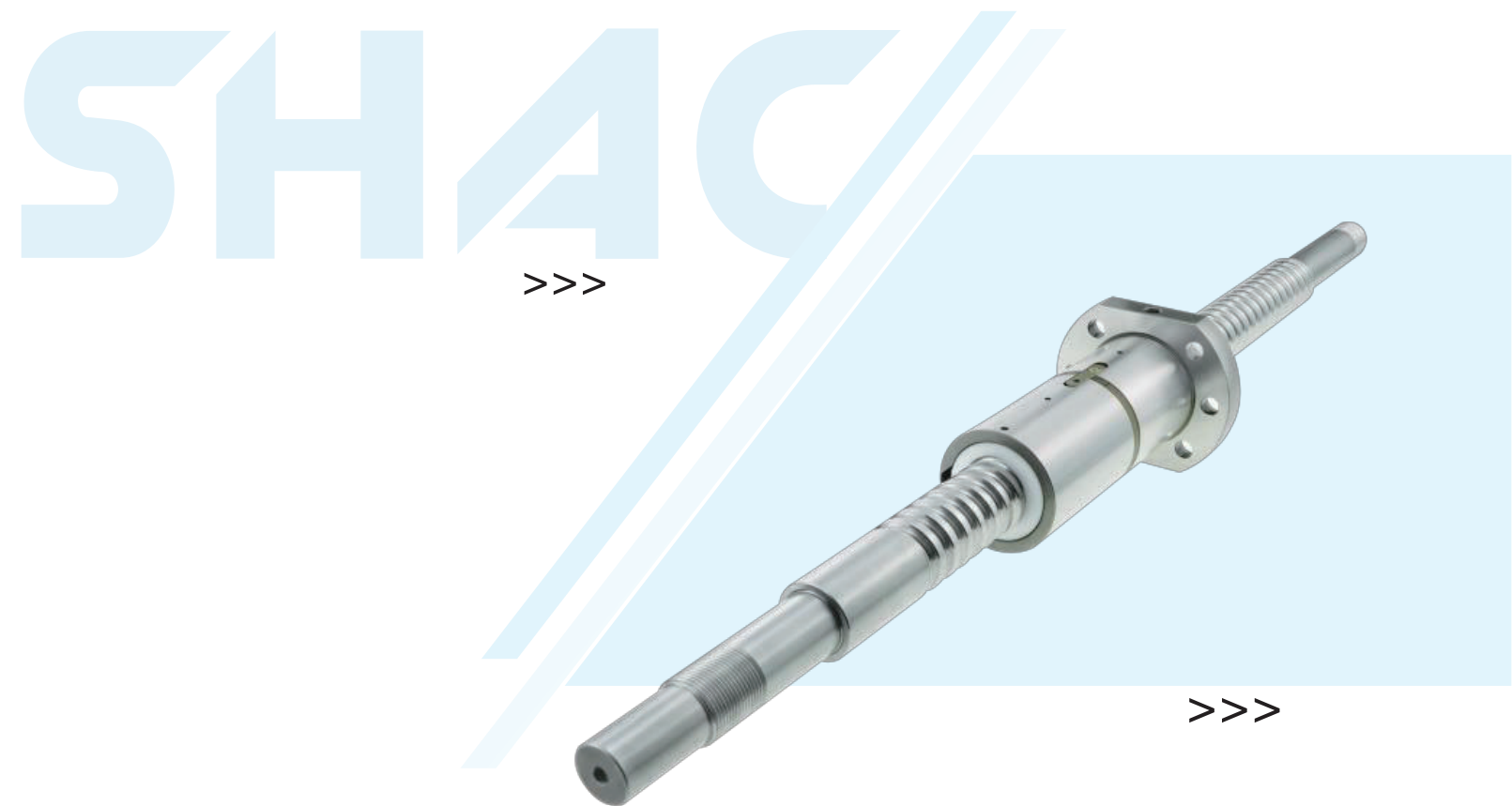




Preface

Ball screw

Ball screw assembly transmission devices were first invented in 1874 and patented in the United States, but remained underutilized until 1940 when General Motors incorporated them into automotive steering mechanisms, marking the inception of their industrial adoption. The late 1970s to early 1980s witnessed the third industrial revolution spearheaded by microelectronics, which accelerated the proliferation of CNC equipment and consequently advanced industrial specialization in ball screw assembly manufacturing.

Founded in 2007, SHAC originated from the pursuit of ultra-precision manufacturing, specializing in the R&D of high-load-capacity, high-rigidity, and high-accuracy ball screws. By integrating advanced roller screw technologies from leading industrial nations with innovative tribological designs, the brand has successfully transcended the performance boundaries of conventional linear transmission components. Today, SHAC serves as a strategic technology partner in cutting-edge sectors including robotics and aerospace engineering.

1. Fundamental Data

1-1. Ball screw Characteristics



Mechanical Efficiency

- 90% above
- Balance of rigidity

Mechanical efficiency refers to the ratio of output work (useful work) to input work (driving work) expressed as a percentage during steady-state operation of machinery.

Ball screws convert sliding friction in conventional lead screws into rolling friction, and through precision surface grinding, significantly reduce frictional resistance to achieve mechanical efficiencies exceeding 90%. (Figure 1-1 Efficiency)

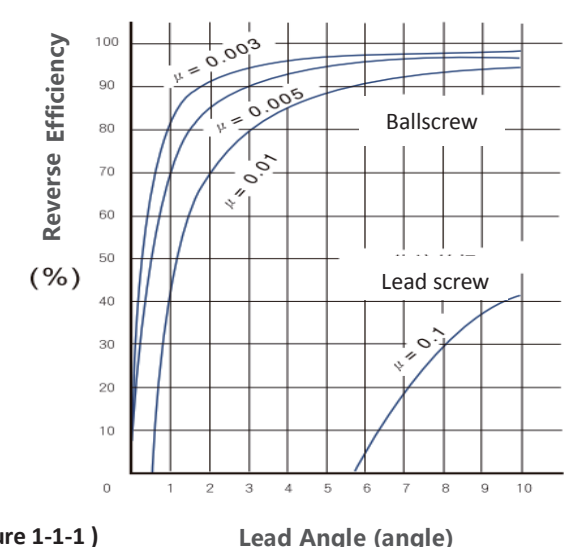
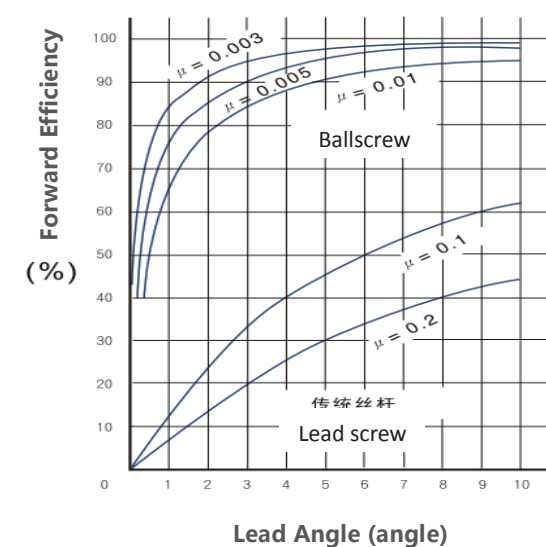
High efficiency

High efficiency stems from the use of balls as the transmission interface. Rolling friction resistance is significantly lower than sliding friction, reducing parasitic energy losses and enabling superior transmission efficiency. Compared to traditional sliding screw assemblies, drive torque requirements drop to less than one-third—meaning only one-third of the input power achieves equivalent motion output.

Reversible

Due to the point-contact rolling motion between the screw, nut, and steel balls, transmission efficiency exceeds 90%. This enables seamless conversion of rotary motion to linear motion, showcasing intrinsic reversible characteristics.

(Figure 1-1 Reverse Efficiency)



(Figure 1-1-1)



Reversibility

- transition between circular and linear motion
- kinetic energy remains

The reversibility of motion in ball screw drives is fundamentally governed by the symmetry and adjustability of their internal structure. When the driving force changes direction, the ball screw rapidly adapts to the new kinematic state, enabling smooth bidirectional operation. The friction coefficient constitutes another critical factor governing reversibility.

Ball screw drives exhibit motion reversibility, enabling bidirectional operation through drive direction reversal. This reversibility is influenced by screw configuration design, friction coefficient (μ), and magnitude of applied load.



Gothic-arch thread profile

- Two-point contact
- Four-point contact

Ball screws and ball nuts feature Gothic-arch shaped raceways (grooves) in their threads. This profile, characterized by pointed arches and ribbed vault structures, exhibits a dual-circular-arc cross-section in the normal plane of the thread groove.

In ball screw assemblies, the steel balls interface between the screw and nut. With single-nut configurations, the Gothic-arch profiles (featuring dual circular arcs on both screw and nut) typically create four contact surfaces. When subjected to excessive preload via oversized balls, the system transitions to four-point contact mode(Fig.1.1.3). Conversely, in double-nut arrangements, a precision spacer washer induces preload, enabling each nut to independently maintain optimized two-point contact(Fig.1.1.4).



Fig.1.1.2 Gothic-arch thread profile



Fig.1.1.3 Single Nut with four-point contact

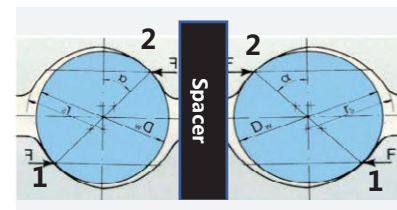
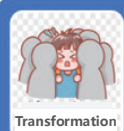


Fig.1.1.4 Double Nut with two-point contact



Zero backlash

- High Rigidity
- Low-Loss

Zero backlash in ball screws refers to an ideal state where no relative displacement occurs between the screw and nut under no-load conditions. Ball screws achieving this state deliver enhanced precision and stability while minimizing transmission errors and vibration.

Ball screws achieve zero backlash functionality through nut spacer structures and optimized ball sizing, where applied preload eliminates axial clearance. By precisely adjusting preload pressure, enhanced rigidity balances operational loads to minimize system losses. SHAC ball screws employ Gothic-arch raceways (Fig. 1.1.2), featuring a 45° contact angle between balls and raceways. Dimensional optimization of steel balls eliminates axial play, enabling supreme motion accuracy.

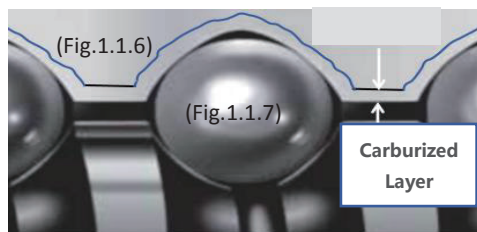


Durability

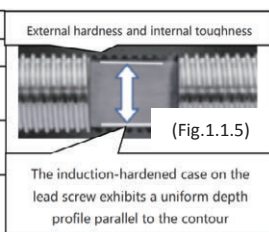
- High Hardness
- Low Roughness

Material selection for ball screws is critical to their durability. High-grade alloys provide superior abrasion resistance, corrosion protection, and fatigue life. Proper quenching and tempering treatments further enhance hardness and tensile strength to demanding specifications.(Table 1.1)

Ball screws achieve exceptional durability through high surface hardness (HRC 58-62) and ultra-finished surfaces ($R_a \leq 0.4\mu m$), effectively resisting frictional wear under operational loads.



Steel and Heat Treatment			Cr-Mo Steel
Crafts	Item name	Material	Hardness
Induction Hardening	Shaft Fig.1.1.5	50CrMo4 S55C	HRC 58°- 62°
Carburization and Quenching	Nut Fig.1.1.6	20CrMoH (Low Carbon Steel)	HRC 58°- 62°
Fully hardened	Steel Ball Fig.1.1.7	Gcr15 100Cr6 (EN)	HRC 60°UP



Micron-grade

- Precision Lead
- Micro motion

The positioning accuracy of ball screws encompasses both repeatability and inherent travel precision. Through synergistic optimization of high mechanical efficiency, low frictional resistance, and enhanced rigidity, micron-level displacement accuracy is achieved.

Ball screws achieve lead accuracy within $3.5\mu m$ per 300mm travel. When integrated with high-load capacity and rigid structural mainframes, they enable micrometer-level displacement control.

1-2 Step-by-Step Selection Guide

1-2-1 Requirements:

1-Equipment Category

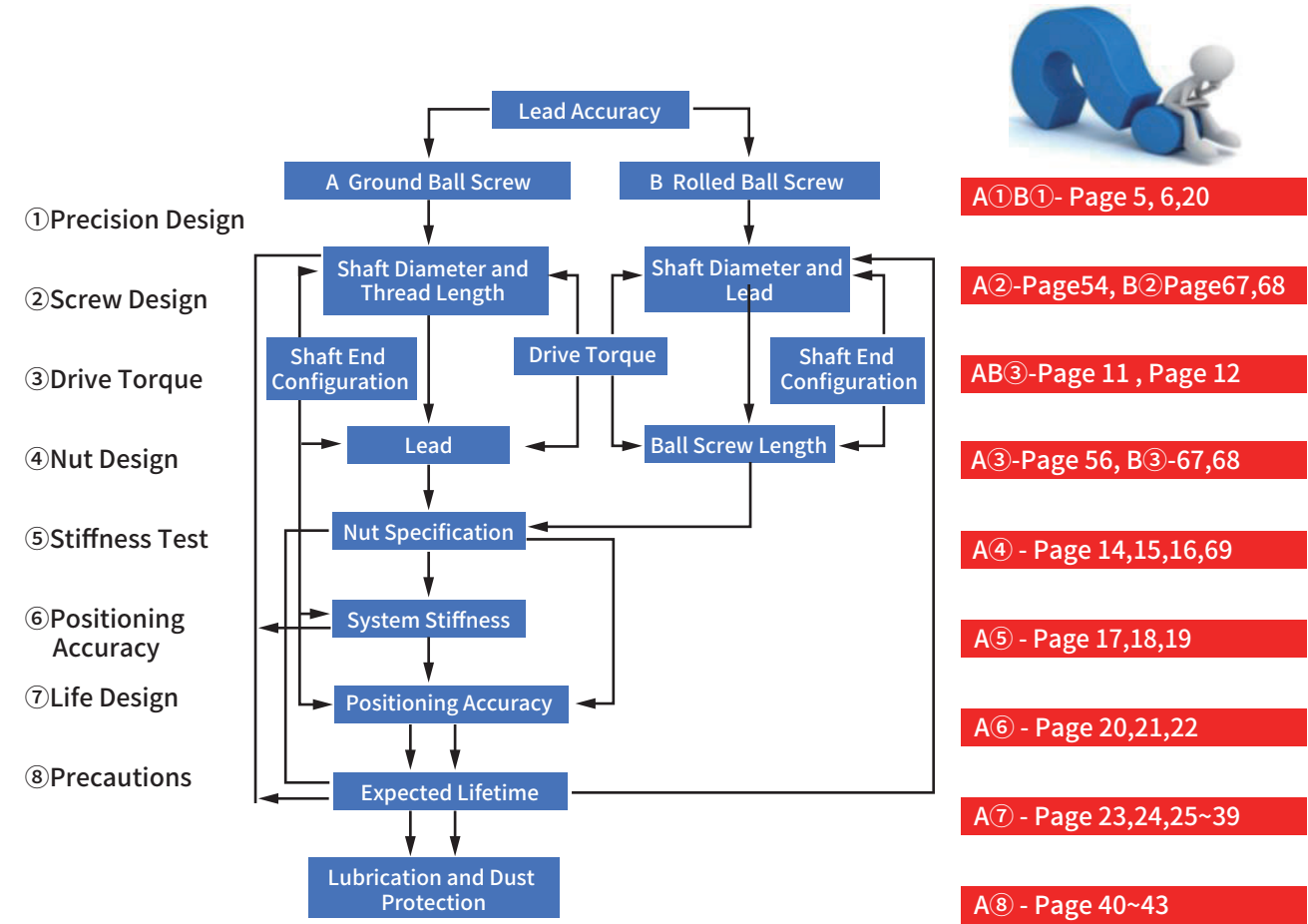
2-Precision Level

3-Speed Level

4-Environmental Conditions

Item	Name of Item	Requirements Analysis	Reference
1	Load	What axial load does the ball screw need to drive?	Page 25, Table 1.9.4, 1.9.8
2	Speed	What is the liner speed of the ball nut in meters per minute?	Page 26, Table 1.9.6
3	Acceleration	What is the liner acceleration of the nut in meters per second squared?	Page 27, Table 1.9.9
4	MaximumDisplacement Stroke	What is the maximum travel of the equipment?	Page 26, Table 1.9.5
5	Precision of Positioning	What is the positioning accuracy of the equipment?	Page 26, Table 1.9.5
6	Life Requirements	What is the expected service life of the ball screw in hours?	Page 27, Table 1.9.10
7	Vibration Environment	Does the equipment produce vibration during operation?	Page 27, Table 1.9.10 (fs), 1.9.13
8	Shock Environment	Will the equipment experience shock phenomena during operation?	Page 27, Table 1.9.10
9	Air Pollution	Are special gases present in the equipment processing environment?	---
10	Lubricate	Are there any lubrication issues during equipment operation?	Page 40, 1-10-2
11	Other	Are there any lubrication issues during equipment operation?	Page 41, Table 1.10.1

1-2-2 8-Step Selection Procedure



1-3 Accuracy Grade Selection ①

1-3-1 Definition of Positioning Accuracy

SHAC Precision Ball Screws (Grade C0 to C5) have their lead accuracy standardized according to JIS B 1192 specifications, defined by six characteristic parameters: T, e, $e2\pi$, Ve, E, Ve300. The definitions and tolerance limits for these characteristics are illustrated in Table 1.3.1 and detailed in Tables 1.3.2 and 1.3.3. For General-Grade Ball Screws (C7, C10), the cumulative lead error is only specified by two parameters:

- The tolerance for any 300mm segment within the screw's effective length ($E₃₀₀$)
- The tolerance over the entire effective length (E)

As per Table 1.3.3, the allowable values are: ± 0.05 mm for E300, ± 0.21 mm for E300.

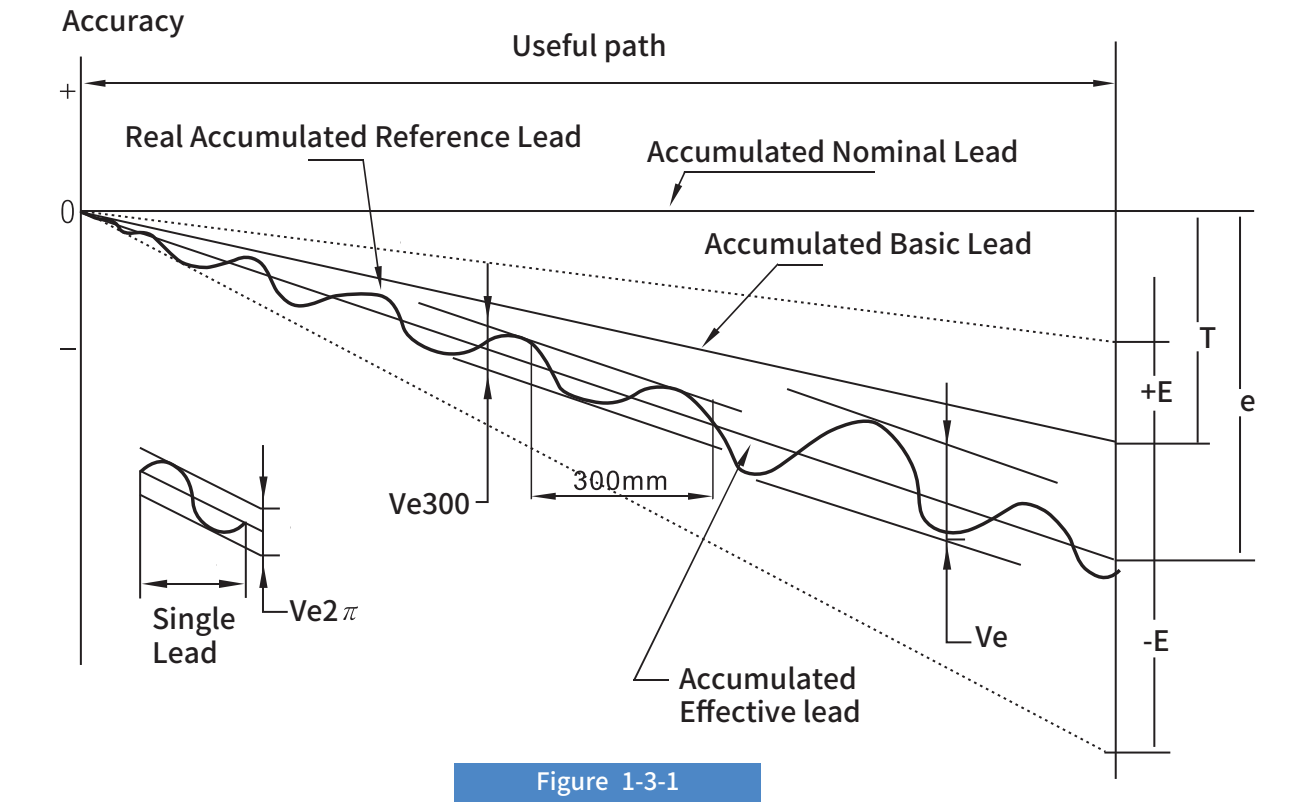


Table1.3.1 Explanation of Lead Accuracy

T : Target point of accumulated lead. This value is determined by customers' different application requirements.
e : Total reference lead deviation. Maximum deviation for accumulated reference lead line over the full length.
$Ve2\pi$: Single lead variation.
Ve : Real accumulated reference lead measured by laser system.
E : Total relative lead deviation. Maximum deviation of the real accumulated lead from the accumulated reference lead in the corresponding range.
Ve300 : Lead deviation over path of 300mm. The above deviation in random 300mm within thread length.

1-3-2 Cumulative Lead Error Comparison Table

For different accuracy classes of ball screws, within a specified effective thread length, corresponding precision requirements apply and can be referenced during selection. The allowable values for the 300mm thread length variation ($e300$) and periodic fluctuation per revolution ($e2\pi$) are defined according to the JIS B1192 standard.

Unit: 0.001mm

1-3-3 Accuracy Grade Comparison Table

Table 1.3.3 Allowable Values for Axial Variation over 300mm Thread Length (e300) and Wobble Error per Revolution (e2 π) per JIS B 1192

1-3-4 Ball Screw Mounting Interface Precision

1. Total Radial Run-out of Screw Shaft Relative to Thread Groove Surface at Outer Diameter AA'
2. Circular Radial Run-out of Screw Support Section Relative to Thread Groove Surface at Outer Diameter AA'
3. Concentricity of Support Section and Component Mounting Surface Relative to Screw Shaft at Outer Diameter AA'
4. Perpendicularity of Screw Support Section End Face Relative to Screw Shaft at Outer Diameter AA'
5. Perpendicularity of Nut Reference Surface/Flange Mounting Face Relative to Screw Shaft at Outer Diameter BB'
6. Run-out of Nut Outer Diameter Relative to Screw Shaft at Outer Diameter BB'
7. Parallelism of Nut Outer Rim (Flat Mounting Face) Relative to Screw Outer Diameter BB'



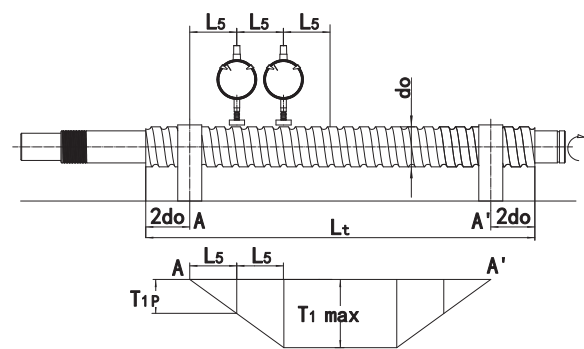


Figure 1.3.5

Table 1.3.4

T1: True running deviation of external diameter relation to AA'

(This measurement is made according to DIN 69051 and JIS B119121)

Nominal diameter do (mm)		Basic length	T1 (μm) Accuracy level					
Above	up to	L5	0	1	2	3	5	7
6	12	80	20	20	20	23	28	40
12	25	160						
25	50	315						
50	100	630						
100	200	1250						
Lt/do			T1 MAX (μm) (for Lt≥4L5), Accuracy level					
Above		up to	0	1	2	3	5	7
		40	40	40	40	45	60	80
40		60	60	60	60	70	85	120
60		80	100	100	100	115	140	200
80		100	160	160	160	180	220	320

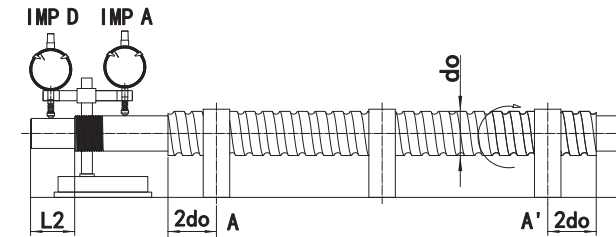


Figure 1.3.7

Table 1.3.6

T3: Coaxial deviation relative to AA'

(This measurement is made according to DIN 69051 and JIS B119121)

Nominal diameter do (mm)		Reference length	T3a (μm) (for L2 ≤ Lr) For tolerance level						
Above	up to	Lr	0	1	2	3	5	7	
6	20	80	4	5	5	6	7	12	
20	50	125	5	6	6	7	9	16	
50	125	200	6	7	8	9	11	20	
125	200	315				10	14	25	

If $L2 > Lr$, then $t3 \leq T3a \cdot L2/Lr$

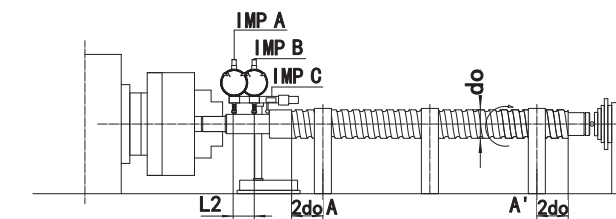


Figure 1.3.8

Table 1.3.7

T4: Run-out deviation of bearing end shoulder relative to AA'

(This measurement is made according to DIN 69051 and JIS B119121)

Nominal diameter do (mm)		T4a (μm) For tolerance level						
Above	up to	0	1	2	3	5	7	
6	63	3	3	3	4	5	6	
63	125	3	4	4	5	6	8	
125	200	-	-	-	6	8	10	

Table 1.3.5

T2: Run out deviation of bearing relative to AA'

(This measurement is made according to DIN 69051 and JIS B119121)

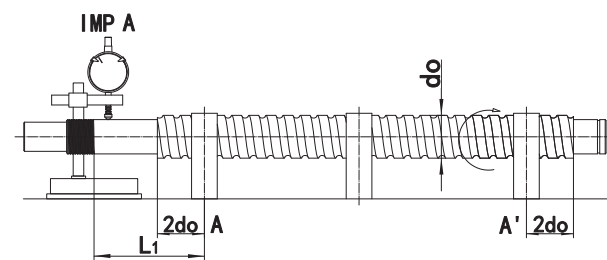


Figure 1.3.6

Nominal diameter do (mm)		Reference length	T2a (μm) (for L1 ≤ Lr) For tolerance level						
Above	up to	Lr	0	1	2	3	5	7	
6	20	80	6	8	10	11	16	40	
20	50	125	8	10	12	14	20	50	
50	125	200	10	12	16	18	26	63	
125	200	315				20	32	82	

If $L1 > Lr$, then $t2b \leq T2a \cdot L1/Lr$

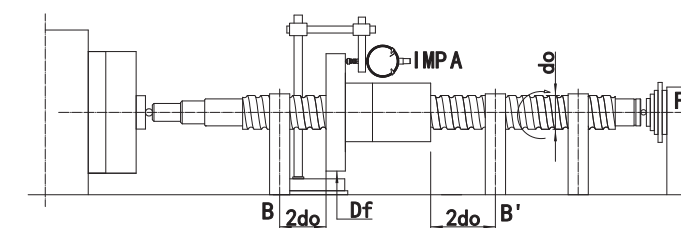


Figure 1.3.9

Table 1.3.8

T5: Face running deviation of locating face (only for nut) relative to BB'

(This measurement is made according to DIN 69051 and JIS B119121)

Nut Flange diameter do(mm)		T5a (μm) For tolerance level						
Above	up to	0	1	2	3	5	7	
	20	5	6	7	8	10	14	
20	32	5	6	7	8	10	14	
32	50	6	7	8	8	11	18	
50	80	7	8	9	10	13	18	
80	125	7	9	10	11	15	20	
125	160	8	10	11	13	17	20	
160	200	-	11	12	14	18	25	
200	250	-	12	14	15	20	30	

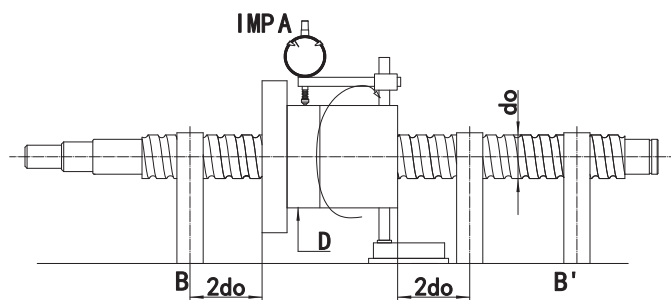


Figure 1.3.10

Table 1.3.9

T6: Run-out deviation of external diameter (only for nut) relative to BB'

(This measurement is made according to DIN 69051 and JIS B119121)

Nut Flange diameter do (mm)		T6a (μm) For tolerance level					
Above	up to	0	1	2	3	5	7
	20	5	6	7	9	12	20
20	32	6	7	8	10	12	20
32	50	7	8	10	12	15	25
50	80	8	10	12	15	19	30
80	125	9	12	16	20	22	40
125	160	10	13	17	22	28	40
160	200		16	20	22	28	40
200	250		17	20	22	28	40

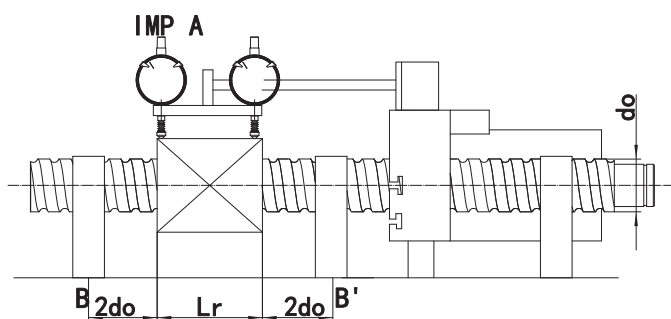


Figure 1.3.11

Table 1.3.10

T7: Deviation of parallelism (only for nut) relative to BB'

(This measurement is made according to DIN 69051 and JIS B119121)

Nouning basic Length (mm) Lr		T7a (μm) /100mm For tolerance level					
Above	up to	0	1	2	3	5	7
	50	5	6	7	8	10	17
50	100	7	8	9	10	13	17
100	200		10	11	13	17	30

Note:

The geometric tolerance standard for SHAC ball screw drawing shall be executed in accordance with the specifications of DIN 69051 and JIS B11921 unless the customer has special requirements.

1-4 Ball Screw Journal/Shaft End Configuration Selection ②

1-4-1 Mounting Configuration

The fixing method constitutes an essential consideration during ball screw selection, directly impacting precision, service life, and system performance. This influence manifests in three core design parameters: rigidity, critical speed, and buckling load. The primary fixation configurations are outlined below and should be selected according to operational requirements.

Figure 1.4 Screw Shaft & Nut Assembly Mounting Configuration

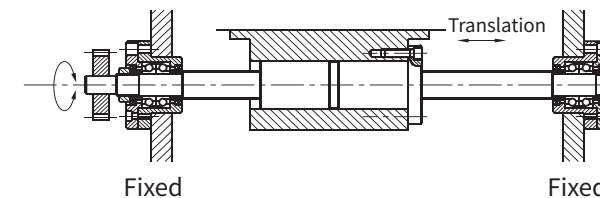


Fig.1.4.1

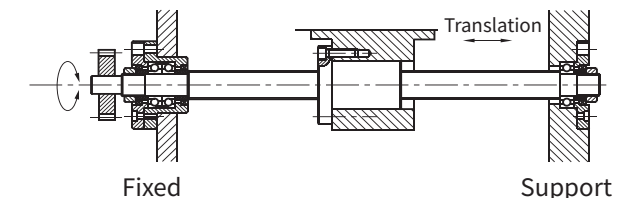


Fig.1.4.2

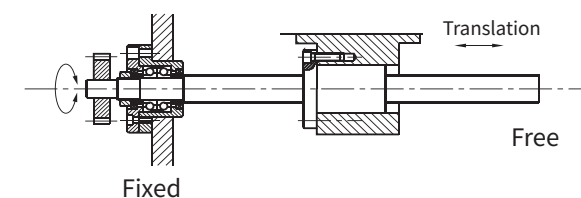


Fig.1.4.3

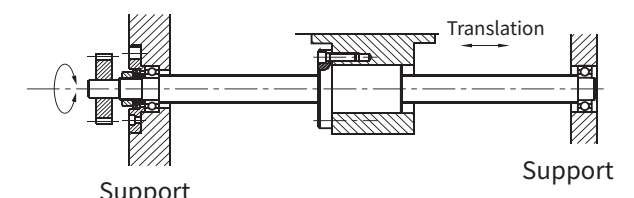


Fig.1.4.4

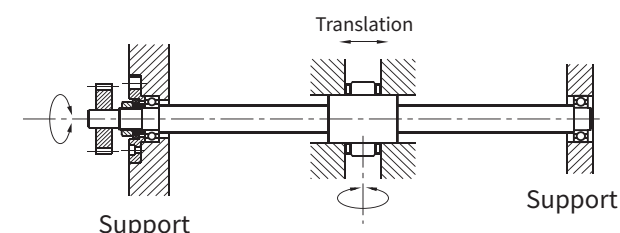


Fig.1.4.5

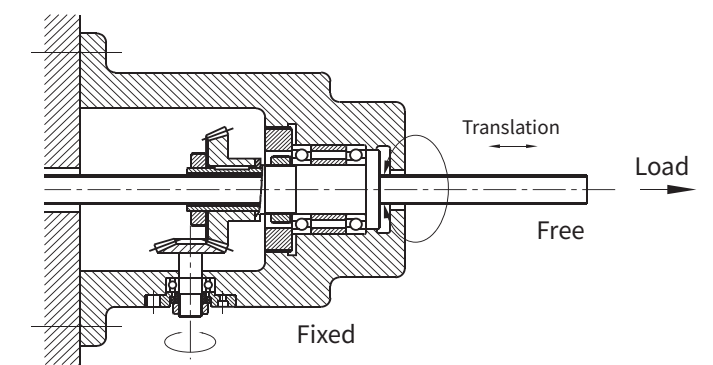


Fig.1.4.6

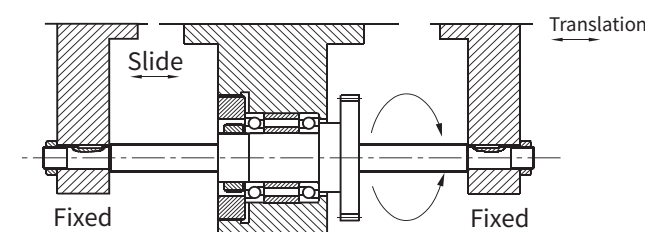


Fig.1.4.7

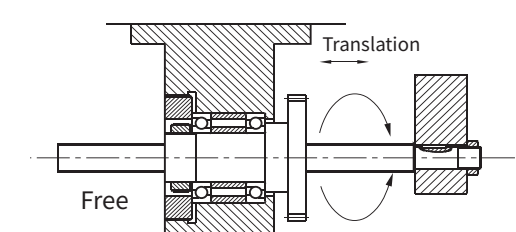


Fig.1.4.8

(Axial Constraint Systems for Ball Screw in Machine)

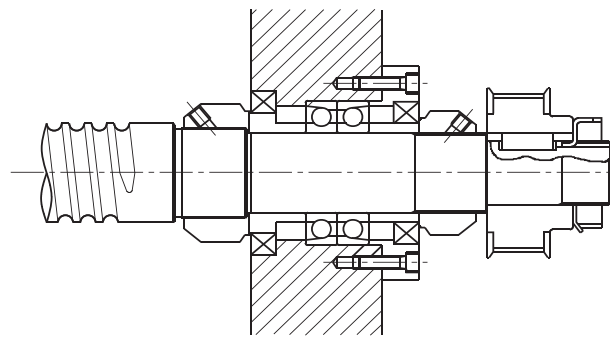


Fig.1.4.9

Fig.1.4.9 Light-Duty Timing Belt Drive with Standard Duplex Bearing Configuration

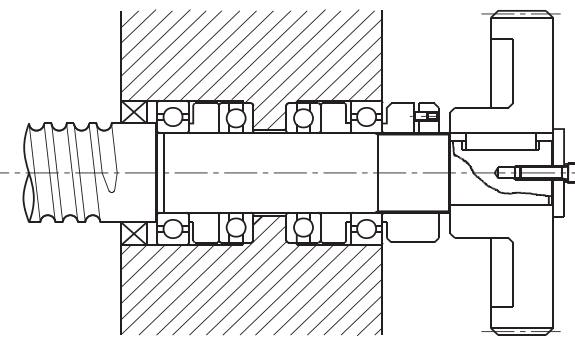


Fig.1.4.10

Fig.1.4.10 Heavy-Duty Gear Transmission with Enhanced Radial Capacity & Sustained Load Bearing Configuration

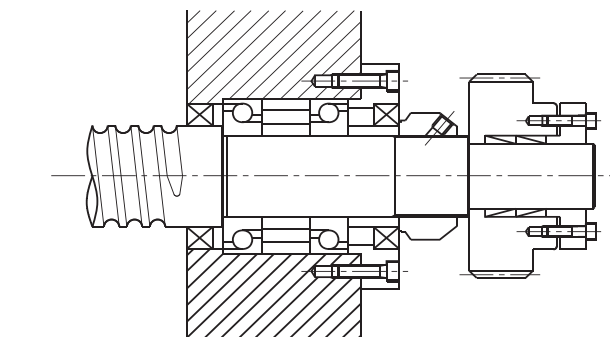


Fig.1.4.11

Fig.1.4.11 Enhanced Radial Load Capacity in Gear-Driven Ball Screws via Extended Bearing Span with Precision Spacer Rings

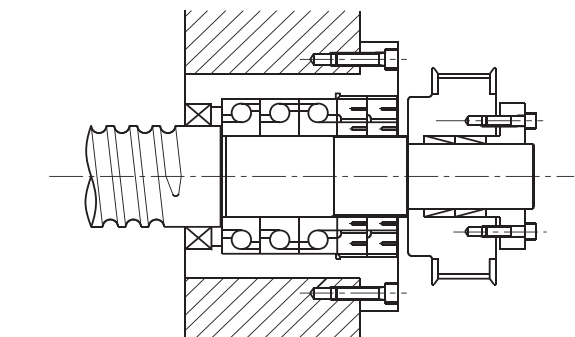


Fig.1.4.12

Fig.1.4.12 Short-Journal Pulley Drive with Enhanced Load Capacity via Triplex Bearing Configuration

Adjustable Pre-Tension Mounting Configuration for Ball Screw

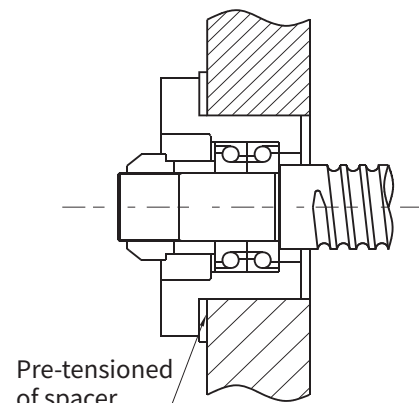


Fig.1.4.13

Fig. 1.4.13 Rapid-Adjust Shim Kits for Pre-Tension Preload Control

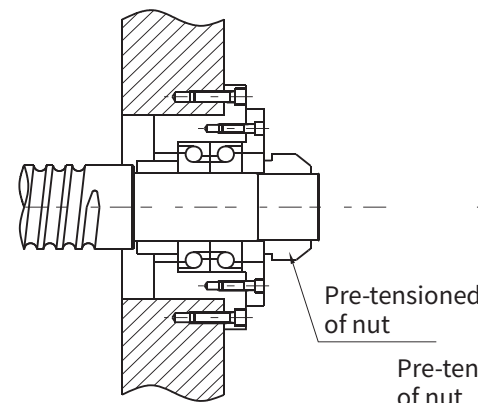


Fig.1.4.14

Fig. 1.4.14 Torque-Controlled Pre-Tensioning with Standard Locknut Assembly

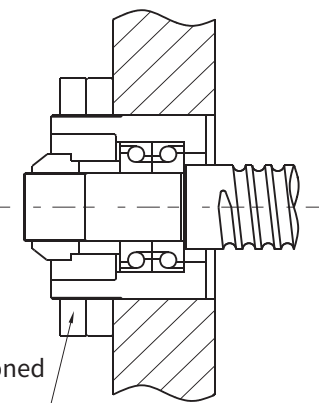


Fig.1.4.15

Fig. 1.4.15 High-Capacity Lock-nut Assembly with Thermal Growth Accommodation for

1-4-2 Screw Shaft End Dimensions

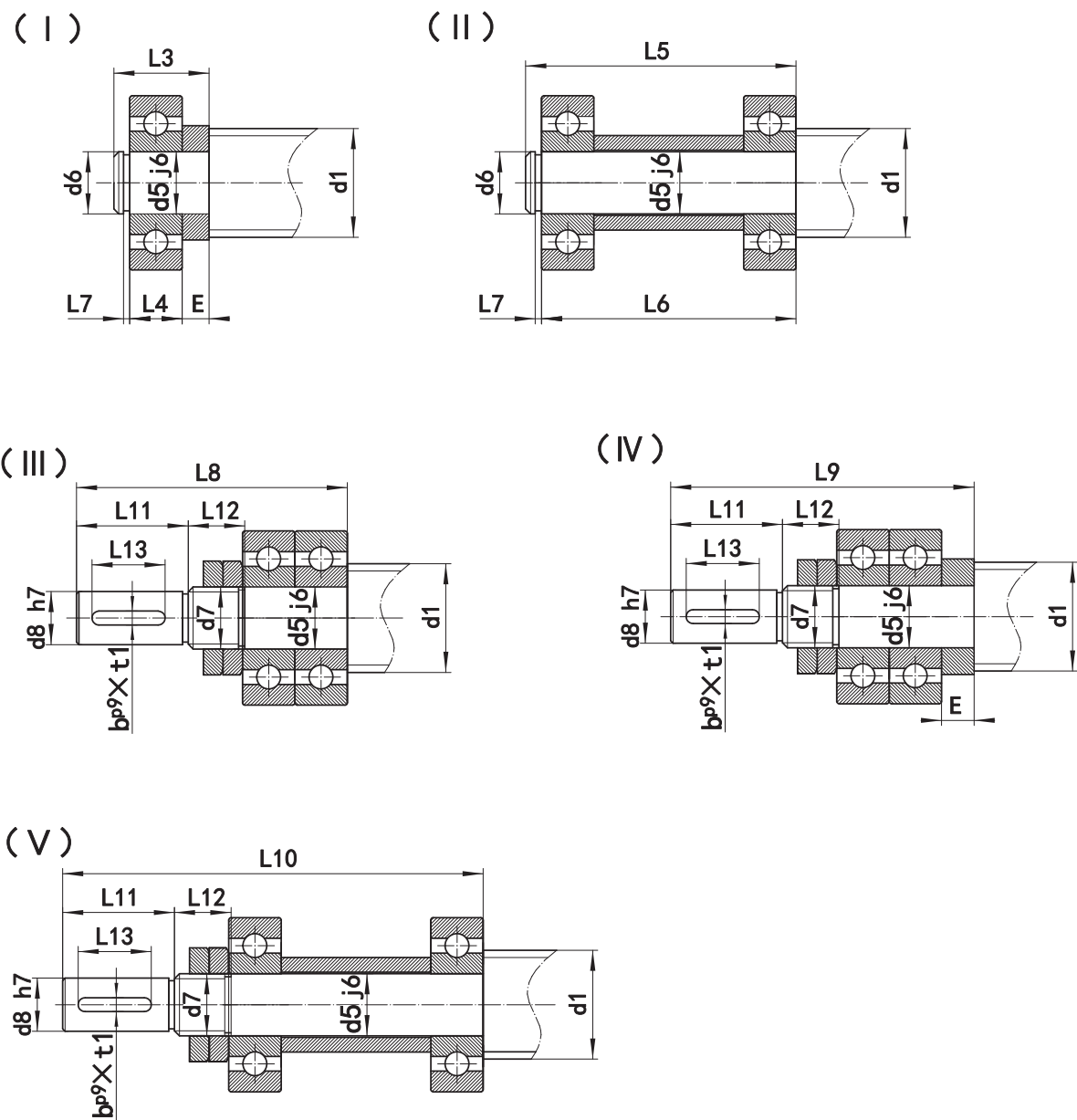
▲Screw Shaft End Configuration

Standard end configurations, as shown in Figure 1.4.16, while bearing model selection based on recommended size ranges is provided in Table 1.4.2 .

Table 1.4.2 Shaft End Dimensions

Model	d1	d5	d6	d7	d8	E	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12	L13	bxt1	Recommended Bearings	
																			I.II.III DIN625	III.IV.V DIN625 628 720
10	10	8	7.6	M8x0.75	6	6	16	7	29	26	0.9	39	50	56	18	10	12	3.0x1.8	608	738B
12	12	8	7.6	M8x0.75	6	6	16	7	29	26	0.9	39	50	56	18	10	12	3.0x1.8	608	738B
14	14	10	9.6	M10x0.75	8	8	20	9	37	34	1.15	45	54	62	20	10	14	3.0x1.8	6200	7200BTVP
16	16	12	11.5	M12x1	10	8	21	10	41	38	1.15	46	56	66	20	10	14	4.0x2.5	6201	7301BTVP
20	20	15	14.3	M15x1	12		22	11	47	44	1.15	55	70	84	25	13	16	5.0x3.0	6202	7302BTVP
25	25	17	16.2	M17x1	15		23	12	49	46	1.15	56	72	86	25	13	16	5.0x3.0	6203	7203BTVP
28	28	20	19.0	M20x1	16		26	14	58	54	1.35	68	82	100	28	20	18	6.0x3.5	6204	7602020BTVP
32	32	25	23.9	M25x1.5	20		27	15	64	60	1.35	79	94	116	36	22	26	7.0x4.0	6205	7602025BTVP
36	36	25	23.9	M25x1.5	20		27	15	64	60	1.35	79	94	116	36	22	26	7.0x4.0	6205	7602025BTVP
40	40	30	28.6	M30x1.5	25		28	16	68	64	1.65	86	102	126	42	22	32	8.0x4.0	6206	7602030BTVP
45	45	35	33.3	M35x1.5	30		29	17	80	76	1.65	97	114	148	50	24	40	10.0x5.0	6207	7602035BTVP
50	50	40	38.0	M40x1.5	35		36	23	93	88	1.95	113	126	160	60	24	45	12.0x5.0	6308	7602040BTVP
55	55	45	42.5	M45x1.5	40		38	25	93	88	1.95	125	138	168	70	24	50	14.0x5.5	6309	7602045BTVP
63	63	50	47.0	M50x1.5	45		33	27	102	97	2.2	140	153	188	80	27	60	14.0x5.5	6310	7602050BTVP
70	70	55	52.0	M55x2.0	50	10	44	29	118	113	2.2	154	167	212	90	27	70	16.0x6.0	6311	7602055BTVP
80	80	65	62.0	M65x2.0	60	10	49	33	132	126	2.7	171	184	234	100	30	80	18.0x7.0	6313	7602065BTVP
100	100	75	72.0	M75x2.0	70	10	53	37	140	134	2.7	195	208	258	120	30	90	20.0x7.5	6315	7602075BTVP

Figure 1.4.16



Note: 1-Over years, the adoption of couplings has largely superseded the use of keyway, reducing the likelihood of radial shear stress occurrence.
2-The use of spacer rings compensates for inadequate bearing abutment area caused by thread relief on the screw shaft.

1-5 Ball Screw Drive Torque ③

1-5-1 Preload Torque

The torque required to continuously rotate a ball screw without external load is defined as the preload torque.
Figure 1.5.1 illustrates the terminology for preload torque generated by rotating a preload ball screw. Table 4.B.4 specifies the allowable range of preload torque variation under JIS standards (JIS B 1192-2019) in page 41.

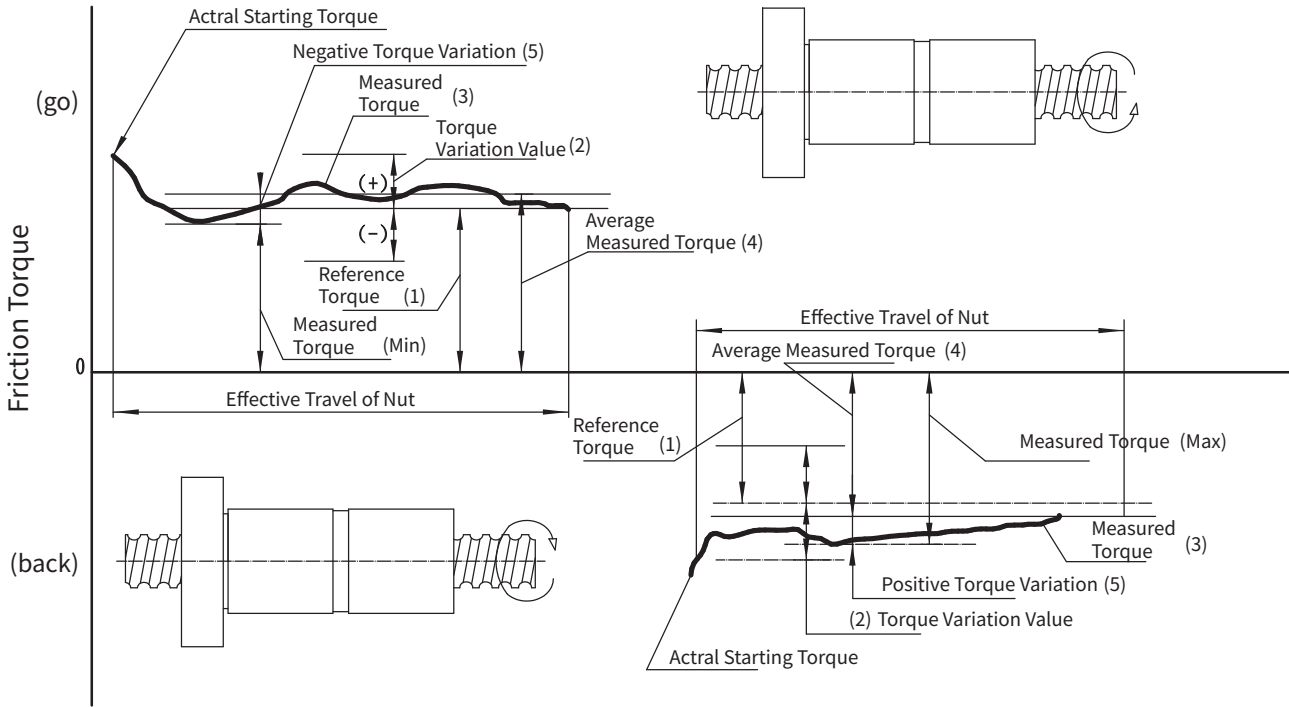


Figure 1.5.1 Preload Torque Illustration

Table 1.5.1 Definition of Preload Torque

Name	Meaning
Preload	To eliminate backlash andincrease rigidity in ball screw assemblies, internal pre-load is generated either by: (1)Installing oversized-diameter balls, (2)Inserting preload spacers between dual nuts, Thereby inducing controlled elastic deformation within the screw/nut/ballinter-face.
Preload Torque	The torque required to continuously rotate the screw or nut without external lo-ad is defined as P reload Torque.
Reference Torque(1)	Predetermined Target Preload Torque Value
Torque Variation Value(2)	Predetermined Reference Torque Variation Allowance
Torque Variation Ratio	Reference Torque to Variation Ration
Measured Torque(3)	Actual Measured Preload Torque Value
Average Measured Torque(4)	Arithmetic Mean of Actual Torque Values Over Effective Thread Length
Actual Torque Variation Value(5)	Within the effective thread length, the maximum variation value of preload torque exhibits both positive and negative deviations relative to the average ac-tual torque.
Actual Torque Variation Ration	Ratiu of Average Actual Torque to Actual Torque Variation

1-5-2 Driving Torque

Drive torque applied to the transmis-sion shaft TS

TS=TP+TD+TF (Uniform velocity)
TS=TG+TP+TD+TF (Acceleration)

TG: Acceleration torque (1)
TP: Load torque (2)
TD: Preload torque (3)
TF: Frictional torque (4)

(1)Acceleration torque TG

$T_G = J\alpha$ (kgf × cm)
 $\alpha = \frac{2\pi n}{60\Delta t}$ (rad/s²)

J: Inertia torque (kgf-cm-S2)
α: Angular acceleration(ra/s2)
n: Rotational Speed (rpm)
Δt: Acceleration Time(s)

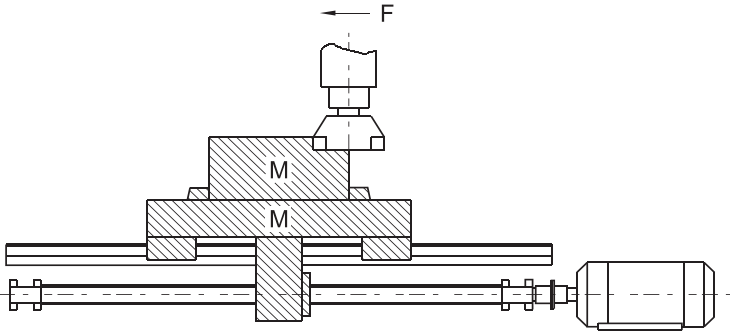


Fig. 1.5.1 Load inertia torque

Please reference Table 1.5.1 Load inertia torque
 $J=JBS+JCU+JW+JM$

JBS: Ball screw Inertia
JCU: Coupling Inertia
JW: Linear motion part Inertia
JM: Motor rotor section Inertia

(2)Load torque TP

$T_P = \frac{P \times \ell}{2\pi\eta_1}$ (kgf×cm)
 $P = F + \mu Mg$

P: Axial Load (kgf)
ℓ: Lead(2)
η₁: Forward Efficiency
↳ Efficiency of converting rotational motion to linear motion
F: Cutting Force (kgf)
μ: Coefficient of Friction
M: Load mass (kg)
g: Gravitational acceleration

$T_P = \frac{P \times \ell \times \eta_2}{2\pi}$ (kgf×cm)
η₂: Backdrive Efficiency
↳ Efficiency of converting rotational motion to linear motion

(3)Preload torque

$T_D = \frac{K \times P_{PL} \times \ell}{\sqrt{\tan\alpha} \times 2\pi}$ (kgf×cm)
K: Internal coefficient (Default:0.05)
P_{PL}: Preload (kgf)
ℓ: Lead(2)
α: Lead Angle

(4) Frictional torque TF

$TF=+TB+T0+TJ$

TB : Frictional torque at the support end
T0 : Frictional torque at the free end
TJ : Frictional torque in electric motors

Note : Frictional torque at the support end is subject to variation depending on operational conditions.

Table 1.5.2 Load Inertia Torque Conversion

Motor Shaft Inertia Torque Conversion	Formula J
Cylindrical Load	$\frac{\pi \rho L D^4}{32}$
Object in Linear Motion	$\frac{M}{4} \left(\frac{V \ell}{\pi \times N_M} \right)^2 = \frac{M}{4} \left(\frac{P}{\pi} \right)^2$
Unit	kg × m ²
Inertia Torque During Deceleration	$J_M = \left(\frac{J \ell}{N_M} \right)^2 \times J \ell$

ρ : thickness
L: Cylinder Length(m)
D: Cylinder Diameter(m)
M: Load Mass(kg)
 $V \ell$: Linear Velocity (m/min)
NM: Motor Speed (rpm)
P: Load Displacement per Motor Revolution
Nℓ: Directional Feed Rate from Rotationa Speed
Jℓ: Load Di rectional l nertia Torque
JM: Motor Directionallnertia Torque

Table 1.5.1 Load Inertia Torque Conversion

Re-circulation Method	Specification		Characteristic
	Single Nut	Double Nut	
Internal circulation	SFK		● Compact outer diameter ● Recommended for small-lead applications
	SFNU	DFNU	
	SFU	DFU/OFNU	
	SFI	DFI	
	SFNI	DFNI/OFNL	
External circulation	SFB	DFB	● Economy Series ● Engineered for large-lead, high-load applications
	SFBH	/	
End-plug circulation	SFS	DFS	● Silent-High Speed Series ● Suitable for high-speed feed applications
	SFY	/	
	SFE	DFE	
	SFA	/	

1-6 Ball Screw Nut Selection ④

1-6-1 Nut Selection

Nut Series

Selecting the appropriate nut type based on comprehensive consideration of precision, dimensions, flange configuration, and lead time

Recirculation Method

Ball recirculation methods can be categorized as internal recirculation, external recirculation, End-plug recirculation, etc., each with distinct advantages and disadvantages that must be selected according to application requirements.

Steel Ball Circuit Rank

Variations in the circuit tie r count significantly impact the nut's load capacity, noise generation, and service life.

Flange Configuration

Flange configuration shall be determined based on the actual spatial constraints of the installation Interface, including round, single-cropped, Double-cropped, and quad-cropped types.

Oil Filler Port

Applying appropriate lubricant (oil/grease) to the nut significantly enhances ball screw smoothness, ensures long-term precision retention, and extends service life.

1-6-2 Nut Configuration

K. NU. NI Type Nut

Internal circulation Nut: Ball bearings travel along the deflector raceway, diagonally climb over the screw thread crest, and return to the cycle origin. One revolution completes a single circuit, while a single nut typically integrates 3-6 discrete circuits as illustrated in Fig 1.6.1. This design is optimized for compact models with small leads

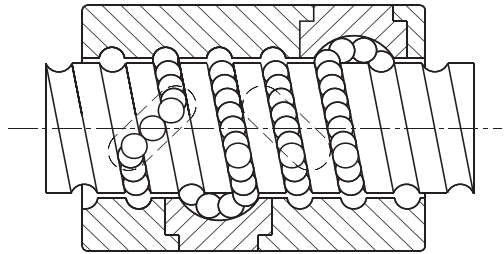
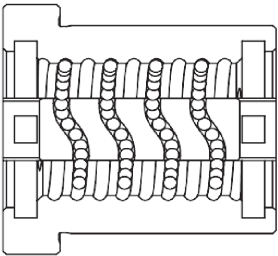


Fig. 1.6.1 Internal Circulation

Table 1.6.2

Specifica tion	Characteristic	Advantage	Deficiency
SFU DFI SFK	● Compact outer diameter ● Optimized for small leads ● DN value 70,000	● Optimized for slow-speed reciprocating motion ● Metal deflector resists impact loads ● Withstands 120° C operating temperatures	● High-speed traverse ● Complex deflector machining



Y.E-Type Nuts:

This circulation design shares similarities with S-type nuts. While retaining the advantages of S-type circulation, it incorporates thin yet resilient end seals that enhance scraping effectiveness. The reinforced return path structure significantly boosts rigidity and high-speed performance. As shown in Fig. 1.6.2 (right)

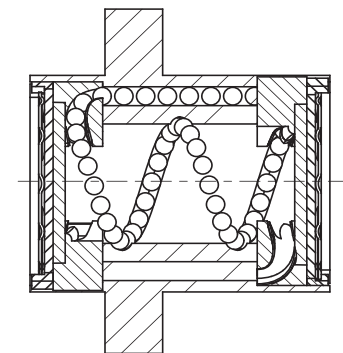


Fig. 1.6.2

Table 1.6.3

Specifica tion	Characteristic	Advantage	Deficiency
SFY SFE	Dual- Start Nuts for High- Speed Traverse & Ex- treme DN Values	• High-Speed, • High- Load Per- formance • DN value 120, 000	• Premium Lubrication • Precision- Controlled Preload



A、 S、 Type Nut

A and S-type nut operates through precision steel balls rolling along the helical grooves between the screw shaft and nut body. These balls are continuously recirculated via dedicated return channels integrated at both ends of the circulator. (Fig. 1.6.3) The circulative system operates identically to E-Type nuts, featuring a helical ball trajectory aligned with the screw thread direction. This design, combined with acoustic-damped end caps and integrated dust seals, reduces operational noise Furthermore, the S-type nut achieves a reduction in installation envelope compared to conventional designs. This compact architec- ture, combined with precision-circulation dynamics, makes it ideal suited for high-speed, light-load applications.

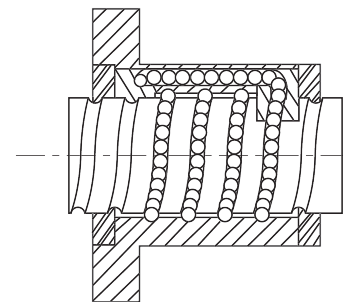
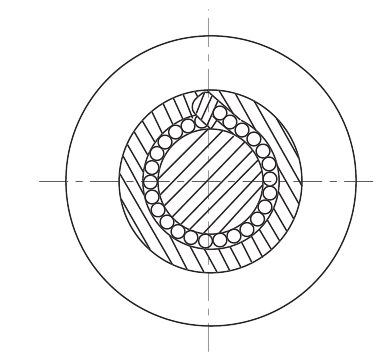


Fig. 1.6.3

Table 1.6.3

Specificati on	Characteristic	Advantage	Deficiency
SFS DFS	• Silent High- Speed Series • High- Speed Translation Com- patible	• Reduced Operat- ing Noise • Compared to Standard Models	• Outer Diame- ter to Lead Ra- tio = 1:1 • Requires En- hanced Lubrca- tion Efficiency



Note:

RRegarding DN values, dust prevention devices, surface treatment, etc, please refer to Table 5.1.1 on Page 52. Please refer to pages 79, 80, 81, and 82 for the outer diameter and nut size tables of each screw.



1-7 Ball Screw Rigidity Design ⑤

The rigidity of ball screw directly governs their positioning accuracy. This consequently affects the over- all system's positioning precision, leading to effect including machining position loss during cutting opera- tions. Therefore, integrated rigidity design of all constituent components is imperative.

1-7-1 Rigidity (K)

Axial Elastic Deformation and Rigidity Calculation Formulas for Lead Screws

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

P: Axial Load on Ball Screws (kgf)

E: Axial Elastic Deformation of Ball Screws (mm)

$$\frac{1}{K} = \frac{1}{K_s} \times \frac{1}{K_N} \times \frac{1}{K_B} \times \frac{1}{K_H} \text{ (mm/kgf)}$$

K_s: Axial Rigidity of Ball Screws (1)

K_B: Axial Rigidity of Ball Screws (3)

K_N: Axial Rigidity of Ball Screws (2)

K_H: Axial Rigidity of Ball Screws (4)

Axial Rigidity K_s and Deformation es δ of Ball Screws

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

P: Axial Load on Ball Screws (kgf)
Fixed-Fixed Mounting Configuration

$$\delta \text{ SF} = \frac{PL}{4AE} \text{ (mm)}$$

$$\delta \text{ SS} = \frac{PL_0}{AE} \text{ (mm)}$$

$$\delta \text{ SS} = 4 \delta \text{ SF}$$

δ SF: Axial Deformation in Fixed-Fixed Mounting Configuration

δ SS: Axial Deformation in Alternative Mounting Configurations

A: Root Cross-Sectional Area of Screw Shaft (mm²)

E: Young's Modulus (Longitudinal Elastic Modulus) = 2.1×10⁴ kgf/mm²

L: Mounting Span (mm)

Lo: Load Application Point Span (mm)

1-8 Positioning Accuracy of Ball Screw ⑥

1-8-1 Selection of Lead Accuracy for Ball Screw

The primary factors affecting the feed accuracy of ball screw systems include: lead accuracy, preload, and axial rigidity of the feed system. Other factors such as thermal deformation induced by temperature rise effects and insufficient mounting precision must also be considered.

☆ Selection of Lead Accuracy for Different Equipment Types

Select appropriate lead accuracy based on positioning accuracy requirements for different applications; Table 1.8.1 provides recommended values for various equipment types.

Table 1.8.1 Selection of Lead Accuracy for Different Applications

Application				Accuracy grade						
				C0	C1	C2	C3	C5	C7	C10
CNC Machinery Tools	Lathes	X		○	○	○	○	○	○	
		Z					○	○	○	
	Milling machines	XY		○	○	○	○	○	○	
		Boring machines Z			○	○	○	○	○	
	Machine Center	XY		○	○	○	○			
		Z			○	○	○			
	Jig borer	Y	○	○						
		Z	○	○						
	Drilling machine	XY				○		○	○	
		Z						○	○	
	Grinder	X	○	○	○	○	○	○	○	
		Z		○	○	○	○	○	○	
	EDM	XY		○	○	○	○	○	○	
		(Z)			○	○	○	○	○	
Semiconductor equipment	Wire cut EDM	XY		○	○	○				
		UV		○	○	○	○	○	○	
	Punching Press	XY					○	○	○	
	Laser Cutting Machine	XY					○	○		
		Z					○	○		
	Wood working Machine						○	○	○	○
	Single Purpose Machine					○	○	○	○	○
	Exposure Equipment			○	○					
	Chemical Treatment Unit						○	○	○	○
	Wire Bonder				○	○	○			
	Flying Probe Tester			○	○	○	○			
	Auto-insertion Machine					○	○	○	○	
Industrial Robots	PCB Drilling Machine				○	○	○	○	○	
	Cartesian Coordinate Robo				○	○	○	○	○	
								○	○	○
	Vertical Articulated Robot					○	○	○		
Other	Cylindrical Coordinate Robot					○	○	○	○	
	Raw Material Processing							○	○	○
	Injection Molding Machine							○	○	○
	Coordinate Measuring Machine			○	○	○				
	Office Equipment							○	○	○
	Machine Vision System			○	○					
Nuclear Power	Control Rod						○	○	○	
	Kinetic Energy Damper								○	○
	Aviation Equipment						○	○		

1-8-2 Temperature Control for Lead Accuracy

A) Thermal Deformation

◎Heat-induced thermal

1-Heat generation is inherently unavoidable during ball screw operation. Due to thermal expansion and contraction, the screw fails to achieve required positioning accuracy. The specific thermal elongation of the screw induced by heating can be calculated using the following formula.

$\Delta L = \alpha \times \Delta t \times L$ - - - - - Formula 1.8.2

ΔL : axial elongation of the screw

α : Coefficient of Thermal Expansion (CTE)

Δt : Temperature variation of the screw (ΔT) C°

L : Effective Thread Length

2-Per 1°C temperature rise, the ball screw shaft elongates by 12μm per meter of length. This thermal deformation directly undermines positioning accuracy—even high-precision screws suffer degraded performance due to heat-induced distortion. When operating at high speed or under preload, temperature rise accelerates and thermal displacement increases significantly. Consequently, implementing countermeasures to suppress temperature increases is imperative.

3-Thermal Control Measures for Ball Screws

● Optimize preload force

Control preloading force on ball screws and angular contact bearings to minimize frictional heat generation

● Increase lead size to reduce rotational speed
Select larger screw leads to lower operating RPM while maintaining feed rate.

● Select appropriate lubricant with optimized volume
Choose lubricants compatible with operating conditions and maintain proper replenishment cycles

● Implement external cooling
Apply lubricating oil or cooling air to screw shaft surfaces

● Utilize internal cooling
Circulate coolant through hollow screw shafts for core temperature reduction

4-Mitigation Strategies for Thermal Displacement Effects

● Execute equipment warm-up protocol
Idle-run machinery until thermal equilibrium is achieved before operation

● Implement pre-tensioned screw installation
Apply axial pre-stretch to compensate for thermal expansion trajectories

● Apply real-time thermal compensation
Program control systems with temperature-derived position offset algorithms

● Deploy closed-loop position feedback
Integrate linear encoders or laser interferometers for actual position verification

B) Pre-tension

©Heat-induced thermal

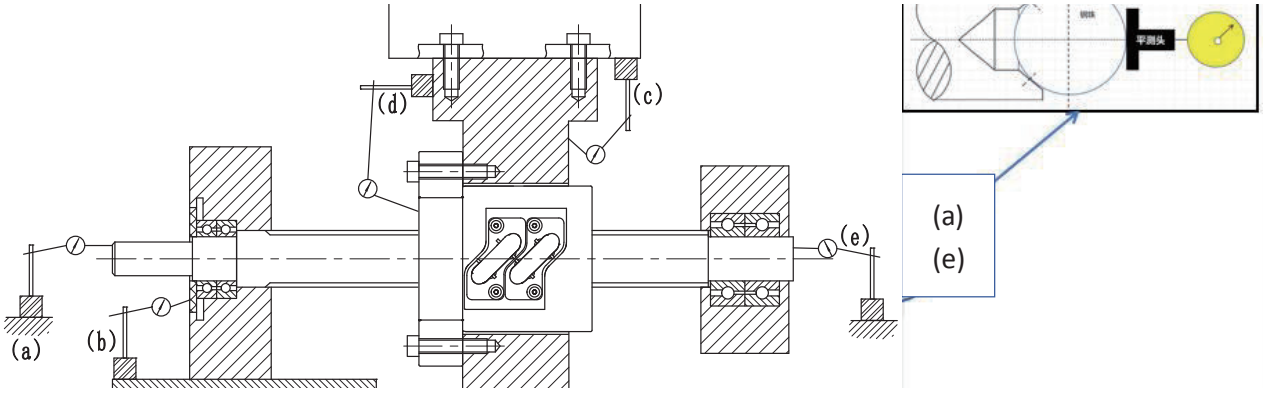


Figure 1.8.1

©Pre-stretch Simplified Procedure:

- Mount dial indicators at both ends of the screw shaft
- Level the screw to eliminate gravitational sag
- Tighten locking nut at fixed-end bearing block
- Tighten locking nut at pre-stretch end
- Verify dial reading displacement at fixed end
- If fixed-end dial shows no change: Continue tightening until reaching predetermined value

Thermal Deformation & Preload Calculation

1. Thermal Displacement

Calculations:

$\Delta L = p \cdot \theta \cdot L$ ----- Formula 1.8.3

ΔL : Thermal Displacement (mm)

p : Coefficient of Thermal Expansion: 12×10^{-6} m/m·°C

θ : Average Temperature Rise of Screw Shaft (°C)

L : Screw Shaft Length (mm)

2. Preload

Calculations:

$F = \Delta L \cdot K_s$ ----- Formula 1.8.4

K_s : Ball Screw Rigidity (kgf/μm) $K_s = \frac{\pi d^3 E}{4L}$ F :

Preload (kgf)

d : Ball Screw Root Diameter (mm)

E : Elastic Modulus of Steel (2.1×10^4 kgf/mm²)

■ Revise the target pitch value on the ball screw drawing with thermal error compensation (T+E) based on lead error measurements taken by laser equipment after thermal stabilization.

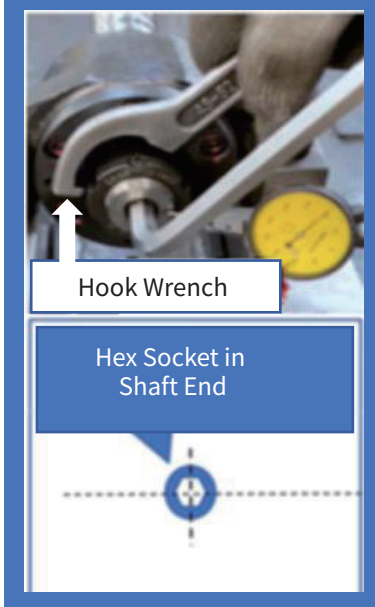


Figure 1.8.1

1-9 Ball Screw Life Calculation ⑦

1-9-1 Ball Screw Service Life

Ball Screw Life refers to the operational period during which a ball screw, under normal operating conditions, eventually fails due to spalling phenomena or wear-induced loss of accuracy. This duration is categorized as either Fatigue Life or Accuracy Life, depending on the failure mechanism

Basic Static Axial Load Rating (C_{0a})

The Basic Static Axial Load Rating (C_{0a}) of a ball screw is defined as the static load value at which the total plastic deformation at the maximum contact stress point between the balls and raceways reaches 0.0001 times the ball diameter, occurring under static or low-speed operating conditions ($n \leq 10$ rpm).

Basic Dynamic Axial Load Rating (C_a)

The Basic Dynamic Axial Load Rating (C_a) is defined as the maximum constant-magnitude axial load, unchanging in direction, that can be sustained by a group of identical ball screws from the same production batch operating under identical conditions for 1 million revolutions, where 90% of the units exhibit no surface fatigue spalling.

$$L^\alpha = \left(\frac{1}{P} \right)^3$$

L : Life
P : Axial Load

Average Load P_e

When the axial load varies over time, the mean load for equivalent fatigue can be calculated using the following formula.

$$P_e = \left(\frac{P_1^3 n_1 t_1 + P_2^3 n_2 t_2 + \dots + P_n^3 n_n t_n}{n_1 t_1 + n_2 t_2 + \dots + n_n t_n} \right)^{\frac{1}{3}} \text{ (kgf)}$$

Axial Load(kgf)	Rotational Speed (rpm)	Rotational Speed (%)
P ₁	n ₁	t ₁
P ₂	n ₂	t ₂
⋮	⋮	⋮
P _n	n _n	t _n

But $t_1 + t_2 + t_3 + \dots + t_n = 100$

Table 1.9.1 Theoretical lifespan for various purposes

Application	Life (h)
Machine Tool	20000
Machinery Equipment	10000
Automation Equipment	15000
Measuring Equipment	15000

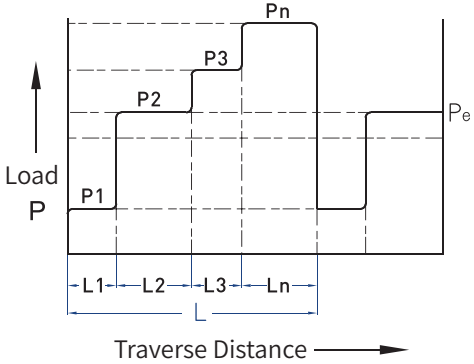


Figure 1-9-1

$$P_e = \frac{2P_{\max} \times P_{\min}}{3} \text{ (kgf)}$$

P_{max}: Maximize Axial Load (kgf)
P_{min}: Minimum Axial Load (kgf)

Table 1.9.2 Load Factor

Shock and Vibration in Reciprocating Motion	Speed (V)	fw
Minute	Creep Traverse Rate	1 ~ 1.2
	$V \leq 0.25\text{m/s}$	
Small	Low Traverse Rate	1.2 ~ 1.5
	$0.25 < V \leq 1\text{m/s}$	
Middle Traverse Rate	Middle Traverse Rate	1.5 ~ 2
	$1 < V \leq 2\text{m/s}$	
Big	High Traverse Rate	2 ~ 3.5
	$V > 2\text{m/s}$	

Load varies sinusoidally (as shown in Figure 1.9.2)

$Pe \hat{=} 0.65P_{max} \dots\dots (Fig\ 1)$

$Pe \hat{=} 0.75P_{max} \dots\dots (Fig\ 2)$

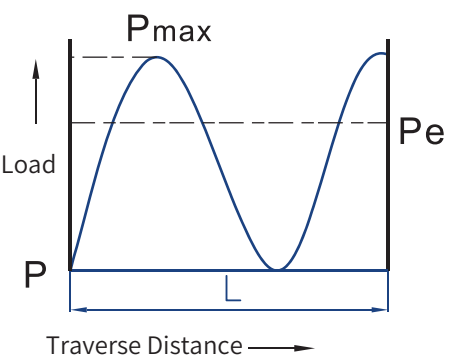


Fig 1

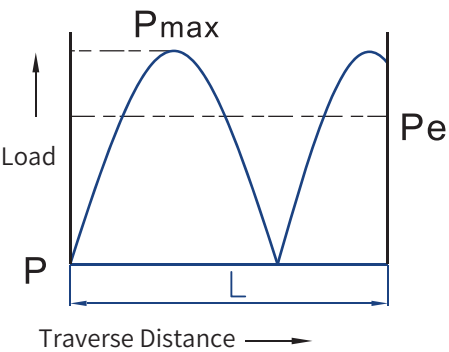


Fig 2

Life Calculation

Formula 1.9.1

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

L: Rated Fatigue Life (rev)
Ls: Traverse Distance Life(km)
Pa: Axial Load(kgf)

Formula 1.9.2

$$Lt = \frac{L}{60n}$$

fw: Load Factor(Operating Condition Factor)
Lt: Lift Time (h)
Ca: Basic Dynamic Load Rating (kgf)

Formula 1.9.3

$$Ls = \frac{L \times \ell}{10^6}$$

n : Rotational Speed (rpm)
 ℓ : Lead (m)

Table 1.9.3 Safe Fctor

Equipment	Load Condition	Minimum of fs
Machine Tool	Normal Operation	1.0 ~ 1.3
	Presence of Shock and Vibration	2.0 ~ 3.0
General Machinery	Normal Operation	1.0 ~ 1.5
	Presence of Shock and Vibration	2.5 ~ 7.0

Required Dynamic Load Rating(Ca)
 $Ca = Pe \times fs$

Required Static Load Rating(Coa)
 $Coa = P_{max} \times fs$

1-9-2 Ball Screw Life Calculation Example

(I) Introduction to SVB1160 CNC machining center machine

1. Main structural features

The SVB1160 vertical machining center adopts a vertical frame layout. The column is fixed on the bed and the spindle box moving up and down (in the Z direction) along the column and the sliding seats moves longitudinally along the bed (Y direction) and the worktable moves laterally along the slide (X direction).

Linear guide rails are used for all three axes, and rolling friction is used instead of sliding friction enables faster movement speed and meets the requirements of high speed and precision. The spindle can achieve continuously variable speed within its speed range, using built-in motor coding machine control to achieve spindle orientation and rigid tapping function.



Figure 1-9-2-1 SVB 1160Outline and Internal Structure Diagram

2. Scope of use

It is specially suitable for precision cutting, high-speed, and large-scale processing of non-ferrous metal parts in industries such as general machinery, engineering machinery, and medical equipment.

3. Main design parameters of the machine tool

Table 1.9.4

	Worktable size	mm	600×1360
	T-slot(N×W×D)	mm	5×18×100
	X axis travel	mm	1160
	Y axis travel	mm	620
	Z axis travel	mm	620
	Distance from spindle center to column front	mm	663
	Distanca from spindle end to worktable	mm	150~770
	L×W×H	mm	3740×2620×2930
	Max. load bearing of worktable	kg	900
	Machine weight	kg	700

Table 1.9.5 Processing center parameters

Travel	X axis travel	mm	1100
	Y axis travel	mm	600
	Z axis travel	mm	600
	Distance from spindle center to column front	mm	130-730
	Distance from spindle end to worktable	mm	650
Work table	Worktable size	mm	1200×600
	Max. Load bearing of Worktable	kg	600
	T-slot	mm	5*18
Spindle	Main motor power	kw	11
	Spindle		8740
	Outside Diameter	mm	150
	Spindle Speed	rpm	8000
	Pull Studs		MAS-P40T-1
Feed rate			
	Pulling force		8KN
Feed rate	X \ Y \ Z axis	m/min	24/24/20
	Cutting feed rate	mm/min	1-12000
Accuracy	positioning accuracy	mm	±0.008/300
	Repetitive positioning accuracy	mm	±0.006
Other	Machine weight	kg	7300
	Machine tool dimensions	mm	3200×2500×2800

Table 1.9.6 Design Parameter Table

Spindle	Spindle Speed	8000rpm
	Speed selection	Full range programmable
Rapid traverse speed	X axis :	24 m/min
	Y axis :	24 m/min
	Z axis :	20 m/min
Machine tool positioning accuracy	Positioning accuracy	±0.008/300mm
	Repetitive positioning accuracy	±0.006mm

(II) Selection analysis

Known conditions: Based on the usage of the SVB1160 CNC vertical machining center, its known X-axis design conditions are as follows:

1 Working conditions

Table 1.9.7 Working conditions

Installation method	■ Horizontal		Vertical		
Positioning accuracy: ±δ2	6	μm	Repetitive positioning accuracy: ±δ1	8	μm
300mmPositioning accuracy: ±δ300	8	μm			
Control system:	Semi closed loop system				

2 Operating conditions

Table 1.9.8 Operating conditions

Operating conditions	■ Time proportion method		□ The maximum value method	
Work condition serial number	Axial load(N)	Radial load(N)	feed rate(m/min)	Time proportion(%)
Work condition 1	6000		0.44	80
Work condition 2	0		16	20

3 working parameters

Table 1.9.9 working parameters

Workbench weight : m1	100	kg		Workbench weight : m2	120	kg
Traveler : L	1100	mm		Maximum moving speed of workbench :	24	m/min
Distance between support points: ls	1403	mm		Transmission ratio: l	1	
Maximum acceleration: a	1	M/s2				
Maximum speed of screw: Nmax	2000	R/min				
Working table dynamic friction coefficient : μ	0.01			Working table dynamic friction coefficient : μ	0.02	

4 Design Requirements

Table 1.9.10 Design Requirements

Mileage lifespan :	/	km	Expected lifespan : Lh	23000	h
Accuracy coefficient : fa	0.9		Reliability coefficient : fc		
Static safety factor : fs			Pre load factor : fe	4.5 (Medium preload)	
Load factor : fw	1.5 (Slight impact)		Pre load percentage: %	0.075 (Medium preload)	

(III) Preliminary selection

The process of determining the basic parameters when selecting the X-axis ball screw pair is as follows: SVB1160 CNC vertical machining center positioning accuracy $\pm 0.008/300\text{mm}$, The cutting force is not significant. Applied to the general machinery industry, mainly for cutting parts. Belonging to high-speed and economical CNC machining centers. Choose a connection method with fixed ends for work conditions and product positioning. This structural form elongates through the reserved gap when the screw generates heat during operation. In situations of high precision and speed, it has a high cost-effectiveness. It is a typical structure of a high-speed economical vertical processing center machine.

1. Selection of accuracy level

Given the effective travel of the thread $L_u=1100\text{mm}$ (assuming a nut length of 200), according to the GB/T 17587.3 standard P3 level accuracy= $\pm 0.024/1100\text{mm}$.

According to the accuracy level table of ball screw pairs differentiated by usage, for CNC machining centers, the accuracy of XYZ axis screw pairs is generally selected as P1 to P3.

The final choice is P3 level accuracy.

2. Determine the minimum lead

According to the maximum speed $N_{\max}$ of the motor and the maximum speed $V_{\max}$ of the worktable, it can be calculated :

$$P_{\text{hmin}} = \frac{V_{\max}}{N_{\max}} = 11\text{mm} = 24 \times 1000 / 2000 = 12\text{mm}$$

3. Determine the type of ball screw pair

Due to the fast forward speed of 24m/min on the X-axis, we have chosen an end plug ball screw pair that is more suitable for high-speed use environments (see Figure 9-2 and Figure 9-3):

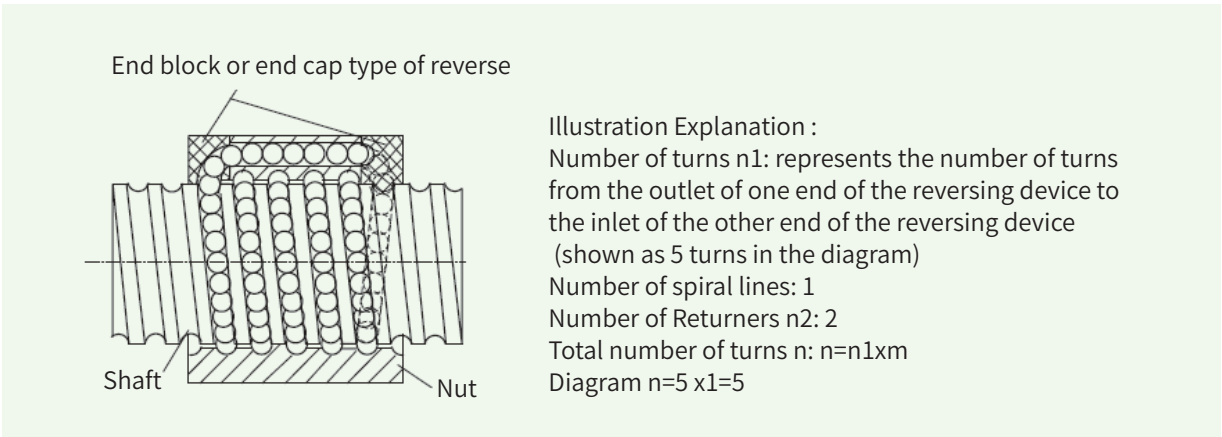


Figure 1-9-2-2 Schematic diagram of end block ball screw pair structure

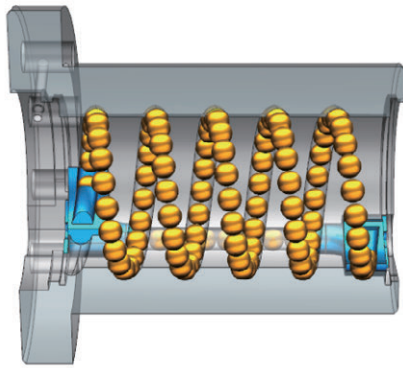


Figure 1-9-2-3 3D diagram of end block reverse structure

This product has the following characteristics:

- High speed. Adopting a special reversing structure to enhance the strength of the reversing structure and meet the requirements of high DN values, this type of screw pair has been tested and found to have a DN value of up to 120000.

- High acceleration. Optimize the reverse circulation structure, reduce the impact of ball bearings on the reverse circulation structure, and achieve instantaneous high acceleration.

Based on the above characteristics, this type of product is widely used in high-speed and high-precision machines such as CNC lathes, vertical machining centers, and horizontal machining centers.

So, the type of X-axis ball screw pair is determined to be an end block high-speed precision ball screw pair, namely DC type. (DFDC X R4012-D1-S-D-PA)

4. Determine the pre tightening type of ball screw pair

The pre tightening method of the X-axis ball screw pair adopts double nut spacer pre tightening, with a simple and reliable structure, good rigidity, and is most suitable for high-speed light load machine tools, which is the most economical.

5. Determine the nominal diameter of the ball screw pair

There are two ways to determine the nominal diameter of a ball screw pair:

- 1) The nominal diameter of the ball screw pair directly affects the rated dynamic load of the ball screw pair. Therefore, we can start from the minimum rated dynamic load of the selected screw pair to determine its nominal diameter range.

- 2) The nominal diameter of the ball screw pair also directly affects the rigidity of the ball screw, so we can also consider the expected rigidity of the selected screw pair to determine its nominal diameter range.

5.1 Determine the nominal diameter range through the minimum rated dynamic load

Firstly, perform force calculation to determine the equivalent speed N_m and equivalent load F_m . According to $P_{\text{hmin}}=11\text{mm}$, the initial lead of the ball screw pair is 12mm.

According to the operating conditions (see Table 9-3), the following can be obtained:

Equivalent speed:

$$N_m = n_1 \times \frac{t_1}{100} = n_2 \times \frac{t_2}{100} = 296 \text{ r/min}$$

Equivalent load:

$$F_m = \sqrt[3]{\frac{F_1^3 n_1 \frac{t_1}{100} + F_2^3 n_2 \frac{t_2}{100}}{N_m}} = 843 \text{ N}$$

Note 1: Due to the use of linear guides in this machine tool, the frictional force caused by radial loads is very small, so it is ignored in this calculation.

Note 2: Due to the small acceleration of the machine tool, the load generated by acceleration is ignored.

Next, determine the minimum rated dynamic load of the X-axis screw pair. The rated dynamic load of the ball screw pair directly affects its service life, so it can be expected that determining the minimum rated dynamic load based on the lifespan. Additionally, for ball screw pairs with preloading, the minimum fixed motion must be determined by the maximum axial load.

Estimate the minimum rated dynamic load based on expected lifespan

$$C_{am} \geq \sqrt[3]{60 N_m L_h} \cdot \frac{F_m f_w}{100 f_a f_c} = 10.4 \text{ KN}$$

Among them,

L_n is 23000h;

f_a is the accuracy coefficient, and P3 is taken as 1, as shown in Table 9-6;

f_c is the reliability coefficient. As it is a high-speed and economical CNC machining machine, the reliability is selected based on the most economical 90%. Here, 1 is taken, as shown in Table 9-7;

f_w is the load factor, which is slightly impacted during processing. Here, it is taken as 1.5, as shown in Table 9-8.

Table 1.9.11 Accuracy coefficient table

Accuracy Grade	1,2,3	4,5	7	10
f_a	1.0	0.9	0.8	0.7

Table 1.9.12 Reliability coefficient table

Reliability	0.90	0.95	0.96	0.97	0.98	0.99
f_c	1	0.62	0.53	0.44	0.33	0.21

Table 1.9.13 Load factor table

Load factor	No impact (very stable)	Slight impact	Accompanied by impact or vibration
f_w	1~1.2	1.2~1.5	1.5~2

Estimate the minimum rated dynamic load based on the maximum axial load

$$C_{am} \geq f_e F_{\max} = 8.2 \text{ KN}$$

$$F_{ma} = F + \mu \cdot (m_1 + m_2) \cdot g \approx 1822 \text{ N}$$

Among which,

f_e is the preload coefficient, and since vertical loading generally adopts medium preload (see Table 9-9), it is taken as 4.5 here (see Table 9-10).

F is the axial force (see Table 9-3), the weight of the worktable is m_1 , the maximum mass of the work-piece fixture is m_2 , and the dynamic friction coefficient of the worktable is (see Table 9-4).

Table 1.9.14 Recommendation Table for Pre tightening Force

Preloading	Application occasions
Light preloading	Electric machining machines (EDM, wire cutting), electronics industry, robots, semiconductor equipment, medical devices, experimental instruments, testing equipment
	Non machine tool industry
Medium preloading	Vertical M/C, horizontal M/C, CNC lathe
Heavy preloading	Heavy duty machine tools such as floor boring, Gartry boring and milling machines, large vertical lathes, gear machining machines, etc

Table 1.9.15 Preloading coefficient f_e

Preload type	Light preloading	Light preloading	Heavy preloading
f_e	6.7	4.5	3.4

Table 1.9.16 Rated dynamic load screening table

Specification	Rated dynamic load	Request dynamic load	whether it complies with
May-12	56.1 KN	$\geq 10.4 \text{ KN}$	✓
May-12	63.3 KN		✓
May-12	70.4 KN		✓

From this, it can be concluded that the rated dynamic load of the selected lead screw should meet the following requirements based on the parameters of the DFDC type in the sample (see Table 9-11):

Table 1-9-16 Rated Dynamic Load Screening Table

One of the three specifications of the X-axis ball screw pair can be determined by the minimum rated dynamic load.

5.2 Determine the nominal diameter range through the minimum rigidity of the screw

The maximum allowable axial deformation of the lead screw, δ_m , should simultaneously meet the following requirements:

$$\delta_m \leq (1/3 \sim 1/4) \times \delta_1$$

$$\delta_m \leq (1/4 \sim 1/5) \times \delta_2$$

According to the known conditions in Table 9-1, the repeated positioning accuracy is 0.006mm and the positioning accuracy is 0.008mm. Therefore, the minimum value in the two equations above should be taken :

$$\delta_m=4\mu\text{m}$$

The calculation formula for the minimum base diameter is as follows:

$$d_{2min} \geq 2 \times 10 \sqrt{\frac{10F_J \cdot l_1}{\pi \cdot \delta_m \cdot E}} \\ = 0.078 \times \sqrt{\frac{\mu_0 \cdot mg \cdot [(1.05 \sim 1.1) \cdot L_u + (10 \sim 14) \cdot P_h]}{\delta_m}} = 12.1 \text{mm}$$

In the formula, d_{2min} - minimum base diameter (mm);

F_J static friction force (N);

L_1 - maximum distance from the ball nut to the fixed end support of the ball screw (mm);

E - Young's modulus of elasticity ($2.1 \times 10^5 \text{N/mm}^2$);

μ_0 - static friction coefficient. (See Table 9-4); M - Quality of workbench and workpiece fixtures, $m=m1+m2$. (See Table 9-4).

So, by determining the minimum rigidity of the screw, it can be determined that all three specifications in Table 11 can meet the requirements.

6 Preliminary verification

DDue to $L_u=1100\text{mm}$, the total length of the screw is generally above 2200. At this time, for ball screw pairs with diameters of 32 and 40, the aspect ratio is close to or exceeds 60 times. According to relevant host design experience, an excessively large aspect ratio can cause sagging problems when using ball screw pairs, limit the rapid movement, and result in vibration during high- speed rotation. Therefore, the maximum speed verification is first carried out for diameters 32, 40, and 50.

6.1 3212 specification

$$n_{cr} = \lambda_2 \cdot \frac{d_1}{l_{cr}^2} \cdot 10^7 = 903 \text{r/min}$$

Table 1.9.17 Critical speed coefficient

Installation method	
Fixed - Free	3.4
Support - Support	9.7
Fixed - Support	15.1
Fixed - Fixed	21.9

In the equation,

N_{cr} critical speed (rad/min);

D_1 - screw base diameter=26.4mm;

λ_2 - coefficient related to installation spacing (see Table 9-12);

L_{cr} - distance of screw support point=1403mm.

Due to $N_{max} \geq n_{cr}$, the critical speed verification of 3212 specification is not qualified.

$$n_{cr} = \lambda_2 \cdot \frac{d_1}{l_{cr}^2} \cdot 10^7 = 1177 \text{r/min}$$

6.2 4012 specification

In the equation,

N_{cr} critical speed (rad/min);

D_1 - Screw base diameter=34.4mm;

λ_2 - coefficient related to installation spacing (see Table 9-12);

L_{cr} - distance of screw support point=1403mm.

Due to $N_{max} \geq n_{cr}$, the critical speed verification of 4012 specification is qualified.

$$n_{cr} = \lambda_2 \cdot \frac{d_1}{l_{cr}^2} \cdot 10^7 = 1503 \text{r/min}$$

6.3 5012 specification

In the equation,

N_{cr} critical speed (rad/min);

D_1 - screw base diameter=44.4mm;

λ_2 - coefficient related to installation spacing (see Table 9-12);

The distance between the l_{cr} screw support point is 1403mm. Due to $N_{max} \geq n_{cr}$, the critical speed verification of the 5012 specification is qualified.

(IV) Performance verification

According to 6.1, 6.2, and 6.3, the final selected ball screw pair specification is DFDC4012-D1. Then perform performance verification on it. The verification process is as follows below:

1 Pre tightening force

(1) $F_p = \frac{1}{3} F_{max} = \frac{1822}{3} = 607.3 \text{N}$.

(2) Due to the low cutting force of the machine tool, it is not recommended to use too much pre tightening force. Therefore, it is recommended to use 5% $Ca=2600\text{N}$, choose the one with the larger preload force of 2600N.

2-way compensation and pre tension force

For closed-loop systems, the use of ball screw pairs with fixed end structures generally considers stroke compensation and pre tension.

3 Stiffness verification

Minimum compressive stiffness of screw:

$$R_{smin} = 165 \cdot \frac{d_c^2}{l_{smax}} = 166 \mu\text{m/N}$$

In the equation,

R_s - Tensile and compressive stiffness of the screw ($\mu \text{ m/N}$);

L_s - the distance from the nut to the fixed end (mm), and the minimum stiffness occurs when the dis-

tance between the nut and the fixed support end is maximum; when the distance between the nut and the fixed support end is minimized, it becomes maximum rigidity;
 $d_c = D_{pw} - D_w \cdot \cos \alpha$ - Bottom diameter of contact point of ball screw (mm);
The maximum compressive stiffness of the screw is:

$$R_{s\max} = 165 \cdot \frac{d_c^2}{l_{s\min}} = 5400 \mu m / N$$

The maximum system stiffness of the ball screw using the simplified algorithm proposed for optimizing design selection is:

$$R_{\max} \approx \frac{R_{s\max}}{3} = 1800 N / \mu m$$

The minimum system stiffness is:

$$R_{\max} \approx \frac{R_{s\max}}{3} = 55 N / \mu m$$

Minimum system stiffness required by design

$$R_0 \approx \frac{1.6 \mu_0 \cdot mg}{\delta_1} = 440 N / \mu m$$

In the equation,
 μ_0 - static friction coefficient. (See Table 9-4;)
M - Quality of workbench and workpiece fixtures. $m = m_1 + m_2$. (See Table 9-4;)
In summary, $R_{\min}$ is greater than R_0 , therefore the stiffness check is qualified.

4 Accuracy verification

$$\delta_k = \mu_0 mg \left(\frac{1}{R_{\min}} - \frac{1}{R_{\max}} \right) = 0.02 \times 220 \times 9.8 \times \left(\frac{1}{55} - \frac{1}{1800} \right) \approx 0.76 \mu m$$

For the validation of closed-loop control systems:
 $e_p = 16 \mu m \leq 0.8(\delta_2 - \delta_k) = 0.8 \times (60 - 0.76) = 47.4 \mu m$
 δ_2 - Positioning accuracy, (see Table 9-2).
Accuracy verification is qualified.

5 Critical compression load verification

$$F_c = K_1 K_2 \frac{d_2^4}{l_s^2} \times 10^5 \geq F'_{\max} = \frac{1}{3} \times 4 \times \frac{44.4^4}{2000^2} \times 10^5 \approx 117500 N > 1822 N$$

K_1 - Safety factor (see Table 9-13);
 K_2 - Support coefficient (see Table 9-14);
 L_s - The distance between the screw support points is 2100mm.

Table 1.9.18 Safety factor table

Safety factor	Vertical installation	Horizontal installation
K1	0.5	0.33

Table 1.9.18 Safety factor table

Supporting type	Fixed - Support	Support - Support	Fixed - Free	Fixed - Fixed
K2	2	1	0.25	4
Ks	2.5	1	0.125	5

Therefore, the critical compression load verification is qualified.

6 Critical speed verification

3.6.3 Verified and qualified.

7 DN value verification

After calculation:
 $(d_2 + D_w) \cdot n_{\max} \leq DN_0 = 50.8 \times 1333 = 67716 \leq DN_0 = 150000$
Therefore, the DN value verification is qualified.
 d_2 - Bottom diameter of ball screw pair thread
 D_w -- Ball diameter

(V) Life Calculation

$$L = f_c \left(\frac{C_a}{F_m f_w} \right)^3 \cdot 10^6 = 70432 \times 10^6 \text{ convert to } L_t = \frac{L}{60n} = 4 \times 10^6 \text{h}$$

In the formula,
L - rated fatigue life, unit: r;
 F_c - reliability coefficient, see Table 9-7, take 1;
 C_a - Basic rated dynamic load, unit: N;
 F_m - equivalent load, unit: N;
 F_w - load factor, see Table 9-8, taken as 1.5;
 L_t - lifespan time, in hours;
N - Rotation speed, unit: r/min.
Note: For CNC lathes used for cutting aluminum alloys, if the machine length is long, due to the limitation of the maximum speed, the lead screw is generally chosen to be thicker, so the theoretical lifespan is far exceeds actual needs.

(VI) Selection Conclusion

In summary, the DFDCXR4012 ball screw pair meets the selection requirements for the X-axis ball screw pair in this CNC machining center. Therefore, the final X-axis screw selection result is DFDCXR4012-D1-G1619/1373-P2C3.

(VII)Final drawing

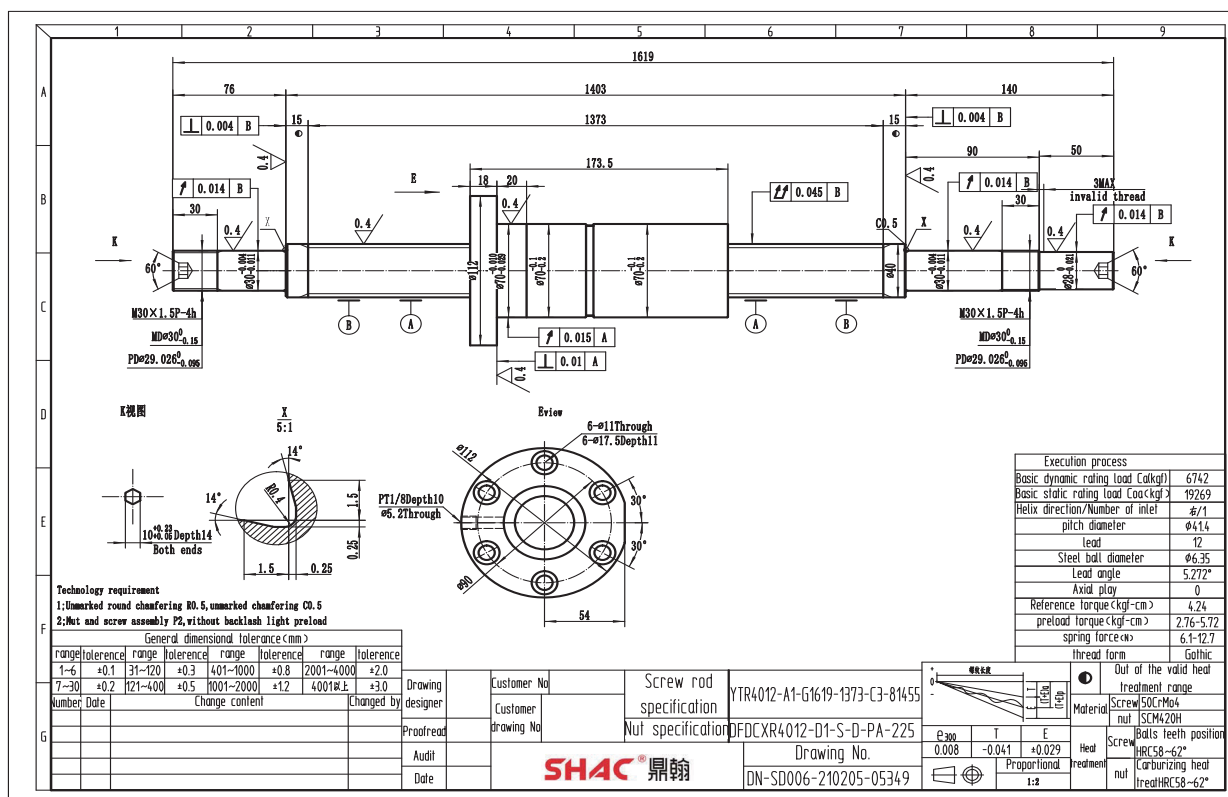


Figure 1-9-2-4 Overall Design Drawing

Refer to DFDCXR4012-D1 in the selection spectrum parameters of ball screw pairs in Chapter 4, Section 3 for the size of the nut part.

(VIII) Selection of servo motor

1. Friction torque calculation

$$T_{p0} = k \frac{F_{a0} f_h}{2\pi} = \frac{0.05}{\sqrt{\tan \psi}} \cdot \frac{F_{a0} P_h}{2\pi} = 0.556 \text{ Nm}$$

Where:

F_{a0} : Pre load, take 1600N;

P: Lead, take 12mm;

ψ : Lead angle is taken as 4.3° .

$$T_{pmax} = (1.2 \sim 1.5) T_{po} = 1.4 \times 0.556 = 0.78 \text{ Nm}$$

2. Friction resistance torque T_u of supporting bearings and sealing devices

According to the data provided by the ball screw manufacturer, the end face sealing ring is selected to increase the friction torque by about 20%.

$$T_u = 0.2 \times T_{po} = 0.15 \text{ Nm}$$

3. Uniform driving torque of screw

The axial force F_b required for the movement of the workbench is :

$$F_b = \mu \cdot mg = 0.01 \times 220 \times 9.8 = 22 \text{ N}$$

After adding the axial working load F , the total axial load F_a is:

$$F_a = F + F_b = 1800 + 22 = 1822 \text{ N}$$

The driving torque T_1 (Nm) of forward transmission is :

$$T_1 = \frac{F_A P_h}{2\pi n_p} \times 10^{-3} = 4.1 \text{ Nm}$$

4. Driving torque for no-load acceleration

The maximum torque required to accelerate the ball screw pair during horizontal use can be obtained by the following formula:

$$T_2 = J_L \cdot \omega + \frac{F_A P_h}{2\pi n_p} \times 10^{-3}$$

$$J_L = \frac{\lambda}{\lambda - 1} \cdot J_{G1} \cdot i^2 \left[J_{G2} + J_L + J_L + m \left(\frac{P_h}{2\pi} \right)^2 \right]$$

The formula for the inertia of a ball screw is as follows:

$$J_b = \frac{\pi \cdot \gamma}{32} D_4 \cdot L \quad (\text{kg} \cdot \text{m}^2)$$

Given the given conditions, the inertia of the screw is:

$$J_b = \frac{3.14 \times 7.9 \times 10^3}{32} \times 0.05^4 \times 2.3 = 11.1 \times 10^{-3} \text{ Kg} \cdot \text{m}^2$$

Platform load inertia:

$$J_t = 220 \times \left(\frac{12}{2 \times 3.14} \right)^2 = 0.8 \times 10^{-3} \text{ Kg} \cdot \text{m}^2$$

Reduction ratio of 1, direct connection of motor, estimation of coupling moment of inertia

$$J_u \approx 0.3 \times 10^{-3} \text{ Kg} \cdot \text{ m}^2$$

Total inertia of the load, select safety factor:

$$J_L = \frac{\lambda}{\lambda - 1} (J_t + J_b + J_u)$$

$$T_2 = J_L \cdot \omega + \frac{F_b P_h}{2\pi\eta_o} \times 10^{-3} = \frac{3}{2} (11.1 + 0.8 + 0.3) \times 10^{-3} = 18.3 \times 10^{-3} \text{ Kg} \cdot \text{m}^2 = 18.3 \times 10^{-3} \times \frac{6.28 \times 1333}{60 \times 0.25} +$$

$$\frac{22}{2 \times 3.14 \times 0.85} \times 10^{-3} = 10.1 \text{ Nm}$$

Accelerating to 16m/min requires 0.25S.

5 Calculate the load torque (TL)

Calculate the load torque converted for the motor shaft.

$$T_l = (T_{pmax} + T_1 + T_u) \cdot i = 0.78 + 4.1 + 0.15 = 5 \text{ Nm}$$

among which

T_{pmax} : maximum pre tightening friction torque;

T_1 : Constant speed driving torque;

T_2 : Acceleration drive torque.

6. Based on the speed and load torque, preliminarily select the motor

Preliminary selection of Yaskawa SGM7G13A motor (parameters shown in Table 1-9-20):

Table 1.9.20 Motor Parameter Table

Voltage		200V			
Model SGM7B-		03A	05A	09A	13A
Rated output ¹	kW	0.3	0.45		
Rated torque ^{1, 2}	N·m	1.96	2.86		
Instantaneous maximum torque ¹	N·m	5.88	8.92		
Rated current ¹	Arms	2.8	3.8		
Instantaneous maximum current ¹	Arms	8.0	11		
Rated speed ¹	min ⁻¹	1500			
Maximum speed ¹	min ⁻¹	3000			
Torque parameters	N·m/Arms	0.776	0.854	0.859	0.891
rotor inertia	×10 ⁻⁴ kg· m ²	2.48(2.73)	3.33(3.58)	13.9(16.0)	19.9(22.0)

The rotational speed meets the usage requirements, $N_m \geq N$
The rated torque meets the usage requirements, $T_N \geq (T_{pmax} + T_1 + T_U) \cdot i$
The peak torque meets the usage requirements, $T_{NMAX} \geq (T_{pmax} + T_2 + T_U) \cdot i$

1-10 Precautions for using ball screw ⑧

1-10-1 Nut disassembly and assembly

Precision components and require special attention to the following:
Avoid Impact on Threaded Surfaces: Do not allow sharp objects or cutting tools to strike the threaded surfaces.
Prevent Separation or Over- Travel: Ensure the nut does not detach from the screw or exceed the allowable travel. If the nut is separated, the balls may dislodge. If this occurs, do not reassemble forcibly, as it may cause the ball screw to seize. Contact our specialist for assistance (as shown in Figure 1.10.1).

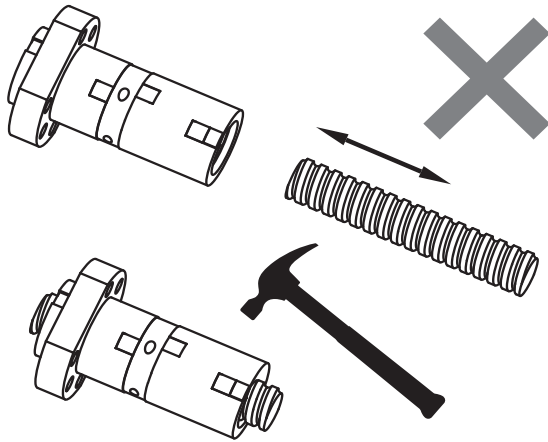


Fig 1.10.1 Error Examples

1-10-2 Lubrication

Lubrication Requirements for Ball Screw
When using the ball screw, it is essential to ensure proper lubrication. Insufficient lubrication can result in metal-to-metal contact, leading to increased friction and wear. This may cause operational failures or shorten the service life of the ball screw.
Lubricants for Ball Screws: Oils vs. Greases
Ball screws primarily use two types of lubricants: oil and grease. In maintenance, grease tends to cause a linear increase in dynamic friction torque as rotational speed rises. For speeds exceeding 3-5 m/min, oil lubrication is generally more effective. However, grease has also been used successfully at speeds up to 10 m/min in certain cases. For cost-sensitive applications, grease may be the more economical choice. To optimize performance, oil lubrication at around 5 m/min is often the best compromise
Table 1.10.1 represents general indicators for the inspection and replenishment intervals of lubricants. During replenishment, old lubricant paste adhering to the screw shaft must be wiped off before applying new grease.

Table 1.10.1 Inspection and Replenishment Intervals of Lubricants

Lubrication Methods	Inspection Time Interval	Inspection Item	Replenishment or Replacement Interval
Automatic Interval Lubrication	Weekly	Oil volume and foreign matter	Supplement based on consumption during each inspection
Grease	Once every two to three months	Dust, iron filings, and others	Supplement the situation with each inspection and replace it annually
submerged lubrication	Before starting up every day	Oil gauge height	Supplement appropriately according to the oil level during each inspection

1-10-3 Protective measures

During the use of ball screw, moisture, cutting fluid, chips, and other foreign objects should be avoided from entering the raceway. When foreign objects enter, it will cause 1. abnormal noise 2. shaking 3. insufficient accuracy 4. jamming and other situations, which will affect the normal use of ball screws. SHAC's nuts are equipped with dust-proof sealing rings at both ends, which can prevent some foreign objects from entering the inside of the nut. If there is a lot of dust and debris in environments such as woodworking machine, stone processing copper and aluminum parts, additional protective accessories must be added. Folding expansion sleeves or spiral expansion tubes can be installed on the screw to protect it.

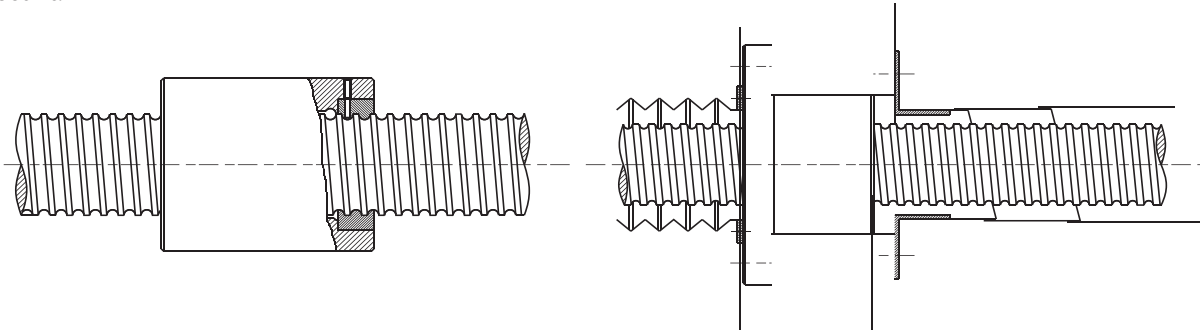


Fig 1.10.2 Dust prevention mechanism

1-10-4 Partial load (Radial force)

As shown in Figure 1.10.3, when the coaxiality between the nut and the lead screw is insufficient, there may be: 1. a feeling of unsmooth rotation, 2. abnormal noise, 3. temperature rise of the lead screw, etc. This is due to the phenomenon of biased load, which is significantly characterized by a large difference in smoothness between unloaded and assembled. In most cases, it is caused by the improper installation of the nut flange combined with the nut seat, and the excessive runout of the flange is also one of the factors.

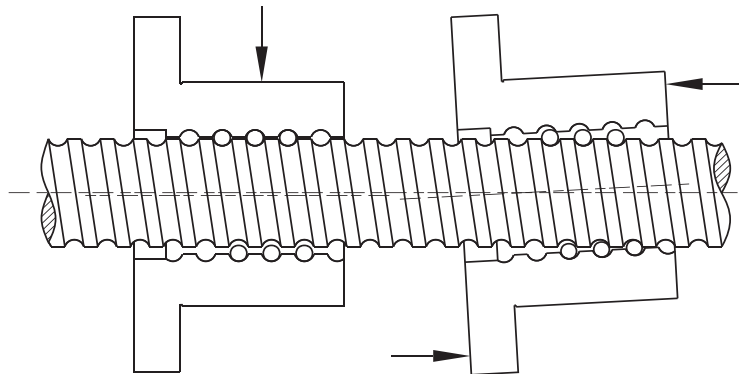


Fig 1.10.3 Partial load

1-10-5 Shaft end machining

1. If you choose ball screw with internal circulation or end cap circulation, the end thread of the screw must be threaded and the maximum shoulder size must be smaller than the base diameter. If the shoulder size is required to be larger than the root diameter, it is also acceptable, but there must be a threaded thread left on the shoulder for easy nut installation. As shown in Figure 1.10.4 below.
2. During screw heat treatment, the thread teeth near the shoulder must be kept soft for 10-20mm in length to facilitate shoulder machining. This area will be marked on the drawing, as shown in Figure 1.10.5. If you have special requirements, please inquire with SHAC business personnel when placing an order.

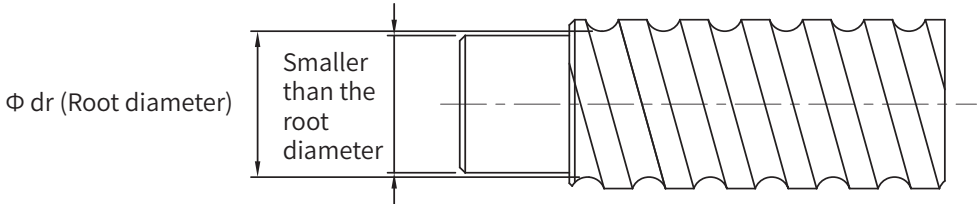


Figure 1.10.4 Specification for shaft end machining

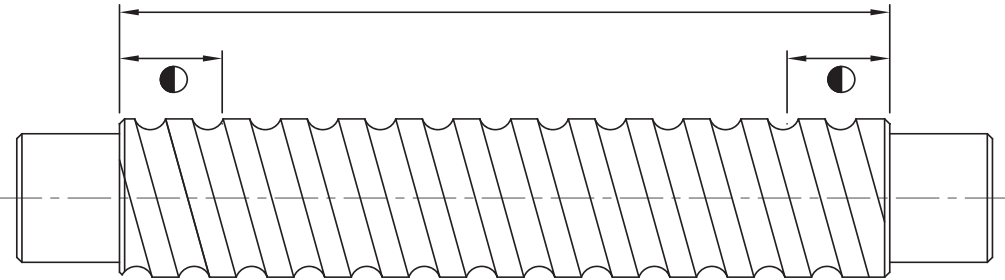


Figure 1.10.5 Effective heat treatment range of screw

If the product you subscribed for is a conversion grade single out nut, please follow the steps below to assemble it:

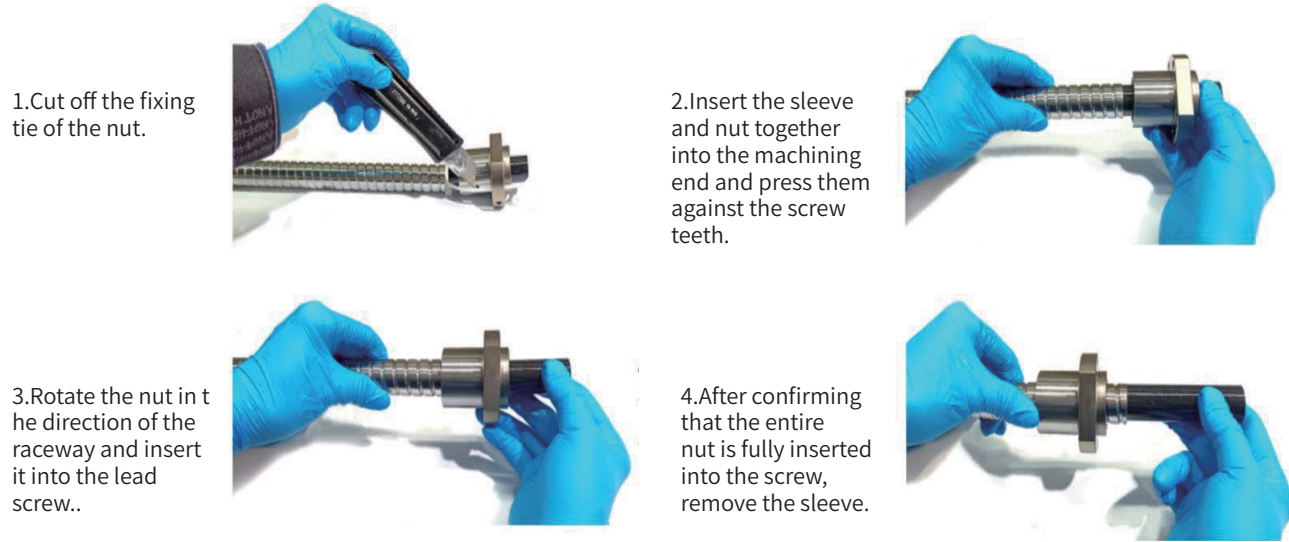


Figure 1.10.6

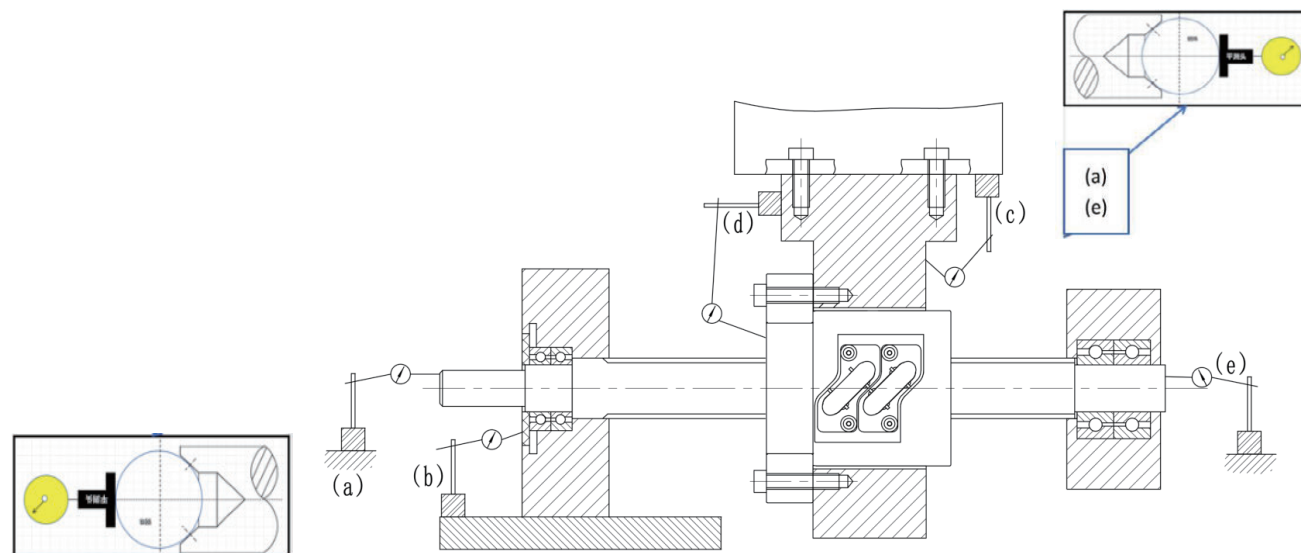


Figure 1.10.7 Axial clearance verification diagram

2 Comprehensive accuracy after installation of ball screw

2-1 Axial clearance (Install)

A) As long as the screw support mode adopts a locking nut and paired bearing fixing method, in order to avoid axial clearance after the installation of ball screws with preload nuts, a 60 degree angular contact bearing (or a combination of one bearing that fully bears axial force and the other bearing that fully bears radial force) must be used to confirm that the locking nut can compress the bearing.

B) After the installation of the screw, a detection structure as shown in the above figure 1.10.7 (page 31) is erected at both ends, and the gauge data is read when the left and right displacement is carried by the nut.

C) The axial clearance may also increase in value due to insufficient rigidity of the bearing seat (b) and nut seat (c), when added together.

2-2 Reverse gap (laser detection)

The parallel pitch error indicates that the reverse clearance is basically consistent throughout the entire stroke. If multiple measurements are stable, the reverse clearance of the shaft can be eliminated through compensation. If the reverse clearance is large, the mechanical structure of the screw should be pre tightened and calibrated to make the reverse error curve coincide with the forward error curve, thereby eliminating the machine tool's reverse clearance.

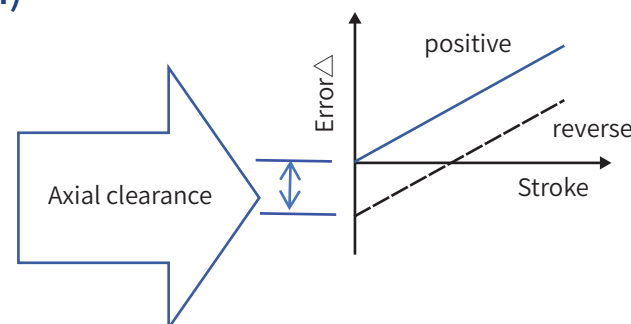


Figure 2.2.1

2-3 Reproducibility of lead accuracy (laser detection)

Repetitive positioning accuracy: Measurements are taken at any three positions near the midpoint and both ends of each coordinate stroke. Fast movement positioning is used for each position, and the positioning is repeated seven times under the same conditions to measure the coordinate values of the positioning points and calculate the maximum difference in readings. The maximum difference of 1/2 among the three positions is taken as the $\pm$ sign and used as the repeated positioning accuracy for that coordinate.

The following figure 2.3.1 shows the continuous testing of the laser instrument twice round trip during a certain stroke after the installation of the ball screw. (You can also take the average of seven round trips back and forth)

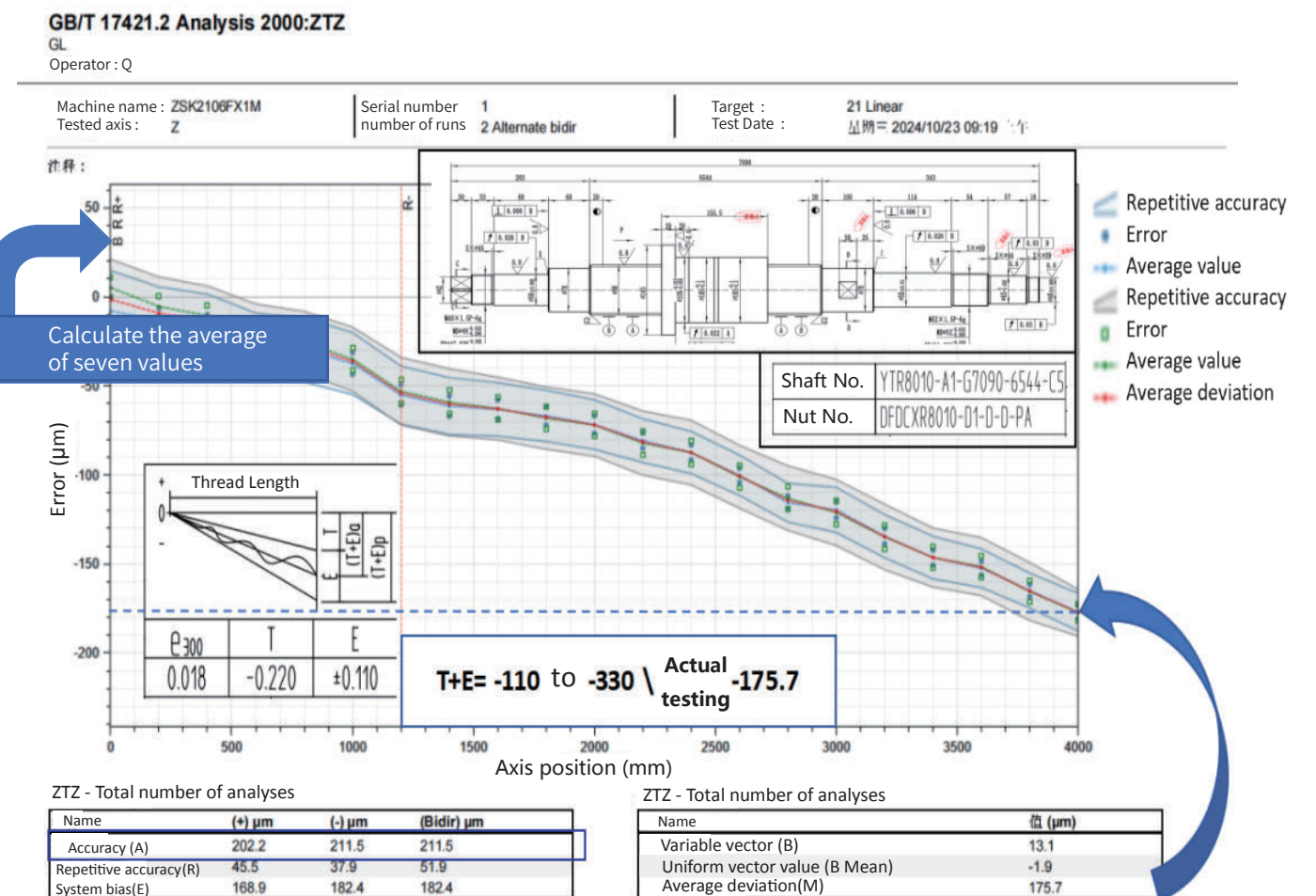


Figure 2.3.1

2-4 Circular accuracy detection (laser detection)

Cross quadrant problem

Due to factors such as reverse clearance friction during the transmission process of the machine tool feed axis, the motor lags behind when running in reverse, resulting in uneven and obvious stripes on the cutting edge at the cross quadrant. This phenomenon is particularly prominent in high gloss machining processes. Usually prone to occur at quadrant switches! (Figure 2.4.1 on page 34)



Figure 2.4.1

When the ball screw have pressure setting, this phenomenon is usually caused by improper installation. Most of them use non 60 degree angular contact bearings or locking nuts to fix the bearings in place.

2-5 The key to prestretching (Figure 2.5.1)

When the prestretching operation is not done properly, there will be a misconception that the results of the prestretching operation are the same, which will also affect the accuracy performance of the equipment.

The biggest problem is usually the implementation of prestretching operations without flattening the sagging screw due to its own weight!

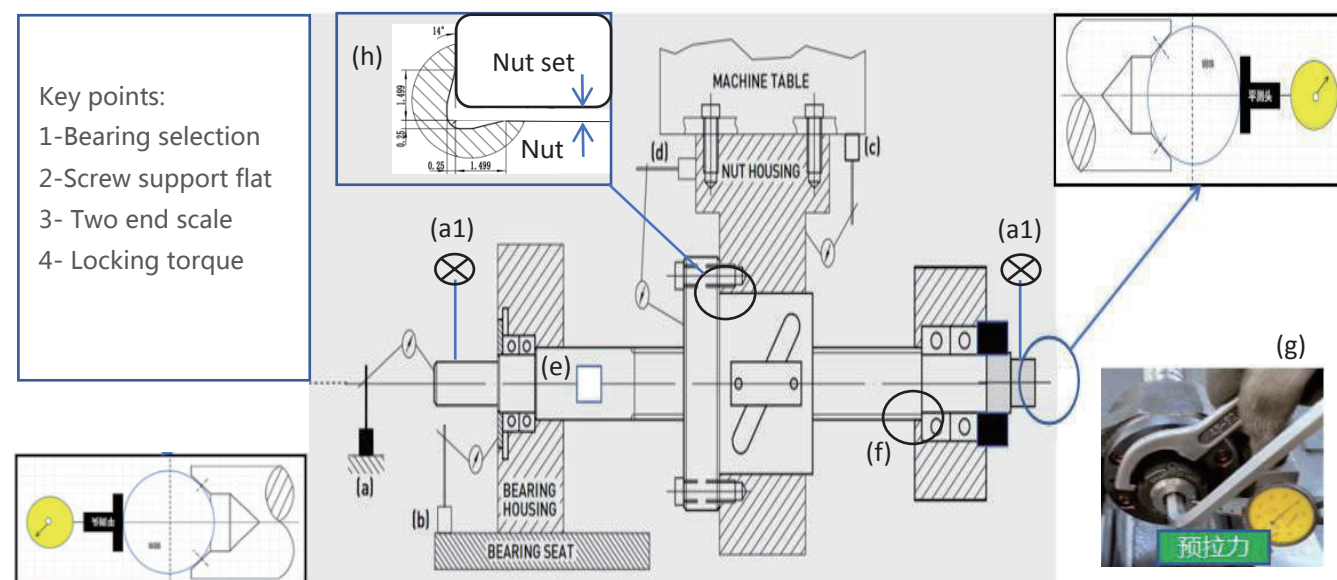


Figure 2.5.1

a) Testing reference point b) Bearing seat rigidity c) Nut seat rigidity d) Nut clearance
e) Fixed key way f) Semi fixed gap g) Pretension h) Anti interference gap a1) Verification outer diameter

3 Abnormal operating factors and elimination

In the 21st century, with the deepening of industrialization, the traditional transmission role of ball screws has gradually been replaced by ball screws. These components that transmit power and control critical accuracy can be seen everywhere in various industries. In the design and application process, there are often problems with design and installation accuracy such as pre pressure, sound, thermal displacement, and reproducibility, which prevent ball screws from developing high-precision and long-life characteristics.

Analyze from four perspectives:

3-1 Poor accuracy

3-1-1 Positioning accuracy

The accuracy problem of equipment occurs frequently in axial clearance. When the nut is not preloaded or the preload is insufficient, a gap will be generated between the screw and the nut, which leads to insufficient accuracy of the equipment. It can be determined that the nut is not preloaded by not feeling torque when turning the lead screw and nut, or by the nut drooping in the vertical direction due to its own weight in the absence of a dust cover.

3-1-2 Backlash

Precision equipment requires precision for both forward and reverse movement. When there is a gap between the nut and displacement reversal due to preloading, the correctness of the bearing needs to be considered. Should we use the commonly used 60 degree angular contact bearing? There will be varying degrees of clearance when contacting bearings from other angles!

3-1-3 Circular exceeding tolerance

When the machine tool has poor circular accuracy, it is usually when the horizontal XY axis moves relative to each other, and there is a gap between one or two axes at the same time. Especially on the circular curve graph, high convex points can be seen when switching between the four quadrants. By determining which quadrant it is in, it can be determined whether the problem is with the X or Y axis.

3-1-4 Insufficient rigidity

The diameter to length ratio design of ball screws has a significant impact on rigidity. The smaller the diameter to length ratio, the higher the rigidity. Conventional designs must be below 60. If the diameter to length ratio is too large, it will cause the self weight of the screw to sag. It is also necessary to avoid weak steel support methods to avoid more fragile stacking situations.

3-1-5 Thermal displacement

The main reasons for the heating of the screw include friction, excessive load, and poor lubrication. During the operation of the screw, friction generates a large amount of heat, especially during the movement between the screw and the nut, which may be caused by surface wear of the screw, thread deformation, or excessive friction of the nut. SHAC will provide appropriate nut preload for different device applications and confirm compliance with drawing requirements before shipment. Therefore please provide detailed equipment operation information when you make a purchase.

3-2 Poor operation

3-2-1 Processing problem

- a) Poor surface roughness of the ball screw raceway will cause the steel ball to move on uneven surfaces, resulting in poor operation.
- b) The true roundness of ball screws, steel balls, and raceways, as well as nuts and screws, is a continuous circle on the pitch diameter of the screw. Therefore, high requirements are placed on the true roundness during machining and grinding to avoid vibration caused by inconsistent contact between steel balls and raceways.
- c) The lead or pitch diameter of ball screws is the most important precision control and presentation in machining operations. If there are not enough precise dimensions, it will directly affect the performance of the operation process.
- d) The assembly of the reverser, the combination of the nut and the reverser, is the key to determine the quality of the screw operation.

3-2-2 Foreign Object

Ball nuts have a more complex operating structure than regular bearings, and any foreign objects entering the nut that obstruct operation will directly cause malfunctions.

3-2-3 Adjustment Issues

The zero clearance ball screw with preloading requires high parallelism during installation, and an error of less than one thread per meter is widely recognized. Different equipment also has its own suitable specifications.

3-2-4 Component Failure

The parts of ball nuts are easily affected and damaged by external forces, which directly affects their operation. For example, damage to the reverser will directly cause discomfort.

3-2-5 Lubrication Issues

Good lubrication has always been a key element in the operation of ball nuts, and it is also a way to avoid poor operation.

3-3 Breakage and damage

3-3-1 Screw fracture

For the intersection of the outer diameters at the end of the shaft, a circular arc angle should be designed as much as possible to avoid stress concentration (Figure 3.3.1) on page 37.

3-3-2 Steel Ball Damage

The hardness of steel balls is higher than that of screw nuts, but their volume is the smallest. When exposed to high temperatures, they will become brittle and break under high pressure caused by metal thermal expansion and contraction.

3-3-3

Ball screws do not bear radial forces at all, and the eccentric torque caused during installation can generate abnormal shear stress, leading to damage of the screw (Figure 3.3.3) on page 37.

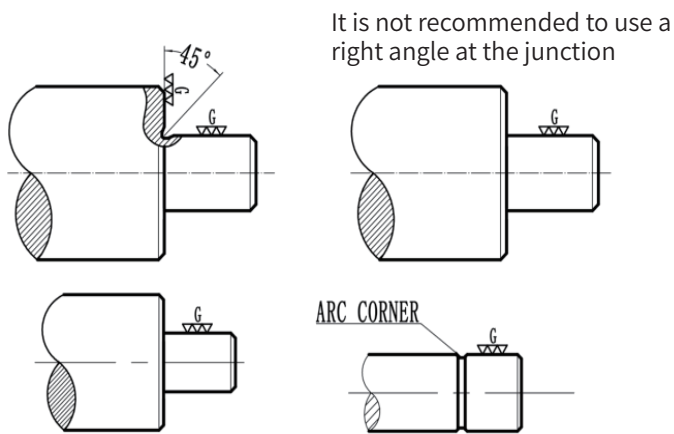


Figure 3.3.1

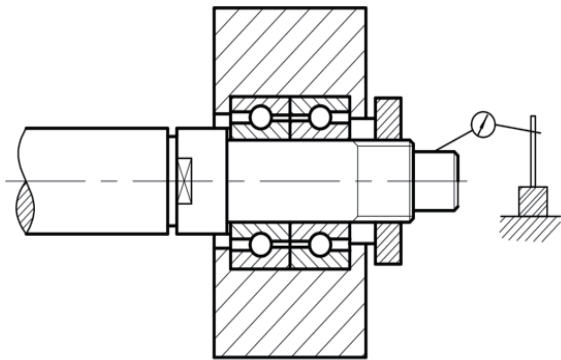


Figure 3.3.3

3-4 Areas prone to abnormalities

There are several parts in the structure of ball screws that are prone to abnormalities:

1. Establish the structure shown in Figure 3.4.1 (e) If the nut, nut seat, and bearing have been correctly installed and fixed, the variation here will not exceed 0.003mm (3 microns).
2. The structure shown in Figure 3.4.1 a. should also be established at the end of the screw motor (a). When there is no change in the screw rotation gauge, if there is a value, it indicates that the bearing is not completely fixed or the bearing is not paired with a 60 degree angular contact bearing.
3. For the detection of bearing seat rigidity, the mode (b) can be set, and when the screw is driven, this gauge cannot display any values.
4. The gap between the nut seat and the nut can be set in the mode shown in (d). When the screw is driven, no value should appear on this gauge.
5. The rigidity detection of the nut seat can be set as (c) mode, and there should be no numerical values on this gauge between the bed and the nut seat.

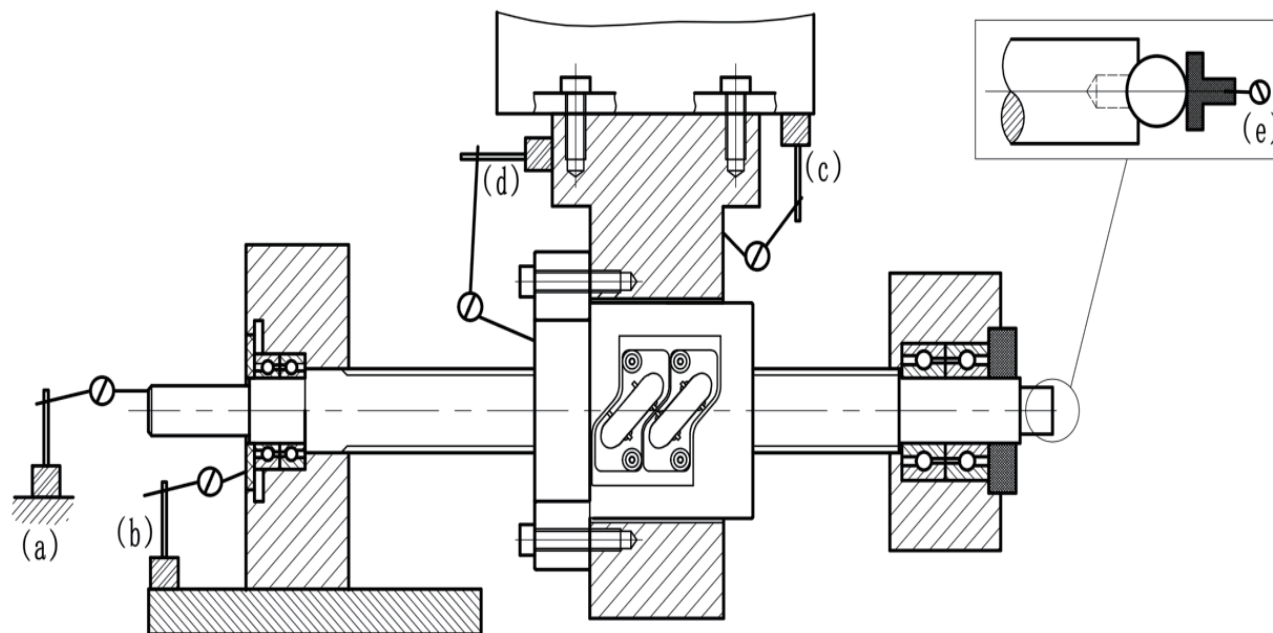


Figure 3.4.1

4. Selection verification of ball screw

Confirm the sequence

How do you further confirm the correctness of the selected ball screw specifications and models that may be suitable?

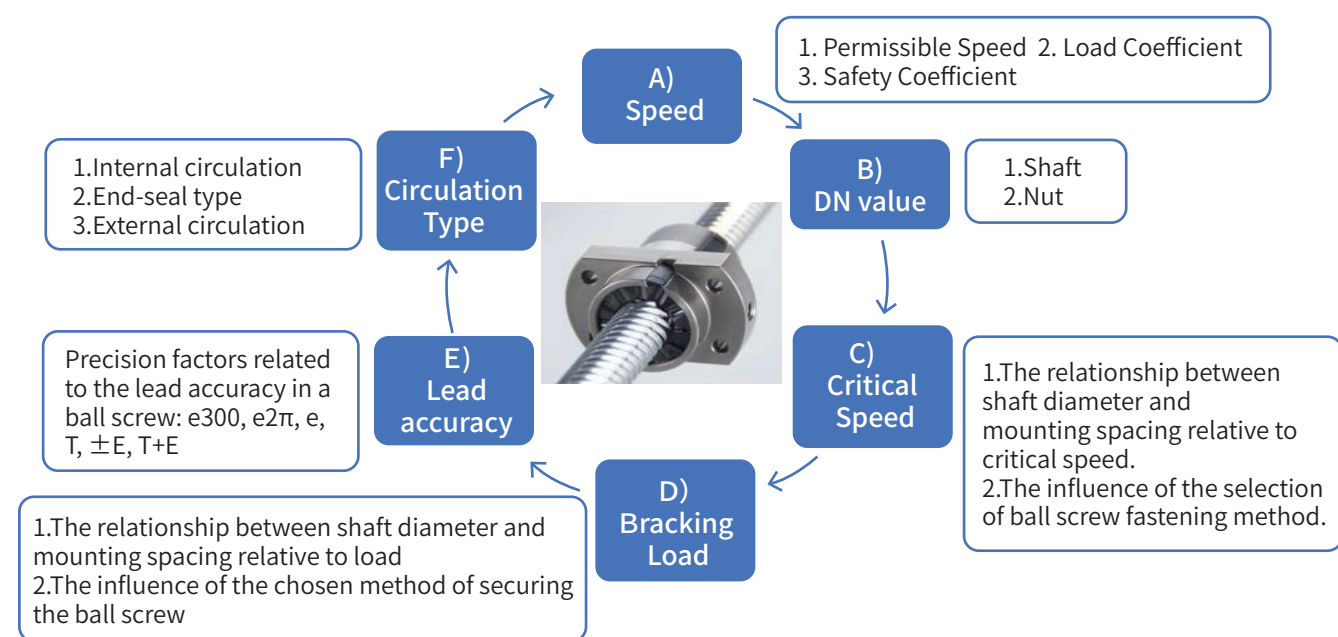


Figure 4.1.1

4-A. Velocity

For most equipment, speed also represents efficiency. The speed of the equipment is directly related to the motor speed and the lead of the screw. To increase speed, it is necessary to increase the motor speed or increase the lead of the screw. Designers can adjust according to the desired purpose.

$S = L / 1000 \text{ (RPM)}$, where S represents the displacement speed per minute, L denotes the lead (mm), and RPM stands for the motor's revolutions speed per minute.

Given the focus on safety in equipment, it is necessary to calculate the permissible speed, load factor, and safety coefficient.

Formula: (4-A-1, 4-A-2, 4-A-3)

4-A-1 Allowable speed

This speed is termed the critical speed when the rotational speed of a ball screw reaches a specific value which will effect normal operation due to the resonance occurs with permissible speeds being below 80% of the critical speed.

A graph showing permissible speed variations for ball screw, based on screw outer diameter and mounting method, is presented in Fig. 1.4.17. on page 42.

If operation occurs exactly at the critical speed, resonance can be eliminated by altering the screw's natural frequency through the addition of a support bearing in the middle of the screw.

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

n : permissible speed at dangerous speed

α : Safety factor (take $\alpha=0.8$)

I : Minimum secondary torque for threaded shaft cross-section

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

E : Longitudinal elasticity coefficient ($E=2.1 \times 10^4 \text{ kgf/mm}^2$) dr :

Thread bottom diameter (mm)

g : Gravitational acceleration

L : Installation spacing (mm)

γ : Material density

A : Threaded shaft cross-sectional area

f_γ : Determined based on threaded shaft fixing method

Support—Support $f=9.7$ ($\lambda=\pi$)
 Fixed—Support $f=15.1$ ($\lambda=3.927$)
 Fixed—Fixed $f=21.9$ ($\lambda=4.73$)
 Fixed—Free $f=3.4$ ($\lambda=1.875$)

4-A-2 Load factor (same on page 24)

Table 1.9.2 Load Factor

Shock and Vibration in Reciprocating Motion	Speed (V)	fw
Minute	Creep Traverse Rate	1 ~ 1.2
	$V \leq 0.25\text{m/s}$	
Small	Low Traverse Rate	1.2 ~ 1.5
	$0.25 < V \leq 1\text{m/s}$	
Middle Traverse Rate	Middle Traverse Rate	1.5 ~ 2
	$1 < V \leq 2\text{m/s}$	
Big	High Traverse Rate	2 ~ 3.5
	$V > 2\text{m/s}$	

Load varies sinusoidally (as shown in Figure 1.9.2)

$Pe \doteq 0.65P_{max} \dots\dots (Fig 1)$

$Pe \doteq 0.75P_{max} \dots\dots (Fig 2)$

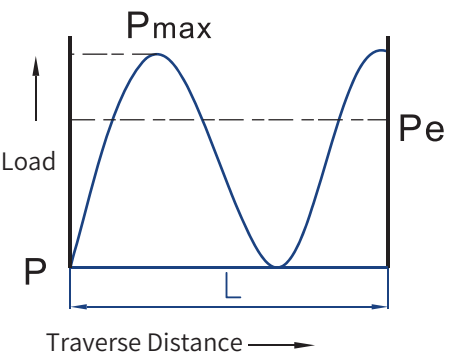


Fig 1

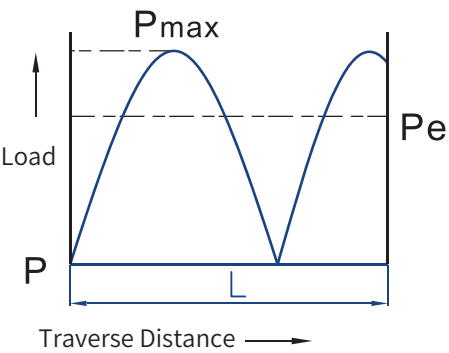


Fig 2

4-A-3 Safety factor

Table 4.1.1 Safe Fctor

Equipment	Load Condition	Minimum of fs
Machine Tool	Normal Operation	1.0 ~ 1.3
	Presence of Shock and Vibration	2.0 ~ 3.0
General Machinery	Normal Operation	1.0 ~ 1.5
	Presence of Shock and Vibration	2.5 ~ 7.0

Required Dynamic Load Rating(Ca)
 $Ca = Pe \times fs$

Required Static Load Rating(Coa)
 $Coa = P_{max} \times fs$

4-B DN Value

Another important parameter that determines the maximum rotational speed of the screw is D, the pitch circle diameter (typically measured as the screw's outer diameter for convenience), and N, the screw speed in revolutions per minute (rpm).
Ball screws have corresponding DN values for both the screw and nut. Exceeding these values during equipment operation can easily lead to abnormal phenomena such as vibration and noise.

4-B-1 DN Value of Shaft

The simple calculation for the DN value of a lead screw is the outside diameter value (mm) multiplied by the motor's maximum speed (rpm).

Precision Grade (above C7)
 $N \leq \frac{70000}{D}$

4-B-2 DN Value of Nut

The DN value of the nut is typically determined by the design of its return system.
SHAC has developed a product with a DN value of 120,000 to meet the market demand for high-speed equipment.

Transmission Grade (C10)
 $N \leq \frac{50000}{D}$

4-B-3 Effective stroke

The travel size of the equipment often determines its added value, as a broader working range can create greater profitability. Therefore, establishing an effective travel setup requires further evaluation, typically referring to "effective travel" or the travel during operation. The working travel calculation formula is $L - M$ (unit: mm).
In practical use, two to three lead lengths are reserved at both ends of the travel as buffer zones.

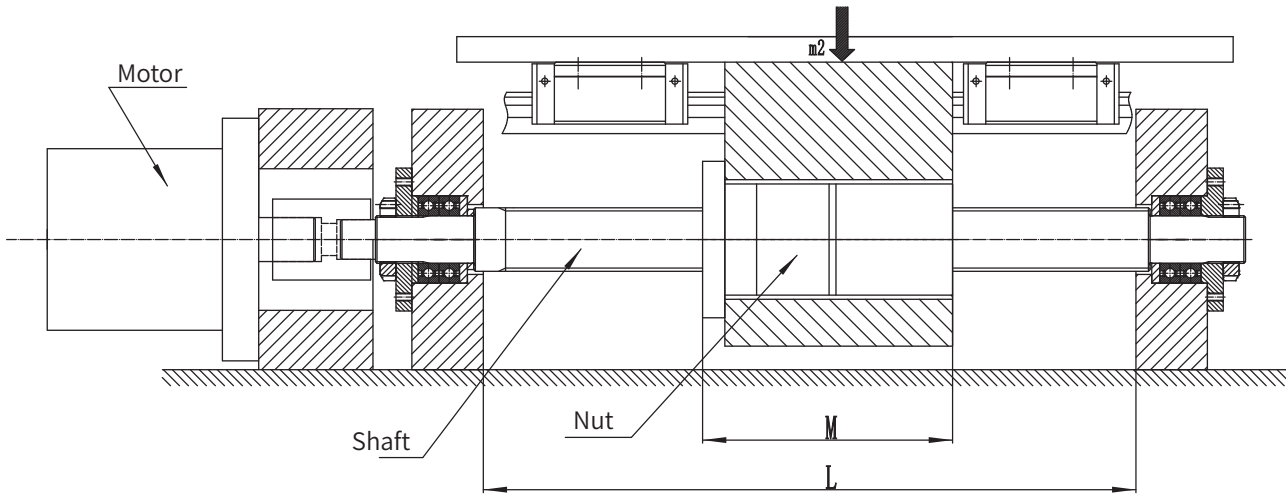


Figure 4.B.3

4-B-4 Slenderness ratio

The slenderness ratio of a ball screw is one of the key factors affecting its performance and equipment quality. The calculation formula: divide the distance between bearing contact surfaces by the screw's outer diameter. From the external appearance, when the screw's outer diameter is smaller while the length is longer, the screw will exhibit sagging in the middle section, indicating a higher slenderness ratio. Therefore, for equipment performance, this value should be as small as possible, as it enables the screw to withstand high-speed rotation without anomalies.
The slenderness ratio is also interrelated with the ball screw's precision grade, support bearing spacing, and outer diameter, collectively influencing the preload range.

Table 4.B.4 Permissible range of torque variation rate (Source: JISB1192)

Reference torque kgf×cm		Effective thread length (mm)										
		4000 below						4000 above - 10000 below				
		Slenderness ratio 1:40 below				Slenderness ratio 1:40 -1:60				-		
		Grade				Grade				Grade		
above	below	C1	C1	C2/C3	C5	C0	C1	C2/3	C5	C1	C2/C3	C5
2	4	±35%	±40%	±45%	±55%	±45%	±45%	±55%	±65%	-	-	-
4	6	±25%	±30%	±35%	±45%	±38%	±38%	±45%	±50%	-	-	-
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%	±20%	-	-	±20%	±22%	-	±25%	±30%

Notes: 1. The diameter-to-length ratio of the screw rod refers to the effective thread length divided by the outer diameter of the screw rod.
2. Design the basic variation range of pre-tightening torque.
3. For base torque values below 2kgf·cm, follow SHAC's alternative regulations

4- B-5 Pre-load range

The setting of the preload range for ball screws can be referenced to Table 1.3.8 by comparing the effective thread length diameter-length ratio e300 precision grade with the reference torque to determine the corresponding variation range, thereby avoiding the situation where a large diameter-length ratio with a low precision grade results in a small variation range of preload.

Calculation of reference torque

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

F_{ao} =Preload (kgf)
 l = Lead (cm)
 β = Lead angel

Detection method:

As shown in Figure 1.3.4, while the lead screw rotates, an opposing force (F) is applied to the nut's lever arm to prevent the nut from rotating.

$$Tp=F \times L$$

F = Force (kgf)
 L = Length of arm (cm)

Detection condition:

- 1.Wen detection without wiper.
- 2.Shaft rotate with 100rpm
- 3.Lubricating oil follow JSK2001\ISOVG68

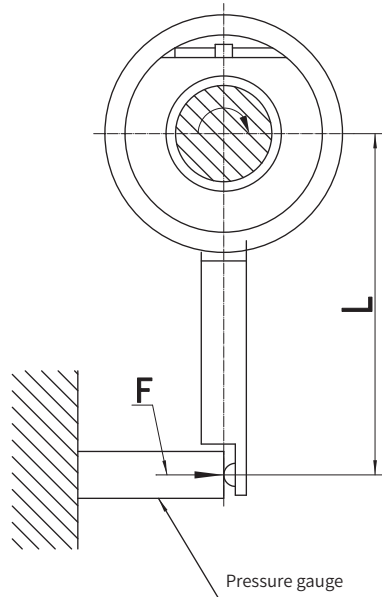


Figure 4.B.4

4-C Critical speed

When the ball screw rotates, the centrifugal force buckling caused by the self-weight sagging of the screw must be resisted by the bending strength of the shaft. When the rotational speed of the ball screw reaches the critical speed, the vibration deflection will increase unbounded. Therefore, from an engineering operation perspective, this phenomenon should be avoided.

$$N_c = 2.71 \times 10^8 \times \frac{M_f d_r}{L_t^2}$$

$N_p = 0.8 N_c$

N_c =critical speed (rpm) Fixed-fixed $M_f=1$
 N_p =maximum allowable speed (rpm) Fixed-support $M_f=0.689$
 d_r :screw shaft root diameter (mm) Support-support $M_f=0.441$
 L_t :support spacing (mm) Fixed-free $M_f=0.157$
 M_f :different assembly types

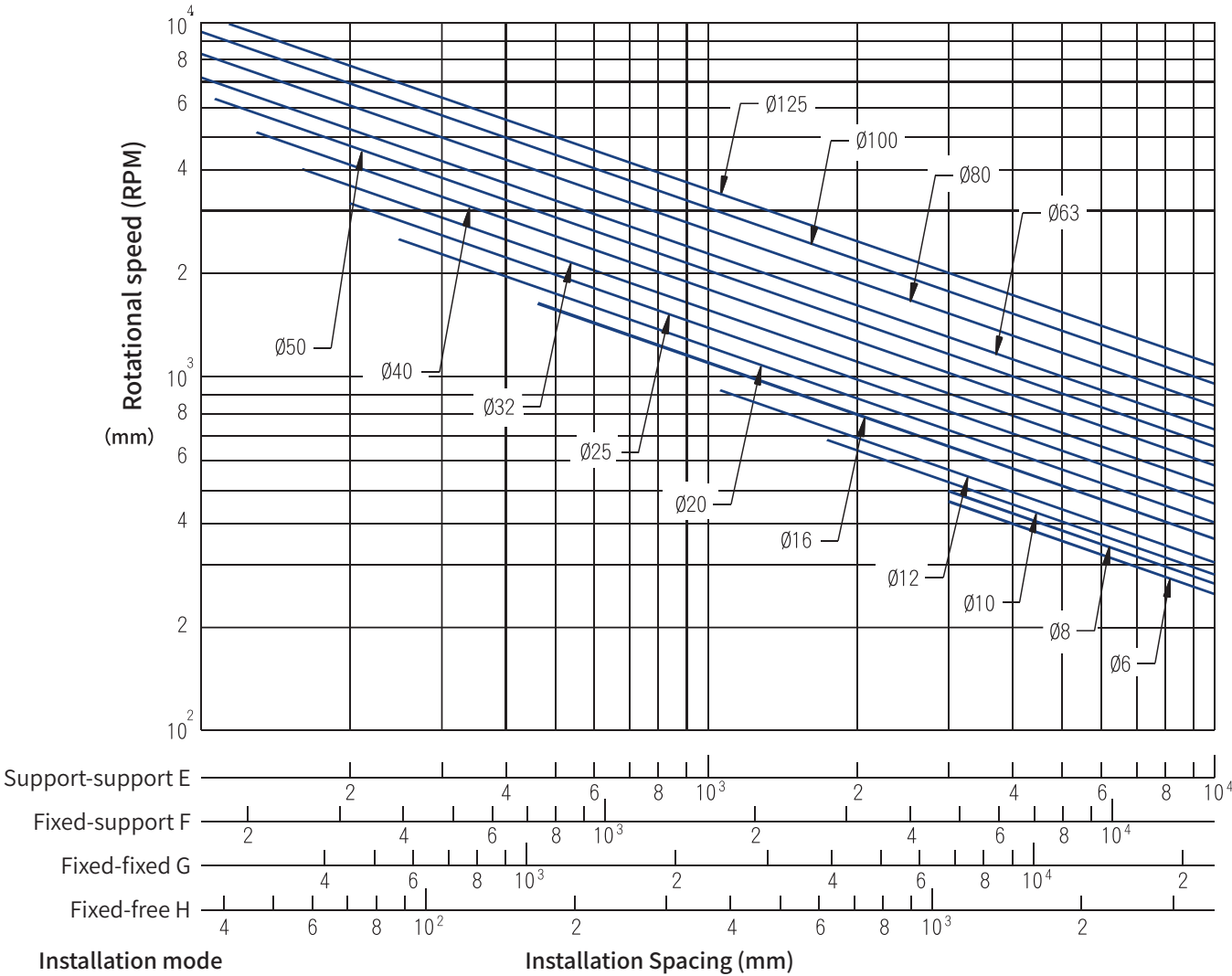


Fig 1.4.17 Max. Speed

By utilizing the lead screw fixing method and outer diameter dimensions, and consulting the critical speed data obtained from the cross-sections of the lines in this diagram based on the installation spacing, determine the suitability of the selection!

4-D Buckling load

The compressive load applied axially to the lead screw due to factors such as the workbench, work-piece, and self-weight can cause plastic deformation of the screw when the load reaches a certain level. This load is referred to as the buckling load, and appropriate shaft diameter and length should be selected to avoid it. Figure 1.4.16 shows the permissible compressive buckling load table.

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

P=Buckling Load(kgf)
a=Safety Factor(a=0.5)
I=Minimum second moment of area for the shaft cross-section of the lead screw
$$I = \frac{\pi}{64} dr^4 (mm^4)$$

E: (E=2.1×10⁴kgf/mm²)
dr=Root Diameter(mm)
L=Installation Spacing(mm)
m、N=Depending on the screw fixing method

Support-support m=5.1 (N=1)
Fixed-support m=10.2 (N=2)
Fixed-fixed m=20.3 (N=4)
Fixed-free m=1.3 (N=1/4)

1. The permissible tensile- compressive load P of the screw shaft's yield stress is given by
 $P = \sigma A = 11.8 dr^2$ (kgf), where:
P: Buckling load (kgf)
 σ : Permissible tensile- compressive stress (kgf/mm²)
A: Cross- sectional area of the screw thread root (mm²)
dr: Screw thread root diameter (mm)
2. Permissible load for the screw channel section:
The maximum axial load must be significantly less than the screw's basic static load rating.

When the installed length is relatively short, the fixing method has almost no effect on the bream compressive load. Please perform the verification according to the following two items.

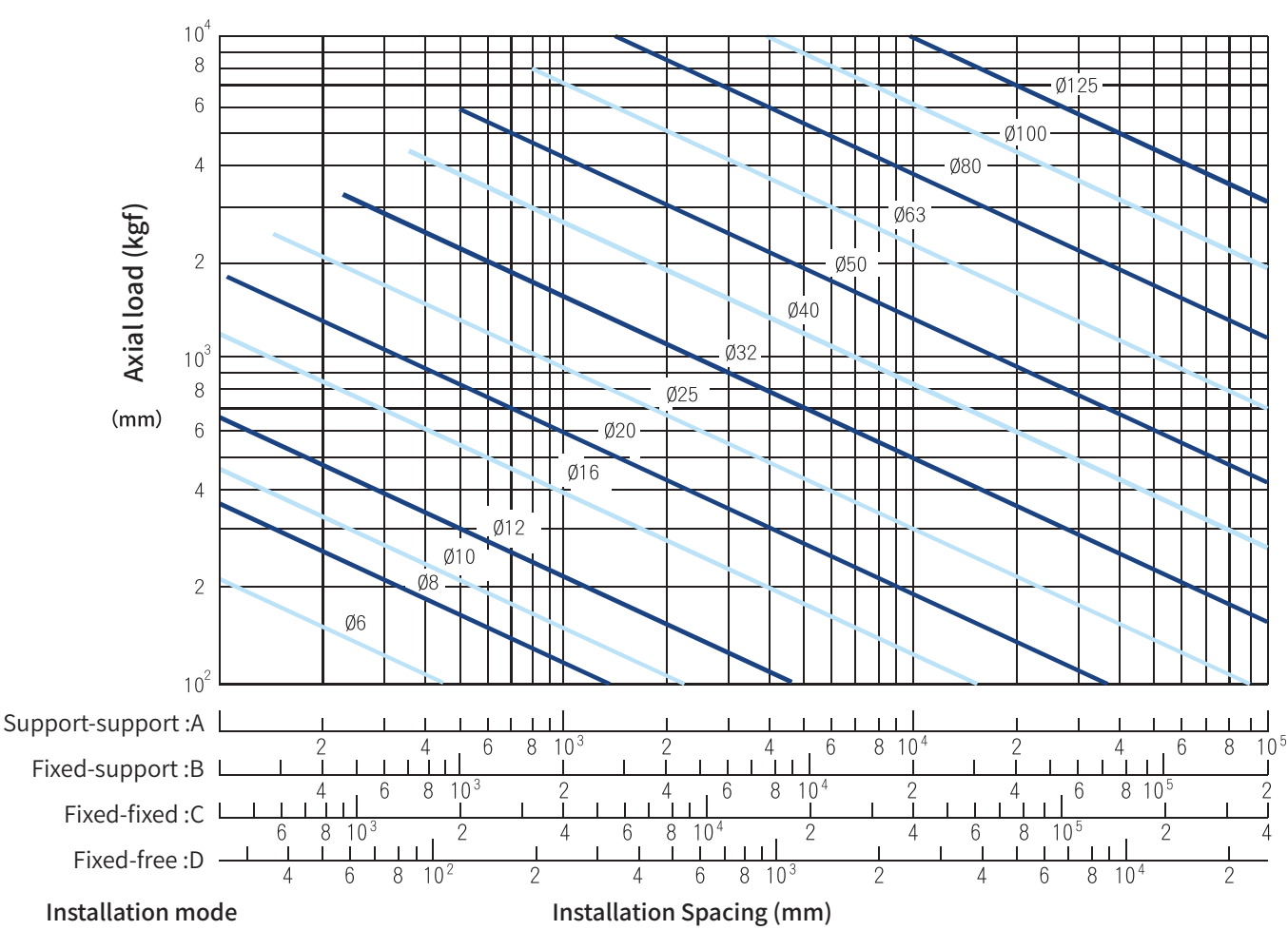


Figure 1.4.16 Permissible Compressive Load

By using the screw shaft fixing method and outer diameter dimensions, and by using the installation spacing to look up the axial load data at the intersection of the lines in this diagram, determine the suitability of the selection!

4- E Lead Accuracy

The various accuracies of the lead screw pitch directly affect the final accuracy of the equipment, so it is necessary to confirm and grasp its corresponding functions.

- e300: It is often said that the ball screw is the heart of equipment. High precision of the screw does not necessarily guarantee high precision of the equipment, but low precision of the screw definitely results in low precision of the equipment. If you want the equipment precision to be within 0.01mm, you can basically choose an e300: 0.008 mm screw.
- e2π: If the accuracy of the equipment needs to be controlled within the range of a single lead change, the range of a single lead variation needs to be considered.
- ± E: The cumulative lead variation over the full stroke directly affects the length of the screw thread, which has a significant impact on the accuracy control of CNC machine tools. Therefore, it is usually designed in the negative direction in CNC machine tool applications, thereby enhancing the control of temperature rise.

- e:** In the case of a longer operational range, besides controlling the length with the E value, if it is desired to maintain a certain range of accuracy variation, further control of the variation in lead over the full range of travel is required, to compress the range of dimensional changes within the operational range.
- T-value:** This is used to assist in confirming the direction and degree of cumulative lead change based on the $\pm E$ value. Typically, in the design of CNC machine tools, it represents the value of pre-tension. It helps ensure that the $\pm E$ value falls in the negative direction, and then reduces thermal deformation caused by the thermal expansion and contraction characteristics of the screw through pre-tensioning operation. Therefore, machine tools use the T-value to enhance control over stability and accuracy.
- T+E:** Due to the sensitivity of equipment accuracy to temperature changes, the ability to control the T+E value can also be regarded as the ability to control accuracy. Generally, this is achieved through 1-establishing a constant temperature workshop, 2-standardizing operation instructions, and 3-adjusting the T value on the screw drawing, thereby elevating equipment accuracy to a higher level.

4- F Nut cycle mode

4- F -1 Internal circulation nut

The cyclic structure of this nut's steel balls follow a three-dimensional S-shaped path, with several steel balls completing the path in a relatively short distance. Therefore, its impact resistance is limited, with a DN value of approximately 70,000. However, it has advantages in applications involving smaller outer diameters, smaller steel balls, and smaller lead screws. Under slow displacement conditions where space is limited, it is a more suitable choice than end-plug nuts.

4- F -2 End-plug nut

The circulating structure of this nut steel ball is achieved through the raceway in the back of the nut wall, which connects the reverser return circulation of the tangent paths on both ends of the nut. Coupled with the sound insulation and dust proof design on both ends of the nut during high-speed operation, the impact of high-speed steel balls is minimized, with a DN value of approximately 120,000. It is particularly suitable for high-speed, high-precision, light-load equipment requirements. If you have a design with a higher DN value, please consult SHAC.

4- F -3 External plugging circulating nut (new)

The circulating structure of this nut steel ball utilizes a reverser return pipe with an external plug-type tangent path for circulation. Coupled with sound insulation and dust proof design on both ends of the nut during high-speed operation, the impact of high-speed steel balls is minimized, with a DN value of approximately 130,000. It is particularly suitable for high-speed, high-precision, light-load equipment requirements. If you have a design with a higher DN value, please consult SHAC.

Hollow Cooling Ball Screw

H.1 Design Principles:

Core Transmission Mechanism (Traditional Ball Screw) Motion Conversion Principle Through the engagement of the screw and nut's helical grooves, the rolling action of internal circulating balls converts rotational motion into linear motion (or reverse conversion).

When the motor drives the screw to rotate, the balls roll along the helical grooves and push the nut to move axially, achieving efficient, and low-friction transmission.

Key Component Functions Screw and Nut: The helical groove structure guides ball circulation, creating rolling friction.

Balls: As rolling elements, they reduce sliding friction losses and enhance transmission efficiency.

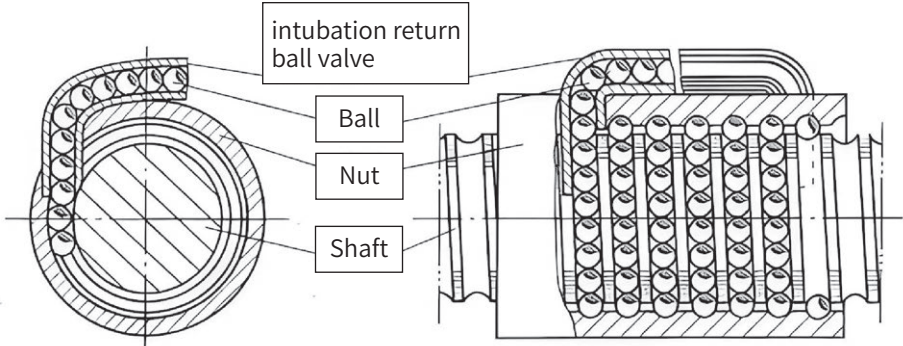


Fig 5.1.1 External return

H.2 Cooling System Function

Thermal Control Mechanism

Hollow structure ball screws are equipped with internal cooling channels.

These channels absorb heat generated during operation (e.g., frictional heat) through circulating cooling liquid (such as water or oil), to reduce the overall temperature of the screw.

This design effectively minimizes thermal deformation while maintaining transmission accuracy and stability.

Cooling Effect Advantages

Compared with the traditional solid structures, hollow water-cooled/forced-cooled technology can extend the service life of ball screw under high-load or long time operation conditions.

It also ensures optimal performance in high-speed and high-precision scenarios.

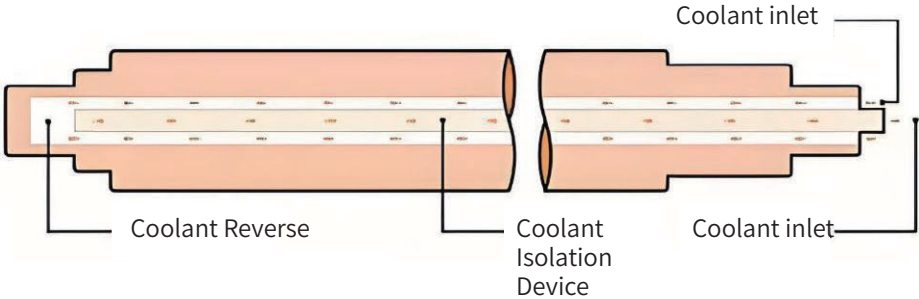


Figure 5.2.1

H.3 Summary

The hollow ball screw integrates rolling friction transmission with active heat dissipation technology. It inherits the efficient and low-resistance motion characteristics of conventional ball screws while addressing the performance degradation caused by temperature rise through its internal cooling system, making it suitable for high-thermal-stability-demanding fields such as CNC machine tools and precision instruments.

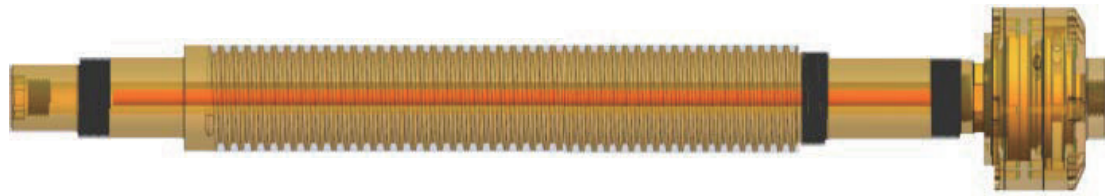


Figure 5.3.1

H.4 Performance:

Test Conditions:

1. When the rotational speed is the same, the temperature of the ball screw increases with the increase in axial load. For every 500 increment in axial load, the temperature of the solid ball screw increases by 5.4°C, while that of the hollow ball screw increases by 1.5°C. This indicates that the temperature change of the solid ball screw is more significantly affected by axial load.

The temperature difference between hollow and solid ball screw reveals that as the axial load increases, the temperature difference between hollow and solid ball screws becomes larger, demonstrating that the hollow ball screw is more suitable for heavy-duty loads.

2. When the axial load is constant, the temperature of the ball screw increases with rotational speed. For every 500 r/min increase in speed, the temperature of the solid ball screw rises by 2.3°C, while the hollow ball screw temperature increases by 1.3°C.

This shows that the solid ball screw temperature is more sensitive by speed changes.

Overall, the hollow ball screw is not only suitable for high-load and high-speed (high feed rate) operating conditions but also exhibits more stable temperature variations.

For machine tools, there is no need to worry about excessive temperature rise caused increasing axial load.

3. Through comparative analysis of heat dissipation between hollow and solid ball screws, it is observed that under the same axial load, their deformation is identical.

The introduction of cooling oil significantly reduces the radial thermal deformation of the hollow ball screw.

Compared with solid ball screws, the hollow ball screw minimizes the pre-tight force caused by thermal expansion between the ball screw and nut, preventing the vicious cycle of "temperature rise - increased thermal deformation - increased pre-tight force - temperature rise." In summary, the hollow ball screw with cooling oil outperforms the solid ball screw in high-speed and high-load scenarios.

Diagram

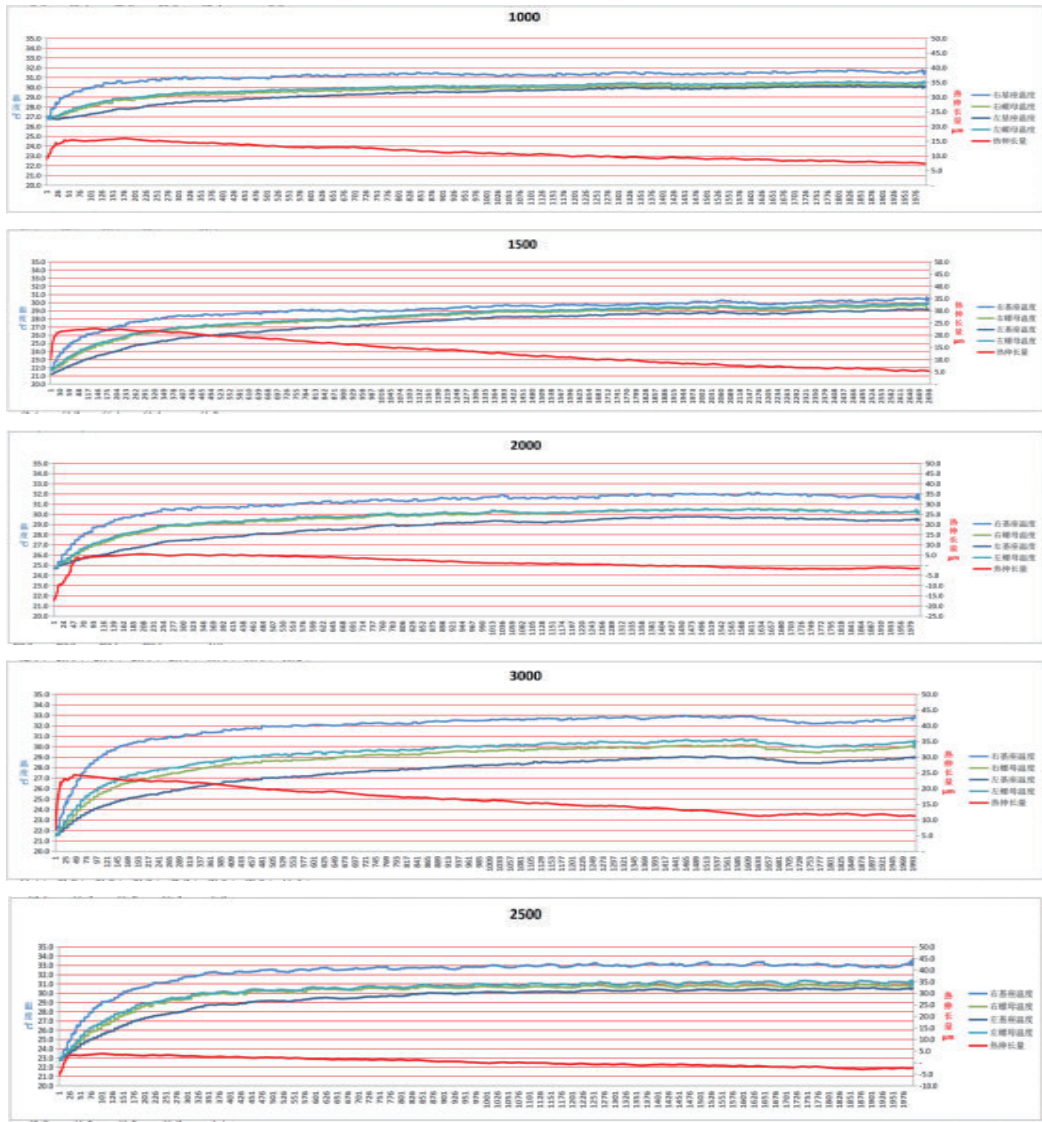
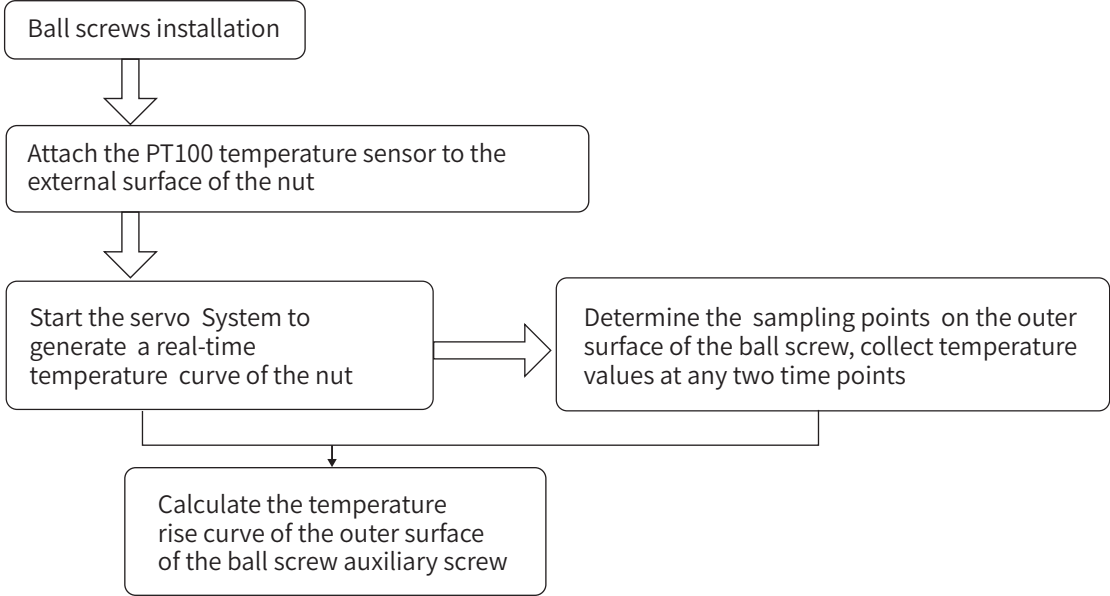


Figure H.4.1

H.5 Test and Inspection Report

		ZHEJIANG JIANZHUANG TRANSMISSION TECHNOLOGY CO.,LTD 浙江健壯傳動科技有限公司				File No.	SJAC/BG.04003-2019		
		Inspection&Testing Report				Date	2021-9-2		
						Version	A0	Page No.	1/1
Test Dept.		R&D		Inspector			Yao Yujie		
Product Name		Ball screw		Model No.			YTR4010-A1-G1865.5-1573-C3		
Screw material		50CrMo4		Nut material			SM420H		
Inspection condetion									
Lab Add.		Ball screw performance testing laboratory		Lab.Equipment			Ball screw multiple performance testing machine		
Preload		P2		Accuracy			C3		
External load (N)		3,000 N		Ambient Temp.			22°C		
Lubrication medium		ISO L-HG (L-HG 68)		Refill method			Automatic oiling		
Refill interval		Every 10minutes, refill 5s		Movement distance			450mm		
Testing projects		Testing ball screw temperature rise curve and thermal elongation curve							
Inspection data									
Date	Nut	Screw	RPM	Achieve balanced running times	Max Thermal elongation	Equilibrium Temp.°C	Cooling medium and Temp.	Attached list	
			r/min		mm				
2024.11.10	Standard	Standard	1000	1000	0.051	33-34		Standard-1000'!A1	
	Standard	Standard	1500	1300	0.065	37-39		Standard-1500'!A1	
	Standard	Standard	2000	1200	0.082	36-38		Standard2000-2'!A1	
	Standard	Standard	2500	1700	0.093	40-42		Standard-2500'!A1	
2025.2.7	Standard	Hollow liquid cooling	1000	1300	0.021	30-32	Water cooling 22°C	Water cooling-1000'!A1	
	Standard	Hollow liquid cooling	1500	1200	0.025	30-32	Water cooling 22°C	Water cooling-1500'!A1	
	Standard	Hollow liquid cooling	2000	1200	0.025	30-33	Water cooling 22°C	Water cooling-2000'!A1	
	Standard	Hollow liquid cooling	2500	1200	0.023	30-33	Water cooling 22°C	Water cooling-2500'!A1	
	Standard	Hollow liquid cooling	3000	1500	0.024	30-33	Water cooling 22°C	Water cooling-3000'!A1	
Experimental Comments		Normal type screw maximum elongation and its equilibrium temperature are positively correlated with the rotational speed; The maximum elongation and equilibrium temperature of the hollow liquid cooled screw have no significant changes with the increase in rotational speed,and remain stable within a certain range. The maximum elongation and its constant temperature of hollow liquid cooled screw are much lower than normal screw							

Recorder: 王

Auditor: 王

Inspection seal:



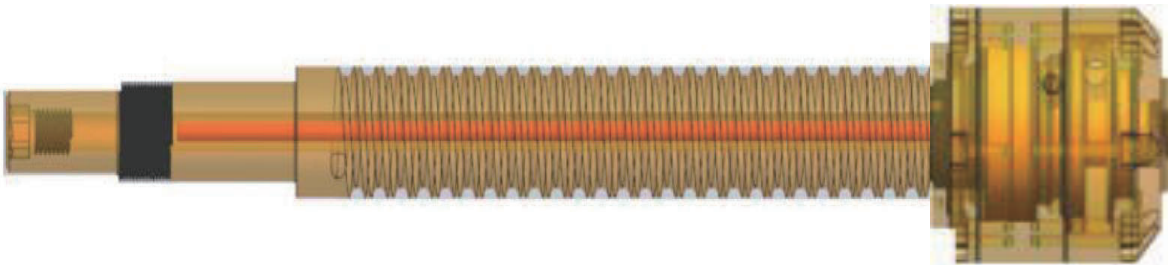
H.6 Application

Hollow ball screw are suitable for high-precision machine tools. They can work well with high-speed operation of conveying mechanisms, especially when high-precision positioning is required. Since motion generates heat causing thermal expansion and contraction, the heat makes the ball screw expansion. To prevent this change, hollow ball screw were developed. The hollow design of the ball screw shaft blocks heat conduction, achieving cooling effects. Moreover, the hollow shaft and standardized processing at both ends of the screw shaft effectively reduce thermal expansion.



H.7 Features:

- The four advantages of hollow shaft ball screw:
1. Stable positioning accuracy: The hollow shaft design effectively suppresses thermal expansion, maintaining the stability of the ball screw's positioning accuracy.
 2. Prevent displacement: By reducing thermal expansion, the hollow shaft keeps the displacement of the ball screw support shaft and base within the minimum range, avoiding thermal deformation in the work-table.
 3. Shorten preheating time: The cooling effect of the hollow shaft rapidly reduces temperature rise, thereby shortening the equipment's preheating time.
 4. Maintain lubrication performance: Preventing heat generation in the ball screw slows down the degradation of lubrication oil, ensuring its effectiveness.
5. DINGHAN exclusively develop hollow shaft ball screw special connector which eliminates leakage issues during general use.



H.8 Technical Specifications: Three Advantages of Hollow Ball Screw:

1. In conventional ball screws, direct friction between the screw and balls generates heat, causing thermal deformation and affecting transmission accuracy.

Under conditions where transmission force and speed are not significant and precision requirements are not strict, ordinary ball screws are generally used due to their lower cost.

However, for special cases requiring high transmission force/speed and precision, hollow oil-cooled ball screws are recommended.

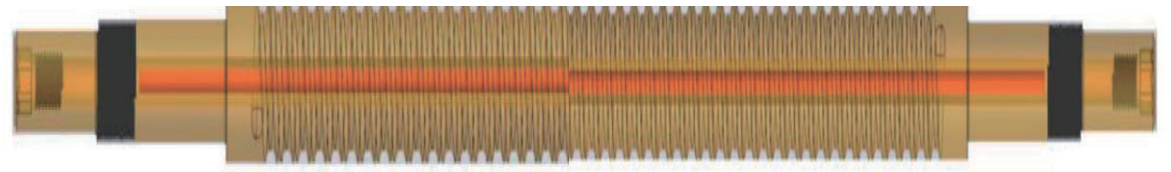
2. Hollow ball screws utilize oil or water circulation to cool the screw body, effectively preventing overheating and maintaining stable temperature control to ensure precision.

3. Hollow ball screws offer advantages of reduced self-weight and increased surface area, minimizing excessive sagging from self-weight and lowering motor driving torque through reduced moment of inertia.

Additionally, the hollow section allows coolant flow to dissipate heat, achieving superior temperature control.

H.9 Specifications and Model:

YTR4010-A1-G1865.5-1573-C3 (Hollow threaded rod)



5 SHAC Ball Screw Product Series

5-1 Nominal Model Code of SHAC Ball Screw

Hollow ball screw are suitable for high-precision machine tools.

They can work well with high-speed operation of conveying mechanisms, especially when high-precision positioning is required.

Since motion generates heat causing thermal expansion and contraction, the heat makes the ball screw expansion.

To prevent this change, hollow ball screw were developed.

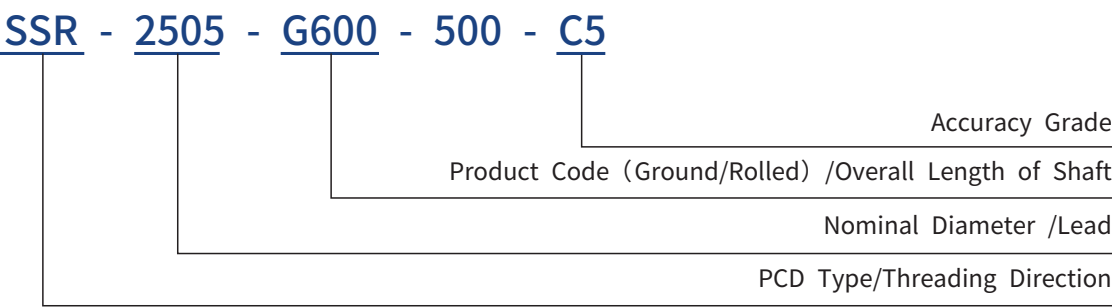
The hollow design of the ball screw shaft blocks heat conduction, achieving cooling effects.

Moreover, the hollow shaft and standardized processing at both ends of the screw shaft effectively reduce thermal expansion.

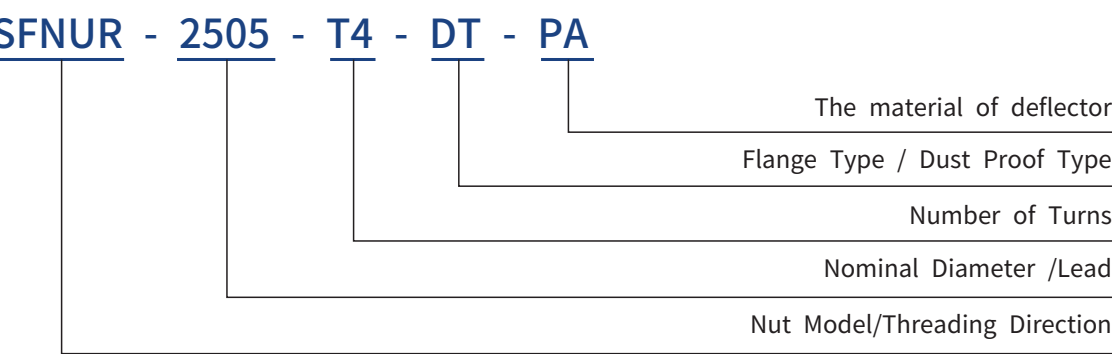
Table 5-1-1 Ball Screw : SFNUR-025-05T4-DT-PA-G-C5-600P1-SS

Code	Feature	1	2	34	5	678	9/10	11/12	13	14	15/16	17	18/19	20/21/22/23	24/25	26/27	28/29	30/31	
Rolled P.C.D. YT SS SC	Ground	S	F	NU	R	025	05	T4	D	T	PA	G	C5	600	P1	B2	N3	N3	
	S: Single D: Double				Threading Direction R:Right L:Left	Nominal Diameter Unit: mm	Lead Unit: mm	Number of Turns (Turn/ Row) T:1, A:1.8, B:2.8, C:3.8, D:4.8 ex: (2.8x2 =B2)	Flange Type N: Not Cutting S: Single Cutting D: Double Cutting M: Multiple Cutting	Dust proof Type K: Hexa Gonal Clamp Spring D: Maze Type G: End Cap T: One Piece Type TPE	Material PA: Plastic Reverser FE: Metal Reverser Y: Plastic Circular Reverser	Production Process G: Ground F: Rolled	Accuracy Grade CO, C1, C2, C3, C5, C7, C10	Total Length of Shaft Unit: mm	Preload PO, P1, P2, P3, P4	Number of Nut (Leave blank if only one nut is required) Ex:Install two nuts on a shaft B2	Nut Surface Treatment S: Standard B1: Black OXidation N1: Hard Chrome Plating P: Phosphating N3: Nickel Plating	Shaft Surface Treatment S: Standard B1: Black OXidation N1: Hard Chrome Plating P: Phosphating N3: Nickel Plating	
	F: With Flange C: Without Flange				Nut Remarks:														
				Type A nuts and shaft Outer diameter above 12 mm are combination type circulators.															
120,000	E: E-type nut/end plug external circulation/double-headed Y: Y-type nut/end plug external circulation/double-headed DC: Multi-piece end plug (single/double head) A,S: S-type nut/end plug external circulation/single head																		
70,000	NI: NI type nut \ internal circulation NU: NU type nut \ U DIN internal circulation				The purpose of the combination circulator is to overcome the problem of the screw rod not coming out at both ends.														
DN Value	K: K-type nut/insert type/ internal circulation X: Customer specific (add X after the third code)				DC The cyclic device of the type nut is also a combination type, designed for those who cannot exit the tail														
120,000	SFBH,DFB,SFB Heavy load type External circulation				D	DC nut U type nut I type nut		T	A,Y type nut NU type nut NI type nut		G	S type nut	K		E type nut		Remarks: When the surface treatment is applied to both the lead screw and nut		
	SFU electric cylinder dedicated				Maze Type			One Piece Type TPE			End cap		Hexagonal Clamp Spring						

5-1-2 Shaft Specification:



5-1-3 Nut Specifications:



5-2 Rolled Ball Screw

Rolling ball screw is a type of screw that uses two thread forming rollers. Through advanced German machine tools and SHAC extrusion technology on circular smooth rods, it produces a Gothic shaped profile screw with low friction and smooth operation, and is supplied quickly and at a good price.

SHAC adopts standardized material selection, rolling process, heat treatment, processing and assembly operation procedures, and strictly controls the quality of rolled lead screws to ensure the best consistency of products. If there is a need for pre tightening force, the elimination of axial clearance can also be fully met.

SHAC rolling screw specifications are fully equipped with a sufficient number of standard inventory parts annually to meet urgent needs and make it easier to exchange screw nuts. The nut type and size are the same as those of grinding grade screws, please refer to the selection.

According to the international standard (ISO), the reference for the lead accuracy of rolling ball screws is as follows: the allowable cumulative lead error for any 300mm within the effective screw length of each grade is C7=0.052mm and C10=0.21mm.

Table 5.2.1 Permissible Values for Variation in Thread Length of 300mm (e300) and Wobble (e2π) (JIS B1192)

Accuracy Class		C5	C7	C10
ISO, DIN	e300	23	52	210
JIS		18	50	210
SHAC		18	50	210
	e2π	8		
Processing Technology		Rotary Milling/Rolling Screw		

SHAC[®] provides C5 grade rotary milling ball screws, produced using high-precision whirlwind milling machines from Germany, providing users with a new option for applications that do not require grinding grade high precision and consider insufficient rolling accuracy.

SHAC[®] sets the specifications for preload and axial clearance to facilitate users in selecting suitable rolling ball screws.

The purpose of applying pressure is to eliminate the axial backlash of the ball screw and increase rigidity. The Gothic raceway design with a 45 degree contact angle has a unique channel structure that can easily eliminate backlash and increase rigidity. Appropriate preload can improve both accuracy and rigidity. Excessive preload can have a certain impact on service life due to temperature rise effects, while insufficient preload can cause step loss. Therefore, the appropriate preload should be selected according to the model and purpose.

Table 5.2.2 Classification of Axial Play

Grade	P0	P1	P2	P3	P4
Axial Play	Yes	a	No	No	No
Preload	No	b	Light	Medium	Heavy
Ca%	0	3 below	3~5%	5~7%	7~9%

Table 5.2.3 Selection reference table

Grade	Suggest Preload	Suggested Nut Form	Suggested Lead Screw Form
C10	P0 (Table 5.2.5)	Single nut	Rolling screw rod
C7	P1a (with axial play \ 50% axial play of P0) P1b (with Preload \ 3% below of Ca) The SHAC [®] standard is (P1)	According to customer needs	Rolling or grinding screw
C5	Produce according to Customer requirements, if not specified The SHAC [®] standard is (P2)	According to customer needs	Rolling or grinding screw (with lead check list attached)
C3	Produce according to customer requirement, otherwise SHAC assistance do calculate.	According to customer needs	Grinding lead screw (with lead check list attached)

SHAC[®] suggests that the maximum preload should not exceed 10% of the dynamic load, as the screw will have a better service life and lower temperature rise effect. Generally, light preload refers to less than 3%, light to medium preload refers to 3% to 5%, medium preload refers to 5% to 7%, and medium to heavy preload refers to 7% to 9%.

Table 5.2.4 P2 Preload Spring Force Reference Table

Model	Spring Force (Kg) Single Nut		Spring Force (Kg) Double Nut	
1605	0.1~0.3	±50	±35	0.3~0.6
2005	0.1~0.3	±50	±35	0.3~0.6
2505	0.2~0.5	±40	±35	0.3~0.6
3205	0.2~0.5	±40	±25	0.5~0.8
4005	0.2~0.5	±40	±25	0.5~0.8
2510	0.2~0.5	±40	±25	0.5~0.8
3210	0.3~0.6	±35	±25	0.5~0.8
4010	0.3~0.6	±35	±25	0.5~0.8
5010	0.3~0.6	±35	±20	0.8~1.2
6310	0.6~1.0	±25	±20	0.8~1.2
8010	0.6~1.0	±25	±20	0.8~1.2

Table 5.2.5 Axial Play (PO) Clearance in the Axial Direction of Rolled and Ground Ball Screw Unit: mm

Nominal Diameter	Rolled Ball Screw Clearance In the Axial Direction(mm)	Ground Ball Screw Clearance in the Axial Direction(mm)
φ04-φ14	0.05	0.015
φ15-φ40	0.08	0.025
φ50-φ100	0.12	0.05

Note:

a) For ball screw with preloading requirements, if the customer does not specify the preloading range, the P2 preloading in Table 1.3.6 will be followed and the spring force range will be further set based on the slenderness ratio, accuracy level, and reference torque.

b) P1 micro gap is 50% of P0 (if there is a gap, there is no preload, or if there is preload, there is no gap!)

Note: For ball screw with clearance requirements, if the customer does not specify the axial clearance size, it will be executed according to Tables 1.3. 7.

5-2-1 Rolled Screw Shaft Standard Specifications

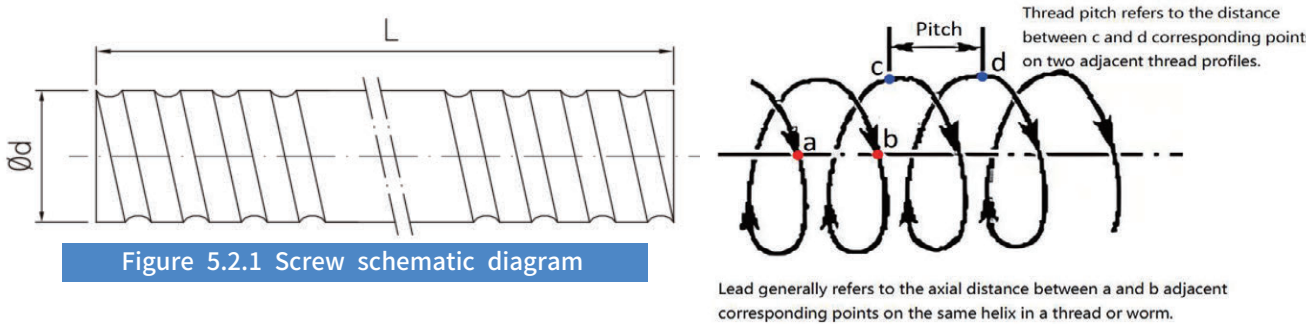


Table 5.2.6 Rolled and Stock Screw Standard Row Dimension Specification Comparison Unit: mm

Model No.			Lead accurat grade	Thread direction	Numbwe of grooves	Standard Code of Shaft	Type of Nut	Max. Length of Shaft
O.D.φd	Lead	Ball Dia.		Left \ Right				
12	10	2.5	C10、C7、C5	R	2	SSR01210	S	3000
16	5	2.778	C10、C7、C5	R/L	1	SSR01605	S、H	1000
	10	2.778	C10、C7、C5	R	2	SSR01610	S、H	
	16	2.778	C10、C7、C5	R	4	SSR01616	S、H	
	20	2.778	C10、C7、C5	R	4	SSR01620	S	
20	10	3.175	C10、C7、C5	R	2	SSR02010	S、H	3000
25	10	3.175	C10、C7、C5	R/L	2	SSR02510	S、H	6000
	25	3.175	C10、C7	R	4	SSR02525	S、H	
32	10	3.969	C10、C7、C5	R	1	SSR03210	S、H	6000
	20	3.969	C10、C7	R	2	SSR03220	S、H	
	32	3.969	C10、C7	R	4	SSR03232	S	
40	10	6.35	C10、C7	R	1	SSR04010	S、H	6000
	20	6.35	C10、C7、C5	R	2	SSR04020	S	
	40	6.35	C10、C7	R	4	SSR04040	S	
50	10	6.35	C10、C7	R	1	SSR05010	S、H	6000
	20	6.35	C10、C7	R	2	SSR05020	S	
	50	6.35	C10、C7	R	4	SSR05050	S	

*The above are standard specifications. For C5 and other requirements, please consult SHAC sales staff.

Table 5.2.7 Standard Size Specifications Comparison Table 40-80

Unit: mm

Model No.			Lead accuract grade	Thread direction	Numbwe of grooves	Standard Code of Shaft	Type of Nut	Max. Length of Shaft
O.D.φd	Lead	Ball Dia.		Left \ Right				
6	1	0.8	C10、C7	R	1	SCR00601	K	1000
8	1	0.8	C10、C7、C5	R	1	SCR00801	K	1000
	2	1.2	C10、C7、C5	R	1	SCR00802	K	
	2.5	1.2	C10、C7、C5	R	1	SCR0082.5	K、BSH	
10	2	1.2	C10、C7、C5	R	1	SCR01002	K、BSH	3000
	4	2	C10、C7、C5	R	1	SCR01004	K、BSH	
12	2	1.2	C10、C7、C5	R	1	SCR01202	K	3000
	4	2.5	C10、C7、C5	R	1	SCR01204	U、BsH	
	5	2.5	C10、C7、C5	R/L	1	SCR01205-A	V、U、BSH、S、H	
	5	2.5	C10、C7、C5	R	1	SCR01205-B	K	
	10	2.5	C10、C7、C5	R	2	SCR01210-B	V	
14	2	1.2	C10、C7、C5	R	1	SCR01402	K	1800
	4	2.5	C10、C7	R	1	SCR01404	BSH	3000
16	4	2.381	C10、C7、C5	R	1	SCR01604	V、I、U、BSH	3000
	5	3.175	C10、C7、C5	R/L	1	SCR01605	V、I、U、BSH	
	10	3.175	C10、C7、C5	R	2	SCR01610	V、I、U、BSH	
	16	2.778	C10、C7、C5	R	4	SCR01616	Y	
	32	2.778	C10、C7	R	8	SCR01632	Y	
20	4	2.381	C10、C7、C5	R	1	SCR02004	V、I、U	3000
	5	3.175	C10、C7、C5	R/L	1	SCR02005	V、U、BSH、S、H	
	20	3.175	C10、C7、C5	R	4	SCR02020	V、Y、S、H	
	40	3.175	C10、C7	R	8	SCR02040	Y	
25	4	2.381	C10、C7	R	1	SCR02504	I、U	6000
	5	3.175	C10、C7、C5	R/L	1	SCR02505	V、U、BsH、S、H	
	10	4.762	C10、C7、C5	R	1	SCR02510—A	I、U、BsH	
	10	6.35	C10、C7、C5	R	1	SCR02510—B	V	
	25	3.969	C10、C7、C5	R	4	SCR02525	V、Y	
	50	3.969	C10、C7	R	8	SCR02550	Y	
32	4	2.381	C10、C7、C5	R	1	SCR03204	V、I、U	6000
	5	3.175	C10、C7、C5	R/L	1	SCR03205	V、I、U、a、S、H	
	10	6.35	C10、C7、C5	R/L	1	SCR03210	V、I、U	
	32	4.762	C10、C7	R	4	SCR03232	Y	
	64	4.762	C10、C7	R	8	SCR03264	Y	

*The above are standard specifications. For C5 and other requirements, please consult SHAC sales staff.

Table 5.2.8 S-Type Dimension Specification Comparison (φ12-50 mm)

Unit: mm

Model No.			Lead accuract grade	Thread direction	Numbwe of grooves	Standard Code of Shaft	Type of Nut	Max. Length of Shaft
O.D.φd	Lead	Ball Dia.		Left \ Right				
40	5	3.175	C10、C7、C5	R	1	SCR04005	V、I、U、S、H	6000
	10	6.35	C10、C7	R	1	SCR04010	V、I、U	
	20	6.35	C10、C7	R	2	SCR04020	V	
	40	6.35	C10、C7	R	4	SCR04040	Y	
	80	6.35	C10、C7	R	8	SCR04080	Y	
50	5	3.175	C10、C7、C5	R	1	SCR05005	V、S、H	6000
	10	6.35	C10、C7、C5	R/L	1	SCR05010	Y、I、U	
	20	9.525	C10、C7	R	1	SCR05020	V	
	50	7.938	C10、C7	R	4	SCR05050	Y	
	100	7.938	C10、C7	R	8	SCR050100	Y	
63	10	6.35	C10、C7、C5	R	1	SCR06310	V、I、U	7000
	20	9.525	C10、C7	R	1	SCR06320	V、U	
80	10	6.35	C10、C7、C5	R	1	SCR08010	V、I、U	7000
	20	9.525	C10、C7	R	1	SCR08020	V、U	

5-3 Ground Ball Screw Standard Specifications

Table 5.3.1 Standard Length of Ground Ball Screw Unit: mm

Nominal Diameter	Lead																			Maximum length of Shaft	Thread length	
	1	1.5	2	2.5	4	5	6	8	10	12	14	16	20	25	30	32	40	50	64		80	Peeling Ballscrew
6	●																				120	
8	●	●	■	●		●															160	
10			●		●		●			●											200	
12			●		■	■			■				■								250	2000
14			●																		300	
16					●	■			■			●	●								800	5500
20					●	■	●	●	●				●				●				1000	5500
25					●	■	●	●	■	●		●	●	●				●			1500	5500
28							●	●	●	●		●									2000	5500
32					■	■	●	●		●		●	●			●			●		2500	5500
36							●		●	●		●	●								2500	5500
40					■	■	●	●		●		●	●				●			●	3000	5500
45										●											3000	5500
50						●	●	●		●		●	●		●		●	●			3000	5500+
55										●											3000	5500+
63									●	●		●	●				●				3000	6300+
80									●	●		●	●	●							3000	6300+
100													●		●		●				3000	

■ Left-hand threaded screw available
● Only right-hand lead screws are produced +Connectable thread

5-3-1 Nut Code

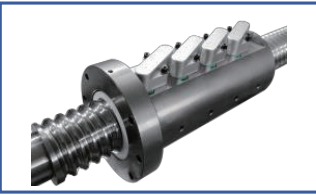
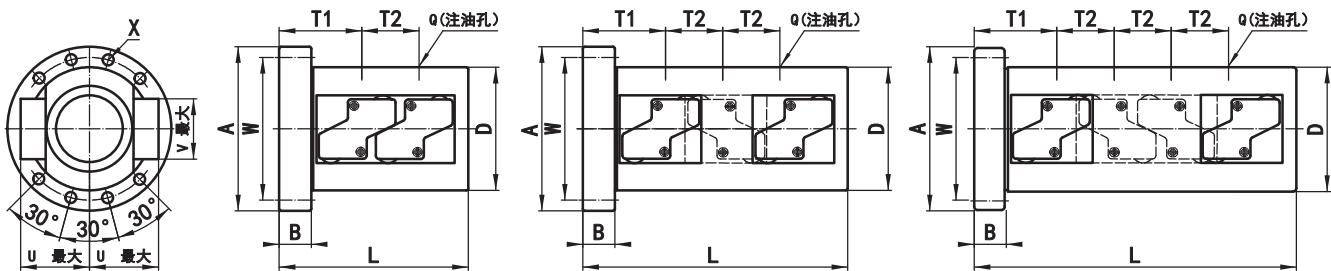
Product Image	Code	Page	Product Image	Code	Page
	Heavy SFBH	P262		OFNU	P277
	Heavy DFB SFB	P263		OFNI	P278
	Heavy DFDC SFDC	P264 P268		DFS SFS	P279 P280
	Heavy DFNU SFNU	P272 P273		DFNI SFNI	P282 P283
	Heavy SFU Special for electric	P274		SFA	P284
	Heavy SFKH Special for electric	P2756		SFK	P286
	SFY	P276		SMA	P287

Figure 5-3-1

5-4 Grinding Ball Screw Standard Model No. Series

Size Table of SFBH Ball Screw (Heavy-duty Tubular Type)



Model no.	d	l	Da	dr	n	Load Rating Ca (kgf)	Load Rating Co (kgf)	Dimension										Bend Protrusion	
								Q	T1	T2	L	A	B	Φ	W	D	V	U	
SFBHR5014-7.5	50	14	9.525	42.25	2.5*3	22015	70623	3-PT1/8	66.5	42	202	114	28	8-Φ9	97	80	39	54.5	
SFBHR5016-7.5		16	12.7	40	2.5*3	31645	93696	3-PT1/8	80	48	226	129	28	8-Φ9	112	95	45	64	
SFBHR6316-5	63	16	12.7	53	2.5*2	25224	78535	2-PT1/8	80	48	164	139	28	8-Φ9	122	105	47	70	
SFBHR6316-7.5					2.5*3	35748	117803	3-PT1/8			228								
SFBHR6320-5		20	15.875	50.24	2.5*2	33362	97641	2-PT1/8	96.5	60	199	157	32	8-Φ11	137	117	56.5	78	
SFBHR6320-7.5					2.5*3	47281	146461	3-PT1/8			279								
SFBHR8016-7	80	16	12.7	70	3.5*2	36785	135509	2-PT1/8	83	64	200	154	32	8-Φ9	137	120	60	80	
SFBHR8016-10.5					3.5*3	52132	203263	3-PT1/8			278								
SFBHR8016-14					3.5*4	66766	271017	4-PT1/8			342								
SFBHR8020-7		20	15.875	67.24	3.5*2	48943	166706	2-PT1/8	96.5	80	239	170	32	8-Φ11	150	130	66	82	
SFBHR8020-10.5					3.5*3	69364	250059	3-PT1/8			339								
SFBHR8025-5		25	19.05	64.49	2.5*2	46197	141328	2-PT1/8	85.75	75	232	185	40	8-Φ11	165	145	69	93	
SFBHR8025-7.5					2.5*3	65472	211991	3-PT1/8			332								
SFBHR10020-10.5		100	20	15.875	87.24	3.5*3	77935	317549	3-PT1/8	97	80	339	185	32	8-Φ11	165	145	78	96
SFBHR10020-14	3.5*4					99811	423399	4-PT1/8	419										
SFBHR10025-10.5	25		19.05	84.49	3.5*3	99783	383666	3-PT1/8	117.75	100	422	199	40	8-Φ11	179	159	71	108	
SFBHR10025-14					3.5*4	127792	511554	4-PT1/8			522								
SFBHR12020-7.5	120	20	15.875	107.24	2.5*3	65381	283691	3-PT1/8	105	60	287	213	40	8-Φ11	193	173	60	108	
SFBHR12020-10					2.5*4	83734	378255	4-PT1/8			347								
SFBHR12025-10.5		25	19.05	104.49	3.5*3	108216	457149	3-PT1/8	117.75	100	421	213	40	8-Φ11	193	173	71	116	
SFBHR12025-14					3.5*4	138592	609533	4-PT1/8			521								

The stiffness values shown in the table represent spring constants.Each constant is obtained from the load and elastic deformation when 30% of the axial basic rated dynamic load (Ca) is applied in the axial direction.

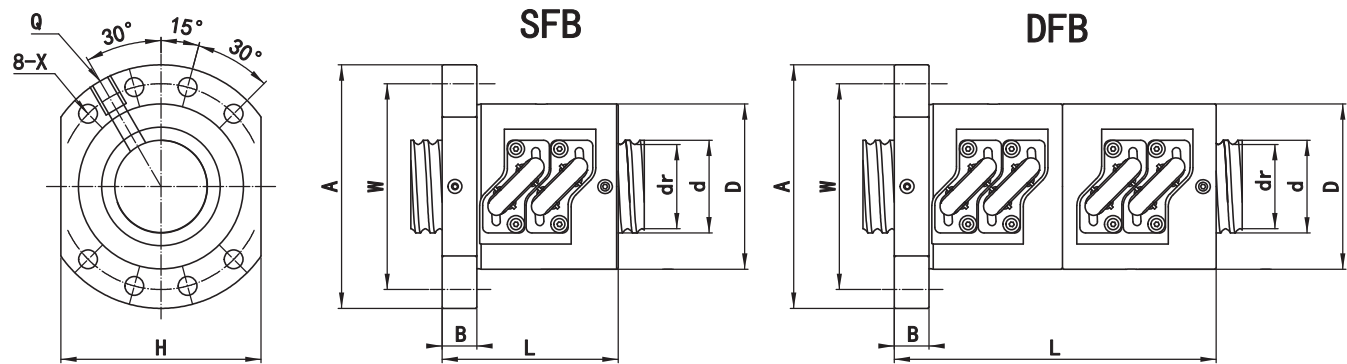
This value does not include the rigidity values of the nut mounting part and related components. Therefore, please take 80% of the values in the table as the approximate evaluation criterion. When the actual axial load (Fa0) is not 0.3Ca, the rigidity value (Kn) can be calculated by the following formula.

$$K_N = K \left(\frac{Fa_0}{0.3Ca} \right)^{\frac{1}{3}}$$

K: The rigid values in the size table

If you need to make different turns in the above table, please consult SHAC.

Size Table of SFB/DFB Ball Screw



Model no.	d	l	Da	dr	Load Rating Ca(kgf)	Load Rating Co(kgf)	K kgf/μm	Dimension								
								D	A	B	L	W	H	X	Q	n
SFBR3205-5	32	5	3.175	29.35	2579	8885	75	57	84	12	63	71	69	6-Φ6.6	M6*1	2.5*2
SFBR4005-5	40	5	3.175	37.35	2829	11191	87	65	95	12	63	80	75	8-Φ9	M8*1	2.5*2
SFBR4006-5	40	6	3.969	36.64	3857	13885	91	65	95	16	73	80	75	6-Φ9	M8*1	2.5*2
SFBR5008-5	50	8	4.762	46.12	5403	20641	112	83	121	18	92	103	92	8-Φ11	M8*1	2.5*2

Model no.	d	l	Da	dr	Load Rating Ca(kgf)	Load Rating Co(kgf)	K kgf/μm	Dimension								
								D	A	B	L	W	H	X	Q	n
DFBR3205-5	32	5	3.175	29.35	2579	8885	116	57	84	12	111	71	69	6-Φ6.6	M6*1	2.5*2
DFBR4005-5	40	5	3.175	37.35	2829	11191	135	65	95	12	111	80	75	8-Φ9	M8*1	2.5*2
DFBR4006-5	40	6	3.969	36.64	3857	13885	141	65	95	16	134.5	80	75	6-Φ9	M8*1	2.5*2
DFBR5008-5	50	8	4.762	46.12	5403	20641	173	83	121	18	161	103	92	8-Φ11	M8*1	2.5*2

1. The values marked with “*” in the table can be used for left-hand lead screws, with nut dimensions identical to those of right-hand lead screws.

2. The stiffness values shown in the table represent spring constants. Each constant is determined by applying a pre-load of 30% of the axial basic rated dynamic load (Ca) and then applying an axial load equal to three times the pre-load, with both the load and elastic deformation taken into account.

This value does not include the stiffness values of the nut mounting section and related components. Therefore, please consider 80% of the values in the table as a rough guideline.

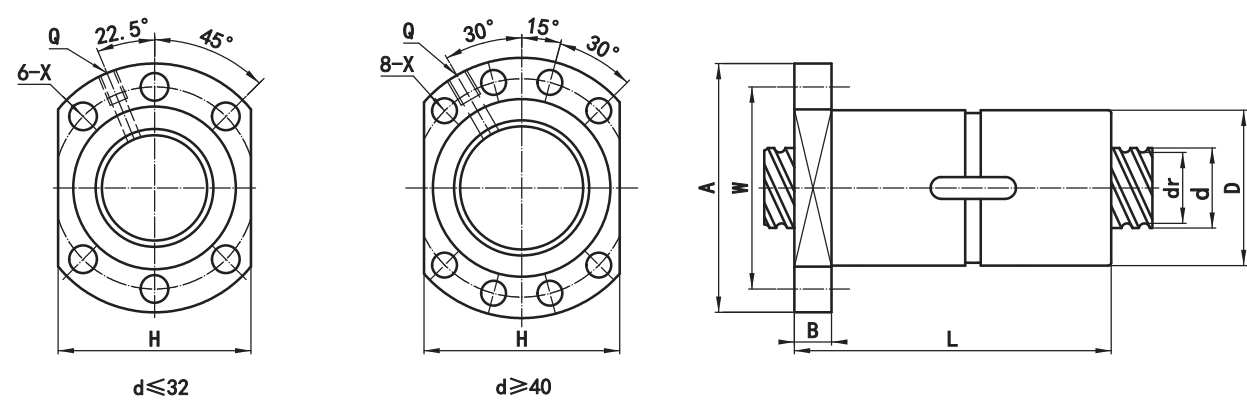
If the actual preload (Fa0) is not 0.1Ca, the stiffness value (Kn) can be calculated using the following formula.

$$K_N = K \left(\frac{Fa_0}{0.3Ca} \right)^{\frac{1}{3}}$$

If you need to produce different numbers of coils from the table above, please consult SHAC.

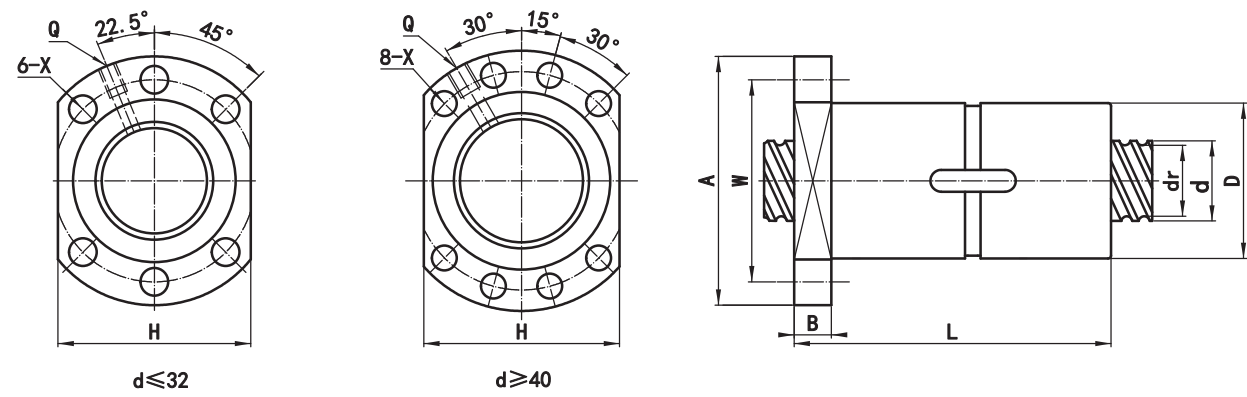
K: The rigid values in the size table

Size Table of DFDC Ball Screw



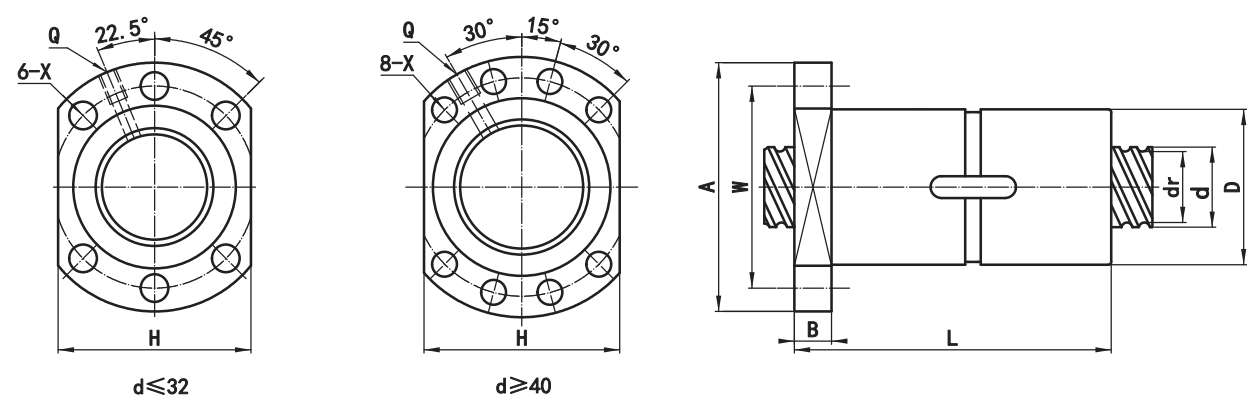
Model no.	d	l	Da	dr	Load Rating Ca(kgf)	Load Rating Co(kgf)	K kgf/μm	Dimension								
								D	A	B	L	W	H	X	Q	n
DFDCR1610-3.8	16	10	3.969	12.64	1729	3558	55	34	56	12	122	45	43	6-Φ6.6	M6*1	3.8*1
DFDCR2006-3.8	20	6	3.175	17.35	1821	4640	72	36	58	12	87	47	44	6-Φ6.6	M6*1	3.8*1
DFDCR2008-3.8		8	3.969	16.64	1975	4510	61	38	60	12	106	49	46	6-Φ6.6	M6*1	3.8*1
DFDCR2010-3.8		10			1964	4491	61				122	49	46			
DFDCR2506-3.8	25	6	3.175	22.35	2027	5879	67	40	62	12	92	51	48	6-Φ6.6	M6*1	3.8*1
DFDCR2508-3.8		8			1652	4645	68				105	51	48			
DFDCR2510-3.8		10	3.969	21.64	2216	5722	71	43	65	15	127	54	51	6-Φ6.6	M6*1	3.8*1
DFDCR2512-3.8		12			2206	5704	72				140					
DFDCR2516-3.8		16			2179	5663	70				180					
DFDCR2508-3.8		8	4.762	21.12	2847	6941	75	45	65	15	111.5	54	51	6-Φ6.6	M6*1	3.8*1
DFDCR2510-3.8		10			2837	6923	75				127					
DFDCR2512-3.8		12			2825	6901	75				147					
DFDCR2516-3.8		16			2795	6845	75				180					
DFDCR2520-3.8		20			2758	6774	73				206					
DFDCR2806-4.8	28	6	3.969	24.64	2926	8416	97	46	68	16	107.5	57	52	6-Φ6.6	M8*1	4.8*1
DFDCR2808-4.8		8	4.762	24.12	3691	9884	101	48	74	12	126.5	60	60	6-Φ6.6	M6*1	4.8*1
DFDCR2810-4.8		10			3680	9863	101				146.5					
DFDCR2812-4.8		12			3668	9837	102				170.5					
DFDCR2816-B1		16			2288	5701	60				143					2.8*1
DFDCR2812-4.8		12	6.35	22.90	5189	12584	108	54	87	16	173.5	72	69	6-Φ9	M8*1	4.8*1

Size Table of DFDC Ball Screw-2



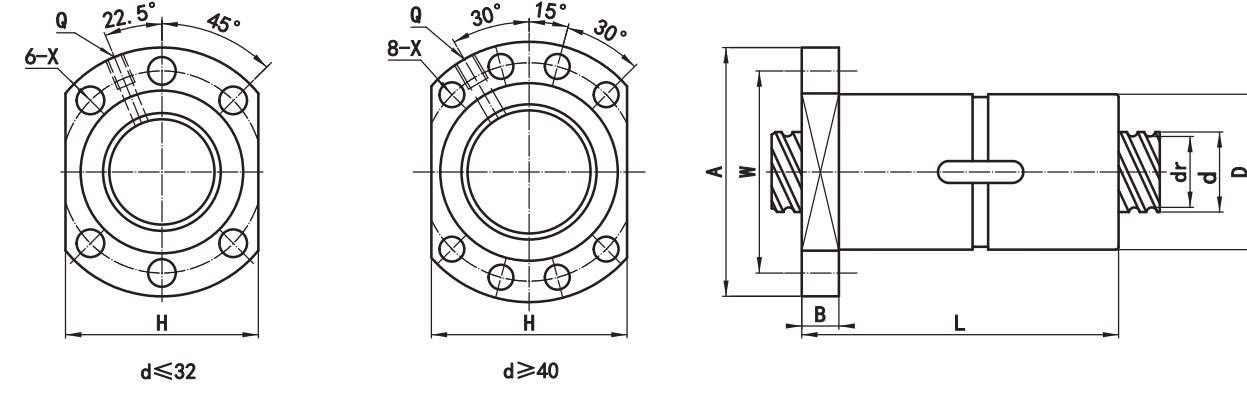
★	Model no.	d	l	Da	dr	Load Rating Ca(kgf)	Load Rating Co(kgf)	K kgf/μm	Dimension								
									D	A	B	L	W	H	X	Q	n
★	DFDCR3204-4.8	32	4	2.381	29.96	1500	5674	91	48	72	12	80	60	54	6-Φ6.6	M6*1	4.8*1
	DFDCR3205-3.8		5	3.175	29.35	1849	6028	79	50	87	16	81.5	72	69	6-Φ9	M8*1	3.8*1
	DFDCR3206-4.8		6	3.969	28.64	3016	9208	101	50	80	16	107.5	65	62	6-Φ9	M8*1	4.8*1
	DFDCR3208-4.8		8			3011	9195	103				126.5					
	DFDCR3210-4.8		10			3084	9547	108				146.5					
	DFDCR3212-4.8		12			3075	9527	109				170.5					
	DFDCR3216-4.8		16			3055	9478	108				210.5					
	DFDCR3208-4.8		8	4.762	28.12	3858	11021	107	53	87	16	127	72	69	6-Φ9	M8*1	4.8*1
	DFDCR3210-4.8		10			3850	11002	108				147					
	DFDCR3212-4.8		12			3840	10980	108				172.5					
	DFDCR3216-3.8		16			3218	9060	90				178.5					3.8*1
	DFDCR3220-3.8		20			3191	9001	89				206.5					
	DFDCR3210-4.8		10	6.35	26.90	5624	14592	116	57	87	16	155	72	69	6-Φ9	M8*1	4.8*1
	DFDCR3212-4.8		12			5609	14563	116				173					3.8*1
	DFDCR3216-3.8		16			5573	14490	116				181.5					
DFDCR3606-4.8	36	6	3.969	32.64	3237	10743	113	54	87	16	107.5	72	69	8-Φ9	M8*1	4.8*1	
DFDCR3610-4.8		10	4.762	32.12	4116	12663	119	57	87	16	147	72	68	8-Φ9	M8*1	4.8*1	
DFDCR3610-4.8		10	6.35	30.90	6011	16617	125	61	91	18	148.5	76	68	6-Φ9	M8*1	4.8*1	
DFDCR3612-4.8		12			5998	16591	125				172.5						
DFDCR3616-4.8		16			5967	16524	126				212.5						
DFDCR3620-3.8		20			4849	13015	101				208.5					3.8*1	
★	DFDCR4004-4.8	40	4	2.381	37.96	1037	3027	62	56	80	12	80	68	62	6-Φ6.6	M8*1	4.8*1
	DFDCR4005-4.8		5	3.175	37.35	2478	9592	112	58	91	18	97	76	68	8-Φ9	M8*1	4.8*1

Size Table of DFDC Ball Screw-3



Model no.	d	l	Da	dr	Load Rating Ca(kgf)	Load Rating Co(kgf)	K kgf/μm	Dimension								
								D	A	B	L	W	H	X	Q	n
DFDCR4006-4.8	40	6	3.969	36.64	3378	11901	118	58	91	18	108.5	76	68	6-Φ9	M8*1	4.8*1
DFDCR4008-4.8		8	4.762	36.12	4361	14340	126	60	91	18	132.5	76	68	8-Φ9	M8*1	4.8*1
DFDCR4010-4.8		10			4355	14325	128				153.5					
DFDCR4010-4.8		10	6.35	34.90	6343	18597	135	66	95	18	157.5	80	72	8-Φ9	M8*1	4.8*1
DFDCR4012-4.8		12			6332	18573	136				173.5					
DFDCR4016-4.8		16			6305	18512	137				212.5					
DFDCR4010-4.8		10	7.144	34.18	7453	21026	141	70	105	18	157	88	80	8-Φ11	M8*1	4.8*1
DFDCR4012-4.8		12			7441	20999	142				174					
DFDCR4016-4.8		16			7409	20931	143				214.5					
DFDCR4020-4.8		20			7370	20844	144				262					
DFDCR4512-4.8		45	12	7.144	39.18	7839	23526	153	80	115	18	173	98	90	8-Φ9	M8*1
DFDCR5008-4.8	50	8	4.762	46.12	4732	17692	143	70	105	18	127.5	88	80	8-Φ11	M8*1	4.8*1
DFDCR5010-4.8		10	6.35	44.90	7053	23544	156	75	118	18	157.5	100	92	8-Φ11	M8*1	4.8*1
DFDCR5012-4.8		12			7045	23524	158				173.5					
DFDCR5016-4.8		16			7026	23474	161				213.5					
DFDCR5010-4.8		10	7.144	44.18	8206	26069	160	80	118	18	157	100	92	8-Φ11	M8*1	4.8*1
DFDCR5012-4.8		12			8197	26047	162				182					
DFDCR5016-4.8		16			8175	25992	164				214.5					
DFDCR5020-4.8		20			8146	25922	165				263					
DFDCR5030-3.8		30	7.938	43.37	9317	28650	170	82	120	20	301	102	94	8-Φ11	M8*1	3.8*1
DFDCR5040-3.8		40			9163	28286	167				393					
DFDCR5012-4.8		12	9.525	42.25	12155	35153	177	89	134	25	185.5	114	100	8-Φ14	M8*1	4.8*1
DFDCR5016-4.8		16			12122	35079	180				226.5					
DFDCR5020-4.8		20			12080	34986	181				266.5					
DFDCR5020-4.8		20			12.7	40.00	17391				46472					
DFDCR5512-4.8	55	12	7.144	49.18	8524	28565	173	90	128	18	173	110	100	8-Φ11	M8*1	4.8*1

Size Table of DFDC Ball Screw-4



Model no.	d	l	Da	dr	Load Rating Ca(kgf)	Load Rating Co(kgf)	K kgf/μm	Dimension								
								D	A	B	L	W	H	X	Q	n
DFDCR6310-4.8	63	10	6.35	57.90	7725	29495	178	88	135	20	155.5	115	100	8-Φ11	M8*1	4.8*1
DFDCR6310-4.8		10	7.144	57.18	9179	33564	186	93	131	20	155.5	113	100	8-Φ11	M8*1	4.8*1
DFDCR6312-4.8		12	7.938	56.37	10534	36804	192	95	135	20	182.5	115	100	8-Φ11	M8*1	4.8*1
DFDCR6316-4.8		16			10515	36754	197				225.5					
DFDCR6316-4.8		16	9.525	55.25	13477	44049	205	102	147	25	228	127	112	8-Φ14	M8*1	4.8*1
DFDCR6320-4.8		20			13447	43973	208				266.5					
DFDCR6340-3.8		40			13203	43360	208				396.5					
DFDCR6316-4.8		16	12.7	53.00	19712	58580	223	115	159	28	245	137	125	8-Φ14	M8*1	4.8*1
DFDCR6320-4.8		20			19670	58482	225				285					
DFDCR8010-4.8	80	10	6.35	74.90	8623	38372	206	105	152	20	155.5	132	122	8-Φ11	M8*1	4.8*1
DFDCR8012-4.8		12	7.938	73.37	11758	47607	210	110	157		181.5	137	120	8-Φ11	M8*1	4.8*1
DFDCR8016-4.8		16	9.525	72.25	15190	57374	242	118	165	25	228	145	130	8-Φ14	M8*1	4.8*1
DFDCR8020-4.8		20			15169	57312	247				265					
DFDCR8016-4.8		16	12.7	70.00	22107	74477	255	132	176	28	245	154	145	8-Φ14	M8*1	4.8*1
DFDCR8030-4.8		30			21972	74128	264				394					
DFDCR10030-3.8	100	30	9.525	92.25	13428	55863	234	145	192	25	328	172	158	8-Φ14	M8*1	3.8*1
DFDCR10040-3.8		40			13370	55675	236				403					
DFDCR10020-4.8			20	12.7	90.00	24549	94184	300	150	194	28	287	172	160	8-Φ14	M8*1

Note: A star symbol can be used to make a left-hand screw.

1. The values marked with “*” in the table can be used for left-hand lead screws, with nut dimensions identical to those of right-hand lead screws.

2. The stiffness values shown in the table represent spring constants. Each constant is determined by applying a pre-load of 10% of the axial basic rated dynamic load (Ca) and then applying an axial load equal to three times the pre-load, with both the load and elastic deformation taken into account.

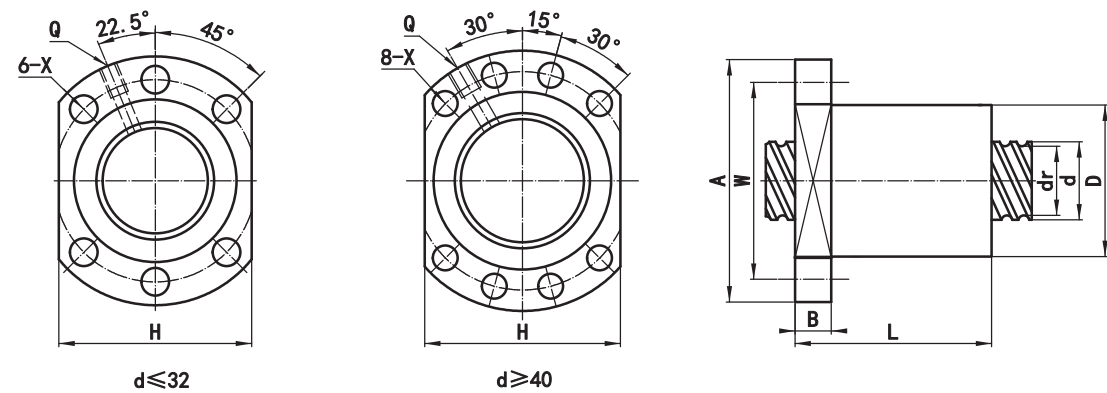
This value does not include the stiffness values of the nut mounting section and related components. Therefore, please consider 80% of the values in the table as a rough guideline. If the actual preload (Fa0) is not 0.1Ca, the stiffness value (Kn) can be calculated using the following formula.

$$K_N = K \left(\frac{Fa_0}{0.3Ca} \right)^{\frac{1}{3}}$$

K: The rigid values in the size table

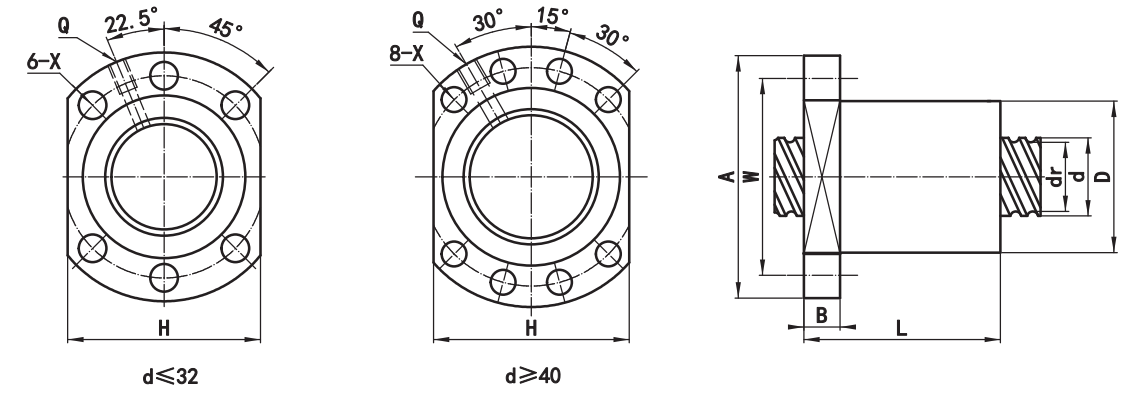
If you need to produce different numbers of coils from the table above, please consult SHAC.

Size Table of SFDC Ball Screw



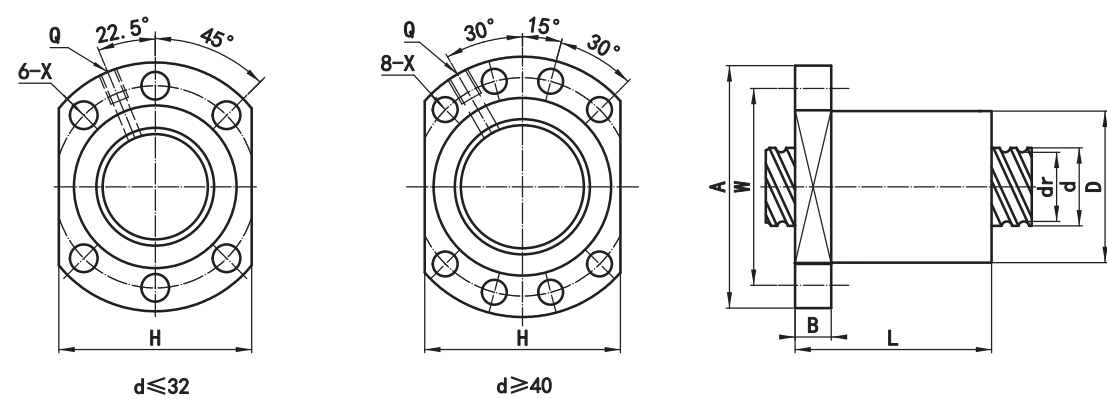
Model no.	d	l	Da	dr	Load Rating Ca(kgf)	Load Rating Co(kgf)	K kgf/μm	Dimension								
								D	A	B	L	W	H	X	Q	n
SFDCR1610-3.8	16	10	3.969	12.64	1729	3558	35	34	56	12	62	45	43	6-Φ6.6	M6*1	3.8*1
SFDCR2006-3.8	20	6	3.175	17.35	1821	4640	46	36	58	12	51	47	44	6-Φ6.6	M6*1	3.8*1
SFDCR2008-3.8		8	3.969	16.64	1975	4510	39	38	60	12	54	49	46	6-Φ6.6	M6*1	3.8*1
SFDCR2010-3.8		10			1964	4491	39				62					
SFDCR2506-3.8	25	6	3.175	22.35	2027	5879	43	40	62	12	56	51	48	6-Φ6.6	M6*1	3.8*1
SFDCR2508-3.8		8			1652	4645	44				57					
SFDCR2510-3.8		10	3.969	21.64	2216	5722	46	43	65	15	67	54	51	6-Φ6.6	M6*1	3.8*1
SFDCR2512-3.8		12			2206	5704	46				74					
SFDCR2516-3.8		16			2179	5663	45				92					
SFDCR2508-3.8		8	4.762	21.12	2847	6941	48	45	65	15	59.5	54	51	6-Φ6.6	M6*1	3.8*1
SFDCR2510-3.8		10			2837	6923	48				67					
SFDCR2512-3.8		12			2825	6901	48				75					
SFDCR2516-3.8		16			2795	6845	48				92					
SFDCR2520-3.8		20			2758	6774	47				106					
SFDCR2806-4.8	28	6	3.969	24.64	2926	8416	63	46	68	16	56.5	57	52	6-Φ6.6	M8*1	4.8*1
SFDCR2808-4.8		8	4.762	24.12	3691	9884	65	48	74	12	66.5	60	60	6-Φ6.6	M6*1	4.8*1
SFDCR2810-4.8		10			3680	9863	65				76.5					
SFDCR2812-4.8		12			3668	9837	66				86.5					
SFDCR2816-1.8		16			2288	5701	39				74.5					2.8*1
SFDCR2812-4.8		12	6.35	22.90	5189	12584	70	54	87	16	89.5	72	69	6-Φ9	M8*1	4.8*1
SFDCR3204-4.8	32	4	2.381	29.96	943	3310	59	48	72	12	34	60	54	6-Φ6.6	M6*1	4.8*1
SFDCR3205-3.8		5	3.175	29.35	1849	6028	51	50	87	16	44	72	69	6-Φ9	M8*1	3.8*1

Size Table of SFDC Ball Screw-2



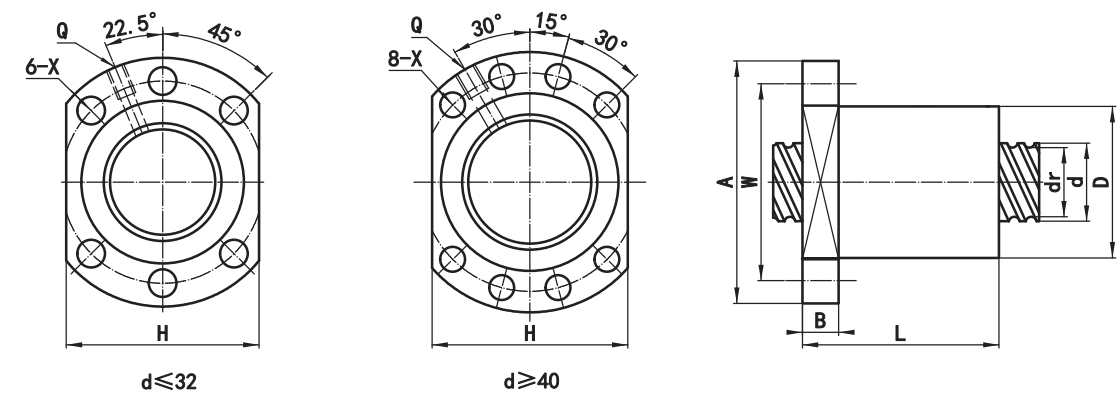
Model no.	d	l	Da	dr	Load Rating Ca(kgf)	Load Rating Co(kgf)	K kgf/μm	Dimension								
								D	A	B	L	W	H	X	Q	n
SFDCR3206-4.8	32	6	3.969	28.64	3016	9208	65	50	80	16	56.5	65	62	6-Φ9	M8*1	4.8*1
SFDCR3208-4.8		8			3011	9195	66				66.5					
SFDCR3210-4.8		10			3084	9547	70				76.5					
SFDCR3212-4.8		12			3075	9527	70				86.5					
SFDCR3216-4.8		16			3055	9478	70				106.5					
SFDCR3208-4.8	32	8	4.762	28.12	3858	11021	69	53	87	16	67	72	69	6-Φ9	M8*1	4.8*1
SFDCR3210-4.8		10			3850	11002	70				77					
SFDCR3212-4.8		12			3840	10980	70				88.5					
SFDCR3216-3.8		16			3218	9060	58				90.5					3.8*1
SFDCR3220-3.8		20			3191	9001	57				106.5					
SFDCR3210-4.8	32	10	6.35	26.90	5624	14592	75	57	87	16	80	72	69	6-Φ9	M8*1	4.8*1
SFDCR3212-4.8		12			5609	14563	75				89					3.8*1
SFDCR3216-3.8		16			5573	14490	75				109.5					
SFDCR3606-4.8	36	6	3.969	32.64	3237	10743	73	54	87	16	56.5	72	69	8-Φ9	M8*1	4.8*1
SFDCR3610-4.8		10	4.762	32.12	4116	12663	77	57	87	16	77	72	68	8-Φ9	M8*1	4.8*1
SFDCR3610-4.8		10	6.35	30.90	6011	16617	81	61	91	18	78.5	76	68	6-Φ9	M8*1	4.8*1
SFDCR3612-4.8		12			5998	16591	81				88.5					
SFDCR3616-4.8		16			5967	16524	81				108.5					
SFDCR3620-3.8		20			4849	13015	65				108.5					3.8*1
SFDCR4004-4.8	40	4	2.381	37.96	1037	3027	40	56	80	12	34	68	62	6-Φ6.6	M8*1	4.8*1
SFDCR4005-4.8		5	3.175	37.35	2478	9592	72	58	91	18	53	76	68	8-Φ9	M8*1	4.8*1
SFDCR4006-4.8		6	3.969	36.64	3378	11901	76	58	91	18	57	76	68	6-Φ9	M8*1	4.8*1
SFDCR4008-4.8		8	4.762	36.12	4361	14340	81	60	91	18	68.5	76	68	8-Φ9	M8*1	4.8*1
SFDCR4010-4.8		10			4355	14325	83				78.5					
SFDCR4010-4.8		10	6.35	34.90	6343	18597	87	66	95	18	82.5	80	72	8-Φ9	M8*1	4.8*1

Size Table of SFDC Ball Screw-3



Model no.	d	l	Da	dr	Load Rating Ca(kgf)	Load Rating Co(kgf)	K kgf/μm	Dimension								
								D	A	B	L	W	H	X	Q	n
SFDCR4012-4.8	40	12			6332	18573	88				89.5					
SFDCR4016-4.8		16			6305	18512	88				108.5					
SFDCR4010-4.8		10	7.144	34.18	7453	21026	91	70	105	18	82	88	80	8-Φ11	M8*1	4.8*1
SFDCR4012-4.8		12			7441	20999	92				90					
SFDCR4016-4.8		16			7409	20931	92				110.5					
SFDCR4020-4.8		20			7370	20844	93				132					
SFDCR4512-4.8	45	12	7.144	39.18	7839	23526	99	80	115	18	89	98	90	8-Φ9	M8*1	4.8*1
SFDCR5008-4.8	50	8	4.762	46.12	4732	17692	92	70	105	18	67.5	88	80	8-Φ11	M8*1	4.8*1
SFDCR5010-4.8		10	6.35	44.90	7053	23544	101	75	118	18	82.5	100	92	8-Φ11	M8*1	4.8*1
SFDCR5012-4.8		12			7045	23524	102				89.5					
SFDCR5016-4.8		16			7026	23474	104				109.5					
SFDCR5010-4.8		10	7.144	44.18	8206	26069	103	80	118	18	82	100	92	8-Φ11	M8*1	4.8*1
SFDCR5012-4.8		12			8197	26047	105				92					
SFDCR5016-4.8		16			8175	25992	106				110.5					
SFDCR5020-4.8		20			8146	25922	106				133					
SFDCR5030-3.8		30	7.938	43.37	9317	28650	110	82	120	20	151	102	94	8-Φ11	M8*1	3.8*1
SFDCR5040-3.8		40			9163	28286	108				193					
SFDCR5012-4.8		12	9.525	42.25	12155	35153	114	89	134	25	95.5	114	100	8-Φ14	M8*1	4.8*1
SFDCR5016-4.8		16			12122	35079	116				114.5					
SFDCR5020-4.8		20			12080	34986	117				136.5					
SFDCR5020-4.8		20	12.7	40.00	17391	46472	133	102	146	28	145	124	112	8-Φ14	M8*1	4.8*1
SFDCR5512-4.8	55	12	7.144	49.18	8524	28565	112	90	128	18	89	110	100	8-Φ11	M8*1	4.8*1

Size Table of SFDC Ball Screw-4



Model no.	d	l	Da	dr	Load Rating Ca(kgf)	Load Rating Co(kgf)	K kgf/μm	Dimension								
								D	A	B	L	W	H	X	Q	n
SFDCR6310-4.8	63	10	6.35	57.90	7725	29495	115	88	135	20	80.5	115	100	8-Φ11	M8*1	4.8*1
SFDCR6310-4.8		10	7.144	57.18	9179	33564	120	93	131	20	82	113	100	8-Φ11	M8*1	4.8*1
SFDCR6312-4.8		12	7.938	56.37	10534	36804	124	95	135	20	92.5	115	100	8-Φ11	M8*1	4.8*1
SFDCR6316-4.8		16			10515	36754	127				113.5					
SFDCR6316-4.8		16	9.525	55.25	13477	44049	132	102	147	25	116	127	112	8-Φ14	M8*1	4.8*1
SFDCR6320-4.8		20			13447	43973	134				136.5					
SFDCR6340-3.8		40			13203	43360	134				196.5					
SFDCR6316-4.8		16	12.7	53.00	19712	58580	144	115	159	28	125	137	125	8-Φ14	M8*1	4.8*1
SFDCR6320-4.8		20			19670	58482	145				145					
SFDCR8010-4.8	80	10	6.35	74.90	8623	38372	133	105	152	20	80.5	132	122	8-Φ11	M8*1	4.8*1
SFDCR8012-4.8		12	7.938	73.37	11758	47607	135	110	157	20	91.5	137	120	8-Φ11	M8*1	4.8*1
SFDCR8016-4.8		16	9.525	72.25	15190	57374	156	118	165	25	116	145	130	8-Φ14	M8*1	4.8*1
SFDCR8020-4.8		20			15169	57312	159				135					
SFDCR8016-4.8		16	12.7	70.00	22107	74477	165	132	176	28	125	154	145	8-Φ14	M8*1	4.8*1
SFDCR8030-4.8		30			21972	74128	170				199					
SFDCR10030-3.8	100	30	9.525	92.25	13428	55863	151	145	192	25	163	172	158	8-Φ14	M8*1	3.8*1
SFDCR10040-3.8		40			13370	55675	152				203					
SFDCR10020-4.8			20	12.7	90.00	24549	94184	194	150	194	28	147	172	160	8-Φ14	M8*1

Note: A star symbol can be used to make a left-hand screw.

1. The values marked with “*” in the table can be used for left-hand lead screws, with nut dimensions identical to those of right-hand lead screws.

2. The stiffness values shown in the table represent spring constants. Each constant is determined by applying a pre-load of 10% of the axial basic rated dynamic load (Ca) and then applying an axial load equal to three times the pre-load, with both the load and elastic deformation taken into account.

This value does not include the stiffness values of the nut mounting section and related components. Therefore, please consider 80% of the values in the table as a rough guideline.

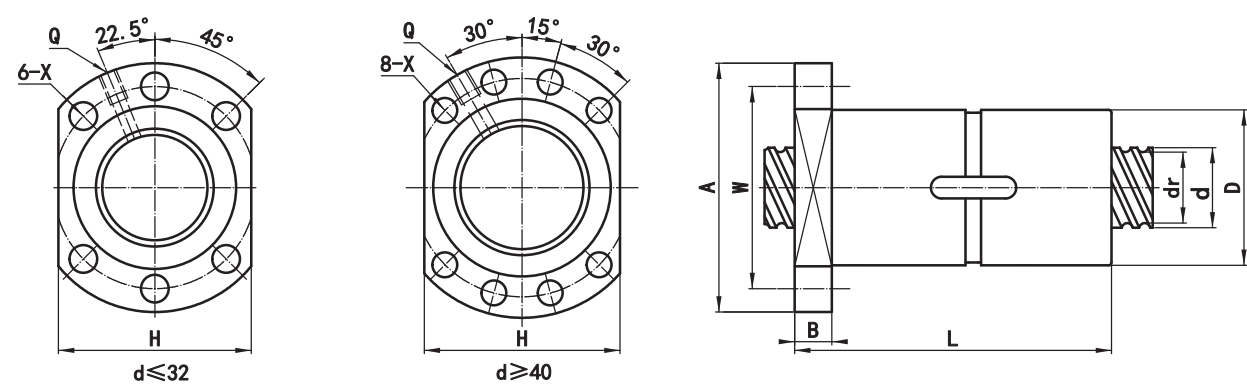
If the actual preload (Fa0) is not 0.1Ca, the stiffness value (Kn) can be calculated using the following formula.

$$K_N = K \left(\frac{Fa_0}{0.3Ca} \right)^{\frac{1}{3}}$$

K: The rigid values in the size table

If you need to produce different numbers of coils from the table above, please consult SHAC.

Size Table of DFNU Ball Screw



Model no.	d	l	Da	dr	Load Rating Ca(kgf)	Load Rating Co(kgf)	K kgf/μm	Dimension								
								D	A	B	L	W	H	X	Q	n
DFNUR1604-4	16	4	2.381	14.38	974	2408	49	28	48	10	80	38	40	6-Φ5.5	M6*1	1*4
DFNUR1605-4		5	3.175	13.82	1381	3055	51				91					1*4
DFNUR1610-3		10			1105	2403	41				118					1*3
DFUR2004-3	20	4	2.381	18.38	833	2242	43	36	58	10	82	47	44	6-Φ6.6	M6*1	1*3
DFNUR2005-4		5	3.175	17.82	1552	3879	60				95					1*4
DFUR2504-4	25	4	2.381	23.38	1181	3799	66	40	62	10	80	51	48	6-Φ6.6	M6*1	1*4
DFNUR2505-4		5	3.175	22.82	1726	4909	69				95					1*4
DFNUR2510-4		10	4.762	21.74	2957	7302	78			12	138.5					1*4
DFNUR3205-4	32	5	3.175	29.82	1924	6350	82	50	80	12	97	65	62	6-Φ9	M6*1	1*4
DFNUR3210-4		10	6.35	27.65	4810	12220	96				153					1*4
DFNUR4005-4	40	5	3.175	37.82	2112	7996	97	63	93	14	101	78	70	8-Φ9	M8*1	1*4
DFNUR4010-4		10	6.35	35.65	5405	15516	112				157				M8*1	1*4
DFNUR5010-4	50	10	6.35	45.65	6010	19634	131	75	110	16	157	93	85	8-Φ11	M8*1	1*4
DFNUR6310-4	63	10	6.35	58.65	6726	25384	154	90	125	18	182	108	95	8-Φ11	M8*1	1*4
DFUR6320-4		20	9.525	56.49	11456	36691	172	95	135	20	290	115	100	8-Φ13.5	M8*1	1*4
DFNUR8010-4	80	10	6.35	75.65	7353	31986	172	105	145	20	170.5	125	110	8-Φ13.5	M8*1	1*4
DFNUR8020-4		20	9.525	73.49	12924	47796	209	125	165	25	285	145	130		M8*1	1*4

Note: A star symbol can be used to make a left-hang screw.

The stiffness values shown in the table represent the spring constants. Each constant is determined by applying a pre-load equivalent to 10% of the axial basic rated dynamic load (Ca) and then applying an axial load three times the preload amount, with the load and elastic deformation measured under these conditions.

These values do not include the stiffness values of the nut mounting section and related components. Therefore, please consider 80% of the values in the table as a rough guideline.

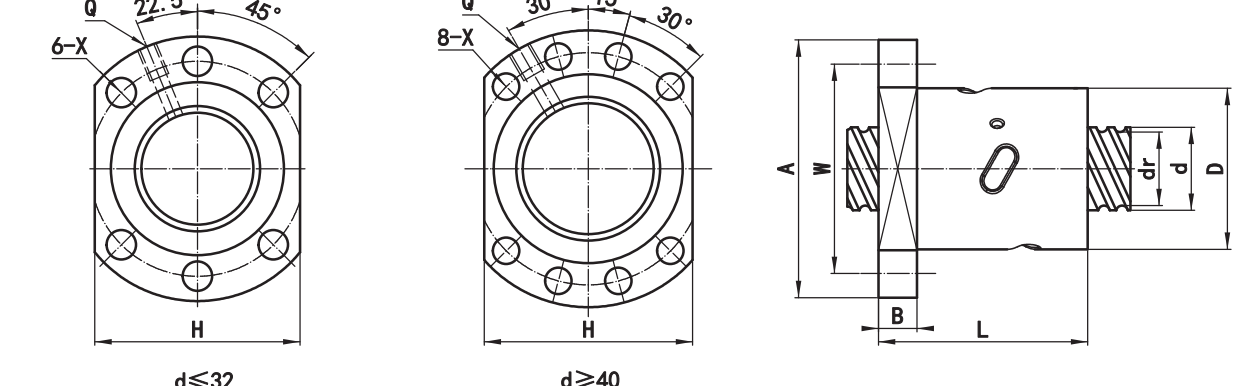
If the actual preload load (Fa0) is not 0.1Ca, the stiffness value (Kn) can be calculated using the following formula.

$$K_N = K \left(\frac{Fa_0}{0.3Ca} \right)^{\frac{1}{3}}$$

If you need to produce different numbers of coils as shown in the table above, please consult SHAC.

K: The rigid values in the size table

Size Table of SFNU Ball Screw



	Model no.	d	l	Da	dr	Load Rating Ca(kgf)	Load Rating Co(kgf)	K kgf/μm	Dimension								
									D	A	B	L	W	H	X	Q	n
★	SFNUR1204-3	12	4	2.5	9.74	678	1321	20	24	40	10	35	32	30	6-Φ4.5	M6*1	1*3
★	SFNUR1204-4					869	1761	26				40					1*4
	SFNUR1604-4	16	4	2.381	14.38	974	2408	32	28	48	10	40	38	40	6-Φ5.5	M6*1	1*4
★	SFNUR1605-3		5	3.175	13.82	1078	2291	25				42					1*3
★	SFNUR1605-4					1381	3055	33				45					1*4
★	SFNUR1610-3		10			1104	2404	27				57					1*3
	SFUR2004-3	20	4	2.381	18.38	833	2242	28	36	58	10	42	47	44	6-Φ6.6	M6*1	1*3
★	SFNUR2005-3		5	3.175	17.82	1212	2909	29				51					1*3
★	SFNUR2005-4					1552	3879	39									1*4
	SFUR2504-4	25	4	2.381	23.38	1181	3799	43	40	62	10	42	51	48	6-Φ6.6	M6*1	1*4
★	SFNUR2505-3		5	3.175	22.82	1348	3681	34				51					1*3
★	SFNUR2505-4					1726	4909	45									70
★	SFNUR2510-3		10	4.762	21.74	2309	5477	38			12	80					1*3
★	SFNUR2510-4					2957	7302	50				1*4					
★	SFNUR3205-4	32	5	3.175	29.82	1924	6350	53	50	80	12	52	65	62	6-Φ9	M6*1	1*4
★	SFNUR3210-3		10	6.35	27.65	3755	9165	47				74					1*3
★	SFNUR3210-4					4810	12220	62				85					1*4
★	SFNUR4005-4	40	5	3.175	37.82	2112	7996	62	63	93	14	55	78	70	8-Φ9	M8*1	1*4
★	SFNUR4010-3		10	6.35	35.65	4220	11637	55				71					1*3
★	SFNUR4010-4					5405	15516	72				88					1*4
★	SFNUR5010-4	50	10	6.35	45.65	6010	19634	84	75	110	16	88	93	85	8-Φ11	M8*1	1*4
	SFNUR6310-4	63	10	6.35	58.65	6726	25384	99	90	125	18	93	108	95	8-Φ11	M8*1	1*4
	SFUR6320-4		20	9.525	56.49	11746	38517	114	95	135	20	149	115	100	8-Φ13.5		1*4
	SFNUR8010-4	80	10	6.35	75.65	7353	31986	111	105	145	20	98	125	110	8-Φ13.5	M8*1	1*4
	SFNUR8020-4		20	9.525	73.49	12924	47796	143	125	165	25	154	145	130			1*4

Note: A star symbol can be used to make a left-hang screw.

The stiffness values shown in the table represent the spring constants. Each constant is determined by applying a pre-load equivalent to 10% of the axial basic rated dynamic load (Ca) and then applying an axial load three times the preload amount, with the load and elastic deformation measured under these conditions.

These values do not include the stiffness values of the nut mounting section and related components. Therefore, please consider 80% of the values in the table as a rough guideline.

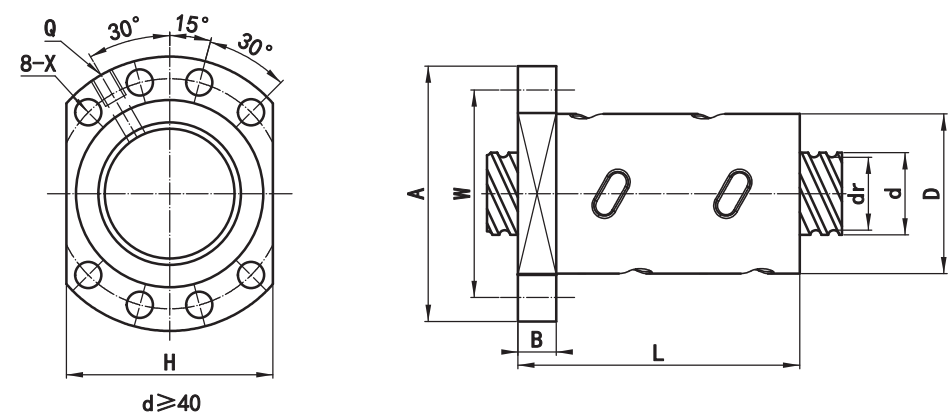
If the actual preload load (Fa0) is not 0.1Ca, the stiffness value (Kn) can be calculated using the following formula.

$$K_N = K \left(\frac{Fa_0}{0.3Ca} \right)^{\frac{1}{3}}$$

If you need to produce different numbers of coils as shown in the table above, please consult SHAC.

K: The rigid values in the size table

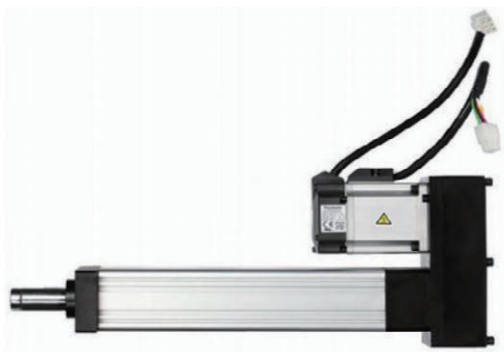
SFUH Special for Electric Cylinders



Model no.	d	l	Da	dr	Load Rating Ca(kgf)	Dimension						
						D	A	B	L	W	X	n
SFUH2510-T4	25	10	4.762	3314	8391	40	62	12	75	51	Φ6.6	1*4
SFUH3210-T5	32	10	6.35	6531	17553	53	83	12	88	68	Φ9	1*5
SFUH4010-T6	40	10	6.35	8585	26744	63	93	14	100	78	Φ9	1*6
SFUH5010-T6	50	10	6.35	9547	33844	75	109	16	102	93	Φ11	1*6
SFUH5012-T6	50	12	7.144	11131	37415	75	118	18	136	95	Φ11	1*6
SFUH6320-T6	63	20	9.525	18195	63244	95	135	23	202	115	Φ13.5	1*6
SFUH8020-T8	80	20	12.7	38391	142490	118	178	28	234	148	Φ17.5	1*8
SFUH8025-T6	80	25	15.875	39855	131396	128	178	28	248	148	Φ17.5	1*6
SFUH10020-T6	100	20	15.875	44875	167131	150	195	28	213	172	Φ17.5	1*6

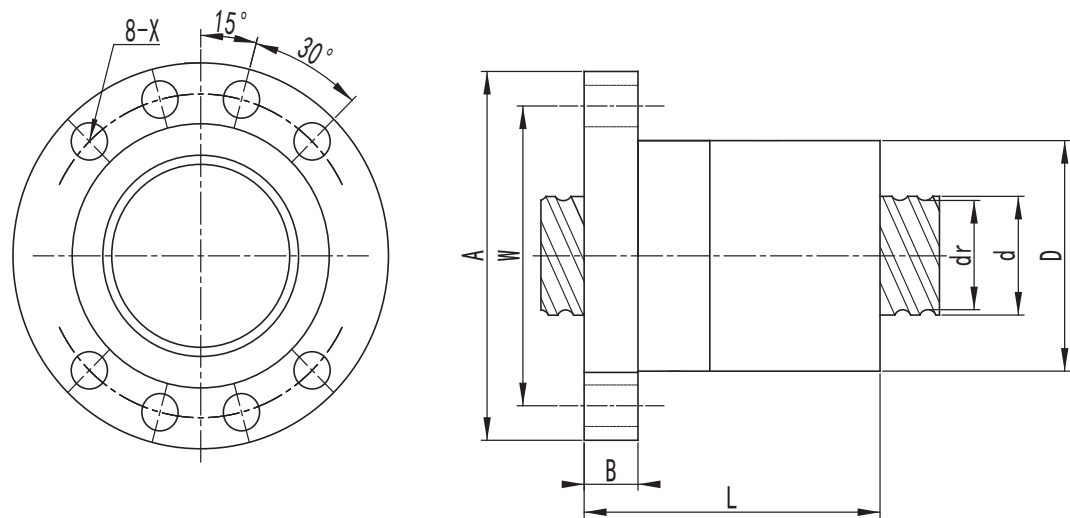
Note: The nut does not have an oil injection hole or a dust ring. The listed models are the preferred sizes for electric cylinder nuts

Specifications with asterisks can be produced using rolling technology



Size Table of SFK Ball Screws (Heavy)

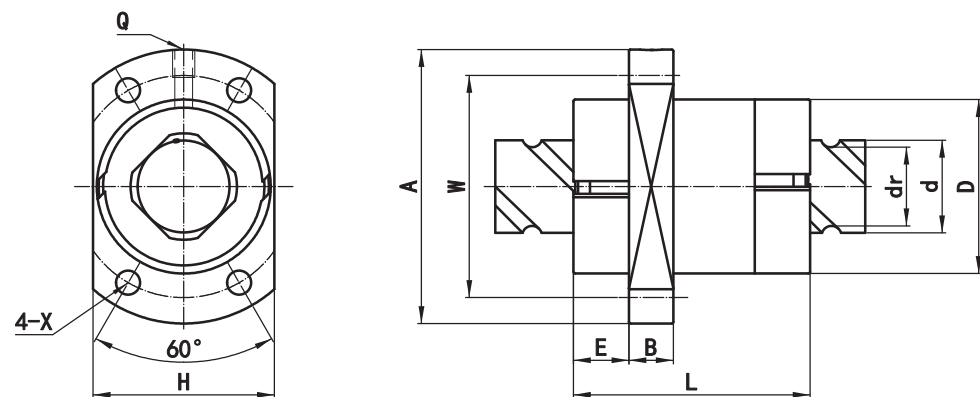
SFK multi array, electric cylinder specific



Model no.	d	l	Da	dr	Load Rating Ca(kgf)	Dimension						
						D	A	B	L	W	X	n
SFKHR5010-8	50	10	7.144	14235	49964	75	109	16	94	93	Φ11	1*8
SFKHR5020-7	50	20	7.144	12629	43440	75	109	16	154	93	Φ11	1*7
SFKHR6320-8	63	20	12.7	34205	112007	100	139	28	184	120	Φ13.5	1*8
SFKHR8020-8	80	20	12.7	38391	142490	125	169	28	182	150	Φ13.5	1*8
SFKHR10020-8	100	20	12.7	42691	180384	150	207	32	184	180	Φ17.5	1*8
SFKHR10025-8	100	25	15.875	57392	222606	150	207	32	227	180	Φ17.5	1*8
SFKHR12525-8	125	25	15.875	63766	281877	180	249	32	227	216	Φ22	1*8

Note: The nut does not have an oil injection hole or a dust ring. The listed models are the preferred sizes for electric cylinder nuts

Size Table of SFY Ball Screw



Model no.	d	l	Da	dr	Load Rating Ca(kgf)	Load Rating Co(kgf)	K kgf/μm	Dimension									
								D	A	E	B	L	W	H	X	Q	n
SFYR1616-3.6	16	16	2.778	13.81	1088	2554	31	32	53	10	10	45	42	34	4-Φ4.5	M6*1	1.8*2
SFYR1632-1.6		32			492	1111	12					42.5					0.8*2
SFYR2020-3.6	20	20	3.175	17.5	1390	3511	35	39	62	13	10	52	50	41	4-Φ5.5	M6*1	1.8*2
SFYR2040-1.6		40			652	1590	15					50					0.8*2
SFYR2040-3.6					1309	3578	32					90					1.8*2
SFYR2525-3.6	25	25	3.969	21.94	2078	5489	44	47	74	15	12	64	60	49	4-Φ6.6	M6*1	1.8*2
SFYR2525-5.6					3038	8538	66					89					2.8*2
SFYR2550-1.6		50			975	2487	18					60					0.8*2
SFYR2550-3.6					1957	5595	39					110					1.8*2
SFYR3232-3.6	32	32	4.762	28.37	2939	8307	53	58	92	17	12	78	74	60	4-Φ9	M6*1	1.8*2
SFYR3232-5.6					4297	12922	81					110					2.8*2
SFYR3264-1.6		64			1373	3742	22					71					0.8*2
SFYR4040-3.6	40	40	6.35	35.25	4840	14057	67	73	114	19.5	15	99	93	75	4-Φ11	M6*1	1.8*2
SFYR4040-5.6					7077	21866	103					139					2.8*2
SFYR4080-1.6		80			2272	6373	28					91					0.8*2
SFYR5050-3.6	50	50	7.938	44.12	7232	21970	83	90	135	21.5	20	117	112	92	4-Φ14	M6*1	1.8*2
SFYR5050-5.6					10576	34175	127					167					2.8*2
SFYR50100-1.6		100			3396	9962	34					111					0.8*2

The stiffness values shown in the table represent the spring constants. Each constant is determined by applying a pre-load equivalent to 10% of the axial basic rated dynamic load (Ca) and then applying an axial load three times the pre-load amount, with the load and elastic deformation measured under these conditions.

These values do not include the stiffness values of the nut mounting section and related components; therefore, please consider 80% of the values in the table as a rough guideline.

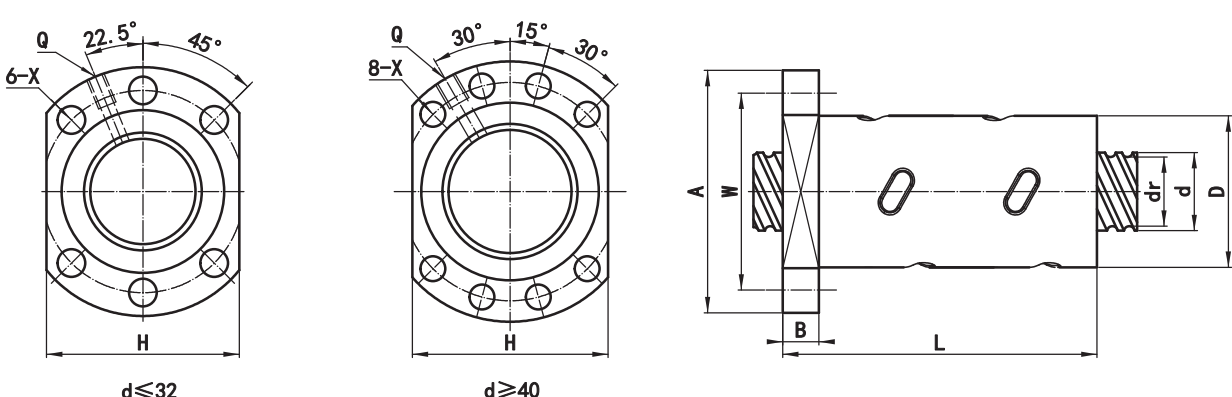
If the actual pre-load load (Fa0) is not 0.1Ca, the stiffness value (Kn) can be calculated using the following formula.

If you need to produce different numbers of coils as shown in the table above, please consult SHAC.

$$K_N = K \left(\frac{Fa_0}{0.3Ca} \right)^{\frac{1}{3}}$$

K: The rigid values in the size table

Size Table of OFNU Ball Screw



Model no.	d	l	Da	dr	Load Rating Ca(kgf)	Load Rating Co(kgf)	K kgf/μm	Dimension								
								D	A	B	L	W	H	X	Q	n
OFNUR1605-4	16	5	3.175	13.82	1381	3055	45	28	48	10	75	38	40	6-Φ5.5	M6*1	1*8
OFNUR2005-4	20	5	3.175	17.82	1552	3879	52	36	58	10	85	47	44	6-Φ6.6	M6*1	1*8
OFNUR2505-4	25	5	3.175	22.82	1726	4909	61	40	62	10	86	51	48	6-Φ6.6	M6*1	1*8
OFNUR2510-4		10	4.762	21.74	2957	7302	69			12	130					1*8
OFNUR3205-4	32	5	3.175	29.82	1924	6350	71	50	80	12	87	65	62	6-Φ9	M6*1	1*8
OFNUR3210-4		10	6.35	27.65	4810	12220	85			145	145					1*8
OFNUR4005-4	40	5	3.175	37.82	2112	7996	82	63	93	14	90	78	70	8-Φ9	M8*1	1*8
OFNUR4010-4		10	6.35	35.65	5405	15516	98			148	148					1*8
OFNUR5010-4	50	10	6.35	45.65	6010	19634	113	75	110	16	148	93	85	8-Φ11	M8*1	1*8

Note: A star symbol can be used to make a left-hand screw.

The stiffness values shown in the table represent the spring constants. Each constant is determined by applying a pre-load equivalent to 10% of the axial basic rated dynamic load (Ca) and then applying an axial load three times the pre-load amount, with the load and elastic deformation measured under these conditions.

These values do not include the stiffness values of the nut mounting section and related components; therefore, please consider 80% of the values in the table as a rough guideline.

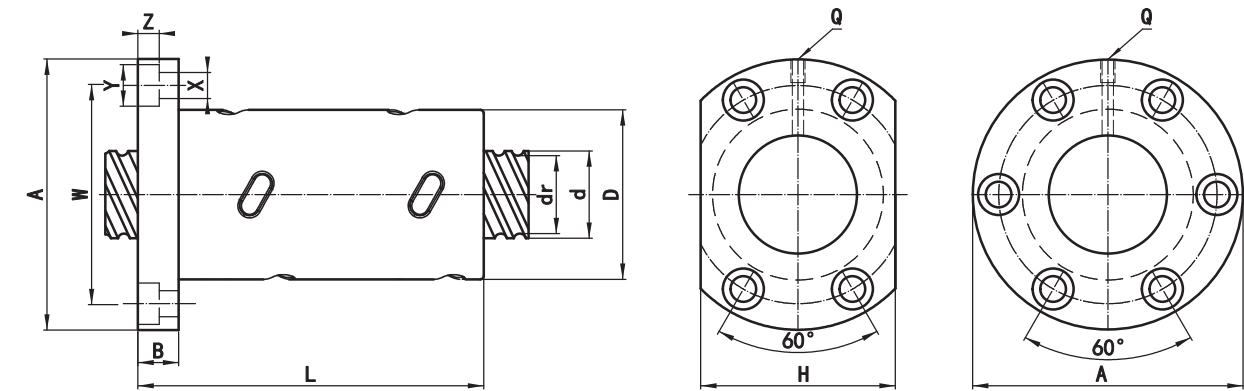
If the actual pre-load load (Fa0) is not 0.1Ca, the stiffness value (Kn) can be calculated using the following formula.

If you need to produce different numbers of coils as shown in the table above, please consult SHAC.

$$K_N = K \left(\frac{Fa_0}{0.3Ca} \right)^{\frac{1}{3}}$$

K: The rigid values in the size table

Size Table of OFNI Ball Screw



Model no.	d	l	Da	dr	Load Rating Ca(kgf)	Load Rating Co(kgf)	K kgf/μm	Dimension										
								D	A	B	L	W	H	X	Y	Z	Q	n
★ OFNIR1605-4	16	5	3.175	13.82	1381	3055	45	30	49	10	75	39	34	4.5	8	4.5	M6*1	1*8
★ OFNIR2005-4	20	5	3.175	17.82	1552	3879	52	34	57	11	85	45	40	5.5	9.5	5.5	M6*1	1*8
★ OFNIR2505-4	25	5	3.175	22.82	1726	4909	61	40	63	11	86	51	46	5.5	9.5	5.5	M8*1	1*8
★ OFNIR2510-4		10	4.762	21.74	2957	7302	69	46	72	12	130	58	52	6.5	11.5	6.5	M6*1	1*8
★ OFNIR3205-4	32	5	3.175	29.82	1924	6350	71	46	72	12	87	58	52	6.5	11.5	6.5	M8*1	1*8
★ OFNIR3210-4		10	6.35	27.65	4810	12220	85	54	88	15	145	70	62	9	14	9	M8*1	1*8
★ OFNIR4005-4	40	5	3.175	37.82	2112	7996	82	56	90	15	90	72	64	9	14	8.5	M8*1	1*8
★ OFNIR4010-4		10	6.35	35.65	5405	15516	98	62	104	18	148	82	70	11	17.5	11	M8*1	1*8
★ OFNIR5010-4	50	10	6.35	45.65	6010	19634	113	72	114	18	148	92	82	11	17.5	11	M8*1	1*8
OFNIR6310-4	63	10	6.35	58.65	6726	12384	132	85	131	22	153	107	95	14	20	13	M8*1	1*8
OFIR8010-4	80	10	6.35	75.65	7353	31986	153	105	150	22	153	127	115	14	20	13	M8*1	1*8

Note: A star symbol can be used to make a left-hang screw.

The stiffness values shown in the table represent the spring constants. Each constant is determined by applying a pre-load equivalent to 10% of the axial basic rated dynamic load (Ca) and then applying an axial load three times the preload amount, with the load and elastic deformation measured under these conditions.

These values do not include the stiffness values of the nut mounting section and related components; therefore, please consider 80% of the values in the table as a rough guideline.

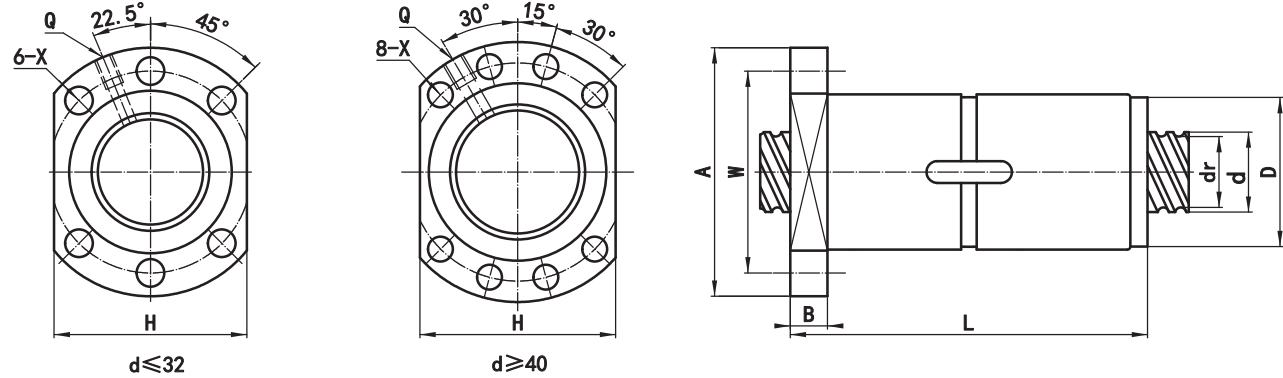
If the actual preload load (Fa0) is not 0.1Ca, the stiffness value (Kn) can be calculated using the following formula.

If you need to produce different numbers of coils as shown in the table above, please consult SHAC.

$$K_N = K \left(\frac{Fa_0}{0.3Ca} \right)^{\frac{1}{3}}$$

K: The rigid values in the size table

Size Table of DFS Ball Screw



	Model no.	d	l	Da	dr	Load Rating Ca(kgf)	Load Rating Co(kgf)	K kgf/μm	Dimension									
									D	A	B	L	W	H	X	Q	n	
★	DFSR1605-3.8	14.8	5	2.778	12.83	1122	2492	48	28	48	10	72.5	38	40	6-Φ5.5	M6*1	3.8*1	
	10		892			1949	38	97			2.8*1							
★	DFSR2005-3.8	20	5	3.175	17.82	1552	3879	60	36	58	10	75	47	44	6-Φ6.6	M6*1	3.8*1	
	10		1586			4039	63	120										
	DFSR2505-3.8	25	5	3.175	22.82	1726	4909	69	40	62	10	72.5	51	48	6-Φ6.6	M6*1	3.8*1	
	10		1714			4882	72	117										
	DFSR3205-3.8	32	5	3.175	29.82	1924	6350	82	50	80	12	82	65	62	6-Φ9	M6*1	3.8*1	
	DFSR3210-3.8	31	10	3.969	28.29	2574	7645	88	50	80	13	122	65	62	6-Φ9	M6*1	3.8*1	
	20		2025			5879	69	12			160	2.8*1						
	DFSR4005-3.8	40	5	3.175	37.82	2112	7996	97	63	93	15	85	78	70	8-Φ9	M8*1	3.8*1	
	DFSR4010-3.8	38	10	6.35	33.02	5281	14676	110	63	93	14	123	78	70	8-Φ9	M8*1	3.8*1	
	DFSR4020-2.8		20			4073	10902	85			162	2.8*1						
	DFSR5005-3.8	50	5	3.175	47.84	2309	10055	112	75	110	15	85	93	85	8-Φ11	M8*1	3.8*1	
	DFSR5010-3.8	48	10	6.35	43.66	5898	18811	128	75	110	18	138	93	85	8-Φ11	M8*1	3.8*1	
DFSR5020-3.8	20		6014			19478	137	147										
DFSR5050-1.8	50		3229			9732	70	218				1.8*1						

Note: A star symbol can be used to make a left-hang screw.

The stiffness values shown in the table represent the spring constants. Each constant is determined by applying a pre-load equivalent to 10% of the axial basic rated dynamic load (Ca) and then applying an axial load three times the preload amount, with the load and elastic deformation measured under these conditions.

These values do not include the stiffness values of the nut mounting section and related components; therefore, please consider 80% of the values in the table as a rough guideline.

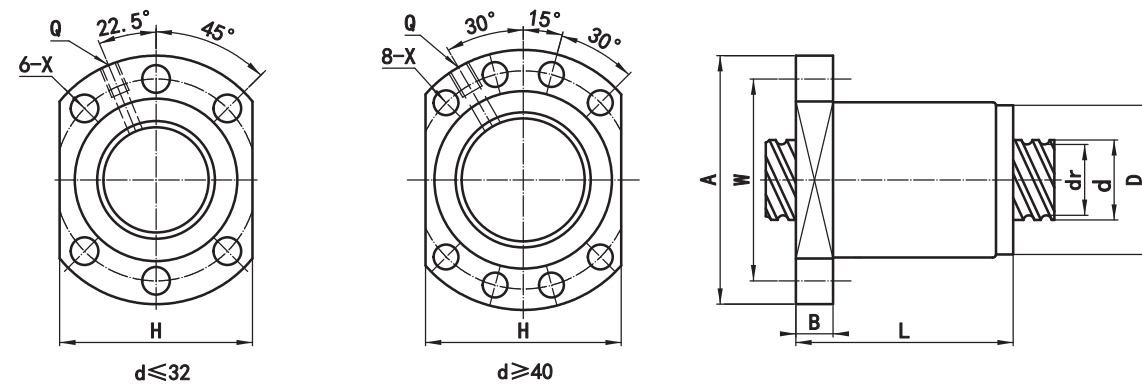
If the actual preload load (Fa0) is not 0.1Ca, the stiffness value (Kn) can be calculated using the following formula.

If you need to produce different numbers of coils as shown in the table above, please consult SHAC.

$$K_N = K \left(\frac{Fa_0}{0.3Ca} \right)^{\frac{1}{3}}$$

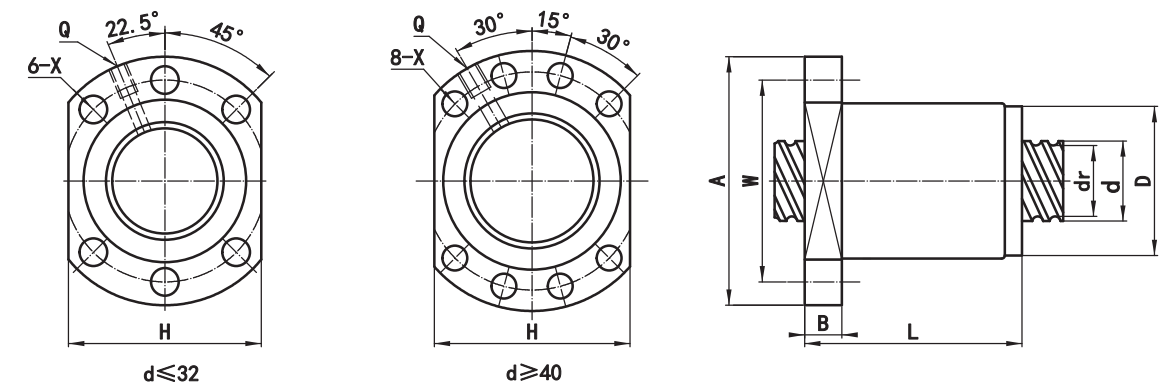
K: The rigid values in the size table

Size Table of SFS Ball Screw



	Model no.	d	l	Da	dr	Load Rating Ca(kgf)	Load Rating Co(kgf)	K kgf/μm	Dimension								
									D	A	B	L	W	H	X	Q	n
★	SFSR1205-2.8	12	5	2.5	9.74	678	1317	20	24	40	10	31	32	30	6-Φ4.5	-	2.8*1
	SFSR1210-2.8		10			655	1286	19				49					
	SFSR1605-3.8	14.8	5	2.778	12.83	1122	2492	31	28	48	10	37.5	38	40	6-Φ5.5	M6*1	3.8*1
	SFSR1610-2.8		10			892	1949	24				47					2.8*1
	SFSR1616-1.8		16			606	1261	16				45					1.8*1
SFSR1620-1.8	20		607			1297	16	56									
★	SFSR2005-3.8	20	5	3.175	17.82	1552	3879	39	36	58	10	40	47	44	6-Φ6.6	M6*1	3.8*1
	SFSR2010-3.8		10			1586	4039	41				60					1.8*1
	SFSR2020-1.8		20		17.5	839	1951	20				57					
	SFSR2505-3.8	25	5	3.175	22.82	1726	4909	45	40	62	10	40	51	48	6-Φ6.6	M6*1	3.8*1
	SFSR2510-3.8		10			1714	4882	46				62					1.8*1
SFSR2525-1.8	25		923			2446	24	12				70					
SFSR2525-2.8												95					2.8*1
	SFSR3205-3.8	32	5	3.175	29.82	1924	6350	53	50	80	12	42	65	62	6-Φ9	M6*1	3.8*1
	SFSR3210-3.8	31	10	3.969	28.29	2574	7645	57	50	80	13	62	65	62	6-Φ9	M6*1	3.8*1
	SFSR3220-2.8		20			2025	5879	45				80					2.8*1
	SFSR3232-1.8		32			1378	3810	29				13					84
	SFSR3232-2.8										116						2.8*1

Size Table of SFS Ball Screw-2



Model no.	d	l	Da	dr	Load Rating Ca(kgf)	Load Rating Co(kgf)	K kgf/μm	Dimension									
								D	A	B	L	W	H	X	Q	n	
SFSR4005-3.8	40	5	3.175	37.82	2112	7997	62	63	93	15	45	78	70	8-Φ9	M8*1	3.8*1	
SFSR4010-3.8	38	10	6.35	33.02	5281	14676	71	63	93	14	63	78	70	8-Φ9	M8*1	3.8*1	
SFSR4020-2.8		20			82	2.8*1											
SFSR4040-1.8		40			2836	7376	37			15	105					1.8*1	
SFSR4040-2.8											145					2.8*1	
SFSR5005-3.8	50	5	3.175	47.84	2309	10055	72	75	110	15	45	93	85	8-Φ11	M8*1	3.8*1	
SFSR5010-3.8	48	10	6.35	43.66	5898	18811	83	75	110	18	68	93	85	8-Φ11	M8*1	3.8*1	
SFSR5020-3.8		20			108	3.8*1											
SFSR5050-1.8		50			3229	9732	45			175	125					1.8*1	
SFSR5050-2.8											175					2.8*1	

Note: A star symbol can be used to make a left-hang screw.

The stiffness values shown in the table represent the spring constants. Each constant is determined by applying a preload equivalent to 10% of the axial basic rated dynamic load (C_a) and then applying an axial load three times the preload amount, with the load and elastic deformation measured under these conditions.

These values do not include the stiffness values of the nut mounting section and related components; therefore, please consider 80% of the values in the table as a rough guideline.

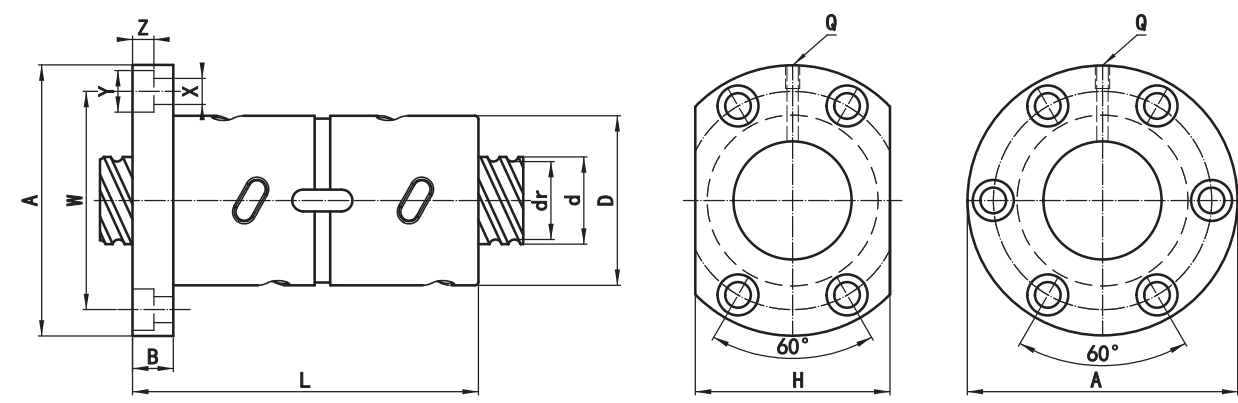
If the actual preload load (F_{a0}) is not $0.1C_a$, the stiffness value (K_n) can be calculated using the following formula.

If you need to produce different numbers of coils as shown in the table above, please consult SHAC.

$$K_N = K \left(\frac{Fa_0}{0.3Ca} \right)^{\frac{1}{3}}$$

K: The rigid values in the size table

Size Table of DFNI Ball Screw



Model no.	d	l	Da	dr	Load Rating Ca(kgf)	Load Rating Co(kgf)	K kgf/μm	Dimension										
								D	A	B	L	W	H	X	Y	Z	Q	n
★ DFNIR1605-4	16	5	3.175	13.82	1381	3055	51	30	49	10	100	39	34	4.5	8	4.5	M6*1	1*4
★ DFNIR1610-3		10	3.175	13.82	1104	2404	41	34	58	10	118	45	34	5.5	9.5	5.5	M6*1	1*3
★ DFNIR2005-4	20	5	3.175	17.82	1552	3879	59	34	57	11	101	45	40	5.5	9.5	5.5	M6*1	1*4
★ DFNIR2505-4	25	5	3.175	22.82	1726	4909	69	40	63	11	101	51	46	5.5	9.5	5.5	M8*1	1*4
★ DFNIR2510-4		10	4.762	21.74	2957	7302	79	46	72	12	145	58	52	6.5	11.5	6.5	M6*1	1*4
★ DFNIR3205-4	32	5	3.175	29.82	1924	6350	80	46	72	12	102	58	52	6.5	11.5	6.5	M8*1	1*4
★ DFNIR3210-4		10	6.35	27.65	4810	12220	97	54	88	15	162	70	62	9	14	9	M8*1	1*4
★ DFNIR4005-4	40	5	3.175	37.82	2112	7996	93	56	90	15	105	72	64	9	14	8.5	M8*1	1*4
★ DFNIR4010-4		10	6.35	35.65	5405	15516	112	62	104	18	165	82	70	11	17.5	11	M8*1	1*4
★ DFNIR5010-4	50	10	6.35	45.65	6010	19634	129	72	114	18	171	92	82	11	17.5	11	M8*1	1*4
DFNIR6310-4	63	10	6.35	58.65	6726	12384	150	85	131	22	182	107	95	14	20	13	M8*1	1*4
DFNIR8010-4	80	10	6.35	75.65	7353	31986	172	105	150	22	182	127	115	14	20	13	M8*1	1*4

Note: A star symbol can be used to make a left-hang screw.

The stiffness values shown in the table represent the spring constants. Each constant is determined by applying a pre-load equivalent to 10% of the axial basic rated dynamic load (Ca) and then applying an axial load three times the preload amount, with the load and elastic deformation measured under these conditions.

These values do not include the stiffness values of the nut mounting section and related components; therefore, please consider 80% of the values in the table as a rough guideline.

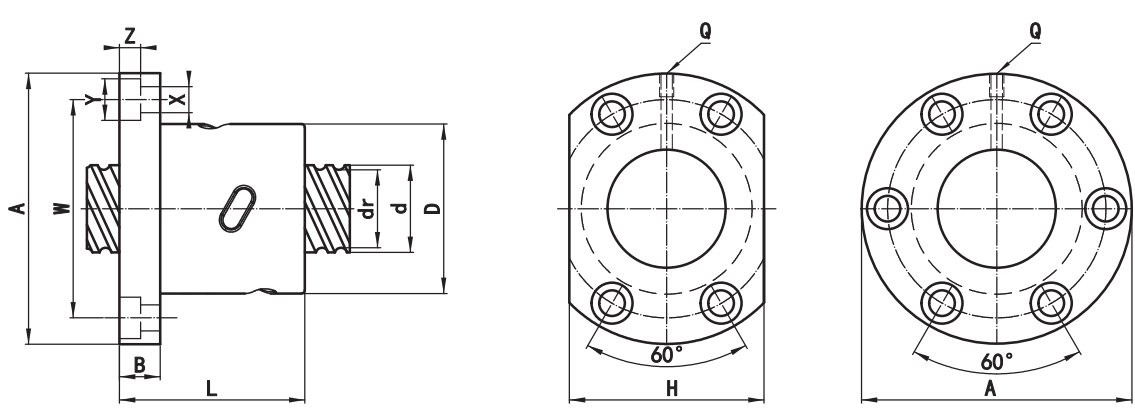
If the actual preload load (Fa0) is not 0.1Ca, the stiffness value (Kn) can be calculated using the following formula.

$$K_N = K \left(\frac{Fa_0}{0.3Ca} \right)^{\frac{1}{3}}$$

If you need to produce different numbers of coils as shown in the table above, please consult SHAC.

K: The rigid values in the size table

Size Table of SFNI Ball Screw



Model no.	d	l	Da	dr	Load Rating Ca(kgf)	Load Rating Co(kgf)	K kgf/μm	Dimension										
								D	A	B	L	W	H	X	Y	Z	Q	n
★ SFNIR1605-4	16	5	3.175	13.82	1381	3055	33	30	49	10	45	39	34	4.5	8	4.5	M6*1	1*4
★ SFNIR1610-3		10			1104	2404	27	34	58		57	45		5.5	9.5	5.5		1*3
★ SFNIR2005-4	20	5	3.175	17.82	1552	3879	38	34	57	11	51	45	40	5.5	9.5	5.5	M6*1	1*4
★ SFNIR2505-4	25	5	3.175	22.82	1726	4909	45	40	63	11	51	51	46	5.5	9.5	5.5	M8*1	1*4
★ SFNIR2510-4		10	4.762	21.74	2957	7302	51	46	72	12	80	58	52	6.5	11.5	6.5	M6*1	1*4
★ SFNIR3205-4	32	5	3.175	29.82	1924	6350	52	46	72	12	52	58	52	6.5	11.5	6.5	M8*1	1*4
★ SFNIR3210-4		10	6.35	27.65	4810	12220	63	54	88	15	85	70	62	9	14	9		1*4
★ SFNIR4005-4	40	5	3.175	37.82	2112	7996	60	56	90	15	55	72	64	9	14	8.5	M8*1	1*4
★ SFNIR4010-4		10	6.35	35.65	5405	15516	72	62	104	18	88	82	70	11	17.5	11		1*4
★ SFNIR5010-4	50	10	6.35	45.65	6010	19634	83	72	114	18	88	92	82	11	17.5	11	M8*1	1*4
SFNIR6310-4	63	10	6.35	58.65	6726	12384	97	85	131	22	93	107	95	14	20	13	M8*1	1*4
SFNIR8010-4	80	10	6.35	75.65	7353	31986	111	105	150	22	93	127	115	14	20	13	M8*1	1*4

Note: A star symbol can be used to make a left-hang screw.

The stiffness values shown in the table represent the spring constants. Each constant is determined by applying a pre-load equivalent to 10% of the axial basic rated dynamic load (Ca) and then applying an axial load three times the preload amount, with the load and elastic deformation measured under these conditions.

These values do not include the stiffness values of the nut mounting section and related components; therefore, please consider 80% of the values in the table as a rough guideline.

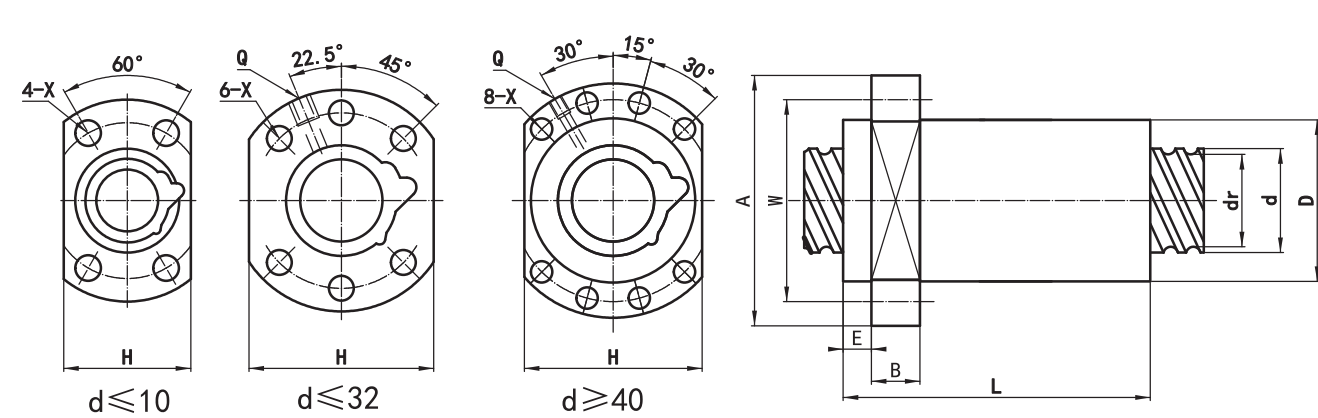
If the actual preload load (Fa0) is not 0.1Ca, the stiffness value (Kn) can be calculated using the following formula.

$$K_N = K \left(\frac{Fa_0}{0.3Ca} \right)^{\frac{1}{3}}$$

K: The rigid values in the size table

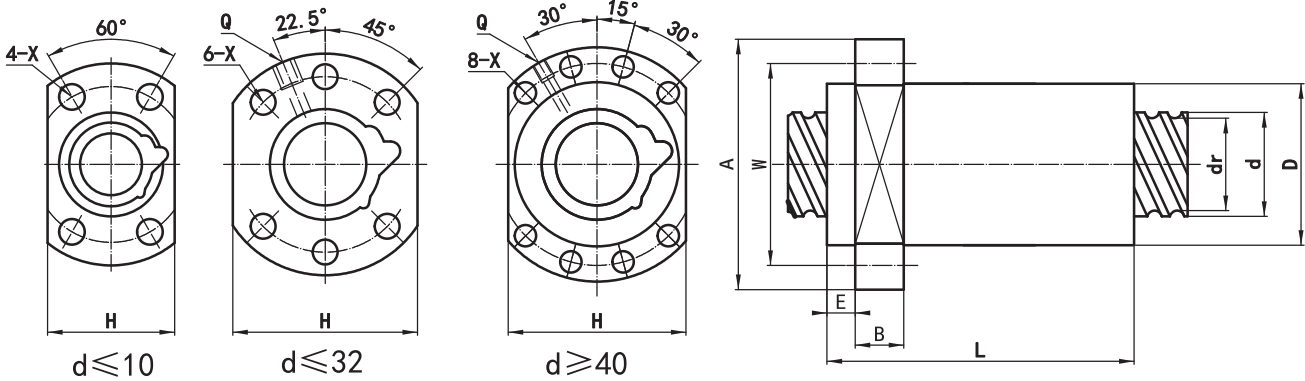
If you need to produce different numbers of coils as shown in the table above, please consult SHAC.

Size Table of SFA Ball Screw



Model no.	d	l	Da	dr	Load Rating Ca(kgf)	Load Rating Co(kgf)	K kgf/μm	Dimension									
								D	A	E	B	L	W	H	X	Q	n
SFAR0602-3.8	6	2	1.2	5.18	240	436	13	12	24	/	3.5	15	18	16	4-Φ3.4	/	3.8*1
SFAR0802-3.8	8	2	1.2	7.18	284	611	17	14	27	3	5	17.5	21	18	4-Φ3.4	/	3.8*1
SFAR0802.5-3.8		2.5			283	610	17					20					1.8*1
SFAR0805-1.8		5			154	301	9					19					1.8*1
SFAR1004-3.8	10	4	2	8.63	600	1208	22	26	46	4	10	30	36	28	4-Φ4.5	M6*1	3.8*1
SFAR1006-2.8		6	1.5875	8.78	343	717	16	18	35	5	6	26	27	22	4-Φ4.5	/	2.8*1
SFAR1012-1.8		12			235	479	10					32					1.8*1
SFAR1204-3.8	12	4	2.5	9.74	869	1761	26	24	40	5	10	30	32	30	6-Φ4.5	M6*1	3.8*1
SFAR1205-2.8		5			676	1317	20					42					2.8*1
SFAL1205-2.8		10			655	1286	19					50					1.8*1
SFAR1210-2.8		20			449	891	12					50					1.8*1
SFAR1220-1.8																	
SFAR1605-3.8	14.8	5	2.778	12.83	1122	2492	31	28	48	5	10	31	38	40	6-Φ5.5	M6*1	3.8*1
SFAL1605-3.8		10			892	1949	24					42					2.8*1
SFAR1610-2.8		16			606	1261	16					43					1.8*1
SFAR1616-1.8					858	1891	23					59					2.8*1
SFAR1616-2.8		20			607	1297	16					50					1.8*1
SFAR1620-1.8																	
SFAR2005-3.8	20	5	3.175	17.82	1552	3879	39	36	58	7	10	33	47	44	6-Φ6.6	M6*1	3.8*1
SFAR2010-3.8		10			1586	4039	41					52					1.8*1
SFAR2020-1.8		20		17.50	839	1951	20					72					2.8*1
SFAR2020-2.8					1189	2926	30					72					2.8*1

Size Table of SFA Ball Screw-2



Model no.	d	l	Da	dr	Load Rating Ca(kgf)	Load Rating Co(kgf)	K kgf/μm	Dimension									
								D	A	E	B	L	W	H	X	Q	n
SFAR2505-3.8	25	5	3.175	22.82	1726	4909	45	40	62	7	10	33	51	48	6-Φ6.6	M6*1	3.8*1
SFAR2510-3.8		10			1714	4882	46				52	2.8*2					
SFAR2520-2.8		20			1336	3726	36				76	1.8*1					
SFAR2525-1.8		25			923	2446	24				60	2.8*1					
SFAR2525-2.8					1309	3669	35				85	2.8*1					
SFAR3205-3.8	32	5	3.175	29.82	1924	6350	53	50	80	9	12	35	65	62	6-Φ9	M6*1	3.8*1
SFAR3210-3.8	31	10	3.969	28.29	2574	7645	57	50	80	9	12	53	65	62	6-Φ9	M6*1	3.8*1
SFAR3220-2.8		20			2025	5879	45				72	2.8*1					
SFAR3232-1.8		32			1378	3810	29				78	1.8*1					
SFAR3232-2.8					1952	5715	43				110	2.8*1					
SFAR4005-3.8	40	5	3.175	37.82	2112	7997	62	63	93	9	15	39	78	70	8-Φ9	M8*1	3.8*1
SFAR4010-3.8	38	10	6.35	33.02	5281	14676	71	63	93	9	14	57	78	70	8-Φ9	M8*1	3.8*1
SFAR4020-2.8		20			4073	10902	55				78	2.8*1					
SFAR4040-1.8		40			2836	7376	37				96	1.8*1					
SFAR4040-2.8					4019	11063	54				136	2.8*1					
SFAR5005-3.8	50	5	3.175	47.84	2309	10055	72	75	110	10.5	15	42	93	85	8-Φ11	M8*1	3.8*1
SFAR5010-3.8	48	10	6.35	43.66	5898	18811	83	75	110	10.5	18	57	93	85	8-Φ11	M8*1	3.8*1
SFAR5020-3.8		20			6014	19478	89				98	1.8*1					
SFAR5050-1.8		50			3229	9732	45				117	2.8*1					
SFAR5050-2.8					4576	14597	66				167	2.8*1					

The stiffness values shown in the table represent the spring constants. Each constant is determined by applying a pre-load equivalent to 10% of the axial basic rated dynamic load (Ca) and then applying an axial load three times the preload amount, with the load and elastic deformation measured under these conditions.

These values do not include the stiffness values of the nut mounting section and related components; therefore, please consider 80% of the values in the table as a rough guideline.

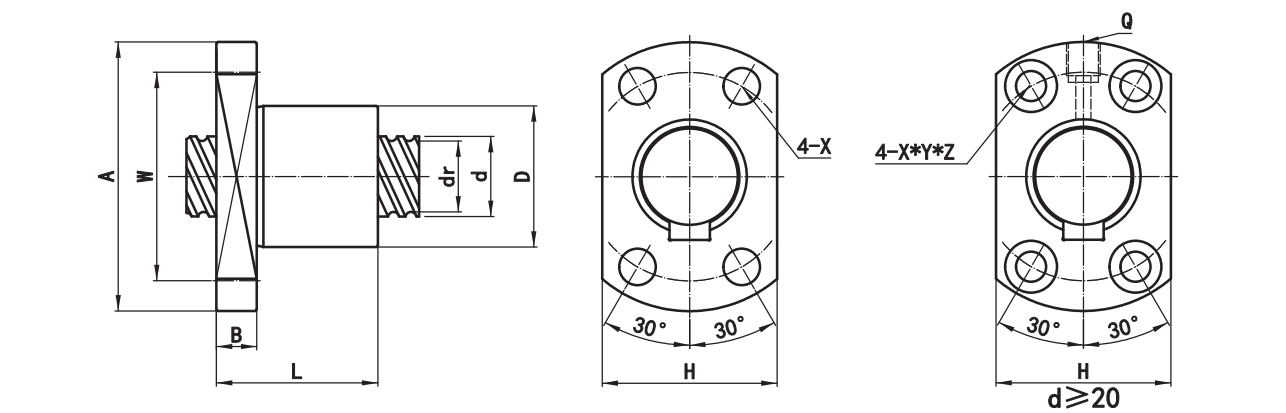
If the actual preload load (Fa0) is not 0.1Ca, the stiffness value (Kn) can be calculated using the following formula.

If you need to produce different numbers of coils as shown in the table above, please consult SHAC.

$$K_N = K \left(\frac{Fa_0}{0.3Ca} \right)^{\frac{1}{3}}$$

K: The rigid values in the size table

Size Table of SFK Ball Screw



Model no.	d	l	Da	dr	Load Rating Ca(kgf)	Load Rating Co(kgf)	K kgf/μm	Dimension										
								D	A	B	L	W	H	X	Y	Z	Q	n
SFKR0401-2	4	1	0.8	3.45	64	97	5	10	20	3	12	15	14	2.9	-	-	-	1*2
SFKR0601-4	6	1	0.8	5.45	142	299	12	12	24	4	14	18	16	3.4	-	-	-	1*4
SFKR0801-4	8	1	0.8	7.38	162	403	14	14	27	4	14	21	18	3.4	-	-	-	1*4
SFKR0802-4		2	1.2		283	612	17			5	24							1*4
SFKR1002-4	10	2	1.2	9.18	311	759	19	18	35	5	24	27	22	4.5	-	-	-	1*4
SFKR1202-4	12	2	1.2	11.18	334	907	22	20	37	5	24	29	24	4.5	-	-	-	1*4
SFKR1402-4	14	2	1.2	13.18	355	1054	23	21	40	6	24	31	26	5.5	-	-	-	1*4
SFKR1602-4	16	2	1.2	15.18	373	1201	26	25	43	10	40	35	29	5.5	-	-	-	1*4
SFKR2002-4	20	2	1.2	19.18	581	2287	47	50	80	15	55	65	68	6.5	10.5	6	M6*1	1*6
SFKR2502-4	25	2	1.2	24.18	540	2383	46	50	80	13	43	65	68	6.5	10.5	6	M6*1	1*5

The stiffness values shown in the table represent the spring constants. Each constant is determined by applying a pre-load equivalent to 10% of the axial basic rated dynamic load (Ca) and then applying an axial load three times the pre-load amount, with the load and elastic deformation measured under these conditions.

These values do not include the stiffness values of the nut mounting section and related components; therefore, please consider 80% of the values in the table as a rough guideline.

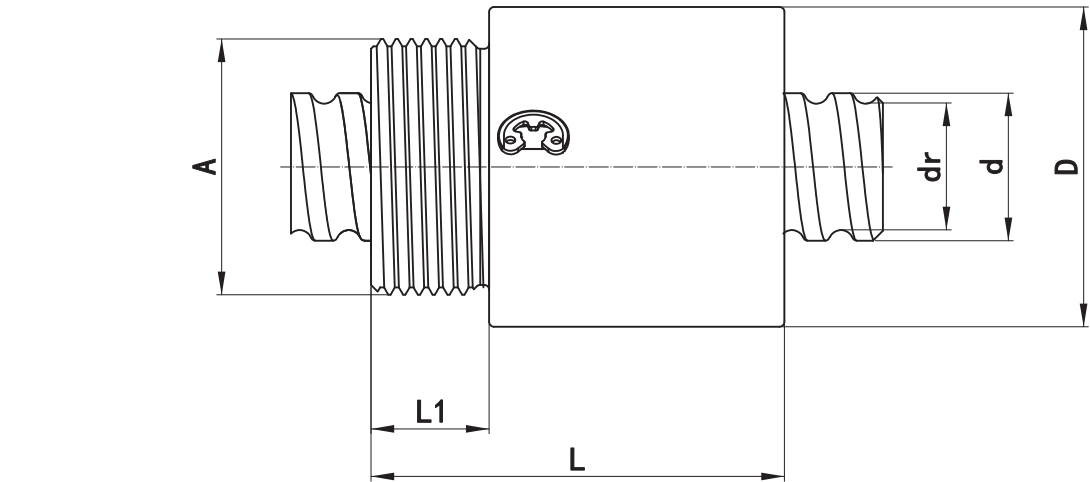
If the actual preload load (Fa0) is not 0.1Ca, the stiffness value (Kn) can be calculated using the following formula.

If you need to produce different numbers of coils as shown in the table above, please consult SHAC.

$$K_N = K \left(\frac{Fa_0}{0.3Ca} \right)^{\frac{1}{3}}$$

K: The rigid values in the size table

Size Table of SMA Ball Screw



Model no.	d	l	Da	dr	Load Rating Ca(kgf)	Load Rating Co(kgf)	K kgf/μm	Dimension								
								D	L1	B	L	L2	H	A	Q	n
SMAR1205-2.8	12	5	2.5	9.74	487	886	14	25.5	6	10	39	10	24	M20*1	M4	2.8*1
SMAR1210-1.8		10			323	556	8				39.5					1.8*1
SMAR1220-1.8		20			313	578	8				58					1.8*1
SMAR1605-3.8	14.8	5	2.778	12.83	821	1706	22	32.5	5 7	10	42	12	30	M26*1.5	M4	3.8*1
SMAR1610-2.8		10			643	1311	17				52					2.8*1
SMAR1620-1.8		20			424	841	10				62					1.8*1

The stiffness values shown in the table represent the spring constants. Each constant is determined by applying a pre-load equivalent to 10% of the axial basic rated dynamic load (Ca) and then applying an axial load three times the pre-load amount, with the load and elastic deformation measured under these conditions.

These values do not include the stiffness values of the nut mounting section and related components; therefore, please consider 80% of the values in the table as a rough guideline.

If the actual preload load (Fa0) is not 0.1Ca, the stiffness value (Kn) can be calculated using the following formula.

If you need to produce different numbers of coils as shown in the table above, please consult SHAC.

$$K_N = K \left(\frac{Fa_0}{0.3Ca} \right)^{\frac{1}{3}}$$

K: The rigid values in the size table

6 Appendix

A) Screw specification inspection table

Table 7-1-1

Taiwan Dinghan Precision

Pre sales Service Inspection Form

SHAC Contact person:Customer person:Date of Contact:

Customer Name					Nature of demand	Urgent		Important		General	
						Completion within 24 hours		Completion within 72 hours		Completion within one day	
Product name	Ballscrew		Linear Guideway		KK Module		Other:				
Customer Needs	New design		Design changes		Brand replacement		Repeat Order		Other:		
Quotation number			Axial direction		Drawing No.			Product model			
(Drawing attach)											

Key data of screw drawing

A.	Load		B.		
C.	Displacement velocity		D.		
E.	Acceleration		F.		
G.	Fixation methcd		H.		
I.	Positioning accuracy		J.		
K.	Slender ratio		L.		
M.	Shaft DN value		N.		
O.	Nut DN value		P.		
Q.	Service life		R.		
S.	Environmental vibration		T.	$\pm E$	
U.	Operation impact		V.	T+E	
W.	Environmental gas		X.	e300	
Y.	Lubrication type		Z.	e	

Thread length

B) Base axis tolerance table

Table 7-1-2

Unit: mm

Diameter(mm)		a	c	d	e	f		g		h						js		j		k		m		n		p		r		
about	below	a13	c12	d6	e6	f5	f6	g5	g6	h5	h6	h7	h8	h9	h10	js5	js6	j5	j6	k5	k6	m5	m6	n5	n6	p5	p6	r6	r7	
3	6	-270	-70	-30	-20	-10	-10	-4	-4	0	0	0	0	0	0	0	±2.5	±4	+3	+6	+6	+9	+9	+12	+13	+16	+17	+20	+23	+27
		-450	-190	-38	-28	-15	-18	-19	-12	-5	-8	-12	-18	-30	-48			-2	-2	+1	+1	+4	+4	+8	+8	+12	+12	+15	+15	+15
6	10	-280	-80	-40	-25	-13	-13	-5	-5	0	0	0	0	0	0	0	±3	±4.5	+4	+7	+7	+10	+12	+15	+16	+19	+21	+24	+28	+34
		-500	-190	-49	-34	-19	-22	-11	-14	-6	-9	-15	-22	-36	-58			-2	-2	+1	+1	+6	+6	+10	+10	+15	+15	+19	+19	+19
10	14	-290	-80	-50	-32	-16	-16	-6	-6	0	0	0	0	0	0	0	±4	±5.5	+5	+8	+9	+12	+15	+18	+20	+23	+26	+29	+34	+41
14	18	-560	-230	-61	-43	-20	-27	-14	-17	-8	-11	-18	-27	-43	-70			-3	-3	+1	+1	+7	+7	+12	+12	+18	+18	+23	+23	+23
18	24	-300	-95	-65	-40	-20	-20	-7	-7	0	0	0	0	0	0	0	±4.5	±6.5	+5	+9	+11	+15	+17	+21	+24	+28	+31	+35	+41	+49
24	30	-630	-275	-78	-53	-29	-33	-16	-20	-9	-13	-21	-33	-52	-84			-4	-4	+2	+2	+8	+8	+15	+15	+22	+22	+28	+28	+28
30	40	-310	-110	-80	-50	-25	-25	-9	-9	0	0	0	0	0	0	0			+6	+11	+13	+18	+20	+25	+28	+33	+37	+42	+50	+59
		-700	-320														±5.5	±8	-5	-5	+2	+2	+9	+9	+17	+17	+26	+26	+34	+34
40	50	-320	-120	-96	-66	-36	-41	-20	-25	-11	-16	-25	-39	-62	-100															
50	65	-340	-130	-100	-60	-30	-30	-10	-10	0	0	0	0	0	0	0			+6	+12	+15	+21	+24	+30	+33	+39	+45	+51	+60	+60
		-800	-380														±6.5	±9.5											+41	+41
65	80	-360	-140	-119	-79	-43	-49	-23	-29	-13	-19	-30	46	-74	-120			-7	-7	+2	+2	+14	+11	+20	+20	+32	+32	+43	+43	+43
80	100	-380	-170	-120	-72	-36	-36	-12	-12	0	0	0	0	0	0	0			+6	+13	+18	+25	+28	+35	+38	+45	+52	+59	+73	+73
		-920	-450														±7.5	±11											+51	+51
100	120	-410	-170	-142	-94	-51	-58	-27	-34	-15	-22	-35	-54	-87	-140			-9	-9	+3	+3	+13	+13	+23	+23	+37	+37	+76	+76	+76
120	140	-460	-180																											+103
		-1090	-530																										+63	+63
140	160	-520	-200	-145	-85	-43	-45	-14	-14	0	0	0	0	0	0		±9	+7	+14	+21	+28	+33	+40	+45	+52	+61	+68	+90	+105	+105
160	180	-1150	-600	-170	-110	-61	-68	-32	-39	-18	-25	-40	-63	-100	-160			-11	-11	+3	+3	+15	+15	+27	+27	+43	+43	+65	+65	+65
		-580	-230																										+93	+108
		-1210	-630																										+65	+68



Preface

The ball screw and linear guide are ingeniously integrated to combine the advantages of both. The innovative U-shaped rail design, optimized through advanced finite element method structural stress analysis, achieves high rigidity with an optimal cross-section.

The two rows of Gothic-style circular rails with 45° contact angle deliver exceptional design that ensures high operational precision and four-directional equal load distribution.

The highly integrated design maximizes space efficiency while simplifying installation for customers, eliminating the need for complex adjustment processes.

(A) Product Structure

Lead Screw, Linear Guide, Base, Motor Base, Compact Module:

A product that integrates traditional ball screws and linear guides into the workbench base and combines them with a replaceable motor base.

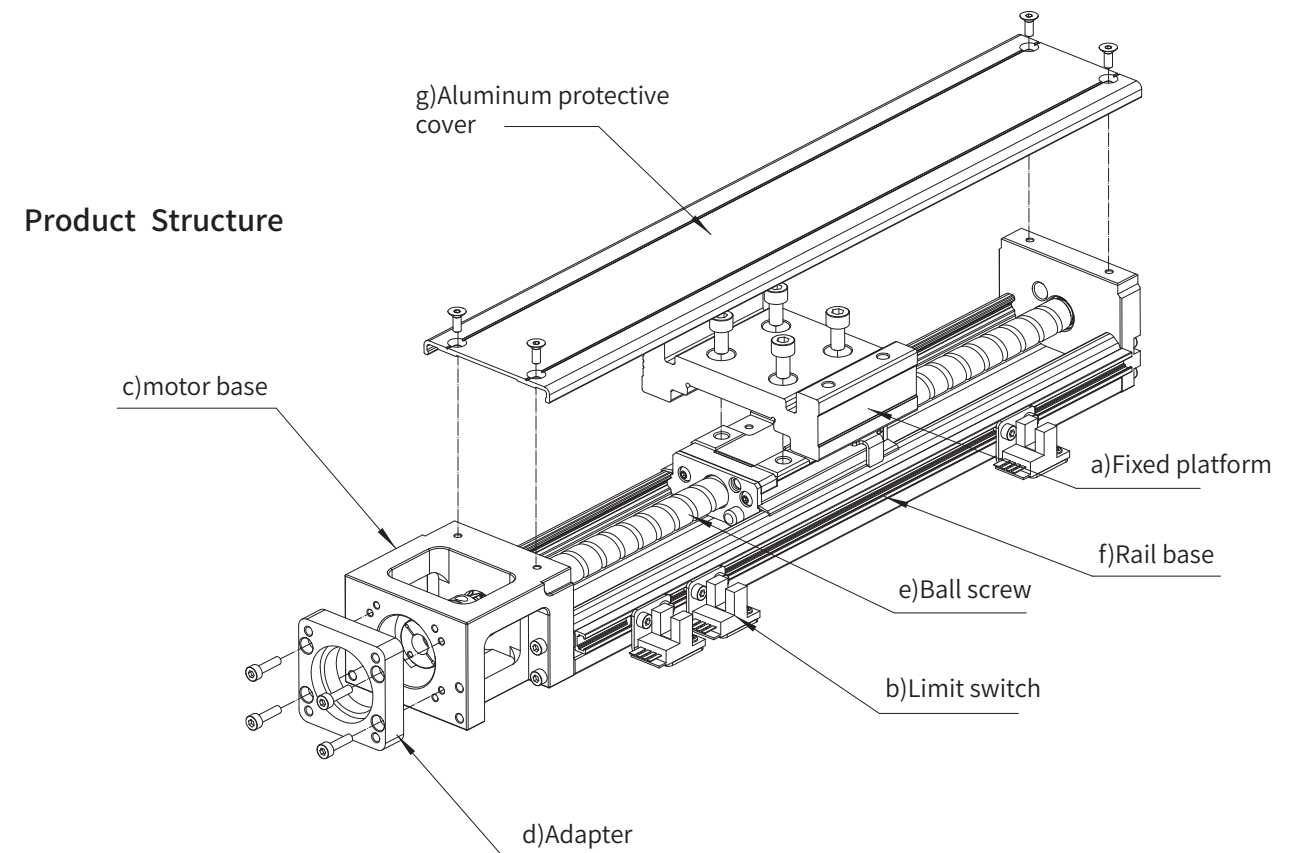


Figure 2-2-1

Integrating the ball screw nut with the linear rail slider into a single unit significantly reduces the spatial footprint of a single-axis mechanical structure. By combining traditional single-axis base with linear guide rails into an integrated configuration, the combination of these two breakthrough structures results in a novel single-axis mechanical product: SHAC Transmission's compact KK modular unit.

This modular unit combines standardized fixed platforms with screw/slider assemblies, achieving precise displacement through ball screw transmission.

An enclosure cover protects the transmission components against dust and contamination, while the standardized motor base allows flexible connection to various motor specifications via motor mounting flanges.

To meet automation requirements, SHAC Transmission's compact modular design incorporates flexibly settable limit switches that satisfy unmanned automatic control needs.

(B) Product Features

I. Multiple specifications, II. Simple assembly and maintenance, III. Customization, IV. Single to multi-axis combination application

SHAC KK compact module offers a wide range of specifications for selection

- KK40:100,150,200
- KK50:150,200,250,300
- KK60:150,200,300,400,500,600
- KK86:340,440,540,640,740,940
- KK100:980,1080,1180,1280,1380
- KK130:980,1180,1380,1680

II. Simple assembly and maintenance

- KK module installation: ensure stable operation of the device
- Want to make your device run smoother Installing the KK module correctly is the key!
1. Clean the surface
Before starting the installation, be sure to clean the burrs, dirt, and surface scratches off the mechanical installation surface. A clean surface is the foundation for ensuring stable operation of the module.
 2. Choose the appropriate torque
Using a torque wrench, select the appropriate locking torque based on the platform material. Slowly tighten the slide rail positioning screws, ensuring that each one is properly tightened, but without applying excessive force.
 3. Tighten the screws in order
Starting from the middle section of the slide rail, sweep towards both sides in order and tighten the slide rail positioning screws. This allows the rail to slightly adhere to the installation surface, achieving relatively stable accuracy. After slightly tightening on the reference surface, the lateral reference surface clamping force of the slide rail will be strengthened, so that the main rail can accurately adhere to the reference surface.

III. Customization

KK compact module offers a standard inventory of multiple specifications. For any special requirements, please contact Dinghan technical engineers

IV. It can be applied in single-axis or multi-axis combinations

KK compact module offers a variety of combination modes to meet various working conditions

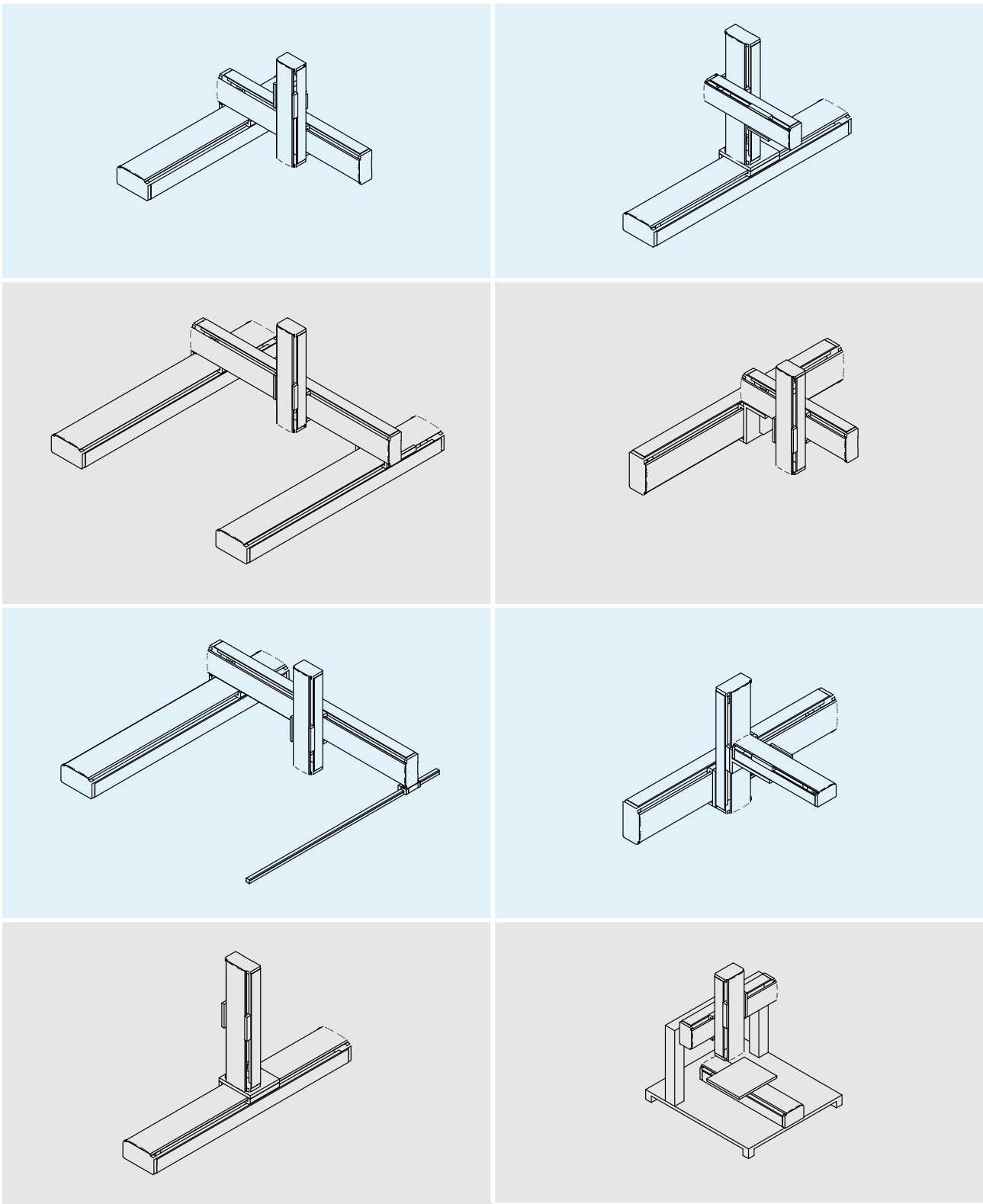


Figure 1-1-2

(C) Comprehensive comparison

a Structural Design and Integration Degree b Performance Differences c Maintenance and Cost

The core difference between KK module and traditional screw module lies in structural integration, precision performance, and maintenance cost. Here is a specific comparison:

1. Structural design and integration degree

1. KK module
Adopting an integrated design, the ball screw and linear guide are embedded in the main body and ground into shape, eliminating the need for independent guide rails and multiple sliders. The slide seat serves as both the nut seat of the screw and the slider of the guide rail, with a compact structure and small installation area, suitable for space limited scenarios.
2. Traditional screw module
Assembled from independent ball screws, aluminum body, linear guide, and 4 sliders, requiring additional connectors and occupying more space.

2. Performance differences

1. Accuracy and rigidity
The KK module reduces assembly errors due to its integrated design, with a repeatability accuracy of $\pm 0.003\text{mm}$, higher rigidity, and strong load stability. The traditional screw module is susceptible to assembly errors due to the separate design of the guide rail and screw, resulting in relatively low accuracy and rigidity.
2. Friction and efficiency
The KK module achieves motion through ball rolling, with a low coefficient of friction, a running speed of up to 0.5m/s , acceleration of up to 9m/s^2 , low noise, and low energy consumption. Traditional screw modules are prone to wear and heat generation due to high sliding friction, which affects long-term efficiency and lifespan.

3. Maintenance and Cost

1. Maintain complexity
The KK module has good sealing, is not prone to dust accumulation, and is easy to maintain. The traditional screw module requires regular cleaning and lubrication of the guide rail, with a high maintenance frequency.
2. Cost effectiveness
The initial cost of KK module is relatively high, but the long-term failure rate is low, and the comprehensive use cost is better. Traditional screw module has lower cost and is suitable for scenarios with limited budget but low precision requirements. If you need to further understand related technologies, you can explore single axis robotic arms, linear module selection, or ball screw optimization design.

(D) Product Application

Various devices
The compact KK module is widely used in high-precision applications due to its compact structure and high precision

The product has powerful functions and complete specifications, suitable for various automation industries



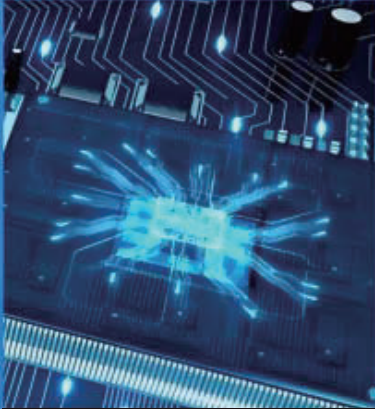
Lithium battery industry



equipment automation



3C industry



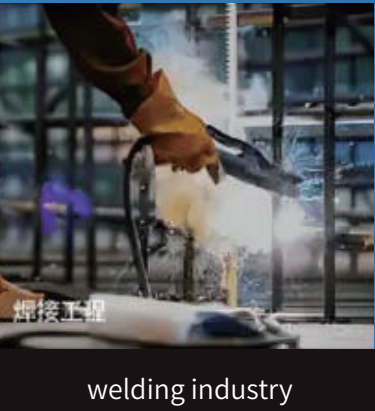
semiconductor industry



photovoltaic industry



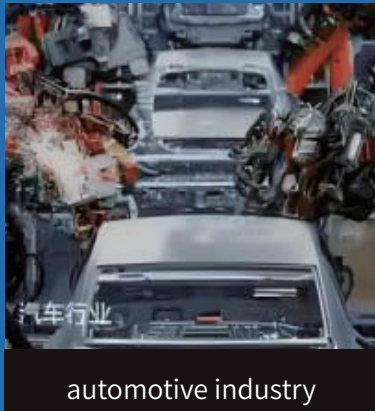
medical industry



welding industry



industrial robots



automotive industry

(E) Selection steps

4 principles, 8 key points

When selecting KK modules, we need to follow a series of basic principles to ensure that the selected modules not only have outstanding cost-effectiveness, but also meet the actual needs of mechanical work. These principles include: clear application requirements, evaluation of module performance, emphasis on brand and service, and reasonable budget planning.

By following these 4 principles, you will be able to easily select the KK module that best suits you.

- ① Performance first, price second: At the beginning of design, the module should be considered first to ensure that it can meet the requirements of mechanical products, and then seek suppliers with high cost-effectiveness.
- ② Type selection is more important than brand: When selecting, different models of products should be flexibly chosen according to actual needs in different occasions and opportunities.
- ③ Continuous supply capability cannot be ignored: When choosing, attention should be paid attention to the stability of the brand's supply, rather than single orders or non-standard specifications.
- ④ Standard models are preferred: In non essential situations, it is recommended to avoid selecting special specifications to ensure smooth ordering, delivery, and maintenance processes.

Mastering these 8 key selection points will help you with module selection and provide strong support for your mechanical work.

- ① Usage conditions
 - Effective travel
 - Space position restrictions (width, height, length)
 - Installation methods (horizontal, vertical, side hanging)
 - Load center of gravity position
 - Operating conditions (lead, speed, acceleration/deceleration, working cycle)
 - Operating environment (high temperature, vibration, oil, water, corrosion)
- ② Accuracy requirements
 - Position accuracy
 - Reproducibility accuracy
 - Walking parallelism
- ③ Application form
 - Single axis
 - Dual axis
 - Multi axis
 - Special combination
- ④ Motor selection
 - AC servo motor
 - Stepper motor
 - With or without brakes
- ⑤ Motor load calculation
 - Maximum speed
 - Motor resolution
 - Motor torque calculation
- ⑥ Operation analysis
 - Acceleration
 - Actual operating mode (V-T diagram)
- ⑦ Other accessories
 - Selection of related accessories (limit switch, adapter plate, telescopic cover, electrical protective cover)
- ⑧ Final confirmation
 - Confirmation of usage conditions
 - Price and delivery time
 - Additional processing
 - Special requirements

(F) key technology

◎Precision speed motor calculation

A)Analysis of Motor Speed Control Accuracy

I) Definition and Calculation Method

The precision of motor speed control refers to the degree of deviation between the actual speed and the set speed, usually expressed as a percentage. The calculation formula is:

Speed regulation accuracy= $\frac{\text{actual speed} - \text{set speed}}{\text{set speed}} \times 100\%$. The lower the value, the more precise the speed control.

II) Core factors affecting accuracy

1. Hardware performance

Motors and Drivers: High performance servo motors (such as servo drives that support 0.02mm positioning accuracy) and matching drivers can significantly reduce errors.

Sensor accuracy: The acquisition accuracy of sensors such as encoders or Hall elements directly affects the accuracy of speed feedback.

2. Control Strategy

Control algorithm: The use of PI/PID controller (proportional integral derivative) can effectively regulate dynamic response and steady-state error. For example, the integral term is used to eliminate steady-state errors, while the proportional term improves response speed.

Closed loop control: By adjusting the output in real-time feedback, it avoids step loss or accumulated errors in open-loop control.

3. External interference

Power fluctuations, temperature changes, and sudden changes in mechanical loads can all cause speed fluctuations. Interference needs to be reduced through filtering circuits, environmental isolation, and other means.

III) Key technologies for improving speed accuracy

1. Parameter tuning

Optimize PID parameters (such as proportional gain Kp, integration time Ki) through trial and error, Ziegler Nichols method, or automatic tuning algorithm.

Adopting adaptive control or sliding mode control (SMC) to adapt to load changes and enhance robustness.

2. High frequency response system

Increase the control cycle frequency (such as shortening the PWM cycle) to ensure fast response to speed commands.

Reduce signal transmission delay by using high-speed communication protocols such as EtherCAT.

3. System calibration and maintenance

Regularly calibrate sensors and drivers to ensure long-term stability during operation.

IV) Accuracy differences among different motors

Motor Type	typical precision range	Applicable scenarios
Stepper motor	$\pm 5\% - \pm 10\%$	low-cost, medium to low precision requirements (such as 3D printing)
Ordinary servo motor	$\pm 0.1\% - \pm 1\%$	Industrial robots, CNC machine tools
High precision servo motor	$\pm 0.02\% - \pm 0.1\%$	Semiconductor manufacturing, precision medical equipment

V) Typical application scenarios

Industrial automation: The conveyor belt of the production line needs to adjust its speed dynamically according to the load, and the PID algorithm can maintain an accuracy within $\pm 20\text{rpm}$.

Medical equipment: The centrifuge requires a speed error of less than $\pm 0.5\%$, which necessitates the integration of closed-loop control and temperature compensation.

Robot technology: Joint motors need to achieve multi-axis coordination with a positioning accuracy of 0.02mm , relying on servo drives and model predictive control (MPC).

VI) Future Trends

AI-optimized algorithms: Employ machine learning to dynamically adjust control parameters and adapt to complex operating conditions.

Integrated design: Drivers, controllers, and sensors are highly integrated to minimize signal loss and interference.

(Notes: The above combines servo systems, control algorithms, and practical cases; specific implementation must be tailored to motor types and system requirements.)

B) Analysis of the Relationship between Motor Speed Control Accuracy and Load

I) The direct impact of load on speed control accuracy

◎The increase in load leads to a decrease in speed and fluctuations in precision

When the load increases, the motor requires greater torque output to maintain speed. If the control system cannot compensate for load variations in real-time, the actual rotational speed will deviate from the set value, resulting in reduced accuracy. For example, in permanent magnet synchronous motors, speed dynamically decreases under increased load and requires closed-loop control to adjust current and voltage for speed stabilization.

- Stepper motor: If the load torque exceeds its holding torque, there will be a loss of step, resulting in speed loss of control.
- Servo motor: Through high-precision encoder feedback and PID algorithm, it can achieve speed control accuracy within $\pm 0.1\%$, even if the load fluctuates.

◎Dynamic errors caused by sudden load changes

The instantaneous change of mechanical load (such as sudden increase or decrease of materials on the production line) can cause a delay in the inertia response of the motor, resulting in short-term speed deviation. At this point, it is necessary to increase the response frequency of the control system or adopt sliding mode control (SMC) to enhance its anti-interference ability.

II) Differences in load adaptability of different types of motors

Motor Type	Load sensitivity	Typical control accuracy range
stepper motor	High (dependent on constant load)	$\pm 5\% - \pm 10\%$
Ordinary servo motor	Medium low (closed-loop compensation)	$\pm 0.1\% - \pm 1\%$
Permanent magnet synchronous motor	Low (requires support for variable frequency speed regulation)	$\pm 0.02\% - \pm 0.5\%$

Stepper motor: prone to step loss during load changes, only suitable for light and stable scenarios (such as 3D printers).

Servo motor: By adjusting the current output through real-time feedback, it can adapt to speed control within the range of 20% -150% rated load.

(G) Instructions for Use

◎Installation ◎ lifespan ◎maintenance

KK Compact module installation, lifespan, and maintenance

Based on relevant technical specifications and usage requirements, the following are key points summarized:

1、 Installation points

Surface cleaning

Before installation, it is necessary to thoroughly clean the mechanical surface of burrs, dirt, and scratches to ensure a smooth installation surface and avoid module deformation or accuracy degradation caused by impurities.

Screw locking specifications

Use a torque wrench and select the appropriate locking torque based on the material (such as aluminum alloy or steel) to avoid excessive tightening and deformation of the slide rail. The tightening sequence should extend from the middle of the slide rail to both sides, ensuring that the rail is evenly attached to the installation surface and improving stability.

Centering and debugging

After installation, it is necessary to check the coaxiality between the screw and the motor shaft, and debug until there is no jamming or abnormal noise during the movement process to improve transmission efficiency.

2、 Factors affecting lifespan and maintenance measures

Oil lubrication:

Before the first use, use kerosene or organic solvents to remove the anti-corrosion oil inside the module, dry it and fill it with lithium soap based grease with a viscosity grade of N0.2; Regular supplementation will be carried out in the future to reduce friction losses.

Oil lubrication: If lubricating oil is used, ISO viscosity grade VG15-100 oil can be directly used, and the model can be adjusted according to the working temperature, and injected into the shaft through the oil supply pipe or bearing seat oil hole.

Dust prevention and cleaning

Regularly clean the dirt on the surface of the module and moving parts to prevent particles from entering the ball track or screw, which may cause increased wear.

Oil lubrication is not recommended for seal ring bearings as they may fail due to oil scraping.

Load and environment adaptation

Avoid overloading operation and match the screw diameter and pitch parameters of module models (such as CM compact module 6010 series) reasonably to ensure load capacity and stability.

In harsh environments such as high temperature and high dust, it is necessary to shorten the maintenance cycle and strengthen the lubrication frequency.

3、 Maintenance and testing

Accuracy testing

Regularly verify the positioning accuracy, walking parallelism, and starting torque to ensure that the module performance meets the design requirements of high rigidity and high precision.

Component inspection

Observe the wear of ball screws and U-shaped slides, and replace deformed or damaged components in a timely manner.

Check if the lubrication system oil circuit is unobstructed to avoid dry friction caused by insufficient oil supply.

summary

The lifespan of KK compact modules is closely related to installation standards and maintenance frequency. By reasonable lubrication, dust-proof cleaning, load control, and regular testing, its service life can be significantly extended (usually up to several years to ten years, depending on the operating conditions), and high-precision and high-efficiency operation can be maintained.

(H) Related matters

Precautions for personal safety, storage, installation, operation, use, and maintenance

KK Compact Module Precautions and Safety Operating Procedures

1、 Personal safety precautions

Operating qualifications and training

Operators need to hold relevant qualification certificates, receive regular safety training, and be familiar with equipment structure, performance, and emergency response procedures.

During work, it is necessary to concentrate throughout the entire process and prohibit unrelated activities. Protective equipment must be worn for high-temperature or high-altitude operations.

Check before starting the device

Verify that the electrical system, braking devices, and safety limit switches (such as photoelectric switches) are functioning properly to avoid accidents caused by voltage fluctuations or circuit abnormalities.

Check the lifting equipment, load weight, and center of gravity to ensure that they are within the rated load range of the module, and overloading is strictly prohibited.

II) Storage and installation specifications

Storage environment requirements

The storage environment should be dry and free of corrosive gases, avoiding moisture and oxidation of magnetic templates or precision components.

During long-term storage, it is necessary to regularly check the condition of the anti-corrosion oil and supplement or replace it if necessary.

Installation steps and details

Surface treatment: Thoroughly clean the mechanical surface of burrs, dirt, and anti-corrosion oil before installation to ensure a smooth and undamaged contact surface.

Screw locking: Use a torque wrench to tighten the screws in the middle to both sides in sequence. The recommended torque for aluminum alloy materials is $\leq 5\text{N} \cdot \text{m}$ to avoid deformation of the slide rail.

Centering and debugging: calibrate the coaxiality of the lead screw and the motor shaft to ensure that the movement is free of stagnation and reduce the risk of abnormal wear.

III) Operation and usage standards

Operation control: After starting, a no-load test run is required to confirm that the lubrication system is supplying oil normally before gradually loading.

Avoid emergency stops, sudden turns, or frequent starts and stops. After high-speed full load operation, run without load for 5-10 minutes to dissipate heat.

Photoelectric switch management: Set starting and limit switches, reserve a safe distance (recommended $\geq 20\text{mm}$) to ensure effective emergency braking.

The photoelectric switch power supply needs to be independently powered and should not be shared with the motor driver to prevent damage to the circuit caused by reverse electromotive force.

IV) Key points of maintenance and upkeep

Lubrication management

Oil lubrication: Remove the anti-corrosion oil before first use and fill with N0.2 lithium soap based grease; Run every 100km or replenish once a month.
Oil lubrication: Select ISO VG15-100 lubricating oil and inject it through oil holes or oil pipes to avoid using oil lubrication for the sealing ring bearings.

Cleaning and dust prevention

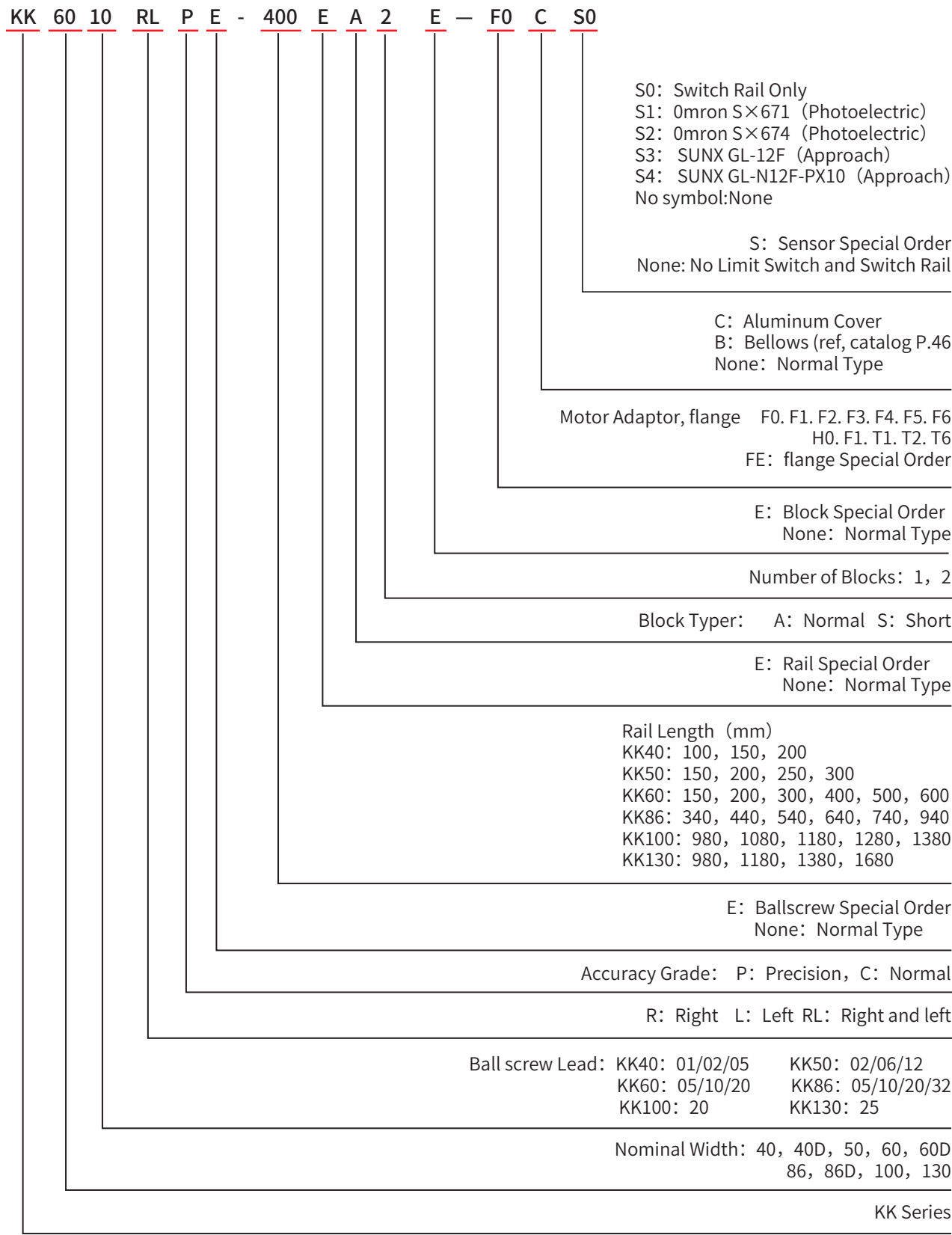
Regularly clean the surface particles of ball screws and sliding rails. If the sealing structure is damaged, it needs to be replaced immediately.
Increase cleaning frequency in dusty environments and install dust covers if necessary.

Regular testing and replacement

Quarterly testing of positioning accuracy, walking parallelism, and starting torque, with calibration deviation ≥ 0.1mm requiring maintenance.
Check the wear of the ball screw and U-shaped slide rail, and replace them if there is local deformation or corrosion exceeding the limit.

(I) KK Compact Module Product Model

KK Compact Module Series (Ready Stock Quick Customization)

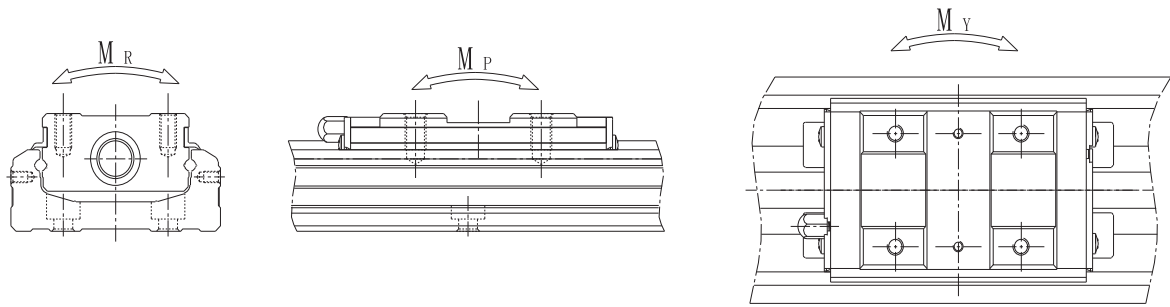


(J) Maximum speed

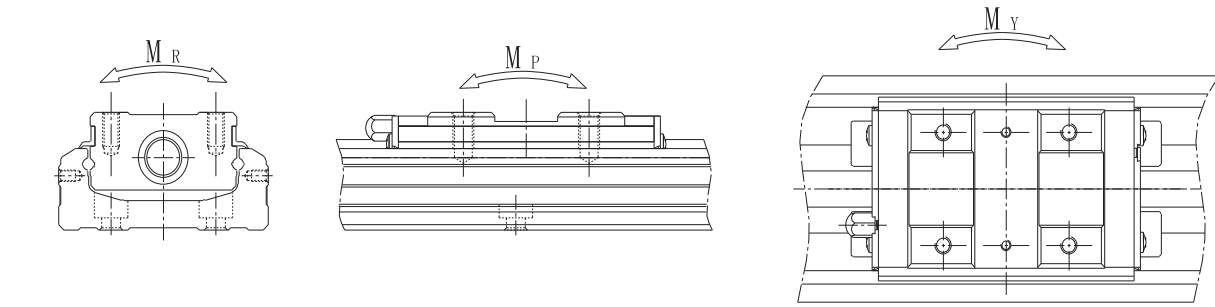
Model	Dia.	Ball screw Lead(mm)	Rail Length (mm)	Speed (mm/sec)	
				Precision	Normal
KK40/ KK40D	8	01	100	100	100
			150	100	100
			200	100	100
		02	100	200	200
			150	200	200
			200	200	200
		05	100	500	500
			150	500	500
			200	500	500
KK50	8	02	150	200	200
			200	200	200
			250	200	200
			300	200	200
	10	06	150	600	480
			200	600	480
			250	600	480
			300	600	480
		12	150	1200	960
			200	1200	960
			250	1200	960
			300	1200	960
KK60/ KK60D	12	05	150	500	400
			200	500	400
			300	500	400
			400	500	400
			500	490	390
			600	340	270
		10	150	1000	800
			200	1000	800
			300	1000	800
			400	1000	800
			500	980	780
			600	680	540
		20	150	1500	1200
			200	1500	1200
			300	1500	1200
			400	1500	1200
			500	1500	1200
			600	1360	1000

Model	Nominal Dia.	Ball screw Lead (mm)	Rail Length (mm)	Speed (mm/sec)	
				Precision	Normal
KK86/ KK86D	15	5	340	500	400
			440	500	400
			540	500	400
			640	390	310
			740	290	230
			940	180	140
		10	340	1000	800
			440	1000	800
			540	1000	800
			640	780	620
			740	580	460
			940	360	280
		20	340	1500	1200
			440	1500	1200
			540	1500	1200
			640	1500	1200
			740	1150	920
			940	730	580
	16	32	340	2400	1920
			440	2400	1920
			540	2400	1920
			640	2400	1920
			740	2030	1620
			940	1250	1000
KK100	20	20	980	910	720
			1080	750	600
			1180	630	500
			1280	530	420
			1380	460	360
KK130	25	25	980	1500	1200
			1180	1000	800
			1380	750	600
			1680	500	400

(K) Load specifications



Model		Ball screw				Basic Dynamic Load Rating(N)		Basic Static Load Rating(N)	
		Nominal Dia. (mm)	Lead (mm)	Basic Dynamic Load (N)	Basic Static Load (N)	Block		Block	
						A	S	A	S
KK4001	Precision	8	01	1585	3950	3920	-	6468	-
	Normal			1211	2846				
KK4002	Precision		02	2784	5992				
	Normal			2128	4318				
KK4005	Precision		05	1374	2657				
	Normal			1050	1914				
KK5002	Precision	8	02	2784	5992	8007	-	12916	-
	Normal			2128	4318				
KK5006	Precision	10	06	3165	6557				
	Normal			2419	4725				
KK5012	Precision		12	2104	4224				
	Normal			1609	3044				
KK6005	Precision	12	05	6239	12047	13230	7173	21462	11574
	Normal			4769	8681				
KK6010	Precision		10	6047	11760				
	Normal			4622	8474				
KK6020	Precision		20	4018	7860				
	Normal			3071	5664				
KK8605	Precision	15	05	10522	23198	31458	-	50674	-
	Normal			8042	16716				
KK8610	Precision		10	8242	17827				
	Normal			6300	12846				
KK8620	Precision		20	5432	11437				
	Normal			4152	8241				
KK8632	Precision	16	32	5100	11440				
	Normal			3899	8243				
KK10020	Precision	20	20	7508	17205	39200	-	63406	-
	Normal			5738	12397				
KK13025	Precision	25	25	8266	21572	48101	-	84829	-
	Normal			6318	15544				



Model		Guideway											
		M _P (N-m)				M _V (N-m)				M _R (N-m)			
		Block A1	Block A2	Block S1	Block S2	Block A1	Block A2	Block S1	Block S2	Block A1	Block A2	Block S1	Block S2
KK4001	Precision	33	182	-	-	33	182	-	-	81	162	-	-
	Normal												
KK4002	Precision												
	Normal												
KK4005	Precision												
	Normal												
KK5002	Precision	116	278	-	-	116	278	-	-	222	444	-	-
	Normal												
KK5006	Precision												
	Normal												
KK5012	Precision												
	Normal												
KK6005	Precision	152	348	72	205	152	348	72	205	419	838	241	482
	Normal												
KK6010	Precision												
	Normal												
KK6020	Precision												
	Normal												
KK8605	Precision	622	3050	-	-	622	3050	-	-	1507	3014	-	-
	Normal												
KK8610	Precision												
	Normal												
KK8620	Precision												
	Normal												
KK8632	Precision												
	Normal												
KK10020	Precision	960	4763	-	-	960	4763	-	-	2205	4410	-	-
	Normal												
KK13025	Precision	1536	7350	-	-	1536	7350	-	-	3885	7770	-	-
	Normal												

(L) Accuracy grade

Model	Rail Length	Repeatability		Accuracy		Running Parallelism		Starting Torque (N-cm)	
		Precision	Normal	Precision	Normal	Precision	Normal	Precision	Normal
KK40	100	±0.003	±0.01	0.02	-	0.01	-	1.2	0.8
	150								
	200								
KK50	150	±0.003	±0.01	0.02	-	0.01	-	4	2
	200								
	250								
	300								
KK60	150	±0.003	±0.01	0.02	-	0.01	-	15	7
	200								
	300								
	400								
	500	±0.003	±0.01	0.025		0.015		15	7
	600								
KK86	340	±0.003	±0.01	0.025	-	0.15	-	15	10
	440								
	540								
	640								
	740	±0.003	±0.01	0.03	-	0.02	-	17	10
	940	±0.003	±0.01	0.04	-	0.03	-	25	10
KK100	980	±0.005	±0.01	0.035	-	0.025	-	17	12
	1080								
	1180	±0.005	±0.01	0.04	-	0.03	-	20	12
	1280	±0.005	±0.01	0.045	-	0.035	-	23	15
	1380			0.05		0.04		25	
KK130	980	±0.005	±0.01	0.035	-	0.025	-	25	15
	1180			0.04		0.03		25	15
	1380								
	1680			±0.007		±0.012		0.05	-

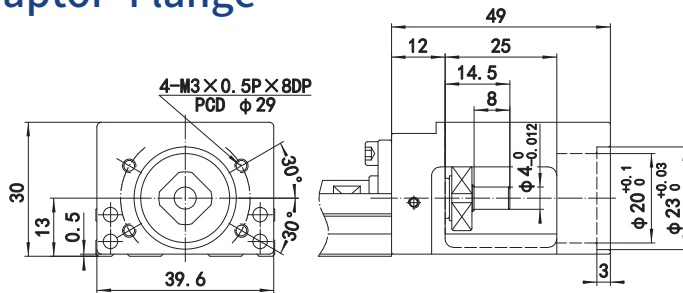
Motor and connection flange

Motor No.		Model	KK40	KK50	KK60	KK86	KK100	KK130
AC servo moto	Panasonic	MSM3AZ (30W)	F2	F2	F2	F3		
		MSM5AZ (50W)						
		MSM01 (100W)						
		MSM02 (200W)				F1		
		MSM04 (400W)						
		MSM08 (750W)						
	Mitsubishi	HP-PQ033 (30W)	F1	F1	F1	F2		
		HC-PQ053 (50W)						
		HC-PQ13 (100W)						
		HC-KFS053 (50W)	F1	F1	F1	F2		
		HC-KFS13 (100W)						
		HC-KFS23 (200W)						
	Yaskawa	HC-KFS43 (400W)				F0	F0	F1
		HC-MF73 (750W)						
		SGMAH-A3 (30W)		F1	F1	F2		
		SGMAH-A5 (50W)						
		SGMAH-01 (100W)						
		SGMPH-01 (100W)				F0	F0	F1
		SGMAH-02 (200W)						
		SGMAH-04 (400W)						
		SGMPH-02 (200W)						F0
		SGMPH-04 (400W)						
		SGMAH-08 (750W)						
Stepping motor	Nema17		F3	F3	F5			
	Nema23			(F-E2)	F4	F6		
	Nema34						F4	
	VEXTA	PK24	F3	F3	F5			
		PK26		(F-E2)	F4	F6		
		PK29					F4	F3
		PK54		F3	F5			
		PK56		(F-E1)		F5		
		PK59					F3	

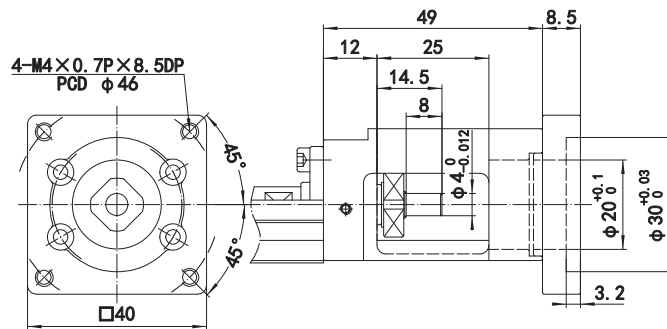
(M) Motor connection flange

KK40 Motor Adaptor Flange

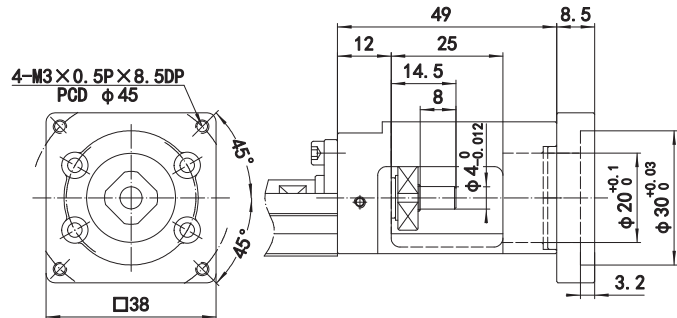
KK40 F0



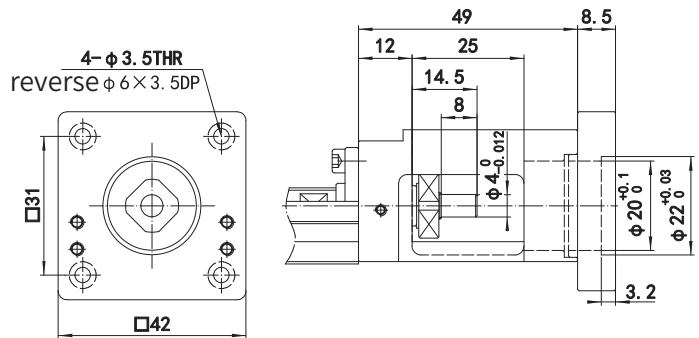
KK40 F1



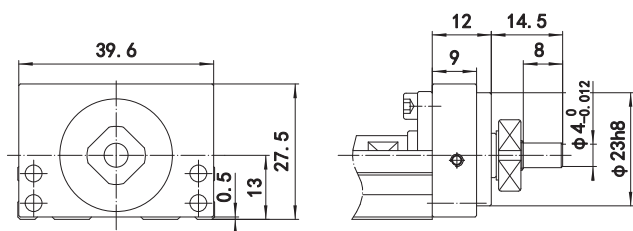
KK40 F2



KK40 F3

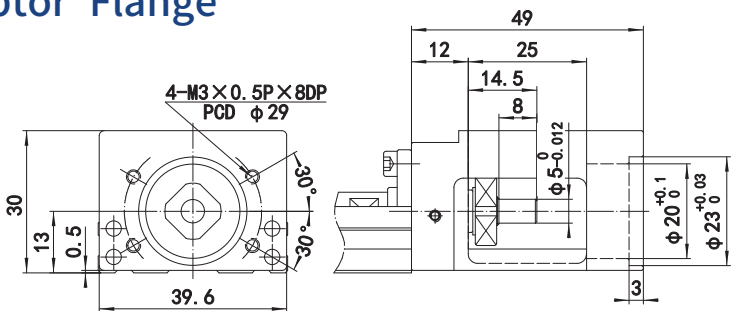


KK40 H0

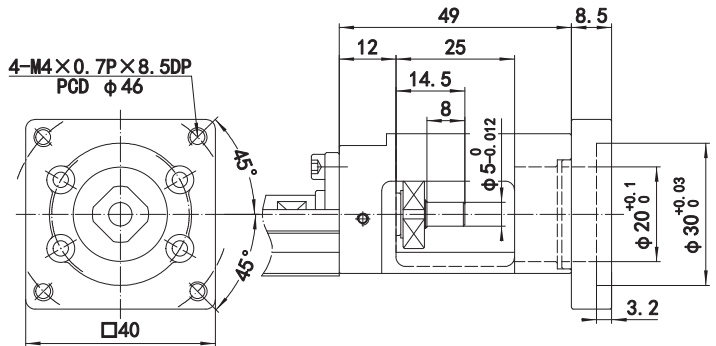


KK40D Motor Adaptor Flange

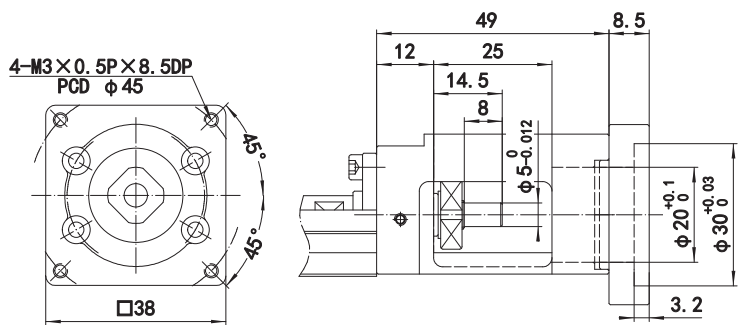
KK40D F0



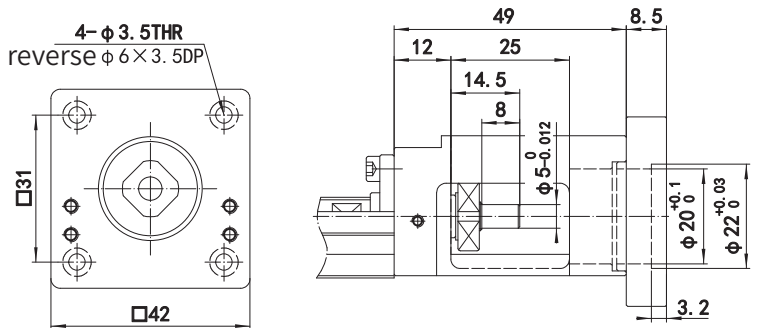
KK40D F1



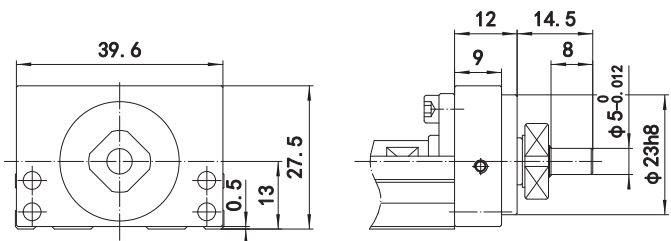
KK40D F2



KK40D F3

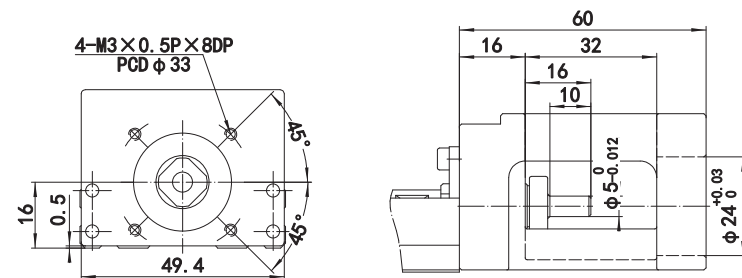


KK40D H0

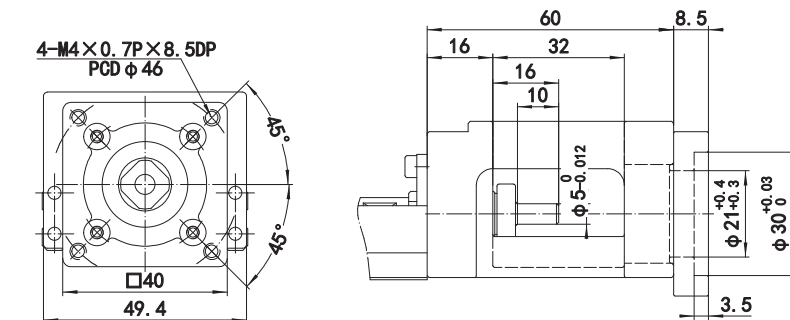


KK50 Motor Adaptor Flange

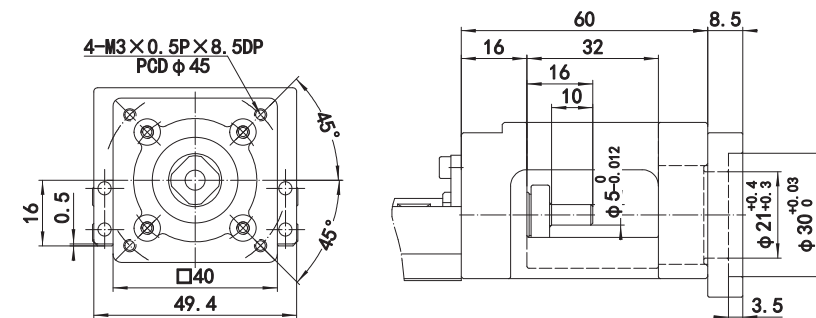
KK50 F0



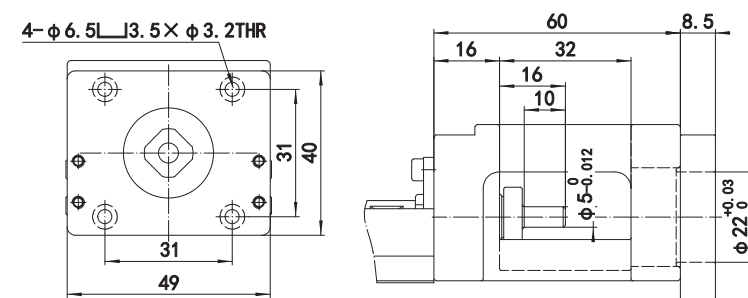
KK50 F1



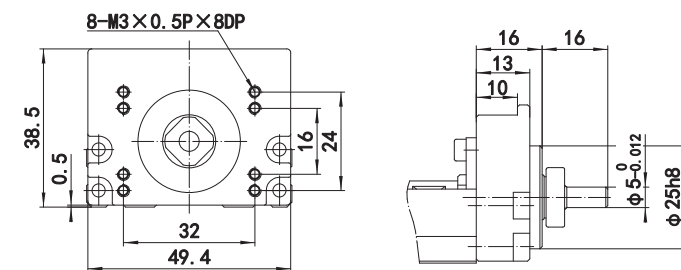
KK50 F2



KK50 F3

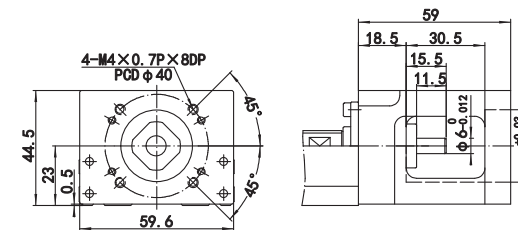


KK50 H0

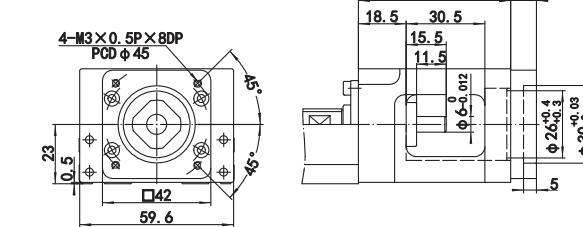


KK60 Motor Adaptor Flange

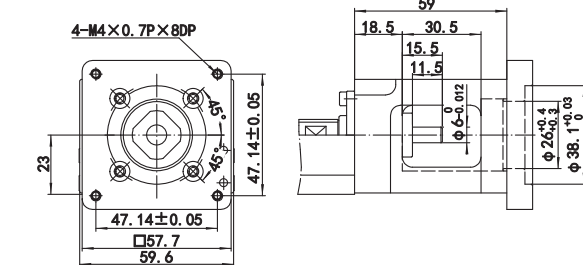
KK60 F0



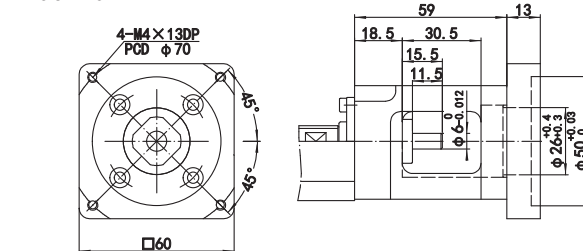
KK60 F2



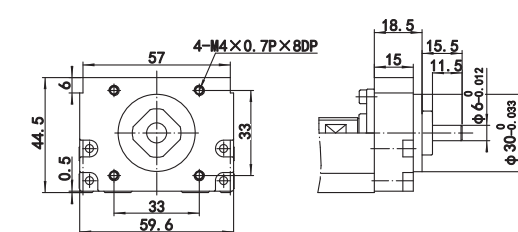
KK60 F4



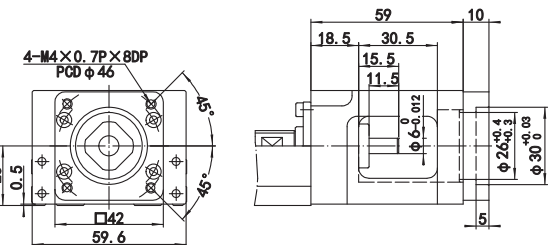
KK60 F6



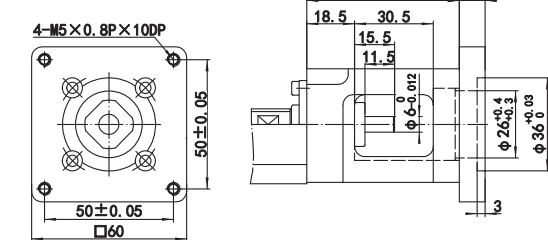
KK60 H0



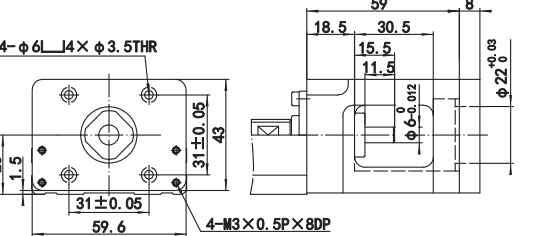
KK60 F1



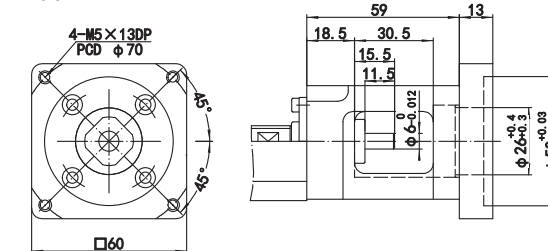
KK60 F3



KK60 F5

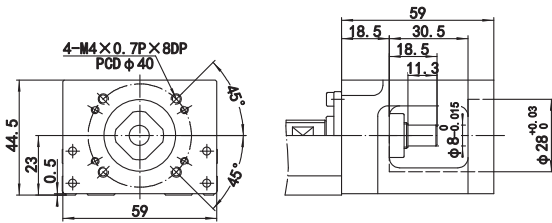


KK60 F7

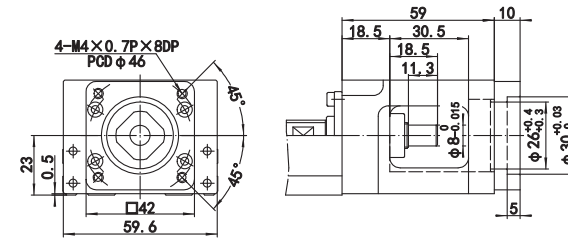


KK60D Motor Adaptor Flange

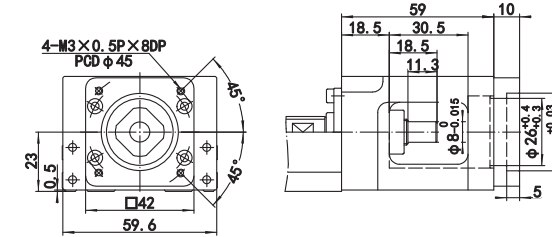
KK60D F0



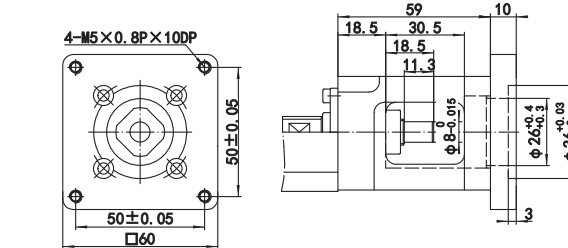
KK60D F1



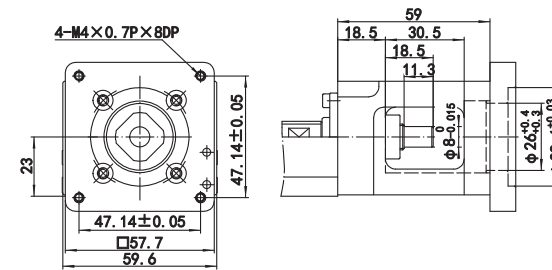
KK60D F2



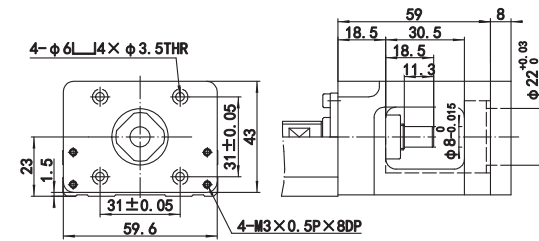
KK60D F3



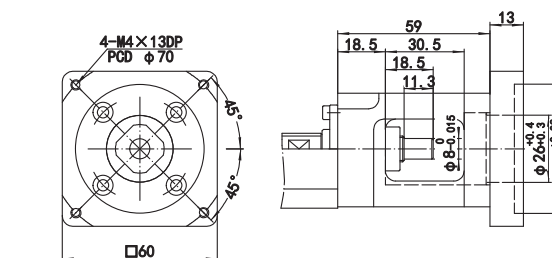
KK60D F4



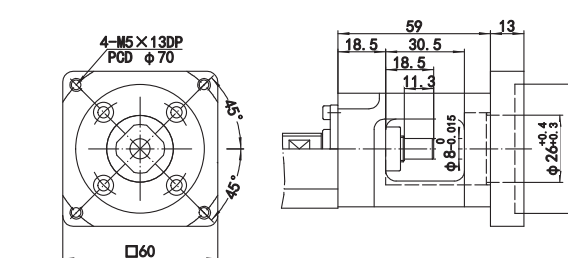
KK60D F5



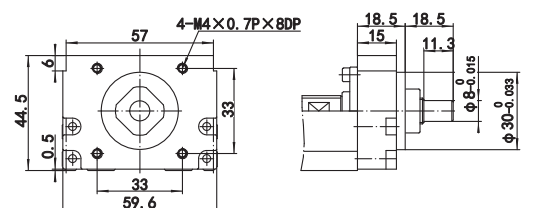
KK60D F6



KK60D F7

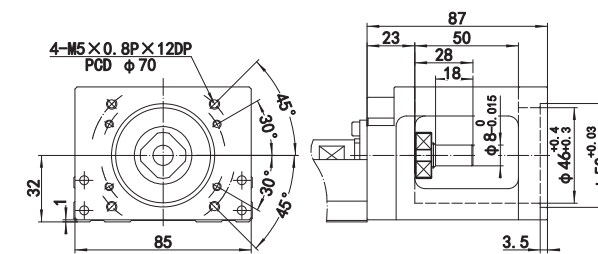


KK60D H0

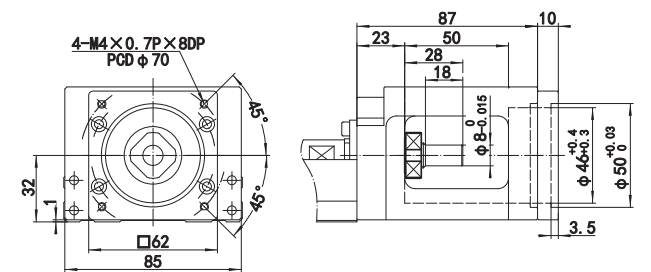


KK86 Motor Adaptor Flange

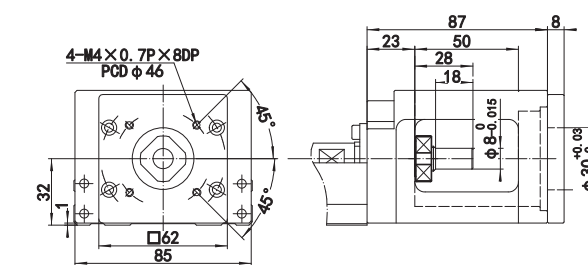
KK86 F0



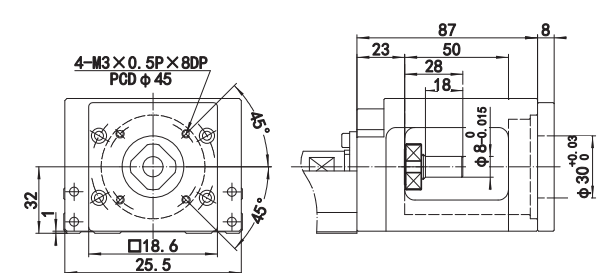
KK86 F1



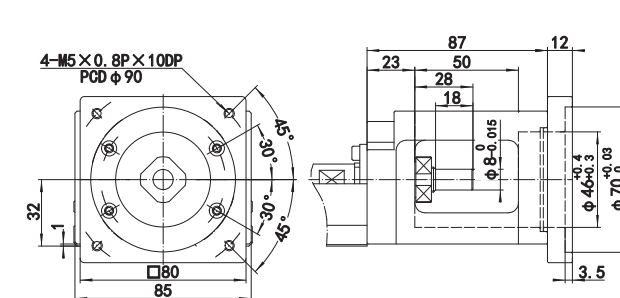
KK86 F2



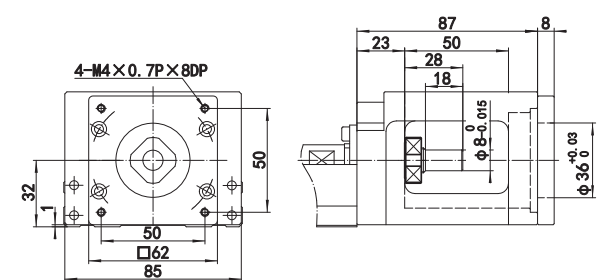
KK86 F3



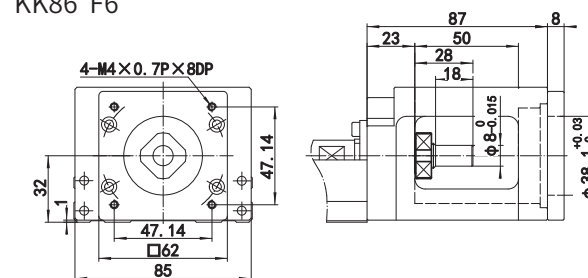
KK86 F4



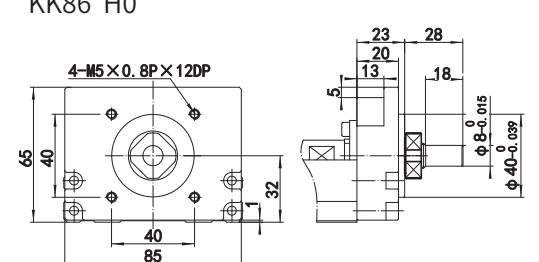
KK86 F5



KK86 F6

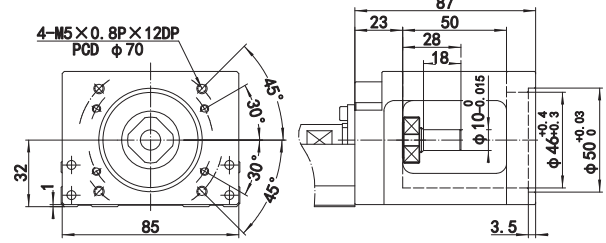


KK86 H0

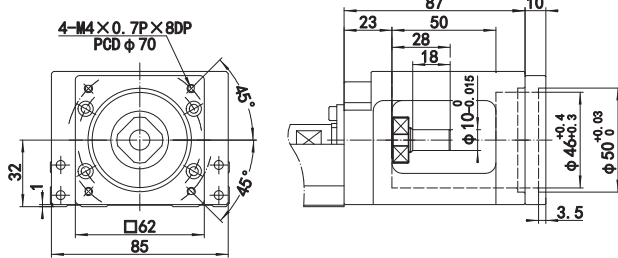


KK86D Motor Adaptor Flange

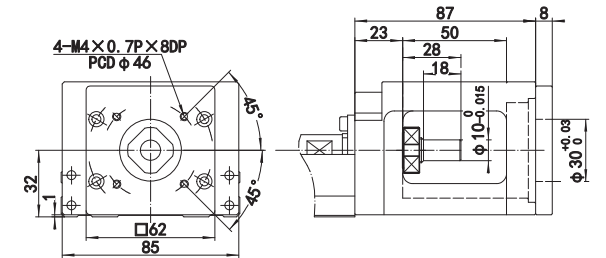
KK86D F0



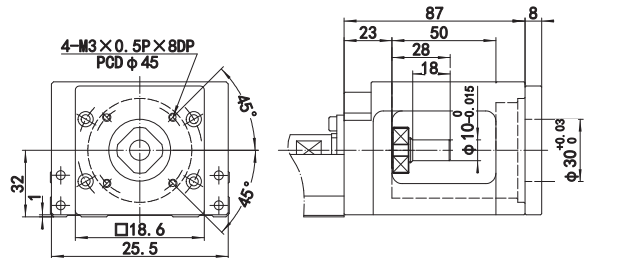
KK86D F1



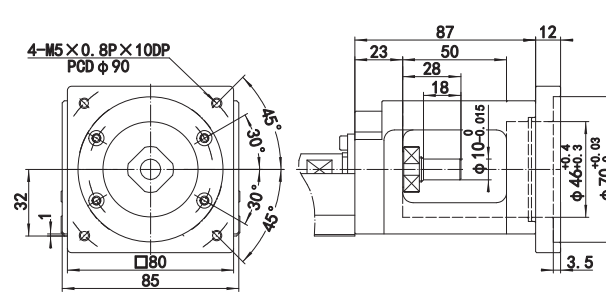
KK86D F2



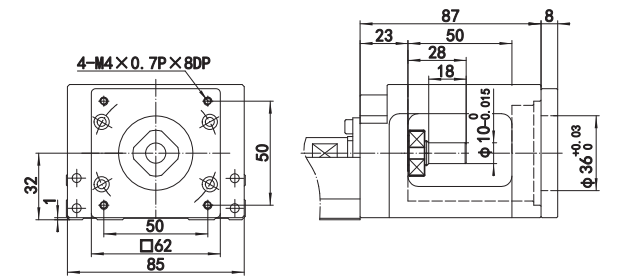
KK86D F3



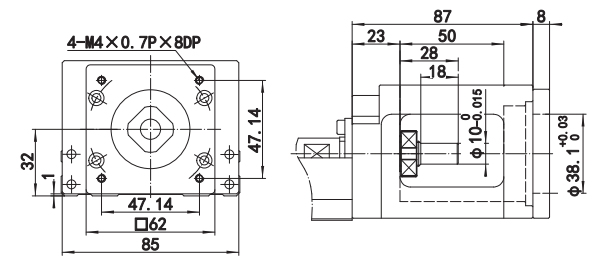
KK86D F4



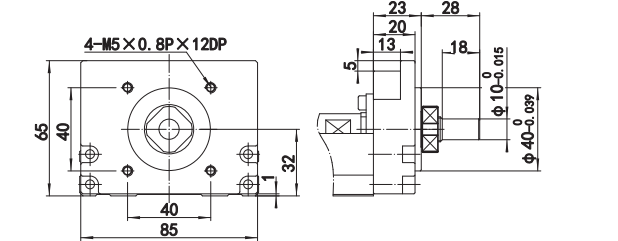
KK86D F5



KK86D F6

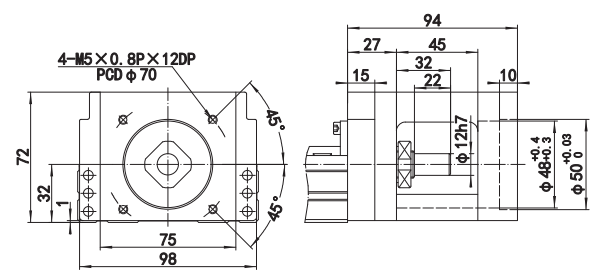


KK86D H0

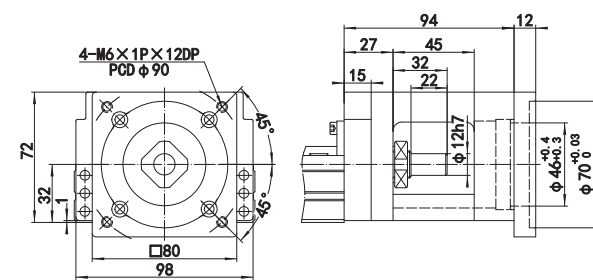


KK100 Motor Adaptor Flange

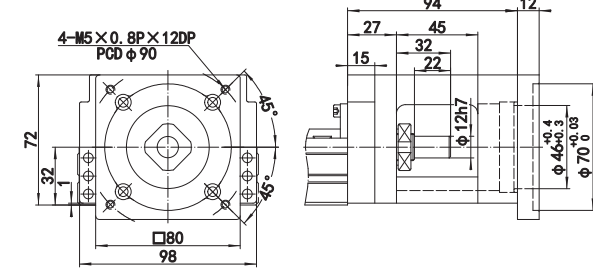
KK100 F0



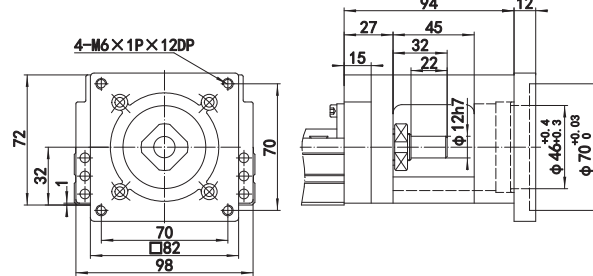
KK100 F1



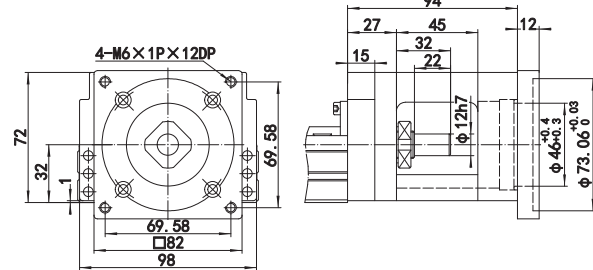
KK100 F2



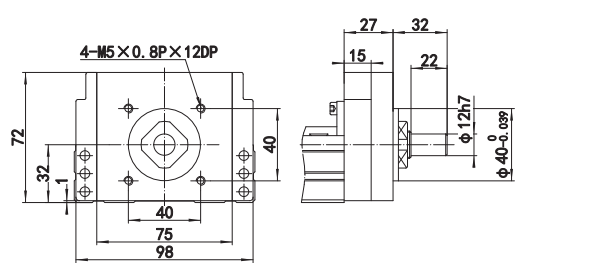
KK100 F3



KK100 F4

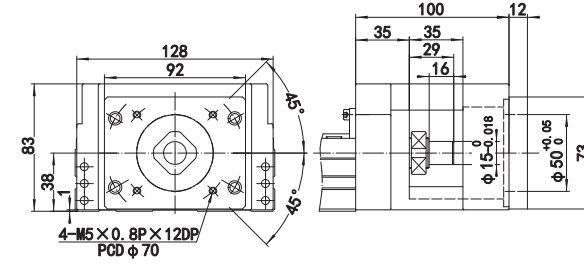
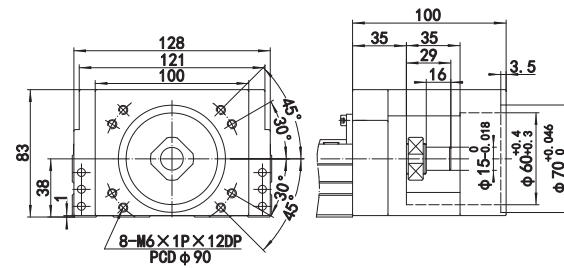


KK100 H0

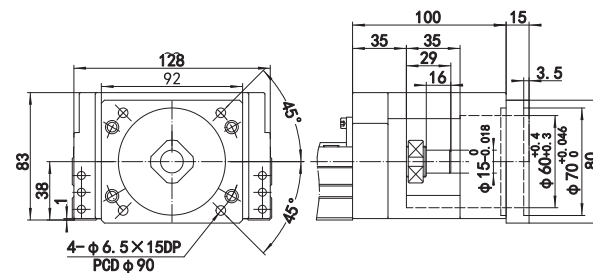


KK130 Motor Adaptor Flange

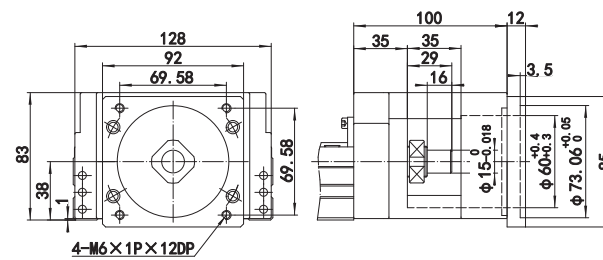
KK130 F0



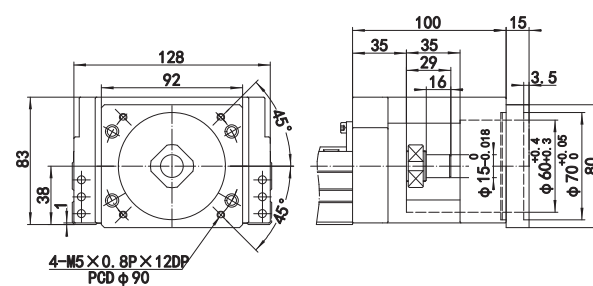
KK130 F2



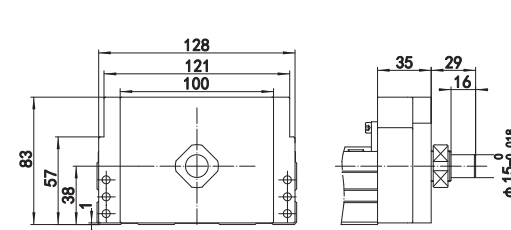
KK130 F3



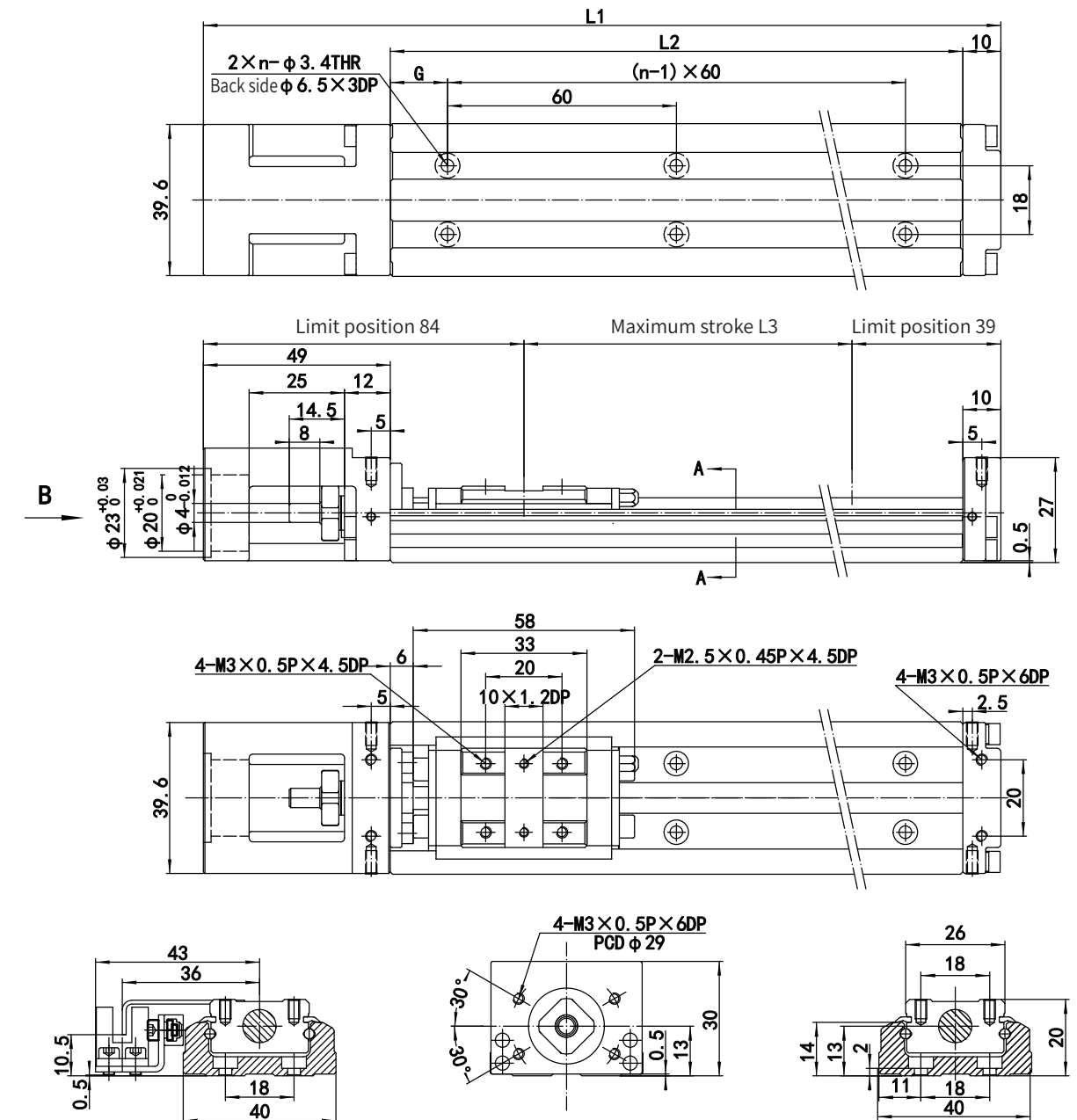
KK130 F4



KK130 H0



(N) Dinghan KK series
KK40 (Excluding protective cover)



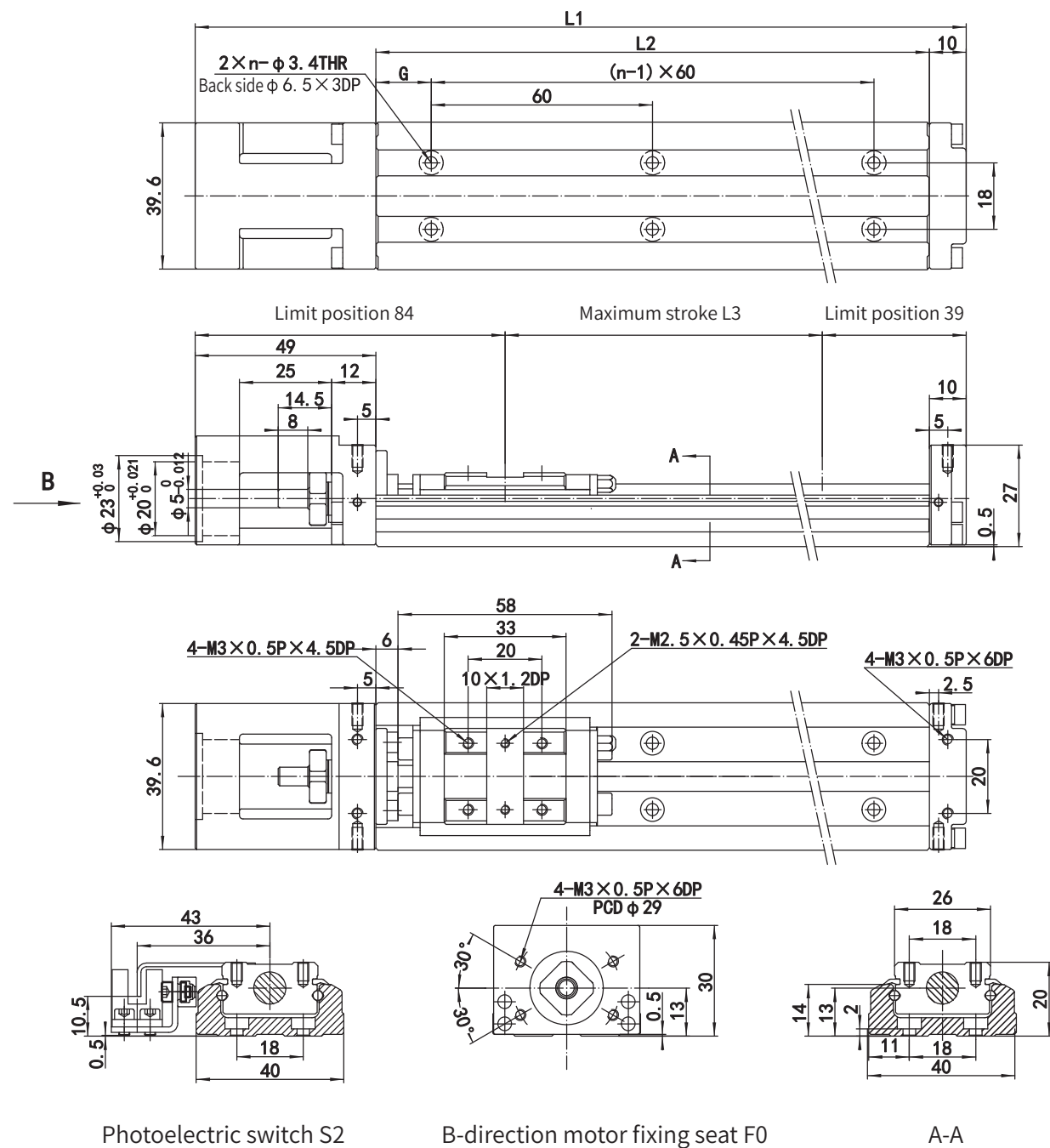
Photoelectric switch S2

B-direction motor fixing seat F0

A-A

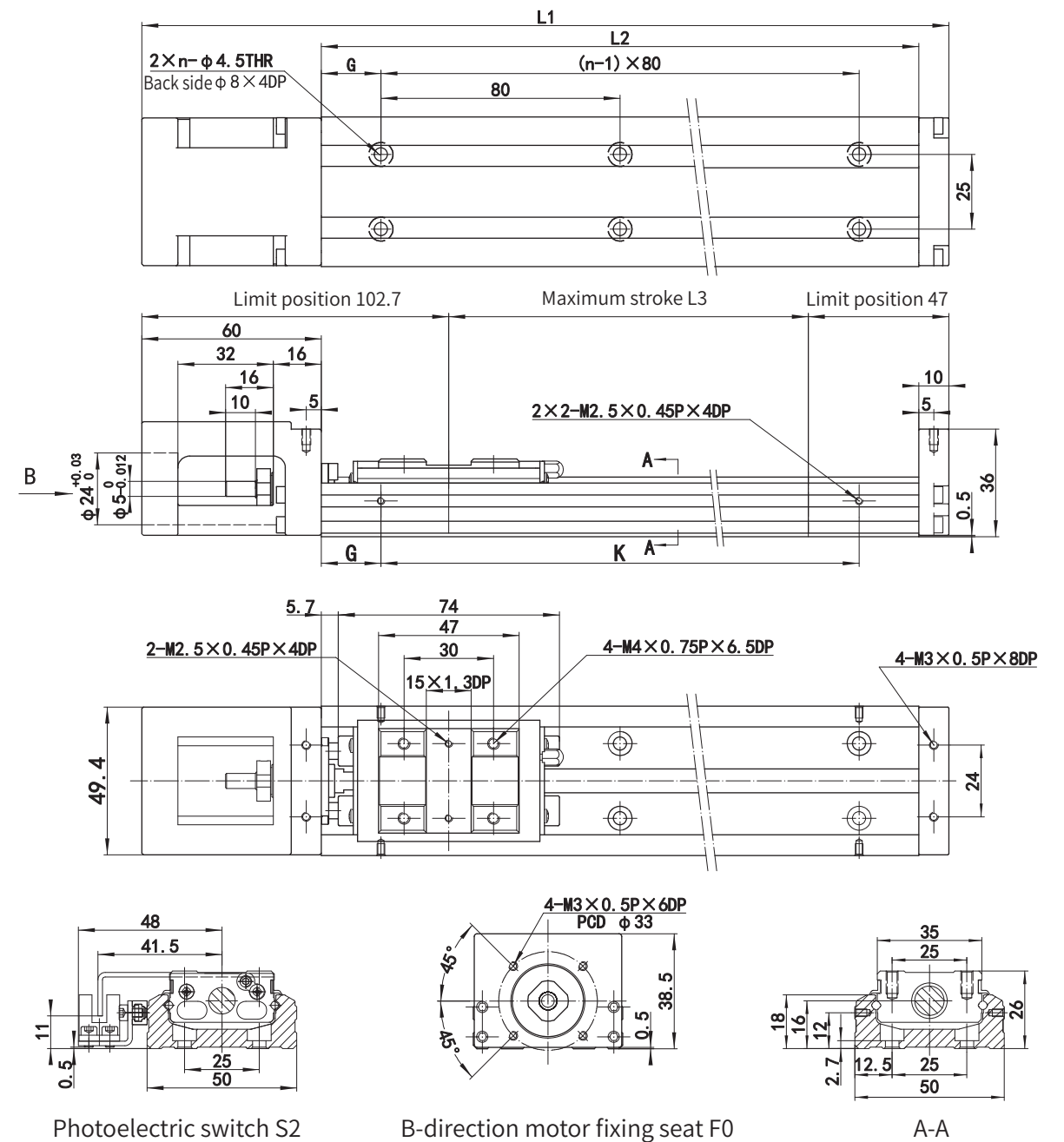
Rail Length L2 (mm)	Total Length (mm)	Maximum Stroke (mm)		G (mm)	n	Mass (kg)	
		Block A1	Block A2			Block A1	Block A2
100	159	36	-	20	2	0.48	-
150	209	86	34	15	3	0.6	0.67
200	259	136	84	40	3	0.72	0.79

KK40D (Excluding protective cover)



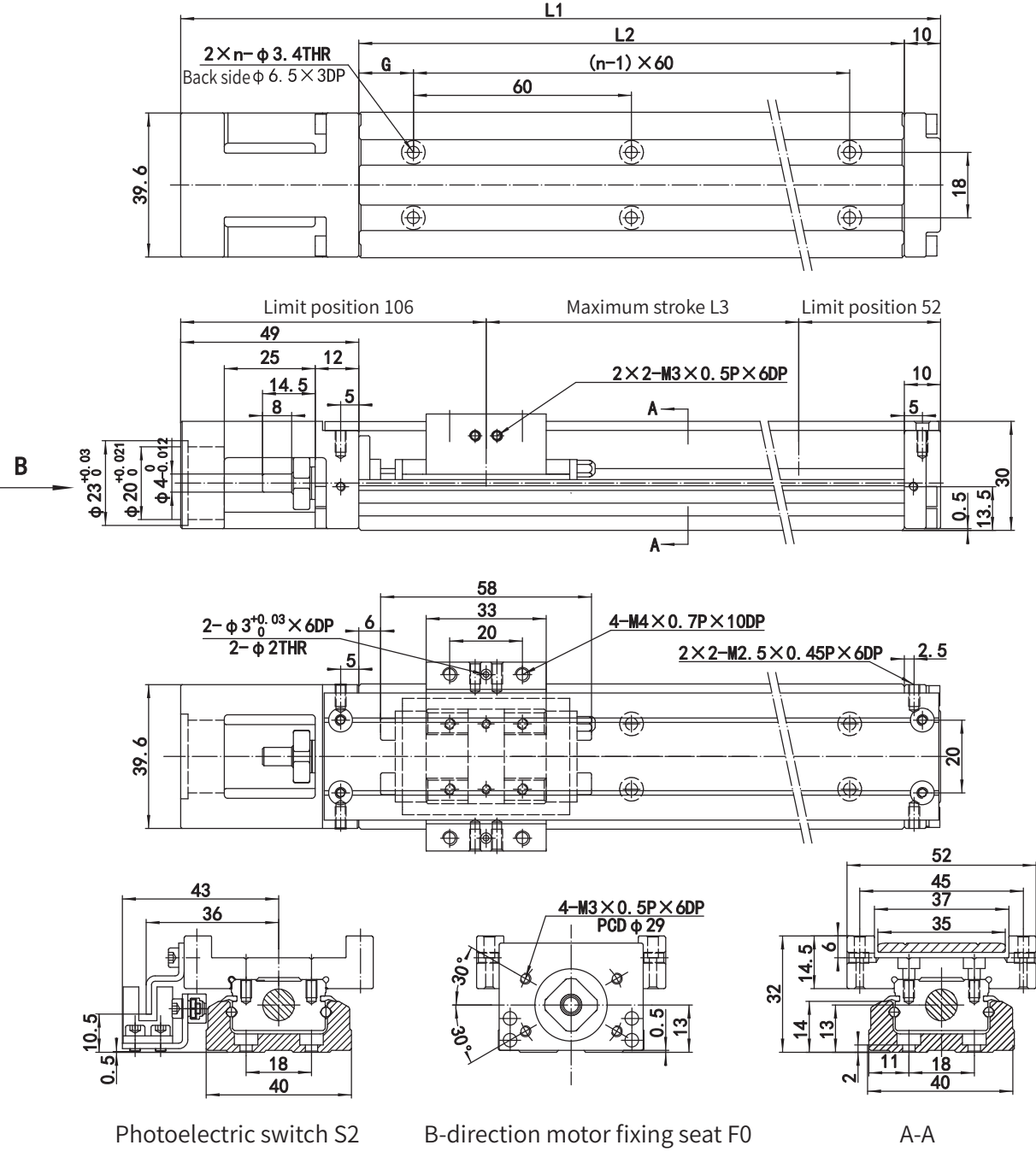
Rail Length L2 (mm)	Total Length (mm)	Maximum Stroke (mm)		G (mm)	n	Mass (kg)	
		Block A1	Block A2			Block A1	Block A2
100	159	36	-	20	2	0.48	-
150	209	86	34	15	3	0.6	0.67
200	259	136	84	40	3	0.72	0.79

KK50 (Excluding protective cover)



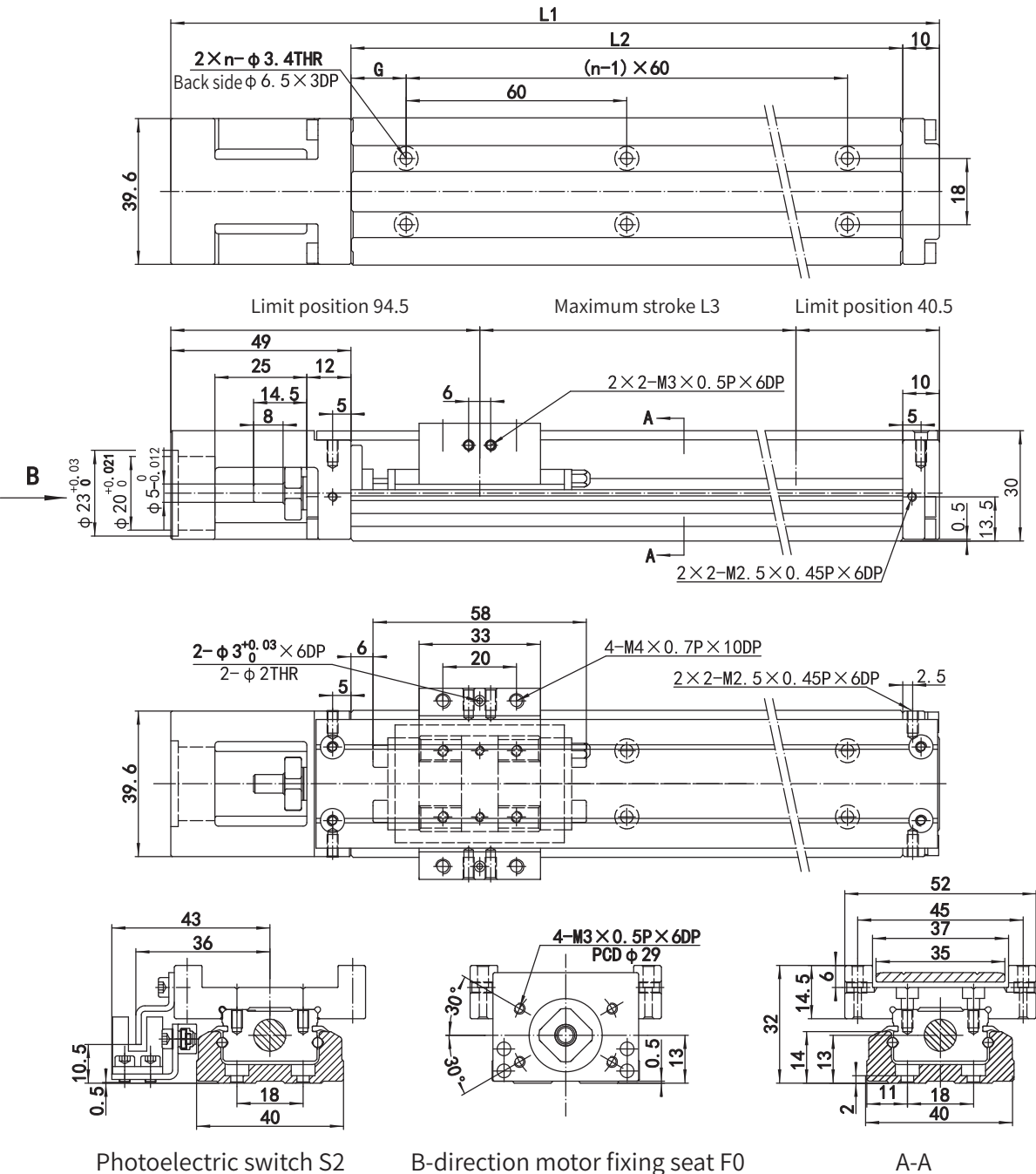
Rail Length L2 (mm)	Total Length (mm)	Maximum Stroke (mm)		G (mm)	K (mm)	n	Mass (kg)	
		Block A1	Block A2				Block A1	Block A2
150	220	70	-	35	80	2	1	-
200	270	120	55	20	160	3	1.2	1.4
250	320	170	105	45	160	3	1.4	1.6
300	370	220	150	30	240	4	1.6	1.8

KK60 (Excluding protective cover)



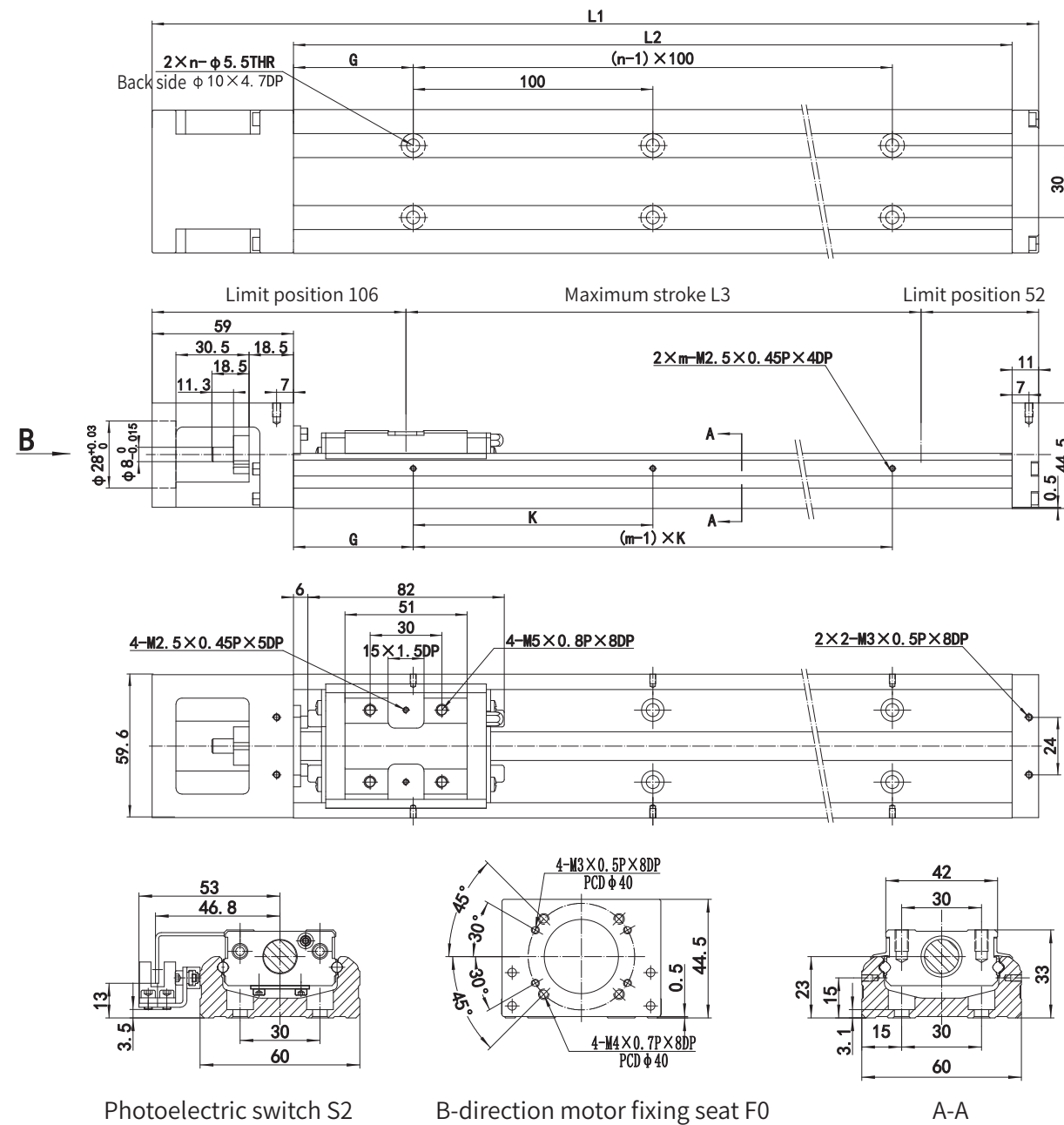
Rail Length L2 (mm)	Total Length (mm)	Maximum Stroke (mm)		G (mm)	K (mm)	n	m	Mass (kg)	
		Block A1	Block A2					Block A1	Block A2
150	220	60	-	25	100	2	2	1.5	-
200	270	110	-	50	100	2	2	1.8	-
300	370	210	135	50	200	3	2	2.4	2.7
400	470	310	235	50	100	4	4	3	3.3
500	570	410	335	50	200	5	3	3.6	3.9
600	670	510	435	50	100	6	6	4.2	4.6

KK60 (Excluding protective cover \ Light load type)



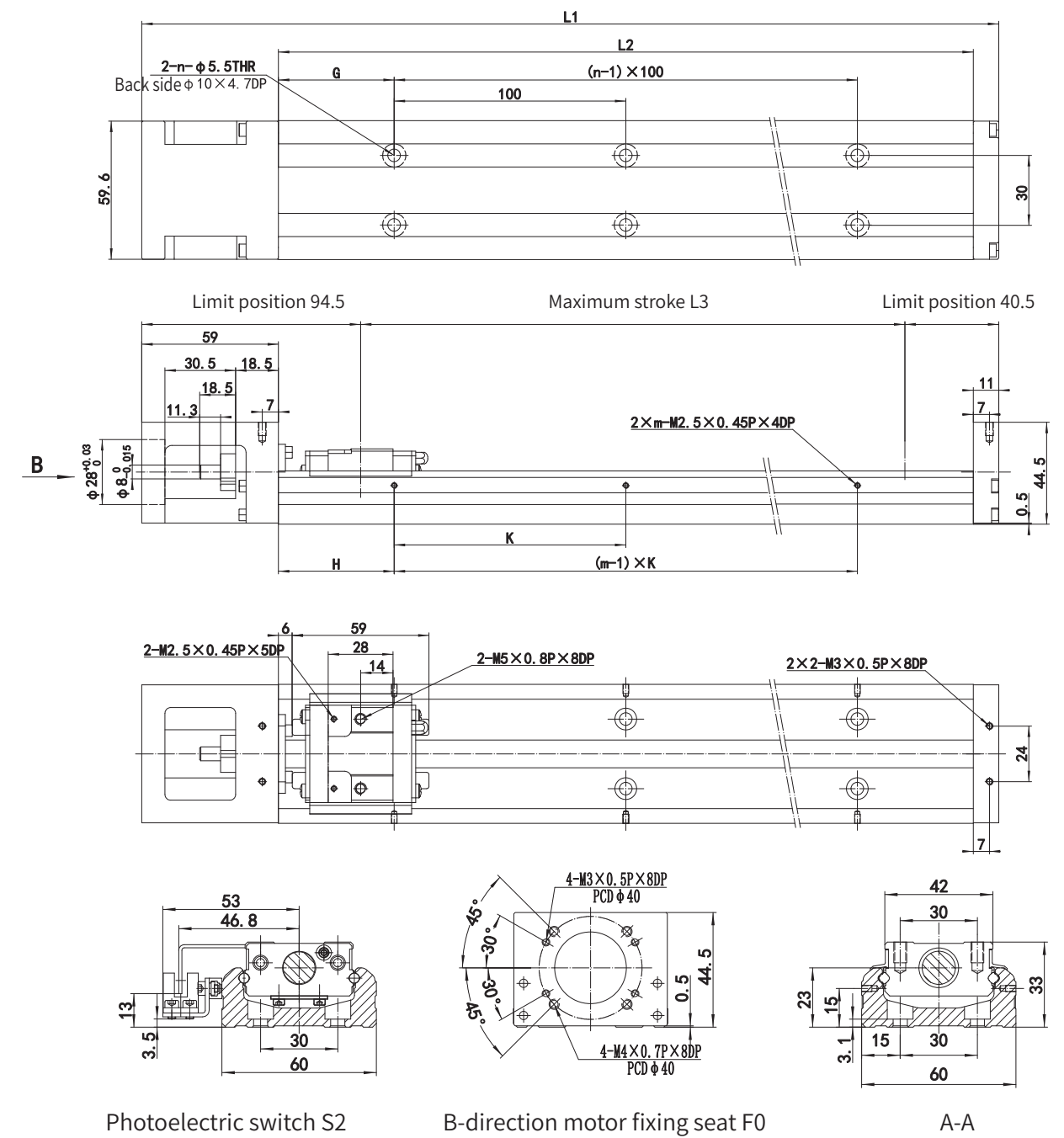
Rail Length L2 (mm)	Total Length (mm)	Maximum Stroke (mm)		G (mm)	K (mm)	n	m	Mass (kg)	
		Block A1	Block A2					Block A1	Block A2
150	220	85	34	25	100	2	2	1.4	1.6
200	270	135	84	50	100	2	2	1.7	1.9
300	370	235	184	50	200	3	2	2.3	2.5
400	470	335	284	50	100	4	4	2.9	3.1
500	570	435	384	50	200	5	3	3.5	3.7
600	670	535	484	50	100	6	6	4.1	4.3

KK60D (Excluding protective cover)



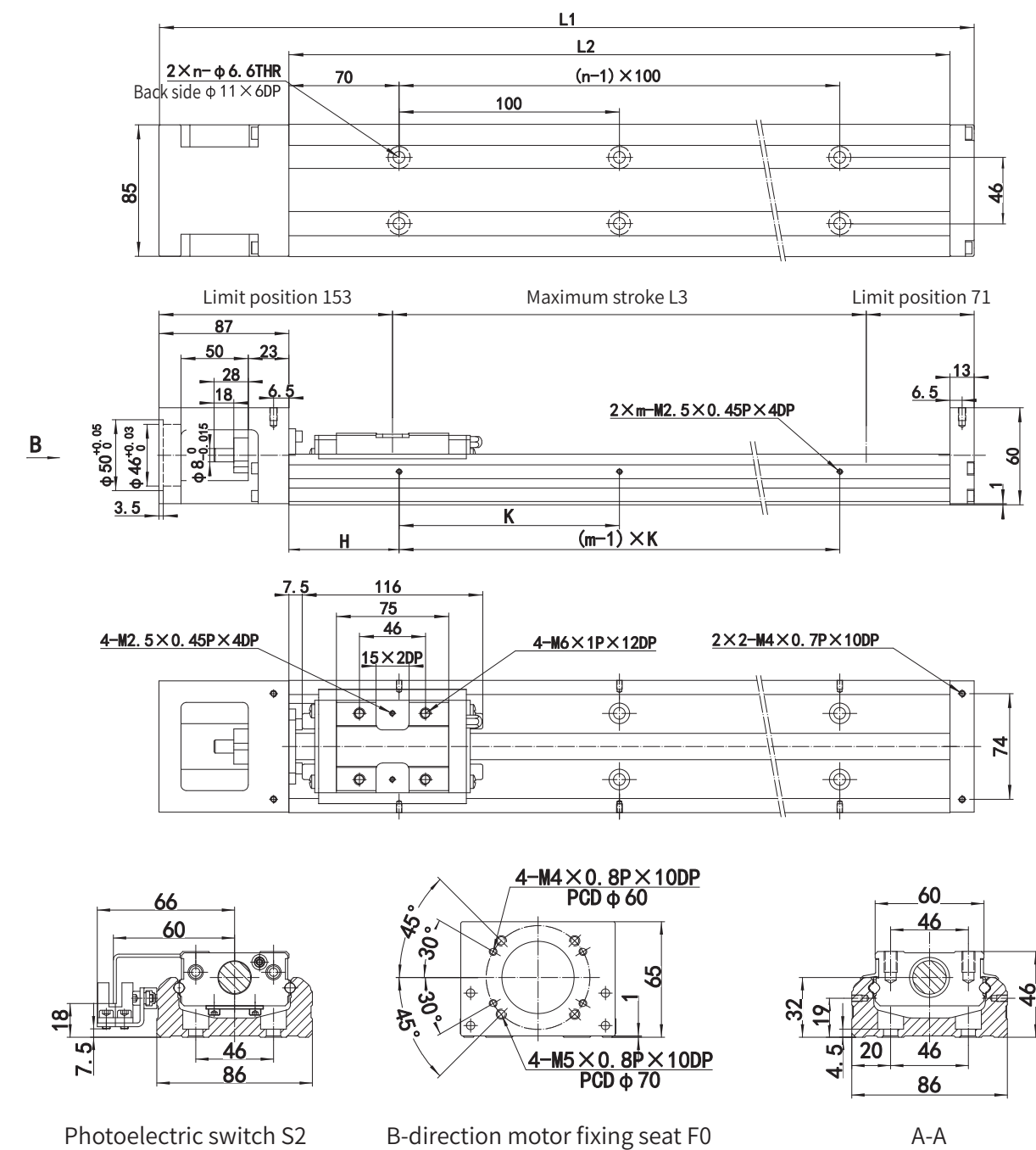
Rail Length L2 (mm)	Total Length (mm)	Maximum Stroke (mm)		G (mm)	K (mm)	n	m	Mass (kg)	
		Block A1	Block A2					Block A1	Block A2
150	220	60	-	25	100	2	2	1.5	-
200	270	110	-	50	100	2	2	1.8	-
300	370	210	135	50	200	3	2	2.4	2.7
400	470	310	235	50	100	4	4	3	3.3
500	570	410	335	50	200	5	3	3.6	3.9
600	670	510	435	50	100	6	6	4.2	4.6

KK60D (Excluding protective cover \ Light load type)



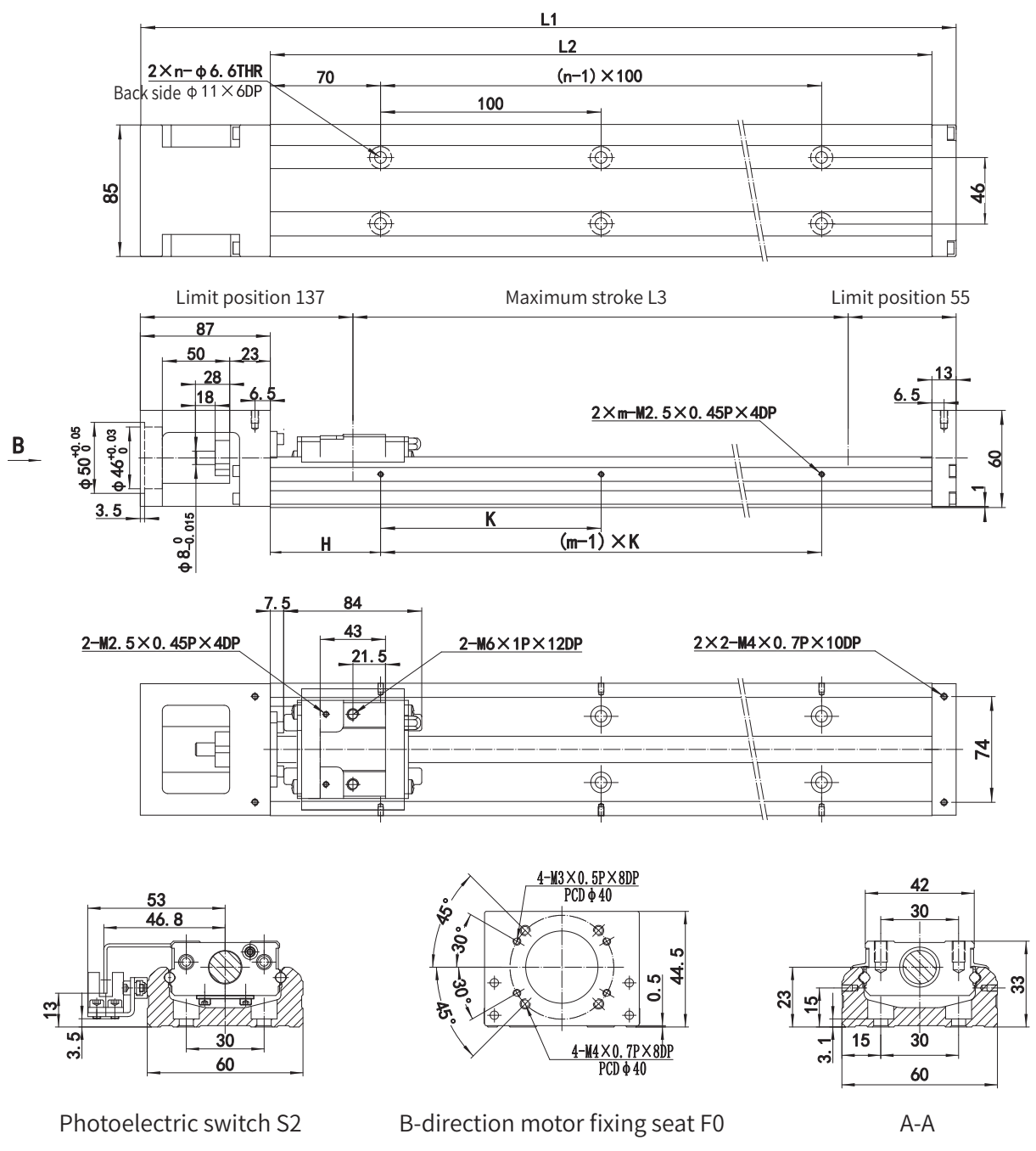
Rail Length L2 (mm)	Total Length (mm)	Maximum Stroke (mm)		G (mm)	K (mm)	n	m	Mass (kg)	
		Block A1	Block A2					Block A1	Block A2
150	220	85	34	25	100	2	2	1.4	1.6
200	270	135	84	50	100	2	2	1.7	1.9
300	370	235	184	50	200	3	2	2.3	2.5
400	470	335	284	50	100	4	4	2.9	3.1
500	570	435	384	50	200	5	3	3.5	3.7
600	670	535	484	50	100	6	6	4.1	4.3

KK86 (Excluding protective cover)



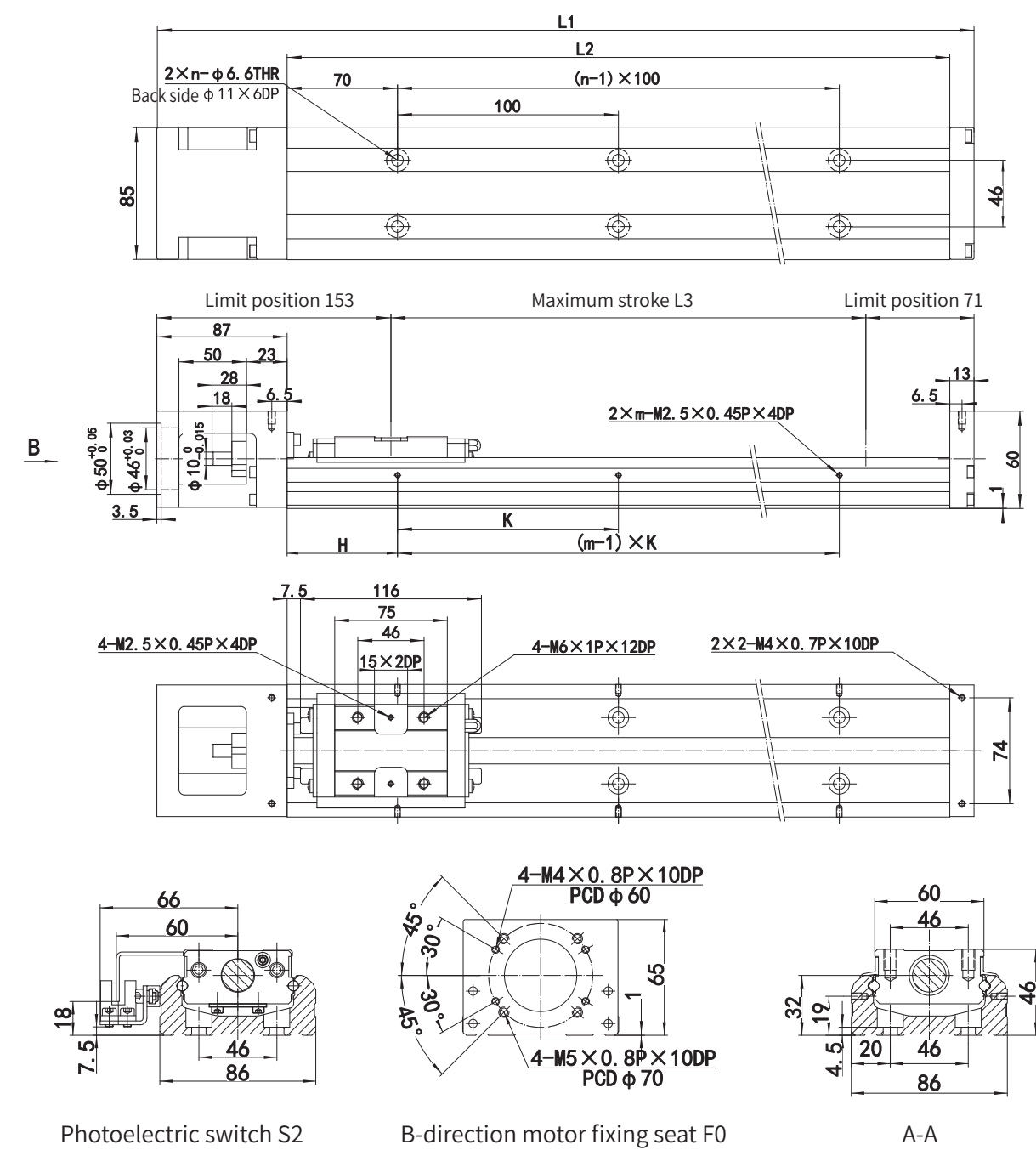
Rail Length L2 (mm)	Total Length (mm)	Maximum Stroke (mm)		H (mm)	n	m	Mass (kg)	
		Block A1	Block A2				Block A1	Block A2
340	440	216	108	70	3	2	5.7	6.5
440	540	316	208	20	4	3	6.9	7.7
540	640	416	308	70	5	3	8	8.8
640	740	516	408	20	6	4	9.2	10
740	840	616	508	70	7	4	10.4	11.2
940	1040	816	708	70	9	5	11.6	12.4

KK86 (Excluding protective cover \ Light load type)

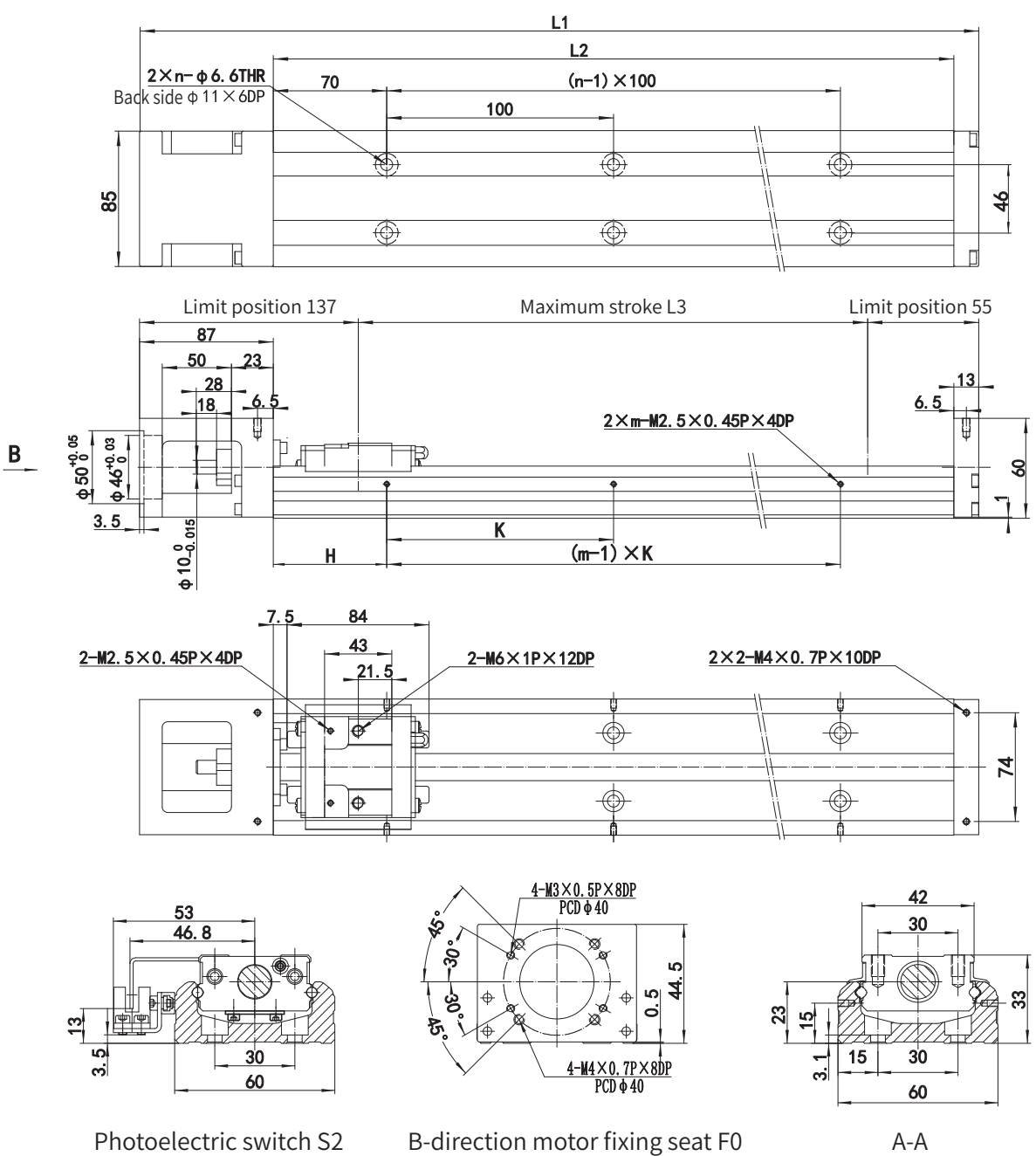


Rail Length L2 (mm)	Total Length (mm)	Maximum Stroke (mm)		H (mm)	n	m	Mass (kg)	
		Block A1	Block A2				Block A1	Block A2
340	440	248	172	70	3	2	5.4	5.9
440	540	348	272	20	4	3	6.5	7.1
540	640	448	372	70	5	3	7.7	8.2
640	740	548	472	20	6	4	8.9	9.4
740	840	648	572	70	7	4	10.1	10.6
940	1040	848	772	70	9	5	11.3	11.8

KK86D (Excluding protective cover)

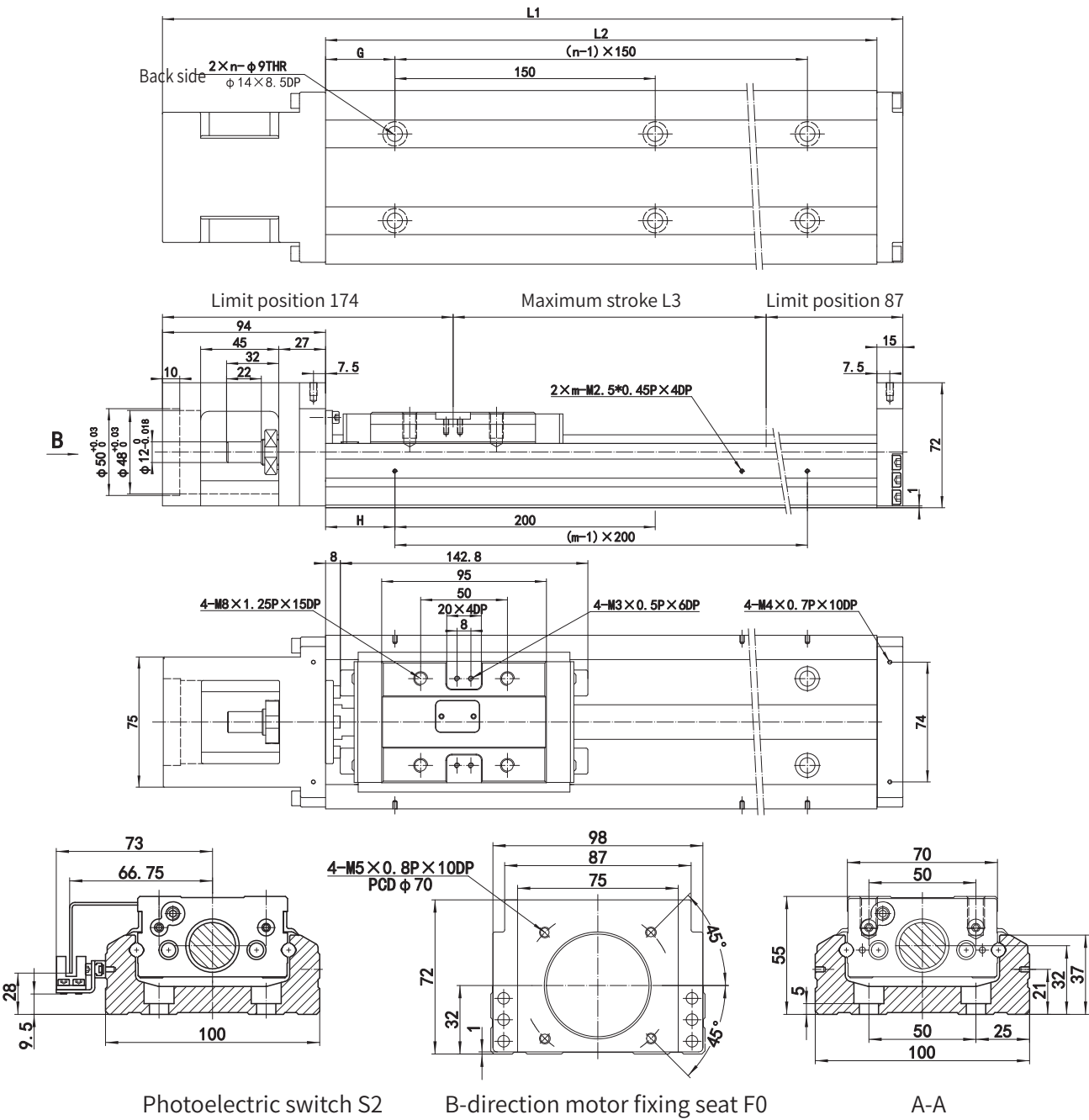


KK86D (Excluding protective cover \ Light load type)



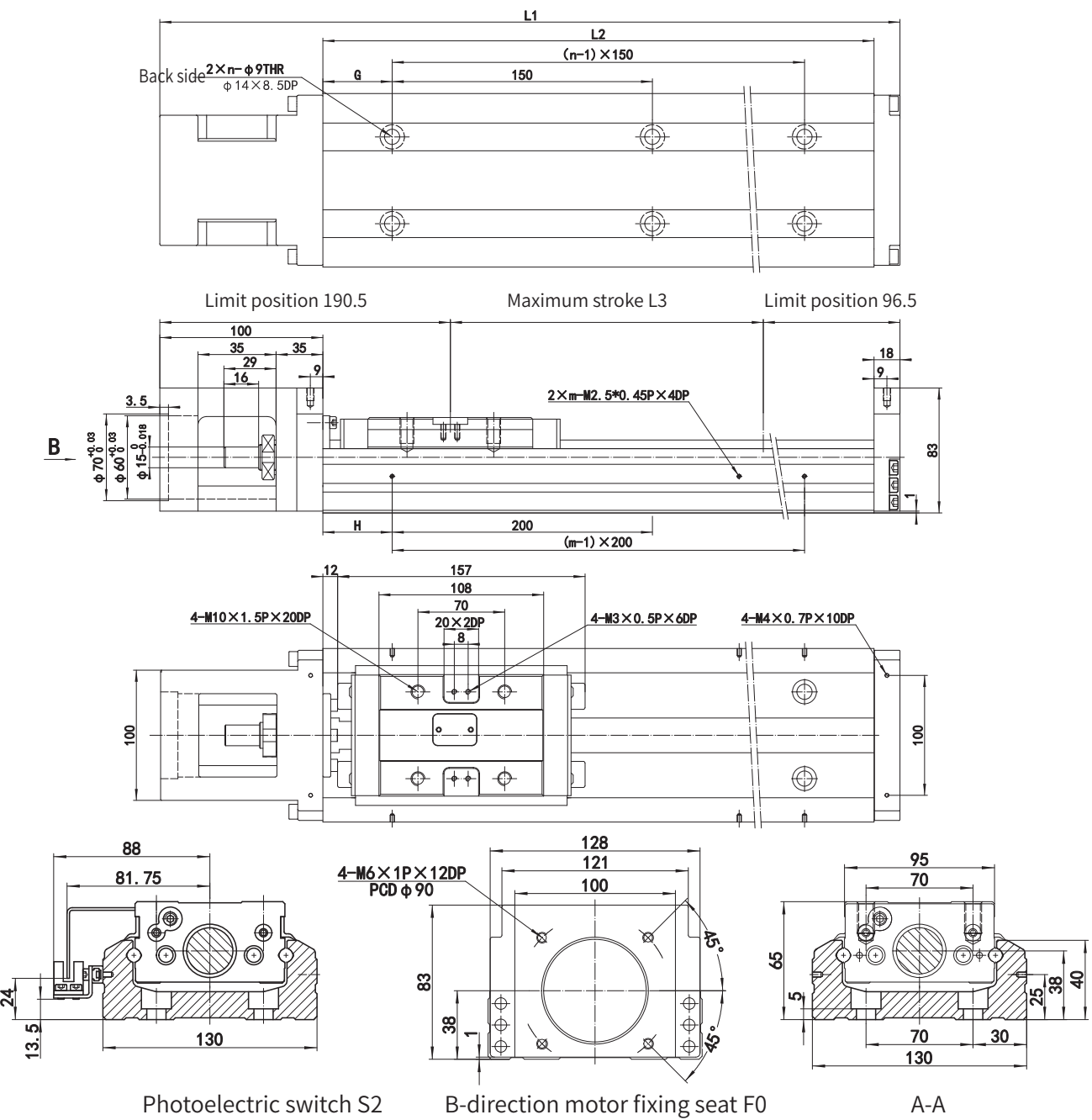
Rail Length L2 (mm)	Total Length (mm)	Maximum Stroke (mm)		H (mm)	n	m	Mass (kg)	
		Block A1	Block A2				Block A1	Block A2
340	440	248	172	70	3	2	5.4	5.9
440	540	348	272	20	4	3	6.6	7.1
540	640	448	372	70	5	3	7.7	8.2
640	740	548	472	20	6	4	8.9	9.4
740	840	648	572	70	7	4	10.1	10.6
940	1040	848	772	70	9	5	11.3	11.8

KK100 (Excluding protective cover)



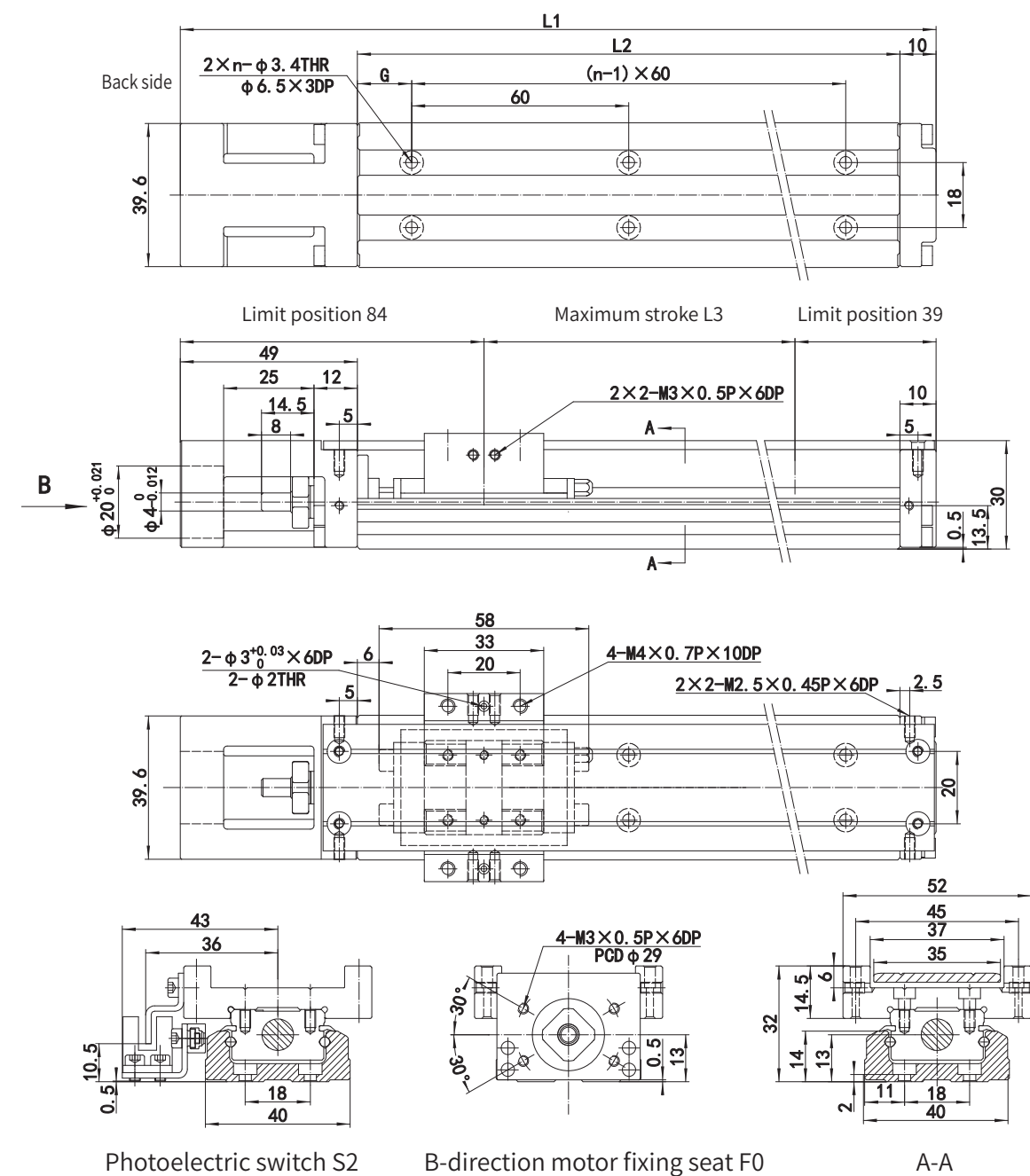
Rail Length L2 (mm)	Total Length (mm)	Maximum Stroke (mm)		G (mm)	K (mm)	n	m	Mass (kg)	
		Block A1	Block A2					Block A1	Block A2
980	1089	828	700	40	90	7	5	18.6	20.3
1080	1189	928	800	15	40	8	6	20.3	22
1180	1289	1028	900	65	90	8	6	22	23.7
1280	1389	1128	1000	40	40	9	7	23.6	25.3
1380	1489	1228	1100	15	90	10	7	25.3	27

KK130 (Excluding protective cover)



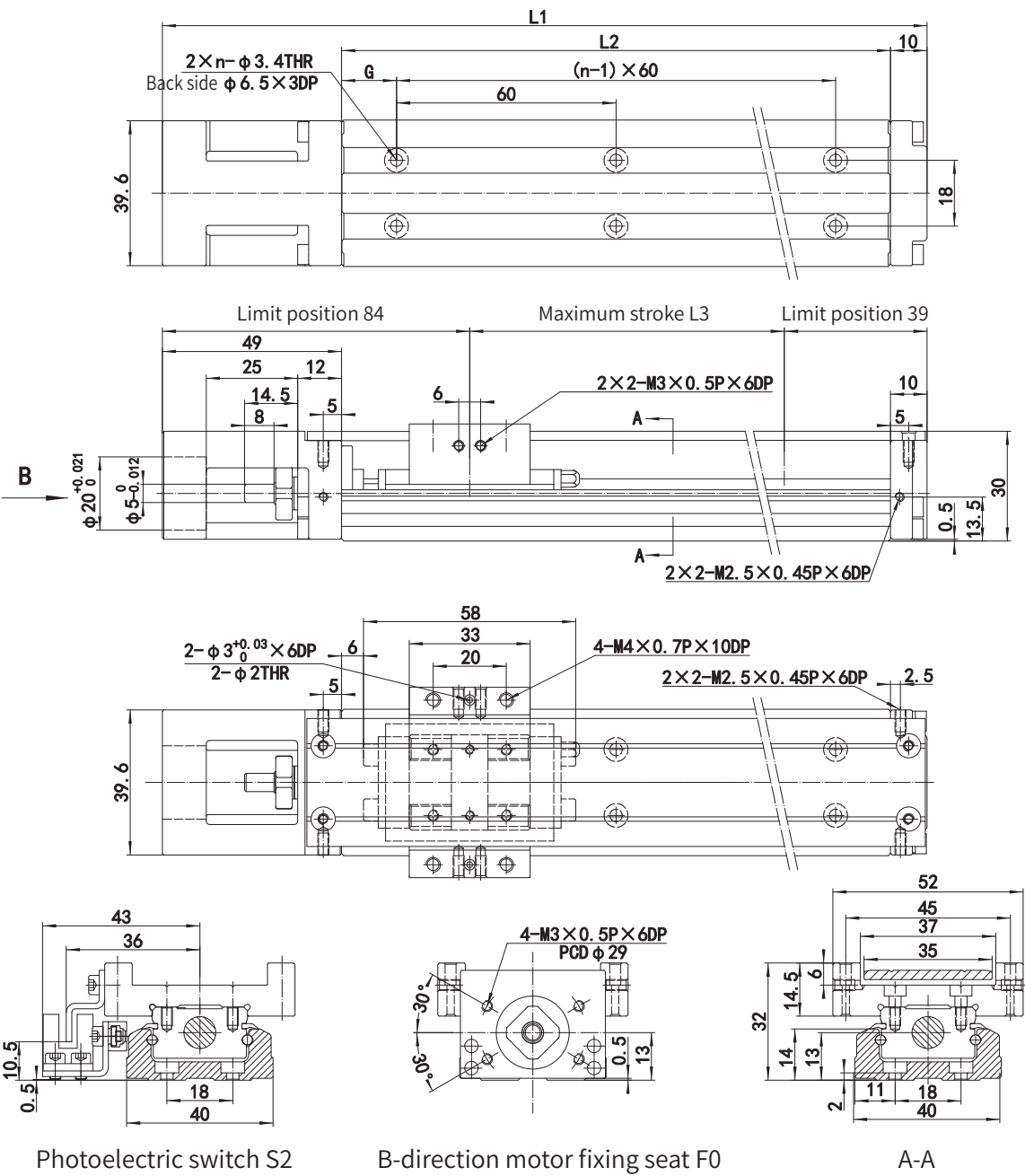
Rail Length L2 (mm)	Total Length (mm)	Maximum Stroke (mm)		G (mm)	K (mm)	n	m	Mass (kg)	
		Block A1	Block A2					Block A1	Block A2
980	1098	811	659	40	90	7	5	29.4	32.3
1180	1298	1011	859	65	90	8	6	34.3	37.2
1380	1498	1211	1059	90	90	9	7	39.2	42.1
1680	1798	1511	1359	90	40	11	9	46.5	49.4

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KK40 (Including protective cover)



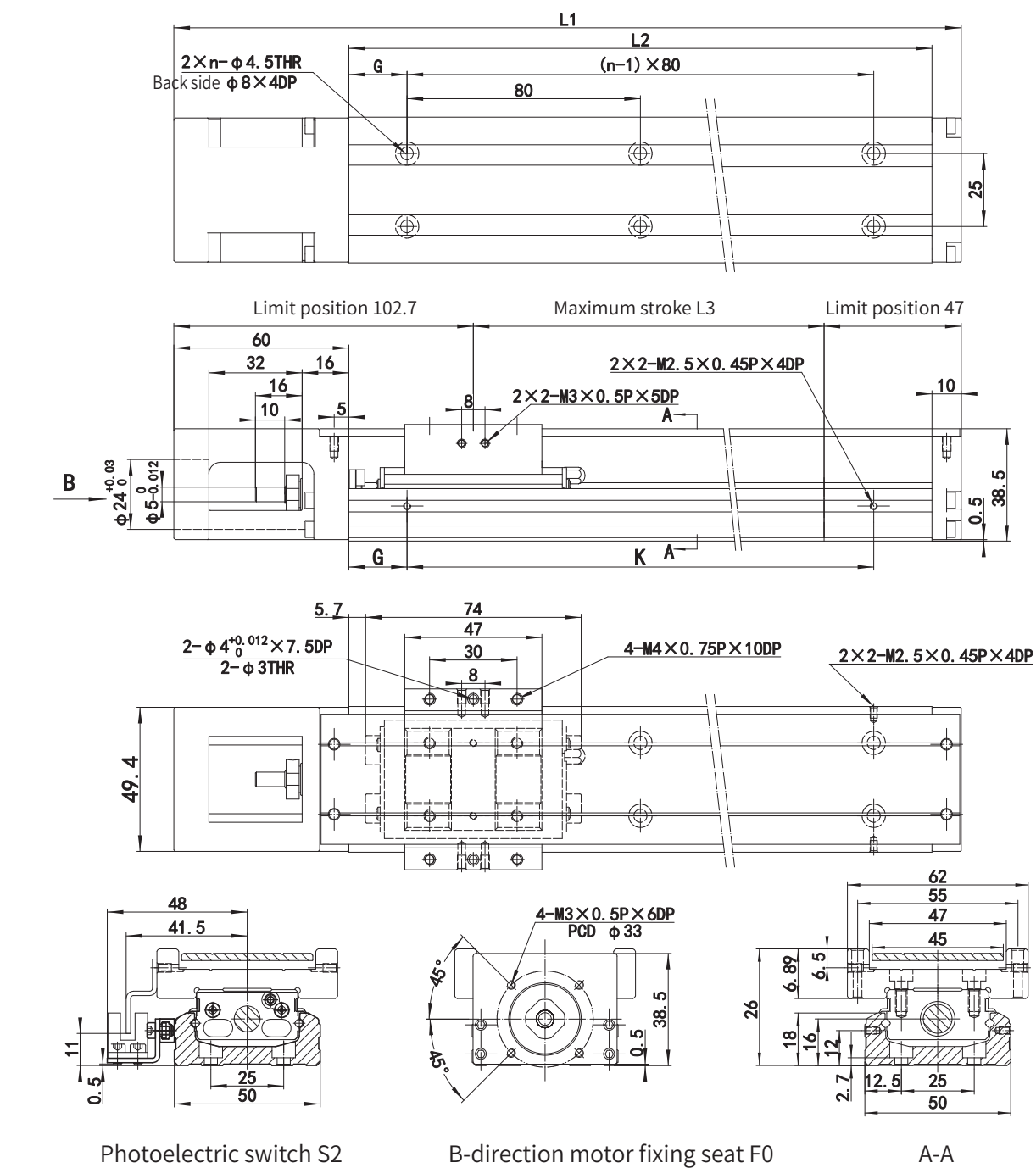
Rail Length L2 (mm)	Total Length (mm)	Maximum Stroke (mm)		G (mm)	n	Mass (kg)	
		Block A1	Block A2			Block A1	Block A2
100	159	36	-	20	2	0.55	-
150	209	86	34	15	3	0.68	0.76
200	259	136	84	40	3	0.82	0.89

KK40D (Including protective cover)



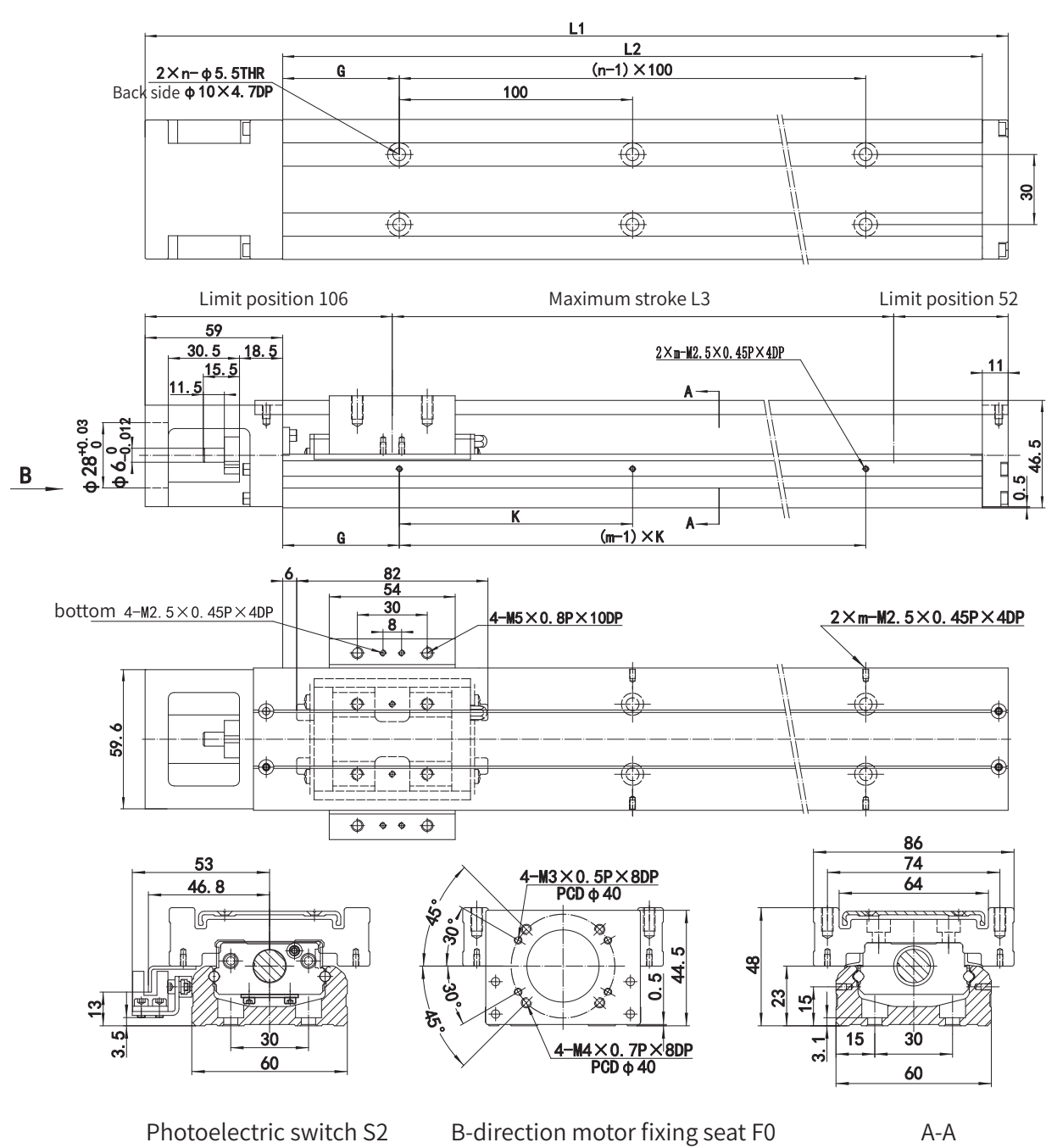
Rail Length L2 (mm)	Total Length (mm)	Maximum Stroke (mm)		G (mm)	n	Mass (kg)	
		Block A1	Block A2			Block A1	Block A2
100	159	36	-	20	2	0.55	-
150	209	86	34	15	3	0.68	0.76
200	259	136	84	40	3	0.82	0.89

KK50 (Including protective cover)



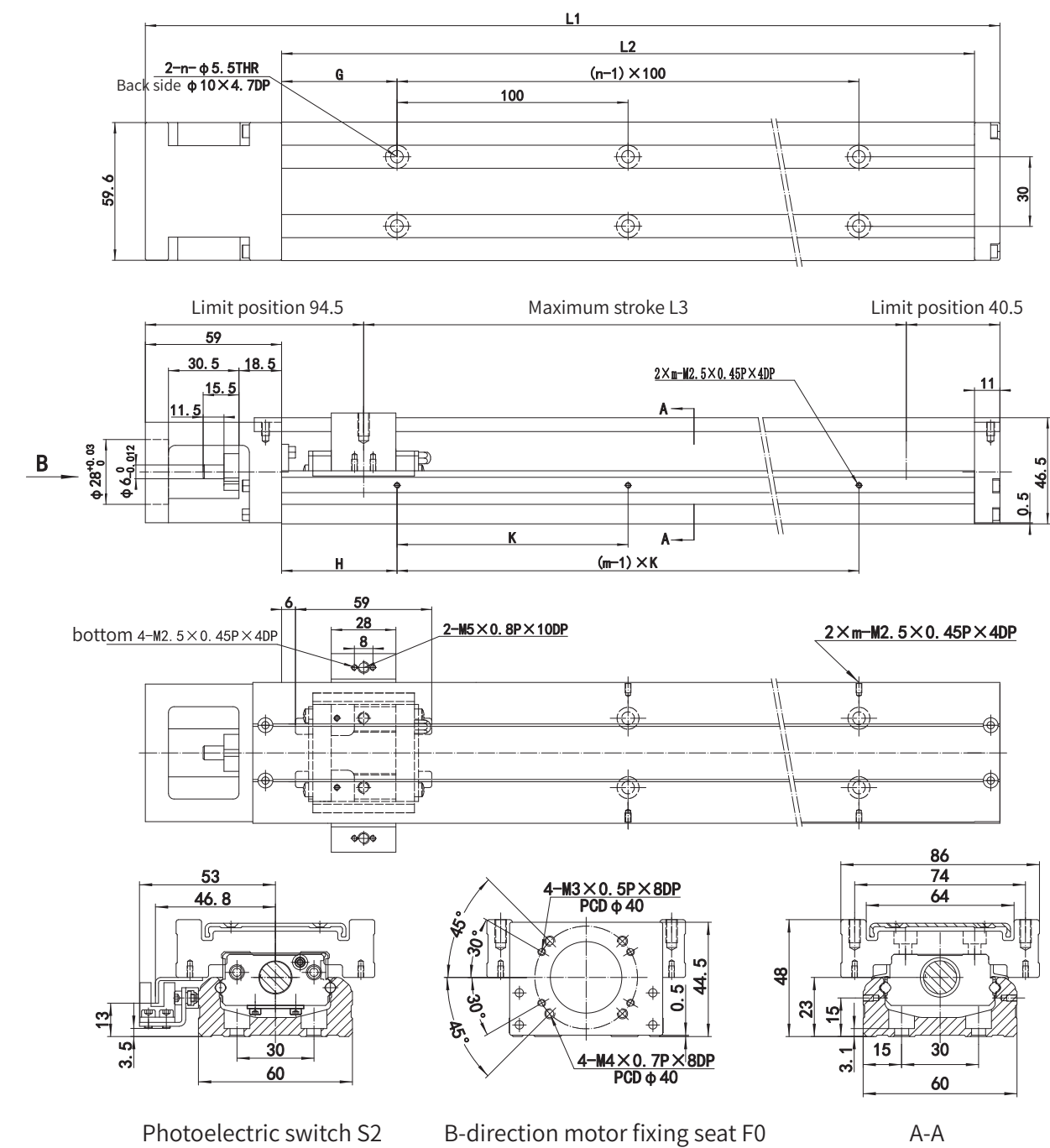
Rail Length L2 (mm)	Total Length (mm)	Maximum Stroke (mm)		G (mm)	K (mm)	n	Mass (kg)	
		Block A1	Block A2				Block A1	Block A2
150	220	70	-	35	80	2	1.1	-
200	270	120	55	20	160	3	1.3	1.5
250	320	170	105	45	160	3	1.6	1.8
300	370	220	150	30	240	4	1.8	2

KK60 (Including protective cover)



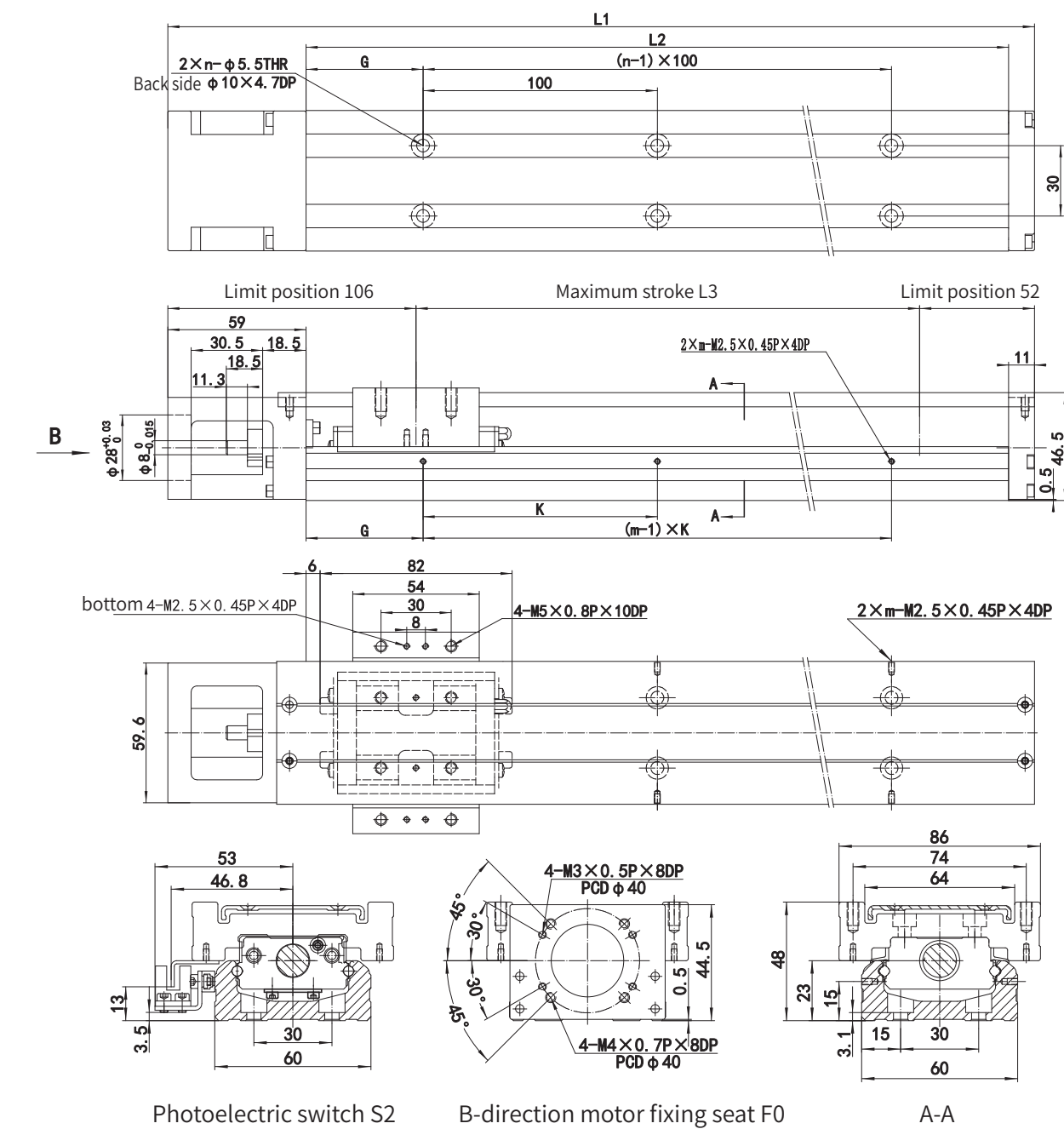
Rail Length L2 (mm)	Total Length (mm)	Maximum Stroke (mm)		G (mm)	K (mm)	n	m	Mass (kg)	
		Block A1	Block A2					Block A1	Block A2
150	220	60	-	25	100	2	2	1.7	-
200	270	110	-	50	100	2	2	2.1	-
300	370	210	135	50	200	3	2	2.7	3.0
400	470	310	235	50	100	4	4	3.3	3.6
500	570	410	335	50	200	5	3	3.9	4.2
600	670	510	435	50	100	6	6	4.6	5.0

KK60 (Including protective cover \ Light load type)



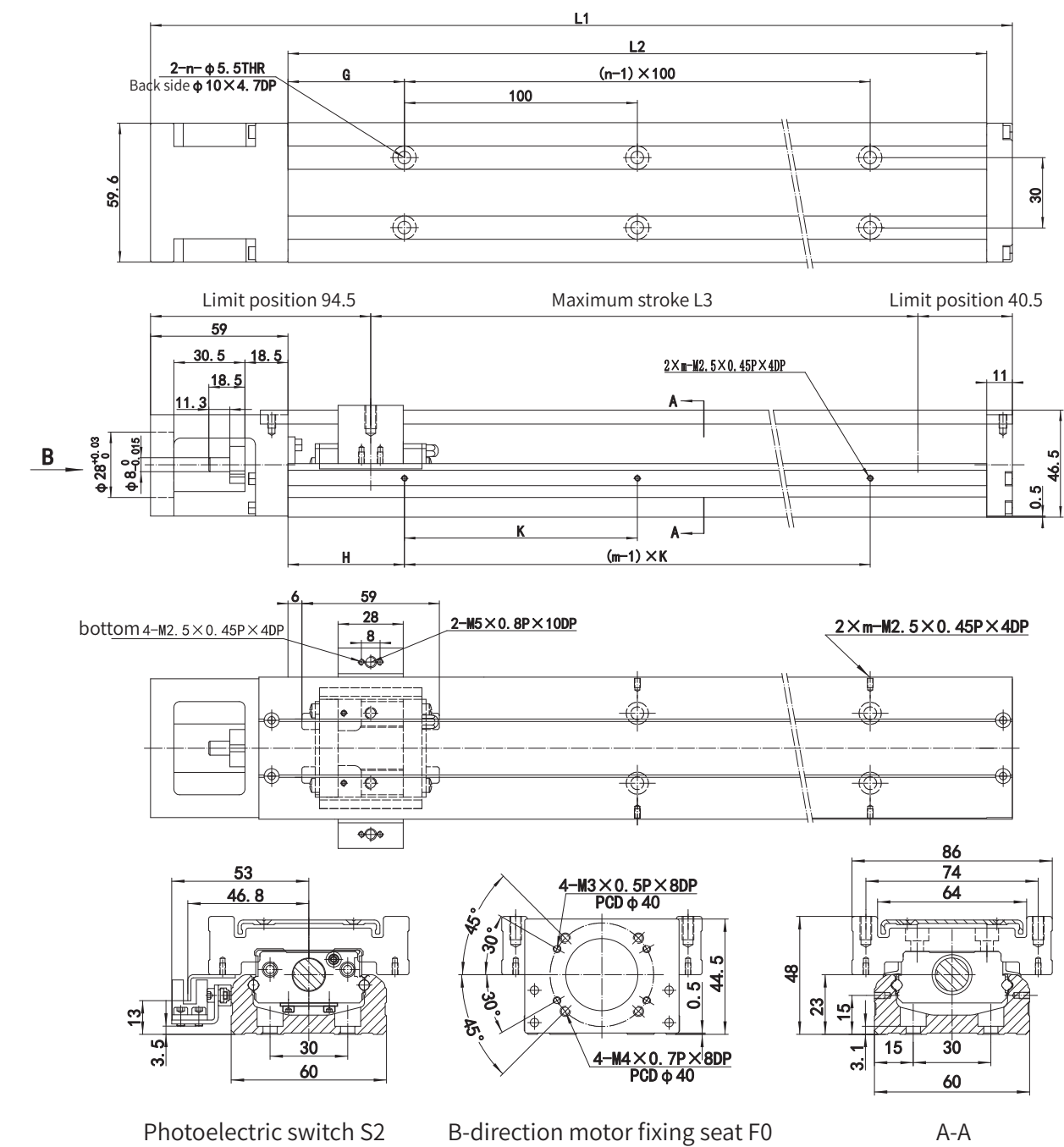
Rail Length L2 (mm)	Total Length (mm)	Maximum Stroke (mm)		G (mm)	K (mm)	n	m	Mass (kg)	
		Block A1	Block A2					Block A1	Block A2
150	220	85	34	25	100	2	2	1.6	1.8
200	270	135	84	50	100	2	2	1.9	2.1
300	370	235	184	50	200	3	2	2.5	2.7
400	470	335	284	50	100	4	4	3.1	3.3
500	570	435	384	50	200	5	3	3.7	3.9
600	670	535	484	50	100	6	6	4.4	4.6

KK60D (Including protective cover)



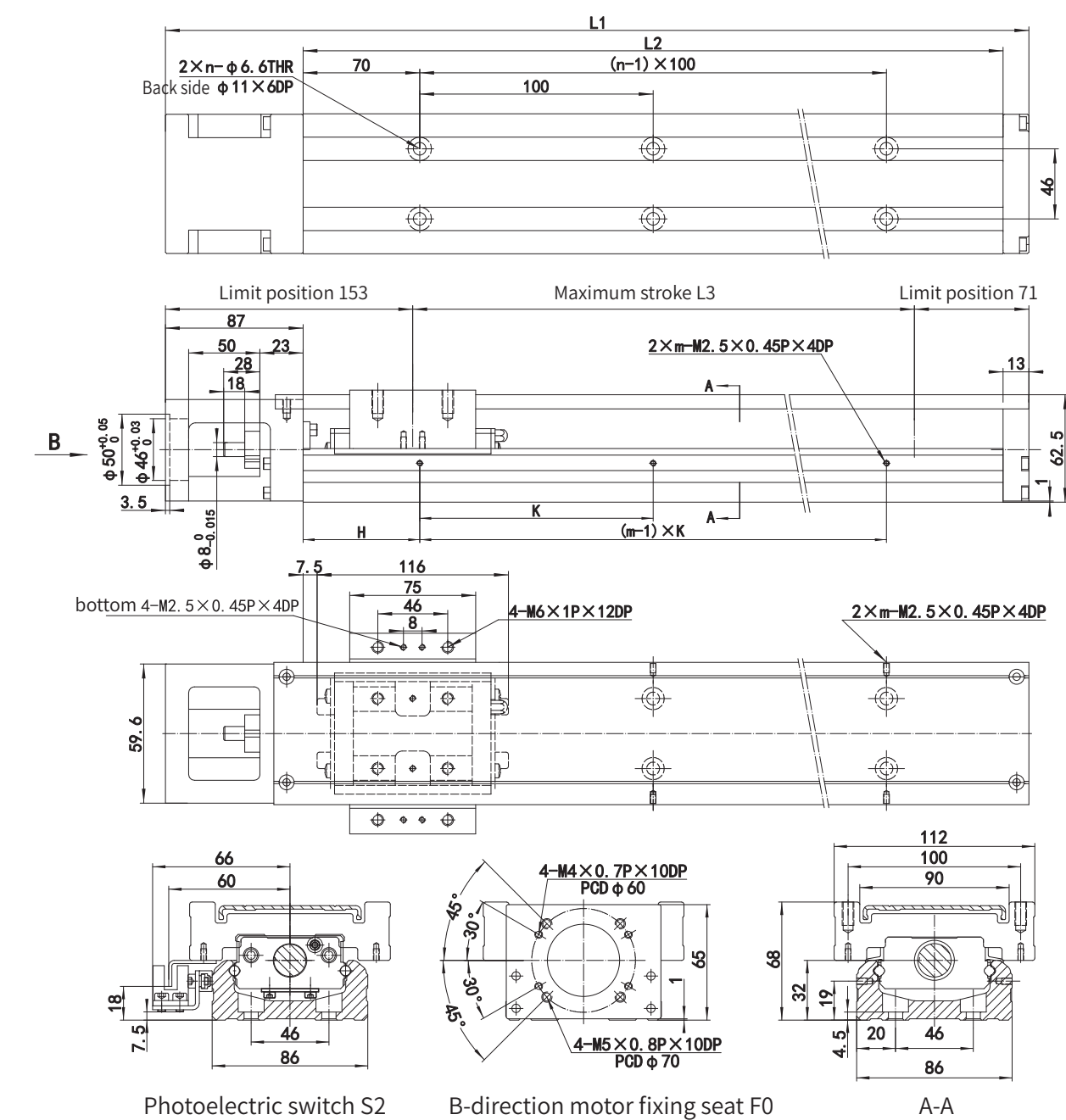
Rail Length L2 (mm)	Total Length (mm)	Maximum Stroke (mm)		G (mm)	K (mm)	n	m	Mass (kg)	
		Block A1	Block A2					Block A1	Block A2
150	220	60	-	25	100	2	2	1.7	-
200	270	110	-	50	100	2	2	2.1	-
300	370	210	135	50	200	3	2	2.7	3.0
400	470	310	235	50	100	4	4	3.3	3.6
500	570	410	335	50	200	5	3	3.9	4.2
600	670	510	435	50	100	6	6	4.6	5.0

KK60D (Including protective cover \ Light load type)



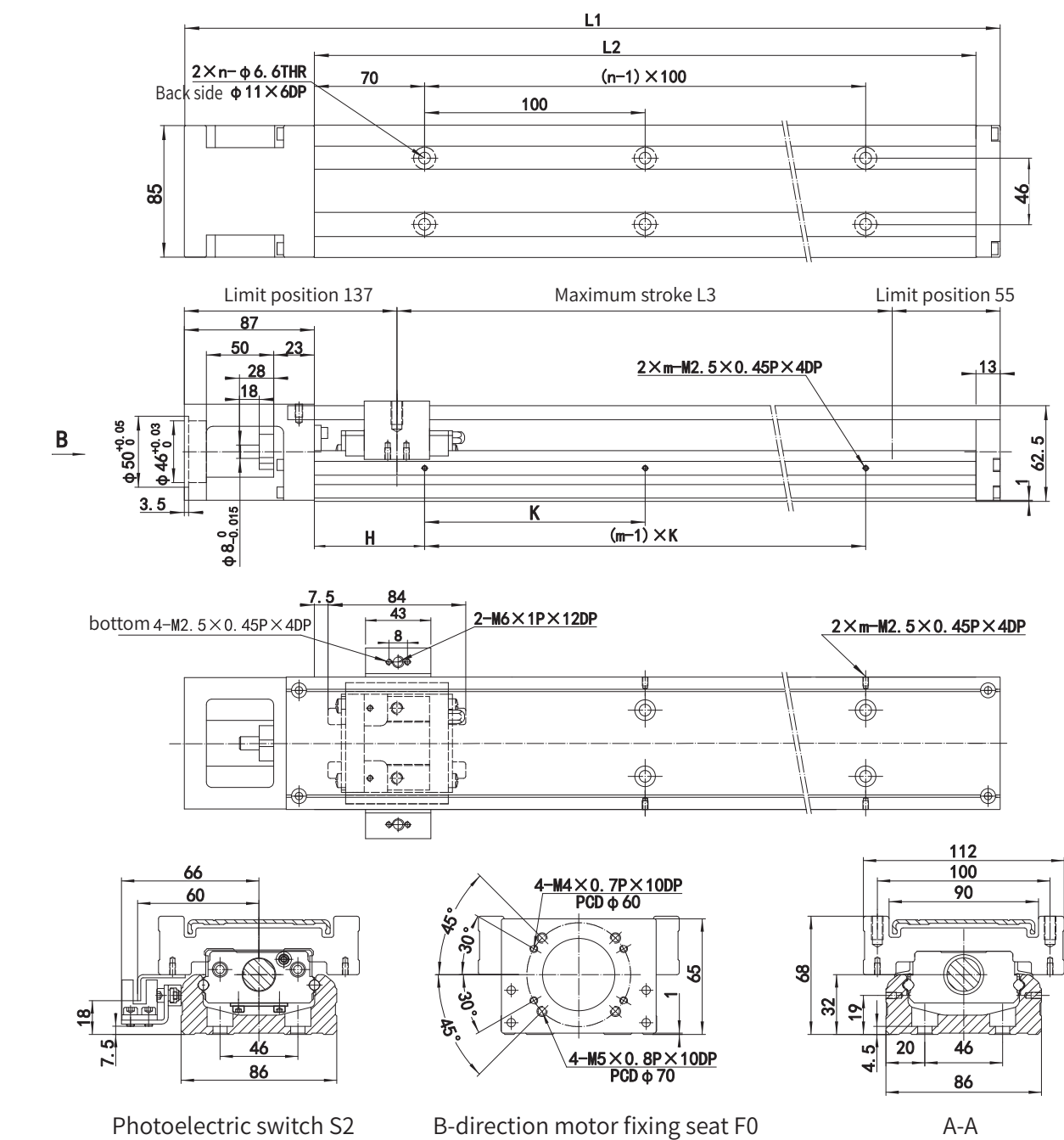
Rail Length L2 (mm)	Total Length (mm)	Maximum Stroke (mm)		G (mm)	K (mm)	n	m	Mass (kg)	
		Block A1	Block A2					Block A1	Block A2
150	220	85	34	25	100	2	2	1.6	1.8
200	270	135	84	50	100	2	2	1.9	2.1
300	370	235	184	50	200	3	2	2.5	2.7
400	470	335	284	50	100	4	4	3.1	3.3
500	570	435	384	50	200	5	3	3.7	3.9
600	670	535	484	50	100	6	6	4.4	4.6

KK86 (Including protective cover)



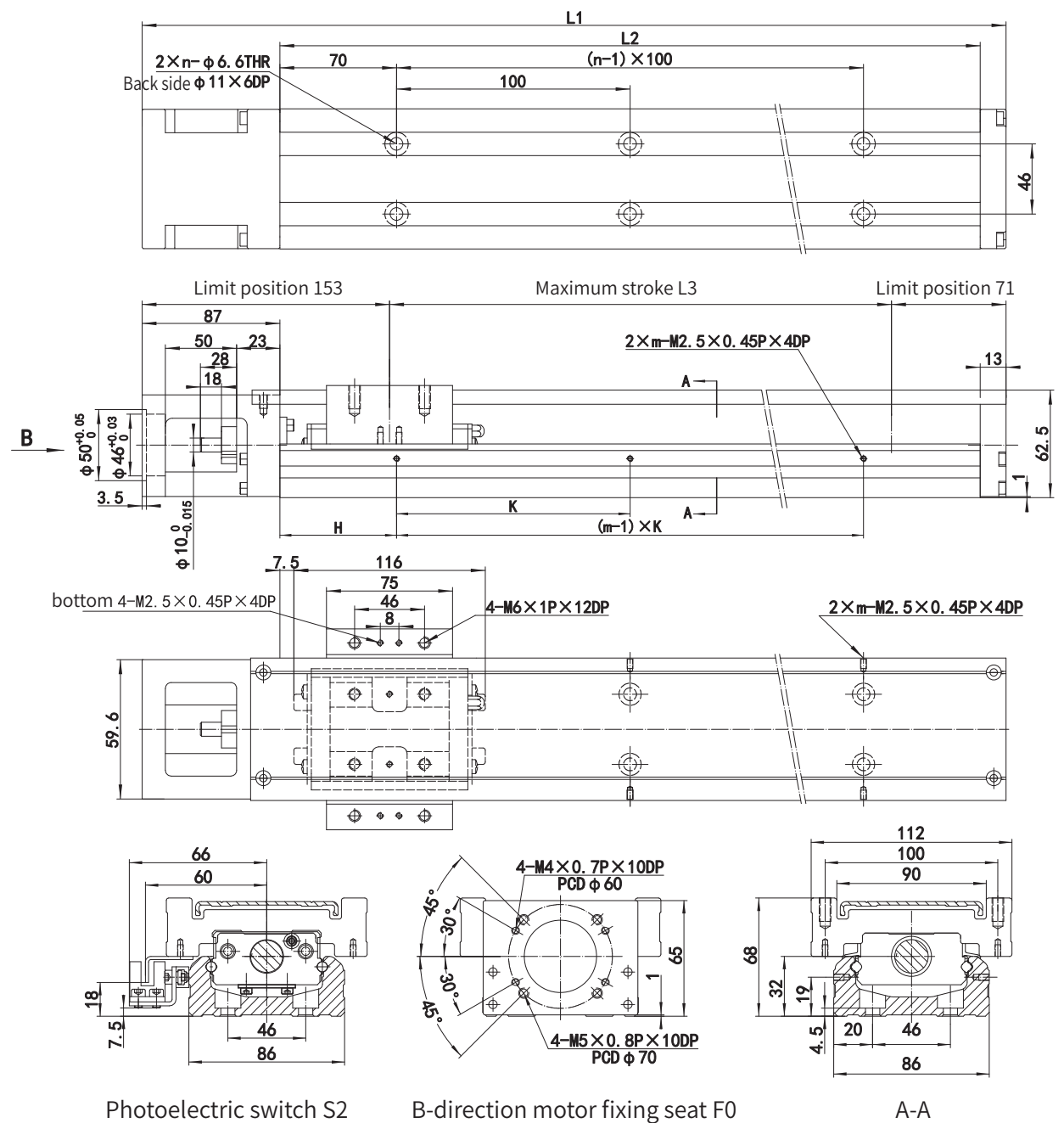
Rail Length L2 (mm)	Total Length (mm)	Maximum Stroke (mm)		H (mm)	n	m	Mass (kg)	
		Block A1	Block A2				Block A1	Block A2
340	440	216	108	70	3	2	6.5	7.3
440	540	316	208	20	4	3	7.8	8.6
540	640	416	308	70	5	3	9	9.8
640	740	516	408	20	6	4	10.3	11.3
740	840	616	508	70	7	4	11.6	12.4
940	1040	816	708	70	9	5	13	13.8

KK86 (Including protective cover \ Light load type)



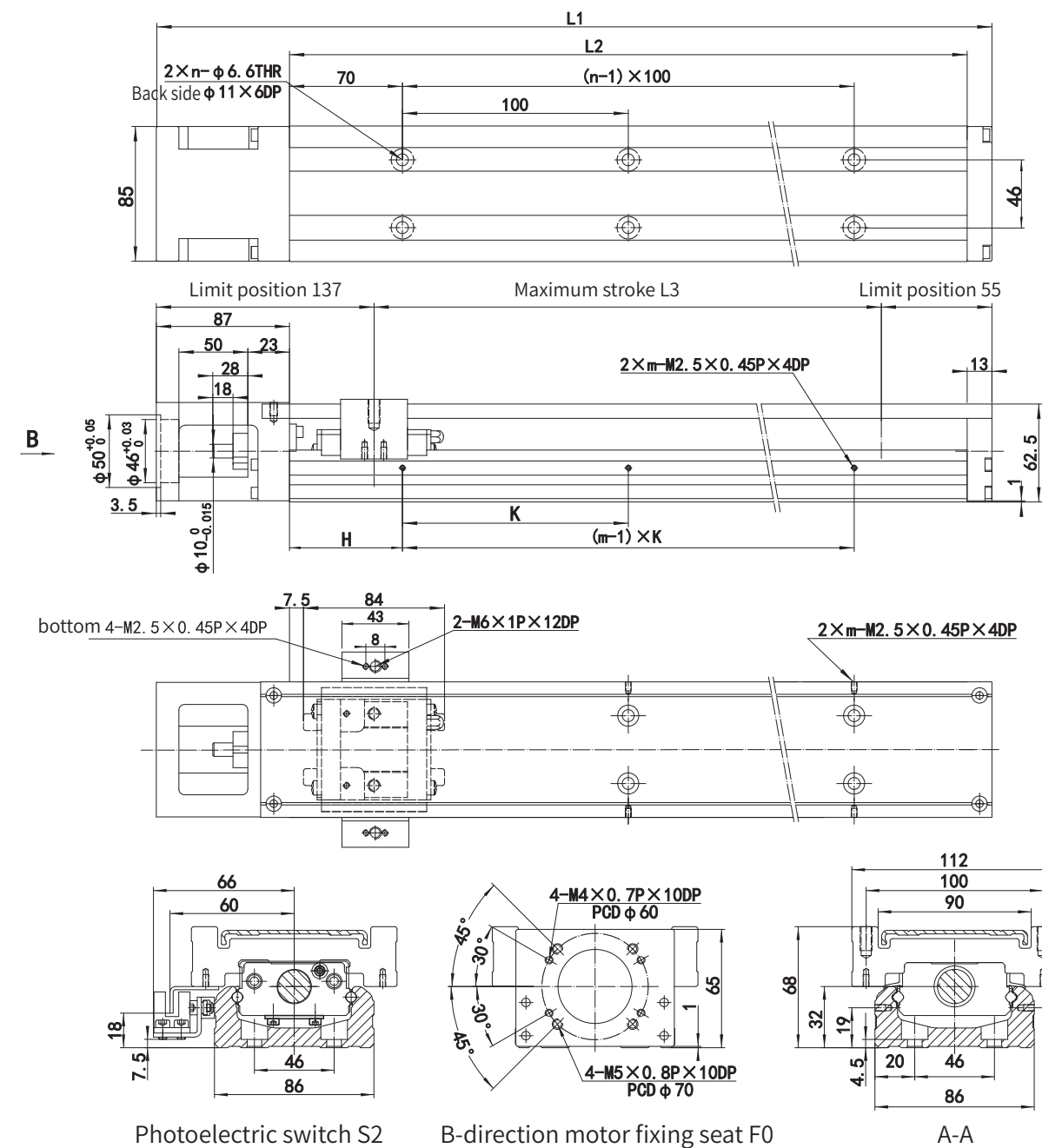
Rail Length L2 (mm)	Total Length (mm)	Maximum Stroke (mm)		H (mm)	n	m	Mass (kg)	
		Block A1	Block A2				Block A1	Block A2
340	440	248	172	70	3	2	6.5	7.3
440	540	348	272	20	4	3	7.8	8.6
540	640	448	372	70	5	3	9	9.8
640	740	548	472	20	6	4	10.3	11.3
740	840	648	572	70	7	4	11.6	12.4
940	1040	848	772	70	9	5	13	13.8

KK86D (Including protective cover)



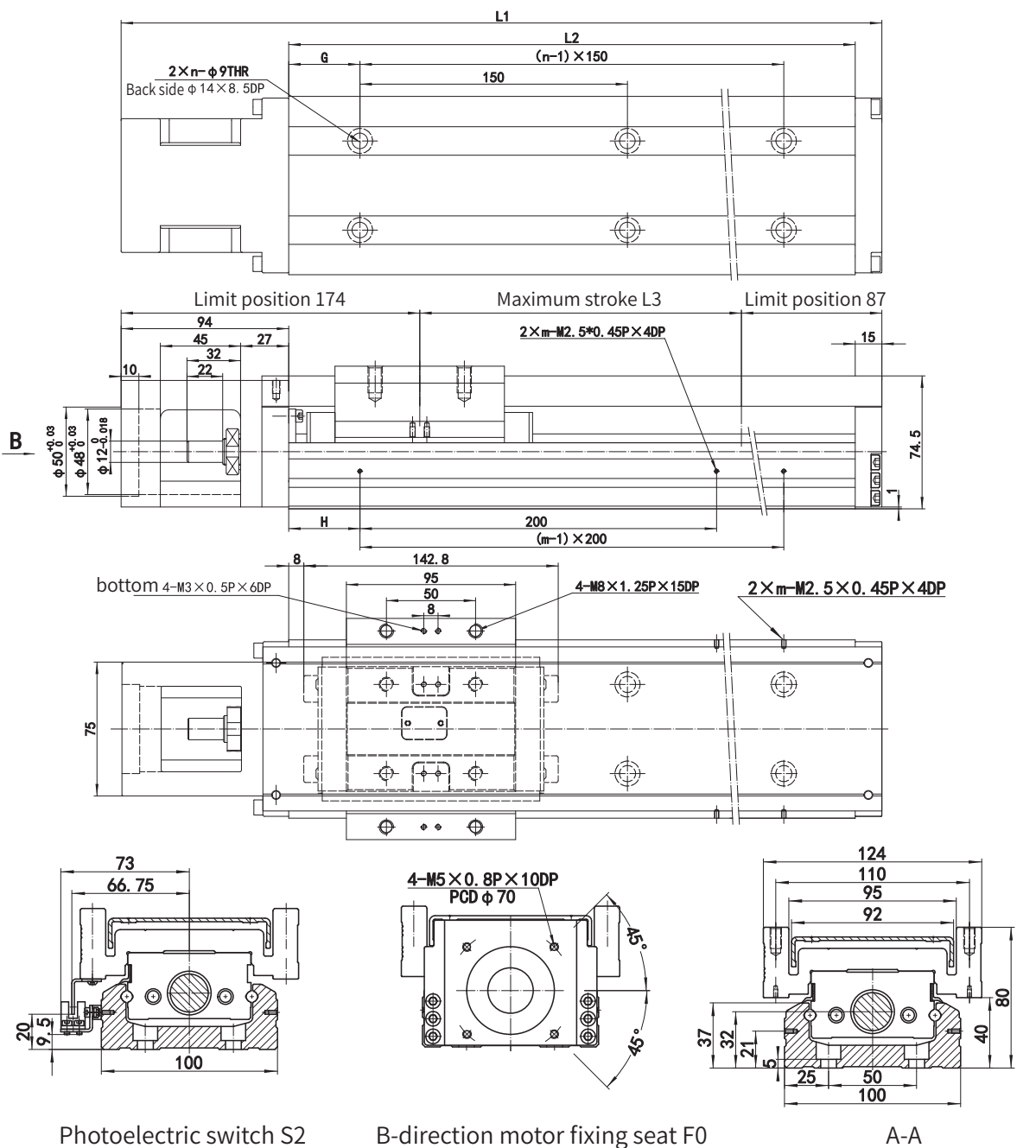
Rail Length L2 (mm)	Total Length (mm)	Maximum Stroke (mm)		H (mm)	n	m	Mass (kg)	
		Block A1	Block A2				Block A1	Block A2
340	440	216	108	70	3	2	6.5	7.3
440	540	316	208	20	4	3	7.8	8.6
540	640	416	308	70	5	3	9	9.8
640	740	516	408	20	6	4	10.3	11.3
740	840	616	508	70	7	4	11.6	12.4
940	1040	816	708	70	9	5	13	13.8

KK86D (Including protective cover \ Light load type)



Rail Length L2 (mm)	Total Length (mm)	Maximum Stroke (mm)		H (mm)	n	m	Mass (kg)	
		Block A1	Block A2				Block A1	Block A2
340	440	248	172	70	3	2	6.5	7.3
440	540	348	272	20	4	3	7.8	8.6
540	640	448	372	70	5	3	9	9.8
640	740	548	472	20	6	4	10.3	11.3
740	840	648	572	70	7	4	11.6	12.4
940	1040	848	772	70	9	5	13	13.8

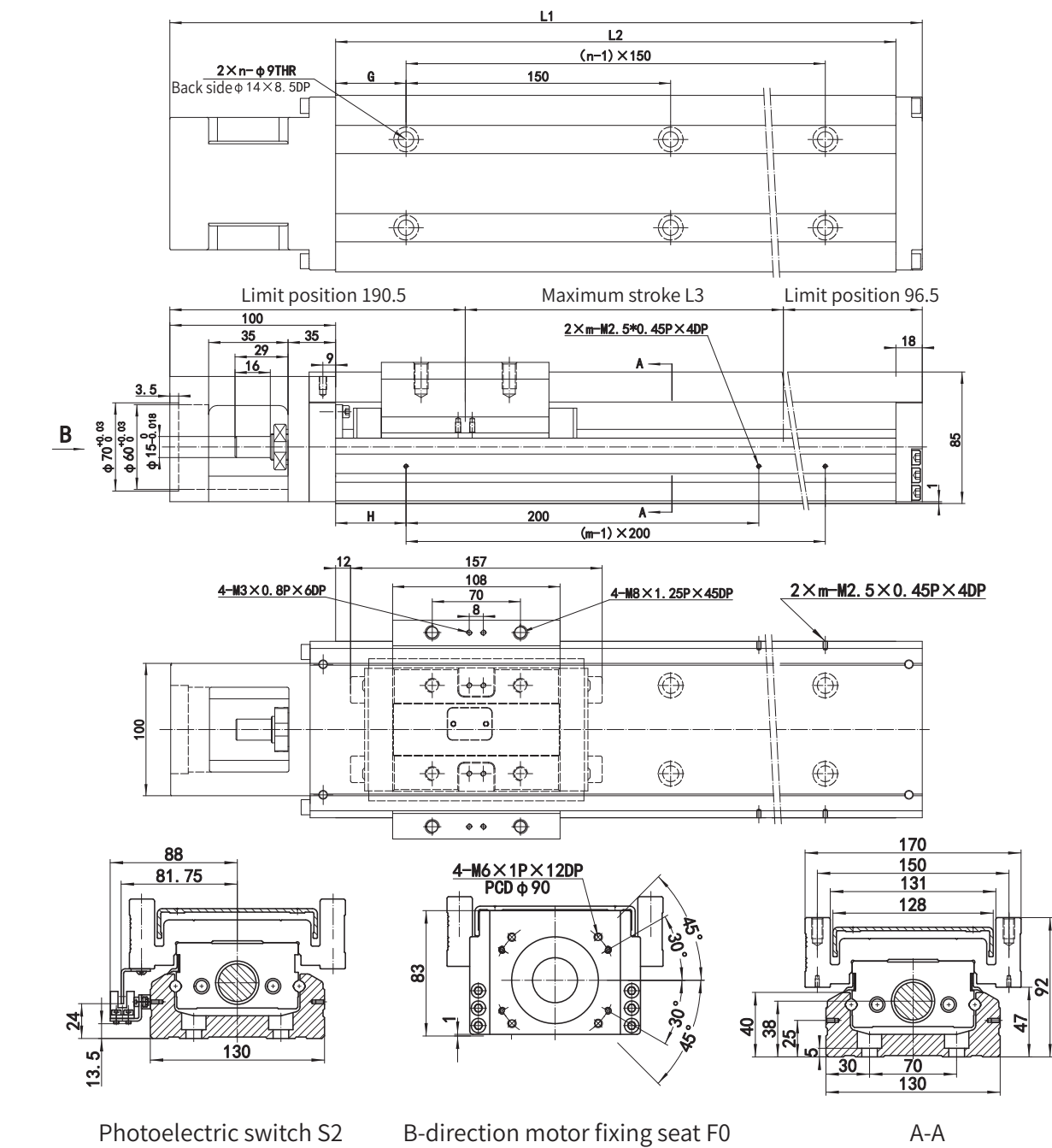
KK100 (Including protective cover)



Rail Length L2 (mm)	Total Length (mm)	Maximum Stroke (mm)		G (mm)	K (mm)	n	m	Mass (kg)	
		Block A1	Block A2					Block A1	Block A2
980	1098	828	700	40	90	7	5	20.4	22.1
1080	1189	928	800	15	40	8	6	22.2	23.9
1180	1289	1028	900	65	90	8	6	24	25.7
1280	1389	1128	1000	40	40	9	7	25.7	27.4
1380	1489	1228	1100	15	90	10	7	27.5	29.2

KK130 (Including protective cover)

Precision Ball Screw Data Collection Form

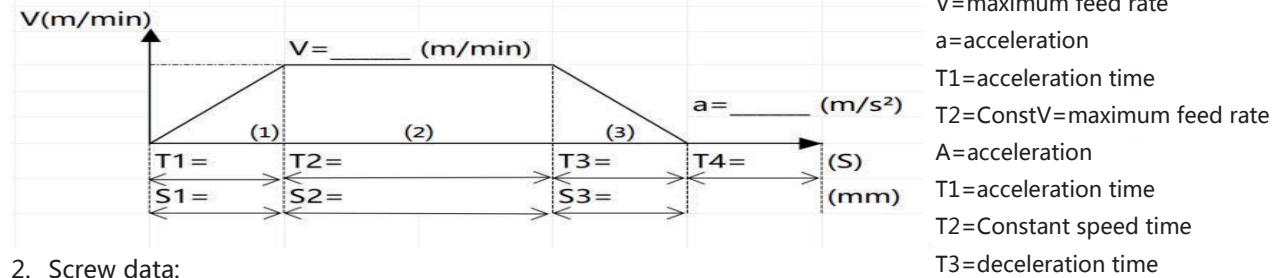


Rail Length L2 (mm)	Total Length (mm)	Maximum Stroke (mm)		G (mm)	K (mm)	n	m	Mass (kg)	
		Block A1	Block A2					Block A1	Block A2
980	1098	811	659	40	90	7	5	31.9	35.9
1180	1298	1011	859	65	90	8	6	37.1	41.1
1380	1498	1211	1059	90	90	9	7	42.2	46.2
1680	1798	1511	1359	90	40	11	9	49.9	53.9

Company Name : _____ Date : year _____ Month _____ Day _____ Form filler: _____
Address : _____
TEL : _____ Cell phone: _____ WeChat ID: _____ FAX: _____
Device Name: _____ Model: _____ Axis direction: ☐ X axis ☐ Y axis ☐ Z axis
Guideways Type: ☐ Steel ball ☐ Steel column ☐ Hard track. Is there a diagram attached: ☐ Yes (Drawing No. _____) ☐ None

1. Operating conditions:

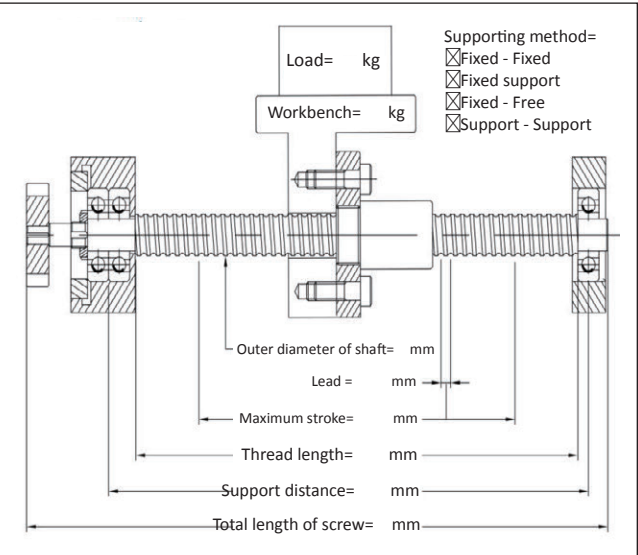
Required service life	Hour	☐ Smooth and impact free operation
lubrication method	☐ Lubricating oil	☐ Ordinary operation
	☐ Grease	☐ Operation accompanied by impact
	☐ Other	☐ Other: _____
Usage environment	☐ General environment ☐ High dust prevention demand ☐ Clean room ☐ Other: _____	
	☐ Vacuum environment(Pressure value _____ Torr/mmHg)	
	☐ High temperature(Temperature _____ °C _____ °F)	



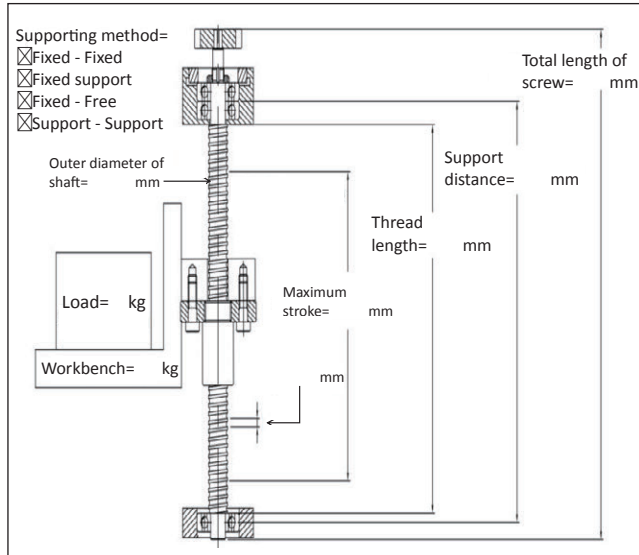
2. Screw data:

movement pattern	☐ Axis rotation	Screw type	Rolled	Preload	kgf
	☐ Nut rotation			Preloading torque	Kgf-cm
Thread rotation direction	☐ right-handed	Lead accuracy e300\mm	μm	What bearings	☐ Ball bearing
	☐ Left-handed			Type number:	☐ Column bearing
Attached scraper brush	☐ Yes ☐ No	Note			Contact angle:

3. Horizontal device:



4. Vertical device:





PERFECT PRODUCTS COME FROM CONSUMMATE PRODUCTION

COMPANY PROFILE

SHAC DINGHAN predecessor "LISHUI YINGTE" was founded in 2007, is a modern enterprise specializing in R&D, manufacturing, sales and after-sales of linear transmission components.

In 2007, Dinghan invested the first production line of ball screw in LISHUI, then 16 million dollars was invested to build three modern production lines, including for rolling ball screw, grinding ball screw and precision ball screw nut.

In 2011, Taiwan Dinghan Transmission Technology Co., Ltd was founded in TAIWAN as a research and development center of the company.

In 2013, Dinghan invested 21 million dollars registered LISHUI JIEXIANG TECHNOLOGY CO., LTD as factory base to expand the reproduction of linear guideway and block, the base around 45000 square meters.

In 2016, Lishui Jiexiang has been rated as a national high-tech enterprise, strictly follows the international standards such as ISO9001, ISO14001, ISO45001 etc.

In 2020, ZHEJIANG JIANZHUANG TRANSMISSION TECHNOLOGY CO., LTD registered and second factory base around 65000 square meter put into production.

DINGHAN has been firmly committed to the business direction of "Production specialization, product branding, market internationalization", provide high-quality products to meet the requirements of market and customers so as to achieve stable development. SHAC products are widely used in various high-tech industries and have established stable strategic cooperation with top rank enterprises in domestic and foreign industries, such as automation, CNC machinery, medical equipment, lithium battery and photovoltaic industries.

DINGHAN enterprises adhering to the "Quality first, The credibility of service first, Quality is the mission entrusted by the market".

Innovation, continuous search, customer satisfaction will be our greatest happiness.

Wholeheartedly welcome customers to visit, negotiate and cooperation!