ALM®
Linear Motion Systems
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MINIATURE
BALL SCREW CATALOG



Shaft dia & Lead

Ball screw shaft dia & lead

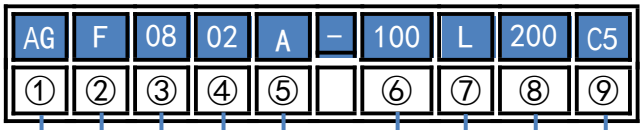
Shaft dia \ Lead	1	2	2.5	4	5	6	8	10	12	15	20
4	●										
5	●	●		○							
6	●	●	●			●	○	●			
8	●	●	●	●	●	○	●	●	●		
10	○	●	○	●	●	○	○	●	○	○	●
12	○	●	○	●	●	○	○	●	○	○	●
14	○	●	○	○	○	○	○	○	○	○	○

◑ Customized Products ○

◑ Standard Products ●

◑ Other Customized shaft dia & lead

Ball screw coding



① Ball screw model.

AG Grinded

AR Rolled

② Nut type

F Flange

C Sleeve Cylindrical Nut

T Tread Nut

S Square Nut

③Shaft dia

mm

④Lead

mm

⑤Circulation mode

A: Outside nut; No mark if inside the nut

⑥Screw thread length

mm

⑦Thread direction

R: Right-hand

L: Left-hand

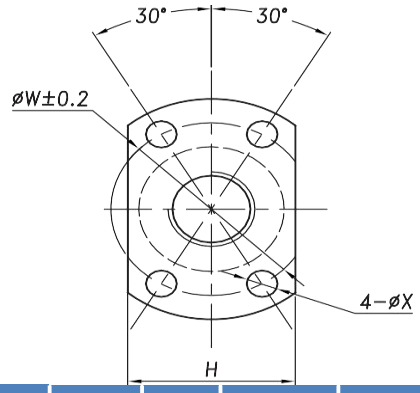
⑧Screw shaft total length

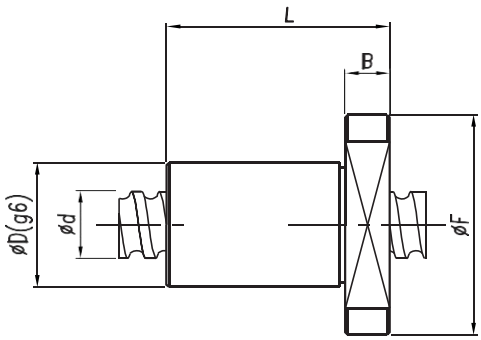
mm

⑨Accuracy grade

C0/C1/C3/C5/C7/C10

Ground ball screw AGF

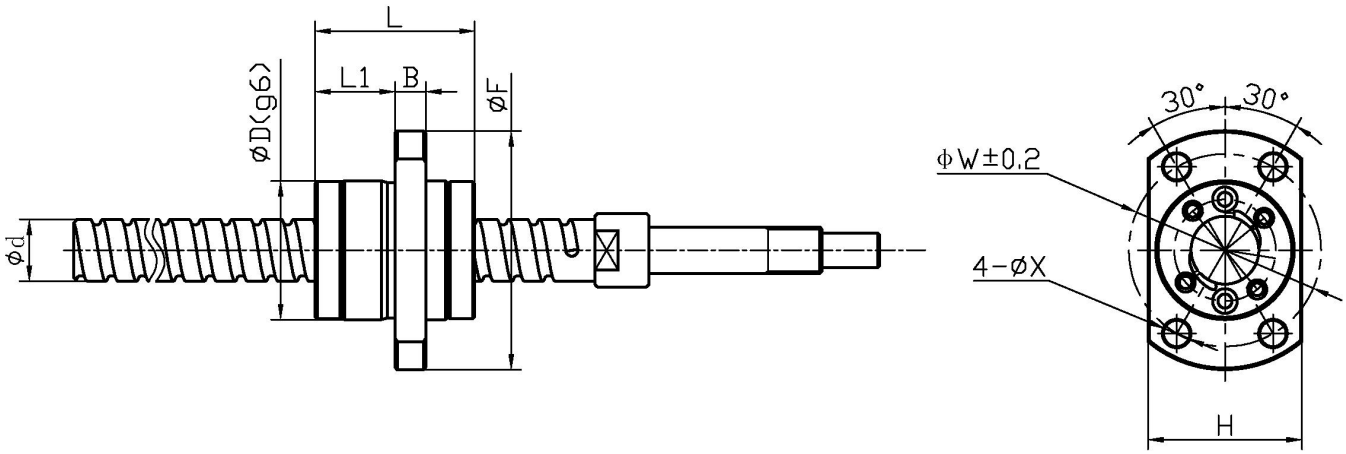






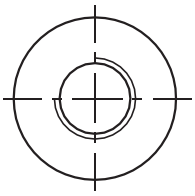
Model	Dia	Lead	Ball size	Circuit No.	Basic load rating N		Nut size						
	d	P	Da	n	Ca (N)	Coa (N)	D	F	B	L	W	H	X
AGF0401	4	1	0.8	3	420	570	10	20	3	12	15	14	2.9
AGF0501	5	1	0.8	3	500	700	10	20	3	12	15	14	2.9
AGF0502	5	2	1.2	3	660	1052	10	20	3	16	15	14	2.9
AGF0601	6	1	0.8	3	560	950	12	24	3.5	15	18	16	3.4
AGF0602	6	2	1.2	3	750	1200	12	24	4	16	18	16	3.4
AGF0801	8	1	0.8	3	650	1300	14	27	4	16	21	18	3.4
AGF0802	8	2	1.2	3	1300	2300	14	27	4	16	21	18	3.4
AGF0802.5	8	2.5	1.2	3	1345	2694	16	29	4	26	23	20	3.4
AGF0804	8	4	1.5875	3	1714	3480	18	31	4	28	25	22	3.4
AGF0805	8	5	1.5875	3	1700	3458	18	31	4	28	25	22	3.4
AGF1002	10	2	1.2	3	1455	3275	18	35	5	28	27	22	4.5
AGF1004	10	4	2.0	3	2310	5261	26	46	10	34	36	28	4.5
AGF1202	12	2	1.2	4	2100	4900	20	37	5	28	29	24	4.5
AGF1204	12	4	2.5	3	4400	9000	24	40	6	28	33	26	4.5
AGF1205	12	5	2.5	3	4400	9000	24	40	6	30	33	26	4.5
AGF1402	14	2	1.2	4	2200	5700	21	40	6	23	31	26	5.5

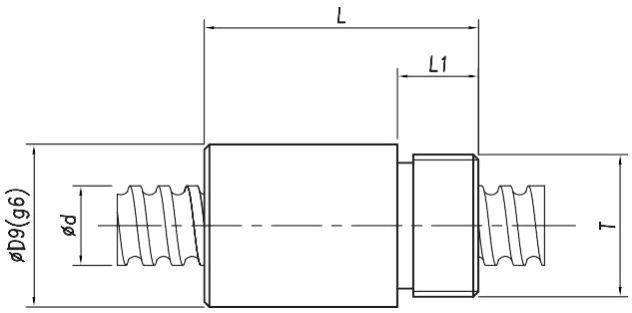
Ground ball screw AGF



Model	Dia.	Lead	Ball size	Circuit No.	Basic Load Rating N		Nut size							
	d	P	Da	n	Ca(N)	Coa(N)	D	F	B	L1	L	W	H	X
AGF0606	6	6	1.2	1.6*2	1260	2130	14	17	4	8	17	21	16	3.4
AGF0610	6	10	1.2	1.2*2	950	1600	14	23	4	11.5	23	21	16	3.4
AGF0808	8	8	1.5875	1.6*2	2200	3800	18	31	4	10	20	25	20	3.4
AGF0810	8	10	1.5875	1.6*2	2200	3800	18	31	4	13	24	25	20	3.4
AGF0812	8	12	1.5875	1.6*2	2200	4000	18	31	4	17	27	25	20	3.4
AGF1010	10	10	2	1.6*2	3300	5980	23	40	5	13	24	32	25	4.5
AGF1015	10	15	2	1.6*2	3300	5980	23	40	5	22	33	32	25	4.5
AGF1020	10	20	2	1.6*2	3300	5980	23	40	5	31	42	32	25	4.5
AGF1210	12	10	2	1.7*2	4200	8900	24	41	6	14.5	24	33	26	4.5
AGF1215	12	15	2.5	1.7*2	5600	12000	24	41	6	24.5	40	33	26	4.5
AGF1220	12	20	2.5	1.7*2	5600	12000	24	41	6	34.5	50	33	26	4.5

Ground ball screw AGT

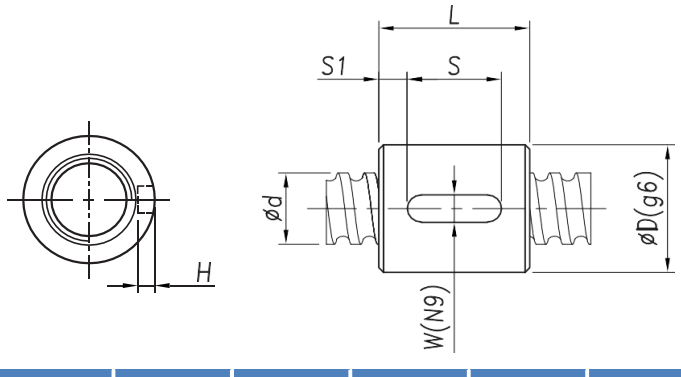






Model	Dia.	Lead	Ball size	Circuit No.	Basic Load Rating N		Nut size			
	d	P	Dw	n	Ca	Coa	D	L	L1	T
AGT0401	4	1	0.8	3	420	570	10	15	5	M8x0.75
AGT0501	5	1	0.8	3	500	700	12	15	5	M10x1
AGT0502	5	2	1.2	3	660	1052	12	20	6	M10x1
AGT0601	6	1	0.8	3	560	950	12	20	6	M10x1
AGT0602	6	2	1.2	3	750	1200	12	20	6	M10x1
AGT0801	8	1	0.8	3	650	1300	12	22	8	M14x1
AGT0802	8	2	1.2	3	1300	2300	16	27	8	M14x1
AGT0802.5	8	2.5	1.2	3	1345	2694	16	29	8	M14x1
AGT0804	8	4	1.588	3	1714	3480	18	34	8	M16x1
AGT0805	8	5	1.588	3	1700	3458	18	34	8	M16x1
AGT1002	10	2	1.2	3	1455	3275	20	22	7.5	M18x1
AGT1004	10	4	2.0	3	2310	5261	26	34	10	M18x1
AGT1202	12	2	1.2	4	2100	4900	20	28	10	M18x1
AGT1204	12	4	2.5	3	4400	9000	24	38	10	M20x1
AGT1205	12	5	2.5	3	4400	9000	24	38	10	M20x1
AGT1402	14	2	1.2	4	2200	5700	24	38	10	M20x1

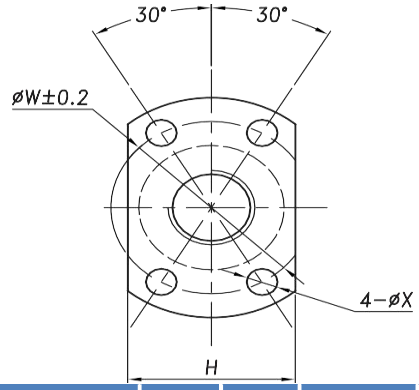
Ground ball screw AGC

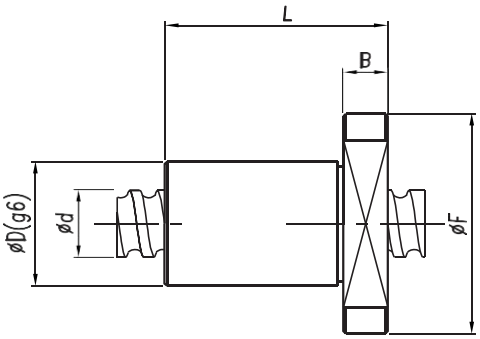




Model	Dia	Lead	Ball size	Circuit No.	Basic Load Rating N		Nut size	
	d	P	Da	n	Ca	Coa	D	L
AGC0401	4	1	0.8	3	420	570	10	12
AGC0501	5	1	0.8	3	500	700	10	12
AGC0502	5	2	1.2	3	660	1052	10	16
AGC0601	6	1	0.8	3	560	950	12	15
AGC0602	6	2	1.2	3	750	1200	12	16
AGC0801	8	1	0.8	3	650	1300	14	16
AGC0802	8	2	1.2	3	1300	2300	14	16
AGC0802.5	8	2.5	1.2	3	1345	2694	16	26
AGC0804	8	4	1.5875	3	1714	3480	18	28
AGC0805	8	5	1.5875	3	1700	3458	18	28
AGC1002	10	2	1.2	3	1455	3275	18	28
AGC1004	10	4	2.0	3	2310	5261	26	34
AGC1202	12	2	1.2	4	2100	4900	20	28
AGC1204	12	4	2.5	3	4400	9000	24	28
AGC1205	12	5	2.5	3	4400	9000	24	30
AGC1402	14	2	1.2	4	2200	5700	21	23

Rolled ball screw ARF

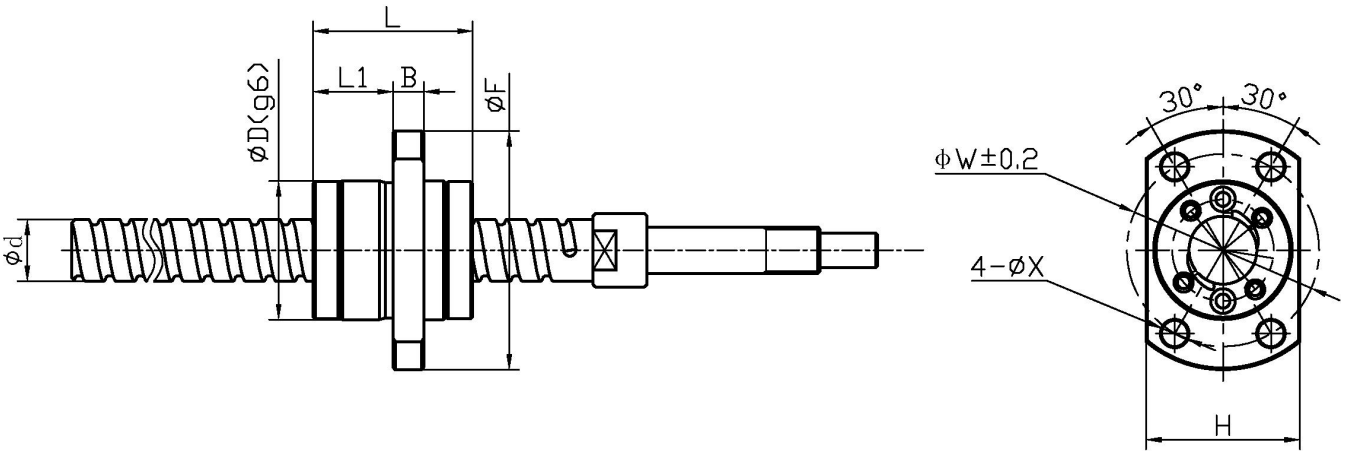






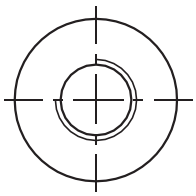
Model	Dia	Lead	Ball size	Circuit No.	Basic Loading Rate N		Nut size						
	d	P	Da	n	Ca (N)	Coa (N)	D	F	B	L	W	H	X
ARF0401	4	1	0.8	3	420	570	10	20	3	12	15	14	2.9
ARF0501	5	1	0.8	3	500	700	10	20	3	12	15	14	2.9
ARF0502	5	2	1.2	3	660	1052	10	20	3	16	15	14	2.9
ARF0601	6	1	0.8	3	560	950	12	24	3.5	15	18	16	3.4
ARF0602	6	2	1.2	3	750	1200	12	24	4	16	18	16	3.4
ARF0801	8	1	0.8	3	650	1300	14	27	4	16	21	18	3.4
ARF0802	8	2	1.2	3	1300	2300	14	27	4	16	21	18	3.4
ARF0802.5	8	2.5	1.2	3	1345	2694	16	29	4	26	23	20	3.4
ARF0804	8	4	1.5875	3	1714	3480	18	31	4	28	27	22	3.4
ARF0805	8	5	1.5875	3	1700	3458	18	31	4	28	27	22	3.4
ARF1002	10	2	1.2	3	1455	3275	18	35	5	28	27	22	4.5
ARF1004	10	4	2.0	3	2310	5261	26	46	10	34	36	28	4.5
ARF1202	12	2	1.2	4	2100	4900	20	37	5	28	29	24	4.5
ARF1204	12	4	2.5	3	4400	9000	24	40	6	28	33	26	4.5
ARF1205	12	5	2.5	3	4400	9000	24	40	6	30	33	26	4.5
ARF1402	14	2	1.2	4	2200	5700	21	40	6	23	31	26	5.5

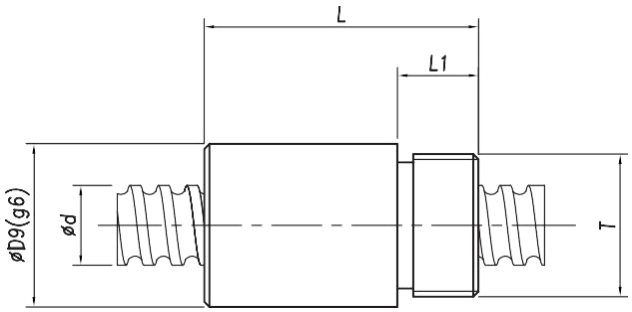
Rolled ball screw ARF



Model	Dia.	Lead	Ball size	Circuit No.	Basic Load Rating N		Nut size							
	d	P	Da	n	Ca(N)	Coa(N)	D	F	B	L1	L	W	H	X
ARF0606	6	6	1.2	1.6*2	1260	2130	14	17	4	8	17	21	16	3.4
ARF0610	6	10	1.2	1.2*2	950	1600	14	23	4	11.5	23	21	16	3.4
ARF0808	8	8	1.5875	1.6*2	2200	3800	18	31	4	10	20	25	20	3.4
ARF0810	8	10	1.5875	1.6*2	2200	3800	18	31	4	13	24	25	20	3.4
ARF0812	8	12	1.5875	1.6*2	2200	4000	18	31	4	17	27	25	20	3.4
ARF1010	10	10	2	1.6*2	3300	5980	23	40	5	13	24	32	25	4.5
ARF1015	10	15	2	1.6*2	3300	5980	23	40	5	22	33	32	25	4.5
ARF1020	10	20	2	1.6*2	3300	5980	23	40	5	31	42	32	25	4.5
ARF1210	12	10	2	1.7*2	4200	8900	24	41	6	14.5	30	33	26	4.5
ARF1215	12	15	2.5	1.7*2	5600	12000	24	41	6	24.5	40	33	26	4.5
ARF1220	12	20	2.5	1.7*2	5600	12000	24	41	6	34.5	50	33	26	4.5

Rolled ball screw ART

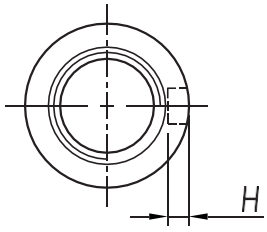


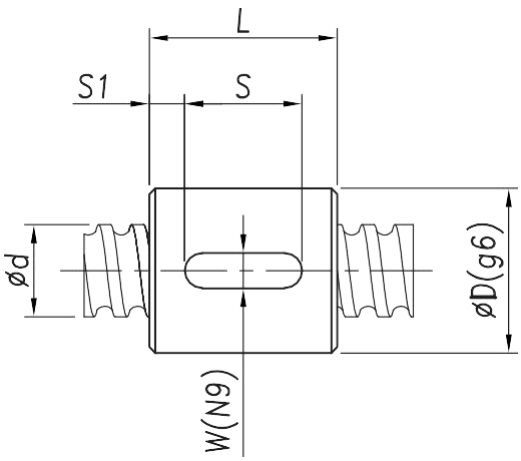




Model	Dia.	Lead	Ball size	Circuit No.	Basic Load Rating N		Nut size			
	d	P	Dw	n	Ca	Coa	D	L	L1	T
ART0401	4	1	0.8	3	420	570	10	15	5	M8x0.75
ART0501	5	1	0.8	3	500	700	12	15	5	M10x1
ART0502	5	2	1.2	3	660	1052	12	20	6	M10x1
ART0601	6	1	0.8	3	560	950	12	20	6	M10x1
ART0602	6	2	1.2	3	750	1200	12	20	6	M10x1
ART0801	8	1	0.8	3	650	1300	12	22	8	M14x1
ART0802	8	2	1.2	3	1300	2300	16	27	8	M14x1
ART0802.5	8	2.5	1.2	3	1345	2694	16	29	8	M14x1
ART0804	8	4	1.588	3	1714	3480	18	34	8	M16x1
ART0805	8	5	1.588	3	1700	3458	18	34	8	M16x1
ART1002	10	2	1.2	3	1455	3275	20	22	7.5	M18x1
ART1004	10	4	2.0	3	2310	5261	26	34	10	M18x1
ART1202	12	2	1.2	4	2100	4900	20	28	10	M18x1
ART1204	12	4	2.5	3	4400	9000	24	38	10	M20x1
ART1205	12	5	2.5	3	4400	9000	24	38	10	M20x1
ART1402	14	2	1.2	4	2200	5700	24	38	10	M20x1

Rolled ball screw ARC







Model	Dia.	Lead	Ball size	Circuit No.	Basic Load Rating N		Nut size	
	d	P	Da	n	Ca	Coa	D	L
ARC0401	4	1	0.8	3	420	570	10	12
ARC0501	5	1	0.8	3	500	700	10	12
ARC0502	5	2	1.2	3	660	1052	10	16
ARC0601	6	1	0.8	3	560	950	12	15
ARC0602	6	2	1.2	3	750	1200	12	16
ARC0801	8	1	0.8	3	650	1300	14	16
ARC0802	8	2	1.2	3	1300	2300	14	16
ARC0802.5	8	2.5	1.2	3	1345	2694	16	26
ARC0804	8	4	1.5875	3	1714	3480	18	28
ARC0805	8	5	1.5875	3	1700	3458	18	28
ARC1002	10	2	1.2	3	1455	3275	18	28
ARC1004	10	4	2.0	3	2310	5261	26	34
ARC1202	12	2	1.2	4	2100	4900	20	28
ARC1204	12	4	2.5	3	4400	9000	24	28
ARC1205	12	5	2.5	3	4400	9000	24	30
ARC1402	14	2	1.2	4	2200	5700	21	23

PERMISSIBLE AXIAL LOAD

It is recommended to use it under the condition that there is a tensile load acting on the screw shaft as much as possible. However, depending on the conditions of use, there may be a compressive load. In this case, the buckling of the screw shaft should be avoided. Especially when the installation distance is small, no matter what installation method is used, it will be limited by the allowable tensile stress or compressive load and the basic rated static load Coa. Buckling load, allowable tensile load and allowable compressive load can be obtained from the following equations.

♦Permissible compression load calculation for buckling

$$P=a\times\frac{n\pi^2 E\cdot I}{L^2} \qquad N\cdot(kgf)(Formula\ for\ Oiler)$$

a: SafetyFactor 0.5

E: Young*smodulus 2.08X10^{5}N/mm2 (MPa) (21,200kgf/mm2)

I: Minimum moment of inertia of screw shaft section

$$I=\frac{\pi}{64}\ d^4 mm^4$$

d: Screw Shaft Root diameter

L: Mounting space distance

n: Depending on factorfor Ball Screw mounting method

(Supported-Supported)	n=1
(Fixed—Suported)	n=2
(Fixed-Fixed)	n=4
(Fixed-Free)	n=1/4

♦Permissible tension, compression load calculation for Screw Shaft yield stress

$P = \sigma\times A$ N{kgf}

a: Permissible stress

A: (Screw Shaft minimum section area) 98N/mm2 (MPa) (10kgf/mm2}

$$A=\frac{\pi}{4}\ d^2 mm^2$$

d: (Screw Shaft Root diameter) mm

PERMISSIBLE SPEED

The installation method of the screw shaft determines the limit speed of the rotating screw shaft. Resonance is caused when the speed is close to the limit value, which makes the screw shaft unable to operate. In addition, regardless of the installation method, the ball screw has a limit speed that can cause damage to the circulation section.

♦Permissible speed calculation for critical speed

$$N = \beta \times \frac{60 \cdot \lambda^2}{2\pi} \times \sqrt{\frac{E \cdot I \cdot g}{\gamma \cdot A \cdot L4}} \quad min^{-1}\{rpm\}$$

a: SafetyFactor 0.5

E: Young*smodulus 2.08X10^{5}N/mm2 (MPa) (21,200kgf/mm2)

I: Minimum moment of inertia of screw shaft section)

$$I = \frac{\pi}{64} d^4 \ mm^4$$

d :Screw Shaft Root diameter mm 9.8X10^{3}mm/sec^2

g: Gravity acceleration 7.7X10^{-5}N/mm3

Y:Material specific gravity (7.85X 10^{-6}kgf/mm^3)

L :Mountingspan distance

A :Screw Shaft minimum section area

$$A = \frac{\pi}{4} d^2 \quad mm^2$$

入: Factor for Ball Screw mounting method

Supported-Supported)		入 =π
Fixed—Suported)		入=3.927
Fixed-Fixed)	n=4	入=4.730
Fixed-Free)	n = I/4	入=1.875

♦Rotation limits for damage on recirculating parts

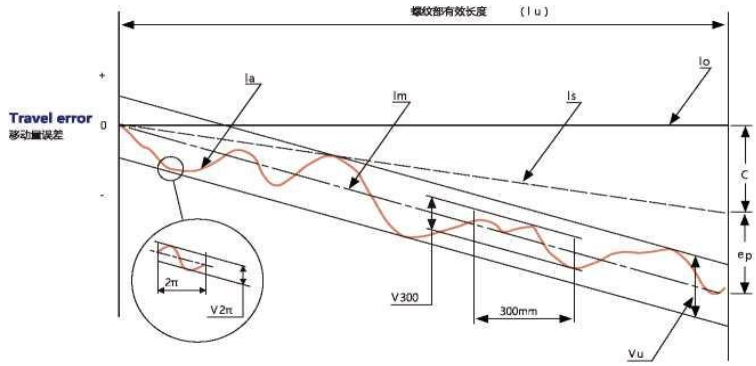
Regarding the limit rotation speed relative to the damage of the circulation part, the upper limit value is generally set according to the ball speed dn value of the ball screw (nominal outer diameter of the screw shaft X rotation speed). The dn value does not apply. The circulatory part of the Seris ball screw is damaged and the rotational speed limit is about 3,500 to 4,000 rpm. The value varies depending on the usage

conditions and environment, please contact us for details.

LEAD ACCURACY OF BALL SCREWS

According to JIS B1192, the lead accuracy of a ball screw refers to the error and fluctuation of the representative movement relative to the effective movement of the nut or the effective length of the screw shaft, and any 300mm and 1 turn relative to the effective length of the screw. (2πrad) fluctuations.

Movement amount error graph



Nominal movement (lo): Axial movement amount at any number of revolutions according to the nominal lead。

Standard lead (Phs): A lead that compensates for the nominal lead by predicting the amount of deformation due to temperature rise and load. Target value (c) representing the movement amount: The target value when the standard movement amount is set as positive or negative in advance.

standard movement (ls): The amount of movement when making any number of revolutions with the standard lead.

actual movement (la): The actual axial movement of the nut relative to any rotation angle of the screw shaft.

Representative movement (Im): A straight line representing the tendency of the actual movement amount. Based on the curve representing the actual movement amount relative to the effective movement amount of the ball screw or the effective length of the thread portion, the representative movement amount (Im): or similar approximation method is obtained by the least squares method.

Representative movement amount error (ep): The difference between the representative movement amount and the standard movement amount corresponding to the effective movement amount of the nut or the effective length of the threaded portion of the screw shaft. Volatility (Vu): The maximum magnitude of the actual movement between the two lines parallel to the movement.

Fluctuation (V300): The maximum range of actual movement relative to any 300mm in the effective length of the thread.

Wave (V2n): The maximum amplitude of the actual movement relative to any one turn (2πrad) of the effective length of the thread.

Typical travel error (± EP) and fluctuation (VU) allowable values for precision ball screws (positioning: C series)

Precision ball screw(Positioning:C series) Movement amount error (± EP)permissable fluctuation value(VU)

Accuracy Grade	C0	C1	C3	C5

Accuracy grade	C0		C1		C3		C5	
Item	V300	V2n	V300	V2n	V300	V2n	V300	V2n
Permissible value	3.5	3	5	4	8	6	18	8

Effective screw length (mm)	Over	Upto	±ep	Vu	±ep	Vu	±ep	Vu	±ep	Vu
	-	100	3	3	3.5	5	8	8	18	18
	100	200	3.5	3	4.5	5	10	8	20	18
	200	315	4	3.5	6	5	12	8	23	18
	315	400	5	3.5	7	5	13	10	25	20
	400	500	6	4	8	5	15	10	27	20
	500	630	6	4	9	6	16	12	30	23
	630	800	7	5	10	7	18	13	35	25
	800	1000	8	6	11	8	21	15	40	27

Permissible value of fluctuation (V300) and (V2n) per 300mm and 1 revolution of precision ball screw (for positioning: C series)

Fluctuation (V3oo) relative to 300mm (C7, C10)

mm

The representative movement amount error of the Ct series (C 7, C 10) is obtained by the following equation

Accuracy grade	Ct	C10
V300	52	210

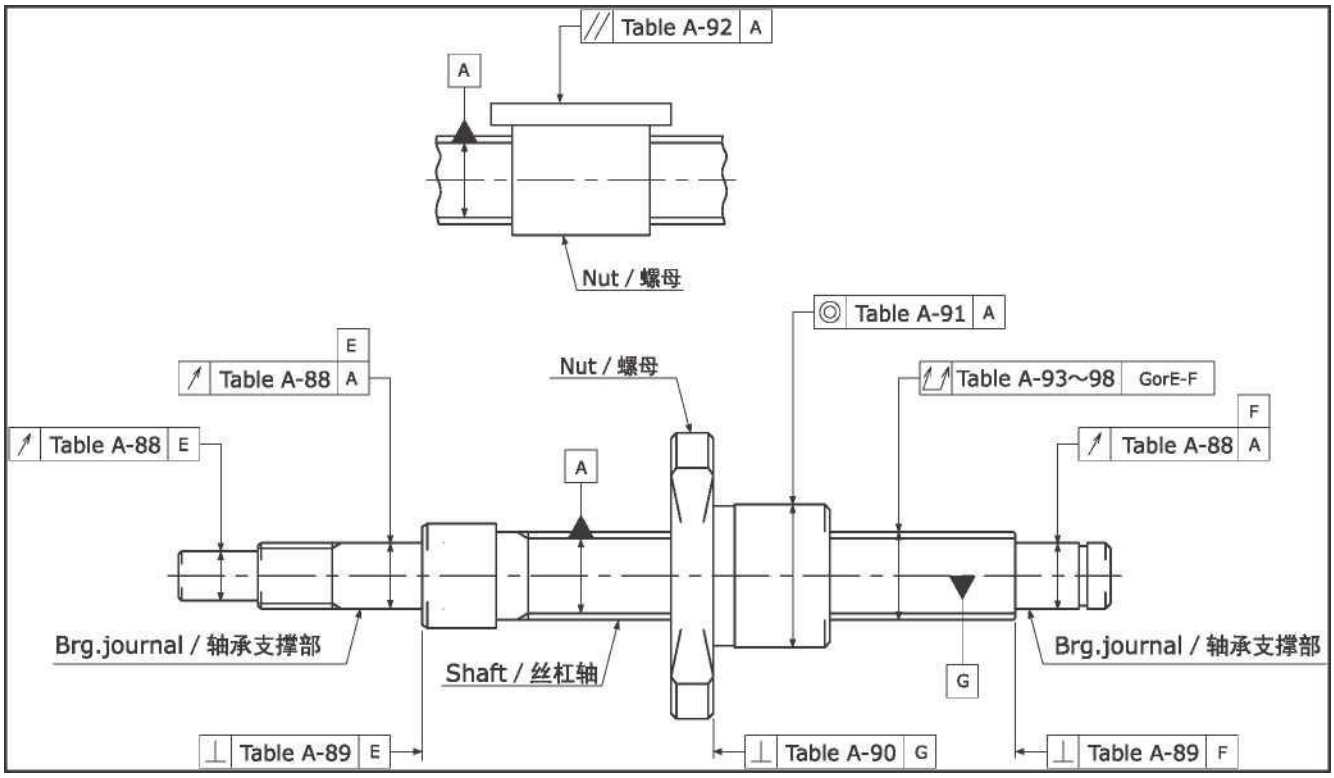
$$e_p = \pm \frac{l_u}{300} \times V_{300}$$

lu：螺纹部有效长度（mm）
Useful travel （mm）

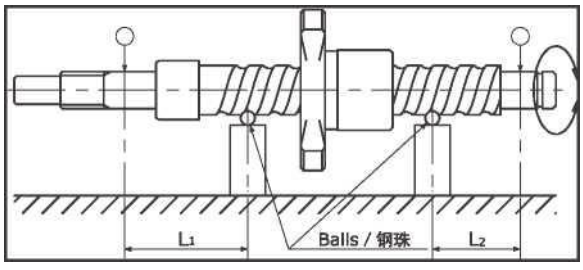
BALL SCREW RUN-OUT AND LOCATION TOLERANCES

According to JIS B1192, the lead accuracy of a ball screw refers to the error and fluctuation of the representative movement relative to the effective movement of the nut or the effective length of the screw shaft, and any 300mm and 1 turn relative to the effective length of the screw. (2πrad) fluctuation.

Example diagram for filling in the accuracy of the mounting part



Compensation for out-running



The circular runout in the radial direction of the outer diameter of the support part relative to the thread groove surface of the screw shaft and the circular runout in the radial direction of the part mounting part relative to the axis of the support part of the screw shaft should be carried out according to the following standards:

Shaft nominal diameter (mm)		Permissible deviation of Radial Run-out					
Over	Upto	C0	C1	C3	C5	C7	C10
–	8	3	5	8	10	14	40
8	12	4	5	8	11	14	40
12	20	4	6	9	12	14	40

The verticality of the end face of the support part relative to the axis of the support part of the screw shaft shall be carried out according to the following standards:

Shaft nominal diameter (mm)		Permissible deviations of Axial Run-out (Perpendicularity)					
Over	Upto	C0	C1	C3	C5	C7	C10
–	8	2	3	4	5	7	10
8	12	2	3	4	5	7	10
12	20	2	3	4	5	7	10

The verticality of the nut datum end face or the flange mounting face relative to the axis of the screw shaft shall comply with the following standards:

Nut outside diameter (mm)		Permissible deviations of Axial Run-out (Perpendicularity))					
Over	Upto	C0	C1	C3	C5	C7	C10
–	20	5	6	8	10	14	20
20	32	5	6	8	10	14	20
32	50	6	7	8	11	18	30

The circular runout in the radial direction of the outer peripheral surface of the nut (in the case of a cylindrical shape) relative to the axis of the screw shaft shall comply with the following standards:

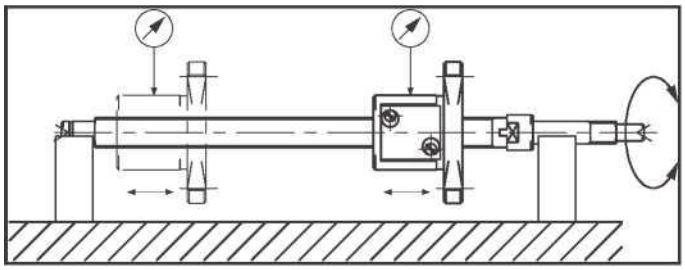
Nut outside diameter (mm)		Permissible deviations of Radial Run-out					
Over	Upto	C0	C1	C3	C5	C7	C10
–	20	5	6	9	*12*	20	40
20	32	6	7	10	*12*	20	40
32	50	7	8	12	*15*	30	60

The parallelism of the outer peripheral surface of the nut with respect to the axis of the screw shaft (when installed on a plane) shall comply with the following standards:

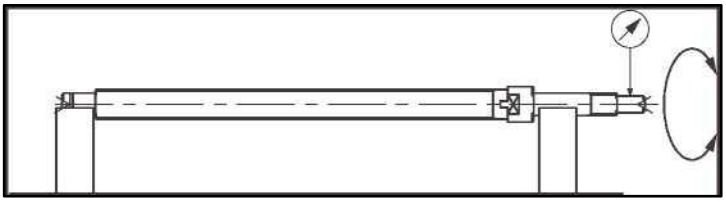
Mounting length (mm)		Permissible deviations of Parallelism					
Over	Upto	C0	C1	C3	C5	C7	C10
–	50	5	6	8	10	17	30
50	100	7	8	10	13	17	30

MEASURING METHOD OF BALL SCREW RUN-OUT AND LOCATION TOLERANCES

Measurement method of circular runout relative to the direction of the outer diameter of the nut at the support part of the shaft end of the screw shaft: Use V-shaped blocks to support both ends of the screw shaft, while rotating the screw shaft, read the dial indicator scale of the measuring head contacting the outer peripheral surface of the nut; or on the deflection meter, use the center hole as the reference to measure the circular runout of the nut .



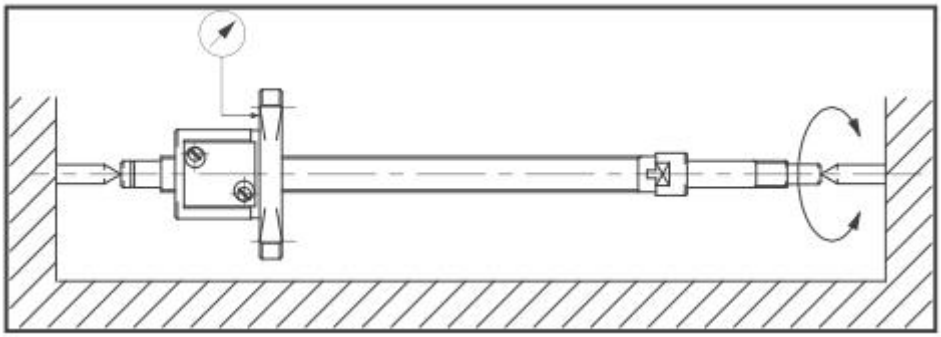
Measurement method of circular runout relative to the shaft end of the support part of the screw shaft: Support both ends of the screw shaft with V-shaped blocks, and read the dial indicator scale on the part where the measuring head is in contact with the part mounting part while rotating the screw shaft.



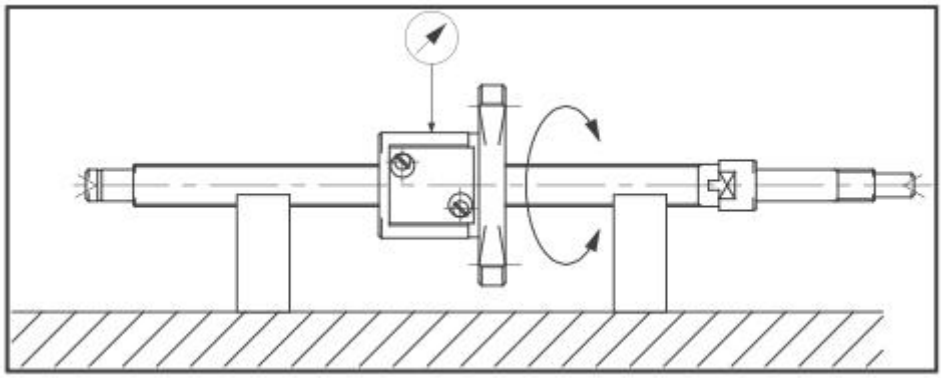
The verticality measurement method of the end face of the support part relative to the axis of the support part of the screw shaft: Support both ends of the screw shaft with the two center holes, while rotating the screw shaft, read the dial indicator scale on the end face of the measuring head contacting the support part.



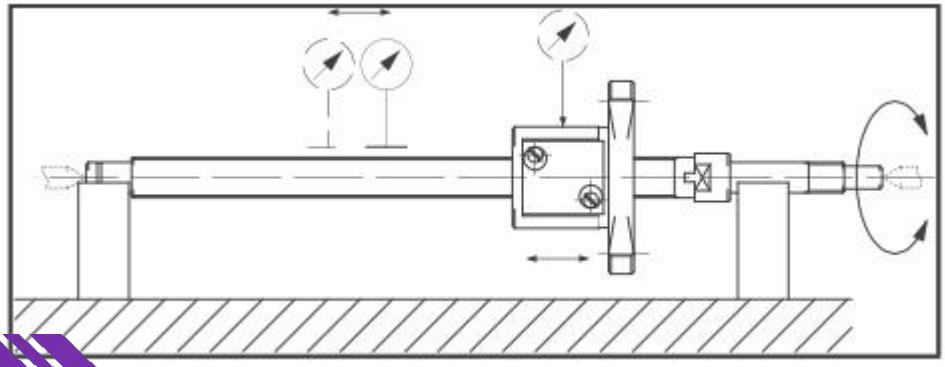
Longitudinal degrees relative to the lead end face or flange mounted in perspective of the lead screw The two shafts at both ends of the welding are rotated together with the axle, and the head wheel is used to connect the dial hole gauge and the rotary joint on the end face of the flange.



Measurement method of circular runout on the outer peripheral surface of the nut relative to the screw thread part: Support the screw thread part of the screw with the V-block, and read the dial indicator scale on the part where the measuring head touches the part mounting part while rotating the screw shaft.



The measurement method of the full runout in the radial direction of the axis of the screw shaft: Use two c enter holes or V-shaped blocks to support both ends of the screw shaft, while rotating the screw shaft, read the dial indicator scale when the measuring head contacts the outer peripheral surface of the screw shaft or the outer peripheral surface of the nut. The measurement operation includes the entire range, and multiple locations are
selected.



AXIAL PLAY AND PRELOAD

Usually, there is a tiny axial play between the screw shaft and the nut of a common single nut ball screw. Therefore, when an axial load acts on the single nut ball screw, the sum of the above-mentioned axial clearance and the elastic displacement caused by the axial load will cause the clearance to become larger and form a backlash. In order to eliminate such backlash, the axial clearance of the ball screw should be negative, that is, the method of applying elastic deformation between the screw shaft and the nut in advance, that is, "preloading".

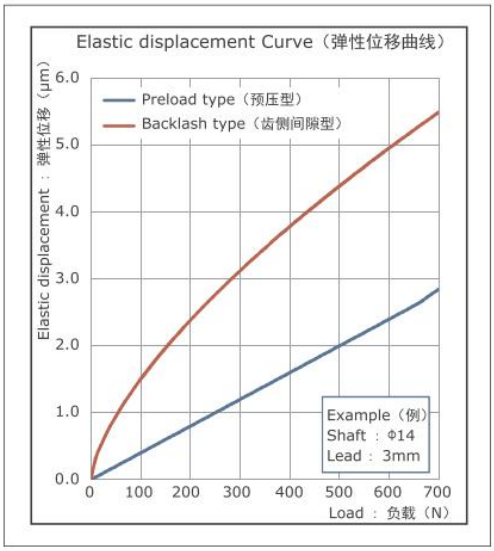
Combination of Ball Screw Accuracy Class and Clearance

Symbol / Accuracy grade	0 clearence	0.002(upto)	0.005(up to)	0.02mm(up to)	0.05(up to)
C0	C0	–	–	–	–
C1	C1	C1	–	–	–
C3	C3	C3	C3	C3–	C3
C5	–	–	C5	C5	C5
C7	–	–	–	C7	C7
C10	–	–	–	C10	C10

The effect of preload

Using preload can not only eliminate the axial play of the ball screw, but also reduce the amount of axial displacement caused by the axial load and improve the rigidity. The figure below shows the difference (theoretical value) in the amount of elastic displacement caused by the axial load of a backlash specification ball screw and a preload (no backlash) specification ball screw. It can be seen that the amount of elastic displacement can be reduced (stiffness increased) by preloading.

Elastic Displacement Curves for Gap Specifications and Preload Specifications



BASIC LOAD RATING AND BASIC RATING LIFE

◑Basic dynamic load rating Ca and basic rating life

The rated life of a ball screw refers to the total rotation of a group of identical ball screws operating under the same conditions, in which 90% of the ball screw grooves and ball surfaces are not fatigued and peeled due to rolling contact. number. The basic dynamic load rating Ca refers to the axial load with a rated life of 1 million revolutions, and this value is marked with Ca in the dimension table. The rated life L10 of the ball screw can be calculated from the following formula using the value of the basic dynamic load rating Ca.

$$L_{10} = \left(\frac{Ca}{f \cdot Fa}\right)^{3} \times 10^{6} \quad rev$$

When the rated life is expressed by the time L10h or the travel distance L10d instead of the total number of revolutions, it can be calculated by the following formula.

$$L_{10h} = \left(\frac{1}{60 \cdot N}\right) \times L_{10} \quad 时间 \ (hours)$$

$$L_{10d} = \left(\frac{r}{10^{6}}\right) \times L_{10} \quad km$$

Ca: (Basic Dynamic Load Rating) N{kgf}
Fa (Axialload) N{kgf}
N: (Revolution) min^{-1}{rpm}
r: (Lead) mm
f: (Load factor)

f=1.0 ∽1.2 Almost no vibration, no shock
f= 1.2 ∽1.5 When there is slight vibration and shock
f= 1.5 ∽3.0 When there is strong vibration and shock

In general, the axial load acting on the equipment is not constant, and the rated life is calculated. It operates in several ways. In this case, the average axial load Fam and the average rotational speed Nm can be obtained from the following equations, and then the rated life can be calculated.

Axial load N{kgf}	Revolution min^{-1} {rpm}	Working time %
Fa1	N1	T1
Fa2	N2	t2
Fa3	N3	t3

$$Fam = \left(\frac{Fa_1^{3} \cdot N_1 \cdot t_1 + Fa_2^{3} \cdot N_2 \cdot t_2 + Fa_3^{3} \cdot N_3 \cdot t_3}{N_1 \cdot t_1 + N_2 \cdot t_2 + N_3 \cdot t_3}\right)^{1/3} \quad N\{kgf\}$$

$$Nm = \frac{N_1 \cdot t_1 + N_2 \cdot t_2 + N_3 \cdot t_3}{t_1 + t_2 + t_3} \quad min^{-1}\{rpm\}$$

In addition, the average axial load Fam when the axial load changes linearly can also be approximated by the following formula.

$$Fam = \frac{Fa\,min + 2 \cdot Fa\,max}{3} \quad N\{kgf\}$$

Minimum axial load N(kgf)

maximum axial load N(kgf)

(Note) The calculation formula of the ball screw life is based on the assumption that the lubrication condition is good and no foreign matter is mixed, and it is a calculation formula under pure axial load without moment load and radial load.

◑Basic static load rating

The basic static load rating Coa refers to the axial static load that makes the sum of the rolling surface of the steel ball and the permanent deformation of the steel ball equal to 1/10000 of the diameter of the steel ball at the contact portion that receives the maximum stress. This value is indicated in the dimension table as Coa. The value of the basic static load rating Coa is used to examine the load conditions in a stationary state or when the rotation speed is very low (10 rpm or less). The above-mentioned amount of permanent deformation does not affect the use in most cases. At this time, the maximum allowable load Fa max of the thread groove portion can be obtained from the following equation.

$$Fa\ max = \frac{Coa}{fs}\ N\{kgf\}$$

fs: Static safety factor

fs=I~2 during normal operation

fs=2∽3 When there is vibration and shock

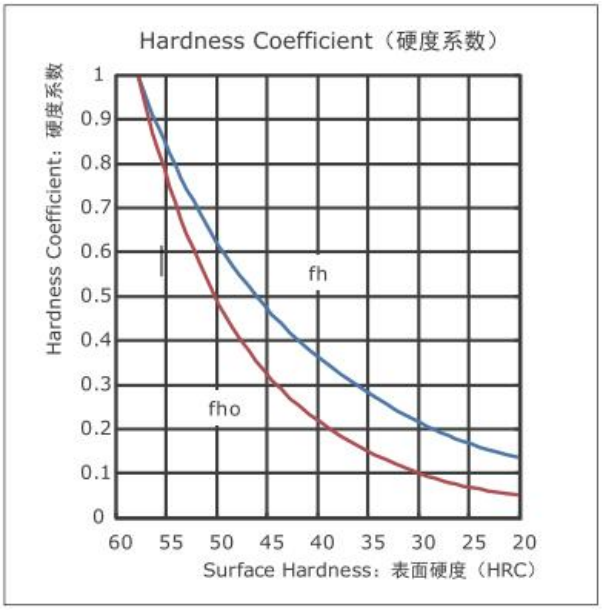
◑Hardness factor

When the surface hardness is less than HRC58, the basic dynamic load rating Ca and the basic static load rating Coa need to be compensated. Compensation is performed by the following equation.

$$Ca' = fh \cdot Ca \quad (N)$$

$$Coa' = fho \cdot Coa \quad (N)$$

fh, fho：硬度系数（右图）



DRIVING TORQUE

The drive torque T of the ball screw system is obtained from the following equation.

T=Ti+T2+T3+T4 N,m {kgf-cm)

Tl: torque from acceleration	N-m(kgf-cm}
T2: Load torque	N-m(kgf-cm}
T3: Preload torque	N-m(kgf-cm}
T4: other torque	N-m(kgf-cm}

The torque produced by the feed screw system needs to be considered when selecting a motor. T1~T3 can be obtained from the following equations.

◑torque from acceleration

$$T_1=\alpha\cdot I \quad N\cdot m$$

$$\alpha=\frac{2\pi N}{60\cdot t} \quad rad/sec^2$$

$$I=Iw\cdot A^2+Is\cdot A^2+I_A A^2+I_B \quad kg\cdot m^2$$

$$Iw=m_w\times\left(\frac{r}{2\pi}\right)^2 \quad kg\cdot m^2$$

$$Is=m_s\times\left(\frac{d^2}{8}\right) \quad kg\cdot m^2$$

$$m_s=\pi\left(\frac{d}{2}\right)^2\times L\times\gamma \quad kg$$

a: Angular acceleration (rad/sec^2) I: Moment of inertia (kg·m^2)

Iw: Moment of inertia converted from the motor shaft of the moving object (kg·m^2)

Is: Moment of inertia of the screw shaft (kg·m^2)

Ia: Inertia moment of gear, etc. on the screw shaft side (kg·m^2)

Ib: Moment of inertia of gears, etc. on t he motor side (kg·m^2)

mw: Weight of moving object (kg) ms: Weight of screw(kg)

r: Lead(m) d: Outer dia. of screw shaft (m)

L : Screw shaft length (m) Y: Specific gravity (7850kg/m^3)

A: Reduction ratio N: Motor speed (min^{-1})

t: Acceleration time (sec)

◑Load torque T2

$$T2=\frac{P\cdot r\cdot A}{2\pi\eta}\ X10^{-3}=\frac{(F+\mu W)}{2\pi\eta}\cdot r\cdot A\ X10^{-3}\quad N\cdot m$$

$$T2=\frac{P\cdot r\cdot A}{2\pi\eta}\ X10^{-1}=\frac{(F+\mu W)}{2\pi\eta}\cdot r\cdot A\ X10^{-1}\quad kgf\cdot cm$$

P: Axialload N{kgf}

F: Load N{kgf}

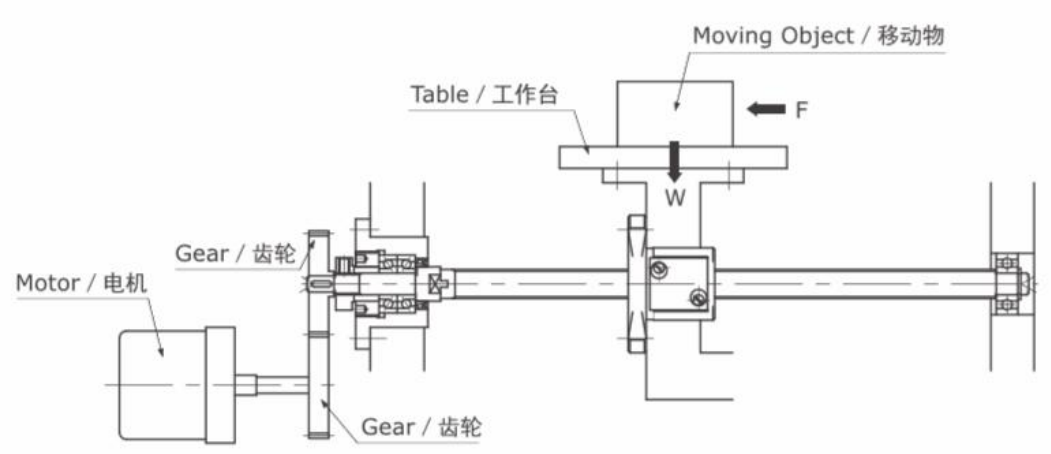
W:Weight of moving object N{kgf}

r: Lead mm

μ : Sliding surface friction coefficient

η: Efficiency 0.9

A: Reduction ratio



◑Preload torque

$$T_3 = 0.05 \times (\tan\beta)^{-0.5} = \frac{Fa \cdot r}{2\pi} \times 10^{-3} \quad N \cdot m$$

$$T_3 = 0.05 \times (\tan\beta)^{-0.5} = \frac{Fa \cdot r}{2\pi} \times 10^{-1} \quad kgf \cdot cm$$

B: Lead angle	deg
Fa: Preload	N{kgf}
r: Lead	mm

◑Other torque

Refers to the torque generated when other than the above. For example, the friction torque of the support bearing and the torque generated by the sliding resistance of the oil seal, etc.

WHERE RELIABILITY MEETS TORQUE

PRECISION IN MOTION POWERING TOMORROW

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