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Rev. 2

Parker

LX80L Precision Grade Product Manual

Effective: September 15, 2004

Supersedes: -



Electromechanical Positioning Systems



Important User Information

WARNING

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LX80L Series Product Manual

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Revision Notes

Revision 1
Original Document

Revision 2
Clarified motor lead connection on page 48
Reduced "Rated Load" on page 15 from 5, 10, 5, 10 to 3, 3, 6, 6 respectively
Added "Maximum Moment Load" to Specification Table on page 15, and note

CHAPTER ONE

Introduction

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Product Description

LX80L Positioner

Although the LX80L is small in size and weight, it is large on performance and reliability. All key components are integral to the unit - residing within the body of the stage to provide a clean looking, reliable, unobstructed package. At the heart of the LX80L is an innovative non-contact linear servo motor (patent pending). This direct drive motor has been optimized for force, speed, and acceleration, to deliver outstanding performance and response. A high precision non-contact linear encoder provides sub-micron resolution and repeatability. Selectable resolutions range from 0.1 to 5 microns. Travel limit and home sensors are conveniently designed into the unit for easy adjustment over the entire travel of the stage. Precision square rail bearings provide load support and precise linear translation, while effectively countering the problematic effects of heat, high speeds, and high acceleration. The cable management system is contained within the table so there are no external moving cables. One or three meters of hi-flex extension cables are options for connectorizing the table. This hi-flex cabling addresses cable flexing concerns associated with the second or third axis in multi-axis system.

Unpacking



Unpacking

Carefully remove the positioner from the shipping container and inspect the unit for any evidence of shipping damage. Report any damage immediately to your local authorized distributor. Please save the shipping container for damage inspection or future transportation.

Incorrect handling of the positioner may adversely affect the performance of the unit in its application. Please observe the following guidelines for handling and mounting of your new positioner.

- DO NOT allow the positioner to drop onto the mounting surface. Dropping the positioner can generate impact loads that may result in flat spots on bearing surfaces or misalignment of drive components.
- DO NOT drill holes into the positioner. Drilling holes into the positioner can generate particles and machining forces that may effect the operation of the positioner. Parker will drill holes if necessary; contact your local authorized distributor.
- DO NOT subject the unit to impact loads such as hammering, riveting, etc. Impacts loads generated by hammering or riveting may result in flat spots on bearing surfaces or misalignment of drive components.
- DO NOT lift the positioner by cables or cable management system. Lifting positioner by cables or cable management system may effect electrical connections and/or cable management assembly. The unit should be lifted by the base structure only.
- DO NOT expose positioner to mist, spray or submersion in liquids.
- DO NOT disassemble positioner. Unauthorized adjustments may alter the positioner's specifications and void the product warranty.

Return Information

Returns

All returns must reference a "Return Material Authorization" (RMA) number. Please call your local authorized distributor or Parker Customer Service Department at 800-245-6903 to obtain a "RMA" number.

Repair Information

Out-of-Warranty Repair

Our Customer Service Department repairs Out-of-Warranty products. All returns must reference a "RMA" number. Please call your local authorized distributor or Parker Customer Service Department at 800-245-6903 to obtain a "RMA" number. You will be notified of any cost prior to making the repair.

Warnings and Precautions



Hot Surfaces

DO NOT touch linear motor coils located in the carriage of the LX80L after high duty operation. Motor temperature may approach 60°C. The unit itself may become warm or hot to the touch.



Electrical Shock

DO NOT take apart or touch any internal components of the positioner while unit is plugged into an electrical outlet. SHUT OFF power before replacing components to avoid electrical shock.



High Magnetic Field

Unit may be HAZARDOUS to people with Pace Makers or any other 'magnetically-sensitive' medical devices. Unit may have an effect on 'magnetically-sensitive' applications.



Ferrous Materials

The positioner's open design WILL ATTRACT ferrous materials. The customer must take additional precautions in these applications to keep positioner free of these highly magnetic particles.



Vertical Operation

The LX80L is NOT recommended for vertical operation. If the table is used in a vertical position, the carriage and customer's load will fall in power loss situations potentially causing product or load damage or personal injury.



General Safety

Because linear motors can accelerate up to 5 g's, and sometimes positioners move without warning, keep all personnel away from dynamic travel range of positioner.

Specification Conditions

Specifications Are Temperature Dependent

Catalog specifications are obtained and measured at 20 Degrees C. Specifications at any other temperature may deviate from catalog specifications. Minimum to maximum continuous operating temperature range (with NO guarantee of any specification except motion) of a standard unit before failure is 5 - 40 degrees C.

Specifications Are Mounting Surface Dependent

Catalog specifications are obtained and measured when the positioner is fully supported, bolted down, and is mounted to a work surface that has a maximum flatness error of:

0.001mm/300mm (0.00004"/ft)

Table will operate with work surface of 0.100mm/300mm flatness or worse, but performance specifications will be significantly effected.

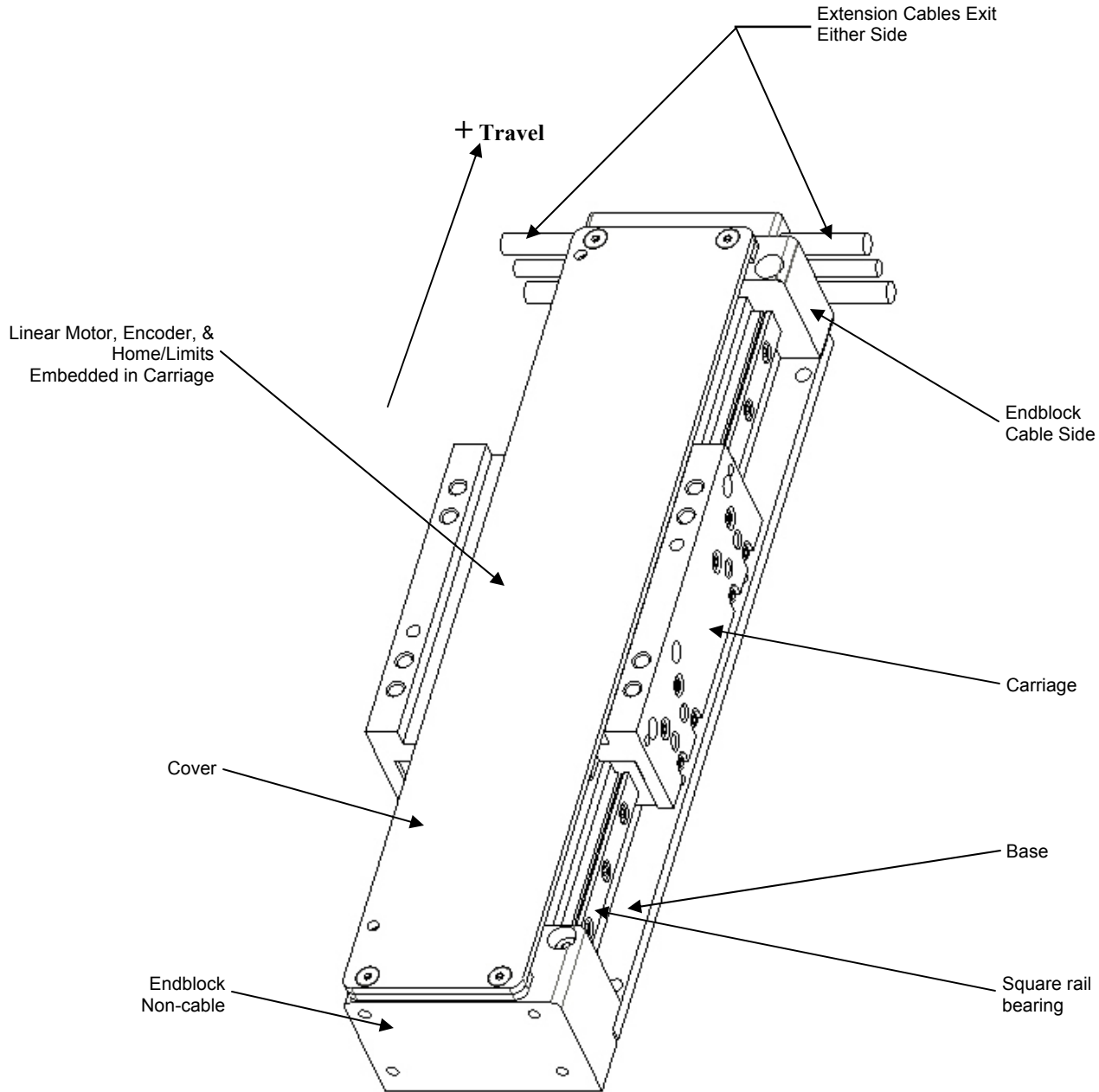
Specifications Are Point of Measurement Dependent

Catalog specifications and specifications in this manual are measured from the center of the carriage, 38 mm above the carriage surface. All measurements taken at any other location may deviate from these values.

Specifications Are Load Mounting Dependent

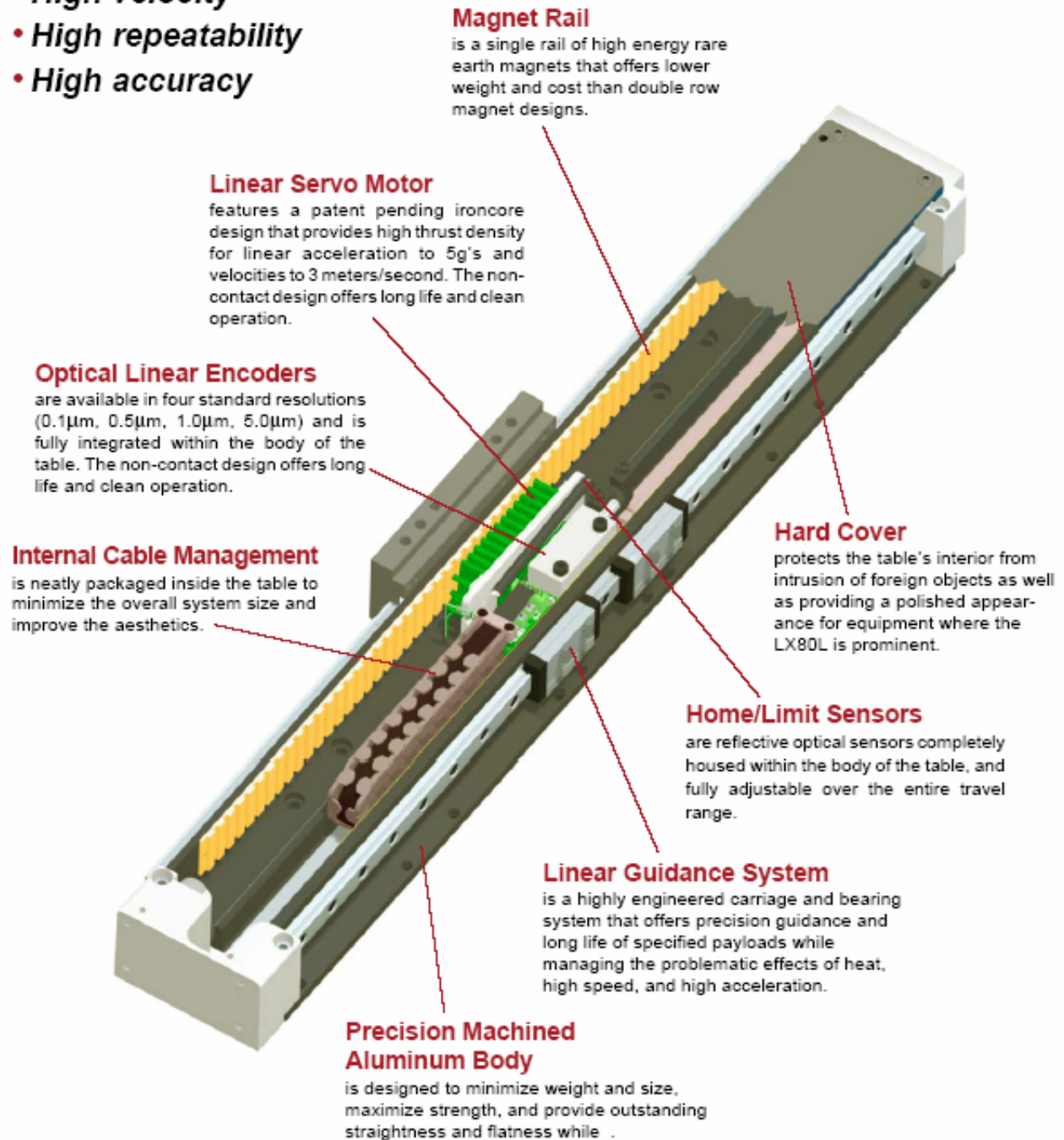
Catalog specifications are obtained and measured when the customer load is fixed to the carriage mounting surface(s) and has a flatness of equal to or less than 0.0025mm (0.0001"). The table will operate with customer load surface greater than 0.0025mm (0.0001") flatness, but performance specifications will be significantly effected.

Assembly Diagram



LX80L Product Highlights

- *Small Cross Section*
- *Long Travels*
- *High acceleration*
- *High velocity*
- *High repeatability*
- *High accuracy*



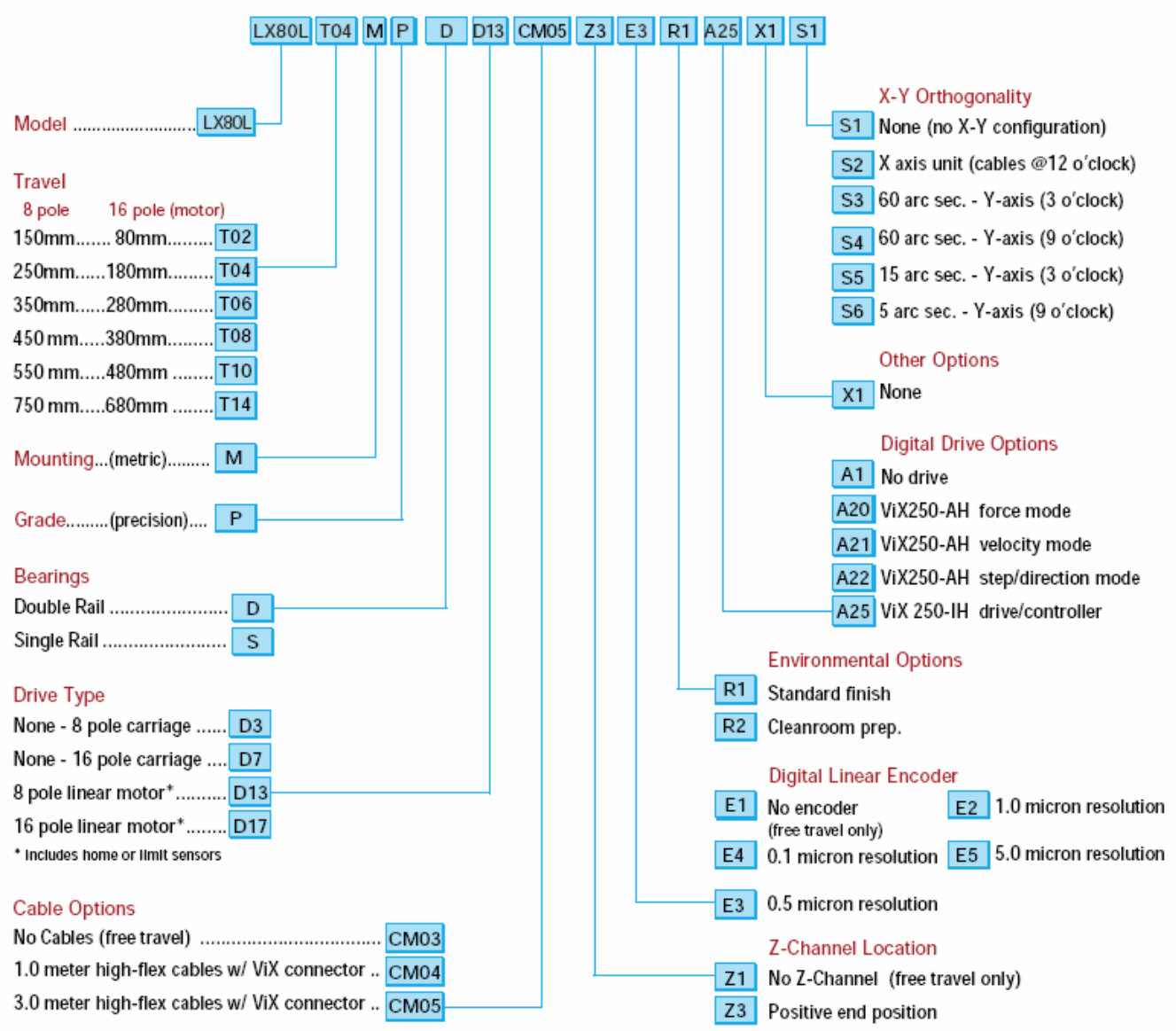
CHAPTER TWO

Table Specifications

IN THIS CHAPTER

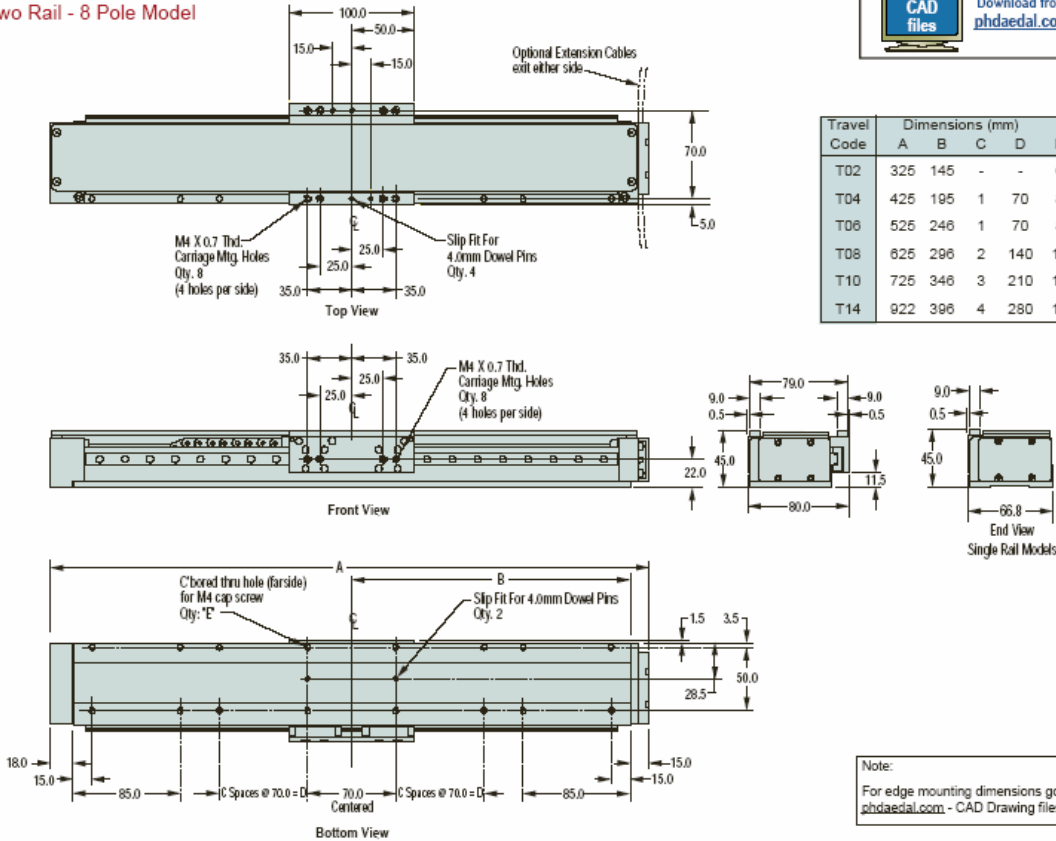
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Order Number Nomenclature



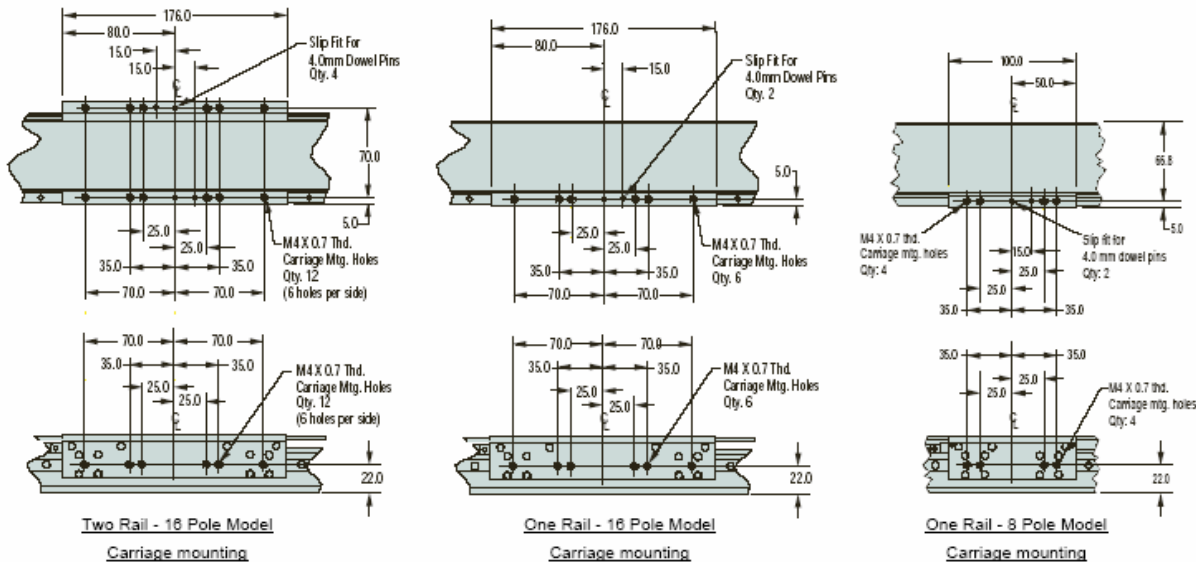
Dimensional Drawings - LX80L

Dimensions (mm)
Two Rail - 8 Pole Model



Travel Code	Dimensions (mm)				
	A	B	C	D	E
T02	325	145	-	-	6
T04	425	195	1	70	8
T06	525	246	1	70	8
T08	625	296	2	140	10
T10	725	346	3	210	12
T14	922	396	4	280	14

Note:
For edge mounting dimensions go to phdaedal.com - CAD Drawing files



General Table Specifications

Specifications

	8 Pole Single Rail	8 Pole Double Rail	16 Pole Single Rail	16 Pole Double Rail
Rated Load (kg)	3	3	6	6
Maximum Moment Load* (N-m)	0.7	1.5	1.5	3.0
Maximum Acceleration	5 g's			
Maximum Velocity (m/sec.)				
Encoder Resolution: 0.1µm	0.3			
0.5µm	1.5			
1.0µm	3.0			
5.0µm	3.0			
Positional Repeatability (µm)				
Encoder Resolution: 0.1µm	±2.5	±1.5	±2.5	±1.5
0.5µm	±2.5	±1.5	±2.5	±1.5
1.0µm	±3.5	±2.5	±3.5	±2.5
5.0µm	±10.0	±10.0	±10.0	±10.0
Maximum Peak Force N (lb)	19 (4.3)	19 (4.3)	36 (8.1)	36 (8.1)
Maximum Continuous Force N (lb)	4.7 (1.0)	4.7 (1.0)	10 (2.2)	10 (2.2)
Carriage Weight (g)	287	388	476	648

*For any direction, for moment loads larger than stated, the use of an Idler Rail Assembly is recommended, see page 29

Table Dependent Specifications

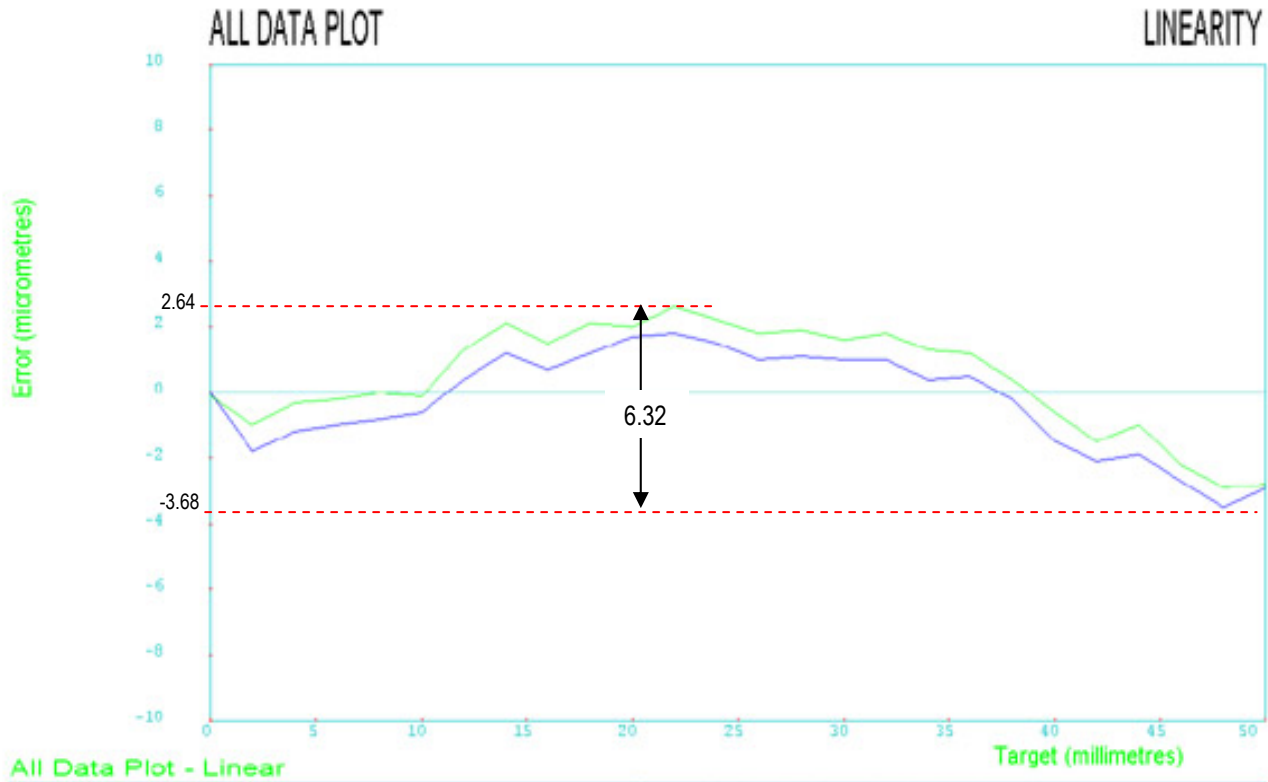
Code	Travel		Accuracy* (µm)			"L" Unit Length (mm)
	8 Pole (mm)	16 Pole (mm)	Positional		Straightness & Flatness* (µm)	
			0.1,0.5,1.0 Resolution (µm)	5.0 Resolution (µm)		
Double Rail Models						
T02	150	80	8	18	9	325
T04	250	180	12	22	14	425
T06	350	280	16	26	19	525
T08	450	380	20	30	24	625
T10	550	480	23	33	29	725
T14	750	680	29	39	37	925
Single Rail Models						
T02	150	80	12	22	13	325
T04	250	180	16	26	18	425
T06	350	280	20	30	23	525
T08	450	380	24	34	28	625
T10	550	480	27	37	33	725
T14	750	680	33	43	41	925

*Accuracy stated is at 20 degrees C, utilizing slope correction factor provided

LX80L Mass in kg (Does not include external extension cables)

	8 POLE MOTOR DOUBLE RAIL	8 POLE MOTOR SINGLE RAIL	16 POLE MOTOR DOUBLE RAIL	16 POLE MOTOR SINGLE RAIL
T01	1.418	1.240	1.681	1.431
T02	1.590	1.396	1.854	1.586
T03	1.768	1.556	2.031	1.746
T04	1.944	1.714	2.207	1.905
T05	2.122	1.875	2.385	2.065
T06	2.300	2.035	2.563	2.225
T07	2.477	2.194	2.740	2.384
T08	2.652	2.352	2.915	2.543
T09	2.829	2.512	3.092	2.702
T10	3.006	2.671	3.269	2.861
T11	3.184	2.832	3.448	3.022
T12	3.361	2.992	3.625	3.182
T13	3.538	3.151	3.801	3.341
T14	3.713	3.308	3.976	3.498

Test Methodology



Published accuracy and repeatability specifications are subject to the testing methodology. Parker's methodology provides specifications over the entire table travel regardless of start or finish position. The accuracy and repeatability specifications are based on the peak to peak error measured by a laser interferometer and prism located at 38mm above the center of the table. This type of measurement sums the X, Y, Z, roll, pitch, and yaw errors. Temperature deviations from test condition may cause deviations in straightness, flatness, accuracy, and repeatability from catalog specifications. Tests are performed with the table mounted to a granite table, unloaded at 20° C.

In this example, the accuracy ranges from -3.68 microns to 2.64 microns. This table would have its accuracy specified as 6.32 micron since the worst case would be starting at one extreme and traveling to the other.

LX80L Series Technical Data

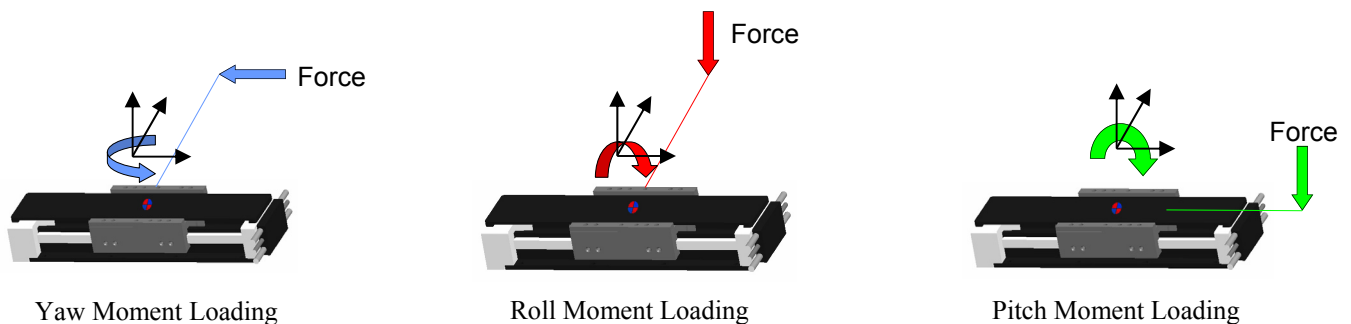
The useful life of a linear table at full catalog specifications is dependent on the forces acting upon it. These forces include both static components resulting from payload weight, and dynamic components due to acceleration/deceleration of the load. In multi-axes applications, the primary positioner at the bottom of the stack usually establishes the load limits for the combined axes. When determining load/life, it is critical to include the weight of all positioning elements that contribute to the load supported by the primary axis. The life/load charts are used to establish the table life relative to the applied loads.

Linear Bearing Life-Load All Travels

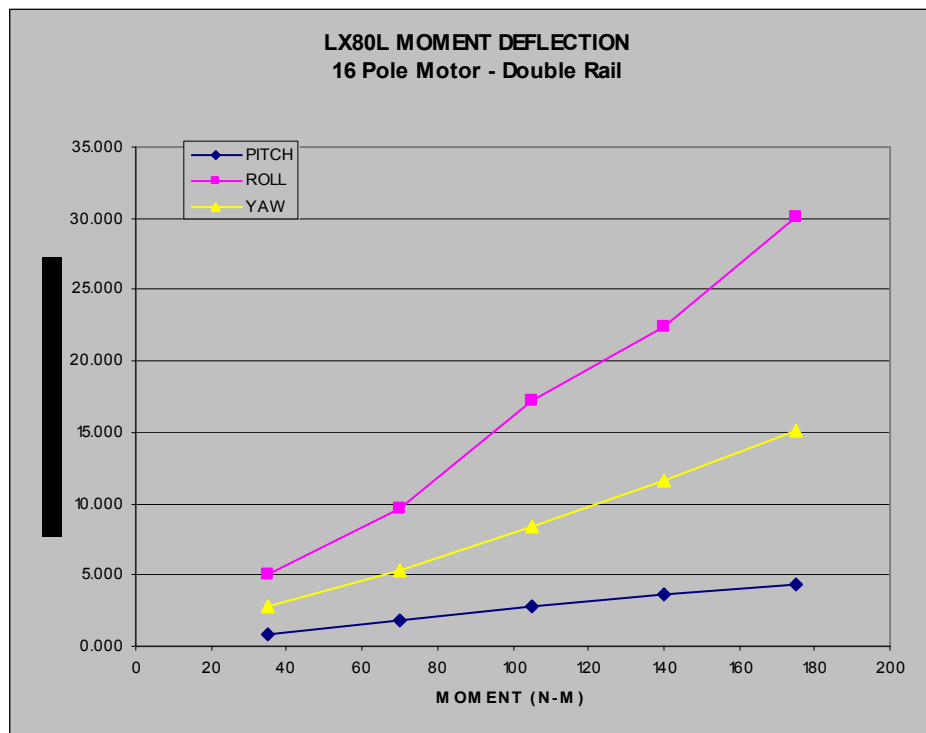
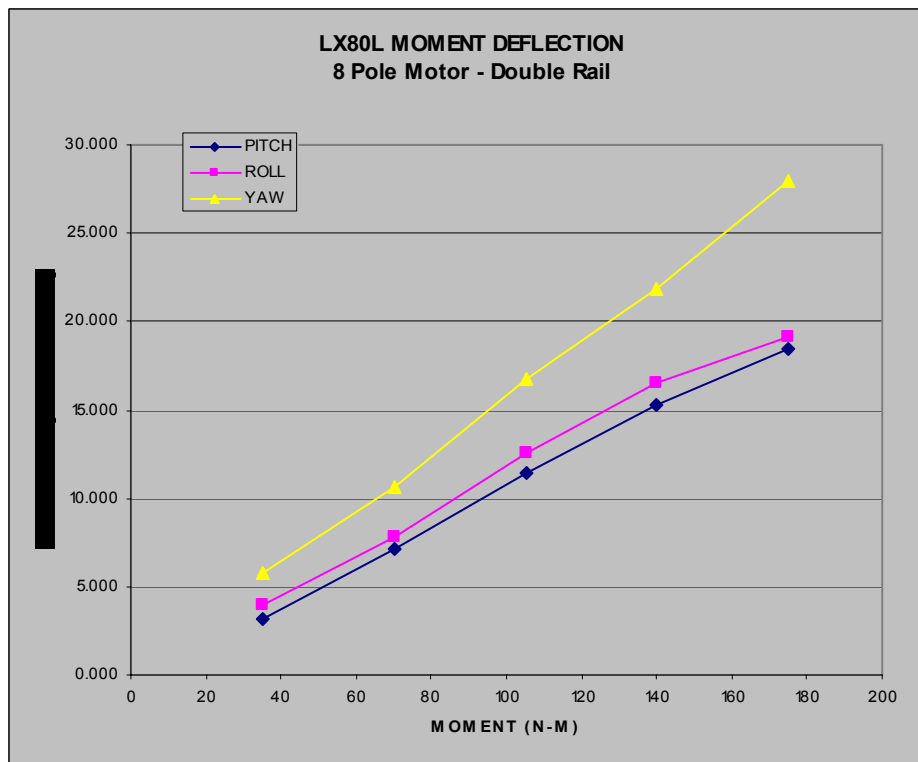
The precision linear bearings used in the LX80L are sized to provide virtually unlimited life, 100,000,000 inches of travel guaranteed. The bearings provide stable and accurate linear motion while maintaining high rigidity even under combined of fluctuating loads. The double rail design offers the best load capacity, straightness, flatness, and stability.

Moment Load – Life Curves

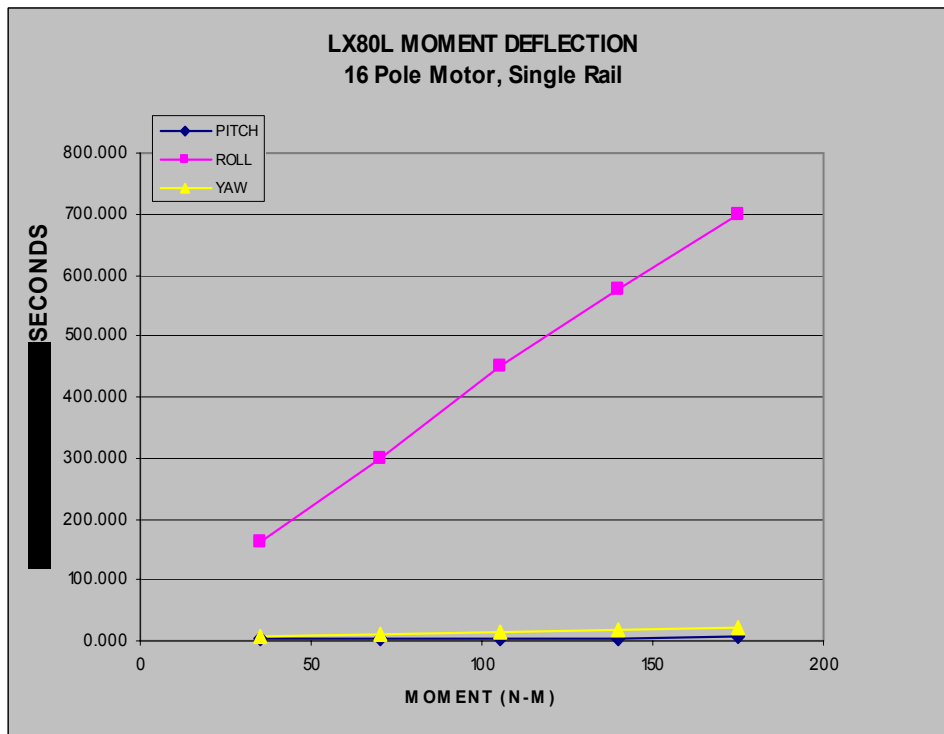
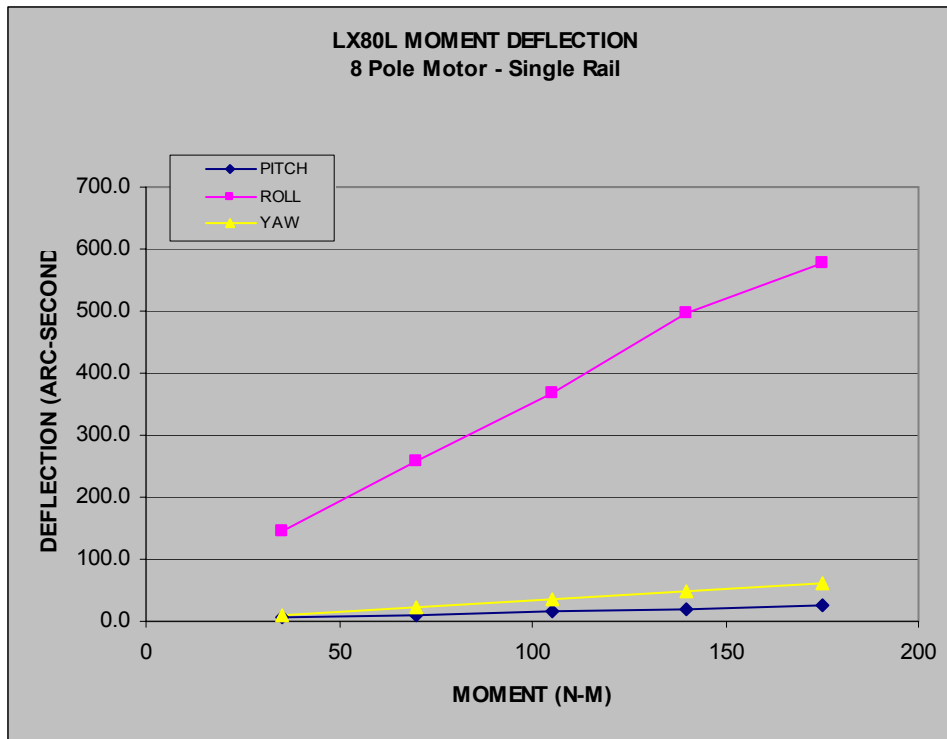
The effect of moment loading on the bearing life is dependent upon load and lever arm. The lever arm in this case is measured from the center of the surface of the table to the point where the load is applied. For dynamic loading, use the distance from the center of the table to the center of mass of the load. The Life-Load charts show curves for various lever arm lengths (units in [mm]). Note Pitch moments and Yaw moments use the same curves.



Moment Deflection – Load Charts for Double Rail Tables

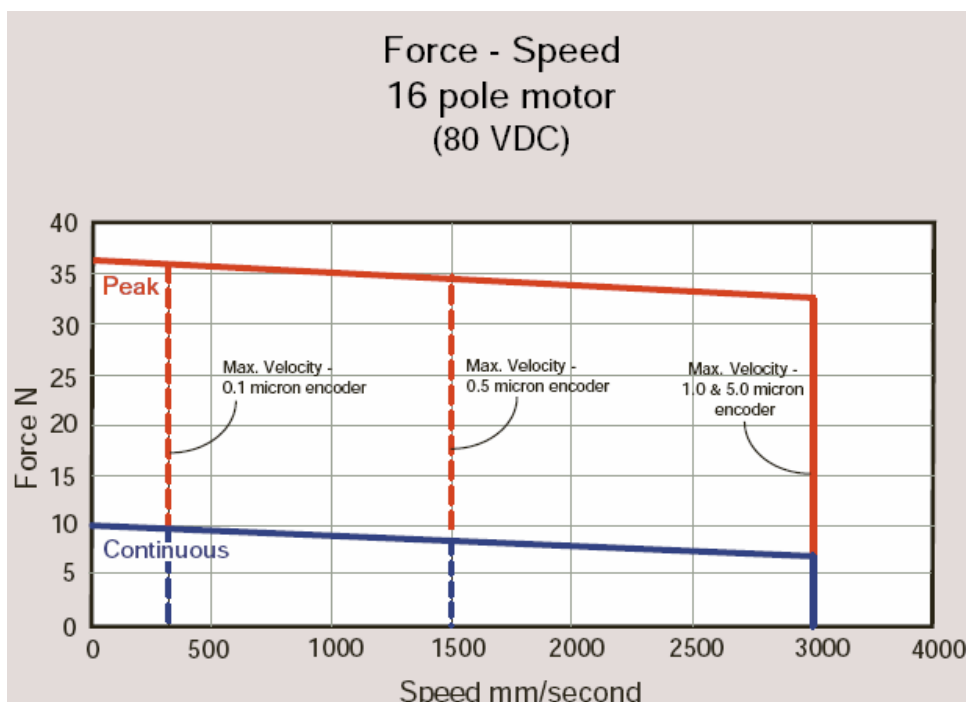
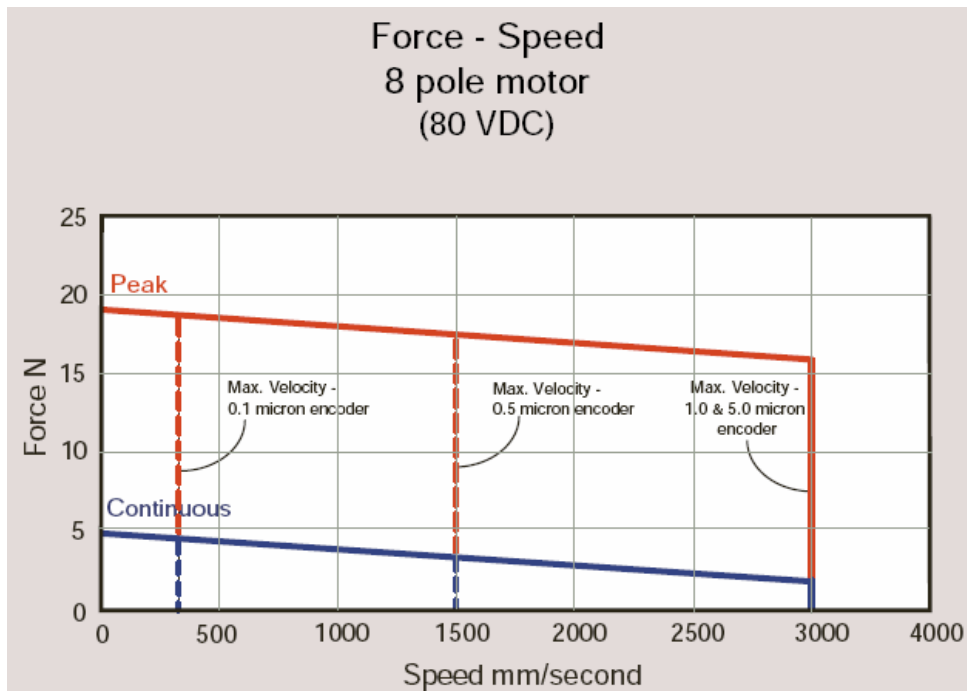


Moment Deflection – Load Charts for Single Rail Tables



Force/Speed Charts

The Force/Speed Charts for the LX80L are shown for each motor size, 8 pole and 16 pole. The motor force is the same for 80 and 48 VDC bus voltage. See Electrical Specifications for motor parameters. Performance based on table mounted to 145mm wide x 50mm thick aluminum plate. **Curves shown include friction and viscous damping values of table.**



Electrical Specifications

Specifications for both the 8 pole (D13) and 16 pole (D17) linear servo motors

Parameter:	Symbol:	Units:	8 Pole D13	16 Pole D17
Stall Force Continuous [1]	Fcs	N	7.20	13.00
Stall Current Continuous [1, 4, 8]	Ics(sine)	Amps Peak	1.85	1.66
Stall Current Continuous [1, 7]	Ics(trap)	Amps DC	1.60	1.44
Stall Current Continuous [1]	Ics(RMS)	Amps RMS	1.31	1.18
Peak Force [6]	Fpk	N	21.60	38.9
Peak Current [4, 6, 8]	Ipk(sine)	Amps Peak	5.50	5.00
Peak Current [6, 7]	Ipk(trap)	Amps DC	4.80	4.30
Peak Current [6]	Ipk(RMS)	Amps RMS	3.90	3.50
Voltage Constant [3, 4]	Ke	Volts/m/s	4.50	9.00
Voltage Constant [3]	Ke (RMS)	Volts RMS/m/s	3.20	6.40
Force Constant [9]	Kf(sine)	N/Amps Peak	3.90	7.79
Force Constant [3, 4]	Kf(trap)	N/Amps DC	4.50	9.00
Force Constant [3]	Kf(RMS)	N/Amps RMS	5.51	11.02
Resistance [3]	R	Ohms	4.40	8.50
Inductance [5]	L	mH	1.80	3.60
Maximum Bus Voltage	Vm	Volts DC	80	80
Thermal Resistance Wind-Amb	Rth w-a	C/watt	4.60	2.93
Motor Constant	Km	N/sqrt(watt)	2.15	3.09
Viscous Damping	B	N/m/s	1.00	1.00
Static Friction [13]	Fs	N	2	2
Motor Thermal Time Constant	Tau_th	minutes	1.3	1.3
Winding Thermal Time Const	Tau_wnd	minutes	0.5	0.5
Intermittent Force Duration [10]	T_2x	seconds	8.0	8.0
Peak Force Duration [11]	T_3x	seconds	2.0	2.0
Electrical Pitch [12]	Pe	mm	13	13
Rated Winding Temperature	RT	C	90	90
Rated Ambient Temperature	AT	C	25	25
Winding Class			H	H

1. @ 25° C ambient, 125C Winding Temperature with the table mounted to a 145mm wide x 50mm thick aluminum plate
2. Measured with a 0.33 mm gap
3. Measured Line to Line +/-10%
4. Value is measured peak of sine
5. +/-30% Line to Line, inductance bridge measurement @1Khz
6. Initial winding temperature must be 60 C or less before Peak Current is applied
7. DC current through a pair of motor phases of a trapezoidal (six state) commutated
8. Peak of the sinusoidal current in any phase for a sinusoidal commutated motor
9. Total motor force per peak of the sinusoidal amps measured in any phase, +/-10%
10. Maximum time duration with 2 times rated current applied with initial winding temp at 60 C
11. Maximum time duration with 3 times rated current applied with initial winding temp at 60 C
12. The Distance from the leading edge of the north pole to the leading edge of the next north pole
13. Average friction over total table travel

Cleanroom Preparation

There is no cleanroom ‘rating’ for motion control products, just individual compatibility with class of cleanrooms. The compatibility is also dependant on measurement location. A point directly below a component may have a different particle count than at a side location. In an effort to clarify the class of cleanroom that our products can be used in with out affecting the overall rating of the cleanroom, Parker provides a Cleanroom Class Compatibility chart for product intended for use in such environments. Due to the linear motor design of the LX80L, minimal particle generation occurs during operation. LX80L tables with cleanroom preparation were tested in Parker’s vertical laminar flow work station which utilizes ULPA filters to produce an environment having a cleanliness of class 10 prior to testing. Tables were tested in a variety of orientations with sampling both below the table and at the carriage mounting surface with a particle counter capable of measuring 0.3 μm diameter and larger particles. Based on results from testing following the 209E Federal Standard, the following chart shows the expected cleanroom compatibility of the LX80L with Class 10 cleanroom prep. Consult factory for details on test methodology and results.

LX80L Cleanroom Class Compatibility*				
Velocity	Standard Mount		Side Mount	
[mm/sec]	4.5" below	At stage top	4.5" below	At stage top
250	25	1	25	1
500	25	1	25	1
750	25	5	50	5
1000	50	5	100	5

* Compatibility is defined as not affecting the cleanroom class rating with the addition of this product for classes shown. The Class 1 rating in the table refers to class 1 levels of 0.3 μ and larger particles detected in Parker’s Class 10 chamber. For complete class 1 compatibility, the particle count for the 0.1 and 0.2 μm particles would also need to be taken into consideration.

Standard Cleanroom Preparation

- Stringent cleaning and handling measures
- Cleanroom rated lubricant
- Reduce force specification by 25% due to additional viscosity of cleanroom lubrication

Encoder Specifications

Description	Specification
Input Power	5 VDC +/-5% 150 to 220 mA depending on encoder resolution
Output (Incremental) E2, E3, E4, E5	Square wave differential line driver (EIA RS422) 2 channels A and B in quadrature (90°) phase shift.
Reference (Z Channel)	Synchronized pulse, duration equal to one resolution bit. Repeatability of position is unidirectional moving toward positive direction and is equal to table repeatability specifications.
Maximum Speed	5.0 micron resolution = 2.0 meters/sec (limited by table) 1.0 micron resolution = 2.0 meters/sec (limited by table) 0.5 micron resolution = 1.5 meters/sec 0.1 micron resolution = 0.3 meters/sec

Hall Effect Specification

Description	Specifications
Input Power	+5 VDC, 30 mA
Output	Open collector, Current Sinking, 20 mA Max

Limit and Home Sensor Specifications

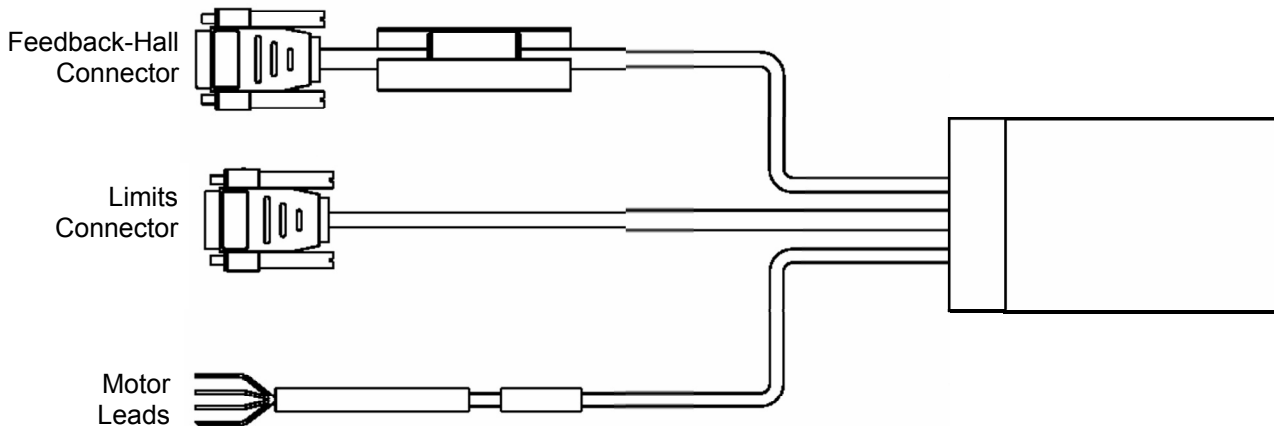
Description	Specification
Input Power	+5 VDC 60 mA (power from encoder, no additional connection needed)
Output	Normally Closed Current Sinking Limits Normally Open Current Sinking Home NPN open collector +5 to +24 VDC All types Sink maximum of 50 mA
Repeatability	Home Sensor: +/- 5 µm (unidirectional) with 1.0 micron or better encoder NOTE: Repeatability using z-channel refers to encoder specifications

ViX Drive Specifications

Refer to Specifications provided in ViX Manual.

Cabling and Wiring Diagrams

Connector Pin Out and Extension Cable Wire Color Codes for the 5, 1, 0.5 and 0.1 micron resolution encoders



FEEDBACK-HALL CONNECTOR		
PIN	FUNCTION	WIRE COLOR
1	Encoder Z+	ORANGE
2	Encoder Z-	BROWN
3	GND	BLACK
5	+5V	RED
6	Temperature-	YELLOW/BLACK
7	Encoder A+	WHITE
8	Encoder A-	YELLOW
9	Hall#1	WHITE/BROWN
10	Temperature+	YELLOW/RED
11	Encoder B-	BLUE
12	Encoder B+	GREEN
13	Hall#2	WHITE/ORANGE
14	Hall#3	WHITE/VIOLET

LIMITS CONNECTOR		
PIN	FUNCTION	WIRE COLOR
1	GND	BLACK
6	+ End of travel	ORANGE
7	- End of travel	BLUE
8	Home	GREEN

MOTOR LEADS	
WIRE COLOR	DRIVE
RED/ORANGE	U
WHITE/BLUE	V
BLACK/BROWN	W
GREEN/YELLOW	GND

CHAPTER THREE

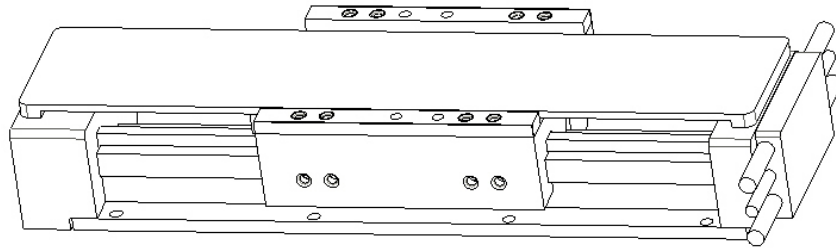
Setup and Usage

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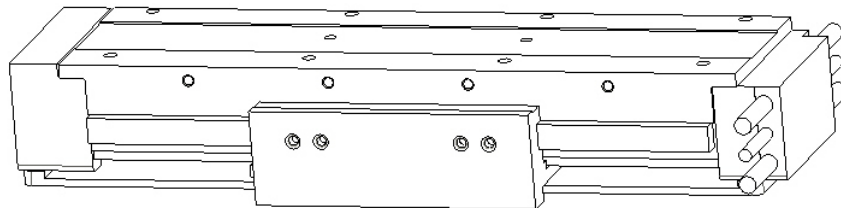
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Mounting Orientations

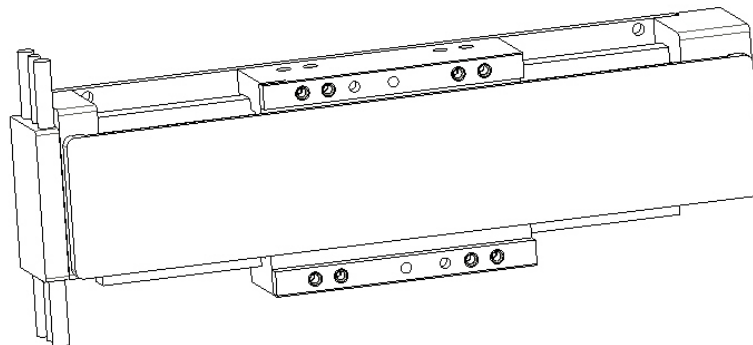
The LX80L can be mounted horizontal, inverted, or side. For all mounting orientations, the cables should be secured as to not interfere with the movement of the carriage and bearings. For inverted, side, and vertical mounting, the main table cover must be used.



HORIZONTAL



INVERTED

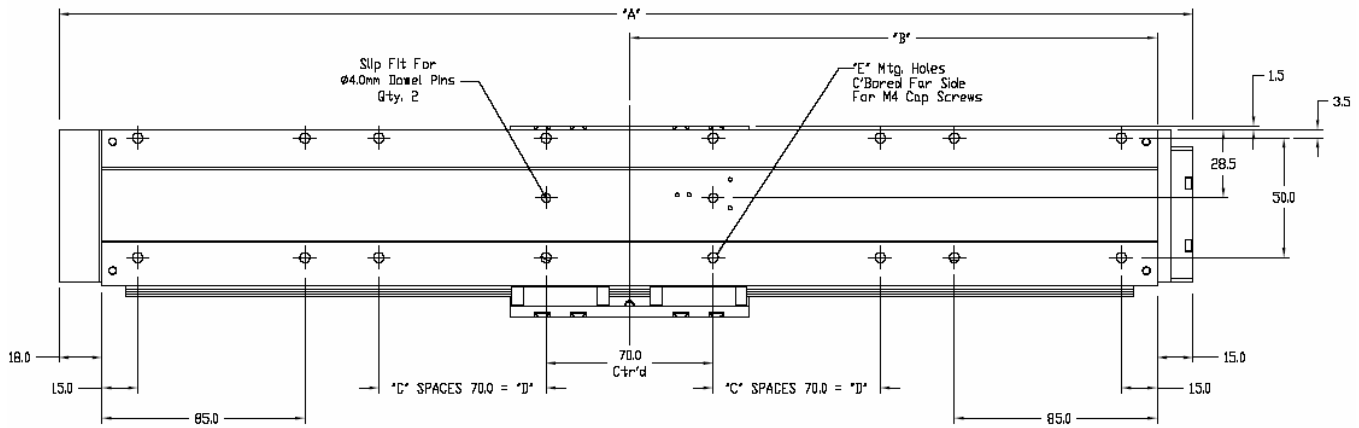


SIDE

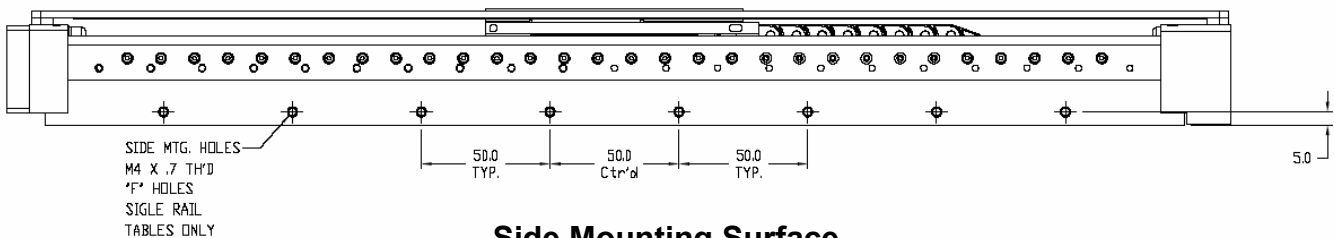
Mounting Surface Requirements

Proper mounting of the LX80L is essential to optimize product performance. All specifications are based on the following conditions:

- The positioner must be bolted down using all mounting holes provided in the base. There are two different mounting surfaces for the LX80L, as seen below. For the **Standard Mounting Surface**, use M4 socket head cap screws to secure the positioner with quantities “E” as listed in the chart. To secure the positioner for the **Side Mounting Surface**, use M4 socket head cap screws with 8mm of engagement as to not damage the positioner. Use quantities “F” as listed in the chart.



Standard Mounting Surface
(Bottom View of Positioner)



Side Mounting Surface
(Side View of Positioner)
(for Single Rail Positioners Only)

MODEL	TRAVEL (mm) 8 Pole	TRAVEL (mm) 16 Pole	A	B	C	D	E	F
T02	150	80	325	146	N/A	N/A	6	6
T04	250	180	425	196	1	70	8	8
T06	350	280	525	246	1	70	8	10
T08	450	380	625	296	2	140	10	12
T10	550	480	725	346	3	210	12	14
T14	750	680	925	446	4	280	14	18

- The positioner must be mounted to a flat, stable surface, with a flatness error less than or equal to 0.025mm/300mm for operation or specifications will be greatly varied from published specification. To meet catalog specifications the surface must have a flatness error less than or equal to 0.003mm/300mm for Standard grade and 0.001mm/300mm for Precision grade.
- Catalog specifications may deviate for positioners mounted to surfaces that do not meet the above conditions.
- If the intended mounting surface cannot meet these specifications a separate rigid mounting plate meeting these specifications should be used to mount to the main structure.
- If mounting conditions require that the table base is overhung, table specifications will not be met over that portion of the table. Additionally, in X-Y Systems the overhung portion of the Y-axis may not meet specifications due to the additional error caused by deflection and non-support of the base. Contact Parker for guidelines on specifications of overhang applications.
- Dowel holes are included in the base of the LX80L for repeatable mounting of the positioner.
- When mounting the positioner in the Standard Mounting position, it is necessary to remove the top cover to gain access to the inner row of counterbored holes. Care must be taken when removing the cover because there are spacers between the endblocks and the top cover. If these spacers are omitted at reassembly, the top cover will interfere with the carriage.

Load Mounting Requirements

Dowel holes are included in the top of the carriage of the LX80L for repeatable mounting of loads/fixtures.

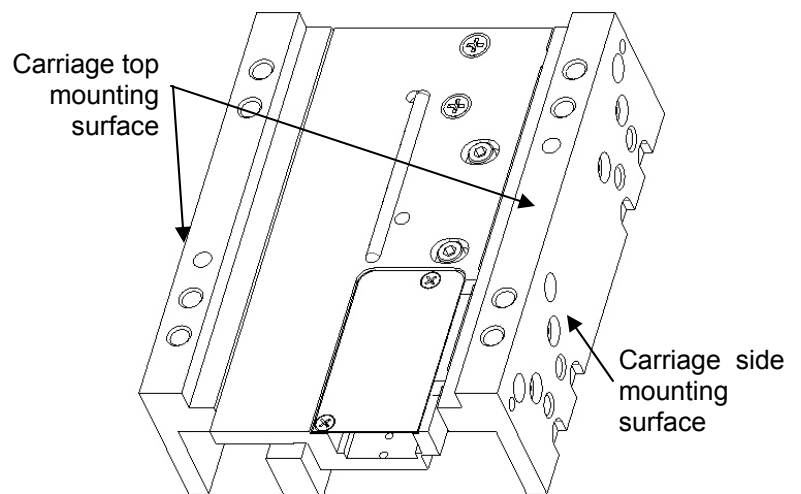


Use appropriate length bolt.

The LX80L compact design requires proper sized bolts to be used when mounting payloads to the carriage. Excessive length bolts can damage bearings or pin the table in position.

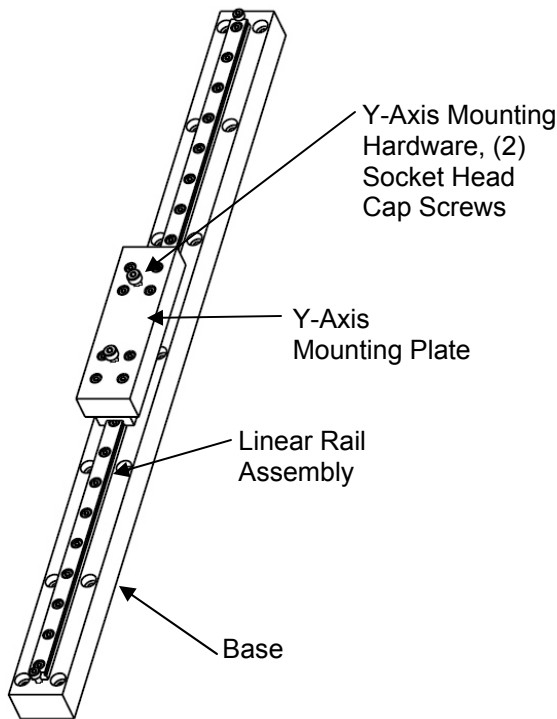
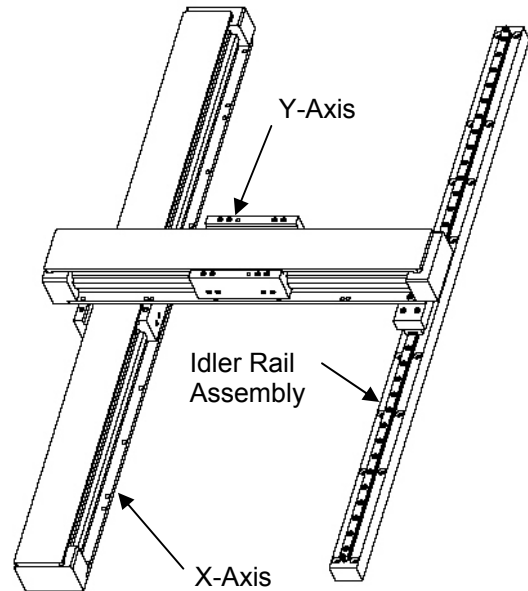
When mounting payload to the top of the carriage, note that there is only 7mm of thread engagement in the mounting holes. When mounting payload to the side of the carriage, note that there is only 4mm of thread engagement in the mounting holes.

There are two (2) dowel holes on the load mounting surface for repeatable payload mounting. These pins are sized for 4mm diameter pins.



Idler Rail Assembly

When using the LX80L in a gantry or “H” configuration, as shown, it is recommended that Parker’s Idler Rail Assembly is used. The Idler Rail Assembly has the same surface mounting requirements as the LX80L, see page #21 “Mounting Surface Requirements”. The Idler Rail Assembly’s linear bearing rail is installed on a base to within 0.0005” straightness. The Idler Rail System must be aligned with the X-Axis positioner’s travel. Failure to properly align the Idler Rail Assembly will cause binding and performance losses. To avoid these alignment issues, a complete system can be ordered from Parker. This system would include a system mounting plate with the positioners and Idler Rail Assembly mounted and aligned. The size of this mounting plate would depend on the positioners’ travels.



The Idler Rail Assembly consists of the following Components:

Base - The base serves as the foundation of the Idler Rail Assembly. There is a series of counterbored holes machined in the base which are used to mount the Idler Rail Assembly. See the following page for a layout drawing and mounting instructions.

Linear Rail Assembly - Consists of a precision linear rail and two bearing trucks.

Y-Axis Mounting Plate - This plate is the mounting surface for the Y-Axis.

Y-Axis Mounting Hardware - There are two (2) M4 x .7 socket head cap screws that secure the Y-Axis to the Idler Rail Assembly.

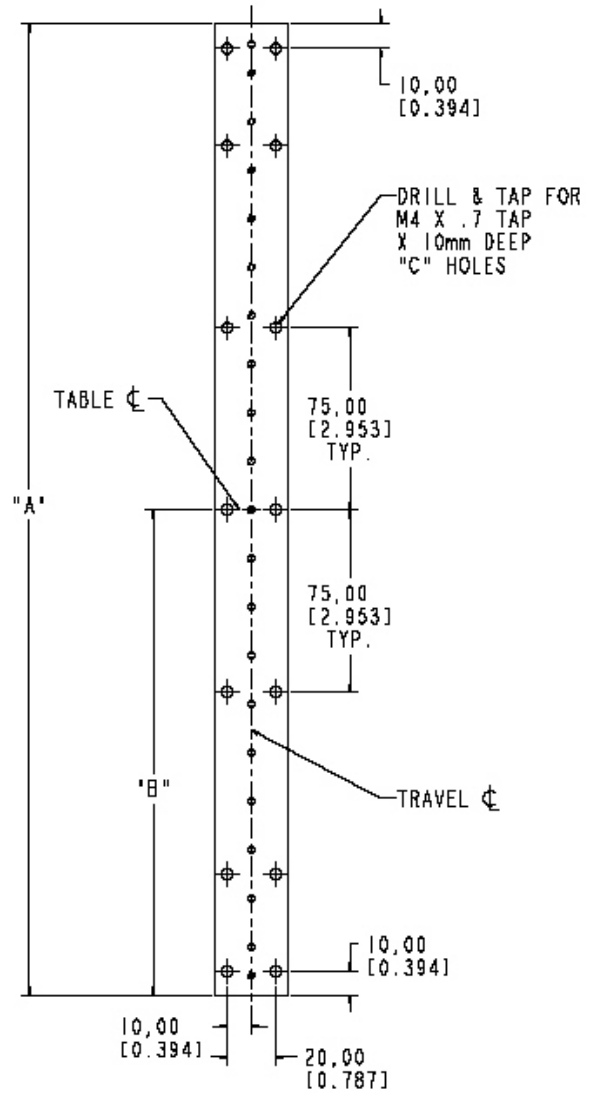
Idler Rail Assembly Dimensions and Layout

The drawing to the right shows hole layout to mount the Idler Rail Assembly. Lay out these holes in the mounting surface as follows:

- Align the centerline of the Idler Rail Assembly with the centerline of the X-Axis LX80L, see page #10 for LX80L centerline dimension.
- Offset the Idler Rail Assembly's "Travel Centerline" from the X-Axis Travel Centerline. These two lines must be parallel. This dimension will vary based on the system's configuration.

Once this layout is complete, drill and tap the necessary holes to mount the Idler Rail Assembly, see drawing and chart on this page.

After holes are drilled and tapped, mount and secure the X-Axis positioner. Next the Idler Rail Assembly can be mounted, do not tighten bolts some adjustment will be necessary. The Y-Axis positioner can now be mounted to the X-Axis and to the Idler Rail Assembly. Traverse, by hand, the X-Axis carriage, adjust the position of the Idler Rail Assembly until no binding is present. It may be necessary to loosen and adjust the Y-Axis to the Idler Rail Assembly. The force to move the X-Axis carriage should be consistent throughout the travel of the carriage. If there is a variation in this force the Idler Rail System needs to be adjusted. After adjustments are complete, secure the Idler Rail Assembly to the mounting surface. Failure to properly align the X-Axis and the Idler Rail Assembly will result in a loss of performance.



Bottom view of Idler Rail Assembly

X-AXIS TRAVEL DESIGNATOR	"A" (mm)	"B" (mm)	"C"
T02	300.0	150.0	10
T04	400.0	200.0	14
T06	500.0	250.0	14
T08	600.0	300.0	18
T10	700.0	350.0	18
T14	900.0	450.0	26

Limit and Home Sensor Operation

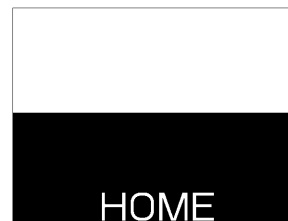
The LX80L utilizes an innovative method for setting limit and home positions. The optical sensors embedded in the carriage of the LX80L change state based on the limit “flag”. This space saving, compact design consists of three (3) parts; optical sensors, limit flag, and home flag. The limit and home optical switches are mounted to a PCB located in the carriage. The limit and home triggers are decals with a black and white pattern which triggers the switches. These triggers are located on a white decal background adhered to a vertical rib, which is part of the base.



Option Upgrades

Limits and Homes can not be added to the LX80L table in the field due to the integrated design which encloses the sensor on a printed circuit board in the carriage. If the optical sensor limit and home are desired the unit must be returned to the factory on an RMA.

To adjust the operating position of the limits and home, limit/home triggers decals can be adhered on the white decal background in the base. These adjustable trigger decals (as shown below) are included on the decal sheets that ships with the unit.



To change the activation position of the sensors:

- Determine desired position
- Adjust the Limit Trigger Position
- Follow Adjusting Limit Flag Procedure to add to the adjustment

Determining Desired Position

The limit sensors are set at the factory for maximum travel. These factory settings only allow for 3mm (0.12”) before the carriage contacts the end stop. In slow speed applications this may be adequate, however as the top speed of the application increases the required deceleration distance increases. To determine the safe Deceleration Distance the Maximum Speed and the Maximum Obtainable Deceleration Rate must be known or calculated. The maximum speed should be known from your application requirements. Velocity limits should be set in your program or in your amplifier to cause a fault if the speed exceeds this value. The maximum deceleration is a factor of load and available peak force of the table. Using $F = ma$, calculate maximum acceleration and then required deceleration distance.

See the following example for calculating maximum deceleration for an application with a payload = 0.25 kg on an LX80-T02, 8 - Pole motor, double rail table with a maximum speed of 500 mm/s.

Total mass = 0.633 kg (Payload mass = 250 grams + Carriage mass (383 grams) = 633 grams)

Application Speed = 500mm/sec

Available peak force at .25 m/sec = 17.2 N (See Chapter 2, *Force / Speed Curve*)

Maximum Obtainable Deceleration Rate

Thus: $F = ma \rightarrow a = F/m \rightarrow = 17.2\text{N} / 0.633\text{kg} \rightarrow \underline{\underline{27.2 \text{ m/sec}^2}}$

Now, calculate the **Deceleration Distance** for linear deceleration:

First... find the Deceleration time:

$T_a = \text{Max Velocity} / \text{Deceleration Rate}$

$T_a = .50 \text{ m/sec} / 27.2 \text{ m/sec}^2 \rightarrow 0.018 \text{ seconds}$

Second... find the Deceleration Distance:

$\text{Distance} = ((\text{Max Velocity}) * (T_a)) / 2$

$\text{Distance} = ((500 \text{ mm/sec}) * (0.018)) / 2 \rightarrow \underline{\underline{4.5 \text{ mm}}}$

This means that both the positive and negative limit switch targets must be moved inward by 4.5 mm.

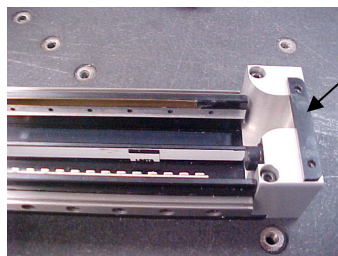
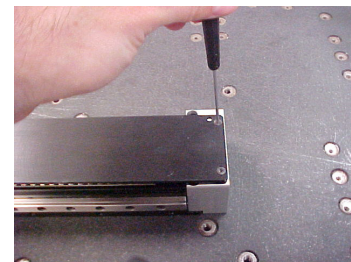
The limit deceleration rate should be set to 27.2 meters/sec². Using the supplied limit trigger decal sheet, change the location of the limit stickers (see "Adjusting the Limit Trigger Position" below).

Adjusting the Limit Trigger Position

The following procedure is to be used to adjust the activation position of the end of travel limits on the LX80L.

Step 1: Remove power from the unit and allow time for the stage base and carriage to reach room temperature.

Step 2: Remove the main top cover, if supplied from the stage by removing the four flat head hex screws.



Spacer

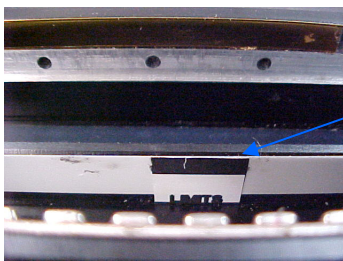
Step 3: Remove main top cover exposing the trigger background decal and the trigger decals.

Note: Care should be taken to not misplace the main top cover spacers.

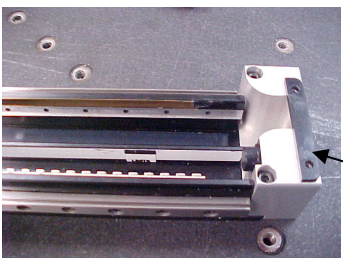
Step 4: Gently remove the existing Limit trigger decal with a razor blade or with your finger nail. Dispose of this decal, **Do Not Reuse Decals**, adhesive may not adhere properly if reused resulting in decal falling off and stage crashing into end stops. Special care should be taken not to nick white trigger background. Clean trigger background with a small amount of isopropyl alcohol and a clean cloth to remove any adhesive left by trigger.



Step 5: Apply new Limit trigger at desired horizontal location as defined in the **Determine Desired Position** on page 23.



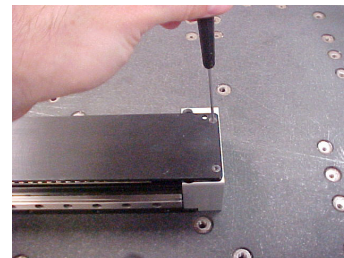
Step 6: The top of the trigger should align with the top of the white background. Smooth and press the trigger decal to insure it is adhered properly. Repeat this procedure for the other limit trigger.



Step 7: If the main top cover is supplied, verify that the two top cover spacers are in position.

Main Top Cover Spacer

Step 8: If supplied with main top cover, reattach with four flat head hex screws.



Setting Home Sensor

The LX80L is equipped with a “home” position reference sensor when purchased with Home configuration option H3. The home sensor is located on the same PCB as the limit sensors and the target is located between the limit targets. If another home location is desired other than what is set at the factory, the home target can be adjusted by using the same procedure as the Limit triggers, see **Adjusting the Limit Trigger Position** section, page 23. The Home sensor location is aligned with the encoder Z-channel. Changing the Home position from the factory setting will disable the Z-channel thus reducing the Home repeatability. Note that the encoder Z-channel can not be adjusted.

Z Channel Position Reference

The Z-channel is an output on the encoder. Many servo controllers support this input. The Z-channel on the LX80L is near the end of travel towards the positive end of the table (See Chapter 2, *Dimensional Drawing*, for positive direction definition). The Z-channel is a unidirectional device. This means that the final homing direction must occur in one direction. The LX80L is set that the final home direction is to be toward the positive end of the table. The repeatability of the Z-channel is equal to the repeatability of the table. Thus the repeatability of the Z-channel equals:

Encoder Resolution	Z Channel Repeatability
5 micron	+/- 10 micron
1 micron	+/- 2 micron
0.5 micron	+/- 1 micron
0.1 micron	+/- 0.4 micron

NOTE: Home repeatability is also very dependent on controller input speed and homing algorithms. The above repeatability does not include possible controller tolerance. Additionally, to achieve the highest repeatability the final homing speed must be slow. Slower final speed usually results in higher repeatability.

NOTE: The Z-channel output is only one resolution count wide. Thus the on-time may be very brief. Due to this some controllers may have difficulty reading the signal. If you are experiencing the positioner not finding the Z-channel during homing, try reducing final homing speed; also refer to your controller manual for frequency rates of the Z-channel input.

NOTE: The Z-channel is located approximately 10mm from the positive end of travel. This is a fixed location.

Grounding / Shielding

All cables are shielded. These shields are to be grounded to a good earth ground. Failure to ground shields properly may cause electrical noise problems. These noise problems may result in positioning errors and possible run away conditions.

The motor cable has an area of the shield exposed to allow a grounding path from shield to drive ground. The Hall/Encoder and Limit/Home cables have the shield carried through the connector hood that is in turn grounded through the drive. LX80L purchased with ViX drives as part of the configurable part number come equipped with p-clips designed for the small OD of the motor cable to allow the cable shield to be grounded to the ViX ground.

Cabling

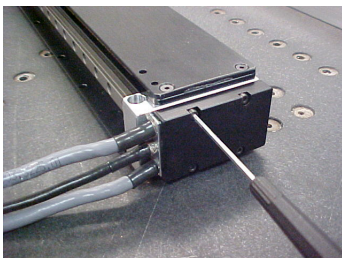
The LX80L is provided with high flex cabling which is strain relieved at the connection point on the positioner.

- The Hall/Encoder cable is terminated with a high density 15 pin D-sub connector which is compatible with the ViX drive from Parker.
- The motor cable is terminated with flying leads which have ferrules attached and are ready for installation into the screw terminals on the ViX drive. For wire color codes and pin outs see tables in electrical section of manual.
- The limit/home cable is provided with a 15 pin D-sub connector which is compatible with the ViX drive. For wire color codes and pin outs see tables in electrical section of manual.
- Recommended bend radius for these extension cables is 50mm. This radius will provide a minimum of 10 million cycles of the cable. Smaller bend radius will reduce cable life while larger bend radius will increase life.
- The cable egress can be changed from left side exit to right side exit, see Cable Egress Reversing below for instructions. For positioners with single rail options (S option, ex. *LX80LT02MPS*), the cables can only exit to the left when side mounting the positioner unless the endblock is overhung off of the mounting surface.
- If the positioner is mounted in a multi-axis configuration, X-Y, it is recommended that the Y-Axis Cable System is used. See the LX80L Y-Axis Cable System in the following “Y-Axis Cable System” for more information. The Y-Axis Cable System should be sized to the x-axis positioner. If the Y-Axis Cable System is not used, special care should be taken in routing and strain relieving the cables so as to prevent flexing of the cable at the connection to the table and where mounted stationary to the structure. Provide sufficient service loop that the cable bends a minimum of 25mm from these end points. It is also recommended to avoid twisting the cable. The cable should be secured in a position which will orient it in a direction that creates a single plane of operation for the cable.

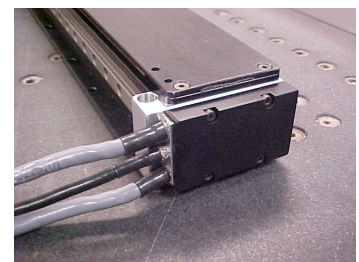
Cable Egress Reversing

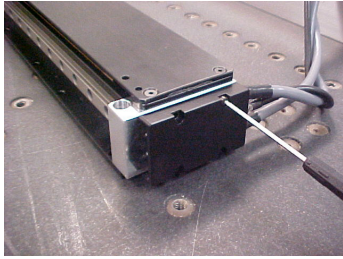
The cables ship from the factory with left side egress, that is cables exit to the left when looking down the positioner from the cable endblock side.

Step 1: Remove power from the table and allow time for the base and carriage to reach room temperature.



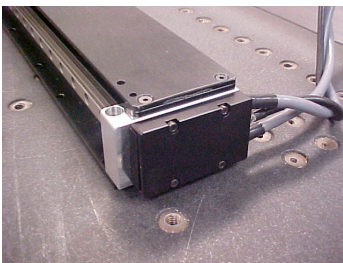
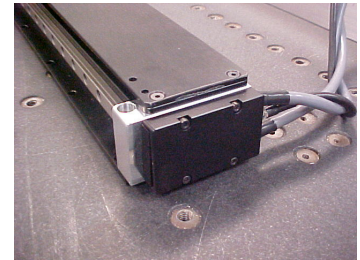
Step 2: Remove the endblock cover/strain relief by removing four (4) socket head cap screws.





Step 3: Reverse the wires to come out the opposite direction. The cables must be in order from top to bottom based on the connector location on the circuit board, not all of the cables are the same diameter so they are to match the endblock cover/strain relief recesses. Replace the endblock cover/strain relief with four (4) socket head cap screws. The endblock/strain relief must secure the cables by clamping the shield of the cables. Do not clamp on the heat shrink on the cables, this may result in improper grounding of the table.

Step 4: Replace the endblock cover by replacing four (4) socket head cap screws. Care must be taken when securing the endblock cover so that no wires are pinched.



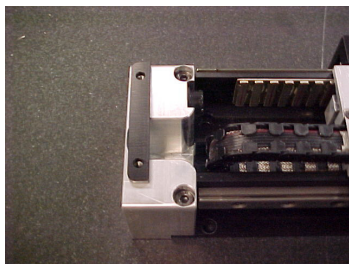
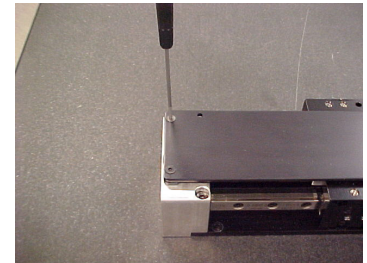
The cables are now reversed and should be secured.

Internal Cable Replacement

Due to the continuous motion of the internal cable system, it may be necessary to replace at some point during the positioner's life. The internal cable assembly should provide a long service life, Parker has tested the internal cable assembly in excess of 20 million cycles. Follow the instructions and images to replace the internal cable assembly.

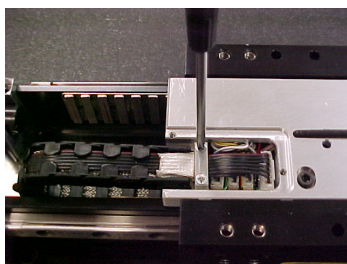
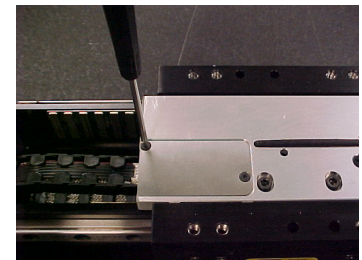
Step 1: Remove power from the table and allow time for the base and carriage to reach room temperature.

Step 2: Remove the top cover by removing four (4) flat hex head screws.



Step 3: Note: After removing the top cover, take notice of the two (2) cover spacers. If these spacers are omitted on reassembly, the top cover will interfere with the carriage.

Step 4: Remove the carriage PCB cover by removing two (2) flat head screws.

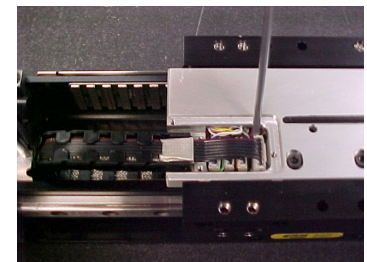


Step 5: Remove the flat cable strain relief by removing two (2) flat head screws.

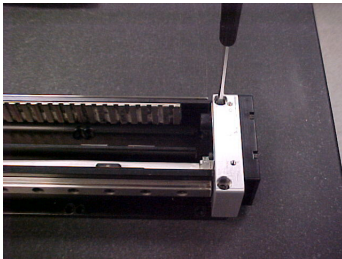
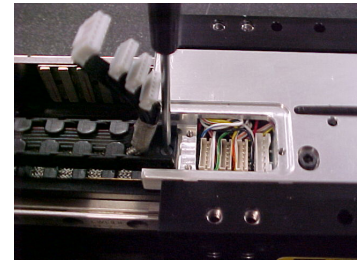
Step 6: Disconnect the four (4) cable plugs. Use a small flat tip screwdriver to gently unplug the plugs. Use the screwdriver to gently pry both sides of the plug.



Warning: excessive force will damage the connectors.

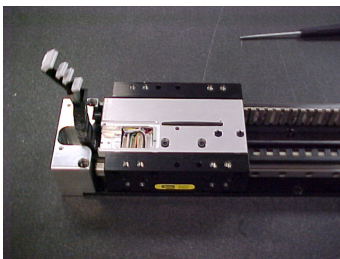
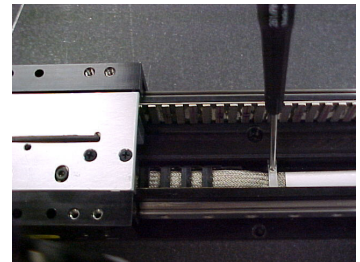


Step 7: Remove the cable assembly from the carriage by removing one (1) flat head screw from the cable carrier link that is attached to the carriage. It is necessary to lift the four (4) connectors to gain access to the flat head screw.



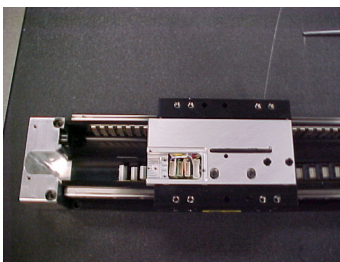
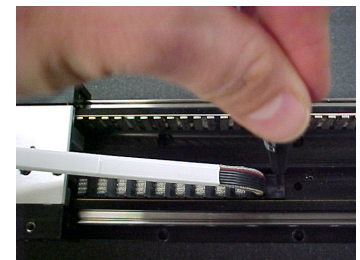
Step 8: Remove the cable side endblock from the base by removing two (2) socket hex head cap screws.

Step 9: Remove the flat cable strain relief, that is located near the centerline of the base, by removing two (2) flat head screws.



Step 10: Move the disconnected cable assembly and the carriage to the non-cable side endblock.

Step 11: Disconnect the cable assembly from the base by folding the portion of the cable assembly that does not have cable carrier links covering the cable over the portion that does have cable carrier links. This will expose one (1) flat head screw in the last cable carrier link. Remove this screw.



Step 12: The cable assembly can now be removed by sliding the connector end of the cable assembly under the carriage.

Step 13: To assemble a new cable assembly repeat the previous steps in reverse order.

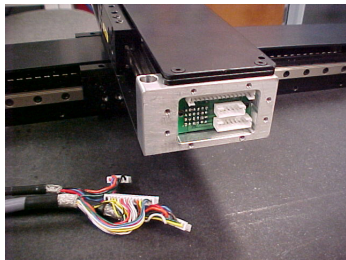
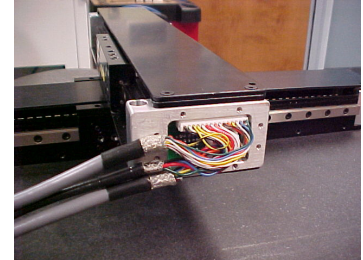
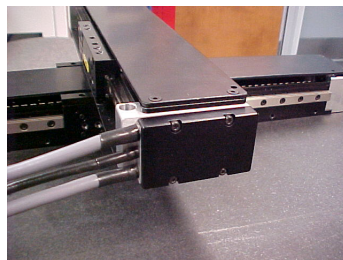
Note: Special care needs to be taken not to pinch any of the wire when reassembling the cable system.

Y-Axis Cable System

When using two LX80L positions in an X-Y configuration care must be taken with the cable management of the Y-axis extension cables. These cables will need to flex through the entire travel of the X-axis positioner. To help eliminate these flexing issues, Daedal has developed a *Y-Axis Cable System*. This system comprises of an adapter block that replaces the cable side endblock cover, a cable system with cable carrier, and an endblock attachment assembly, that is mounted to the X-axis mounting surface. See following pictures and instructions.

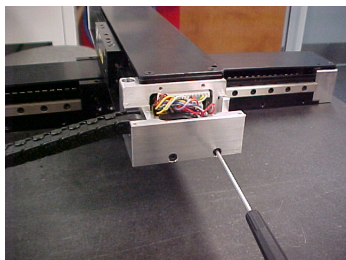
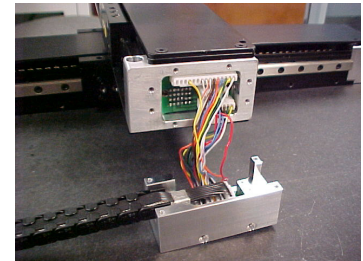
Step 1: Remove power from the table and allow time for the base and carriage to reach room tem-

Step 2: Remove endblock cover/strain relief by removing four (4) socket head cap screws on the Y-axis.



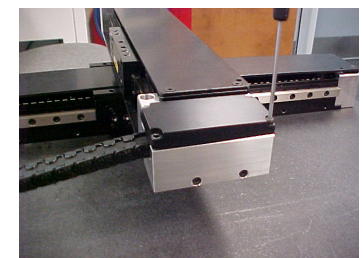
Step 3: Disconnect all three (3) cables that are attached to the endblock pc board.

Step 4: Connect the three (3) cable plugs of the Y-Axis Cable System to the corresponding sockets in the endblock pc board.

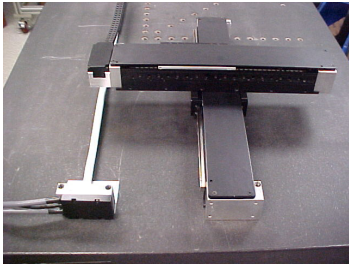
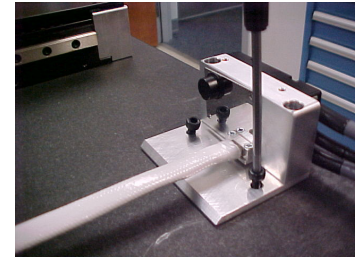


Step 5: Attach the Y-Axis Cable System mounting block with two (2) socket head cap screws to the positioner endblock. *Take special care not to pinch wires when assembling parts.*

Step 6: Attach the Y-Axis Cable System cover using four (4) socket head cap screws to the Y-Axis Cable System mounting block. *Take special care not to pinch wires when assembling parts.*



Step 7: Connect the stationary end of the Y-Axis Cable System with two (2) socket head cap screws to the same mounting surface as the x-axis positioner. See drawing and instructions below for placement.

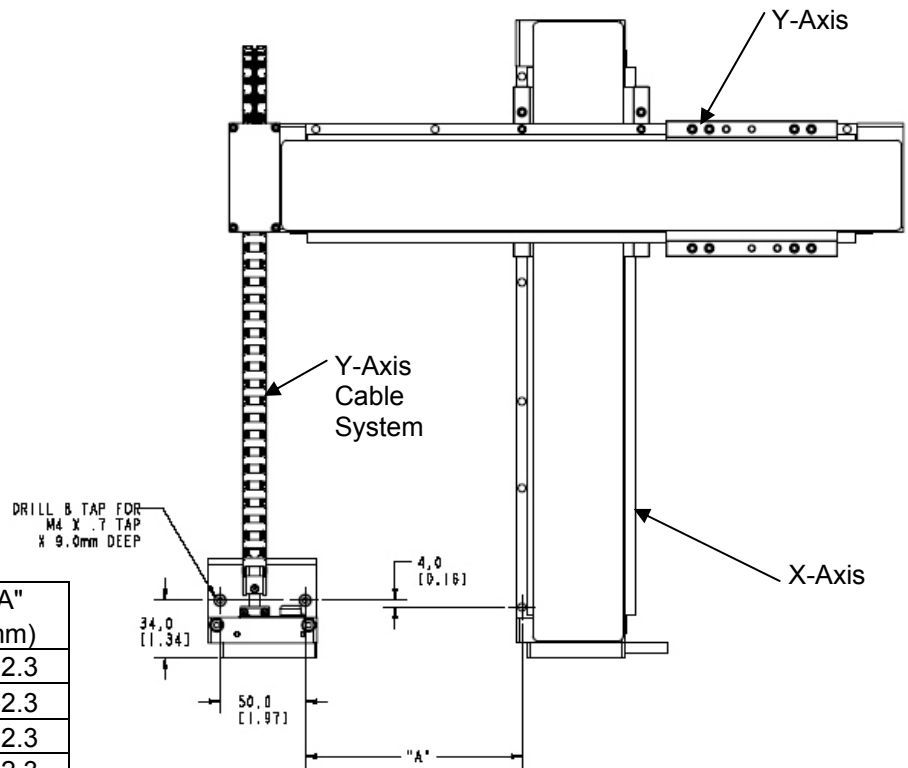


Step 8: After the stationary end of the Y-Axis Cable System is secured to the mounting surface, move the x-axis positioner's carriage through its travel to insure that the Y-Axis Cable System is tracking properly. If it is not tracking properly, loosen the two (2) socket head cap screws securing the stationary end and adjust until tracking is running parallel to the x-axis.

Placement of Y-Axis Cable System

Use this drawing to layout the location of the Y-Axis Cable System in relation to the LX80L X-Y system. Note that dimension "A" is for the Y-axis positioner centered on the X-axis carriage. Y-axis positioner can be offset from center which will change dimension "A" by the amount offset.

TRAVEL DESIGNATOR	"A" (mm)
T02	102.3
T04	152.3
T06	202.3
T08	252.3
T10	302.3
T14	402.3



Top View of X-Y Configuration

CHAPTER FOUR

4 Performance

IN THIS CHAPTER

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- Speed Limits 43
- Thermal Effects on Accuracy and Repeatability..... 29

Acceleration Limits

Acceleration of linear servo driven tables is typically limited by four (4) factors:

- **Linear Bearings**
The linear bearings used in the LX80L have a continuous acceleration limit of 2 g's. This means that the bearings are designed to take repetitive accelerations of 2 g's and maintain the rated bearing life. Additionally, the bearings can take a periodic acceleration of up to 5 g's, however continued accelerations of these magnitudes will reduce bearing life.
- **Reduced Bearing Life**
Bearing loading due to high acceleration may reduce bearing life to an unacceptable application limit. This is not usually a limiting factor unless loading is significantly cantilevered causing high moment loads during accelerations. (Chapter 2, *LX80L Series Technical Data* to determine bearing load life for your application).
- **Available Motor Force**
This is the primary factor that reduces acceleration. This is simply the amount of motor force available to produce acceleration. The larger the inertial and or frictional load the lower the accelerations limit.
- **Settling Time**
In many applications reducing cycle time is a primary concern. To this end, the "settling" time (the amount of time needed after a move is completed for table and load oscillating to come within acceptable limits) become very important. In many cases where very small incrementing moves are executed, the settling time is greater than the actual move time. In these cases accelerations may need to be reduced thus reducing the settling time.

Speed Limits

Acceleration of linear servo driven tables is typically limited by three (3) factors:

- **Linear Bearings**

The linear bearings used in the LX80L are limited to a maximum speed of 3 meters/second.

- **Linear Encoder Limit**

The linear encoder has speed limits relative to encoder resolution; these limits are listed below:

Encoder Resolution	Maximum Velocity	Required Post Quadrature Input Bandwidth (²)
5 micron	5 meters/second (¹)	2 MHz
1 micron	3 meters/second(¹)	6.7 MHz
0.5 micron	1.5 meters/second	6.7 MHz
0.1 micron	0.3 meters/second	10 MHz

(¹) When using an encoder with 5 micron resolution, velocity limited by speed dependant force.

(²) This is the bandwidth frequency that the amplifier or servo control input should have to operate properly with the encoder output at maximum speeds. This frequency is post-quadrature, to determine pre-quadrature divide above values by 4. Above frequencies include a safety factor for encoder tolerances and line loses.

- **Force / Speed Limit**

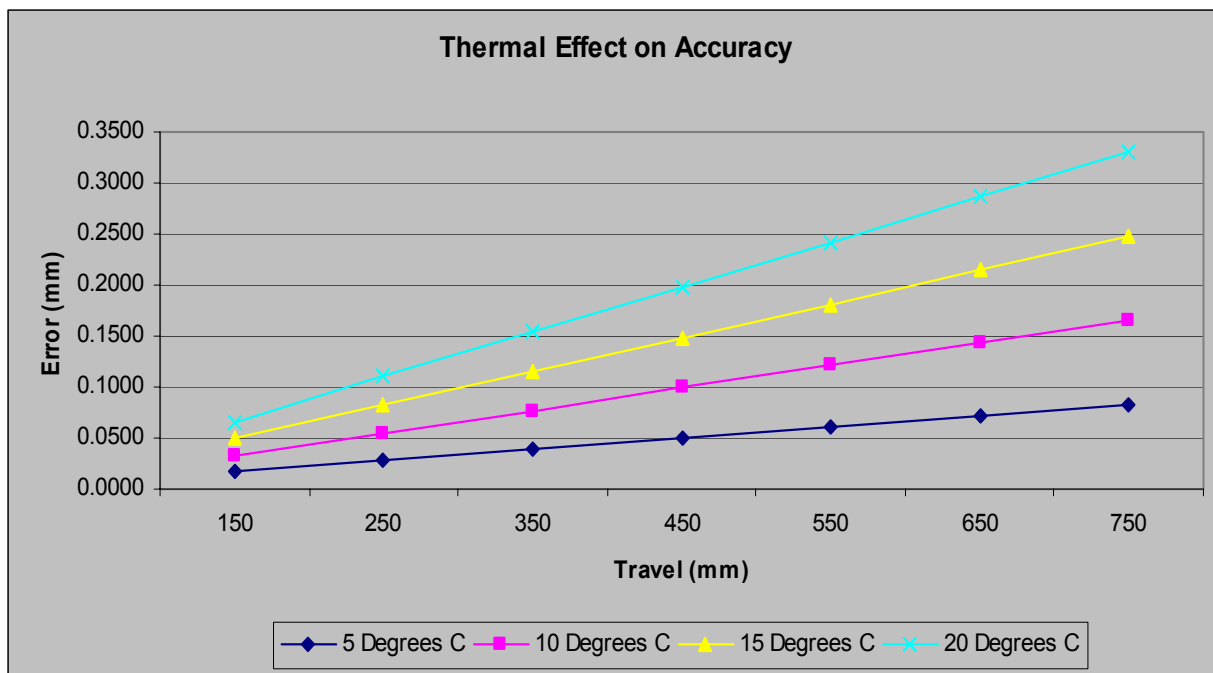
The available force of the LX80L reduces as speed increases. (Chapter 2, *LX80L Series Technical Data*)

Thermal Effects on Accuracy

The LX80L uses a magnet linear servo motor. The magnet rails and the encoder tape are mounted to the base. The motor coils are mounted in the carriage and unless the payload is insulated, the heat generated in the coils should radiate out the payload maintaining a low thermal delta between base and carriage. All specifications for the LX80L are taken at 20 C. Variation from this temperature will cause additional positional errors. If the base of the LX80L varies from this temperature the encoder scale will expand or contract, thus changing its measuring length and thus encoder resolution.

The factor by which this thermal effect occurs is 0.000022mm/mm/° C. Although this is a very small number it can make significant accuracy and repeatability effects on your applications, especially on longer travel applications. To understand this better following is an example:

Example: A precision grade LX80L with 250mm travel is being used. The accuracy over the entire travel is 12 microns @ 20° C. If the base temperature increases by 5 C an additional error of 28 microns will be added over the total travel (0.000022mm/mm/° C)*250mm*5 C. However, this additional error can be compensated for since the error is linear.



Thermal Effects on Repeatability

Repeatability will not be affected as long as the temperature remains constant. However the repeatability will be affected as the temperature changes from one level to another. This is most commonly experienced when starting an application cold. Then as the application runs the MX80L comes to its operational temperature. The positions defined when the unit was “cold” will now be offset by the thermal expansion of the unit. To compensate for this offset, all positions should be defined after the system has been exercised and brought to operational temperature.

Causes of Temperature Increases

One or more of the following conditions may affect the temperature of the MX80L carriage:

Ambient Temperature

This is the air temperature that surrounds the LX80L

Application or Environment Sources

These are mounting surfaces or other items which produce a thermal change that affect the temperature of the LX80L base (i.e. X/Y configurations with motors or other heat generating devices that heat the mounting surface and thus thermally affect the LX80L base).

Motor heating from LX80L

Since the LX80L uses a servo motor as its drive, it produces no heat unless there is motion, or a force being generated. In low duty cycle applications heat generation is low, however as duty cycles increase, temperature of the LX80L will increase, causing thermal expansion of the carriage. With very high duty cycles these temperatures can reach temperatures as high as 30° C above ambient.

Compensating for Thermal Effects

If the application requires high accuracy, the thermal effects must either be removed by regulating base temperature or compensated for with a correction factor added to the commanded position. *Controlling the base temperature* is the best method. However, this means controlling the ambient temperature by removing all heat/cold generators from the area and operating at very low duty cycles. *Compensation* is the other way of achieving accuracy without sacrificing performance. In this case the system must be exercised through its normal operating cycle. The temperature of the base should be measured and recorded from the beginning (cold) until the base becomes thermally stable. This base temperature should be used in a compensation equation. Below is the fundamental *thermal compensation equation*:

$$C_d = (I_d - ((I_d) * (T_e) * DT))$$

C_d = Corrected displacement (mm)

I_d = Incremental displacement (mm)

T_e = Thermal Expansion (0.000022 mm/mm/° C)

DT = Temperature Differential from 20° C

Example:

base Temperature of 32° C required move of 100mm

$$C_d = 100\text{mm} - (100\text{mm} * 0.000022\text{mm/mm/}^\circ\text{C} * 12^\circ\text{C}) = 99.9736\text{mm}$$

In this example the commanded move should be 26.4 microns less (100mm – 99.9736mm) than the desired move. This will compensate for the thermal expansion of the scale. This is a simple linear correction factor and can be programmed in to most servo controllers using variables for the position commands.

CHAPTER FIVE

Connecting the Vix Amplifier

IN THIS CHAPTER

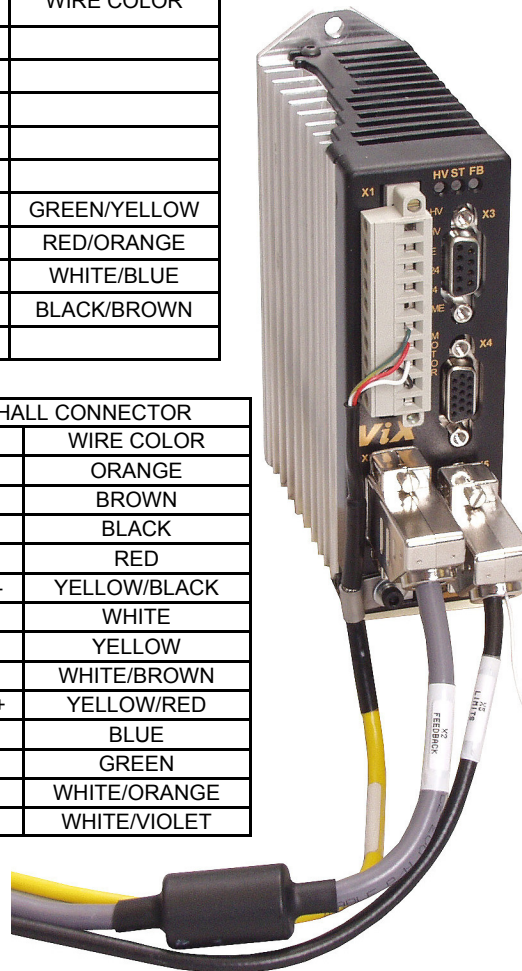
- Drive Connections.....48

LX80L Series Product Manual

The LX80L is designed to be plug and run compatible with the Parker ViX drive. The cables on the LX80L are labeled to match the labels on the ViX for ease of use and quick installation. When purchased as part of the part number, the ViX will have the motor parameters already downloaded.

X1 - MOTOR LEADS		
	DRIVE	WIRE COLOR
10	24-80 VDC +HV	
9	0V/GND - HV	
8	EARTH - PE	
7	24V DC	
6	0V (GND 24V DC)	
5	MOTOR EARTH	GREEN/YELLOW
4	U	RED/ORANGE
3	V	WHITE/BLUE
2	W	BLACK/BROWN
1	MOTOR BRAKE	

X - FEEDBACK-HALL CONNECTOR		
PIN	FUNCTION	WIRE COLOR
1	Encoder Z+	ORANGE
2	Encoder Z-	BROWN
3	GND	BLACK
5	+5V	RED
6	Temperature-	YELLOW/BLACK
7	Encoder A+	WHITE
8	Encoder A-	YELLOW
9	Hall#1	WHITE/BROWN
10	Temperature+	YELLOW/RED
11	Encoder B-	BLUE
12	Encoder B+	GREEN
13	Hall#2	WHITE/ORANGE
14	Hall#3	WHITE/VIOLET



X5 – LIMITS CONNECTOR*		
PIN	FUNCTION	WIRE COLOR
1	GND	BLACK
6	+ End of travel	ORANGE
7	- End of travel	BLUE
8	Home	GREEN

* For Drive Only versions of the ViX, the limits need to be connected to the motion controller NOT the drive.



Limits use Inputs

The ViX drive has 5 digital inputs. When using with LX80L, the EOT Limits and Home use 3 of the 5 inputs. A VM15-PF screw terminal breakout board may be purchased to allow access to the remaining 2 inputs and all of the outputs.

CHAPTER SIX

Maintenance and Lubrication

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Square Rail Bearing Lubrication

Materials Required: Replacement square rail bearing lubrication (See below for lubrication type and ordering information), clean cloth, small brush

Lubrication Type

For positioners with cleanroom preparation **R1**, class 1000 compatible (standard): Use NSK#2.

For positioners with cleanroom preparation **R2**, class 10 compatible: Use Braycote 803

Lubricant Appearance

R1 - Translucent-white, smooth and buttery.

R2 - Creamy-white, smooth and buttery

Maintenance Frequency

For both '**R1**' and '**R2**' Preparations: Square rail bearing blocks are lubricated at our facility prior to shipment. For lubrication inspection and supply intervals following shipment, apply grease every 1000 hours of usage. The time period may change depending on frequency of use and environment. Inspect for contamination, chips, etc, and replenish according to inspection results.

Lubricant Application

For both '**R1**' and '**R2**' Preparations: Wipe the rails down the entire length with a clean cloth. Apply lubrication on the rails, using a small brush, allowing a film of fresh grease to pass under the wipers and into the recirculating bearings.

Notes:

Do not use/mix petroleum base grease with synthetic base grease at any time. For lubrication under special conditions consult factory.

Shorter lubrication interval may be required in environments with high amounts of dust and other contamination.

Appendix A - Internal Protection

Parker has conducted testing to determine the *degree* to which the positioner is protected by using a British standard called an **Ingress Protection Rating (IP Rating)**. The LX80L has an IP 10 protection rating.

Definition

Reference: British standard EN 60529 : 1992

This standard describes a system of classifying degrees of protection provided by enclosures of electrical equipment. Standardized test methods and the establishment of a two digit numeric rating verify the extent of protection provided against access to hazardous parts, against ingress of solid foreign objects, and against the ingress of water.

First Number – The first number indicates protection of persons against access to dangerous parts and protection of internal equipment against the ingress of solid foreign objects.

1 - Protection against access to hazardous parts with the back of a hand, and protected against solid foreign objects of 50 mm diameter and larger.

Second Number – The second number indicates protection of internal equipment against harmful ingress of water.

0 - No special protection provided.

Note: Number Indicators above represent only a partial list of IP Rating specifications.

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