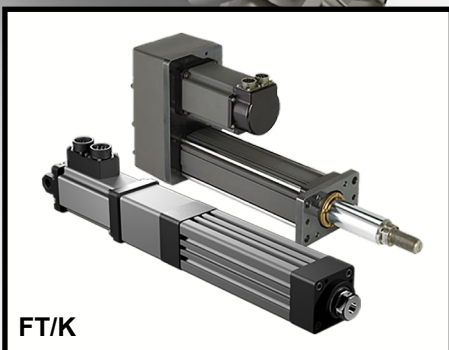
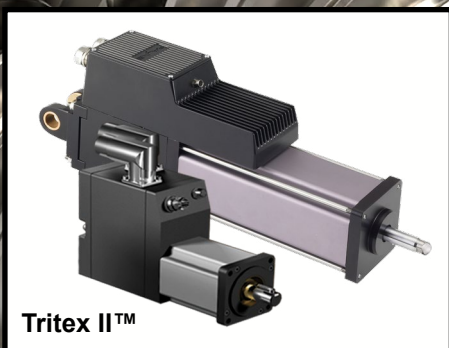


CURTISS - WRIGHT

EXLAR®

伺服电动缸



2017

行星滚柱丝杠概述

行星滚柱丝杠概述

机械设计工程师通常有几种方式来实现直线运动（液压缸、气缸、电动缸或电机驱动滚珠丝杠机构）。Exlar系列电动缸的设计出发点是为了设计通用可靠的电动直线执行器，所以在全系列均使用行星滚柱丝杠作为主要运动部件来保证高速度、大负载与高可靠性。但有些读者对行星滚柱丝杠技术还不了解，所以在此将行星滚柱丝杠的基本原理进行说明。

行星滚柱丝杠基本原理与梯形丝杠或滚珠丝杠类似。不同的是，滚柱丝杠可以在恶劣的工况下承载大负载并连续工作成千上万小时，这使它成为要求高负载且需要长期连续工作的应用的理想选择。

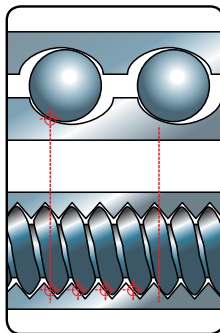
行星滚柱丝杠的独特之处在于它的负载传递机构：多个螺纹滚柱按行星状环绕于主丝杠周围，将电机的旋转运动转化为丝杠或螺母的直线运动，这种设计使它具有其它机构无法得到的高性能。



Exlar伺服电动缸与液压缸/气缸的比较

在需要高负载或高频率的应用中，Exlar伺服电动缸为替换液压缸或气缸选择提供了理想的选择，使用电动缸可以让系统大幅度简化。

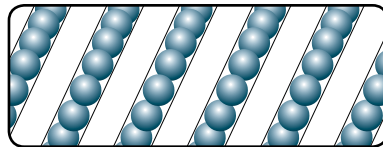
- 不需要阀门、泵、管线、过滤器等复杂系统
- 小体积
- 长寿命
- 免维护
- 不会泄漏
- 噪音更小
- 能进行柔性控制



滚柱丝杠与滚珠丝杠性能的比较

负载能力与机械刚性: 滚珠丝杠接触点的数量受到滚珠大小的限制，而Exlar的行星滚柱丝杠在相同长度上提供了更多的接触点，使得行星滚柱丝杠具有更大的承载能力，同时也增加了机械刚性。相同的额定动载下，滚柱丝杠的体积明显比滚珠丝杠小。

使用寿命: 由于有更多的接触点，Exlar行星滚柱丝杠在使用寿命上也相应地有巨大的优势。同样加载2000磅平均负载到直径均为1.2英寸、导程为0.2英寸的滚柱丝杠与滚珠丝杠时，滚柱丝杠的预期寿命是滚珠丝杠的15倍。



最高转速: 因为滚珠丝杠旋转时滚珠之间会相互碰撞，相邻的滚珠向相反方向旋转，会产生剧烈摩擦并产生极大

噪音，所以滚珠丝杠的最高转速一般被限制在2000RPM左右。而行星滚柱丝杠的螺纹滚柱均匀环绕于主丝杠周围并安装于保持架上，它们之间并不会产生相互碰撞。因此行星滚柱丝杠的工作速度可达到5000RPM以上，相应地输出更高的直线速度。

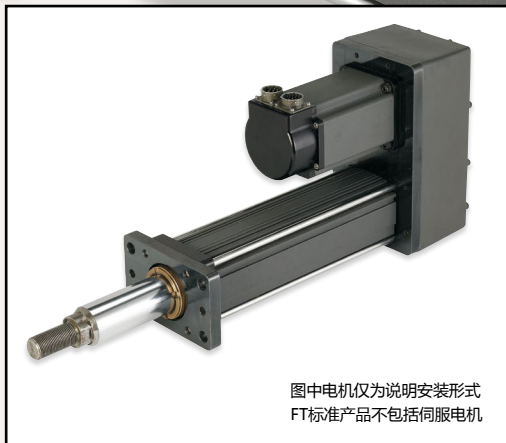
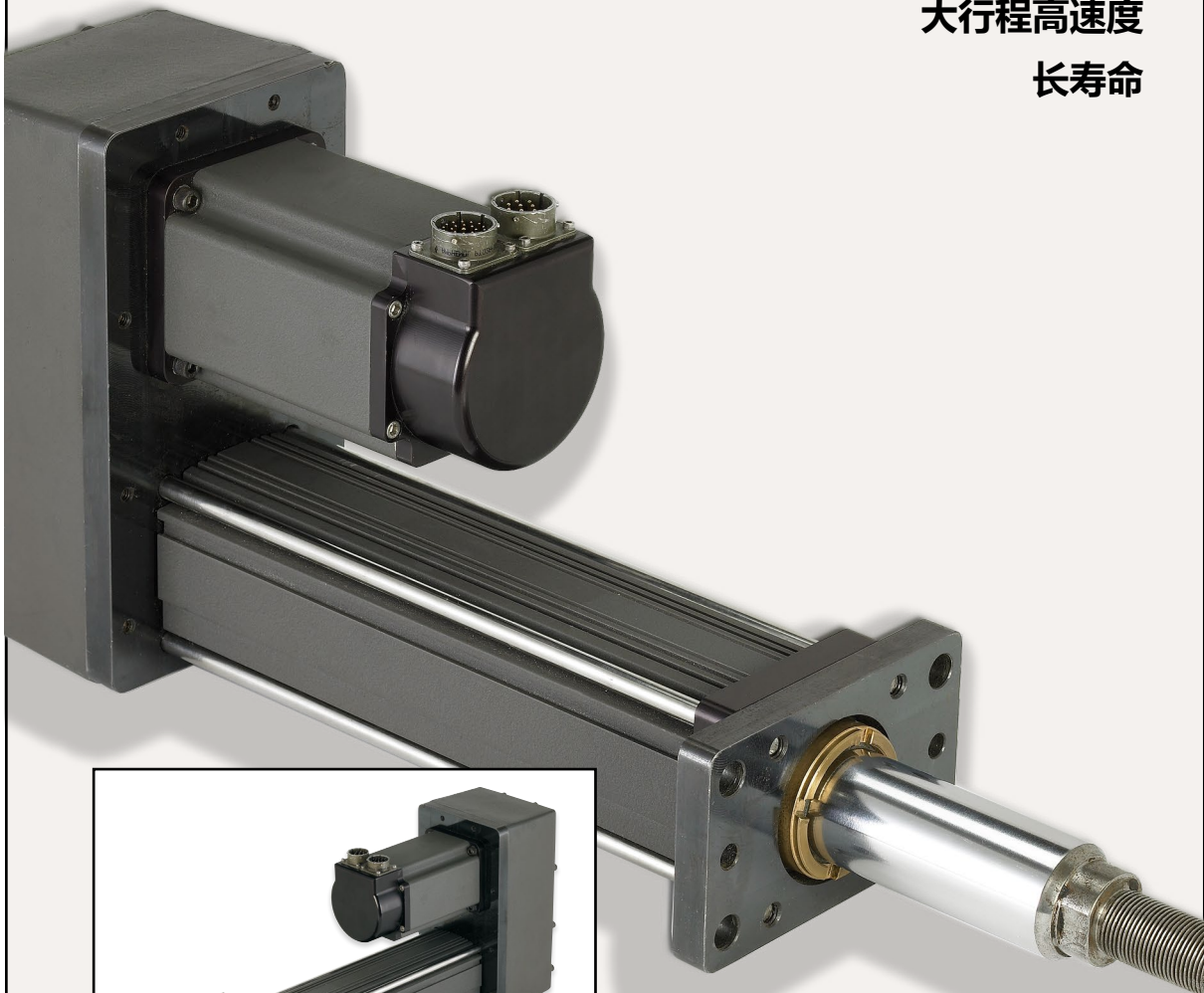
FT 系列

大推力行星滚柱丝杠电动缸

可搭配各种伺服电机

大行程高速度

长寿命



图中电机仅为说明安装形式
FT标准产品不包括伺服电机

FT 系列

高性能

同Exlar其它电动缸一样, 对比其它形式的直线传动方式, FT系列大推力电动缸同样具有高负荷, 高速度与长寿命的特点。

相同体积的其它直线传动产品特别是采用滚珠丝杠或梯形丝杠的电动缸, 它们的承载能力低, 速度慢而且寿命短。在重载或中等负载的应用下, FT电动缸的寿命是相同尺寸其它电动缸的15倍。对于OEM设备制造商来讲, 这意味着使用更小的安装体积可以得到更大的推力与更长的寿命。

高防护

FT系列设计具有液压缸体的所有密封优点, 且不受限制的负荷、寿命与速度的限制。所有的部分都装在密封的外壳中, 可以防止微小的粉尘、颗粒等污染物进入缸体内损坏内部的部件, 保证电动缸在最恶劣的环境中也能正常工作。

FT系列标准润滑形式为脂润滑, 同时也可根据客户要求提供油润滑形式。

特性	标准
行程	6 inch, 12 inch, 18 inch, 24 inch, 36 inch, 48 inch
安装方式	侧面安装, 前端拉杆安装, 尾部铰接, 侧面耳轴, 前法兰, 尾部法兰
电机配置	直联安装 同步带1:1 同步带2:1

设计兼容性

Exlar电动缸与外部连接部分包括电机接口与安装板接口都按标准尺寸设计, 用户可直接安装使用, 省去了传统直线运动机构的复杂设计, 安装或调试的工作。

技术参数	
法兰尺寸-in (mm)	3.5 (90), 4.8 (120), 6.0 (150), 8.0 (200)
丝杠导程- in (mm)	0.2 (5), 0.25 (6), 0.4 (10), 0.5 (12), 0.8 (20), 1.2 (30)
标准行程-in (mm)	6 (152)*, 12 (305), 18 (457), 24 (610), 36 (914), 48 (1219)
推力范围	最大 40,000 lbf (178 kN)
最高速度	最大 60 in/sec (1524 mm/s)

*FT60或FT80不提供此行程

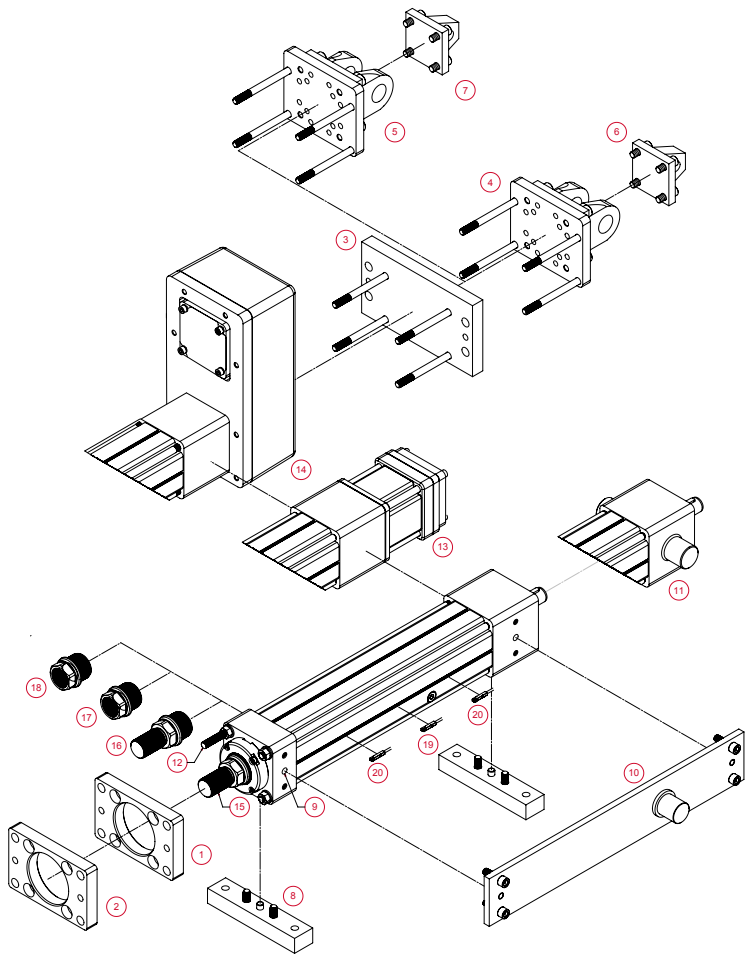
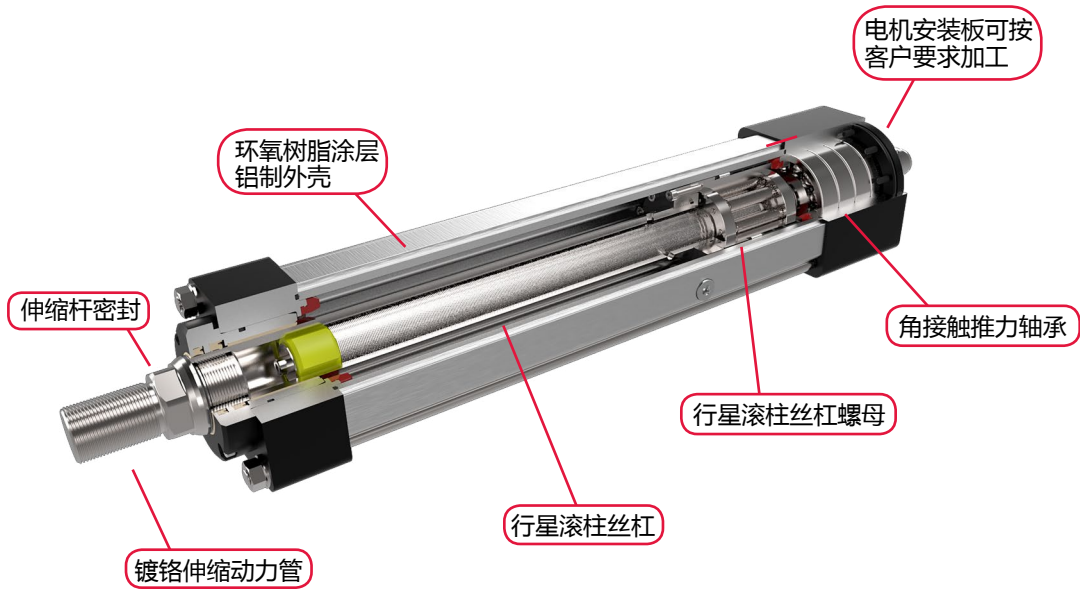
精度与防护等级		
精度:		
丝杠导程误差	in/ft (µm / 300 mm)	0.001 (25)
丝杠行程误差	in/ft (µm / 300 mm)	0.0012 (30)
反向间隙*	in (mm)	0.002 (0.06)
摩擦扭矩	lbf-in (Nm)	FT35: 7.0 (0.79) FT45: 11.00 (1.24) FT60: 14.0 (1.58) FT80: 35.0 (3.95)
传动效率:		
电机直联	%	80
电机并联	%	80
使用环境:		
标准使用温度	°C	0 to 65
非标使用温度***	°C	-30 ~ 65
储存温度	°C	-40 ~ 85
防护等级**		IP65

* 反向间隙与电机的安装形式有关, 请与当地销售代表联系讨论您的应用。

** 如果安装电机后也要求达到IP65S等级, 请与当地销售代表联系。

*** 非标使用温度范围请与当地销售代表联系咨询。

产品特点



- 1 - 英制前法兰
- 2 - 公制前法兰
- 3 - 英制后法兰
- 4 - 英制尾部铰接
- 5 - 公制尾部铰接
- 6 - 英制尾部销孔端
- 7 - 公制尾部销孔端
- 8 - 侧面安装座
- 9 - 双侧安装孔
- 10 - 侧面耳轴安装
- 11 - 后部耳轴安装
- 12 - 前端拉杆安装
- 13 - 直联式电机
- 14 - 同步带1:1, 同步带2:1安装
- 15 - 英制外螺纹
- 16 - 公制外螺纹
- 17 - 英制内螺纹
- 18 - 公制内螺纹
- 19 - 外置限位开关-常开, PNP or NPN
- 20 - 外置限位开关-常闭, PNP or NPN

行业及应用

替换液压缸
替换滚珠丝杠机构
替换气缸

汽车工业

升降
自动装配
铆接/紧固/连接
压装

木工机械

定位锯
护板定位

过程控制

纠偏/闸门
阀控制
张力控制

机械加工

自动化柔性夹具
机床
零件夹紧
精密研磨机

六自由度平台/模拟器

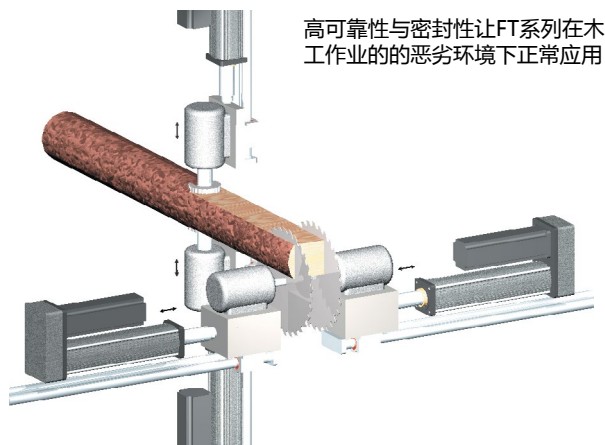
动感影院
训练模拟器
游戏模拟器

材料处理

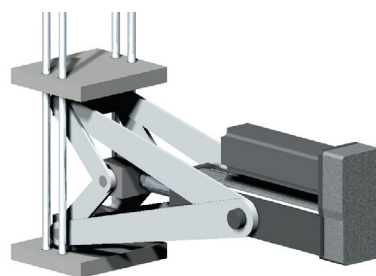
冲压
产品分拣
材料切割
卷筒定向
绕线
弯管

测试

试验台



高可靠性与密封性让FT系列在木作业的的恶劣环境下正常应用



大推力，小体积与推力的平滑控制让FT系列十分适用于注塑模具切换。使用FT系列伺服电动缸可以提高模具的使用寿命，保证产品的一致性。

图中电机仅用于展示。
FT系列电动缸标准产品不包含电机

机械参数

FT35

		高性能丝杠			标准丝杠		
		05	10	20	05	10	20
导程	in	0.197	0.394	0.787	0.197	0.394	0.787
	mm	5	10	20	5	10	20
最大推力 ²	lbf	5,000	5,000	5,000	5,000	5,000	5,000
	kN	22.2	22.2	22.2	22.2	22.2	22.2
最大推力下预期寿命 L ₁₀	in x 10 ⁶	15.4	24.6	56.7	8.88	14.15	32.05
	km	392	626	1,440	225.6	359.4	814.2
C _a (额定动载)	lbf	21,400	19,850	20,800	17,800	16,500	17,200
	kN	95.2	88.3	92.5	79.2	73.4	76.5
最大输入扭矩	lbf-in	196	392	783	196	392	783
	Nm	22.1	44.3	88.5	22.1	44.3	88.5
最大输入转速	RPM	4,500	4,500	4,500	4,500	4,500	4,500
最高直线速度	in/sec	14.7	29.5	59.3	14.7	29.5	59.3
	mm/sec	373	750	1,500	373	750	1,500

¹ FT35电动缸选择高性能丝杠长度将会比标准长出20mm, 请参考104页

² 最大推力指电动缸可以连续应用的推力, 超过这一推力可能会导致电动缸永久性的损坏。大推力短行程的应用请与Exlar联系。

重量 kg (lbs)

基本单元重量	行程	6 Inch	12 Inch	18 Inch	24 Inch	36 Inch	48 Inch
	lb	30	35	40	45	55	65
	kg	14	16	18	21	25	30

直联式法兰 (不包含电机)	同步带箱体 (不包含电机)	前法兰	尾部法兰	尾部铰接	尾部销孔	前后安装孔	耳轴安装	侧面安装板
8 (3.6)	16 (7.3)	5.4 (2.5)	7.4 (3.4)	3.0 (1.4)	NA	NA	19.5 (8.9)	3.3 (1.5)

FT35折算惯量	5 mm 行程	10 mm 行程	20 mm 行程	
基本单元-J (0行程)	0.0004087	0.0004121	0.0004259	kg-m ² (折算到输入轴)
基本单元-J (行程)	0.0000159	0.0000162	0.0000171	kg-m ² /inch 行程
直联式 (含联轴器) - J (0行程)	0.0005127	0.0005161	0.0005299	kg-m ² (折算到电机轴)
直联式 (含联轴器) - J (行程)	0.0000159	0.0000162	0.0000171	
同步带安装 1:1-J (0行程)	0.0011042	0.0011855	0.0014480	kg-m ² /inch 行程
同步带安装 1:1-J (行程)	0.0000159	0.0000162	0.0000171	
同步带安装 2:1-J (0行程)	0.0014029	0.0014038	0.0015345	
同步带安装 2:1-J (行程)	0.0000040	0.0000040	0.0000043	

[†]同步带安装形式按最大推力时所配同步带轮计算

FT35标准惯量	
惯量	
FT35	0.000104 kg-m ² (0.000920 lbf-in s ²)

同步带轮的惯量包括同步带轮, 皮带与标准轴套的惯量。因为电机选择的不同导致这个参数可能会有变动。如果惯量参数对您的应用十分关键, 请与当地销售代表联系。

定制产品惯量请与当地销售代表联系。

*定义参考100页

FT45

		高性能丝杠		标准丝杠	
		05	10	05	10
导程	in	0.197	0.394	0.197	0.394
	mm	5	10	5	10
最大推力 ²	lbf	10,000	10,000	10,000	10,000
	kN	44.5	44.5	44.5	44.5
最大推力下预期寿命 L ₁₀	in x 10 ⁶	9.81	19.14	5.67	11.06
	km	249.2	486.3	144.0	280.9
C _s (额定动载)	lbf	36,800	36,500	30,650	30,400
	kN	163.7	162.4	136.3	135.2
最大输入扭矩	lbf-in	392	783	392	783
	Nm	44.1	88.2	44.1	88.2
最大输入转速	RPM	3,500	3,500	3,500	3,500
最高直线速度	in/sec	11.5	23.0	11.5	23.0
	mm/sec	292	583	292	583

¹最大推力指电动缸可以连续应用的推力，超过这一推力可能会导致电动缸永久性的损坏。大推力短行程的应用请与Exlar联系。

重量 kg (lbs)

基本重量	行程长度	6 Inch	12 Inch	18 Inch	24 Inch	36 Inch	48 Inch
	lb	57	68	79	90	112	135
	kg	26	31	36	41	51	61

直联式法兰 (不包含电机)	同步带安装 (不包含电机)	前法兰	尾部法兰	尾部铰接	尾部销孔	前后安装孔	耳轴安装	侧面安装板
7.1 (3.2)	42.5 (19.3)	6.1 (2.8)	17.4 (7.9)	18.9 (8.6)	19.8 (9)	NA	17.2 (7.8)	10.4 (4.7)

FT35折算惯量	5 mm 行程	10 mm 行程	
基本单元-J (0行程)	0.002463	0.002474	kg-m ² (折算到输入轴)
基本单元-J (行程)	0.000045	0.000046	
直联式 (含联轴器) - J (0行程)	0.002571	0.002581	kg-m ² (折算到电机轴)
直联式 (含联轴器) - J (行程)	0.000045	0.000046	
同步带安装 1:1-J (0行程)	0.006911	0.006921	kg-m ² /inch 行程
同步带安装 1:1-J (行程)	0.000045	0.000046	
同步带安装 2:1-J (0行程)	0.003466	0.003469	
同步带安装 2:1-J (行程)	0.000011	0.000011	

¹同步带安装形式按最大推力时所配同步带轮计算

FT45基本单元 标准惯量	
FT45	惯量
	0.00010743 kg-m ² (0.000951 lbf-in s ²)

同步带轮的惯量包括同步带轮，皮带与标准轴套的惯量。因为电机选择的不同导致这个参数可能会有变动。如果惯量参数对您的应用十分关键，请与当地销售代表联系。

定制产品惯量请与当地销售代表联系。

*定义参考100页

FT 系列电动缸

FT60

		高性能丝杠			标准丝杠		
		06	12	30	06	12	30
导程	in	0.236	0.472	1.181	0.236	0.472	1.181
	mm	6	12	30	6	12	30
最大推力 ¹	lbf	20,000	20,000	20,000	20,000	20,000	20,000
	kN	89.0	89.0	89.0	89.0	89.0	89.0
最大推力下预期寿命 L ₁₀	in x 10 ⁶	5.7	7.3	38.6	4.1	5.2	10.7
	km	145.8	184.7	981.1	104.8	133.1	271.9
C _a (额定动载)	lbf	57,933	49,750	63,958	51,900	44,600	41,700
	kN	257.7	221.3	284.5	230.9	198.4	185.5
最大输入扭矩	lbf-in	940	1880	4699	940	1880	4699
	Nm	106	212	531	106	212	531
最大输入转速	RPM	2,000	2,000	2,000	2,000	2,000	2,000
最高直线速度	in/sec	7.9	15.8	39.0	7.9	15.8	39.0
	mm/sec	201	401	1000	201	401	1000

¹ 最大推力指电动缸可以连续应用的推力，超过这一推力可能会导致电动缸永久性的损坏。

大推力短行程的应用请与Exlar联系。

重量 kg (lbs)

基本缸体重量	行程长度	12 inch	24 inch	36 Inch	48 Inch
	lb	100	130	160	190
	kg	45	59	72	86

直联式安装 (不包含电机)	同步带安装 (不包含电机)	前法兰	尾部法兰	尾部铰接	尾部销孔	侧面安装孔	耳轴安装	侧面安装板
20.4 (9.3)	39.1 (17.7)	13.4 (6.1)	15.9 (7.2)	11.1 (5)	NA	NA	44.3 (20.1)	10.4 (4.7)

FT60 折算惯量	6 mm 行程	12 mm 行程	30 mm 行程	
基本单元-J (0行程)	0.0078464	0.0078709	0.0080424	kg-m ² (折算到输入轴)
基本单元-J (行程)	0.0002539	0.0002547	0.0002600	kg-m ² /inch of 行程
直联式 (含联轴器) - J (0行程)	0.0081764	0.0082009	0.0083724	kg-m ² (折算到电机轴)
直联式 (含联轴器) - J (行程)	0.0002539	0.0002547	0.0002600	
直联式 (含联轴器) - J (0行程)	0.0129357	0.0146113	0.0312682	
直联式 (含联轴器) - J (行程)	0.0002539	0.0002547	0.0002600	
直联式 (含联轴器) - J (0行程)	0.0049158	0.0057202	0.0214777	kg-m ² /inch of 行程
直联式 (含联轴器) - J (行程)	0.0000635	0.0000637	0.0000650	

FT60基本单元 标准惯量	
FT60	惯量
	0.000330 kg-m ² (0.002921 lbf-in s ²)

同步带轮的惯量包括同步带轮，皮带与标准轴套的惯量。因为电机选择的不同导致这个参数可能会有变动。如果惯量参数对您的应用十分关键，请与当地销售代表联系。

定制产品惯量请与当地销售代表联系。

[†]同步带安装形式按最大推力时所配的同步带轮计算

*定义参考100页

FT80

		高性能丝杠			标准丝杠		
		06	12	30	06	12	30
丝杠导程	in	0.236	0.472	1.181	0.236	0.472	1.181
	mm	6	12	30	6	12	30
最大推力 ¹	lbf	40,000	40,000	40,000	40,000	40,000	40,000
	kN	177.9	177.9	177.9	177.9	177.9	177.9
最大推力下的预期寿命L ₁₀	in x 10 ⁶	3.1	4.4	16.3	1.94	2.55	5.00
	km	78.7	111.4	414.3	49.3	64.9	127
C _a (额定动载)	lbf	94,330	84,079	95,971	80,700	70,200	64,700
	kN	419.6	374	426.9	359	312.2	287.8
最大输入扭矩	lbf-in	1,880	3,760	9,399	1,880	3,760	9,399
	Nm	212	425	1,062	212	425	1,062
最高输入转速	RPM	1,750	1,750	1,750	1,750	1,750	1,750
最高直线速度	in/sec	6.9	13.8	34.4	6.9	13.8	34.4
	mm/sec	175	351	875	175	351	875

¹ 最大推力指电动缸可以连续应用的推力，超过这一推力可能会导致电动缸永久性的损坏。大推力短行程的应用请与Exlar联系。

重量 kg (lbs)

基本缸体重量	行程长度	12 Inch	24 Inch	36 Inch	48 Inch
	lb	190	265	340	415
	kg	86	120	153	187

直联式安装 (不包含电机)	同步带安装 (不包含电机)	前法兰	尾部法兰	尾部铰接	尾部销孔	侧面安装孔	耳轴安装	侧面安装板
54.9 (24.9)	79.1 (35.9)	28.5 (17.5)	NA	NA	NA	NA	NA	34.8 (15.8)

FT80 折算惯量	6 mm 行程	12 mm 行程	30 mm 行程		FT80基本单元 标准惯量
基本单元-J (0行程)	0.0302504	0.0303275	0.0308673	kg-m ² (折算到输入轴)	FT80 惯量 0.0001210 kg-m ² (0.010709 lbf-in s ²)
基本单元-J (行程)	0.0008022	0.0008035	0.0008124	kg-m ² /inch of 行程	
直联式 (含联轴器) - J (0行程)	0.0314604	0.0315375	0.0320773	kg-m ² (折算到电机轴) kg-m ² /inch of 行程	同步带轮的惯量包括同步带轮，皮带与标准轴套的惯量。因为电机选择的不同导致这个参数可能会有变动。如果惯量参数对您的应用十分关键，请与当地销售代表联系。 定制产品惯量请与当地销售代表联系。
直联式 (含联轴器) - J (行程)	0.0008022	0.0008035	0.0008124		
直联式 (含联轴器) - J (0行程)	0.0721056	0.0535533	0.1342578		
直联式 (含联轴器) - J (行程)	0.0008022	0.0008035	0.0008124		
直联式 (含联轴器) - J (0行程)	0.0198765	0.0270490	0.0753395		
直联式 (含联轴器) - J (行程)	0.0002006	0.0002009	0.0002031		

¹ 同步带安装形式按最大推力时所配同步带轮计算

*定义参考100页

名词定义:

最大推力: 应用计算出的三次均方根载荷不应该超过此数值。(此数据取决于电动缸的内部设计, 不可超过或长期在此数据上运行。)

最大推力下的预期寿命: 在最大推力下运行时的预期使用寿命。(基于电动缸的额定动载与应用的三次均方根载荷计算。)

C_s (额定动载): 用于计算电动缸预期使用寿命的丝杠常数。

最大输入扭矩: 电动缸达到最大推力时所需要的输入扭矩。超过此扭矩可能会导致电动缸部件损坏。

最高输入转速: 电动缸基本单元输入轴端的最高输入转速。取决于电动缸的丝杠长度与电动缸的螺母所允许的最高转速。

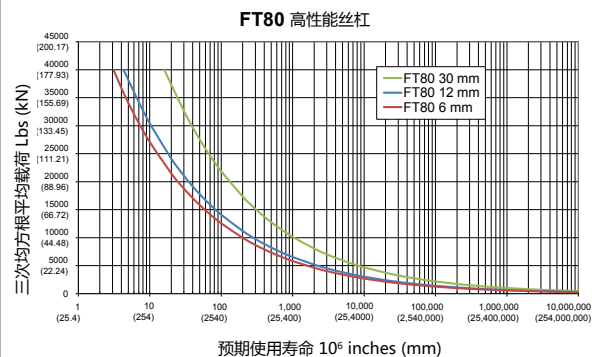
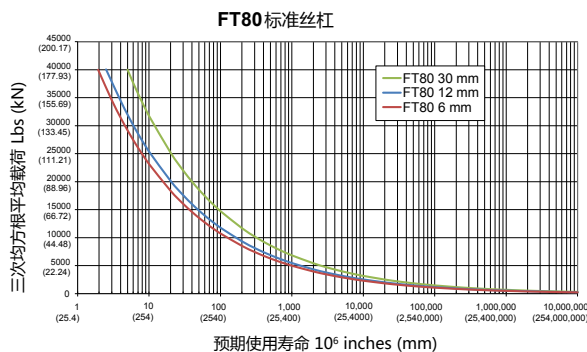
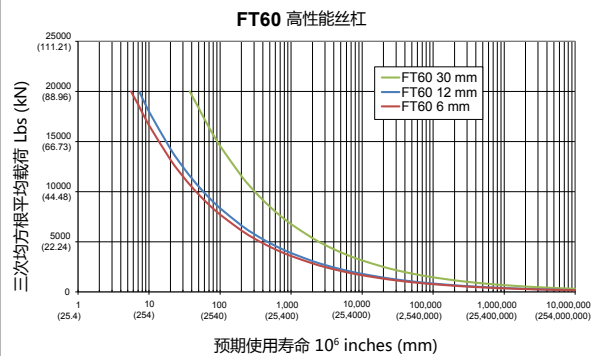
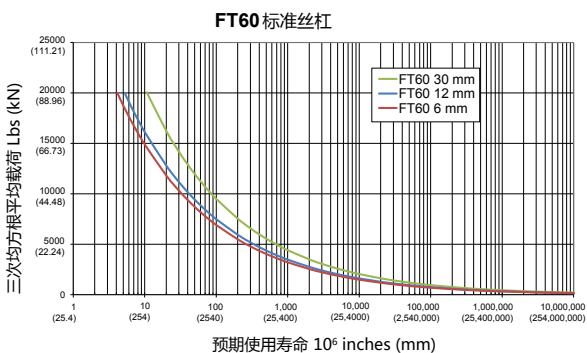
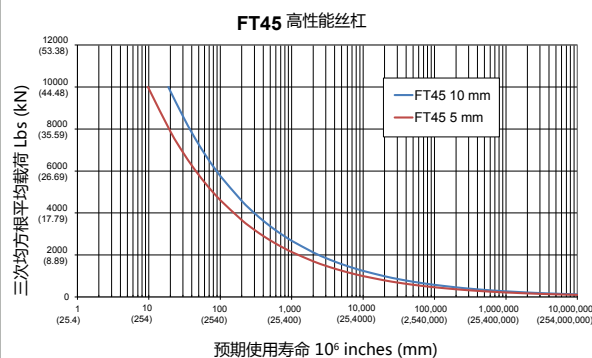
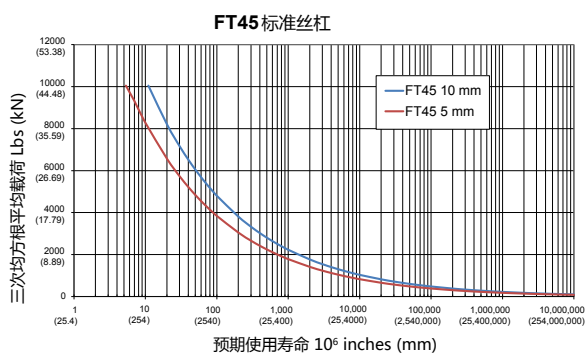
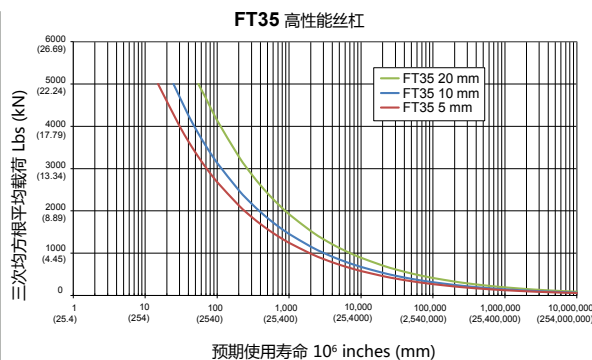
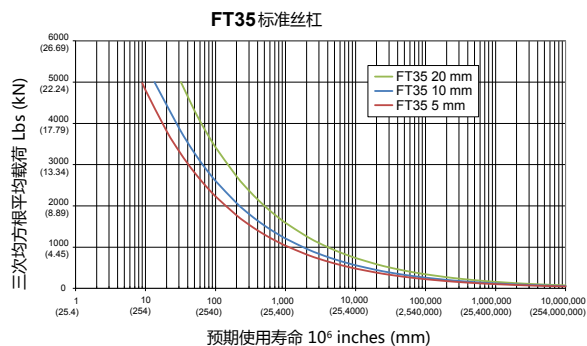
最高直线速度: 最高输入转速时得到的电动缸直线速度。

FT 系列附件

限位开关 (型号标注上有上标明 L1, L2, L3)			
FT35, FT60, FT80			
选项	数量	订货号	产品
L1	1	14453	PNP常闭限位开关 (10-30 VDC, 1m. 3 芯电缆)
L2	2	14453	PNP常闭限位开关 (10-30 VDC, 1m. 3 芯电缆)
L3	3	14453	PNP常闭限位开关 (10-30 VDC, 1m. 3 芯电缆)
L4			NA
L5			NA
L6			NA
FT45			
L1	1	43403	PNP常开限位开关 (10-30 VDC, 1m. 3 芯电缆)
L2	2	43404	PNP常闭限位开关 (10-30 VDC, 1m. 3 芯电缆)
L3	1	43403	PNP常开限位开关 (10-30 VDC, 1m. 3 芯电缆)
	2	43404	PNP常闭限位开关 (10-30 VDC, 1m. 3 芯电缆)
L4	1	67634	PNP常开限位开关 (10-30 VDC, 1m. 3 芯电缆)
L5	2	67635	PNP常闭限位开关 (10-30 VDC, 1m. 3 芯电缆)
L6	1	67634	PNP常开限位开关 (10-30 VDC, 1m. 3 芯电缆)
	2	67635	PNP常闭限位开关 (10-30 VDC, 1m. 3 芯电缆)

请联系当地销售代表咨询在您所选配置下最大可用行程。

预期使用寿命



FT 系列电动缸

预期使用寿命的假设基于以下条件:

- 在使用期间保证高质量的润滑 (请参考169页关于润滑的说明。)
- 轴承与丝杠温度在20°C到40°C之间。
- 无机械上的硬停机或冲击性载荷
- 无侧向载荷
- 此计算方式不适用于预测短行程高频率的应用 (如疲劳测试应用) 及短行程高压力的应用 (如压装应用)。
- 其它应用的计算方式请见169页

L10 的定义是行星滚柱丝杠的预期寿命里程 (英寸)。在正确的维护下90%的丝杠均能够达到或超过计算出来的理论预期寿命。预期使用寿命计算值仅是电动缸选型时的一个参考因素, 计算结果并不等于对丝杠寿命的保证。

计算公式定义如下:

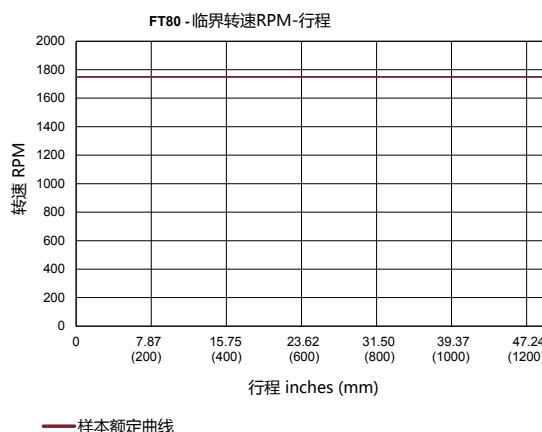
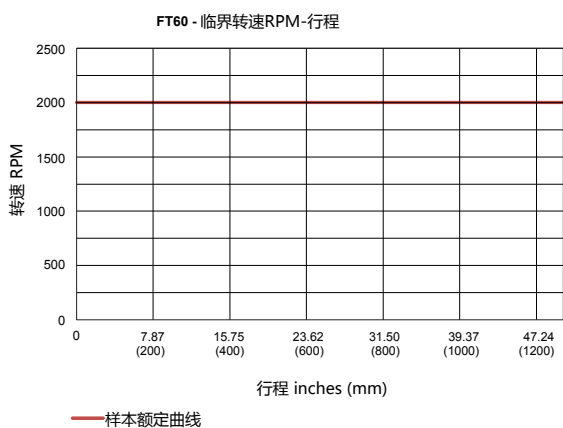
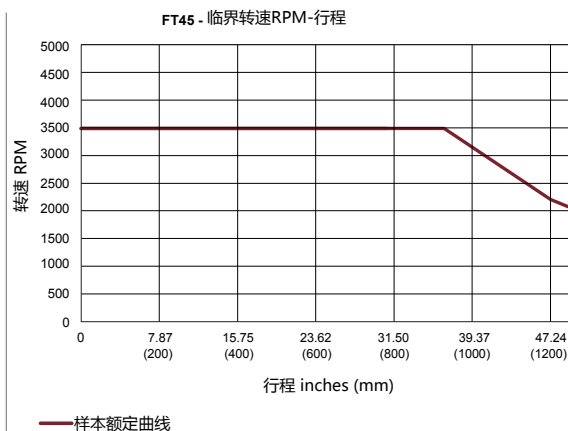
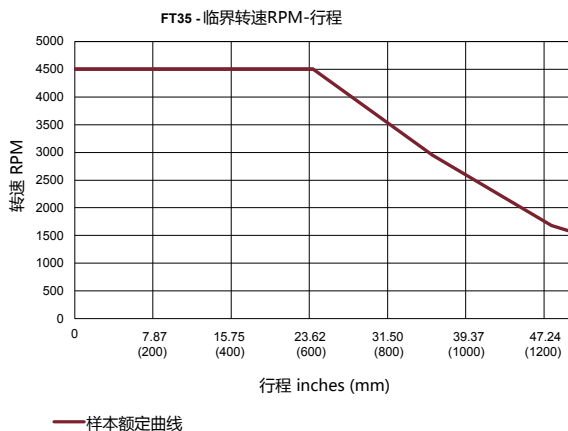
$$L_{10} = \left(\frac{C_a}{F_{cml}} \right)^3 \times l$$

C_a = 额定动载 (lbf)
 F_{cml} = 均方根平均载荷 (lbf)
 l = 丝杠导程 (inches)

详细计算请参阅第 169 页。

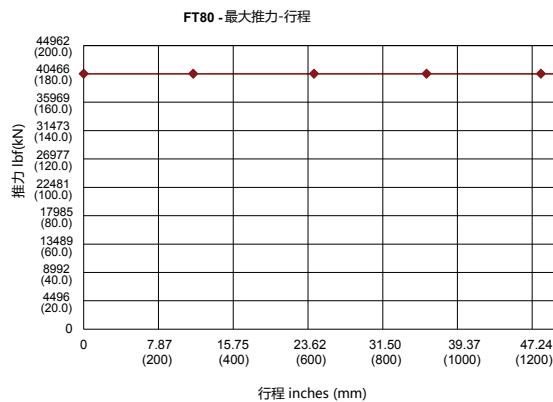
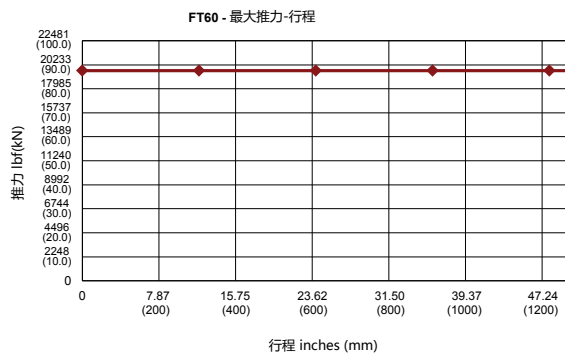
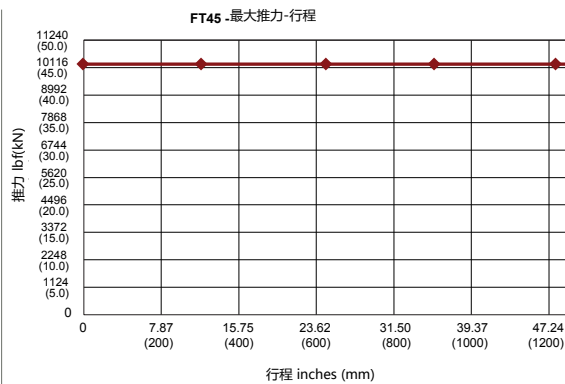
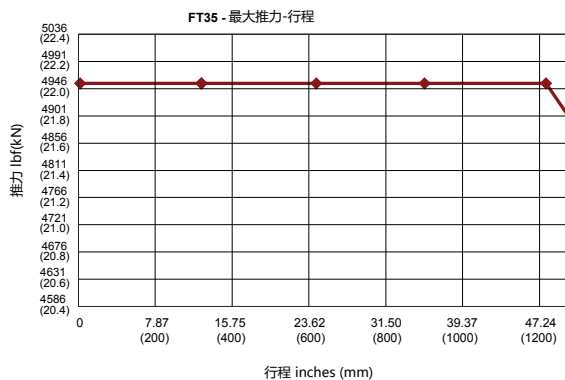
数据曲线

临界转速-行程



* 长行程的电动缸最大输入速度取决于丝杠的临界速度。

最大推力-行程

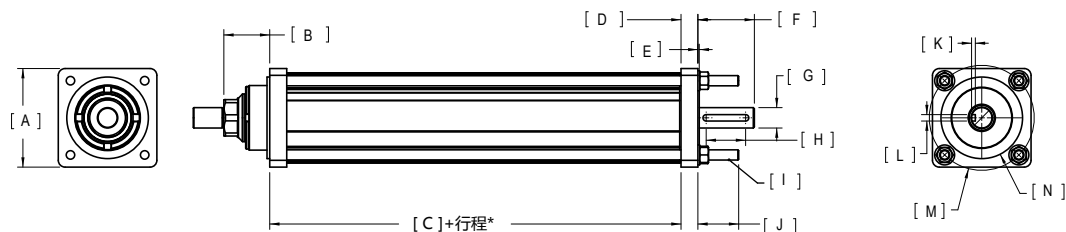


* 长行程的电动缸最大输入速度取决于丝杠的临界速度.

FT 系列电动缸

尺寸

基本单元 (FT35, FT60, FT80)



		FT35	FT60	FT80
A	in	□ 3.63	□ 6.38	□ 8.50
	mm	92.1	161.9	215.9
B	in	1.69	2.25	3.03
	mm	42.9	57.1	77.0
C	in	9.1*	15.3	19.8
	mm	232*	389	503
D	in	0.62	0.83	0.90
	mm	15.7	21.1	22.9
E	in	0.05	0.10	0.10
	mm	1.3	2.5	2.5
F	in	2.08	2.41	3.34
	mm	52.8	61.2	84.7
G	in	∅ 0.748 +0.00/- 0.0005	∅ 1.378 +0.00/- 0.0006	∅ 2.362 +0.00/-0.0005
	mm	19.0 +0.00/-0.013	35.0 +0.00/-0.016	60.0 +0.00/-0.013
H	in	1.45	1.60	1.48
	mm	36.8	40.5	37.5

		FT35	FT60	FT80
I	in	3/8- 16 UNC-2A	9/16- 12 UNC-2A	3/4- 10 UNC-2A
	mm	M8 x 1.25 6g	M14 x 2.0 6g	M20 x 2.5 6g
J	in	1.50	2.0	2.0
	mm	38.1	50.7	50.7
K	in	0.138 +0.004/-0.00	0.197 +0.008/-0.00	0.278 +0.005/- 0.00
	mm	3.5 +0.1 0.0	5.0 +0.2 -0.0	7.0 +0.1 -0.0
L	in	0.236 -0.00/-0.002	0.3937 +0.0006/- 0.0020	0.709 -0.001/- 0.002
	mm	6.0 -0.012/- 0.042	10.0 -0.015/-0.051	18.0 -0.018/- 0.061
M	in	∅ 3.860 BC	∅ 6.79 BC	∅ 9.33 BC
	mm	98.0	172.4	237.0
N	in	∅ 3.00	∅ 5.00	∅ 6.75
	mm	76.2	127.0	171.5

*FT35系列选择高性能丝杠时长度增加20mm。

基本单元 (FT45)

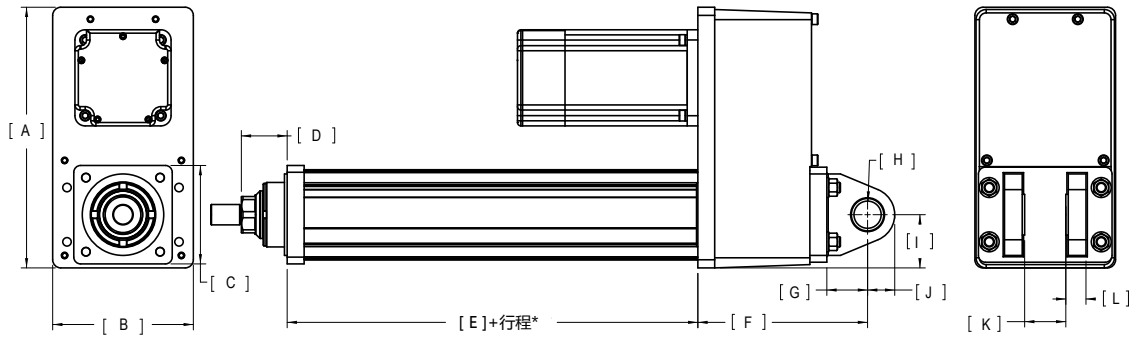


		FT45
A	in	□ 4.80
	mm	122.0
B	in	1.99
	mm	50.5
C	in	13.9
	mm	354
D	in	0.72
	mm	18.3
E	in	∅ 3.15
	mm	80.00

		FT45
F	in	∅ 1.102 +0.00/-0.0005
	mm	28.0 +0.00/-0.013
G	in	2.73
	mm	69.3
H	in	∅ 5.236 BC
	mm	133.0
I	mm	4X M12X1.75-6H ↓ 1.0

以上尺寸仅供参考，详情请咨询Exlar。

尾部铰接



		FT35	FT45 (选项 C)	FT45 (选项 G)	FT60
A	in	9.60	14.55	14.55	15.55
	mm	243.8	369.5	369.5	395.0
B	in	5.18	7.48	7.48	8.53
	mm	131.6	190.0	190.0	216.7
C	in	□ 3.63	□ 4.80	□ 4.80	□ 6.38
	mm	92.1	122.0	122.0	161.9
D	in	1.69	1.99	1.99	2.25
	mm	42.9	50.5	50.0	57.1
E	in	9.1*	13.9	13.9	15.3
	mm	232*	354	354	368
F	in	6.3	9.0	7.9	9.0
	mm	159	229	201	229
G	in	1.50	2.12	1.26	2.5
	mm	38.1	53.8	32.0	63.5
H	in	∅ 1.000** +0.002 / -0.001	∅ 1.378 ±0.001	∅ 0.787 H9	∅ 1.750*** +0.002 / -0.001
	mm	25.4 +0.05 / -0.03	35.0 ±0.03	20.00 H9	44.45 +0.05 / -0.03
I	in	2.0	3.1	3.1	3.43
	mm	50	78	78	87.1
J	in	1.00	1.4	0.6	2.13
	mm	25.4	35	15	54.0
K	in	0.74	1.0	0.6	2.51
	mm	19	25	15	63.9
L	in	1.52	2.03	1.18	1.25
	mm	38.5	51.6	30.0	31.8

图中显示为同步带安装形式

*FT35选择高性能丝杠时长度需要增加20mm。

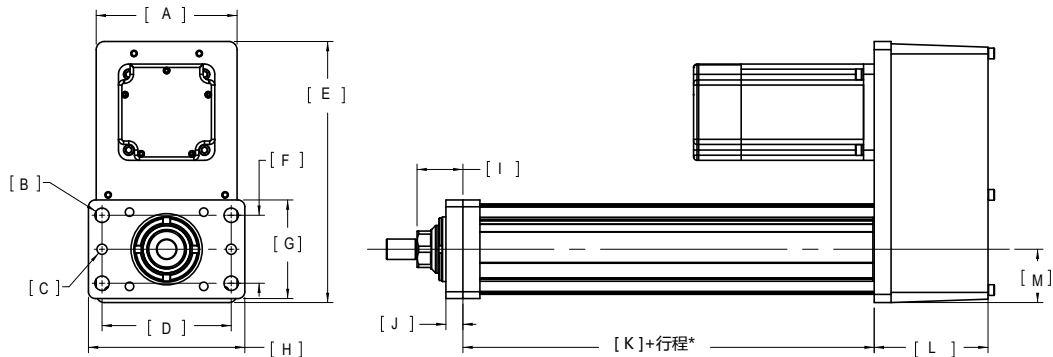
** If “G” 公制尾部铰接, ∅ 27 mm + 0.00 / -0.06

*** If “G” 公制尾部铰接, ∅ 45 mm + 0.00 / -0.08

以上尺寸仅供参考, 详情请咨询Exlar。

FT 系列电动缸

前法兰

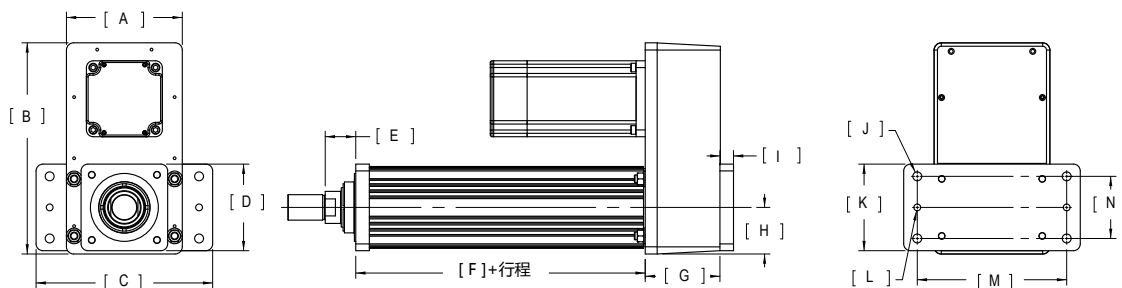


		FT35	FT45	FT60	FT80
A	in	5.18	7.48	6.82	8.77
	mm	131.6	190.0	173.2	222.8
B	in	Ø 0.53	Ø 0.69	Ø 0.66	Ø 0.78
	mm	13.5	17.5	16.7	19.8
C	in	Ø 0.375 +0.001 / -0.000	Ø 0.500 +0.001 / -0.000	Ø 0.501 +0.001 / -0.000	Ø 0.625 +0.001 / -0.000
	mm	9.53 +0.03 / 0.00	12.70 +0.03 / 0.00	12.7 +0.03 / 0.00	15.9 +0.025 / 0.000
D	in	4.75	6.38	8.32	10.75
	mm	120.7	161.9	211.2	273.1
E	in	9.6	14.55	14.32	17.33
	mm	243.8	369.5	363.7	440.2
F	in	2.50	3.82	4.57	6.00
	mm	63.5	97.0	116.2	152.4
G	in	3.63	5.00	6.38	8.50
	mm	92.1	127.0	161.9	215.9
H	in	5.8	7.63	10.00	12.75
	mm	146	193.7	254.0	323.9
I	in	1.69	1.99	2.25	3.03
	mm	42.9	50.5	57.1	77.0
J	in	0.63	1.00	1.00	1.25
	mm	15.9	25.4	25.4	31.8
K	in	9.1*	13.9	15.3	19.8
	mm	232*	354	388	503
L	in	4.19	5.26	4.6	6.43
	mm	106.3	133.7	116	163.3
M	in	1.96	3.05	3.19	4.40
	mm	49.8	77.5	81.0	111.8

*FT35系列选择高性能丝杠时长度增加20mm

以上尺寸仅供参考，详情请咨询Exlar。

前法兰 (FT35, FT60)

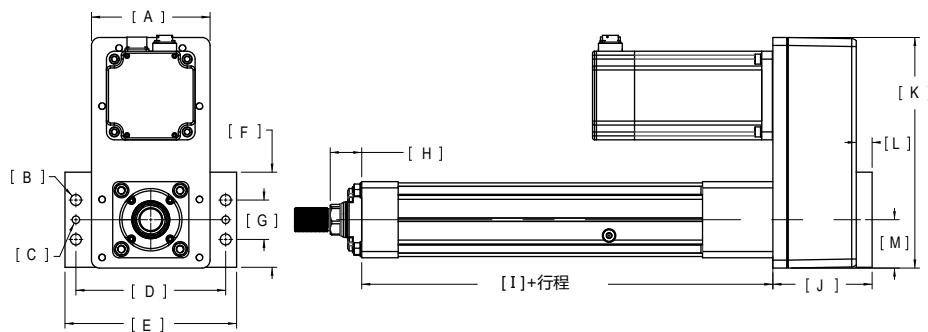


		FT35	FT60
A	in	5.18	8.53
	mm	131.6	216.7
B	in	9.60	15.55
	mm	243.8	395.0
C	in	9.00	13.00
	mm	228.6	330.2
D	in	□ 3.63	□ 6.38
	mm	92.1	161.9
E	in	1.69	2.25
	mm	42.9	57.1
F	in	9.1*	15.3
	mm	232*	388
G	in	4.13	5.50
	mm	104.8	139.7

*FT35系列选择高性能丝杠时长度增加20mm

		FT35	FT60
H	in	1.96	3.43
	mm	49.8	87.1
I	in	0.63	1.00
	mm	15.9	25.4
J	in	∅ 0.53	∅ 0.66
	mm	13.5	16.7
K	in	3.5	6.38
	mm	88.9	161.9
L	in	∅ 0.375 +0.001/- 0.000	∅ 0.501 +0.001/- 0.000
	mm	∅ 9.53 +0.03/-0.00	12.7 +0.03/0.00
M	in	6.5	11.00
	mm	165.1	279.4
N	in	2.50	4.58
	mm	63.5	116.2

尾部法兰 (FT45)



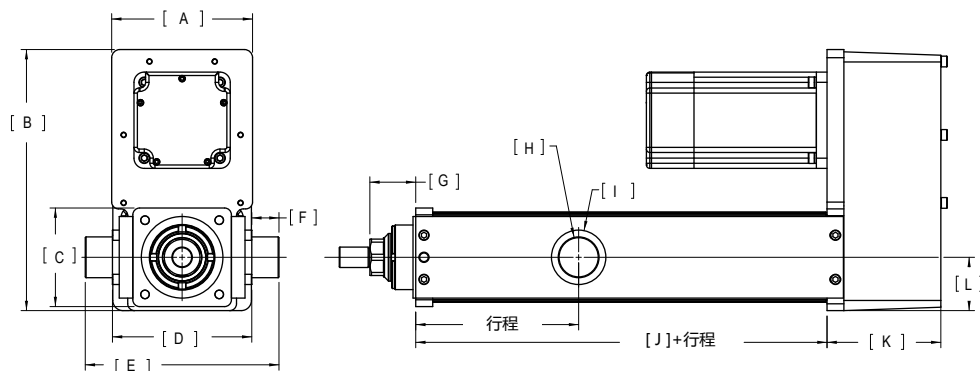
	A	B	C	D	E	F	G
in	7.48	∅ 0.69	∅ 0.472 +0.001/- 0.00	9.45	10.83	6.00	2.48
mm	190.0	17.5	12.00 +0.03/0.00	240.0	275.0	152.4	63.1

	H	I	J	K	L	M
in	1.99	13.9	6.26	14.55	1.00	3.05
mm	50.5	354	159.0	369.5	25.4	77.5

以上尺寸仅供参考, 详情请咨询Exlar.

FT 系列电动缸

耳轴安装 (FT35, FT60)



		FT35	FT60
A	in	5.18	6.82
	mm	131.6	173.2
B	in	9.60	14.32
	mm	243.8	363.7
C	in	□ 3.63	□ 6.38
	mm	92.1	161.9
D	in	5.12	8.13
	mm	130.1	206.4
E	in	7.12	12.13
	mm	180.9	308.0
F	in	1.00	2.00
	mm	25.4	50.8

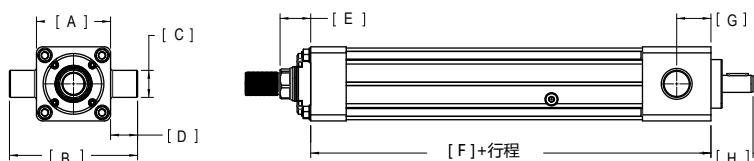
		FT35	FT60
G	in	1.69	2.25
	mm	42.9	57.1
H	in	∅ 1.500** ±0.001	∅ 2.500*** ±0.001
	mm	38.1 ±0.03	63.50 ±0.03
I	in	∅ 2.00	∅ 3.50
	mm	50.8	88.9
J	in	9.1*	15.3
	mm	232*	388
K	in	4.19	4.57
	mm	106.3	116.1
L	in	1.96	3.19
	mm	49.8	81.0

*FT35系列选择高性能丝杠时长度增加20mm.

** If "Q" 公制耳轴安装, ∅ 35 mm h7

*** If "Q" 公制耳轴安装, ∅ 60 mm h9

耳轴安装 (FT45)

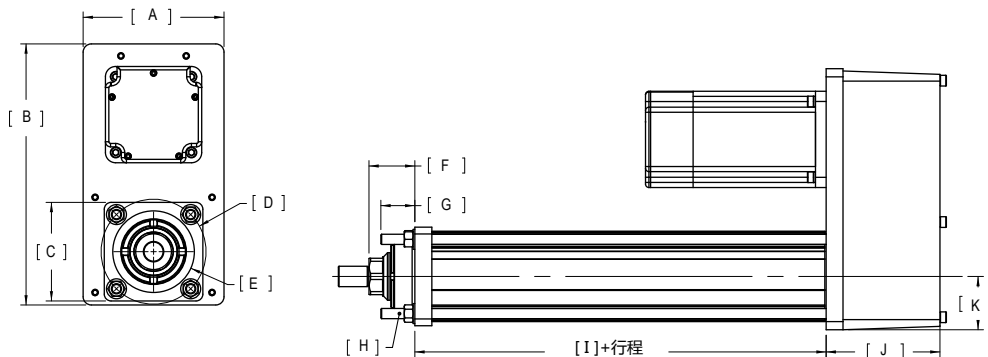


		英制 (A or 2)	公制 (V or P)
A	in	□ 4.80	□ 4.80
	mm	122.0	122.0
B	in	8.30	7.95
	mm	210.9	202.0
C	in	∅ 1.750 +0.000/- 0.002	∅ 1.969 +0.000/- 0.002
	mm	44.45 0.00/-0.05	50.00 0.00/-0.05
D	in	1.75	1.57
	mm	44.5	40.00

		英制 (A or 2)	公制 (V or P)
E	in	1.99	1.99
	mm	50.5	50.5
F	in	13.9	13.9
	mm	354	354
G	in	2.22	2.22
	mm	56.4	56.4
H	in	2.73	2.73
	mm	69.3	69.3

以上尺寸仅供参考, 详情请咨询Exlar.

前拉杆安装 (FT35, FT60, FT80)

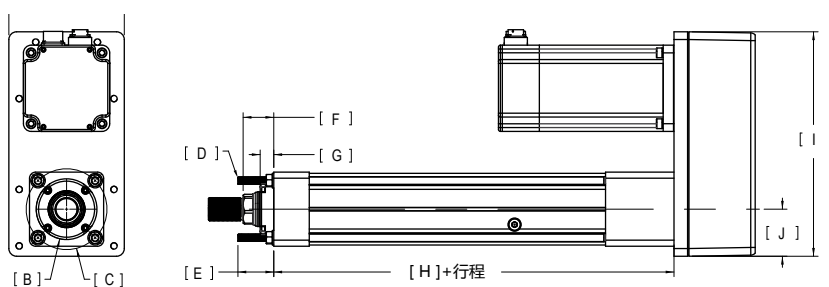


		FT35	FT60	FT80
A	in	5.18	6.82	8.77
	mm	131.6	173.2	222.8
B	in	9.60	14.32	17.33
	mm	243.8	363.7	440.2
C	in	□ 3.63	□ 6.38	□ 8.50
	mm	92.1	161.9	215.9
D	in	∅ 3.86 BC	∅ 6.79 BC	∅ 9.33 BC
	mm	98.0	172.4	237.0
E	in	∅ 3.000 +0.000/- 0.002	∅ 5.000 +0.000/- 0.002	∅ 6.75 +0.000/- 0.002
	mm	76.20 0.00/-0.05	127.0 0.00/-0.05	171.45 0.00/-0.05
F	in	1.69	2.25	3.03
	mm	42.9	57.1	77.0

		FT35	FT60	FT80
G	in	1.25	2.00	3.50
	mm	31.8	50.8	88.9
H	in	3/8-16 UNC-2A	9/16-12 UNC-2A	3/4-10 UNC-2A
	mm	M8 x 1.25 6g	M14 x 2.0 6g	M20 x 2.5 6g
I	in	9.1*	15.3	19.8
	mm	232*	388	503
J	in	4.19	4.57	6.43
	mm	106.3	116.1	163.3
K	in	1.96	3.19	4.40
	mm	49.8	81.0	111.8

*FT35系列选择高性能丝杠时长度增加20mm.

前拉杆安装 (FT45)



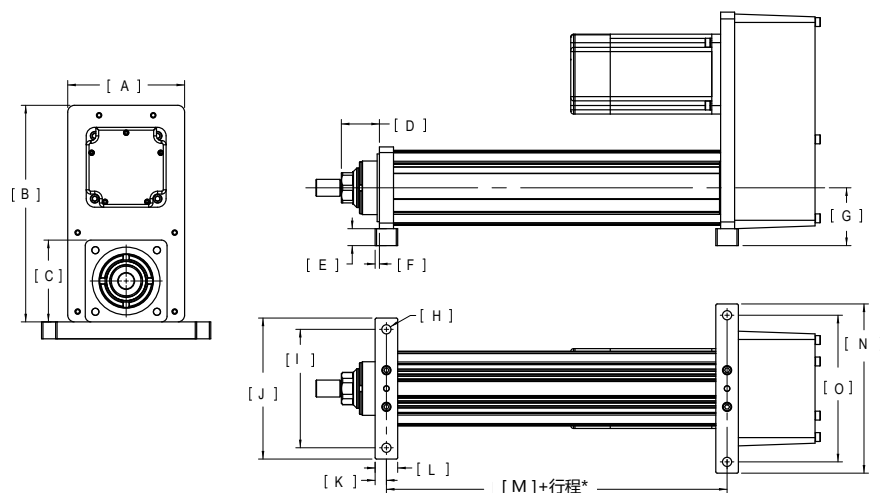
	A	B	C	D	E
in	7.48	∅ 3.937	∅ 5.236 BC	1/2-13 UNC	2.3
mm	190.0	100.00	133.00	M12 x 1.75 6g	59

	F	G	H	I	J
in	1.99	0.88	13.9	14.55	3.05
mm	50.5	22.4	354	369.5	77.5

以上尺寸仅供参考，详情请咨询Exlar.

FT 系列电动缸

侧面安装板 (FT35, FT60, FT80)



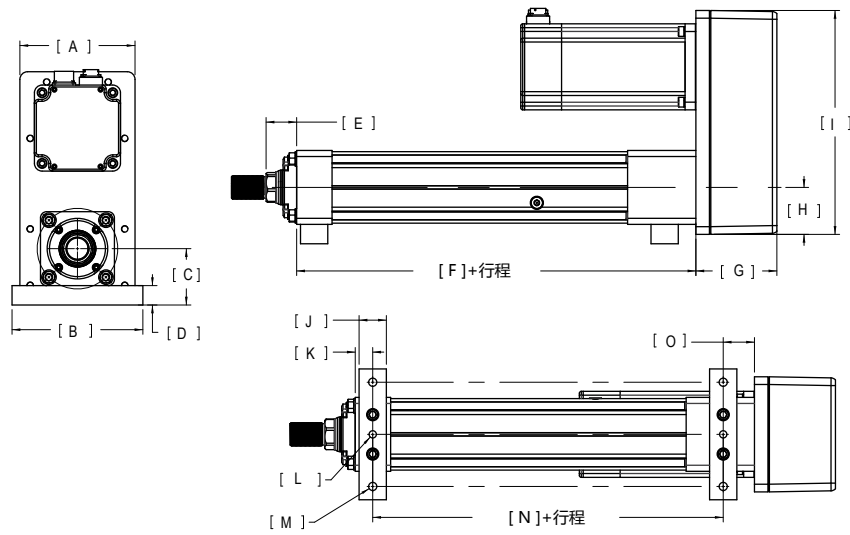
		FT35	FT60	FT80
A	in	5.18	6.82	8.77
	mm	131.6	173.2	222.8
B	in	9.60	14.32	17.33
	mm	243.8	363.7	440.2
C	in	□ 3.63	□ 6.38	□ 8.50
	mm	92.1	161.9	215.9
D	in	1.69	2.25	3.03
	mm	42.9	57.1	77.0
E	in	0.75	1.0	2.00
	mm	19.1	25.4	50.8
F	in	0.19	0.50	0.50
	mm	4.8	12.7	12.7
G	in	2.56	4.19	6.25
	mm	65.1	106.4	158.75

*FT35系列选择高性能丝杠时长度增加20mm.

		FT35	FT60	FT80
H	in	Ø 0.41	Ø 0.53	Ø 0.78
	mm	10.3	13.5	19.8
I	in	5.25	8.50	12.75
	mm	133.4	215.9	323.9
J	in	6.25	10.00	10.75
	mm	158.8	254.0	273.1
K	in	0.50	1.00	1.25
	mm	12.7	25.4	31.8
L	in	1.00	2.00	2.50
	mm	25.4	50.8	63.5
M	in	9.1*	15.3	19.6
	mm	232*	388	498
N	in	7.50	10.00	12.75
	mm	190.5	254.0	323.9
O	in	6.5	8.50	10.75
	mm	165.1	215.9	273.1

以上尺寸仅供参考，详情请咨询Exlar。

侧面安装板 (FT45)



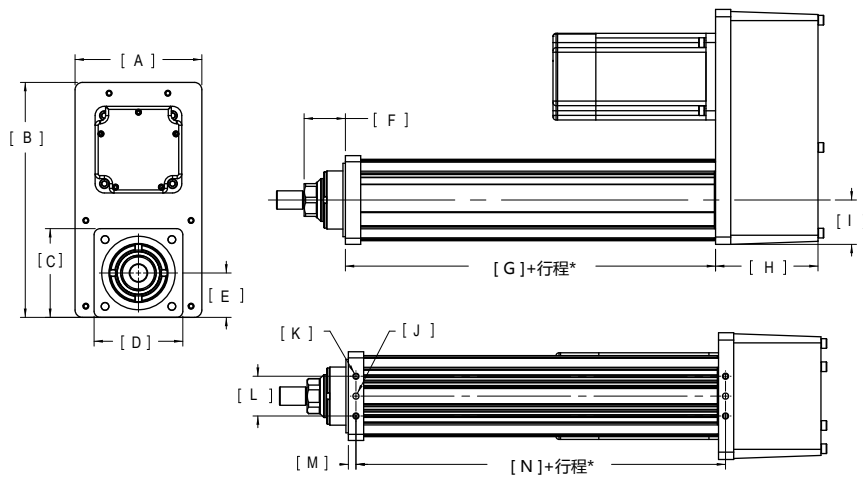
		FT45	
A	in	7.48	
	mm	190.0	
B	in	8.50	
	mm	215.9	
C	in	3.66	
	mm	93.0	
D	in	1.26	
	mm	32.0	
E	in	1.99	
	mm	50.5	
F	in	13.9	
	mm	354	
G	in	5.26	
	mm	133.6	

		FT45	
H	in	3.05	
	mm	77.5	
I	in	14.55	
	mm	369.5	
J	in	1.77	
	mm	45.0	
K	in	1.15	
	mm	29.2	
L	in	Ø 0.472 +0.001/0.000	
	mm	12.0 +0.03/0.00	
M	in	Ø 0.53	
	mm	13.5	
N	in	10.57	
	mm	269.4	
O	in	2.22	
	mm	56.4	

以上尺寸仅供参考，详情请咨询Exlar。

FT 系列电动缸

侧面安装



*FT35系列选择高性能丝杠时长度增加20mm.

		FT35	FT60	FT80
A	in	5.18	6.82	8.77
	mm	131.6	173.2	222.8
B	in	9.60	14.32	17.38
	mm	243.8	363.7	440.2
C	in	□ 3.63	□ 6.38	□ 8.50
	mm	92.1	161.9	215.9
D	in	□ 3.63	□ 6.38	□ 8.50
	mm	92.1	161.9	215.9
E	in	1.81	NA	NA
	mm	46.0	NA	NA
F	in	1.69	2.25	3.03
	mm	42.9	57.1	77.0
G	in	9.1*	15.3	19.8
	mm	232*	388	503

		FT35	FT60	FT80
H	in	4.19	4.57	6.43
	mm	106.3	116.1	163.5
I	in	1.81	3.19	4.25
	mm	46.1	81.0	108.0
J	Ø	0.2500 ¹ 0.400 ¹ +0.0000/ -0.0005	Ø 0.5000 ¹ 1.00 ² +0.0000/ -0.0005	Ø 0.6250 ¹ 1.375 ³ +0.0000/ -0.0005
K		1/4-20 UNC- 2B ↓ .63 ¹	1/2-13 UNC- 2B ↓ 1.13 ²	5/8-11 UNC- 2B ↓ 1.25 ³
L	in	1.63	2.50	4.00
	mm	41.3	63.5	101.6
M	in	0.31	0.50	0.75
	mm	8	12.7	19.1
N	in	9.1*	15.3	19.6
	mm	232*	388	498

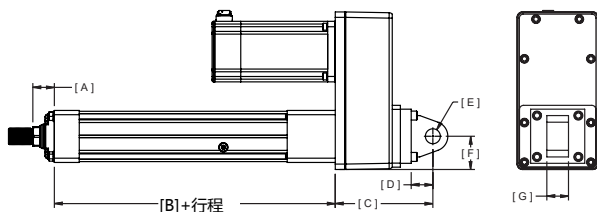
*FT35系列选择高性能丝杠时长度增加20mm.

¹ “J” 或 “K” 公制侧面安装, M6 x 1.0 ↓ 9 mm 带 Ø 6 mm M7 ↓ 9 mm 定位孔

² “J” 或 “K” 公制侧面安装, M12 x 1.75 ↓ 19 mm 带 Ø 12 mm M7 ↓ 12 mm 定位孔

³ “J” 或 “K” 公制侧面安装, M16 x 2.0 ↓ 16 mm 带 Ø 12 mm M7 ↓ 12 mm 定位孔

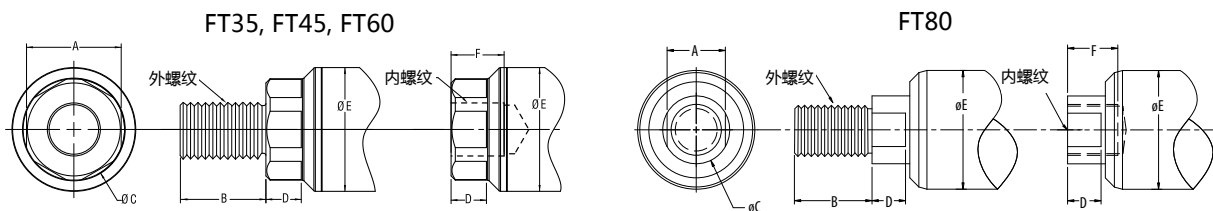
尾部销孔



		FT45 (选项 Y)	FT45 (选项 W)
A	in	1.99 (50.5)	1.99 (50.5)
	(mm)		
B	in	13.9 (354)	13.9 (354)
	(mm)		
C	in	9.01 (228.9)	7.90 (200.7)
	(mm)		
D	in	2.00 (50.8)	1.26 (32.0)
	(mm)		
E	in	1.378 ± 0.001 (35.0 ± 0.03)	0.787 H9 (20.00 H9)
	(mm)		
F	in	3.07 (77.9)	3.07 (77.9)
	(mm)		
G	in	2.00 (50.8)	1.18 (30.0)
	(mm)		

以上尺寸仅供参考, 详情请咨询Exlar.

杆端尺寸

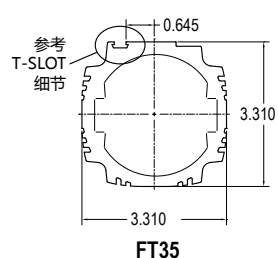


	A	B	ØC	D	ØE	F	英制外螺纹	公制外螺纹	英制内螺纹	公制内螺纹
FT35	1.34 (34)	1.125 (28.6)	1.434 (36.4)	0.50 (12.7)	1.750 (44.5)	0.750 (19.1)	3/4-16 UNF-2A	M16x1.5 6g	3/4-16 UNF-2B	M16x1.5 6h
FT45	1.81 (46.0)	2.25 (57.2)	2.0 (50.8)	0.63 (15.9)	2.250 (57.2)	1.50 (38.1)	1 1/2-12 UN-2A	M36x3 6g	1 1/2-12 UN-2B	M36x3 6h
FT60	2.36 (60.0)	2.750 (69.9)	2.360 (59.9)	0.750 (19.1)	3.000 (76.2)	2.000 (50.8)	1 7/8-12 UN-2A	M42x4.5 6g	1 7/8-12 UN-2B	M42x4.5 6h

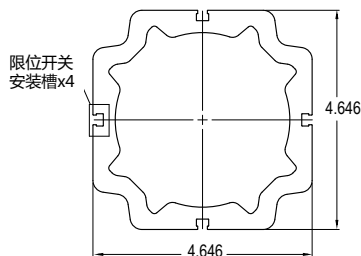
	A	B	ØC	D	ØE	F	英制外螺纹	公制外螺纹	英制内螺纹	公制内螺纹
FT80	2.75 (69.9)	4.019 (102.1)	3.143 (79.8)	1.000 (25.4)	4.000 (101.6)	2.250 (57.2)	2 1/2-12 UN-2A	M56x5.5 6g	2 1/2-12 UN-2B	M56x5.5 6h

尺寸标注 inches (mm)

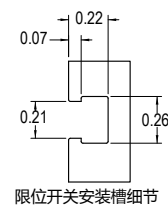
外壳尺寸



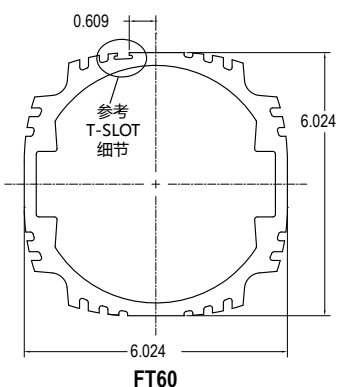
FT35



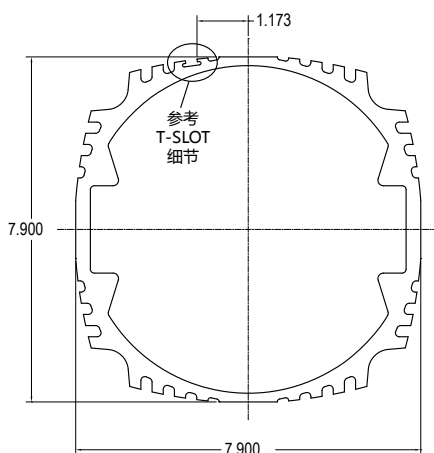
FT45



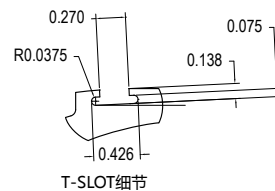
限位开关安装槽细节



FT60



FT80

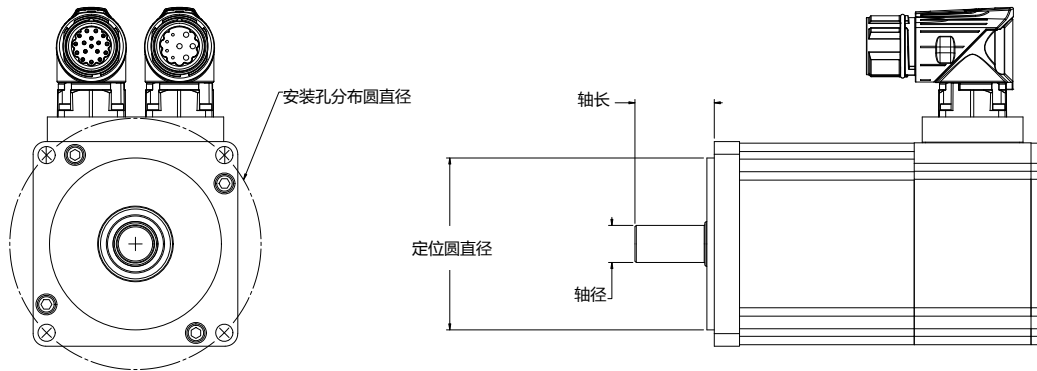


T-SLOT细节

以上尺寸仅供参考，详情请咨询Exlar。

FT 系列电动缸

电机安装尺寸



FT35 电机安装代码

安装孔分布圆直径 (mm)	定位圆直径 (mm)	轴径 (mm)	轴长 (mm)	键宽 (mm)	电机安装代码
68	60	12	30	4	GFB
68	60	16	48	5	GFA
70	50	14	30	5	JGA
70	50	16	30	5	GGB
70	50	16	36	5	EGB
70	50	16	40	5	GGA
75	60	14	30	5	IHB
75	60	16	32	5	GHB
75	60	16	48	5	GHA
85	70	16	37	5	GIB
85	70	22	56	6	GIA
90	60	19	40	6	JKF
90	70	14	30	5	JKD
90	70	16	35	NA	JKC
90	70	16	40	5	JKG
90	70	19	40	6	JKA
95	50	14	30	5	ELC
95	65	14	30	5	ELA
95	65	16	30	5	ELB
100	50	16	31	6	GMC
100	80	14	30	5	IMA
100	80	14	40	5	JMC
100	80	16	40	5	IMB
100	80	19	40	6	IMC
100	80	19	55	6	JMD
100	80	20	40	6	GMB
100	80	22	48	6	GMA
115	95	19	40	6	INA
115	95	19	55	6	JNC
115	95	22	45	8	JND

安装孔分布圆直径 (mm)	定位圆直径 (mm)	轴径 (mm)	轴长 (mm)	键宽 (mm)	电机安装代码
115	95	22	70	NA	JNB
115	95	24	45	8	JNA
115	95	24	50	8	INB
120	60	22	39	6	G7C
120	90	22	46	6	G7B
130	95	19	40	6	IPC
130	95	24	50	8	IPD
130	110	19	40	6	IPA
130	110	24	50	8	IPB
140	110	32	64	10	E5A
145	110	19	40	6	JQJ
145	110	19	55	5	JQG
145	110	19	55	6	JQK
145	110	22	55	8	JQH
145	110	22	55	6	JQF
145	110	22	70	8	JQE
145	110	24	55	8	JQD
145	110	24	65	8	JQC
145	110	28	55	8	JQB
145	110	28	63	8	JQA
165	95	24	50	8	IRG
165	110	24	50	8	IRF
165	130	24	50	8	IRA
165	130	28	60	8	IRB
165	130	32	50	10	IRD
165	130	32	58	10	IRC
165	130	32	80	10	IRE
165	130	32	80	10	IRE

FT45 电机安装代号

安装孔分布圆直径 (mm)	定位圆直径 (mm)	轴径 (mm)	轴长 (mm)	键宽 (mm)	电机安装代码
85	70	22	49	6	GIA
95	65	16	30	5	ELB
100	50	16	31	6	GMC
100	80	14	30	5	IMA
100	80	14	40	5	JMC
100	80	16	40	5	IMB
100	80	19	40	6	IMC
100	80	19	55	6	JMD
100	80	20	40	6	GMB
100	80	22	52	6	GMA
115	95	19	40	6	INA
115	95	19	55	6	JNC
115	95	22	45	8	JND
115	95	22	70	NA	JNB
115	95	24	45	8	JNA
115	95	24	50	8	INB
120	60	22	39	6	G7C
120	90	22	46	6	G7B
120	90	32	88	10	G7A
120	100	32	85	10	G7D
130	95	19	40	6	IPC
130	95	24	50	8	IPD
130	110	19	40	6	IPA
130	110	24	50	8	IPB
140	110	32	64	10	E5A
145	110	19	55	5	JQG
145	110	19	55	6	JQK
145	110	22	55	8	JQH
145	110	22	55	6	JQF
145	110	22	70	8	JQE

安装孔分布圆直径 (mm)	定位圆直径 (mm)	轴径 (mm)	轴长 (mm)	键宽 (mm)	电机安装代码
145	110	24	58	8	JQD
145	110	24	65	8	JQC
145	110	28	55	8	JQB
145	110	28	63	8	JQA
165	95	24	50	8	IRG
165	110	24	50	8	IRF
165	130	24	50	8	IRA
165	130	28	60	8	IRB
165	130	32	50	10	IRD
165	130	32	58	10	IRC
165	130	32	80	10	IRE
190	155	32	60	10	I2A
200	114.3	22	55	6	JSE
200	114.3	28	55	8	JSF
200	114.3	35	70	10	JSB
200	114.3	35	79	10	JSA
200	114.3	42	113	10	JSD
200	114.3	42	113	NA	JSG
215	130	32	60	10	ITE
215	180	24	50	10	ITA
215	180	28	60	10	ITB
215	180	32	58	10	ITC
215	180	32	80	10	ITD
215	180	38	80	10	ITF
215	180	42	82	12	ITG
215	180	42	82	12	ITG

FT60 电机安装代号

安装孔分布圆直径 (mm)	定位圆直径 (mm)	轴径 (mm)	轴长 (mm)	键宽 (mm)	电机安装代码
100	50	16	31	6	GMC
100	80	20	40	6	GMB
100	80	22	48	6	GMA
115	95	19	40	6	INA
115	95	19	55	6	JNC
115	95	22	45	8	JND
115	95	22	70	NA	JNB
115	95	24	45	8	JNA
115	95	24	50	8	INB
120	60	22	39	6	G7C
120	90	22	46	6	G7B
120	90	32	88	10	G7A
120	100	32	85	10	G7D
120	130	40	112	12	G7E
130	95	19	40	6	IPC
130	95	24	50	8	IPD
130	110	19	40	6	IPA
130	110	24	50	8	GPC
130	110	24	50	8	IPB
130	110	25	55	8	GPB
130	110	32	65	10	GPA
140	110	32	64	10	E5A
145	110	19	55	5	JQG
145	110	19	55	6	JQK
145	110	22	55	8	JQH
145	110	22	55	6	JQF
145	110	22	70	8	JQE
145	110	24	58	8	JQD
145	110	24	65	8	JQC

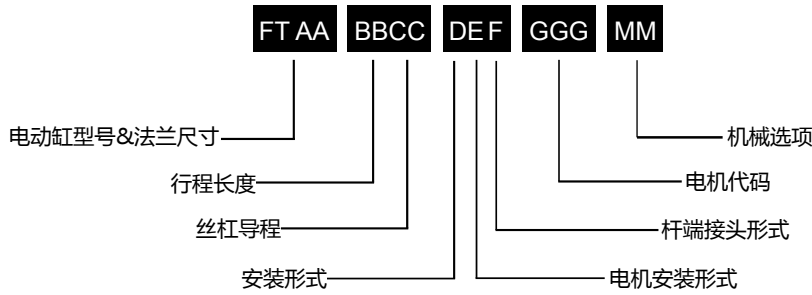
安装孔分布圆直径 (mm)	定位圆直径 (mm)	轴径 (mm)	轴长 (mm)	键宽 (mm)	电机安装代码
145	110	28	55	8	JQB
145	110	28	63	8	JQA
165	80	32	63	10	GRE
165	95	24	50	8	IRG
165	110	24	50	8	IRF
165	130	24	50	8	IRA
165	130	28	60	8	IRB
165	130	32	50	10	IRD
165	130	32	58	10	IRC
165	130	32	72	10	GRD
165	130	32	80	10	IRE
165	130	40	80	12	GRB
165	130	40	97	12	GRC
165	130	40	112	12	GRA
190	155	32	60	10	I2A
200	114.3	22	55	6	JSE
200	114.3	28	55	8	JSF
200	114.3	35	70	10	JSB
200	114.3	35	80	10	JSA
200	114.3	42	113	10	JSD
200	114.3	42	113	12	JSG
215	130	32	60	10	ITE
215	180	24	50	10	ITA
215	180	28	60	10	ITB
215	180	32	58	10	ITC
215	180	32	80	10	ITD
215	180	38	80	10	ITF
215	180	42	85	12	ITG

FT80 电机安装代号

安装孔分布圆直径 (mm)	定位圆直径 (mm)	轴径 (mm)	轴长 (mm)	键宽 (mm)	电机安装代号
130	110	24	50	8	GPC
130	110	25	55	8	GPB
130	110	32	72	10	GPA
165	80	32	63	10	GRE
165	95	24	50	8	IRG
165	110	24	50	8	IRF
165	130	24	50	8	IRA
165	130	28	60	8	IRB
165	130	32	50	10	IRD
165	130	32	58	10	IRC
165	130	32	72	10	GRD
165	130	32	80	10	IRE
165	130	40	80	12	GRB
165	130	40	102	12	GRC
165	130	40	112	12	GRA
190	155	32	60	10	I2A
200	114.3	28	55	8	JSF
200	114.3	35	70	10	JSB
200	114.3	35	80	10	JSA
200	114.3	42	113	10	JSD
200	114.3	42	113	12	JSG
215	130	32	60	10	ITE
215	160	40	100	12	GTC

安装孔分布圆直径 (mm)	定位圆直径 (mm)	轴径 (mm)	轴长 (mm)	键宽 (mm)	电机安装代号
215	160	55	112	16	GTA
215	180	24	50	10	ITA
215	180	28	58	10	ITB
215	180	32	58	10	ITC
215	180	32	80	10	ITD
215	180	38	80	10	ITF
215	180	42	82	12	ITG
235	200	35	70	10	JUC
235	200	42	85	12	JUB
235	200	42	116	12	JUD
235	200	55	116	16	JUA
265	230	38	80	10	IVA
265	230	38	110	10	IVB
265	230	42	110	12	IVC
265	230	55	110	16	JVA
265	230	60	140	18	JVC
265	230	65	140	18	JVB
300	250	48	82	14	IWB
300	250	48	112	14	IWA
300	250	60	140	18	JWA

FT 系列订购指南



AA=FT 法兰尺寸

35=3.5 inch (90 mm)
45=4.8 inch (122 mm)
60=6.4 inch (162 mm)
80=8.5 inch (216 mm)

BB=行程长度

06=06 inch (152 mm) FT35, FT45
12=12 inch (305 mm) FT35, 45, 60, 80
18=18 inch (457 mm) FT35, 45
24=24 inch (610 mm) FT35, 45, 60, 80
36=36 inch (914 mm) FT35, 45, 60, 80
48=48 inch (1219 mm) FT35, 45, 60, 80

CC=丝杠导程

05=0.20 inch(5.08mm), FT35, 45
06=0.23 inch(5.84mm), FT60, 80
10=0.39 inch(9.90mm), FT35, 45
12=0.47 inch(11.9mm), FT60, 80
20=0.79 inch(20.0mm), FT35
30=1.18 inch(29.9mm), FT60, 80

D=安装形式¹

N=基本单元
F=英制前法兰
Z=公制前法兰, 只应用于FT45
R=英制尾部法兰^{4,5}
C=英制尾部铰接^{4,5}
G=公制尾部铰接^{4,5}
Y=英制尾部销孔⁴, 只应用于FT45
W=公制尾部销孔⁴, 只应用于 FT45
L=侧面安装板
S=英制侧面安装, 只适用于FT35, 60, 80
J=公制侧面安装, 只适用于 FT35, 60, 80
T=英制侧面耳轴^{5,6}只适用于FT35, 60, 80
Q=公制侧面耳轴^{5,6}只适用于FT35, 60, 80
2=英制耳轴安装, 只适用于 FT45
P=公制尾部耳轴安装, 只适用于 FT45
E=英制前端拉杆安装
M=公制前端拉杆安装

E=电机安装形式³

N=基本单元
I=直连式安装 (包括标准联轴器)
P=同步带1:1
Q=同步带2:1

F=杆端接头形式

M=英制外螺纹
A=公制外螺纹
F=英制内螺纹
B=公制内螺纹

GGG=电机代码^{3,4}

电机安装代码参考 114-117页。

MM=机械选项²

XT=高性能丝杠

限位开关

限位开关参考第100页

当订购产品时, 请提供电机的3D及CAD图
以确保电机安装尺寸的正确性



未列出的非标配置或需要在超出
标准温度范围, 请联系Exlar

注意:

- 电机安装面尺寸, 电机轴长度及其它细节可能会使得在电动缸与电机安装时需要做特殊处理, 在选型时请联系当地销售代表讨论您所需要选用的电机。
- 非标使用温度请咨询当地销售代表
- 标准最大法兰尺寸: FT35: 5.6 inch/165 mm, FT45: 7.1 inch/215 mm, FT60: 7.9 inch/215 mm, FT80: 8.5 inch/300 mm. 如果超过最大尺寸, 请联系当地销售代表。
- 不适用于直连式电机安装方式, 请联系当地销售代表。
- 如果选择FT80需要提供十分详细的应用细节以确保选型的适用性。
- 不提供IP65防护等级。

选型

运动曲线

在分析一个应用并选择电动缸时，第一步要做的是绘制出合理的运动曲线。确定运动曲线需要知道各段动作的运动距离及完成各段运动的时间。下列计算有助于工程师选择合适的运动曲线。

在给定的负载下，每个直线执行器都有它能达到的最高速度。这个最高速度将决定完成这个运动需要采用哪种运动曲线形式。三角形曲线与梯形曲线是两种最常用的运动曲线。如果整个运动的平均速度小于最高速度的一半，则可以使用三角形曲线。此时可以得到更小的加/减速度。在其它的情况下则需要使用梯形运动曲线。

下图的梯形运动曲线中，加速、减速、匀速三段运动时间相等，最高速度比三角形速度曲线低25%，而加速度/减速度要高12.5%。这种曲线通常称为等分三段梯形加速曲线。

后面几页将给出在选择Exlar电动缸或伺服电机时的一些公式。

第一个公式是关于在直线运动中电动缸所需要的推力。

第二个公式是计算关于在直线运动或旋转运动中所需的扭矩，在旋转应用中，还需要考虑到减速机与带轮的减速比。而在直线运动中需要考虑到的是丝杠的导程。

这些页面所包含的公式可以让您轻松的以现有的数据直接填写来计算出所需要的结果。您也可以在将运动曲线发送到Exlar进行选型。

最后的表格提供了常见的单位换算及运动计算中可能用到的一些常数。

直线运动参数

- V_{max} = 最高速度-in/sec (m/sec)
- V_{avg} = 平均速度-in/sec (m/sec)
- t_{acc} = 加速时间 time (sec)
- t_{dec} = 减速时间 time (sec)
- t_{cv} = 匀速时间 (sec)
- t_{total} = 总运动时间 (sec)
- acc = 加速度-in/sec² (m/sec²)
- dec = 减速度-in/sec² (m/sec²)
- cv = 平均速度-in/sec (m/sec)
- D = 总移动距离-in (m)
或 圈数 (旋转运动)

标准方程

$$V_{avg} = D / t_{total}$$

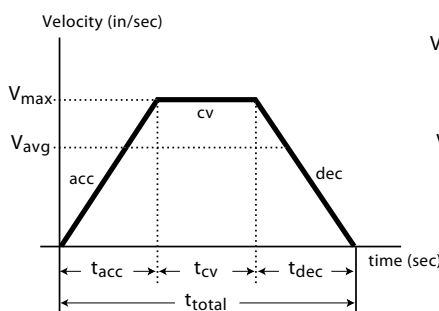
设： $t_{acc} = t_{dec}$

$$\text{则：} V_{max} = (t_{total} / (t_{total} - t_{acc})) (V_{avg})$$

$$D = \text{曲线包围区域面积}$$

$$D = (1/2(t_{acc} + t_{dec}) + t_{cv})(V_{max})$$

梯形运动曲线



梯形运动曲线公式

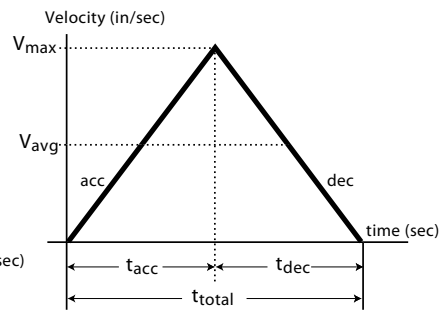
设： $t_{acc} = t_{cv} = t_{dec}$ 则有：

$$V_{max} = 1.5 (V_{avg})$$

$$D = (2/3) (t_{total}) (V_{max})$$

$$acc = dec = V_{max} / t_{acc}$$

三角形运动曲线



三角形运动曲线公式

设 $t_{acc} = t_{total} / 2$ 则有：

$$V_{max} = 2.0 (V_{avg})$$

$$D = (1/2) (t_{total}) (V_{max})$$

$$acc = dec = V_{max} / t_{acc}$$

术语与单位

- THRUST = 总推力-lbf (N)
- θ = 倾斜角度-(deg)
- $F_{friction}$ = 摩擦力-lbf (N)
- t_{acc} = 加速时间-(sec)
- F_{acc} = 加速推力-lbf (N)
- v = 速度变化值-in/sec (m/s)
- $F_{gravity}$ = 重力分力-lbf (N)
- μ = 滑动摩擦系数(参考174页不同材料摩擦系数)
- $F_{applied}$ = 作用力-lbf (N)
- WL = 负载重量-lbf (N)
- g = 重力加速度-386.4 in/sec² (9.8 m/sec²)

推力计算公式

$$THRUST = F_{friction} + [F_{acceleration}] + F_{gravity} + F_{applied}$$

$$THRUST = WL\mu\cos\theta + [(WL / 386.4) (v/t_{acc})] + WL\sin\theta + F_{applied}$$

计算示例：要求将一个重量200磅的物体在0.2秒内加速到8inch/s。计算在倾斜角度(θ)分别为 0°, 90° 与30°时所需要的推力。（假设在运动方向上有弹簧施加25磅的推力）

$$WL=200 \text{ lbf}, v=8.0 \text{ in/sec.}, t_{acc}=0.2 \text{ sec.}, F_{app}=25 \text{ lbf}, \mu=0.15$$

$\theta=0^\circ$

$$THRUST = WL\mu\cos\theta + [(WL / 386.4) (v/t_{acc})] + WL\sin\theta + F_{applied}$$

$$= (200)(0.15)(1) + [(200/386.4)(8.0/0.2)] + (200)(0) + 25$$

$$= 30 \text{ lbs} + 20.73 \text{ lbs} + 0 \text{ lbs} + 25 \text{ lbs} = 75.73 \text{ lbs force}$$

$\theta=90^\circ$

$$THRUST = WL\mu\cos\theta + [(WL / 386.4) (v/t_{acc})] + WL\sin\theta + F_{applied}$$

$$= (200)(0.15)(0) + [(200/386.4)(8.0/0.2)] + (200)(1) + 25$$

$$= 0 \text{ lbs} + 20.73 \text{ lbs} + 200 \text{ lbs} + 25 \text{ lbs} = 245.73 \text{ lbs force}$$

$\theta=30^\circ$

$$THRUST = WL\mu\cos\theta + [(WL / 386.4) (v/t_{acc})] + WL\sin\theta + F_{applied}$$

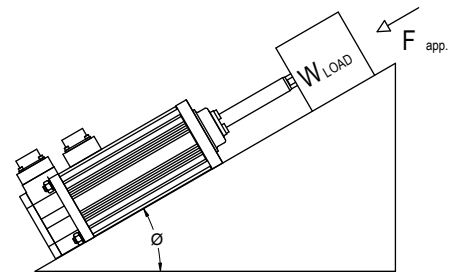
$$= (200)(0.15)(0.866) + [(200/386.4)(8.0/0.2)] + (200)(0.5) + 25$$

$$= 26 \text{ lbs} + 20.73 \text{ lbs} + 100 + 25 = 171.73 \text{ lbs force}$$

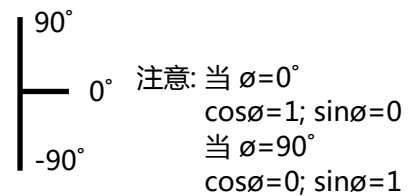
推力计算

推力的定义:

完成某个特定的运动曲线所需要的推力为以下四个力的总和：负载加速度，重力，摩擦力与轴向的作用力。



倾斜的角度



在选型时需要计算出整个运动曲线中各段所需要的推力，以其中最大的推力作为选型依据。左侧所示为加速段推力计算过程。一般来讲在运动过程中加速段所需要的推力最大。

电机扭矩的计算

在选型同时也需要计算出来达到满足这个应用所需要的电机扭矩，然后将计算值与给定放大器和电机组合的额定扭矩进行比较，这有助于更好地控制电动缸的速度与位置。

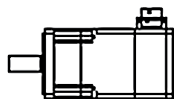
当使用分体式电动缸如FT与K系列时，电机的额定扭矩需要咨询伺服电机厂家电机；在使用GSX系列执行器的情况下，所需的转矩除以电机的转矩常数（Kt）必须小于GSX或SLM电机的额定电流。

惯量值与转矩额定值可以在GSX，FT和SLM / SLG系列产品规格中找到。

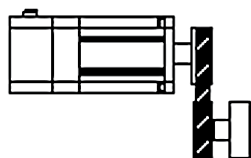
伺服电机驱动丝杠 (GSX, FT, & EL)



伺服电机/伺服减速电机 (SLM/SLG & ER)



伺服电机驱动同步带



术语与单位

- λ = 所需扭矩, lbf-in (N-m)
- λ_a = 所需电机加速扭矩, lbf-in (N-m)
- F = 外部负载, 无惯量, lbf (kN)
- l = 丝杠导程, in (mm)
- R = 减速比
- T_L = 负载所需的扭矩 lbf-in (N-m)
- v_L = 负载直线速度 in/sec (m/sec)
- ω_L = 负载角速度 rad/sec
- ω_m = 电机角速度 rad/sec
- η = 丝杠或减速机效率
- g = 重力加速度, 386.4 in/s² (9.75 m/s²)
- α = 电机角加速度, rad/s²
- m = 负载质量, lb (N)
- J_L = 负载折算惯量, lbf-in-s² (N-m-s²)
- J_r = 减速机折算惯量, lbf-in-s² (N-m-s²)
- J_s = 丝杠折算惯量, lbf-in-s² (N-m-s²)
- J_m = 电机电枢惯量, lbf-in-s² (N-m-s²)
- L = 丝杠长度, in (m)
- ρ = 丝杠材料密度, lb/in³ (kg/m³)
- r = 丝杠半径, in (m)
- π = 圆周率 (3.14159)
- C_a = 额定动载, lbf (N)

速度方程

丝杠: $V_L = \omega_m \cdot S / 2\pi$ in/sec (m/sec)

同步带或减速机: $\omega_m = \omega_L \cdot R$ rad/sec

扭矩方程

因负载产生的静扭矩：

丝杠 (GS, FT 或外置丝杠): $\lambda = (S \cdot F) / (2 \cdot \pi \cdot \eta)$ lbf-in (N-m)

同步带: $\lambda = T_L / R \cdot \eta$ lbf-in (N-m)

减速机: $\lambda = T_L / R \cdot \eta$ lbf-in (N-m)

因加速产生的动扭矩：

$\lambda_a = (J_m + J_r + (J_s + J_L) / R^2) \alpha$ lbf-in

$\alpha = \text{角加速度} = ((\text{RPM} / 60) \times 2\pi) / t_{acc}$ rad/sec².

$J_s = (\pi \cdot L \cdot \rho \cdot r^4) / (2 \cdot g)$ lb-in-s² (N-m-s²)

运动所需总扭矩

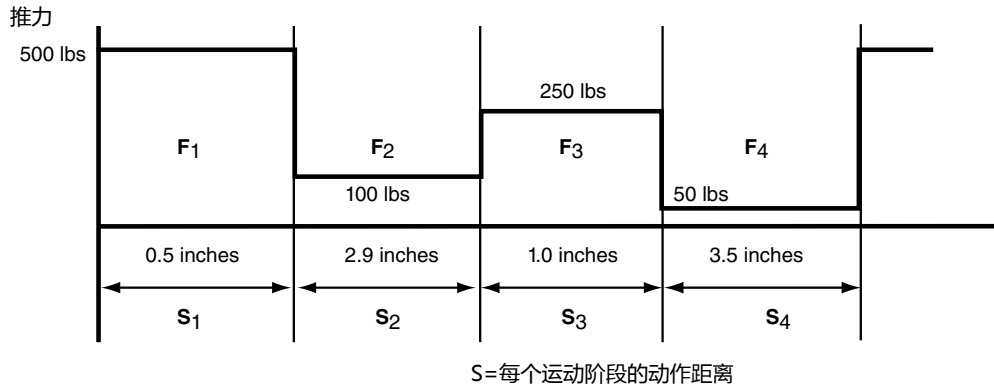
$\lambda_T = \lambda_a + \lambda$ lbf-in (N-m)

三次均方根载荷计算

使用均方根平均载荷来计算丝杠的预期寿命会更加准确。下图展示出载荷与相应行程的曲线，以及计算均方根平均载荷的计算公式。

注：1，本图中负载值仅做参考用。

2，在计算中，负值的载荷应转为正值来计算。



三次均方根载荷公式

$$F_{cml} = \sqrt[3]{\frac{F_1^3 S_1 + F_2^3 S_2 + F_3^3 S_3 + F_4^3 S_4}{S_1 + S_2 + S_3 + S_4}}$$

本例计算数值为217lbs

使用寿命计算

L10 的定义是行星滚柱丝杠的预期寿命里程（英寸）。在正确的维护下90%的丝杠均能够达到或超过计算出来的理论预期寿命，计算此数据的公式见下方。计算出来的值是 10^6 (mm)。

行程寿命的计算前提是丝杠得到正确的维护，不受杂质污染并各到适当的润滑。如果要保证大于90%的行程寿命可靠性，预期寿命需要乘以以下系数：

- 95% x 0.62 96% x 0.53
- 97% x 0.44 98% x 0.33
- 99% x 0.21

单螺母（无预紧）：

$$L_{10} = \left(\frac{C_a}{F_{cml}} \right)^3 \times l$$

短行程寿命计算

如果应用是大推力，短行程并且动作行程比螺母或导程短，使用寿命可能会比预期的短。请联系Exlar计算使用寿命。您也可以从www.exlar.com下载“Calculating Life Expectancy”，根据说明进行计算。

注意：零反向间隙（预紧滚柱丝杠选项）滚柱丝杠的额定动载参数为标准无预紧滚柱丝杠的63%，对于相同应用，包含预紧机构的滚柱丝杠的预期使用寿命为标准滚柱丝杠的25%

推力计算

总推力计算

术语与单位	变量
THRUST=总推力-lbf (N)	\emptyset = 倾斜角度-deg = _____
$F_{friction}$ = 摩擦力-lbf (N)	t_{acc} = 加速时间-sec..... = _____
F_{acc} = 加速度推力-lbf (N)	v = 速度-in/sec (m/s)..... = _____
$F_{gravity}$ = 重力-lbf (N)	μ = 滑动摩擦系数..... = _____
$F_{applied}$ = 轴向推力-lbf (N)	W_L = 负载重量-lbm (kg)..... = _____
386.4 = 重力加速度-in/sec ² (9.8 m/sec ²)	$F_{applied}$ = 轴向推力-lbf (N) = _____

推力计算公式

$THRUST = [F_{friction}] + [F_{acceleration}] + F_{gravity} + F_{applied}$
 $THRUST = [W_L \times \mu \times \cos\emptyset] + [(W_L / 386.4) \times (v / t_{acc})] + W_L \sin\emptyset + F_{applied}$

$THRUST = [() \times () \times ()] + [(/ 386.4) \times (/)] + [() \times ()] + ()$
 $THRUST = [] + [() \times ()] + [] + ()$
 $= \text{_____ lbf.}$

计算每一运动阶段的值，并把计算值用于接下来的计算

三次均方根平均推力计算

$$\sqrt[3]{\frac{F_1^3 S_1 + F_2^3 S_2 + F_3^3 S_3 + F_4^3 S_4}{S_1 + S_2 + S_3 + S_4}}$$

$F_1 = \text{_____}$	$S_1 = \text{_____}$	$F_1^3 S_1 = \text{_____}$
$F_2 = \text{_____}$	$S_2 = \text{_____}$	$F_2^3 S_2 = \text{_____}$
$F_3 = \text{_____}$	$S_3 = \text{_____}$	$F_3^3 S_3 = \text{_____}$
$F_4 = \text{_____}$	$S_4 = \text{_____}$	$F_4^3 S_4 = \text{_____}$

实际运动阶段可能多于或少于4段，请按实际情况对公式进行调整

扭矩计算

术语与单位

λ	= 扭矩, lb-in (N-m).....	=-----
F	= 外加负载, 无惯量, lbf (N).....	=-----
S	= 丝杠导程, in (m).....	=-----
η	= 丝杠或减速机惯量 (滚柱丝杠~85%).....	=-----
g	= 重力加速度常数, 386 in/s ² (9.8 m/s ²).....	=-----
α	= 电机角加速度, rad/s ²	=-----
R	= 减速比.....	=-----
T_L	= 负载所需要扭矩, lbf-in (N-m).....	=-----
V_L	= 负载直线速度, in/sec (m/sec).....	=-----
ω_L	= 负载角速度, rad/sec.....	=-----
ω_m	= 电机角速度, rad/sec.....	=-----
m	= 负载质量, lbf (kg).....	=-----
J_R	= 减速机构折算惯量, lb-in-s ² (N-m-s ²).....	=-----
J_S	= 丝杠折算惯量, lb-in-s ² (N-m-s ²).....	=-----
J_L	= 负载折算惯量, lb-in-s ² (N-m-s ²).....	=-----
J_M	= 电机电枢惯量, lb-in-s ² (N-m-s ²).....	=-----
π	= 圆周率.....	= 3.14159
K_t	= 电机扭矩常数, lb-in/amp (N-m/amp).....	=-----

* GS系列 J_S 与 J_M 值相同, 请查看GS 机械规格表

扭矩公式

因推力产生的静扭矩计算：

$$\lambda_f = S \cdot F / (2 \cdot \pi \cdot \eta) \text{ lb-in (N-m)} = (\quad) \times (\quad) / 2\pi \cdot 0.85 = (\quad) \times (\quad) / 5.34 = \underline{\quad}$$

旋转扭矩计算：

同步带驱动: $\lambda = T_L / R \cdot \eta$ lbf-in (N-m)

减速机驱动: $\lambda = T_L / R \cdot \eta$ lbf-in (N-m)

因加速产生的动扭矩计算：

$$\lambda_t = (J_m + (J_s + J_L) / R^2) \cdot \alpha \text{ lb-in (N-m)} = [(\quad) + (\quad + \quad) / (\quad)] \cdot (\quad) = \underline{\quad}$$

总扭矩=因推力产生的扭矩 + 因加速产生的动扭矩

$$\lambda_{total} = (\quad) + (\quad) + (\quad) = \underline{\quad}$$

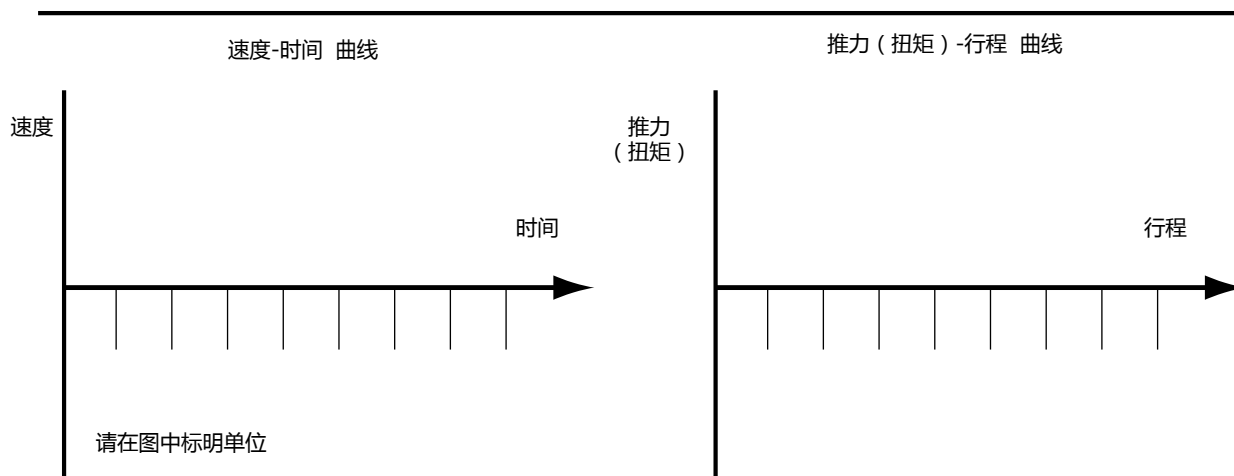
$$\text{电机电流} = \lambda_{total} / K_t = (\quad) / (\quad) = \underline{\quad}$$

Exlar 应用需求表

日期: _____		公司名称: _____	
地址: _____			
城市: _____		国家: _____	
电话 (手机): _____		传真: _____	
联系人: _____		职位: _____	

发送至:
Exlar Automation
Email: cha_applications@curtisswright.com
Fax: (952) 368-4877
Attn: Applications Engineering

图表/应用工况描述



Exlar 应用需求表

日期: _____ 联系人: _____ 公司名称: _____

行程/速度要求

所需最大行程..... _____ inches (mm), revs
 运动行程..... _____ inches (mm), revs
 运动时间..... _____ sec
 最高速度..... _____ in/sec (mm/sec), revs/sec
 最低速度..... _____ in/sec (mm/sec), revs/sec
 精度要求..... _____ inches (mm), arc min

负载与使用寿命要求

重力分力负载..... _____ lb (N)
 外部轴向负载..... _____ lbf (N)
 惯量负载..... _____ lbf (N)
 摩擦力..... _____ lbf (N)
 旋转惯量负载..... _____ lbf-in-sec² (Kg-m²)
 或旋转质量与质量半径..... _____ lb (kg) _____ in (mm)
 径向力 (伺服电机/伺服电动缸)..... _____ lb (N)
 受力方向 _____ 伸出 _____ 缩回 _____ 两者均有
 电动缸安装方向 _____ 垂直向上 _____ 垂直向下 _____ 水平
 _____ 固定角度 _____ 与水平成一角度
 _____ 变化的角度 从 _____ 到 _____
 工作周期..... _____ 次数/分钟/小时/天
 每天工作时间..... _____ 小时
 使用寿命要求..... _____ 次数/小时/英寸/毫米

配置选项

安装形式: _____ 侧面安装 _____ 法兰 _____ 前拉杆 _____ 尾部铰接 _____ 耳轴
 前端接头: _____ 外螺纹 _____ 内螺纹 _____ 球形铰接 _____ 销孔端 _____ 叉销端
 是否有防转: _____ 不需要带防转机构 _____ 需要带防转机构
 是否需要制动器: _____ 需要 _____ 不需要
 电缆长度: _____ ft (m)

旋转惯量 从A单位转到B单位，乘以表格中的数值

B	Kg-m ²	Kg-cm ²	g-cm ²	kgf-m-s ²	kgf-cm-s ²	gf-cm-s ²	oz-in ²	ozf-in-s ²	lb-in ²	lbf-in-s ²	lb-ft ²	lbf-ft-s ²
A												
Kg-m ²	1	10 ⁴	10 ⁷	0.10192	10.1972	1.01972x10 ⁴	5.46745x10 ⁴	1.41612x10 ²	3.41716x10 ³	8.850732	23.73025	0.73756
Kg-cm ²	10 ⁻⁴	1	10 ³	1.01972x10 ⁵	1.01972x10 ³	1.01972	5.46745	1.41612x10 ⁻²	0.341716	8.85073x10 ⁻⁴	2.37303x10 ⁻³	7.37561x10 ⁻⁵
g-cm ²	10 ⁻⁷	10 ⁻³	1	1.01972x10 ⁸	1.01972x10 ⁻⁶	1.01972x10 ⁻³	5.46745x10 ⁻³	1.41612x10 ⁻⁵	3.41716x10 ⁻⁴	8.85073x10 ⁻⁷	2.37303x10 ⁻⁶	7.37561x10 ⁻⁸
kgf-m-s ²	9.80665	9.80665x10 ⁴	9.80665x10 ⁷	1	10 ²	10 ⁴	5.36174x10 ⁵	1.388674x10 ³	3.35109x10 ⁴	86.79606	2.32714x10 ³	7.23300
kgf-cm-s ²	9.80665x10 ⁻²	9.80665x10 ²	9.80665x10 ⁵	10 ⁻²	1	10 ⁵	5.36174 x10 ³	13.8874	3.35109x10 ⁻²	0.86796	2.32714	7.23300x10 ⁻²
gf-cm-s ²	9.80665x10 ⁻⁵	0.980665	9.80665x10 ²	10 ⁻⁵	10 ⁻³	1	5.36174	1.38874 x10 ⁻²	0.335109	8.67961x10 ⁻⁴	2.32714x10 ⁻³	7.23300x10 ⁻⁵
oz-in ²	1.82901x10 ⁻⁵	0.182901	1.82901x10 ²	1.86505x10 ⁻⁶	1.86505x10 ⁻⁴	0.186506	1	2.59008 x10 ⁻³	6.25 x10 ⁻²	1.61880x10 ⁻⁴	4.34028x10 ⁻³	1.34900x10 ⁻³
oz-in-s ²	7.06154x10 ⁻³	70.6154	7.06154x10 ⁴	7.20077x10 ⁴	7.20077x10 ⁻²	72.0077	3.86089x10 ²	1	24.13045	6.25 x10 ⁻²	0.167573	5.20833x10 ⁻⁴
lb-in ²	2.92641x10 ⁻⁴	2.92641	2.92641x10 ³	2.98411x10 ⁵	2.98411x10 ³	2.98411	16	4.14414 x10 ²	1	2.59008x10 ⁻³	6.94444x10 ³	2.15840x10 ⁻⁴
lbf-in-s ²	0.112985	1.129x10 ³	1.12985x10 ⁶	1.15213x10 ²	1.15213	1.51213 x10 ³	6.1774 x10 ³	16	3.86088x10 ²	1	2681175	8.3333x10 ⁻²
lbf-ft ²	4.21403x10 ⁻²	4.21403x10 ²	4.21403x10 ⁵	4.29711x10 ³	0.429711	4.297114	2.304 x10 ³	5.96755	144	0.372971	1	3.10809x10 ⁻²
lbf-ft-s ²	1.35583	1.35582x10 ⁴	1.35582x10 ⁷	0.138255	13.82551	1.38255x10 ⁴	7.41289x10 ⁴	192	4.63306x10 ³	12	32.17400	1

扭矩 从A单位转到B单位，乘以表格中的数值

B	N-m	N-cm	dyn-cm	Kg-m	Kg-cm	g-cm	oz-in	ft-lb	in-lb
A									
N-m	1	10 ⁻²	10 ⁷	0.109716	10.19716	1.019716 x10 ⁴	141.6199	0.737562	8.85074
N-cm	102	1	10 ⁵	1.019716 x10 ³	0.1019716	1.019716 x10 ²	1.41612	7.37562 x10 ⁻³	8.85074 x10 ⁻²
dyn-cm	10 ⁻⁷	10 ⁻⁵	1	1.019716 x10 ⁻⁸	1.019716 x10 ⁻⁶	1.019716 x10 ⁻³	1.41612 x10 ⁻⁵	7.2562 x10 ⁻⁸	8.85074 x10 ⁻⁷
Kg-m	9.80665	980665x10 ²	9.80665 x10 ⁷	1	10 ²	10 ⁵	1.38874 x10 ³	7.23301	86.79624
Kg-cm	9.80665x10 ⁻²	9.80665	9.80665 x10 ⁵	10 ⁻²	1	10 ³	13.8874	7.23301 x10 ⁻²	0.86792
g-cm	9.80665x10 ⁻⁵	9.80665x10 ⁻³	9.80665 x10 ²	10 ⁻⁵	10 ⁻³	1	1.38874 x10 ⁻²	7.23301 x10 ⁻⁵	8.679624 x10 ⁻⁴
oz-in	7.06155x10 ⁻³	0.706155	7.06155 x10 ⁴	7.20077 x10 ⁻⁴	7.20077 x10 ⁻²	72.077	1	5.20833 x10 ⁻³	6.250 x10 ⁻²
ft-lb	1.35582	1.35582x10 ²	1.35582 x10 ⁷	0.1382548	13.82548	1.382548 x10 ⁴	192	1	12
in-lb	0.113	11.2985	1.12985 x10 ⁶	1.15212 x10 ⁻²	1.15212	1.15212 x10 ³	16	8.33333 x10 ⁻²	1

常见金属密度

材料	oz/in ³	gm/cm ³
铝 (铸铝或冷拉)	1.54	2.66
黄铜 (铸造或轧制)	4.80	8.30
青铜 (铸造)	4.72	8.17
铜 (铸铝或冷拉)	5.15	8.91
塑料	0.64	1.11
钢 (热轧或冷轧)	4.48	7.75
硬木	0.46	0.80
软木	0.28	0.58

滑动摩擦系数

材料	μ
钢对钢(无润滑)	0.58
钢对钢(有润滑)	0.15
铝对钢	0.45
铜对钢	0.36
青铜对钢	0.44
塑料对钢	0.20
直线导轨	0.001

采购条款

1. OFFER AND ACCEPTANCE: These terms and conditions constitute Seller's offer to Buyer and acceptance by Buyer and any resulting sale is expressly limited to and conditioned upon Seller's terms and conditions as set forth below. If Buyer objects to any of Seller's terms and conditions, such objections must be expressly stated and brought to the attention of Seller in a written document which is separate from any purchase order or other printed form of Buyer. Such objections, or the incorporation of any additional or different terms or conditions by Buyer into a resulting order shall constitute non-acceptance of these Terms and Conditions, releasing Seller from any obligation or liability hereunder and a proposal for different terms and conditions which shall be objected to by Seller unless expressly accepted in writing by an authorized representative of Seller. Acknowledgment copy, if any, shall not constitute acceptance by Seller of any additional or different terms or conditions, nor shall Seller's commencement of effort, in itself, be construed as acceptance of an order containing additional or different terms and conditions.

2. PRICES: Published prices and discount schedules are subject to change without notice. They are prepared for the purpose of furnishing general information and are not quotations or offers to sell on the part of the company.

3. TRADE TERMS: Shipment terms are FCA, shipping point (Exlar, Chanhassen, MN). FCA (Free Carrier) per Incoterms 2010 means the Seller delivers the goods, cleared for export into the custody of the first carrier named by the buyer at the named place, above. This term is suitable for all modes of transport, including carriage by air, rail, road, and containerized/multi-modal transport. Title of the merchandise transfers from Exlar Corporation to the Buyer when it is received from Exlar by the carrier. Where allowable, Exlar will arrange the transportation via the carrier specified by the Buyer. The Buyer is responsible for all costs associated with the shipment.

4. PAYMENT TERMS: Subject to approval of Buyer's credit, the full net amount of each invoice is due and payable in cash within thirty (30) days of shipment. No payment discounts are offered, and minor inadvertent administrative errors contained in an invoice are subject to correction and shall not constitute reason for untimely payment. If, in the judgment of the Seller, the financial credit of Buyer at any time does not justify continuance of production or shipment of any product(s) on the payment terms herein specified, Seller may require full or partial payment prior to completion of production or shipment, or may terminate any order, or any part thereof, then outstanding. Custom products and blanket orders are subject to payment terms: 30% due at time of order, 70% due net 30 days from shipment.

5. MINIMUM BILLING: Minimum billing will be \$50.00.

6. DELAYS: Exlar shall not be liable for any defaults, damages or delays in fulfilling any order caused by conditions beyond Seller's control, including but not limited to acts of God, strike, lockout, boycott, or other labor troubles, war, riot, flood, government regulations, or delays from Seller's subcontractors or suppliers in furnishing materials or supplies due to one or more of the foregoing clauses.

7. CANCELLATIONS: All cancelled orders for standard products are subject to order cancellation charges. The minimum cancellation charge will be 20% of the order total. Standard products, if unused may be returned in accordance with the current return policy. All returns are subject to prior approval by Exlar, and return charges may apply. No return credit for any product will be issued or authorized prior to evaluation of the product by Exlar. Custom product is not returned. Orders for custom product are not cancellable.

8. QUANTITY PRICING AND BLANKET ORDER PRICING TERMS: Blanket order quantity pricing requires a complete delivery schedule for the volume being ordered, with all units scheduled to deliver within a 15 month period from the placement of the purchase order to the final scheduled shipment. Any requests to change the delivery schedule of a blanket order must be received in writing 60 days prior to the requested change. Failure to take delivery of the entire ordered volume will result in back charges equal to the difference in quantity price between the volume ordered and the volume received times the number of units received. A cancellation charge in accordance with the cancellation policy (item 7) will apply to any reduction in delivered volume from the original ordered quantity.

For orders receiving quantity discounts, but not as scheduled blanket orders, the same quantity pricing rules apply. Failure to take delivery of the entire quantity ordered will result in back charges equal to the difference in quantity price between the volume ordered and the volume received times the number of units received. Cancellation charges in accordance with the cancellation policy (item 7) will apply to any reduction in delivered volume from the original ordered quantity. For either blanket orders or quantity orders, in addition to any applicable cancellation charges, the customer is responsible for the value of any additional inventory allocated specifically to their order. Charges for this inventory will be invoiced in addition to cancellation charges, along with any back charges for quantity variance.

9. DESTINATION CONTROL STATEMENT: Exlar products, technology or software are exported from the United States in accordance with the Export Administration Regulations (EAR) or International Traffic in Arms Regulations (ITAR) as applicable. Diversion, transfer, transshipment or disposal contrary to U.S. law is prohibited.

10. EXPORT CONTROL AND SHIPMENT REGULATIONS: Purchaser agrees at all times to comply with all United States laws and regulations as well as International Trade Laws, as they may exist from time to time, regarding export licenses or the control or regulation of exportation or re-exportation of products or technical data sold or supplied to Distributor. Seller may terminate or suspend this order, without remedy, should the Purchaser become an entity identified on any US export denial listing. Products ordered may require authorization and/or validated export license from a U.S. government agency. Seller may terminate or suspend this order, without remedy, should a government agency approval be denied.

11. GOVERNING LAW AND VENUE: This order shall be governed by, and construed in accordance with the laws of the State of Minnesota, U.S.A. All disputes shall be resolved by a court of competent jurisdiction in the trial courts

of Carver County, in the State of Minnesota.

12. ATTORNEY FEES: Reasonable attorney's fees and other expenses of litigation must be awarded to the prevailing party in an action in which a remedy is sought under this order.

13. NON-WAIVER: The failure by the Seller to require performance of any provision shall not affect the Seller's right to require performance at any time thereafter, nor shall a waiver of any breach or default of this Order constitute a waiver of any subsequent breach or default or a waiver of the provision itself.

14. MERGER AND INTEGRATION: These Terms and Conditions contain the entire agreement of the parties with respect to the subject matter of this order, and supersede all prior negotiations, agreements and understandings with respect thereto. Purchase orders may only be amended by a written document duly executed by buyer and seller.

15. INDEMNITY: Buyer agrees to indemnify, defend and hold harmless Exlar from any claims, loss or damages arising out of or related to Seller's compliance with Buyer's designs, specifications or instructions in the furnishing of products to Buyer, whether based on infringement of patents, copyrights, trademark or other right of others, breach of warranty, negligence, or strict liability or other tort.

WARRANTY AND LIMITATION OF LIABILITY: Products are warranted for two years from date of manufacture as determined by the serial number on the product label. Labels are generated and applied to the product at the time of shipment. The first and second digits are the year and the third and fourth digits represent the manufacturing week. Product repairs are warranted for 90 days from the date of the repair. The date of repair is recorded within the Exlar database and tracked by individual product serial number.

Exlar Corporation warrants its product(s) to the original purchaser and in the case of original equipment manufacturers, to their original customer to be free from defects in material and workmanship and to be made only in accordance with Exlar standard published catalog specifications for the product(s) as published at the time of purchase. Warranty or performance to any other specifications is not covered by this warranty unless otherwise agreed to in writing by Exlar and documented as part of any and all contracts, including but not limited to purchase orders, sales orders, order confirmations, purchase contracts and purchase agreements. In no event shall Exlar be liable or have any responsibility under such warranty if the product(s) has been improperly stored, installed, used or maintained, or if Buyer has permitted any unauthorized modifications, adjustments and/or repairs to such product(s). Seller's obligation hereunder is limited solely to repairing or replacing (at its option), at the factory any product(s), or parts thereof, which prove to Seller's satisfaction to be defective as a result of defective materials, or workmanship and within the period of time, in accordance with the Seller's stated product warranty (see Terms and Conditions above), provided, however, that written notice of claimed defects shall have been given to Exlar within thirty (30) days from the date of any such defect is first discovered. The product(s) claimed to be defective must be returned to Exlar, transportation prepaid by Buyer, with written specification of the claimed defect. Evidence acceptable to Exlar must be furnished that the claimed defects were not caused by misuse, abuse, or neglect by anyone other than Exlar.

Components such as seals, wipers, bearings, brakes, bushings, gears, spindle, and roller screw parts are considered wear parts and must be inspected and serviced on a regular basis. Any damage caused by failure to properly lubricate Exlar products and/or to replace wear parts at appropriate times, is not covered by this warranty. Any damage due to excessive loading is not covered by this warranty.

The use of products or components under load such that they reach the end of their expected life is a normal characteristic of the application of mechanical products. Reaching the end of a product's expected life does not indicate any defect in material or workmanship and is not covered by this warranty.

Costs for shipment of units returned to the factory for warranty repairs are the responsibility of the owner of the product. Exlar will return ship all warranty repairs or replacements via UPS Ground at no cost to the customer.

For international customers, Exlar will return ship warranty repairs or replacements via UPS Expedited Service and cover the associated shipping costs. Any VAT or local country taxes are the responsibility of the owner of the product.

The foregoing warranty is in lieu of all other warranties (except as Title), whether expressed or implied, including without limitation, any warranty of merchantability, or of fitness for any particular purpose, other than as expressly set forth and to the extent specified herein, and is in lieu of all other obligations or liabilities on the part of Exlar.

Seller's maximum liability with respect to these terms and conditions and any resulting sale, arising from any cause whatsoever, including without limitation, breach of contract or negligence, shall not exceed the price specified of the product(s) giving rise to the claim, and in no event shall Exlar be liable under this warranty otherwise for special, incidental or consequential damages, whether similar or dissimilar, of any nature arising or resulting from the purchase, installation, removal, repair, operation, use or breakdown of the product(s) or any other cause whatsoever, including negligence.

The foregoing warranty shall also apply to products or parts which have been repaired or replaced pursuant to such warranty, and within the period of time, in accordance with Seller's stated warranty.

NO PERSON INCLUDING ANY AGENT OR REPRESENTATIVE OF EXLAR CORPORATION IS AUTHORIZED TO MAKE ANY REPRESENTATION OR WARRANTY ON BEHALF OF EXLAR CONCERNING ANY PRODUCTS MANUFACTURED BY EXLAR, EXCEPT TO REFER PURCHASERS TO THIS WARRANTY.

USA & CANADA

Exlar Automation
18400 West 77th Street
Chanhassen, MN 55317
Phone: 855-620-6200 (US & Canada)
Fax: 952-368-4877

EUROPE

Exlar Europe GmbH
Schleißheimer Str., 91a
Garching bei München D-85748
Germany
Phone: +49 6142 17590-0

ASIA

Exlar Asia Pacific
1007 Pine City Hotel
8 Dong An Road, Xuhui District,
Shanghai 200032 China
Phone: +86 021-6495-7868

Distributed by:

The logo for EXLAR, featuring the word "EXLAR" in a bold, stylized, sans-serif font. The letter "X" is particularly prominent, with a long horizontal stroke extending to the right. A registered trademark symbol (®) is located at the top right of the "R".

www.exlar.com

Exlar® actuators are a brand of Curtiss-Wright, Sensors and Controls Division.