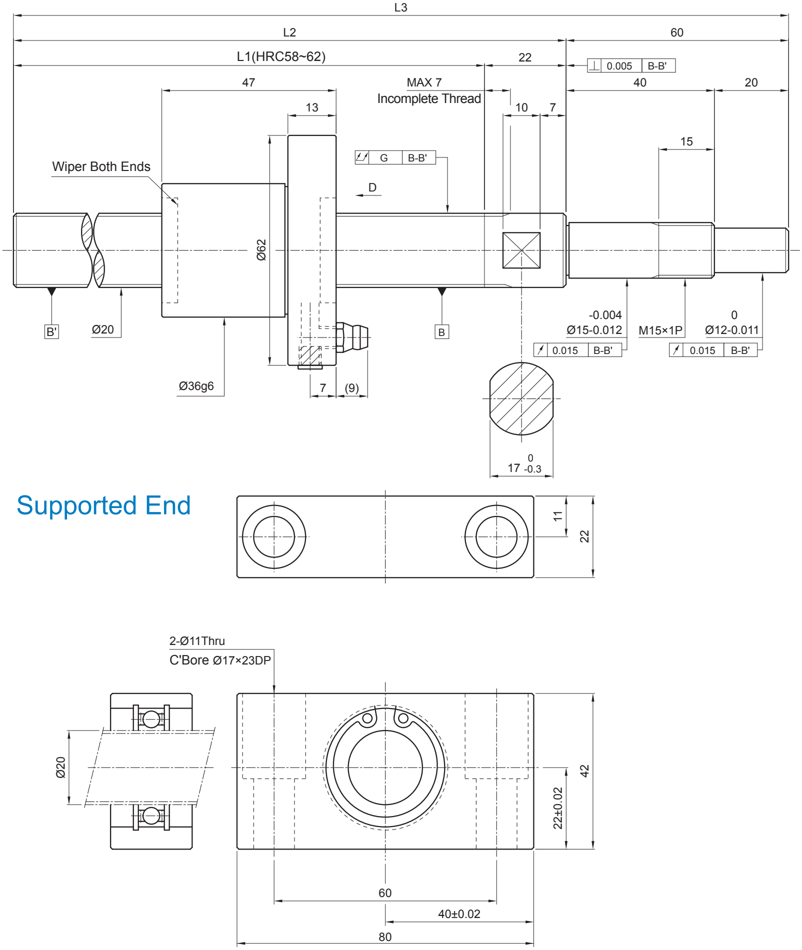




Unit: mm

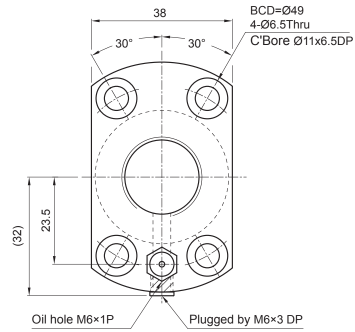
	Axial Play	Lead Accuracy			Tolerances	Fixed End–bearing (kgf)		Supported End–bearing (kgf)	
		Specified Travel (T)	Accumulated reference lead deviation (E)	Lead Deriation in random 300mm (e300)	Overall Radial Runout	Dynamic Ca	Static Co	Dynamic Ca	Static Co
	<0.005	0	0.030	0.018	0.075	622	352	408	252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

FA FA Series Ballscrews
Screw Dia.Ø20 Lead10



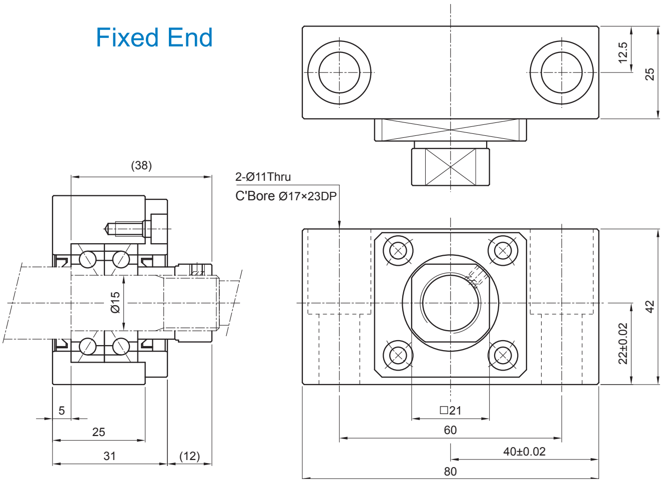
Model No.	Screw Dia.	Lead	Modified Load Capacity(kgf)		Screw Shaft Length			Accuracy Grade
	d	l	Dynamic Cam	Static Coam	L1	L2	L3	
BL020100600+A000	20	10	990	2220	518	540	600	C5
BL020101000+A000	20	10	990	2220	918	940	1000	C5
BL020101450+A000	20	10	990	2220	1368	1390	1450	C5

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



D View

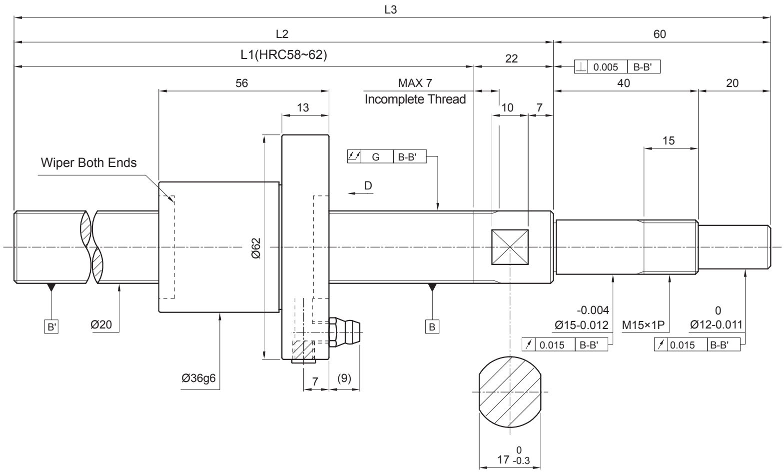
Fixed End



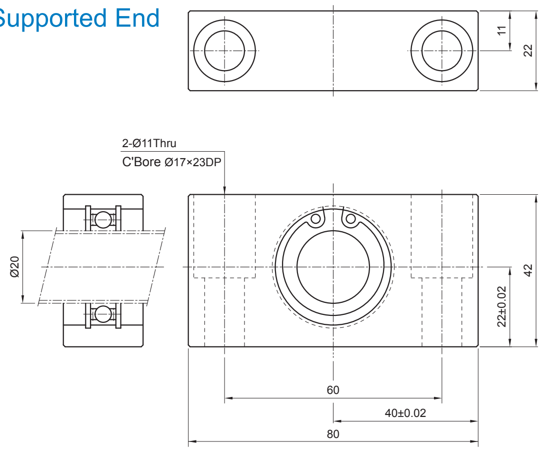
Unit: mm

	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	Static Co
	<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

FA FA Series Ballscrews
Screw Dia.Ø20 Lead20

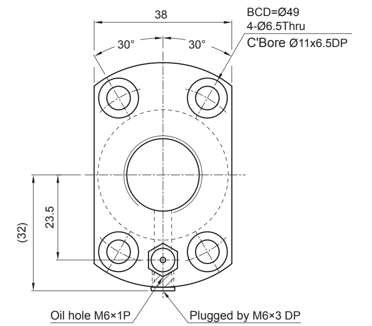


Supported End



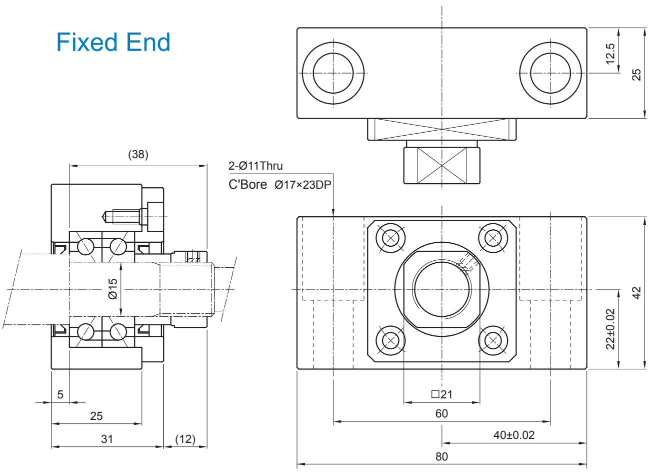
Model No.	Screw Dia.	Lead	Modified Load Capacity(kgf)		Screw Shaft Length			Accuracy Grade
	d	l	Dynamic Cam	Static Coam	L1	L2	L3	
BL020200600+A000	20	20	670	1450	518	540	600	C5
BL020201000+A000	20	20	670	1450	918	940	1000	C5
BL020201450+A000	20	20	670	1450	1368	1390	1450	C5

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



D View

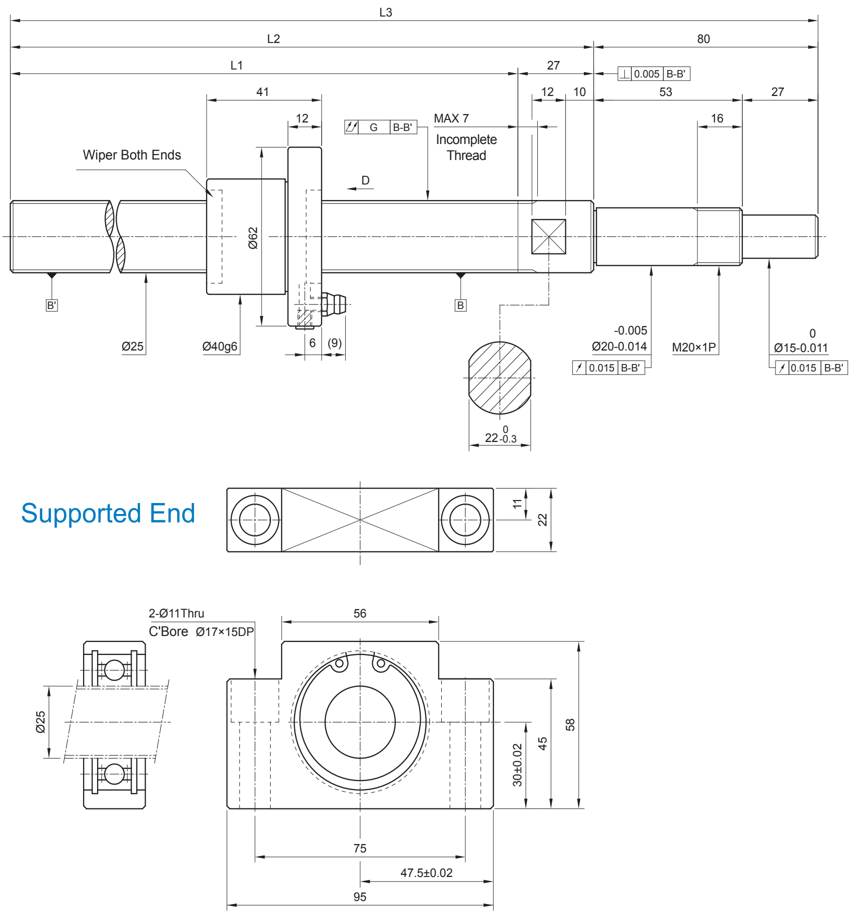
Fixed End



Unit: mm

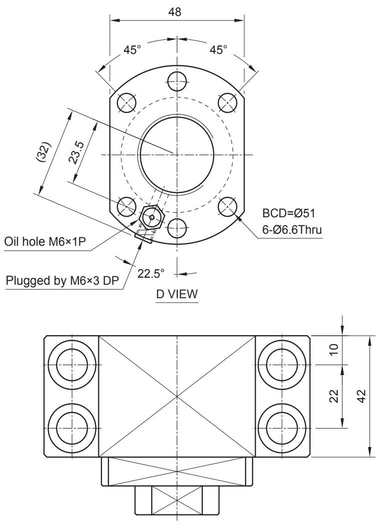
	Axial Play	Lead Accuracy			Tolerances	Fixed End–bearing (kgf)		Supported End–bearing (kgf)	
		Specified Travel (T)	Accumulated reference lead deviation (E)	Lead Deriation in random 300mm (e300)	Overall Radial Runout	Dynamic Ca	Static Co	Dynamic Ca	Static Co
	<0.005	0	0.027	0.018	0.075	622	352	408	252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

FA
FA Series Ballscrews
Screw Dia.Ø25 Lead05

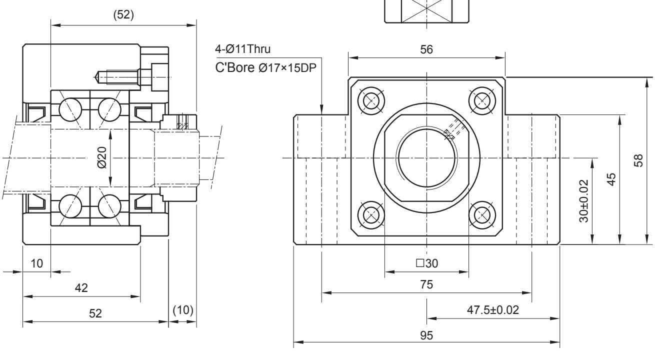


Model No.	Screw Dia.	Lead	Modified Load Capacity(kgf)		Screw Shaft Length			Accuracy Grade
	d	l	Dynamic Cam	Static Coam	L1	L2	L3	
BL025050600+A000	25	05	1440	3840	493	520	600	C5
BL025051000+A000	25	05	1440	3840	893	920	1000	C5
BL025051450+A000	25	05	1440	3840	1343	1370	1450	C5

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



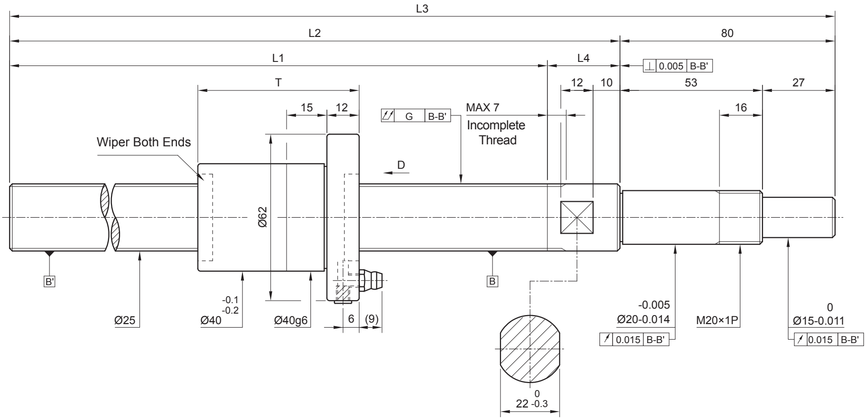
Fixed End



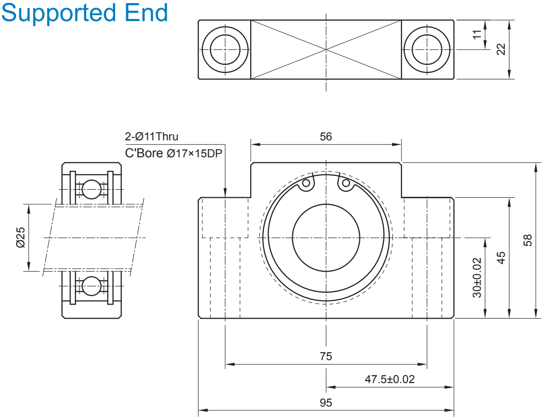
Unit: mm

	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	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

FA
FA Series Ballscrews
Screw Dia.Ø25 Lead10, 20, 25

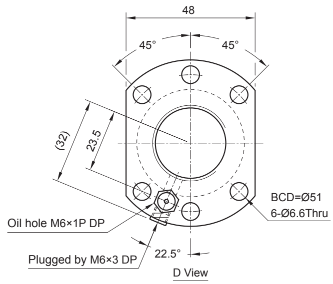


Supported End

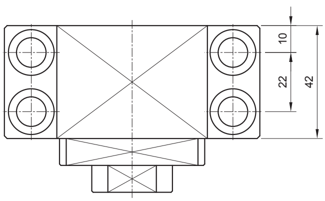


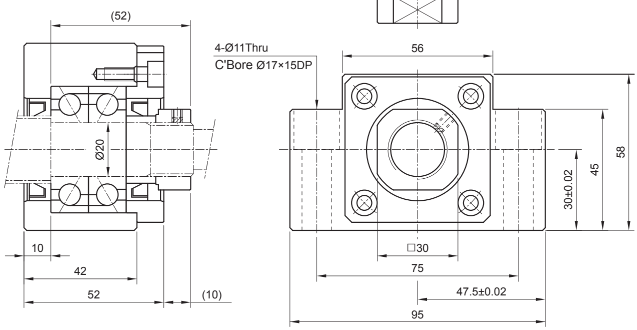
Model No.	Screw Dia.	Lead	Modified Load Capacity(kgf)		Screw Shaft Length				Nut	Accuracy Grade
	d	l	Dynamic Cam	Static Coam	L1	L2	L3	L4	T	
BL025100600+A000	25	10	1440	3840	493	520	600	27	60	C5
BL025101000+A000	25	10	1440	3840	893	920	1000	27	60	C5
BL025101450+A000	25	10	1440	3840	1343	1370	1450	27	60	C5
BL025200600+A000	25	20	750	1840	494	520	600	26	60	C5
BL025201000+A000	25	20	750	1840	894	920	1000	26	60	C5
BL025201450+A000	25	20	750	1840	1344	1370	1450	26	60	C5
BL025250600+A000	25	25	730	1810	490	520	600	30	71	C5
BL025251000+A000	25	25	730	1810	890	920	1000	30	71	C5
BL025251450+A000	25	25	730	1810	1340	1370	1450	30	71	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	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 *PMI* Ballscrews of Blank Shaft End

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.

PTR 20 10 B1 C7 S -1500

- -1500: Overall length
- S: Axial play
- C7: Grade
- B1: Effective ball circuits
- 10: Lead
- 20: Screw nominal O.D.
- PTR: Nut type

Nut type:

PPR: FSMM(Miniature Series)

PTR: FSDM (End Deflector Series)

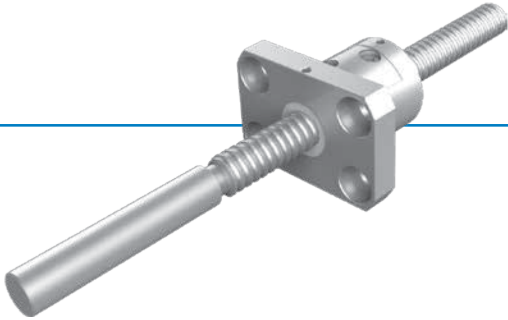
Effective ball circuits:

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

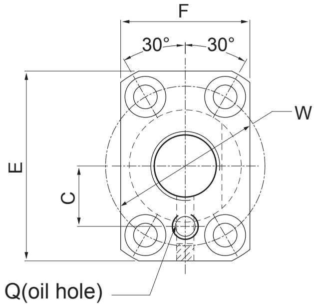
The ballnut diameter reduces 20%~25% substantially and the length of nut is shorter.

Low Noise

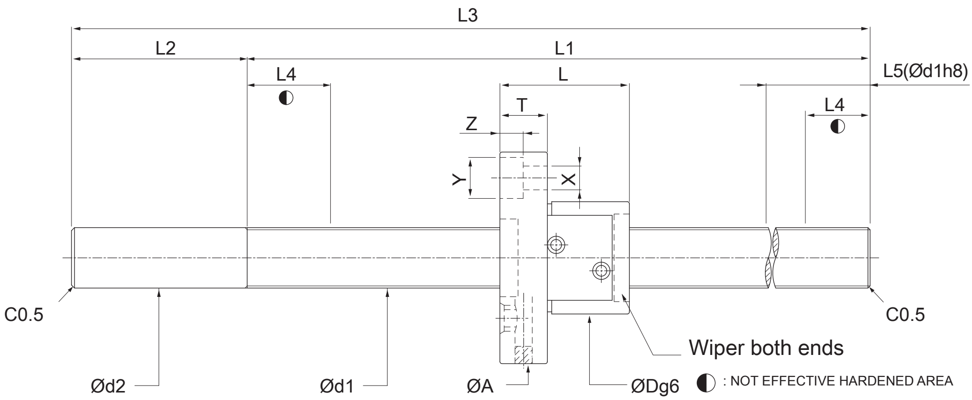
The average and accurate ball circle diameter (BCD) through whole threads make the ballscrews to obtain the stable and consistent drag torque as well as to reduce the noise.

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

PPR Miniature nut series C5



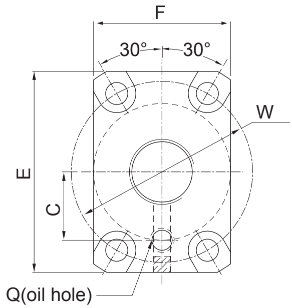
Model No.	SCREW SIZE		EFFECTIVE TURNS	BASIC RATE LOAD(kgf)		SCREW SHAFT LENGTH				
	O.D d1	LEAD		Dynamic $(1\times10^6$ REV.) Ca	Static Co	L1	L2	L3	L4	
PPR0802B1C5T-0220	8	2	2.5×1	190	290	160	60	220	10	
PPR1202B1C5T-0220	12	2	2.5×1	240	450	160	60	220	10	
PPR1202B1C5T-0300						240		300	15	



Unit:mm

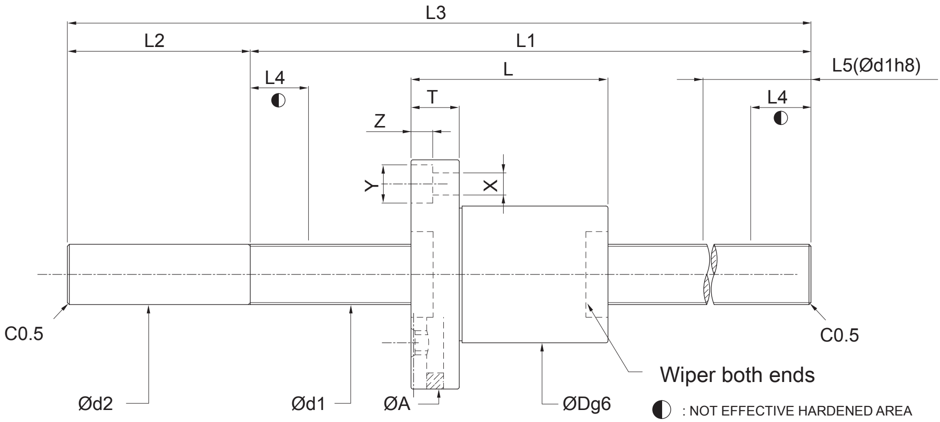
	SCREW SHAFT LENGTH		NUT		FLANGE					OIL HOLE		BOLT		
	L5	d2	Dg6	L	A	T	W	E	F	C	Q	X	Y	Z
	160	10	20	25	40	6	30	36	25	-	-	4.5	8	4.4
	160 240	12	25	31	45	10	35	41	28	13	M6	4.5	8	4.4

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 PTR1205T3C5T-0450	12	5	3	610	1190	240 390	60	300 450	10 15
PTR1210T3C5T-0300 PTR1210T3C5T-0450	12	10	3	590	1160	240 390	60	300 450	10 15
PTR1220T3C5T-0450 PTR1220T3C5T-0600	12	20	3	390	770	390 540	60	450 600	15
PTR1505T3C5T-0300 PTR1505T3C5T-0450 PTR1505T3C5T-0600 PTR1505T3C5T-0750 PTR1505T3C5T-0900	15	5	3	850	1640	240 390 540 690 840	60	300 450 600 750 900	10 15
PTR1510T3C5T-0300 PTR1510T3C5T-0450 PTR1510T3C5T-0600 PTR1510T3C5T-0750 PTR1510T3C5T-0900 PTR1510T3C5T-1100	15	10	3	840	1610	240 390 540 690 840 1040	60	300 450 600 750 900 1100	10 15
PTR1520T2C5T-0450 PTR1520T2C5T-0600 PTR1520T2C5T-0750 PTR1520T2C5T-0900 PTR1520T2C5T-1000 PTR1520T2C5T-1100 PTR1520T2C5T-1300	15	20	2	560	1050	390 540 690 840 940 1040 1240	60	450 600 750 900 1000 1100 1300	15
PTR2005T3C5T-0400 PTR2005T3C5T-0600 PTR2005T3C5T-0800 PTR2005T3C5T-1000	20	5	3	1000	2240	320 520 720 920	80	400 520 720 920	15
PTR2010T3C5T-0600 PTR2010T3C5T-0800 PTR2010T3C5T-1000 PTR2010T3C5T-1300 PTR2010T3C5T-1500	20	10	3	1530	3280	515 715 915 1215 1415	85	600 800 1000 1300 1500	15

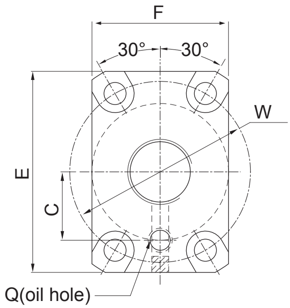
Coam and Cam are the modified static and dynamic load capacities,calculated according to ISO-3408-5



Unit:mm

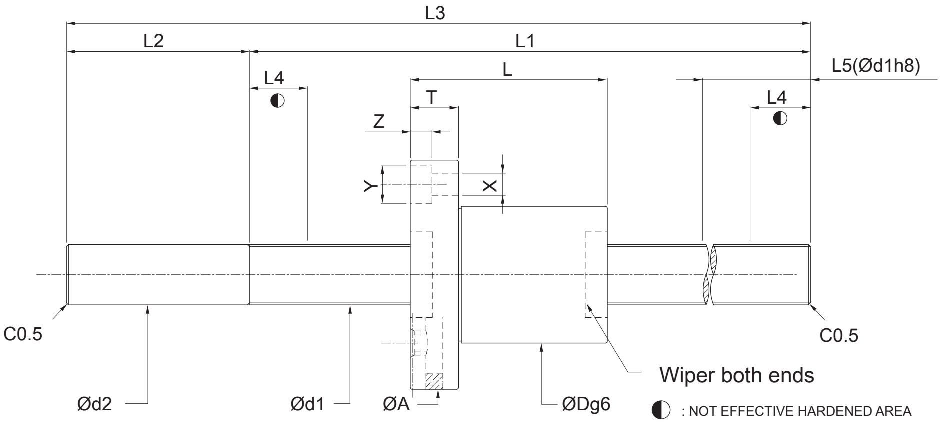
	SCREW SHAFT LENGTH		NUT		FLANGE					OIL HOLE		BOLT		
	L5	d2	Dg6	L	A	T	W	E	F	C	Q	X	Y	Z
	180	12	30	32	50	10	40	45	32	15	M6	4.5	8	4.4
	180	12	30	45	50	10	40	45	32	15	M6	4.5	8	4.4
	180	12	30	54	50	12	40	45	32	15	M6	4.5	8	4.4
	230	15	34	35	57	11	45	50	34	17	M6	5.5	9.5	5.4
	230	15	34	47	57	11	45	50	34	17	M6	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 (1×10^6 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	2	560	1050	540	60	600	15
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	600	15
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 Service Problems Analysis of Ball Screws

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 getting 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 concerned.

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, aspecially 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*** recommened, 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 cpmpensated 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*** recommened, 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*** recommened, 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 Diametion 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 -24	-14 -28	-14 -39	-6 -12	-6 -16	-6 -20	-2 -6	-2 -8	0 -4	0 -6	0 -10	0 -14	0 -25	±2	±3	±5	+4 0	+6 0	+6 +2	+8 +2	+10 +4
3	6	-20 -32	-20 -38	-20 -50	-10 -18	-10 -22	-10 -28	-4 -9	-4 -12	-0 -5	0 -8	0 -12	0 -18	0 -30	±2.5	±4	±6	+6 +1	+9 +1	+9 +4	+12 +4	+16 +8
6	10	-25 -40	-25 -47	-25 -61	-13 -22	-13 -28	-13 -35	-5 -11	-5 -14	0 -6	0 -9	0 -15	0 -22	0 -36	±3	±4.5	±7	+7 +1	+10 +1	+12 +6	+15 +6	+19 +10
10	14	-32 -50	-32 -59	-32 -75	-16 -27	-16 -34	-16 -43	-6 -14	-6 -17	0 -8	0 -11	0 -18	0 -27	0 -43	±4	±5.5	±9	+9 +1	+12 +1	+15 +7	+18 +7	+23 +12
14	18																					
18	24	-40 -61	-40 -73	-40 -92	-20 -33	-20 -41	-20 -53	-7 -16	-7 -20	0 -9	0 -13	0 -21	0 -33	0 -52	±4.5	±6.5	±10	+11 +2	+15 +2	+17 +8	+21 +8	+28 +15
24	30																					
30	40	-50 -75	-50 -89	-50 -112	-25 -41	-25 -50	-25 -64	-9 -20	-9 -25	0 -11	0 -16	0 -25	0 -39	0 -62	±5.5	±8	±12	+13 +2	+18 +2	+20 +9	+25 +9	+33 +17
40	50																					
50	65	-60 -90	-60 -106	-60 -134	-30 -49	-30 -60	-30 -76	-10 -23	-10 -29	0 -13	0 -19	0 -30	0 -46	0 -74	±6.5	±9.5	±15	+15 +2	+21 +2	+24 +11	+30 11	+39 +20
65	80																					
80	100	-72 -107	-72 -126	-72 -159	-36 -58	-36 -71	-36 -90	-12 -27	-12 -34	0 -15	0 -22	0 -35	0 -54	0 -87	±7.5	±11	±17	+18 +3	+25 +3	+28 +13	+35 +13	+45 +23
100	120																					
120	140	-85 -125	-85 -148	-85 -185	-43 -68	-43 -83	-43 -106	-14 -32	-14 -39	0 -18	0 -25	0 -40	0 -63	0 -100	±9	±12.5	±20	+21 +3	+28 +3	+33 +15	+40 +15	+52 +27
140	160																					
160	180																					
180	200	-100 -146	-100 -172	-100 -215	-50 -79	-50 -96	-50 -122	-15 -35	-15 -44	0 -20	0 -29	0 -46	0 -72	0 -115	±10	±14.5	±23	+24 +4	+33 +4	+37 +17	+46 +17	+60 +31
200	225																					
225	250																					

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
14	18																					
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
24	30																					
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
40	50																					
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
65	80																					
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
100	120																					
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
140	160																					
160	180																					
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																					