



**Ballscrews/ Precision Ball Screw Spline/ Linear  
Guideway/ Ball Spline/ Actuator General Catalog**

---

# COMPANY INTRODUCTION

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

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





## Environment Policy

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



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

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

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

## Quality Policy

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

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



# PRODUCT INFORMATION

## Precision Ground Series

### Internal Ball Circulation Series

FSIC

A1-118



FDIC

A1-122



FOIC

A1-126



RSIC

A1-128



### End Deflector Series

RDIC

A1-130



FSDC

A1-133



### External Ball Circulation Series

FDDC

A1-137



FSWC

A1-142



**FDWC**

A1-147



**FSVC**

A1-152



**FDVC**

A1-156



**FOWC**

A1-160



**High Lead Series**

**FSWE**

A1-163



**FDWE**

A1-167



**FSVE**

A1-171



**FDVE**

A1-175



## End Cap Series

FSKC

A1-179



## Heavy Load Series

FSVH

A1-185



FSDH

A1-187



## Rolled Series

### DIN Standard Series

FSDN

A1-241



FSDU

A1-242



FSIN

A1-244



### Internal Ball Circulation Series

FSIW

A1-252



## End Cap Series

FSDW

A1-253



FSKW

A1-251



## External Ball Circulation Series

FSWW

A1-245



FSVW

A1-247



RSVW

A1-248



FSBW

A1-249



SSVW

A1-250



## Miniature Series

FSMW

A1-255



## Standard Type series

### Miniature Series

FSMC

A1-188



### FA Series

A1-258



## Automation Industry Specialized Type

PPR

A1-278



PTR

A1-280



## Precision Ball Screw Spline

PBSA

A2-12



## Full Ball Linear Guideway

### Heavy Load Type

MSA-A / MSA-LA MSA-E / MSA-LE B1-56



Model No.  
MSA15~65

MSA-S / MSA-LS

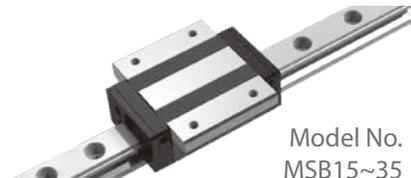
B1-60



Model No.  
MSA15~65

## Compact Type

**MSB-E / MSB-TE / MSB-LE** B1-78

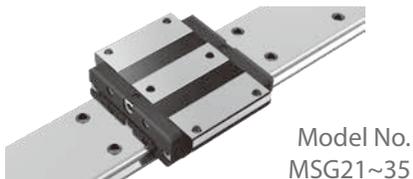


**MSB-S / MSB-TS / MSB-LS** B1-80

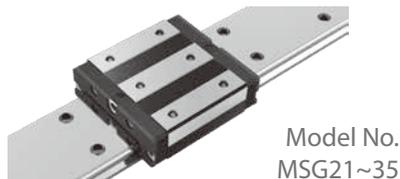


## Wide Rail Type

**MSG-E** B1-96



**MSG-S** B1-98



## Miniature Type

**MSC-M / MSC-LM** B1-114



**MSD-M / MSD-LM** B1-116



## Cross Linear Guideway

**MSH-LS** B1-130



## Full Roller Linear Guideway

### Heavy Load Type

MSR-E / MSR-LE

B1-148



MSR-S / MSR-LS

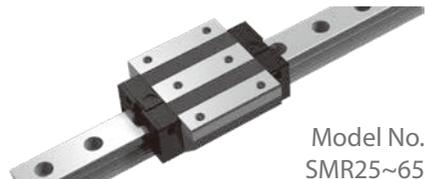
B1-150



### Roller Chain Type

SMR-E / SMR-LE

B1-170



SMR-S / SMR-LS

B1-172



## Ball Chain Linear Guideway

### Heavy Load Type

SME-E / SME-LE

B1-192



SME-S / SME-LS

B1-196



### Cross Linear Guideway

SMH

B1-212



## Ball Spline

### Ball Spline

SLT

B2-32



SLF

B2-34



### Rotary Ball Spline

STRA

B2-42



## Actuator

### KM Series

C1-33



Model No.  
KM20~65 Lead:1~25

# CONTENTS

<b>A1-1</b>	<b>Ballscrews</b>	A1-62	<b>Driving Torque</b>
A1-2	<b>Features of <i>PMI</i> Ballscrews</b>	A1-62	• Operating Torque of Ballscrew
A1-4	<b>Lead Accuracy and Torque</b>	A1-62	• Drive Torque of Motor
A1-4	• Lead Accuracy	A1-65	<b>Flow chart for Selecting Correct Type of Ballscrew</b>
A1-10	• Preloading Torque	A1-66	<b>Nomenclature of ballscrew</b>
A1-13	• Tolerances on Various Areas of <i>PMI</i> Ballscrew	A1-66	• Nomenclature of External Circulation Ballscrew
A1-14	• Standard tolerance of accuracy measuring of ballscrew	A1-68	• Nomenclature of internal Circulation Ballscrew
A1-22	<b>Design of Screw Shaft</b>	A1-70	<b>Sample Process of Selecting the Type of Ballscrew</b>
A1-22	• Production Limit Length of Screw Shaft	A1-70	• Cutting Machine
A1-23	• Mounting Method	A1-82	• High Speed Portorage Apparatus (Horizotal application)
A1-24	• Permissible Axial Load	A1-90	• Vertical Portorage Apparatus
A1-26	• Permissible Rotational Speed	A1-100	<b><i>PMI</i> Ballscrew Cooling System</b>
A1-28	• Notes on Screw Shaft	A1-100	• Introduction to Hollow Cooling Screw Shaft
A1-32	<b>Design of Ball Nut</b>	A1-101	• Patent of Hollow Cooling Screw Shaft
A1-32	• Selecting the Type of Nut	A1-102	• Thermal control experiment
A1-33	• Calculation the Axial Load	A1-104	• Nut Cooling
A1-35	• Notes on Nut Design	A1-109	<b>Options</b>
A1-36	<b>Rigidity</b>	A1-109	• Ball screw of High Dustproof
A1-36	• Axial Rigidity	A1-113	• Spacer Ball Screw
A1-48	• Positioning Accuracy	A1-114	• Self- Lubricant Unit
A1-50	<b>Life</b>	A1-115	<b><i>PMI</i> Precision Ground Ballscrew</b>
A1-50	• Life of the Ballscrew	A1-115	• Internal Ball Circulation Nuts
A1-50	• Fatigue Life	A1-130	• End Deflector Series
A1-56	• Permissible Load on Thread Grooves	A1-139	• External Ball Circulation Nuts
A1-56	• Materials and Hardness	A1-160	• High Lead Ballscrews
A1-58	• Heat Treatment Inspection certificate		
A1-59	• Lubrication		
A1-61	• Dustproof		

A1-177	• End Cap Series	A2-2	• Features
A1-178	• Ultra Lead-End Cap Series	A2-4	• Types and Features
A1-179	• Ballscrews For Heavy Load	A2-5	• Product Explanation of Precision Ball Screw Spline
A1-185	• Heavy Load Series of End De-flector	A2-12	• PBSA
A1-186	• Miniature Series	<b>B1-1</b>	<b>Linear Guideway</b>
A1-195	• Standard Type Series		
A1-230	<b>PMI Rolled Ballscrews</b>	B1-2	<b>The Characteristics of PMI Linear Guideways</b>
A1-230	• Introduction to Rolled Ballscrews	B1-4	<b>The Classification Chart of PMI Linear Guideways</b>
A1-230	• Features of the PMI Rolled Ballscrew		
A1-231	• Lead Accuracy of Rolled Screws ( $e_{300}$ )	B1-10	<b>The Procedure of Select Linear Guideway</b>
A1-232	• Reference Table of the Nominal Outer Diameter and Lead of the PMI's Rolled Screw Shaft		
A1-234	• Axial Play	B1-11	<b>Load Rating and Service Life of Linear Guideway</b>
A1-234	• Materials and Hardness		
A1-235	• Types and Dimensions of Rolled Screw Shaft	B1-11	• Basic Static Load Rating ( $C_0$ )
A1-237	• Nut Types of Rolled Ballscrew	B1-11	• Static Permissible Moment ( $M_0$ )
A1-254	<b>FA Series</b>	B1-12	• Static Safety Factor ( $f_s$ )
A1-274	<b>Automation Industry Specialized Type</b>	B1-13	• Basic Dynamic Load Rating ( $C$ )
A1-274	• Product Features	B1-13	• Calculation of Nominal Life ( $L$ )
A1-275	• PPR (Miniature Series) - Features	B1-15	• Calculation of Service Life in Time ( $L_h$ )
A1-275	• PTR (End Deflector Series) - Features	B1-16	<b>Friction Coefficient</b>
A1-282	<b>Service Problems Analysis of Ball Screws</b>	B1-17	<b>Calculation of Working Load</b>
A1-282	• Preface	B1-25	<b>Calculation of the Equivalent Load</b>
A1-282	• The Cause and Precautions of Ballscrew Problems	B1-26	<b>The Calculation of the Mean Load</b>
		B1-26	• Examples for calculating mean load
<b>A2-1</b>	<b>Precision Ball Screw Spline</b>	B1-28	<b>Calculation Example</b>
		B1-29	• Calculate the load that each carriage exerts
A2-2	• Precision Ball Screw Spline	B1-32	• Calculate equivalent load
A2-2	• Design Principle	B1-32	• Calculation of static factor
		B1-33	• Calculate the mean load on each carriage $P_{mn}$

# CONTENTS

B1-33	• Calculation of nominal life ( $L_n$ )	B1-196	• Dimensions of SME-SA / SME-LSA
B1-34	<b>Accuracy Standard</b>	B1-198	• Dimensions of SME-SB / SME-LSB
B1-35	• The Selection of Accuracy Grade	B1-200	<b>Ball Chain Type Cross Linear Guideway, SMH Series</b>
B1-37	<b>Calculation of the Equivalent Load</b>	B1-212	• Dimensions of SMH-LS
B1-38	• The Selection of Preload	B1-214	<b>Point of Design</b>
B1-39	<b>Introduction of Each Series</b>	B1-214	• Installation Direction of Linear Guideway
B1-40	<b>Heavy Load Type, MSA Series</b>	B1-216	• Fixing Methods of Linear Guideway
B1-56	• Dimensions of MSA-A / MSA-LA	B1-219	• Marking on Master Linear Guideway and Combined Case
B1-58	• Dimensions of MSA-E / MSA-LE	B1-222	<b>Installation of Linear Guideway</b>
B1-60	• Dimensions of MSA-S / MSA-LS	B1-222	• Installation of Linear Guideway When Machine Subjected to Vibration and Impact
B1-62	<b>Compact Type, MSB Series</b>	B1-225	• Installation of Linear Guideway without Push Screws
B1-78	• Dimensions of MSB-TE / MSB-E / MSB-LE	B1-228	• The Installation of Carriage of Linear Guideway without the Reference Side for Master Rail
B1-80	• Dimensions of MSB-TS / MSB-S / MSB-LS	B1-230	• Accuracy Measurement after Installation
B1-82	<b>Wide Rail Type, MSG Series</b>	B1-231	• The Recommended Tightening Torque for Rails
B1-96	• Dimensions of MSG-E	B1-232	<b>Options</b>
B1-98	• Dimensions of MSG-S	B1-232	<b>Dust Proof</b>
B1-100	<b>Miniature Type, MSC, MSD Stainless Steel Series</b>	B1-234	• Contamination protection
B1-114	• Dimensions of MSC-M / MSC-LM	B1-236	• HD-Enhanced Dust-proof
B1-116	• Dimensions of MSD-M / MSD-LM	B1-243	• Cover Strip
B1-118	<b>Cross Linear Guideway, MSH Series</b>	B1-247	<b>ME Type - Metallic End Cap Linear Guideway</b>
B1-130	• Dimensions of MSH-LS	B1-249	<b>Lubrication</b>
B1-132	<b>Full Roller Type, MSR Series</b>	B1-249	• Grease lubrication
B1-148	• Dimensions of MSR-E / MSR-LE	B1-252	• Oil lubrication
B1-150	• Dimensions of MSR-S / MSR-LS	B1-253	• SL Lubricator
B1-152	<b>Roller Chain Type, SMR Series</b>		
B1-170	• Dimensions of SMR-E / SMR-LE		
B1-172	• Dimensions of SMR-S / SMR-LS		
B1-174	<b>Ball Chain Type, SME Series</b>		
B1-192	• Dimensions of SME-EA / SME-LEA		
B1-194	• Dimensions of SME-EB / SME-LEB		

B1-262	• Lubrication equipment - Grease gun	C1-2	• Construction
B1-263	• Grease nipple and piping joint	C1-2	• Characteristics
B1-265	• The Relationship between the Direction of Lubrication and the Reference Side	C1-4	• Carriage-Nut Type
B1-267	• Lubrication position	C1-5	• Description of Specification
B1-270	<a href="#">Surface Treatment</a>	C1-6	• Load Ratings
B1-270	• Electroless Nickel Plating	C1-7	• Static Permissible Moments
B1-270	• Hard Chrome Plating	C1-8	• Accuracy Grade
B1-271	• Black Chrome Plating	C1-9	• Maximum Travel Speed and the Maximum Length
B1-271	• Low Temp. Black Chrome Plating	C1-11	• Life Calculation
B1-274	<a href="#">Precautions of Linear Guideway</a>	C1-12	• Options
<b>B2-1</b>	<b>Ball Spline</b>	C1-33	<a href="#">Specification of KM Series</a>
B2-2	<a href="#">Ball Spline</a>	C1-34	• KM20
B2-2	• Design Principle	C1-36	• KM26
B2-2	• Features	C1-38	• KM30
B2-3	• Types and Features	C1-42	• KM33
B2-8	• The Procedure of Select Ball Spline	C1-46	• KM45
B2-9	• Studying the Spline Shaft Strength	C1-50	• KM46
B2-16	• Predicting the Service Life	C1-54	• KM55
B2-25	• Selecting a Preload	C1-56	• KM65
B2-28	• Accuracy Grade	<b>X-1</b>	<b>Appendix</b>
B2-30	• Product Explanation of Ball Spline	X1-2	<a href="#">Appendix</a>
B2-37	<a href="#">Rotary Ball Spline</a>	X1-2	• <i>PMI</i> Ballscrew Request Form
B2-37	• Design Principle	X1-3	• <i>PMI</i> Linear Guideway Request Form
B2-37	• Features	X1-4	• Service Life Calculation of <i>PMI</i> Linear Guideway
B2-38	• Types and Features	X1-9	• Dimensional Tolerance of Standard Sheet for Shafts and Holes
B2-40	• Product Explanation of Rotary Ball Spline		
<b>C1-1</b>	<b>Actuator</b>		
C1-2	<a href="#">KM Series</a>		





# Ball screws



# Features of *PMI* Ballscrews

## 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.

## 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 accuracy inspection certificate. The ground ball screw which accuracy grade is C5 or above, will attach an accuracy certificate of inspection.

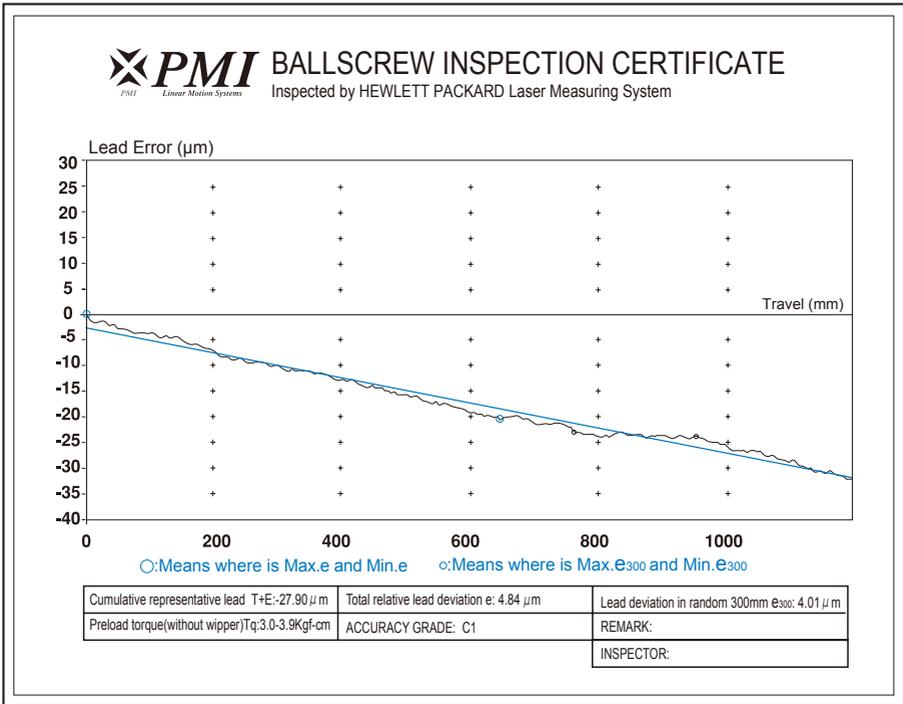


Fig.1 Accuracy inspection certificate.

## 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.

## 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.

## 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.

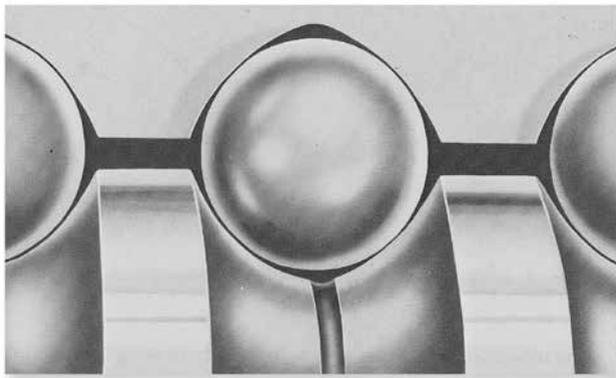
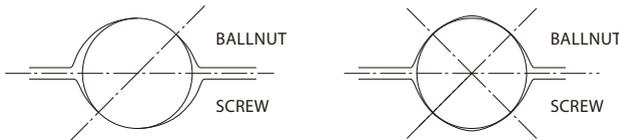


Fig.2 Gothic arch thread

# Lead Accuracy and Torque

## 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.

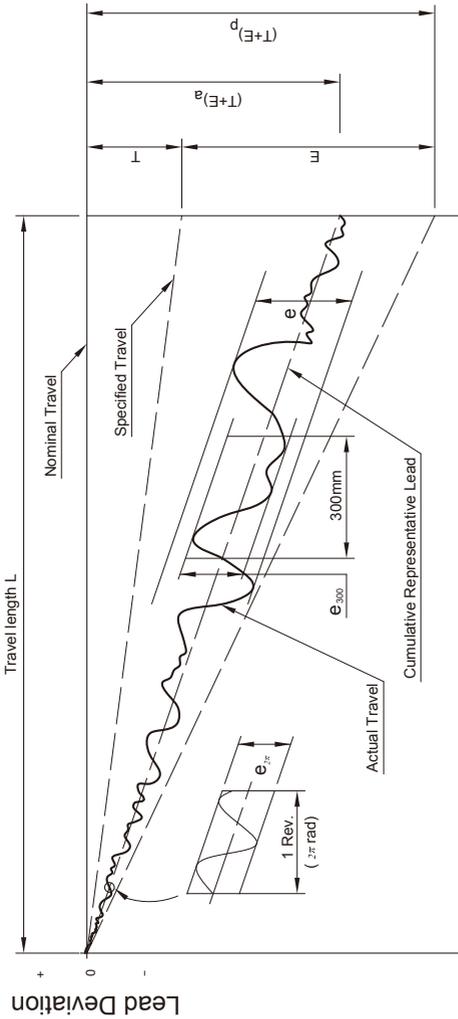


Fig.3 Technical Terms Concerning the Lead

Table 1 Terms

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

Table 2 Accumulated reference lead deviation ( $\pm E$ ) and total relative variation (e)

Unit:  $\mu\text{m}$

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

Table 3 Accuracy grade

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

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:  $\mu m$ 

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 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					●	●	●				

## Preloading Torque

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

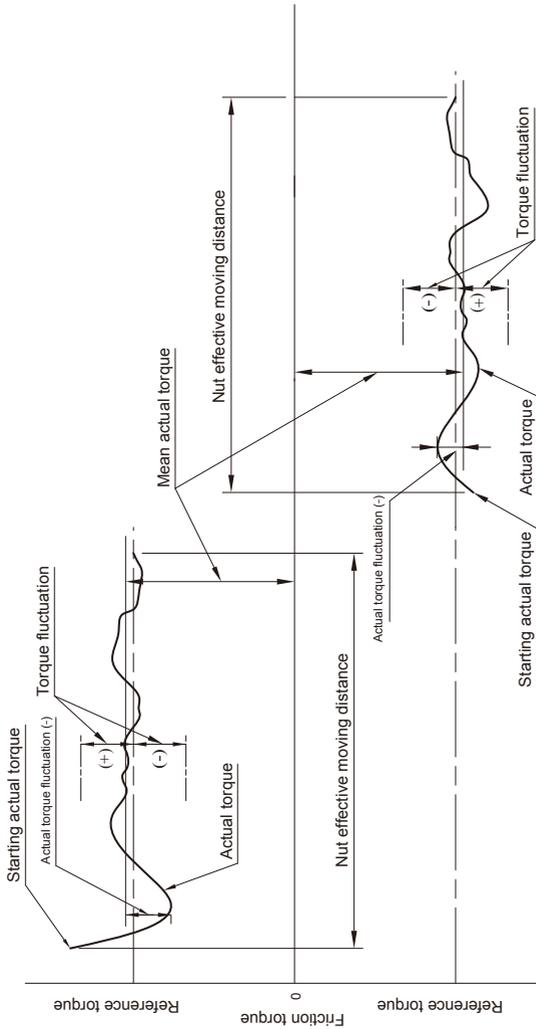


Fig.4 Technical terms concerning preload

<b>Preload</b>	The goal in preload is to clear axial play and increase rigidity of Ballscrew. Reference to A1-12 Ballscrew's preload and effect.
<b>Preload torque</b>	Torque needed to continuously turn a Ballscrew with preload with no other load applied to it.
<b>Reference torque</b>	Preload torque set as a goal.
<b>Torque fluctuation</b>	Fluctuation from a goal value of the preload torque. Defined as positive or negative in respect to the reference torque.
<b>Rating of torque fluctuation</b>	Rating on reference torque and torque fluctuation.
<b>Actual torque</b>	Preloaded dynamic torque measured by using an actual value of Ballscrew.
<b>Mean actual torque</b>	In the effective thread length, the net reciprocate to measure the maximum actual torque and minimum actual torque are doing count mean.
<b>Actual torque fluctuation</b>	In the effective thread length, the net reciprocate to measure the maximum fluctuant value.
<b>Rating of Actual torque fluctuation</b>	Rating on mean actual torque and actual torque fluctuation.

Table 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%

Note: Slenderness Ratio: Effective Thread Length/Screw Nominal O.D.

## Reference torque

$$T_p = 0.05 (\tan \beta)^{-0.5} \times \frac{F_{ao} \times l}{2\pi} \dots\dots\dots(1)$$

Here

$T_p$  Reference torque (kgf.cm)       $l$  Lead (cm)

$F_{ao}$  Preload (kgf)       $\beta$  Lead angle

## Tolerances on Various Areas of *PMI* Ballscrew

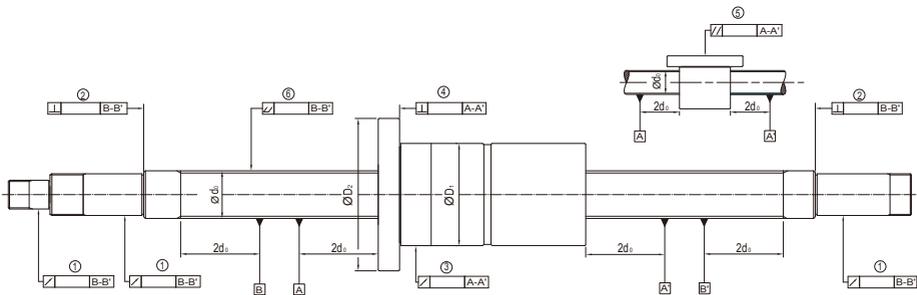


Fig.5

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

⊥ : Perpendicularity    ↗ : Radial runout    // : Parallel    ▼ : 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:** The mounting surface of the Ballscrew is finished to the accuracy specified in JIS B 1192:1997

## Standard tolerance of accuracy measuring of ballscrew

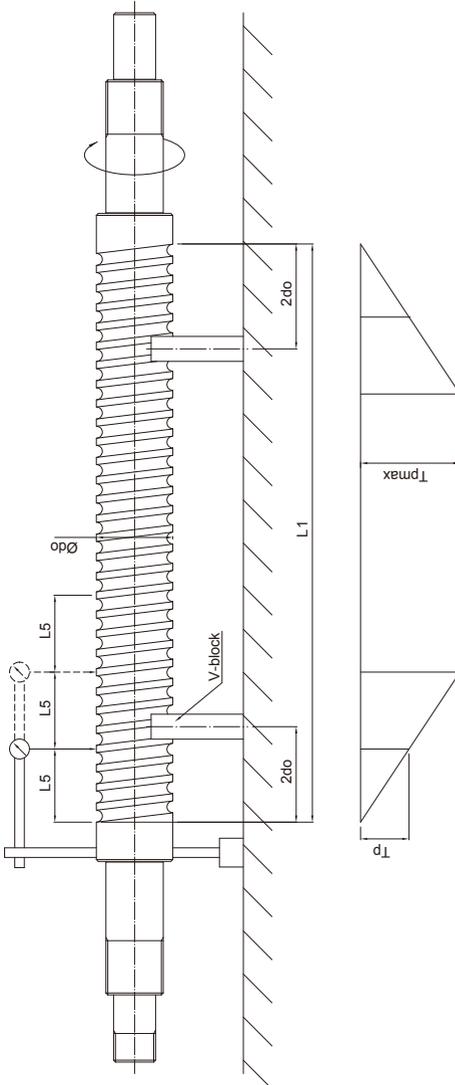


Table 6 Total runout in radial direction of outside diameter of screw shaft threaded part in respect to measuring basic length (measuring basic length is according to DIN 69051 and JIS B1192)

Unit:  $\mu\text{m}$

Normal diameter $d_o$ (mm)	Measuring basic length $L_s$	PMI's Grade $T_{pmax}$									
		C0	C1	C2	C3	C4	C5	C6	C7	C10	
above	up to and incl.	-	C0	C1	C2	C3	C4	C5	C6	C7	C10
6	80										
12	25										
	160										
25	50										
	315										
50	100		20	20	20	23	25	28	32	40	80
	630										
100	200										
	1250										
Slenderness ratio $L_s/d_o$ (mm)		PMI's Grade ( $L_s \geq 4L_5$ )									
above	up to and incl	C0	C1	C2	C3	C4	C5	C6	C7	C10	
-	40	40	40	40	45	50	60	64	80	160	
40	60	60	60	60	70	75	85	96	120	240	
60	80	100	100	100	115	125	140	160	200	400	
80	100	160	160	160	180	200	220	256	320	640	

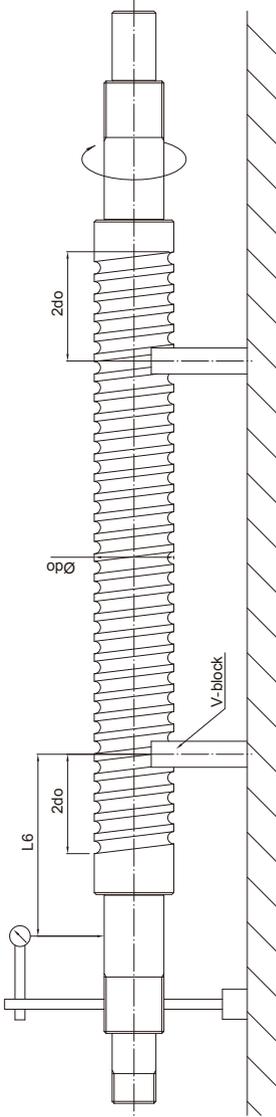


Table 7 Circumferential runout in radial direction of outside diameter of mounting part of parts in respect to threaded part axial line of screw shaft (measuring basic length is according to DIN 69051 and JIS B1192)

Unit:  $\mu\text{m}$

Normal diameter $d_o$ (mm)	Measuring basic length $L_r$	PMI's Grade ( $L_6 < L_r$ )																		
		C0	C1	C2	C3	C4	C5	C6	C7	C10										
above	up to and incl.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
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									

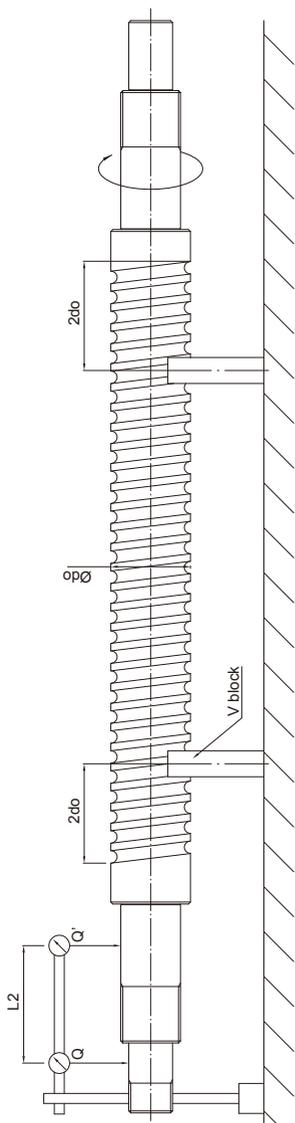


Table 8 Perpendicularity on supporting-part end face in respect to the threaded part axial line of screw shaft (measuring basic length is according to DIN 69051 and JIS B1192)(Difference of maximum value within Q and Q')

Unit:  $\mu\text{m}$

Normal diameter $d_0$ (mm)	Measuring basic length $L_F$	PMI's Grade ( $L_2 \leq L_F$ )													
		C0	C1	C2	C3	C4	C5	C6	C7	C10					
above up to and incl.	-														
6	80	4	5	5	6	6	7	8	8	9	10	12	16		
20	125	5	6	6	7	8	9	10	10	11	12	16	20		
50	200	6	7	8	9	10	11	12	12	14	16	20	25		
125	315	-	-	-	10	12	14	16	16	25	32				

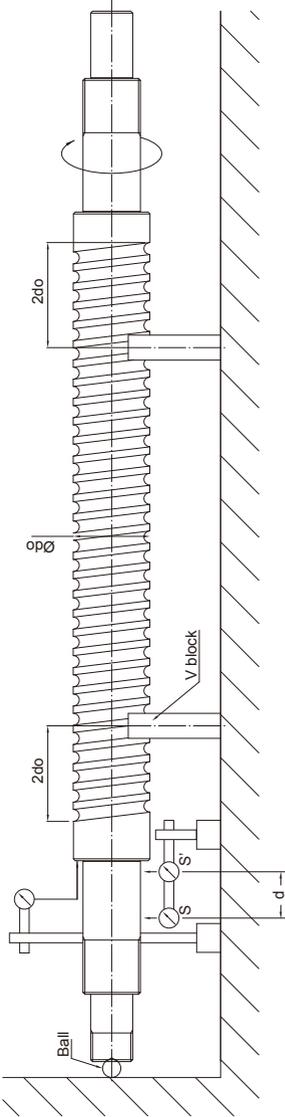


Table 9 Perpendicularity on supporting-part end face in respect to the threaded part axial line of screw shaft (measuring basic length is according to DIN 69051 and JIS B1192)  
(the value of deflection supports two ends' deflection of difference between S and S')

Unit:  $\mu\text{m}$

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

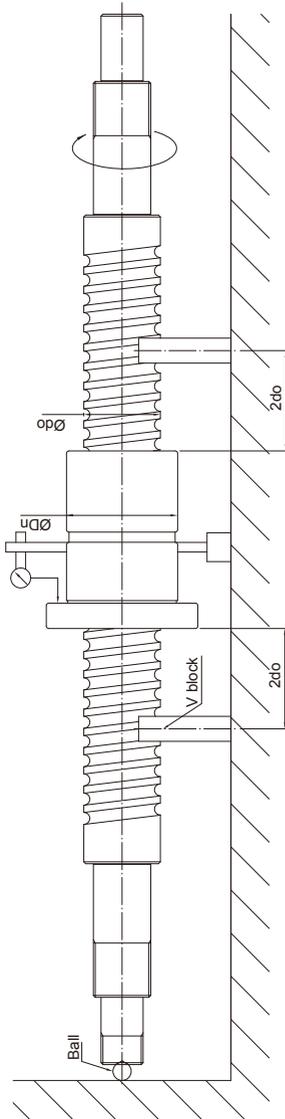


Table 10 Perpendicularity on mounting face of flang of nut  
(measuring basic length is according to DIN 69051 and JIS B1192)

Outside diameter of nut $D_n$		PMI's Grade										Unit: $\mu m$
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	-		

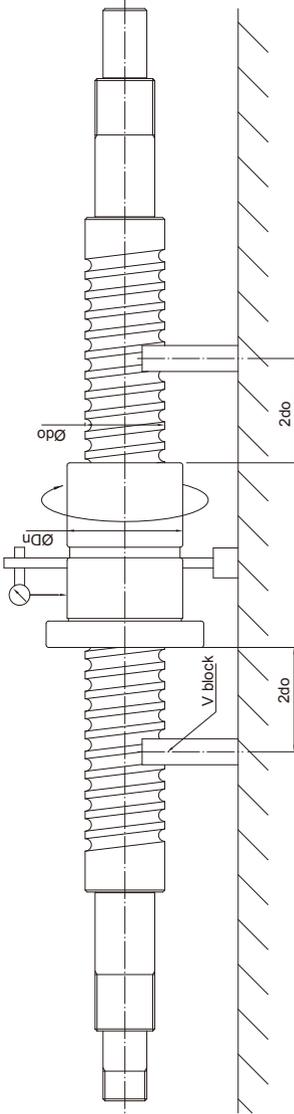


Table 11 Circumferential runout in radial direction on outer peripheral face of nut (measuring basic length is according to DIN 69051 and JIS B1192)

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

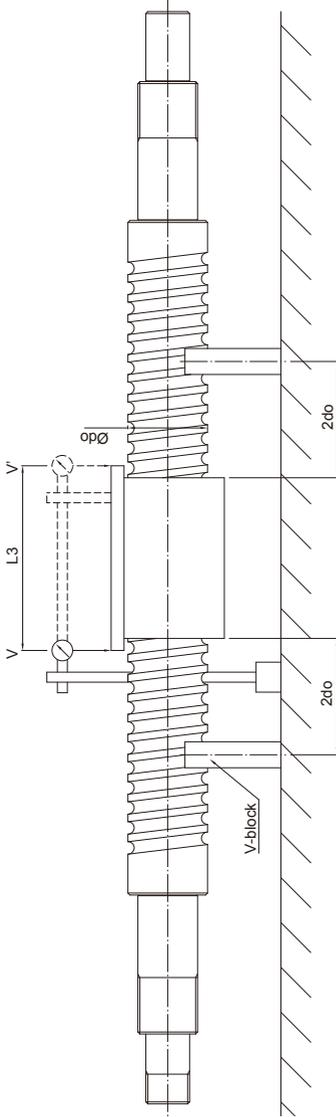


Table 12 Parallelism on outer peripheral face of nut (V-V)/(measuring basic length is according to DIN 69051 and JIS B1192)

Measuring basic length $L_3$ above up to and incl	PMI's Grade											Unit: $\mu\text{m}$
	C0	C1	C2	C3	C4	C5	C6	C7	C10			
-	5	6	7	8	9	10	14	17	-	-	-	-
50	6	7	8	10	11	12	15	17	-	-	-	-
100	-	10	11	13	15	17	24	30	-	-	-	-



# Design of Screw Shaft

## 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 8 mm, Limit length of Ballscrew is 1000 mm.

When screw shaft O.D. is 80 mm, Limit length of Ballscrew is 6000 mm.

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



## 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.

Fig.6~8 illustrate a typical method for mounting a screw shaft.

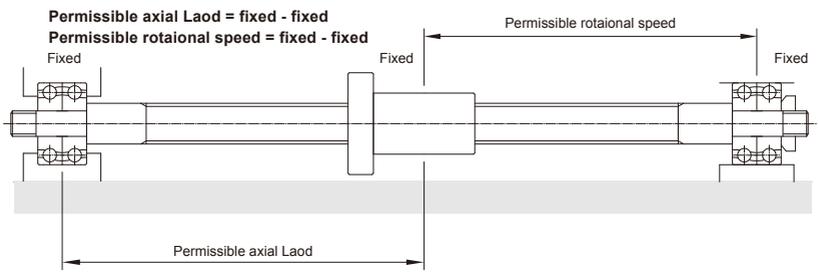


Fig.6 Mount method : fixed-fixed

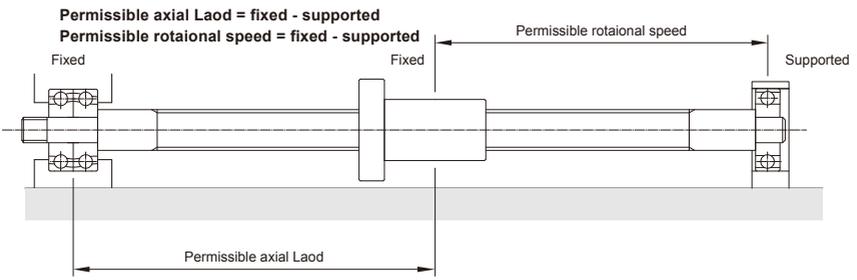


Fig.7 Mount method : fixed-supported

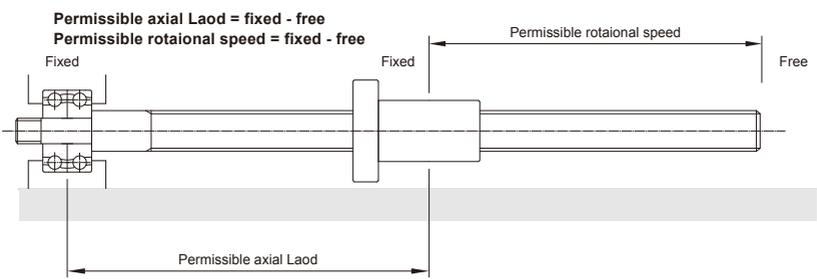


Fig.8 Mount method : fixed-free

## Permissible Axial Load

### 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 (2).

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

Here:

- $\alpha$  Safety factor ( $\alpha=0.5$ )
- $E$  Young's modulus ( $E=2.1 \times 10^4 \text{kgf/mm}^2$ )
- $I$  Minimum geometrical moment of inertia of the screw shaft cross section ( $I=\pi dr^4/64 \text{mm}^4$ )
- $dr$  Screw shaft thread minor diameter ( $mm$ )
- $L$  Distance between mounting positions ( $mm$ )
- $m, N$  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  $m=1.3$  ( $N=1/4$ )

### 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).

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

$$P = \sigma \cdot A = \sigma \cdot \pi \cdot dr^2/4 \dots\dots\dots(3)$$

Here:

- $\sigma$  Permissible tensile-compressive stress ( $147MPa$ )
- $A$  Cross section area of root diameter of screw shaft ( $mm^2$ )
- $dr$  Screw-shaft thread minor diameter ( $mm$ )

- 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 A1-56, Permissible Load on Thread Grooves.

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

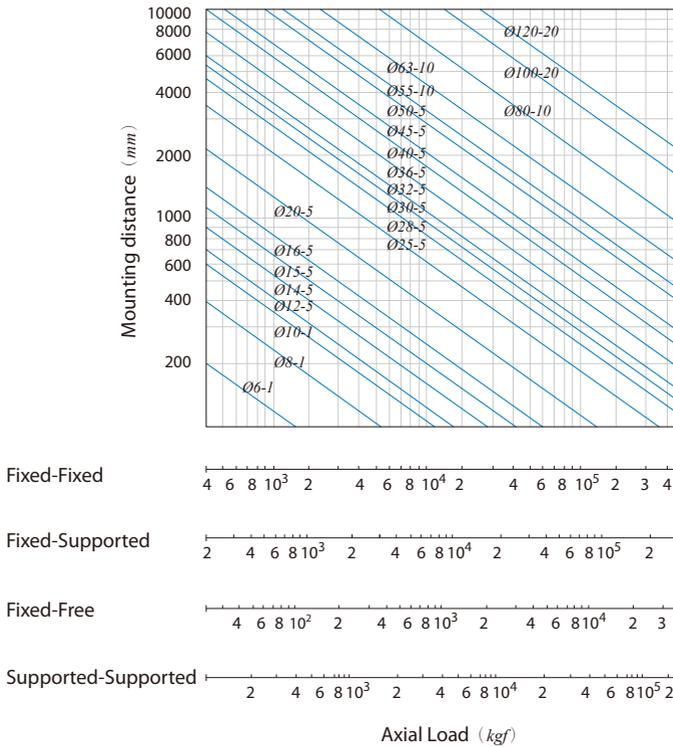


Fig.9 Permissible Axial Load

## Permissible Rotational Speed

### 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 (4).

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

$$n = \alpha \times \frac{60\lambda^2}{2\pi L^2} \sqrt{\frac{EIg}{\gamma A}} = f \frac{dr}{L^2} \times 10^7 \text{ (rpm)} \dots\dots\dots(4)$$

Here:

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

supported-supported	$f=9.7$	$(\lambda=\pi)$
fixed-supported	$f=15.1$	$(\lambda=3.927)$
fixed-fixed	$f=21.9$	$(\lambda=4.730)$
fixed-free	$f=3.4$	$(\lambda=1.875)$

### *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:

Rolled ball screw	Allowable <i>dm.n</i> value	Criterion of permissible rotational speed( $\text{min}^{-1}$ )
Standard specification(normal lead)	$\leq 50000$	1500~2000
High-speed specification(large lead)	$\leq 70000$	2000~2500

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

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

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.

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)

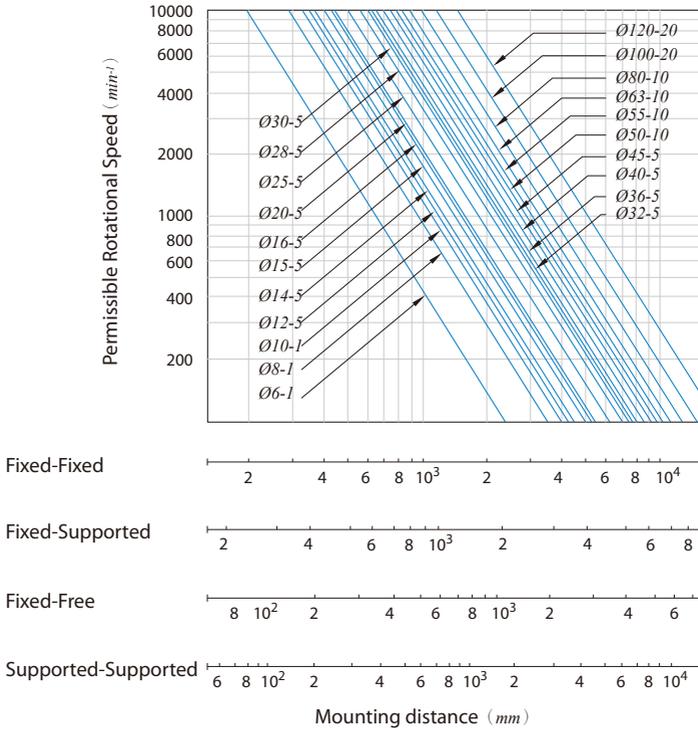


Fig.10 Permissible Rotational Speed

## Notes on Screw shaft design

### Through end thread

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



Fig.11 Incomplete thread



Fig.12 Through end thread

### 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.

### Not effective hardened area

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

### 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

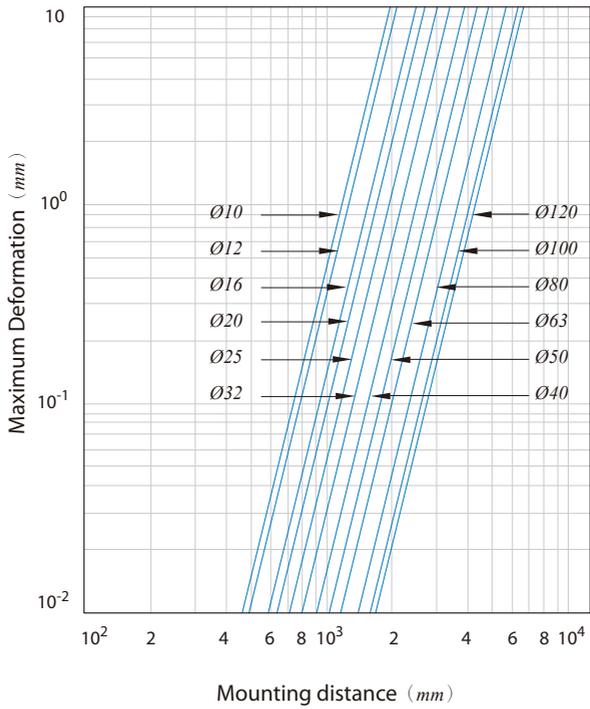
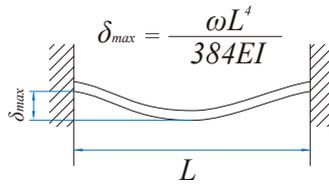
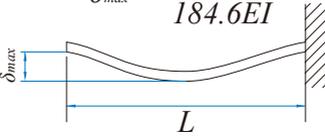


Fig.13 Maximun deformation for fixed-fixed

Fixed-Supported

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


The diagram shows a shaft of length  $L$  fixed at the right end. The maximum deflection  $\delta_{max}$  is indicated at the free end on the left.

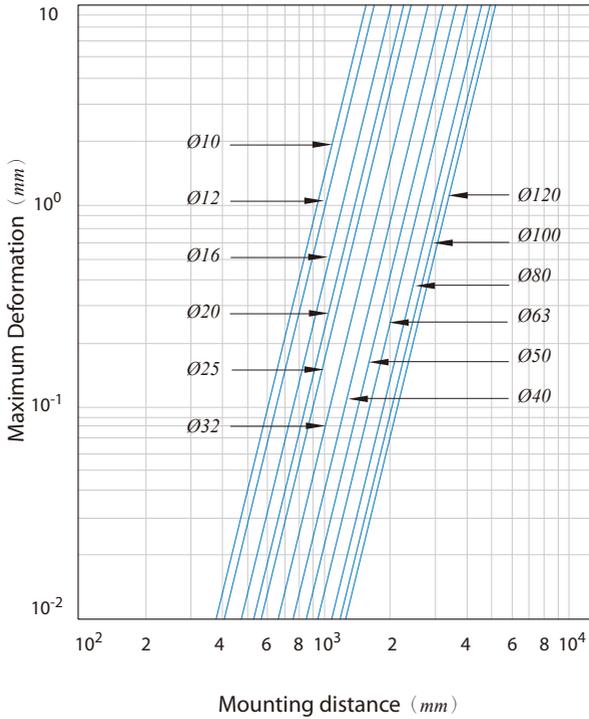


Fig.14 Maximun deformation for fixed-supported

# Design of Ball Nut

## Selecting the Type of Nut

### 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.

### Circulation

#### 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.

#### Internal ball circulation

Advantages:

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

#### Effective turns

Selecting effective turns have to consider required capability; life and rigidity. Refer to the **Table 13**

#### 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.

#### Oil hole

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

Table 13 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

## Calculating the Axial Load

### Horizontal reciprocating moving mechanism

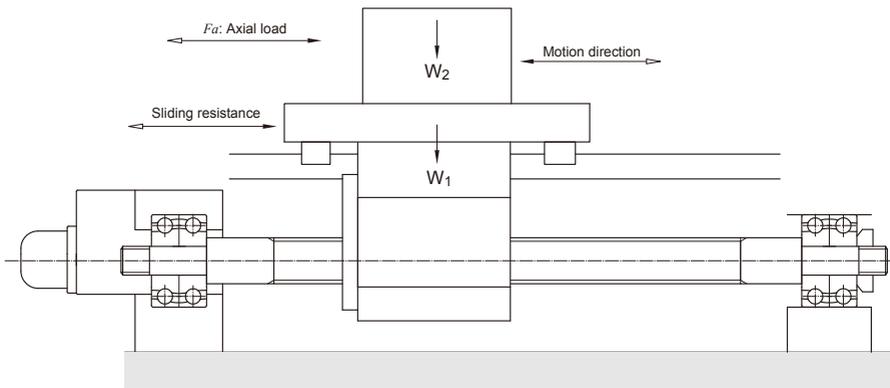


Fig.15 Horizontal reciprocating moving mechanism

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

Acceleration (leftward)  $F_{a_1} = \mu \times mg + f + ma$  .....(5)

Constant speed (leftward)  $F_{a_2} = \mu \times mg + f$  .....(6)

Deceleration (leftward)  $F_{a_3} = \mu \times mg + f - ma$  .....(7)

Acceleration (rightward)  $F_{a_4} = -\mu \times mg - f - ma$  .....(8)

Constant speed (rightward)  $F_{a_5} = -\mu \times mg - f$  .....(9)

Deceleration (rightward)  $F_{a_6} = -\mu \times mg - f + ma$  .....(10)

Here:

**a** Acceleration

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

**m** Total weight (table weight + work piece weight)

**$\mu$**  Friction coefficient of sliding surface

**f** Non-load resistance

## 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)  $Fa_1 = mg + f + ma$  .....(11)

Constant speed (upward)  $Fa_2 = mg + f$  .....(12)

Deceleration (upward)  $Fa_3 = mg + f - ma$  .....(13)

Acceleration (downward)  $Fa_4 = mg - f - ma$  .....(14)

Constant speed (downward)  $Fa_5 = mg - f$  .....(15)

Deceleration (downward)  $Fa_6 = mg - f + ma$  .....(16)

Here:

$a$  Acceleration

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

$m$  Total weight(table weight + work piece weight)

$\mu$  Friction coefficient of sliding surface

$f$  Non-load resistance

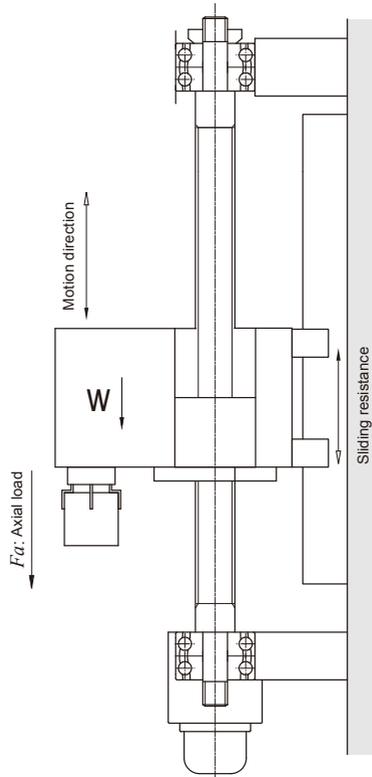


Fig.16 Vertical reciprocating moving mechanism

## 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.

# Rigidity

## 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.

### 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 (17).

$$\delta = \frac{F_a}{K_T} \dots\dots\dots(17)$$

$$\frac{1}{K_T} = \frac{1}{K_S} + \frac{1}{K_N} + \frac{1}{K_B} + \frac{1}{K_H} \dots\dots\dots(18)$$

Here:

- $\delta$  Feed-screw system elastic displacement in the axial direction ( $\mu m$ )
- $F_a$  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 ( $kgf / \mu m$ )

**Axial rigidity of Screw shaft:  $K_s$** 

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

- fixed - free (Axial direction)

$$K_s = \frac{A \times E}{x} \times 10^{-3} \dots\dots\dots(19)$$

Here:

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

- fixed - fixed (Axial direction)

$$K_s = \frac{A \times E \times L}{x(L - x)} \times 10^{-3} \dots\dots\dots(20)$$

Here:

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

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

Fixed-Free

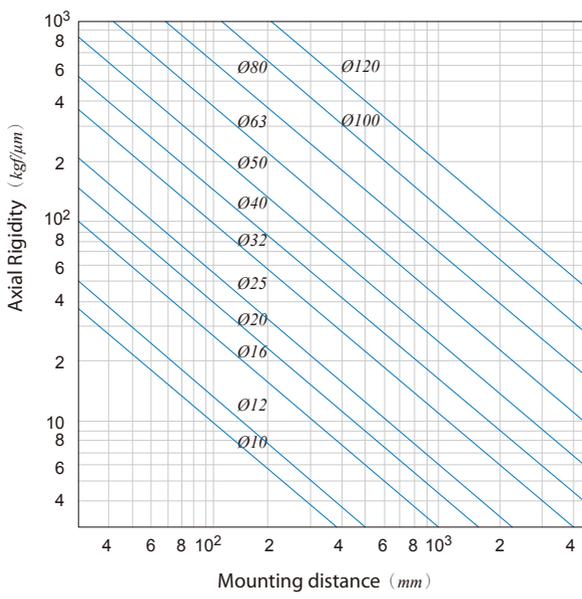
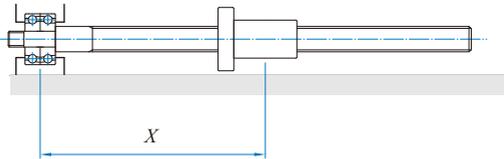


Fig.17 Rigidity of ball screw shaft (Fixed-Free)

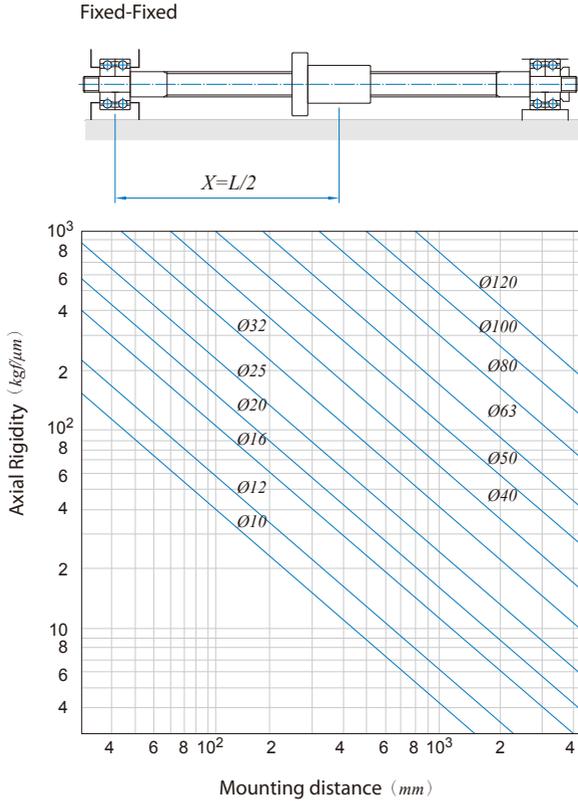


Fig.18 Rigidity of ball screw shaft (Fixed-Fixed)

**Axial rigidity of Nut:  $K_N$**

Computation of the elastic displacement can be using equation (21):

$$\delta_a = \frac{C}{\sin \alpha} \left( \frac{Q^2}{D_w} \right)^{1/3} \times \zeta \text{ (}\mu\text{m)} \dots\dots\dots(21)$$

Here:

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

• 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 (22).

$$K_N = 0.8 \times K \left( \frac{Fa}{0.3Ca} \right)^{1/3} \dots\dots\dots(22)$$

Here:

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

• 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 (23).

$$K_N = 0.8 \times K \left( \frac{F_{ao}}{\varepsilon \times Ca} \right)^{1/3} \dots\dots\dots(23)$$

Here:

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

#### 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 (24).

$$K_B = \frac{3F_{ao}}{\delta_{ao}} \dots\dots\dots(24)$$

Here:

- $\delta_{ao}$  Displacement in the axial direction.

$$\left. \begin{aligned} \delta_{ao} &= \frac{0.44}{\sin \alpha} \left( \frac{Q^2}{D_w} \right)^{1/3} \\ Q &= \frac{F_{ao}}{Z \times \sin \alpha} \end{aligned} \right\} \dots\dots\dots(25)$$

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

### 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.

### Torsional rigidity of the feed-screw system

The factors of positions error caused by twisting are:

- Torsional deformation of screw shaft.
- Torsional deformation of coupling.
- Torsional deformation of motor.

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

### 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.

#### Methods of preloading

- Double-nut method:

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

One is illustrated in **Fig.19** 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".

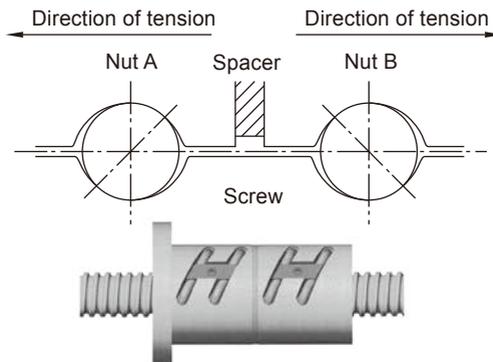


Fig.19 Extensive preload

Illustrated in **Fig.20**, 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".

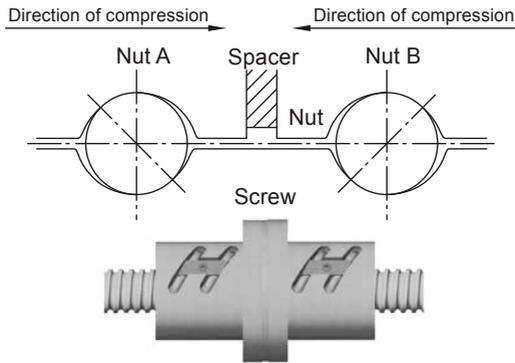


Fig.20 Compressive preload

- Single-nut method:

As that illustrated on **Fig.21**, 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.

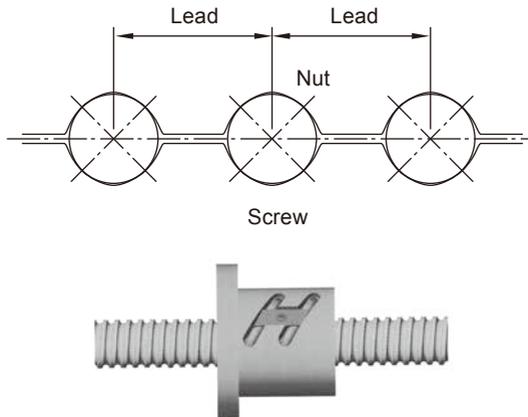


Fig.21 Four-point contact preload

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.22 to preload Ballscrew.

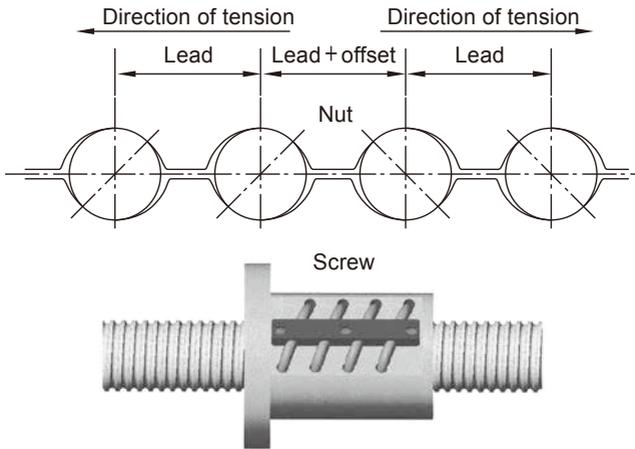


Fig.22 Lead offset preload

### Relation between preload force and elastic deformation

**Fig.23**, Nuts A and B are assembled with preloading spacer. The preload forces on Nut A and B are  $F_{a0}$ , but with reversed direction. The elastic deformation on both Nuts are  $\delta_{a0}$ .

Then there is a external axial force  $F_a$  applied to Nut A as shown on **Fig.24**. The deformation of Nut A and B becomes:

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

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

The load in nut A and nut B are:

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

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

**Note:**  $F_{a'}$  and  $F_p$  are opposite direction.

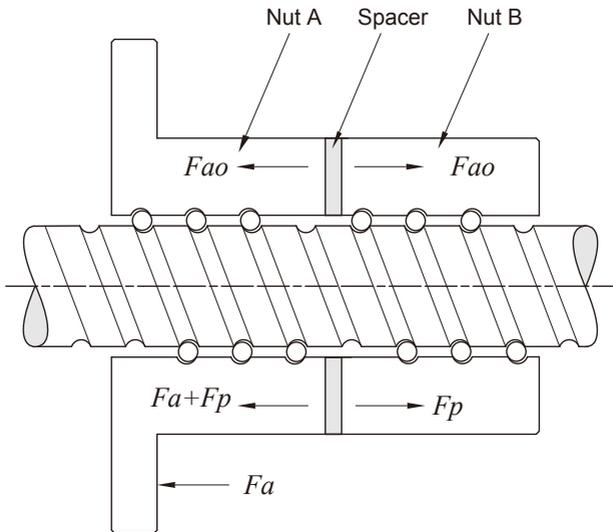


Fig.23 Double-nut positioning preload

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

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

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

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

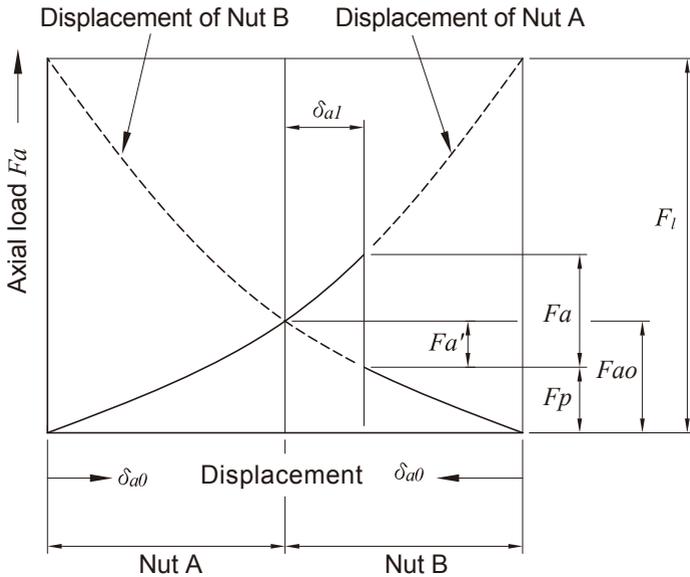


Fig.24 Positioning preload diagram

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.25, 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.

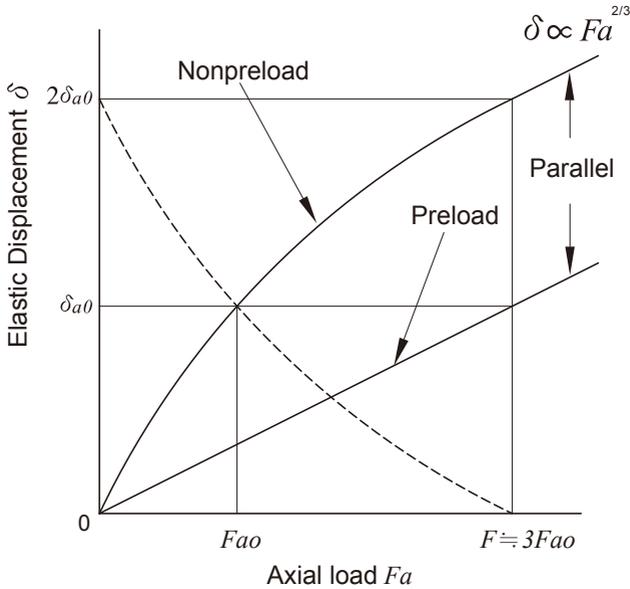


Fig.25 Elastic Displacement of the Ballscrew

---

## Positioning Accuracy

### 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.

### Selecting the Lead Accuracy

Refer to **page[A1-4]**, 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.

### 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 (26).

$$\Delta L_{\theta} = \rho \cdot \theta \cdot L \dots\dots\dots(26)$$

Here:

- $\Delta L_{\theta}$  Thermal displacement ( $\mu m$ )
- $\rho$  Thermal-expansion coefficient ( $12 \mu m/m^{\circ}C$ )
- $\theta$  Screw-shaft temperature change ( $^{\circ}C$ )
- $L$  Ballscrew length ( $mm$ )

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

**To control temperature:**

- Selecting appropriate preload.
- Selecting correct and appropriate lubricant.
- Selecting larger lead for the Ballscrew and decrease the rotation speed.

**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.

**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.

## 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 losing of accuracy caused by wearing happened on thread groove surface, hence to make Ballscrew can no longer be used.

---

## 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.

### **Basic dynamic rate load $C_a$**

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

### **Fatigue life**

#### **Calculating life**

There are three ways to show fatigue life:

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

$$L = \left( \frac{Ca}{Fa \times fw} \right)^3 \times 10^6 \dots\dots\dots(27)$$

$$L_t = \frac{L}{60 \times n} \dots\dots\dots(28)$$

$$L_s = \frac{L \times l}{10^6} \dots\dots\dots(29)$$

here:

- L* Fatigue life (total number of revolutions)(*rev*)
- L<sub>t</sub>* Fatigue life (total operating time)(*hr*)
- L<sub>s</sub>* 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 Table 14)

Table 14 Load factor *fw*

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

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

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

**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 ( $n, t$ ) as X-axis. Getting three kind curves or lines:

- Gradational variation curve (Fig.26[A1-53])

Mean load can be calculated by using equation (30):

$$F_m = \left( \frac{F_1^3 \cdot n_1 \cdot t_1 + F_2^3 \cdot n_2 \cdot t_2 + \dots + F_n^3 \cdot n_n \cdot t_n}{n_1 \cdot t_1 + n_2 \cdot t_2 + \dots + n_n \cdot t_n} \right)^{\frac{1}{3}} \dots\dots\dots(30)$$

Mean rotational speed can be calculated by using equation (31):

$$N_m = \frac{n_1 \cdot t_1 + n_2 \cdot t_2 + \dots + n_n \cdot t_n}{t_1 + t_2 + \dots + t_n} \dots\dots\dots(31)$$

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

• Similar straight line (Fig.27)

When mean load variation curve like similar straight line. Mean rotational speed can be calculated using equation (32).

$$F_m = 1/3(F_{min} + 2F_{max}) \dots\dots\dots(32)$$

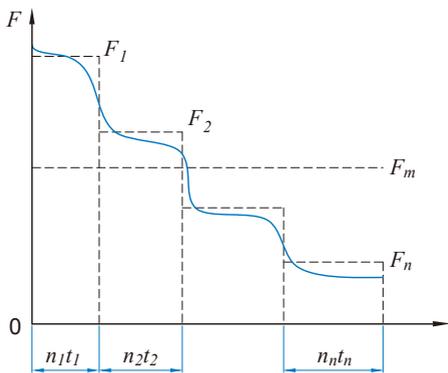


Fig.26 Gradational variation curve's load

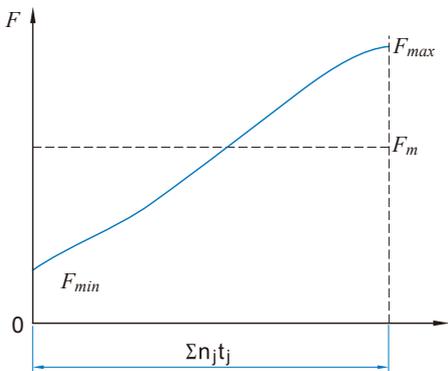


Fig.27 Similar straight line's load

• Sine curve there are two cases

1. When mean load variation curve shown as the **Fig.28** below. Mean rotational speed can be calculated by using equation (33):

$$F_m = 0.65F_{max} \dots\dots\dots(33)$$

2. When mean load variation curve shown as the **Fig.29** below. Mean rotational speed can be calculated by using equation (34):

$$F_m = 0.75F_{max} \dots\dots\dots(34)$$

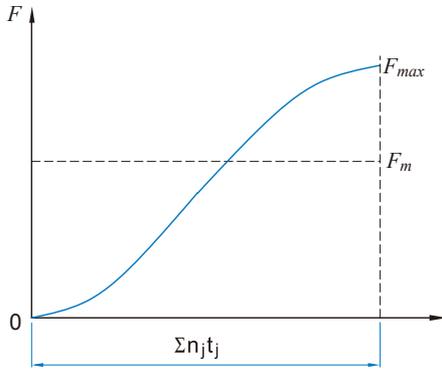


Fig.28 Variation like Sine curve's load (1)

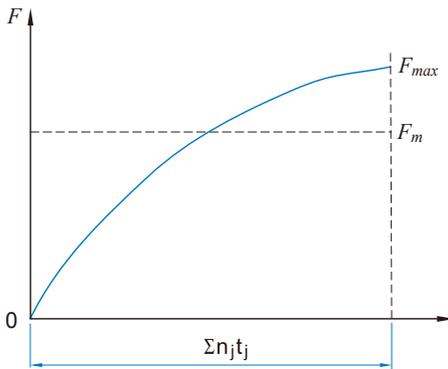


Fig.29 Variation like Sine curve's load (2)

### Affection of installation errors

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

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

Scales of reference calculate for support torque of ball screw, allow **Fig.30**

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  $\mu$ m

conditions

- Axial force  $F_a=300$  kgf
- Radial displacement:0

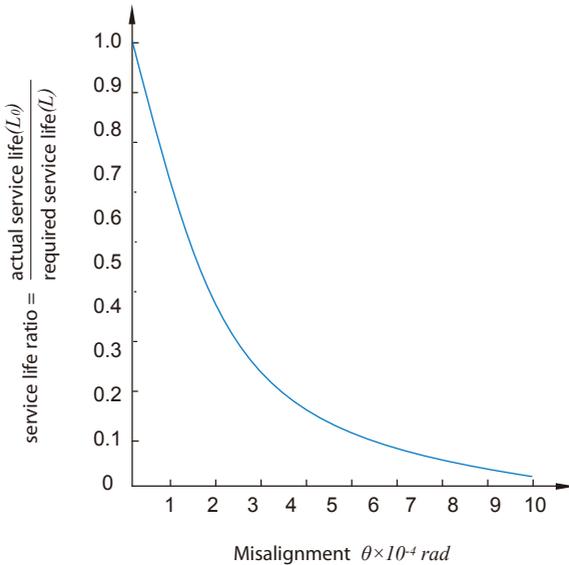


Fig.30 The effect on service life of a radial load caused by misalignment

## 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.

### Basic static rate load $C_o$

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

### Permissible axial load

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

Here:

- $f_s$  Static safety factor  
General industrial machine.....1.2~2  
Machine tool.....1.5~3

## Material and Hardness

### Material and Hardness of *PMI* Ballscrews

Table 15 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

### Hardness factor

If used *PMI*'s standard materials else one, for a surface hardness of less than HRC58, the basic dynamic rate load ( $C_a$ ) and the basic static rate load ( $C_o$ ) must be adjusted. Adjustment is made by the following formula. Show in **Fig.31**

$$C_a' = f_H \times C_a$$

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

Here:

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

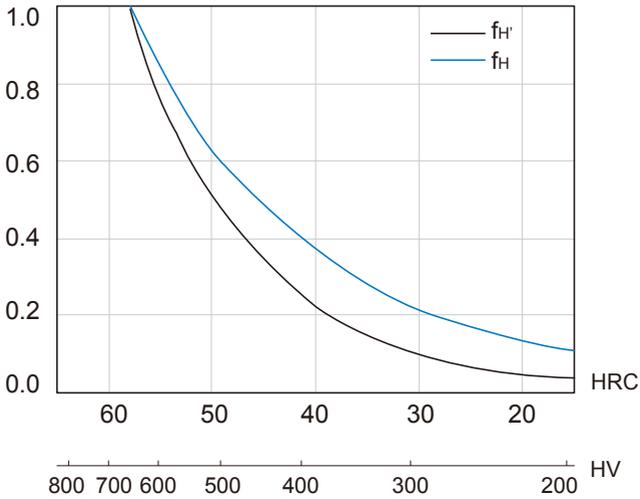


Fig.31 Hardness coefficient

# Heat Treating Inspection Certificate



**PRECISION MOTION INDUSTRIES, INC.**

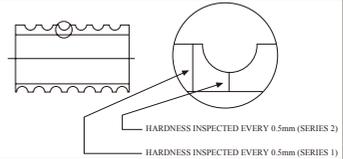
**REPORT FOR HEAT TREATING INSPECTION**



<b>SPECIMEN#</b>	P90227	<b>P.O.NUMBER</b>	
<b>CUSTOMER</b>		<b>SPECIFICATION</b>	
<b>PRODUCT</b>	BALLSCREW	03-016030-1	R38-15B2-FSVC-557-685.8-C4
<b>MATERIAL</b>	50CrMo4QT		
<b>HEATTREAT</b>	INDUCTION SURFACE HARDENING		

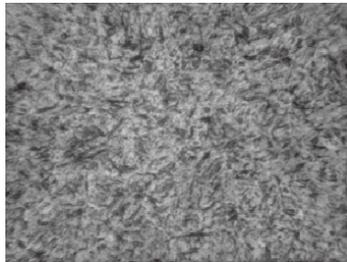
<b>ITEM</b>	<b>INSPECTION DATA</b>
<b>HARDNESS</b>	58 - 62 HRC AT SURFACE
<b>CASEDEPTH</b>	1.5 mm BELOW THREAD ROOT
<b>MICRO-STRUCTURE</b>	Martensite IN SURFACE AREA Sorbite IN CORE AREA
<b>TEMPERING</b>	AT 160 DEGREES CELCIUS

HEATTREATEDARE (SEESKETCH)

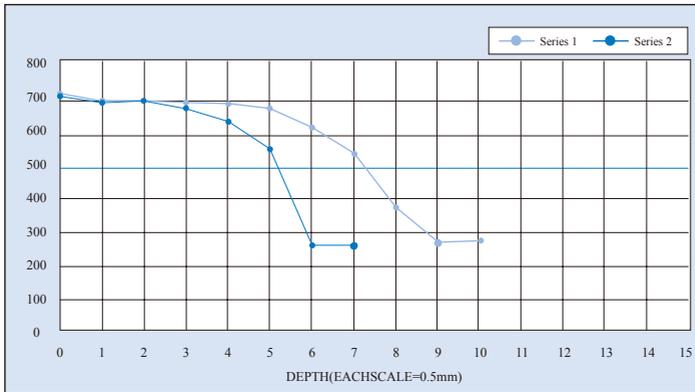


DEPTH	Series1	Series2
0	725	718
1	705	698
2	704	705
3	698	681
4	694	642
5	679	562
6	625	277
7	547	277
8	390	
9	286	
10	288	
11		
12		
13		
14		
15		

MICROSTRUCTURE



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



<b>REMARKS</b>		<b>PASS OR NOT</b>		<b>Q.C.CHIEF</b>		<b>INSPECTOR</b>	
----------------	--	--------------------	--	------------------	--	------------------	--

## 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 16 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 17 calculate of supply lubricate oil

Lubrication method	Principles of inspection and add
oil	<p>Checked and add depending on the tank capacity every week. Oil should be changed when oil is dirty.</p> <p>Calculation of oil Capacity: Capacity of supply oil every 10 min. <math>Q = \frac{\text{Shaft diameter (mm)}}{90} \text{ c.c.} \dots\dots(35)</math></p>

Table 18 calculate of supply lubricate grease

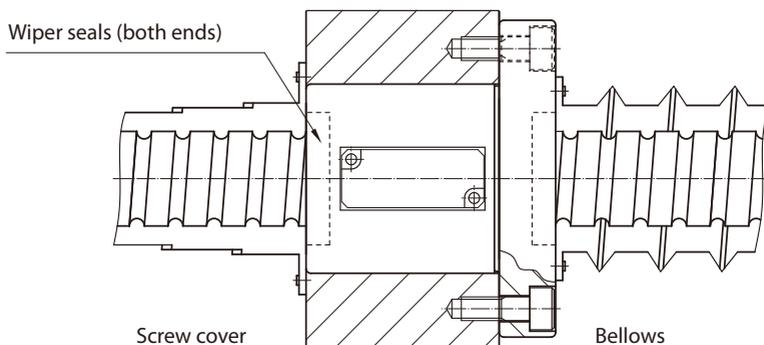
Lubrication method	Principles of inspection and add							
grease	<p>Checked every 2~3 months after begin of the operation and see whether foreign matter. Change grease when dirty.</p> <p>Add grease depending on the use condition and operation environment. The add capacity should be the 50% of the internal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

$$Q = \left[ \left( \sqrt{(\pi \times dm)^2 + Ld^2} \times \pi d^2 \times \text{effective turns} \right) \times \frac{1}{1000} + \left( \frac{\pi L \times (2DG + G^2)}{4} \right) \right] \times \frac{1}{1100} \dots\dots\dots(36)$$

- $Q$  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( $mm$ )

## 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.



Dustproof by screw cover and bellows

# Driving Torque

## Operating Torque of Ballscrew

### Normal Drive

Rotational motion converted to linear motion is called normal drive. The torque required can be obtained by using equation (37)

$$T_a = \frac{F_a \times l}{2\pi \times \eta_1} \dots\dots\dots(37)$$

Here:

- $T_a$  Normal operation torque
- $F_a$  Axial load
- $l$  Lead
- $\eta$  Normal efficiency

### Reverse operation

Linear motion converted rotational motion is called reverse operation motion. The torque required can be obtained using equation (38)

$$T_b = \frac{F_a \times l \times \eta_2}{2\pi} \dots\dots\dots(38)$$

Here:

- $T_b$  Reverse operation torque
- $\eta_2$  Reverse efficiency

### Preload torque

Friction torque due to preload on the Ballscrew, The torque required can be obtained by using equation (39)

$$T_p = k \times \frac{F_{ao} \times l}{2\pi} \dots\dots\dots(39)$$

here:

- $T_p$  Preload torque
  - $F_{ao}$  Preload
  - $k$  Coefficient of preload torque see equation (1)
- $$k = 0.05 \times (\tan\beta)^{-0.5}$$

## Drive Torque of Motor

### Driving torque at constant speed

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

$$T_1 = \left( k \times \frac{F_{a0} \cdot l}{2\pi} + \frac{F_a \cdot l}{2\pi \cdot \eta} + T_B \right) \times \frac{N_1}{N_2} \dots\dots\dots(40)$$

Here:

- $T_1$  Driving torque at constant speed
- $F_{a0}$  Preload
- $F_a$  Axial load
- $F$  Cutting resistance
- $\mu$  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.

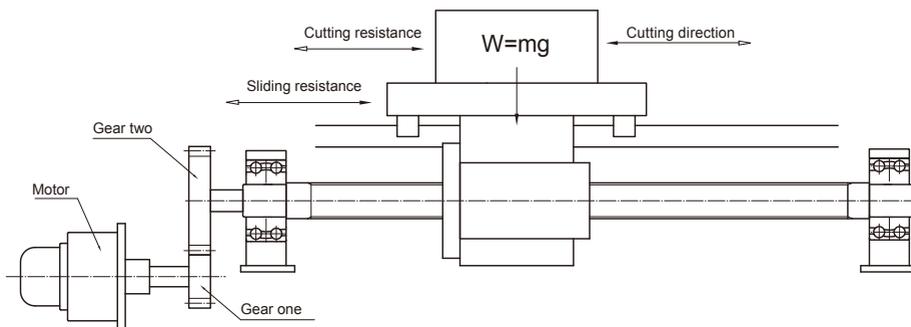


Fig.32 Cutting machine diagram

**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.

$$T_2 = T_l + J \cdot \dot{\omega} \dots\dots\dots(41)$$

$$J = J_M + J_{G1} + \left(\frac{N_1}{N_2}\right)^2 \times [J_{G2} + J_{SH} + J_w + J_C] \dots\dots\dots(42)$$

$$J_w = \frac{m}{g} \left(\frac{l}{2\pi}\right)^2 \dots\dots\dots(43)$$

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)

$$J = \frac{l}{32} \rho \pi D^4 L \quad (kg \cdot m^2) \dots\dots\dots(44)$$

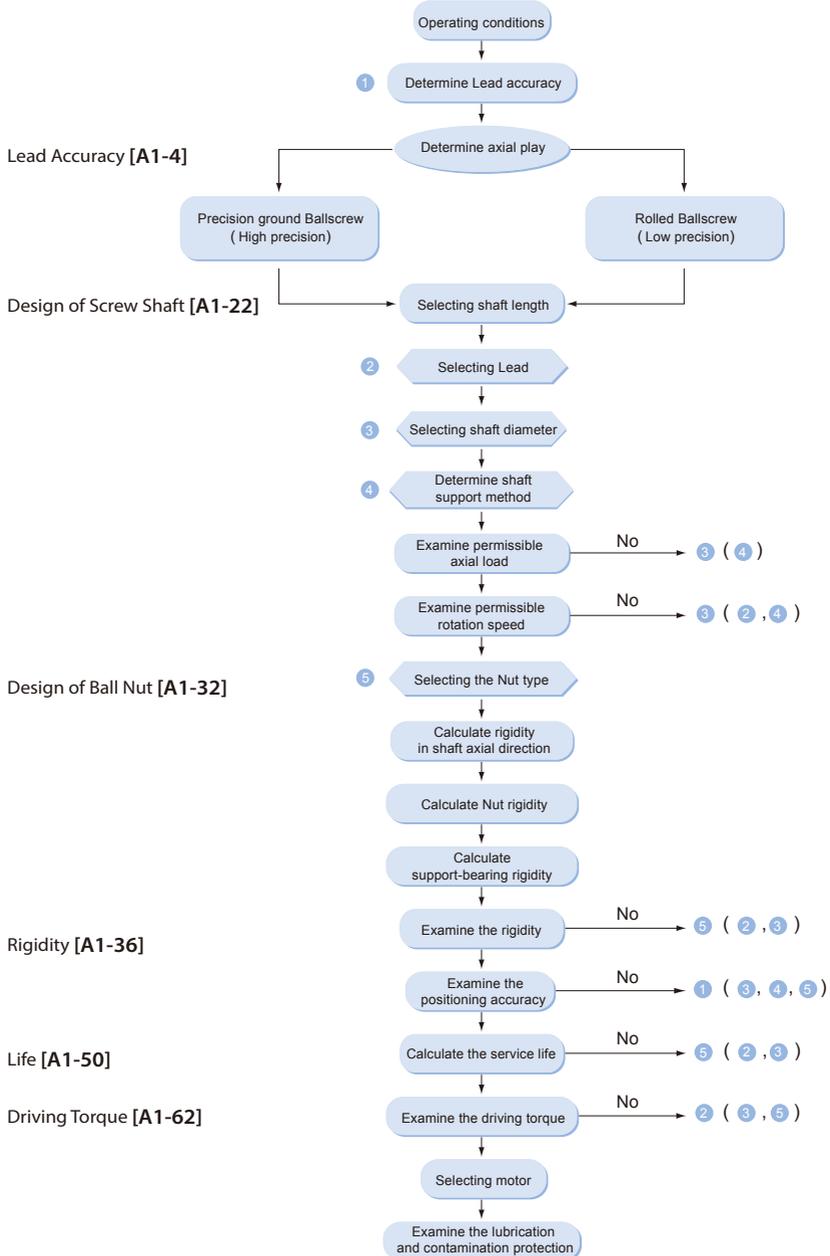
$$= \frac{\pi \gamma}{32g} D^4 L \quad (kg \cdot m^2) \dots\dots\dots(45)$$

$$= \frac{mD^2}{8} \quad (kg \cdot m^2) \dots\dots\dots(46)$$

Here:

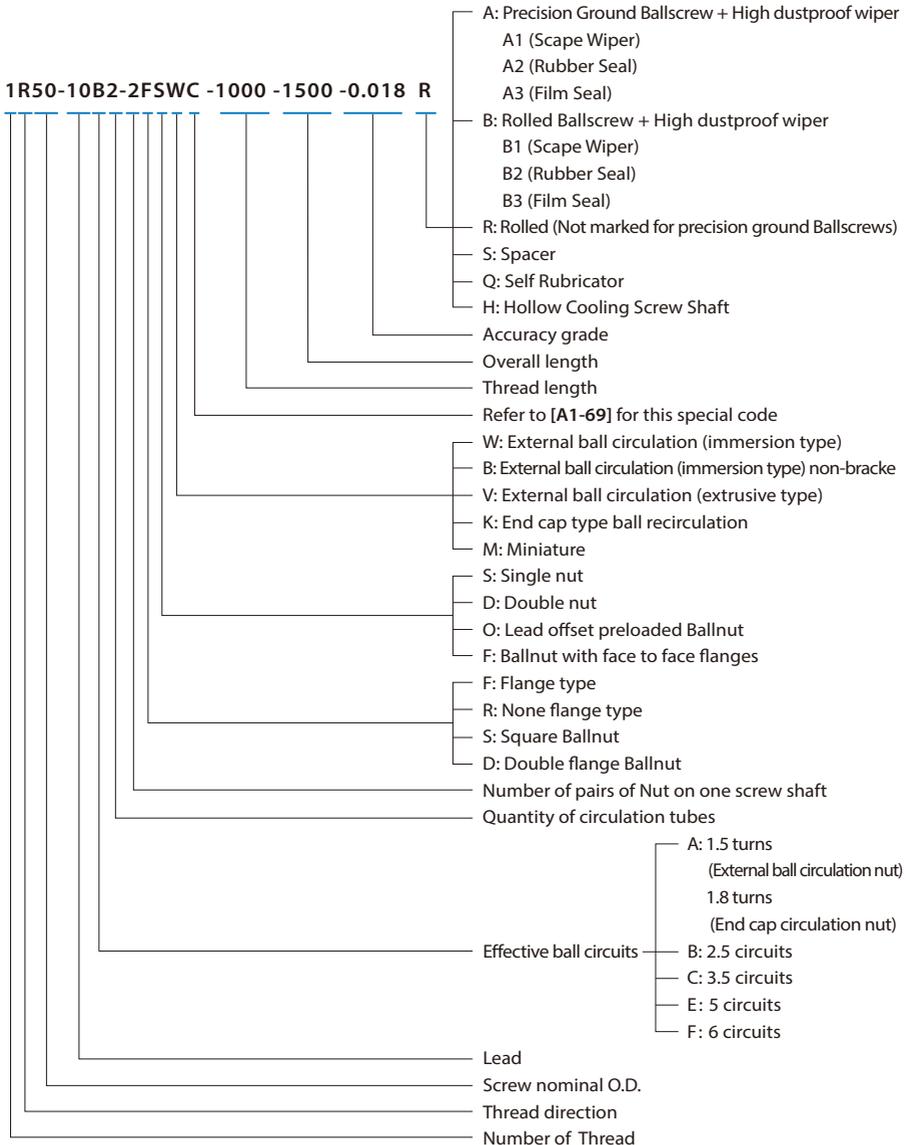
- $\rho$  Material Density
- $\gamma$  Specific Gravity
- $D$  Diameter of Cylinder
- $L$  Length of Cylinder
- $m$  Mass of Cylinder

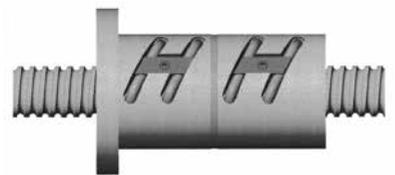
# Flow Chart for Selecting Correct Type of Ballscrew



# Nomenclature of *PMI* Ballscrew

## Nomenclature of External Circulation Ballscrew





TYPE  
FDWC



TYPE  
DFWC



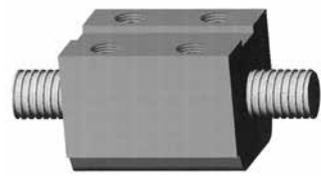
TYPE  
FSWC



TYPE  
FOWC



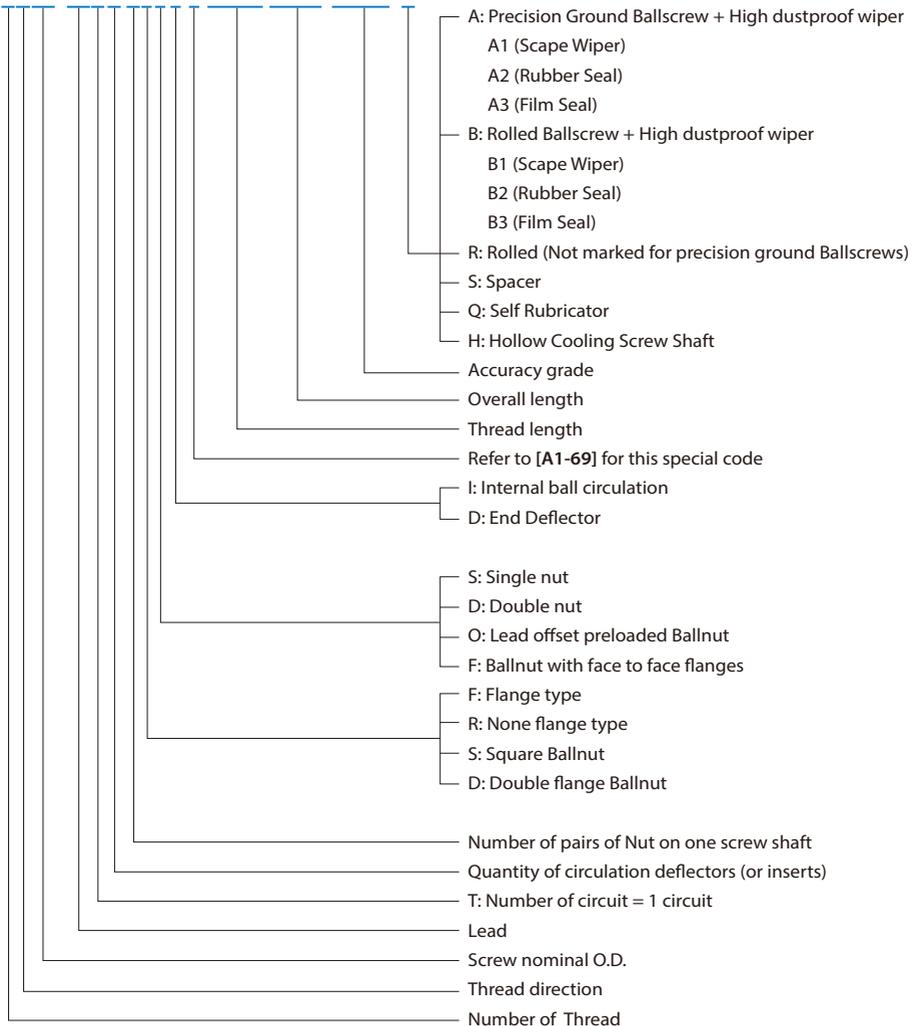
TYPE  
RSWC



TYPE  
SSWC

## Nomenclature of Internal Circulation Ballscrew

1R50-10T 4-2FS I C -1000 -1500 -0.018 R



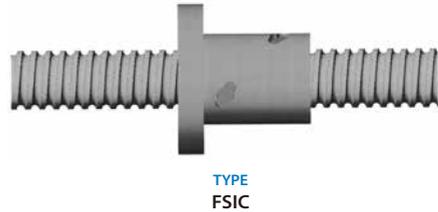
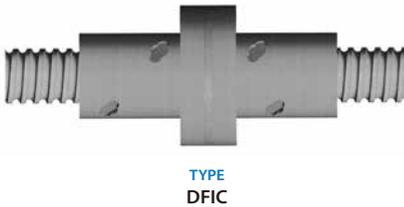
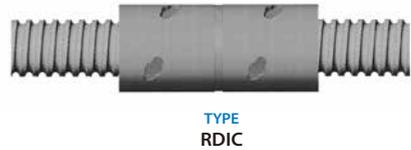
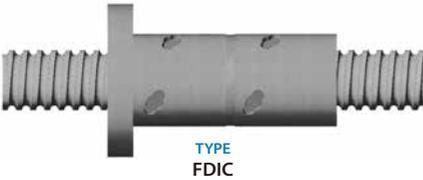


Table 19 Special Code for Nut

<b>C</b>	Ground Grade
<b>W</b>	Rolled Grade
<b>E</b>	High Lead Ballscrews
<b>H</b>	Heavy Load Ballscrews
<b>N</b>	Rolled Grade (DIN 69051 Nut Dimension)
<b>U</b>	Rolled Grade + Seal (DIN 69051 Nut Dimension)
<b>M</b>	Automation Industry Specialized Type
<b>A</b>	Deflector Type Cooling Nut- Recirculation Type
<b>B</b>	Deflector Type Cooling Nut- Direct Passing Type
<b>K</b>	High Lead Type Cooling Nut- Recirculation Type
<b>T</b>	Rotation Nut Type

# Sample Process of Selecting The Type of Ballscrew

## Cutting Machine

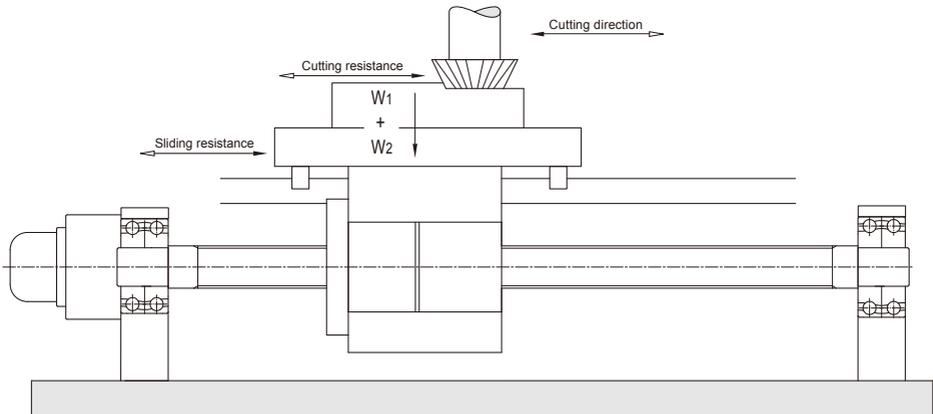


Fig.33 Cutting machine

## Design Conditions

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

## Mechanical Conditions

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

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

## Items to Be Decided

- Screw nominal O.D., Lead, Type of Nut
- Accuracy grade
- Thermal displacement
- Driving motor

### Selecting Screw nominal O.D., Lead, Nut

- Lead ( $l$ ):

The highest rotation speed of motor

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

☉Lead have to be 7mm or more.

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

- Basic dynamic rate load ( $Ca$ )

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

Calculation of mean load and mean rotation

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

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

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

Calculation of basic dynamic rate load

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

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

As per design Conditions:

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

$$fw = 1.2$$

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

If life > 25000 (hours) is needed,

$Ca$  must be > 3756 (kgf)

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

If life > 25000 (hours) is needed,

$Ca$  must be > 3487 (kgf)

- Selecting the type of nut

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

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

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

Unit: (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

- 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 :

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

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

$L = \text{Max. stroke} + \text{Nut length}/2 + \text{Unthread area length}$

$$= 1000 + 100 + 200 = 1300 \text{ (mm)}$$

Screw shaft supported method is fixed-fixed

$$\Rightarrow f = 21.9$$

when  $l = 8 \text{ (mm)}$  .....  $dr \geq 13.5 \text{ (mm)}$

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  $l = 10 \text{ (mm)}$  .....  $dr \geq 10.8 \text{ (mm)}$

If the highest rotational speed reaches 1400 rpm,

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

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

- Considering rigidity

By initial conditions:

Lost motion : 0.02 mm (no load)

Assume total displacement of components (including screw shaft, ballnut and support bearing)

of feed system is 0.016 mm. Thus the unilateral elastic displacement of feed system is  $\Delta L \leq 8 \text{ (}\mu\text{m)}$

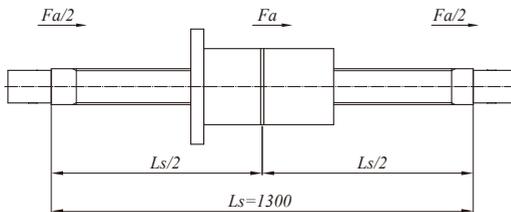
**Axial rigidity of the screw shaft:  $K_S$**

**Elastic displacement of the screw shaft:  $\Delta L_S$**

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

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

From following diagram Using  $x = L/2$



$$\Rightarrow K_S = \frac{\pi \times d r^2 \times E}{L_S} \times 10^{-3}$$

$$\Delta L_S = \frac{F_a}{K_S} = \frac{F_a \times L_S}{\pi \times d r^2 \times E} \times 10^3$$

Here  $F_a$  is sliding resistance of 190 (kgf)

The results are in the **Table 21[A1-76]**

**Axial rigidity of the nut:  $K_n$**

**Elastic displacement of the nut:  $\Delta L_n$**

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

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

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

$\varepsilon = 0.1$ , then

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

The results are in the **Table 21[A1-76]**

Table 21

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

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

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

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

• Length of Ballscrew

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

• Preliminary check

a. Fatigue life

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

$$\approx 83900 \text{ (hours)} \geq 25000 \text{ (hours)}$$

b. Permissible rotational speed

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

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

### Selecting lead accuracy

Positioning accuracy required:  $\pm 0.030/1000 \text{ mm}$  (Max. travel) Refer to **Table 2[A1-6]**, accumulated reference lead deviation ( $\pm E$ ) and total relative variation ( $e$ )

Accuracy grades: C4

$E = \pm 0.025/1250 \text{ (mm)}$

$e = 0.018 \text{ (mm)}$

### Considering thermal displacement

According to the load capability of support bearings, make the specified travel (T) compensation to be  $3^\circ\text{C}$

- Thermal displacement:  $\Delta L_\theta$

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

- Pretension force:  $F_\theta$

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

Specified Travel (T):  $-0.047/1300$

Pretension force: 436 (kgf)

Stretching:  $-0.047 \text{ (mm)}$

## Selecting driving motor

<Required specifications>

The highest rotation speeds is 1500 (rpm)

Time required to reach highest rotational speed is within 0.15 sec.

- Inertial

a. Screw shaft:

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

b. Moving parts:

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

c. Coupling:

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

d. Total of inertial:

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

- Driving torque

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

a. Preloading torque:

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

$$k = 0.18$$

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

b. Friction torque

Rapid feed:

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

Light cutting:

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

Heavy cutting:

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

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

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

- Selecting driving motor

<Selecting conditions>

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

b. Rated torque:  $T_M > T_L$

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

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

◎ Motor specifications:

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

- Check required time period for reaching highest rotation speed

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

Here

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

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

$T_L$  : Rotation Torque (rapid)

$f$  : Safe factor (choose 1.4 for this case)

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

This above motor specifications match design needs.

### Calculating the stress of the Ballscrew

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

( $dr$  is screw shaft thread root diameter)

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

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

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

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

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

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

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

◎ So the Ballscrew selected is safe.

#### Calculating the buckling load of the screw shaft

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

◎ So the Ballscrew selected is safe.

## High Speed Porterage Apparatus (Horizontal application)

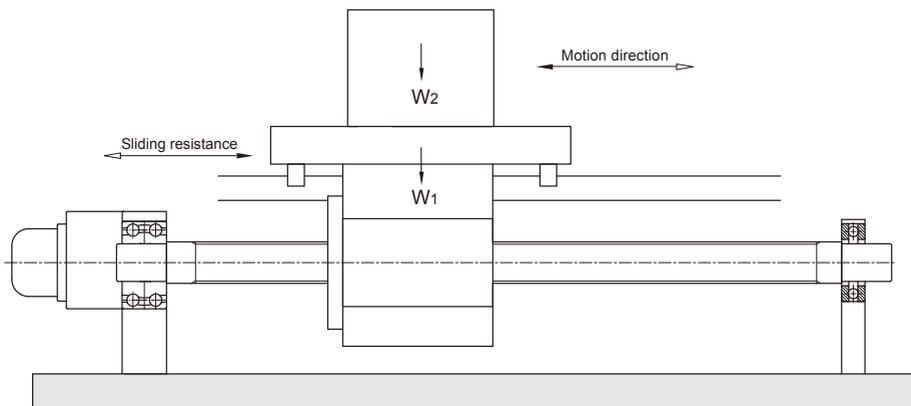


Fig.34 High speed porterage apparatus

## Design Conditions

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

## Motion Conditions

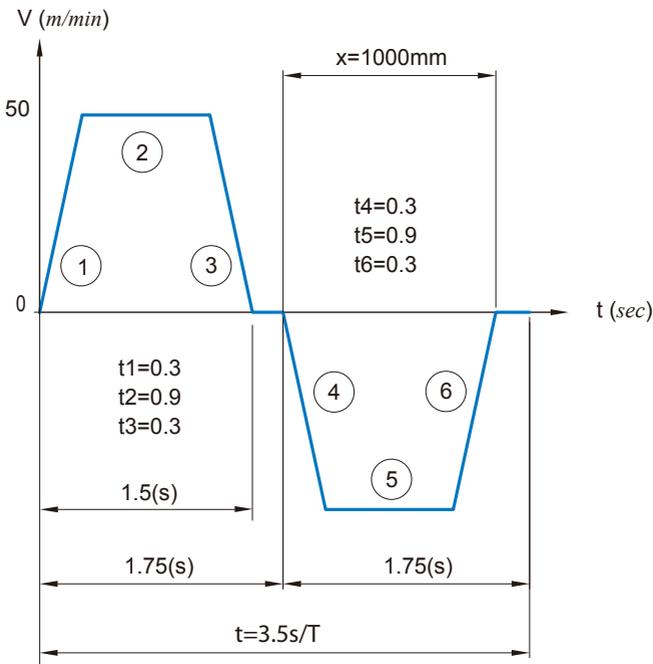


Fig.35 Portage apparatus v-t diagram

## Items to be decided

- Screw nominal O.D., Lead
- Accuracy grade
- Type of nut
- Driving motor

### Selecting Screw nominal O.D., Lead

- Lead ( $l$ )

The highest rotation speed of motor

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

☉ Lead have to be 18 mm or more.

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

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

- Initial selection of screw shaft length

$L = \text{Max. travel} + \text{Nut length} + \text{Unthreaded area length}$

$$= 1000 + 100 + 100 = 1200 \text{ (mm)}$$

- 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 :

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

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

$L = \text{Max. travel} + \text{Nut length}/2 + \text{Unthread area length}$

$$= 1000 + 50 + 100 = 1150 \text{ (mm)}$$

Screw shaft support method is fixed-supported

$$f = 15.1$$

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

If the high rotational speed is 2500 *rpm*,

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

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

- Considering service life

First to analyze **Fig.35[A1-83]** (V-t diagram)

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

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

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

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

a. Running distance during acceleration

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

b. Running distance during constant speed

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

c. Running distance from highest speed to stop

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

d. The line segment

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

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

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

e. The line segment

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

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

f. The line segment

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

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

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:

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

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

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

h. Calculation of life

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

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

©Above conforms design requirements.

**Selecting accuracy grade**

Positioning accuracy of  $\pm 0.1/1000$  mm (Max. travel) From page.A1-6

Accuracy grade: C5

$E = \pm 0.040/1000$

$e = 0.027$

**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

**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

• Inertial

a. Screw shaft:

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

b. Moving parts:

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

c. Coupling:

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

d. Total of Inertial:

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

- Driving torque

a. During constant speed:

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

$$\eta = 0.9$$

b. During acceleration

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

preselect motor, and give the specifications for the rate inertia

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

c. During deceleration

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

- Selecting driving motor

<Selecting conditions>

a. The highest rotation speed:  $N_{max} \geq 3000 \text{ (rpm)}$

b. Rated torque -----  $T_M > T_L$

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

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

◎ Motor specifications:

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

- Effective torque:

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

◎ It conforms to design requirements.

- Time required to reach highest rotational speed.

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

Here:

$J$  : Total inertia

$$T_M' = 2 \times T_M$$

$T_L$  : Rotation Torque (rapid)

$f$  : Safe factor (choose 1.4 for this case)

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

⊙ It conforms to design requirements.

### Calculating the stress of the Ballscrew

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

$$dr = 25 + 1.4 \cdot 762 = 21.238 \text{ (mm)}$$

( $dr$  is screw shaft thread minor diameter)

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

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

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

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

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

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

⊙ So the Ballscrew selected is safe.

### Calculating the buckling load of the screw shaft

$$\begin{aligned} P &= \alpha \frac{\pi^2 nEI}{L^2} = m \frac{dr^4}{L^2} \times 10^3 \\ &= 10.2 \times \frac{22.425^4}{1160^2} \times 10^3 \\ &= 1917 \text{ (kgf)} > F_{max} (22.14 \text{ kgf}) \end{aligned}$$

⊙ So the Ballscrew selected is safe.

## Vertical Porterage Apparatus

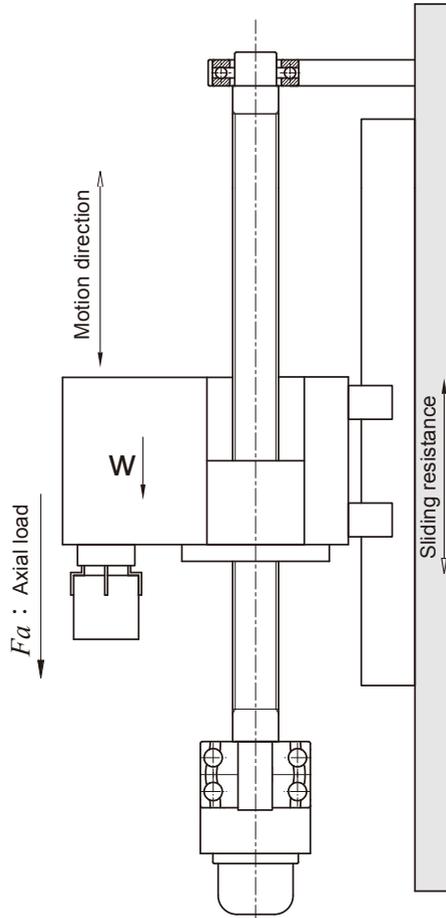


Fig.36 Vertical porterage apparatus

## Design Conditions

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

## Motion Conditions

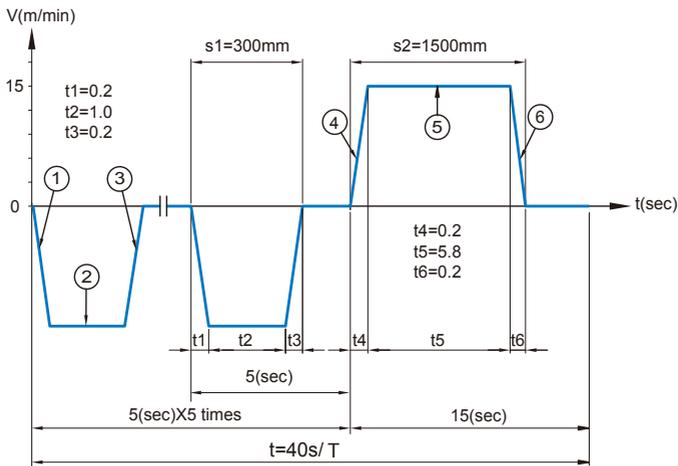


Fig.37 Porterage apparatus v-t diagram

## Items to be decided:

- Accuracy grade
- Screw nominal O.D., Lead
- Driving motor

## Selecting accuracy grades

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

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

Refer to **Table 2[A1-6]**, accumulated reference lead deviation ( $\pm E$ ) and total relative variation (e)

Accuracy grades C7

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

☉ So the portorage apparatus can use Rolled Ballscrew.

## Selecting screw nominal O.D., Lead

- Lead ( $l$ ) :

The highest rotation speed of motor

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

☉ Lead have to be  $10 \text{ mm}$  or more.

(As per **PMI** catalog : select  $10 \text{ mm}$  for further analysis)

- Permissible axial load

Setting up is positive.

a. Force during acceleration (downward)

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

$$f = \mu (W_1 + W_2) \times g = 0.01(300 + 50) \times 9.8 = 35 \text{ (N)} \text{ (Friction)}$$

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

b. Force during constant speed (downward)

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

c. Force during deceleration (downward)

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

d. Force during acceleration (upward)

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

e. Force during constant speed (upward)

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

f. Force during deceleration (upward)

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

So

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

• Buckling load:

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

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

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

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

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

• The length of screw shaft

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

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

Slenderness ratio: 60 or less

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

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

- Permissible rotational speed

Assume the supporting ends are fixed-supported

So the permissible rotational speed:

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

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

$$\geq 30$$

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

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

- Calculating of basic dynamic rate load:

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

Mean load

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

Mean rotation

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

As per design condition:

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

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

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

☉ If the life required is  $> 20000$  (hours),  
 $Ca$  has to be  $> 3426$  (kgf)

- Calculating basic static rate load:

$$\begin{aligned} Co &= F_{max} \times f_s & f_s &= 2.0 \\ &= 7806 \text{ (N)} \\ &= 800 \text{ (kgf)} \end{aligned}$$

$Co$  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)

### Selecting driving motor

<Required specifications>

The highest rotation speeds is 1500 mm/min

Time required to reach highest rotational speed is within 0.2 sec.

- Inertial

a. Screw shaft:

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

b. Moving parts:

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

c. Coupling:

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

d. Total of Inertial:

$$GD_L^2 = GD_s^2 + GD_w^2 + GD_j^2 = 334.6 \text{ (kgf} \cdot \text{cm}^2)$$

• Driving torque:

(1)Friction torque

a.Acceleration (downward):

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

b.Constant speed (downward):

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

c.Deceleration (downward):

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

d.Acceleration (upward):

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

e.Constant speed (upward):

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

f.Deceleration (upward):

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

(2)Preloading torque

$$T_p = k \times \frac{F_{a0} \times l}{2\pi} \quad \therefore F_{a0} = 0 \quad \therefore T_p = 0$$

(3)Torque required for acceleration:

$$\begin{aligned} T_7 &= J \cdot \omega \\ &= (J_L + J_M) \times \frac{2\pi n}{60t_1} = \frac{(178 + 120)}{4 \times 980} \times \left( \frac{2\pi \times 1500}{60 \times 0.2} \right) = 59.7 \text{ (kgf}\cdot\text{cm)} = 585 \text{ (N}\cdot\text{cm)} \\ G D_M &= 120 \text{ (kgf}\cdot\text{cm}^2) \end{aligned}$$

(4) Total torque:

a. Acceleration (downward):

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

b. Constant speed (downward):

$$T_{l1} = T_2 = 600 \text{ (N}\cdot\text{cm)}$$

c. Deceleration (downward):

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

d. Acceleration (upward):

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

e. Constant speed (upward):

$$T_{l2} = T_5 = 610 \text{ (N}\cdot\text{cm)}$$

f. Deceleration (upward):

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

The maximum torque takes place at the time of acceleration.

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

- Selecting driving motor

<Selecting conditions>

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

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

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

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

© Motor specifications:

Output	$W_M = 2000$ (W)
Highest rotation speeds	$N_{max} = 1500$ (rpm)
Rated torque	$T_M = 13$ (N.m)
Rotor inertia	$GD_M^2 = 120$ (kgf.cm <sup>2</sup> )

- Effective torque:

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

© It conforms to design requirements.

**Calculating the stress of the Ballscrew**

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

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

$$= 4.04 \text{ N/mm}^2$$

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

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

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

$$= 1.72 \text{ N/mm}^2$$

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

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

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

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

( $dr$  is screw shaft thread root diameter)

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

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

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

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

©So the Ballscrew selected is safe.

**Calculating the buckling load of the screw shaft**

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

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

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

©So the Ballscrew selected is safe.

# PMI Ballscrew 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.

## Introduction to Hollow Cooling Screw Shaft

The hollow cooling system is designed by PMI (Fig.38) 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.

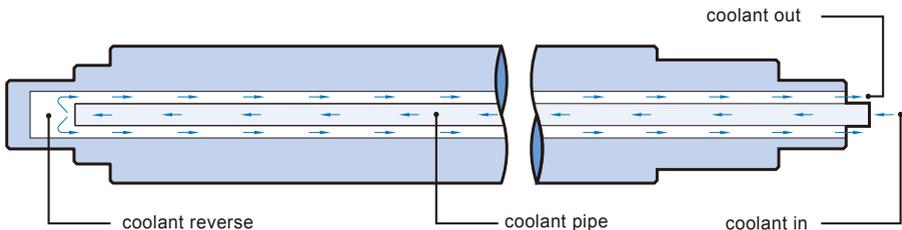


Fig.38 Hollow cooling diagram

## Patent of Hollow Cooling Screw Shaft

### Hollow cooling system

Features:

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



Fig.39 Hollow cooling system

### Cooling entrance

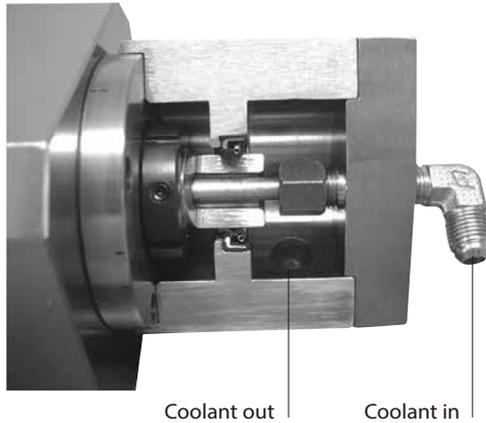


Fig.40 Cooling entrance

## End sealing

Features: Easy for installing, disassembling and maintenance.

## Coolant pipe support installation

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

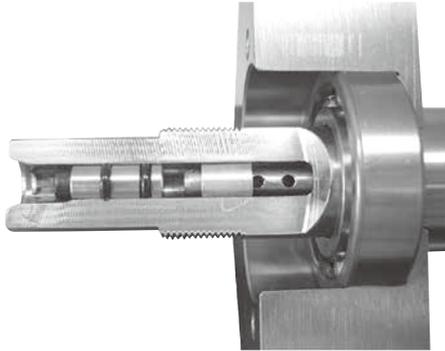


Fig.41 End sealing structure

## Thermal control experiment

### Test condition

Screw nominal O.D. :  $\varnothing 40 \text{ mm}$   
Lead:  $10 \text{ mm}$   
Rotation speed:  $1000 \text{ min}^{-1}$   
Speed:  $10 \text{ m/min}$   
Load:  $400 \text{ kgf}$   
Slideways: Box ways

## 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.

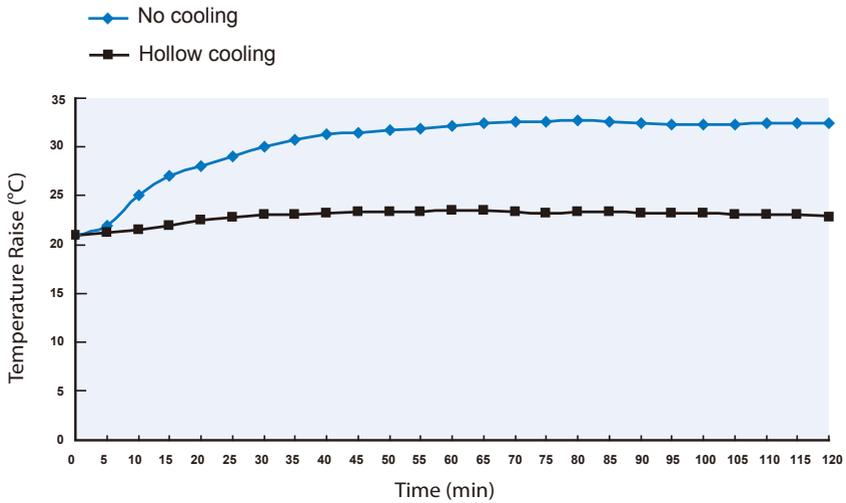


Fig.42 The results of experiment

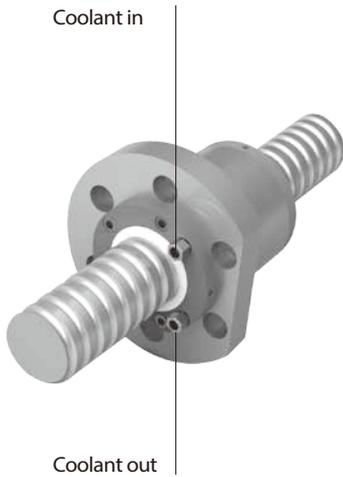
## Nut Cooling

### The principle of design

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

### Type A - Recirculation Type cooling

#### Single Nut Cooling



#### Double Nut Cooling

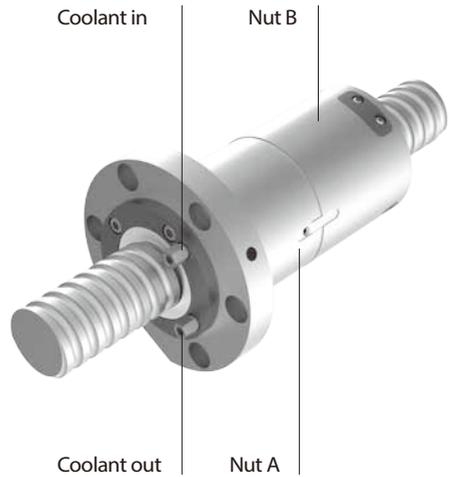


Fig.43 Single nut cooling and Double nut cooling diagram

Table 21 Recirculation type cooling nut- Testing Parameters

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

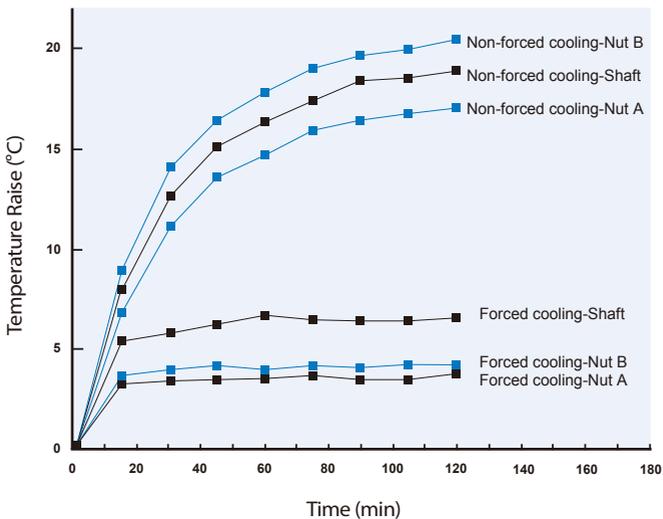


Fig.44 The results of experiment

### **Type B - Direct passing type cooling**

Cooling liquid at the same time enter the cooling channel of nut by direct passing, it's better cooling rate than recirculation channel type.

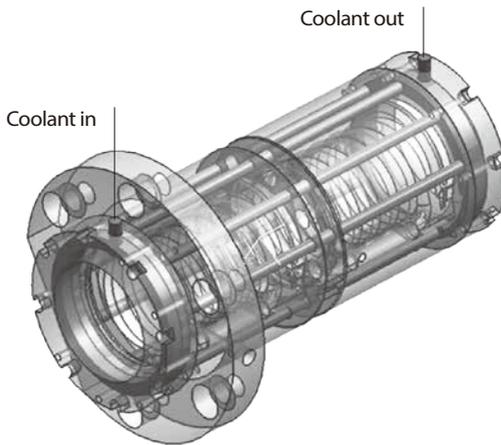


Fig.45 Direct passing type

## **Characteristics**

### **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.

### **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.

### **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.

Table 22 Recirculation type and Direct passing type cooling nut- Testing Parameters

Model no.	R45-12T5-FDDA-1274-1569-0.018 R45-12T5-FDDB-1274-1569-0.018
Operation travel(mm)	690
Feed speed(m/min)	7.2
Mean rotation (rpm)	550
Acceleration (m/s <sup>2</sup> )	5
Preload (kgf )	392
Table weight (kgf )	250
Mounting method	fixed-supported
Coolant	Mobil Velocite oil no.3 (ISO VG 2)
Coolant flow (L/min)	3.1
Coolant Temperature (°C)	Room temperature $\pm 0.5^{\circ}\text{C}$

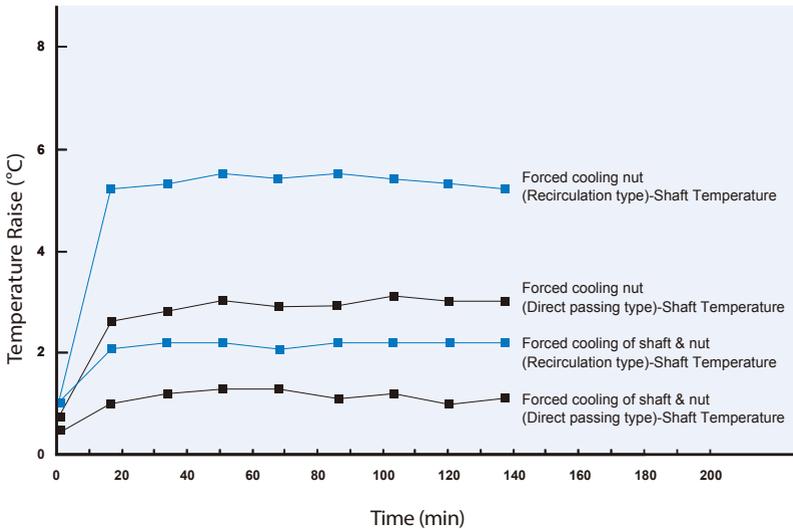


Fig.46 Recirculation type &amp; Direct passing type Comparison

---

## Nomenclature

Example: R45-12T5-FDDA-700-800-0.008

**A** (Recirculation type cooling)

**B** (Direct passing type cooling)

## Cooling Nut Applications

CNC Machine / Precision Machine / High Speed Machine / Medical equipment

## Ball screw of High Dustproof

The ballscrew which is applied to particular environment is easily affected by foreign matters like metal and wood dust intruding inside the screw and affecting the lifetime. In order to prevent from this, high dust-proof series accessories are designed. The special groove design of ballscrew can make the internal dust-proof and sealed washer of wiper fully attached the surface of whorl, and achieves the double effect of dust-free and dust-proof.

As the ballscrews 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 dust.

### Type A1: Scrape Wiper

Scrapers specially developed for ballscrews, with a multi-layered contact structure that ensures effective dust removal, with a reduced mounting surface spring, threads are more closely matched, making for a better scraping capacity, the outer ring of the scraper is clamped by a spring. As the scraper gradually wears, the preload of scraper is automatically adjusted. The shaft ends of the ballscrew should not be larger than the root diameter ( $\psi dr$ ). If you have any questions concerning the size of the rest area of ballscrew, please contact **PMI** engineers.

#### Pioneering Design

Greatly improves dustproof effect

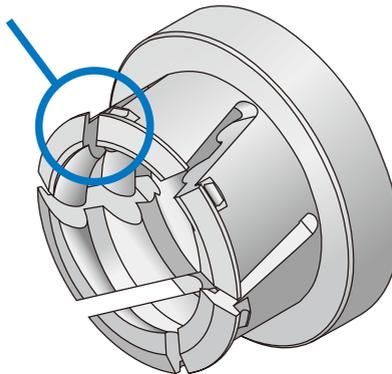
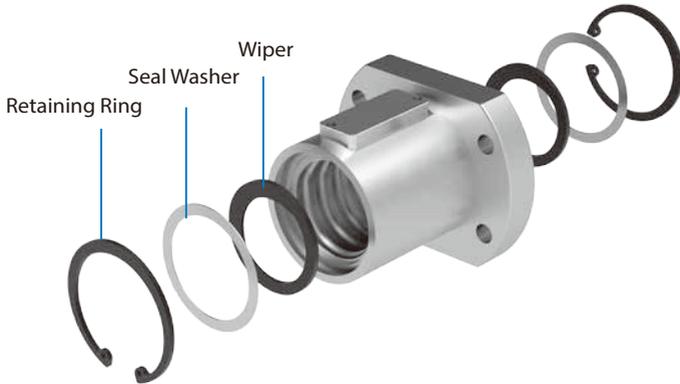


Fig.47 Scrape Wiper

## Type A2 : Rubber Seal

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



Assembly of rubber seal

Table 23 High dustproof Test Conditions

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

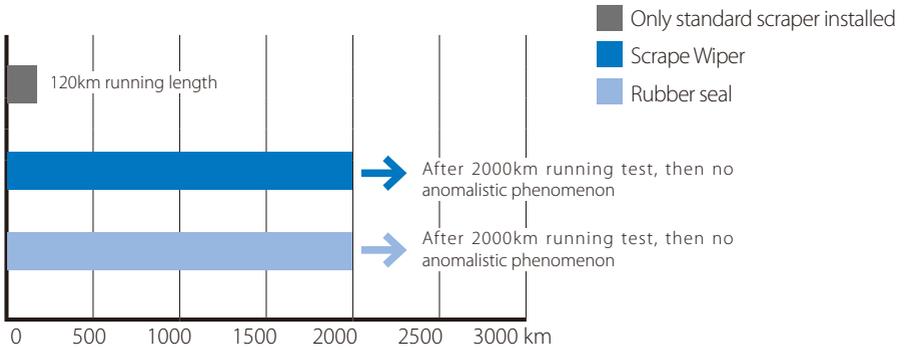


Fig.48 Dustproof performance Comparison

### Type A3: Film Seal

The dustproof seals develop focus on general tool machine industrial that doesn't obviously increase of preload torque and temperature rise. Inhibit the grease leakage and scattering achieve cleaner operating environment. Provide the kind of seals that have better strength, service life and prevent fine dust or metal bit into the nut.

#### Heat generates and preload torque

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

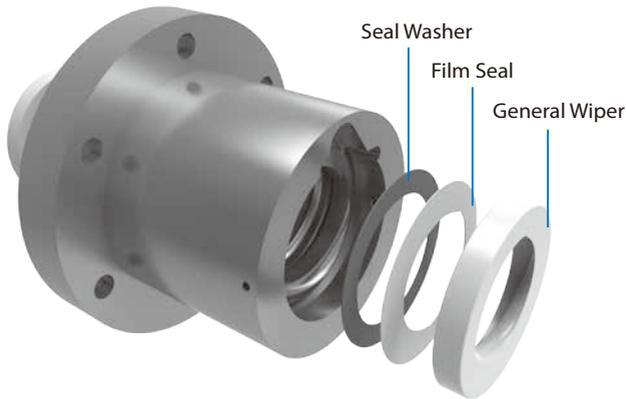


Fig.49 Assembly of a Film seal

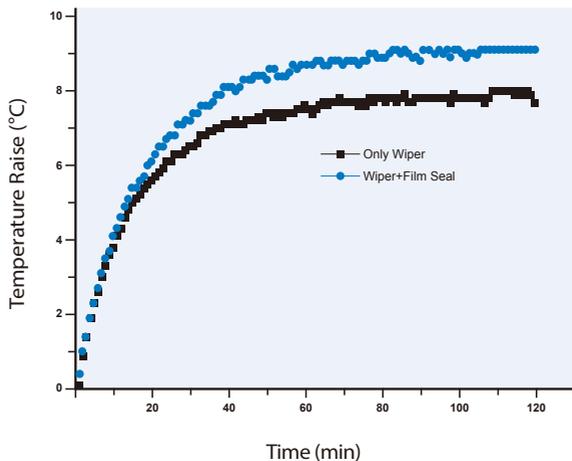


Fig.50 Heat generation comparison

### Nomenclature

Example: R 32-10 B2-F S V E-600-700-0.008 A1

A1 (Precision Grade + Scrape Wiper), A2 (Precision Grade + Rubber Seal),

A3 (Precision Grade + Film Seal)

B1 (Rolled grade + Scrape Wiper), B2 (Rolled Grade+ Rubber seal type),

B3 (Rolled grade + Film Seal)

### Application of High Dustproof Ballscrew

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

---

## Spacer Ball Screw

### Structure and Features

The Ball Screw with the Spacer eliminates collision and friction between balls and increases the grease retention. This makes it possible to achieve a low noise, extends the lubrication maintenance interval and outstanding sliding.

### Features

#### Low Noise, Soft Noise Tone and High Accuracy

With Spacer can avoid the interference sound among balls. And due to non-mutual friction thus increase heat generation, keep the accuracy in the range.



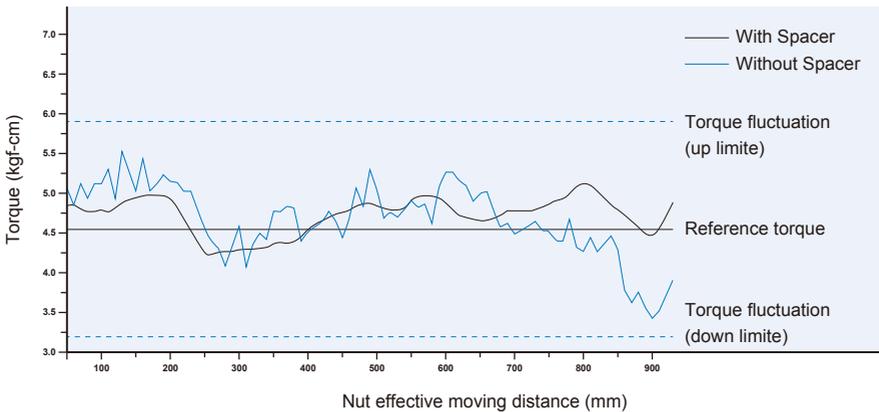
#### Extend the Maintenance Interval

The friction between the balls has been eliminated; the oil storage grooves design of Spacer and grease retention has been improved, the long-term maintenance-free operation is achieved.



### Smooth Motion

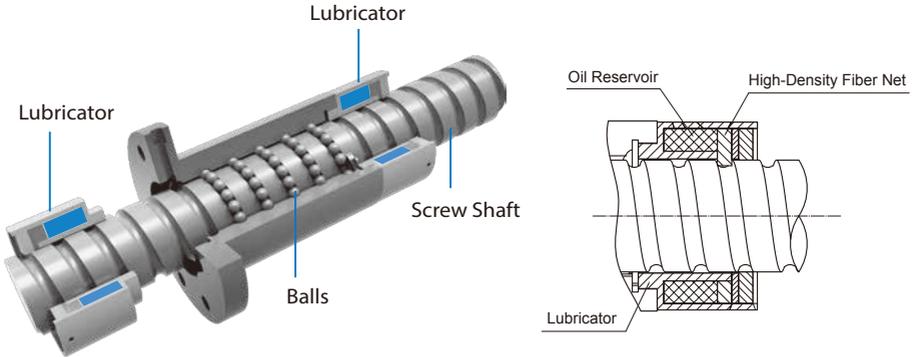
The use of a Spacer eliminates the friction between the balls, improves the torque feature, minimizes the torque fluctuation, and keeps constant speed during low-speed, thus high positioning accuracy to be achieved.



### Self-Lubricant Unit- Q Lubricator

*PMI* lubricator unit is designed with an oil reservoir which equipped with a high-density fiber net. The lubricator feeds the right amount of lubricant to the raceway on the ballscrew. This allows an oil film to continuously be formed between the steel balls and the raceway, and drastically extends the lubrication and maintenance intervals.

## Construction



## Features

Contrary to the oil losing problem caused by ordinary lubrication, the Q lubricator effectively and evenly distributes adequate amount of oil onto ball raceway during the movement.

- Lengthening the maintenance intervals
- Environmentally Friendly
- Without the installation of other lubricating device, the cost of overall equipment cost is reduce.

### Fits the Following Type of Nuts

Internal Ball Circulation Nuts, External Ball Circulation Nuts, End Deflector Series

PMI Precision Ground BallScrew

## 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 [A1-29] 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.

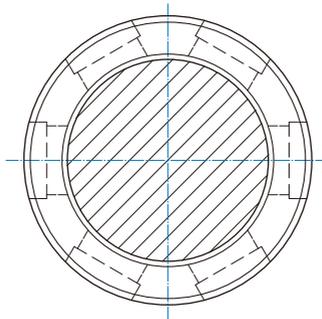
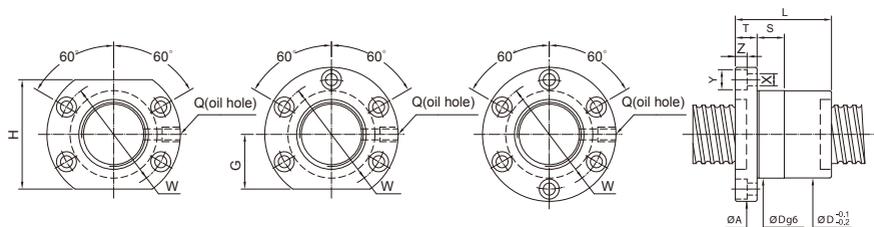


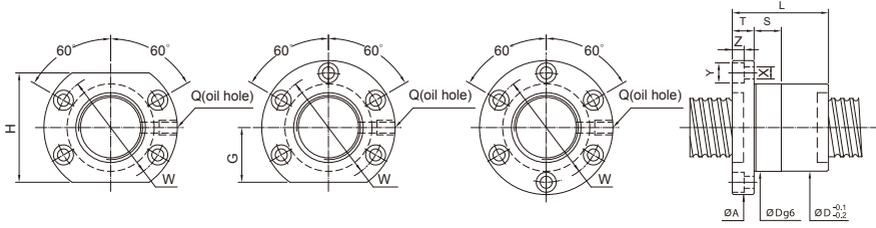
Fig.1 Internal ball circulation's side view

# FSIC



Unit:mm

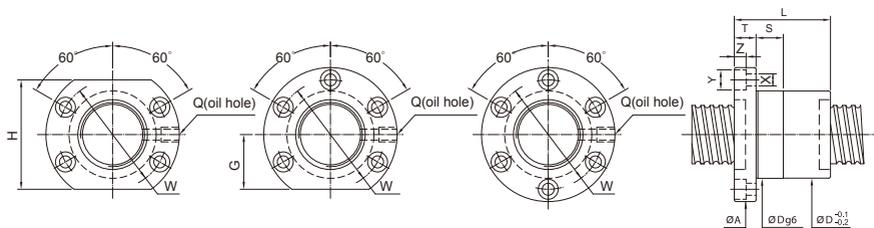
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD (kgf)		NUT		FLANGE				FIT		BOLT			OIL HOLE Q	STIFFNESS kgf/μm	
O.D.	LEAD			Dynamic (1×10 <sup>5</sup> REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	S	X	Y	Z			
14	3	2	3	260	460	26	37	46	10	36	-	-	10	4.5	8	4.5	M6×1P	13	
	4	2.381	3	420	805	26	42	46	10	36	20	40	10	4.5	8	4.5	M6×1P	14	
		2.778	4	840	1870	26	47	46	10	36	20	40	10	4.5	8	4.5	M6×1P	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	48.5	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	M6×1P	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	53	57	12	45	20	40	12	5.5	9.5	5.5	M6×1P	21	
			4	1100	2280													42	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	
			3	980	2300													47	26
	5	3.175	4	1250	3070	40	53	63.5	12	51	22	44	15	5.5	9.5	5.5	M8×1P	33	
			5	1520	3830													57	42
			6	1275	2740													40	53
	4	1630	3650	61	34														
	8	3.969	4	1630	3650	40	69	77	63.5	12	51	22	44	15	5.5	9.5	5.5	M8×1P	34
			5	1970	4560														70
	10	3.175	3	980	2300	38	70	81	68	15	55	26	52	15	6.6	11	6.5	M8×1P	26
			4	1250	3070														81
3			1620	3205	80														27
28	4.762	4	2070	4270	42	85	68.5	15	55	26	52	15	6.6	11	6.5	M8×1P	35		
		5	2510	5340													91	44	
		3	1030	2630													43	50	68
10	3.175	4	1320	3510	45	77	73	12	60	30	60	15	6.6	11	6.5	M8×1P	37		



Unit:mm

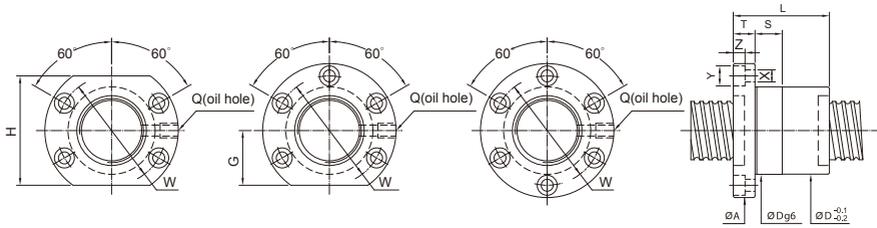
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD (kgf)		NUT		FLANGE					FIT		BOLT			OIL HOLE	STIFFNESS kgf/μm	
O.D.	LEAD			Dynamic (1×10 <sup>5</sup> REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	S	X	Y	Z	Q			
32	4	2.381	3	560	1840	43	40											6.5	M8×1P	28
			5	870	3070	47	49	68	15	55	26	52	15	6.6	11	6.5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

# FSIC



Unit:mm

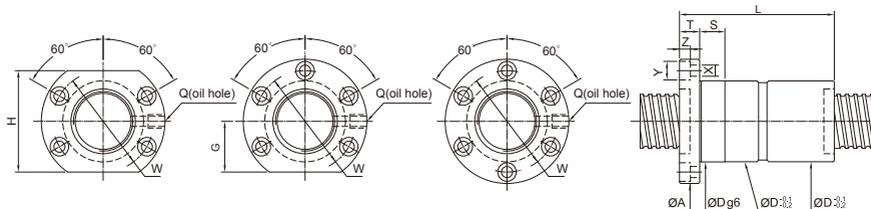
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD (kgf)		NUT		FLANGE					FIT			BOLT		OIL HOLE	STIFFNESS kgf/ $\mu$ m
O.D.	LEAD			Dynamic (1 $\times$ 10 <sup>5</sup> REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	S	X	Y	Z	Q		
45	8	4.762	4	2870	8620	64	72	92	16	75	36	72	15	9	14.5	9	M6 $\times$ 1P	54	
	12	7.144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



Unit:mm

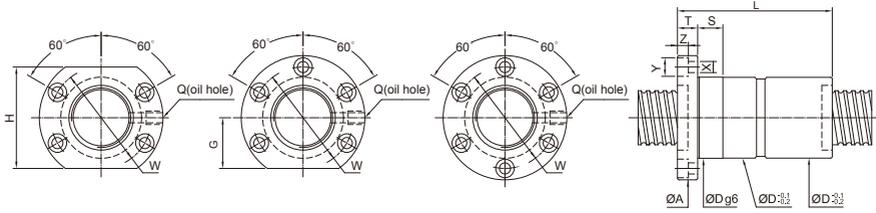
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD (kgf)		NUT		FLANGE					FIT		BOLT		OIL HOLE	STIFFNESS kgf/µm	
O.D.	LEAD			Dynamic (1×10 <sup>6</sup> REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	S	X	Y	Z	Q		
63	6	3.969	4	2610	10550	67	122	18	100	45	90	20	11	17.5	11	PT1/8"	73		
			6	3700	15830	80											107		
	8	4.762	4	3375	12200	80	124	18	102	46	92	20	11	17.5	11	PT1/8"	76		
			6	4780	18300	82											111		
	10	6.35	4	5020	16450	98	132	22	107	48	96	20	14	20	13	PT1/8"	79		
			6	7110	24680	118											116		
12	7.938	4	6580	19430	111	136	22	112	52	104	20	14	20	13	PT1/8"	80			
		6	9320	29150	136											111			
20	9.525	3	8490	23610	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	98	105	105	151	22	127	57	114	20	14	20	13	PT1/8"	95
			6	7810	31800	118													118
	12	7.938	4	7500	25700	111	156	22	132	59	118	20	14	20	13	PT1/8"	98		
			6	10620	38550	136											143		
	20	9.525	3	9770	31700	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	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	140	135	157	205	28	169	73	146	30	18	26	17.5	PT1/8"	140
			5	17490	68700	175													173
			6	20460	82440	175													205
			4	14440	54960	159													140
20	9.525	5	17490	68700	135	180	205	28	169	73	146	30	18	26	17.5	PT1/8"	173		
		6	20460	82440	200												205		

# FDIC



Unit:mm

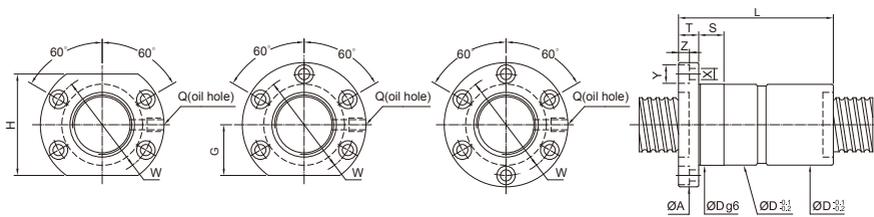
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD (kgf)		NUT		FLANGE				FIT		BOLT			OIL HOLE	STIFFNESS kgf/μm	
O.D.	LEAD			Dynamic (1×10 <sup>6</sup> REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	S	X	Y	Z			Q
16	4	2.381	3	435	920	30	66	48.5	10	39	20	40	10	4.5	8	4.5	M6×1P	31	
	5	3.175	3	765	1240	30	80	49	10	39	20	40	10	4.5	8	4.5	M6×1P	35	
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	
20	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	1620	3205		140											53		
10	4.762	3	1620	3205	42	155	68.5	15	55	26	52	15	6.6	11	6.5	M8×1P	70		
		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	109	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															



Unit:mm

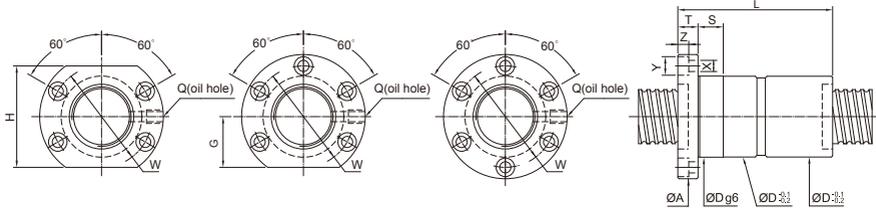
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD (kgf)		NUT		FLANGE					FIT			BOLT			OIL HOLE	STIFFNESS kgf/μm
O.D.	LEAD			Dynamic (1×10 <sup>6</sup> REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	S	X	Y	Z	Q			
40	5	3.175	4	1575	5290	96													100	
			5	1910	6610	55	111	88.5	16	72	29	58	15	9	14	8.5	M8×1P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

# FDIC



Unit:mm

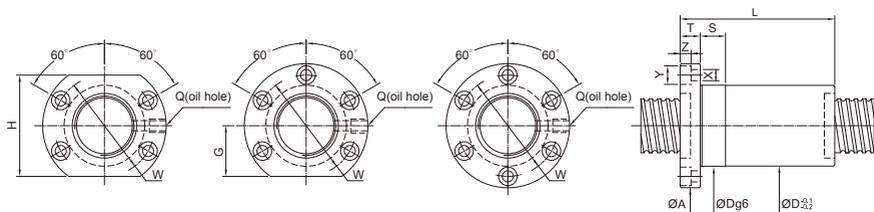
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD (kgf)		NUT		FLANGE					FIT		BOLT			OIL HOLE	STIFFNESS kgf/μm
O.D.	LEAD			Dynamic (1×10 <sup>6</sup> REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	S	X	Y	Z	Q		
50	5	3.175	4	1730	6760	96													119
			5	2100	8450	66	111	98	16	82	36	72	20	9	14	8.5	PT1/8"	148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



Unit:mm

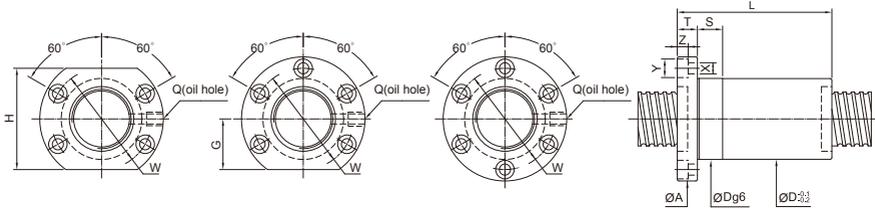
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD (kgf)		NUT		FLANGE					FIT		BOLT			OIL HOLE	STIFFNESS kgf/μm	
O.D.	LEAD			Dynamic (1×10 <sup>6</sup> REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	S	X	Y	Z	Q			
63	6	3.969	4	2610	10550	120												PT1/8"	146	
			6	3700	15830	80	144	122	18	100	45	90	20	11	17.5	11			217	
	8	4.762	4	3375	12200	141												PT1/8"	151	
			6	4780	18300	82	178	124	18	102	46	92	20	11	17.5	11			222	
	10	6.35	4	5020	16450	166													PT1/8"	158
			6	7110	24680	85	209	132	22	107	48	96	20	14	20	13			232	
12	7.938	4	6580	19430	195													PT1/8"	161	
		6	9320	29150	90	248	136	22	112	52	104	20	14	20	13			236		
20	9.525	3	8490	23610	255													PT1/8"	157	
		4	10870	31480	95	296	153	28	123	59	118	20	18	26	17.5			207		
80	10	6.35	4	5510	21200	166													190	
			5	6670	26500	105	185	151	22	127	57	114	20	14	20	13			235	
			6	7810	31800	209													280	
	12	7.938	4	7500	25700	195													196	
			6	10620	38550	110	248	156	22	132	59	118	20	14	20	13			288	
	20	9.525	3	9770	31700	254													193	
4			12510	42270	115	297	173	28	143	66	132	20	18	26	17.5			254		
			6	17720	63410	376												373		
100	10	6.35	3	4760	20090	143													173	
			4	6090	26790	164													228	
			5	7380	33490	125	184	171	22	147	67	134	25	14	20	13			281	
			6	8630	40190	210														334
	16	9.525	4	14440	54960	252													266	
			5	17490	68700	135	285	205	28	169	73	146	30	18	26	17.5			329	
			6	20460	82440	318												391		
20	9.525	4	14440	54960	299													266		
		5	17490	68700	135	340	205	28	169	73	146	30	18	26	17.5			329		
			6	20460	82440	381												391		

# FOIC



Unit:mm

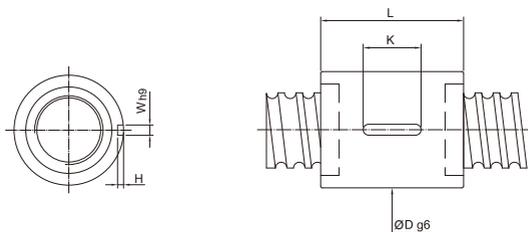
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD (kgf)		NUT		FLANGE					FIT		BOLT			OIL HOLE	STIFFNESS kgf/μm
O.D.	LEAD			Dynamic (1×10 <sup>6</sup> REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	S	X	Y	Z	Q		
20	5	3.175	2×(2) 3×(2)	610 860	1140 1710	34	53 67	57	12	45	20	40	12	5.5	9.5	5.5	M6×1P	29 43	
	6	3.969	2×(2) 3×(2)	760 1080	1370 2050	34	61 77	57	12	45	20	40	12	5.5	9.5	5.5	M6×1P	29 50	
25	4	2.381	2×(2)	350	960	44												30	
			3×(2)	500	1440	40	56	63	12	51	22	44	15	5.5	9.5	5.5	M8×1P	46	
			4×(2)	640	1920	64												59	
	5	3.175	2×(2)	690	1530	53												35	
			3×(2)	980	2300	40	67	63.5	12	51	22	44	15	5.5	9.5	5.5	M8×1P	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		
28	6	3.175	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	
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	



Unit:mm

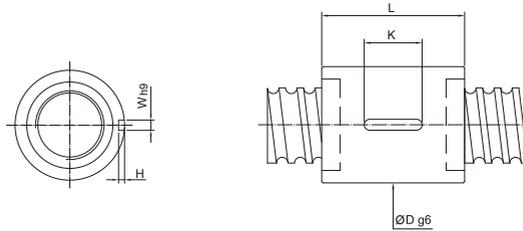
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD (kgf)		NUT		FLANGE					FIT		BOLT			OIL HOLE	STIFFNESS kgf/μm
O.D.	LEAD			Dynamic (1×10 <sup>6</sup> REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	S	X	Y	Z	Q		
40	5	3.175	3×(2)	1230	3970	65												75	
			4×(2)	1575	5290	55	80	88.5	16	72	29	58	15	9	14	8.5	M8×P	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×P	103	
			6×(2)	3020	9620	118													149
			4×(2)	2720	7620	60	116	93	16	76	36	72	20	9	14	8.5	M8×P	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	65												89	
			4×(2)	1730	6760	66	80	98	16	82	36	72	20	9	14	8.5	PT1/8"	119	
			6×(2)	2450	10140	101													174
	6	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×P	99	
			4×(2)	4390	12400	143													129
12	7.144	4×(2)	5530	16330	75	164	121	22	97	47	94	20	14	20	13	PT1/8"	135		
		7.938	3×(2)	4510	11150	75	147	121	22	97	47	94	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	
			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

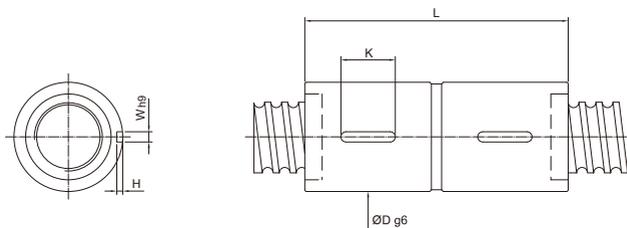
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD (kgf)		NUT		KEYWAY			STIFFNESS
O.D.	LEAD			Dynamic (1×10 <sup>6</sup> REV.) Ca	Static Co	Dg6	L	K	W	H	kgf/μm
16	5	3.175	3	765	1240	30	40	20	3	1.8	18
			4	860	1710	34	41	20	3	1.8	21
20	5	3.175	4	1100	2280	34	48	20	3	1.8	28
			3	1080	2050	34	46	20	4	2.5	22
25	6	3.969	4	1380	2730	34	56	25	4	2.5	28
			3	980	2300	40	41	20	4	2.5	26
32	5	3.175	4	1250	3070	40	48	20	4	2.5	33
			3	1275	2740	40	46	20	4	2.5	26
40	6	3.969	4	1630	3650	40	56	25	4	2.5	34
			3	1095	3060	41	20	31			
50	5	3.175	4	1400	4080	48	48	20	4	2.5	41
			6	1980	6120	61	25	60			
60	6	3.969	3	1500	3750	46	20	32	3	3.0	32
			4	1920	5000	50	56	25	5	3.0	43
70	8	4.762	6	2720	7500	70	32	63			
			3	1820	4230	50	59	25	5	3.0	32
80	10	6.35	4	2330	5640	50	70	25	5	3.0	43
			3	2605	5310	50	68	25	6	3.5	33
90	5	3.175	4	3340	7080	50	79	32	6	3.5	45
			4	1575	5290	55	48	20	4	2.5	49
100	6	3.969	6	2230	7940	55	61	25	4	2.5	73
			4	2130	6410	55	56	25	5	3.0	51
120	8	4.762	6	3020	9620	55	70	32	5	3.0	75
			4	2720	7620	60	70	25	5	3.0	52
140	10	6.35	6	3850	11430	60	91	40	5	3.0	77
			3	3010	7100	65	68	25	6	3.5	41
160	10	6.35	4	3850	9470	65	79	32	6	3.5	53



Unit:mm

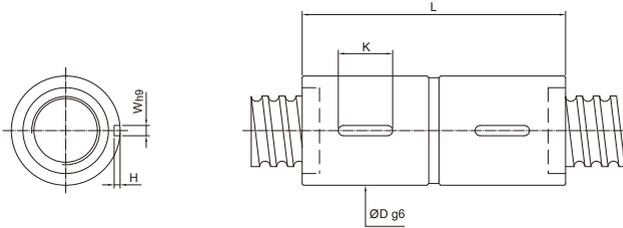
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD (kgf)		NUT		KEYWAY			STIFFNESS	
O.D.	LEAD			Dynamic (1×10 <sup>6</sup> REV.) Ca	Static Co	Dg6	L	K	W	H	kgf/μm	
50	5	3.175	4	1730	6750	66	48	20	4	2.5	60	
			6	2450	10130		61	25			86	
	6	3.969	4	2380	8250	66	56	25	5	3.0	61	
			6	3370	12380		70	32			90	
	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		6	3.5	49		
		4	4390	12400		79	32			65		
12	7.938	6	6220	18600	75	102		6	3.5	95		
		3	4510	11150		82	40			50		
4			4	5770	14870		95				66	
			4	2610	10550		80	56			25	6
63	6	3.969	6	3700	15830	80	70	32	6	3.5	107	
			4	3375	12200		82	70			32	76
	8	4.762	6	4780	18300	82	91	40	6	3.5	111	
			4	5020	16450		85	79			32	79
	10	6.35	6	7110	24680	85	85	40	8	4.0	116	
			4	6580	19430		90	95			40	80
12	7.938	6	9320	29150	90	123	50	8	4.0	118		
		4	5510	21200		105	79			32	8	4.0
80	10	6.35	6	7810	31800	105	102	40	8	4.0	140	
			4	7500	25700		110	95			40	98
	12	7.938	6	10620	38550	110	123	50	8	4.0	143	
			3	9770	31700		115	126			50	97
	20	9.525	4	12510	42270	115	149	63	10	5.0	127	
			3	4760	20090		72					91
100	10	6.35	4	6090	26790	125	82	50	10	5	120	
			5	7380	33490		94					148
	6			6	8630	40190		104				176
				4	14440	54960		128				
	16	9.525	5	17490	68700	135	77	63	10	5	173	
			6	20460	82440		162					205
20	9.525	4	14440	54960	135	144		10	5	140		
		5	17490	68700		164	63			10	5	173
6			6	20460	82440		187				205	

# RDIC



Unit:mm

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



Unit:mm

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD (kgf)		NUT		KEYWAY			STIFFNESS
O.D.	LEAD			Dynamic (1×10 <sup>6</sup> REV.) Ca	Static Co	Dg6	L	K	W	H	kgf/μm
50	5	3.175	4	1730	6750	66	85	20	4	2.5	119
			6	2450	10130		105	25			174
	6	3.969	4	2380	8250	66	103	25	5	3.0	123
			6	3370	12380		127	32			181
	8	4.762	4	3010	9610	70	127	32	5	3.0	125
			6	4260	14420		161	40			185
10	6.35	3	3430	9300	74	135	32	6	3.5	99	
		4	4390	12400		155	32			129	
12	7.938	6	6220	18600	75	197	40	6	3.5	191	
		3	4510	11150		161	40			101	
			4	5770	14870		185	40			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
20	9.525	6	20460	82440	135	306	63	10	5	391	
		4	14440	54960		284				266	
			5	17490	68700	135	324	63	10	5	329
			6	20460	82440		366				391

# 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.

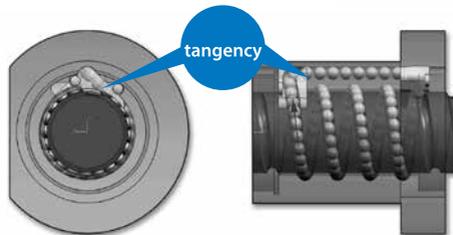
The total space shall be reduced to approximately 50% consequently.

### Circulation

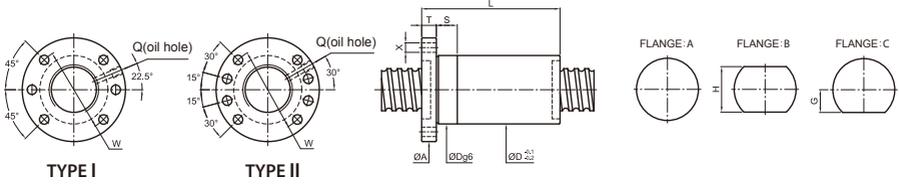
The specially designed pathway of the Recirculation System makes a contact with lead angle and also with BCD in the same tangency, improving its smoothness effectively.

### Applications

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



**Note:** The ball diameter above(include) 7.983mm of End Deflector is made from metal.

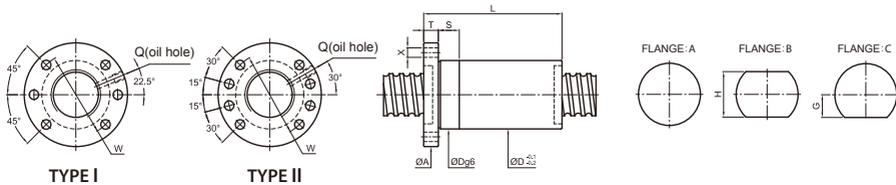


Unit:mm

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS	MODIFIED LOAD CAPACITY (kgf)		NUT		FLANGE					FIT	OIL HOLE	BOLT	STIFFNESS	
O.D.	LEAD			Dynamic (1×10° REV.) Cam	Static Coam	Dg6	L	A	T	W	G	H					TYPE
12	4	2.381	3	610	1190	28										20	
	5		3	610	1190	24	32	44	10	34	16	32	I	10	M6×1P	4.5	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	35										26	
	10		3	840	1610	29	47	51	10	39	19	38	I	10	M6×1P	5.5	26
	20		2	560	1050	58											18
16	5	3.175	3	890	1760	29	35									27	
	10		3	870	1740	29	50	51	10	39	19	38	I	10	M6×1P	5.5	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	40										43	
	10		3	990	2220	36	47	62	12	49	24	48	I	12	M6×1P	6.6	33
	20	2	670	1450	56											23	
	6	3.969	3	1540	3310	37	38	62	12	49	23	46	I	12	M6×1P	6.6	34
	8		3	1540	3300	45											34
10	4.762	4	2560	5530	40	62	62	12	51	24	48	I	15	M6×1P	6.6	47	
25	4	2.381	3	870	2560	36	28	62	12	49	22	44	I	12	M6×1P	6.6	34
	5	3.175	4	1440	3840	41										50	
	10		3	1100	2810	50											38
	15	4	1410	3780	40	81	62	12	51	24	48	I	15	M6×1P	6.6	50	
	20	2	750	1840	60											26	
	25	2	730	1810	71											26	
	6	3.969	4	2250	5710	45										53	
	12		4	2240	5660	43	70	64	12	51	24	48	I	15	M6×1P	6.6	53
	25	2	1160	2720	70											28	
	8	4.762	4	2880	6890	55										55	
	10		4	2880	6870	63										55	
	16		4	2830	6790	85	65	15	54	25.5	51		I	15	M6×1P	6.6	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	

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

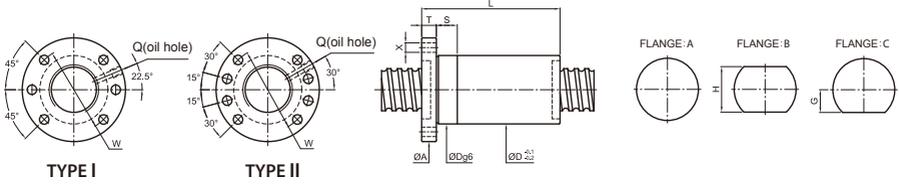
# FSDC



Unit:mm

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

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

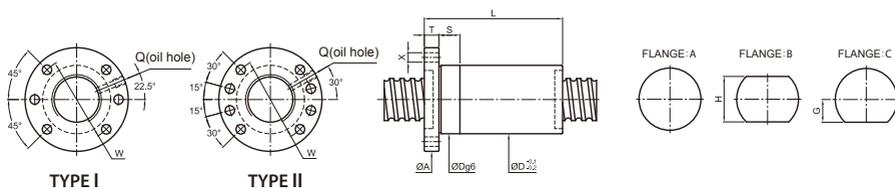


Unit:mm

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS	MODIFIED LOAD CAPACITY (kgf)		NUT		FLANGE						FIT	OIL HOLE	BOLT	STIFFNESS	
O.D.	LEAD			Dynamic (1×10 <sup>6</sup> REV.) Cam	Static Coam	Dg6	L	A	T	W	G	H	TYPE	S	Q	X	kgf/μm	
36	8	4.762	5	4170	12580	56	63	84	11	68	34	68	I	15	M8×1P	9	86	
	10		5	6050	16460	78												93
	12		5	6080	16430	88												93
	16	6.35	5	6050	16360	61	109	91	18	76	34	68	II	15	M8×1P	9	93	
	20		4	4910	12890	109												76
	36		2	2570	6250	95												41
38	10	6.35	5	6260	17740	80											97	
	12		5	6260	17410	88												97
	16		5	6220	17350	63	109	93	18	78	35	70	II	20	M8×1P	9	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		5	3420	11810	58	52	91	18	76	34	68	II	15	M8×1P	9	92	
	8	6.35	4	3610	11260	60	56	91	18	76	34	68	II	15	M8×1P	9	77	
	10		5	6430	18440	78												101
	12		5	6420	18410	88												101
	15		5	6380	18350	65	103	95	18	80	36	72	II	20	M8×1P	9	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	

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

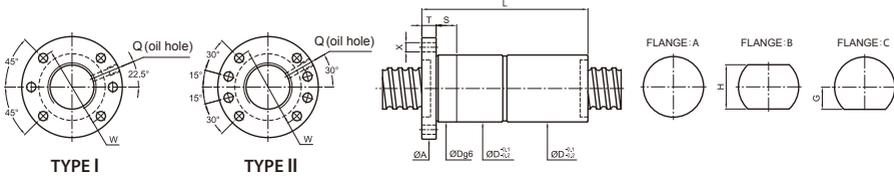
# FSDC



Unit:mm

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS	MODIFIED LOAD CAPACITY (kgf)		NUT		FLANGE					FIT	OIL HOLE	BOLT	STIFFNESS	
O.D.	LEAD			Dynamic (1×10 <sup>6</sup> REV.) Cam	Static Coam	Dg6	L	A	T	W	G	H					TYPE
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	73	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		90										119
	16		5	7120	23250	75	109	118	18	100	46	92	II	20	M8×1P	11	119
	20		3	4460	13520		95										74
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

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

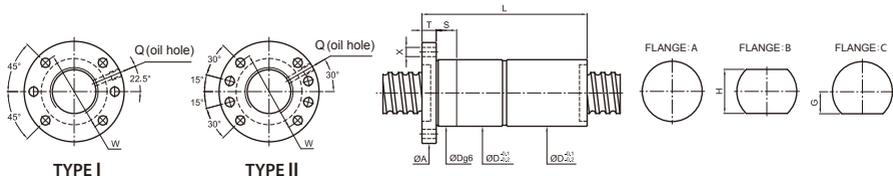


Unit:mm

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS	MODIFIED LOAD CAPACITY (kgf)		NUT		FLANGE						FIT	OIL HOLE	BOLT	STIFFNESS
O.D.	LEAD			Dynamic (1×10 <sup>6</sup> REV.) Cam	Static Coam	Dg6	L	A	T	W	G	H	TYPE				
20	4	2.381	3	780	2000	32	61	54	12	42	19	38	I	12	M6×1P	5.5	44
	5		4	1300	3030		80										65
	10	3.175	3	990	2220	36	97	62	12	49	24	48	I	12	M6×1P	6.6	50
	20		2	670	1450		116										33
	6	3.969	3	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		4	1440	3840		81										77
	10		3	1100	2810		100										58
	15	3.175	4	1410	3780	40	166	62	12	51	24	48	I	15	M6×1P	6.6	77
	20		2	750	1840		120										39
	25		2	730	1810		146										39
	6	3.969	4	2250	5710		87										80
	12		4	2240	5660	43	142	64	12	51	22	44	I	15	M6×1P	6.6	80
	25		2	1160	2720		145										41
	8	4.762	4	2880	6890		111										83
	10		4	2880	6870		128										83
	16		4	2830	6790	45	173	65	15	54	25.5	51	I	15	M6×1P	6.6	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

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

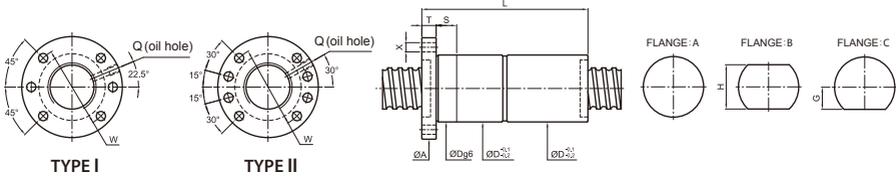
# FDDC



Unit:mm

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS	MODIFIED LOAD CAPACITY (kgf)		NUT		FLANGE						FIT	OIL HOLE	BOLT	STIFFNESS		
O.D.	LEAD			Dynamic (1×10 <sup>6</sup> REV.) Cam	Static Coam	Dg6	L	A	T	W	G	H	TYPE					S	Q
28	5	3.175	5	1850	5460	43	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		
	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		5	5280	12530		158											118	
	12	6.35	5	5270	12500	54	172	87	16	72	34.5	69	I		M8×1P	9		118	
32	5	3.175	4	1610	4970	50	81	87	16	72	34.5	69	I	15	M8×1P	9	93		
	6		5	3050	9140		106											120	
	10	3.969	4	2550	7500	53	126	87	16	72	34.5	69	I	15	M8×1P	9	96		
	32		2	1300	3540		172											60	
	8		5	3900	10930		132											124	
	10		5	3890	10910		147											124	
	12	4.762	5	3890	10890		171											124	
	15		5	3860	10850	53	221	87	16	72	34.5	69	I	15	M8×1P	9		124	
	20		2	1700	4230		140											51	
	32		2	1640	4120		186											51	
	10		5	4900	13360		153												129
	12		5	4890	13340		172												129
	16	5.556	5	4860	13280	55	211	87	16	72	34.5	69	I	15	M8×1P	9		121	
	20		3	3140	8110		177												79
	10		5	5720	14490		153												131
12		5	5710	14470		172												131	
16	6.35	4	4520	11100		180												105	
20		3	3530	8340		178												80	

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

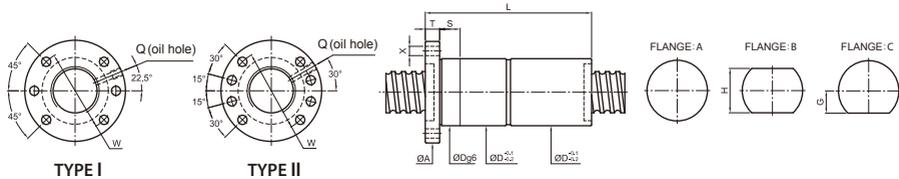


Unit:mm

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS	MODIFIED LOAD CAPACITY (kgf)		NUT		FLANGE					FIT	OIL HOLE	BOLT	STIFFNESS	
O.D.	LEAD			Dynamic (1×10 <sup>6</sup> REV.) Cam	Static Coam	Dg6	L	A	T	W	G	H	TYPE	S	Q	X	kgf/μm
36	8	4.762	5	4170	12580	56	127	84	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		172										149
	16		5	6220	17350	63	213	93	18	78	35	70	II	20	M8×1P	9	149
	40		3	3830	10220		282										106
40	5	3.175	4	1760	6260	60	87	91	18	76	34	68	II	15	M8×1P	9	111
	6	3.969	5	3420	11810	60	108	91	18	76	34	68	II	15	M8×1P	9	142
	8	4.762	4	3610	11260	62	118	91	18	76	34	68	II	15	M8×1P	9	118
	10		5	6430	18440		158										155
	12		5	6420	18410		172										155
	15	6.35	5	6380	18350	68	226	95	18	80	36	72	II	20	M8×1P	9	155
	16		5	6390	18330		212										155
	20		4	5190	14450		220										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	

Note: 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	MODIFIED LOAD CAPACITY (kgf)		NUT		FLANGE				FIT	OIL HOLE	BOLT	STIFFNESS		
O.D.	LEAD			Dynamic (1×10 <sup>6</sup> REV.) Cam	Static Coam	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		5	6910	21330		158										170
	12	6.35	5	6910	21310	70	171	105	18	88	40	80	II	20	M8×1P	11	170
	16		5	6880	21250		215										170
	12	7.144	5	7930	23300	73	178	105	18	88	40	80	II	20	M8×1P	11	173
	20		4	6440	18340		220										139
50	5	3.175	5	2360	9950	75	98	105	18	88	40	80	II	20	M8×1P	11	164
	8	4.762	5	4780	17550	75	128	105	18	88	40	80	II	20	M8×1P	11	169
	10		5	7160	23320		158										185
	12	6.35	5	7150	23300	75	174	118	18	100							185
	16		5	7120	23250		215				46	92	II	20	M8×1P	11	185
	20		3	4460	13520	75	185	118	18	100							112
20	7.938	4	7810	22680	80	220	121	18	104	46	92	II	20	M8×1P	11	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		5	15350	56760		283										305
	25	9.525	4	12530	44860	118	296	165	25	145	65	130	II	25	M8×1P	14	245
	30		3	9610	32980		254										185

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

# 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.2 and "extrusive type" of Fig.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.

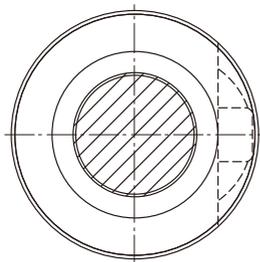


Fig.2 Immersion type

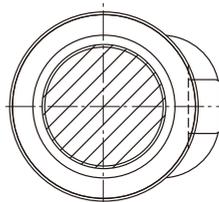
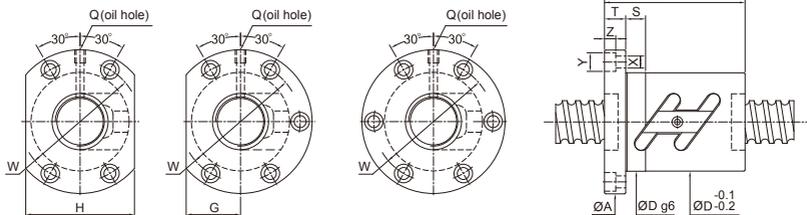


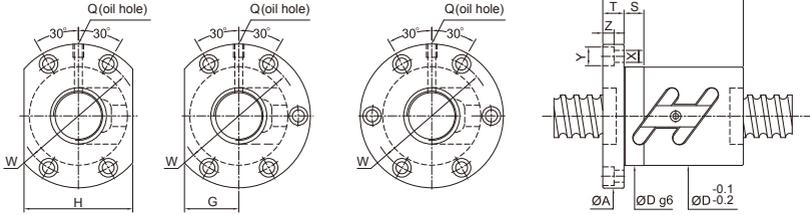
Fig.3 Extrusive type

# FSWC



Unit:mm

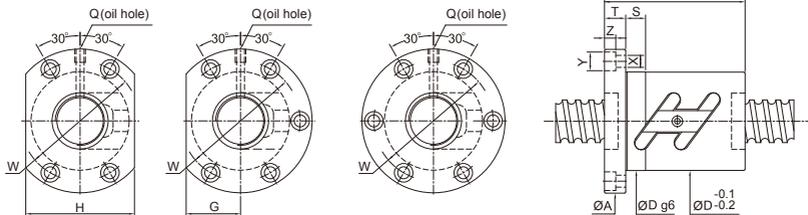
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD (kgf)		NUT		FLANGE					FIT		BOLT		OIL HOLE	STIFFNESS
O.D.	LEAD			Dynamic (1×10 <sup>6</sup> REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	S	X	Y	Z	Q	
10	3	2.000	2.5×1	250	430	37												9
	4	2.000	2.5×1	250	430	26	40	46	10	36	14	28	10	4.5	8	4.5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



Unit:mm

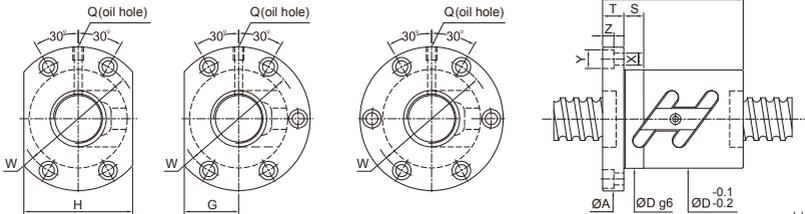
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD (kgf)		NUT		FLANGE					FIT		BOLT		OIL HOLE	STIFFNESS	
O.D.	LEAD			Dynamic (1×10 <sup>6</sup> REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	S	X	Y	Z	Q	kgf/μm	
25	4	2.381	1.5×2	600	1630	44												26	
			2.5×1	510	1355	46	40	69	11	57	26	52	15	5.5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

# FSWC



Unit:mm

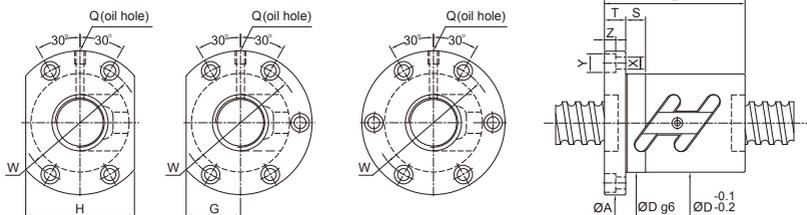
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD (kgf)		NUT		FLANGE					FIT		BOLT		OIL HOLE	STIFFNESS	
O.D.	LEAD			Dynamic (1×10 <sup>6</sup> REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	S	X	Y	Z	Q	kgf/μm	
32	4	2.381	2.5×1	565	1750	54	40	81	12	67	32	64	15	6.6	11	6.5	M6×1P	26	
			2.5×2	1020	3500	50	50												50
	5	3.175	1.5×2	1180	3410	47													34
			2.5×1	1010	2840	43													29
			2.5×2	1830	5680	58	57	85	12	71	32	64	15	6.6	11	6.5	M8×1P	56	
			2.5×3	2590	8520	72													82
	6	3.969	3.5×1	1350	3980	47													40
			1.5×2	1560	4135	57													35
			2.5×1	1330	3450	45													29
			2.5×2	2410	6900	62	63	88	12	75	34	68	15	6.6	11	6.5	M8×1P	57	
	8	4.762	3.5×1	1770	4830	57													40
			1.5×2	2010	5010	64													36
			2.5×1	1720	4180	63													30
			2.5×2	3120	8360	66	80	98	15	82	38	76	15	9	14	8.5	M8×1P	59	
	10	6.35	3.5×1	2300	5850	68													42
			1.5×2	3000	6530	78													38
			2.5×1	2570	5440	68													32
			2.5×2	4660	10880	74	97	108	15	90	41	82	15	9	14	8.5	M8×1P	61	
	12	6.35	3.5×1	3430	7620	78													44
			1.5×2	3000	6530	88													38
			2.5×1	2570	5440	74	77	108	18	90	41	82	15	9	14	8.5	M8×1P	32	
			2.5×2	4660	10880	74	110												62
	36	5	3.175	3.5×1	3430	7620	91												44
				1.5×2	1240	3850	50												38
2.5×2				1920	6420	60													62
2.5×3				2720	9630	65	75	98	15	82	38	76	15	9	14	8.5	M8×1P	90	
6		3.969	3.5×1	1410	4490	50													44
			2.5×2	2600	7900	66													63
			2.5×3	3680	11850	65	84	98	15	82	38	76	15	9	14	8.5	M8×1P	93	
			1.5×2	3180	7410	81													41
10		6.35	2.5×1	2720	6180	71													35
			2.5×2	4930	12360	75	103	118	18	98	45	90	15	11	17.5	11	M8×1P	68	
			3.5×1	3630	8650	81													48
			2.5×1	2720	6180	77													35
12	6.35	2.5×2	4930	12360	75	110	118	18	98	45	90	15	11	17.5	11	M8×1P	68		
		3.5×1	3630	8650	91													48	



Unit:mm

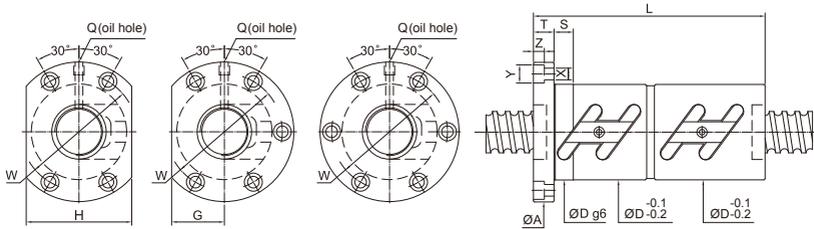
SCREW SIZE		EFFECTIVE TURNS circuit × row	BASIC RATE LOAD (kgf)		NUT		FLANGE					FIT		BOLT	OIL HOLE	STIFFNESS				
O.D.	LEAD		BALL DIA.	Dynamic (1×10 <sup>6</sup> REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	S	X	Y	Z	Q	kgf/μm		
40	5	3.175	1.5×2	1280	4275	50												41		
			2.5×1	1090	3560	48													34	
			2.5×2	1980	7120	67	60	101	15	83	39	78	15	9	14	8.5	M8×1P		66	
			2.5×3	2800	10680	75														98
			3.5×1	1450	4980	50														47
	6	3.969	1.5×2	1750	5300	60													42	
			2.5×1	1500	4420	53													35	
			2.5×2	2720	8840	70	66	104	15	86	40	80	15	9	14	8.5	PT1/8"		69	
			2.5×3	3850	13260	84														101
			3.5×1	2000	6190	60														49
	8	4.762	1.5×2	2220	6320	64													43	
			2.5×1	1900	5270	63													36	
			2.5×2	3450	10540	74	83	108	15	90	41	82	15	9	14	8.5	PT1/8"		70	
			3.5×1	2540	7380	68														50
			1.5×2	3370	8335	81														45
	10	6.35	2.5×1	2880	6950	71													35	
			2.5×2	5220	13900	82	103	124	18	102	47	94	20	11	17.5	11	PT1/8"		74	
			3.5×1	3840	9730	81														52
2.5×1			2880	6950	77														38	
12	6.35	2.5×2	5220	13900	86	112	128	18	106	48	96	20	11	17.5	11	PT1/8"		74		
		3.5×1	3840	9730	91														52	
		2.5×2	5480	15700	101														81	
10	6.35	2.5×3	7760	23550	88	131	132	18	110	50	100	20	11	17.5	11	PT1/8"		119		
		2.5×1	3550	8950	84														43	
		2.5×2	6440	17900	90	112	132	18	110	50	100	20	11	17.5	11	PT1/8"		82		
		2.5×3	9120	26850	148														121	

# FSWC



Unit:mm

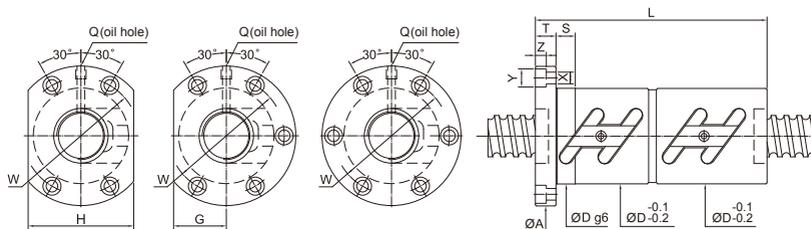
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD (kgf)		NUT		FLANGE					FIT		BOLT		OIL HOLE	STIFFNESS	
O.D.	LEAD			Dynamic (1×10 <sup>6</sup> REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	S	X	Y	Z	Q	kgf/μm	
50	5	3.175	1.5×2	1410	5305	50												49	
			1.5×3	2000	7960	80	60	114	15	96	43	86	15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



Unit:mm

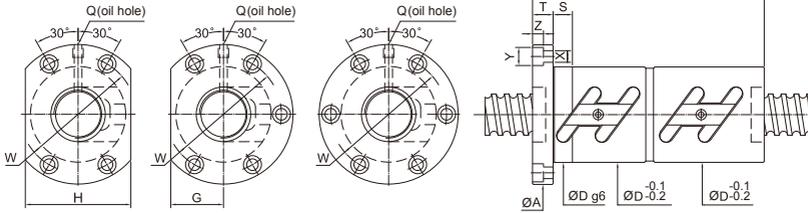
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD (kgf)		NUT		FLANGE					FIT		BOLT		OIL HOLE	STIFFNESS	
O.D.	LEAD			Dynamic (1×10 <sup>6</sup> REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	S	X	Y	Z	Q	kgf/μm	
16	4	2.381	1.5×2	490	1010	81												36	
			2.5×1	430	850	34	70	57	11	45	17	34	15	5.5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

# FDWC



Unit:mm

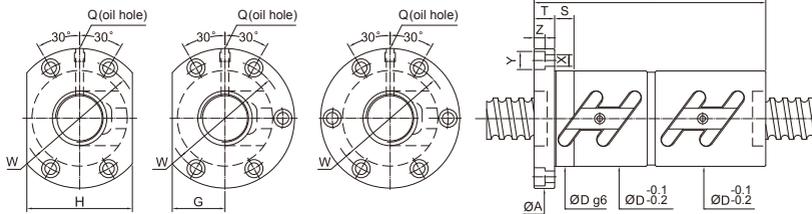
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD (kgf)		NUT Dg6	FLANGE					FIT S	BOLT X	OIL HOLE Y Z	Q	STIFFNESS kgf/μm		
O.D.	LEAD			Dynamic (1×10 <sup>6</sup> REV.) Ca	Static Co		L	A	T	W	G						H	
25	4	2.381	1.5×2	600	1630	83											51	
			2.5×1	510	1355	67												43
			2.5×2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



Unit:mm

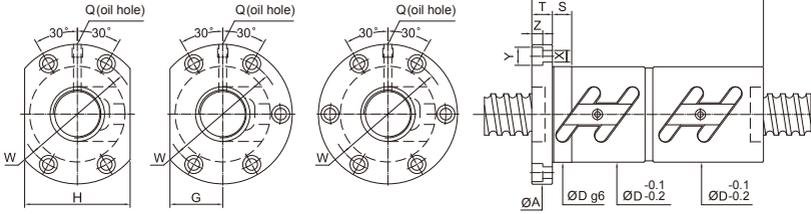
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD (kgf)		NUT		FLANGE				FIT		BOLT		OIL HOLE	STIFFNESS				
O.D.	LEAD			Dynamic (1×10 <sup>6</sup> REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	S	X	Y	Z	Q	kgf/μm			
32	4	2.381	2.5×1	565	1750	54	68	81	12	67	32	64	15	6.6	11	6.5	M6×1P	52			
			2.5×2	1020	3500	90	90												101		
	5	3.175	1.5×2	1180	3410		82												69		
			2.5×1	1010	2840		78													58	
			2.5×2	1830	5680	58	105	85	12	71	32	64	15	6.6	11	6.5	M8×1P	112			
	6	3.969	2.5×3	2590	8520		136												164		
			3.5×1	1350	3980		82													80	
			1.5×2	1560	4135		100													70	
	8	4.762	2.5×1	1330	3450	62	87	88	12	75	34	68	15	6.6	11	6.5	M8×1P	59			
			2.5×2	2410	6900		123													114	
			3.5×1	1770	4830		100													81	
	10	6.35	1.5×2	2010	5010		113												76		
			2.5×1	1720	4180		106													64	
			2.5×2	3120	8360	66	152	98	15	82	38	76	15	9	14	8.5	M8×1P	123			
	12	6.35	3.5×1	2300	5850		113												88		
			1.5×2	3000	6530		138													76	
			2.5×1	2570	5440		118													64	
	36	5	3.175	2.5×2	4660	10880	74	177	108	15	90	41	82	15	9	14	8.5	M8×1P	123		
				3.5×1	3430	7620		148													88
				1.5×2	3000	6530		160													76
		6	3.969	2.5×1	2570	5440		137												64	
				2.5×2	4660	10880	74	208	108	18	90	41	82	15	9	14	8.5	M8×1P	124		
				3.5×1	3430	7620		160													88
		8	4.762	3.175	1.5×2	1240	3850		91											75	
2.5×2					1920	6420		110													123
2.5×3					2720	9630	65	139	98	15	82	38	76	15	9	14	8.5	M8×1P	181		
10		6.35	3.969	3.5×1	1410	4490		90											87		
				2.5×2	2600	7900		123													126
				2.5×3	3680	11850	65	159	98	15	82	38	76	15	9	14	8.5	M8×1P	187		
12	6.35	4.762	2.5×2	3265	9450	70	153	114	18	92	46	92	20	11	17.5	11	M8×1P	129			
			1.5×2	3180	7410		141													83	
			2.5×1	2720	6180		131													70	
12	6.35	4.762	2.5×2	4930	12360	75	180	118	18	98	45	90	15	11	17.5	11	M8×1P	136			
			3.5×1	3630	8650		151													96	
			2.5×1	2720	6180		137													70	
12	6.35	4.762	2.5×2	4930	12360	75	208	118	18	98	45	90	15	11	17.5	11	M8×1P	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 <sup>6</sup> 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	88												82		
			2.5×1	1090	3560	84													69	
			2.5×2	1980	7120	67	108	101	15	83	39	78	15	9	14	8.5	M8×1P		133	
			2.5×3	2800	10680	139														196
			3.5×1	1450	4980	88														95
	6	3.969	1.5×2	1750	5300	103													85	
			2.5×1	1500	4420	90														71
			2.5×2	2720	8840	70	123	104	15	86	40	80	15	9	14	8.5	PT1/8"		138	
			2.5×3	3850	13260	159														202
			3.5×1	2000	6190	103														98
	8	4.762	1.5×2	2220	6320	124													86	
			2.5×1	1900	5270	108														73
			2.5×2	3450	10540	74	108	15	90	41	82	15	9	14	8.5	PT1/8"			141	
			3.5×1	2540	7380	125														100
			1.5×2	3370	8335	141														91
	10	6.35	2.5×1	2880	6950	131													71	
			2.5×2	5220	13900	82	180	124	18	102	47	94	20	11	17.5	11	PT1/8"		148	
			3.5×1	3840	9730	151														105
			2.5×1	2880	6950	137														76
			2.5×2	5220	13900	86	208	128	18	106	48	96	20	11	17.5	11	PT1/8"		148	
	12	6.35	3.5×1	3840	9730	161													105	
			2.5×1	2880	6950	137														76
			2.5×2	5220	13900	86	208	128	18	106	48	96	20	11	17.5	11	PT1/8"		148	
			3.5×1	3840	9730	161														105
2.5×1			2880	6950	137														76	
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

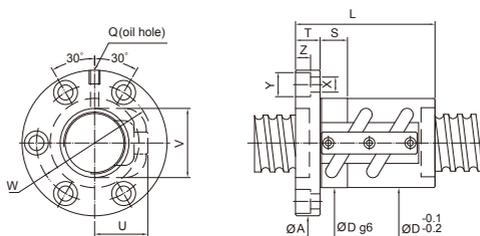


Unit:mm

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 <sup>6</sup> 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	108												98	
			1.5×3	2000	7960	80	128												144
			2.5×2	2190	8840		113	114	15	96	43	86	15	9	14	8.5	PT1/8"		159
			3.5×1	1610	6190		108												114
	6	3.969	1.5×2	1920	6600	111												101	
			2.5×2	2980	11000	84	123												164
			2.5×3	4220	16500		159	118	15	100	45	90	15	9	14	8.5	PT1/8"		242
			3.5×1	2190	7700		107												117
	8	4.762	1.5×2	2515	7810	127												104	
			2.5×2	3900	13020	87	156												170
			2.5×3	5520	19530		208	128	18	107	49	98	20	11	17.5	11	PT1/8"		250
			3.5×1	2870	9110		127												121
	10	6.35	1.5×2	3725	10450	151												108	
			2.5×1	3190	8710		132												91
			2.5×2	5790	17420	93	180	135	18	113	51	102	20	11	17.5	11	PT1/8"		177
			2.5×3	8200	26130		243												261
	12	7.144	3.5×1	4260	12190	151												126	
			2.5×1	3700	10050	100	140												92
	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											
	63	10	6.35	2.5×1	3510	11200		136											110
				2.5×2	6370	22400	108	189	154	22	130	58	116	20	14	20	13	PT1/8"	213
		12	7.938	2.5×3	9020	33600		249											313
				2.5×1	4760	13820	115	144											
16	9.525	2.5×2	8650	27560		214	161	22	137	61	122	20	14	20	13	PT1/8"	218		
		2.5×1	8050	23100	122	200	178	28	150	69	138	20	18	26	17.5	PT1/8"	144		
80	10	6.35	2.5×2	7130	28500	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	

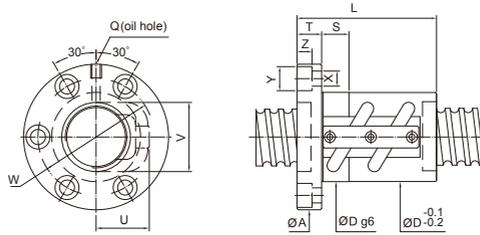
# FSVC

Specifications External Ball Circulation Nuts



Unit:mm

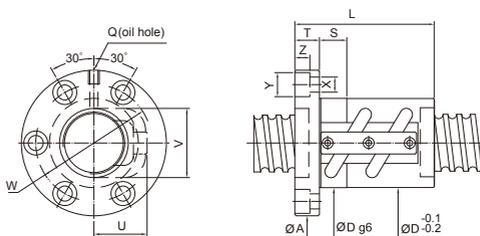
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD (kgf)		NUT		FLANGE			FIT			BOLT		RETURN TUBE	OIL HOLE	STIFFNESS		
O.D.	LEAD			Dynamic (1×10 <sup>6</sup> REV.) Ca	Static Co	Dg6	L	A	T	W	S	X	Y	Z	U	V	Q	kgf/μm		
14	4	2.381	2.5×1	410	750	25	40	45	10	35	10	5.5	9.5	5.5	19	21	M6×1P	14		
	5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



Unit:mm

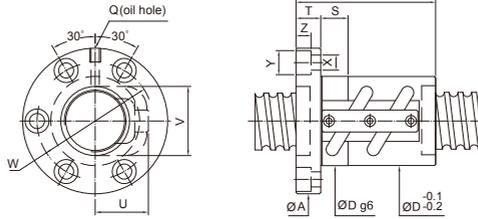
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD (kgf)		NUT		FLANGE			FIT			BOLT		RETURN TUBE		OIL HOLE	STIFFNESS	
O.D.	LEAD			Dynamic (1×10 <sup>6</sup> REV.) Ca	Static Co	Dg6	L	A	T	W	S	X	Y	Z	U	V	Q	kgf/μm		
32	5	3.175	1.5×2	1180	3410	50													34	
			2.5×1	1010	2840	45						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

# FSVC



Unit:mm

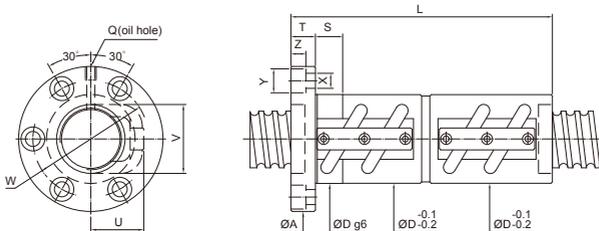
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD (kgf)		NUT		FLANGE			FIT			BOLT		RETURN TUBE	OIL HOLE	STIFFNESS		
O.D.	LEAD			Dynamic (1×10 <sup>4</sup> REV.) Ca	Static Co	Dg6	L	A	T	W	S	X	Y	Z	U	V	Q	kgf/μm		
40	5	3.175	1.5×2	1280	4270	55												41		
			2.5×1	1090	3560	50													34	
			2.5×2	1980	7120	58	65	92	16	72	15	9	14	8.5	34	47	M8×1P		66	
			2.5×3	2800	10680	80														98
			3.5×1	1450	4980	55														47
	6	3.969	1.5×2	1750	5300	60													42	
			2.5×1	1500	4420	54														35
			2.5×2	2720	8840	60	72	94	16	76	15	9	14	8.5	36	48	PT1/8"		69	
			2.5×3	3850	13260	90														101
			3.5×1	2000	6190	60														49
	8	4.762	1.5×2	2220	6320	70													43	
			2.5×1	1900	5270	62	62	96	16	78	15	9	14	8.5	38	50	PT1/8"		36	
2.5×2			3450	10540	62	86													70	
3.5×1			2540	7380	70														50	
10	6.35	1.5×2	3370	8335	82													45		
		2.5×1	2880	6950	72	72													35	
		2.5×2	5220	13900	65	102	106	18	85	20	11	17.5	11	42	52	PT1/8"		74		
		3.5×1	3840	9730	82														52	
45	10	6.35	2.5×1	3020	7850	74	74											42		
			2.5×2	5480	15700	70	104	112	18	90	20	11	17.5	11	48	58	PT1/8"		81	
12	7.144	2.5×1	3550	8950	74	87												43		
		2.5×2	6440	17900	74	123	122	18	97	20	14	20	13	49	60	PT1/8"		82		



Unit:mm

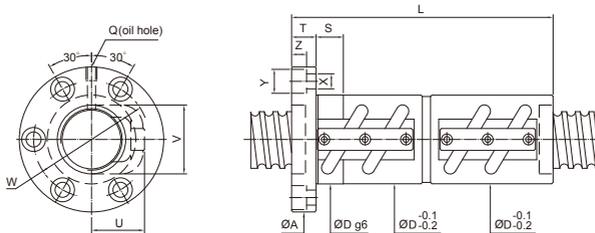
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD (kgf)		NUT		FLANGE			FIT				BOLT		RETURN TUBE		OIL HOLE	STIFFNESS	
O.D.	LEAD			Dynamic (1×10 <sup>6</sup> REV.) Ca	Static Co	Dg6	L	A	T	W	S	X	Y	Z	U	V	Q	kgf/μm			
50	5	3.175	1.5×2	1410	5305	63													49		
			1.5×3	2000	7960	70	73	104	16	86	15	9	14	8.5	40	57	PT1/8"		72		
			3.5×1	1610	6190	63														57	
	6	3.969	2.5×2	2980	11000	72	75	106	16	88	15	9	14	8.5	43	59	PT1/8"		82		
			2.5×3	4220	16500	93														121	
			2.5×2	3900	13020	75	88	116	18	95	20	11	17.5	11	45	60	PT1/8"		85		
	8	4.762	2.5×3	5520	19530	112													125		
			1.5×2	3725	10450	84														54	
			2.5×1	3190	8710	74														45	
			2.5×2	5790	17420	78	104	119	18	98	20	11	17.5	11	48	62	PT1/8"		88		
	10	6.35	2.5×3	8200	26130	134													130		
			3.5×1	4260	12190	84														63	
2.5×1			3700	10050	87	87	128	22	105	20	14	20	13	52	64	PT1/8"		46			
12	7.144	2.5×2	6710	20100	123													89			
		2.5×2	6005	19540	100	100	125	18	103	20	11	17.5	11	54	68	PT1/8"		95			
55	10	6.35	2.5×3	8150	29310	130												140			
			2.5×1	3510	11200	77														55	
63	10	6.35	2.5×2	6370	22400	90	107	132	20	110	20	11	17.5	11	53	76	PT1/8"		106		
			2.5×3	9020	33600	137														156	
			2.5×1	4770	13780	88															59
	12	7.938	2.5×2	8650	27560	94	124	142	22	117	20	14	20	13	57	76	PT1/8"		113		
			2.5×3	12250	41340	160															167
			2.5×1	8050	23100	105	105	150	22	123	20	14	20	13	62	79	PT1/8"		72		
16	9.525	2.5×2	14600	46200	153													140			
		2.5×2	7130	28500	109	109	163	22	137	20	14	20	13	64	91	PT1/8"		129			
80	10	6.35	2.5×3	10100	42750	139												190			
			2.5×2	9710	35560	125	125	169	22	143	25	14	20	13	67	94	PT1/8"		137		
12	7.938	9.525	2.5×3	13760	53340	159												202			
			2.5×2	16450	59280	156	156	190	28	154	25	18	26	17.5	70	96	PT1/8"		170		
16	9.525	9.525	2.5×3	23300	88920	204												250			

# FDVC



Unit:mm

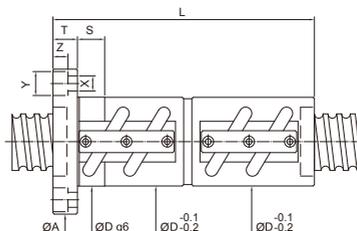
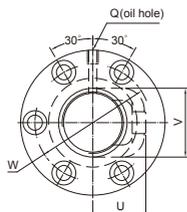
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD (kgf)		NUT		FLANGE				FIT				BOLT		RETURN TUBE		OIL HOLE	STIFFNESS	
O.D.	LEAD			Dynamic (1×10 <sup>6</sup> REV.) Ca	Static Co	Dg6	L	A	T	W	S	X	Y	Z	U	V	Q	kgf/μm				
16	5	3.175	1.5×2	805	1525	90														39		
			2.5×1	690	1270	80															33	
			2.5×2	1250	2540	31	110	54	12	41	15	5.5	9.5	5.5	20	23	M6×1P				63	
			3.5×1	920	1780	90															45	
20	5	3.175	1.5×2	965	2070	90														47		
			2.5×1	830	1730	80															40	
			2.5×2	1510	3460	35	110	58	12	46	15	5.5	9.5	5.5	22	27	M6×1P				77	
			3.5×1	1110	2420	90															55	
6	3.969	1.5×2	1285	2545	104															49		
		2.5×1	1100	2120	36	92	60	12	47	15	5.5	9.5	5.5	23	28	M6×1P				41		
		3.5×1	1470	2970	104															56		
25	5	3.175	1.5×2	1065	2575	90														57		
			2.5×1	910	2150	80															48	
			2.5×2	1650	4300	40	110	64	12	52	15	5.5	9.5	5.5	25	32	M6×1P				92	
			3.5×1	1210	3010	90															65	
	6	3.969	1.5×2	1420	3215	104															58	
			2.5×1	1210	2680	92															49	
			2.5×2	2190	5360	42	128	68	12	55	15	5.5	9.5	5.5	28	33	M6×1P				94	
			3.5×1	1610	3750	104															67	
10	4.762	1.5×2	1820	3840	136															60		
		2.5×1	1560	3200	45	122	72	16	58	15	6.6	11	6.5	29	35	M6×1P				50		
		3.5×1	2080	4480	136															69		
28	5	3.175	1.5×2	1110	2960	90															62	
			2.5×1	950	2470	80																52
			2.5×2	1720	4940	44	110	70	12	56	15	6.6	11	6.5	28	35	M6×1P				101	
			3.5×1	1270	3460	90																72
	6	3.969	1.5×2	1480	3605	110																63
			2.5×1	1270	3000	98																53
			2.5×2	2300	6000	44	134	70	12	56	15	6.6	11	6.5	28	36	M6×1P				103	
			3.5×1	1690	4200	110																73



Unit:mm

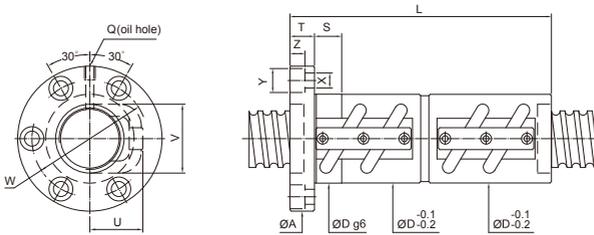
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD (kgf)		NUT		FLANGE				FIT				BOLT		RETURN TUBE		OIL HOLE	STIFFNESS
O.D.	LEAD			Dynamic (1×10 <sup>6</sup> REV.) Ca	Static Co	Dg6	L	A	T	W	S	X	Y	Z	U	V	Q	kgf/μm			
32	5	3.175	1.5×2	1180	3410	90														69	
			2.5×1	1010	2840	80															58
			2.5×2	1830	5680	50	110	76	12	63	15	6.6	11	6.5	30	39	M6×1P				112
			2.5×3	2590	8520	140															164
			3.5×1	1350	3980	90															80
	6	3.969	1.5×2	1560	4135	104															70
			2.5×1	1330	3450	52	92	78	12	65	15	6.6	11	6.5	32	40	M6×1P				59
			2.5×2	2410	6900	128															114
			3.5×1	1770	4830	104															81
	8	4.762	1.5×2	2010	5010	126															73
			2.5×1	1720	4180	54	110	88	16	70	15	9	14	8.5	33	42	M6×1P				61
			2.5×2	3120	8360	158															118
3.5×1			2300	5850	126															84	
10	6.35	1.5×2	3000	6530	142															76	
		2.5×1	2570	5440	57	122	91	16	73	15	9	14	8.5	37	45	M8×1P				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	45	M6×1P			65	
			2.5×2	2600	7900	128															126
	10	6.35	1.5×2	3180	7410	144														83	
			2.5×1	2720	6180	62	124	104	18	82	20	11	17.5	11	40	49	M6×1P				70
			2.5×2	4930	12360	184															136
			3.5×1	3630	8650	144													90		

# FDVC



Unit:mm

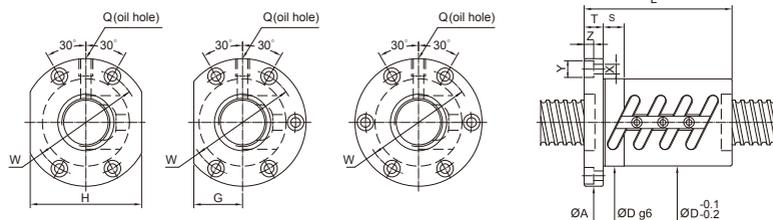
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit x row	BASIC RATE LOAD (kgf)		NUT	FLANGE				FIT				BOLT		RETURN TUBE		OIL HOLE	STIFFNESS		
O.D.	LEAD			Dynamic (1×10 <sup>6</sup> REV.) Ca	Static Co		Dg6	L	A	T	W	S	X	Y	Z	U	V	Q			kgf/μm	
40	5	3.175	1.5×2	1280	4275	94														82		
			2.5×1	1090	3560	84															69	
			2.5×2	1980	7120	58	114	92	16	72	15	9	14	8.5	34	47	M8×1P				133	
			2.5×3	2800	10680	144															196	
			3.5×1	1450	4980	94															95	
	6	3.969		1.5×2	1750	5300	108														85	
				2.5×1	1500	4420	96															71
				2.5×2	2720	8840	60	132	94	16	76	15	9	14	8.5	36	48	PT1/8"				138
				2.5×3	3850	13260	168															202
				3.5×1	2000	6190	108															98
	8	4.762		1.5×2	2220	6320	126														86	
				2.5×1	1900	5270	62	110														73
2.5×2				3450	10540	158	96	16	78	15	9	14	8.5	38	50	PT1/8"				141		
3.5×1				2540	7380	126															100	
10	6.35		1.5×2	3370	8335	152														91		
			2.5×1	2880	6950	65	132														71	
			2.5×2	5220	13900	192	106	18	85	20	11	17.5	11	42	52	PT1/8"				148		
			3.5×1	3840	9730	152													105			
45	10	6.35	2.5×1	3020	7850	134														84		
			2.5×2	5480	15700	70	194	112	18	90	20	11	17.5	11	48	58	PT1/8"				163	
	12	7.144	2.5×1	3550	8950	74	158													85		
2.5×2			6440	17900	230	230	122	18	97	20	14	20	13	49	60	PT1/8"				165		



Unit:mm

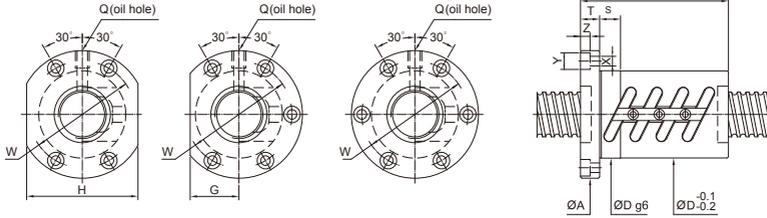
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD (kgf)		NUT		FLANGE		FIT		BOLT		RETURN TUBE		OIL HOLE	STIFFNESS		
O.D.	LEAD			Dynamic (1×10 <sup>6</sup> REV.) Ca	Static Co	Dg6	L	A	T	W	S	X	Y	Z	U	V	Q	kgf/μm	
50	5	3.175	1.5×2	1410	5305	107											98		
			1.5×3	2000	7960	70	127	104	16	86	15	9	14	8.5	40	57	PT1/8"	144	
			3.5×1	1610	6190	107													114
	6	3.969	2.5×2	2980	11000	72	134											164	
			2.5×3	4220	16500	170	106	16	88	15	9	14	8.5	43	59	PT1/8"		242	
			2.5×2	3900	13020	75	160												170
	8	4.762	2.5×3	5520	19530	208	116	18	95	20	11	17.5	11	45	60	PT1/8"		250	
			1.5×2	3725	10450	154													119
			2.5×1	3190	8710	134													91
	10	6.35	2.5×2	5790	17420	78	194	119	18	98	20	11	17.5	11	48	62	PT1/8"	177	
			2.5×3	8200	26130	254													261
			3.5×1	4260	12190	154													126
12	7.144	2.5×1	3700	10050	82	160											92		
		2.5×2	6710	20100	232	128	22	105	20	14	20	13	52	64	PT1/8"		179		
55	10	6.35	2.5×2	6005	19540	84	194										191		
			2.5×3	8510	29310	254	125	18	103	20	11	17.5	11	54	68	PT1/8"		281	
63	10	6.35	2.5×1	3510	11200	136												110	
			2.5×2	6370	22400	90	196	132	20	110	20	11	17.5	11	53	76	PT1/8"	213	
			2.5×3	9020	33600	256													313
	12	7.938	2.5×1	4760	13820	160													112
			2.5×2	8650	27560	94	232	142	22	117	20	14	20	13	57	76	PT1/8"	218	
			2.5×3	12250	41340	304													322
16	9.525	2.5×1	8050	23100	100	200												144	
		2.5×2	14600	46200	296	150	22	123	20	14	20	13	62	79	PT1/8"		280		
80	10	6.35	2.5×2	7130	28500	200												258	
			2.5×3	10100	42750	260	163	22	137	20	14	20	13	64	91	PT1/8"		380	
	12	7.938	2.5×2	9710	35560	232													265
			2.5×3	13760	53340	302	120	169	22	143	25	14	20	13	67	94	PT1/8"	391	
	16	9.525	2.5×2	16450	59280	302													339
			2.5×3	23300	88920	398	125	190	28	154	25	18	26	17.5	70	96	PT1/8"	500	

# 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 <sup>6</sup> REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	S	X	Y	Z	Q	kgf/μm	
20	4	2.381	2.5×1×(2)	450	1060	50	63.5	11	51	21	42	10	5.5	9.5	5.5	M6×1P	32		
			3.5×1×(2)	600	1480	40												60	49
	5	3.175	2.5×1×(2)	830	1730	56	67	11	55	26	52	15	5.5	9.5	5.5	M6×1P	40		
			3.5×1×(2)	1110	2420	44												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		
			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	50	69	11	57	26	52	15	5.5	9.5	5.5	M6×1P	43		
			2.5×2×(2)	930	2710	46												74	84
	5	3.175	2.5×1×(2)	910	2150	55	73	11	61	28	56	15	5.5	9.5	5.5	M6×1P	48		
			2.5×2×(2)	1650	4300	50												85	92
	6	3.969	2.5×1×(2)	1210	2680	62	76	11	64	29	58	15	5.5	9.5	5.5	M6×1P	49		
				2.5×2×(2)	2190	5360												53	98
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	56	83	12	69	31	62	15	6.6	11	6.5	M8×1P	52		
			2.5×2×(2)	1720	4940	55												86	101
	6	3.969	2.5×1×(2)	1270	3000	63	83	12	69	31	62	15	6.6	11	6.5	M8×1P	53		
			2.5×2×(2)	2300	6000	55												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	50	81	12	67	32	64	15	6.6	11	6.5	M6×1P	52		
			2.5×2×(2)	1020	3500	54												76	101
	5	3.175	2.5×1×(2)	1010	2840	57	85	12	71	32	64	15	6.6	11	6.5	M8×1P	58		
			2.5×2×(2)	1830	5680	58												87	112
	6	3.969	2.5×1×(2)	1330	3450	63	88	12	75	34	68	15	6.6	11	6.5	M8×1P	59		
			2.5×2×(2)	2410	6900	62												99	114
	8	4.762	1.5×1×(2)	1110	2510	64	100	15	82	38	76	15	9	14	8.5	M8×1P	37		
			2.5×1×(2)	1720	4180	66												80	61
10	6.35	1.5×1×(2)	1660	3260	78	108	15	90	41	82	15	9	14	8.5	M6×1P	39			
		2.5×1×(2)	2570	5440	74												97	64	
12	6.35	1.5×1×(2)	1660	3260	88	108	18	90	41	82	15	9	14	8.5	M8×1P	39			
		2.5×1×(2)	2570	5440	74												110	64	



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 <sup>6</sup> 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	6.35	1.5×1×(2)	1750	3710	75	81	118	18	98	45	90	15	11	17.5	11	M8×1P	43	
			2.5×1×(2)	2720	6180		103											70	
40	5	3.175	2.5×1×(2)	1090	3560	67	60	101	15	83	39	78	15	9	14	8.5	M8×1P	69	
			2.5×2×(2)	1980	7120		90											133	
	6	3.969	2.5×1×(2)	1500	4420	70	66	104	15	86	40	80	15	9	14	8.5	PT1/8"	71	
			2.5×2×(2)	2720	8840		102											138	
	8	4.762	2.5×1×(2)	1900	5270	74	83	108	15	90	41	82	15	9	14	8.5	PT1/8"	73	
			2.5×2×(2)	3450	10540		131											141	
	10	6.35	6.35	1.5×1×(2)	1860	4710	81	81	102	18	102	47	94	20	11	17.5	11	PT1/8"	47
				2.5×1×(2)	2880	6950		82											76
2.5×2×(2)				3850	9730	121		105											
3.5×1×(2)				2880	6950	86		106											
12	6.35	2.5×1×(2)	2.5×1×(2)	2880	6950	86	112	128	18	106	48	96	20	11	17.5	11	PT1/8"	76	
			2.5×2×(2)	3020	7850		88											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	
			2.5×2×(2)	3550	8950		90											85	
50	5	3.175	2.5×1×(2)	1210	4420	80	60	114	15	96	43	86	15	9	14	8.5	PT1/8"	83	
			2.5×2×(2)	2980	11000		84											164	
	6	3.969	2.5×1×(2)	2980	11000	84	103	118	15	100	45	90	15	9	14	8.5	PT1/8"	170	
			2.5×2×(2)	3900	13020		87											126	
	8	4.762	2.5×1×(2)	3900	13020	87	134	129	18	107	49	98	20	11	17.5	11	PT1/8"	91	
			2.5×2×(2)	3190	8710		101											126	
10	6.35	2.5×1×(2)	5790	17420	93	161	135	18	113	51	102	20	11	17.5	11	PT1/8"	177		
		2.5×2×(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		
		2.5×2×(2)	3310	9770		102											126		
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	

# 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.

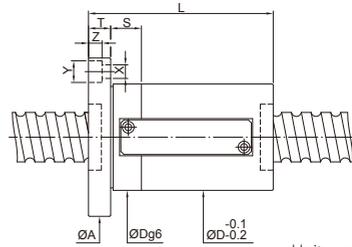
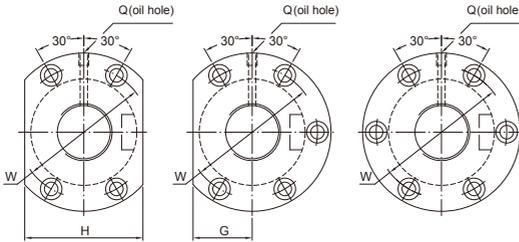
Multiple thread starts are available to make more steel balls loaded in the ballnut for higher rigidity and durability.

### 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.

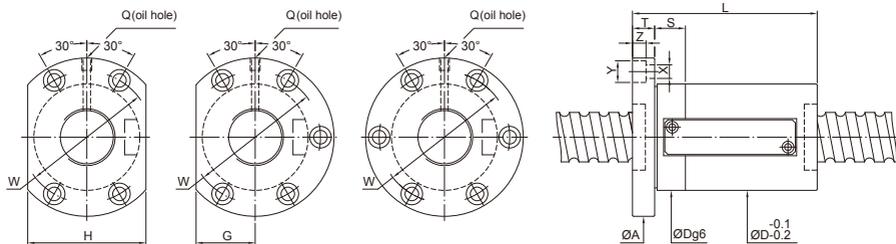




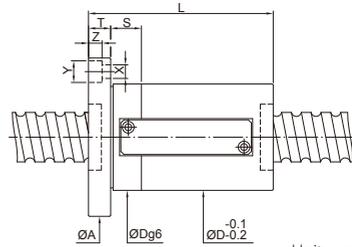
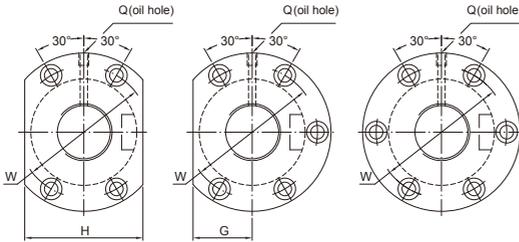
Unit:mm

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 <sup>6</sup> 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		
			3.5×1	1210	2380	46	73	73.5	13	59	25	50	10	5.5	9.5	5.5	M6×1P	34		
	16	3.969	1.5×1	830	1530	46	63	73.5	13	59	25	50	10	5.5	9.5	5.5	M6×1P	24		
			2.5×1	1210	2380	46	79	73.5	13	59	25	50	10	5.5	9.5	5.5	M6×1P	34		
20	16	3.969	1.5×1	830	1530	46	70	73	13	59	25	50	10	5.5	9.5	5.5	M6×1P	24		
			2.5×1	1210	2380	46	79	73.5	13	59	25	50	10	5.5	9.5	5.5	M6×1P	34		
	20	4.762	1.5×1	920	1930	58	68	85	15	71	32	64	15	6.6	11	6.5	M6×1P	28		
			2.5×1	1340	3000	58	84	85	15	71	32	64	15	6.6	11	6.5	M6×1P	40		
25	16	3.969	1.5×1	1170	2300	74	74	108	15	90	41	82	15	9	14	8.5	M8×1P	29		
			2.5×1	1710	3580	58	94	85	15	71	32	64	15	6.6	11	6.5	M6×1P	42		
	20	4.762	3.5×1	2220	4860	114	114	108	15	90	41	82	15	9	14	8.5	M8×1P	55		
			5×1	2340	6620	115	115	108	15	90	41	82	15	9	14	8.5	M8×1P	77		
32	16	3.969	1.5×1	1010	2480	74	74	108	15	90	41	82	15	9	14	8.5	M8×1P	33		
			2.5×1	1470	3860	74	83	108	15	90	41	82	15	9	14	8.5	M8×1P	48		
	20	4.762	3.5×1	1910	5240	99	99	108	15	90	41	82	15	9	14	8.5	M8×1P	63		
			5×1	2340	6620	115	115	108	15	90	41	82	15	9	14	8.5	M8×1P	77		
32	16	6.35	2.5×1	2830	6090	92	92	108	15	90	41	82	15	11	17.5	11	M8×1P	54		
			3.5×1	3680	8270	74	108	108	18	88	41	82	15	11	17.5	11	M8×1P	69		
	20	4.762	5×1	4490	10450	124	124	108	15	90	41	82	15	11	17.5	11	M8×1P	85		
			1.5×1	1010	2480	74	74	108	15	90	41	82	15	9	14	8.5	M8×1P	33		
32	20	3.969	2.5×1	1470	3860	74	94	108	15	90	41	82	15	9	14	8.5	M8×1P	48		
			3.5×1	1910	5240	74	114	108	15	90	41	82	15	9	14	8.5	M8×1P	63		
	20	6.35	5×1	2350	6610	134	134	108	15	90	41	82	15	11	17.5	11	M8×1P	77		
			2.5×1	2830	6090	104	104	108	15	90	41	82	15	11	17.5	11	M8×1P	54		
32	20	6.35	3.5×1	3680	8270	74	124	108	18	88	41	82	15	11	17.5	11	M8×1P	69		
			5×1	4490	10450	144	144	108	18	88	41	82	15	11	17.5	11	M8×1P	85		

# FSWE



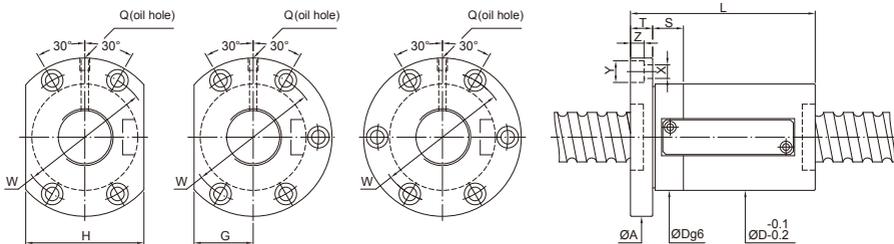
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD (kgf)		NUT		FLANGE					FIT	BOLT			OIL HOLE	STIFFNESS	
O.D.	LEAD			Dynamic (1×10 <sup>6</sup> REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	S	X	Y	Z	Q	kgf/μm	
36	10	6.35	3.5×1	3890	9390	75	84	118	18	98	45	90	15	11	17.5	11	M8×1P	76	
			5×1	4750	11860		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	
	16	6.35	5×1	4750	11860	75	109	107	118	18	98	45	90	15	11	17.5	11	M8×1P	93
			2.5×1	2990	6920		91												58
	20	6.35	3.5×1	3890	9390	75	107	118	18	98	45	90	15	11	17.5	11	PT1/8"	76	76
			5×1	4750	11860		123												93
			1.5×1	2050	4450		91												41
			2.5×1	2990	6920		111												58
40	10	6.35	3.5×1	4130	10560	86	86	128	18	106	49	98	15	11	17.5	11	PT1/8"	82	
			5×1	5050	13340		96											101	
	12	6.35	2.5×1	3180	7780	86	86	98	128	18	106	49	98	15	11	17.5	11	PT1/8"	63
			3.5×1	4130	10560		98												82
	16	6.35	5×1	5050	13340	86	110	108	128	18	106	49	98	15	11	17.5	11	PT1/8"	101
			2.5×1	3180	7780		92												63
	16	7.144	3.5×1	4870	11930	86	108	128	18	106	49	98	15	11	17.5	11	PT1/8"	84	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"	82	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		



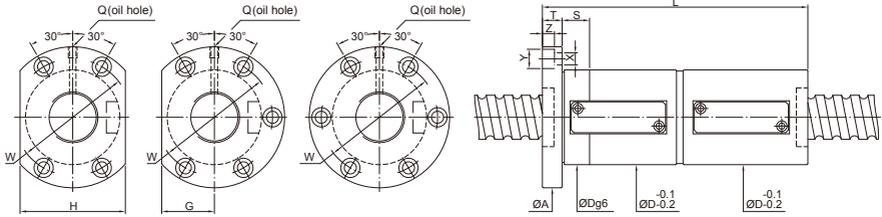
Unit:mm

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 <sup>6</sup> REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	S	X	Y	Z	Q	kgf/μm	
50	10	6.35	3.5×1	4560	13230	93	85	135	18	113	51	102	20	11	17.5	11	PT1/8"	97	
			5×1	5580	16710													95	119
	12	6.35	2.5×1	3510	9750	93	80	135	18	113	51	102	20	11	17.5	11	PT1/8"	74	
			3.5×1	4560	13230													92	97
	12	7.144	2.5×1	4080	11260	100	93	105	146	25	122	55	110	20	14	20	13	PT1/8"	75
			3.5×1	5300	15280														104
	16	6.35	2.5×1	3510	9750	93	94	135	18	113	51	102	20	11	17.5	11	PT1/8"	74	
			3.5×1	4560	13230													110	97
	16	7.144	2.5×1	4080	11260	100	100	146	25	122	55	110	15	14	20	13	PT1/8"	75	
			3.5×1	5300	15280													116	99
	20	7.144	1.5×1	2790	7240	100	104	146	25	122	55	110	15	14	20	13	PT1/8"	52	
			2.5×1	4080	11260													124	75
			3.5×1	5300	15280													144	99
			5×1	6480	19300													164	121
20	7.938	2.5×1	4750	12090	105	119	139	152	25	128	58	116	20	14	20	13	PT1/8"	78	
		3.5×1	6180	16400														139	101
50	7.938	1.5×1	3250	7770	105	157	152	25	128	58	116	20	14	20	13	PT1/8"	53		
		3.5×1	6180	16400													159	124	

# FSWE



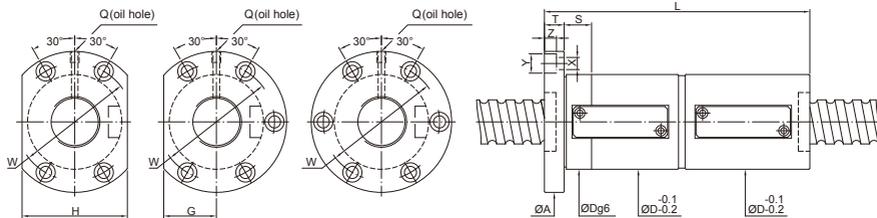
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit x row	BASIC RATE LOAD (kgf)		NUT		FLANGE					FIT			BOLT			OIL HOLE	STIFFNESS
O.D.	LEAD			Dynamic (1×10 <sup>6</sup> REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	S	X	Y	Z	Q	kgf/μm		
63	10	6.35	3.5×1	5030	17020	108	86	154	22	130	58	116	20	14	20	13	PT1/8"	115		
			5×1	6150	21500													141		
	12	6.35	2.5×1	3870	12540	108	96	154	22	130	58	116	20	14	20	13	PT1/8"	87		
			3.5×1	5030	17020													115		
	12	7.144	2.5×1	4540	14460	115	102	161	22	137	61	122	20	14	20	13	PT1/8"	89		
			3.5×1	5900	19620													117		
	16	7.144	2.5×1	4540	14460	115	113	161	22	137	61	122	20	14	20	13	PT1/8"	145		
			3.5×1	5900	19620													117		
	16	7.938	2.5×1	5260	15430	120	128	180	28	150	72	144	25	18	26	17.5	PT1/8"	91		
			3.5×1	6840	20940													120		
	20	6.35	2.5×1	3870	12540	108	124	154	22	130	58	116	20	14	20	13	PT1/8"	87		
			3.5×1	5030	17020													115		
20	9.525	2.5×1	8870	25870	122	140	182	28	150	72	144	25	18	26	17.5	PT1/8"	105			
		3.5×1	11530	35110													136			
10	6.35	2.5×1	5630	21660	130	90	176	22	152	66	132	20	14	20	13	PT1/8"	164			
		3.5×1	6880	27360													133			
12	7.938	2.5×1	7670	27030	136	101	182	22	158	68	136	20	14	20	13	PT1/8"	143			
		3.5×1	9380	34140													177			
16	9.525	2.5×1	9900	33200	140	108	124	204	28	172	77	154	30	18	26	17.5	PT1/8"	124		
		3.5×1	12990	45050														143		
20	9.525	2.5×1	9900	33200	140	120	140	204	28	172	77	154	30	18	26	17.5	PT1/8"	162		
		3.5×1	12990	45050														162		
16	9.525	2.5×1	11320	41820	170	115	140	204	28	172	77	154	30	22	32	21.5	PT1/8"	201		
		3.5×1	14720	56750														139		
20	9.525	2.5×1	11320	41820	170	128	148	243	32	205	91	182	30	22	32	21.5	PT1/8"	226		
		3.5×1	14720	56750														182		
20	9.525	2.5×1	11320	41820	170	128	148	243	32	205	91	182	30	22	32	21.5	PT1/8"	139		
		3.5×1	14720	56750														182		
20	9.525	2.5×1	11320	41820	170	128	148	243	32	205	91	182	30	22	32	21.5	PT1/8"	226		
		3.5×1	14720	56750														226		



Unit:mm

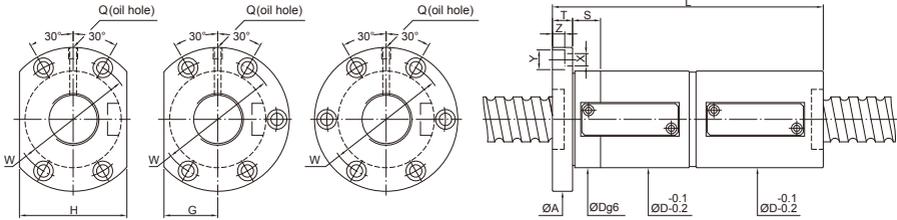
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD (kgf)		NUT		FLANGE				FIT		BOLT			OIL HOLE	STIFFNESS															
O.D.	LEAD			Dynamic (1×10 <sup>6</sup> REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	S	X	Y	Z	Q	kgf/μm															
12	10	2.381	2.5×1	420	720	30	102	50	10	40	16	32	10	4.5	8	4.4	M6×1P	30															
	20	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													68															
	20	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	51																												
25	16	3.969	1.5×1	920	1930	58	126	85	15	71	32	64	15	6.6	11	6.5	M6×1P	41															
			2.5×1	1340	3000													61															
	20	4.762	1.5×1	1170	2300	58	194	85	15	71	32	64	15	6.6	11	6.5	M6×1P	43															
			2.5×1	1710	3580													63															
32	16	3.969	3.5×1	2220	4860	74	164	108	15	90	41	82	15	9	14	8.5	M8×1P	83															
			5×1	2340	6620													120															
			1.5×1	1010	2480													132	74	164	108	15	90	41	82	15	9	14	8.5	M8×1P	49		
			2.5×1	1470	3860													73															
			3.5×1	1910	5240													96															
	16	6.35	5×1	2340	6620	228	74	205	108	18	90	41	82	15	11	17.5	11	M8×1P	120														
			2.5×1	2830	6090	173																											
			3.5×1	3680	8270	205													74	174	108	15	90	41	82	15	9	14	8.5	M8×1P	80		
			5×1	4490	10450	237																											
			20	3.969	1.5×1	1010													2480	134	74	174	108	15	90	41	82	15	9	14	8.5	M8×1P	105
					2.5×1	1470													3860	73													
					3.5×1	1910													5240	96													
5×1	2350	6610			120																												
2.5×1	2830	6090			204																												
20	6.35	3.5×1	3680	8270	244	74	244	108	18	88	41	82	15	11	17.5	11	M8×1P	105															
		5×1	4490	10450	284																												

# FDWE



Unit:mm

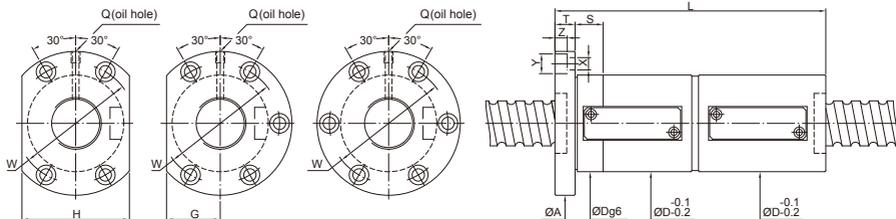
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD (kgf)		NUT		FLANGE				FIT		BOLT		OIL HOLE	STIFFNESS			
O.D.	LEAD			Dynamic (1×10 <sup>6</sup> REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	S	X	Y	Z	Q	kgf/μm		
36	10	6.35	3.5×1	3890	9390	75	155	118	18	98	45	90	15	11	17.5	11	M8×1P	115		
			5×1	4750	11860													175	143	
	12	6.35	2.5×1	2990	6920	140	88	118	18	98	45	90	15	11	17.5	11	M8×1P	115		
			5×1	4750	11860													188	143	
	16	6.35	2.5×1	2990	6920	171	88	118	18	98	45	90	15	11	17.5	11	M8×1P	115		
			5×1	4750	11860													235	143	
	20	6.35	1.5×1	2050	4450	164	59	118	18	98	45	90	15	11	17.5	11	PT1/8"	115	88	
			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	141	95	128	18	106	49	98	15	11	17.5	11	PT1/8"	125		
			5×1	5050	13340													189	155	
	16	6.35	2.5×1	3180	7780	173	98	128	18	106	49	98	15	11	17.5	11	PT1/8"	125		
			5×1	5050	13340													237	155	
	16	7.144	2.5×1	3740	8790	173	98	128	18	106	49	98	15	11	17.5	11	PT1/8"	128		
			5×1	5950	15070													237	159	
	20	6.35	1.5×1	2180	5000	143	64	128	18	106	49	98	15	11	17.5	11	PT1/8"	125	64	
			2.5×1	3180	7780														183	95
			3.5×1	4130	10560														223	125
			5×1	5050	13340														263	155
40	6.35	1.5×1	2180	5000	86	242	128	18	106	49	98	15	11	17.5	11	PT1/8"	64			



Unit:mm

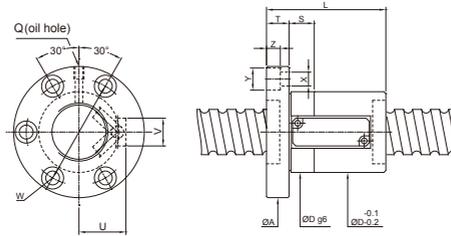
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD (kgf)		NUT		FLANGE				FIT		BOLT			OIL HOLE	STIFFNESS
O.D.	LEAD			Dynamic (1×10 <sup>6</sup> REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	S	X	Y	Z	Q	kgf/μm
50	10	6.35	3.5×1	4560	13230	93	155	135	18	113	51	102	20	11	17.5	11	PT1/8"	149
			5×1	5580	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		173											114
16	7.144	3.5×1	5300	15280	100	205	146	25	122	55	110	15	14	15	13	PT1/8"	151	
		5×1	6480	19300		237											187	
		2.5×1	4080	11260		173											114	
20	7.144	1.5×1	2790	7240	100	164	146	25	122	55	110	15	14	15	13	PT1/8"	77	
		2.5×1	4080	11260		204											114	
		3.5×1	5300	15280		244											151	
20	7.938	1.5×1	2790	7240	100	164	146	25	122	55	110	15	14	15	13	PT1/8"	77	
		2.5×1	4080	11260		204											114	
		3.5×1	5300	15280		244											151	
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	
		1.5×1	2790	7240		164											77	
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

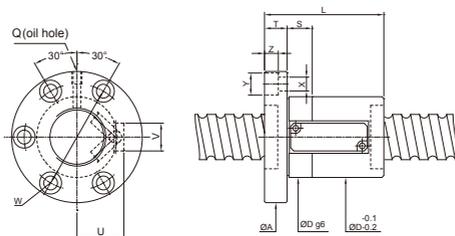
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit x row	BASIC RATE LOAD (kgf)		NUT		FLANGE				FIT		BOLT		OIL HOLE	STIFFNESS		
O.D.	LEAD			Dynamic (1x10 <sup>6</sup> REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	S	X	Y	Z	Q	kgf/μm	
63	10	6.35	3.5x1	5030	17020	108	155	154	22	130	58	116	20	14	20	13	PT1/8"	178	
			5x1	6150	21500													220	
	12	6.35	2.5x1	3870	12540	108	153	154	22	130	58	116	20	14	20	13	PT1/8"	134	
			3.5x1	5030	17020													178	
	12	7.144	2.5x1	4540	14460	115	158	182	161	22	137	61	122	20	14	20	13	PT1/8"	136
			3.5x1	5900	19620														180
	16	7.144	2.5x1	4540	14460	115	177	209	161	22	137	61	122	20	14	20	13	PT1/8"	224
			3.5x1	5900	19620														224
	16	7.938	2.5x1	5260	15430	120	207	239	180	28	150	72	144	25	18	26	17.5	PT1/8"	139
			3.5x1	6840	20940														184
	20	6.35	2.5x1	3870	12540	108	205	245	154	22	130	58	116	20	14	20	13	PT1/8"	228
			3.5x1	5030	17020														228
20	9.525	2.5x1	8870	25870	122	219	259	182	28	150	72	144	25	18	26	17.5	PT1/8"	158	
		3.5x1	11530	35110														208	
10	6.35	3.5x1	5630	21660	130	159	176	22	152	66	132	20	14	20	13	PT1/8"	256		
		5x1	6880	27360													256		
12	7.938	3.5x1	7670	27030	136	184	182	22	158	68	136	20	14	20	13	PT1/8"	222		
		5x1	9380	34140													275		
16	9.525	2.5x1	9900	33200	143	188	220	204	28	172	77	154	30	18	26	17.5	PT1/8"	189	
		3.5x1	12990	45050														251	
20	9.525	2.5x1	9900	33200	143	252	260	204	28	172	77	154	30	18	26	17.5	PT1/8"	311	
		3.5x1	12990	45050														311	
16	9.525	2.5x1	11320	41820	170	211	243	243	32	205	91	182	30	22	32	21.5	PT1/8"	213	
		3.5x1	14720	56750														283	
20	9.525	2.5x1	11320	41820	170	228	268	243	32	205	91	182	30	22	32	21.5	PT1/8"	351	
		3.5x1	14720	56750														213	
			5x1	17990	71690		308											283	
			5x1	17990	71690		308												351



Unit:mm

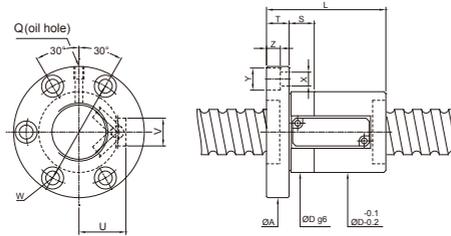
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD (kgf)		NUT		FLANGE		FIT		BOLT		RETURN TUBE		OIL HOLE	STIFFNESS	
O.D.	LEAD			Dynamic (1×10 <sup>6</sup> REV.) Ca	Static Co	Dg6	L	A	T	W	S	X	Y	Z	U	V	Q	kgf/μm
12	10	2.381	2.5×1	420	720	25	50	48	10	36	10	4.5	8	4.4	14	12	M6×1P	20
	10	3.969	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													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	34													
20	16	3.969	1.5×1	830	1530	38	70	62	13	50	10	5.5	9.5	5.5	23	15	M6×1P	24
	16	3.969	1.5×1	920	1930	42	68	68	15	55	15	6.5	11	6.6	26	14	M6×1P	28
			2.5×1	1340	3000													40
	20	4.762	1.5×1	1170	2300	44	94	72	15	59	15	6.6	11	6.5	28	14	M6×1P	29
3.5×1			2220	4860	114													55
32	16	3.969	1.5×1	1010	2480	49	83	78	15	63	15	6.6	11	6.5	30	16	M8×1P	33
			2.5×1	1470	3860													48
			3.5×1	1910	5240													63
			5×1	2340	6610													77
	16	6.35	2.5×1	2830	8200	57	108	98	18	77	20	11	17.5	11	34	22	M8×1P	54
			3.5×1	3680	11120													69
			5×1	4490	14050													85
			1.5×1	1010	2480													74
	20	3.969	2.5×1	1470	3860	49	94	78	15	63	15	6.6	11	6.5	30	16	M8×1P	48
			3.5×1	1910	5240													63
			5×1	2350	6610													77
			2.5×1	2830	8200													104
20	6.35	3.5×1	3680	11120	57	124	98	18	77	20	11	17.5	11	34	22	M8×1P	69	
		5×1	4490	14050													85	
		1.5×1	1010	2480													74	
		2.5×1	1470	3860													104	

# FSVE



Unit:mm

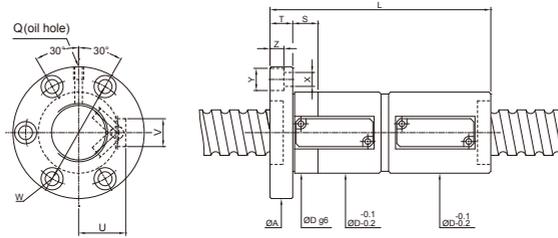
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD (kgf)		NUT		FLANGE			FIT			BOLT		RETURN TUBE		OIL HOLE	STIFFNESS
O.D.	LEAD			Dynamic (1×10 <sup>6</sup> REV.) Ca	Static Co	Dg6	L	A	T	W	S	X	Y	Z	U	V	Q	kgf/μm	
36	10	6.35	3.5×1	3890	9390	60	84	100	18	80	20	11	17.5	11	36	22	M8×1P	76	
			5×1	4750	11860														93
		2.5×1	2990	6920	85	58													
	12	6.35	3.5×1	3890	9390	60	97	100	18	80	20	11	17.5	11	36	22	M8×1P	76	
			5×1	4750	11860														93
		2.5×1	2990	6920	91	58													
	16	6.35	3.5×1	3890	9390	60	107	100	18	80	20	11	17.5	11	36	22	M8×1P	76	
			5×1	4750	11860														93
		1.5×1	2050	4450	91	41													
	20	6.35	2.5×1	2990	6920	60	111	100	18	80	20	11	17.5	11	36	22	M8×1P	58	
			3.5×1	3890	9390														131
		5×1	4750	11860	151	93													
40	10	6.35	3.5×1	4130	10560	64	86	104	18	84	20	11	17.5	11	38	22	PT1/8"	82	
			5×1	5050	13340														96
		2.5×1	3180	7780	86	63													
	12	6.35	3.5×1	4130	10560	64	98	104	18	84	20	11	17.5	11	38	22	PT1/8"	82	
			5×1	5050	13340														110
		2.5×1	3180	7780	93	63													
	16	6.35	3.5×1	4130	10560	64	109	104	18	84	20	11	17.5	11	38	22	PT1/8"	82	
			5×1	5050	13340														125
		2.5×1	3740	8790	92	65													
	16	7.144	3.5×1	4870	11930	64	108	104	18	84	15	11	17.5	11	39	20	PT1/8"	84	
			5×1	5950	15070														124
		1.5×1	2180	5000	84	43													
20	6.35	2.5×1	3180	7780	64	104	104	18	84	20	11	17.5	11	38	22	PT1/8"	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	20	PT1/8"	43		



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 <sup>6</sup> 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												PT1/8"	97		
			5×1	5580	16710	73	95	118	18	96	20	11	17.5	11	43	22					119	
			2.5×1	3510	9750		82															74
	12	6.35	3.5×1	4560	13230	73	94	118	18	96	20	11	17.5	11	43	22				PT1/8"	97	
			5×1	5580	16710		106															119
			2.5×1	4080	11260		93															75
	12	7.144	3.5×1	5300	15280	75	105	122	20	98	15	14	20	13	44	24				PT1/8"	99	
			5×1	6480	19300		117															121
			2.5×1	3510	9750		94															74
	16	6.35	3.5×1	4560	13230	73	110	118	18	96	20	11	17.5	11	43	22				PT1/8"	97	
			5×1	5580	16710		126															119
			2.5×1	4080	11260		100															75
16	7.144	3.5×1	5300	15280	75	116	122	20	98	15	14	20	13	44	22				PT1/8"	99		
		5×1	6480	19300		132															121	
		1.5×1	2790	7240		98															52	
20	7.144	2.5×1	4080	11260		118															75	
		3.5×1	5300	15280	75	138	122	20	98	15	14	20	13	44	20				PT1/8"	99		
		5×1	6480	19300		158															121	
20	7.938	2.5×1	4750	12090		119															78	
		3.5×1	6180	16400	76	139	123	25	99	20	14	20	13	46	25				PT1/8"	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			

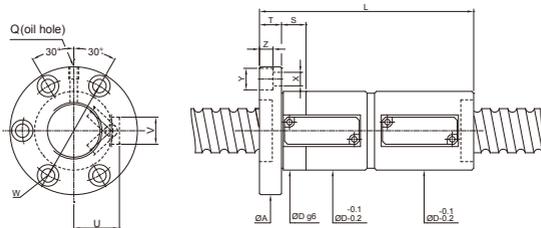




Unit:mm

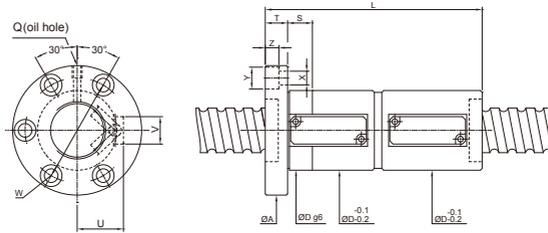
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD (kgf)		NUT		FLANGE			FIT			BOLT			RETURN TUBE	OIL HOLE	STIFFNESS
O.D.	LEAD			Dynamic (1×10 <sup>6</sup> REV.) Ca	Static Co	Dg6	L	A	T	W	S	X	Y	Z	U	V	Q	kgf/μm	
12	10	2.381	2.5×1	420	720	25	102	48	10	36	10	4.5	8	4.4	14	12	M6×1P	30	
	10	3.969	2.5×1	1210	2380	38	113	62	13	50	10	5.5	9.5	5.5	23	15	M6×1P	51	
			3.5×1	1580	3230													68	
	20	16	3.969	1.5×1	830	1530	38	128	62	13	50	10	5.5	9.5	5.5	23	15	M6×1P	35
2.5×1				1210	2380	51													
25	16	3.969	1.5×1	920	1930	42	126	68	15	55	15	6.6	11	6.5	26	14	M6×1P	41	
			2.5×1	1340	3000													61	
	20	4.762	1.5×1	1170	2300	44	154	72	15	59	15	6.6	11	6.5	28	14	M6×1P	43	
			2.5×1	1710	3580													63	
32	16	3.969	1.5×1	1010	2480	49	164	78	15	63	15	6.6	11	6.5	30	16	M8×1P	49	
			2.5×1	1470	3860													73	
			3.5×1	1910	5240													96	
			5×1	2340	6610													120	
	16	6.35	2.5×1	2830	8200	57	205	98	18	77	20	11	17.5	11	34	22	M8×1P	80	
			3.5×1	3680	11120													105	
			5×1	4490	14050													131	
			1.5×1	1010	2480													134	
	20	3.969	2.5×1	1470	3860	49	174	78	15	63	15	6.6	11	6.5	30	16	M8×1P	73	
			3.5×1	1910	5240													96	
			5×1	2350	6610													120	
			2.5×1	2830	8200													204	
20	6.35	3.5×1	3680	11120	57	244	98	18	77	20	11	17.5	11	34	22	M8×1P	105		
		5×1	4490	14050													284		

# FDVE



Unit:mm

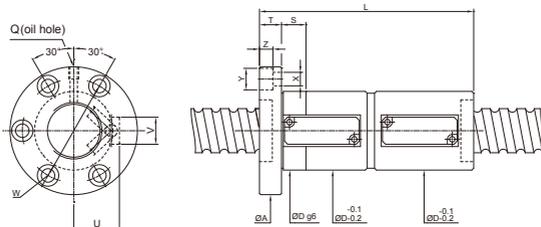
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD (kgf)		NUT		FLANGE			FIT			BOLT			RETURN TUBE		OIL HOLE	STIFFNESS
O.D.	LEAD			Dynamic (1×10 <sup>6</sup> REV.) Ca	Static Co	Dg6	L	A	T	W	S	X	Y	Z	U	V	Q	kgf/μm		
36	10	6.35	3.5×1	3890	9390	60	155	100	18	80	20	11	17.5	11	36	22	M8×1P	115		
			5×1	4750	11860		175											143		
	12	6.35	2.5×1	2990	6920	60	152	100	18	80	20	11	17.5	11	36	22	M8×1P	88		
			3.5×1	3890	9390		176											115		
	16	6.35	5×1	4750	11860	60	200	100	18	80	20	11	17.5	11	36	22	M8×1P	143		
			2.5×1	2990	6920		173											88		
	20	6.35	3.5×1	3890	9390	60	205	100	18	80	20	11	17.5	11	36	22	M8×1P	115		
			5×1	4750	11860		237											143		
1.5×1			2050	4450	164		59													
2.5×1			2990	6920	204		88													
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		
	16	6.35	5×1	5050	13340	64	189	104	18	84	20	11	17.5	11	38	22	PT1/8"	155		
			2.5×1	3180	7780		173											95		
	16	7.144	3.5×1	4870	11930	64	205	104	18	84	15	11	17.5	11	39	20	PT1/8"	128		
			5×1	5950	15070		237											159		
	20	6.35	1.5×1	2180	5000	64	143	104	18	84	20	11	17.5	11	38	22	PT1/8"	64		
			2.5×1	3180	7780		183											95		
			3.5×1	4130	10560		223											125		
			5×1	5050	13340		263											155		
40	6.35	1.5×1	2180	5000	64	242	104	18	84	20	11	17.5	11	38	20	PT1/8"	64			



Unit:mm

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD (kgf)		NUT		FLANGE			FIT			BOLT		RETURN TUBE		OIL HOLE	STIFFNESS
O.D.	LEAD			Dynamic ( $1 \times 10^6$ REV.) Ca	Static Co	Dg6	L	A	T	W	S	X	Y	Z	U	V	Q	kgf/ $\mu$ m	
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	152													112
			3.5×1	4560	13230	73	176	118	18	96	20	11	17.5	11	43	22	PT1/8"	149	
	12	7.144	5×1	5580	16710	200													185
			2.5×1	4080	11260	161													
	16	6.35	3.5×1	5300	15280	75	185	122	20	98	15	14	20	13	44	24	PT1/8"	151	
			5×1	6480	19300	209													
	16	7.144	2.5×1	3510	9750	174													112
			3.5×1	4560	13230	73	206	118	18	96	20	11	17.5	11	43	22	PT1/8"	149	
	20	7.144	5×1	5580	16710	238													185
			2.5×1	4080	11260	173													
	20	7.938	3.5×1	5300	15280	75	205	122	20	98	15	14	20	13	44	22	PT1/8"	151	
			5×1	6480	19300	237													
	50	7.938	1.5×1	2790	7240	164													77
			2.5×1	4080	11260	204													
50	7.938	3.5×1	5300	15280	75	244	122	20	98	15	14	20	13	44	20	PT1/8"	151		
		5×1	6480	19300	284														187
50	7.938	2.5×1	4750	12090	219													117	
		3.5×1	6180	16400	76	259	123	25	99	20	14	20	13	46	25	PT1/8"	154		
50	7.938	5×1	7550	20720	299													191	
		1.5×1	3250	7770	76	305	123	25	99	20	14	20	13	46	25	PT1/8"	79		

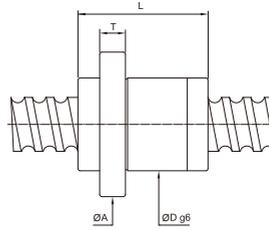
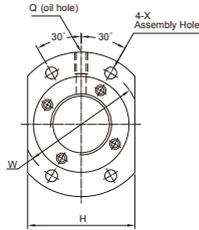
# FDVE



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 <sup>6</sup> REV.) Ca	Static Co	Dg6	L	A	T	W	S	X	Y	Z	U	V	Q	kgf/μm	
63	10	6.35	3.5×1	5030	17020	86	155	133	22	108	20	14	20	13	49	24	PT1/8"	178	
			5×1	6150	21500	175	220												
	12	6.35	2.5×1	3870	12540	153	86	177	133	22	108	20	14	20	13	49	24	PT1/8"	134
			3.5×1	5030	17020	201													178
	12	7.144	2.5×1	4540	14460	158	87	182	134	22	110	20	14	20	13	50	25	PT1/8"	136
			3.5×1	5900	19620	206													180
	16	7.144	2.5×1	4540	14460	177	87	209	134	22	110	20	14	20	13	50	25	PT1/8"	228
			3.5×1	5900	19620	241													184
	16	7.938	2.5×1	5260	15430	207	89	239	148	28	118	25	18	26	17.5	52	25	PT1/8"	134
			3.5×1	6840	20940	271													178
	20	6.35	2.5×1	3870	12540	205	86	245	133	22	108	20	14	20	13	49	24	PT1/8"	220
			3.5×1	5030	17020	285													178
20	7.938	2.5×1	5260	15430	221	89	261	148	28	118	25	18	26	17.5	52	25	PT1/8"	139	
		3.5×1	6840	20940	301													184	
20	9.525	2.5×1	8870	25870	219	93	259	152	28	122	25	18	26	17.5	54	28	PT1/8"	158	
		3.5×1	11530	35110	299													208	
80	10	6.35	3.5×1	5630	21660	103	159	150	22	126	20	14	20	13	58	25	PT1/8"	207	
			5×1	6880	27360	179	256												
	12	7.938	3.5×1	7670	27030	184	123	184	170	22	146	20	14	20	13	66	28	PT1/8"	222
			5×1	9380	34140	208													275
	16	9.525	2.5×1	9900	33200	188	126	220	185	28	155	30	18	26	17.5	70	28	PT1/8"	189
			3.5×1	12990	45050	252													251
20	9.525	2.5×1	9900	33200	220	126	260	185	28	155	30	18	26	17.5	70	28	PT1/8"	311	
		3.5×1	12990	45050	300													251	
100	16	9.525	2.5×1	11320	41820	211	146	243	217	32	181	30	22	32	21.5	82	35	PT1/8"	213
			3.5×1	14720	56750	275													283
	20	9.525	2.5×1	11320	41820	228	146	268	217	32	181	30	22	32	21.5	82	35	PT1/8"	213
			3.5×1	14720	56750	308													283

# End Cap Series



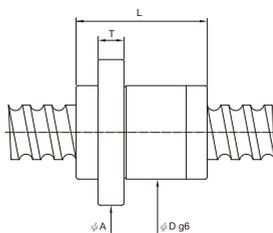
Unit:mm

SCREW SIZE		BALL DIA	EFFECTIVE TURNS circuit × number of thread	BASIC RATE LOAD (kgf)		BALLNUT DIMENSION									
O.D.	LEAD			Dynamic (1×10 <sup>6</sup> REV.) Ca	Static Co	NUT		FLANGE			BOLT	OIL HOLE	STIFFNESS		
						Dg6	L	A	T	H	W	X	Q	kgf/μm	
15	10	3.175	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 1.8×4	1650 2830	3900 7800	47	62	74	12	56	60	6.6	M6×1P	35 69	
32	32	4.762	1.8×2 1.8×4	2360 4280	5940 11800	58	78	92	15	68	74	9	M6×1P	44 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 1.8×4	3860 7000	9900 19880	73	95	114	17	84	93	11	M6×1P	55 108	
50	50	7.938	1.8×2 1.8×4	5800 10520	15800 31600	90	122	135	20	104	112	14	M6×1P	68 135	

PMI Precision Ground BallScrew

# Ultra Lead-End Cap Series

FSKC



Unit:mm

SCREW SIZE		BALL DIA	EFFECTIVE TURNS circuit × number of thread	BASIC RATE LOAD (kgf)		BALLNUT DIMENSION								
O.D.	LEAD			Dynamic (1×10 <sup>6</sup> REV.) Ca	Static Co	NUT		FLANGE			BOLT	OIL HOLE	STIFFNESS	
						Dg6	L	A	T	H	W	X	Q	kgf/μm
15	30	3.715	0.8×2	480	800	32	34	53	10	33	43	5.5	M6×1P	12
			1.8×1	530	900	64	64							13
20	40	3.175	0.8×2	550	1110	38	41	58	10	40	48	5.5	M6×1P	14
			1.8×1	610	1250	81	81							16
25	50	3.969	0.8×2	820	1730	46	50	70	12	48	58	6.6	M6×1P	17
			1.8×1	910	1950		100							100

# 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.

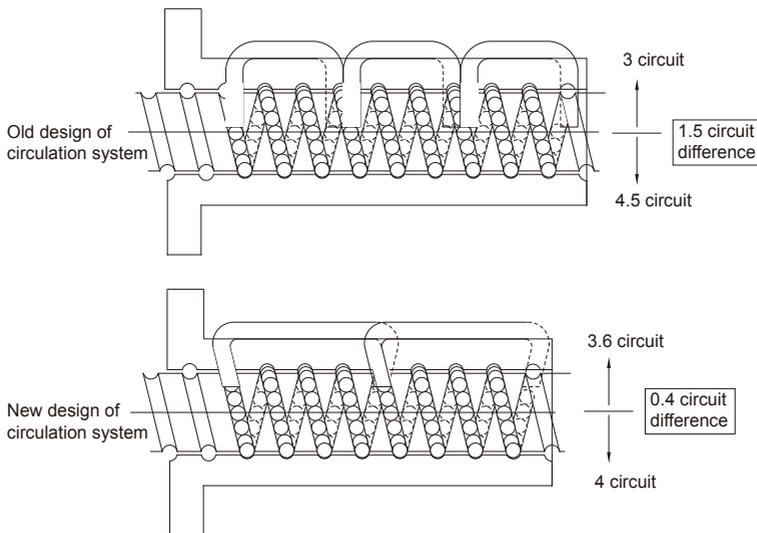


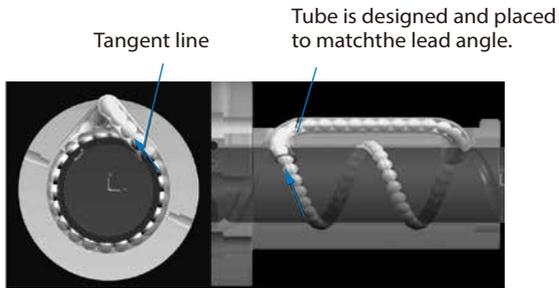
Fig.4 Circuit difference for heavy load ballScrew

## High DN Value

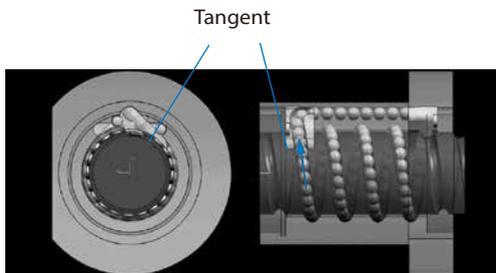
With the newly developed circulation system, ballscrews can meet the demands of high speed running with high DN value.

## Low Noise

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

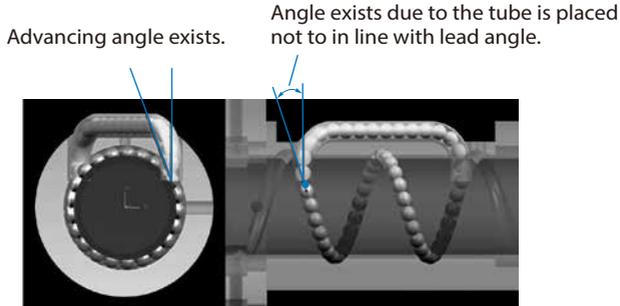


**FSVH circulation system structure(NEW)**



**FSDH circulation system structure (NEW)**

Fig.5 Circulation system structure for FSVH and FSDH



### FSVC circulation system structure

Fig.6 Circulation system structure for FSVC

## Various Specifications Combination

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

## Recommend mounting direction of heavy load ball screws

In order to support equal load distribution for shaft and nut, recommend mounting direction of ball screws allow **fig.7[A1-182]** 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

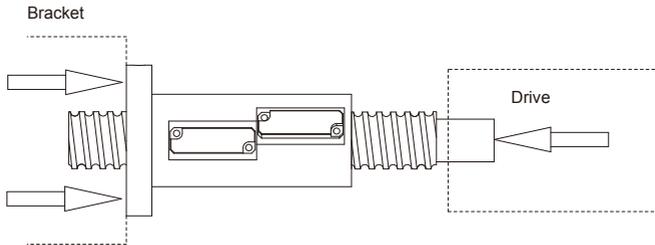


Fig.7 Recommend mounting direction of heavy load ballscrew

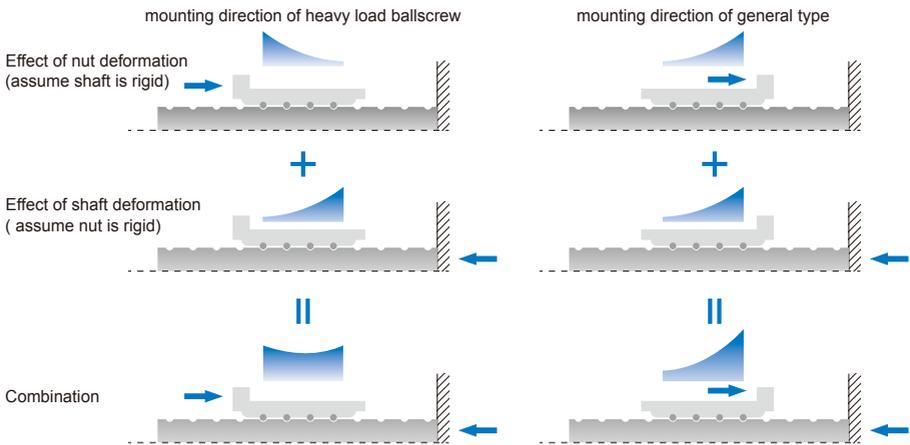
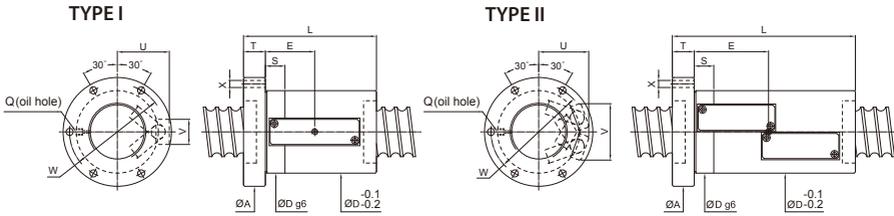


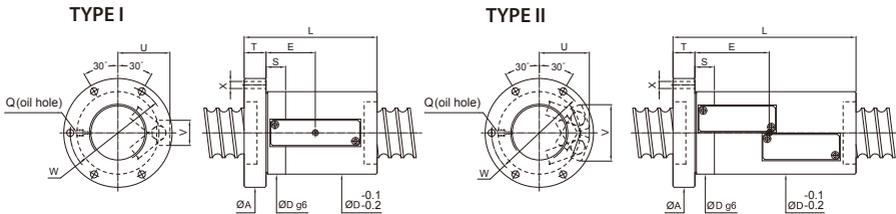
Fig.8 Load distribution



Unit:mm

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD (kgf)		NUT		FLANGE			FIT	OIL HOLE		BOLT			RETURN TUB	Type
O.D.	LEAD			Dynamic (1×10 <sup>5</sup> 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	
	10	7.938	3.5×2	16700	52900	77	133	109	18	92	20	M6x1P	53.7	9	60	48	II	
50	16	12.7	6×1	24800	63700	95	168	128	28	112	20	PT1/8"	70.5	9	32	60	I	
	12	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
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	
63	16	12.7	3.5×2	32600	94000	100	200	133	28	115	20		84.5	9	77	64	II	
			6×1	27800	81700	105	168	138	28	122	25	65.25	9	32	66	I		
			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	66	9	36	73	I		
			3.5×2	39000	136700	120	205	158	32	139	25	PT1/8"	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	87.5	11	90	83	II		
			3.5×2	52100	172400	130	250	168	32	150	25	PT1/8"	107.5	11	90	83	II	
			6×2	75000	263200	130	330	168	32	150	30	147.5	11	90	83	II		
25	19.05	3.5×2	67700	206100	145	305	188	40	165	25	PT1/8"	119	11	108	94	II		
		6×2	97200	314600	145	402	188	40	165	30		169	11	108	94	II		

# FSVH

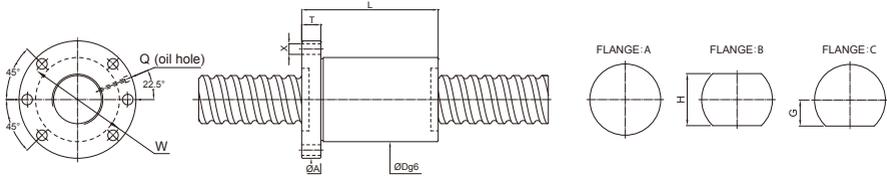


Unit:mm

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD (kgf)		NUT		FLANGE			FIT	OIL HOLE		BOLT		RETURN TUB		Type
O.D.	LEAD			Dynamic (1×10 <sup>6</sup> 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	173	261	213	40	193	30	PT1/8"	109.5	11	50	106	I	
			3.5×2	82100	314300	173	314	213	40	193	30		135.5	11	129	109	II	

# Heavy Load Series of End Deflector

# FSDH

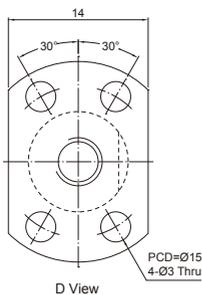
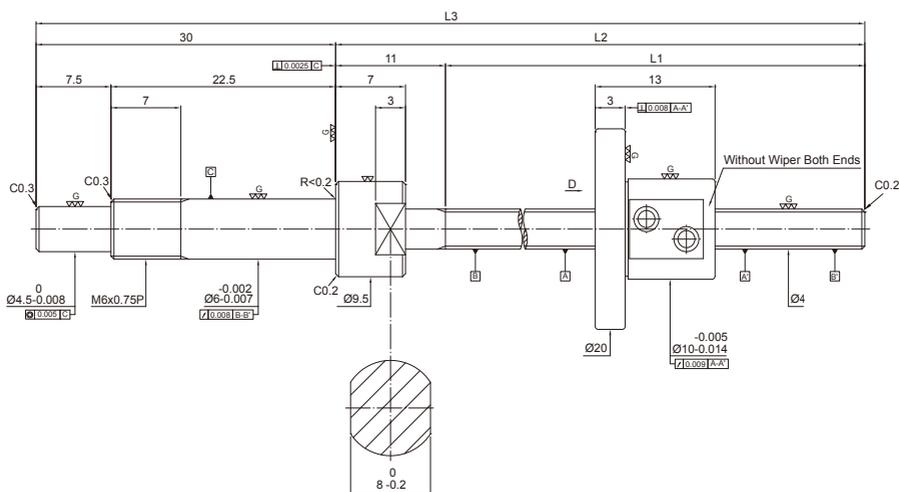


Unit:mm

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × number of thread	BASIC RATE LOAD (kgf)		NUT		FLANGE					OIL HOLE	BOLT
O.D.	LEAD			Dynamic (1×10 <sup>6</sup> REV.) Ca	Static Co	Dg6	L	A	T	W	G	H	Q	X
45	12	9.525	5×1	13600	35400	84	98	128	24	106	57	114	PT1/8"	14
	16	9.525	5×1	13500	35300	84	122	128	24	106	57	114	PT1/8"	14
	20	9.525	4×1	11000	27900	84	122	128	24	106	57	114	PT1/8"	14
50	16	12.7	5×1	21100	53700	102	125	146	28	124	65	130	PT1/8"	14
	20	12.7	4×1	17200	42400	102	124	146	28	124	65	130	PT1/8"	14
	40	12.7	3×2	23400	61200	102	163	146	28	124	65	130	PT1/8"	14
63	32	15.875	4×1	25500	66000	126	176	182	32	154	81	162	PT1/8"	18
	40	15.875	3×2	35300	96600	126	169	182	32	154	81	162	PT1/8"	18
80	50	19.05	4×2	66600	204000	155	255	224	40	190	100	200	PT1/8"	22
100	60	19.05	4×2	73400	251500	175	295	244	40	210	100	200	PT1/8"	22

PMI Precision Ground BallScrew

## Miniature Series

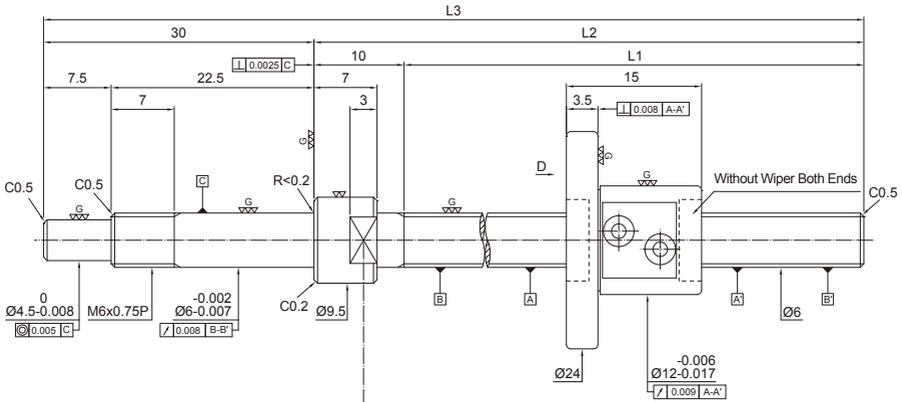
Miniature BallScrews  
Screw Dia.  $\varnothing 4$  Lead 01 **FSMC**

## 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 $C_a$ (kgf)		49
Static Rate Load $C_o$ (kgf)		70
Axial Play	0	0.005 or less
Preloading Torque (kgf-cm)	0.01~0.1	0.03 or less

Unit: mm

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



**Specification of ball screw**

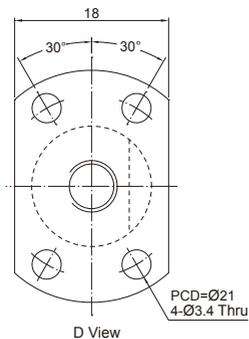
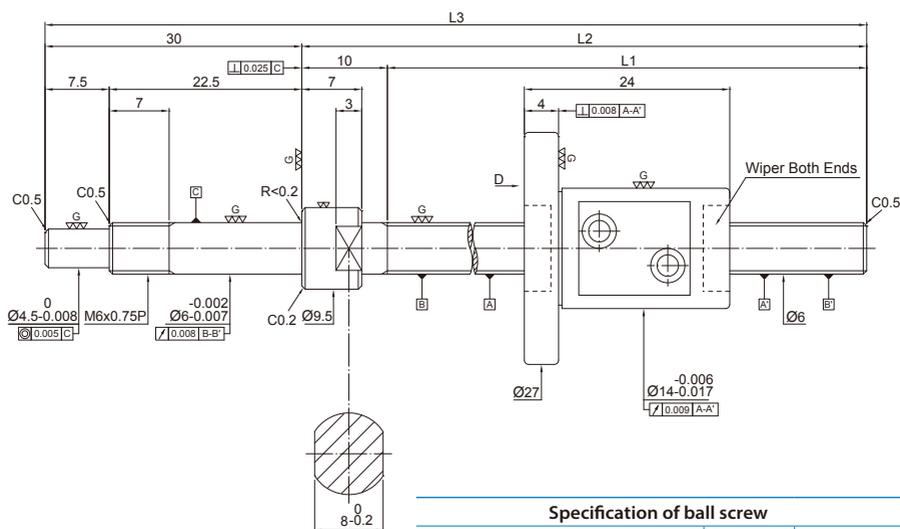
Production Specification	With Preload	Without Preload
Number of Thread / Thread Direction	1/Right	
BCD	6.1	
Lead	1	
Ball Dia.	0.8	
Effective Turns (Circuit $\times$ Row)	2.5 $\times$ 1	
Lead Angle	2.99	
Dynamic Rate Load $C_d$ (kgf)	58	
Static Rate Load $C_0$ (kgf)	100	
Axial Play	0	0.005 or less
Preloading 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.  $\varnothing 6$  Lead 02



### Specification of ball screw

Production Specification	With Preload	Without Preload
Number of Thread / Thread Direction	1/Right	
BCD	6.3	
Lead	2	
Ball Dia.	1.588	
Effective Turns (Circuit $\times$ Row)	2.5 $\times$ 1	
Lead Angle	5.77	
Dynamic Rate Load 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

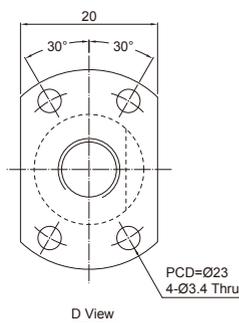
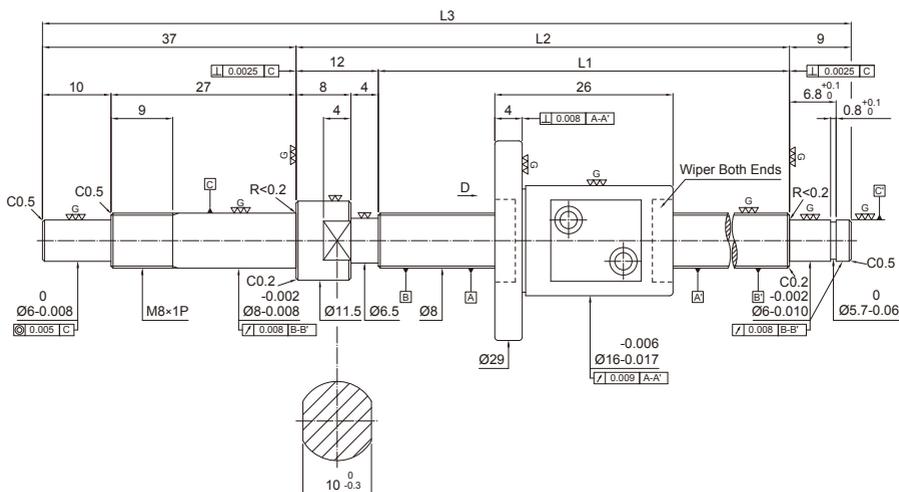
Unit: mm

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



# FSMC

Miniature Ballscrews

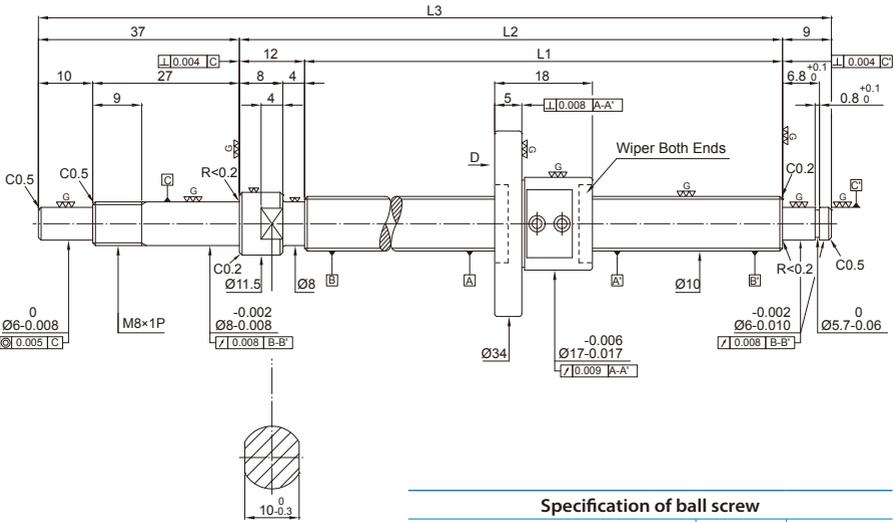
Screw Dia.  $\varnothing 08$  Lead 02

### Specification of ball screw

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

Unit: mm

Model No.	Screw Spindle (Shaft) Length			Accuracy Grade	Lead Accuracy		
	L1	L2	L3		Specified Travel (T)	Accumulated reference lead deviation E	Lead Derivation 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



Specification of ball screw

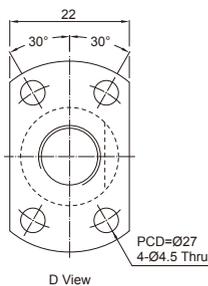
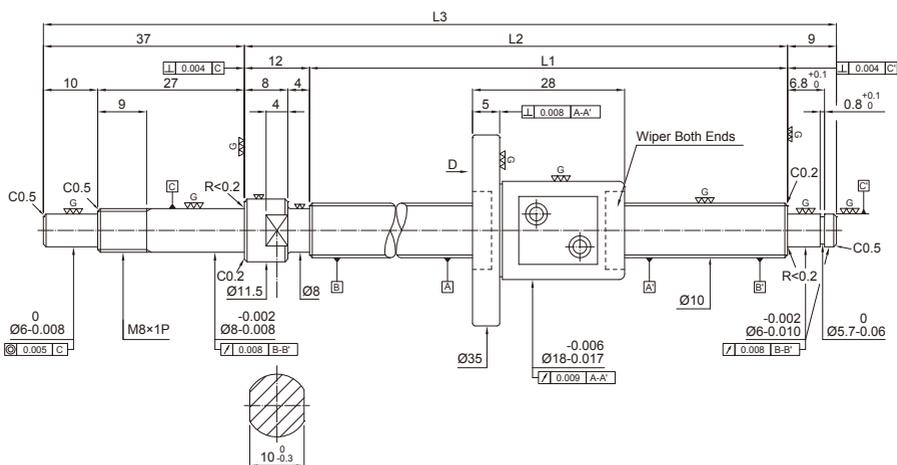
Production Specification	With Preload	Without Preload
Number of Thread / Thread Direction	1/Right	
BCD	10.1	
Lead	1	
Ball Dia.	0.8	
Effective Turns (Circuit × Row)	2.5 × 1	
Lead Angle	1.8	
Dynamic Rate Load Ca (kgf)	73	
Static Rate Load Co (kgf)	180	
Axial Play	0	0.005 or less
Preloading Torque (kgf-cm)	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 Derivation in random 300mm $\epsilon_{300}$
FSM1001-C3-1R-0168	110	122	168	3	0	0.012	0.008
FSM1001-C3-1R-0218	160	172	218	3	0	0.012	0.008
FSM1001-C3-1R-0268	210	222	268	3	0	0.012	0.008
FSM1001-C3-1R-0318	260	272	318	3	0	0.012	0.008
FSM1001-C3-1R-0368	310	322	368	3	0	0.013	0.008

# FSMC

Miniature Ballscrews  
Screw Dia.  $\varnothing 10$  Lead 02

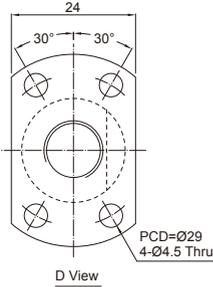
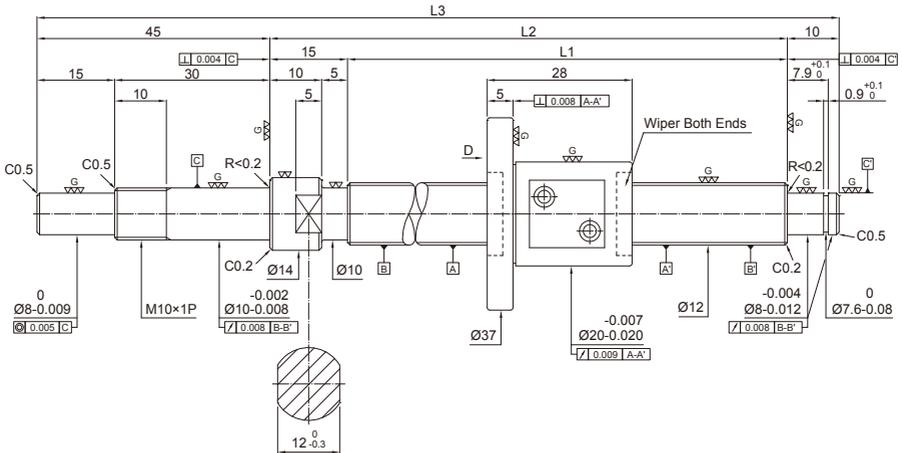


### Specification of ball screw

Production Specification	With Preload	Without Preload
Number of Thread / Thread Direction	1/Right	
BCD	10.3	
Lead	2	
Ball Dia.	1.588	
Effective Turns (Circuit × 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 Derivation in random 300mm $e_{300}$
FSM1002-C3-1R-0168	110	122	168	3	0	0.012	0.008
FSM1002-C3-1R-0218	160	172	218	3	0	0.012	0.008
FSM1002-C3-1R-0268	210	222	268	3	0	0.012	0.008
FSM1002-C3-1R-0318	260	272	318	3	0	0.012	0.008
FSM1002-C3-1R-0368	310	322	368	3	0	0.012	0.008



**Specification of ball screw**

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

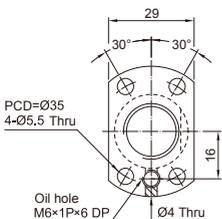
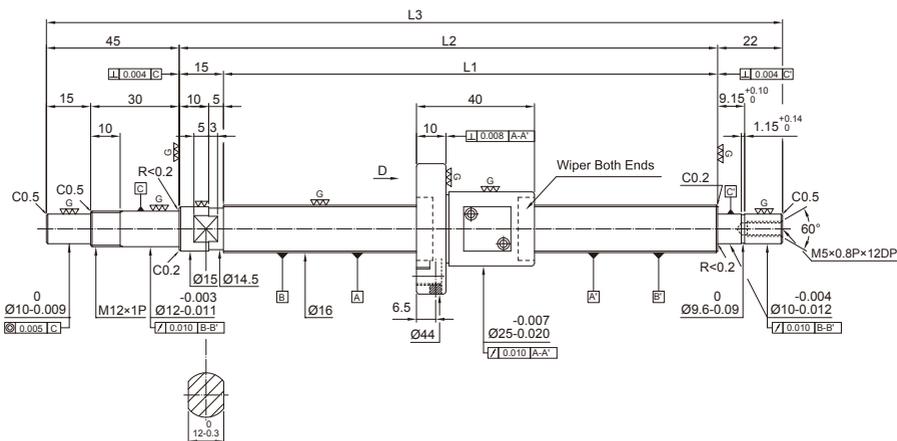
Unit: mm

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

# FSMC

Miniature Ballscrews

Screw Dia. Ø16 Lead02



### Specification of ball screw

Production Specification	With Preload	Without Preload
Number of Thread / Thread Direction	1/Right	
BCD	16.3	
Lead	2	
Ball Dia.	1.588	
Effective Turns (Circuit × 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

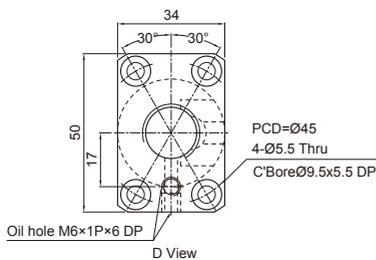
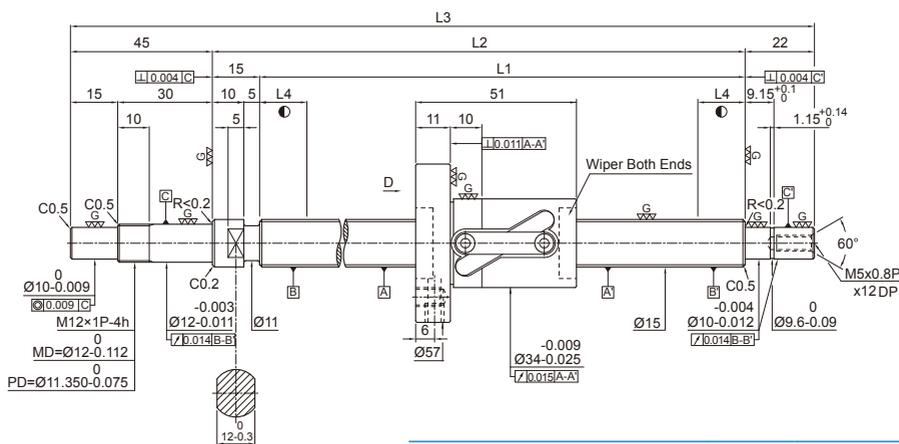






# FSWC Standard ballscrews

Screw Dia. Ø15 Lead10

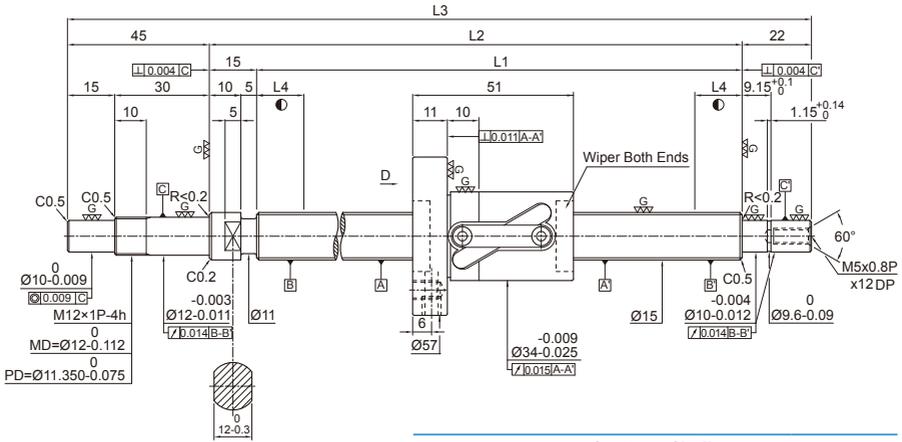


### Specification of ball screw

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

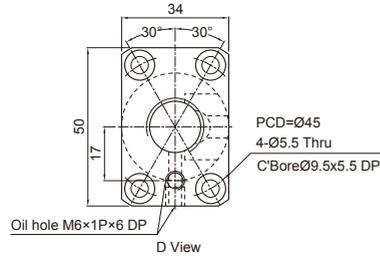
Model No.	Screw Spindle (Shaft) Length				Accuracy Grade	Lead Accuracy	
	L1	L2	L3	L4		Accumulated reference lead deviation E	Lead Derivation in random 300mm $e_{300}$
1R15-10B1-FSWC-189-271-0.018	189	201	271	10	5	0.023	0.018
1R15-10B1-FSWC-239-321-0.018	239	254	321	10	5	0.023	0.018
1R15-10B1-FSWC-289-371-0.018	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

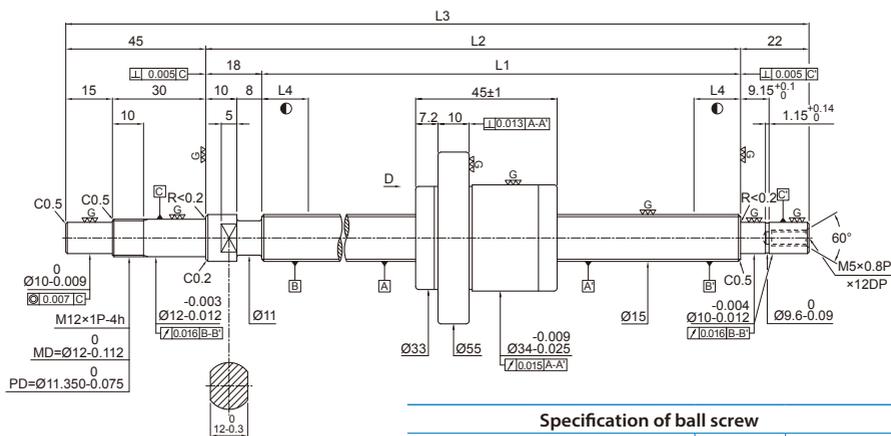


Oil hole M6x1Px6 DP  
D View

Model No.	Screw Spindle (Shaft) Length				Accuracy Grade	Lead Accuracy	
	L1	L2	L3	L4		Accumulated reference lead deviation E	Lead Deriation in random 300mm $\epsilon_{300}$
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

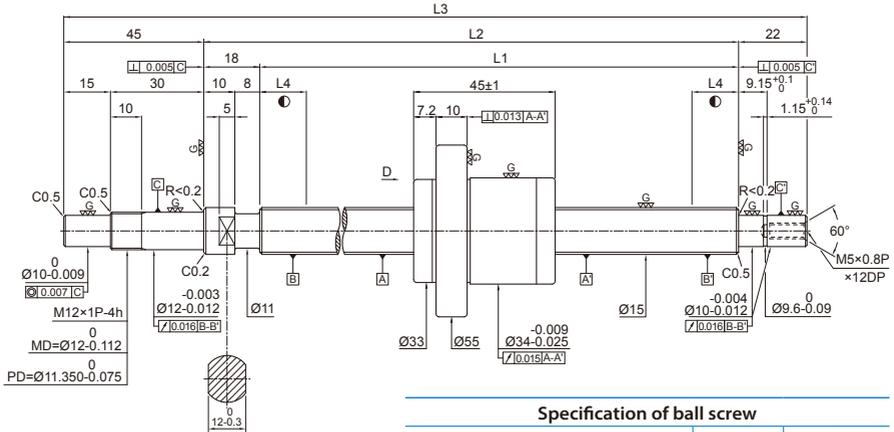


### Specification of ball screw

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 $\epsilon_{300}$
1R15-20A1-FSKC-186-271-0.018	186	204	271	10	5	0.023	0.018
1R15-20A1-FSKC-236-321-0.018	236	254	321	10	5	0.023	0.018
1R15-20A1-FSKC-286-371-0.018	286	304	371	15	5	0.023	0.018
1R15-20A1-FSKC-336-421-0.018	336	354	421	15	5	0.023	0.018
1R15-20A1-FSKC-386-471-0.018	386	404	471	15	5	0.025	0.018
1R15-20A1-FSKC-436-521-0.018	436	454	521	15	5	0.025	0.018
1R15-20A1-FSKC-486-571-0.018	486	504	571	15	5	0.027	0.018



**Specification of ball screw**

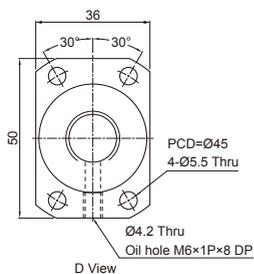
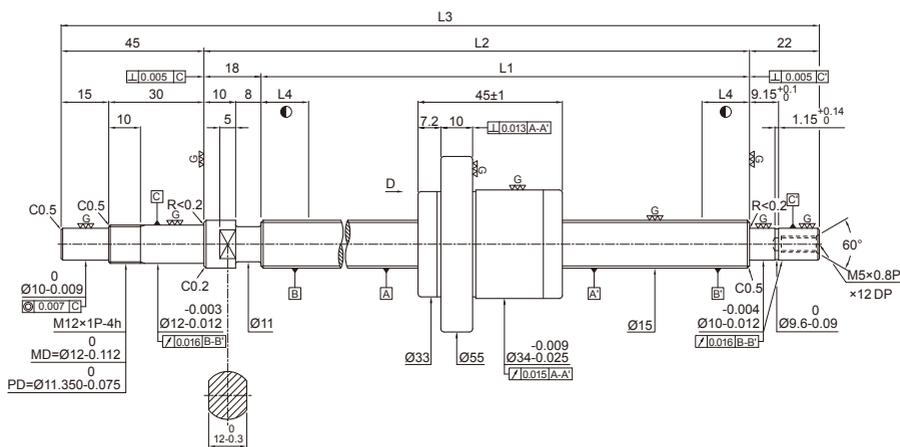
Production Specification	With Preload	Without Preload
Number of Thread / Thread Direction	1/Right	
BCD	15.6	
Lead	20	
Ball Dia.	3.175	
Effective Turns (Circuit × Row)	1.8 × 1	
Lead Angle	22.2	
Dynamic Rate Load Ca (kgf)	780	
Static Rate Load Co (kgf)	1400	
Axial Play	0	0.005 or less
Preloading Torque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

Unit:mm

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

# FSKC Standard ballscrews

## Screw Dia.Ø15 Lead20

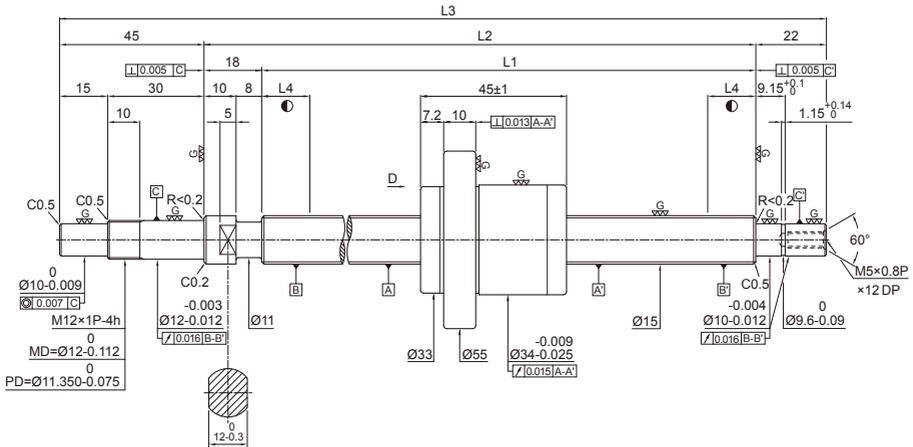


### Specification of ball screw

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 Derivation in random 300mm $e_{300}$
2R15-20A1-FSKC-236-321-0.018	236	254	321	10	5	0.023	0.018
2R15-20A1-FSKC-286-371-0.018	286	304	371	10	5	0.023	0.018
2R15-20A1-FSKC-336-421-0.018	336	354	421	15	5	0.023	0.018
2R15-20A1-FSKC-386-471-0.018	386	404	471	15	5	0.025	0.018
2R15-20A1-FSKC-436-521-0.018	436	454	521	15	5	0.025	0.018
2R15-20A1-FSKC-486-571-0.018	486	504	571	15	5	0.027	0.018

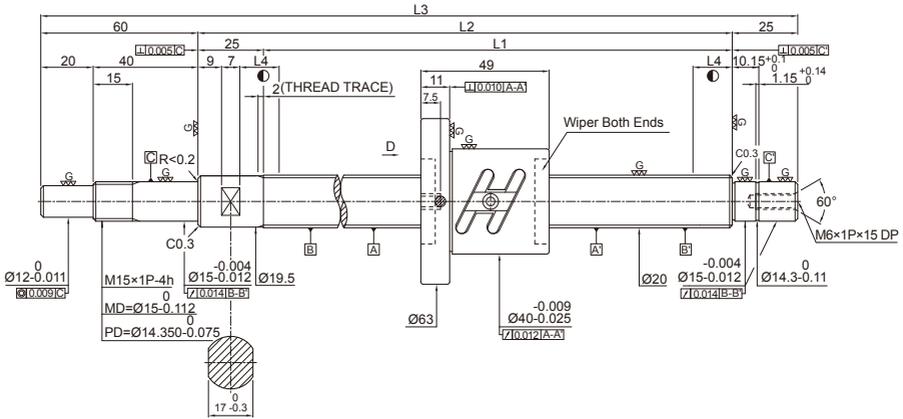


Specification of ball screw		
Production Specification	With Preload	Without Preload
Number of Thread / Thread Direction	2/Right	
BCD	15.6	
Lead	20	
Ball Dia.	3.175	
Effective Turns (Circuit × Row)	1.8 × 2	
Lead Angle	22.2	
Dynamic Rate Load Ca (kgf)	1400	
Static Rate Load Co (kgf)	2800	
Axial Play	0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

Unit:mm

Model No.	Screw Spindle (Shaft) Length				Accuracy Grade	Lead Accuracy	
	L1	L2	L3	L4		Accumulated reference lead deviation E	Lead 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





### Specification of ball screw

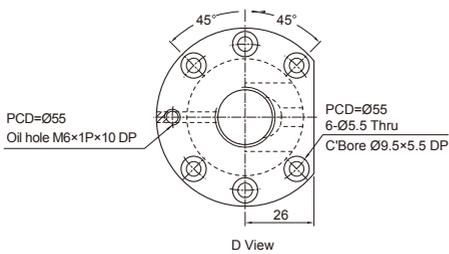
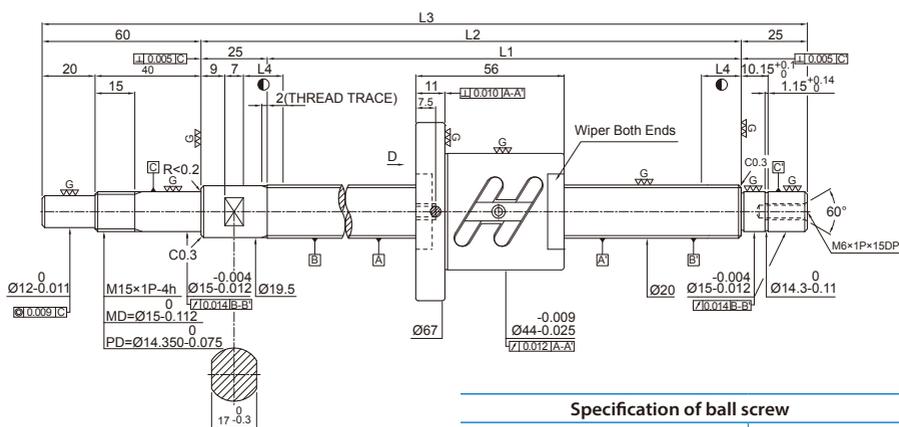
Production Specification	With Preload
Number of Thread /Thread Direction	1/Right
BCD	20.4
Lead	4
Ball Dia.	2.381
Effective Turns (Circuit × Row)	2.5 × 2
Lead Angle	3.57
Dynamic Rate Load Ca (kgf)	820
Static Rate Load Co (kgf)	2110
Axial Play	0
Preloading Torque (kgf-cm)	0.12~0.68

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 <sub>300</sub>
1R20-04B2-FSWC-225-335-0.018	225	250	335	10	5	0.023	0.018
1R20-04B2-FSWC-275-385-0.018	275	300	385	10	5	0.023	0.018
1R20-04B2-FSWC-375-485-0.018	375	400	485	15	5	0.025	0.018
1R20-04B2-FSWC-475-585-0.018	475	500	585	15	5	0.027	0.018
1R20-04B2-FSWC-575-685-0.018	575	600	685	15	5	0.030	0.018
1R20-04B2-FSWC-675-785-0.018	675	700	785	15	5	0.035	0.018

# FSWC Standard ballscrews

## Screw Dia. Ø20 Lead05

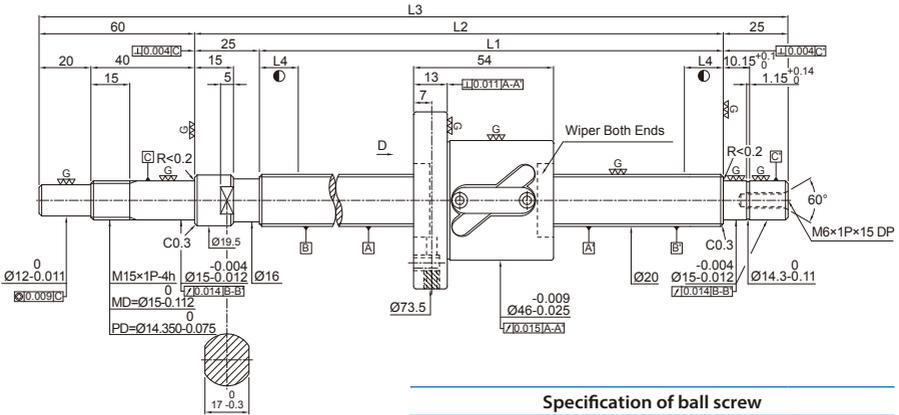


### Specification of ball screw

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

Unit: mm

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



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

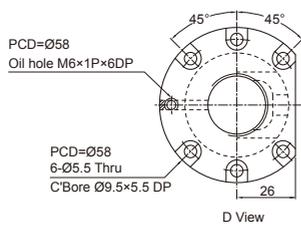
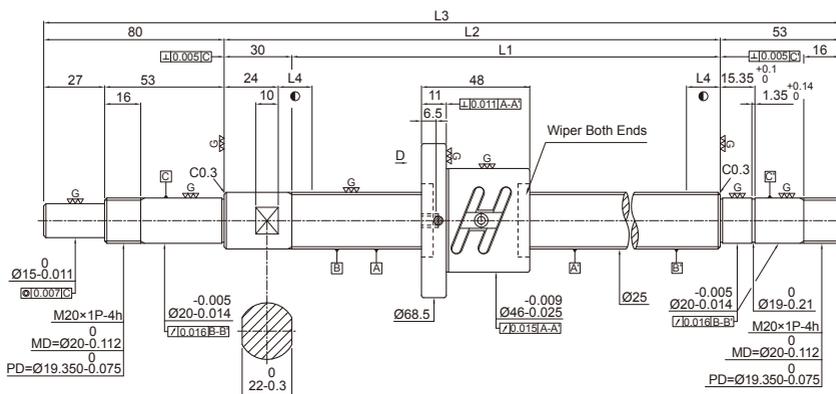
Unit: mm

Model No.	Screw Spindle (Shaft) Length				Accuracy Grade	Lead Accuracy	
	L1	L2	L3	L4		Accumulated reference lead deviation E	Lead Derivation in random 300mm $\epsilon_{300}$
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

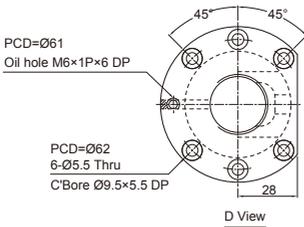
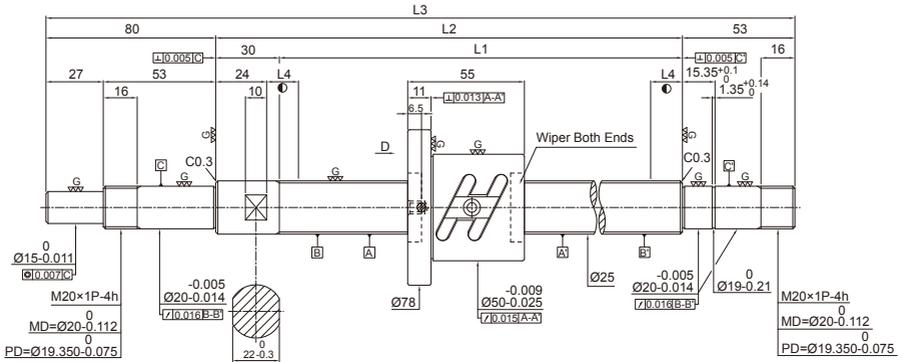


### Specification of ball screw

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 $\epsilon_{300}$
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

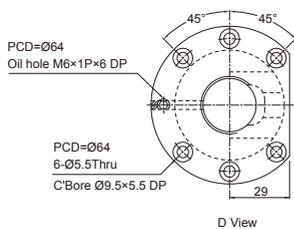
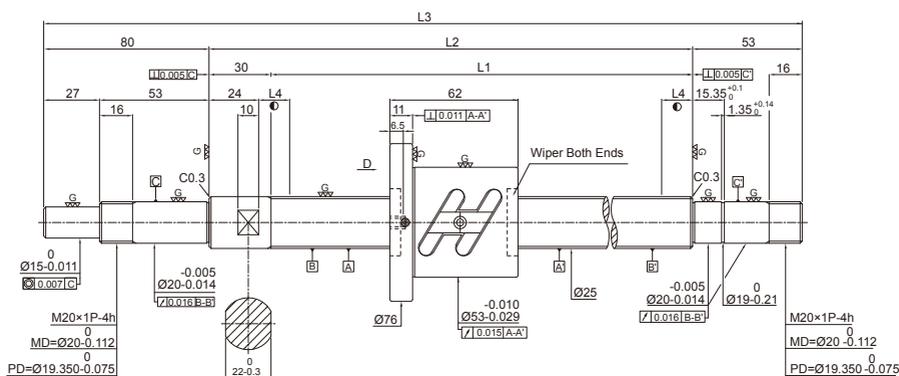
Unit:mm

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 <sub>300</sub>
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

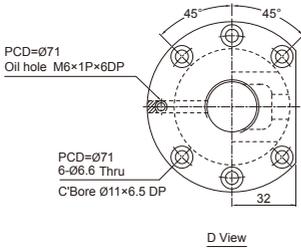
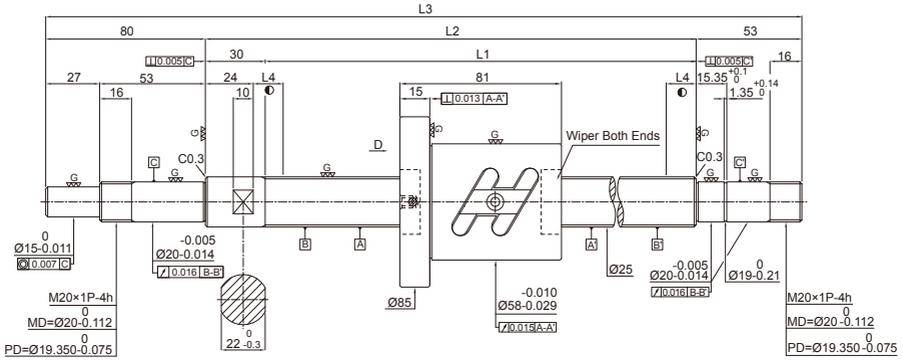


### Specification of ball screw

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



**Specification of ball screw**

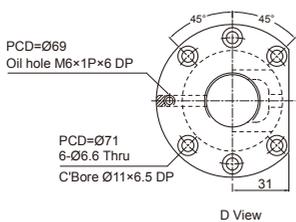
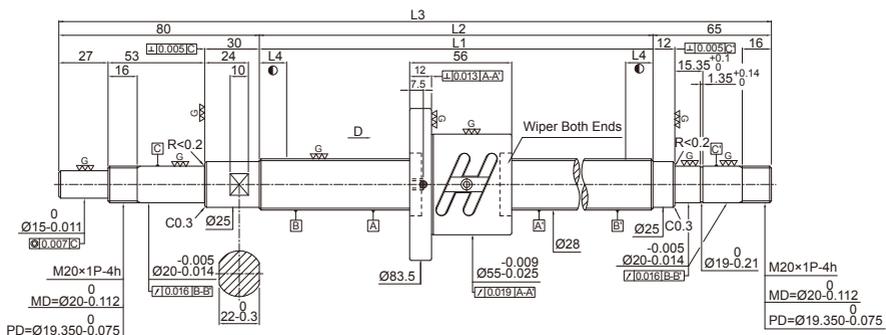
Production Specification	With Preload
Number of Thread / Thread Direction	1/Right
BCD	26
Lead	10
Ball Dia.	4.762
Effective Turns (Circuit × Row)	1.5 × 2
Lead Angle	6.98
Dynamic Rate Load Ca (kgf)	1820
Static Rate Load Co (kgf)	3840
Axial Play	0
Preloading Torque (kgf-cm)	0.42~2.4

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 <sub>300</sub>
1R25-10A2-FSWC-370-533-0.018	370	400	533	10	5	0.025	0.018
1R25-10A2-FSWC-570-733-0.018	570	600	733	10	5	0.030	0.018
1R25-10A2-FSWC-770-933-0.018	770	800	933	15	5	0.035	0.018
1R25-10A2-FSWC-970-1133-0.018	970	1000	1133	15	5	0.040	0.018
1R25-10A2-FSWC-1170-1333-0.018	1170	1200	1333	15	5	0.046	0.018
1R25-10A2-FSWC-1470-1600-0.018	1470	1500	1633	15	5	0.054	0.018

# FSWC Standard ballscrews

## Screw Dia.Ø28 Lead05



### Specification of ball screw

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

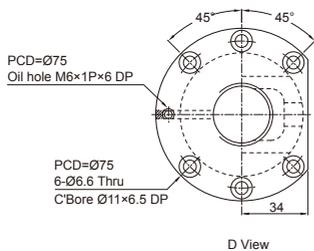
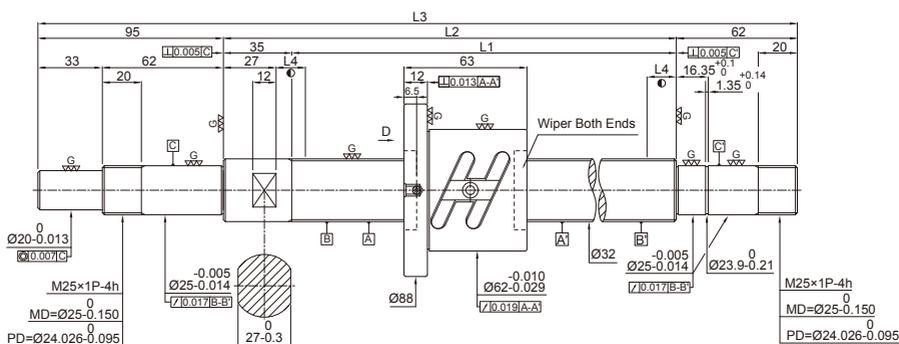
Unit:mm

Model No.	Screw Spindle (Shaft) Length				Accuracy Grade	Lead Accuracy	
	L1	L2	L3	L4		Accumulated reference lead deviation E	Lead Deriation in random 300mm $\epsilon_{300}$
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



# FSWC Standard ballscrews

Screw Dia.  $\varnothing 32$  Lead 06

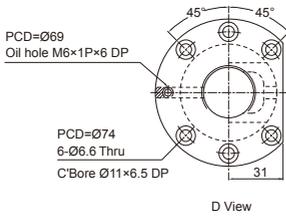
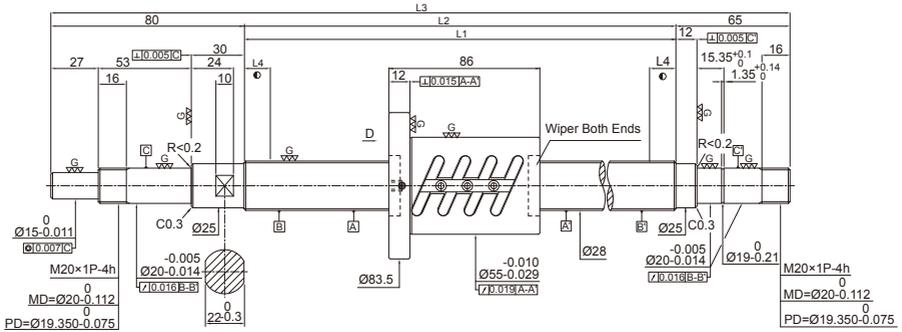


### Specification of ball screw

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

Unit:mm

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



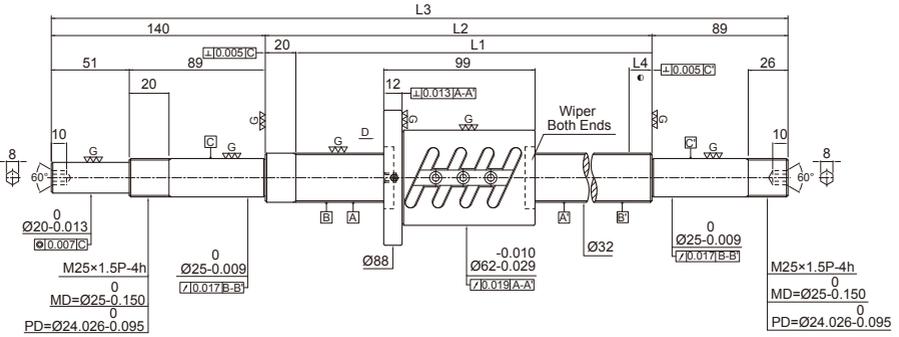
**Specification of ball screw**

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

Unit:mm

Model No.	Screw Spindle (Shaft) Length				Accuracy Grade	Lead Accuracy	
	L1	L2	L3	L4		Accumulated reference lead deviation E	Lead Deriation in random 300mm e <sub>300</sub>
1R28-05B2-FOWC-270-433-0.018	270	300	433	10	5	0.023	0.018
1R28-05B2-FOWC-370-533-0.018	370	400	533	15	5	0.025	0.018
1R28-05B2-FOWC-470-633-0.018	470	500	633	15	5	0.027	0.018
1R28-05B2-FOWC-558-733-0.018	558	600	733	15	5	0.030	0.018
1R28-05B2-FOWC-758-933-0.018	758	800	933	15	5	0.035	0.018
1R28-05B2-FOWC-958-1133-0.018	958	1000	1133	15	5	0.040	0.018
1R28-05B2-FOWC-1158-1333-0.018	1158	1200	1333	15	5	0.046	0.018



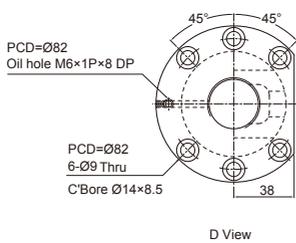
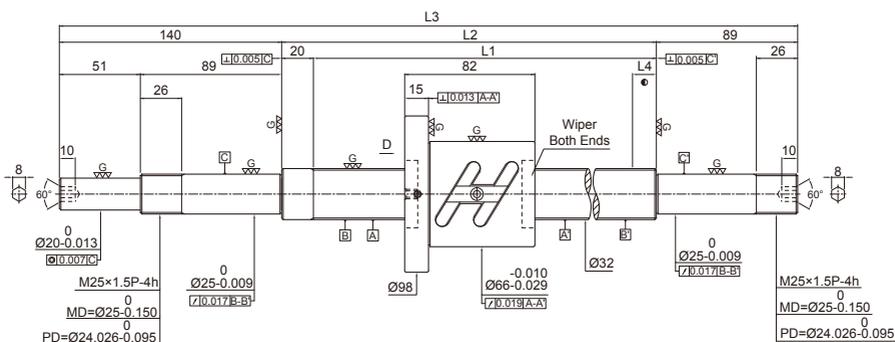


Specification of ball screw	
Production Specification	With Preload
Number of Thread / Thread Direction	1/Right
BCD	32.7
Lead	6
Ball Dia.	3.969
Effective Turns (Circuit × Row)	2.5 × 2(2)
Lead Angle	3.34
Dynamic Rate Load Ca (kgf)	2410
Static Rate Load Co (kgf)	6900
Axial Play	0
Preloading Torque (kgf-cm)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

Unit:mm

Model No.	Screw Spindle (Shaft) Length				Accuracy Grade	Lead Accuracy	
	L1	L2	L3	L4		Accumulated reference lead deviation E	Lead Deriation in random 300mm e <sub>300</sub>
1R32-06B2-FOWC-380-629-0.018	380	400	629	15	5	0.025	0.018
1R32-06B2-FOWC-580-829-0.018	580	600	829	15	5	0.030	0.018
1R32-06B2-FOWC-780-1029-0.018	780	800	1029	15	5	0.035	0.018
1R32-06B2-FOWC-980-1229-0.018	980	1000	1229	15	5	0.040	0.018
1R32-06B2-FOWC-1180-1429-0.018	1180	1200	1429	15	5	0.046	0.018
1R32-06B2-FOWC-1480-1729-0.018	1480	1500	1729	15	5	0.054	0.018

# FOWC

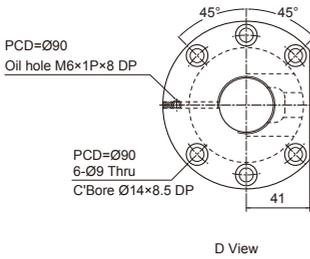
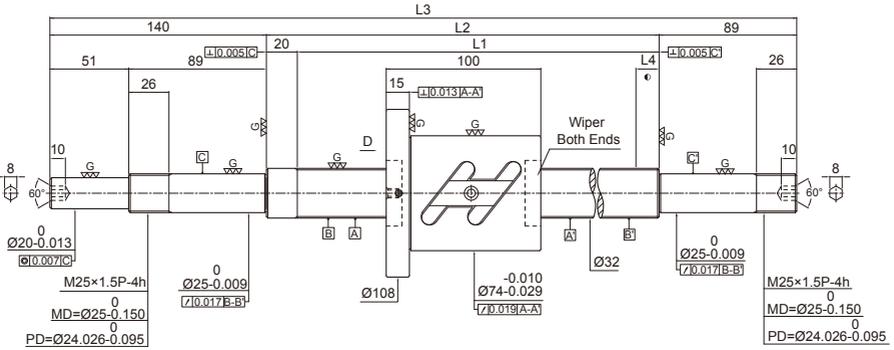
 Standard ballscrews  
Screw Dia.  $\varnothing 32$  Lead 08


### 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 $C_a$ (kgf)	1720
Static Rate Load $C_o$ (kgf)	4180
Axial Play	0
Preloading Torque (kgf-cm)	1.26~5.06

Unit: mm

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



**Specification of ball screw**

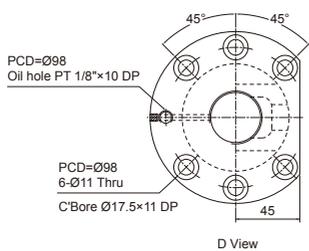
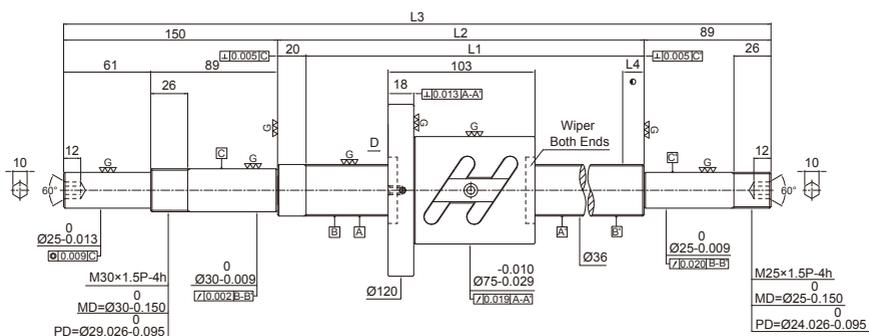
Production Specification	With Preload
Number of Thread / Thread Direction	1/Right
BCD	33.4
Lead	10
Ball Dia.	6.35
Effective Turns (Circuit × Row)	2.5 × 1(2)
Lead Angle	5.44
Dynamic Rate Load Ca (kgf)	2570
Static Rate Load Co (kgf)	5440
Axial Play	0
Preloading Torque (kgf-cm)	3.58~7.44

Unit:mm

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

# FOWC

Standard ballscrews  
Screw Dia.  $\varnothing 36$  Lead 10

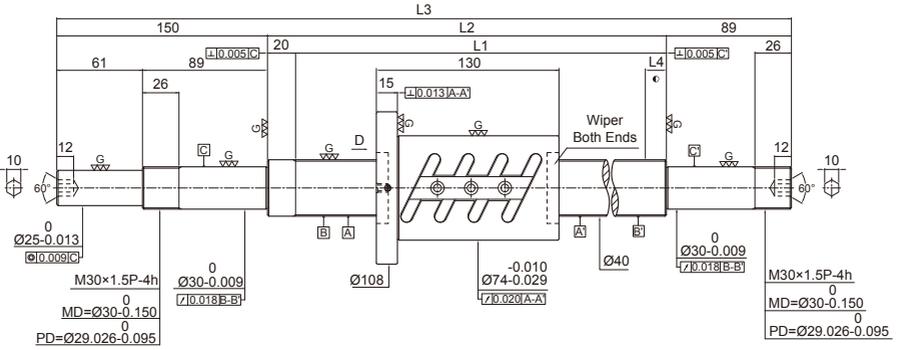


### Specification of ball screw

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

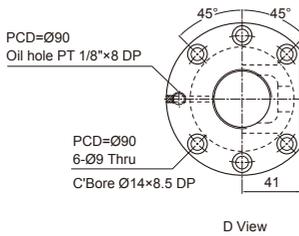
Unit:mm

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



**Specification of ball screw**

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

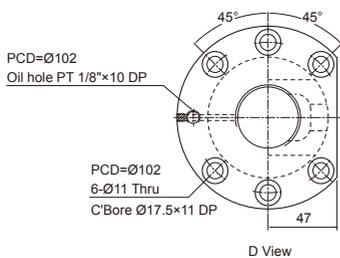
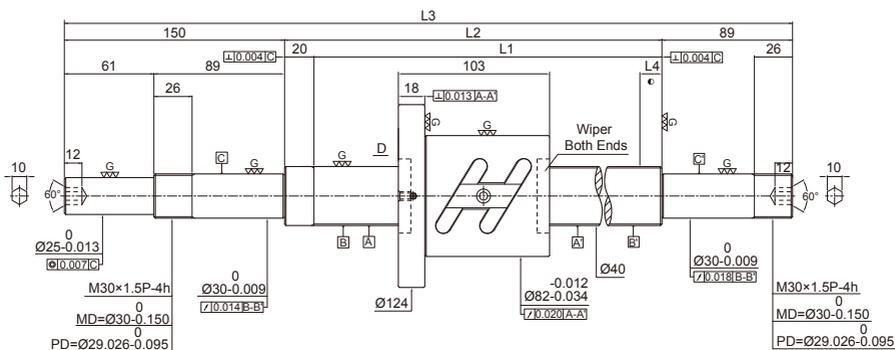


Unit:mm

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

# FOWC

Standard ballscrews

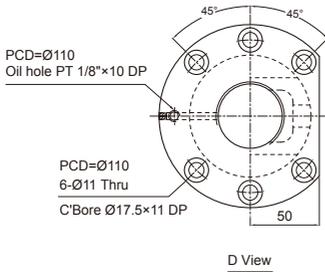
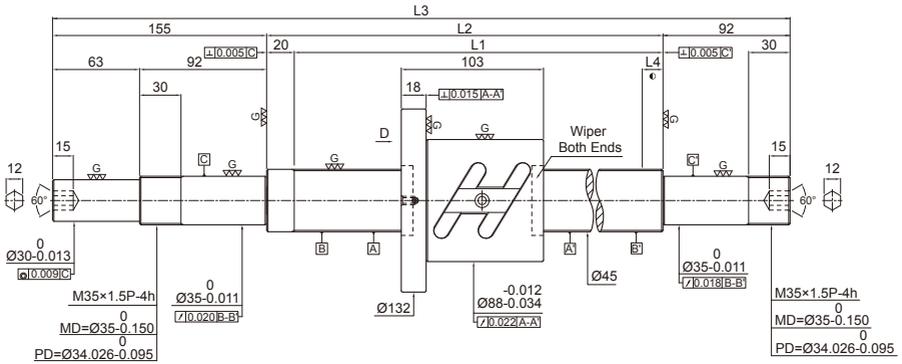
Screw Dia.  $\varnothing 40$  Lead 10

### Specification of ball screw

Production Specification	With Preload
Number of Thread / Thread Direction	1/Right
BCD	41.4
Lead	10
Ball Dia.	6.35
Effective Turns (Circuit × 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 Derivation in random 300mm $e_{300}$
1R40-10B1-FOWC-480-739-0.018	480	500	739	15	5	0.027	0.018
1R40-10B1-FOWC-580-839-0.018	580	600	839	15	5	0.030	0.018
1R40-10B1-FOWC-680-939-0.018	680	700	939	15	5	0.030	0.018
1R40-10B1-FOWC-780-1039-0.018	780	800	1039	15	5	0.035	0.018
1R40-10B1-FOWC-980-1239-0.018	980	1000	1239	15	5	0.040	0.018
1R40-10B1-FOWC-1180-1439-0.018	1180	1200	1439	15	5	0.046	0.018
1R40-10B1-FOWC-1380-1639-0.018	1380	1400	1639	15	5	0.054	0.018
1R40-10B1-FOWC-1580-1839-0.018	1580	1600	1839	15	5	0.054	0.018
1R40-10B1-FOWC-1780-2039-0.018	1780	1800	2039	15	5	0.065	0.018
1R40-10B1-FOWC-2380-2639-0.018	2380	2400	2639	15	5	0.077	0.018



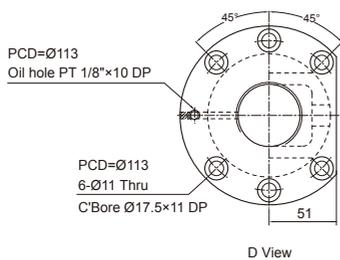
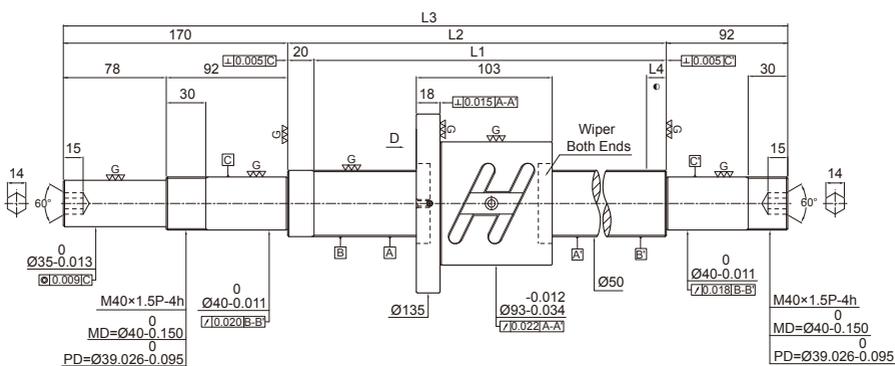
**Specification of ball screw**

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

Unit:mm

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

# FOWC

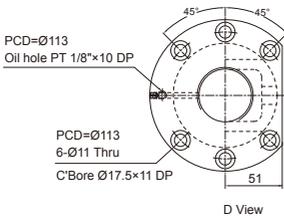
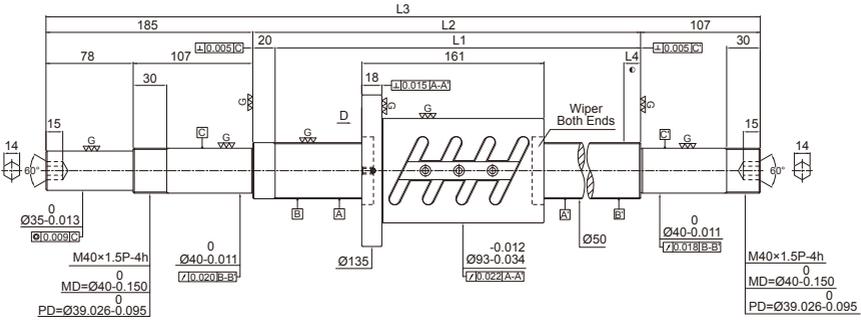
 Standard ballscrews  
Screw Dia.  $\varnothing 50$  Lead 10


### Specification of ball screw

Production Specification	With Preload
Number of Thread / Thread Direction	1/Right
BCD	51.4
Lead	10
Ball Dia.	6.35
Effective Turns (Circuit × 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-580-862-0.018	580	600	862	15	5	0.030	0.018
1R50-10B1-FOWC-780-1062-0.018	780	800	1062	15	5	0.035	0.018
1R50-10B1-FOWC-980-1262-0.018	980	1000	1262	15	5	0.040	0.018
1R50-10B1-FOWC-1180-1462-0.018	1180	1200	1462	15	5	0.046	0.018
1R50-10B1-FOWC-1480-1762-0.018	1480	1500	1762	15	5	0.054	0.018
1R50-10B1-FOWC-1980-2262-0.018	1980	2000	2262	15	5	0.065	0.018
1R50-10B1-FOWC-2580-2862-0.018	2580	2600	2862	15	5	0.093	0.018

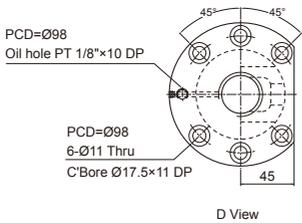
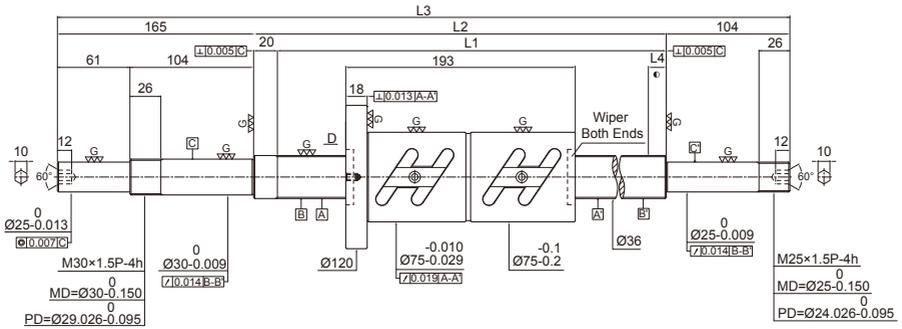


Specification of ball screw	
Production Specification	With Preload
Number of Thread / Thread Direction	1/Right
BCD	51.4
Lead	10
Ball Dia.	6.35
Effective Turns (Circuit × Row)	2.5 × 2(2)
Lead Angle	3.54
Dynamic Rate Load Ca (kgf)	5790
Static Rate Load Co (kgf)	17420
Axial Play	0
Preloading Torque (kgf-cm)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

Unit:mm

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





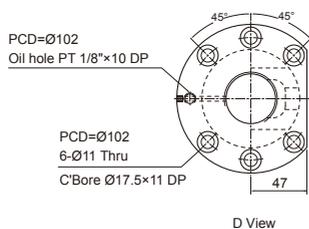
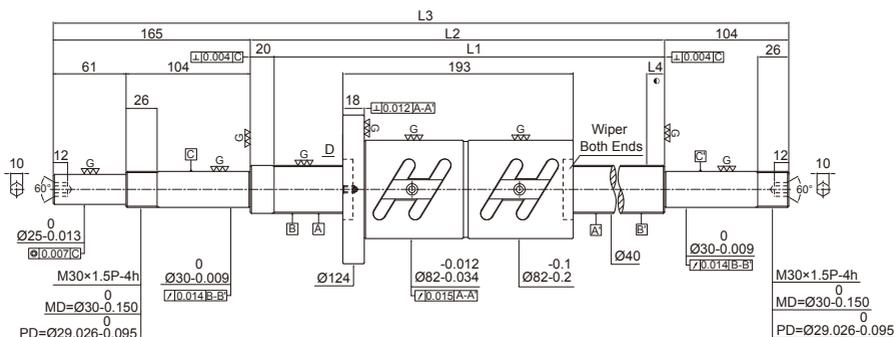
Specification of ball screw	
Production Specification	With Preload
Number of Thread / Thread Direction	1/Right
BCD	37.4
Lead	10
Ball Dia.	6.35
Effective Turns (Circuit x Row)	2.5 x 2
Lead Angle	4.86
Dynamic Rate Load Ca (kgf)	4930
Static Rate Load Co (kgf)	12360
Axial Play	0
Preloading Torque (kgf-cm)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

Unit: mm

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

# FDWC

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

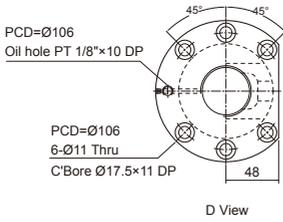
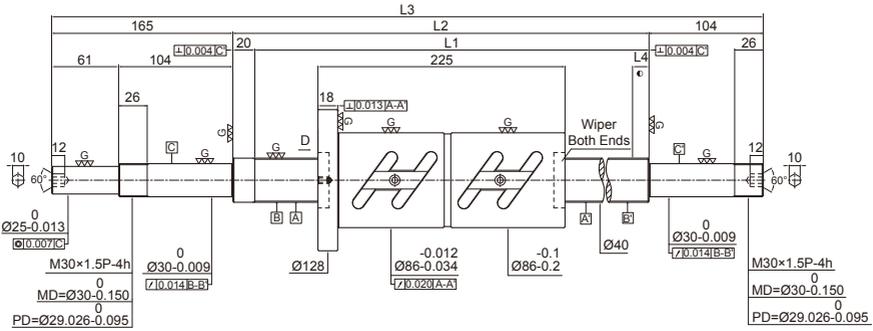


### Specification of ball screw

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

Unit: mm

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



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

Unit:mm

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

# *PMI* Rolled Ballscrews

## Introduction to Rolled Ballscrews

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.

---

## 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.

## Lead Accuracy of Rolled Screws ( $e_{300}$ )

According to ISO 3408-3, the definition of lead accuracy for **PMI** rolled ballscrews is as follows: Within the effective thread length, the permissible value of accumulated lead deviation in random 300mm. As shown in **Table 1**:

Table 1 Lead Accuracy

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

Unit:  $\mu\text{m}$

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

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

Unit:  $\mu\text{m}$

Grade	C5	C7	C8	C10
<b>PMI</b>	$e_p = \pm(l_u/300) \times e_{300}$ $l_u$ : Effective thread length (Unit: mm)			

Unit:  $\mu\text{m}$

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

## 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 2~3**:

Table 2 Specifications of Rolled Ballscrews

Screw nominal outer diameter Ø	Lead															Maximum rolled ballscrew length
	1	2	2.5	4	5	5.08	6	10	12	16	20	25	32	40	50	
8	●	●	●													1000
10		●														1000
12				●	●			●	●							1500
14				●	●											3000
15					●			●		●	●					3000
16				●	●			●		●						3000
20				●	●			●			●			●		3000
25				●	●/○	●/○		●				●				6000
28					●		●									6000
32					●/○	●/○		●			●		●/○			6000
36								●								6000
38								●			●			●		6000
40					●			●			●			●		6000
50								●			●				●	6000
63								●			●					6000
80								●								6000

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

**Note:** Rolled ballscrews are limited in length and accuracy, please contact us for other requirements.

Table 3 Lead Accuracy and Maximum Rolled Length

Screw nominal outer diameter $\varnothing(mm)$	Lead Accuracy Grade ( $e_{300}$ ) Maximum Rolling Length (mm)			
	C5	C7	C8	C10
8	-	1000	1000	1000
10	-	1000	1000	1000
12	1500	1500	1500	1500
14	3000	3000	3000	3000
15				
16				
20				
25		6000	6000	6000
28				
32				
36				
38				
40				
50	-	6000	6000	6000
63				
80	-	6000	6000	6000

---

## Axial Play

The maximum axial play under normal non-preload condition, as shown in **Table 4**

Table 4 Maximum Axial Play

Ball Diameter $\varnothing d$ (mm)	0.8~1.2	1.588~2.381	2.778~4.762	6.35~7.938
Maximum Axial Play (mm)	<0.01	<0.02	<0.04	<0.07

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

---

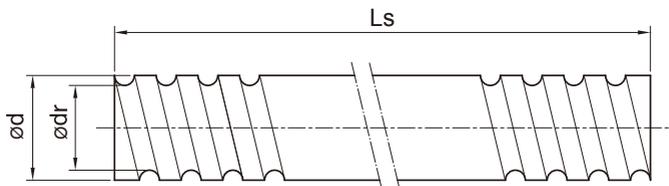
## Materials and Hardness

Standard material and surface hardness for *PMI* rolled screw, as shown in **Table 5**

Table 5

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

## Types and Dimensions of Rolled Screw Shaft



Unit: mm

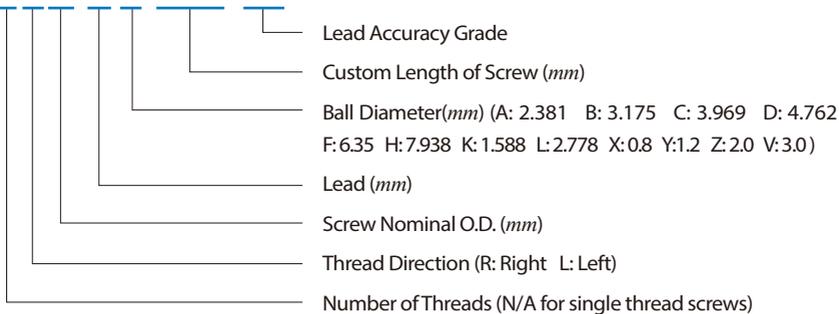
SCREW SIZE			Lead Accuracy Grade	Thread Direction	Number of Threads	Maximum Rolling Length	Screw Number
O.D.	LEAD	BALL DIA.		L: Left / R: Right			
8	1	0.8	C7,C8,C10	R	1	1000	R0801X
	2	1.2		R	1		R0802Y
	2.5	2		R	1		R0812Z
10	2	1.588	C7,C8,C10	R	1	1000	R1002K
12	4	2.381	C5,C7,C8,C10	R	1	1500	R1204A
	5	2		R	1		R1205Z
	10	2		R	1		R1210Z
	12	2.381		R	2		2R1212A
14	4	2.381	C5,C7,C8,C10	R	1	3000	R1404A
	5	3.175		R	1		R1405B
15	5	3	C5,C7,C8,C10	R	1	3000	R1505V
	10	3		R	2		2R1510V
	10	3.175		R	2		2R1510B
	16	3		R	2		2R1516V
	20	3.175	C7,C8,C10	R	4	4R1520B	
16	4	2.381	C5,C7,C8,C10	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	C5,C7,C8,C10	R	1	3000	R2004A
	5	3.175		R	1		R2005B
	10	4.762		R	1		R2010D
	20	3.175		R	2		2R2020B
	40	3.175	C7,C8,C10	R	4	4R2040B	

Unit: mm

SCREW SIZE			Lead Accuracy Grade	Thread Direction	Number of Threads	Maximum Rolling Length	Screw Number
O.D.	LEAD	BALL DIA.		L: Left / R: Right			
25	4	2.381	C5,C7,C8,C10	R	1	6000	R2504A
	5	3.175		R/L	1		R(L)2505B
	5.08	3.175		R/L	1		R(L)2515B
	10	3.175		R	2		2R2510B
	10	4.762		R	1		R2510D
	10	6.350		R	1		R2510F
	25	3.175		R	4		4R2525B
	25	3.969		R	4		4R2525C
28	5	3.175	C5,C7,C8,C10	R	1	6000	R2805B
	6	3.175		R	1		R2806B
32	5	3.175	C5,C7,C8,C10	R/L	1	6000	R(L)3205B
	5.08	3.175		R/L	1		R(L)3215B
	10	3.969		R	1		R3210C
	10	6.350		R	1		R3210F
	20	3.969		R	2		2R3220C
	20	6.350		R	2		2R3220F
	32	3.969		R	4		4R3232C
	32	4.762		R/L	4		4R(L)3232D
36	10	6.350	C5,C7,C8,C10	R	1	6000	R3610F
38	10	6.350	C5,C7,C8,C10	R	1	6000	R3810F
	20	6.350		R	2		2R3820F
	40	6.350		R	4		4R3840F
40	5	3.175	C5,C7,C8,C10	R	1	6000	R4005B
	10	6.350		R	1		R4010F
	20	6.350		R	2		2R4020F
	40	6.350		R	4		4R4040F
50	10	6.350	C5,C7,C8,C10	R	1	6000	R5010F
	20	6.350		R	2		2R5020F
	50	7.938		R	4		4R5050H
63	10	6.350	C7,C8,C10	R	1	6000	R6310F
	20	6.350		R	2		2R6320F
80	10	6.350	C7,C8,C10	R	1	6000	R8010F

## Nomenclature

1 R 15 10 A -1500 -C7



## Nut Types of Rolled Ballscrew

### Standard Models:

FSIN



FSIW



FSDN



FSKW



FSDW



FSDU



**Optional Models:**

**FSWW**



**FSVW**



**RSVW**



**SSVW**



**FSBW**

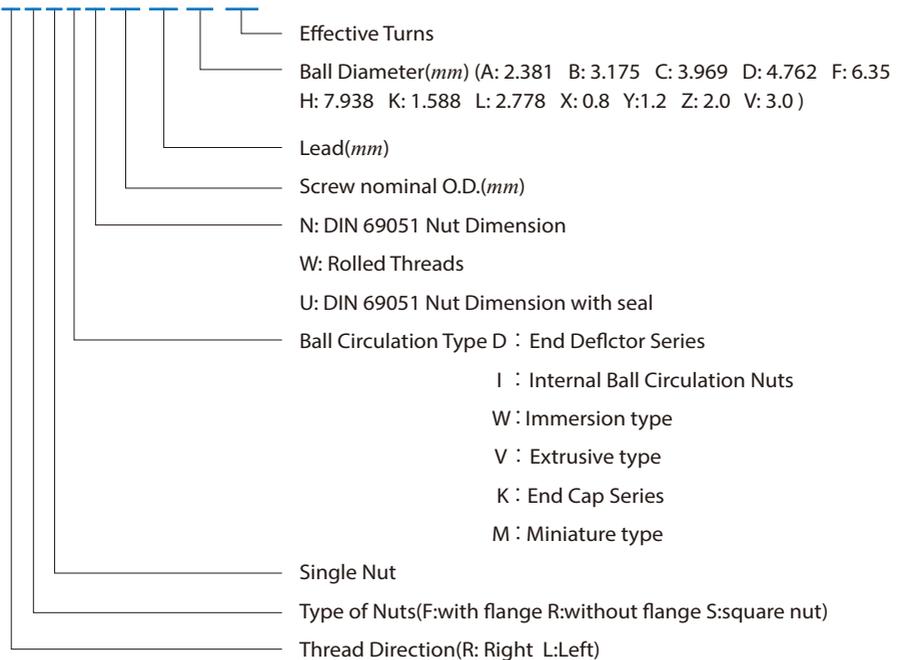


**FSMW**

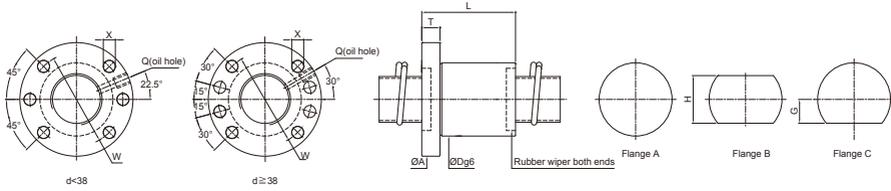


**Nomenclature:**

**R F S D N 25 05 A 4 T**



# DIN Nut Dimension



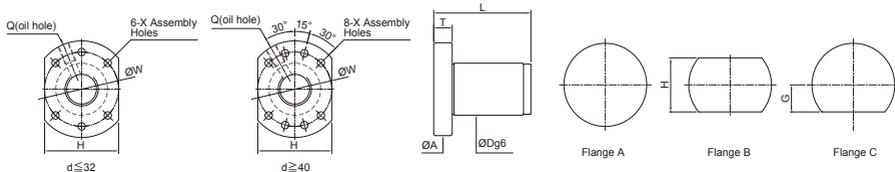
Unit: mm

SCREW SIZE		BALL DIA.	circuit × number of thread	MODIFIED LOAD CAPACITY (kgf)		BALLNUT DIMENSION										
O.D.	LEAD			Dynamic (1×10 <sup>3</sup> REV.) Cam	Static Coam	O.D.	Length	Flange					Oil Hole	Assembly Hole	STIFFNESS	Nut Model NO.
					D	L	A	T	W	G	H	Q	X	kgf/μm		
15	5	3	4×1	1210	2130	28	39	48	10	38	20	40	M6×1P	5.5	22	FSDN1505V-4.0P
	10		3×1	950	1650	28	47	48	10	38	20	40	M6×1P	5.5	17	FSDN1510V-3.0P
	16		3×1	910	1600	28	64	48	10	38	20	40	M6×1P	5.5	17	FSDN1516V-3.0P
20	5	3.175	4×1	1570	3270	36	40	58	10	47	22	44	M6×1P	6.6	28	FSDN2005B-4.0P
	20		2×2	1460	3120	36	58	58	10	47	22	44	M6×1P	6.6	28	FSDN2020B-4.0P
25	5	3.175	5×1	2130	5230	40	46	62	10	51	24	48	M6×1P	6.6	41	FSDN2505B-5.0P
	10		4×1	1740	4120	40	60	62	10	51	24	48	M6×1P	6.6	33	FSDN2510B-4.0P
	25		2×2	1610	3900	40	68	62	10	51	24	48	M6×1P	6.6	33	FSDN2525B-4.0P
32	5	3.175	6×1	2800	8180	50	53	80	12	65	31	62	M6×1P	9	59	FSDN3205B-6.0P
	10		5×1	3240	8480	50	73	80	12	65	31	62	M6×1P	9	52	FSDN3210C-5.0P
	20	3.969	4×1	2600	6630	50	101	80	12	65	31	62	M6×1P	9	42	FSDN3220C-4.0P
	32		2×2	2460	6340	50	84	80	12	65	31	62	M6×1P	9	41	FSDN3232C-4.0P
38	10	6.35	5×1	6500	15610	63	78	93	14	78	35	70	M8×1P	9	64	FSDN3810F-5.0P
	20		4×1	5250	12240	63	107	93	14	78	35	70	M8×1P	9	52	FSDN3820F-4.0P
	40		2×2	4940	11770	63	104	93	14	78	35	70	M8×1P	9	51	FSDN3840F-4.0P

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

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

# FSDU

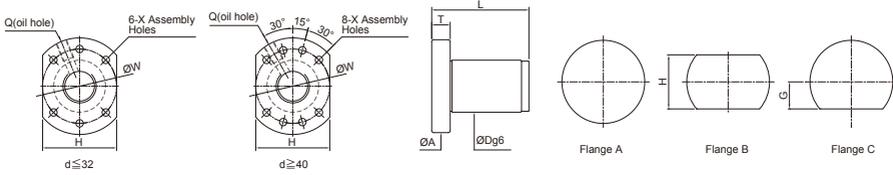


Unit: mm

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × number of thread	MODIFIED LOAD CAPACITY (kgf)		BALLNUT DIMENSION									Nut Model NO.
O.D.	LEAD			Dynamic (1×10° REV.) Cam	Static Coam	O.D.		Length		Flange			Oil Hole	Assembly Hole	
						D	L	A	T	W	H	Q	X		
12	5	2	3x1	630	1060	24	31	40	10	32	30	M6×1P	4.5	FSDU1205Z-3.0P	
	10		3x1	620	1040	24	45	40	10	32	30	M6×1P	4.5	FSDU1210Z-3.0P	
	20	2.381	2x1	590	1070	24	53	40	10	32	30	M6×1P	4.5	FSDU1220A-2.0P	
15	20	2.778	2x1	560	970	28	53	48	10	32	30	M6×1P	5.5	FSDU1520L-2.0P	
	5	3	4x1	1210	2130	28	36	48	10	38	40	M6×1P	5.5	FSDU1505V-4.0P	
	10		3x1	950	1650	28	45	48	10	38	40	M6×1P	5.5	FSDU1510V-3.0P	
	16		2x1	620	1040	28	46	48	10	38	40	M6×1P	5.5	FSDU1516V-2.0P	
	16		3x1	910	1600	28	62	48	10	38	40	M6×1P	5.5	FSDU1516V-3.0P	
20	5	3.175	4x1	1570	3270	36	40	58	10	47	44	M6×1P	6.6	FSDU2005B-4.0P	
	10		4x1	1560	3250	36	58	58	10	47	44	M6×1P	6.6	FSDU2010B-4.0P	
	20		2x1	810	1550	36	58	58	10	47	44	M6×1P	6.6	FSDU2020B-2.0P	
	20		3x1	1180	2430	36	78	58	10	47	44	M6×1P	6.6	FSDU2020B-3.0P	
25	5	3.175	4x1	1750	4150	40	40	62	10	51	48	M6×1P	6.6	FSDU2505B-4.0P	
	10		4x1	1740	4120	40	59	62	10	51	48	M6×1P	6.6	FSDU2510B-4.0P	
	20		2x1	910	1990	40	59	62	12	51	48	M6×1P	6.6	FSDU2520B-2.0P	
	25		2x1	900	1950	40	70	62	12	51	48	M6×1P	6.6	FSDU2525B-2.0P	
	25		3x1	1290	3040	40	95	62	12	51	48	M6×1P	6.6	FSDU2525B-3.0P	

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

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



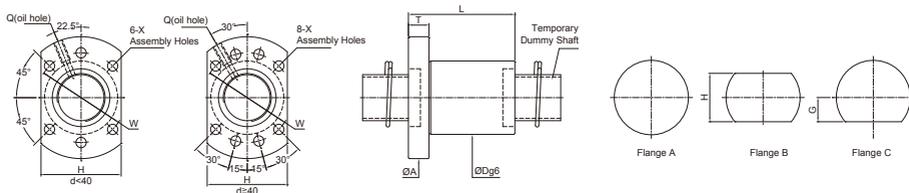
Unit:mm

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × number of thread	MODIFIED LOAD CAPACITY (kgf)		BALLNUT DIMENSION									
O.D.	LEAD			Dynamic (1×10 <sup>6</sup> REV.) Cam	Static Coam	O.D.		Flange					Oil Hole	Assembly Hole	Nut Model NO.
						D	L	A	T	W	H	Q	X		
32	5	3.175	4x1	1940	5360	50	42	80	12	65	62	M6×1P	9	FSDU3205B-4.0P	
	10					50	62	80	12	65	62	M6×1P	9	FSDU3210C-4.0P	
	20					50	81	80	12	65	62	M6×1P	9	FSDU3210C-3.0P	
	32					50	84	80	13	65	62	M6×1P	9	FSDU3325C-2.0P	
	32					50	116	80	13	65	62	M6×1P	9	FSDU3232C-3.0P	
38	10	6.35	4x1	5110	13800	63	67	93	14	78	70	M8×1P	9	FSDU3810F-4.0P	
	20					63	86.4	93	14	78	70	M8×1P	9	FSDU3820F-3.0P	
	40					63	103	93	15	78	70	M8×1P	9	FSDU3840F-2.0P	
	40					63	143	93	15	78	70	M8×1P	9	FSDU3840F-3.0P	
40	5	3.175	4x1	1760	6260	63	43	93	15	78	70	M8×1P	9	FSDU4005B-4.0P	

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

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

# FSIN

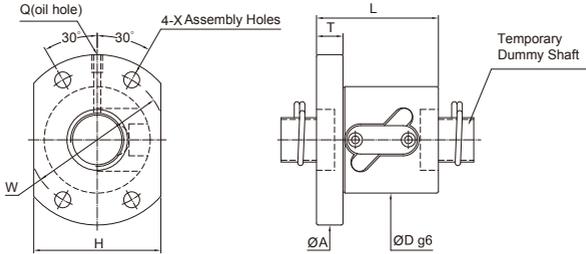


Unit: mm

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS	MODIFIED LOAD CAPACITY (kgf)		BALLNUT DIMENSION											
O.D.	LEAD			Dynamic (1×10 <sup>6</sup> REV) Cam	Static Coam	O.D.	Length	Flange						Oil Hole	Assembly Hole	STIFFNESS	Nut Model NO.
								D	L	A	T	W	G				
16	5	3.175	3	1050	2200	28	42	48	10	38	20	40	M6×1P	5.5	17	FSIN1605B-3.0P	
	10	4.762	4	2900	6990	40	50	62	12	51	24	48	M6×1P	6.5	37	FSIN2505B-4.0P	
25	5	3.175	4	1700	4720	40	50	62	12	51	24	48	M6×1P	6.5	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	4	1900	6090	50	50	80	12	65	31	62	M6×1P	9	50	FSIN3205B-4.0P	
	10	6.35	4	4720	11670	50	80	80	13	65	31	62	M6×1P	9	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	
	10	6.35	4	5310	14850		82								60	FSIN4010F-4.0P	
50	10	6.35	4	5890	18780	75	88	110	18	93	42.5	85	M8×1P	11	70	FSIN5010F-4.0P	

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

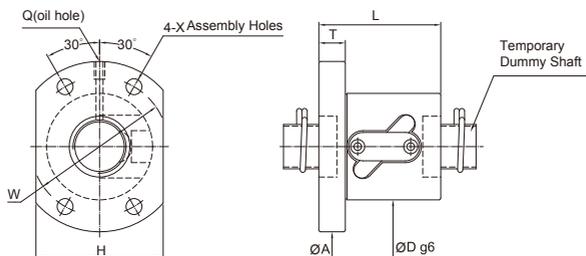
2. Stiffness of nut: Stiffness values listed above are derived from theoretical formula to the elastic deformation between thread grooves and balls while axial load is 30% dynamic load rating.



Unit: mm

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD (kgf)		BALLNUT DIMENSION										Nut Model NO.
O.D.	LEAD			Dynamic (1×10 <sup>6</sup> REV) Ca	Static Co	O.D.		Length		Flange				Assembly Hole	Oil Hole	
		D	L			A	T	W	H	X	Q	kgf/μm				
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	3.5x1	610	1470	34	42	57	11	45	34	5.5	M6x1P	17	FSWW1604A-3.5P	
	5	3.175	2.5x1	550	1140	40	41	63	11	51	42	5.5	M6x1P	13	FSWW1605B-2.5P	
	10	3.175	2.5x1	550	990	40	56	63	11	51	42	5.5	M6x1P	13	FSWW1610B-2.5P	
20	4	2.381	2.5x2	1140	3120	40	56	67	11	55	52	5.5	M6x1P	30	FSWW2004A-5.0P	
	5	3.175	2.5x1	625	1450	44	41	67	10	55	52	5.5	M6x1P	15	FSWW2005B-2.5P	
	10	4.762	2.5x1	1100	2200	52	61	82	12	67	64	6.6	M6x1P	16	FSWW2010D-2.5P	
25	5	3.175	2.5x2	1120	3710	50	56	73	11	61	56	6.6	M6x1P	37	FSWW2505B-5.0P	
	10	4.762	2.5x1	1270	2780	58	65	85	15	71	64	6.6	M6x1P	20	FSWW2510D-2.5P	
	10	6.35	2.5x2	3200	7170	60	97	96	15	78	72	9	M6x1P	40	FSWW2510F-5.0P	

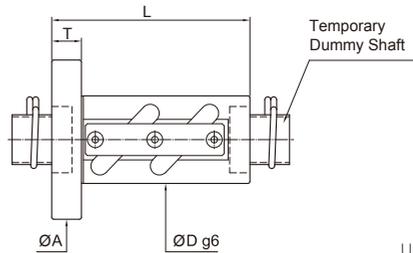
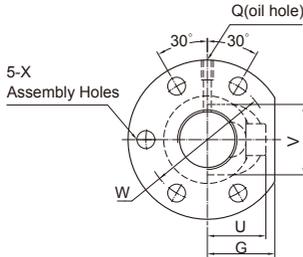
**Note:** Stiffness of nut: Stiffness values listed above are derived from theoretical formula to the elastic deformation between thread grooves and balls while axial load is 30% dynamic load rating.



Unit: mm

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD (kgf)		BALLNUT DIMENSION										Nut Model NO.
O.D.	LEAD			Dynamic (1×10 <sup>6</sup> REV) Ca	Static Co	O.D.		Flange				Assembly Hole X	Oil Hole Q	STIFFNESS kgf/μm		
						D	L	A	T	W	H					
28	5	3.175	1.5x2	910	2470	46									21	FSWW2805B-3.0P
			2.5x1	780	2060	42									18	FSWW2805B-2.5P
			2.5x2	1410	4120	55	56	83	12	69	62	6.6	M8x1P	33	FSWW2805B-5.0P	
			3.5x1	1040	2880	47										24
32	5	3.175	2.5x2	1540	4720	58	57	85	12	71	64	6.6	M8x1P	41	FSWW3205B-5.0P	
	10	6.35	2.5x2	3130	9410	67	97	103	15	85	78	9	M6x1P	49	FSWW3210F-5.0P	
36	10	6.35	1.5x2	2170	6480	81									30	FSWW3610F-3.0P
			2.5x2	3370	10800	70	99	110	17	90	82	11	M6x1P	29	FSWW3610F-5.0P	
			3.5x1	2480	7560	81										35
40	5	3.175	2.5x2	1830	5940	67	60	101	15	83	78	9	M8x1P	60	FSWW4005B-5.0P	
	10	6.35	2.5x2	3520	12000	76	100	116	17	96	88	11	M6x1P	59	FSWW4010F-5.0P	
50	10	6.35	2.5x2	3900	15000	88	101	128	18	108	100	11	M6x1P	72	FSWW5010F-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.

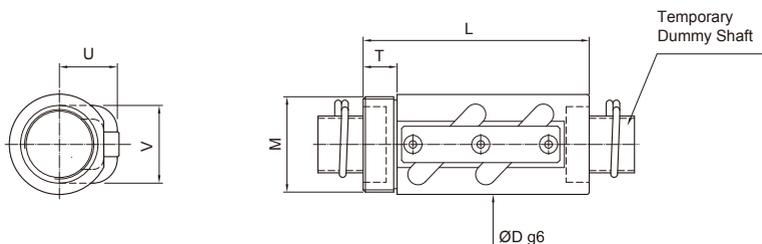


Unit: mm

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD (kgf)		BALLNUT DIMENSION													Nut Model NO.
O.D.	LEAD			Dynamic (1×10 <sup>3</sup> REV.) Ca	Static Co	O.D.		Flange					Return tube		Assembly Hole		Oil Hole	STIFFNESS kgf/μm	
						D	L	A	T	W	G	U	V	X	Q				
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	19	21	4.5	M6x1P	11	FSVW1405B-2.5P		
16	5	3.175	2.5x2	1000	2280	31	60	54	12	41	24	20	23	5.5	M6x1P	23	FSVW1605B-5.0P		
20	5	3.175	2.5x2	1130	2900	40	60	60	12	50	28	23	27	4.5	M6x1P	28	FSVW2005B-5.0P		
	10	4.762	2.5x1	1100	2200	40	60	67	12	53	30	27	30	6.6	M6x1P	16	FSVW2010D-2.5P		
25	5	3.175	2.5x1	720	1830	42	45	71	12	57	28	25	32	6.6	M6x1P	18	FSVW2505B-2.5P		
	10	4.762	3.5x1	1690	3900	45	75	72	16	58	34	29	34	6.6	M6x1P	27	FSVW2510D-3.5P		
28	5	3.175	2.5x1	910	2470	50										21	FSVW2805B-3.0P		
			1.5x2	780	2060	45											18	FSVW2805B-2.5P	
			2.5x2	1410	4120	60	70	12	56	28	28	35	6.6	M6x1P	33	FSVW2805B-5.0P			
			3.5x1	1040	2880	50											24	FSVW2805B-3.5P	
32	5	3.175	2.5x2	1540	4720	50	60	76	12	63	36	30	39	6.6	M6x1P	41	FSVW3205B-5.0P		
	10	6.35	2.5x2	3130	9410	55	101	97	18	75	39	37	44	11	M6x1P	49	FSVW3210F-5.0P		
36	10	6.35	1.5x2	2170	6480	60	82	105	18	80	42	40	49	11	M6x1P	30	FSVW3610F-3.0P		
40	5	3.175	3.5x1	1350	4160	58	55	92	16	72	42	34	46	9	M8x1P	43	FSVW4005B-3.5P		
	10	6.35	3.5x1	2590	8400	65	82	106	18	85	44	42	52	11	PT1/8"	45	FSVW4010F-3.5P		
50	10	6.35	3.5x2	4940	21000	80	125	138	22	110	52	48	62	18	M6x1P	98	FSVW5010F-7.0P		
63	10	6.35	2.5x2	4770	18660	108	105	154	22	130	44	53	76	14	M8x1P	75	FSVW6310F-5.0P		
80	10	6.35	2.5x2	5340	23750	130	105	176	22	152	48	64	91	14	M8x1P	90	FSVW8010F-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.

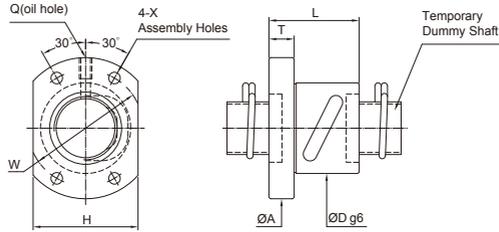
## RSVW



Unit: mm

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD (kgf)		BALLNUT DIMENSION							Nut Model NO.	
O.D.	LEAD			Dynamic (1×10 <sup>6</sup> REV.) Ca	Static Co	O.D.		Length		Flange		Return tube		STIFFNESS
						D	L	M	T	U	V	kgf/μm		
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	19	21	11	RSVW1405B-2.5P	
20	5	3.175	2.5×1	625	1450	40	43	M36×1.5P	12	23	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	
25	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	37	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	48	62	98	RSVW5010F-7.0P	

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

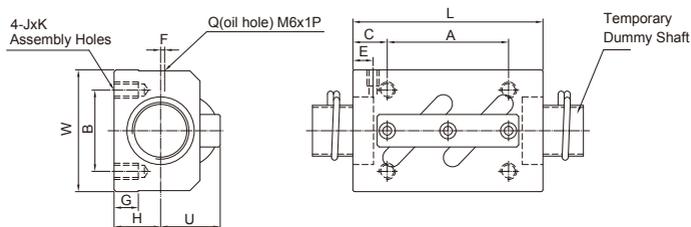


Unit: mm

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD (kgf)		BALLNUT DIMENSION										Nut Model NO.		
O.D.	LEAD			Dynamic (1×10 <sup>6</sup> REV.) Ca	Static Co	O.D.			Length			Flange			Assembly Hole		Oil Hole	STIFFNESS kgf/μm
						D	L	A	T	W	H	X	Q					
12	5	2.000	2.5×1	270	350	26	40	47	10	37	30	4.5	M6×1P	8.2	FSBW1205Z-2.5P			
	4	2.381	3.5×1	500	1100	31	40	50	10	40	37	4.5	M6×1P	15	FSBW1404A-3.5P			
14	5	3.175	2.5×1	515	990	32	40	50	10	40	38	4.5	M6×1P	11	FSBW1405B-2.5P			
	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



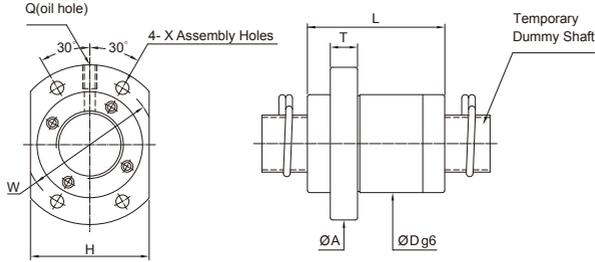
Unit: mm

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

# End Cap Series

# FSKW



Unit: mm

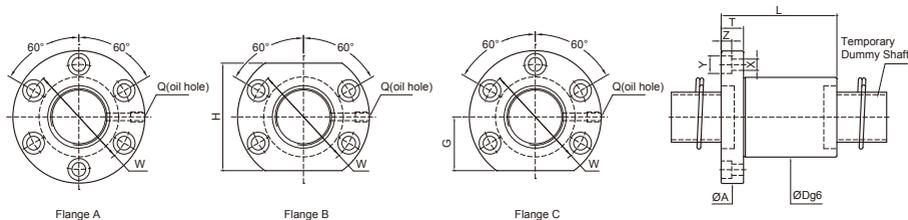
SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × number of thread	BASIC RATE LOAD (kgf)		BALLNUT DIMENSION										Nut Model NO.
O.D.	LEAD			Dynamic (1x10 <sup>6</sup> REV.) Ca	Static Co	O.D.		Length		Flange			Assembly Hole	Oil Hole	STIFFNESS	
						D	L	A	T	W	H	X	Q	kgf/µm		
12	12	2.381	1.8x2	410	850	25	31	40	6	32	21	4.5	M4x0.7P	13	FSKW1212A-3.6P	
15	10	3.175	2.8 × 2	1000	2570	34	44	57	10	45	40	5.5	M6 × 1P	26	FSKW1510B-5.6P	
	20	3.175	1.8 × 1	380	830	34	45	57	10	45	40	5.5	M6 × 1P	26	FSKW1520B-1.8P	
16	16	3.175	1.8 × 1	330	640	32	38	53	10	42	38	4.5	M6 × 1P	9	FSKW1616B-1.8P	
	20	3.175	1.8 × 2	780	2280	39	52	62	10	50	46	5.5	M6 × 1P	21	FSKW2020B-3.6P	
20	40	3.175	0.8 × 2	390	1010	38	41	58	10	48	40	5.5	M6 × 1P	14	FSKW2040B-1.6P	
			1.8 × 1	430	1140									16	FSKW2040B-1.8P	
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	78	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	
50	50	7.938	1.8x4	7890	26330	90	122	135	20	112	104	14	M6 × 1P	103	FSKW5050H-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.

PMI Rolled BallScrews

# Internal Ball Circulation Series

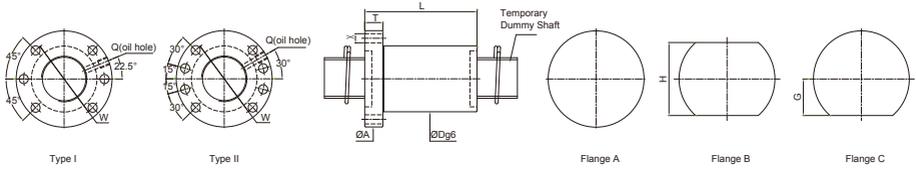
# FSIW



Unit: mm

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS	BASIC RATE LOAD (kgf)		BALLNUT DIMENSION														Nut Model NO.	
O.D.	LEAD			Dynamic (1x10 <sup>6</sup> REV.) Ca	Static Co	O.D.		Length				Flange				Assembly Hole			Oil Hole Q		STIFFNESS kgf/µm
						D	L	A	T	W	G	H	X	Y	Z						
14	4	2.381	4	400	890	26	47	46	10	36	20	40	4.5	8	4.5	8	4.5	M6x1P	18	FSIW1404A-4.0P	
	4	2.381	3	320	760	28	42	48.5	10	39	20	40	4.5	8	4.5	8	4.5	M6x1P	13	FSIW1604A-3.0P	
16	5	3.175	3	570	1030	30	42	49	10	39	20	40	4.5	8	4.5	8	4.5	M6x1P	17	FSIW1605B-3.0P	
	4	2.381	4	450	1270	34	44	60	12	48	22	44	5.5	9.5	5.5	5.5	M6x1P	19	FSIW2004A-4.0P		
20	5	3.175	4	830	1890	34	53	57	12	45	20	40	5.5	9.5	5.5	5.5	M6x1P	21	FSIW2005B-4.0P		
	4	2.381	3	380	1195	40	40	63	12	51	22	44	5.5	9.5	5.5	5.5	M8x1P	17	FSIW2504A-3.0P		
25	5	3.175	4	940	2420	40	53	63.5	12	51	22	44	5.5	9.5	5.5	5.5	M8x1P	26	FSIW2505B-4.0P		
	10	4.762	4	1550	3540	42	85	68.5	15	55	26	52	6.6	11	6.5	6.5	M8x1P	28	FSIW2510D-4.0P		
28	6	3.175	3	770	2180	43	50	68	12	55	26	52	6.6	11	6.5	6.5	M8x1P	22	FSIW2806B-3.0P		
	5	3.175	4	1050	3390	48	53	73.5	12	60	30	60	6.6	11	6.5	6.5	M8x1P	32	FSIW3205B-4.0P		
32	10	6.35	4	2510	5880	54	90	88	16	70	34	68	9	14	8.5	8.5	M8x1P	34	FSIW3210F-4.0P		
	10	6.35	4	2570	6870	58	89	98	18	77	36	72	11	17.5	11	8.5	M8x1P	39	FSIW3610F-4.0P		
36	5	3.175	4	1180	4390	55	56	88.5	16	72	29	58	9	14	8.5	8.5	M8x1P	38	FSIW4005B-4.0P		
	10	6.35	4	2630	7860	64	93	106	18	84	43	86	11	17.5	11	8.5	M8x1P	41	FSIW4010F-4.0P		
40	10	6.35	4	2770	10290	74	93	116	18	94	42	84	11	17.5	11	8.5	M8x1P	50	FSIW5010F-4.0P		
	10	6.35	4	3760	13700	85	98	132	22	107	48	96	14	20	13	8.5	M8x1P	60	FSIW6310F-4.0P		
80	10	6.35	4	4130	17660	105	98	151	22	127	57	114	14	20	13	8.5	M8x1P	73	FSIW8010F-4.0P		

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

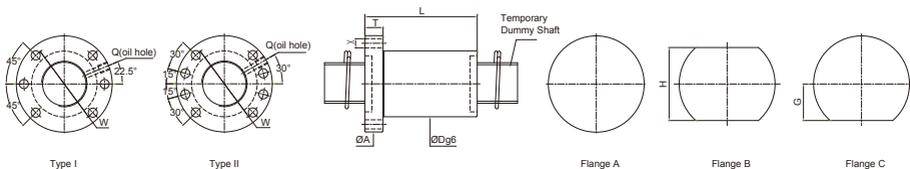


Unit: mm

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit x number of thread	MODIFIED LOAD CAPACITY (kgf)		BALLNUT DIMENSION													Nut Model NO.
O.D.	LEAD			Dynamic (1x10 <sup>6</sup> REV) Cam	Static Coam	O.D. Length		Flange					Oil Hole	Assembly Hole	STIFFNESS				
						D	L	A	T	W	G	H	TYPE	Q	X	kgf/μm			
12	4	2.381	3x1	410	990	24	28	44	10	34	16	32	I	M6x1P	4.5	13	FSDW1204A-3.0P		
14	4	2.381	3x1	460	1210	26	32	46	10	36	17	34	I	M6x1P	4.5	14	FSDW1404A-3.0P		
			4x1	590	1610											18	FSDW1404A-4.0P		
15	5	3.175	3x1	550	1260	29	32	51	10	36	16	32	I	M6x1P	4.5	14	FSDW1405B-3.0P		
	10	3.175	3x1	560	1340	29	47	51	10	39	19	38	I	M6x1P	5.5	15	FSDW1510B-3.0P		
16	20	3.175	2x1	370	900	29	58	51	10	39	19	38	I	M6x1P	5.5	10	FSDW1520B-2.0P		
	5	3.175	3x1	600	1460	29	35	51	10	39	19	38	I	M6x1P	5.5	16	FSDW1605B-3.0P		
20	10	3.175	3x1	580	1440	29	50	51	10	39	19	38	I	M6x1P	5.5	15	FSDW1610B-3.0P		
	16	3.175	2x1	400	950	29	51	51	10	39	19	38	I	M6x1P	5.5	11	FSDW1616B-2.0P		
25	4	2.381	3x1	520	1660	32	28	54	12	42	19	38	I	M6x1P	5.5	18	FSDW2004A-3.0P		
	5	3.175	3x1	670	1860	36	35	62	12	49	24	48	I	M6x1P	6.6	19	FSDW2005B-3.0P		
	10	4.762	3x1	1320	3390	40	52	62	12	51	24	48	I	M6x1P	6.6	21	FSDW2010D-3.0P		
	20	3.175	2x2	450	1200	36	56	62	12	49	24	48	I	M6x1P	6.6	13	FSDW2020B-4.0P		
28	40	3.175	1x2	610	1290	36	56	62	12	49	24	48	I	M6x1P	6.6	11	FSDW2040B-1.6P		
	4	2.381	3x1	580	2120	37	28	62	12	49	22	44	I	M6x1P	6.6	21	FSDW2504A-3.0P		
	5	3.175	3x1	740	2350	40	36	62	12	51	24	48	I	M6x1P	6.6	21	FSDW2505B-3.0P		
32	10	4.762	4x1	1920	5700	45	63	65	15	54	25.5	51	I	M6x1P	6.6	32	FSDW2510D-4.0P		
	6.35	5x1	3380	9550	51	78	84	16	67	32	64	I	M6x1P	9	42	FSDW2510F-5.0P			
32	25	3.969	2x1	780	2260	43	71	64	12	51	24	48	I	M6x1P	6.6	16	FSDW2525C-2.0P		
	5	3.175	5x1	1240	4530	43	48	65	12	51	24	48	I	M8x1P	6.6	38	FSDW2805B-5.0P		
32	5	3.175	4x1	1080	4130	50	41	87	16	72	34.5	69	I	M8x1P	9	34	FSDW3205B-4.0P		
	10	6.35	5x1	3820	12030	57	78	87	16	72	34.5	69	I	M8x1P	9	50	FSDW3210F-5.0P		
	32	4.762	2x1	1100	3420	53	90	87	16	72	34.5	69	I	M8x1P	9	20	FSDW3232D-2.0P		

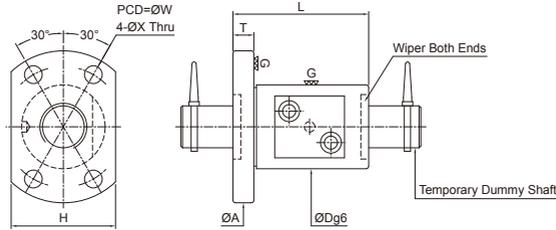
**Note:** Stiffness of nut: Stiffness values listed above are derived from theoretical formula to the elastic deformation between thread grooves and balls while axial load is 30% dynamic load rating.

# FSDW

Unit: *mm*

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × number of thread	MODIFIED LOAD CAPACITY (kgf)		BALLNUT DIMENSION											
O.D.	LEAD			Dynamic (1×10 <sup>6</sup> REV.) Cam	Static Coam	O.D.	Length	Flange						Oil Hole	Assembly Hole	STIFFNESS	Nut Model NO.
								D	L	A	T	W	G				
36	10	6.35	3×1	2560	7970	61	58	91	18	76	34	68	II	M6x1P	9	52	FSDW3610F-3.0P
			5×1	3970	13750	61	78									55	FSDW3610F-5.0P
40	5	3.175	4×1	1180	5200	60	42	91	18	76	34	68	II	M8x1P	9	40	FSDW4005B-4.0P
	10	6.35	5×1	4290	15290	65	78	95	18	80	36	72	II	M8x1P	9	59	FSDW4010F-5.0P
	20	6.35	4×1	3480	11990	65	110	98	18	83	37	74	II	M8x1P	11	48	FSDW4020F-4.0P
	40		2×1	1810	5770											25	FSDW4040F-2.0P
50	10	6.35	5×1	4780	19360	75	78	118	18	100	46	92	II	M8x1P	11	70	FSDW5010F-5.0P
63	10	6.35	5×1	5230	24240	88	84	135	22	115	50	110	II	M8x1P	14	84	FSDW6310F-5.0P
	20	6.35	5×1	5320	24930		130									137	FSDW6320F-5.0P
80	10	6.35	5×1	5840	31540	106	80	165	25	145	65	130	II	M8x1P	14	101	FSDW8010F-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.



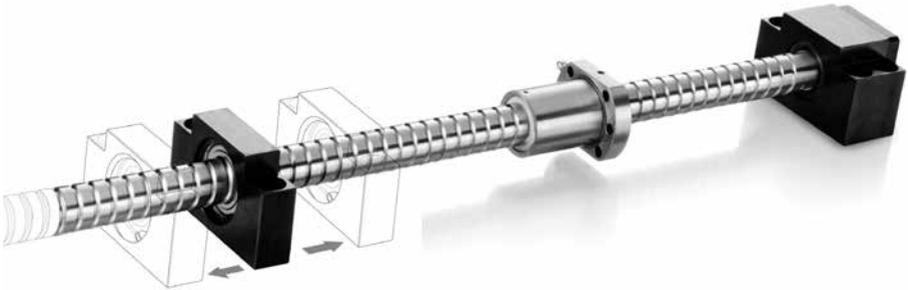
Unit: mm

SCREW SIZE		BALL DIA.	EFFECTIVE TURNS circuit × row	BASIC RATE LOAD (kgf)		BALLNUT DIMENSION								Nut Model NO.	
O.D.	LEAD			Dynamic (1×10 <sup>6</sup> REV) Ca	Static Co	O.D.		Length			Flange				Assembly Hole
						D	L	A	T	W	H	X			
8	1	0.8	2.5x1	66	140	14	16	27	4	21	18	3.4	FSMW00801X-2.5P		
	2	1.2	2.5x1	100	190	16	26	29	4	23	20	3.4	FSMW00802Y-2.5P		
	2.5	2	2.5x1	260	370	18	26	29	4	25	20	3.4	FSMW00812Z-2.5P		
10	2	1.588	2.5x1	220	370	18	28	35	5	27	22	4.5	FSMW01002K-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.

# FA Series

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



## Features

### Short Delivery

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

### Flexibility of stroke length

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

### High accuracy with reasonable price

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

### Space saving

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

### High speed and lower noise

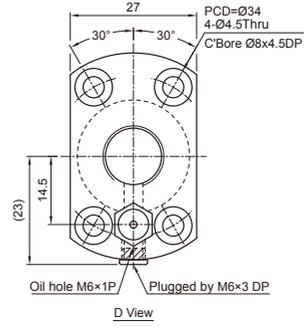
Taking advantage of *PMI* unique technology of high-speed, noise reduction, the rotation speed can be as higher as 5000 rpm. Moreover, due to the design of special circulation system, the vibration and noise(6 db less) are much lower than conventional type of ballscrew.

---

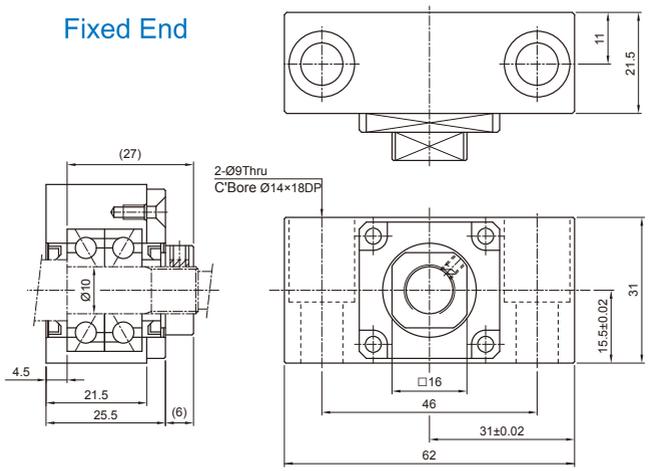
### Application range

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





Fixed End



Unit: mm

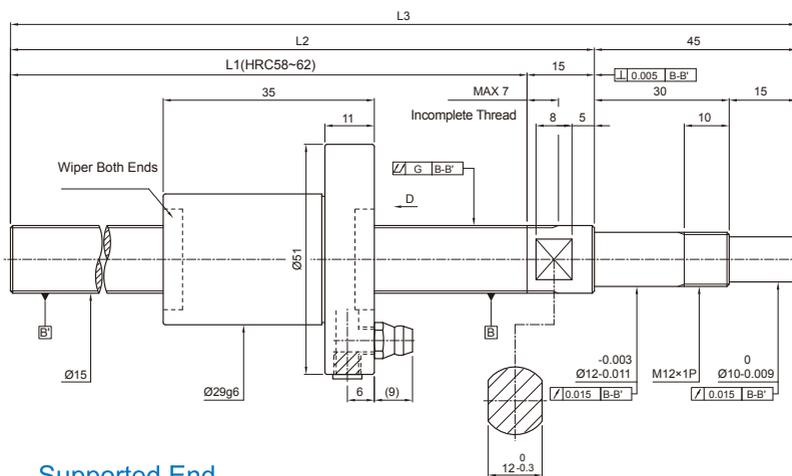
Axial Play	Lead Accuracy			Tolerances	Fixed End-bearing (kgf)		Supported End-bearing (kgf)	
	Specified Travel (T)	Accumulated reference lead deviation (E)	Lead Deriation in random 300mm (E <sub>300</sub> )		Dynamic Ca	Static Co	Dynamic Ca	Static Co
<0.005	0	0.023	0.018	0.065	546	265	196	106
<0.005	0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



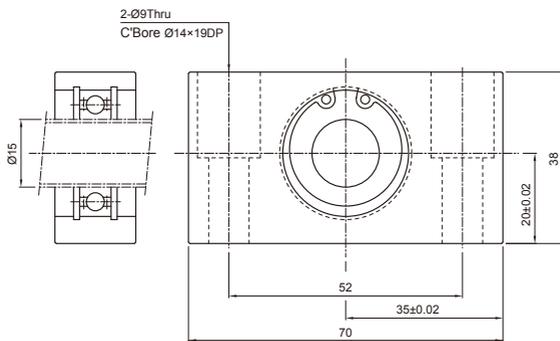


# FA FA Series Ballscrews

Screw Dia.  $\varnothing 15$  Lead 05

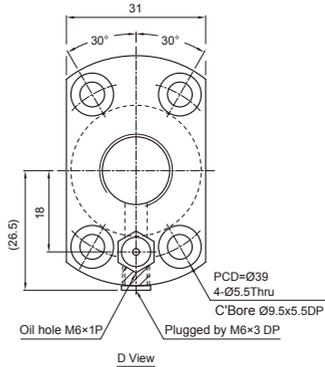


## Supported End

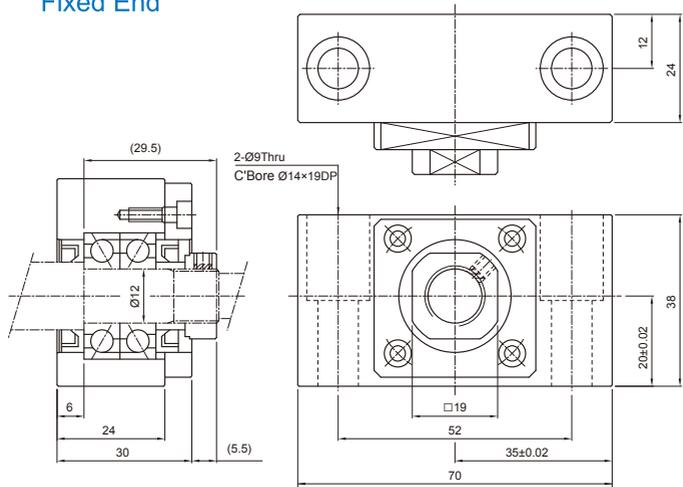


Model No.	Screw Dia.	Lead	Modified Load Capacity(kgf)		Screw Shaft Length			Accuracy Grade
	d	l	Dynamic Cam	Static Coam	L1	L2	L3	
BL015050500+A000	15	05	850	1640	440	455	500	C5
BL015051000+A000	15	05	850	1640	940	955	1000	C5
BL015051450+A000	15	05	850	1640	1390	1405	1450	C5

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



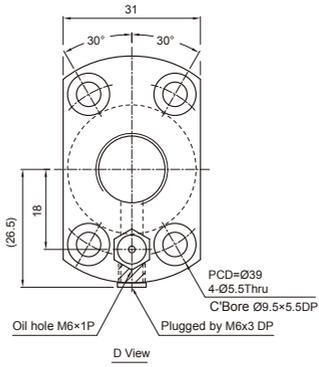
Fixed End



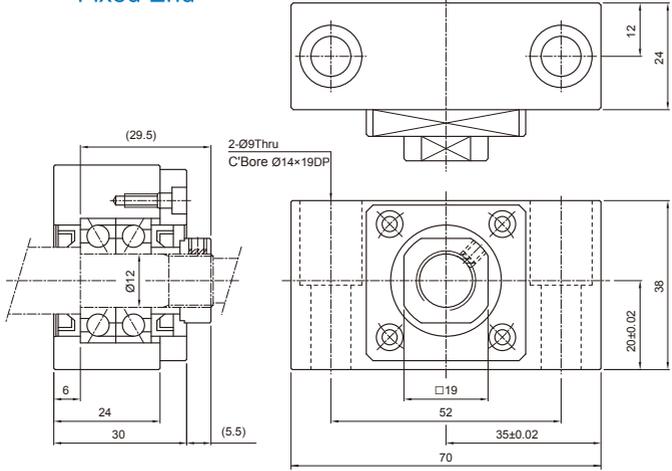
Unit: mm

Axial Play	Lead Accuracy			Tolerances Overall Radial Runout	Fixed End-bearing (kgf)		Supported End-bearing (kgf)	
	Specified Travel (T)	Accumulated reference lead deviation (E)	Lead Deriation in random 300mm (E <sub>300</sub> )		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





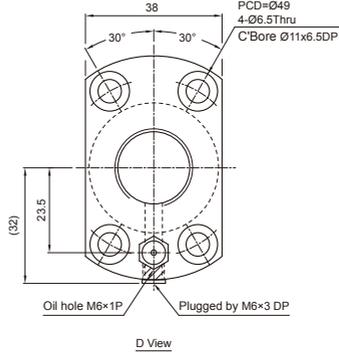
Fixed End



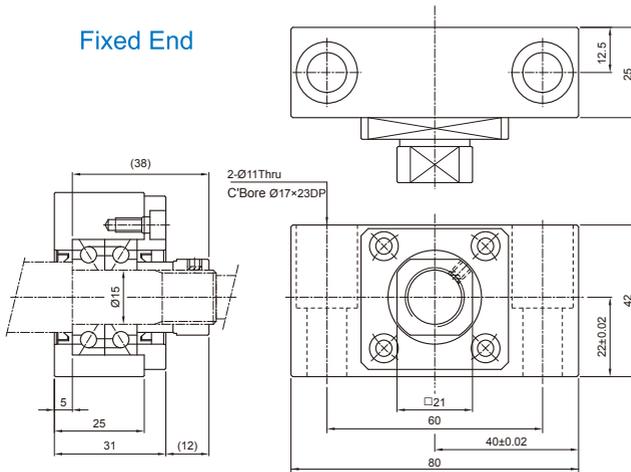
Unit: mm

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 (E <sub>300</sub> )		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





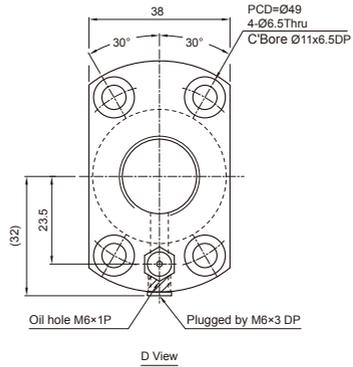
Fixed End



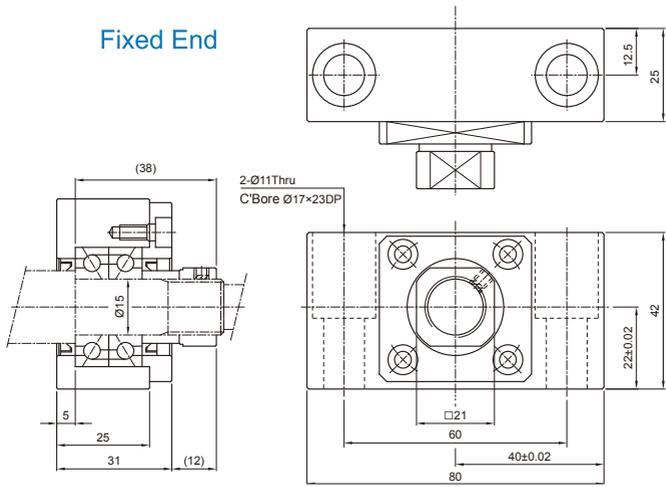
Unit: mm

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 (E <sub>300</sub> )		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





Fixed End

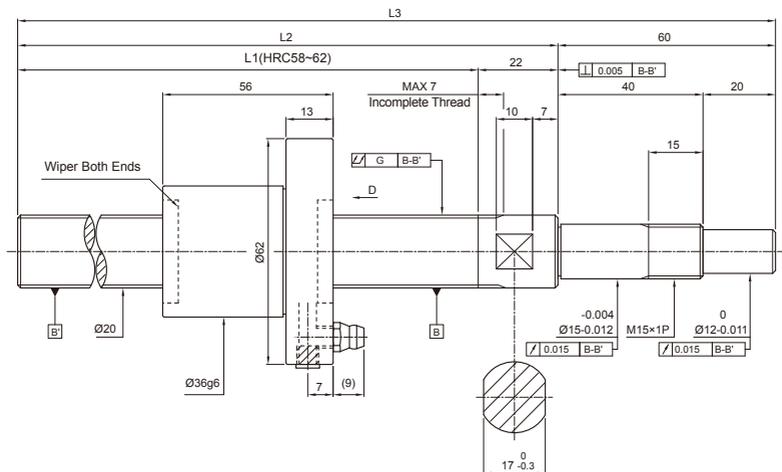


Unit: mm

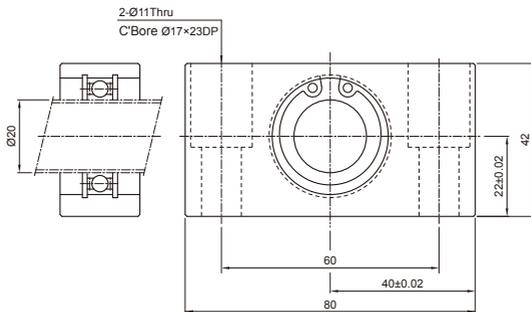
Axial Play	Lead Accuracy			Tolerances	Fixed End-bearing (kgf)		Supported End-bearing (kgf)	
	Specified Travel (T)	Accumulated reference lead deviation (E)	Lead Deriation in random 300mm (E <sub>300</sub> )		Overall Radial Runout	Dynamic Ca	Static Co	Dynamic Ca
<0.005	0	0.030	0.018	0.075	622	352	408	252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

# FA FA Series Ballscrews

Screw Dia.  $\varnothing 20$  Lead 20

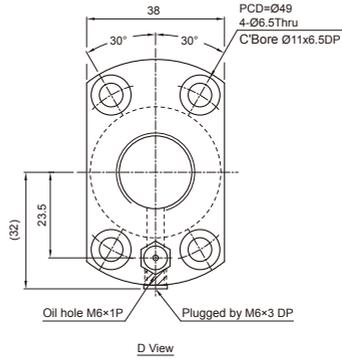


## Supported End

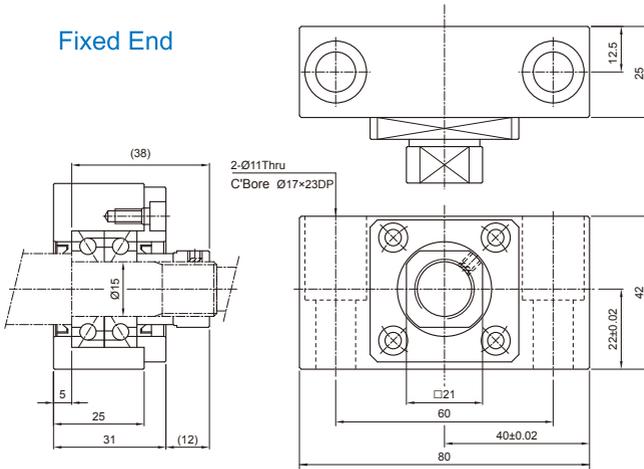


Model No.	Screw Dia.	Lead	Modified Load Capacity(kgf)		Screw Shaft Length			Accuracy Grade
	d	l	Dynamic Cam	Static Coam	L1	L2	L3	
BL020200600+A000	20	20	670	1450	518	540	600	C5
BL020201000+A000	20	20	670	1450	918	940	1000	C5
BL020201450+A000	20	20	670	1450	1368	1390	1450	C5

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



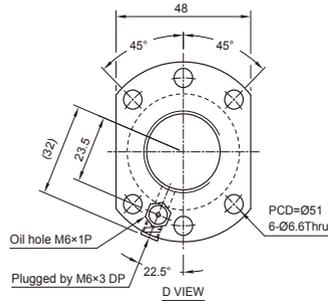
Fixed End



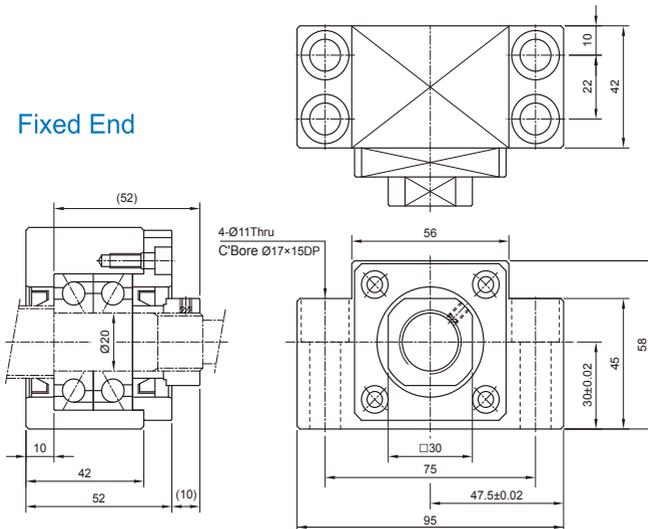
Unit: mm

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 (E <sub>300</sub> )		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





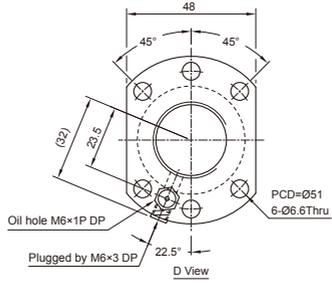
## Fixed End



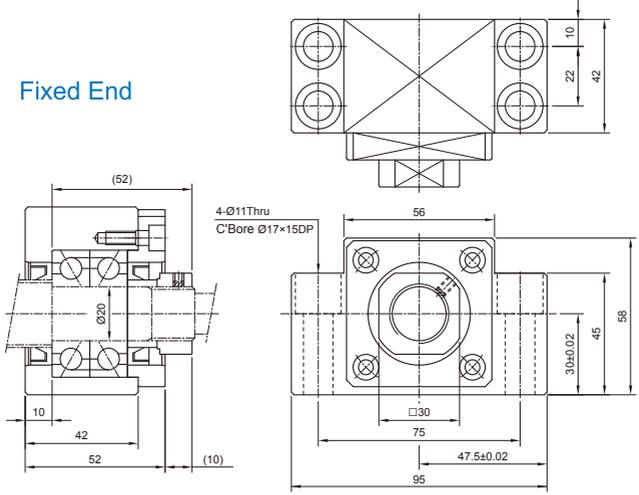
Unit: mm

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 ( $\epsilon_{300}$ )		Overall Radial Runout	Dynamic Ca	Static Co	Dynamic Ca
<0.005	0	0.027	0.018	0.050	1480	847	1030	597
<0.005	0	0.040	0.018	0.085	1480	847	1030	597
<0.005	0	0.054	0.018	0.130	1480	847	1030	597





Fixed End



Unit:mm

Axial Play	Lead Accuracy			Tolerances	Fixed End-bearing (kgf)		Supported End-bearing (kgf)	
	Specified Travel (T)	Accumulated reference lead deviation (E)	Lead Deriation in random 300mm (e <sub>300</sub> )		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

# Automation Industry Specialized Type

## 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

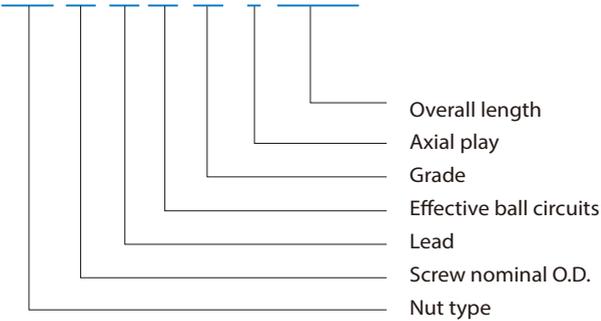
Standardized stock for general specification's thread length and length of blank shaft ends.

### Lower Price

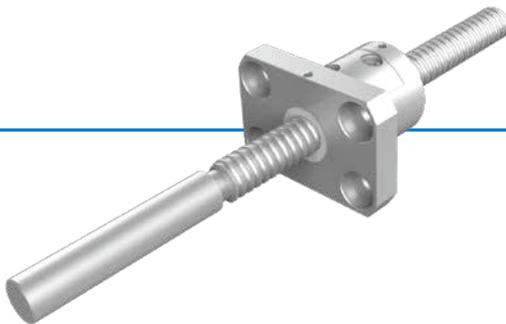
The accuracy can be as good as JIS C5 and C7 grade and with standardized axial clearance for the reason that can be cost down and the price will be cheaper.

## Nomenclature

**PTR 20 10 T3 C7 S -1500**



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

## 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.

## 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.

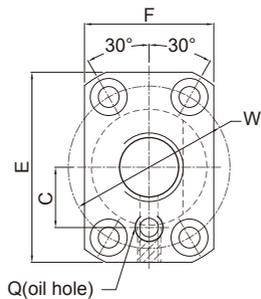
The audio frequency is low and deep due to the designed of plastic circulation system.

# PPR

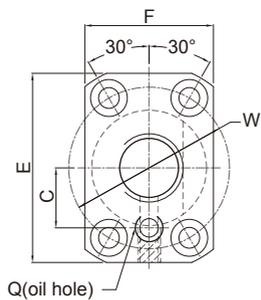
Miniature nut series

C5

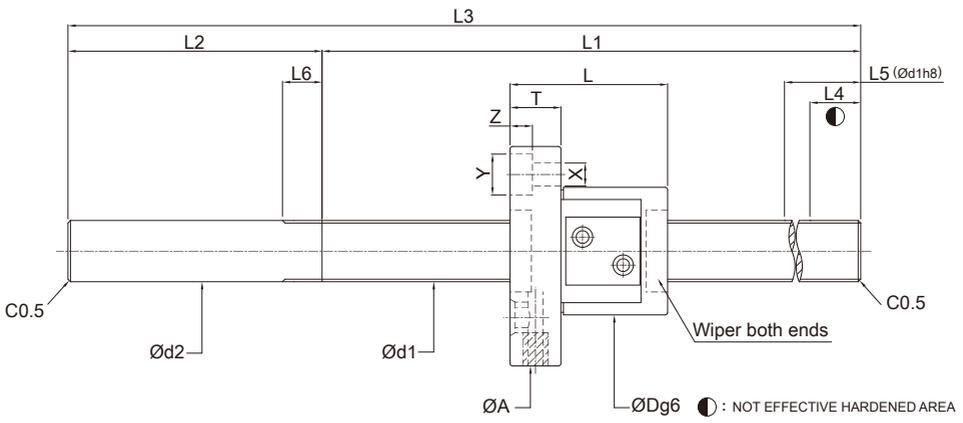
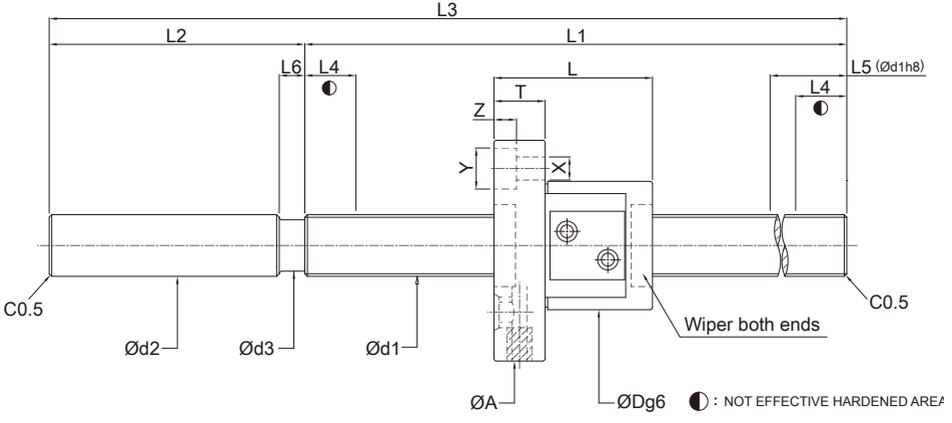
## TYPE I



## TYPE II



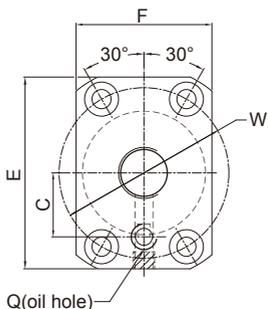
Model No.	SCREW SIZE		EFFECTIVE TURNS	BASIC RATE LOAD(kgf)		SCREW SHAFT LENGTH					
	O.D d1	LEAD		Dynamic ( $1 \times 10^6$ REV.) Ca	Static Co	L1	L2	L3	L4	L5	L6
PPR0802B1C5T-0220	8	2	2.5 × 1	190	290	160	60	220	10	50	3
PPR1202B1C5T-0220	12	2	2.5 × 1	240	450	160	60	220	10	80	3
PPR1202B1C5T-0300						240					



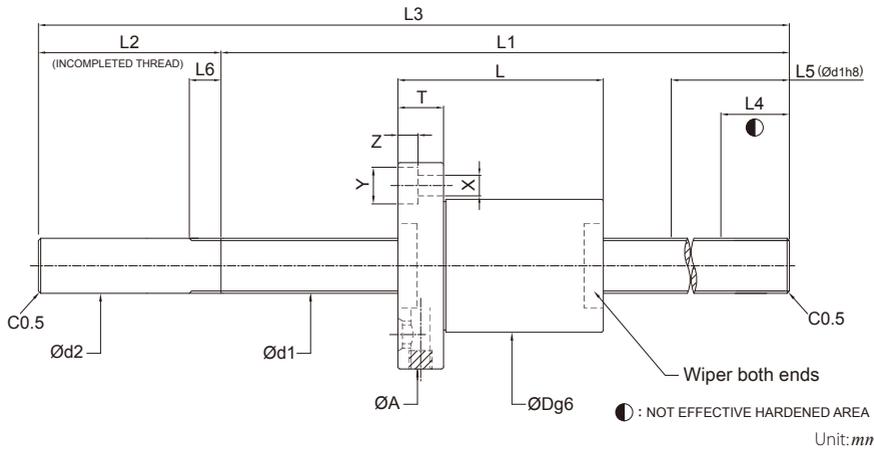
Unit: mm

SCREW SHAFT LENGTH		NUT		FLANGE						OIL HOLE		BOLT		
d2	d3	Dg6	L	A	T	W	E	F	TYPE	C	Q	X	Y	Z
10	6.5	20	25	40	6	30	36	25	I	-	-	4.5	8	4.4
12	-	25	31	45	10	35	41	28	II	13	M6	4.5	8	4.4

# PTR

 End deflector nut series


Model No.	SCREW SIZE		EFFECTIVE TURNS	MODIFIED LOAD CAPACITY(kgf)		SCREW SHAFT LENGTH			
	O.D d1	LEAD		Dynamic (1×10 <sup>6</sup> REV.) Cam	Static Coam	L1	L2	L3	L4
PTR1205T3C5T-0300	12	5	3	610	1190	240	60	300	10
PTR1205T3C5T-0450						390		450	15
PTR1210T3C5T-0300	12	10	3	590	1160	240	60	300	10
PTR1210T3C5T-0450						390		450	15
PTR1220T2C5T-0450	12	20	2	390	770	390	60	450	15
PTR1220T2C5T-0600						540		600	15
PTR1505T3C5T-0300	15	5	3	850	1640	240	60	300	10
PTR1505T3C5T-0450						390		450	10
PTR1505T3C5T-0600						540		600	10
PTR1505T3C5T-0750						690		750	15
PTR1505T3C5T-0900						840		900	15
PTR1510T3C5T-0300	15	10	3	840	1610	240	60	300	10
PTR1510T3C5T-0450						390		450	10
PTR1510T3C5T-0600						540		600	10
PTR1510T3C5T-0750						690		750	15
PTR1510T3C5T-0900						840		900	15
PTR1510T3C5T-1100						1040		1100	15
PTR1520T2C5T-0450	15	20	2	560	1050	390	60	450	15
PTR1520T2C5T-0600						540		600	15
PTR1520T2C5T-0750						690		750	15
PTR1520T2C5T-0900						840		900	15
PTR1520T2C5T-1000						940		1000	15
PTR1520T2C5T-1100						1040		1100	15
PTR1520T2C5T-1300						1240		1300	15
PTR2005T3C5T-0400						20		5	3
PTR2005T3C5T-0600	520	600	15						
PTR2005T3C5T-0800	720	800	15						
PTR2005T3C5T-1000	920	1000	15						
PTR2010T3C5T-0600	20	10	3	1530	3280	515	85	600	15
PTR2010T3C5T-0800						715		800	15
PTR2010T3C5T-1000						915		1000	15
PTR2010T3C5T-1300						1215		1300	15
PTR2010T3C5T-1500						1415		1500	15

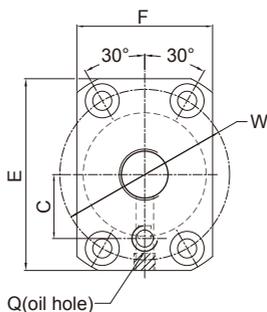


SCREW SHAFT LENGTH			NUT		FLANGE						OIL HOLE		BOLT		
L5	L6	d2	Dg6	L	A	T	W	E	F	C	Q	X	Y	Z	
150	7	12	30	32	50	10	40	45	32	15	M6	4.5	8	4.4	
150	7	12	30	45	50	10	40	45	32	15	M6	4.5	8	4.4	
150	7	12	30	54	50	12	40	45	32	15	M6	4.5	8	4.4	
150	7	15	34	35	55	11	45	50	34	18	M6	5.5	9.5	5.4	
150	7	15	34	47	55	11	45	50	34	18	M6	5.5	9.5	5.4	
150	7	15	34	47	55	11	45	50	34	18	M6	5.5	9.5	5.4	
150	7	15	34	47	55	11	45	50	34	18	M6	5.5	9.5	5.4	
200	7	15	34	47	55	11	45	50	34	18	M6	5.5	9.5	5.4	
200	7	15	34	47	55	11	45	50	34	18	M6	5.5	9.5	5.4	
200	7	20	44	35	67	11	55	60	44	22	M6	5.5	9.5	5.4	
200	7	20	44	35	67	11	55	60	44	22	M6	5.5	9.5	5.4	
200	8	20	46	52	74	13	59	66	46	24	M6	6.6	11	6.5	
200	8	20	46	52	74	13	59	66	46	24	M6	6.6	11	6.5	
200	8	20	46	52	74	13	59	66	46	24	M6	6.6	11	6.5	
200	8	20	46	52	74	13	59	66	46	24	M6	6.6	11	6.5	

# PTR

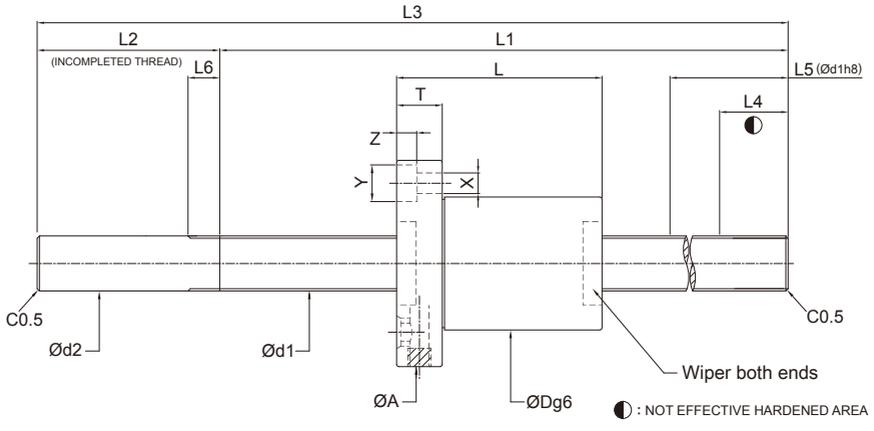
 End deflector nut series

C7



Model No.	SCREW SIZE		EFFECTIVE TURNS	MODIFIED LOAD CAPACITY(kgf)		SCREW SHAFT LENGTH			
	O.D d1	LEAD		Dynamic (1×10 <sup>6</sup> 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						390		450	
PTR1510T3C7S-0600						540		600	
PTR1510T3C7S-0750						690		750	
PTR1510T3C7S-0900	15	10	3	840	1610	840	60	900	15
PTR1510T3C7S-1000						940		1000	
PTR1510T3C7S-1100						1040		1100	
PTR1510T3C7S-1300						1240		1300	
PTR1520T2C7S-0600						540		600	
PTR1520T2C7S-0750						690		750	
PTR1520T2C7S-0900	15	20	2	560	1050	840	60	900	15
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						515		600	
PTR2010T3C7S-1000	20	10	3	1530	3280	915	85	1000	15
PTR2010T3C7S-1500						1415		1500	

Note: 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	L6	d2	Dg6	L	A	T	W	E	F	C	Q	X	Y	Z
180	7	12	30	32	50	10	40	45	32	15	M6	4.5	8	4.4
180	7	12	30	45	50	10	40	45	32	15	M6	4.5	8	4.4
180	7	12	30	54	50	12	40	45	32	15	M6	4.5	8	4.4
230	7	15	34	35	55	11	45	50	34	18	M6	5.5	9.5	5.4
230	7	15	34	47	55	10	45	50	34	18	M6	5.5	9.5	5.4
230	7	15	34	58	55	12	45	50	34	18	M6	5.5	9.5	5.4
230	7	20	44	35	67	11	55	60	44	22	M6	5.5	9.5	5.4
230	8	20	46	52	74	13	59	66	46	24	M6	6.6	11	6.5

# Service Problems Analysis of Ball Screws

## 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.

---

## The Cause and Precautions of Ballscrew Problems

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

### **Unsmooth operation**

#### **Defects from ballscrew manufacturing**

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

#### **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.

#### **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.

#### **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.

#### **Damaged return tube**

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

#### **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.

#### **Ballscrew unit is damaged during transportation**

- During installation, avoid nuts separating away from screw, otherwise the balls will get out of the nut, that lead to change of the preload and damage of the circulation system and wiper.
- 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.

### **Too much plays**

#### **No preload or insufficient preload**

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

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

#### **Inappropriate bearing selection and installation**

- 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.

- Two lock nuts and a spring washer should be used in the bearing installation to prevent them from getting loose in operation.
- 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.
- 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.

#### **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.

#### **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.

#### **The ball nut housing or the bearing housing is not mounted properly**

- Ball-nut-seated screws become loose due to vibration and lack of a spring washer.
- Ball-nut-seated screws are not seated firmly because the screws are too long or the thread holes on housing are too short.
- 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.
- Not enough locking forces for fixing screw because of too short screws

#### **The motor and the ballscrew spindle are not assembled properly**

- 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.

- Key is loose in the groove. Any inappropriate match among the hub, key, and key seat may cause these components to generate backlash.
- 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.

## Fracture

### 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

### 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.

### Ballscrew shaft end breaks

- Inappropriate design: Sharp corners on the ballscrew spindle should be avoided to reduce local stress concentration.
- 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).
- Radial force or fluctuating stress: Misalignment in the ballscrew installation creates abnormal fluctuating shear stress and causes the ballscrew to fail prematurely.
- It should be avoided, that the dimension of ball screw shaft end too much different designed from ball screw shaft section area.

## Influence of temperature raise on ball screw

During the operation of ball screws, the accuracy of machine drive system will be influenced by the raise of the temperature, especially for the high speed and high accuracy machines. Following factors affect the temperature raise of ball screws.

- 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 is preloaded, the friction torque will increase, making the temperature raised during operation. *PMI* recommends that the preload force should be 1/3 of the maximal axial load and is not bigger than 10% of the dynamic load, in order to obtain the optimal life time and lower temperature raise effect.

- The Influence of Pretension

The elongation and deformation of ball screws because of heat will deteriorate the position accuracy. The amount of thermal elongation can be calculated by certain formula and compensated by preloading torque. The target value of the Pretension compensation is the negative T value on the diagram. Too much Pretension will burn the support bearing. Therefore *PMI* recommends that the pretension should be smaller than the Pretension by 5°C; however when the ball screw 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* recommends that 2~5°C of temperature raise should be used as standard to compensate the value T (about -0.02~-0.06mm every 1000mm of ball screw)

- The Influence of Lubrication

The choice of the lubrication will directly affect the temperature raise of the ball screws. The ball screws of *PMI* should be lubricated by oil or grease. Normally lubrication oil for bearings will be recommended as ball screw lubrication, and grease from lithium soap will be recommended as lubrication 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 chosen 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 through nut to meet the cooling requirement.