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3D选型软件
3D Selection Software

KGG

MINIATURE GNK GROUND BALL SCREW

微型GNK研磨滚珠丝杠

目录 CONTENTS

KGG产品简介 OUTLINE OF KGG PRODUCT

主要用途 Main Usage

多运用于工作定位、夹取、搬运、插件等产能自动化。
Positioning, Pick And Place, Carrying, Press-fitting.

运用范围 Application

- 电子部件组装 Electronic Device Assemble
- 液体注入填充装置 Liquid Filling
- 点熔接装置 Welding
- 电路板与晶圆盒定位插入装置 Press-fitting Of Circuit Board And Wafer Box

产业 Industries

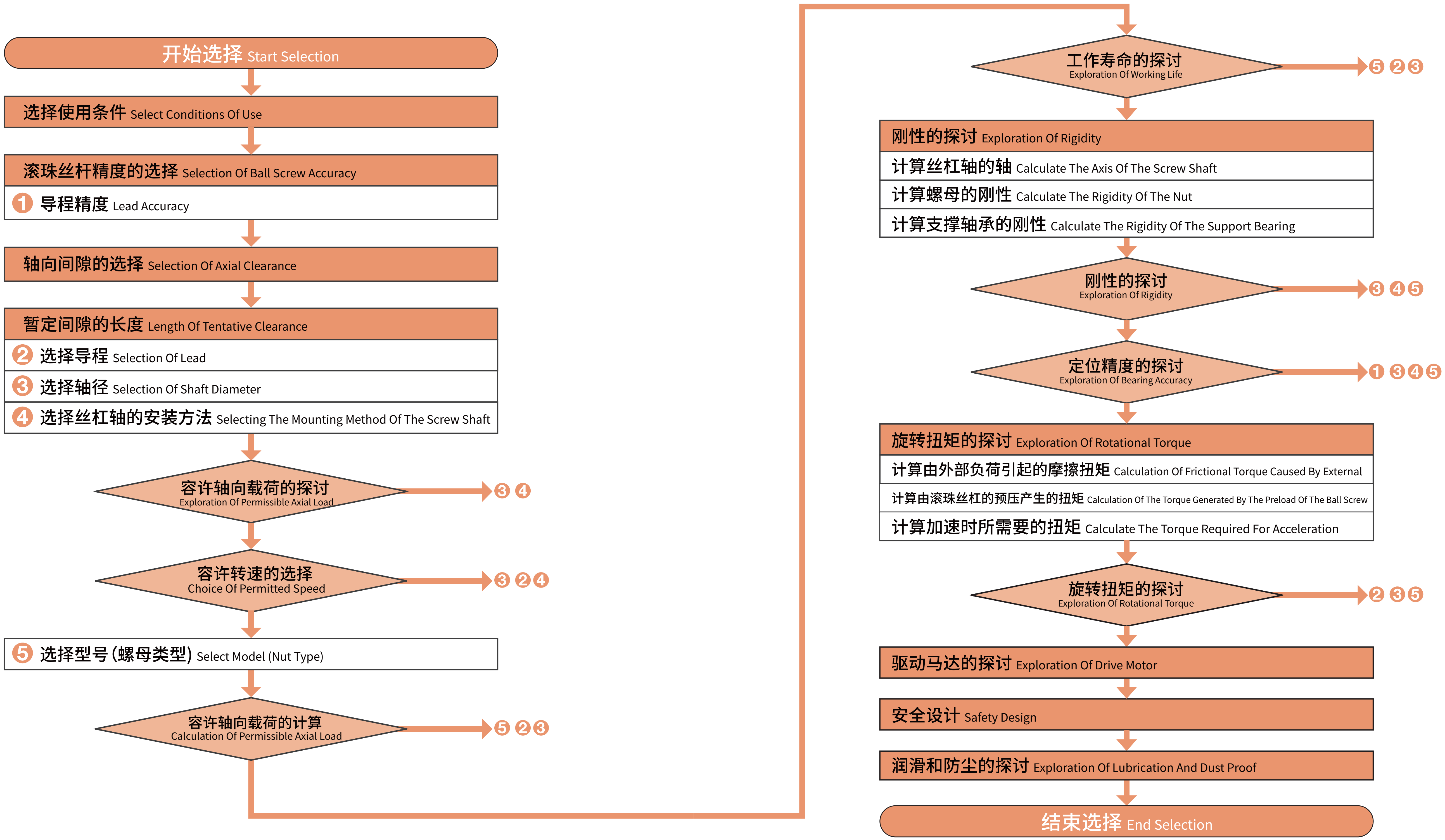
- LCD液晶面板设备 LCD Panel Equipment
- 半导体设备 Semiconductor
- LED线上设备 LED Online Equipment
- 太阳能设备 Solar Energy
- 生物医疗、器械设备 Biomedical Equipment
- 点胶、焊接设备 Dispensing And Welding Equipment

滚珠丝杠的选型流程图 /Flow Chart Of Ball Screw Selection

【滚珠丝杠选型流程】Flow Chart Of Ball Screw Selection

选择滚珠丝杠时，主要根据使用条件并综合考虑各种因素来选择。下列流程图是选择滚珠丝杠方法的大致标准。

When Selecting A Ball Screw, The Selection Is Mainly Based On The Conditions Of Use And Takingvarious Factors Into Consideration. The Following Flow Chart Shows The General Criteria For Themethod Of Selecting A Ball Screw.



研磨滚珠丝杠
Ground Ball Screw

微型研磨滚珠丝杠GNK系列(C3/C5)
GNK Series Miniature Ground Ball Screw(C3/C5)

微型研磨滚珠丝杠标准库存品 Miniature Ground Ball Screw Standard Products in Stock

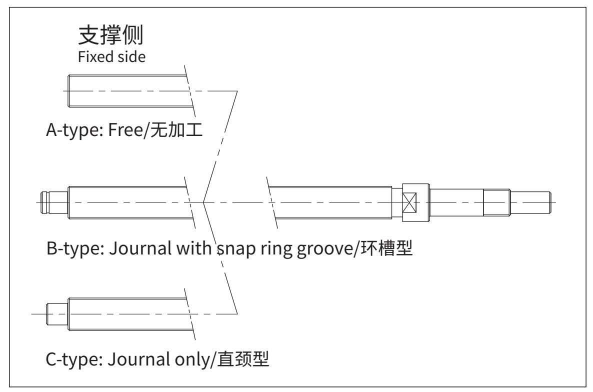
公称型号的构成 Model number notation

GNK	08	02	—	3	RR	G0	+	125L	C3	Y
1	2	3		4	5	6		7	8	9

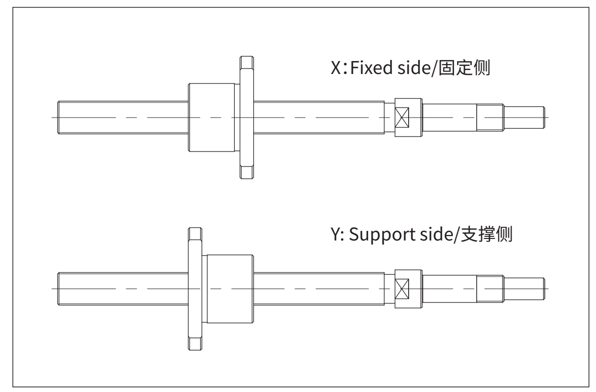
1 系列符号
GNK: 微型研磨滚珠丝杠
2 丝杆轴公称外径(mm)
3 导程(mm)
4 圈数
5 密封圈标记
无标记:不带密封圈
RR:两侧带有迷宫式密封圈
6 轴向间隙的标记
7 丝杆轴总长度(mm)
8 精度标记
9 带轴标准库存品标记(Y:轴端完成品)

1 Series of symbols
GNK: Miniature Ground Ball Screw
2 Nominal outer diameter of screw shaft (mm)
3 Lead (mm)
4 Cylinder number
5 Seal ring mark
No mark: No sealing ring
RR: With labyrinth seals on both sides
6 Marking of the axial gaps
7 Total wire rod shaft length (mm)
8 Precision marking
9 Standard stock mark with shaft (Y: shaft end finishes)

图A-01:轴端加工型
Fig.A-01:Shaft supported end profile



图A-02:螺母法兰朝向
Fig.A-02:Nut Flange direction



精度等级和轴向间隙

GNK系列（微型研磨滚珠丝杠标准库存品）的精度等级有JISC3/C5两种。轴向间隙根据精度等级不同备有0mm（预压：C3）和0.005mm以下（C5）。

Accuracy class and axial clearance

Accuracy grade of GNK series（standard stock of miniature ground ball screw） are based on C3 and C5（JIS B 1192-3）. According to accuracy grade, Axial play 0（Preload： C3） and 0.005mm or less（C5） are in stock.

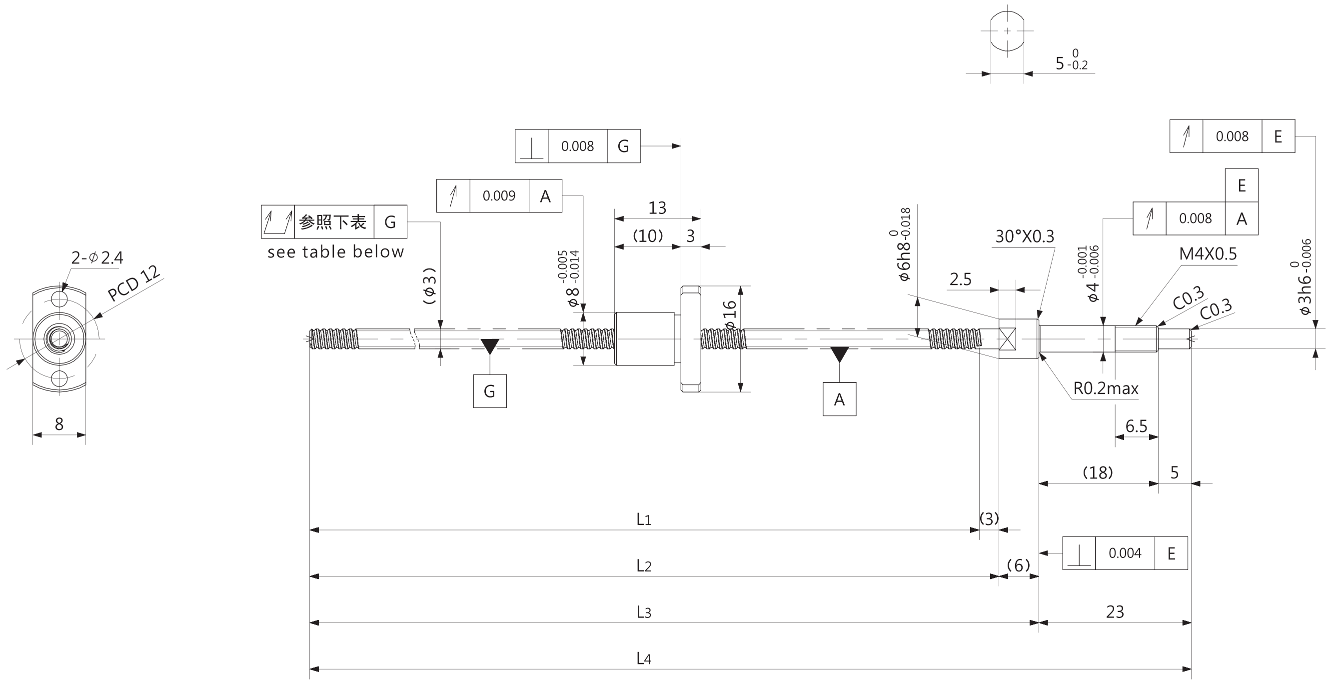
材质和表面硬度

GNK系列（微型研磨滚珠丝杠标准库存品）的螺杆轴丝杆材料S55C（高频淬火）、螺母材料SCM415H（渗碳淬火），滚珠丝杆部分的表面硬度为HRC58以上。

Material & Surface Hardness

GNK series (standard stock of miniature ground ball screw) of screw shaft screw material S55C (induction hardening), nut material SCM415H (carburizing and hardening), the surface hardness of the ball screw part is HRC58 or higher.

GNK0301 | Shaft dia.(轴径)ϕ3 Lead(导程)1mm | C3



Unit(单位):mm

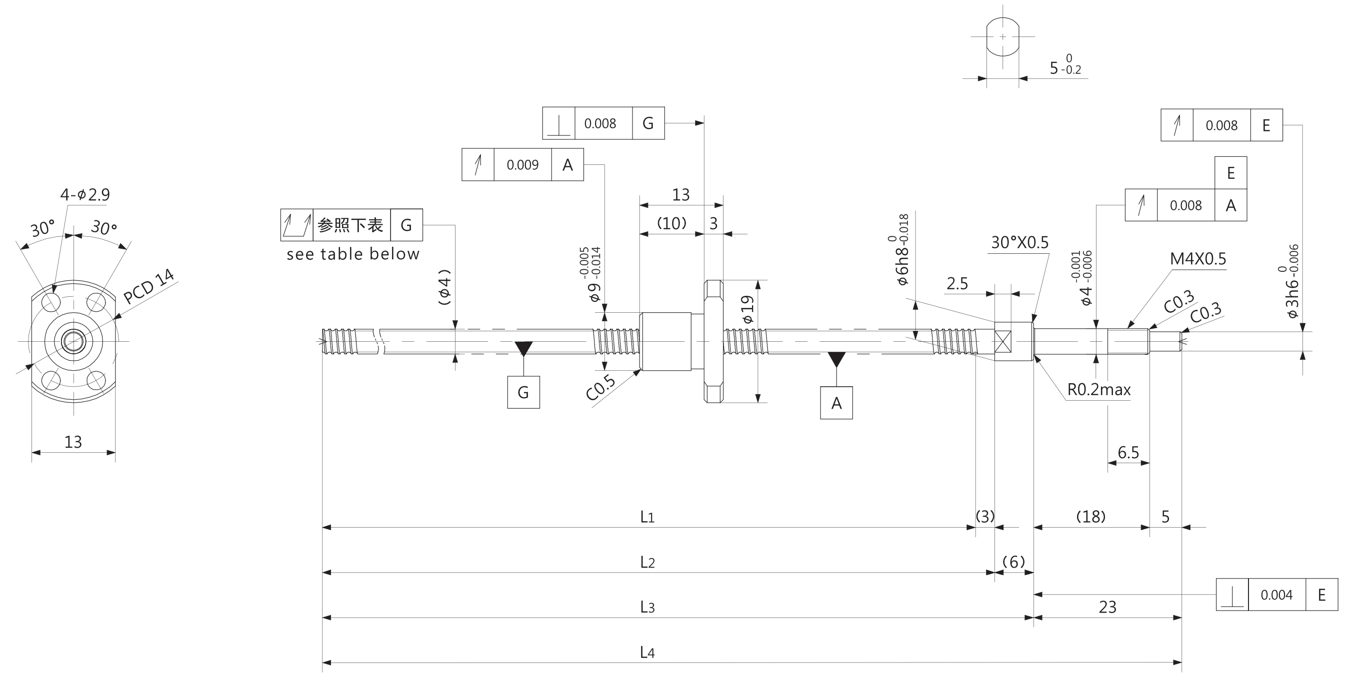
Ball Screw Specifications 主要技术参数				
Ball size 钢珠直径	ϕ0.6	BCD 钢珠中心直径		3.18
Lead Angle 导程角	5°43´	Number of thread 螺纹条数		1
Thread direction 螺纹旋向	Right 右旋	Shaft root dia 丝杠轴底径		ϕ2.5
Number of circuit 循环数	1×3	Material 材质	Shaft 轴	S55C
			Nut 螺母	SCM415H
Surface hardness 螺纹部表面硬度	HRC58～62（Thread area）	Anti-rust treatment 防锈处理		Anti-rust oil 防锈油

Unit(单位):mm

Ball Screw Model 滚珠丝杠型号	Travel 行程	Shaft length 丝杠轴长度 L1	L2	L3	L4	Lead accuracy 导程精度 Travel deviation 代表移动量误差 ep	Variation 波动 V300	Total Run-out 全跳动	Axial play 轴向间隙	Preload Torque 预压扭矩 Nm	Basic Load Rating 基本额定负载 N Dynamic 额定动负载 Ca	Static 额定静负载 Coa
GNK0301-3G0+070LC3Y	20	38	41	47	70	±0.008	0.008	0.025	~0.005	-	330	440

Note）Please designate end-journal profile with your sketch. 注）轴端的追加加工请结合图纸进行指示。

GNK0401 | Shaft dia.(轴径)ϕ4 Lead(导程)1mm | C3



Unit(单位):mm

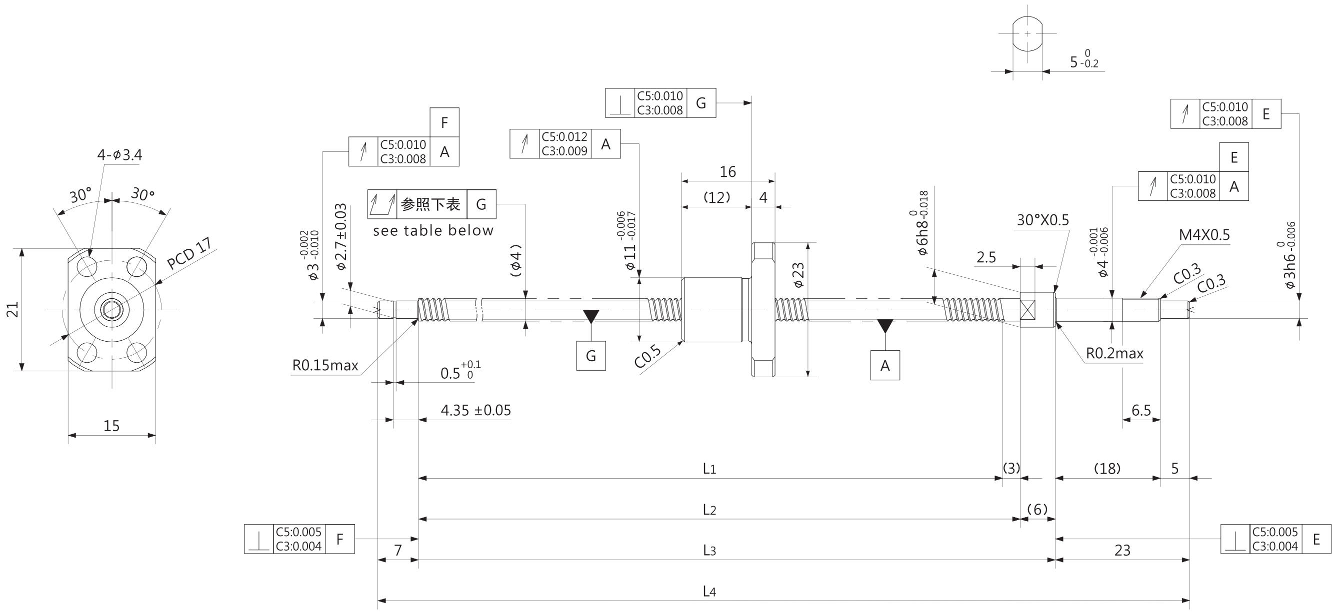
Ball Screw Specifications 主要技术参数				
Ball size 钢珠直径	ϕ0.8	BCD 钢珠中心直径		4.15
Lead Angle 导程角	4°23´	Number of thread 螺纹条数		1
Thread direction 螺纹旋向	Right 右旋	Shaft root dia 丝杠轴底径		ϕ3.3
Number of circuit 循环数	3×1	Material 材质	Shaft 轴	S55C
			Nut 螺母	SCM415H
Surface hardness 螺纹部表面硬度	HRC58～62（Thread area）	Anti-rust treatment 防锈处理		Anti-rust oil 防锈油

Unit(单位):mm

Ball Screw Model 滚珠丝杠型号	Travel 行程	Shaft length 丝杠轴长度 L1	L2	L3	L4	Lead accuracy 导程精度 Travel deviation 代表移动量误差 ep	Variation 波动 V300	Total Run-out 全跳动	Axial play 轴向间隙	Preload Torque 预压扭矩 Nm	Basic Load Rating 基本额定负载 N Dynamic 额定动负载 Ca	Static 额定静负载 Coa
GNK0401-3G0+77LC3Y	25	45	48	54	77	±0.008	0.008	0.025	0	~0.010	420	570
GNK0401-3G0+97LC3Y	45	65	68	74	97	±0.008		0.025				
GNK0401-3G0+127LC3Y	75	95	98	104	127	±0.008		0.035				

Note）Please designate end-journal profile with your sketch. 注）轴端的追加加工请结合图纸进行指示。

GNK0402 | Shaft dia.(轴径)ϕ4 Lead(导程)2mm | C3 |



Unit(单位):mm

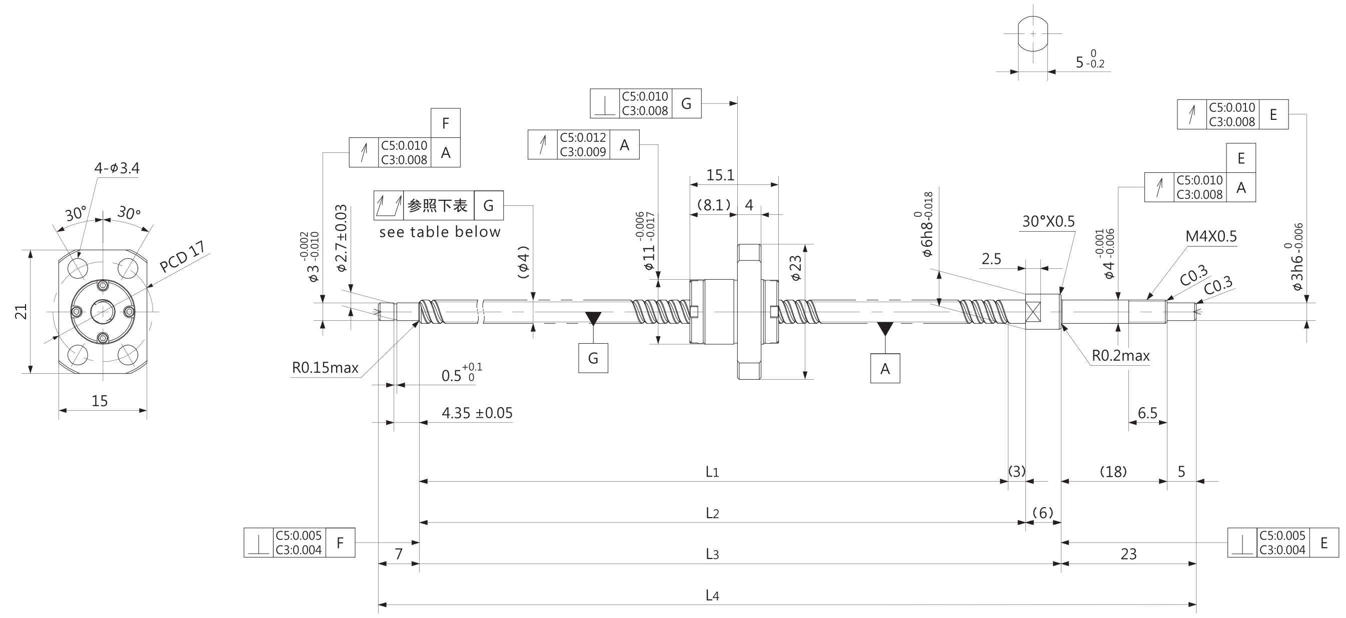
Ball Screw Specifications 主要技术参数			
Ball size 钢珠直径	ϕ0.8	BCD 钢珠中心直径	4.15
Lead Angle 导程角	8°43′	Number of thread 螺纹条数	1
Thread direction 螺纹旋向	Right 右旋	Shaft root dia 丝杠轴底径	ϕ3.3
Number of circuit 循环数	2.7×1	Material 材质 Shaft 轴	S55C
		Material 材质 Nut 螺母	SCM415H
Surface hardness 螺纹部表面硬度	HRC58~62（Thread area）	Anti-rust treatment 防锈处理	Anti-rust oil 防锈油

Unit(单位):mm

Ball Screw Model 滚珠丝杠型号	Travel 行程	Shaft length 丝杠轴长度 L_1	L_2	L_3	L_4	Lead accuracy 导程精度 Travel deviation 代表移动量误差 e_p	Variation 波动 V_{300}	Total Run-out 全跳动	Axial play 轴向间隙	Preload Torque 预压扭矩 Nm	Basic Load Rating 基本额定负载 N Dynamic 额定动负载 Ca	Static 额定静负载 Coa
GNK0402-3G0+134LC3Y	70	95	98	104	134	±0.008	0.008	0.035	0	~0.010	420	570

Note）Please designate end-journal profile with your sketch. 注）轴端的追加加工请结合图纸进行指示。

GNK0404 | Shaft dia.(轴径)ϕ4 Lead(导程)4mm | C3 |



Unit(单位):mm

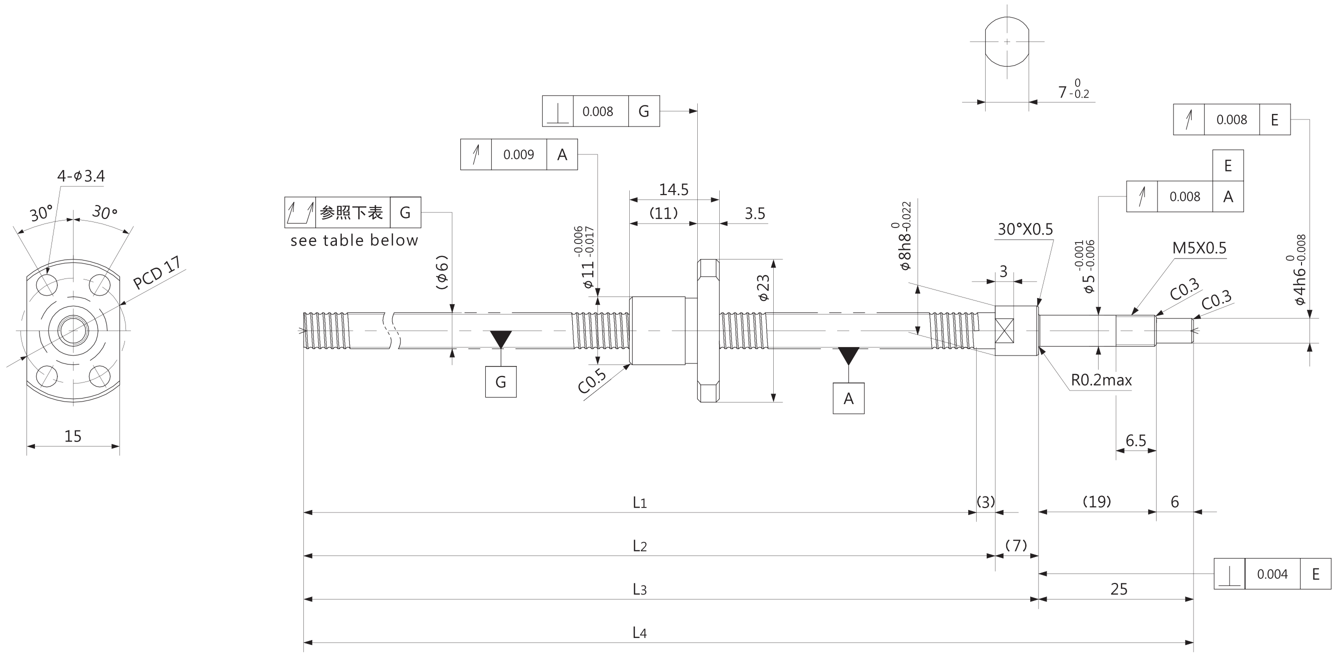
Ball Screw Specifications 主要技术参数			
Ball size 钢珠直径	ϕ0.8	BCD 钢珠中心直径	4.2
Lead Angle 导程角	16°51′	Number of thread 螺纹条数	2
Thread direction 螺纹旋向	Right 右旋	Shaft root dia 丝杠轴底径	ϕ3.3
Number of circuit 循环数	2.6×2	Material 材质 Shaft 轴	S55C
		Material 材质 Nut 螺母	SCM415H
Surface hardness 螺纹部表面硬度	HRC58~62（Thread area）	Anti-rust treatment 防锈处理	Anti-rust oil 防锈油

Unit(单位):mm

Ball Screw Model 滚珠丝杠型号	Travel 行程	Shaft length 丝杠轴长度 L_1	L_2	L_3	L_4	Lead accuracy 导程精度 Travel deviation 代表移动量误差 e_p	Variation 波动 V_{300}	Total Run-out 全跳动	Axial play 轴向间隙	Preload Torque 预压扭矩 Nm	Basic Load Rating 基本额定负载 N Dynamic 额定动负载 Ca	Static 额定静负载 Coa
GNK0404-3G0+134LC3Y	75	95	98	104	134	±0.008	0.008	0.035	0	~0.010	750	1150

Note）Please designate end-journal profile with your sketch. 注）轴端的追加加工请结合图纸进行指示。

GNK0601 | Shaft dia.(轴径)ф6 Lead(导程)1mm | C3 |



Unit(单位):mm

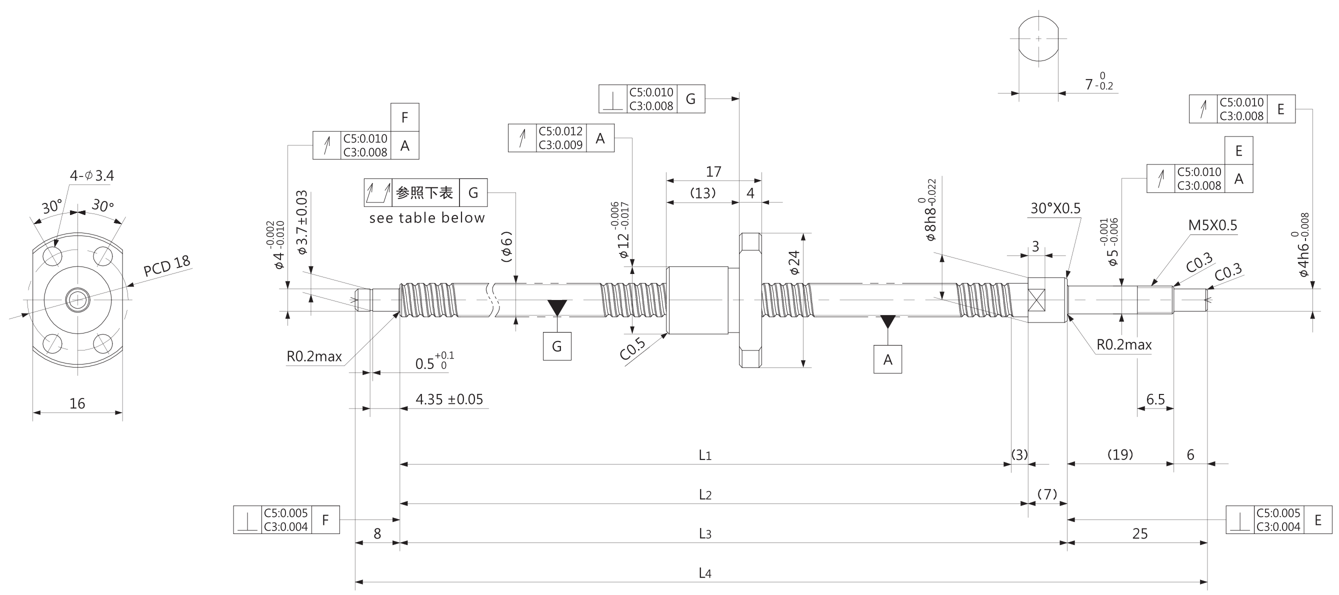
Ball Screw Specifications 主要技术参数				
Ball size 钢珠直径	ф0.8	BCD 钢珠中心直径		6.15
Lead Angle 导程角	2°58´	Number of thread 螺纹条数		1
Thread direction 螺纹旋向	Right 右旋	Shaft root dia 丝杠轴底径		ф5.3
Number of circuit 循环数	3×1	Material 材质	Shaft 轴	S55C
			Nut 螺母	SCM415H
Surface hardness 螺纹部表面硬度	HRC58～62（Thread area）	Anti-rust treatment 防锈处理		Anti-rust oil 防锈油

Unit(单位):mm

Ball Screw Model 滚珠丝杠型号	Travel 行程	Shaft length 丝杠轴长度				Lead accuracy 导程精度		Total Run-out 全跳动	Axial play 轴向间隙	Preload Torque 预压扭矩 Nm	Basic Load Rating 基本额定负载 N	
		L1	L2	L3	L4	Travel deviation 代表移动量误差 e_p	Variation 波动 V_{300}				Dynamic 额定动负载 Ca	Static 额定静负载 Coa
GNK0601-3G0+100LC3Y	45	65	68	75	100	±0.008	0.008	0.025	0	~0.013	560	950
GNK0601-3G0+130LC3Y	75	95	98	105	130	±0.008		0.035				
GNK0601-3G0+160LC3Y	105	125	128	135	160	±0.010		0.035				

Note）Please designate end-journal profile with your sketch.　注）轴端的追加加工请结合图纸进行指示。

GNK0602 | Shaft dia.(轴径)ф6 Lead(导程)2mm | C3 |



Unit(单位):mm

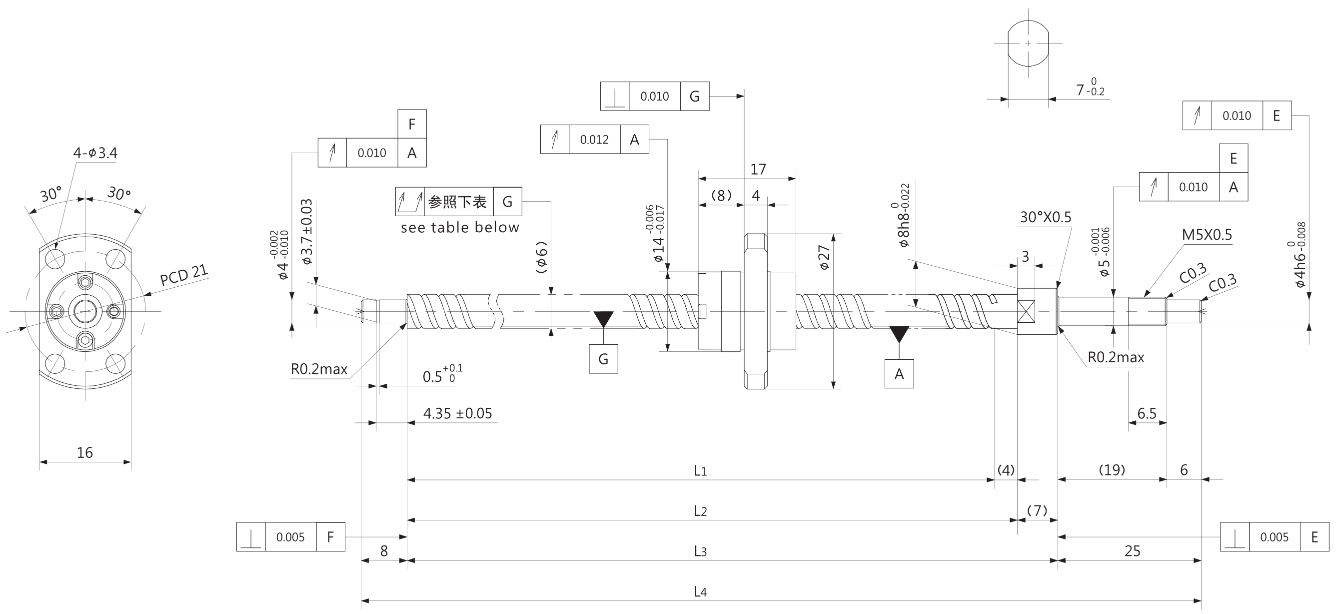
Ball Screw Specifications 主要技术参数				
Ball size 钢珠直径	ф1.0	BCD 钢珠中心直径		6.20
Lead Angle 导程角	5°52´	Number of thread 螺纹条数		1
Thread direction 螺纹旋向	Right 右旋	Shaft root dia 丝杠轴底径		ф5.1
Number of circuit 循环数	1×3	Material 材质	Shaft 轴	S55C
			Nut 螺母	SCM415H
Surface hardness 螺纹部表面硬度	HRC58～62（Thread area）	Anti-rust treatment 防锈处理		Anti-rust oil 防锈油

Unit(单位):mm

Ball Screw Model 滚珠丝杠型号	Travel 行程	Shaft length 丝杠轴长度				Lead accuracy 导程精度		Total Run-out 全跳动	Axial play 轴向间隙	Preload Torque 预压扭矩 Nm	Basic Load Rating 基本额定负载 N	
		L1	L2	L3	L4	Travel deviation 代表移动量误差 e_p	Variation 波动 V_{300}				Dynamic 额定动负载 Ca	Static 额定静负载 Coa
GNK0602-3G0+168LC3Y	105	125	128	135	168	±0.010	0.008	0.035	0	~0.015	750	1200

Note）Please designate end-journal profile with your sketch.　注）轴端的追加加工请结合图纸进行指示。

GNK0606 | Shaft dia.(轴径)φ6 Lead(导程)6mm | C5



Unit(单位):mm

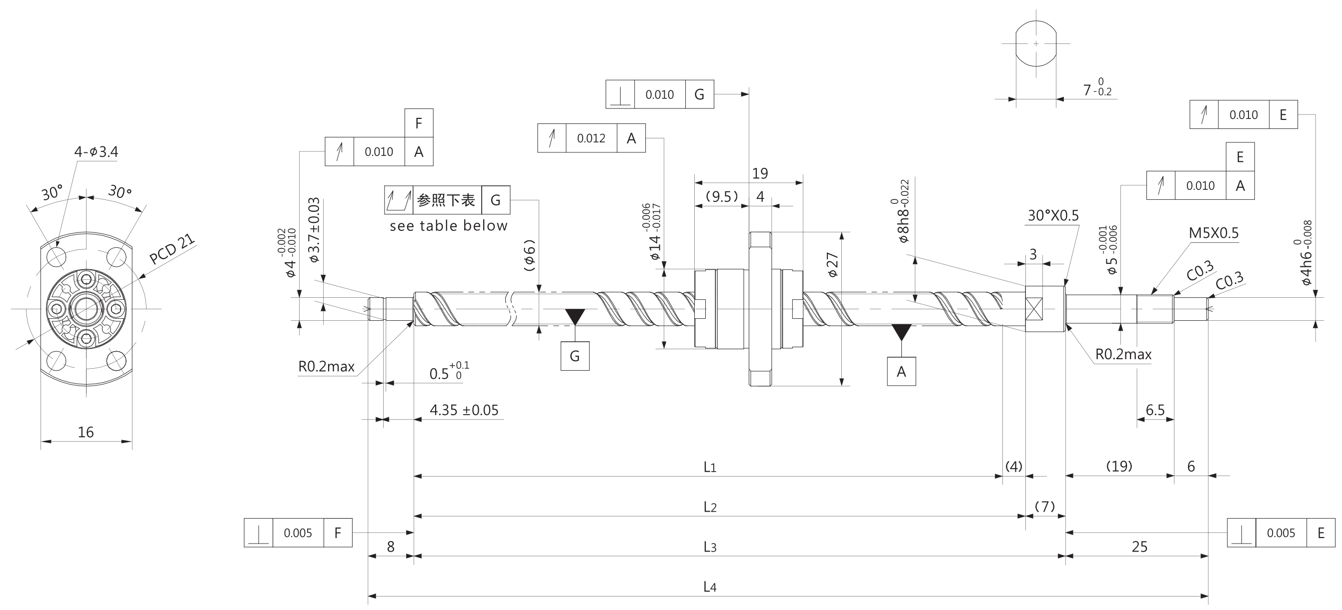
Ball Screw Specifications 主要技术参数				
Ball size 钢珠直径	φ1.0	BCD 钢珠中心直径		6.30
Lead Angle 导程角	16°50′	Number of thread 螺纹条数		2
Thread direction 螺纹旋向	Right 右旋	Shaft root dia 丝杠轴底径		φ5.2
Number of circuit 循环数	1.6×2	Material 材质	Shaft 轴	S55C
			Nut 螺母	SCM415H
Surface hardness 螺纹部表面硬度	HRC58～62（Thread area）	Anti-rust treatment 防锈处理		Anti-rust oil 防锈油

Unit(单位):mm

Ball Screw Model 滚珠丝杠型号	Travel 行程	Shaft length 丝杠轴长度 L1	L2	L3	L4	Lead accuracy 导程精度 Travel deviation 代表移动量误差 ep	Variation 波动 V300	Total Run-out 全跳动	Axial play 轴向间隙	Preload Torque 预压扭矩 Nm	Basic Load Rating 基本额定负载 N Dynamic 额定动负载 Ca	Static 额定静负载 Coa
GNK0606-3G0+168LC5Y	100	124	128	135	168	±0.020	0.018	0.050	~0.005	-	870	1450

Note）Please designate end-journal profile with your sketch. 注）轴端的追加加工请结合图纸进行指示。

GNK0610 | Shaft dia.(轴径)φ6 Lead(导程)10mm | C5



Unit(单位):mm

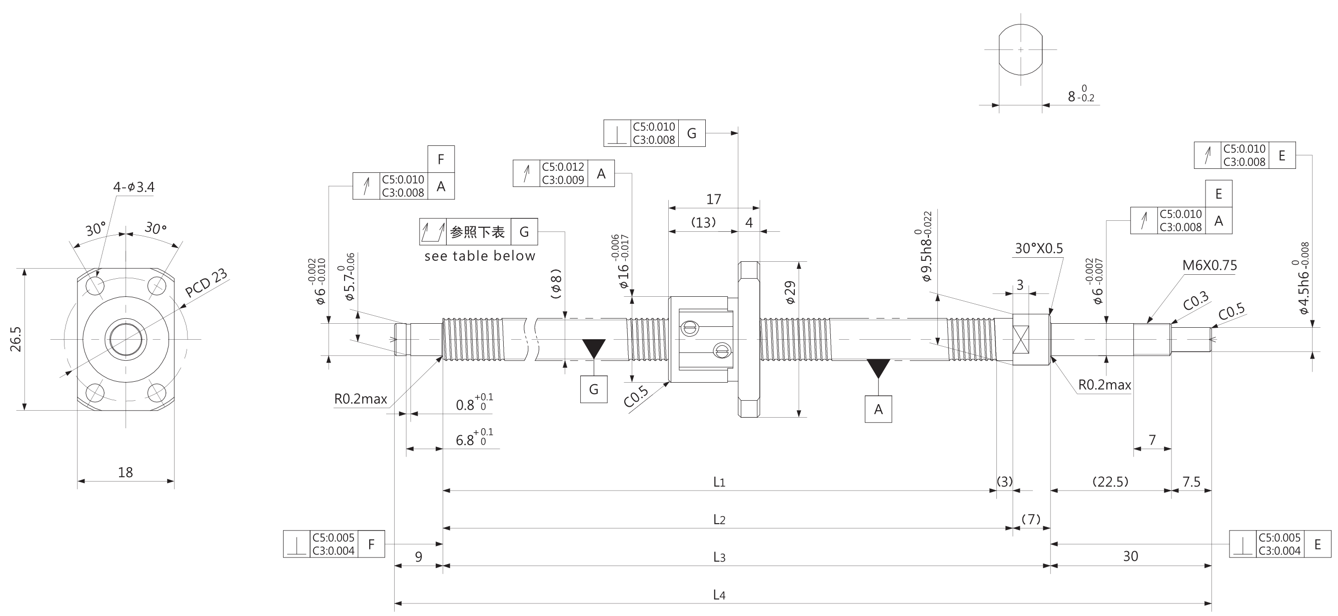
Ball Screw Specifications 主要技术参数				
Ball size 钢珠直径	φ1.2	BCD 钢珠中心直径		6.30
Lead Angle 导程角	26°48′	Number of thread 螺纹条数		2
Thread direction 螺纹旋向	Right 右旋	Shaft root dia 丝杠轴底径		φ5.0
Number of circuit 循环数	1.2×2	Material 材质	Shaft 轴	S55C
			Nut 螺母	SCM415H
Surface hardness 螺纹部表面硬度	HRC58～62（Thread area）	Anti-rust treatment 防锈处理		Anti-rust oil 防锈油

Unit(单位):mm

Ball Screw Model 滚珠丝杠型号	Travel 行程	Shaft length 丝杠轴长度 L1	L2	L3	L4	Lead accuracy 导程精度 Travel deviation 代表移动量误差 ep	Variation 波动 V300	Total Run-out 全跳动	Axial play 轴向间隙	Preload Torque 预压扭矩 Nm	Basic Load Rating 基本额定负载 N Dynamic 额定动负载 Ca	Static 额定静负载 Coa
GNK0610-3G0+168LC5Y	95	124	128	135	168	±0.020	0.018	0.050	~0.005	-	950	1600

Note）Please designate end-journal profile with your sketch. 注）轴端的追加加工请结合图纸进行指示。

GNK0801 | Shaft dia.(轴径)ϕ8 Lead(导程)1mm | C3 |



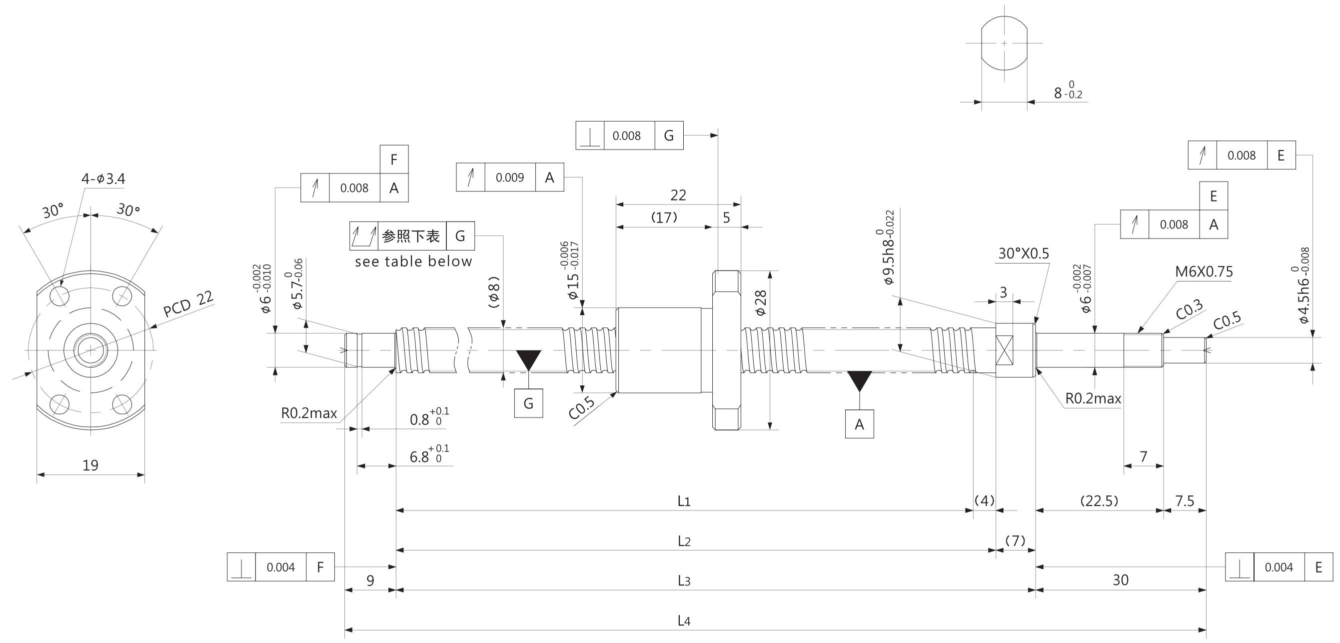
Ball Screw Specifications 主要技术参数				
Ball size 钢珠直径	ϕ0.8	BCD 钢珠中心直径		8.15
Lead Angle 导程角	2°15´	Number of thread 螺纹条数		1
Thread direction 螺纹旋向	Right 右旋	Shaft root dia 丝杠轴底径		ϕ7.3
Number of circuit 循环数	1×3	Material 材质	Shaft 轴	S55C
			Nut 螺母	SCM415H
Surface hardness 螺纹部表面硬度	HRC58～62（Thread area）	Anti-rust treatment 防锈处理		Anti-rust oil 防锈油

Unit(单位):mm

Ball Screw Model 滚珠丝杠型号	Travel 行程	Shaft length 丝杠轴长度 L1	L2	L3	L4	Lead accuracy 导程精度 Travel deviation 代表移动量误差 ep	Variation 波动 V_{300}	Total Run-out 全跳动	Axial play 轴向间隙	Preload Torque 预压扭矩 Nm	Basic Load Rating 基本额定负载 N Dynamic 额定动负载 Ca	Static 额定静负载 Coa
GNK0801-3G0+115LC3Y	45	66	69	76	115	±0.008	0.008	0.025	0	~0.018	650	1300
GNK0801-3G0+145LC3Y	75	96	99	106	145	±0.008		0.035				
GNK0801-3G0+175LC3Y	105	126	129	136	175	±0.010		0.035				
GNK0801-3G0+225LC3Y	155	176	179	186	225	±0.010		0.050				

Note）Please designate end-journal profile with your sketch.　注）轴端的追加加工请结合图纸进行指示。

GNK0802 | Shaft dia.(轴径)ϕ8 Lead(导程)2mm | C3 |



Unit(单位):mm

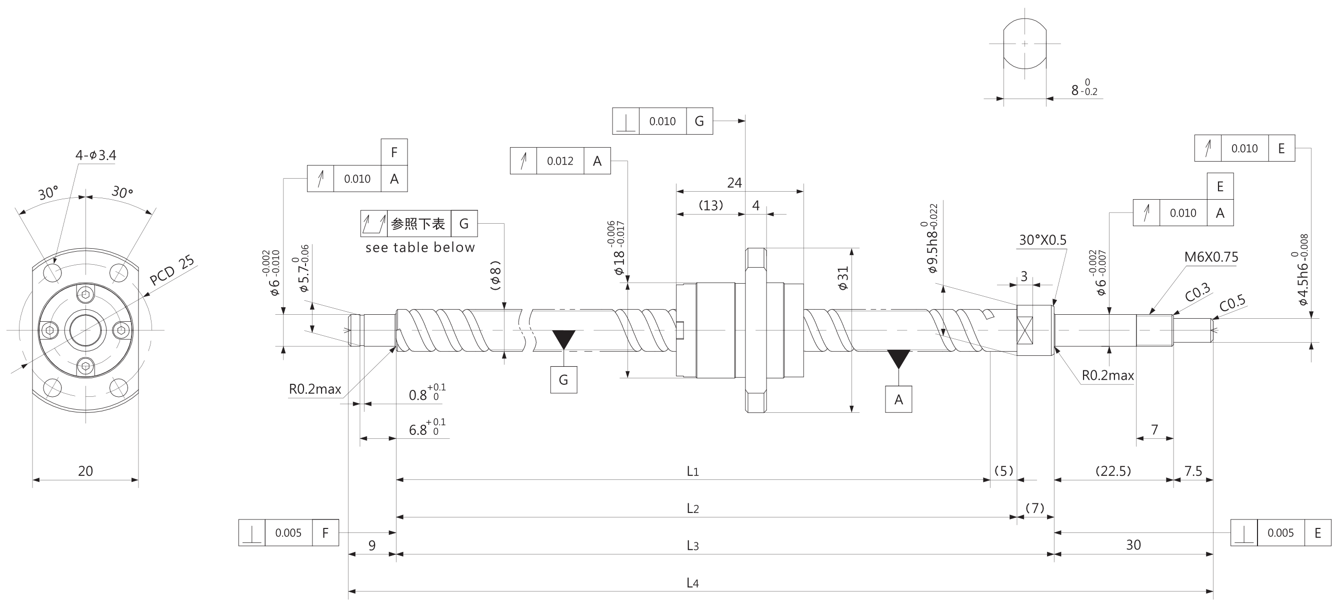
Ball Screw Specifications 主要技术参数				
Ball size 钢珠直径	ϕ1.2	BCD 钢珠中心直径		8.30
Lead Angle 导程角	4°23´	Number of thread 螺纹条数		1
Thread direction 螺纹旋向	Right 右旋	Shaft root dia 丝杠轴底径		ϕ7.0
Number of circuit 循环数	1×3	Material 材质	Shaft 轴	S55C
			Nut 螺母	SCM415H
Surface hardness 螺纹部表面硬度	HRC58～62（Thread area）	Anti-rust treatment 防锈处理		Anti-rust oil 防锈油

Unit(单位):mm

Ball Screw Model 滚珠丝杠型号	Travel 行程	Shaft length 丝杠轴长度 L1	L2	L3	L4	Lead accuracy 导程精度 Travel deviation 代表移动量误差 ep	Variation 波动 V_{300}	Total Run-out 全跳动	Axial play 轴向间隙	Preload Torque 预压扭矩 Nm	Basic Load Rating 基本额定负载 N Dynamic 额定动负载 Ca	Static 额定静负载 Coa
GNK0802-3RRG0+125LC3Y	50	75	79	86	125	±0.008	0.008	0.025	0	~0.020	1300	2300
GNK0802-3RRG0+155LC3Y	80	105	109	116	155	±0.010		0.035				
GNK0802-3RRG0+185LC3Y	110	135	139	146	185	±0.010		0.035				
GNK0802-3RRG0+235LC3Y	160	185	189	196	235	±0.010		0.050				

Note）Please designate end-journal profile with your sketch.　注）轴端的追加加工请结合图纸进行指示。

GNK0810 | Shaft dia.(轴径)φ8 Lead(导程)10mm | C5 |



Unit(单位):mm

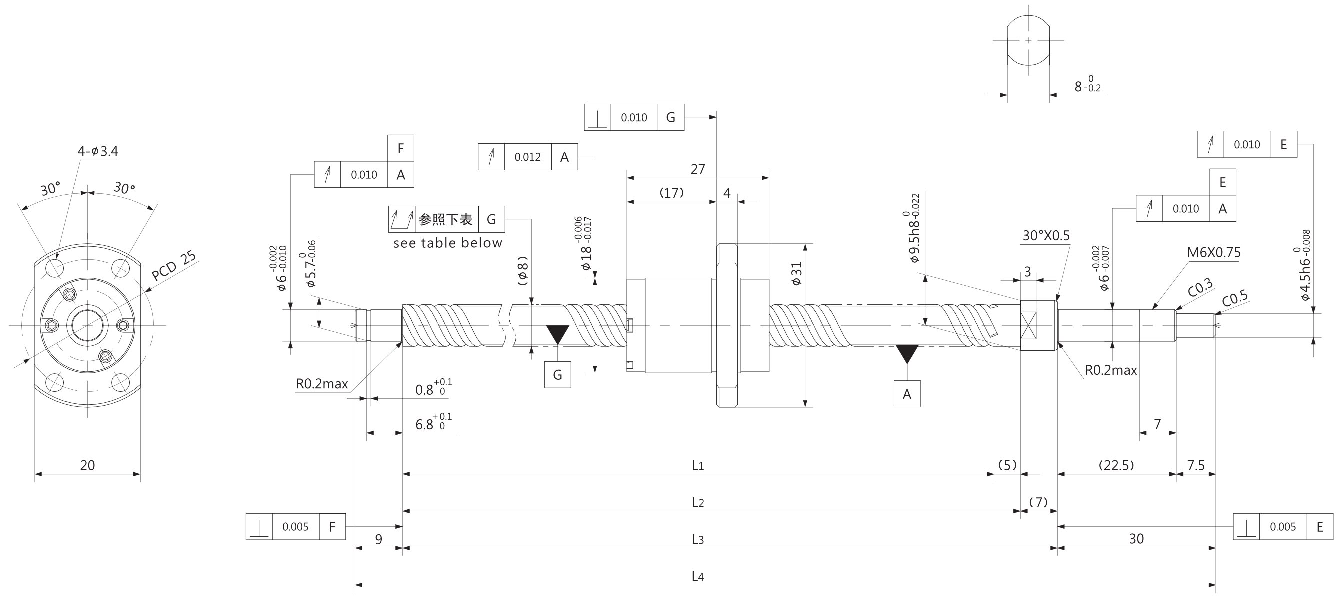
Ball Screw Specifications 主要技术参数			
Ball size 钢珠直径	φ1.5875	BCD 钢珠中心直径	8.40
Lead Angle 导程角	20°45´	Number of thread 螺纹条数	2
Thread direction 螺纹旋向	Right 右旋	Shaft root dia 丝杠轴底径	φ6.7
Number of circuit 循环数	1.6×2	Material 材质 Shaft 轴	S55C
		Material 材质 Nut 螺母	SCM415H
Surface hardness 螺纹部表面硬度	HRC58~62（Thread area）	Anti-rust treatment 防锈处理	Anti-rust oil 防锈油

Unit(单位):mm

Ball Screw Model 滚珠丝杠型号	Travel 行程	Shaft length 丝杠轴长度 L1	L2	L3	L4	Lead accuracy 导程精度 Travel deviation 代表移动量误差 e_p	Variation 波动 V_{300}	Total Run-out 全跳动	Axial play 轴向间隙	Preload Torque 预压扭矩 Nm	Basic Load Rating 基本额定负载 N Dynamic 额定动负载 Ca	Static 额定静负载 Coa
GNK0810-3GT+205LC5Y	125	154	159	166	205	±0.020	0.018	0.065	~0.005	-	2200	3800
GNK0810-3GT+305LC5Y	225	354	259	266	305	±0.023		0.065				
GNK0810-3GT+405LC5Y	325	354	359	366	405	±0.025		0.075				

Note）Please designate end-journal profile with your sketch. 注）轴端的追加加工请结合图纸进行指示。

GNK0812 | Shaft dia.(轴径)φ8 Lead(导程)12mm | C5 |



Unit(单位):mm

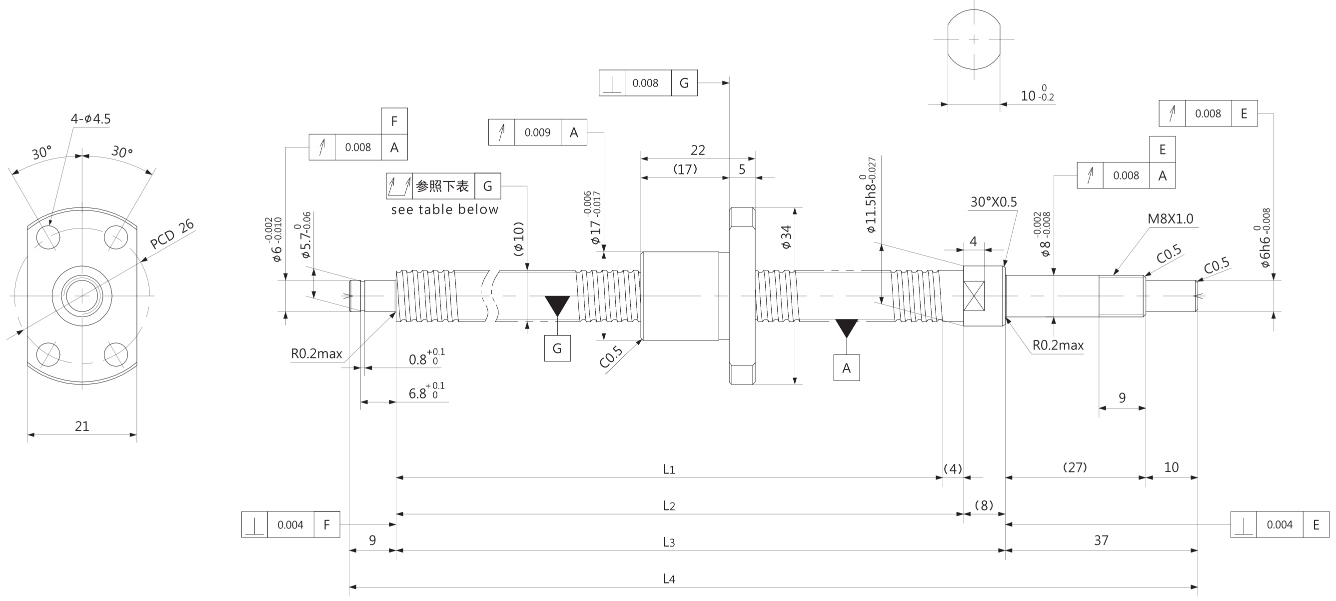
Ball Screw Specifications 主要技术参数			
Ball size 钢珠直径	φ1.5875	BCD 钢珠中心直径	8.40
Lead Angle 导程角	24°27´	Number of thread 螺纹条数	2
Thread direction 螺纹旋向	Right 右旋	Shaft root dia 丝杠轴底径	φ6.7
Number of circuit 循环数	1.6×2	Material 材质 Shaft 轴	S55C
		Material 材质 Nut 螺母	SCM415H
Surface hardness 螺纹部表面硬度	HRC58~62（Thread area）	Anti-rust treatment 防锈处理	Anti-rust oil 防锈油

Unit(单位):mm

Ball Screw Model 滚珠丝杠型号	Travel 行程	Shaft length 丝杠轴长度 L1	L2	L3	L4	Lead accuracy 导程精度 Travel deviation 代表移动量误差 e_p	Variation 波动 V_{300}	Total Run-out 全跳动	Axial play 轴向间隙	Preload Torque 预压扭矩 Nm	Basic Load Rating 基本额定负载 N Dynamic 额定动负载 Ca	Static 额定静负载 Coa
GNK0812-3GT+405LC5Y	325	354	359	366	405	±0.025	0.018	0.075	~0.005	-	2200	3800

Note）Please designate end-journal profile with your sketch. 注）轴端的追加加工请结合图纸进行指示。

GNK1002 | Shaft dia.(轴径)ϕ10 Lead(导程)2mm | C3 |



Unit(单位):mm

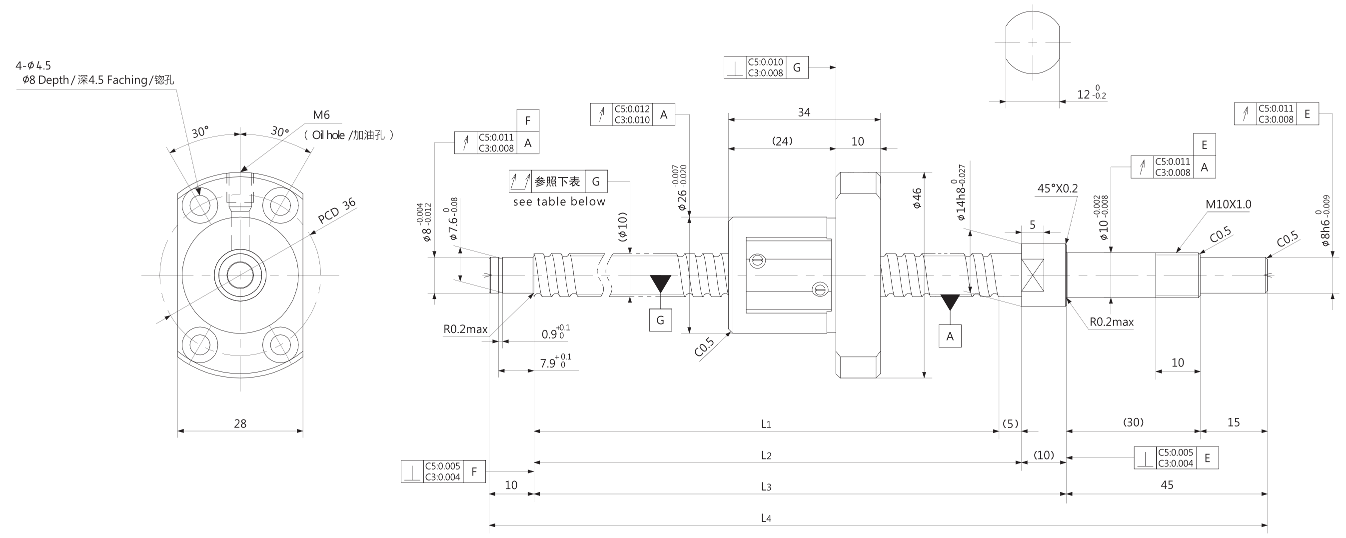
Ball Screw Specifications 主要技术参数			
Ball size 钢珠直径	ϕ1.2	BCD 钢珠中心直径	10.30
Lead Angle 导程角	3°32´	Number of thread 螺纹条数	1
Thread direction 螺纹旋向	Right 右旋	Shaft root dia 丝杠轴底径	ϕ9.0
Number of circuit 循环数	3×1	Material 材质 Shaft 轴	S55C
		Material 材质 Nut 螺母	SCM415H
Surface hardness 螺纹部表面硬度	HRC58～62（Thread area）	Anti-rust treatment 防锈处理	Anti-rust oil 防锈油

Unit(单位):mm

Ball Screw Model 滚珠丝杠型号	Travel 行程	Shaft length 丝杠轴长度				Lead accuracy 导程精度		Total Run-out 全跳动	Axial play 轴向间隙	Preload Torque 预压扭矩 Nm	Basic Load Rating 基本额定负载 N	
		L_1	L_2	L_3	L_4	Travel deviation 代表移动量误差 e_p	Variation 波动 V_{300}				Dynamic 额定动负载 Ca	Static 额定静负载 Coa
GNK1002-3RRG0+143LC3Y	60	85	89	97	143	±0.008	0.008	0.035	0	~0.025	1450	3000
GNK1002-3RRG0+193LC3Y	110	135	139	147	193	±0.010		0.035				
GNK1002-3RRG0+243LC3Y	160	185	189	197	243	±0.010		0.050				
GNK1002-3RRG0+293LC3Y	210	235	239	247	293	±0.012		0.050				

Note）Please designate end-journal profile with your sketch.　注）轴端的追加加工请结合图纸进行指示。

GNK1004 | Shaft dia.(轴径)ϕ10 Lead(导程)4mm | C3 |



Unit(单位):mm

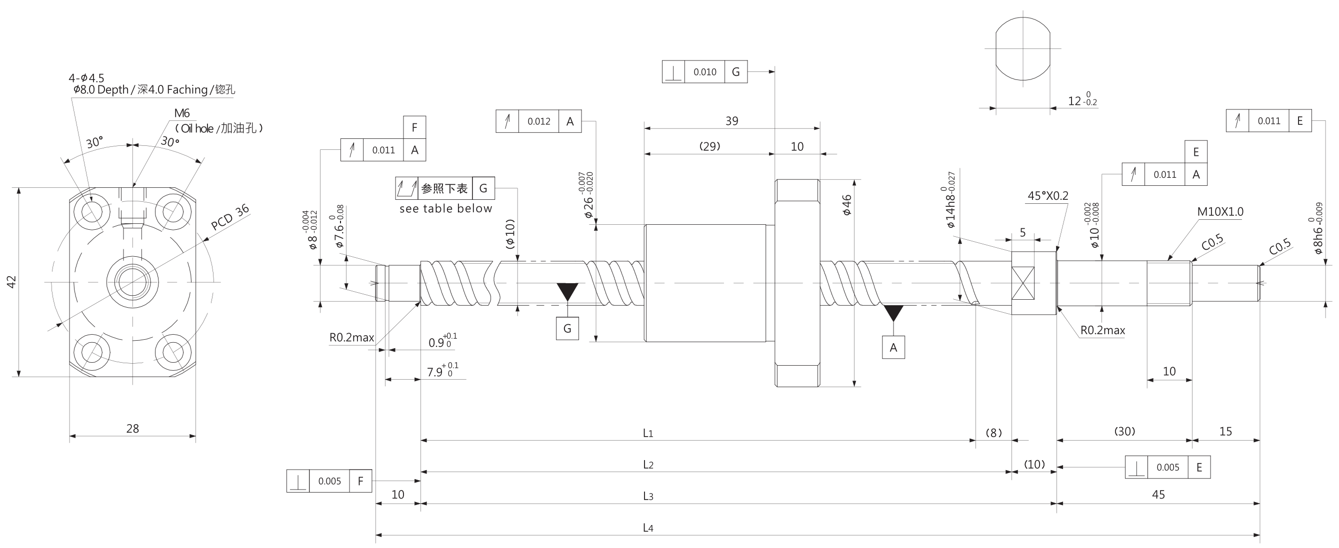
Ball Screw Specifications 主要技术参数			
Ball size 钢珠直径	ϕ2.0	BCD 钢珠中心直径	10.30
Lead Angle 导程角	7°03´	Number of thread 螺纹条数	1
Thread direction 螺纹旋向	Right 右旋	Shaft root dia 丝杠轴底径	ϕ8.2
Number of circuit 循环数	2.7×1	Material 材质 Shaft 轴	S55C
		Material 材质 Nut 螺母	SCM415H
Surface hardness 螺纹部表面硬度	HRC58～62（Thread area）	Anti-rust treatment 防锈处理	Anti-rust oil 防锈油

Unit(单位):mm

Ball Screw Model 滚珠丝杠型号	Travel 行程	Shaft length 丝杠轴长度				Lead accuracy 导程精度		Total Run-out 全跳动	Axial play 轴向间隙	Preload Torque 预压扭矩 Nm	Basic Load Rating 基本额定负载 N	
		L_1	L_2	L_3	L_4	Travel deviation 代表移动量误差 e_p	Variation 波动 V_{300}				Dynamic 额定动负载 Ca	Static 额定静负载 Coa
GNK1004-2.5RRG0+180LC3Y	70	110	115	125	180	±0.010	0.008	0.035	0 Spacer ball 间隔钢珠 (1:1)	0.005~0.040	1800	2600
GNK1004-2.5RRG0+280LC3Y	170	210	215	225	280	±0.012		0.040				
GNK1004-2.5RRG0+380LC3Y	270	310	315	325	380	±0.012		0.050				

Note）Please designate end-journal profile with your sketch.　注）轴端的追加加工请结合图纸进行指示。

GNK1010 | Shaft dia.(轴径)ϕ10 Lead(导程)10mm | C5



Unit(单位):mm

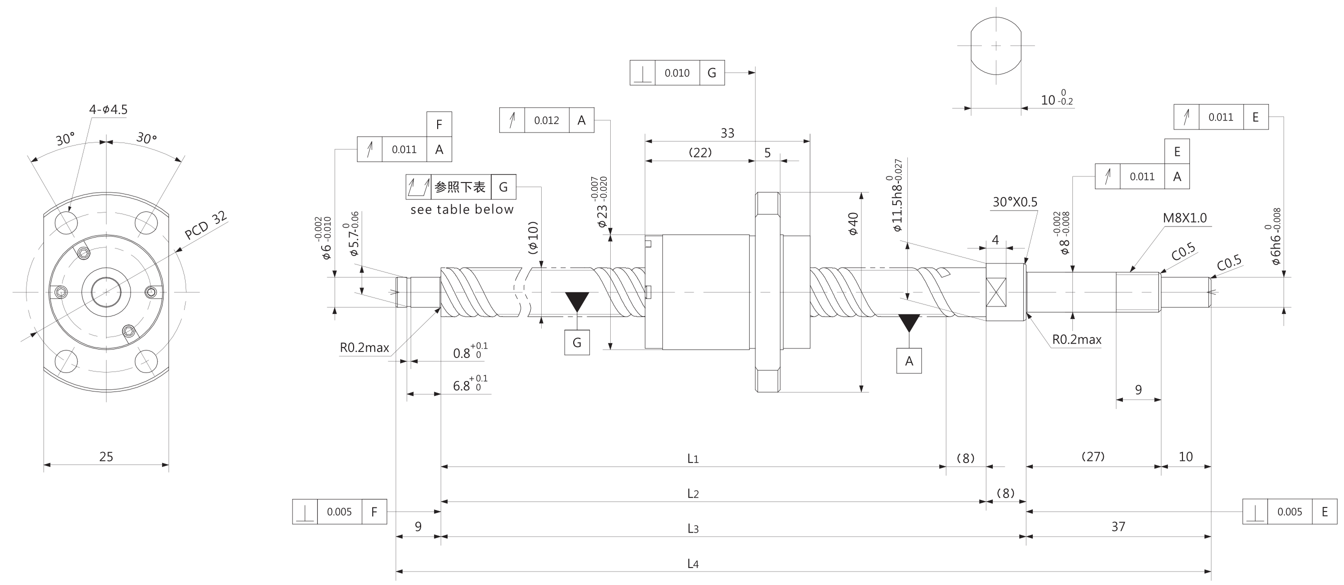
Ball Screw Specifications 主要技术参数				
Ball size 钢珠直径	ϕ2.0	BCD 钢珠中心直径		10.50
Lead Angle 导程角	16°52´	Number of thread 螺纹条数		2
Thread direction 螺纹旋向	Right 右旋	Shaft root dia 丝杠轴底径		ϕ8.4
Number of circuit 循环数	1.6×2	Material 材质	Shaft 轴	S55C
			Nut 螺母	SCM415H
Surface hardness 螺纹部表面硬度	HRC58～62（Thread area）	Anti-rust treatment 防锈处理		Anti-rust oil 防锈油

Unit(单位):mm

Ball Screw Model 滚珠丝杠型号	Travel 行程	Shaft length 丝杠轴长度 L1	L2	L3	L4	Lead accuracy 导程精度 Travel deviation 代表移动量误差 ep	Variation 波动 V300	Total Run-out 全跳动	Axial play 轴向间隙	Preload Torque 预压扭矩 Nm	Basic Load Rating 基本额定负载 N Dynamic 额定动负载 Ca	Static 额定静负载 Coa
GNK1010-1.5RRG0+240LC5Y	125	167	175	185	240	±0.020	0.018	0.055	~0.005	-	3300	5900
GNK1010-1.5RRG0+340LC5Y	225	267	275	285	340	±0.023		0.065				
GNK1010-1.5RRG0+440LC5Y	325	367	375	385	440	±0.025		0.080				

Note）Please designate end-journal profile with your sketch. 注）轴端的追加加工请结合图纸进行指示。

GNK1015 | Shaft dia.(轴径)ϕ10 Lead(导程)15mm | C5



Unit(单位):mm

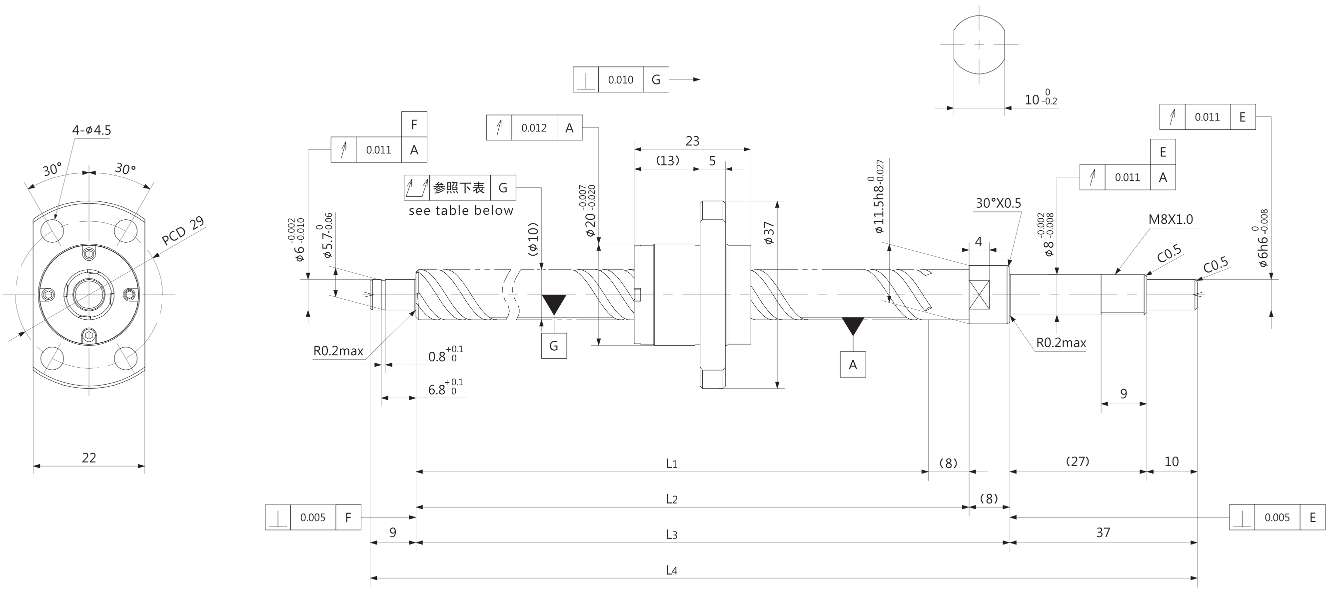
Ball Screw Specifications 主要技术参数				
Ball size 钢珠直径	ϕ2.0	BCD 钢珠中心直径		10.40
Lead Angle 导程角	24°27´	Number of thread 螺纹条数		2
Thread direction 螺纹旋向	Right 右旋	Shaft root dia 丝杠轴底径		ϕ8.4
Number of circuit 循环数	1.6×2	Material 材质	Shaft 轴	S55C
			Nut 螺母	SCM415H
Surface hardness 螺纹部表面硬度	HRC58～62（Thread area）	Anti-rust treatment 防锈处理		Anti-rust oil 防锈油

Unit(单位):mm

Ball Screw Model 滚珠丝杠型号	Travel 行程	Shaft length 丝杠轴长度 L1	L2	L3	L4	Lead accuracy 导程精度 Travel deviation 代表移动量误差 ep	Variation 波动 V300	Total Run-out 全跳动	Axial play 轴向间隙	Preload Torque 预压扭矩 Nm	Basic Load Rating 基本额定负载 N Dynamic 额定动负载 Ca	Static 额定静负载 Coa
GNK1015-1.5RRG0+431LC5Y	330	369	377	385	431	±0.025	0.018	0.080	~0.005	-	3300	6400

Note）Please designate end-journal profile with your sketch. 注）轴端的追加加工请结合图纸进行指示。

GNK1020 | Shaft dia.(轴径)φ10 Lead(导程)20mm | C5



Unit(单位):mm

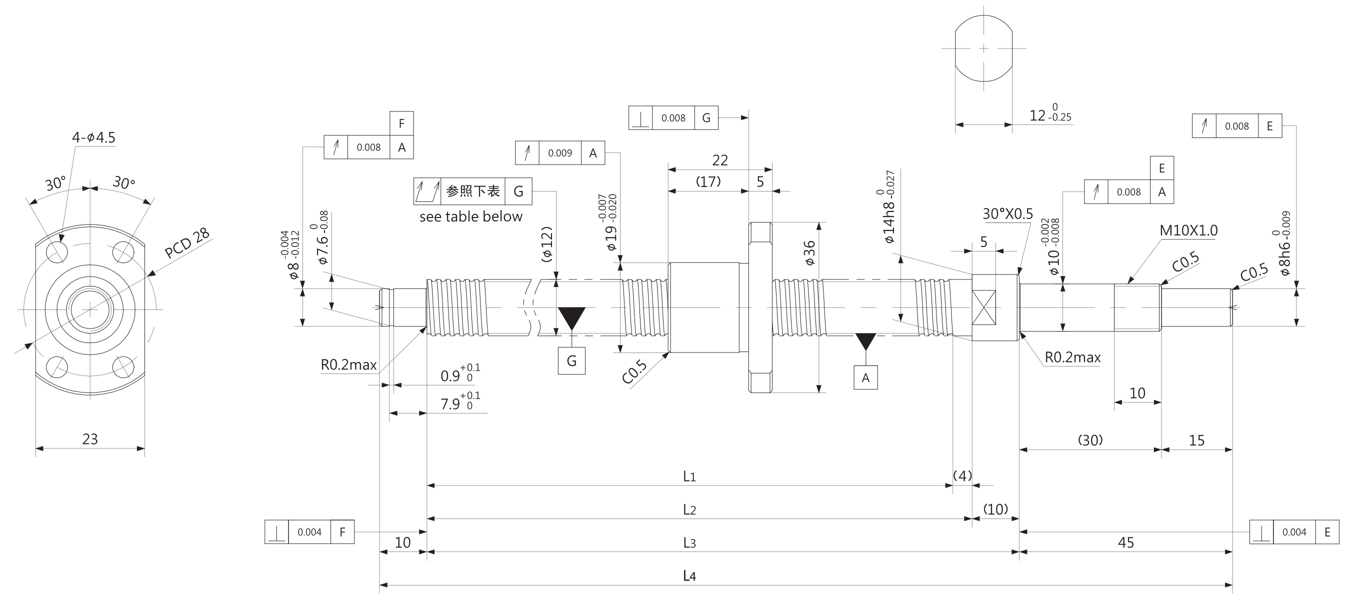
Ball Screw Specifications 主要技术参数			
Ball size 钢珠直径	φ1.5875	BCD 钢珠中心直径	10.40
Lead Angle 导程角	31°28´	Number of thread 螺纹条数	4
Thread direction 螺纹旋向	Right 右旋	Shaft root dia 丝杠轴底径	φ8.4
Number of circuit 循环数	0.7×4	Material 材质 Shaft 轴	S55C
		Material 材质 Nut 螺母	SCM415H
Surface hardness 螺纹部表面硬度	HRC58~62（Thread area）	Anti-rust treatment 防锈处理	Anti-rust oil 防锈油

Unit(单位):mm

Ball Screw Model 滚珠丝杠型号	Travel 行程	Shaft length 丝杠轴长度 L1	L2	L3	L4	Lead accuracy 导程精度 Travel deviation 代表移动量误差 e_p	Variation 波动 V_{300}	Total Run-out 全跳动	Axial play 轴向间隙	Preload Torque 预压扭矩 Nm	Basic Load Rating 基本额定负载 N Dynamic 额定动负载 Ca	Static 额定静负载 Coa
GNK1020-1.5RRG0+431LC5Y	340	369	377	385	431	±0.025	0.018	0.080	~0.005	-	2100	4000

Note）Please designate end-journal profile with your sketch. 注）轴端的追加加工请结合图纸进行指示。

GNK1202 | Shaft dia.(轴径)φ12 Lead(导程)2mm | C3



Unit(单位):mm

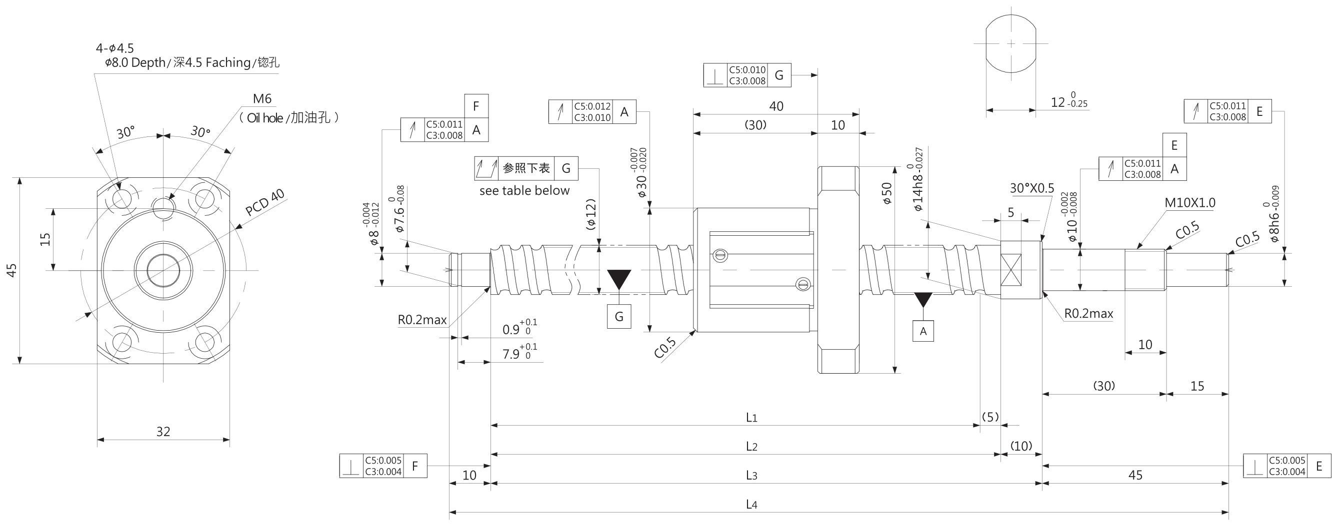
Ball Screw Specifications 主要技术参数			
Ball size 钢珠直径	φ1.2	BCD 钢珠中心直径	12.30
Lead Angle 导程角	2°58´	Number of thread 螺纹条数	1
Thread direction 螺纹旋向	Right 右旋	Shaft root dia 丝杠轴底径	φ11.0
Number of circuit 循环数	1×3	Material 材质 Shaft 轴	S55C
		Material 材质 Nut 螺母	SCM415H
Surface hardness 螺纹部表面硬度	HRC58~62（Thread area）	Anti-rust treatment 防锈处理	Anti-rust oil 防锈油

Unit(单位):mm

Ball Screw Model 滚珠丝杠型号	Travel 行程	Shaft length 丝杠轴长度 L1	L2	L3	L4	Lead accuracy 导程精度 Travel deviation 代表移动量误差 e_p	Variation 波动 V_{300}	Total Run-out 全跳动	Axial play 轴向间隙	Preload Torque 预压扭矩 Nm	Basic Load Rating 基本额定负载 N Dynamic 额定动负载 Ca	Static 额定静负载 Coa
GNK1202-3RRG0+154LC3Y	60	85	89	99	154	±0.008	0.008	0.035	0	~0.005	1600	3700
GNK1202-3RRG0+254LC3Y	160	185	186	199	254	±0.010		0.040				
GNK1202-3RRG0+354LC3Y	260	285	289	299	354	±0.012		0.050				

Note）Please designate end-journal profile with your sketch. 注）轴端的追加加工请结合图纸进行指示。

GNK1205 | Shaft dia.(轴径)ϕ12 Lead(导程)5mm | C3



Unit(单位):mm

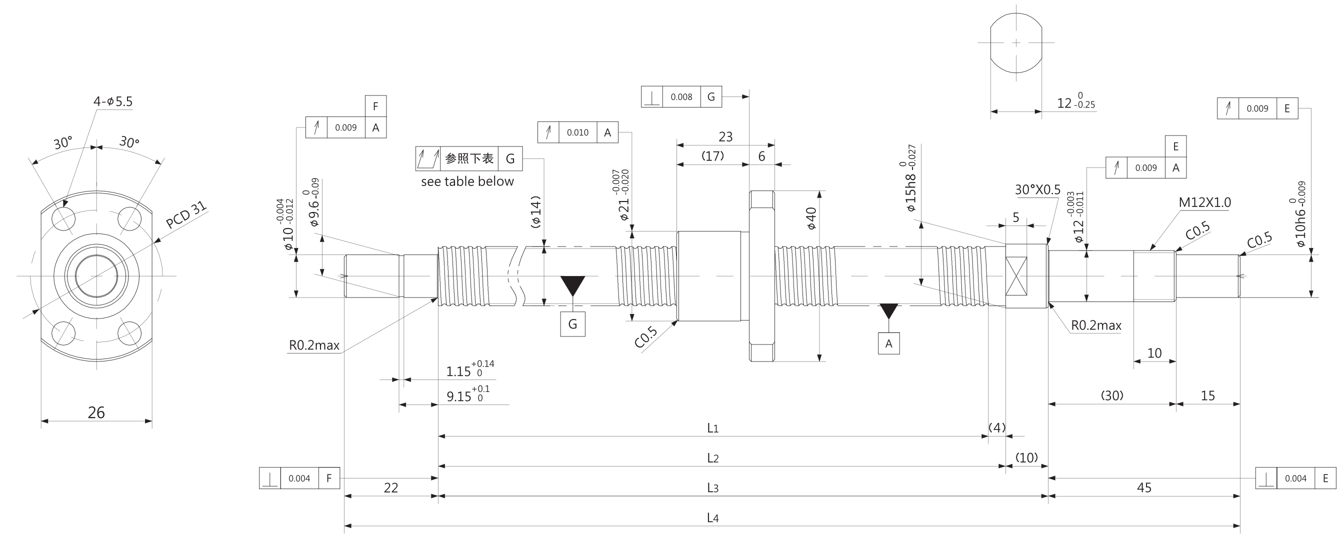
Ball Screw Specifications 主要技术参数				
Ball size 钢珠直径	ϕ3.175	BCD 钢珠中心直径		12.50
Lead Angle 导程角	7°15´	Number of thread 螺纹条数		1
Thread direction 螺纹旋向	Right 右旋	Shaft root dia 丝杠轴底径		ϕ9.6
Number of circuit 循环数	2.7×1	Material 材质	Shaft 轴	S55C
			Nut 螺母	SCM415H
Surface hardness 螺纹部表面硬度	HRC58~62（Thread area）	Anti-rust treatment 防锈处理		Anti-rust oil 防锈油

Unit(单位):mm

Ball Screw Model 滚珠丝杠型号	Travel 行程	Shaft length 丝杠轴长度				Lead accuracy 导程精度		Total Run-out 全跳动	Axial play 轴向间隙	Preload Torque 预压扭矩 Nm	Basic Load Rating 基本额定负载 N	
		L_1	L_2	L_3	L_4	Travel deviation 代表移动量误差 e_p	Variation 波动 V_{300}				Dynamic 额定动负载 Ca	Static 额定静负载 Coa
GNK1205-2.5RRG0+180LC3Y	65	110	115	125	180	±0.010	0.008	0.035	0	0.005~0.050	4100	7000
GNK1205-2.5RRG0+280LC3Y	165	210	215	225	280	±0.012		0.040				
GNK1205-2.5RRG0+380LC3Y	265	310	315	325	380	±0.012		0.050				

Note）Please designate end-journal profile with your sketch. 注）轴端的追加加工请结合图纸进行指示。

GNK1402 | Shaft dia.(轴径)ϕ14 Lead(导程)2mm | C3



Unit(单位):mm

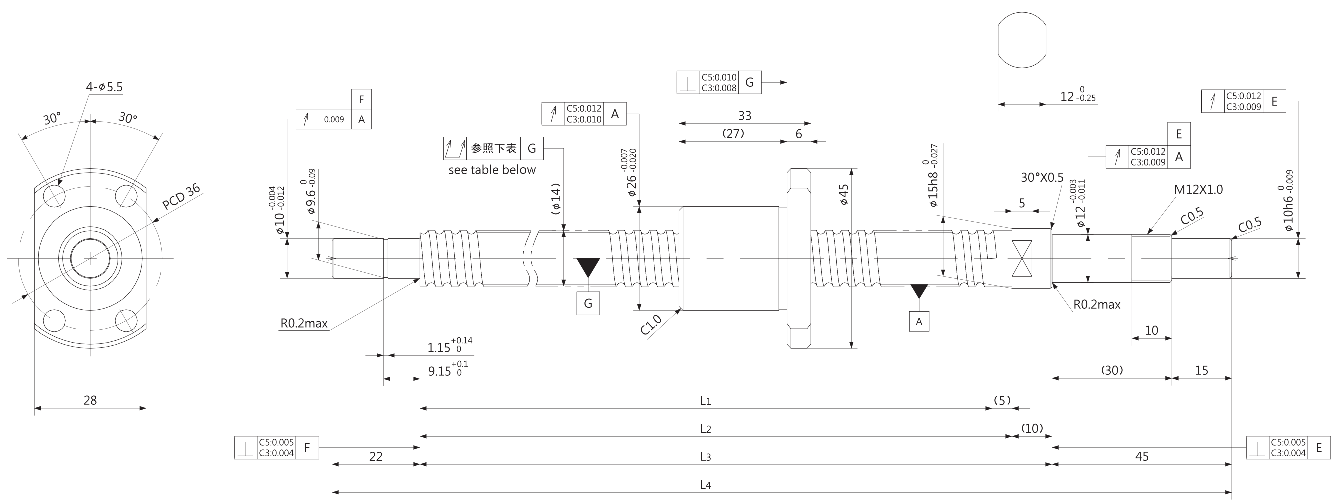
Ball Screw Specifications 主要技术参数				
Ball size 钢珠直径	ϕ1.2	BCD 钢珠中心直径		14.41
Lead Angle 导程角	2°32´	Number of thread 螺纹条数		1
Thread direction 螺纹旋向	Right 右旋	Shaft root dia 丝杠轴底径		ϕ13.0
Number of circuit 循环数	3×1	Material 材质	Shaft 轴	S55C
			Nut 螺母	SCM415H
Surface hardness 螺纹部表面硬度	HRC58~62（Thread area）	Anti-rust treatment 防锈处理		Anti-rust oil 防锈油

Unit(单位):mm

Ball Screw Model 滚珠丝杠型号	Travel 行程	Shaft length 丝杠轴长度				Lead accuracy 导程精度		Total Run-out 全跳动	Axial play 轴向间隙	Preload Torque 预压扭矩 Nm	Basic Load Rating 基本额定负载 N	
		L_1	L_2	L_3	L_4	Travel deviation 代表移动量误差 e_p	Variation 波动 V_{300}				Dynamic 额定动负载 Ca	Static 额定静负载 Coa
GNK1402-3RRG0+166LC3Y	60	85	89	99	166	±0.008	0.008	0.025	0	~0.040	1800	4300
GNK1402-3RRG0+266LC3Y	160	185	189	199	266	±0.010		0.030				
GNK1402-3RRG0+406LC3Y	300	325	329	399	406	±0.013		0.050				

Note）Please designate end-journal profile with your sketch. 注）轴端的追加加工请结合图纸进行指示。

GNK1404 | Shaft dia.(轴径)ϕ14 Lead(导程)4mm | C3 |



Unit(单位):mm

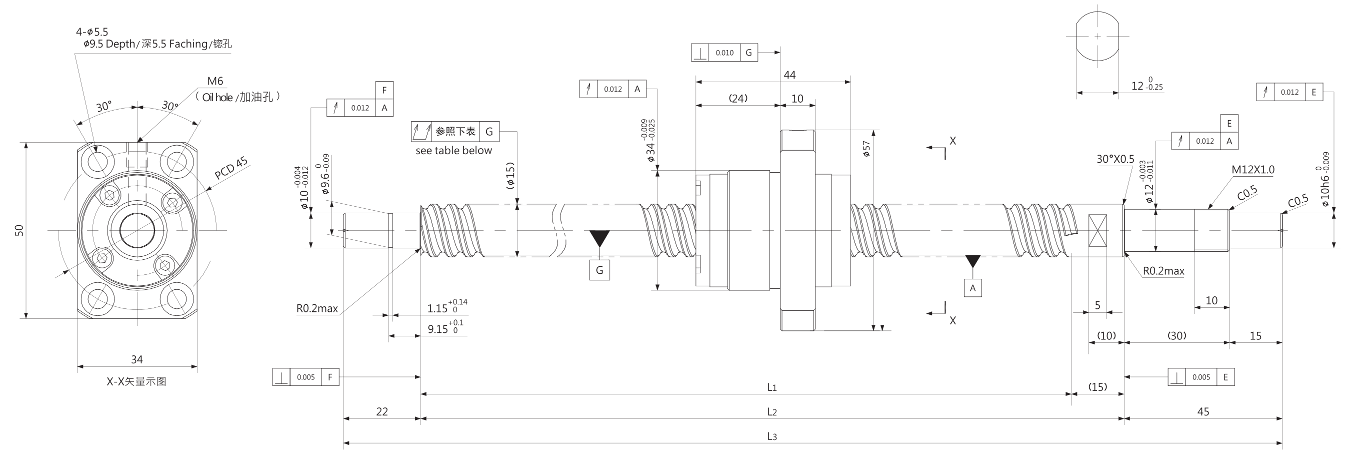
Ball Screw Specifications 主要技术参数				
Ball size 钢珠直径	ϕ2.381	BCD 钢珠中心直径		14.30
Lead Angle 导程角	5°50´	Number of thread 螺纹条数		1
Thread direction 螺纹旋向	Right 右旋	Shaft root dia 丝杠轴底径		ϕ12.2
Number of circuit 循环数	3.8×1	Material 材质	Shaft 轴	S55C
			Nut 螺母	SCM415H
Surface hardness 螺纹部表面硬度	HRC58～62（Thread area）	Anti-rust treatment 防锈处理		Anti-rust oil 防锈油

Unit(单位):mm

Ball Screw Model 滚珠丝杠型号	Travel 行程	Shaft length 丝杠轴长度 L1	L2	L3	L4	Lead accuracy 导程精度 Travel deviation 代表移动量误差 ep	Variation 波动 V300	Total Run-out 全跳动	Axial play 轴向间隙	Preload Torque 预压扭矩 Nm	Basic Load Rating 基本额定负载 N Dynamic 额定动负载 Ca	Static 额定静负载 Coa
GNK1404-3RRG0+230LC3Y	110	148	153	163	230	±0.010	0.008	0.030	0	0.020~0.070	5800	11900
GNK1404-3RRG0+330LC3Y	210	248	253	263	330	±0.012		0.040				
GNK1404-3RRG0+530LC3Y	410	448	453	463	530	±0.015		0.055				

Note）Please designate end-journal profile with your sketch.　注）轴端的追加加工请结合图纸进行指示。

GNK1510 | Shaft dia.(轴径)ϕ15 Lead(导程)10mm | C5 |



Unit(单位):mm

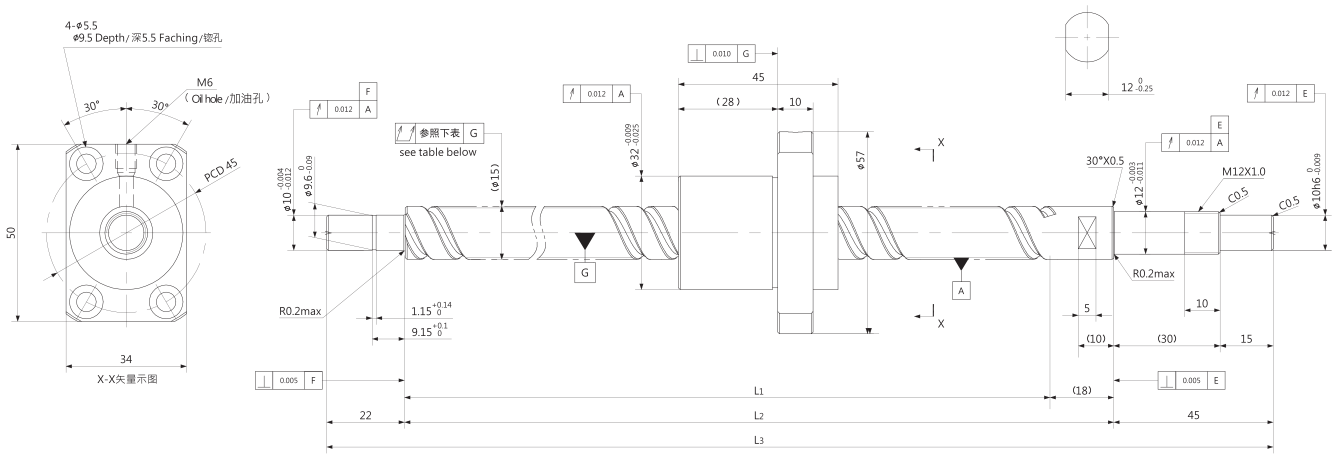
Ball Screw Specifications 主要技术参数				
Ball size 钢珠直径	ϕ3.175	BCD 钢珠中心直径		15.5
Lead Angle 导程角	11°36´	Number of thread 螺纹条数		2
Thread direction 螺纹旋向	Right 右旋	Shaft root dia 丝杠轴底径		ϕ12.20
Number of circuit 循环数	2.7×2	Material 材质	Shaft 轴	S55C
			Nut 螺母	SCM415H
Surface hardness 螺纹部表面硬度	HRC58～62（Thread area）	Anti-rust treatment 防锈处理		Anti-rust oil 防锈油

Unit(单位):mm

Ball Screw Model 滚珠丝杠型号	Travel 行程	Shaft length 丝杠轴长度 L1	L2	L3	Lead accuracy 导程精度 Travel deviation 代表移动量误差 ep	Variation 波动 V300	Total Run-out 全跳动	Axial play 轴向间隙	Preload Torque 预压扭矩 Nm	Basic Load Rating 基本额定负载 N Dynamic 额定动负载 Ca	Static 额定静负载 Coa
GNK1510-5.6G0+321LC5Y	190	239	254	321	±0.023	0.018	0.045	~0.005	-	12000	25000
GNK1510-5.6G0+421LC5Y	290	339	354	421	±0.025		0.060				
GNK1510-5.6G0+521LC5Y	440	439	454	521	±0.027		0.075				
GNK1510-5.6G0+621LC5Y	540	539	554	621	±0.030		0.075				
GNK1510-5.6G0+721LC5Y	640	639	654	721	±0.030		0.090				
GNK1510-5.6G0+871LC5Y	740	789	804	871	±0.030		0.120				

Note）Please designate end-journal profile with your sketch.　注）轴端的追加加工请结合图纸进行指示。

GNK1520 | Shaft dia.(轴径)ϕ15 Lead(导程)20mm | C5 |



Unit(单位):mm

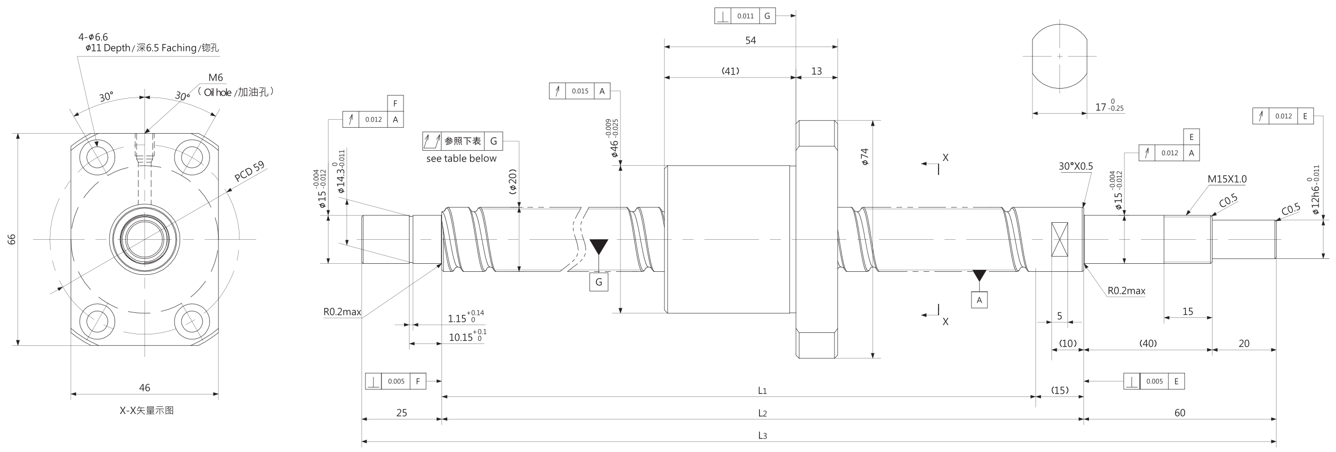
Ball Screw Specifications 主要技术参数				
Ball size 钢珠直径	ϕ3.175	BCD 钢珠中心直径		15.75
Lead Angle 导程角	22°01´	Number of thread 螺纹条数		2
Thread direction 螺纹旋向	Right 右旋	Shaft root dia 丝杠轴底径		ϕ12.7
Number of circuit 循环数	1.7×2	Material 材质	Shaft 轴	S55C
			Nut 螺母	SCM415H
Surface hardness 螺纹部表面硬度	HRC58～62（Thread area）	Anti-rust treatment 防锈处理		Anti-rust oil 防锈油

Unit(单位):mm

Ball Screw Model 滚珠丝杠型号	Travel 行程	Shaft length 丝杠轴长度			Lead accuracy 导程精度		Total Run-out 全跳动	Axial play 轴向间隙	Preload Torque 预压扭矩 Nm	Basic Load Rating 基本额定负载 N	
		L1	L2	L3	Travel deviation 代表移动量误差 ep	Variation 波动 V300				Dynamic 额定动负载 Ca	Static 额定静负载 Coa
GNK1520-3G0+321LC5Y	185	236	254	321	±0.023	0.018	0.045	~0.005	-	8000	16000
GNK1520-3G0+421LC5Y	285	336	354	421	±0.025		0.060				
GNK1520-3G0+521LC5Y	415	436	454	521	±0.027		0.075				
GNK1520-3G0+621LC5Y	515	536	554	621	±0.030		0.075				
GNK1520-3G0+721LC5Y	615	636	654	721	±0.030		0.090				
GNK1520-3G0+871LC5Y	725	786	804	871	±0.030		0.120				

Note）Please designate end-journal profile with your sketch. 注）轴端的追加加工请结合图纸进行指示。

GNK2010 | Shaft dia.(轴径)ϕ20 Lead(导程)10mm | C5 |



Unit(单位):mm

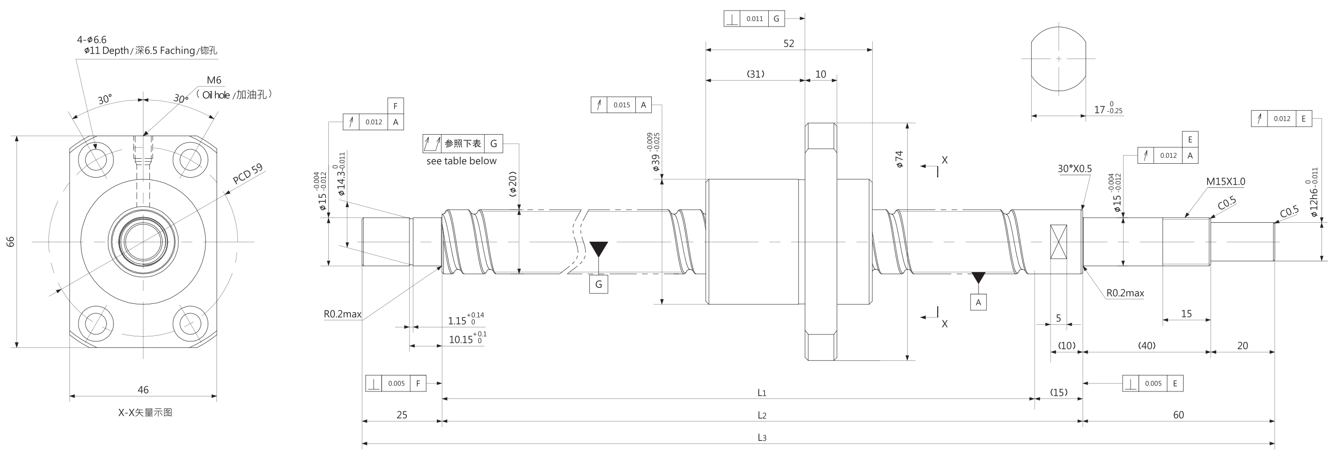
Ball Screw Specifications 主要技术参数				
Ball size 钢珠直径	ϕ3.175	BCD 钢珠中心直径		21.075
Lead Angle 导程角	8°35´	Number of thread 螺纹条数		1
Thread direction 螺纹旋向	Right 右旋	Shaft root dia 丝杠轴底径		ϕ17.6
Number of circuit 循环数	2.7×1	Material 材质	Shaft 轴	S55C
			Nut 螺母	SCM415H
Surface hardness 螺纹部表面硬度	HRC58～62（Thread area）	Anti-rust treatment 防锈处理		Anti-rust oil 防锈油

Unit(单位):mm

Ball Screw Model 滚珠丝杠型号	Travel 行程	Shaft length 丝杠轴长度			Lead accuracy 导程精度		Total Run-out 全跳动	Axial play 轴向间隙	Preload Torque 预压扭矩 Nm	Basic Load Rating 基本额定负载 N	
		L1	L2	L3	Travel deviation 代表移动量误差 pe	Variation 波动 V 300				Dynamic 额定动负载 Ca	Static 额定静负载 Coa
GNK2010-2.5RRG0+499LC5Y	340	399	414	499	±0.025	0.018	0.060	~0.005	-	7000	16500
GNK2010-2.5RRG0+799LC5Y	640	699	714	799	±0.030		0.090				
GNK2010-2.5RRG0+1099LC5Y	940	999	1014	1099	±0.040		0.150				

Note）Please designate end-journal profile with your sketch. 注）轴端的追加加工请结合图纸进行指示。

GNK2020 | Shaft dia.(轴径)ф20 Lead(导程)20mm | C5



Unit(单位):mm

Ball Screw Specifications 主要技术参数				
Ball size 钢珠直径	ф3.175	BCD 钢珠中心直径		20.075
Lead Angle 导程角	17°03′	Number of thread 螺纹条数		1
Thread direction 螺纹旋向	Right 右旋	Shaft root dia 丝杠轴底径		ф17.6
Number of circuit 循环数	1.8×1	Material 材质	Shaft 轴	S55C
			Nut 螺母	SCM415H
Surface hardness 螺纹部表面硬度	HRC58～62（Thread area）	Anti-rust treatment 防锈处理		Anti-rust oil 防锈油

Unit(单位):mm

Ball Screw Model 滚珠丝杠型号	Travel 行程	Shaft length 丝杠轴长度			Lead accuracy 导程精度		Total Run-out 全跳动	Axial play 轴向间隙	Preload Torque 预压扭矩 Nm	Basic Load Rating 基本额定负载 N	
		L_1	L_2	L_3	Travel deviation 代表移动量误差 e_p	Variation 波动 V_{300}				Dynamic 额定动负载 Ca	Static 额定静负载 Coa
GNK2020-3.6G0+520LC5Y	365	420	435	520	±0.025		0.075				
GNK2020-3.6G0+720LC5Y	565	620	635	720	±0.030		0.090				
GNK2020-3.6G0+920LC5Y	765	820	835	920	±0.040	0.018	0.150	~0.005	-	5900	11700
GNK2020-3.6G0+1120LC5Y	965	1020	1035	1120	±0.040		0.150				
GNK2020-3.6G0+1320LC5Y	1165	1220	1235	1320	±0.040		0.190				

Note）Please designate end-journal profile with your sketch. 注）轴端的追加加工请结合图纸进行指示。

MEMO

滚珠丝杆的特点

FEATURE OF BALL SCREWS

◆ 高精度

拥有多年精密加工生产经验，KGG滚珠丝杆均在温度经过严格控制的厂房内进行研磨、组装和检查，确保了KGG滚珠丝杆的高精度和高可靠性。

◆ High precision

With many years of experience in precision machining and production, the ball screw on the well is in The temperature is grinded, assembled and inspected in the strictly controlled workshop to ensure the high precision and reliability of the ball screw on the well.

◆ 传动效率高

滚珠丝杆有的传动效率高达90%以上。它所需要的力矩仅为普通滚珠丝杆的1/3甚至更小。这使得很容易将直线运动转化为旋转运动。(见图1、图2)

◆ High transmission efficiency

Some transmission efficiency of ball screw is over 90%. The moment it needs It is only 1 / 3 or smaller than the ordinary ball screw. This makes it easy to convert linear motion into rotational motion. (see Figure 1 and Figure 2)

◆ 耐久性

材料的精挑细选、正确的热处理，以及先进的研磨加工工艺保证了KGG滚珠丝杆的长久寿命。

◆ Durability

Fine selection of materials, correct heat treatment and advanced grinding The technology ensures the long life of the ball screw

◆ 轴向间隙

KGG的滚珠丝杆螺纹槽是歌德弧槽，轴向间隙非常小，可以使螺母平稳地运动。此外，预压可减少轴向间隙，同时增加滚珠丝杆的刚度。

◆ Axial clearance

The thread groove of the ball screw on the well is Goethe arc groove with axial clearance Very small to allow the nut to move smoothly. In addition, preloading can reduce the axial clearance and increase the rigidity of the ball screw.

◆ 精密微进给

KGG滚珠丝杆是滚动接触，所以其启动力矩很小。所以，不像英制梯形螺纹丝杆，滚珠丝杆甚至可以在低速下点动，做精确的微进给操作。

◆ Precision micro feed

The ball screw is in rolling contact, so its starting torque is very small. place Therefore, unlike the British trapezoidal screw rod, the ball screw rod can even be inched at low speed for precise micro feed operation.

◆ 高速转动

KGG滚珠丝杆拥有较高传动效率，在高速转动的情况下温升很小。

◆ High speed rotation

The upper well ball screw has high transmission efficiency and can rotate at high speed In this case, the temperature rise is very small.

◆ 易于维护

滚珠丝杆是滚动接触，在正常运行条件下，只需要定期地加润滑油脂即可。

◆ Easy to maintain

The ball screw is in rolling contact. Under normal operation conditions, only regular Add grease to the ground.

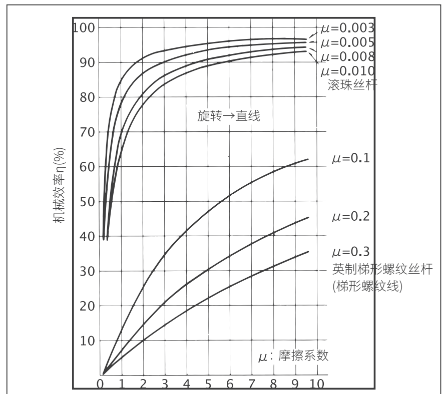


图1

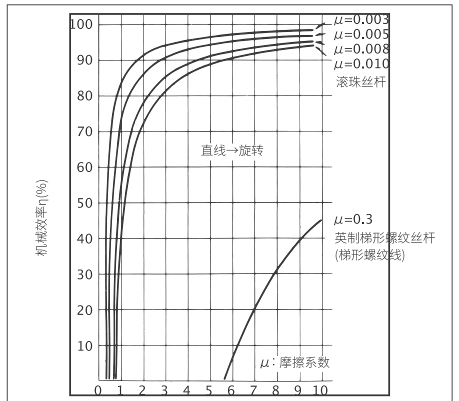


图2

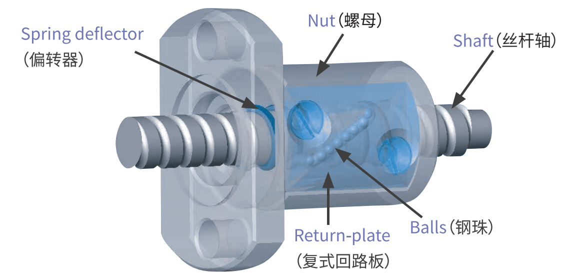
滚珠丝杆的构造

CONSTRUCTION OF BALL SCREWS

◆ 复式回路板循环方式 RETURN-PLATE SYSTEM

复式回路板循环方式，是通过安装在螺母内部的螺旋型偏转器将钢球抛出，使其沿着复式回路板的槽进行循环运动的方式。与回路管循环方式相比，具有可以缩小螺母外径的优点。在设备上安装时，如果将复式回路板部分安装在上方，则可使回转动作更加顺畅。

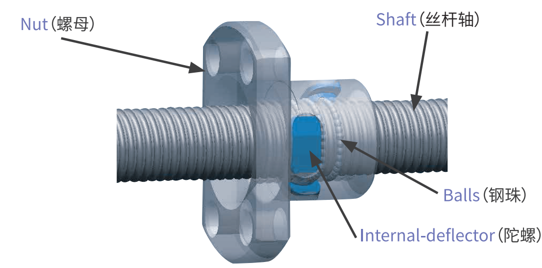
The Return-plate system uses coil-type deflectors incorporated inside the Nut to pick up the steel Balls and circulate them via the Return-plate channel. This system has the advantage of allowing the use of a Nut that is smaller in diameter than those employed in Return-tube systems. In addition, the upward-angle installation of the Return-plate ensures even smoother rotation.



◆ 陀螺式循环方式 INTERNAL-DEFLECTOR SYSTEM

陀螺式循环方式最大限度地缩小了螺母的外径及长度，使微型滚珠丝杆的结构更紧凑、更轻量。钢珠在承受轴向负载的同时，在轴及螺母的钢珠滚动槽中滚动时，沿着螺母内部的陀螺槽进入相邻的滚动槽，然后再次返回负载区，进行无限滚动循环。

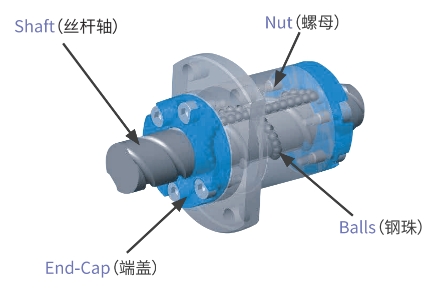
The Internal-deflector system employs a lightweight Miniature Ball Screw, which enables the Nut diameter and length to be reduced to the smallest possible size. The Balls bear the load while rolling along the screw groove between the Shaft and the Nut. The Balls are continuously circulated, transferred to the adjacent groove in the screw via the Internal-deflector channel and then back to the loaded groove area.



◆ 端盖式循环方式 END-CAP SYSTEM

端盖式循环方式，是指钢珠沿着丝杆轴与螺母之间的槽滚动前行，从安装在螺母两端的循环部件（端盖）上的通路穿过螺母上的通孔，返回原位的循环方式。

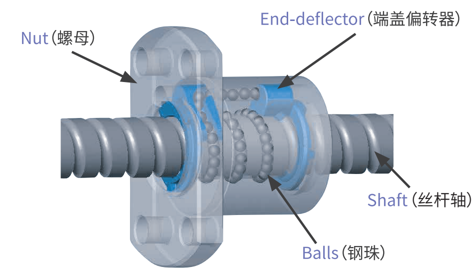
The End-cap system is a recirculating system in which the Balls advance by rolling through the screw groove between the Nut and the Screw Shaft. The Balls are then returned via the holes in the Nut and the channels in the recirculating sections of the End-caps on either end of the Nut.



◆ 偏转器式循环方式 END-DEFLECTOR SYSTEM

偏转器式循环方式，是指钢珠从设置于螺母内部或外部的端盖偏转器，穿过螺母通孔，在原来的滚动槽内循环的方式。与复式回路板循环方式相比，可缩小螺母的外径，是一种最适用于中导程的循环方式。

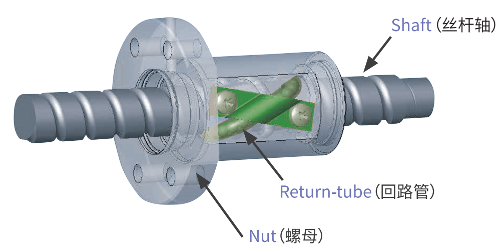
The Balls are circulated from End-deflector incorporated inside the Nut or outside the Nut through the hole in the Nut and the channels in the recirculating sections. Ball Nut diameter can be smaller than Return-plate system. This is suitable for the middle lead Ball Screws.



◆ 回路管循环方式 RETURN-TUBE SYSTEM

回路管循环方式，是指通过插入螺母中的回路管的前端，将正沿着丝杆轴与螺母之间的槽滚动的钢珠取出，使其穿过回路管后，再次返回螺纹槽的循环方式。

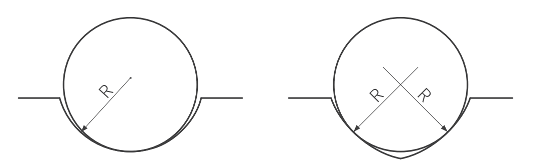
In the Return-tube system, Balls rolling between the Nut and the Shaft are picked up from the screw groove by the end of the Return-tube built into the Nut. Then, they flow back through the Return-tube to the screw groove.



◆ 螺纹槽形状 THREAD GROOVE PROFILE

滚珠丝杆分为由1个弧形形成的圆弧和由2个弧形形成的拱弧两种类型。KGG滚珠丝杆采用哥德弧形。

Ball screws may have either a circular arc profile, formed of a single arc, or a gothic arc profile, formed from two arcs. KGG Ball Screws feature a gothic arc profile.



Circular arc groove (圆弧)　　Gothic arc groove (哥德弧形)

滚珠丝杆的生产范围

THE RANGE OF MANUFACTURING FOR BALL SCREWS

按丝杆轴公称外径划分，KGG滚珠丝杆的生产范围为ф4.0~ф20mm。以下介绍了不同精度等级的丝杆轴的参考极限长度。具体长度会因轴端形状、材质及丝杆轴系列而异，详情请垂询本公司。

The range of manufacturing for KGG Ball Screws is from ф4.0 to ф20mm as Shaft nominal diameter. Maximum limit of overall lengths are shown below. Maximum limit of overall lengths will vary depending on the Shaft end configuration, materials and KGG series. Please inquire KGG for details.

◆ 精密滚珠丝杆的生产极限长度(全长) Maximum limit of overall lengths for Precision Ball Screws

Unit （单位）:mm

Shaft nominal diameter 丝杆轴公称外径 \ Accuracy grade 精度等级	C0	C1	C3	C5
4	90	120	160	600
6	140	180	240	600
8	200	250	330	600
10	260	320	420	600
12	320	390	510	1200
13-14	380	460	600	1200
15-16	450	540	700	1200
20	800	900	1400	2000

注1) 超出生产极限长度时，请垂询本公司。 Note 1) If required length exceeds the number in table above, please ask KGG representative.

◆ 冷轧滚珠丝杆(Ct7&Ct10)的生产极限长度 Maximum limit of overall lengths for Rolled Ball Screws (Ct7 & Ct10)

Unit （单位）:mm

Shaft nominal diameter 丝杆轴公称外径	Maximum length 极限长度
4	600
5	600
6	600
8	1200
10	1200
12	1200
13	1200
14	1200
15	1200
20	2400

注1) 超出生产极限长度时，请垂询本公司。 注2) 冷轧滚珠丝杆的极限长度值中包括丝杆两端各25mm的不完全螺纹部分。

Note 1) If required length exceeds the number in table above, please ask KGG representative.

Note 2) Maximum limit of overall length for Rolled Ball Screws includes 25mm of incomplete thread area at both end.

滚珠丝杆的导程精度

LEAD ACCURACY OF BALL SCREWS

JIS B1192中规定，滚珠丝杆的导程精度是指，相对于螺母有效移动量或丝杆轴螺纹部有效长度的代表移动量误差及波动，以及相对于螺纹部有效长度中任意300mm及1圈（2π rad）的波动。

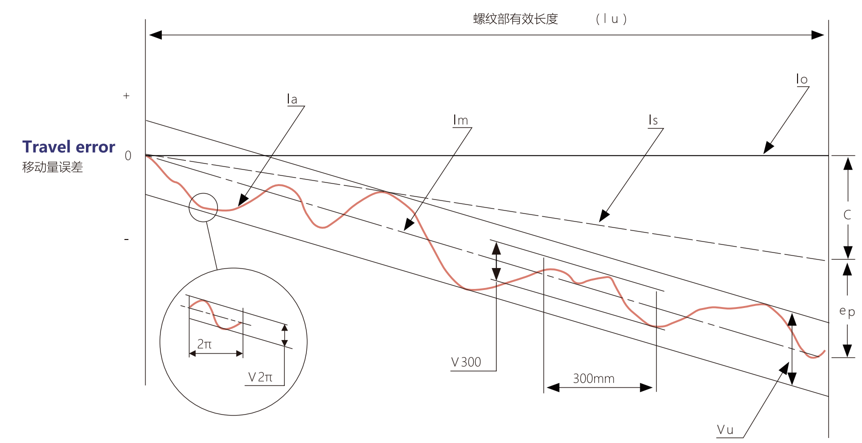
表C-02、03、04中列出了不同精度等级的各种特性的公差。

Ball Screw lead accuracy conforming to JIS B1192 is specified by the tolerance of actual mean travel error over the Nut effective travel amount, or Screw Shaft effective length, travel variation and travel variation within arbitrary 300mm, travel variation within arbitrary 1 revolution (2π rad) over the Screw Shaft effective length.

Tolerance of each accuracy grades are shown in the Table C-02 ,03, 04.

图C-01：移动量误差线图

Fig. C-01：Travel deviation diagram



公称移动量（lo）：按照公称导程旋转任意圈数时的轴向移动量。
标准导程（Phs）：预测因温度上升及负载而引起的变形量，对公称导程进行了若干补偿的导程。
代表移动量的目标值（c）：预先将标准移动量设定为正或负时的目标值。
标准移动量（ls）：按照标准导程旋转任意圈数时的移动量。
实际移动量（la）：相对于任意丝杆轴旋转角的螺母实际轴向移动量。
代表移动量（lm）：代表实际移动量倾向的直线。根据表示相对于滚珠丝杆有效移动量或螺纹部有效长度的实际移动量曲线，通过最小二乘法代表移动量（lm）：或类似的近似法求出。
代表移动量误差（ep）：与螺母的有效移动量或丝杆轴的螺纹部有效长度相应的代表移动量与标准移动量之差。
波动（Vu）：平行于代表移动量的两条线间的实际移动量最大幅度。
波动（V300）：相对于螺纹部有效长度中任意300mm的实际移动量最大幅度。
波动（V2π）：相对于螺纹部有效长度中任意1圈（2π rad）的实际移动量最大幅度。

Nominal travel（lo）：Travel in axial direction when rotated arbitrary number of revolution according to the Nominal lead
Specified Lead（Phs）：Lead given some amount of correction to the Nominal lead in order to compensate the deformation generated due to the temperature rise or the load.
Travel compensation（c）：Difference between the Specified travel and the Nominal travel within the valid travel.
Specified travel（ls）：Travel in axial direction when rotated arbitrary number of revolution according to the Specified lead.
Actual travel（la）：Actual travel of Ball Nut in axial direction in respect to an arbitrary angle of rotation of Ball Screw Shaft.
Actual mean travel（lm）：Straight line which represents the tendency of Actual travel. It is obtained by the least square method or a simple and appropriate approximation method from the curve indicating the Valid travel of Ball Nut.
Tolerance on specified travel（ep）：Difference between the Actual mean travel and the Specified travel corresponding to the Valid travel of Ball Nut or the Useful travel of Ball Screw Shaft.
Travel variation（Vu）：Maximum width of the Actual travel curve between the two straight lines put in parallel to the Actual mean travel line, that corresponding to Valid travel of Ball Nut or Useful travel of Ball Screw Shaft.
Travel variation（V300）：Maximum width of the Actual travel curve between the two straight lines put in parallel to the Actual mean travel line, that corresponding to arbitrary 300mm taken within Useful travel of Ball Screw Shaft.
Travel variation（V2π）：Maximum width of the Actual travel curve between the two straight lines put in parallel to the Actual mean travel line, that corresponding to arbitrary one revolution (2π rad) within Useful travel of Ball Screw Shaft.

表C-02：精密滚珠丝杆(定位用:C系列)的代表移动量误差(±EP)和波动(VU)许用值
Table C-02：Tolerance on actual mean travel deviation(±ep) and permissible variation of precision Ball Screws (for positioning :C series)

Unit （单位）:μm

Accuracy Grade 精度等级			C0		C1		C3		C5	
Effective screw length（mm）螺纹部有效长度(mm)	Over 超过	Up to 以下	±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

表 C-03：精密滚珠丝杆(定位用: C系列)每300mm及1圈的波动(V_{300})、($V_{2\pi}$)许用值
Table Y-03： Permissible travel variation V300, V2π（for positioning： C series）

Unit （单位）:μm

Accuracy grade 精度等级	C0		C1		C3		C5	
Item 项目	V_{300}	$V_{2\pi}$	V_{300}	$V_{2\pi}$	V_{300}	$V_{2\pi}$	V_{300}	$V_{2\pi}$
Permissible value 许用值	3.5	3	5	4	8	6	18	8

表 C-04：相对于300mm的Ct系列(7、10级)的波动(V_{300})
Table Y-04： Permissible travel variation V300 for Ct serie（s 7,10 grade）

Unit （单位）:μm

Accuracy grade 精度等级	Ct7	Ct10
V_{300}	52	210

Ct系列（7级、10级）的代表移动量误差由下式求出。
Tolerance on actual mean travel deviation（ep）is calculated as follows.

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

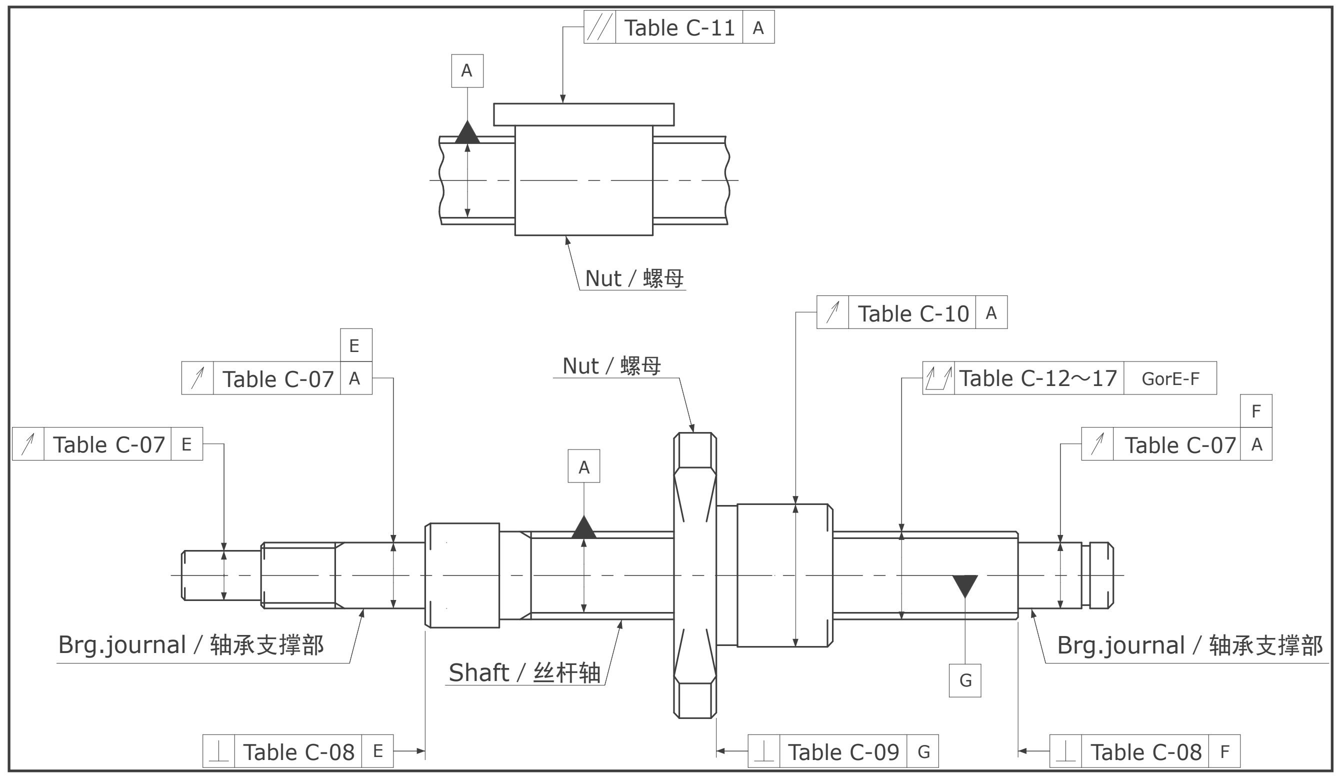
lu：螺纹部有效长度（mm）
Useful travel（mm）

滚珠丝杆的安装部精度
BALL SCREW RUN-OUT AND LOCATION TOLERANCES

JIS B1192中规定，滚珠丝杆的导程精度是指，相对于螺母有效移动量或丝杆轴螺纹部有效长度的代表移动量误差及波动，以及相对于螺纹部有效长度中任意300mm及1圈（2π rad）的波动。
表C-02、03、04中列出了不同精度等级的各种特性的公差。

Ball Screw lead accuracy conforming to JIS B1192 is specified by the tolerance of actual mean travel error over the Nut effective travel amount, or Screw Shaft effective length, travel variation and travel variation within arbitrary 300mm, travel variation within arbitrary 1 revolution (2π rad) over the Screw Shaft effective length.
Tolerance of each accuracy grades are shown in the Table C-02, 03, 04.

图C-05：安装部精度的填写示例
Fig. C-05：Description of Run-out and location tolerances for Ball Screws



图C-06：圆跳动的补正
Fig. C-06：Compensation of Radial Run-out

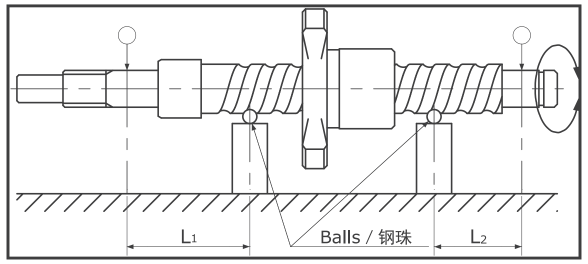


表 C-07：相对于丝杆轴螺纹槽面的支撑部外径的半径方向圆跳动以及相对于丝杆轴支撑部轴线的零件安装部的半径方向圆跳动
Table C-07：Radial Run-out of Bearing seat related to the centerline of screw groove and Radial Run-out of journal diameter related to the Bearing seat

Unit （单位）:μm

Shaft nominal diameter（mm）丝杆轴公称外径(mm)		Permissible deviation of Radial Run-out 跳动公差(最大)					
Over 超过	Up to 以下	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

在测量该项目时，由于受丝杆轴轴线全跳动的影响，因此需要进行补偿。补偿方法为，根据丝杆轴总长与支点到测量点的距离（L1,L2）的比值（参照图C-06），利用第C-28～30页的表C-12～17的丝杆轴轴线的全跳动公差，求出补偿值（参照下式），然后加上表C-07中的公差。

This measurement item is affected by Total Run-out of the Screw Shaft, and so it must be corrected as follows. Find the corrected value from the Total Run-out tolerances given in Tables C-28～30 on page C-12～17 using the ratio of the total Shaft length to the distance between the supporting point and the measuring poin(t L1,L2) (see Fig. C-06), and add the values obtained to the tolerance given in Table C-07.

$$\text{圆跳动的补正} = \frac{\text{全跳动公差（表C-12～17）}}{\text{总长}} \times \text{测量间距（}L_1\text{或}L_2\text{）}$$

$$\text{Compensation Value of Run-out} = \frac{\text{Tolerance of total Run-out（Table C-12～17）}}{\text{Total shaft length}} \times (L_1 \text{ or } L_2)$$

L_1、L_2：支点到测量点的距离（mm）
Distance btw supporting pt & measuring pt（mm）

表 C-08：相对于丝杆轴支撑部轴线的支撑部端面的垂直度
Table C-08：Axial Run-out (Perpendicularity) of Shaft (Bearing) face related to the centerline of the Bearing seat

Unit （单位）:μm

Shaft nominal diameter（mm）丝杆轴公称外径(mm)		Permissible deviations of Axial Run-out（Perpendicularity）垂直度 公差(最大)					
Over 超过	Up to 以下	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

表 C-09：相对于丝杆轴轴线的螺母基准端面或法兰安装面的垂直度
Table C-09：Axial Run-out (Perpendicularity) of Ball Nut location face related to the centerline of Screw Shaft

Unit （单位）:μm

Nut outside diameter（mm）螺母外径		Permissible deviations of Axial Run-out（Perpendicularity）垂直度公差(最大)					
Over 超过	Up to 以下	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

表 C-10：相对于丝杆轴轴线的螺母外周面(圆柱形时)的半径方向圆跳动
Table C-10：Radial Run-out of Ball Nut location diameter related to the centerline of Screw Shaft

Unit （单位）:μm

Nut outside diameter（mm）螺母外径		Permissible deviations of Radial Run-out 跳动公差(最大)					
Over 超过	Up to 以下	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

表 C-11：相对于丝杆轴轴线的螺母外周面(平面安装时)的平行度
Table C-11：Parallelism of rectangular Ball Nut related to the centerline of Screw Shaft

Unit （单位）:μm

Mounting length（mm）标准安装长度(mm)		Permissible deviations of Parallelism 平行度公差(最大)					
Over 超过	Up to 以下	C0	C1	C3	C5	C7	C10
-	50	5	6	8	10	17	30
50	100	7	8	10	13	17	30

表 C-12：丝杆轴轴线的半径方向全跳动(C0)

Table C-12：Total Run-out in radial direction of Screw Shaft related to the centerline of Screw Shaft（C0）

Unit（单位）:mm

Shaft total length 丝杆轴总长		Shaft nominal diameter 丝杆轴公称外径		
	Over/超过	-	8	12
	Up to/以下	8	12	20
Over 超过	Up to 以下	Permissible deviations of total Run-out in radial direction 跳动公差(最大)		
-	125	0.015	0.015	0.015
125	200	0.025	0.020	0.020
200	315	0.035	0.025	0.020
315	400	-	0.035	0.025
400	500	-	0.045	0.035
500	630	-	0.050	0.040
630	800	-	-	0.050
800	1000	-	-	0.065

表 C-13：丝杆轴轴线的半径方向全跳动(C1)

Table C-13：Total Run-out in radial direction of Screw Shaft related to the centerline of Screw Shaft（C1）

Unit（单位）:mm

Shaft total length 丝杆轴总长		Shaft nominal diameter 丝杆轴公称外径		
	Over/超过	-	8	12
	Up to/以下	8	12	20
Over 超过	Up to 以下	Permissible deviations of total Run-out in radial direction 跳动公差(最大)		
-	125	0.020	0.020	0.015
125	200	0.030	0.025	0.020
200	315	0.040	0.030	0.025
315	400	0.045	0.040	0.030
400	500	-	0.050	0.040
500	630	-	0.060	0.045
630	800	-	-	0.060
800	1000	-	-	0.075

表 C-14：丝杆轴轴线的半径方向全跳动(C3)

Table C-14：Total Run-out in radial direction of Screw Shaft related to the centerline of Screw Shaft（C3）

Unit（单位）:mm

Shaft total length 丝杆轴总长		Shaft nominal diameter 丝杆轴公称外径		
	Over/超过	-	8	12
	Up to/以下	8	12	20
Over 超过	Up to 以下	Permissible deviations of total Run-out in radial direction 跳动公差(最大)		
-	125	0.025	0.025	0.020
125	200	0.035	0.035	0.025
200	315	0.050	0.040	0.030
315	400	0.060	0.050	0.040
400	500	-	0.065	0.050
500	630	-	0.070	0.055
630	800	-	-	0.070
800	1000	-	-	0.095

表 C-15：丝杆轴轴线的半径方向全跳动(C5)

Table C-15：Total Run-out in radial direction of Screw Shaft related to the centerline of Screw Shaft（C5）

Unit（单位）:mm

Shaft total length 丝杆轴总长		Shaft nominal diameter 丝杆轴公称外径		
	Over/超过	-	8	12
	Up to/以下	8	12	20
Over 超过	Up to 以下	Permissible deviations of total Run-out in radial direction 跳动公差(最大)		
-	125	0.035	0.035	0.035
125	200	0.050	0.040	0.040
200	315	0.065	0.055	0.045
315	400	0.075	0.065	0.055
400	500	-	0.080	0.060
500	630	-	0.090	0.075
630	800	-	-	0.090
800	1000	-	-	0.120

表 C-16：丝杆轴轴线的半径方向全跳动(C7)
Table C-16：Total Run-out in radial direction of Screw Shaft related to the centerline of Screw Shaft（C7）

Unit （单位）：mm

Shaft total length 丝杆轴总长		Shaft nominal diameter 丝杆轴公称外径		
	Over/超过	-	8	12
	Up to/以下	8	12	20
Over 超过	Up to 以下	Permissible deviations of total Run-out in radial direction 跳动公差(最大)		
-	125	0.060	0.055	0.055
125	200	0.075	0.065	0.060
200	315	0.100	0.080	0.070
315	400	-	0.100	0.080
400	500	-	0.120	0.095
500	630	-	0.150	0.110
630	800	-	-	0.140
800	1000	-	-	0.170

表 C-17：丝杆轴轴线的半径方向全跳动(C10)
Table C-17：Total Run-out in radial direction of Screw Shaft related to the centerline of Screw Shaft（C10）

Unit （单位）：mm

Shaft total length 丝杆轴总长		Shaft nominal diameter 丝杆轴公称外径		
	Over/超过	-	8	12
	Up to/以下	8	12	20
Over 超过	Up to 以下	Permissible deviations of total Run-out in radial direction 跳动公差(最大)		
-	125	0.100	0.095	0.090
125	200	0.140	0.120	0.110
200	315	0.210	0.160	0.130
315	400	-	0.210	0.160
400	500	-	0.270	0.200
500	630	-	0.350	0.250
630	800	-	0.460	0.320
800	1000	-	-	0.420

注) Ct7、Ct10规格时，有时会根据JIS B1192-2013标准，采用基于细长比的全跳动规格(下表)。
Note）In case of Ct7, Ct10 grade, KGG may use the standard of Total Run-out based on slenderness ratio, which conforms to JIS B1192-2013.

Unit （单位）：mm

Slenderness ratio 细长比		Total Run-out 全跳动	
Over/超过	Up to/以下	Ct7	Ct10
-	40	0.080	0.160
40	60	0.120	0.240
60	80	0.200	0.400
80	100	0.320	0.640

细长比 / Slenderness ratio= lu/do

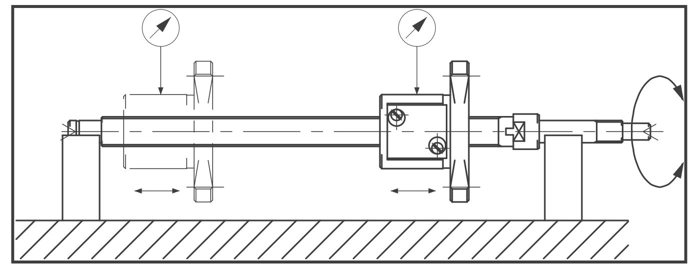
lu : 螺纹部有效长度 / Useful travel（mm）
do: 丝杆轴公称外径 / Nominal diameter of Ball Screw (mm)

滚珠丝杆安装部精度的测量方法
MEASURING METHOD OF BALL SCREW RUN-OUT AND LOCATION TOLERANCES

◆ 相对于丝杆轴螺纹槽面的支撑部外径的半径方向圆跳动(表 C-07)
Radial Run-out of Bearing seat related to the centerline of screw groove（Table C-07）

用V形块支撑丝杆轴两端，一边使丝杆轴旋转，一边读取测量头接触螺母外周面的千分表刻度。测量作业在支撑部附近的2处进行。此外，直接用千分表测量支撑部外径时，用两个中心孔支撑丝杆轴进行测量。

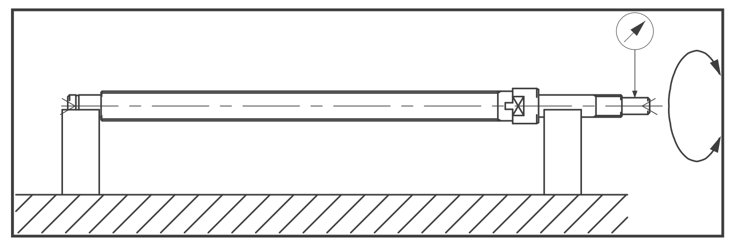
Place the Ball Screw in identical V-blocks at both Bearing seat. Place the dial gauge perpendicular to the Nut cylindrical surface. Rotate Screw Shaft slowly and record the dial gauge readings. Measurement should be done at near both ends of threaded part. Some cases, this measurement will be done by both centerhole support, and directly measured on Bearing seat.



◆ 相对于丝杆轴支撑部轴线的零件安装部的半径方向圆跳动(表C-07)
Radial Run-out of journal dia meter related to the Bearing seat (Table C-07)

用V形块支撑丝杆轴两端，一边使丝杆轴旋转，一边读取测量头接触零件安装部的千分表刻度。

Place the Ball Screw in identical V-blocks at both Bearing seats. Place the dial gauge perpendicular to the journal cylindrical surface. Rotate the Screw Shaft slowly and record the dial gauge readings.



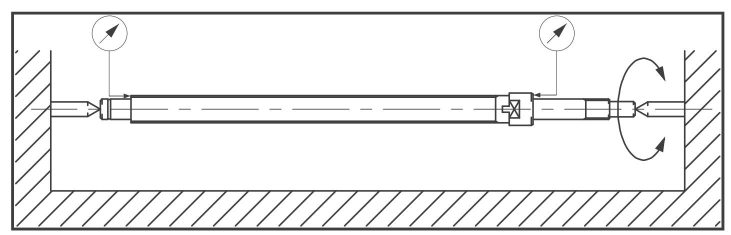
◆ 相对于丝杆轴支撑部轴线的支撑部端面的垂直度(表 C-08)
Axial Run-out (Perpendicularity) of shaft (Bearing) face related to the centerline of the Bearing seat (Table C-08)

用两个中心孔支撑丝杆轴两端，一边使丝杆轴旋转，一边读取测量头接触支撑部端面的千分表刻度。

Support a Screw Shaft at both centers. Place the dial gauge perpendicular to the end face of the journal.Rotate the Screw Shaft slowly and record the dial gauge readings.

**图纸中的标示以支撑部外周面为基准，但由于支撑部外周面以中心孔为基准进行了加工，因此与用V形块支撑支撑部外周面时相同。

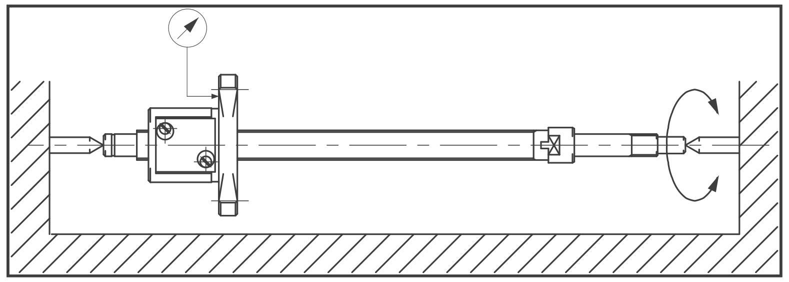
**This method is equivalent to the one, which is supported at both Bearing seats, because Bearing seats are ground related to both centers.



◆ 相对于丝杆轴轴线的螺母基准端面或法兰安装面的垂直度（表 C-09）
Axial Run-out (Perpendicularity) of Ball Nut location face related to the centerline of Screw Shaft (Table C-09)

用两个中心孔支撑丝杆轴两端，一边使轴与螺母一起旋转，一边读取测量头接触螺母法兰端面的千分表刻度。

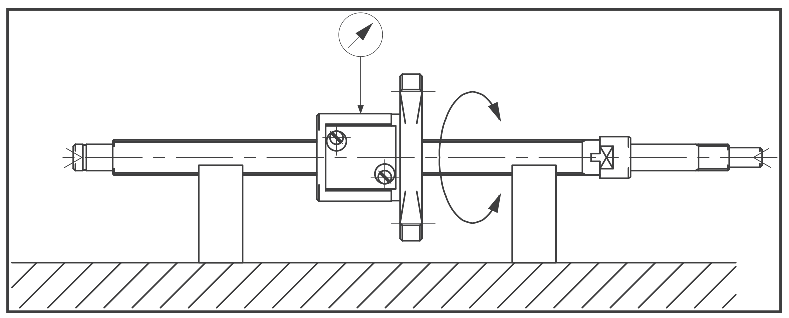
Support the Ball Screw at both centers. Place the dial gauge perpendicular to the flange face. Rotate the Screw Shaft with Ball Nut slowly and record the dial gauge readings. Secure the Ball Nut against rotation on the Screw Shaft.



◆ 相对于丝杆轴轴线的螺母外周面的半径方向圆跳动（表 C-10）
Radial Run-out of Ball Nut location diameter related to the centerline of Screw Shaft (Table C-10)

用V形块支撑丝杆轴螺母附近的外周面，一边使螺母旋转，一边读取测量头接触螺母外周面的千分表刻度。

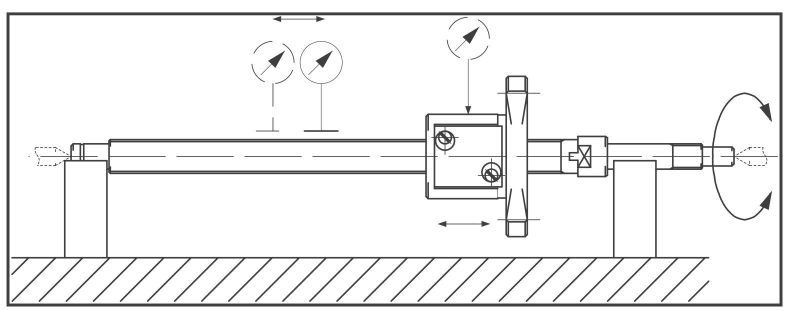
Place the Ball Screw on V-blocks at adjacent sides of the Ball Nut. Place the dial gauge perpendicular to the cylindrical surface of Ball Nut. Secure the Screw Shaft against rotation of Ball Nut. Rotate Ball Nut slowly and record the dial gauge readings.



◆ 丝杆轴轴线的半径方向全跳动（表 C-12～17）
Total Run-out in radial direction of Screw Shaft related to the centerline of Screw Shaft (Table C-12~17)

用两个中心孔或V形块支撑丝杆轴两端，一边使丝杆轴旋转， 一边读取测量头接触丝杆轴外周面或螺母外周面的千分表 刻度。测量作业含整个范围，选多处进行。

Place the Ball Screw in identical V-blocks at both Bearing seats, or support the Ball Screw at both centers. Place the dial gauge with measuring shoe at the several points over the full thread length.Rotate the Screw Shaft slowly and record the dial gauge readings. Maximum value of measurement should be the Total Run-out.



材质和热处理、硬度
MATERIAL AND HEAT TREATMENT, SURFACE HARDNESS

KGG滚珠丝杆的标准材质、热处理和硬度如表C-18、19所示。
表中数值可能会因系列及型号不同而略有差异，请参照本公司出示的规格图。

Standard material of KGG Ball Screws, Heat treatment
and Surface hardness are shown in table C-18, 19. However, they vary depending on series or model number. Please refer to KGG drawings.

表 C-18：一般产品的材质和热处理、硬度
Table C-18：Material, Heat treatment & Surface hardness for regular items

	Material 材质	Heat treatment 热处理	Surface hardness 表面硬度
Screw Shaft 丝杆轴	S55C	Induction quenching 高频淬火	HRC 58-62
Nut 螺母	SCM415	Carburizing and quenching 渗碳淬火	HRC 58-62

注）表中所示硬度为滚珠丝杆部的表面硬度。
Note） Hardness on table shows surface hardness of thread part.

表 C-19：不锈钢产品的材质和热处理、硬度
Table C-19：Material, Heat treatment & Surface hardness for stainless steel items

	Material 材质	Heat treatment 热处理	Surface hardness 表面硬度
Screw Shaft 丝杆轴	SUS440C	Quenching and tempering 淬火、回火	HRC min.55 HRC 55以上
Nut 螺母	SUS440C	Quenching and tempering 淬火、回火	HRC min.55 HRC 55以上

注）表中所示硬度为滚珠丝杆部的表面硬度。
Note） Hardness on table shows surface hardness of thread part.

许用轴向负载
PERMISSIBLE AXIAL LOAD

建议尽量在有拉伸负载作用于丝杆轴的条件下使用。但根据使用条件，可能会有压缩负载作用，此时应避免丝杆轴发生压曲。
尤其在安装间距较小时，无论采用何种安装方法，都会受到许用拉伸应力或压缩负载及基本额定静负载Coa的限制。
压曲负载、许用拉伸和许用压缩负载可用下式求出。

It is recommended that Ball Screw Shafts be used almost exclusively under tension load conditions. However, in some applications, compression loads may exist, and under such conditions it must be determined that Shaft buckling will not occur.
Also, when the mounting span distance is short, there is a restriction on the permissible tension or compression load and the Basic Static Load Rating Coa unrelated to mounting.
Buckling load, permissible tension and permissible compression load can be calculated below.

◆ 相对于压曲的许用压缩负载的计算公式
Permissible compression load calculation for buckling

$$P = \alpha \times \frac{n\pi^2 E \cdot I}{L^2} \ \text{N\{kgf\}欧拉公式} \quad \text{(Formula for Oiler)}$$

α：安全系数（Safety Factor）0.5
E：杨氏模量（Young's modulus） 2.08×10^5N/mm²（MPa） {21,200kgf/mm²}
I：丝杆轴截面的最小惯性矩（Screw Shaft minimum moment of inertia of area）

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

d：丝杆轴底径（Screw Shaft Root diameter） mm
L：安装间距（Mounting span distance） mm
n：取决于滚珠丝杆安装方法的系数（Factor for Ball Screw mounting method）

支撑-支撑（Supported－Supported）	n=1
固定-支撑（Fixed－Supported）	n=2
固定-固定（Fixed－Fixed）	n=4
固定-自由（Fixed－Free）	n=1/4

◆ 相对于丝杆轴屈服应力的许用拉伸、压缩负载的计算公式
Permissible tension, compression load calculation for Screw Shaft yield stress

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

σ：许用应力（Permissible stress）
A：丝杆轴的最小截面积（Screw Shaft minimum section area） 98N/mm²（MPa）{10kgf/mm²}

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

d：丝杆轴底径（Screw Shaft Root diameter） mm

许用转速
PERMISSIBLE SPEED

丝杆轴的安装方法决定了旋转丝杆轴的极限转速。转速接近极限值时会引起共振，导致丝杆轴无法运行。
此外，无论采用何种安装方法，滚珠丝杆都存在会导致循环部损坏的极限转速。

For Screw Shaft rotation, the mounting method determines the established rotation limits. When this value is approached, resonance phenomenon can occur, and operation becomes impossible. There is also rotation limit which causes damages to recirculating parts. This limit is unrelated to mounting methods.

◆ 相对于临界速度的许用转速的计算公式
Permissible speed calculation for critical speed

$$N = \beta \times \frac{60 \cdot \lambda^2}{2\pi} \times \sqrt{\frac{E \cdot I \cdot g}{\gamma \cdot A \cdot L^4}} \ \text{min}^{-1}\text{\{rpm\}}$$

β：安全系数（Safety Factor）0.8
E：杨氏模量（Young's modulus） 2.08×10^5 N/mm²（MPa） {21,200kgf/mm²}
I：丝杆轴截面的最小惯性矩（Screw Shaft minimum moment of inertia of area）

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

d：丝杆轴底径（Screw Shaft Root diameter） mm
g：重力加速度（Gravity acceleration） 9.8×10^3mm/sec²
γ：材料的比重（Material specific gravity） 7.7×10^{-5}N/mm³ {7.85×10^{-6}kgf/mm³}
L：安装间距（Mounting span distance） mm
A：丝杆轴的最小截面积（Screw Shaft minimum section area）

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

λ：取决于滚珠丝杆安装方法的系数（Factor for Ball Screw mounting method）

支撑-支撑（Supported－Supported）	λ＝π
固定-支撑（Fixed－Supported）	λ＝3.927
固定-固定（Fixed－Fixed）	λ＝4.730
固定-自由（Fixed－Free）	λ＝1.875

◆ 相对于循环部损坏的极限转速
Rotation limits for damage on recirculating parts

关于相对于循环部损坏的极限转速，一般多根据滚珠丝杆的钢珠速度dn值（丝杆轴公称外径×转速）来设定上限值，但对于像KGG滚珠丝杆这样的微型滚珠丝杆，dn值则不适用。KGG滚珠丝杆的循环部损坏极限转速为3,500～4,000rpm左右。该数值会因使用条件及环境而异，详情请垂询本公司。

Generally, regarding critical speed for damage on recirculating parts, limitation is established by dn value, which is multiplied Shaft nominal diameter of revolution, but dn value cannot be applied to Miniature Ball Screws. For KGG Ball Screws, please consider rotation limits by damage on recirculating parts as 3,500 to 4,000rpm. This value varies depending on operating conditions and environment. Please inquire KGG for details.

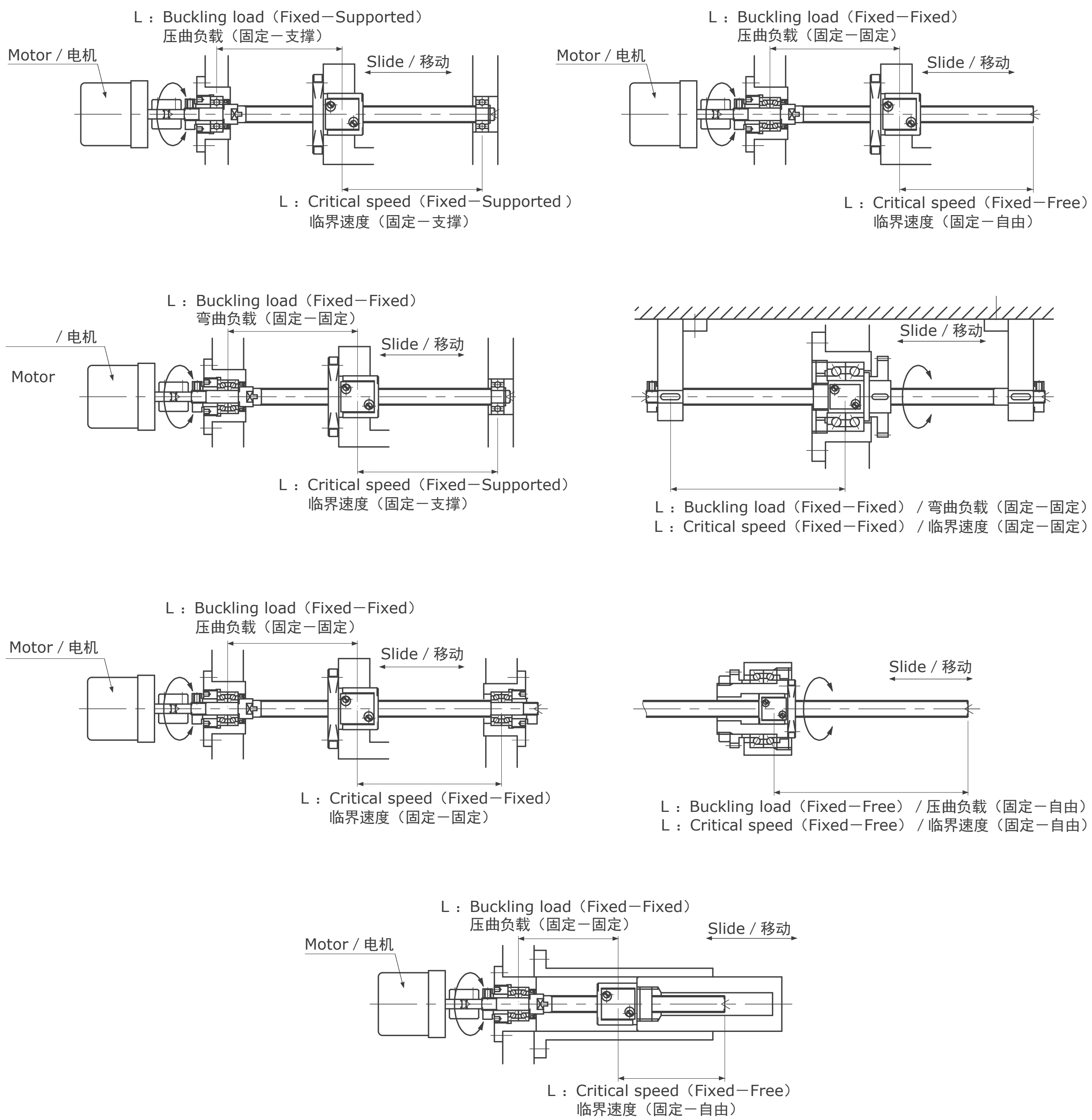
滚珠丝杆的安装方法

BALL SCREW MOUNTING METHODS

滚珠丝杆的典型安装方法如图C-20所示。由于安装方法会影响相对于压曲的许用轴向负载、以及相对于临界速度的许用转速，因此请在设计强度和转速时予以考虑。

Typical Ball Screw's mounting methods are shown in Fig. C-20. Mounting configuration affects permissible Axial load in relation to buckling, as well as permissible speed in relation to critical speed. Please refer to below when studying strength and speed.

图C-20：滚珠丝杆的安装方法
Fig. C-20： Ball Screw mounting methods



轴向间隙和预压

AXIAL PLAY AND PRELOAD

通常，普通的单螺母滚珠丝杆的丝杆轴和螺母之间存在微小的轴向间隙。因此，当单螺母滚珠丝杆上有轴向负载作用时，上述轴向间隙和轴向负载所产生的弹性位移量的和就会导致间隙变大，形成齿隙。为消除这样的齿隙，应使滚珠丝杆的轴向间隙为负，即采用预先向丝杆轴和螺母间施加弹性变形，也就是"预压"的方法。

For standard Single Nut Ball Screws under normal conditions, a slight Axial play exists between the Screw Shaft and Nut. Consequently, when Axial loads act on Single Nut Ball Screws, total amount of Axial play and Elastic displacement due to Axial load becomes backlash. In order to prevent this backlash in Ball Screws, the Axial play can be reduced to a negative value. That is what we cal"l Preload", which is the method of causing Elastic deformation to the Balls between the Screw Shaft and Nut in advance.

◆ 轴向间隙 Axial play

KGG滚珠丝杆的间隙符号和轴向间隙的许用值如表C-21 所示。
滚珠丝杆的精度等级和间隙符号的组合如表C-22所示。

Symbol and permissible value for Axial play are shown in Table C-21.
Combination of accuracy grade and symbol are shown in Table C-22.

表 C-21：间隙符号和轴向间隙的许用值
Table C-21： Symbol and permissible value for Axial play

Unit （单位）：mm

Symbol 间隙符号	0	02	05	20	50
Axial play 轴向间隙	0（Preloading） 0（预压）	0.002 max. 0.002以下	0.005 max. 0.005以下	0.02 max. 0.02以下	0.05 max. 0.05以下

表 C-22：精度等级和间隙符号的组合
Table C-22： Combination of accuracy grade and Axial play

Unit （单位）：mm

Symbol 间隙符号 / Accuracy grade 精度等级	0	02	05	20	50
C0	C0-0	-	-	-	-
C1	C1-0	C1-02	-	-	-
C3	C3-0	C3-02	C3-05	C3-20	C3-50
C5	-	-	C5-05	C5-20	C5-50
C7	-	-	-	C7-20	C7-50
C10	-	-	-	C10-20	C10-50

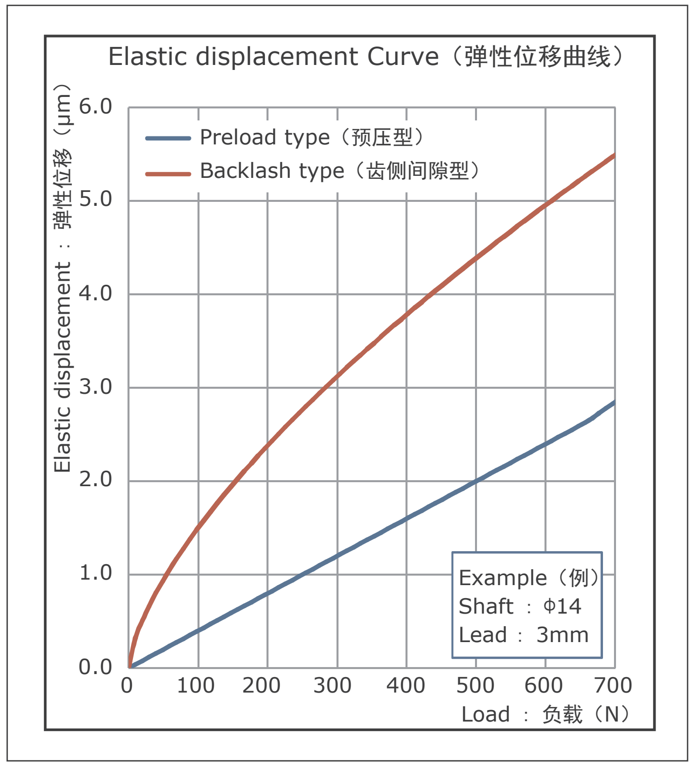
注）希望采用上述以外的组合时，请垂询本公司。
Note）When combinations other than the above are requested, please inquire KGG.

◆ 预压的效果 Preload effect

使用预压，不仅可以消除滚珠丝杆的轴向间隙，还可减少由轴向负载引起的轴向位移量，提高刚性。
图C-23表示间隙规格滚珠丝杆和预压（无间隙）规格滚珠丝杆的轴向负载引起的弹性位移量的不同（理论值）。可以看出，通过预压，可减少（刚性提高）弹性位移量。

Preload is not only used for removing Axial play, it also has the effect of reducing the amount of Axial displacement due to Axial load, and improving the Rigidity in Ball Screws. Fig. C-23 shows the difference of the amount of Elastic displacement (theoretical value) regarding Ball Screw with Axial play and Ball Screw with Preload under the Axial load.

图C-23：间隙规格和预压规格的弹性位移曲线
Fig. C-23： Elastic displacement curve comparison between Backlash type and Preload type



◆ 适当的预压量 Proper amount of Preload

预压量应该由所需刚性或许用齿侧间隙决定，但施加预压后，可能会产生以下影响：
1）动扭矩增大
2）因发热、温度上升而导致定位精度降低
3）缩短使用寿命
因此，应尽可能设定较低的预压量。

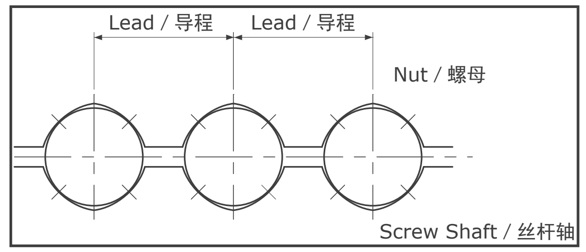
Although the amount of Preload should be determined by the required Rigidity and the permissible amount of backlash, when setting Preload, there are some concerning issues as follows.
1) Increased Dynamic Drag Torque.
2) Heat generation lowering of positioning accuracy due to the temperature rise.
3) Shortened life.
Therefore, it is advisable to establish the amount of Preload at the lowest possible limits.

◆ 预压的方法 Preload methods

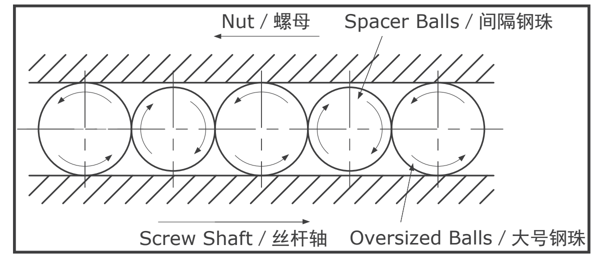
滚珠丝杆一般采用在2个螺母之间插入隔片（填隙片）的预 压方法，即双螺母预压法。KGG滚珠丝杆充分发挥微型滚珠丝杆的特点，采用插入略微大于丝杆轴和螺母间隙的钢珠的预压方法、即“大号钢珠预压”法。利用该方法，只需1个螺母即可完全消除间隙，可保持紧凑结构。另外，通过每隔一处使 用间隔钢珠（略小于施加预压的大号钢珠），避免了动作性能 下降。

Generally, a method of Double Nut Preload by inserting a spacer between two Nuts is adopted. KGG Ball Screw adopts「Oversized Ball Preload」by inserting Balls slightly bigger than space between Screw Shaft and Nut. As a result, it can eliminate Axial play even with a Single Nut and it is possible to maintain compact.Moreover, operating performance will never be deteriorated by using spacer Balls (Balls with slightly smaller diameter than those of the oversize Balls) alternatively with oversize Balls.

图C-24：使用大号钢珠的预压状态
Fig. C-24： Preload by oversized Balls



图C-25：间隔钢珠
Fig. C-25： Spacer Balls

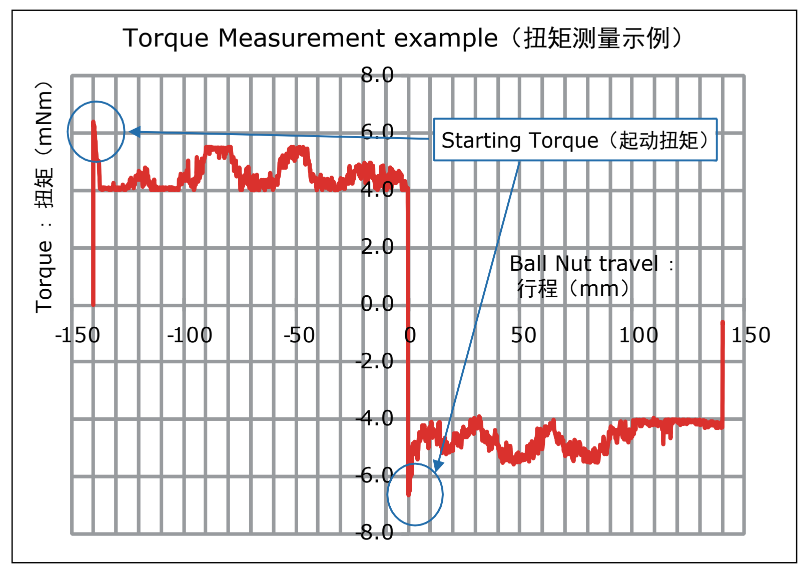


◆ 预压的管理方法 Preload control

直接测量并管理滚珠丝杆的预压量相当困难。因此，通常将 滚珠丝杆的预压换算成预压动扭矩，通过测量该动扭矩来管 理预压。预压动扭矩的值标示在规格图中，与客户协商决定。为了管理预压量（轴向间隙必须为0），预压动扭矩始终在一定的条件下进行测量。因此，润滑条件及使用条件的不同的机 械会导致动扭矩产生差异，敬请注意。此外，起动扭矩（驱动滚珠丝杆时的扭矩）会略大于动扭矩，敬请注意。

It is difficult to control Preload amount by measuring. Therefore, Preload of Ball Screw is controlled by measuring Preload Dynamic Drag Torque, which is converted from Preload amount. Amount of Preload Dynamic Drag Torque is decided with customers by specification drawing. Preload Dynamic Drag Torque is measured under specific condition to verify the amount of Axial play is 0. Dynamic Drag Torque installed actual machine will vary depending on lubricating condition, load condition and so on. Starting torque (Torque for starting Ball Screw) is slightly bigger than Dynamic Drag Torque.

图C-26：动扭矩测量示例
Fig. C-26： Dynamic Drag Torpue measurement



*为便于说明，图中所示的扭矩波动比实际有所夸大。
*Torque wave in this diagram is exaggerated for explanation.

进给丝杆轴系统的刚性
RIGIDITY IN FEED SCREW SYSTEM

在精密机械中，为了提高进给丝杆的定位精度、增强抗负载刚性，必须对进给丝杆轴系统整体的刚性进行探讨。
进给丝杆轴系统的刚性如下所示。

In precision machinery, to improve positioning accuracy of the feed screws or to increase Rigidity for load, the Rigidity of the entire feed screw system must be examined.
Feed screw system Rigidity is as follows.

$$\frac{1}{K} = \frac{1}{K_1} + \frac{1}{K_2} + \frac{1}{K_3} + \frac{1}{K_4} \quad \text{N/mm\{kgf/mm\}}$$

K：进给丝杆轴系统整体的刚性（Total Rigidity of feed screw system） N/mm
K1：丝杆轴的刚性（Screw Shaft Rigidity） N/mm
K2：螺母的刚性（Nut Rigidity） N/mm
K3：支撑轴承的刚性（Support Bearing Rigidity） N/mm
K4：螺母和轴承安装部的刚性（Nut, Bearing fitting part Rigidity） N/mm

◆ 进给丝杆轴系统整体的刚性 Total Rigidity of feed screw system K

$$K = \frac{Fa}{\delta} \quad \text{N/μm}$$

Fa：进给丝杆轴系统承受的轴向负载（Axial load applied to feed screw system） N
δ：进给丝杆轴系统的弹性位移量（Elastic displacement of feed screw system） mm

◆ 丝杆轴的刚性 Screw Shaft Rigidity K_1

（1）普通安装时（轴向为固定—自由时）（图C-27）
In case of general mounting (Fixed-Free in axial direction) (Fig. C-27)

$$K_1 = \frac{A \cdot E}{r} \times 10^{-3} \quad \text{N/μm}$$

（2）两端固定时（图C-28）
In case of Fixed-Fixed mounting in axial direction (Fig. C-28)

$$K_1 = \frac{A \cdot E \cdot L}{r\,(L-r)} \times 10^{-3} \quad \text{N/μm}$$

r=L/2时将产生最大轴向位移，刚性如下所示。
The max. axial displacement occurs when r = L/2. The formula is as follows.

$$K_1 = \frac{4 \cdot A \cdot E}{L} \times 10^{-3} \quad \text{N/μm}$$

A：丝杆轴的最小截面积 (Screw Shaft minimum section area)

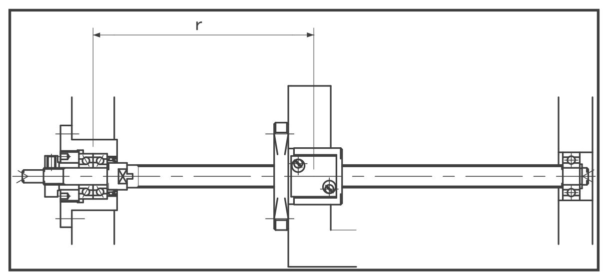
$$A = \frac{\pi}{4} d^2 \quad \text{mm}^2$$

d：丝杆轴底径（Screw Shaft Root diameter） mm
E：杨氏模量（Young's modulus） 2.08×10^5N/mm²（MPa）{21,200kgf/mm²}
l：轴向固定点和螺母中央的距离（Axial distance between fixed point & Nut center） mm
L：安装间距（Mounting span distance） mm

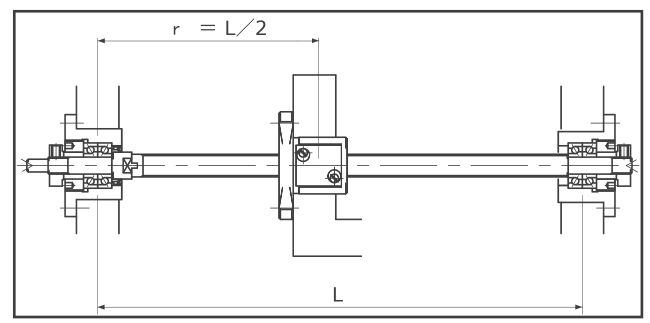
因此，因轴向负载Fa引起的丝杆轴弹性位移量δ可由下式求出。
Accordingly, the amount of Screw Shaft Elastic displacement δ due to Axial load Fa is as follows.

$$\delta = \frac{Fa}{K_1} \quad \text{μm}$$

图C-27：轴向为固定-自由时
Fig. C-27： Fixed-Free in axial direction



图C-28：两端固定时
Fig. C-28： Fixed-Fixed in axial direction



◆ 螺母的刚性 K_2　Nut Rigidity K_2

2018年制定的JIS B1192第4部规定了轴向静刚性的计算公式。KGGI依据JIS规定的计算公式计算理论静刚性。

Calculation formula of static Rigidity is defined by JIS B1192-4 established in 2018. KGGI will use the formula which is defined by JIS to identify the static Rigidity.

（1）单螺母间隙规格的刚性

单螺母间隙规格的螺母理论静刚性K2用下式计算。

(1) Rigidity of Single Nut with backlash

Theoretical static Rigidity (K2) of the Single Nut with backlash is calculated by the formula as follows.

$$K_2 = f_{ar} \times (3/2) \times Fa/\delta \quad (N/\mu m)$$

K_2：螺母的理论静刚性（Theoretical Nut Rigidity）　N/µm
Fa：轴向负载 (Axial Load)　N
δ：轴向负载Fa时的弹性位移量（Amount of Elastic displacement at Axial Load Fa）　µm
f_{ar}：补偿系数（Correction factor）　= 0.67

$$\delta = \times Fa^{2/3} \quad (\mu m)$$

$$k = \frac{C}{Z^{2/3} \times Dw^{1/3} \times (\sin\alpha \times \cos\beta)^{5/3}}$$

K：刚性特性系数（Rigidity characterization factor）
Z：承受负载的滚珠数量（Quantity of loaded Ball）　个(qty.)
Dw：钢珠直径（Diameter of Ball）　mm
α：螺纹槽接触角（Contact angle to the thread groove）　度(deg.)
β：导程角（Lead angle）　度(deg.)
C：由材料、形状、尺寸决定的辅助系数　0.52～0.58
（Coefficient depending on the material, shape and dimension）　(0.52～0.58)

基本额定动负载Ca的30%的轴向负载作用时，螺母的理论静刚性值K2　请见“尺寸表”。轴向负载非基本额定动负载Ca的30%时，可用下式简单计算。

The theoretical static Rigidity K2 of the Nut under an Axial load equivalent to 30% of the Basic Dynamic Load Rating Ca is described in dimension table. For Axial loads which are not 30% of the Basic Dynamic Load Rating Ca, it can be easily calculated by following formula.

$$K`_2 = K_2 \times \left(\frac{Fa}{0.3Ca}\right)^{1/3} \quad N/\mu m$$

K2：尺寸表中标出的螺母刚性值(Nut Rigidity in dimension table)　N/µm
Fa：轴向负载(Axial load)　N
Ca：基本额定动负载(Basic Dynamic Load Rating)　N

(2) 预压规格(零间隙规格)的刚性单螺母预压规格的螺母理论静刚性K2在轴向负载Fa为预压量F_{pr}的 $2\sqrt{2}$ 两倍以下时为固定值，不受轴向负载Fa的影响，用下式计算。

(2) Rigidity of preloaded Ball Nut

Theoretical static Rigidity (K2) of the preloaded single Ball Nut will become a fixed value if axial load (Fa) is less than $2\sqrt{2}$ times of the preload amount (F_{pr}) regardless of the value of the axial load (Fa), and this will be calculated as follows.

$$K_2 = 2^{3/2} \times \frac{1}{K} \times F_{Pr}^{1/3} \quad N/\mu m$$

K　：刚性特性系数(Rigidity Characterization factor)
　　参照上述内容(See formula stated above)
Fpr：预压负载(Preload amount)

预压品(轴向间隙为0)的刚性值也会随预压动扭矩值的偏差而发生变化。
因此，详情请垂询本公司。
此外，轴向负载Fa超过预压量Fpr的两倍时，计算公式与单螺母的理论静刚性值相同。

In case of Preload type Ball Screws, Rigidity varies depending on the dispersion of Preload Dynamic Drag Torque.
Therefore, please inquire KGG for details.
If the axial load (Fa) will be more than times of the preload amount (F_{pr}), the calculation formula will be the same as the formula for single Nut Theoretical static Rigidity.

施加相当于基本额定动负载Ca的5%的预压负载时的螺母理论静刚性值K2请见“尺寸表”。预压负载与上述不同时，可用下式计算。

The theoretical static Rigidity K_2 under a Preload equivalent to 5% (10% for Double Nut) of the Basic Dynamic Load Rating Ca is described in dimension table.
For Preload amounts other than the above,please use the following formula.

$$K`_2 = K_2 \times \left(\frac{F_{pr}}{0.05Ca}\right)^{1/3} \quad N/mm$$

K_2：尺寸表中标出的螺母刚性值（NutRigidity in dimension table）　N/µm
F_{pr}：预压负载（Preload amount）　N
Ca：基本额定动负载（Basic Dynamic Load Rating）　N

◆ 支撑轴承的刚性 K_3　Support Bearing Rigidity K_3

支撑轴承的刚性因所用轴承及其预压量而异，详情请洽询轴承制造商。

Support Bearing Rigidity varies depending on the type of Bearing and amount of Preload. Please inquire Bearing manufacturers.

◆ 螺母和轴承安装部的刚性 K_4　Nut, Bearing fitting part Rigidity K_4

螺母安装部及轴承安装部等的刚性因装置的结构和设计而异，本公司未作具体规定，请尽量采用高刚性设计。

Rigidity of Nut mounting part and Bearing mounting part vary depending on machine structure and design. KGG cannot mention the details but a design of high Rigidity must be considered.

◆ 丝杆轴的扭曲刚性　Screw Shaft torsion Rigidity

与轴向位移相比，扭曲造成的定位误差值很小，需要考虑时， 可由下式求出。

For positioning error due to torsion, this error is a relatively small compared to axial displacement. However, if investigation is required, the following formula may be used for calculation.

$$\theta = \frac{32T\,L}{\pi G d^4} \times \frac{180}{\pi} \times 10 \quad deg$$

θ：扭力矩引起的扭曲角（Torsion angle due to torsion moment）　deg
T：扭力矩（Torsion moment）　N·cm
L：螺母与轴端支撑部的距离（Distance between Nut & Shaft end support）　mm
G：切变模量（Modulus of Rigidity）　$8.3\times10^4 N/mm^2 (MPa)$
d：丝杆轴底径（Screw Shaft Root diameter）　mm

因扭曲角而引起的轴向位移量δa如下所示。

Amount of axial displacement δa due to torsion angle is as follows.

$$\delta a = r \times \frac{\theta}{360} \times 10^3 \quad mm$$

r：导程（Lead）　mm

基本额定负载和基本额定寿命

BASIC LOAD RATING AND BASIC RATING LIFE

◆ 基本额定动负载Ca与基本额定寿命
Basic Dynamic Load Rating Ca and Basic Rating Life

滚珠丝杆的额定寿命是指一组相同的滚珠丝杆在相同的条件下运行时，其中90%的滚珠丝杆的滚珠槽及滚珠表面没有因滚动接触而导致疲劳剥落的状态下的总转数。基本额定动负载Ca是指额定寿命为100万转的轴向负载，该值以Ca标记在尺寸表中。滚珠丝杆的额定寿命L10可利用该基本额定动负载Ca的值，通过下式推算。

The Basic Rating Life of Ball Screws means the total number of revolutions which 90% of the Ball Screws can endure. Failure is indicated by flaking caused by rolling fatigue on the surface of grooves or Balls. These figures are valid when a group of the same type Ball Screws are operated individually under the same conditions. The Basic Dynamic Load Rating Ca is the Axial load for which the Basic Rating Life is 1,000,000 revolutions. These values are listed under Ca in the dimension tables. Ball Screw's Basic Rating Life L10 can be estimated using Basic Dynamic Load Rating Ca in the following formula.

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

不用总转数而用时间L_{10h}或行走距离L_{10d}来表示额定寿命时，可通过以下公式计算。

Also, in place of the total number of revolutions, the Basic Rating Life can be expressed in hours：L10h or traveled distance：L10d, and these can be calculated through the following formulas.

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

Ca：基本额定动负载（Basic Dynamic Load Rating） N
Fa：轴向负载（Axial load） N
N ：转速（Revolution） min^{-1}
r ：导程（Lead） mm
f ：负载系数（Load factor）

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

f=1.0～1.2 几乎无振动、无冲击时
(for almost no vibration, no shock condition)
f=1.2～1.5 稍有振动、冲击时
(for slight vibration, shock condition)
f=1.5～3.0 有强烈振动、冲击时
(for severe vibration, shock condition)

一般情况下，作用于设备的轴向负载并不固定，其运行方式可分为几种。此时，可通过下式求出平均轴向负载Fam、平均转速Nm，然后算出额定寿命。

Generally, Axial load on the most machine is not constant and it can be divided into several operating pattern. In this case, Basic Rating Life can be calculated to figure up average Axial load Fam, average Revolution Nm in the following formula.

Axial load 轴向负载 N {kgf}	Revolution 转速 min^{-1} {rpm}	Working time 使用时间 %
Fa_1	N_1	t_1
Fa_2	N_2	t_2
Fa_3	N_3	t_3

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

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

此外，轴向负载呈直线变化时的平均轴向负载Fam也可通过下式近似求出。

Also, for Axial loads which vary linearly, the average Axial load Fam can be calculated approximately using the following formula.

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

Fa min：最小轴向负载（Minimum Axial load） N
Fa max：最大轴向负载（Maximum Axial load） N

注）滚珠丝杆寿命的计算公式以润滑状态良好、无异物混入为前提，且是在无力矩负载以及径向负载作用的纯轴向负载下的计算公式。
Note）As the Basic Rating Life varies due to lubricating conditions, and contaminations, Moment load or Radial load, etc., this should be considered a rough estimate only.

2018年制定的JIS B1192第5部规定了在计算基本额定寿命时应考虑负载方向和预压负载。因此，小型滚珠丝杆的额定寿命计算也适用以此为基准的计算公式。

Load direction and Preload will be taken into consideration when calculate the Basic Rating Life by JIS B1192-5, which was established in 2018. Therefore, KGG uses a calculation formula of Basic Rating Life for Miniature Ball Screws that is conformed to JIS B1192-5.

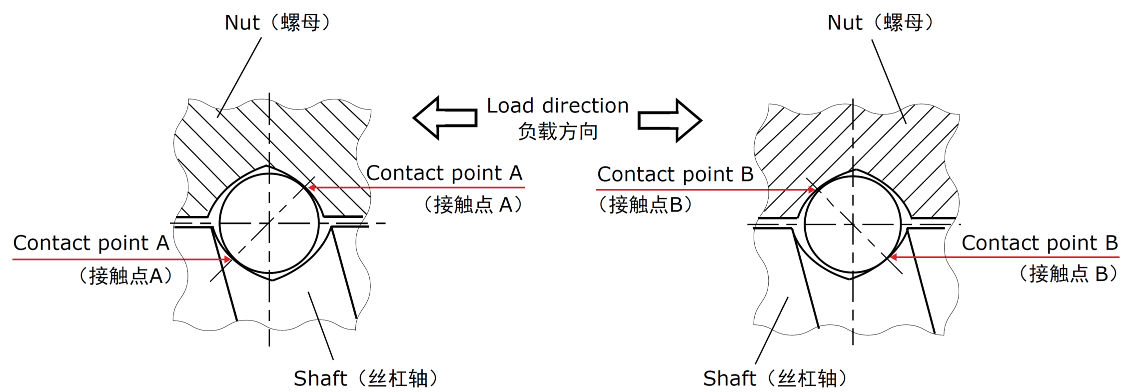
◆ 考虑负载方向的寿命计算
Life calculation considered the Load direction

因为负载方向会导致滚珠的接触点位置发生改变（参照图C-29），所以要计算出各个滚珠接触点的额定寿命，将某一接触点发生剥落（Flaking）的时间点视为寿命。计算公式如下。

Contact point of the Steel Balls changes based on Load direction (see Fig. C-29), therefore it is considered the lifetime when flaking occurred at any contact points, with calculating the Rating Life at each contact point of the Steel Balls.
The calculating formula is as follows.

$$L'_{10} = (L10_{(A)})^{-10/9} + L10_{(B)}^{-10/9}) \quad \text{rev.}$$

L'10 ：接触点A侧与B侧的合成寿命（Merged Basic Rating Life of contact point A and B）
$L10_{(A)}$：滚珠接触点A侧的额定寿命（Basic Rating Life on contact point A）
$L10_{(B)}$：滚珠接触点B侧的额定寿命（Basic Rating Life on contact point B）



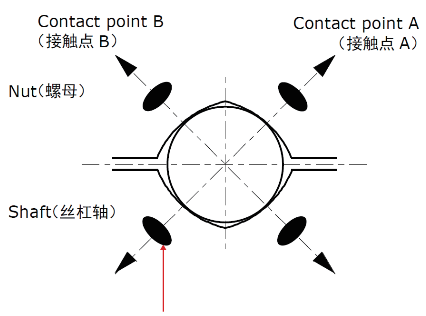
图C-29：各负载方向的钢珠接触状态
Fig. C-29：Ball contact condition by load direction

◆考虑预压负载的寿命计算
Life calculation considered the Preload

负载预压的滚珠丝杆装有大号钢珠，在无负载状态下，钢珠为4点接触。因此要计算出各个滚珠接触点的额定寿命，将某一接触点发生剥落(Flaking)的时间点视为寿命。

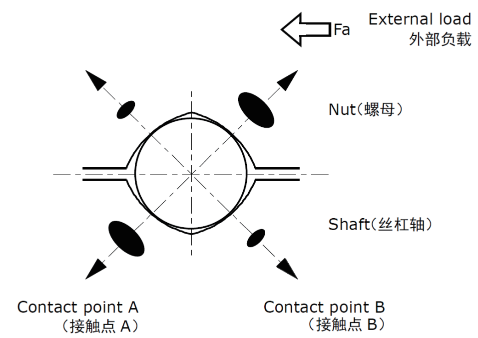
Preloaded Ball Screw is filled with oversized Balls, therefore each Steel Ball is contacted at four (4) points between Screw Shaft and Ball Nut. It is considered the lifetime when flaking occurred at any contact points, with calculating the Rating Life at each contact point.

大号钢珠施加预压时，钢珠接触状态如图C-30所示。弹性位移的大小大致可用椭圆（接触椭圆）表示。在没有外部负载的状态下，接触点A、B的接触状态相同。
The contact point of the Steel Balls is described in Fig. C-30, when Preload is effective by oversized Balls. The amount of Elastic displacement is described schematically by ova (l contact ellipse). Both contact point A and B are evenly contacted under no load from outside.



图C-30：预压作用状态下的钢珠接触状态
Fig. C-30：Ball Contact condition under Preload

外部负载Fa作用于此处后，接触点A侧的弹性位移增大，接触点B侧的弹性位移缩小（图C-31）。此时，作用于接触点A、B的负载根据赫兹的弹性位移理论，可用下式计算。
将其代入基本额定寿命的基本公式，即可计算出各个接触点的额定寿命。
When external load (Fa) is applied, Elastic displacement increases at contact point A, and decreases at contact point B (see Fig. C-31). In this case, the load at contact point A and B can be calculated as below based on the Hertz theory of Elastic displacement.
By substituted each values into the formula of Basic Rating Life, Rating Life of each contact point can be calculated.



图C-31：外部负载作用状态下的钢珠接触状态
Fig. C-31：Ball contact condition under preload & external load

$Fa \leqq 2\sqrt{2}F_{pr}$时　　In case of $Fa \leqq 2\sqrt{2}F_{pr}$

$$Fa_{(A)} = F_{pr} \times \left(1 + \frac{Fa}{2^{3/2} \times F_{pr}}\right)^{3/2} \qquad Fa_{(B)} = Fa_{(A)} - Fa$$

Fa　：外部轴向负载 (Amount of external load)　N
$Fa_{(A)}$：作用于接触点A侧的轴向负载 (Axial load applying on contact point A)　N
$Fa_{(B)}$：作用于接触点B侧的轴向负载 (Axial load applying on contact point B)　N
F_{pr}　：预压负载 (Preload)　N

$Fa > 2\sqrt{2}F_{pr}$时　　In case of $Fa > 2\sqrt{2}F_{pr}$

$Fa(A) = Fa$　　$Fa(B) = 0$

注）A和B的负载方向相反。　　Note) Load direction of A and B is opposite.

使用通过上式计算出的轴向负载值，计算接触点A、B的额定寿命（L10 (A)、L10 (B)），计算由二者合成的组合寿命。
Using the value calculated by the above formula, calculate the Rating Life at each contact point A and B (L10 (A), L10 (B)), then merge both value to calculate the merged Basic Rating Life.

$$L10_{(A)} = \left(\frac{Ca}{f \cdot Fa_{(B)}}\right)^3 \times 10^6 \quad \text{rev.}$$

$$L10_{(B)} = \left(\frac{Ca}{f \cdot Fa_{(B)}}\right)^3 \times 10^6 \quad \text{rev.}$$

$$L'_{10} = (L10_{(A)}{}^{-10/9} + L10_{(B)}{}^{-10/9})^{-10/9} \quad \text{rev.}$$

注）粗略计算时，有时也会简单地将外部负载与预压负载Fpr之和作为轴向负载计算寿命。
Note) As a rough estimation of Basic Rating Life, we consider the Axis load as external load added by preload amount Fpr for some cases.

◆ 基本额定静负载Coa　Basic Static Load Rating Coa

基本额定静负载Coa是指在承受最大应力的接触部，使钢珠的滚动面和钢珠的永久变形量的和为钢珠直径的1/10000的轴向静止负载。该值以Coa标记于尺寸表中。该基本额定静负载Coa的值用于探讨静止状态或转速非常低（10min^{-1}以下）时的负载条件。上述的永久变形量在多数情况下不影响使用。此时，螺纹槽部的最大许用负载Fa max可由下式求出。

The Basic Static Load Rating Coa is the Axial Static load at which the amount of permanent deformation (Ball ＋Raceway) occurring at the maximum stress contact point between the Ball and Raceway surfaces is 1/10,000 times the Ball diameter. These values are listed under Coa in the dimension tables. The Basic Static Load Rating Coa values apply to investigation of stationary state or extremely low Revolution load conditions (less than 10 rpm). However, in most cases the amount of permanent deformation causes absolutely no problems under the general conditions.
The maximum permissible load Fa max for the screw groove can be found by using the following formula.

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

fs：静态安全系数（Static safety factor）
　fs=1～2　正常运行时（for normal operation）
　fs=2～3　有振动、冲击时（for vibration, shock）

◆ 硬度系数　Hardness coefficient

表面硬度小于HRC58（654 Hv10）时，需要对基本额定动负载Ca和基本额定静负载Coa进行补偿。通过下式进行补偿。

For Surface hardness of less than HRC58 (654 Hv10), the Basic Dynamic Load Rating Ca and the Basic Static Load Rating Coa must be adjusted. Adjustment is made by the following formula.

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

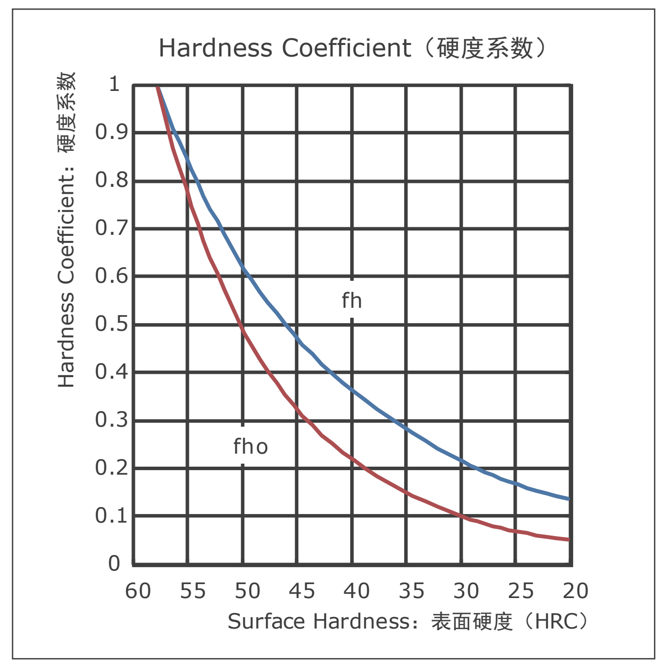
$$Coa' = f_{ho} \cdot Coa \quad (N)$$

$$f_h = \left(\frac{H_a}{654}\right)^3 \leqq 1$$

$$f_{h0} = \left(\frac{H_a}{654}\right)^3 \leqq 1$$

fh, fho：硬度系数（右图）
Hardness coefficient
（See formula above and graph right）

Ha：维氏硬度
（Vickers hardness）　Hv10



驱动扭矩

DRIVING TORQUE

进给丝杆系统的驱动扭矩T由下式求出。

The feed screw system Driving Torque T is expressed according to the following formula.

$$T=T_1+T_2+T_3+T_4 \quad N\cdot m$$

T1:	加速产生的扭矩（Acceleration Torque）	N·m
T2:	负载扭矩（Load Torque）	N·m
T3:	预压动扭矩（Preload Dynamic Drag Torque）	N·m
T4:	其他扭矩（Additional Torque）	N·m

选择电机时需考虑进给丝杆系统产生的扭矩。
T1～T3可由下式求出。

When Motor selection, the feed screw system Driving Torque is needed.
T1～T3 can be calculated by the following formula

◆ 加速产生的扭矩　Acceleration Torque　T1

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

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

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

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

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

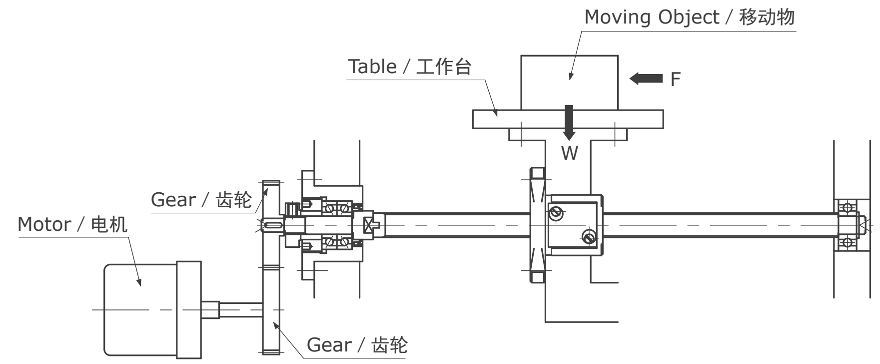
$$m_s=\pi\left(\frac{d}{2}\right)^2\times L\times\gamma \quad kg$$

α ：	角加速度（Angular acceleration）	rad/sec^2
I ：	惯性矩（Inertia moment）	$kg\cdot m^2$
Iw：	移动物的电机轴换算的惯性矩（Inertia moment of moving object by Motor axial conversion）	$kg\cdot m^2$
Is ：	丝杆轴的惯性矩（Inertia moment of Screw Shaft）	$kg\cdot m^2$
I_A ：	丝杆轴侧的齿轮等的惯性矩（Inertia moment of gears on screw side）	$kg\cdot m^2$
I_B ：	电机侧的齿轮等的惯性矩（Inertia moment of gears on motor side）	$kg\cdot m^2$
m_w：	移动物质量（Mass of moving object）	kg
m_s：	丝杆轴质量（Mass of Screw Shaft）	kg
r ：	导程（Lead）	m
d ：	丝杆轴外径（Screw Shaft diameter）	m
L ：	丝杆轴长度（Ball Screw length）	m
γ ：	比重（Specific gravity）	$7{,}850kg/m^3$
A ：	减速比（Reduction ratio）	
N ：	电机转速（Motor speed）	min^{-1}
t ：	加速时间（Acceleration time）	sec

◆ 负载扭矩　Load Torque　T2

$$T_2=\frac{p\cdot r\cdot A}{2\pi\eta}\times10^{-3}=\frac{(F+mW)}{2\pi\eta}\cdot r\cdot A\times10^{-3} \quad N\cdot m$$

P ：	轴向负载（Axial load）	N
F ：	负载（Load）	N
m：	移动物重量（Weight of moving object）	kg
g ：	重力加速度（Gravity acceleraration）=9.8×103 mm/sec2	
r ：	导程（Lead）	mm
μ ：	滑动面摩擦系数（Sliding surface friction coefficient）	
η ：	效率（Efficiency）0.9	
A ：	减速比（Reduction ratio）	



◆ 预压动扭矩　Preload Dynamic Drag Torque　T3

$$T_3=0.05\times(\tan\beta)^{-0.5}=\frac{Fa\cdot r}{2\pi}\times10^{-3} \quad N\cdot m$$

β ：	导程角（Lead angle）	deg
Fa：	预压负载（Preload）	N
r ：	导程（Lead）	mm

◆ 其他扭矩　Additional Torque　T4

指上述以外时产生的扭矩。例如支撑轴承的摩擦扭矩及油封滑动阻力产生的扭矩等。

Described as Torque which occurs in addition to those listed above. For example, support Bearing friction Torque, oil seal resistance Torque, etc.

防锈与润滑
RUST PREVENTION AND LUBRICATION

◆ 防锈处理　Rust prevention

KGG滚珠丝杆以长期存放为前提，涂抹有防锈油。使用前请用清洁的精制煤油将其洗净，并涂抹润滑油或油脂。根据客户的需求，也可在出厂前涂抹油脂，但长期存放时可能会导 致丝杆生锈，敬请注意。

注）KGG涂抹的防锈油侧重于防锈性能，并不具备润滑性能。因此，如果在涂有防锈油的状态下直接使用，可能会缩短丝杆寿命、导致扭矩变大、异常发热等问题。

KGG Ball Screws are applied anti-rust oil when shipping　in case of no specific instruction. This oil should be removed before use. Wash Ball Screws with cleaned Kerosine and apply lubrican(t　Grease or Oil) on Ball Screws. As customer's request, specified Grease or Oil can be applied, but it should be noted that they are not suitable for long term storage purpose and rust might occur.

Note) Anti-rust oil is focused on anti-rust performance and it does not have lubricating function.Therefore, when using Ball Screws with anti-rust oil coating, the problems such as shortened Life, increase of Torque and abnormal heat generation occurs.

◆ 润滑　Lubrication

使用滚珠丝杆时，必须涂抹润滑剂。否则会造成扭矩变大或缩短丝杆使用寿命等问题。涂抹润滑剂可以抑制因摩擦而导致的升温、机械效率下降，以及因磨损而导致的精度下降。滚珠丝杆的润滑方式分为油脂润滑和油润滑。使用油脂润滑时，一般建议使用锂皂基油脂；使用油润滑时，建议使用ISO　VG32～68（透平油）。此外，根据用途选择润滑剂也非常重要。特别是微型滚珠丝杆，油脂的搅拌阻力可能会引起扭矩变大等不良情况。本公司备有可在维持滚珠丝杆动作特性的。

同时，发挥优异润滑性能的KGG原装油脂。用于注重动作特性的低速定位时，备有MSG　　No.1（稠度1号）油脂；用于高速、一般用途时，备有GHY No.2（稠度 2号）油脂。详情请参照目录第C101页的“微型滚珠丝杆专用油脂”。

In Ball Screw use, lubricant should be required. If lubricant is not applied with, the problem such as increase of Torque and shortened Life occurs. Applying lubricant can minimize temperature increases, decline of mechanical efficiency due to friction, and deterioration of accuracy caused by wear.Ball Screw lubrication is divided into Greasing and Oiling. A regular lithium-soap-based Grease and ISO VG32-68 Oi(lturbine Oil #1 to #3) are recommended.It is highly important to choose lubricant depending on customer's usage. Especially in case of Miniature Ball Screws, malfunction such as increase of Torque are caused by the stir resistance.

KGG original Greases which maintains Ball Screw's smooth movement and have high lubricating performance are prepared. MSG No.1 is appropriate for high smooth requirement and high positioning usage(consistency 1). GHY No.2 is suitable for high speed and general usage(consistency 2). Please refer to catalogue page C101「Original Grease for Miniature Ball Screws」.

一般使用条件下的润滑剂示例
Recommended lubricants for normal operating conditions

Lubricant 润滑剂	Type 种类	Product name 产品名称
Grease 油脂	Lithium-based Grease 锂基油脂	KGG original Grease GHY No.2 KGG原装油脂 GHY No.2
Lubricating Oil 润滑油	Sliding surface Oil or turbine Oil 滑动面油或透平油	Super Multi 68 Super Multi68

◆ 检查和补充　Inspection and replenishment

使用油脂润滑时，大致检查时间为每2～3个月，使用油润滑时为每隔1周。检查时，请检查油量及有无脏污，并根据需要加油。在追加新油脂时，请尽量擦掉旧的并已变色的油脂。

Grease inspection should be performed once every two to three months, and Oil inspection should be performed approximately weekly. Check the Oil or Grease amount and contamination at each inspection and replenish if needed. When re-greasing, the old or discolored one should be wiped off as much as you can.

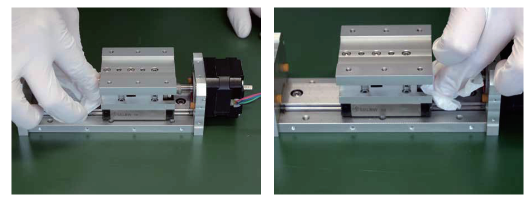
润滑剂的检查和补充时间间隔
Inspection and replenishment Interval of lubricant

Lubrication 润滑方法	Inspection frequency 检查时间间隔	Inspection Items 检点项目	Replenishment and replacement frequency 补充或更换时间间隔
Automatic intermittent lubrication 自动间歇加油	Weekly 每隔1周	Oil level, contamination 油量、脏污等	Replenish at each inspection, depending on tank capacity 根据油箱容量，在每次检查时适量补充
Grease 油脂	Every 2 to 3 months initially 运行初期2～3个月	Contamination, swarf contamination 脏物、切屑的混入等	Replenish annually or as necessary, depending on Inspection results 通常每1年补充一次，但应根据检查结果适量补充
Oil bath 油浴	Daily before operation 每天开工前	Oil suface check 油面管理	Set a rule for replenishment as necessary, depending on amount of wear. 根据消耗情况适当规定。

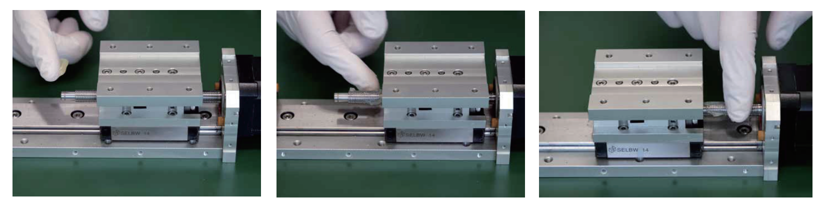
◆ 加注润滑脂的步骤(例)　Grease-up Procedure(Example)

1） 加注润滑脂时，请佩戴橡胶手套，切勿直接用手触摸滚珠丝杆。
It is desirable to wear rubber gloves, not to handle Ball Screw by bear hand.

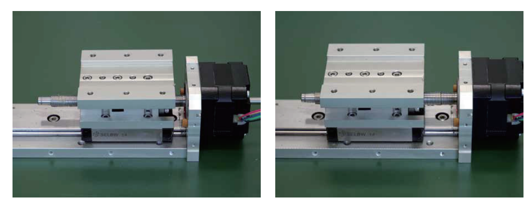
2） 使用专用巾（金伯利擦拭纸等）擦去丝杆轴上附着的变色的润滑脂。请移动螺母，尽可能擦去残留在螺母内的润滑脂。
Wipe off discolored Grease on the Screw Shaft by using cloth or paper exclusive for wiping Grease or oil （e.g.: Kim Wipes by Kimberly-Clark Corp.）.Move the Ball Nut to wipe off remaining Grease inside the Ball Nut as much as possible.



3） KGG滚珠丝杆未标准设置加油孔。因此，要将润滑脂涂遍整个丝杆轴。请使用专用刷具或佩戴橡胶手套，直接在丝杆轴上涂抹。螺母上若有加油孔，请使用加油孔封入新润滑脂。
There is no oil hole on the flange for KGG Ball Screws as standard design, apply Grease entirely throughout the Screw Shaft. Please use the brush exclusive for applying Grease, or apply directly to the Screw Shaft by hand with wearing rubber gloves. If the Ball Nut has an oil hole, utilize it to fill in the new Grease.



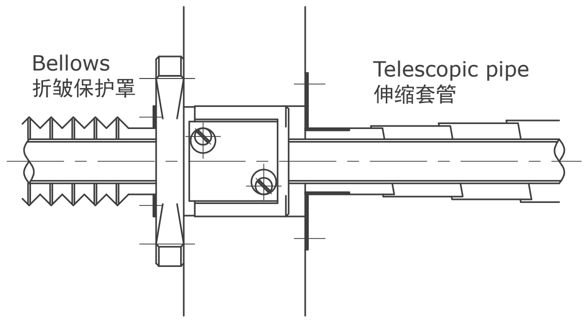
4） 在整根丝杆轴上移动螺母，在尚未涂抹到的部分也涂抹润滑脂。尽可能使螺母往复移动多次，进行简单的磨合。请擦去积存于轴端的多余润滑脂。
In order to apply Grease entirely on the Screw Shaft, move the Ball Nut over full travel manually, or install in the device and do running-in.Remove any remaining Grease on either end of the Screw Shaft.



防尘
DUST PREVENTION

滚珠丝杆的螺母内如果混入脏物或异物，可能会导致过早磨损、螺纹槽损伤、钢珠破裂和循环部损坏等，从而使滚珠丝杆无法工作。如果可能有上述情形发生，建议采取折皱保护罩和伸缩套管等防尘措施，以避免丝杆部外露。

In Ball Screws, if dust or other contaminations intrude into the Ball Nut, wear is accelerated, the screw groove will be damaged, circulation will be obstructed due to Ball fracture, damage of recirculation parts and so on.Eventually, the Ball Screws will cease to function. Where the possibility of dust or other contaminant exists, the screw thread section cannot be left exposed, and dust prevention measure such as a bellows or Telescopic pipe must be taken.



图C-32： 折皱保护罩和伸缩套管
Fig. C-32： Bellows & Telescopic pipe

KGG滚珠丝杆充分发挥微型滚珠丝杆的特点，重视小型化设计。因此，目录中介绍的型号均为不带密封的尺寸。需要密封时，请垂询本公司。螺母尺寸可能会因安装密封而发生变化，敬请注意。此外，某些型号不能安装密封，敬请谅解。

KGG Ball Screws are concentrated on compact design for a feature of Miniature Ball Screw. Therefore, all models in the catalogue are the dimension without seals. Please inquire KGG if seals are required. Please note that Nut dimension may change due to seal installation. Some models cannot install the seals.

表面处理
SURFACE TREATMENT

出于防锈目的，本公司可对滚珠丝杆实施表面处理。本公司的防锈表面处理以极低温黑铬处理为标准。需要其他表面处理时，请垂询本公司。

Surface treatment can be possible for the purpose of rust prevention. Very Low temp. Black Chrome treatment （BCr） is KGG standard surface treatment for the purpose of rust prevention. Please inquire KGG if other surface treatments are needed.

◆ KGG黑铬处理滚珠丝杆的特点 Feature of KGG Ball Screws with Black Chrome (BCr) coating

·涂层薄（2~3μm），可安装配合零件。
·在严格的工序管理下，涂膜的厚度均一，不会影响滚珠丝杆的动作特性。
·覆膜密接性良好，具有优异的防锈能力。
·是MIL标准（MIL-DTL-14538D）公认的表面处理品。
·需提高滑动特性时，可一并进行氟树脂涂层。

·Due to thin film thickness (2~3μm) , mating part can be applicable with BCr.
·Due to strict production management,film thickness can be treated equally and smoothness is kept.
·High anti-rust ability is possible.
·The surface treatment is officially authorized by MIL standard (MIL-DTL-14538D)
·To improve sliding characteristics, BCr+fluorine resin coating is also available.

照片C-33： 极低温黑铬处理品
PhotoC-33： Very Low temp. Black Chrome coating

◆ 防锈能力试验数据 Examination data of anti-rust ability

根据盐水喷雾试验，使用标准试样进行的防锈能力评估结果如下所示。

Based on the salt spray corrosion test（JIS Z2371）, anti-rust ability has been evaluated, as follows.

·标准试样 / Standard test piece： 70mm×150mm×1mm（SPCC材/ material=SPCC ）
·数据 / Data： 盐水喷雾试验24小时后的外观和评价数法的评估结果（数值越小，腐蚀越严重）
Evaluated by appearance and rating number method
after 24 hours of salt spray corrosion test.（The less number, the more corrosion）

	Rating number（Average） 评价数(平均值)
Sample A（BCr coating） 试样A（BCr处理）	9.3
Sample B（R coating） 试样B（R处理）	9～8
Sample C（M coating） 试样C（M处理）	3～4

Sample A
试样A

Sample B
试样B

Sample C
试样C

◆ ROHS指令的符合性 About RoHS compliance

KGG黑铬处理后的滚珠丝杆的Cr^{+6}量低于RoHS指令规定的阈值，完全符合RoHS指令。

The Cr^{+6} amount of KGG Black Chrome（BCr）coating is less value than the based on RoHS regulation.

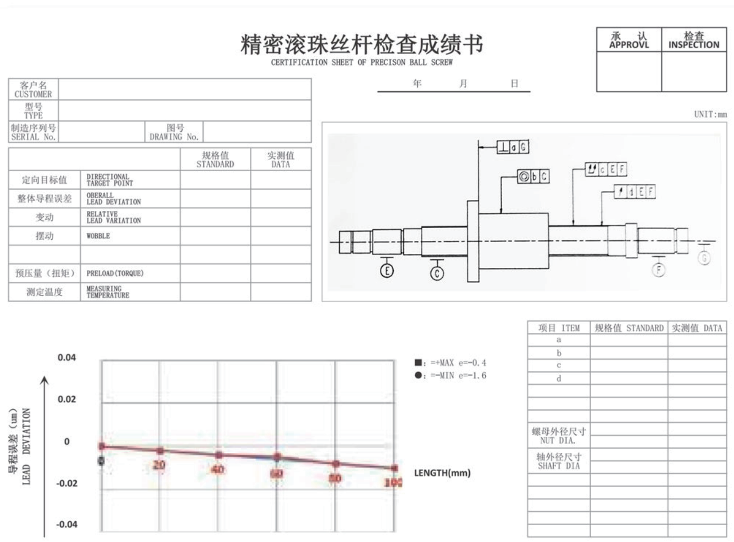
可追溯性
TRACEABILITY

KGG滚珠丝杆的生产采用严格精选的材料，使用先进的生产的设备，在严格的温度管理下进行，从各生产工序到产品检查、出厂，采用一条龙的生产管理体。

如照片C-34所示，出厂检查合格的滚珠丝杆会发放合格证。如有需要，也可提供检查结果表（照片C-35）。

KGG Ball Screws are manufactured from rigidly selected materials in our temperature controlled factory. They are manufactured using the latest production equipment, with consistent quality control supervision ranging from the production process to inspection and shipping.
Certificate of inspection, Photo C-34, will be attached with the Ball Screws which pass shipping inspection. Inspection report can be handed in as customer's request shown in Photo C-35.

照片 C-34



照片 C-35

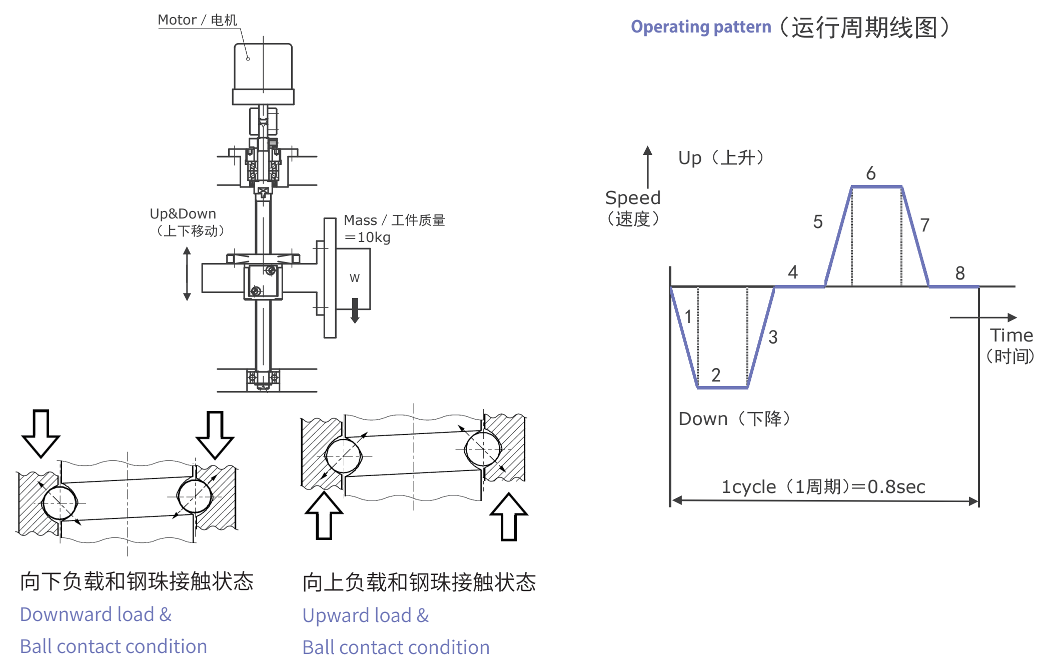
滚珠丝杆各种特性的计算示例
CALCULATION EXAMPLE OF CHARACTERISTIC FOR BALL SCREWS

2018年制定的JIS B1192第5部规定了在计算基本额定寿命时应考虑负载方向和预压负载。因此，小型滚珠丝杆的额定寿命计算也适用以此为基准的计算公式。

Calculation example of characteristic for Ball Screws are mentioned as follows. Each calculation example is modeled so that there is a case which is unrealistic.

例 1：竖轴规格 Pick&Place
Example 1: Vertical Pick&Place

滚珠丝杆的型号和使用条件
Ball Screw model and operating condition



图C-37：负载方向和钢珠接触状态
Fig. C-37：Load direction and Ball Contact condition

对于竖轴规格用途，计算寿命时考虑负载方向（滚珠接触点）。本事例以向下为正，向上为负。各负载方向的钢珠接触状态如图C-37所示。

Load direction (Ball contact point) should be considered in calculation of lifetime for Vertical axis application. Load direction is defined as plus for downward, and as minus for upward. The status of Ball contact point is indicated in Fig. C-37.

滚珠丝杆的主要技术参数	Ball Screw spec.
轴径＝ϕ10mm	Shaft dia.＝ϕ10mm
导程＝10mm	Lead＝10mm
基本额定动负载Ca＝3,300N	Dynamic Capacity Ca＝3,300N
滚珠丝杆总长＝180mm	Total length＝180mm
轴向间隙＝20μm以下	Axial play＝20μm or less

运行条件	Operating Pattern
最高速度＝0.4m/sec	Max Speed＝0.4m/sec
**导程10mm时2,400 $\min^{-1}$	** 2,400 $\min^{-1}$ because of Lead 10mm
加减速时间＝0.05sec	Acceleration & Deceleration time＝0.02sec
**图中1357	**①③⑤⑦ in diagram above
等速时间＝0.1sec	Constant speed time＝0.2sec
**图中26	**②⑥ in diagram above
停止时间＝0.2sec	Halt time＝0.1sec
**图中48	**④⑧ in diagram above
1周期＝0.8sec	Cycle time＝0.68sec

基本额定寿命的计算
Calculation of Basic Rating Life

基本额定寿命按以下步骤计算得出。
Basic Rating Life is calculated in the following procedure.

各种运行方式下的负载条件的计算 Calculation of Load condition for each operating pattern.
→ 各种运行方式下的速度条件的计算 Calculation of Speed condition for each operating pattern.
→ 各负载方向（滚珠接触点）的等价负载、等价转速的计算 Calculation of Equivalent load, Equivalent revolution in each Load direction（Ball contact point）.
→ 各负载方向（滚珠接触点）的额定寿命的计算 Calculation of Basic Rating Life for each Load direction（Ball contact point）.
→ 由各负载方向（滚珠接触点）的额定寿命合并而成的额定寿命的计算 Calculation of merged Basic Rating Life in each Load direction（Ball contact point）.
→ 考虑停止时间的总寿命的计算 Calculation of total Life with taking halt time into consideration.

1）根据周期线图（运行方式）计算负载条件
带编号的各种运行方式的负载条件
如下所示。

①下降加速
$Fa_1 = mg - m\alpha = 10 \times 9.807 - 10 \times 20 = -101.9$（N）
②下降等速
$Fa_2 = mg = 10 \times 9.807 = 98.1$（N）
③下降减速
$Fa_3 = mg + m\alpha = 10 \times 9.807 + 10 \times 20 = 298.1$（N）
④停止
$Fa_4 = 0$
⑤上升加速
$Fa_5 = mg + m\alpha = 10 \times 9.807 + 10 \times 20 = 298.1$（N）
⑥上升等速
$Fa_6 = mg = 10 \times 9.807 = 98.1$（N）
⑦上升减速
$Fa_7 = mg - m\alpha = 10 \times 9.807 - 10 \times 20 = -101.9$（N）
⑧停止
$Fa8 = 0$

式中，
m：移动物质量 = 10 kg
g：重力加速度 = 9.807 m/sec²
α：加速度
达到0.4m/sec前的加速度
$\alpha = 0.4/0.02 = 20$ m/sec²

1) Calculation of Load condition from Operating pattern
Load condition of each operating pattern which is numbered is as follows.

①Down & Acceleration
$Fa_1 = mg - m\alpha = 10 \times 9.807 - 10 \times 20 = -101.9$（N）
②Down & Constant speed area
$Fa_2 = mg = 10 \times 9.807 = 98.1$（N）
③Down & Deceleration
$Fa_3 = mg + m\alpha = 10 \times 9.807 + 10 \times 20 = 298.1$（N）
④Halt
$Fa4 = 0$
⑤Up & Acceleration
$Fa_5 = mg + m\alpha = 10 \times 9.807 + 10 \times 20 = 298.1$（N）
⑥Up & Constant speed area
$Fa_6 = mg = 10 \times 9.807 = 98.1$（N）
⑦Up & Deceleration
$Fa_7 = mg - m\alpha = 10 \times 9.807 - 10 \times 20 = -101.9$（N）
⑧Halt
$Fa_8 = 0$

Here,
m：Mass = 10 kg
g：Gravity Acceleration = 9.807 m/sec²
α：Acceleration
Acceleration up to 0.4m/sec
$\alpha = 0.4/0.02 = 20$ m/sec²

2）根据周期线图（运行方式）计算速度条件
带编号的各种运行方式的速度条件（转速条件）如下示。

等速时（②、⑥）：
0.4m/sec = 400 × 60 mm/min = 24,000mm/min
= 2,400 $\min^{-1}$（导程10mm时）
加减速时（①、③、⑤、⑦）：
上述的平均转速为2,400/2 = 1,200 $\min^{-1}$

2) Calculation of Speed condition from Operating pattern
Speed condition（Revolution condition） of each operating pattern which is numbered is as follows.

Constant speed area（②、⑥）；
0.4m/sec = 400 × 60 mm/min = 24,000mm/min
= 2,400 $\min^{-1}$（Lead 10mm）
Acceleration and deceleration area（①、③、⑤、⑦）；
as an average revolution above, 2,400/2 = 1,200 $\min^{-1}$

各种运行方式下的负载条件和速度条件（转速条件）的计算结果如下表所示。
Calculation result of the load condition and speed condition (revolution) for each operating patterns are as below.

Condition 条件	Axial load 轴向负载 Fa(iN)	Revolution 转速 N(min^{-1})	Frequency of use 使用频率 ti(sec)
①Down & Acceleration / 下降加速	−101.9	1,200	0.02
②Down & Constant speed / 下降等速	98.1	2,400	0.2
③Down & Deceleration / 下降减速	298.1	1,200	0.02
④Halt / 停止	0	0	0.1
⑤Up & Acceleration / 上升加速	298.1	1,200	0.02
⑥Up & Constant speed / 上升等速	98.1	2,400	0.2
⑦Up & Deceleration / 上升减速	−101.9	1,200	0.02
⑧Halt / 停止	0	0	0.1

负载条件中，＋（正）为向下负载，—（负）为向上负载。
plus(＋) indicates downward load and minus(—) indicates upward load.

3） 分别计算各负载方向（滚珠接触点）的等价负载、等价转速
Calculation of Equivalent load, Equivalent revolution for in each Load direction （Ball contact poin）

计算出各运行方式下作用的负载和方向后，下面分别计算各负载方向（滚珠接触点）的等价负载、等价转速。等价负载、等价转速的计算使用第C1-125页的计算公式。
As we could calculate the applying load and direction in each operating pattern, now we calculate the Equivalent load and Equivalent revolution for each Load direction. Calculation formula shown in page C1-125 will be used for calculating Equivalent load and Equivalent revolution.

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

$$N_m = \left(\frac{N_1 \cdot t_1 + N_2 \cdot t_2 + N_3 \cdot t_3 + ... + N_i \cdot t_i}{t_1 + t_2 + t_3 + ... + t_i} \right) \quad min^{-1}$$

各负载方向（滚珠接触点）的运行条件及其各自的等价负载、等价转速的计算结果如下表所示。
Now calculation table should be re-arranged as below by load direction, and Equivalent load and Equivalent evolution in each load direction are as follows.

Condition 条件	Downward load / 向下负载		Upward load / 向上负载		Frequency of use 使用频率 ti(sec)
	Axial load 轴向负载 Fa(iN)	Revolution 转速 N(min^{-1})	Axial load 轴向负载 Fa(iN)	Revolution 转速 N(min^{-1})	
①Down & Acceleration / 下降加速	—	—		1,200	0.02
②Down & Constant speed / 下降等速	98.1	2,400	—	—	0.2
③Down & Deceleration / 下降减速	298.1	1,200	—	—	0.02
④Halt / 停止	—	—	—	—	0.1
⑤Up & Acceleration / 上升加速	298.1	1,200	—	—	0.02
⑥Up & Constant speed / 上升等速	98.1	2,400	—	—	0.2
⑦Up & Deceleration / 上升减速	—	—	101.9	1,200	0.02
⑧Halt / 停止	—	—	—	—	0.1
Equivalence 等价	Fam（d）＝129.3	Nm（d）＝2,290.9	Fam（u）＝101.9	Nm（u）＝1,200	Working duration（运行）：0.48sec Halt time（停止）：0.2 sec 1 cycle（1周期）：0.68 sec

4）计算各负载方向(滚珠接触点)的额定寿命使用
Calculation of Basic Rating Life for each Load direction（Ball contact point）

使用各负载方向（滚珠接触点）的等价负载、等价转速，计算向下负载、向上负载的额定寿命。
Then calculate the Basic Rating Life for downward load, upward load by using the value of Equivalent load, Equivalent revolution in each load directi（Ballcontact point）.

【向下负载】【Downward load】
将等价负载Fam（d）和等价转速Nm（d）代入第C1-125页的寿命计算公式中，可得出以下结果。
Substitute the Equivalment Load Fam（d） and Revolution Nm（d） in the following formula in page C1-125.

$$L10h（d） = \left(\frac{Ca}{f \cdot Fam（d）} \right)^3 \times \left(\frac{10^6}{60 \cdot Nm（d} \right)^3 = 69,991 \text{ 小时（hours）}$$

其中，假设基本额定动负载Ca＝3,300N、负载系数f＝1.2。
Here, Basic Dynamic Load Rating Ca = 3,300N, Load factor f = 1.2.

【向上负载】【Upward load】
向上负载也可用同样的方式计算。
Calculate the upward load as same method as above.

$$L10h（u） = \left(\frac{Ca}{f \cdot Fam（d）} \right)^3 \times \left(\frac{10^6}{60 \cdot Nm（d} \right)^3 = 272,988 \text{ 小时（hours）}$$

5） 计算由各负载方向（滚珠接触点）的额定寿命合并而成的额定寿命
Calculation of merged Basic Rating Life in each Load direction（Ball contact point）

使用第C1-126页的公式，计算由各负载方向（滚珠接触点）的额定寿命L10h（d）、L10h（u）合成的组合寿命。
Calculate the merged Basic Rating Life by combining the Basic Rating Life of each Load direction（L10h（d）, L10h（u））, with the calculation formula of page C1-126.

$$L'10h = （L10h（d）^{-10/9} + L10h（u）^{-10/9}）^{-10/9} = 58,504 \text{ 小时（hours）}$$

6）考虑停止时间的总寿命的计算
Calculation of total Life with taking halt time into consideration

上述计算只是运行时间的计算结果，计算总寿命还需要考虑1个周期中的停止时间。
Above calculation is only for the working duration, therefore calculate the total Life with taking halt time in each cycle into consideration.

$$L''10h = L'10h \times（\text{周期时间 cycle time}）/（\text{运行时间 working duration}） = 58,504 \times（0.68 / 0.48） = 82,881 \text{ 小时（hours）}$$

进给丝杆系统的驱动扭矩的计算
Calculation of Driving Torque for feed screw system

根据第C1-129页计算进给丝杆系统的驱动扭矩。这在选择电机时非常重要。上述示例并非预压规格的滚珠丝杆，所以不产生预压动扭矩。因此只计算加速扭矩T_1、负载扭矩T_2。

Calculate Driving Torque for Linear Motion system according to page C1-129. It is important for motor selection. In the above case, due to backlash type Ball Screw, Preload Dynamic Drag Torque does not occur. Therefore, calculate acceleration Torque T1 and Load Torque T2.

$$T = T_1 + T_2 + T_3 + T_4 \quad N\cdot m$$

T_1：加速产生的扭矩（Acceleration Torque） N·m
T_2：负载扭矩（Load Torque） N·m
T_3：预压动扭矩（Preload Dynamic Drag Torque） N·m
T_4：其他扭矩（Additional Torque） N·m

1）加速扭矩T_1的计算（Calculation of acceleration Torque T_1）

$$T_1 = \alpha \cdot I = \alpha\,(Iw + Is)\ N\cdot m$$

α：角加速度（Angular acceleration） rad/sec²
I：惯性矩（Inertia moment） kg·m²
Iw：移动物的电机轴换算的惯性矩（Inertia moment of moving object by motor axial conversion） kg·m²
Is：丝杆轴的惯性矩（Inertia moment of Screw Shaft） kg·m²

$$Iw = m_w \times (r/2\pi)^2 = 2.53 \times 10^{-5} \quad kg\cdot m^2$$

m_w：移动物质量（Mass of moving object）＝10kg
r：滚珠丝杆导程（Ball Screw Lead）＝0.01m

$$Is = m_s \times (d^2/8) = (d/2)^2 \pi \gamma \times L \times (d/8) = 0.139 \times 10^{-5} \quad kg\cdot m2$$

m_s：丝杆轴质量（Mass of Screw Shaft）kg
γ：丝杆轴比重（Specific gravity of Screw Shaft）＝7,850kg/m³
d：丝杆轴外径（Shaft dia.）＝0.01m
L：丝杆轴长度（Shaft length）＝0.18m

$$\alpha = (2\pi N)/60t = 12{,}566.4 \ \ rad/sec^2$$

N：最高速度（Max speed）＝2,400min⁻¹
t：加速时间（Acceleration time）＝0.02sec

$$T_1 = 12{,}566.4 \times (2.53 + 0.139) \times 10^{-5} = 0.335N\cdot m$$

2）负载扭矩T_2的计算（Calculation of Load Torque T_2）

$$T_2 = mgr/(2\pi\eta) = 0.173N\cdot m$$

m：移动物质量（Mass of moving object）＝10kg
g：重力加速度（Gravity Acceleration）＝9.807m/sec²
r：滚珠丝杆导程（Ball Screw Lead）＝0.01m
η：滚珠丝杆效率（Ball Screw efficiency）＝0.9

3）进给丝杆系统的驱动扭矩T的计算

根据以上计算，在不考虑支撑轴承等产生的扭矩时，滚珠丝杆轴系统的驱动扭矩如下所示。

Calculation of Driving Torque T for feed screw system

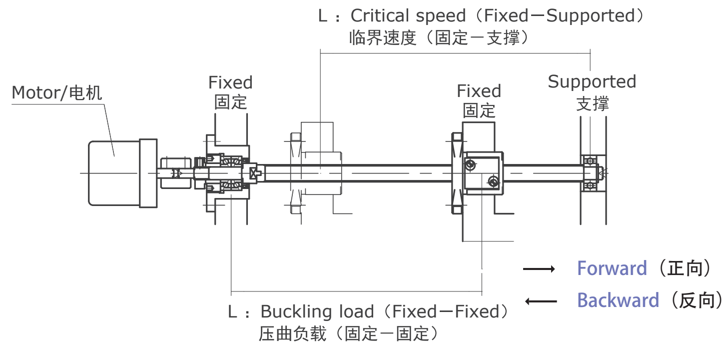
In case without consideration of Torque by support Bearings, Driving Torque of Ball Screw is as follows.

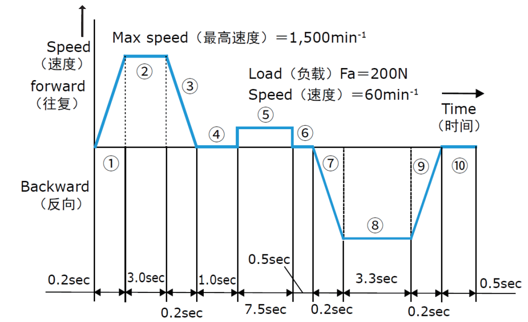
$$T = T_1 + T_2 = 0.134N\cdot m + 0.173\ N\cdot m = 0.307N\cdot m$$

例2：横轴规格小型车床
Example2:Horizontal Small lathe

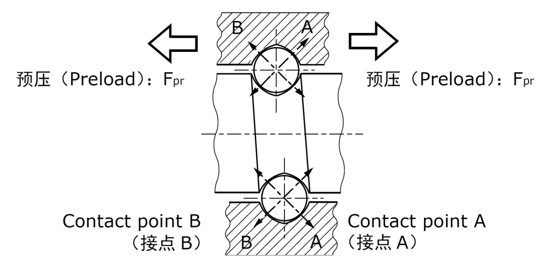
滚珠丝杆的型号和使用条件
Ball Screw model and operating condition

Operating pattern（运行周期线图）





(Plus) ＋ Load direction －(Minus)
（正）＋ 负载方向 －（负）



图C-38： 使用条件和钢珠接触状态
FigC-38： Operating condition and Ball Contact point

主要技术参数	Ball Screw spec.
轴径＝ϕ12mm	Shaft dia. ＝ ϕ12mm
导程=2mm	Lead ＝ 2mm
丝杆轴底径 d＝ϕ10.6mm	Shaft Root dia. d ＝ ϕ10.6mm
基本额定动负载Ca＝1,900N	Dynamic Capacity Ca ＝1,900N
安装间距L＝400mm	Mounting span L ＝ 400mm
轴向间隙=0μm以下	Axial play ＝ 0μm or less
移动物质量 m ＝ 10kg	Mass of moving object m ＝ 10kg
滑动面摩擦系数 μ=0.05	Sliding surface friction coefficient μ ＝ 0.05
预压负载 Fpr ＝ 95N（Ca×5%）	Preload Fpr ＝ 95N（Ca×5%）

运行条件	Operating Pattern
最高速度=50mm/sec	Max Speed ＝ 50mm/sec
**导程2mm时1,500 min-1	** 1,500 min—1 because of Lead 2mm
周期线图： 参照上图	Operating pattern： see diagram above
①⑦加速 ＝ 0.2sec	①⑦Acceleration ＝ 0.2sec
②正向等速 ＝ 3.0sec	②Constant speed（forward） ＝ 3.0sec
③⑨减速 ＝ 0.2sec	③⑨Deceleration ＝ 0.2sec
④⑥⑩停止 ＝ 2.0sec（合计）	④⑥⑩halt ＝ 2.0sec（total）
⑤切削时间 ＝ 7.5sec	⑤Turning time ＝ 7.5sec
⑧反向等速 ＝ 3.3sec	⑧Constant speed（backward） ＝ 3.3sec
切削阻力Fa ＝ 200N	Load Fa ＝ 200N
切削时速度 ＝ 2mm/sec	Cutting speed ＝ 2mm/sec
**导程2mm时60min-1	**60min-1 due to 2 mm lead

许用轴向负载的计算
Calculation of permissible Axial load

1）弯曲负载的探讨
根据第C1-115页的计算公式计算压曲负载。
Study of Buckling load
Calculate Buckling load according to the following formula in page C1-115.

$$p = \alpha \times \frac{n\pi^2 E \cdot I}{L^2} \text{ N} \qquad I = \frac{\pi}{64} d^4 \text{ mm}^4$$

将安全系数 α＝0.5
杨氏模量 E＝2.08×10^5N/mm^2（MPa）
底径 d＝10.6mm
固定—固定的安装系数 n=4
安装间距 L＝400mm代入上式

Substitute safety factor α＝0.5
Young's modulus E＝2.08×10^5N/mm^2 (MPa)
Root diameter d＝10.6mm
Fixed—Fixed mounting factor n=4
mounting span distance L＝400mm in formula above

P = 15,900N

该值远大于使用负载，因此没有问题。
It is more than maximum Load so that there is no problem.

2）相对于屈服应力的许用负载的探讨
C1-115页的计算公式计算。
Study of permissible Load for yield stress
Calculate permissible Load for yield stress based on the formula in page C1-115.

$$p = \alpha \times A \quad \text{N} \qquad A = \frac{\pi}{4} d^2 \text{ mm}^2$$

将许用应力σ=98N/mm^2（MPa）
底径 d＝10.6mm代入上式。

Substitute permissible stress σ=98N/mm^2 (MPa)
Root diameter d＝10.6mm in the formula above

P =8,650 N

该值远大于使用负载，因此没有问题。
It is more than maximum Load so that there is no problem.

许用转速的计算
Calculation of permissible Revolution

C1-116页的计算公式计算。
Calculate permissible Revolution based on the formula in page C1-116

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

$$I = \frac{\pi}{64} d^4 \text{ mm}^4 \qquad A = \frac{\pi}{4} d^2 \text{ mm}^2$$

将安全系数β=0.8、
杨氏模量E＝2.08×10^5N/mm^2（MPa）、
重力加速度 g= 9.8×10^3mm/sec^2、
比重 γ=7.7×10^{-5}N/mm^3、
底径 d＝10.6mm、
固定—支撑的安装系数λ=3.927、
安装间距L＝400mm代入上式。

Substitute safety factor β=0.8
Young's modulus E＝2.08×10^5N/mm (MPa)
gravity acceleration g=9.8×10^3mm/sec^2
material specific gravity γ=7.7×10^{-5}N/mm^3
Root diameter d＝10.6mm
Fixed—Support mounting factor λ=3.927
mounting span distance L＝400mm in formula above

N＝10,000min^{-1}

该值远大于使用负载，因此没有问题。
It is more than maximum Load so that there is no problem.

基本额定寿命的计算
Calculation of Basic Rating Life

2018年制定的JIS B1192第5部规定了在计算基本额定寿命时应考虑负载方向和预压负载。因此，小型滚珠丝杆的额定寿命计算也适用以此为基准的计算公式。

Load direction and Preload will be taken into consideration when calculate the Basic Rating Life by JIS B1192-5, which was established in 2018. Therefore, KGG uses a calculation formula of Basic Rating Life for Miniature Ball Screws that is conformed to JIS B 1192-5.

大号钢珠施加预压时，钢珠接触状态如图C-30所示，为4点接触。正如第C1-127页的解说，外部负载会使预压下的初期接触状态发生变化，考虑到这些因素，要先分别计算出作用于接触点A、B的负载、额定寿命后，再计算总寿命。

In case when preload is effective by oversized Ball,the contact condition of the Ball is 4 points as per Fig. C-30. As explained in page C1-127, total Life can be calculated after calculation of Rating Life at contact point A and B due to the change of initial contact condition under the preload casused by external load.

各种运行方式下的负载条件的计算 Calculation of Load condition for each operating pattern.

→ 各种运行方式下的速度条件的计算 Calculation of Speed condition for each operating pattern.

→ 左右接触点的负载、速度条件的计算 Calculation of the Load condition, speed condition at left/right contact point.

→ 各负载方向（滚珠接触点）的等价负载、等价转速的计算 Calculation of Equivalent load, Equivalent revolution in each Load direction（Ball contact point）.

→ 各负载方向（滚珠接触点）的额定寿命的计算 Calculation of Basic Rating Life for each Load direction（Ball contact point）.

→ 由各负载方向（滚珠接触点）的额定寿命合并而成的额定寿命的计算 Calculation of merged Basic Rating Life in each Load direction（Ball contact point）.

→ 考虑停止时间的总寿命的计算 Calculation of total Life with taking halt time into consideration.

1）根据周期线图（运行方式）计算负载条件
带编号的各种运行方式的负载条件
如下所示。

①正向加速
Fa_1 = μmg + mα = 0.05 × 10 × 9.807+10 × 0.25 = 7.4（N）
②正向等速
Fa_2 = μmg = 0.05×10×9.807 = 4.9（N）
③正向减速
Fa_3 = μmg − mα = 0.05 × 10 × 9.807 − 10 × 0.25 = 2.4（N）
④停止
Fa_4 = 0
⑤切削时
Fa_5 = μmg + Fa = 0.05 × 10 × 9.807 + 200 = 204.9（N）
⑥停止
Fa_6 = 0
⑦反向加速
Fa_7 = −（μmg + mα） = −（0.05 × 10 × 9.807 + 10 × 0.25） = − 7.4（N）
⑧反向等速
Fa_8 = − μmg = − 0.05 × 10 × 9.807 = −4.9（N）
⑨反向减速
Fa_9 = − μmg + mα = − 0.05 × 10 × 9.807 + 10 × 0.25 = − 2.4（N）
⑩停止
Fa_{10} = 0

式中，
m：移动物质量 = 10 kg
g：重力加速度 = 9.807 m/sec²
α：加速度
达到0.05m/sec前的加速度
α = 0.05/0.02 = 0.25m/sec²

2）根据周期线图（运行方式）计算速度条件
带编号的各种运行方式的速度条件（转速条件）如C-39示。

等速时（②、⑧）：
50mm/sec = 50 × 60 mm/min = 3,000mm/min
= 1,500 min⁻¹（导程10mm时）
加减速时（①、③、⑦、⑨）：
上述的平均转速为1,500/2 = 700 min⁻¹

1）1）Calculation of Load condition from Operating pattern
Load condition of each operating pattern which is numbered is as follows.

①Forward Acceleration
Fa_1 = μmg + mα =0.05 × 10 × 9.807 + 10 × 0.25 = 7.4（N）
②Forward at constant speed area
Fa_2 = μmg = 0.05 × 10 × 9.807 = 4.9（N）
③Forward Deceleration
Fa_3 = μmg − mα = 0.05 × 10 × 9.807 − 10 × 0.25 = 2.4（N）
④Halt
Fa_4 = 0
⑤at Turning
Fa_5 = μmg + Fa = 0.05 × 10 × 9.807 + 200 = 204.9（N）
⑥Halt
Fa_6 = 0
⑦Backward Acceleration
Fa_7 = −（μmg + mα） = −（0.05 × 10 × 9.807 + 10 × 0.25） = − 7.4（N）
⑧Backward at constant speed area
Fa_8 = − μmg = −0.05 × 10 × 9.807 = − 4.9（N）
⑨Backward Deceleration
Fa_9 = − μmg + mα = −0.05 × 10 × 9.807 + 10 × 0.25 = − 2.4（N）
⑩Halt
Fa_{10} = 0

Here,
m：Mass = 10 kg
g：Gravity Acceleration = 9.807 m/sec²
α：Acceleration
Acceleration up to 50mm/sec
α = 0.05/0.02=0.25m/sec²

2）Calculate the speed condition according to the cycle diagra(operation mode)The speed conditions (rotation speed conditions) of various running modes with numbers are shown in Table C-39.

Constant speed area（②、⑧）；
50mm/sec = 50 × 60 mm/min = 3,000mm/min
=1,500 min⁻¹（Lead 10mm）
Acceleration and deceleration area（①、③、⑦、⑨）；
as an average revolution above, 1,500/2 = 700 min⁻¹

各种运行方式下的负载条件和速度条件 (转速条件) 的计算结果如下表所示。
Calculation result of the load condition and speed condition (revolution) for each operating patterns are as below.

表C-39:各接触点的负载、转速条件
Table C-39: Load and speed conditions of each contact point

Condition 条件	Axial load 轴向负载 Fa(iN)	Revolution 转速 N(min^{-1})	Frequency of use 使用频率 ti(sec)
①Forward Acceleration / 正向加速	7.4	750	0.2
②Forward at Constant speed / 正向等速	4.9	1,500	3.0
③Forward Deceleration / 正向减速	2.4	750	0.2
④Halt / 停止	0	0	1.0
⑤Turning / 切削	204.9	60	7.5
④Halt / 停止	0	0	0.5
⑦Backward Acceleration / 反向加速	−7.4	750	0.2
⑧Backward at constant speed / 反向等速	−4.9	1,500	3.3
⑨Backward Deceleration / 反向减速	−2.4	750	0.2
⑩Halt / 停止	0	0	0.5

3) 计算左右接触点各自的负载条件
Calculation of the Load condition at left/right contact point

在预压负载下，滚珠与螺纹槽4点接触，该状态会在外部负载的作用下，变化为第C1-127页（图C-31）的接触状态。根据发生了变化的弹性位移反推，用下式计算作用于接触点（A、B）的负载。

Ball contact condition in 4 point between Balls and thread grooves by preload may changes by external load as shown in page C1-127（Fig. C-31）. Based on the changed Elastic displacement, load applying on the contact point A and B will be calculated by formula below.

【外部负载方向为＋（正）方向时】【If the direction of the external load is plus（+）】

$$Fai_{(A)} = F_{pr} \times \left(1 + \frac{|Fai|}{2^{3/2} \times F_{pr}}\right)^{3/2}$$

$$Fai_{(B)} = Fai_{(A)} - Fai$$

【外部负载方向为＋（正）方向时】【If the direction of the external load is plus（+）】

$$Fai_{(A)} = F_{pr} \times \left(1 + \frac{|Fai|}{2^{3/2} \times F_{pr}}\right)^{3/2}$$

$$Fai_{(B)} = Fai_{(A)} - |Fai|$$

式中，
Fpr ：预压负载＝95 N
Fai ：各条件下的轴向负载(N)
(A)、(B)：表示滚珠接触点

Here,
Fpr ：Preloaded load = 95 N
Fai ：Axial load in each condition (N)
(A) (, B)：This means contact point

分别计算接触点（A、B）在上述各运行条件下的负载及转速条件，结果如表C-40所示。
The calculation result of each load condition and revolution condition as per contact point A and B is shown in tableC-40.

4） 分别计算左右接触点的等价负载、等价转速
Calculation of Equivalent load, Equivalent revolution at left and right contact point

计算出各运行条件下作用于接触点A、B的负载后，下面分别计算各接触点的等价负载、等价转速。接触点A、B仅为负载条件不同，速度条件（转速条件）、使用频率相同。等价负载、等价转速的计算使用第C1-125页的计算公式。

Load applying on contact point A and B is calculated under each operating condition, then Equivalent load and Equivalent revolution at each contact point will be calculated. However, the speed and frequency of use stay the same, only the load condition will be different. Calculation formula shown in page C1-125 will be used for calculating Equivalent load and Equivalent revolution.

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

$$N_m = \left(\frac{N_1 \cdot t_1 + N_2 \cdot t_2 + N_3 \cdot t_3 + \ldots\ldots + N_i \cdot t_i}{t_1 + t_2 + t_3 + \ldots\ldots + t_i}\right) \quad min^{-1}$$

各种运行方式下作用于接触点A、B的负载及其各自的等价负载、等价转速的计算结果如下表所示。
The axial load applying on contact point A and B for each condition, Equivalent load and Equivalent revolution are as follows.

表 C-40：各接触点的负载、转速条件
Table C-40：Load & Revolution condition at each contact point

Condition 条件	Axial load 轴向负载 Fa(iN)	Revolution 转速 N(min^{-1})	Axial load 轴向负载 Fa(iN)	Revolution 转速 N(min^{-1})	Frequency of use 使用频率 ti(sec)
① Forward Acceleration/ 反向加速	7.4	99.0	91.6	750	0.2
② Forward at Constant speed / 反向等速	4.9	97.6	92.7	1,500	3.0
③ Forward Deceleration/ 反向减速	2.4	96.3	93.9	750	0.2
④Halt / 停止	0	—	—	0	1.0
⑤Turning / 切削	204.9	222.3	17.4	60	7.5
⑥ Halt / 停止	0	—	—	0	0.5
⑦ Backward Acceleration / 反向加速	-7.4	91.6	99.0	750	0.2
⑧ Backward at constant speed / 反向等速	-4.9	92.7	97.6	1,500	3.3
⑨ Backward Deceleration/ 反向减速	-2.4	93.9	96.3	750	0.2
⑩ Halt / 停止	0	—	—	0	0.5
Equivalence 等价		Fam (A) ＝109.0	Fam (B) ＝94.0	Nm ＝719.2	Working duration（运行）： 0.48sec Halt time（停止）： 0.2 sec 1 cycle（1周期）： 0.68 sec

注) 接触点A、B的负载计算结果均用绝对值表示。
Note）Results of applying load at contact point A and B are all absolute number.

5）分别计算左右接触点的额定寿命
Calculation of Rating Life at each contact point

使用滚珠接触点A、B各自的等价负载、等价转速，计算接触点A、B的额定寿命。
Calculate the Basic Rating Life at contact point A and B by using the value of Equivalent load, Equivalent revolution in each contact point A, B.

【接触点A】【Contact point A】
将等价负载Fam（A）和等价转速Nm代入第C1-125页的寿命计算公式，可得出以下结果。
Substitute the Equivalent load Fam（A） and Equivalent revolution Nm in the following formula as shown in page C1-125.

$$L10h_{(A)} = \left(\frac{Ca}{f \cdot Fam_{(A)}}\right)^3 \times \left(\frac{10^6}{60 \cdot N_m}\right)^3 = 71{,}029 \text{ 小时（hours）}$$

【接触点B】【Contact point B】
将等价负载Fam（B）和等价转速Nm代入第C1-125页的寿命计算公式，可得出以下结果。
Substitute the Equivalent load Fam（B） and Equivalent revolution Nm in the following formula as shown in page C1-125.

$$L10h_{(B)} = \left(\frac{Ca}{f \cdot Fam_{(B)}}\right)^3 \times \left(\frac{10^6}{60 \cdot Nm}\right)^3 = 110{,}747 \text{小时（hours）}$$

其中，假设基本额定动负载Ca＝1,900N、负载系数f＝1.2。
Here, Basic Dynamic Load Rating Ca＝1,900N,Load factor f＝1.2.

6）计算由左右接触点的额定寿命合并而成的额定寿命
Calculation of merged Basic Rating Life in each contact point

使用第C1-126页的公式，计算由接触点A、B的额定寿命（L10h（A）、L10h（B））合成的组合寿命。
Calculate merged Basic Rating Life of contact point A,B（L10h（A）, L10h（B））by using formula in page C1-126.

$$L'10h = \left(L10h_{(A)}^{-10/9} + L10h_{(B)}^{-10/9}\right)^{-10/9} = 46{,}257 \text{ 小时（hours）}$$

7）考虑停止时间的总寿命的计算
Calculation of total Life with taking halt time into consideration

上述计算只是运行时间的计算结果，计算总寿命还需要考虑1个周期中的停止时间。
Above calculation is only for the working duration, therefore calculate the total Life with taking halt time into consideration.

L"10h＝L'10h ×（周期时间 cycle time）/（运行时间 working duration）＝46,257 ×（16.6 / 14.6）＝52,594 小时（hours）

MEMO

存放、操作及使用注意事项
PRECAUTION OF STORAGE, HANDLING AND OPERATING

●滚珠丝杆操作注意事项
滚珠丝杆属于精密零件，请遵照下述事项谨慎操作。
存放
存放时，请保持本公司原装包装状态。请勿随意开包或弄破内部包装。
否则会有异物进入或生锈，从而导致产品性能下降 。
操作
1.严禁拆分产品。否则会导致异物进 入、精度下降或引发事故。
2. 重新组装时，如果组装错误，可能会导致滚珠丝杆的功能丧失。因此，客户请勿自行重新组装。请将产品送回本公司，我们将有偿为您维修并重新组装。
3. 滚珠丝杆的轴和螺母可能会因自重而掉落，请注意避免受伤。如果掉落，可能会因循环部件受损而导致性能下降，因此请务必委托本公司进行检查。请务必将产品送回本公司。我们将有偿为您检查。
4. 如果滚珠丝杆掉落，循环部件、轴的外径以及钢珠等可能会划伤、损坏。这可能会导致产品功能丧失，如回转不良等。

●滚珠丝杆使用注意事项
防尘
请在清洁环境下使用滚珠丝杆。请同时使用防尘罩等防止异物、切屑等进入滚珠丝杆中。如果因防尘不当而导致异物、切屑等进入滚珠丝杆，可能会降低滚珠丝杆的性能或损坏循环部件，从而导致产品锁死。
润滑
请在使用前确认润滑状况。如果润滑不良，可能会导致滚珠丝杆在短期内丧失功能。
此外，防锈油并非润滑剂，使用前请用精制煤油等清洗滚珠丝杆，去除防锈油后涂上润滑剂（油脂或润滑油）。在常规用途下使用时，请每2～3个月检查一次油脂。使用过程中油脂变脏时，请擦去旧的油脂后涂抹新油脂。
许用转速和许用轴向负载
根据尺寸、材质及安装方式等不同，滚珠丝杆会受到轴向负载和转速的限制。建议在产品的设计阶段就使用条件与本公司充分协商。关于使用条件，请充分利用卷末的技术数据表。
超程
滚珠丝杆螺母发生超程时，可能导致钢珠脱落、循环部件受损或钢珠槽产生压痕等，从而引起动作不良。如果在该状态下继续使用，还可能导致早期磨损或循环部件损坏。因此请务必避免超程。
发生超程时，请与本公司联系检查事宜。我们将有偿为您检查。
此外，为了防止螺纹端出现螺母超程或从螺纹部脱落，可能会安装O形圈。
使用时请拆下O形圈。
使用温度
使用温度的极限通常设计在80°C以下。超过该温度使用时，可能会产生如下现象：
· 钢珠循环性能下降；
· 循环部件损伤或损坏；
· 相对于热处理部位的硬度降低。
如需在超过80°C的条件下使用，请垂询本公司。
偏负载
滚珠丝杆是一种产生轴向推力的机械元件，其结构不能承受径向负载和力矩负载。请注意避免对螺母部施加径向负载和力矩负载。如果滚珠丝杆承受径向负载或力矩负载，将会导致滚珠负载不均，从而显著缩短产品的使用寿命。
另外，安装滚珠丝杆时，轴承部与螺母托架之间的偏心也会导致偏负载，敬请注意。
摇摆运动
让滚珠丝杆做摇摆运动（重复进行短行程＋正反转）时，由于滚珠的相互挤压，动扭矩有逐渐增大的倾向。这个问题可通过定期使用假行程（全行程）来解决。

●Handling precaution for Ball Screws
Ball screws are precision components, and must be handled carefully in accordance with the instruction below.
Storage
Ball Screws should be stored unopened in their original KGG packaging. Avoid opening the package or breaking the inner package unnecessarily. This may result in contamination or rusting, and may degrade operating performance.
Handling
1.Never disassemble Ball Screws. This will cause contamination, reduce accuracy, and lead to accidents.
2. Customers should not attempt to reassemble Ball Screws by themselves. Incorrect reassembly can easily result in malfunction. Ball Screws should be returned to KGG, where they will be repaired and reassembled for a fee.
3. Take care to avoid injuries due to falling Ball Screw Shafts or Nuts. If dropped, performance may be adversely affected by damage to the recirculating component. Ball Screws must therefore be inspected by KGG for a fee. Please make sure you return dropped Shafts or Nuts.
4. Dropping Ball Screws may cause scratching or impact damage to recirculating components, Shaft outside diameters, Balls, or screw grooves, which may cause malfunction, such as incorrect rotation.

●Precaution of Ball Screw for operating
Dust proof
Ball Screws must be used in a clean environment. They should be used with a dustproof cover to prevent contamination from dust or swarf. Dust or swarf contamination due to insufficient dust protection may reduce the Ball Screw performance, cause damage to recirculating components, which lead to locking.
Lubrication
Check lubrication before use. Insufficient lubrication will rapidly deteriorate the operating performance of the Ball Screw. Since anti-rust oil is not lubricant（Grease/ Oil）, Ball Screws should be washed off anti-rust oil with clean Kerosene and apply lubricant before using Ball Screws. Please check the lubricant condition every 2 to 3months. If Grease is contaminated, remove old Grease, and replace with new Grease.
Critical speed and Axial load
Ball Screws have the maximum limit of speed and Axial load depending on its size, material, mounting method etc. when design Ball Screws, KGG would recommend that you consult with KGG engineering about the operating condition and model selection. To release your operating condition, please use Technical Data Sheet at the end of this catalogue.
Over-run
Allowing Ball Screw Nuts to overrun may result in malfunctioning due to Balls escaping, damage to recirculation components, and indentation of the Ball grooves. Continued use in this state will lead to rapid wear and damage to recirculation components. Ball Screw Nuts must therefore never be allowed to overrun. If overrunning occurs, contact KGG for an inspection for a fee.
Some products may fit the O-ring on the end of the shaft for the purpose of preventing fall off or overrunning the Ball Nut. Please detach O-ring in such case in prior to use.
Temperature
Ball Screws are designed to be used at operating temperatures up to 80°C. Avoid use at higher temperatures. This may result in the following problems .
· Reduced performance of Ball recirculation, and smooth movement.
· Damage to recirculation components.
· Reduced hardness of heat treated components.
If it is necessary to work beyond the recommended temperatures, please consult with KGG first as we may be able to provide a solution.
Moment load or Radial load
Ball Screws primarily generate thrusts in the axial direction, and are not designed to withstand Radial loads and Moment loads. Care must be taken not to apply Radial loads and Moment loads to the Nut. If there loads act on the Ball Screws, Ball load uniformity is lost, and the life of Ball Screws is drastically reduced. When installing Ball Screws, misalignment between Ball Screw and Support Bearings or Nut Bracket causes the unbalanced load on Ball Screw, care must be taken.
Oscillation
Under the oscillation（short stroke + back & forth operation）of Ball Screws, Drag Torque tends to increase gradually due to the stuck of Balls inside Ball Nut. Dummy stroke（preferably full length stroke）would be effective to release this phenomenon.

公制单位换算表
SI UNIT CONVERSION TABLE

◆ 前缀 SI-Prefixes

	SI-Prefixes 前缀			SI-Prefixes 前缀			SI-Prefixes 前缀	
	Prefix 名称	Symbol 符号		Prefix 名称	Symbol 符号		Prefix 名称	Symbol 符号
10^{18}	exa（艾）	E	10^{2}	hecto（百）	h	10^{-9}	nano（毫微）	n
10^{15}	peta（贝脱）	P	10^{1}	deca（十）	da	10^{-12}	pico（皮）	p
10^{12}	tera（兆兆）	T	10^{-1}	deci（十分之一）	d	10^{-15}	femto（千万亿分之一）	f
10^{9}	giga（千兆）	G	10^{-2}	centi（厘）	c	10^{-18}	atto（微微微）	a
10^{6}	mega（兆）	M	10^{-3}	milli（毫）	m			
10^{3}	kilo（千）	k	10^{-6}	micro（微）	μ			

◆ 力、重量 Force, Weight

N（牛顿） kg · m/s^2	dy（达因） g · cm/s^2	kgf （重量：千克力）	lbf （重量：磅）
1	10^{5}	0.101972	0.224809
10^{-5}	1	1.01972×10^{-6}	0.224809×10^{-6}
9.80665	9.80665×10^{5}	1	2.20462
4.44822	44822×10^{5}	0.453592	1

注）带底色的单元格为公制单位。 Note） Highlighted cells show SI unit.

◆ 质量 mass

kg (牛顿)	g (克)	lb (磅)	t (吨)	oz (盎司)
1	10^{3}	2.20462	10^{-3}	35.274
10^{-3}	1	2.20462×10^{-3}	10^{-6}	0.035274
0.453592	453.592	1	0.453592×10^{-3}	16
1000	10^{6}	2204.62	1	3.5274×10^{4}
0.0283495	28.3495	0.06250	2.83495×10^{-5}	1

注）带底色的单元格为公制单位。 Note） Highlighted cells show SI unit.

◆ 应力 Stress

N（牛顿） kg · m/s^2	dy（达因） g · cm/s^2	kgf （重量：千克力）	lbf （重量：磅）
1	1×10^{-6}	1.01972×10^{-7}	1.01972×10^{-5}
1×10^{6}	1	1.01972×10^{-1}	1.01972×10
9.80665×10^{6}	9.80665	1	1×10^{2}
9.80665×10^{4}	9.80665×10^{-2}	1×10^{-2}	1

注）带底色的单元格为公制单位。 Note） Highlighted cells show SI unit.

◆ 压力 Pressure

Pa（帕） N/m^2	MPa（兆帕） N/mm^2	bar	kgf/cm^2	atm	mmH_2O	mmHg Torr
1	1×10^{-6}	1×10^{-5}	1.01972×10^{-5}	9.86923×10^{-6}	1.01972×10^{-1}	7.50062×10^{-3}
1×10^{3}	1×10^{-3}	1×10^{-2}	1.01972×10^{-2}	9.86923×10^{-3}	1.01972×10^{2}	7.50062
1×10^{6}	1	1×10	1.01972×10	9.86923	1.01972×10^{5}	7.50062×10^{3}
1×10^{5}	1×10^{-1}	1	1.01972	9.86923×10^{-1}	1.01972×10^{4}	7.50062×10^{2}
9.80665×10^{4}	9.80665×10^{-2}	9.80665×10^{-1}	1	9.67841×10^{-1}	1×10^{4}	7.35559×10^{2}
1.01325×10^{5}	1.01325×10^{-1}	1.01325	1.03323	1	1.03323×10^{4}	7.60000×10^{2}
9.80665	9.80665×10^{-6}	9.80665×10^{-5}	1×10^{-4}	9.67841×10^{-5}	1	7.35559×10^{-2}
1.33322×10^{2}	1.33322×10^{-4}	1.33322×10^{-3}	1.35951×10^{-3}	1.31579×10^{-3}	1.35951×10	1

注）带底色的单元格为公制单位。 Note） Highlighted cells show SI unit.

◆ 动粘度 Kinematic Viscosity

m^2/s	cSt mm^2/s	st cm^2/s
1	1×10^{6}	1×10^{4}
1×10^{-6}	1	1×10^{-2}
1×10^{-4}	1×10^{2}	1

注）带底色的单元格为公制单位。 Note） Highlighted cells show SI unit.

速度 Velocity

m/s	m/min	km/h	ft/s	ft/min	mile/h
1	60	3.6	3.28084	196.850	2.23693
0.0166667	1	0.06	0.0546807	3.2808	0.0372823
0.277778	16.667	1	0.911344	54.6807	0.621371
0.30480	18.288	1.09728	1	60	0.681818
5.0800×10^{-3}	0.30480	0.018288	0.0166667	1	0.0113636
0.447041	26.8224	1.60934	1.46667	88	1

速度 Velocity

m（米）	cm（厘米）	mm（毫米）	µm（微米）	nm（毫微米）	Å（埃）	in（英寸）	ft（英尺）
1	100	1000	10^{6}	10^{9}	10^{10}	39.3701	3.28084
0.01	1	10	10^{4}	10^{7}	10^{8}	0.393701	0.0328084
0.001	0.1	1	10^{3}	10^{6}	10^{7}	0.0393701	3.28084×10^{-3}
10^{-6}	10^{-4}	10^{-3}	1	10^{3}	10^{4}	39.3701×10^{-6}	3.28084×10^{-6}
10^{-9}	10^{-7}	10^{-6}	10^{-3}	0	10	39.3701×10^{-9}	3.28084×10^{-9}
10^{-10}	10^{-8}	10^{-7}	10^{-4}	0.1	1	39.3701×10^{-10}	3.28084×10^{-10}
0.0254	2.54	25.4	25.4×10^{3}	25.4×10^{6}	25.4×10^{7}	1	0.0833333
0.3048	30.48	304.8	304.8×10^{3}	304.8×10^{6}	304.8×10^{7}	12	1

硬度换算表

CONVERSION TABLE FOR HARDNESS

Rockwell hardness C-scale 洛氏硬度 标尺C	Vickers hardness 维氏硬度	Brinell hardness 布氏硬度		Rockwell hardness 洛氏硬度		Shore hardness 肖氏硬度
		Standard Ball 标准球	Tungsten Carbide Ball 碳化钨球	A-Scale Load; 600N barle Pressure Piece 标尺A 负载：600N barle压头	B-Scale Load; 1000N 1/16-in dia.Ball 标尺B 负载：1000N 1/16in球	
HRC	Hv	HB	HB	HRA	HRB	Hs
68	940	-	-	85.6	-	97
67	900	-	-	85.0	-	95
66	865	-	-	84.5	-	92
65	832	-	739	83.9	-	91
64	800	-	722	83.4	-	88
63	772	-	705	82.8	-	87
62	746	-	688	82.3	-	85
61	720	-	670	81.8	-	83
60	697	-	654	81.2	-	81
59	674	-	634	80.7	-	80
58	653	-	615	80.1	-	78
57	633	-	595	79.6	-	76
56	613	-	577	79.0	-	75
55	595	-	560	78.5	-	74
54	577	-	543	78.0	-	72
53	560	-	525	77.4	-	71
52	544	500	512	76.8	-	69
51	528	487	496	76.3	-	68
50	513	475	481	75.9	-	67
49	498	464	469	75.2	-	66
48	484	451	455	74.7	-	64
47	471	442	443	74.1	-	63
46	458	432	432	73.6	-	62
45	446	421	421	73.1	-	60
44	434	409	409	72.5	-	58
43	423	400	400	72.0	-	57
42	412	390	390	71.5	-	56
41	402	381	381	70.9	-	55
40	392	371	371	70.4	-	54
39	382	362	362	69.9	-	52
38	372	353	353	69.4	-	51
37	363	344	344	68.9	-	50
36	354	336	336	68.4	(109.0)	49
35	345	327	327	67.9	(108.5)	48
34	336	319	319	67.4	(108.0)	47
33	327	311	311	66.8	(107.5)	46
32	318	301	301	66.3	(107.0)	44
31	310	294	294	65.8	(106.0)	43
30	302	286	286	65.3	(105.5)	42
29	294	279	279	64.7	(104.5)	41
28	286	271	271	64.3	(104.0)	41
27	279	264	264	63.8	(103.0)	40
26	272	258	258	63.3	(102.5)	38
25	266	253	253	62.8	(101.5)	38
24	260	247	247	62.4	(101.0)	37
23	254	243	243	62.0	100.0	36
22	248	237	237	61.5	99.0	35
21	243	231	231	61.0	98.5	35
20	238	226	226	60.5	97.8	34
(18)	230	219	219	-	96.7	33
(16)	222	212	212	-	95.5	32
(14)	213	203	203	-	93.9	31
(12)	204	194	194	-	92.3	29
(10)	196	187	187	-	90.7	28
(8)	188	179	179	-	89.5	27
(6)	180	171	171	-	87.1	26
(4)	173	165	165	-	85.5	25
(2)	166	158	158	-	83.5	24
(0)	160	152	152	-	81.7	24

材料的化学成分

MATERIAL CHEMICAL COMPOSITION

Category 材料类别	Std. No. 标准号	Designation 符号	Chemical Composition（化学成分）%									
			C	Si	Mn	P	S	Ni	Cr	Mo	Al	others 其他
Carbon Steels for machine structural use 机械结构用碳素钢	JIS G 4051	S40C	0.37～0.43	0.15～0.35	0.60～0.90	≤0.030	≤0.035	≤0.20	≤0.20			Cu≤0.30 Ni+Cr≤0.35
		S45C	0.42～0.48	0.15～0.35	0.60～0.90	≤0.030	≤0.035	≤0.20	≤0.20			Cu≤0.30 Ni+Cr≤0.35
		S50C	0.47～0.53	0.15～0.35	0.60～0.90	≤0.030	≤0.035	≤0.20	≤0.20			Cu≤0.30 Ni+Cr≤0.35
		S53C	0.50～0.56	0.15～0.35	0.60～0.90	≤0.030	≤0.035	≤0.20	≤0.20			Cu≤0.30 Ni+Cr≤0.35
		S55C	0.52～0.58	0.15～0.35	0.60～0.90	≤0.030	≤0.035	≤0.20	≤0.20			Cu≤0.30 Ni+Cr≤0.35
Structural Steels with specified hardenability bands 保证淬透性结构钢	JIS G 4052	SCM415H	0.12～0.18	0.15～0.35	0.55～0.95	≤0.030	≤0.030	≤0.25	0.85～1.25	0.15～0.30		
		SCM420H	0.17～0.23	0.15～0.35	0.55～0.95	≤0.030	≤0.030	≤0.25	0.85～1.25	0.15～0.30		
		SCM435H	0.32～0.39	0.15～0.35	0.55～0.95	≤0.030	≤0.030	≤0.25	0.85～1.25	0.15～0.35		
		SCM440H	0.37～0.44	0.15～0.35	0.55～0.95	≤0.030	≤0.030	≤0.25	0.85～1.25	0.15～0.35		
		SCM445H	0.42～0.49	0.15～0.35	0.55～0.95	≤0.030	≤0.030	≤0.25	0.85～1.25	0.15～0.35		
Chrome-molybdenum Steel 铬钼钢	JIS G 4105	SCM415	0.13～0.18	0.15～0.35	0.60～0.85	≤0.030	≤0.030	≤0.25	0.90～1.20	0.15～0.30		Cu≤0.30
		SCM418	0.16～0.21	0.15～0.35	0.60～0.85	≤0.030	≤0.030	≤0.25	0.90～1.20	0.15～0.30		Cu≤0.30
		SCM420	0.18～0.23	0.15～0.35	0.60～0.85	≤0.030	≤0.030	≤0.25	0.90～1.20	0.15～0.30		Cu≤0.30
		SCM430	0.28～0.33	0.15～0.35	0.60～0.85	≤0.030	≤0.030	≤0.25	0.90～1.20	0.15～0.30		Cu≤0.30
		SCM435	0.35～0.38	0.15～0.35	0.60～0.85	≤0.030	≤0.030	≤0.25	0.90～1.20	0.15～0.30		Cu≤0.30
		SCM440	0.38～0.43	0.15～0.35	0.60～0.85	≤0.030	≤0.030	≤0.25	0.90～1.20	0.15～0.30		Cu≤0.30
		SCM445	0.43～0.48	0.15～0.35	0.60～0.85	≤0.030	≤0.030	≤0.25	0.90～1.20	0.15～0.30		Cu≤0.30

Category 材料类别	Std. No. 标准号	Designation 符号	Chemical Composition（化学成分）%							
			Cu	Pb	Fe	Sn	Zn	Mn	Ni	others 其他
Copper alloy 铜合金	JIS H 3270	C5191B				5.5～7.0				P; 0.03～0.35 Cu+Sn+P≥99.5
	JIS H 3260	C3604W	57.0～61.0	1.8～3.7	≤0.50		Remains 剩余部分			Fe+Sn≤1.2

////////////////// APPENDED TABLE 附表

Category 材料类别	Std. No. 标准号	Designation 符号	Chemical Composition（化学成分）%								
			C	Si	Mn	P	S	Ni	Cr	Mo	others 其他
Stainless Steels 不锈钢	JIS G 4303 ～ JIS G 4305	SUS303	≤0.15	≤1.00	≤2.00	≤0.20	≥0.15	8.00～10.00	17.00～19.00	≤0.60	
		SUS304	≤0.08	≤1.00	≤2.00	≤0.045	≤0.030	8.00～10.50	18.00～20.00		
		SUS316	≤0.08	≤1.00	≤2.00	≤0.045	≤0.030	10.00～14.00	16.00～18.00	2.00～3.00	
		SUS317	≤0.08	≤1.00	≤2.00	≤0.045	≤0.030	11.00～15.00	18.00～20.00	3.00～4.00	
		SUS440A	0.60～0.75	≤1.00	≤1.00	≤0.040	≤0.040		16.00～18.00	≤0.75	
		SUS440B	0.75～0.95	≤1.00	≤1.00	≤0.040	≤0.030		16.00～18.00	≤0.75	
		SUS440C	0.95～1.20	≤1.00	≤1.00	≤0.040	≤0.030		16.00～18.00	≤0.75	
		SUS630	≤0.07	≤1.00	≤1.00	≤0.040	≤0.030	3.00～5.00	15.50～17.50		
		SUS631	≤0.09	≤1.00	≤1.00	≤0.040	≤0.030	6.5～7.75	16.00～18.00		

Category 材料类别	Std. No. 标准号	Designation 符号	Chemical Composition（化学成分）%									
			C	Si	Mn	P	S	Pb	Cr	Mo	W	others 其他
Alloy Tool Steels 合金工具钢	JIS G 4404	SKS 2	1.00～1.10	≤0.35	≤0.80	≤0.030	≤0.030		0.50～1.00		1.00～1.50	
		SKS 3	0.90～1.00	≤0.35	0.90～1.20	≤0.030	≤0.030		0.50～1.00		0.50～1.00	
		SKS 4	0.45～0.55	≤0.35	≤0.50	≤0.030	≤0.030		0.50～1.00		0.50～1.00	
High Carbon Chromium Bearing Steels 高碳铬轴承钢	JIS G 4805	SUJ 1	0.95～1.10	0.15～0.35	≤0.50	≤0.025	≤0.025		0.90～1.20	≤0.08		
		SUJ 2	0.95～1.10	0.15～0.35	≤0.50	≤0.025	≤0.025		1.30～1.60	≤0.08		
		SUJ 3	0.95～1.10	0.40～0.70	0.90～1.15	≤0.025	≤0.025		0.90～1.20	≤0.08		
		SUJ 4	0.95～1.10	0.15～0.35	≤0.50	≤0.025	≤0.025		1.30～1.60	0.10～0.25		

Category 材料类别	Std. No. 标准号	Designation 符号	Chemical Composition（化学成分）%									
			Cu	Zn	Al	Mn	Ni	Pb	Sn	Fe	Si	others 其他
Copper alloy 铜合金	JIS H 5111	BC6	82.0～87.0	4.0～6.0	≤0.01		≤1.0	4.0～6.0	4.0～6.0	≤0.3	≤0.01	

与材料有关的JIS标准和相关国外标准

COMPARISON WITH OTHER COUNTRY'S STANDARD FOR MATERIAL

Japan Industrial Standard; JIS 日本工业标准			ISO (国际标准)	USA (美国)	UK (英国)	Germany (德国)	France (法国)
Category 材料类别	Std. No. 标准号	Designation 符号					
Carbon Steels for Machine structural use 机械结构用碳素钢	JIS G 4051	S40C	C40/C40E4/C40M2	AISI 1040	EN-C40, C40E, C40R		
		S45C	C45/C45E4/C45M2	AISI 1045	EN-C45, C45E, C45R		
		S50C	C50/C50E4/C50M2	AISI 1049	EN-C50, C50E, C50R		
		S53C	-	AISI 1053	-	-	-
		S55C	C55/C55E4/C55M2	AISI 1055	EN-C55, C55E, C55R		
Structural Steels with specified hardenability bands 保证淬透性结构钢	JIS G 4052	SCM415H	-	-	-	-	-
		SCM420H	-	-	708H20	-	-
		SCM435H	34CrMo4/34CrMoS4	AISI 4137H	-	-	-
		SCM440H	42CrMo4/42CrMoS4	AISI 4140H	EN-42CrMo4/42CrMoS4		
		SCM445H	-	AISI 4147H	-	-	-
Chrome-molybdenum Steel 铬钼钢	JIS G 4105	SCM415	-	-	-	-	-
		SCM418	18CrMo4/18CrMoS4	-	-	-	-
		SCM420	-	-	708M20	-	-
		SCM430	-	AISI 4130	-	-	-
		SCM435	34CrMo4/34CrMoS4	AISI 4137	-	-	-
		SCM440	42CrMo4/42CrMoS4	AISI 4140	EN-42CrMo4/42CrMoS4		
		SCM445	-	AISI 4147	-	-	-

Japan Industrial Standard; JIS 日本工业标准			ISO (国际标准)	USA (美国)	UK (英国)	Germany (德国)	France (法国)
Category 材料类别	Std. No. 标准号	Designation 符号					
Stainless Steels 不锈钢	JIS G 4303 ~ JIS G 4305	SUS303	TR15510（1997）-13	ASTM-S 30300	303 S 31	X10CrNiS 189	Z8 CNF 18.09
		SUS304	TR15510（1997）-6	ASTM-S 30400	304 S 31	X5CrNi 1810	Z7CN 18.09
		SUS316	TR15510（1997）-26	ASTM-S 31600	316 S 31	X5CrNiMo17122	Z7CND 17.11-02
		SUS317	-	ASTM-S 31700	317 S 16	-	-
		SUS440A	-	ASTM-S 44002	EN-1.4109		
		SUS440B	-	ASTM-S 44003	-	-	-
		SUS440C	-	ASTM-S 44004	EN-1.4125		Z100CD17
		SUS630	TR15510（1997）-58	ASTM-S 17400	-	-	Z7CNU 17.04
		SUS631	TR15510（1997）-59	ASTM-S 17700	-	X7CrNiAl 177	Z9CNA 17.07
Alloy Tool Steels 合金工具钢	JIS G 4404	SKS 2	105WCr1	-	-	105WCr6	105WCr5
		SKS 3	-	-	-	-	-
		SKS 4	-	-	-	-	-
High Carbon Chromium Bearing Steels 高碳铬轴承钢	JIS G 4805	SUJ 1	-	ASTM 51100	-	-	-
		SUJ 2	100Cr6	ASTM 52100	-	100Cr6	100Cr6
		SUJ 3	100CrMnSi4-4	ASTM A 485 Grade1	-	-	-
Copper alloy 铜合金	JIS H 3270	C5191B	CuSn6	-	PB103	CuSn6	-
	JIS H 3260	C3604W	CuZn 39 PB 3	-	-	CuZn 39 PB 3	-
	JIS H 5111	BC6	-	ASTM-C 83600	LG2	CuSn 5 ZnPb	-

常用配合尺寸公差

FITS TOLERANCES FOR FREQUENT USE　JIS B 0401

◆ 孔用尺寸公差　Fit tolerances of normal holes

Unit（单位）:μm

Dimensional division 基准尺寸的分类		Fit tolerance grade for holes 孔的公差带															
over 超过	up to 以下	D8	D9	D10	E7	E8	E9	F6	F7	F8	G6	G7	H6	H7	H8	H9	H10
-	3	+34 +20	+45 +20	+60 +20	+24 +14	+28 +14	+39 +14	+12 +6	+16 +6	+20 +6	+8 +2	+12 +2	+6 0	+10 0	+14 0	+25 0	+40 0
3	6	+48 +30	+60 +30	+78 +30	+32 +20	+38 +20	+50 +20	+18 +10	+22 +10	+28 +10	+12 +4	+16 +4	+8 0	+12 0	+18 0	+30 0	+48 0
6	10	+62 +40	+76 +40	+98 +40	+40 +25	+47 +25	+61 +25	+22 +13	+28 +13	+35 +13	+14 +5	+20 +5	+9 0	+15 0	+22 0	+36 0	+58 0
10	14	+77 +50	+93 +50	+120 +50	+50 +32	+59 +32	+75 +32	+27 +16	+34 +16	+43 +16	+17 +6	+24 +6	+11 0	+18 0	+27 0	+43 0	+70 0
14	18																
18	24	+98 +65	+117 +65	+149 +65	+61 +40	+73 +40	+92 +40	+33 +20	+41 +20	+53 +20	+20 +7	+28 +7	+13 0	+21 0	+33 0	+52 0	+84 0
24	30																
30	40	+119 +80	+142 +80	+180 +80	+75 +50	+89 +50	+112 +50	+41 +25	+50 +25	+64 +25	+25 +9	+34 +9	+16 0	+25 0	+39 0	+62 0	+100 0
40	50																
50	65	+146 +100	+174 +100	+220 +100	+90 +60	+106 +60	+134 +60	+49 +30	+60 +30	+76 +30	+29 +10	+40 +10	+19 0	+30 0	+46 0	+74 0	+120 0
65	80																
80	100	+174 +120	+207 +120	+260 +120	+107 +72	+126 +72	+159 +72	+58 +36	+71 +36	+90 +36	+34 +12	+47 +12	+22 0	+35 0	+54 0	+87 0	+140 0
100	120																

Unit（单位）:μm

Dimensional division 基准尺寸的分类		Fit tolerance grade for holes 孔的公差带															
over 超过	up to 以下	JS6	JS7	K6	K7	M6	M7	N6	N7	N8	N9	P6	P7	P8	P9	R7	S7
-	3	±3	±5	0 -6	0 -10	-2 -8	-2 -12	-4 -10	-4 -14	-4 -18	-4 -29	-6 -12	-6 -16	-6 -20	-6 -31	-10 -20	-14 -24
3	6	±4	±6	+2 -6	+3 -9	-1 -9	0 -12	-5 -13	-4 -16	-2 -20	0 -30	-9 -17	-8 -20	-12 -30	-12 -42	-11 -23	-15 -27
6	10	±4.5	±7.5	+2 -7	+5 -10	-3 -12	0 -15	-7 -16	-4 -19	-3 -25	0 -36	-12 -21	-9 -24	-15 -37	-15 -51	-13 -28	-17 -32
10	14	±5.5	±9	+2 -9	+6 -12	-4 -15	0 -18	-9 -20	-5 -23	-3 -30	0 -43	-15 -26	-11 -29	-18 -45	-18 -61	-16 -34	-21 -39
14	18																
18	24	±6.5	±10.5	+2 -11	+6 -15	-4 -17	0 -21	-11 -24	-7 -28	-3 -36	0 -52	-18 -31	-14 -35	-22 -55	-22 -74	-20 -41	-27 -48
24	30																
30	40	±8	±12.5	+3 -13	+7 -18	-4 -20	0 -25	-12 -28	-8 -33	-3 -42	0 -62	-21 -37	-17 -42	-26 -65	-26 -88	-25 -50	-34 -59
40	50																
50	65	±9.5	±15	+4 -15	+9 -21	-5 -24	0 -30	-14 -33	-9 -39	-4 -50	0 -74	-26 -45	-21 -51	-32 -78	-32 -106	-30 -60	-42 -72
65	80															-32 -62	-48 -78
80	100	±11	±17.5	+4 -18	+10 -25	-6 -28	0 -35	-16 -38	-10 -45	-4 -58	0 -87	-30 -52	-24 -59	-37 -91	-37 -124	-38 -73	-58 -93
100	120															-41 -76	-66 -101

◆ 轴用尺寸公差　Fit tolerances of normal shafts

Unit（单位）:μm

Dimensional division 基准尺寸的分类		Fit tolerance grade for shafts 轴的公差带															
over 超过	up to 以下	d8	d9	e7	e8	e9	f6	f7	f8	g5	g6	g7	h5	h6	h7	h8	h9
-	3	-20 -34	-20 -45	-14 -24	-14 -28	-14 -39	-6 -12	-6 -16	-6 -20	-2 -6	-2 -8	-2 -12	0 -4	0 -6	0 -10	0 -14	0 -25
3	6	-30 -48	-30 -60	-20 -32	-20 -38	-20 -50	-10 -18	-10 -22	-10 -28	-4 -9	-4 -12	-4 -16	0 -5	0 -8	0 -12	0 -18	0 -30
6	10	-40 -62	-40 -76	-25 -40	-25 -47	-25 -61	-13 -22	-13 -28	-13 -35	-5 -11	-5 -14	-5 -20	0 -6	0 -9	0 -15	0 -22	0 -36
10	14	+50 +77	-50 -93	-32 -50	-32 -59	-32 -75	-16 -27	-16 -34	-16 -43	-6 -14	-6 -17	-6 -24	0 -8	0 -11	0 -18	0 -27	0 -43
14	18																
18	24	-65 -98	-65 -117	-40 -61	-40 -73	-40 -92	-20 -33	-20 -41	-20 -53	-7 -16	-7 -20	-7 -28	0 -9	0 -13	0 -21	0 -33	0 -52
24	30																
30	40	-80 -119	-80 -142	-50 -75	-50 -89	-50 -112	-25 -41	-25 -50	-25 -64	-9 -20	-9 -25	-9 -34	0 -11	0 -16	0 -25	0 -39	0 -62
40	50																
50	65	-100 -146	-100 -174	-60 -90	-60 -106	-60 -134	-30 -49	-30 -60	-30 -76	-10 -23	-10 -29	-10 -40	0 -13	0 -19	0 -30	0 -46	0 -74
65	80																
80	100	-120 -174	-120 -207	-72 -107	-72 -126	-72 -159	-36 -58	-36 -71	-36 -90	-12 -27	-12 -34	-12 -47	0 -15	0 -22	0 -35	0 -54	0 -87
100	120																

Unit（单位）:μm

Dimensional division 基准尺寸的分类		Fit tolerance grade for shafts 轴的公差带														
over 超过	up to 以下	js5	js6	js7	k5	k6	k7	m5	m6	n6	p6	r6	s6	t6	u6	x6
-	3	±2	±3	±5	+4 0	+6 0	+10 0	+6 +2	+8 +2	+10 +4	+12 +6	+16 +10	+20 +14	-	+24 +18	+26 +20
3	6	±2.5	±4	±6	+6 +1	+9 +1	+13 +1	+9 +4	+12 +4	+16 +8	+20 +12	+23 +15	+27 +19	-	+31 +23	+36 +28
6	10	±3	±4.5	±7.5	+7 +1	+10 +1	+16 +1	+12 +6	+15 +6	+19 +10	+23 +15	+28 +19	+32 +23	-	+37 +28	+43 +34
10	14	±4	±5.5	±9	+9 +1	+12 +1	+19 +1	+15 +7	+18 +7	+23 +12	+29 +18	+34 +23	+39 +28	-	+44 +33	+51 +40
14	18													-		+56 +45
18	24	±4.5	±6.5	±10.5	+11 +2	+15 +2	+23 +2	+17 +8	+21 +8	+28 +15	+35 +22	+42 +28	+48 +35	-	+54 +41	+67 +54
24	30													+54 +41	+61 +48	+77 +64
30	40	±5.5	±8	±12.5	+13 +2	+18 +2	+27 +2	+20 +9	+25 +9	+33 +17	+42 +26	+50 +34	+59 +43	+64 +48	+76 +60	-
40	50													+70 +54	+86 +70	-
50	65	±6.5	±9.5	±15	+15 +2	+21 +2	+32 +2	+24 +11	+30 +11	+39 +20	+51 +32	+60 +41	+72 +53	+85 +66	+106 +87	-
65	80											+62 +43	+78 +59	+94 +75	+121 +102	-
80	100	±7.5	±11	±17.5	+18 +3	+25 +3	+38 +3	+28 +13	+35 +13	+45 +23	+59 +37	+73 +51	+93 +71	+113 +91	+146 +124	-
100	120											+76 +54	+101 +79	+126 +104	+166 +144	-

加工尺寸的普通公差
GENERAL TOLERANCES

◆ 切削加工尺寸的普通公差　General tolerances for linear dimensions　JIS B 0405

Unit（单位）:mm

Tolerance grade 公差等级		Dimensional division 基准尺寸的分类					
Symbol 符号	Remark 说明	0.5 or over up to 3 0.5以上 3以下	over 3 up to 6 超过3 6以下	over 6 up to 30 超过6 30以下	over 30 up to 120 超过30 120以下	over 120 up to 400 超过120 400以下	over 400 up to 1000 超过400 1000以下
f	Fine 精密级	±0.05	±0.05	±0.1	±0.15	±0.2	±0.3
m	Medium 中级	±0.1	±0.1	±0.2	±0.3	±0.5	±0.8
c	Coarse 普通级	±0.2	±0.3	±0.5	±0.8	±1.2	±2
v	Very coarse 极普通级	-	±0.5	±1	±1.5	±2.5	±4

◆ 倒角部长度尺寸的公差　General tolerances for chamfer dimensions　JIS B 0405

Unit（单位）:mm

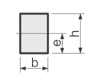
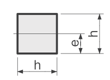
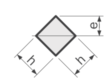
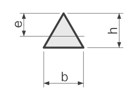
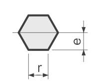
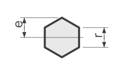
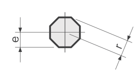
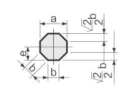
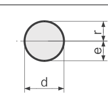
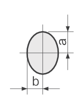
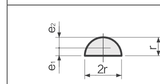
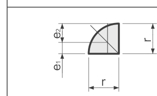
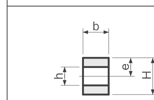
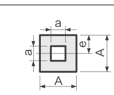
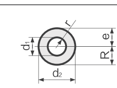
Tolerance grade 公差等级		Dimensional division 基准尺寸的分类		
Symbol 符号	Remark 说明	0.5 or over up to 3 0.5以上 3以下	over 3 up to 6 超过3 6以下	over 6 超过6
f	Fine 精密级	±0.2	±0.5	±1
m	Medium 中级	±0.2	±0.5	±1
c	Coarse 普通级	±0.4	±1	±2
v	Very coarse 极普通级	±0.4	±1	±2

◆ 角度尺寸的公差　General tolerances for angular dimensions　JIS B 0405

Unit（单位）:mm

Tolerance grade 公差等级		Dimensional division 基准尺寸的分类				
Symbol 符号	Remark 说明	up to 10 10以下	over 10 up to 20 超过10 50以下	over 50 up to 120 超过50 120以下	over 120 up to 400 超过120 400以下	over 400 超过400
f	Fine 精密级	±1°	±30′	±20′	±10′	±5′
m	Medium 中级	±1°	±30′	±20′	±10′	±5′
c	Coarse 普通级	±1°30′	±1°	±30′	±15′	±10′
v	Very coarse 极普通级	±3°	±2°	±1°	±30′	±20′

面积、重心、截面惯性矩
AREA · CENTER OF GRAVITY · MOMENT OF INERTIA OF AREA

Cross section 截面	Sectional area 截面积A	Distance to center of gravity 重心距离e	Moment of Inertia of area 截面惯性矩I	Section modulus 截面模量Z＝I/e
	bh	$\frac{h}{2}$	$\frac{bh^3}{12}$	$\frac{bh^2}{6}$
	h^2	$\frac{h}{2}$	$\frac{h^4}{12}$	$\frac{h^3}{6}$
	h^2	$\frac{h}{2}\sqrt{2}$	$\frac{h^4}{12}$	$0.1179h^3=\frac{\sqrt{2}}{12}h^3$
	$\frac{bh}{12}$	$\frac{2}{3}h$	$\frac{bh^3}{36}$	$\frac{bh^2}{24}$
	$\frac{3\sqrt{3}}{2}r^2$	$\sqrt{\frac{3}{4}}r$	$\frac{5\sqrt{3}}{16}r^4$	$\frac{5}{8}r^3$
		r		$\frac{5\sqrt{3}}{16}r^3$
	$2.828r^2$	$0.924r^2$	$\frac{1+2\sqrt{2}}{6}r^4$	$0.6906r^3$
	$0.8284a^2$	$b=\frac{a}{1+\sqrt{2}}$	$0.0547a^2$	$0.1095a^3$
	$\pi r^2=\frac{\pi d^2}{4}$	$\frac{d}{2}$	$\frac{\pi d^4}{64}=\frac{\pi d^4}{4}$	$\frac{\pi d^3}{32}=\frac{\pi d^3}{4}$
	πab	a	$\frac{\pi}{4}ba^3$	$\frac{\pi}{4}ba^2$
	$\frac{\pi}{2}r^2$	$e_1=0.4244r$ $e_2=0.5756r$	$\left(\frac{\pi}{8}-\frac{8}{9\pi}\right)r^4$	$z_1=0.2587r^3$ $z_2=0.1908r^3$
	$\frac{\pi}{4}r^2$	$e_1=0.4244r$ $e_2=0.5756r$	$0.055r^4$	$z_1=0.1296r^3$ $z_2=0.0956r^3$
	b（H-h）	$\frac{H}{2}$	$\frac{b}{12}(H^3-h^3)$	$\frac{b}{6H}(H^3-h^3)$
	A^2-a^2	$\frac{A}{2}$	$\frac{A^4-a^4}{12}$	$\frac{1}{6}\,\frac{A^4-a^4}{A}$
	$\frac{\pi}{4}(d_2^2-d_1^2)$	$\frac{d_2}{2}$	$\frac{\pi}{64}(d_2^4-d_1^4)=\frac{\pi}{4}(R^4-r^4)$	$\frac{\pi}{32}\left(\frac{d_2^4-d_1^4}{d_2}\right)=\frac{\pi}{4}\,\frac{R^4-r^4}{R}$

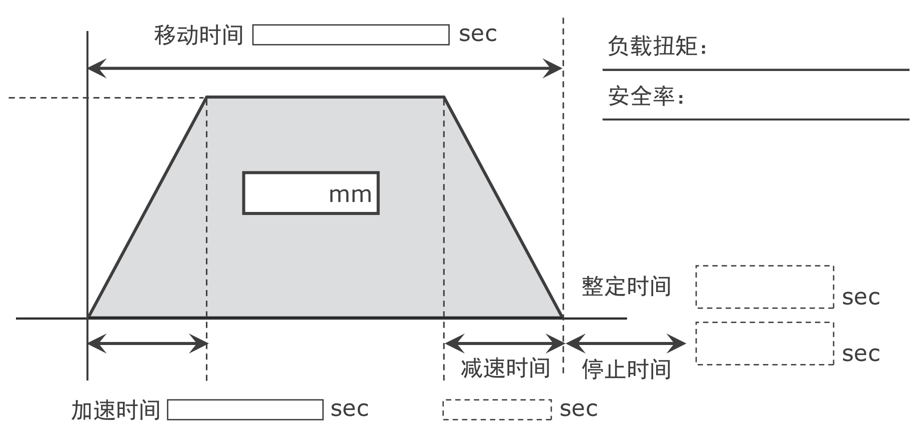
技术数据表

本公司可根据客户的需求选择滚珠丝杆。选择滚珠丝杆时，请尽可能详细告知使用条件，以便我们更准确地选型。使用以下技术数据表，可方便您快速选型。

◆ 技术数据表

日期和时间	/ /		联系人姓名			
贵公司名称						
TEL			E-mail			
行业	□半导体 □液晶 □测量仪器 □滑台 □光学仪器 □食品机械 □医疗器械 □航空、宇宙相关 □汽车 □军事 □其他（ ）					
产品种类	□滚珠丝杆 □进给丝杆 □树脂导程丝杆 □带电机滚珠丝杆 □执行器 □其他（ ）					
使用条件	装置名称		轴径（mm）		导程（mm）	
	使用位置		精度等级		间隙（μm）	
	设置姿态	□水平 □垂直 □（ ）度	行程（mm）		润滑	
	环境温度	□常温 □其他（ ）度	负载（最大·常用）		速度（最高·常用）	
	特别事项					
精度要求	绝对定位 μm		重复定位 μm	空转 μm		

● 运行曲线 / 速度线图 ●　　[ ] 必备项目　[ ] 可选项



负载扭矩：
安全率：
□单脉冲进给运行（ μm）
□三角驱动
□自起动运行

记录			
□滚珠丝杆寿命计算委托 □滚珠丝杆选型委托 □电机选型委托 □其他（ ）			
计算寿命	（小时·日·年）	推荐的滚珠丝杆 / 电机	
受理号			

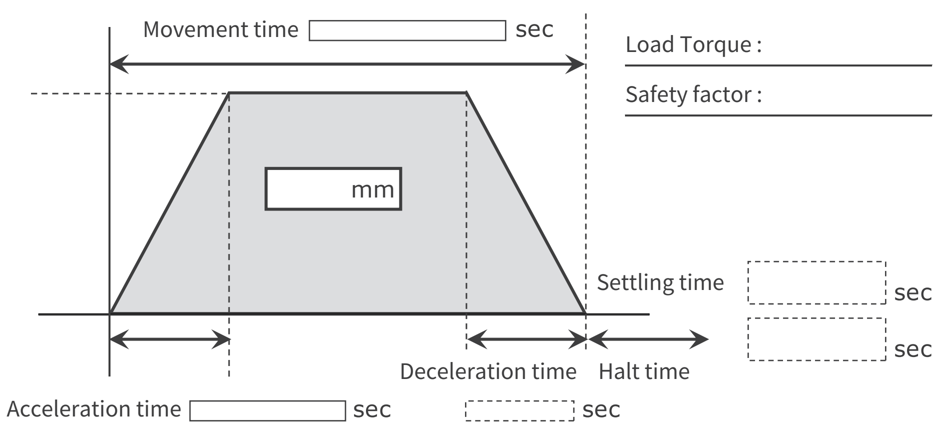
Technical Data Sheet

As customer's request, KGG selects Ball Screws. For selection of Ball Screws, please let us know detail of usage condition as much as possible and it enables precise selection.Prompt selection can be possible by using technical data sheet below.

◆ TECHNICAL DATA SHEET

Date	/ /		Person in charge			
Company Name						
Telephone No.			E-mail address			
Industry Field	□ Semiconductor □ LCD □ Measuring Equipment □ Stage □ Optical □ Food □ Medical □ Aero space □ Automobile □ Military affairs □ Others （ ）					
Products	□Ball Screw □ Lead Screw □ Resin Lead Screw □ Direct Motor Drive Ball Screw □Actuator □ Others （ ）					
Operating Condition	Machine Name		Shaft dia.（mm）		Lead（mm）	
	Application		Accuracy Grade		Axial play（μm）	
	Position	□ Hor. □Vert. □（ ）deg	Travel（mm）		Lubrication	
	Operating Temp	□ Room Temp. □Others（ ） deg	Load（max/mean）		Speed（max/mean）	
	Remarks					
Reqd. accuracy	Absolute Positioning μm		Repeatability μm	Lost motion μm		

● Operating Pattern ●　　[ ] Crucial items　[ ] Optional Items



Load Torque :
Safety factor :
□1 pulse feed operation（μm）
□Triangle drive motion
□Starting operation

Memorandum			
Request items	□ Ball Screw life time □ Ball Screw Model selection □ Motor Model selection □ Others（ ）		
Calculated Ball Screw Life	(hours/days/years)	Recommended Ball Screw/Motor	
Resistered No.			