所有人孜孜以求，但至今无人企及……

be precise with SAIZIN®

CRP系列滚轮齿条
Clean Rack Pinion

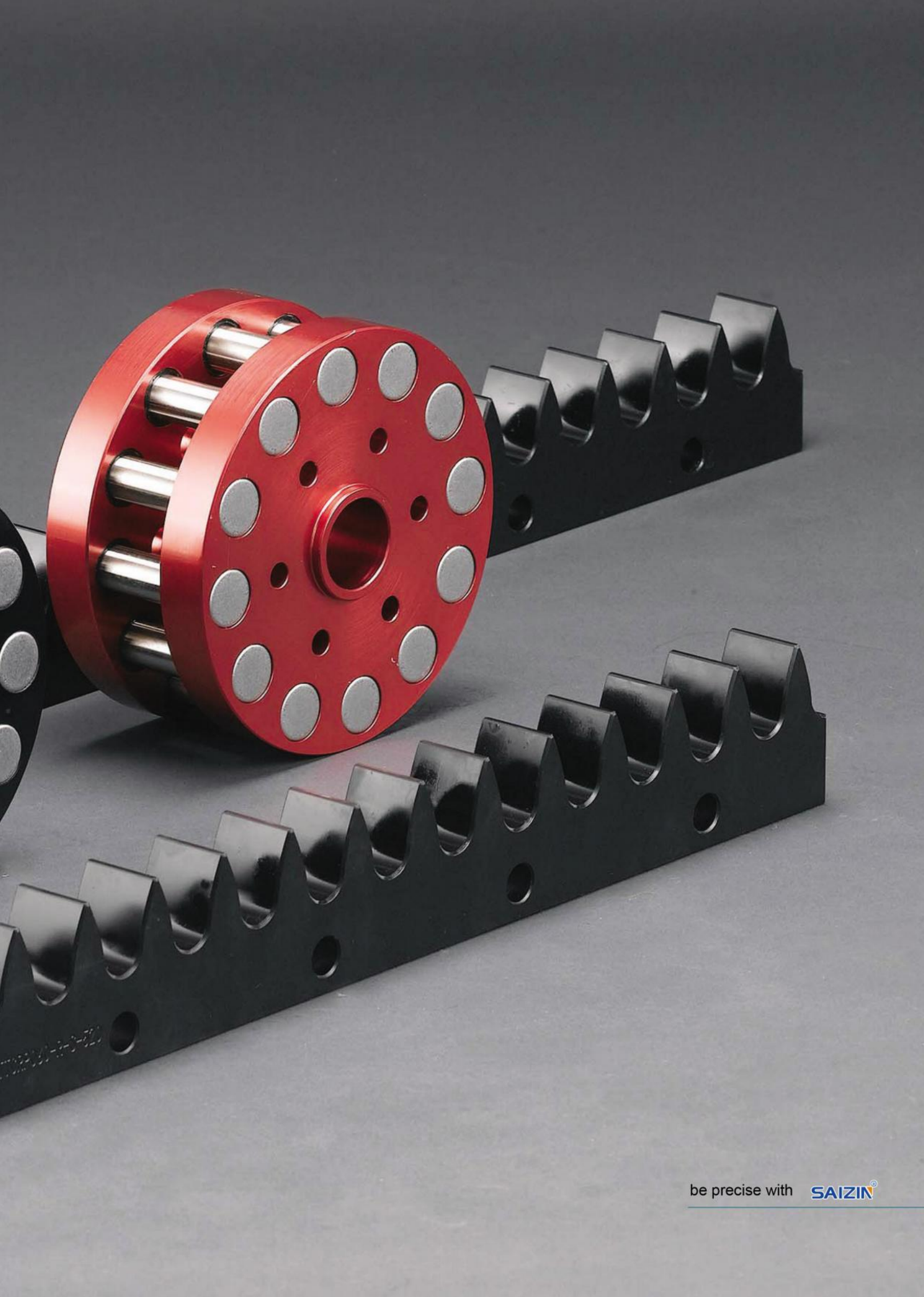


SAIZIN®

CRP系列滚轮齿条

- 整洁的外观 Clean Performer
- 整洁的安装 Clean Installation
- 多种选择 Various Selections
- 整数测距 Integer Movement
- 多齿接触 Multiple Tooth Contact
- 轨迹成型齿 Generated Tooth profile
- 高加速度 High Acceleration
- 高效率 High Efficiency
- 超低噪音 Extremely Silent
- 优秀的动态表现 Highly Performance
- 简单易用 Simple To Use





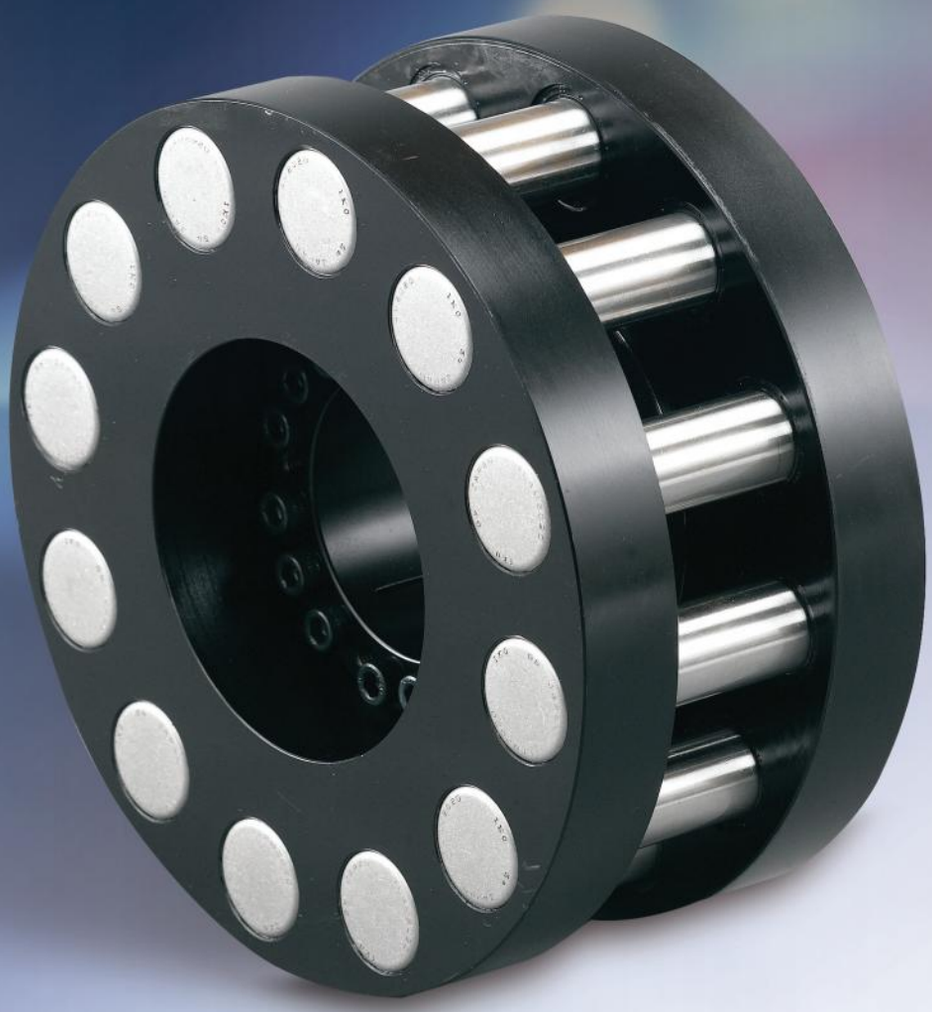
be precise with SAIZIN®

CRP滚轮齿条规格参数表 Clean Rack Pinion Series Ratings at a Glance

齿条规格 Rack Specifications		单位 Unit	型号 Model									
			CRP002	CRP004	CRP008	CRP015	CRP020	CRP040	CRP060	CRP080	CRP120	CRP180
滚轮动态下允许的切向力（注：速度超过6m/s，请联系赛劲） Permitted tangential force vs. Pinion rpm (Note: Please contact SEJINiGB for faster than 6m/s)	720rpm [630rpm]	N	1.8m/s	2.6m/s	2.88m/s	3.6m/s	4.32m/s	5.04m/s	[5.04m/s]	[5.67m/s]	–	–
			426	702	789	1137	1368	2075	[2882]	[3778]	–	–
	600rpm [510rpm]		1.5m/s	1.8m/s	2.4m/s	3.0m/s	3.6m/s	4.2m/s	4.8m/s	5.4m/s	5.1m/s	–
			468	737	816	1200	1439	2180	2934	3836	[5000]	–
	480rpm [420rpm]		1.2m/s	1.44m/s	1.92m/s	2.4m/s	2.88m/s	3.36m/s	3.84m/s	4.32m/s	4.8m/s	[5.04m/s]
			511	772	868	1284	1544	2331	3132	4105	5084	[7842]
	360rpm		0.9m/s	1.08m/s	1.44m/s	1.8m/s	2.16m/s	2.52m/s	2.88m/s	3.24m/s	3.6m/s	4.32m/s
			553	842	947	1389	1684	2541	3408	4468	5547	8211
	240rpm		0.6m/s	0.72m/s	0.96m/s	1.2m/s	1.44m/s	1.68m/s	1.92m/s	2.16m/s	2.4m/s	2.88m/s
			596	912	1053	1579	1895	2872	3855	5041	6263	9271
	120rpm		0.3m/s	0.36m/s	0.48m/s	0.6m/s	0.72m/s	0.84m/s	0.96m/s	1.08m/s	1.2m/s	1.44m/s
			638	947	1447	2105	2632	4060	5263	6199	8421	10526
最大加（减）速时的切向力 Max. acc./dec. tangential force		N	851	1403	2105	3158	3509	6015	7895	9357	12632	15789
最大急停时的切向力 Peak tangential force (E-stop)		N	1702	2807	4210	6316	7018	12030	15789	18713	25263	31579
齿条节距 Pitch		mm	12.5	15	20	25	30	35	40	45	50	60
每米单位质量 Unit mass		kg/m	2.6	4.4	5.8	7.3	8.9	11.3	14.9	17.5	23.8	30.1
标准长度 Standard length		mm	475	480	520	500	540	560	560	630	700	720
			925	930	1000	950	1020	980	1040	1170	1100	1200
定制的可变最小长度 Min. length variation (Min. length)		mm	75 (100)	75 (105)	80 (120)	75 (125)	60 (120)	70 (140)	80 (160)	90 (180)	100 (200)	120 (240)
最大长度 Unit max. length		mm	1450	1455	1480	1475	1440	1470	1440	1440	1500	1560
齿条宽度 Rack width		mm	15	18	21	24	27	32	37	42	52	56
齿顶高度 Addendum (Rack) height		mm	28.5	39	47	53	60.5	66	75.5	80	87.5	105
齿根高度 Dedendum height		mm	19	27	30	31	35	35.5	40	42	43.5	51
齿高度 Pitch height		mm	22	31	35	37	43	44.5	50	54.5	56	66
滚轮中心高度 Pinion installation height		mm	45.5	59.5	73	84.5	100	111	126	140	151	180
标准长度齿数 Standard length no. of teeth		teeth	38	32	26	20	18	16	14	14	14	12
			74	62	50	38	34	30	26	26	26	22
最小长度齿数 Minimum length no. of teeth		teeth	8	7	6	5	4	4	4	4	4	4
最大长度齿数 Unit max. length no. of teeth		teeth	116	97	74	59	48	42	36	32	30	26
滚轮规格 Pinion Specifications			CRP002	CRP004	CRP008	CRP015	CRP020	CRP040	CRP060	CRP080	CRP120	CRP180
滚轮动态下的额定扭矩 Permitted torque vs.Pinion rpm	720rpm [630rpm]	Nm	10	20	30	54	78	138	[219]	[323]	-	-
	600rpm [510rpm]		11	21	31	57	82	145	223	328	[475]	-
	480rpm [420rpm]		12	22	33	61	88	155	238	351	483	[894]
	360rpm		13	24	36	66	96	169	259	382	527	936
	240rpm		14	26	40	75	108	191	293	431	595	1057
	120rpm		15	27	55	100	150	270	400	530	800	1200
最大加（减）速扭矩 Maximum acc./dec. torque		Nm	20	40	80	150	200	400	600	800	1200	1800
瞬时扭矩（急停） Peak torque (E-stop)		Nm	40	80	160	300	400	800	1200	1600	2400	3600
每转传动距离 Feeding rate per revolution		mm/rev	150	180	240	300	360	420	480	540	600	720
滚柱节圆直径 Pitch circle diameter		mm	47	57	76	95	114	133	152	171	190	228
惯量 Inertia (1)	铝材质 Aluminum	$\times 10^{-4}$ kgm^2	1.56	4.23	11.5	32.7	74.8	160.6	307.5	671	993.5	2625.9
	钢材质 Steel		2.71	7.08	20.5	57.6	125	274.7	537.3	1043.3	1748	4689.7
质量 Mass (1)	铝材质 Aluminum	kg	0.3	0.56	0.9	1.6	2.7	4.2	6.3	10.6	13	23.8
	钢材质 Steel		0.6	1.1	1.9	3.4	5.3	8.4	12.8	17.3	24.1	45.5
传动精度 Positioning accuracy		μm	±30	±30	±25	±25	±25	±25	±20	±20	±20	±20
滚柱数量 No. of roller		rollers	12	12	12	12	12	12	12	12	12	12
模数 Module		mm	3.92	4.75	6.33	7.92	9.5	11.1	12.7	14.25	15.83	19
最大压力角 Max. pressure angle		deg.	27	27	27	27	27	27	27	27	27	27
滚柱节圆弧长 Arc distance between roller		mm	12.5	15	20	25	30	35	40	45	50	60
使用寿命 Lifetime basis (L_{10}) (2)		hrs.	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000

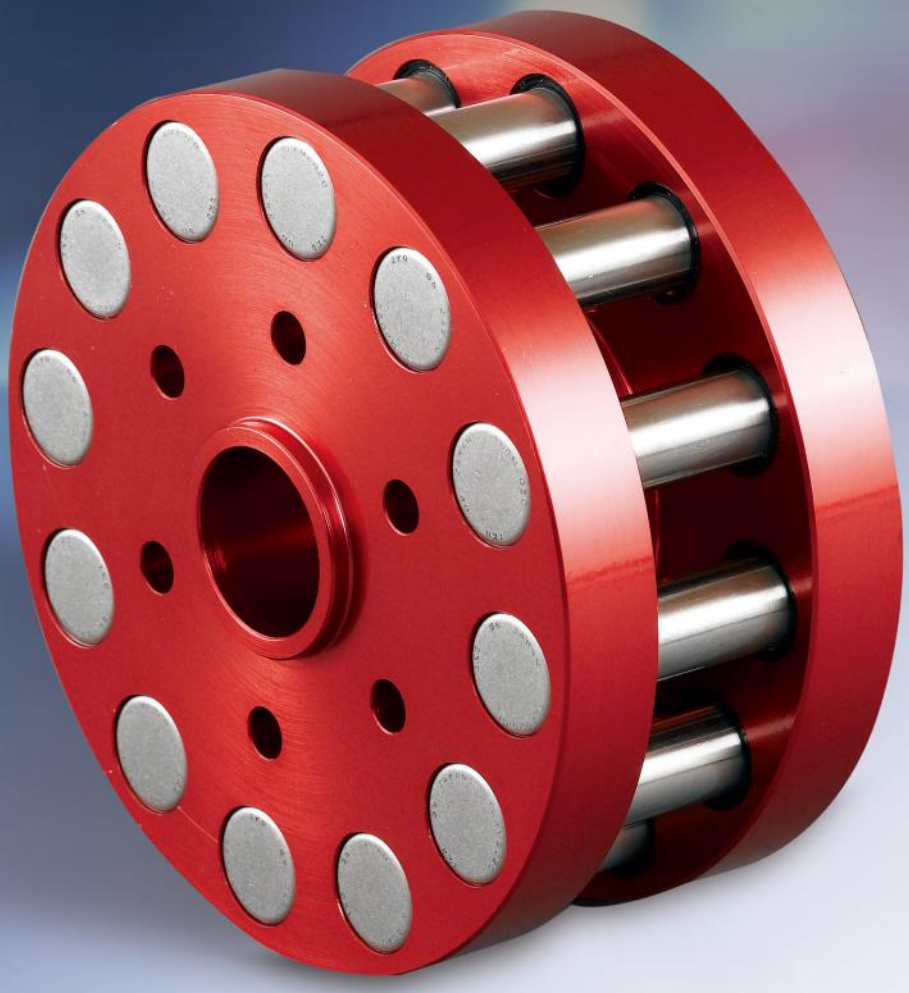
参数(1)仅针对标准滚轮 Reference value only for standard pinion.
参数(2)针对平均负载扭矩小于额定扭矩的情况 Average load torque ≤ Permitted torque

CRP滚轮齿条
Clean Rack Pinion



胀套连接设计
Shrink Fitting

CRP滚轮齿条
Clean Rack Pinion



螺栓连接设计
Bolt Clamping

CRP命名规则 CRP Ordering Information

齿条 CRP □□□ - R - S - □□□□
Rack ① ② ④

滚轮 CRP □□□ - P - (A/S) - □□□□□(□□□□)
Pinion ① ② ③ ④

① 名称：Clean Rack Pinion
② 型号：最大加（减）速扭矩
③ 滚轮材质：
A：铝材质 — 螺栓连接
S：钢材质 — 胀套链接 或 键连接
④ 代码：
齿条：齿条长度
滚轮：滚轮代码或匹配的减速机代码

[滚轮代码请参考本页下表]
[关于"匹配的减速机"，详情请联系赛劲精密设备有限公司]

例如：CRP008-R-S-1000,CRP004-P-A-B06M05018,
CRP002-P-S-K1431,CRP002-P-S-S1023,
CRP002-P-A-MM065

① Model Name : Clean Rack Pinion
② Model Number : Maximum acc./dec. torque
③ Pinion Material :
A : Aluminum – Bolt clampin]
S : Steel – Shrink fitting or Feather keyway
④ Indication :
Rack : Rack length
Pinion : Pinion shape code or applied gearbox

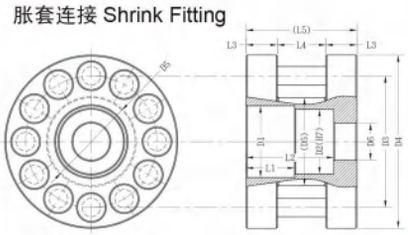
[Please refer below table for Pinion shape code.]
[In case of 'applied gearbox', please contact SEJINIGB for availability and detail dimensions.]

Ex. CRP008-R-S-1000, CRP004-P-A-B06M05018,
CRP002-P-S-K1431, CRP002-P-S-S1023, CRP002-P-A-MM065

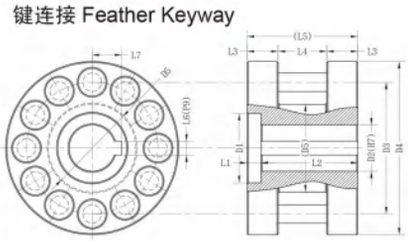
CRP滚轮代码 CRP Pinion Shape Code

标准滚轮 Standard Pinion

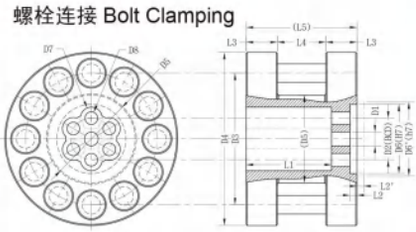
胀套连接 Shrink Fitting



键连接 Feather Keyway



螺栓连接 Bolt Clamping

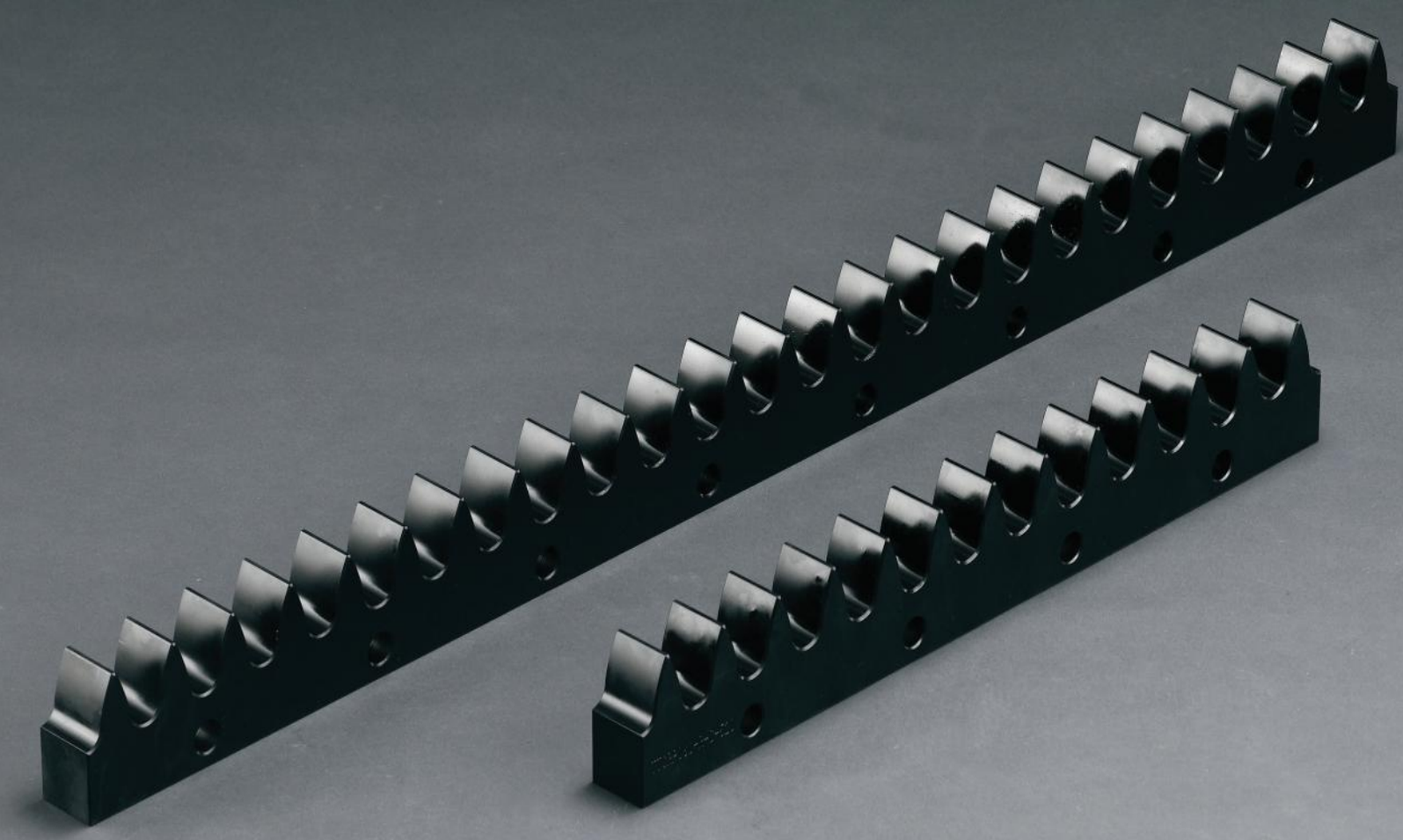


注：螺栓连接的类型，铝材质是标准的，钢材质为可选的.
[In case of bolt clamping shape, aluminum material is standard, steel is optional.]

		滚轮型号 Pinion Model Number & Shape Code									
		CRP002	CRP004	CRP008	CRP015	CRP020	CRP040	CRP060	CRP080	CRP120	CRP180
胀套连接 Shrink Fitting	D1	S1023	26	S1428	31	S2038	43	S2543	48	S2543	48	S4062	68	S4062	68	S5577	84	S6082	88	S7097	106
	D2		23		28		38		43		43		62		62		77		82		97
	D3		47		57		76		95		114		133		152		171		190		228
	D4		62		75		97		120		144		166		188		216		238		280
	D5		31		38		49		60		75		86		97		116		123		146
	D6		11		16		22		26		26		42		42		56		62		72
	L1		22		21		18		18		19,5		31		35,5		30		43		65
	L2		38		38		41		43		44,5		60		64,5		61		74		99
	L3		11,5		13,5		13,5		17		16,5		20,5		24,5		24,5		30,5		44,5
	L4		18		21		24		27		31		36		41		46		56		60
	L5		41		48		51		61		64		77		90		95		117		149
键连接 Feather Keyway	D1	K1431	22	K2042	30	K2042	30	K2552	35	K2552	35	K4073	52	K4073	52	—	–	—	–	—	–
	D2		14		20		20		25		25		40		40		–		–		–
	D3		47		57		76		95		114		133		152		171		190		228
	D4		62		75		97		120		144		166		188		216		238		280
	D5		31		38		49		60		75		86		97		116		123		146
	L1		9,5		6		9		8,5		12		40		17		–		–		–
	L2		31,5		42		42		52,5		52		73		73		–		–		–
	L3		11,5		13,5		13,5		17		16,5		20,5		24,5		24,5		30,5		44,5
	L4		18		21		24		27		31		36		41		46		56		60
	L5		41		48		51		61		64		77		90		95		117		149
	L6		6		6		6		8		8		12		12		–		–		–
	L7		9,3		12,8		12,8		15,8		15,8		23,3		23,3		–		–		–
螺栓连接 Bolt Clamping	D1	B06M05018	6	B06M05018	6	B08M06030	15	B08M08037	18	B08M08037	18	B08M10045	20	B08M10045	20	B12M08100	50	B12M08100	50	B12M10125	70
	D2		18		18		30		37		37		45		45		100		100		125
	D3		47		57		76		95		114		133		152		171		190		228
	D4		62		75		97		120		144		166		188		216		238		280
	D5		31		38		49		60		75		86		97		117		123		146
	D6		30		30		45		58		58		70		70		–		–		–
	D6		–		–		–		–		–		–		–		63		63		80
	D7		6X9,5		6X9,5		8X11		8X14		8X14		8X11		8X11		12X9		12X9		12X11
	D8		6X5,5		6X5,5		8X6,6		8X9		8X9		8X17,5		8X17,5		12X14		12X14		12X17,5
	L1		30		37		39,5		49		52		57		70		77		99		124
	L2		3		3		3		3		3		3		3		–		–		–
	L2'		–		–		–		–		–		–		–		5		5		8
	L3		11,5		13,5		13,5		17		16,5		20,5		24,5		24,5		30,5		44,5
	L4		18		21		24		27		31		36		41		46		56		60
	L5		41		48		51		61		64		77		90		95		117		149

客户定制的滚轮也可生产，详情请联系赛劲精密设备有限公司. [Customized pinion is available on request. Please contact SEJINiGB for more detail.]

CRP滚轮齿条
Clean Rack Pinion



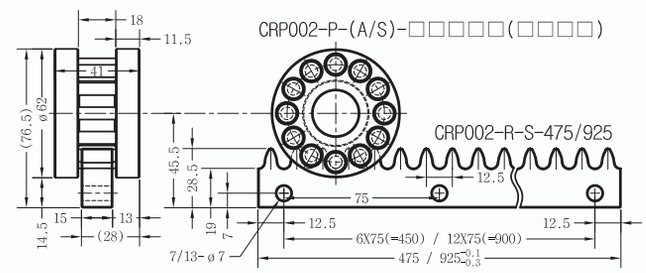
齿条
Rack

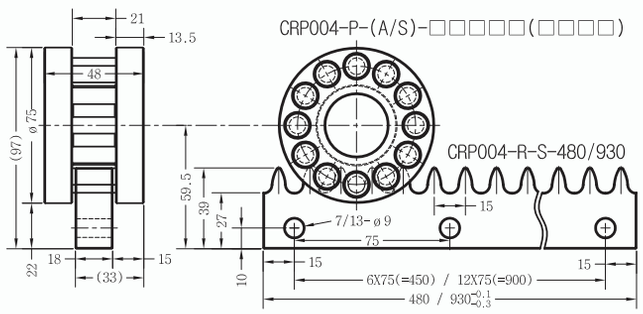
CRP滚轮齿条与赛劲减速机匹配表 CRP & iGB gearbox combination at a glance

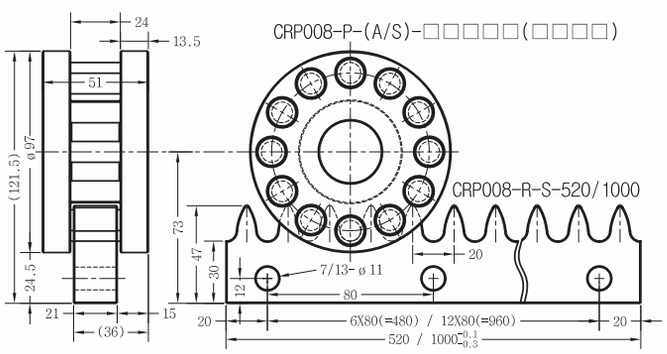
CRP型号 CRP Model		CP系列（轴输出/Shaft）	MM系列（面输出/Flange）	XP系列（面输出/Flange）	SS系列（面输出/Flange）	Cubic系列（面输出/Flange）	XQ，XG系列（面输出/Flange）
CRP002	胀套连接 Shrink Fitting	CP050 (S1023)					
	键连接 Feather Key	[CP050] CP065 (K1431)					
	螺栓连接 Bolt Clamping		MM065 (B06M05018)	[XP07A] XP015	[SS03A] SS001	Cubic 001 (B08M 03020)	[XQ08A] XQ15A, XQ25A
CRP004	胀套连接 Shrink Fitting	CP065 (S1428)					
	键连接 Feather Key	[CP065] CP085 (K2042)					
	螺栓连接 Bolt Clamping		MM065 (B06M05018)	XP015	SS001	Cubic 002 (B08M 04028)	XQ35A XG15A
CRP008	胀套连接 Shrink Fitting	CP085 (S2038)					
	键连接 Feather Key	CP085 (K2042)					
	螺栓连接 Bolt Clamping		MM085 (B08M06030)	XP045	SS003	Cubic 003 (B08M 05032)	XQ70A XG30A
CRP015	胀套连接 Shrink Fitting	CP120(S2543)					
	键连接 Feather Key	CP120 (K2552)					
	螺栓连接 Bolt Clamping		MM120 (B08M08037)	XP090	SS006	Cubic 006 (B08M 06043)	XQ009 XG007
CRP020	胀套连接 Shrink Fitting	CP120(S2543)					
	键连接 Feather Key	CP120 (K2552)					
	螺栓连接 Bolt Clamping		MM120 (B08M08037)	XP090 (B06M8080)	SS010	Cubic 010 (B08M 08054)	XQ009 XG007
CRP040	胀套连接 Shrink Fitting	CP150 (S4062)					
	键连接 Feather Key	CP150 (K4073)					
	螺栓连接 Bolt Clamping		MM150 (B08M10045)	XP180 (B06M10090)	SS030	Cubic 020 (B08M 10070)	XQ024 XG014
CRP060	胀套连接 Shrink Fitting	CP150 (S4062)					
	键连接 Feather Key	CP150 (K4073)					
	螺栓连接 Bolt Clamping		MM150 (B08M10045)	XP180 (B06M10090)	SS030	Cubic 035 (B08M 10086)	XQ034 , XQ060 XG033
CRP080	胀套连接 Shrink Fitting						
	键连接 Feather Key						
	螺栓连接 Bolt Clamping					Cubic 035 (B08M 10086)	XQ042, XQ060 XG033, XG045
CRP120	胀套连接 Shrink Fitting						
	键连接 Feather Key						
	螺栓连接 Bolt Clamping					Cubic 050 (B08M 10130)	XQ060, XQ090 XG045, XG064
CRP180	胀套连接 Shrink Fitting						
	键连接 Feather Key						
	螺栓连接 Bolt Clamping					SF090	XQ090, XQ120 XG064, XG095

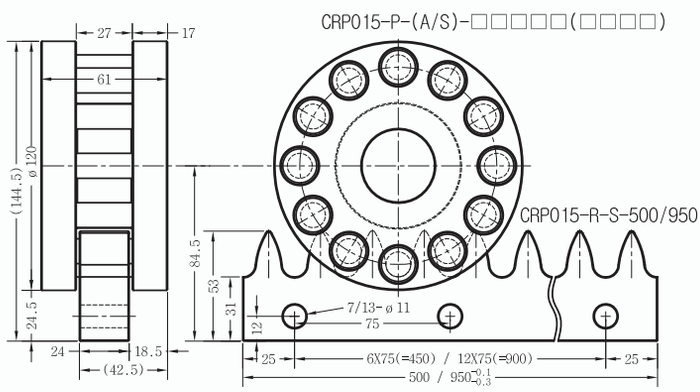
- 实际的切向力或扭矩请参考规格参数表.
  Please refer ratings at a glance for actual available tangential force or torque range.
- 未定的滚轮代码也可选择，详情请联系赛劲精密设备有限公司.
  In case of no pinion shape code, please contact SEJINiGB, it is optional.
- 表格中的匹配建议仅供参考，根据不同的设计应用，匹配方式可任意设计.
  Listed combination is only for reference. Unlimited combination is possible, depends on design.
- 表格上未列举的代码，需要适配的构件用于安装，详情请联系赛劲精密设备有限公司.
  In case of no pinion shape code on the list, it may need adaptor for installation. Please contact SEJINiGB for details.

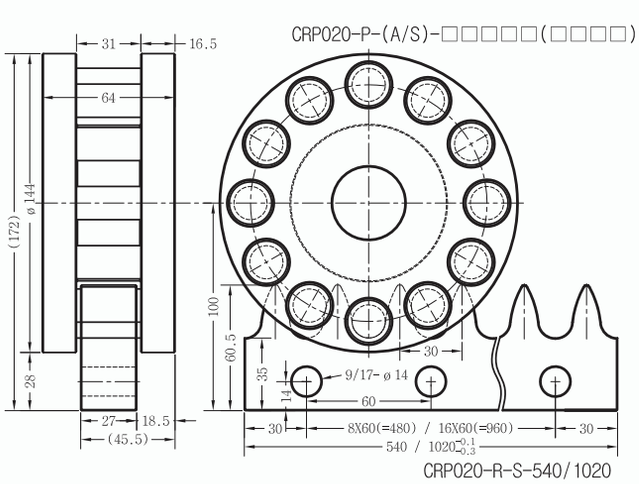
CRP标准尺寸 (mm)
CRP Standard Dimensions (mm)

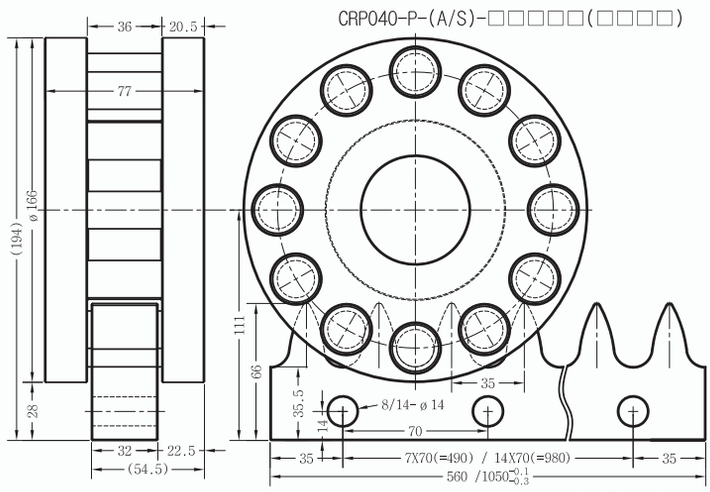


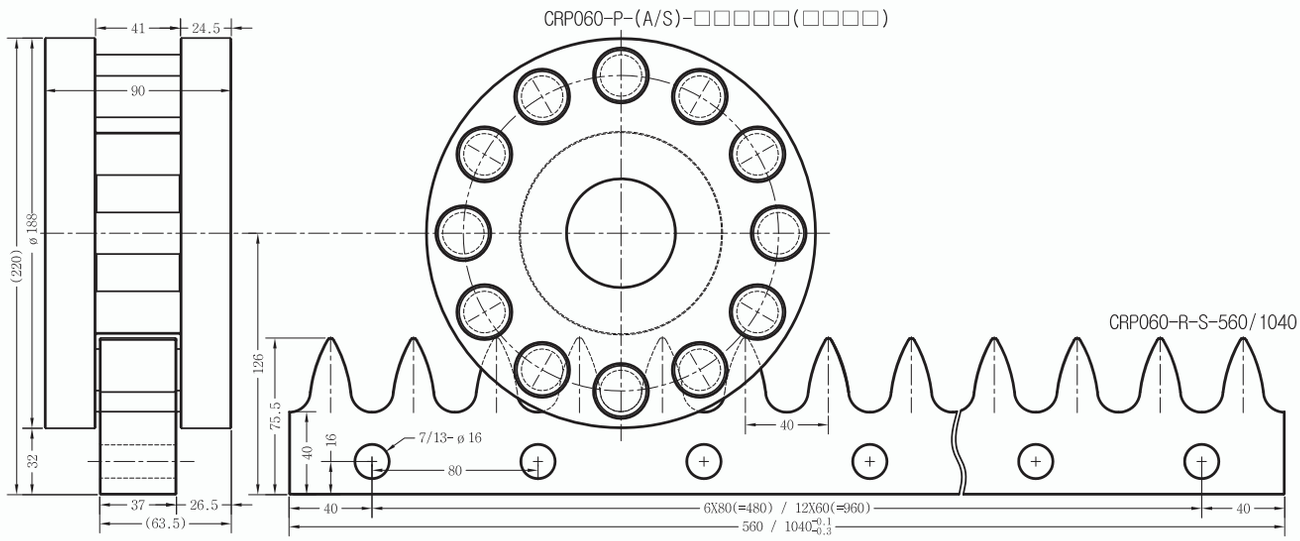


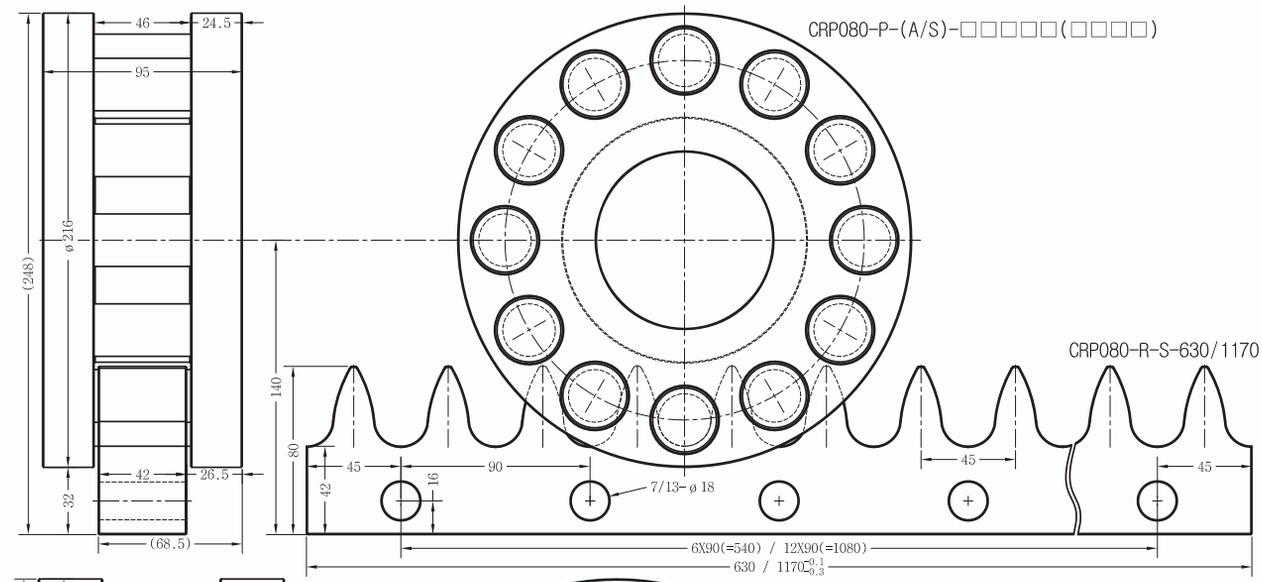


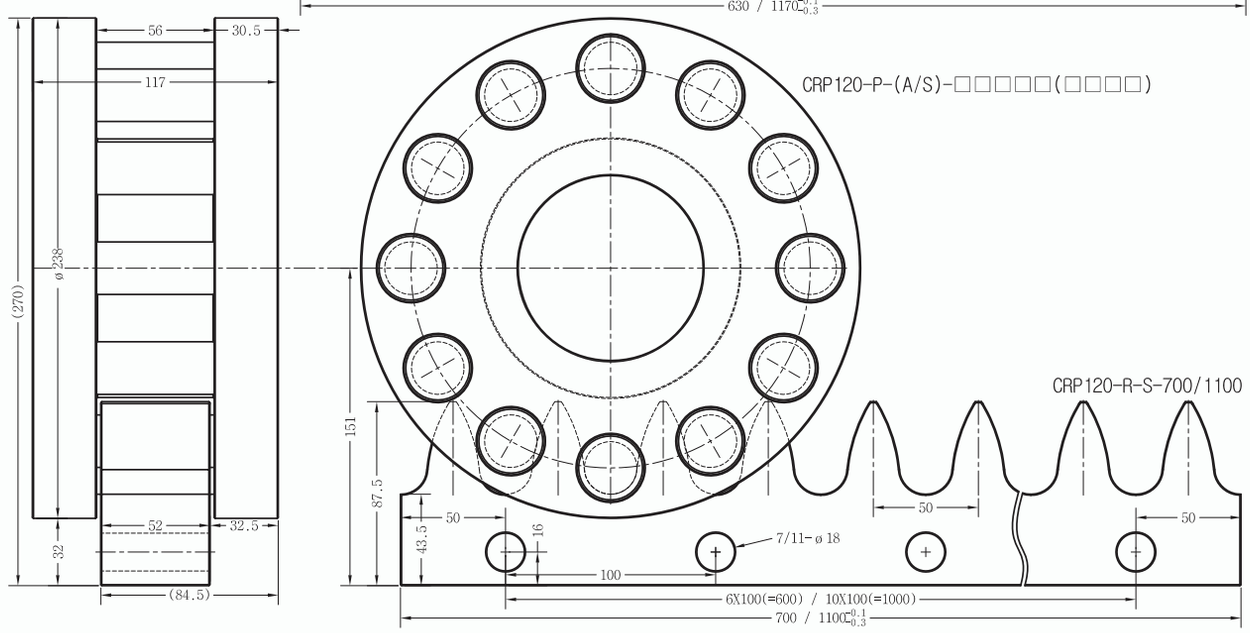


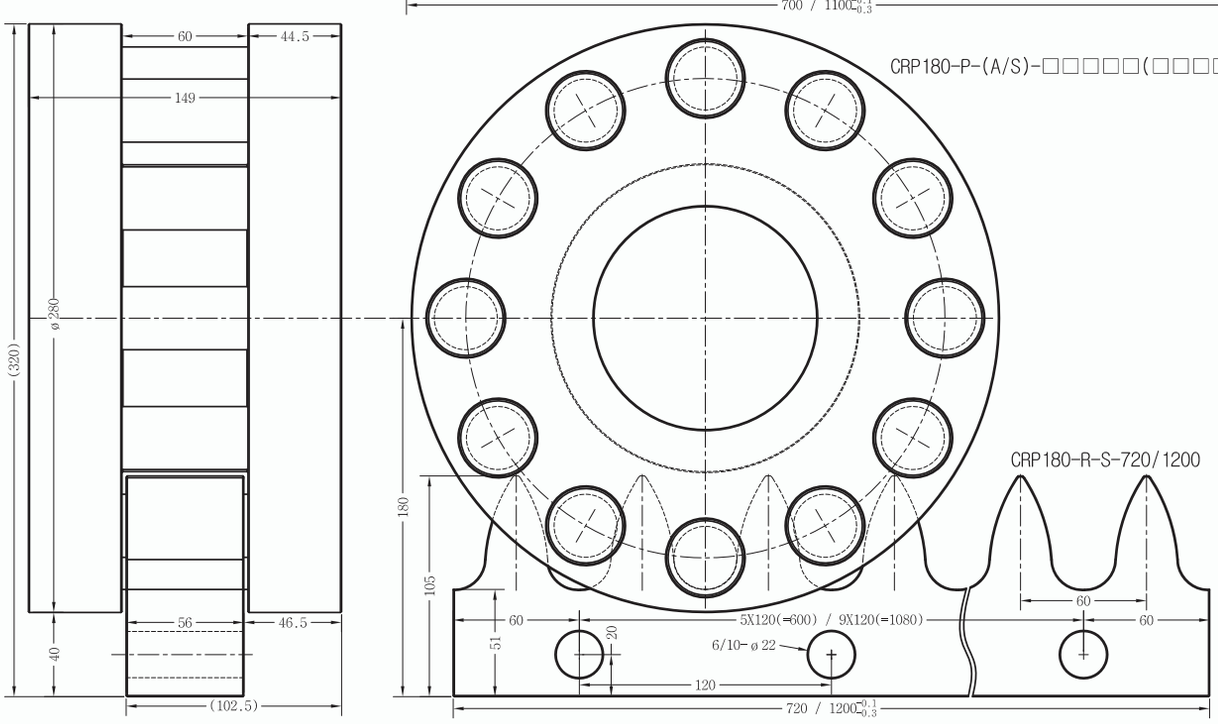




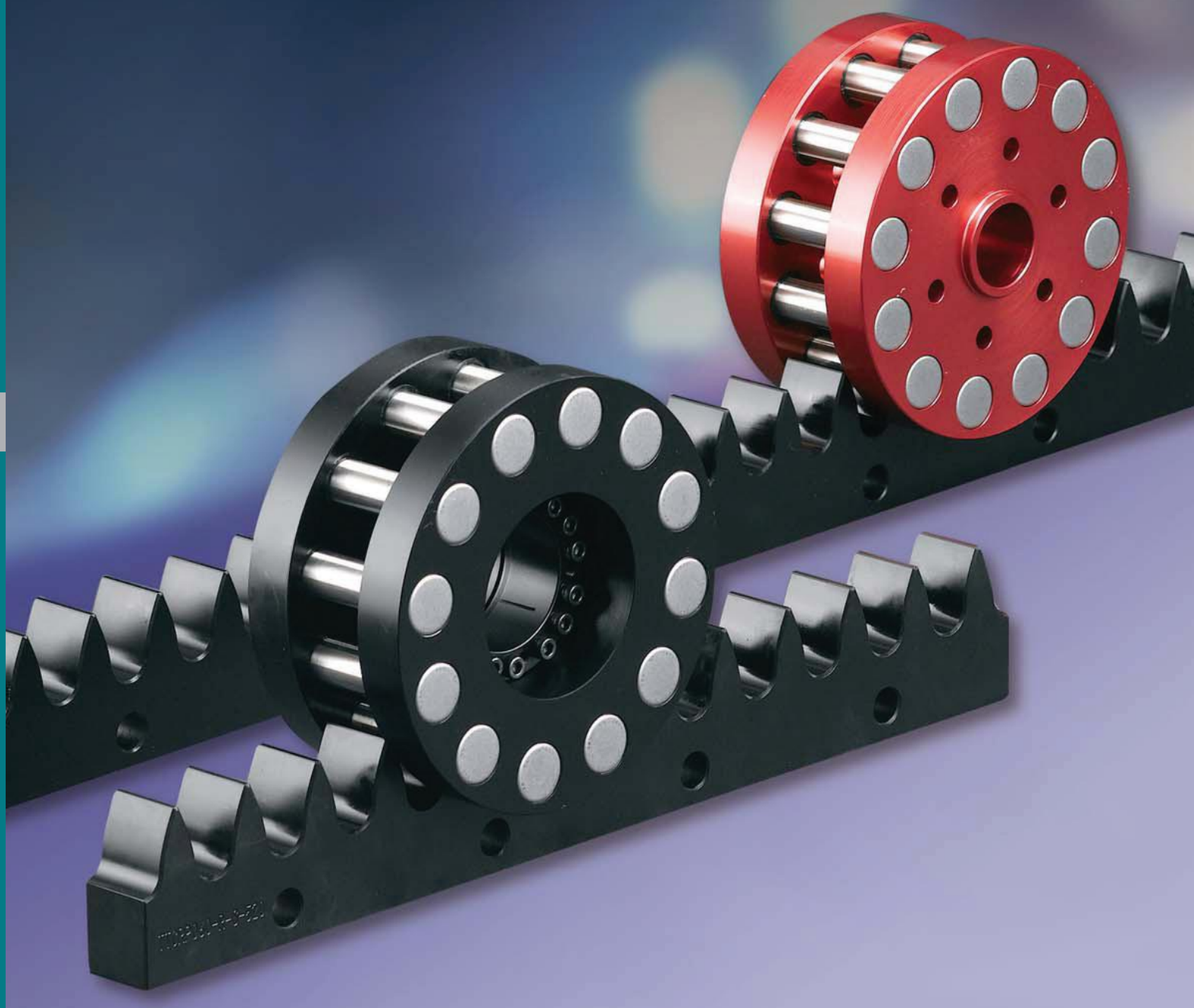



CRP080-P-(A/S)-□□□□□(□□□□)
CRP080-R-S-630/1170
46
24.5
95
ø 216
(248)
42
26.5
32
(68.5)
140
80
42
45
90
16
7/13-ø 18
45
45
6X90(=540) / 12X90(=1080)
630 / 1170 0.1 -0.3


CRP120-P-(A/S)-□□□□□(□□□□)
CRP120-R-S-700/1100
56
30.5
117
ø 238
(270)
52
32.5
32
(84.5)
151
87.5
43.5
50
16
7/11-ø 18
100
50
50
6X100(=600) / 10X100(=1000)
700 / 1100 0.1 -0.3


CRP180-P-(A/S)-□□□□□(□□□□)
CRP180-R-S-720/1200
60
44.5
149
ø 280
(320)
56
46.5
40
(102.5)
180
105
51
60
20
6/10-ø 22
120
5X120(=600) / 9X120(=1080)
60
60
720 / 1200 0.1 -0.3

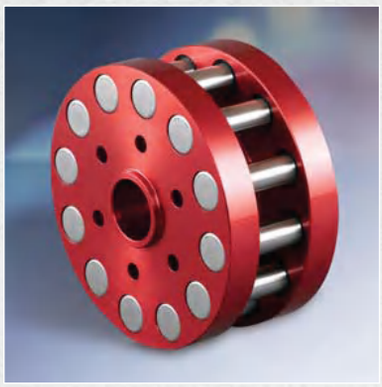
CRP滚轮齿条
Clean Rack Pinion



CRP用户手册
CRP User Guide



胀套连接 Shrink Fitting



螺栓连接 Bolt Clamping



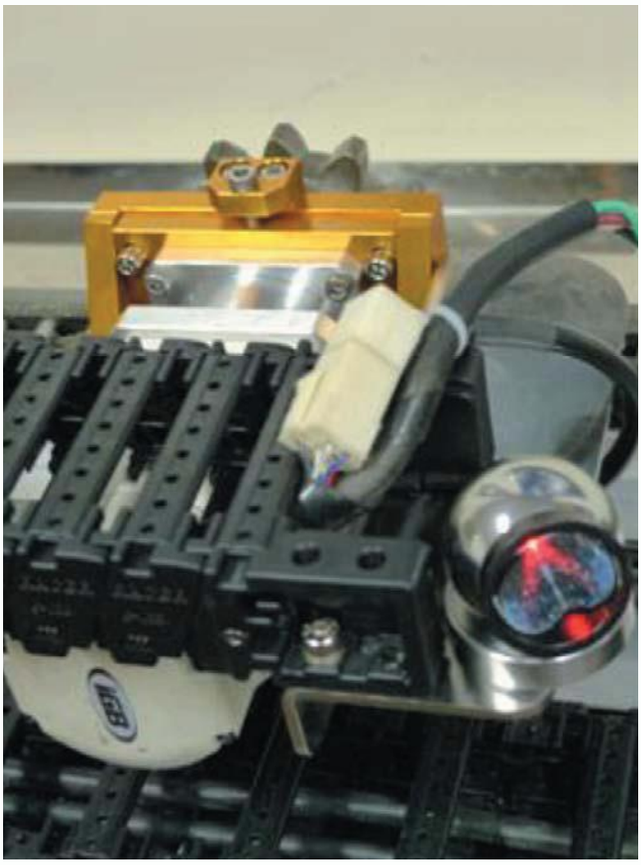
齿条 Rack

- 整洁的外观 Clean Performer
- 整洁的安装 Clean Installation
- 多种选择 Various Selections
- 整数测距 Integer Movement
- 多齿接触 Multiple Tooth Contact
- 轨迹成型齿 Generated Tooth Profile
- 高加速度 High Acceleration
- 高效率 High Efficiency
- 超低噪音 Extremely Silent
- 优秀的动态表现 Highly Performance
- 简单易用 Simple To Use

性能实验 Performance experiments



图片1. 可靠性测试和冲击实验
Figure 1.Reliability & emergency impact test



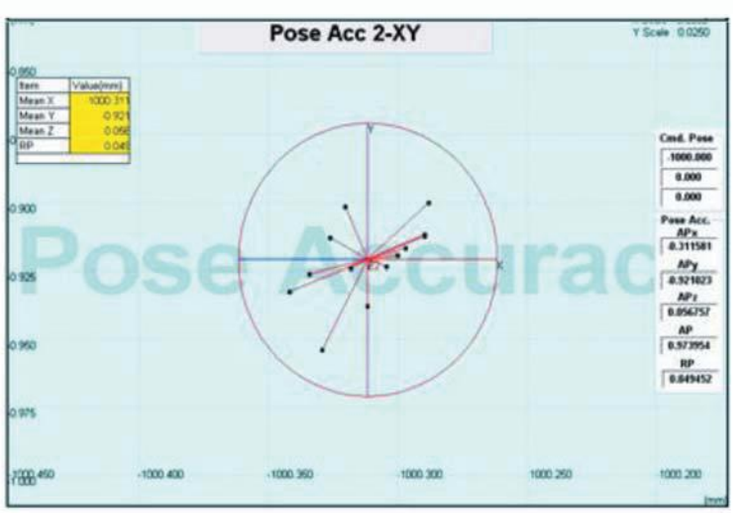
图片2. 精度测试
Figure 2. Accuracy test

精度测试 Accuracy test

■ 绝对精度

·样品型号：
　　滚轮： CRP004-P-A-B06M05018
　　齿条： CRP004-R-S-930
·运动距离： 5m
·环境温度： 20℃
·测量设备： 激光追踪器
·测试结果： ±0.03mm

※ 从任意位置为始点开始测试，无累积误差。



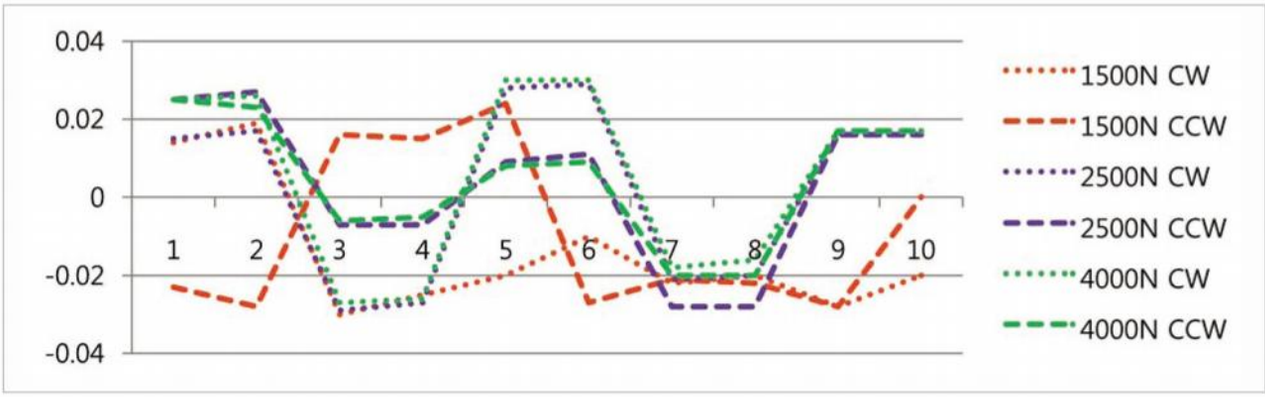
■ Absolute accuracy
Specimen model no.:
　Pinion : CRP004-P-A-B06M05018
　Rack : CRP004-R-S-930
Traveling range : 5m
Ambient temperature : 20℃
Measuring equipment : Laser tracker
Results :±0.03mm

※ Measuring absolute positioning from arbitrary origin.No accumulat error

■ 线性传动精度（带负载）Linear transmission (positioning) accuracy (with load)

·样本型号：
　滚轮：CRP060-P-A-B08M10045
　齿条：CRP060-R-S-1040
·运动范围：0～2m
·环境温度：20℃
·测量设备：线性编码器
·测试结果：±0.03mm

Specimen model no. :
　Pinion : CRP060-P-A-B08M10045
　Rack : CRP060-R-S-1040
Traveling range: 0~2m
Ambient temperature : 20℃
Measuring equipment : Linear Encoder
Results :±0.03mm



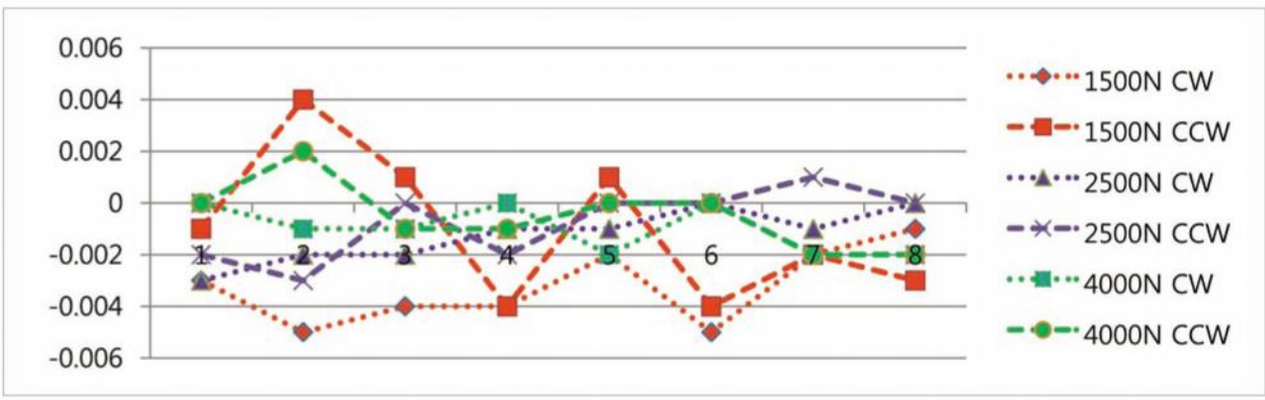
※ 滚轮一圈行程对应齿条直线行程的误差
　零背隙（逆向运行误差小于正向运行误差）
　不同负载下仍保持相同的位置精度
　无累积误差

※ One revolution of pinion vs. linear motion of rack error measurements.
　No backlash (Error in direction change < error in the same direction).
　Maintain the same poisoning accuracy under different load condition.
　No accumulate error.

■ 重复定位精度（带负载） Repeatability (with load)

·样本型号：
　滚轮：CRP060-P-A-B08M10045
　齿条：CRP060-R-S-1040
·运动范围：0～2m
·环境温度：20℃
·测量设备：线性编码器
·测试结果：±0.005mm

Specimen model no. :
　Pinion : CRP060-P-A-B08M10045
　Rack : CRP060-R-S-1040
Traveling range : 0~2m
Ambient temperature : 20℃
Measuring equipment : Linear Encoder
Results :±0.005mm



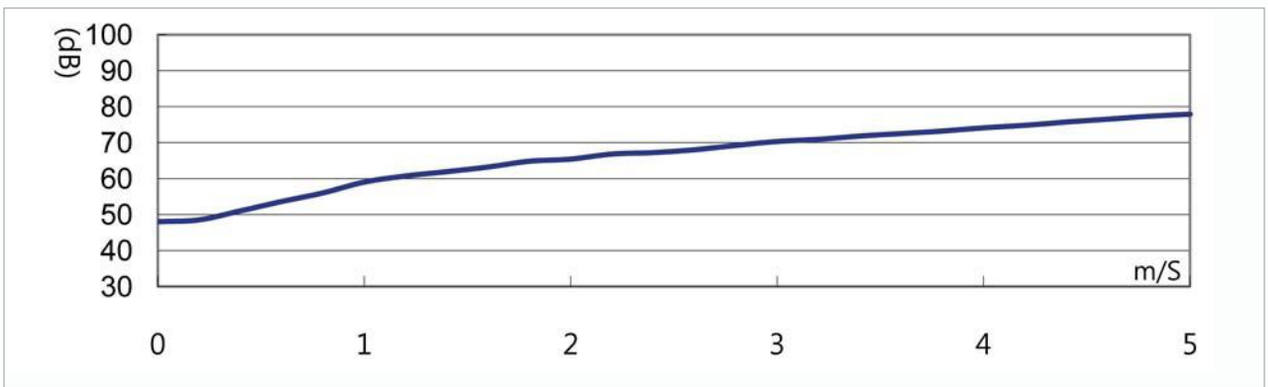
※ 重复定位精度是以任意位置为始点测量
零背隙（逆向运行误差小于正向运行误差）
不同负载下仍保持相同的定位精度
无累积误差

※ Repetitive positioning accuracy at arbitrary position.
No backlash (Error in direction change < error in the same direction).
Maintain the same repeatability under different load condition.
No accumulate error.

■ 噪音 Noise

·样本型号：
滚轮：CRP004-P-A-B06M05018
齿条：CRP004-R-S-930
·运动距离 : 5m
·环境温度：20℃
·测量设备：收音器和分贝计

Specimen model no. :
Pinion : CRP004-P-A-B06M05018
Rack : CRP004-R-S-930
Traveling range : 5m
Ambient temperature : 20℃
Measuring equipment : Micro phone & decibel meter



※ 噪音是在不同的滚轮速度下测定，测定的是整个运行系统的噪音（包括电机、导轨、减速机等配件产生的噪音）
每个测量值会因测量设备的不同而异，还有一些因素比如工作环境、装配精度、生产工艺等会影响测试结果。
噪音测量值仅供参考，具体选型请参考产品样本。

※ Noise is measured at each linear velocity when the pinion is driven to rotate.
Including related-noise (e.g., noise caused from motor, LM guide, gearbox, cablevayor etc.)
Each measurement values are based on practical measurement. It depends on related elements, ambient condition, assembly accuracy, workmanship and so on. The measurement value can be used as reference only. Please refer specifications on catalogue for selections.

CRP选型实例 CRP quick selection



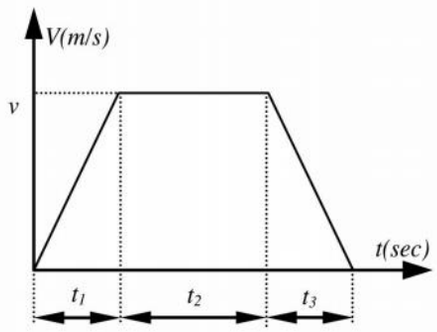


表1.摩擦系数 [Table 1. Friction coefficient]（μ）

滚动接触 [Rolling contact]	0.005~0.02
滑动接触 [Sliding contact]	0.1~0.2

表2.安全系数 [Table 2. Safety factor]（S_f）

无冲击运行 [Operations without impact]	1.0~1.2
一般运行 [General operations]	1.2~1.5
有冲击运行 [Operations with impact]	1.5~2.5

1. 平均速度计算

加速位移 ： $S_1 = \frac{1}{2} \times v \times t_1$

匀速位移 ： $S_2 = v \times t_2$

减速位移 ： $S_3 = \frac{1}{2} \times v \times t_3$

平均速度 ： $v_m = \frac{S_1 + S_2 + S_3}{t_1 + t_2 + t_3}$

1. 平均切向力计算

加速负载 ： $F_{a1} = m \cdot a_1 = m \times (v/t_1)$

摩擦力 ： $F_r = \mu \cdot m \cdot g$

其中，μ 是摩擦系数，g 是地球重力加速度

减速负载 ： $F_{a3} = m \cdot a_3 = m \times (v/t_3)$

外力 ： F_e

总加速切向力 ： $F_1 = F_{a1} + F_r + F_e$

总匀速切向力 ： $F_2 = F_r + F_e$

总减速切向力 ： $F_3 = F_{a3} - (F_r + F_e)$

平均切向力 ：

$$F_m = \sqrt[\frac{10}{3}]{\frac{t_1 F_1^{\frac{10}{3}} + t_2 F_2^{\frac{10}{3}} + t_3 F_3^{\frac{10}{3}}}{t_1 + t_2 + t_3}}$$

1. Linear mean speed calculation

Acceleration distance : $S_1 = \frac{1}{2} \times v \times t_1$

Constant speed distance : $S_2 = v \times t_2$

Deceleration distance : $S_3 = \frac{1}{2} \times v \times t_3$

Linear mean speed : $v_m = \frac{S_1 + S_2 + S_3}{t_1 + t_2 + t_3}$

2. Tangential mean force calculation

Load @ acc. period : $F_{a1} = m \cdot a_1 = m \times (v/t_1)$

Friction load : $F_r = \mu \cdot m \cdot g$

where, μ is friction coefficient, g is gravitational acceleration.

Load @ dec. period : $F_{a3} = m \cdot a_3 = m \times (v/t_3)$,

External force : F_e

Total force @ acc. period : $F_1 = F_{a1} + F_r + F_e$

Total force @ constant speed period : $F_2 = F_r + F_e$

Total force @ dec. period : $F_3 = F_{a3} - (F_r + F_e)$

Tangential mean force :

$$F_m = \sqrt[\frac{10}{3}]{\frac{t_1 F_1^{\frac{10}{3}} + t_2 F_2^{\frac{10}{3}} + t_3 F_3^{\frac{10}{3}}}{t_1 + t_2 + t_3}}$$

需要的平均切向力 ：

$$F_{dm}=\frac{F_m}{\cos\alpha}\times S_f(N)$$

α 为压力角，F_m为平均切向力，S_f 为安全系数

需要的径向负载 ：

$$F_{dr}=F_{dm}\times\sin\alpha(N)$$

3. 寿命计算

$$L_{10}=10000\times\frac{v_o}{v_m}\times\left(\frac{F_o}{F_{dm}}\right)^{\frac{10}{3}}$$

v_m = 平均速度 (*m/s*),
F_{dm} = 平均切向力 (F_m) X安全系数 (S_f) (*N*),
v_o = 额定速度 (*m/s*),
F_o = 额定切向力 (*N*).

▶ 额定速度和额定切向力请参考“CRP滚轮齿条规格参数表”上滚轮转速在360rpm的数值。

▶ 允许的最大切向力不可超过“CRP滚轮齿条规格参数表”上滚轮转速在120rpm时的数值。

▶ 直线轴承、驱动器支撑构件等配件的选用，其可承受的负载应大于需要的径向负载（ F_{dr} ）计算值。

■ 选型例子

▶ 工作条件

质量：m =200kg, 速度：v =2m/s
加/减速时间：t_1=t_3 =0.5sec, 匀速时间：t_2 =4sec
外力：F_e =100N
摩擦系数：μ =0.01 （表1）
重力加速度：g =9.81m/s^2
正常运行：S_f = 1.4（表2）
1、加速度：$a_1=a_3=v/t_1=2/0.5=4\,m/s^2$
2、加速负载：$F_{a1}=F_{a3}=m\cdot a_1=200\times4=800N$

Desired tangential mean force:

$$F_{dm}=\frac{F_m}{\cos\alpha}\times S_f(N)$$

where, α =Pressure angle,
F_m =Tangential mean force, S_f =Safety factor
Desired radial mean load:
$$F_{dr}=F_{dm}\times\sin\alpha(N)$$

3. Lifetime calculation

$$L_{10}=10000\times\frac{v_o}{v_m}\times\left(\frac{F_o}{F_{dm}}\right)^{\frac{10}{3}}$$

where,
v_m = Linear mean speed (*m/s*),
F_{dm} = Tangential mean force (F_m) X Safety factor (S_f) (*N*),
v_o = Rated linear speed (*m/s*),
F_o = Rated tangential force (*N*).

▶ Rated linear speed & rated tangential speed, refer the value where pinion rpm 360, at 'Rating at a glance'.

▶ Permitted maximum desired tangential mean force should not exceed the value where pinion rpm 120, at 'Rating at a glance'.

▶ Linear bearing, and actuator supporting structure etc. should bigger than desired radial mean load.

■ Selection example

▶ Operating conditions

Mass : m =200kg, Linear speed : v =2m/s
Acc./dec. time : t_1=t_3 =0.5sec,
Constant speed time : t_2 =4sec
External force : F_e =100N
Friction coefficient : μ =0.01 (Refer Table 1)
Gravitational acceleration : g =9.81m/s^2
General operations : S_f = 1.4 (Refer Table 2)

1. Acceleration : $a_1=a_3=v/t_1=2/0.5=4\,m/s^2$
2. Acceleration load :
$$F_{a1}=F_{a3}=m\cdot a_1=200\times4=800N$$

3. 摩擦力：

$$F_r = \mu \cdot m \cdot g = 0.01 \times 200 \times 9.81 = 19.62N$$

4. 总加速切向力：

$$F_1 = F_{a1} + F_r + F_e$$
$$= 800 + 19.62 + 100 = 919.62N$$

5. 总匀速切向力：

$$F_2 = F_r + F_e = 19.62 + 100 = 119.62N$$

6. 总减速切向力：

$$F_3 = F_{a3} - (F_r + F_e)$$
$$= 800 - (19.62 + 100) = 680.38N$$

7. 平均切向力：

$$F_m = \sqrt[\frac{10}{3}]{\frac{t_1 F_1^{\frac{10}{3}} + t_2 F_2^{\frac{10}{3}} + t_3 F_3^{\frac{10}{3}}}{t_1 + t_2 + t_3}}$$
$$= \sqrt[\frac{10}{3}]{\frac{0.5 \times 919.62^{\frac{10}{3}} + 4 \times 119.62^{\frac{10}{3}} + 0.5 \times 680.38^{\frac{10}{3}}}{0.5 + 4 + 0.5}}$$
$$\cong 507N$$

8. 平均速度：

$$v_m = \frac{S_1 + S_2 + S_3}{t_1 + t_2 + t_3} = \frac{0.5 + 8 + 0.5}{0.5 + 4 + 0.5} = 1.8m/s$$

9. 选型

需要的加速切向力：

$$F_{d1} = S_f \times \frac{F_1}{\cos\alpha} = 1.5 \times \frac{919.62}{\cos 27} = 1548.2N$$

需要的平均切向力：

$$F_{dm} = S_f \times \frac{F_m}{\cos\alpha} = 1.5 \times \frac{507}{\cos 27} = 853.5N$$

需要的径向负载：

$$F_{dr} = F_{dm} \times \sin\alpha = 853.5 \times \sin 27 = 387.5N$$

根据计算结果，查表可选CRP008

$F_{d1} = 1548.2N < 2105N$ （CRP008最大加减速切向力）

$F_{dm} = 853.5N < 868N$ （CRP008速度在1. 92m/s时允许的切向力）

10. 寿命计算

$$L_{10} = 10000 \times \frac{v_o}{v_m} \times \left(\frac{F_o}{F_{dm}}\right)^{\frac{10}{3}}$$
$$= 10000 \times \frac{1.44}{1.8} \times \left(\frac{947}{853.5}\right)^{\frac{10}{3}} \cong 11313hrs$$

3. Frictional load:

$$F_r = \mu \cdot m \cdot g = 0.01 \times 200 \times 9.81 = 19.62N$$

4. Total tangential force @ acc. period:

$$F_1 = F_{a1} + F_r + F_e$$
$$= 800 + 19.62 + 100 = 919.62N$$

5. Total tangential force @ constant speed period

$$F_2 = F_r + F_e = 19.62 + 100 = 119.62N$$

6. Total tangential force @ dec. period:

$$F_3 = F_{a3} - (F_r + F_e)$$
$$= 800 - (19.62 + 100) = 680.38N$$

7. Tangential mean force:

$$F_m = \sqrt[\frac{10}{3}]{\frac{t_1 F_1^{\frac{10}{3}} + t_2 F_2^{\frac{10}{3}} + t_3 F_3^{\frac{10}{3}}}{t_1 + t_2 + t_3}}$$
$$= \sqrt[\frac{10}{3}]{\frac{0.5 \times 919.62^{\frac{10}{3}} + 4 \times 119.62^{\frac{10}{3}} + 0.5 \times 680.38^{\frac{10}{3}}}{0.5 + 4 + 0.5}}$$
$$\cong 507N$$

8. Linear mean speed

$$v_m = \frac{S_1 + S_2 + S_3}{t_1 + t_2 + t_3} = \frac{0.5 + 8 + 0.5}{0.5 + 4 + 0.5} = 1.8m/s$$

9. Selection

Desired tangential force @ acc. period:

$$F_{d1} = S_f \times \frac{F_1}{\cos\alpha} = 1.5 \times \frac{919.62}{\cos 27} = 1548.2N$$

Desired tangential mean force:

$$F_{dm} = S_f \times \frac{F_m}{\cos\alpha} = 1.5 \times \frac{507}{\cos 27} = 853.5N$$

Desired radial mean load:

$$F_{dr} = F_{dm} \times \sin\alpha = 853.5 \times \sin 27 = 387.5N$$

As a result, CRP008 is selected.

$F_{d1} = 1548.2N < 2105N$ ←CRP008 Max.acc./dec. tan. force

$F_{dm} = 853.5N < 868N$ ←CRP008 Permitted tan. force @1.92m/s

10. Lifetime calculation

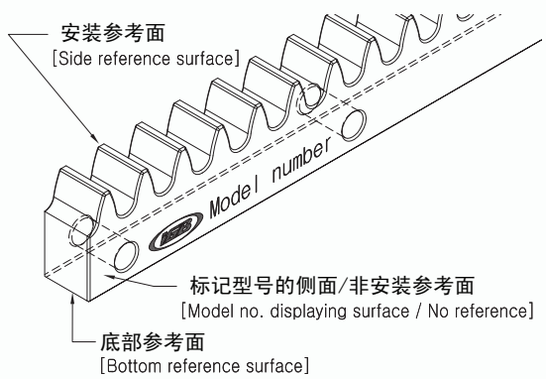
$$L_{10} = 10000 \times \frac{v_o}{v_m} \times \left(\frac{F_o}{F_{dm}}\right)^{\frac{10}{3}}$$
$$= 10000 \times \frac{1.44}{1.8} \times \left(\frac{947}{853.5}\right)^{\frac{10}{3}} \cong 11313hrs$$

CRP设计和安装说明 CRP general design & installation guideline

■ 将齿条安装固定在坚硬平整的平面

CRP 滚轮齿条可在运行中保持零机械间隙，它需要系统有适合的装配精度。这种装配精度在系统整体运行中仍然保持约束，使运动可控。为了使产品发挥最佳性能表现，导向系统需与 CRP 滚轮齿条尽可能保持平行。要注意的是，为保证滚轮装配精度，导向系统和 CRP 滚轮齿条要整体升降运行。使导向系统和 CRP 滚轮齿条之间的运行变化误差最小化的一个最好方法是，让它们的安装位置点参考同一个平面。

齿条上有 5 个面，其中标记型号的侧面和被切掉的端面不可作为参考面。标记型号的侧面不可以被安装在机身上。齿条的切割端必须位于运行的末端。



■ 安装说明

为了使背隙最小化，获得最高的定位精度，CRP 滚轮齿条必须安装在坚硬平整的基准面上。安装误差要求如图 3 所示。

为获得适合的 CRP 性能表现，安装时必须满足以下要求：

①. 安装直线导轨的平面与 CRP 齿条安装平面要保持平行，保持相同的平整度。

②. 滚轮轴中心线与齿条安装平面的平行度为 ±0.02mm，滚轮轴中心线与齿条长度方向保持垂直，垂直度误差为 90° ±0.1°

③. 滚轮轴须有足够的支撑力，以保证滚柱与齿面完全接触。

④. 为了获得适合的支撑，齿条安装面必须至少超过齿条宽边面的一半。齿条不应该只有紧固件单独支撑，不建议将齿条直接钉在安装面上。

⑤. CRP 滚轮齿条可以以任意角度安装，只要能够保证齿条、导向系统和安装面保持平行，以及滚轮轴中心线与齿条保持垂直。

■ Secure the rack at rigid & straight surface

The CRP can maintain zero mechanical clearance and requires proper system assembly accuracy. This assembly accuracy must remain relatively consistent over the entire run to obtain optimal system performance. To achieve this it is crucial that the guiding system be as parallel as possible to the CRP.The main consideration is that the guiding system and the CRP system are rising or falling at the same place in the run so the pinion assembly accuracy remains within specifications. The best way to minimize the variance between the guiding system and the CRP system is to machine their mounting locations in a single machining operation. Five sides of the CRP rack are reference surfaces. The side displaying the model no., or ends that have been cut (not factory full or half sections) are non-reference surfaces. The side displaying the model no. should not be mounted against the machine bed and cut rack ends must be at the end of the run.

■ Installation guideline

In order to minimize backlash, obtain the highest positional accuracy, and minimize wear on the rack, the CRP system must be installed on a rigid, straight, flat mounting surface with the tolerances shown in below Figure 3.

The following requirements must be met to ensure proper CRP operation:

① Mount a linear guide rail on a surface parallel to the CRP rack mounting surface with the same flatness as the rack mounting surface.

② The pinion shaft must be parallel (±0.02 mm) to the rack mounting surface opposite the rack teeth and the angle between the pinion shaft and the face of the rack must be 90°±0.1°.

③ The pinion shaft must be supported adequately to ensure full contact of the pinion rollers along the face of rack teeth.

④ The rack must sit on a step at least one half the width of the rack for proper support. The rack should not be supported by fasteners alone. Pinning the rack to its mounting surface is not recommended.

⑤ Systems may be mounted at any angle as long as the rack, guiding system and mounting surface remain parallel with the shaft at a 90° angle from the rack.

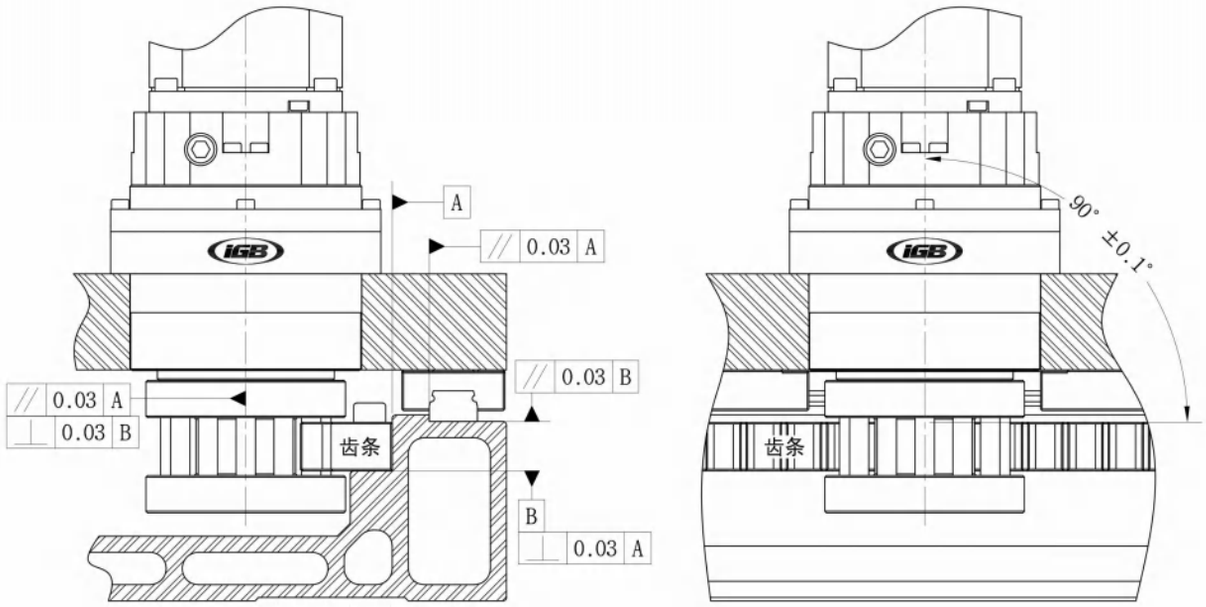


图3. CRP安装误差要求 [Figure 3. CRP installation examples]

■ 齿条切割

如果您需要比标准长度短的齿条，齿条是可以切割的。切割应从齿条底部参考面开始。另外，赛劲可提供额外的侧边或底部螺纹孔、沉头孔的加工，这需要客户支付额外的费用。

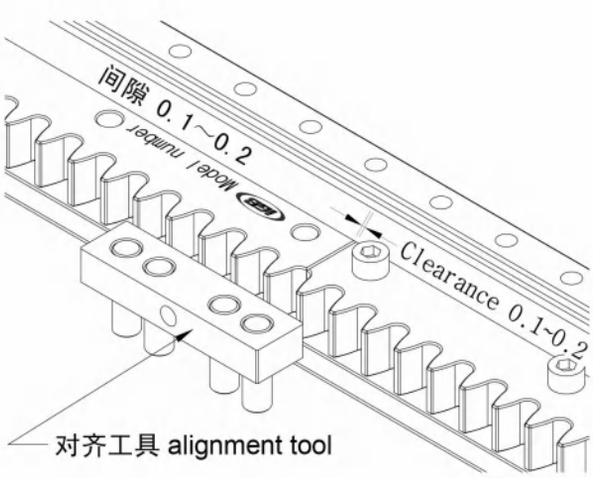
■ 多齿条连接

当多个齿条连接在一起使用时。建议使用对齐工具。对齐工具可以通过工钳或螺栓紧固在两根齿条的接头处，通过压紧对齐工具圆柱上的钢块固定两根齿条。

如果不方便使用工钳夹紧，可以手动压入对齐工具。两根齿条的间隙如果安装适当，来回推动对齐工具，不会有相对移动。

注意：建议采用工钳压紧对齐工具的方法，使用螺栓或手动阀座可能会导致 CRP 系统定位精度降低，当滚轮经过两齿条接头处会增加累积误差。

详细信息，请参阅“ 多齿条安装 ”部分。



■ Rack modification

CRP rack can be cut, if it is necessary. Cutting should be start from the bottom reference surface of rack. iGB can provide additional tapped, untapped or countersunk holes in the side or bottom of the rack or cut the rack to a specific length for an additional charge.

■ Multiple rack

When joining multiple sections of rack it is recommended that the alignment tool should be used whenever possible. The alignment tool can be clamped or bolted in place by placing the alignment tool in position across the rack joint and laying a flat steel bar across the pins and clamping against the steel bar.

If clamping is not possible then the alignment tool can be manually seated across the rack joint while pressing the pins forcefully into the rack teeth. When the adjoining rack section is properly spaced, no movement should be felt when alternately pushing down on opposite ends of the alignment tool.

Note: Lightly clamping down the alignment tool is the recommended method, using the bolting or manually seating procedures may result in reduced CRP system positional accuracy and cumulative error when crossing rack joints.

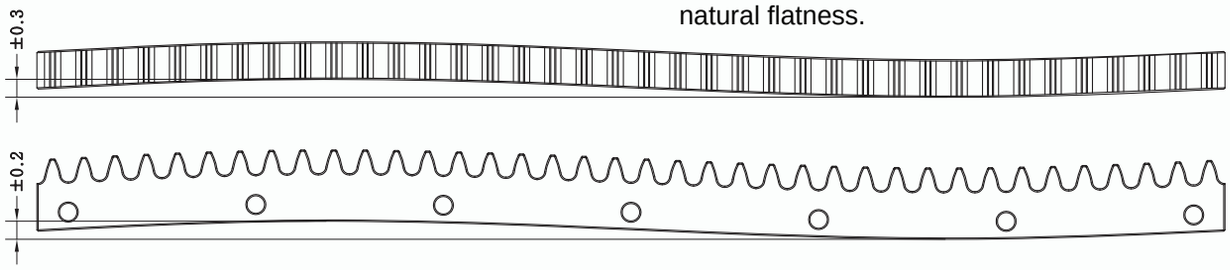
Refer ‘Additional rack installations’ section for further information.

■ 齿条自身平整度

齿条自身的平整度如下图所示。平整度的值会因齿条的长度、厚度和型号等因素的不同而不同。通过合理的安装，齿条的形变可以恢复到原来的精度要求。平整度的值仅供参考。当然，不适当的存储也可导致齿条发生永久变形。存储时不要垂直放置或将齿条的一端挂在货架上。为保持自身的平整度，齿条必须水平放置在平面上。

■ Natural Flatness of Rack

Natural flatness of CRP rack alone, before installation, is shown in below figure. This flatness depends on length, thickness, model and so on. This deformation can be restored to original accuracy by proper installation. Therefore, this value can use as reference only. However, it is possible to occurring permanent deformation without proper storing. Do not store the rack vertically or hang on part of rack only. It must store flat floor with entire rack length support to maintain natural flatness.



■ 安装

齿条和导向系统必须与安装面保持平行，平行度请参考表 3。保持平行的最佳方法是，导向系统和齿条的安装孔位都采用同样的装配和加工方式。

为了尽量减少灰尘碎屑对滚轮齿条啮合的干涉，建议将齿条以齿牙朝下或朝侧面安装。标有型号的侧面和被切割的端面不适合做安装参考面。被切割的端面应位于系统运行的末端。滚轮不可越过齿条末端运行。

请遵循以下顺序安装。

1. 确保安装面和齿条干净清洁、平整无毛刺、无污染物等。

2. 将千分表安装在导向系统导轨上的滑块上，测量底部安装参考面和侧边安装参考面的垂直度和平行度。移动滑块，确保跳动不超过 ±0.03 毫米（图 4）的要求。把所有处于上限公差的位置标记。

3. 从刚刚标记的误差较大的底部参考面安装点开始安装，其他安装点可通过加薄垫片的方式，以确保相对应的齿顶与第一个安装位置相对应的齿顶误差在 ±0.03 毫米范围内。

■ INSTALLATION

The mounting surface for both the rack and the linear guiding system must be parallel within the specifications shown in Figure 3. This parallelism requirement is best achieved by machining the mounting locations for both the guiding system and rack in the same machining operation.

iGB recommends orienting the rack teeth downward or to the side so it minimizes the possibility of debris collecting on the teeth and causing meshing interference. The model number displaying surface and arbitrary cut surface cannot be used as reference surface. And any rack ends that have been cut must be located at the end of the run; the pinion must not cross cut rack ends.

1. Ensure that the mounting surface and rack are completely clean, free of burrs, or anything that could interfere with full contact with the mounting surfaces.

2. With the guiding system in place mount a dial indicator on the carriage and measure the perpendicularity and parallelism variance on the two rack mounting surfaces by moving the carriage down the run and monitoring the dial indicator readings. Verify they meet specified tolerance of ±0.03 mm as shown in Figure 4. Mark the location of the high point in the mounting surface the rack bottom sits on.

3. Start rack installation at the high point in the mounting surface the rack bottom sits on. Additional sections of rack will be shimmed as required throughout the rest of the run to bring the rack tooth peak variance into recommended tolerance (0.03mm) relative to the first rack section.

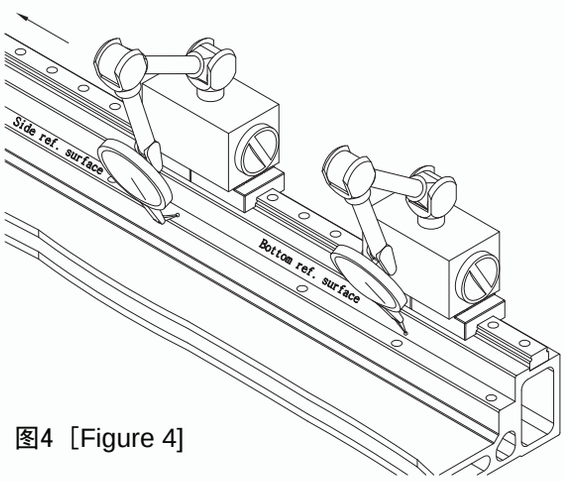


图4 [Figure 4]

4. 用螺栓固定齿条时，压紧时要用较厚的金属板压在齿牙上，使压紧应力分散在多个齿而不是集中在一个齿上。夹紧时确保夹具离螺栓较近，使齿条和安装面能够完全接触，请参考表 5 图示。建议采用圆柱头内六角螺栓以保持离滚轮的间隙。确保刻字面反向于安装面。

5. 依次从齿条中心到两边逐渐增加拧紧力，先施加约四分之一的力，再用一半的力，最后用完全拧紧力。完全拧紧力大小请参考表 3。

6. 齿条完全固定后，用千分表检查齿顶误差是否小于 0.03 毫米（或者齿条底部参考面最大平整度误差是否小于 0.05 毫米），如图 6 所示，将千分表的探头探触整个齿条所有的齿顶（或底部参考面）。如果测量的误差超出规定值而安装面的平整度符合要求，须将齿条拆卸下来，重新检查齿条、安装面是否有影响安装精度的灰尘污垢。如果安装面平整度不符合规定值，需要在齿条底部与安装面之间加载薄垫片。加载薄垫片时，先标记误差较大的位置点，然后在其他安装点加载薄垫片，调整误差，确保安装精度符合使用要求。

表3. 建议拧紧力 Recommended tightening torque

螺栓等级 [Bolt Class] 10.9～12.9		单位：Nm		
材质 Material		钢 Steel	铸铁 Cast Iron	铝 Aluminum
螺栓大小 [Bolt Size]	M6	15	10	8
	M8	37	25	13
	M10	73	51	36
	M12	128	89	64
	M14	204	142	102
	M16	318	222	159
	M20	622	435	311
螺栓等级 [Bolt Class] 6.9～8.8		单位：Nm		
材质 Material		钢 Steel	铸铁 Cast Iron	铝 Aluminum
螺栓大小 [Bolt Size]	M6	10	10	8
	M8	25	25	13
	M10	51	51	36
	M12	89	89	64
	M14	142	142	102
	M16	222	222	159
	M20	435	435	311

4. Apply mounting bolts, lightly secure the first rack length to the mounting surface and clamp it with additional thick steel plate to protect the rack teeth by distributing the clamp load over several teeth. Make sure the clamps are close to each bolt as they are tightened to ensure full rack to mounting surface contact. See Figure 5. Hexa-socket head cap screws are recommended for maximum pinion shoulder clearance. Make sure the side of the rack with the model number on it is not against the mounting surface.

5. Tighten the mounting bolts on the first rack alternately and incrementally 25%, 50%, then fully torque, working from the center of the rack towards the ends. Refer to Table 3 for recommended tightening torques.

6. Once the rack mounting bolts are fully torqued, verify tooth peak variance is less than 0.03mm(or the rack bottom reference surface peak variance less than 0.05mm) by placing a dial indicator on the movable carriage with the indicator tip on the tooth peaks.(or the rack bottom reference surface) Measure the tooth peak variance (or the rack bottom reference surface)at points throughout the entire rack section as shown in Figure 6. If the tooth peak variance (or rack bottom reference surface) is out of recommended tolerances and the mounting surface was in recommended tolerances, then dismount the rack and inspect for dirt, burs, or anything that would prevent proper rack to mounting surface seating. If the mounting surface is out of recommended tolerances, then shimming between the rack bottom reference surface and the mounting surface will be required. Locate the high point within the rack section and shim all other points to meet recommended tolerances. When shimming, it is preferred to support the rack as much as possible, not just short pieces near mounting bolts.

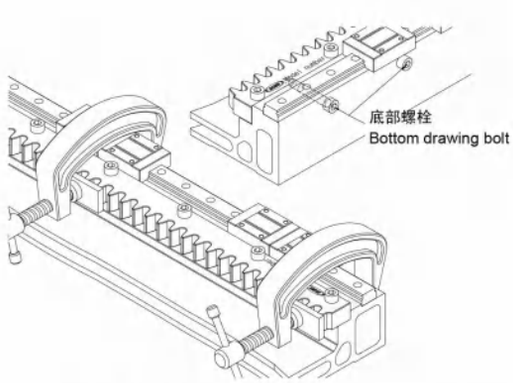


图5. 两种固定齿条的方法
Figure 5. Two way to securing the rack

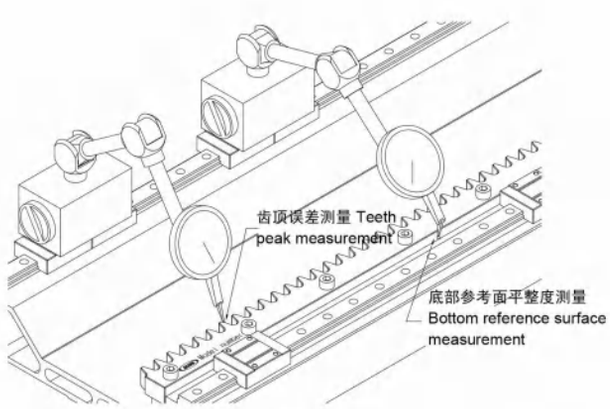


图6. 检查齿条安装误差
Figure 6. Rack verification

■ 多齿条安装

注意：每种型号的齿条都有专用的对齐工具，用于多齿条的安装。请将对齐工具作为必需品从我公司购入。

1. 将第二根齿条与第一根已安装固定好的齿条拼接起来，轻轻拧入螺栓，使齿条与安装面完全接触。开始不要拧紧，确保齿条可以微调安装孔位。

2. 将对齐工具压入两根齿条相邻的齿之间，如图 7 所示，请小心压入，以避免损坏齿牙和对齐工具。用工钳夹紧时，将一块厚钢板压在对齐工具的 4 个针柱上，使夹紧力均匀分布在多个齿上。注意不要夹得过紧，只要齿条或工钳不容易松动即可。

如果不方便使用工钳夹紧，可以手动压入对齐工具。两根齿条的间距如果安装适当，来回推动对齐工具，不会有相对移动。采用工钳夹紧是最好的方法，采用手动的方式，可能会降低 CRP 系统的运行精度。

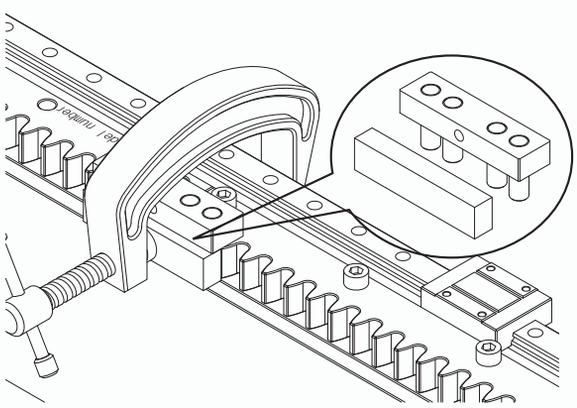


图7. 压紧对齐工具
Figure 7. Clamping the alignment tool

3. 从中心向两端交替拧紧第二根齿条上的螺栓，拧紧力依次由 25%，50%，100% 增加。推荐拧紧力大小请参考表 3。

4. 小心地取出对齐工具。

5. 根据“ 安装 ”部分的步骤 6，从第一根齿条开始检查齿顶最大形变是否在规定范围内。如果第二根齿条齿顶形变超出规定，加载薄垫片使其安装精度与第一根齿条一致。

6. 下一根齿条拼接安装，请重复步骤 1-5。安装检查时请都以第一根齿条做参考。

■ Additional rack installations

NOTE: Alignment Tools for each CRP size are required and available for purchase from iGB. This tool is required for proper installation of multiple rack segment runs.

1. Butt the second rack segment against the first fully secured rack on the mounting surface and lightly secure it with fasteners with serviceable thread locking compound applied so it is in full contact with the mounting surface but still moveable within the rack mounting hole tolerances.

2. Clamp the alignment tool between the two racks utilizing the two adjacent tooth roots of each rack while being careful not to damage the rack or alignment tool as shown in Figure 7. When clamp it,placing additional thick steel plate over all 4 pins in between alignment tool and clamp, to protect the rack teeth by distributing the clamp load over several teeth. Do not apply excessive force clamp the alignment tool. Lightly clamp it until rack or clamp itself is not move easily is enough.
If clamping is not possible then the alignment tool can be manually seated across the rack joint while pressing its pins forcefully into the rack tooth roots. When the adjacent rack section is properly spaced, no movement should be felt when alternately pushing down on opposite ends of the tool. Lightly clamping the alignment tool in place is the preferred method and will give the best results, using manual methods may reduce the CRP system accuracy.

3. Tighten the mounting bolts on the second rack alternately and incrementally 25%, 50%, then fully torque, working from the center of the rack towards the ends. Refer to Table 3 for recommended tightening torques.

4. Carefully remove the alignment tool.

5. Starting on the first rack perform the tooth peak variance check and extend it to the second rack as covered in step 6. If the tooth peak variance on the second rack is out of recommended tolerances shim it to match the first rack.

6. Repeat Steps 1 through 5 for any additional rack sections. Always reference the runout of additional rack sections against the first.

■ 滚轮安装

滚轮应尽量靠近轴的支撑轴承安装，以减少轴向偏差和径向载荷。

施加在致动器输出轴（或线性轴承）上的径向载荷，可以通过以下等式计算：

$$Fr = Ft \cdot \sin\theta$$

（其中，Fr是径向载荷，Ft 是实际作用力，θ是最大压力角）

选择致动器时，不仅要考虑“输出扭矩”，还要考虑 “径向载荷”。另外，在大多数应用中，滚轮不可能两端都有支撑。因此，施加到致动器输出轴的支撑轴承上的径向载荷，会产生一个倾覆力矩。这个倾覆力矩可能会导致致动器输出轴倾斜偏差。这种倾斜偏差会影响CRP滚轮齿条之间的正常啮合。

为了获得CRP最高的性能，建议选择适合的致动器倾覆刚度（硬度）规格。通过以下公式计算所需的倾覆刚度：

倾覆刚度 ≥ 径向载荷距离(m) × 径向载荷(N)

即使倾覆力矩和致动器的径向载荷满足要求，如果倾覆刚度不明确，根据实际运行情况，则仍有可能导致较差的滚轮齿条之间的啮合。在这种情况下，它会降低CRP的性能，如噪音、使用寿命和定位精度等。

致动器输出轴的规格应符合表4的规定。

表4. 致动器输出轴规格要求
Table 4. Desired actuator specifications

	圆度 [Circularity]	径向跳动 [Runout]
轴输出 [Shaft]	<0.02mm	<±0.01mm
法兰输出 [Flange]	<0.02mm	<±0.01mm

滚轮轴中心和致动器转轴中心必须尽可能保持重合。偏差会影响定位精度。机械胀套安装滚轮的方式，致动器与CRP滚轮之间，建议采用有自我中心圆的构件。

安装完成后，请检查致动器输出轴上的滚轮径向跳动误差。滚轮必须至少转动一圈，并确保滚轮上的滚柱（而不是滚轮壳）的最大误差不超过0. 03毫米。

■ Pinion installation requirements

Pinion should be mounted as close to a shaft supporting bearing as possible to minimize shaft deflection, radial load.
Exerted radial load to actuator output shaft (or add on linear bearingload) can be calculated by using equation below;

$$Fr = Ft \cdot \sin\theta$$

(where, Fr is radial load, Ft is actual tangential force, θ is maximum pressure angle.)

When selecting actuator for CRP, not only ‘Output torque’ but also ‘Applicable radial load’ has to be considered. Also, in most of application, pinion cannot be supported both ends, therefore, this radial load can be exerted into actuator output support bearing as a tilting moment with actuator output bearing support span. This tilting moment may cause tilting deflection of actuator output shaft. This tilting deflection may cause poor engagement of CRP pinion and rack.
To obtain maximum performance of CRP, it is recommended that select actuator with tilting rigidity (or stiffness) specifications. Desired tilting rigidity can be calculated by using following equation;

Actuator tilting rigidity ≥ Radial load distance （m） × Radial load （N）

Even though tilting moment load and radial load of actuator is sufficient, if tilting rigidity is not clear, then it is possible to have a poor engagement between pinion and rack, depends on operating condition. In this case, it may reduce the performance of CRP, such as noise, lifetime, and accuracy etc.
Actuator output shaft specifications should satisfy requirement in Table 4.
Pinion and actuator shaft rotary axis must align as close as possible. Eccentric alignment of pinion cause poor accuracy. In case of shrink fitting, between actuator output shaft and CRP pinion, self-centered products are recommended.
After install the pinion on the actuator output shaft, it is necessary to check the runout of pinion. Pinion must rotate at least one revolution, and ensure peak value of each pin (not pinion frame) remain within ‘<0.03mm’.

■ 滚轮和齿条的啮合

图 8 显示了如何调整 CRP 滚轮与齿条间的啮合间距。将滚轮上的一个滚柱压入齿条齿根处，轻轻施加大约 50N 或 5kg 的力，此时滚轮和齿条间啮合间距约为 0.005～0.015mm。避免如图 8 右边所示的安装方式，因为滚轮的两个滚柱同时压入齿根，会产生干涉，损坏齿牙和导轨。CRP 齿条拥有专利齿形，使产品更容易安装，齿面接触比例更高，产品性能也更好。

CRP 系统需要一个机械装置来获得适合的装配精度。建议将伺服驱动系统安装在一个可调节的滑动支架上。另一种调节滚轮位置的方法是利用有偏心安装槽的支架。一般的滚轮安装思路如图 9 所示，允许滚轮齿条间的啮合可调。弹簧调节装置不可使用，因为弹簧弹力会抵消滚轮齿条间的啮合反力，并会降低滚轮上滚针轴承的使用寿命，增加系统噪音。

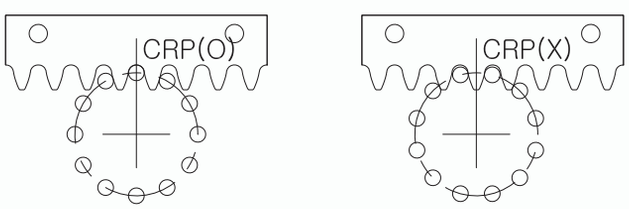


图8. 滚轮滚柱放入齿条位置示意图
Figure 8. Pinion positioning for assembly

■ Pinion and rack engagement

Figure 8 shows how to adjust CRP pinion and rack engagement distance. Place the pinion as only one pin on pinion locate at dedendum (root) of rack tooth. Gently press the pinion (approximately 50N or 5kg), then pinion and rack engagement distance become 0.005~0.015mm. If two pin of pinion locate at dedendum (root) of rack tooth, which is shown in right side of Figure 8, it may damage the teeth and (or) linear guide, by interference. CRP has patented tooth profile, which allow easier assembly and high teeth contact ratio to obtain maximum performance.

The CRP system requires a mechanism to achieve proper system assembly accuracy. The recommended method is to mount the iGB servo drive system on a sliding bracket that has an adjustment to push it into the rack. Another possible adjusting pinion location method utilizes a bracket with eccentric mounting slot pattern. General design concept for pinion installation, which allows teeth engagement adjustment shows in Figure 9. Spring loaded locating pinion mechanisms shall not be used since the spring force required to counteract the extra separation forces in between pinion and rack, and would cause a reduction in pinion needle bearing life and increase system noise.

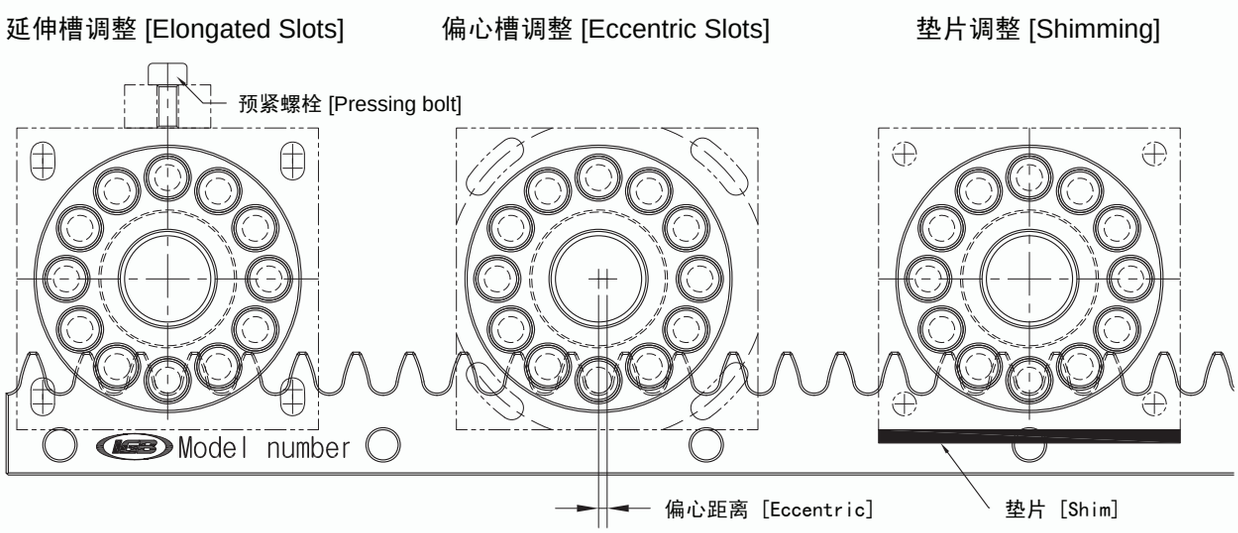


图9. 调整滚轮齿条啮合的安装实例
Figure 9. Pinion installation examples for teeth engagement adjustment

■ 润滑

大多数情况下，CRP 系统需要定期润滑，以防腐蚀。（标准的 CRP 齿条已通过了一定的耐腐蚀电镀处理）。在特殊情况下，如果运行速度不超过 1m/s（根据实际负载情况，最高速度不超过 2m/s），CRP 可免润滑。特别是在脏的工作环境中，污染物会粘在润滑剂中，产生干涉，加速产品磨损。（在这种情况下，可考虑我们赛劲替代线性运动的解决方案，即“BRP 系列 ”。它具有防尘的特征。如果您有任何这方面的需求，请咨询赛劲）。食品加工、无尘室、涂料和其他对于碎屑排放有限制要求的工作情况，免润滑方案更有益。免润滑的情况下 CRP 的使用寿命会有所降低，降低幅度根据负载的情况而不同。CRP 系列定期润滑的主要目的是为了防腐蚀。关于替代润滑或免润滑方案的更多信息，请咨询我公司。

■ 防护

避免齿条的齿牙向上安装，因为脱落的碎屑会停留并干涉滚轮齿条间的啮合。如果齿牙必须向上安装，要注意防护齿条或在滚轮前面安装一个空气刀，及时清洁碎屑，或者也可以考虑赛劲的“BRP 系列 ”替代方案。

■ Lubrication

Under most circumstances, the CRP system requires (minimized) periodic lubrication for anti-corrosion. (Standard CRP rack has ‘galvanic’ treatment for initial moderate corrosion resistance.)In special cases, CRP can be operated lubrication free on request, if the maximum speed does not exceed 1m/sec (Maximum speed 2m/sec, depends on load conditions an applications). Typically this will involve dirty environments where contaminates will be attracted/stick to the lubricant on the rack creating mechanical interference or an abrasive paste that can accelerate wear.(In this case consider alternative linear motion solution from iGB, so called BRP, which has dust resistance characteristics. If you have an application with any of these characteristic consult iGB.) Other applications where no rack lubrication may be beneficial include food processing, clean rooms, coating, and others where low particle emissions are desirable. If the CRP system is operated lubrication free there may be some reduction in life which could vary depending on the applications. CRP system needs lubrication mainly for anti-corrosion. iGB recommend that CRP should have periodic lubrication for anti-corrosion. Consult iGB for more information regarding alternative lubrication options or lubrication-free applications.

■ Shield

Avoid mounting the rack teeth up since debris could collect on the rack and interfere with the meshing of the CRP system. If the teeth must be mounted up, shield the CRP system from debris or install an air knife just ahead of the pinion or consider iGB BRP system.

■ 备注

• 确保机身和导向系统具有足够的刚性，以防止偏差，影响 CRP 系统的安装精度。

• 齿条底部和侧边与机身的安装接触面必须至少超过齿条厚度的一半。齿条不能仅仅通过紧固件或销钉安装连接。

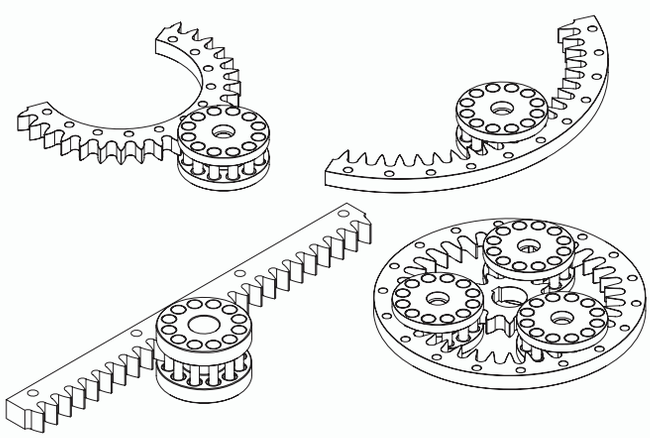
• 运行距离较长时，不可能仅将齿条安装在单个机身上，通过多个分段机身安装。安装时，导向系统和 CRP 齿条的接头不要位于机身接头的附近，应尽可能分开它们。

• 滚轮和齿条间会产生反向力，选择导向系统时，确保这个力也计算在内。详细请参考“ 滚轮安装 ”部分。

• CRP 系统的运行环境温度为 -5 ～ 40℃，热膨胀或较大的温度变化会影响系统的安装和啮合精度。如果您有任何特殊的环境应用要求，请咨询赛劲精密设备有限公司。

• 应要求，CRP 系统可采用不锈钢材质（不包括滚轮，滚柱采用轴承合金钢，滚轮壳采用铝合金），具有一定的防腐性。滚柱的腐蚀会导致滚针轴承的损坏和系统失效。滚轮需要注意适时地保养和维护。赛劲不保证 CRP 系列在任何使用情况下的都具有良好的耐腐蚀性。

• 根据客户要求，赛劲可提供底部或侧边带有接头孔、沉头孔的齿条，或切割定制长度的齿条，这需要额外费用。



客户定制齿条实例
[Modification examples on request]

■ Remarks

• Make sure that the machine bed and guiding system are rigid enough to prevent deflection that will affect CRP system assembly accuracy.

• The bottom of the rack and one side must be supported by a step in the machine bed at least half the rack thickness. The rack should not be supported only by fasteners or pins.

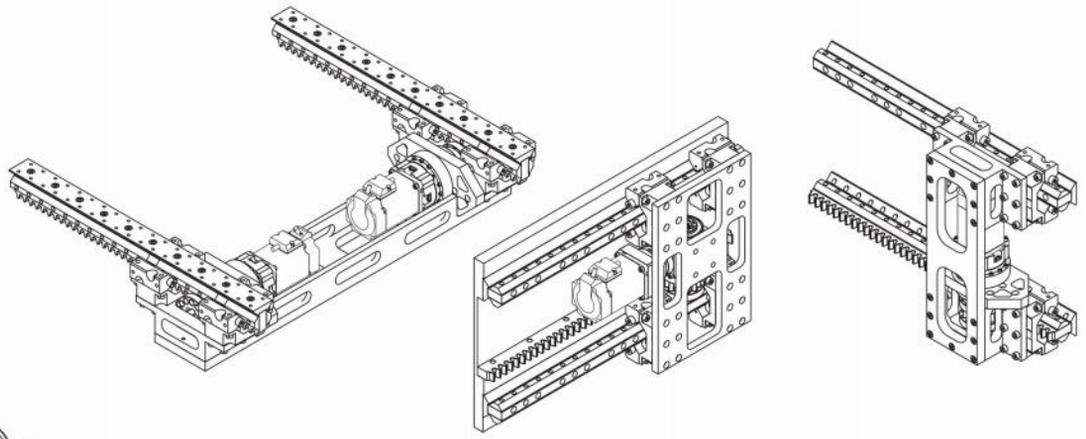
• Over long distances a single piece machine bed will become impractical requiring a segmented bed. When installing the guiding system and the CRP rack, their joints should not be located near the machine bed joints but span them as much as possible.

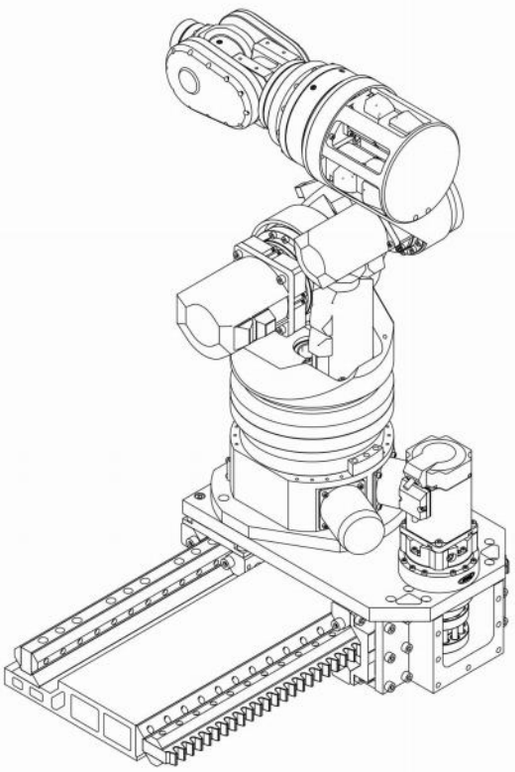
• The CRP system generates a separation force between the pinion and rack. Make sure this is accounted for when selecting the guiding system. Refer ‘Pinion installation requirement’ section.

• Do not use the CRP system in environments with temperatures outside of a -5~40℃ range, or with wide temperature variations since thermal expansion can affect the assembly accuracy and meshing of the system. If you have an application with any of these characteristics consult iGB.

• On request CRP systems made out of stainless steel, on request(with the exception of the pinion rollers that consist of bearing grade steel, and pinion housing with aluminum alloy as an option), and will have moderate corrosion resistance. Pinion roller corrosion will lead to pinion needle bearing damage and then system failure. Always protect the pinion from adverse conditions. iGB makes no claims for CRP corrosion resistance in any applications.

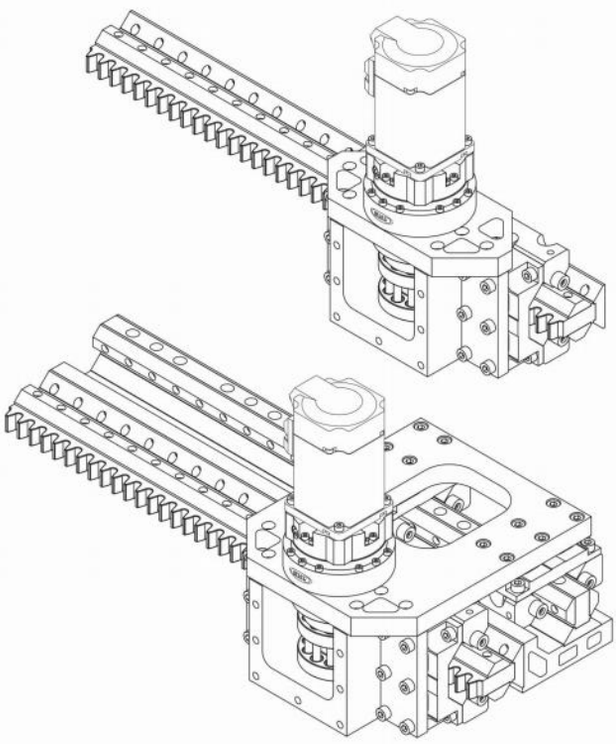
• iGB can provide additional tapped, untapped or countersunk holes in the side or bottom of the rack or cut the rack to a specific length for an additional charge.

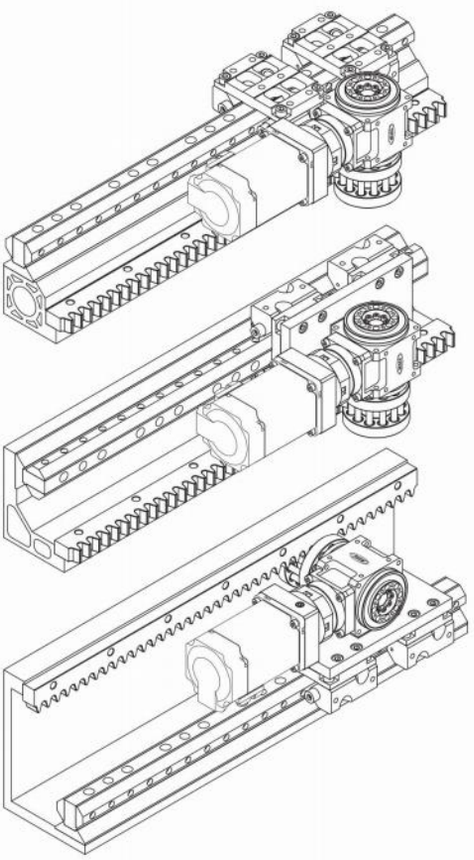




CRP安装实例

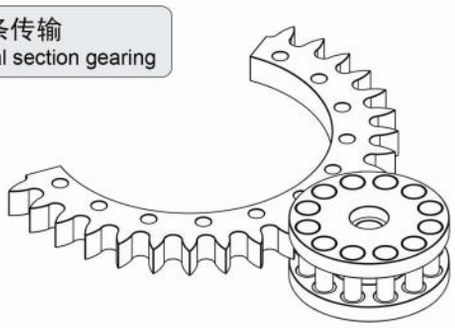
CRP Installation Examples



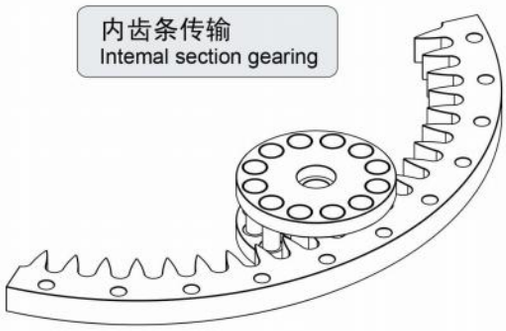


干润滑传输解决方案 Dry lubrication transmission on request

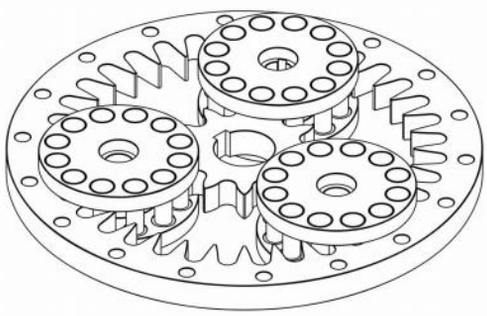
外齿条传输
Extemal section gearing



内齿条传输
Intemal section gearing

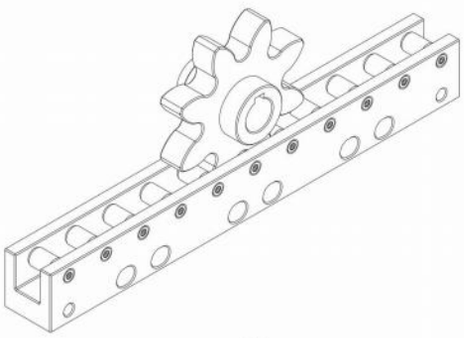


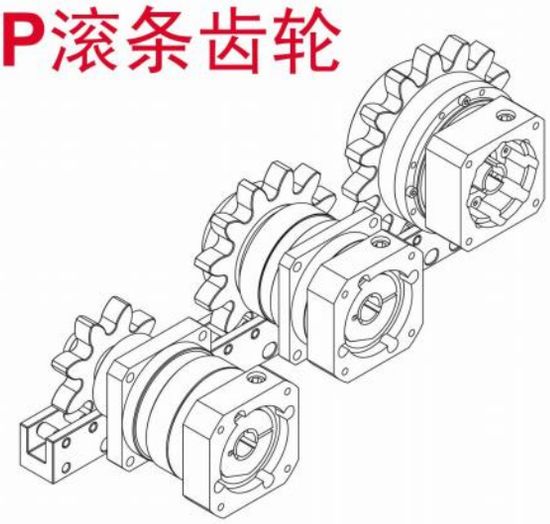
行星齿条传输
Planetary gearing

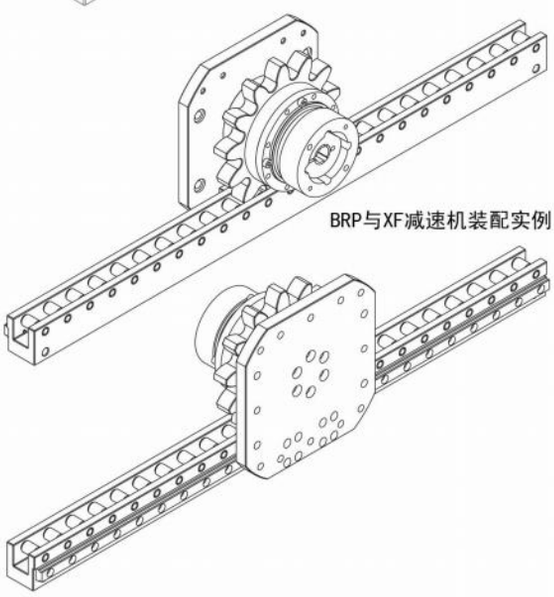


防尘传输解决方案 Dust Resistance

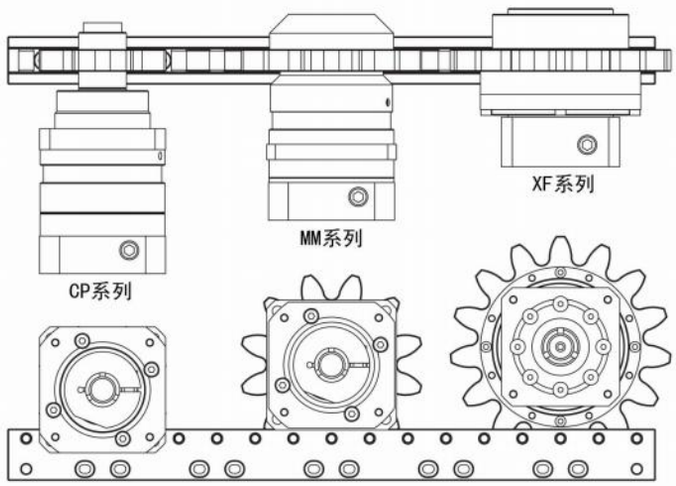
Bearing Rack Pinion
BRP滚条齿轮



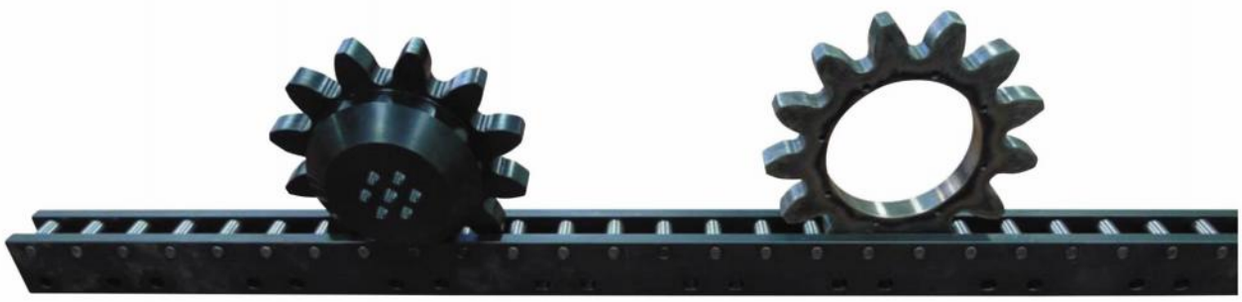


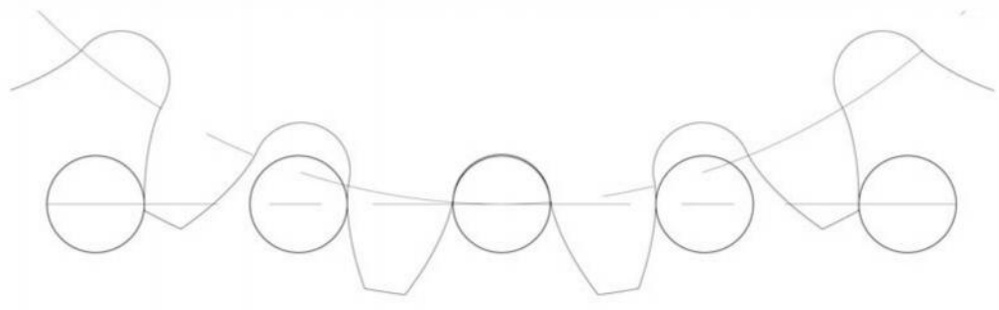


BRP与XF减速机装配实例



产品特性
Liner Performer





BRP滚条齿轮系列
通用的安装方式
齿面完全接触
防尘

BRP series
Universal Installation
Ultimate Tooth Contact
Dust Resistance

我们也提供多种行星减速机方案
We also provide various planetary solution



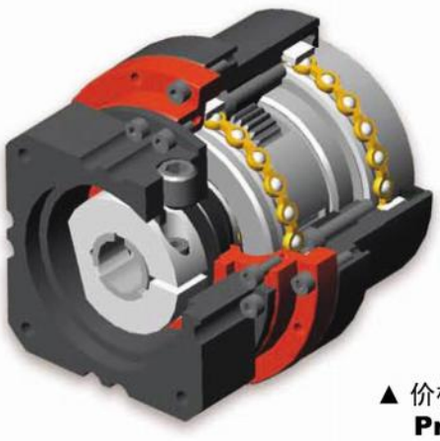
CP 系列
Classic Planetary



XP[XF] 系列
Xcellent Planetary



MM 系列
Minimum Space
Maximum Performance



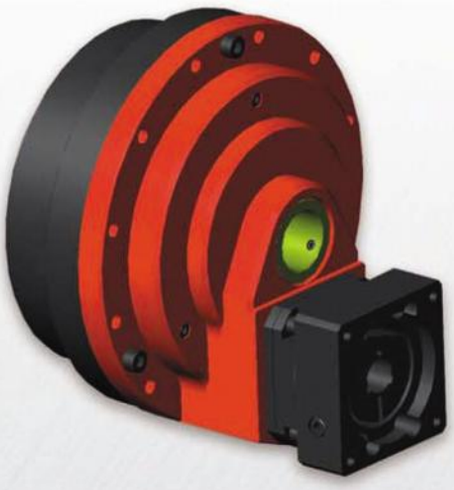


▲ 价格优先考虑可选XP系列
Price Performer / Xcellent Planetary

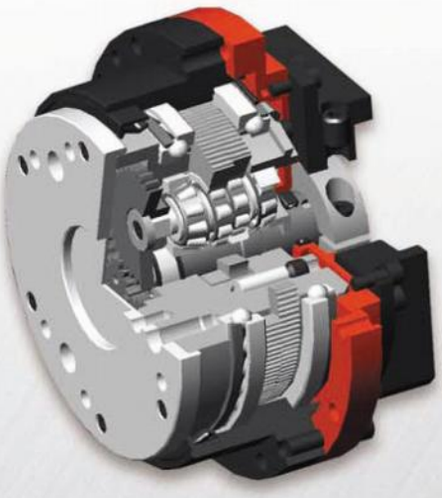


▲ 节省空间优先考虑可选SS系列
Space Performer / Space Saver

QH系列



XQ系列



▲ 传动精度优先考虑可选QH和XQ系列
Precision Performer / Quadro-Hollow & Xeno-quadro

※ 规格如有改进，怒不另行通知。
Specifications are subject to change without notice.

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赛劲

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所有人孜孜以求，但至今无人企及……

Everybody strives for,nobody has achieved yet ……

Note

Note

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