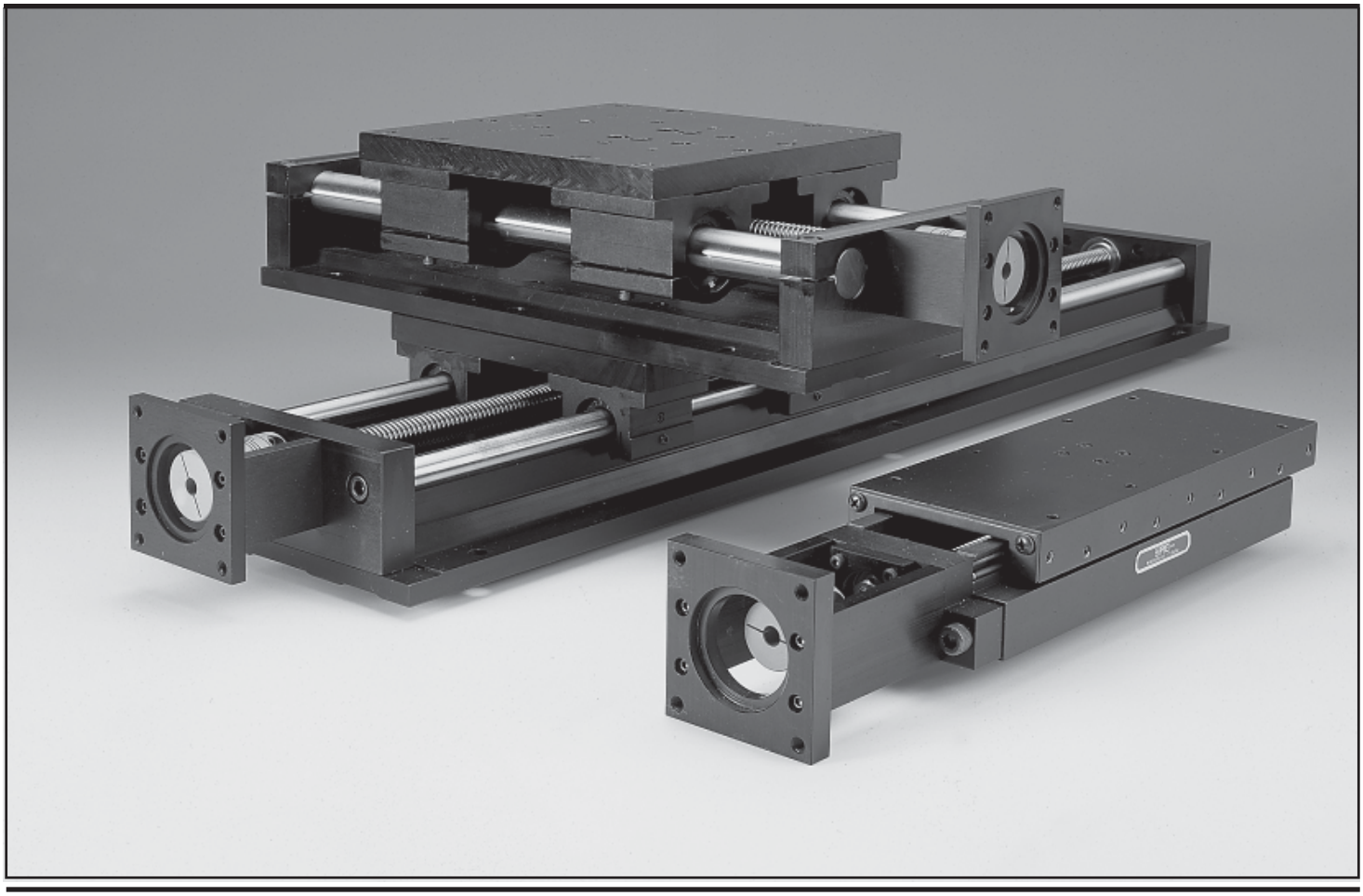
PIC DESIGN®

PRECISION INDUSTRIAL COMPONENTS

LINEAR MOTION SYSTEMS

User-assembled or Pre-assembled



PIC now offers a comprehensive line of linear motion systems.

Single sourcing eliminates the need for extensive, expensive component and system design and time consuming searches through different manufacturers' catalogs for all required designs and sizes.

The first few pages offer a guide to linear motion calculations, for determining effective loads, life of linear bearings, and shaft deflections. These pages are not meant to replace the thinking of an engineer but rather to assist.

System 3 is made up of our standard components found in section 4 of this catalog. This popular configuration is made up of two linear bearings mounted in housings, with a shaft and shaft support rail.

System 9 is available with or without bellows covers. This is a modular pre-assembled precision product, with 4 linear bearings mounted in housings with two parallel shafts mounted to a base plate, with a table top, lead screw and coupling. The key to this unit is standard one-size shafting, which allows for quick delivery at a discounted price. System 9 is ideal for vertical applications. The optional protective Bellows Cover is made of polyurethane coated nylon. These covers protect the shafting and lead screw from damage-causing debris.

System 10 is available with or without bellows covers. It is similar to system 9, but the shafts are fully supported by a one piece integral rail. As with system 9 the one size shafting allows for quick delivery at a discounted price. System 10 is ideal for applications that require greater travel.

Positioning Stages: PIC's industrial grade tables provide solutions for indexing where the strict requirements of scientific stages are not needed. Mounting holes in top and base are located to easily allow two stages to be configured as an X-Y positioner. Ready to hook up to your standard NEMA 23 motor.

STEP 1

CALCULATION OF SYSTEM LOADING AND BEARING SELECTION

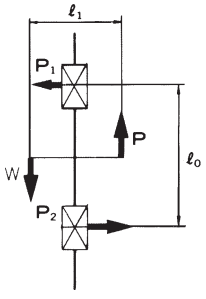
LOAD CALCULATION

The main factors involved in the selection of bearing material and size are the load on a single bearing and the total travel life required. The load on a single bearing varies with the position of the center of gravity on the table top or carriage. To calculate the load on a single bearing:

1. For system 3, use load calculation diagram 1 for vertical applications, and load calculation diagram 2 for horizontal applications.
2. For other frequently used system configurations, use load calculation diagram 3 for horizontal axis, load calculation diagram 4 for vertical axis, and load calculation diagram 5 for vertical lateral axes.

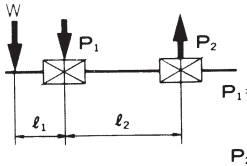
LOAD CALCULATION DIAGRAMS

DIAGRAM 1



$$P_1 = P_2 = \frac{\ell_1}{\ell_0} W$$

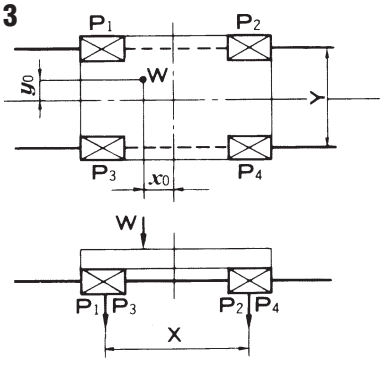
DIAGRAM 2



$$P_1 = \frac{\ell_1 + \ell_2}{\ell_2} W$$

$$P_2 = \frac{\ell_1}{\ell_2} W$$

DIAGRAM 3



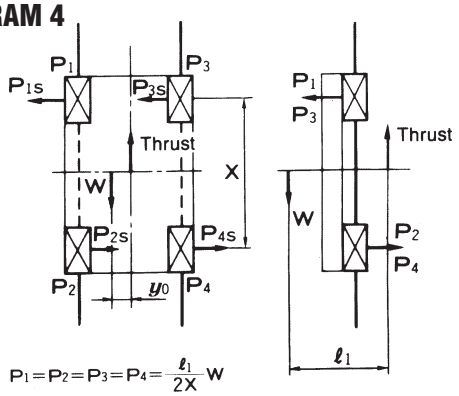
$$P_1 = \frac{1}{4} W + \frac{x_0}{2X} W + \frac{y_0}{2Y} W$$

$$P_2 = \frac{1}{4} W - \frac{x_0}{2X} W + \frac{y_0}{2Y} W$$

$$P_3 = \frac{1}{4} W + \frac{x_0}{2X} W - \frac{y_0}{2Y} W$$

$$P_4 = \frac{1}{4} W - \frac{x_0}{2X} W - \frac{y_0}{2Y} W$$

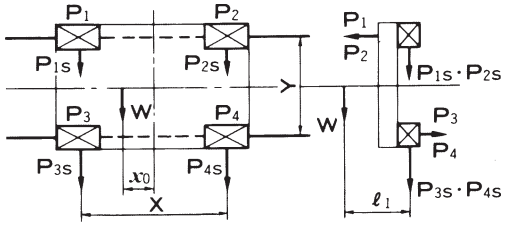
DIAGRAM 4



$$P_1 = P_2 = P_3 = P_4 = \frac{\ell_1}{2X} W$$

$$P_{1S} = P_{2S} = P_{3S} = P_{4S} = \frac{y_0}{2X} W$$

DIAGRAM 5



$$P_1 = P_2 = P_3 = P_4 = \frac{\ell_1}{2Y} W$$

$$P_{1S} = P_{3S} = \frac{1}{4} W + \frac{x_0}{2X} W$$

$$P_{2S} = P_{4S} = \frac{1}{4} W - \frac{x_0}{2X} W$$

P = FORCE ON BEARINGS
W = WEIGHT ON SYSTEM

STEP 2

BEARING SELECTION

Two types of bearings, self-aligning recirculating ball bearings and engineered plastic bearings, are available from PIC for use in linear motion systems. Both types are available in inch or metric sizes, and closed or open styles.

SELF-ALIGNING BEARINGS

The formulas and tables listed below will enable the designer to select the proper self-aligning bearings to meet the required life.

Basic Dynamic Load Rating and Life Expectancy

The basic dynamic load rating of a self-aligning bearing is the load which allows a rating life of 2,000,000 inches or 50,000 meters of travel, without change in magnitude or direction. The rating life of a bearing for a particular application can be calculated from the following equations:

For inch calculations,

$$L = \left[\frac{f_h}{f_w} \bullet \frac{C}{P}\right]^3 \bullet 2 \bullet 10^6$$

For metric calculations,

$$L(km) = \left[\frac{f_h}{f_w} \bullet \frac{C}{P}\right]^3 \bullet 50$$

With:

- L = rating life in inches for inch calculations, in kilometers for metric calculations
- f_h = hardness factor (1.0); shafts are 60-65 HRC
- f_w = load coefficient (refer to table 1)
- C = basic design load rating in pounds for inch calculations, in Newtons for metric calculations (refer to table 2 or 3)
- P = force in pounds for inch calculations, force in Newtons for metric calculations, determined from load calculation diagrams 1 through 5, as applicable

Rating life in hours can be calculated from the travel distance per unit of time, as follows:

$$L_h = \frac{L}{2 \bullet L_s \bullet n_1 \bullet 60}$$

With:

- L_h = rating life in hours
- L_s = stroke length in inches for inch calculations, in meters for metric calculations
- n_1 = rating in cycles per minute

To calculate the basic dynamic load rating, use the following formulas:

For distances in inches,

$$C = \sqrt[3]{\frac{L}{2 \bullet 10^6}} \bullet \frac{f_w}{f_h} \bullet P$$

For distances in kilometers,

$$C = \sqrt[3]{\frac{L}{1 \bullet 50}} \bullet \frac{f_w}{f_h} \bullet P$$

Example of Calculations using standard PIC components

Expected Life:	20,000 hours
Number Of Bearings:	4
Weight On Carriage:	175 lb
Stroke Distance:	24 inches
Traveling Speed:	1000 in. / min
Cycle:	2 x 24 inches
Shaft:	A10L series

From the life expectancy in hours formula, the life expectancy in traveling distance is:

$$L_h = \frac{L}{2\ L_s\ n_1 \bullet 60}$$

$$L = L_h \bullet 2 \bullet L_s \bullet n_1 \bullet 60$$

$$L = 20{,}000 \bullet 2 \bullet 24 \bullet \frac{1000}{2 \bullet 24} \bullet 60$$

$$L = 1.20 \times 10^9 \text{ inches}$$

From the dynamic load rating formula:

$$C = \sqrt[3]{\frac{L}{2 \bullet 10^6}} \bullet \frac{f_w}{f_h} \bullet P$$

$$C = \sqrt[3]{\frac{1.2 \bullet 10^9}{2 \bullet 10^6}} \bullet \frac{1.5}{1.0} \bullet \frac{175}{4}$$

$$C = 553 \text{ lb}$$

The assumption is that the 175 pound load is distributed evenly between bearings; therefore, using diagram 3 with1-inch with 1-inch diameter bearings having a load capacity of 850 pounds is selected.

Table 1. Load Coefficient

Operating Conditions	f_w
Operation at low speed (50 ft/min or 15 m/min or less) without impulsive shock from outside	1 - 1.5
Operation at intermediate speed (200 ft/min or 60 m/min or less) without impulsive shock	1.5 - 2.0
Operation at high speed (over 200 ft/min or 60 m/min) with impulsive shock from outside	2.0 - 3.5

Table 2. C Dynamic Load Rating of Inch Bearings

Shaft Diameter (inch)	Rating (lb)	PIC Part No.	
		Closed	Open
1/4	60	**PFL-4**	—
3/8	95	**PFL-6**	—
1/2	230	**PFL-8**	**PFLO-8**
5/8	400	**PFL-10**	**PFLO-10**
3/4	470	**PFL-12**	**PFLO-12**
1	850	**PFL-16**	**PFLO-16**
1 1/4	1230	**PFL-20**	**PFLO-20**
1 1/2	1480	**PFL-24**	**PFLO-24**

Table 3. C Dynamic Load Rating of Metric Bearings

Shaft Diameter (mm)	Rating (Newtons)	PIC Part No.
CLOSED TYPE		
12	650	**MPFL-12**
16	800	**MPFL-16**
20	1500	**MPFL-20**
25	2500	**MPFL-25**
30	3200	**MPFL-30**
40	5550	**MPFL-40**
OPEN TYPE		
12	750	**MPFLO-12**
16	920	**MPFLO-16**
20	1560	**MPFLO-20**
25	2600	**MPFLO-25**
30	3330	**MPFLO-30**
40	5740	**MPFLO-40**

ENGINEERED PLASTIC LINEAR BEARINGS

PIC self-lubricating plastic bearings are maintenance free, run quietly, are not subject to catastrophic failure, do not gall or brinell the mating shaft, and can run on “soft” non-corrosive 303 stainless steel shafting. These bearings are also capable of operation in hostile environments and are interchangeable with PIC self-aligning, recirculating bearings.

Bearing PV Rating

The performance capabilities of engineered plastic linear bearings are defined by the PV rating of the bearings, where P is the pressure in pounds per square inch on the projected bearing area, and V is the velocity in feet per minute of the wear surface. Maximum PV for continuous operation is 7500 PSI/FPM. To calculate PV for a particular application, divide the total load in pounds on the bearing by the effective area in square inches, and multiply by the average bearing velocity in feet per minute.

Example of Calculation:

Number Of Bearings:	4
Weight On Carriage:	175 lb
Load Per Bearing:	175/4 = 43.75 lb
Traveling Speed:	1000 in./min or 83.33 ft/min
Bearing Selected:	PLC-16 (1 in. = ID, 2.25 in. long = L)

$$P = \frac{\text{Load (lb.)}}{\text{ID} \bullet \text{L}} = \frac{43.75}{1 \bullet 2.25} = 19.44 \text{ PSI}$$

$$PV = 19.44 \bullet 83.33 = 1620 \text{ PSI/FPM}$$

STEP 3 DETERMINATION OF SHAFT DEFLECTION

Once the appropriate bearing has been selected to fulfill the load requirements of the application, the shaft deflection must be determined. Dimensions and tolerances of PIC shafts are listed in table 4. The required shaft diameter is dictated by the ID of the selected bearing, and the deflection can be determined from table 5 or 6 for inch or metric systems, respectively.

Table 4. Shaft Diameters and Tolerances

Diameter (inch)	PIC Series	Tolerance (inch)
1/4	A10L-4	0.2495 / 0.2490
3/8	A10L-6	0.3745 / 0.3740
1/2	A10L-8	0.4995 / 0.4990
5/8	A10L-10	0.6245 / 0.6240
3/4	A10L-12	0.7495 / 0.7490
1	A10L-16	0.9995 / 0.9990
1 1/4	A10L-20	1.2495 / 1.2490
1 1/2	A10L-24	1.4994 / 1.4989

Table 5. Shaft Deflection Table (Inch Systems). Deflection Per Pound At Center Of Fixed Supporting Shaft.

Shaft Diameter (inches)	Length Of Unsupported Section (inches)												
	4	6	8	10	12	16	20	24	30	36	42	48	72
1/4	5.85×10^{-5}	1.98×10^{-4}	4.68×10^{-4}	9.15×10^{-4}	1.58×10^{-3}	3.75×10^{-3}	7.32×10^{-3}	1.26×10^{-2}	2.5×10^{-2}				
3/8	1.20×10^{-5}	4.05×10^{-5}	9.63×10^{-5}	1.79×10^{-4}	3.25×10^{-4}	7.68×10^{-4}	1.43×10^{-3}	2.60×10^{-3}	4.83×10^{-3}	8.33×10^{-3}	1.32×10^{-2}	1.98×10^{-2}	
1/2	3.63×10^{-6}	1.23×10^{-5}	2.90×10^{-5}	5.68×10^{-5}	9.83×10^{-5}	2.33×10^{-4}	4.50×10^{-4}	7.85×10^{-4}	1.53×10^{-3}	2.65×10^{-3}	4.20×10^{-3}	6.28×10^{-3}	2.12×10^{-2}
3/4	7.15×10^{-7}	2.42×10^{-6}	5.73×10^{-6}	1.12×10^{-5}	1.94×10^{-5}	4.58×10^{-5}	8.95×10^{-5}	1.55×10^{-4}	3.02×10^{-4}	5.23×10^{-4}	8.30×10^{-4}	1.24×10^{-3}	4.18×10^{-3}
1	2.25×10^{-7}	7.70×10^{-7}	1.76×10^{-6}	3.55×10^{-6}	6.15×10^{-6}	1.46×10^{-5}	2.85×10^{-5}	4.93×10^{-5}	9.63×10^{-5}	1.66×10^{-4}	2.63×10^{-4}	3.93×10^{-4}	1.33×10^{-3}
1 1/4	9.30×10^{-8}	3.13×10^{-7}	7.45×10^{-7}	1.45×10^{-6}	2.50×10^{-6}	5.95×10^{-6}	1.16×10^{-5}	2.01×10^{-5}	3.93×10^{-5}	6.78×10^{-5}	1.08×10^{-4}	1.61×10^{-4}	5.43×10^{-4}
1 1/2	4.48×10^{-8}	1.51×10^{-7}	3.58×10^{-5}	7.00×10^{-7}	1.21×10^{-6}	2.88×10^{-6}	5.60×10^{-6}	9.68×10^{-6}	1.89×10^{-5}	3.28×10^{-5}	5.18×10^{-5}	7.75×10^{-5}	2.58×10^{-4}
2	1.42×10^{-8}	4.78×10^{-8}	1.13×10^{-7}	2.21×10^{-7}	3.83×10^{-7}	9.05×10^{-7}	1.77×10^{-6}	3.05×10^{-6}	5.98×10^{-6}	1.03×10^{-5}	1.64×10^{-5}	2.45×10^{-5}	8.25×10^{-5}

Note:

Deflections listed above are based on system being fixed at both ends, with load in center of span.

Using the formula:

$$\text{Deflection} = \frac{W_S L^3}{192EI}$$

W_S = Load on shaft
L = Length
E = Modulus of elasticity
I = Moment of inertia of cross section

Example:

Shaft: 1/4 in. diameter
Load: 8 pounds
Length: 10 inches
Multiplier (From Table 5): 9.15×10^{-4} inches/pound

$$\text{Deflection} = \frac{9.15 \times 10^{-4} \text{ inches}}{\text{pound}} \times 8 \text{ pounds} = .0073 \text{ inches}$$

Note:

If deflection is greater than 1/2° suggest using shaft supports and open bearings

Table 6. Shaft Deflection Table (Metric Systems). Deflection Per kgf At Center Of Fixed Supporting Shaft.

Shaft Diameter (mm)	Length Of Unsupported Section (mm)							
	125	250	500	750	1000	1250	1500	2000
12	4.75×10^{-4}	3.80×10^{-3}	3.04×10^{-2}	1.02×10^{-1}	2.4×10^{-1}	4.75×10^{-1}	8.21×10^{-1}	1.95
16	1.50×10^{-4}	1.20×10^{-3}	9.62×10^{-3}	3.25×10^{-2}	7.7×10^{-2}	1.50×10^{-1}	2.59×10^{-1}	6.16×10^{-1}
20	6.15×10^{-5}	4.92×10^{-4}	3.94×10^{-3}	1.33×10^{-2}	3.15×10^{-2}	6.15×10^{-2}	1.06×10^{-1}	2.52×10^{-1}
25	2.52×10^{-5}	2.02×10^{-4}	1.62×10^{-3}	5.45×10^{-3}	1.29×10^{-2}	2.52×10^{-2}	4.36×10^{-2}	1.03×10^{-1}
30	1.21×10^{-5}	9.72×10^{-5}	7.78×10^{-4}	2.63×10^{-3}	6.23×10^{-3}	1.21×10^{-2}	2.10×10^{-2}	4.98×10^{-2}
40	3.84×10^{-6}	3.07×10^{-5}	2.45×10^{-4}	8.30×10^{-4}	1.96×10^{-3}	3.84×10^{-3}	6.64×10^{-3}	1.57×10^{-2}

Note:

Deflections listed above are based on system being fixed at both ends, with load in center of span.

Using the formula:

$$\text{Deflection} = \frac{W_S L^3}{192EI}$$

W_S = Load on shaft
L = Length
E = Modulus of elasticity
I = Moment of inertia of cross section

Example:

Shaft: 20 mm diameter
Load: 25 kgf
Length: 1000 mm
Multiplier (From Table 6): 3.15×10^{-2} mm/kg

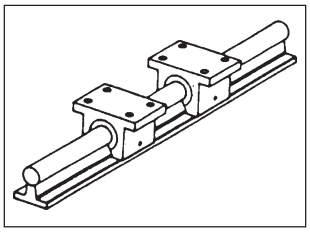
$$\text{Deflection} = \frac{3.15 \times 10^{-2} \text{ mm}}{\text{kgf}} \times 25 \text{ kgf} = 0.7875 \text{ mm}$$

$$\text{Shaft Load} = \frac{\text{Total Load}}{\text{Number of Shafts}}$$

USES STANDARD PIC COMPONENTS

STEP 4

User Assembled †



SYSTEM 3

COMPONENT SELECTION SYSTEMS 3 / INCH & METRIC

Bill of Material — Systems 3 / Inch

Shaft Dia. (in)	Bearing			Bearing Housing		Shafting		Shaft Support Rail	
	Type	Part No.	QTY	Part No.	QTY	Type	Part No.	Part No.	QTY *
1/2	Self-Aligning	PFLO-8	2	S5-13S	2	1060 Steel	A10-8D-**	PSR-8-PD	1
	Engr. Plastic	PLO-8	2	S5-13		303 Stainless	A11-8D-**		
5/8	Self-Aligning	PFLO-10	2	S5-14S	2	1060 Steel	A10-10D-**	PSR-10-PD	1
	Engr. Plastic	PLO-10	2	S5-14		303 Stainless	A11-10D-**		
3/4	Self-Aligning	PFLO-12	2	S5-15S	2	1060 Steel	A10-12D-**	PSR-12-PD	1
	Engr. Plastic	PLO-12	2	S5-15		303 Stainless	A11-12D-**		
1	Self-Aligning	PFLO-16	2	S5-16S	2	1060 Steel	A10-16D-**	PSR-16-PD	1
	Engr. Plastic	PLO-16	2	S5-16		303 Stainless	A11-16D-**		
1 1/4	Self-Aligning	PFLO-20	2	S5-17S	2	1060 Steel	A10-20D-**	PSR-20-PD	1
	Engr. Plastic	PLO-20	2	S5-17		303 Stainless	A11-20D-**		
1 1/2	Self-Aligning	PFLO-24	2	S5-18S	2	1060 Steel	A10-24D-**	PSR-24-PD	1
	Engr. Plastic	PLO-24	2	S5-18		303 Stainless	A11-24D-**		

Bill of Material — Systems 3 / Metric

Shaft Dia. (mm)	Bearing			Bearing Housing		Shafting			Shaft Support Rail	
	Type	Part No.	QTY	Part No.	QTY	Type	Part No.	QTY	Part No.	QTY *
12	Self-Aligning	MPFLO-12	2	MSO-12	2	1060 Steel	MA10-12D-**	1	MPSR-12-PD	1
	Engr. Plastic	MPLO-12	2			303 Stainless	MA11-12D-**			
16	Self-Aligning	MPFLO-16	2	MSO-16	2	1060 Steel	MA10-16D-**	1	MPSR-16-PD	1
	Engr. Plastic	MPLO-16	2			303 Stainless	MA11-16D-**			
20	Self-Aligning	MPFLO-20	2	MSO-20	2	1060 Steel	MA10-20D-**	1	MPSR-20-PD	1
	Engr. Plastic	MPLO-20	2			303 Stainless	MA11-20D-**			
25	Self-Aligning	MPFLO-25	2	MSO-25	2	1060 Steel	MA10-25D-**	1	MPSR-25-PD	1
	Engr. Plastic	MPLO-25	2			303 Stainless	MA11-25D-**			
30	Self-Aligning	MPFLO-30	2	MSO-30	2	1060 Steel	MA10-30D-**	1	MPSR-30-PD	1
	Engr. Plastic	MPLO-30	2			303 Stainless	MA11-30D-**			
40	Self-Aligning	MPFLO-40	2	MSO-40	2	1060 Steel	MA10-40D-**	1	MPSR-40-PD	1
	Engr. Plastic	MPLO-40	2			303 Stainless	MA11-40D-**			

Example

System 3 Bill of Material Example:

System 3, 48 inches long, with self-aligning recirculating bearings would consist of the following:

- 2 PFLO-8 bearings
- 2 S5-13S bearing housings
- 1 A10-8D-48 shaft
- 2 PSR-8-PD shaft support rails

Example — System 3:

48" long, 1/2" shaft with self-aligining recirculating bearings.

Part Number = LS38-48

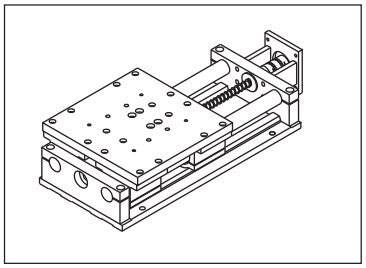
NOTE: * Quantity of support rail depends on shaft length: each support rail is 24 inches (610 mm) long.

** Length of shaft in inches for inch systems. Length of shaft in millimeters for metric systems.

† Can be ordered pre-assembled by PIC

TECHNICAL SECTION

System 9 — Economical and Quick Delivery



SYSTEM 9

PIC Design has developed a modular pre-assembled precision product. This unit is ideal for vertical applications. It is made with 3/4 inch suspended shafting with a 1/2 inch diameter lead screw.

Specifications

Flatness (No Load): ± .0002 in./in.

Straightness: ± .0002 in./in.

Repeatability: ± .0005 in.

Positional Accuracy: ± 0.0006 in./in.

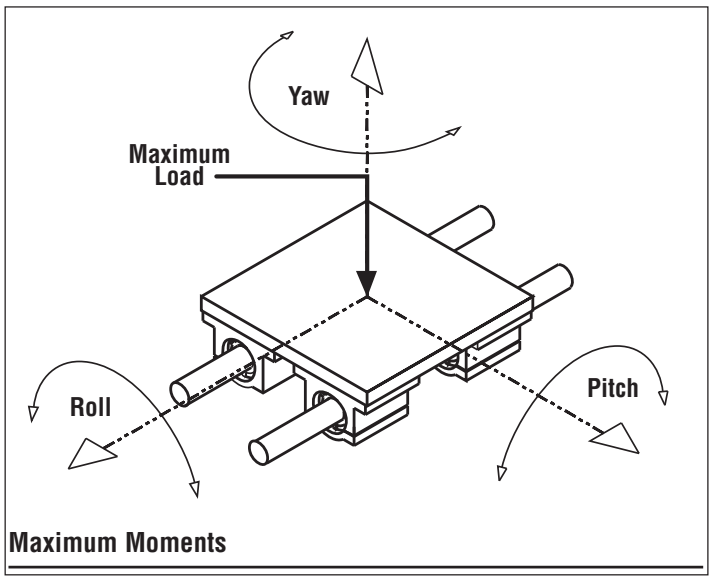
Coef. of Friction: .01 recirculating ball linear bearings
.2 for engineered plastic linear bearings

Break Away Torque Typ.: 10 to 25 inch-ounces

Weight: System 9 with 4 inches of travel = 11.6 pounds
For longer travels add 0.5 pounds per inch of travel (carriage assembly 3.5 pounds)

Material:
- — Aluminum base, carriage and pillow blocks
- — Stainless steel lead screw with engineered plastic nut
- — C1060 hardened & ground shafting & self-aligning recirculating linear ball bearings or 303 stainless steel shafting & engineered plastic bearings
- — Stainless steel radial bearings ABEC 7
- — 17-4 Stainless steel zero backlash coupling
  NEMA 23 for 1/4" motor shaft
  NEMA 34 for 3/8" motor shaft

Finish: Aluminum; black anodize



Maximum Moments

Maximum Loads — Load Centered On Carriage Top (pounds)

Recirculating Ball Linear Bearings

Travel (Inches)	20	16	12	8	4
Loads Static & Dynamic*	190	220	270	350	480

Engineered Plastic Linear Bearings

Travel (Inches)	20	16	12	8	4
Loads Static	190	220	270	350	480
Loads Dynamic**	360	360	360	360	360

Deflection — Load Centered On Carriage Top

Travel (Inches)	20	16	12	8	4
Deflection (Inch/100 lb.)	.013	.008	.005	<.001	<.001

Maximum Moments — Ft. - lbs.

Recirculating Ball Linear Bearing

	Static	Dynamic*
Roll Axis	300	80
Pitch Axis	350	100
Yaw Axis	350	100

Engineered Plastic Linear Bearing

Travel	20	16	12	8	4
Roll Axis Static	110	130	160	200	270
Roll Axis Dynamic	50	50	50	50	50
Pitch Axis Static	480	480	480	480	480
Pitch Axis Dynamic	60	60	60	60	60
Yaw Axis Static	480	480	480	480	480
Yaw Axis Dynamic	60	60	60	60	60

Notes

** Dynamic loads for recirculating ball linear bearings are based on 50 Million inches of life.*

*** Dynamic loads for engineered plastic linear bearings are based on PV = 16,000 with a V = 100 FPM.*

System Ordering Code

System 9 ordering code is as follows:

LS	9	XX	X	XX	X	X	X

LS = Linear system

9 = System number (9)

XX — Travel in Inches Standard Travel / Overall Length Not Including Motor Mount

Travel in Inches Standard Travel	Overall Length Not Including Motor Mount
04	12
08	16
12	20
16	24
20	28

X — Style of Lead Screw & Nut

(See Section 3 for Lead Screw Information)

- A = Anti Backlash — Acme style
- B = Ballscrew Powernut
- C = Ballscrew Anti Backlash
- P = Acme Power Nut — Acme style
- V = Anti Backlash — PV style
- Z = Anti Backlash — PZ style

XX — Lead Screw Code: 1/2" Diameter Screw

(See Section 3 for Lead Screw Information)

Code	Lead	Nut Style
40	.05	V & Z
41	.1	A, P, V & Z
42	.2	A, B, P, V & Z
43	.5	B, C, V & Z
44	1.0	V & Z

X — Motor Code

- 2 = NEMA 23 motor adapter & coupling
- 3 = NEMA 34 motor adapter & coupling
- H = Hand crank

X — Blank = Self aligning recirculating linear ball bearings & 1060

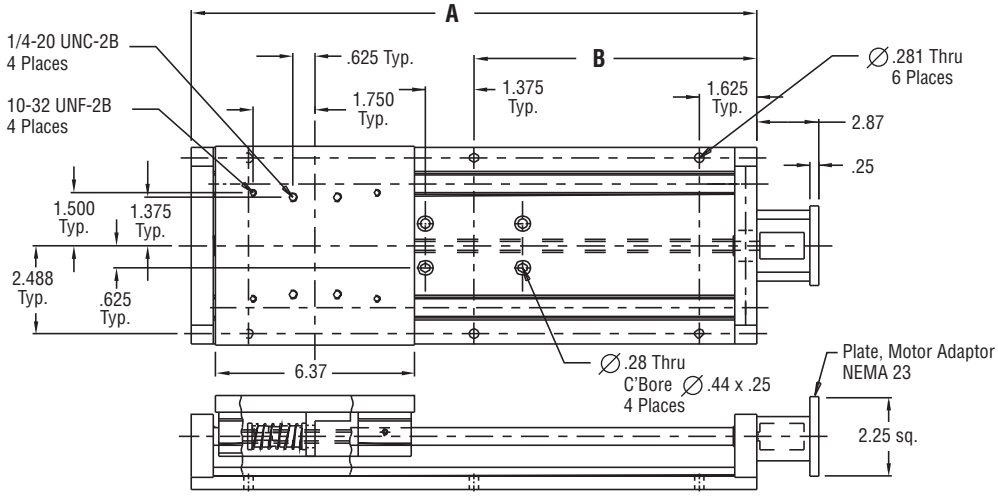
E = Engineered plastic linear bearings & 303 stainless steel shafting

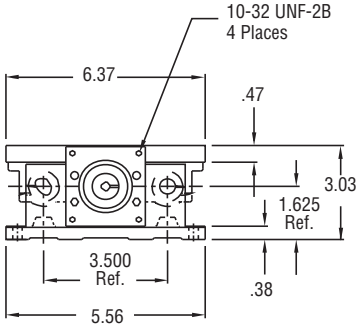
(see Section 4 for Linear Bearing Information)

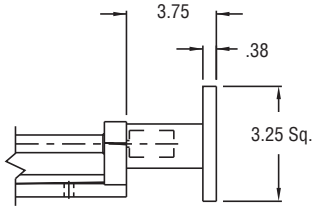
X — T = PTFE (Teflon) coated lead screw

(If lubrication is not desired, PTFE coated lead screw and PV or PZ style nut is recommended)

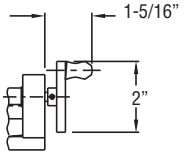
Model LS904 Thru LS920







NEMA 34 Motor Adapter



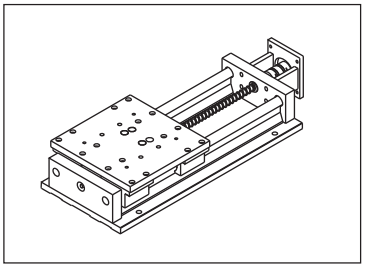
Hand Crank (W3-4)

'A' Inches	'B' Inches	Travel Inches	Part Number
12.00	6.00	4	**LS904**
16.00	8.00	8	**LS908**
20.00	10.00	12	**LS912**
24.00	12.00	16	**LS916**
28.00	14.00	20	**LS920**

(Shown with NEMA 23 motor adapter plate.
Options: NEMA 34 motor adapter plate or hand crank)

TECHNICAL SECTION

System 10 — Economical, Quick Delivery & Accuracy



SYSTEM 10

PIC Design has incorporated rail supports in an integral base plate and rail support system. Standardizing on 1/2" diameter shafting and lead screw allows for lower production costs and ease of stocking of the components which transfers to lower prices and quicker deliveries. Travels over 17 inches incorporates two standard base plates without jeopardizing the integrity of the system.

Specifications

Flatness: ± .0002 in/in

Straightness: ± .0002 in/in

Positional Repeatability: ± .0005 in.

Positional Accuracy: ± .0006 in/in

Coefficient of Friction: .01 recirculating ball linear bearing
.20 for engineered plastic linear bearing

Break Away Torque Typical: 10 to 25 inch-ounces

Weight: System 10 with 5 inches of travel: 8.1 pounds.
For longer travels add 0.4 pounds per inch of travel.
(Carriage assembly 2.4 pounds)

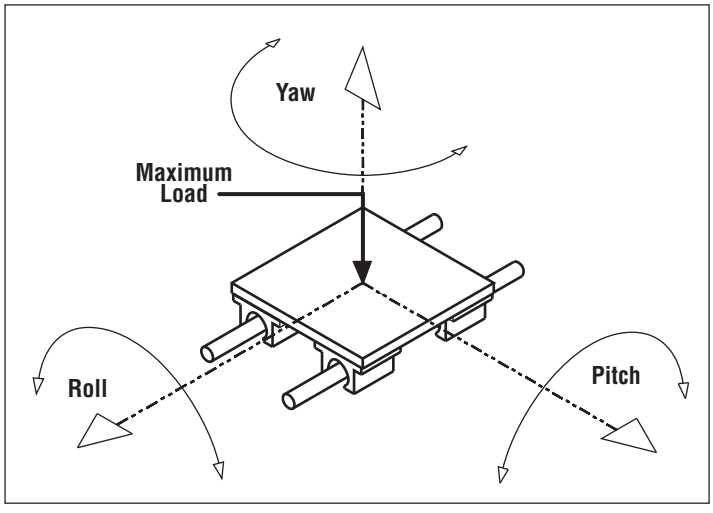
Material:
- — Aluminum base, carriage and pillow blocks
- — 303 stainless steel lead screw with engineered plastic nut
- — C1060 hardened & ground shafting & self-aligning recirculating linear ball bearings or 303 stainless steel Shafting & engineered plastic bearings
- — Stainless steel radial bearings ABEC 7
- — 17-4 Stainless steel zero backlash coupling
  NEMA 23 for 1/4" motor shaft
  NEMA 34 for 3/8" motor shaft

Finish: Aluminum black anodize

Loads Maximum:
- — Loads centered on carriage
- — Static 700 pounds
- — Dynamic 300 pounds for recirculating ball (50 million inches of life)
- — Dynamic 240 pounds for engineered plastic (PV = 10,000, V = 100 Fpm)

Maximum Moments

		Recirculating Ball Ft-Lb.	Engineered Plastic Ft-Lb.
Roll Axis —	Static	44	44
	Dynamic	15	12
Pitch Axis —	Static	52	52
	Dynamic	17	14
Yaw Axis —	Static	110	110
	Dynamic	28	22



Life With Recirculating Ball Linear Bearings $L = [C/F]^3 (B)$

L = Normal travel life
C = Rated dynamic load capacity of carriage
F = User applied load
B = 50 million inches of travel

Example: User is using recirculating ball bearing and has a 200 pound load center on carriage top. How many inches of travel can he expect?
$L = (300/200)^3(50 \text{ million}) =$
168 million inches or about 2660 miles.

Velocity = rpm x lead of lead screw

Example: Determine the velocity of a system with a motor running at 1750 rpm if a lead screw with a one-inch lead is used.

Velocity = 1750 rpm x 1 inch lead = 1750 inches per minute or 146 feet per minute.

High lead screw rpm and/or low lead screw leads may require lubrication of the lead screw.

System Ordering Code

System 10 ordering code is as follows:

LS	10	XX	X	XX	X	X	X

LS = Linear system

System number (10)

Travel in Inches Standard Travel	Overall Length Not Including Motor Mount
05	12
09	16
13	20
17	24
21	28
25	32
29	36
33	40
37	44
41	48

Style of Lead Screw & Nut

(See Section 3 for Lead Screw Information)

A = Anti Backlash — Acme style

B = Ballscrew Powernut

C = Ballscrew Anti Backlash

P = Acme Power Nut — Acme style

V = Anti Backlash — PV style

Z = Anti Backlash — PZ style

Lead Screw Code: 1/2" Diameter Screw

(See Section 3 for Lead Screw Information)

Code	Lead	Nut Style
40	.05	V & Z
41	.1	A, P, V & Z
42	.2	A, B, P, V & Z
43	.5	B, C, V & Z
44	1.0	V & Z

Motor Code

2 = NEMA 23 motor adapter & coupling

3 = NEMA 34 motor adapter & coupling

H = Hand crank

Blank = Self aligning recirculating linear ball bearings & 1060 shafting

E = Engineered plastic linear bearings & 303 stainless steel shafting

(see Section 4 for Linear Bearing Information)

T = PTFE (Teflon) coated lead screw

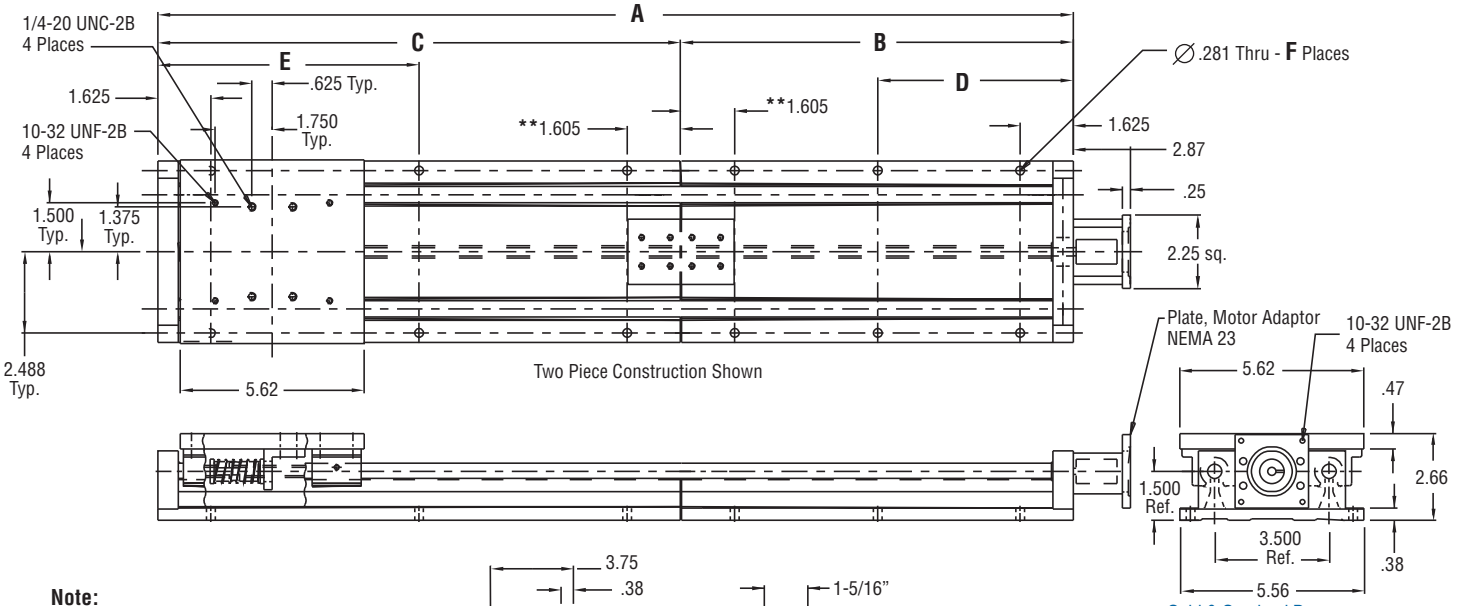
(If lubrication is not desired, PTFE coated lead screw and PV or PZ style nut is recommended)

Model LS1021 Thru LS1041 - Two Piece Construction

A Inches	B Inches	C Inches	D Inches	E Inches	F	Travel Inches	Part Number
*28.00	11.98	15.98	6.00	8.00	12	21	**LS1021**
32.00	15.98	15.98	8.00	8.00	12	25	**LS1025**
36.00	15.98	19.98	8.00	10.00	12	29	**LS1029**
40.00	19.98	19.98	10.00	10.00	12	33	**LS1033**
44.00	19.98	23.98	10.00	12.00	12	37	**LS1037**
48.00	23.98	23.98	12.00	12.00	12	41	**LS1041**

Model LS1005 Thru LS1017 - One Piece Construction

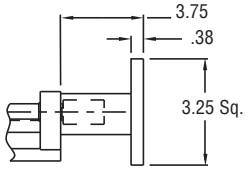
A Inches	D Inches	F	Travel Inches	Part Number
12.00	6.00	6	5	**LS1005**
16.00	8.00	6	9	**LS1009**
20.00	10.00	6	13	**LS1013**
24.00	12.00	6	17	**LS1017**



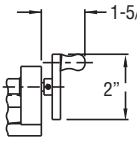
Note:

* Can be shipped as one piece construction

** Used for two piece construction or one piece 21" travel only



NEMA 34 Motor Adapter



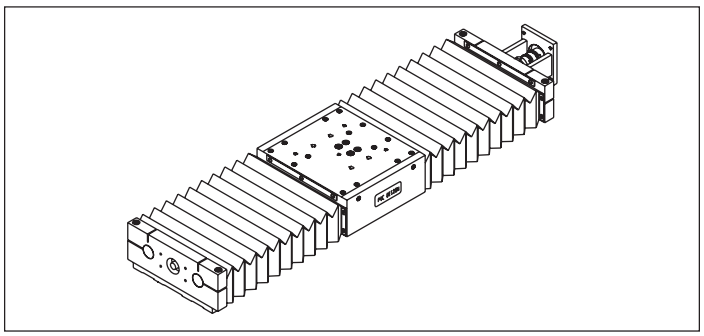
Hand Crank (W3-4)

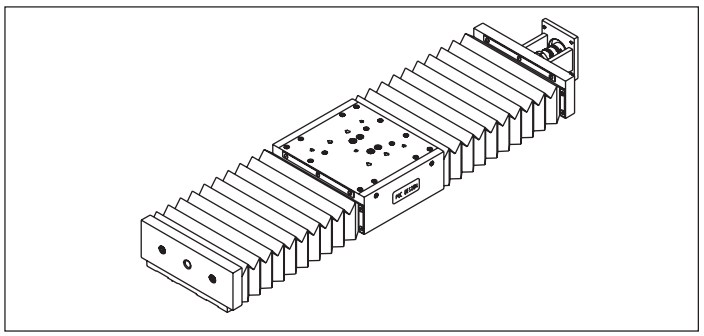
(Shown with NEMA 23 motor adapter plate. Options: NEMA 34 motor adapter plate or hand crank)

LINEAR MOTION SYSTEMS WITH INTEGRAL BELLOWS

Systems 9B and 10B

Systems 9 and 10 are available with a Protective Bellows Cover made of polyurethane –coated nylon. These units have the same load carrying ability as the standard Systems 9 and 10 but are protected from damage-causing debris. The cover is resistant to oil and will operate over a temperature range from — 65° to 250°F.





System 9B
System 9B is ideal for vertical applications. It is made with 3/4 inch and end suspended shafting and a 1/2 inch diameter lead screw.

System 10B
System 10B incorporates rail supports that are integral to the base plate and rail.

Specifications
Same as systems without Bellows Covers.

System Ordering Code — System 9B ordering code is as follows:

LS	9	B	XX	X	XX	X	X	X

LS = Linear system

System number (9)

B = Bellows Cover

Code	Travel In Inches	Overall Length Not Including Motor Mount
04	2.86	12
08	6.10	16
12	8.96	20
16	12.20	24
20	15.44	28

Style of Lead Screw & Nut

A = Anti Backlash — Acme style

B = Ballscrew Powernut

C = Ballscrew Anti Backlash

P = Acme Power Nut — Acme style

V = Anti Backlash — PV style

Z = Anti Backlash — PZ style

Lead Screw Code: 1/2" Diameter Screw

Code	Lead	Nut Style
40	.05	V & Z
41	.1	A, P, V & Z
42	.2	A, B, P, V & Z
43	.5	B, C, V & Z
44	1.0	V & Z

Motor Code

2 = NEMA 23 motor adapter & coupling

3 = NEMA 34 motor adapter & coupling

H = Hand crank

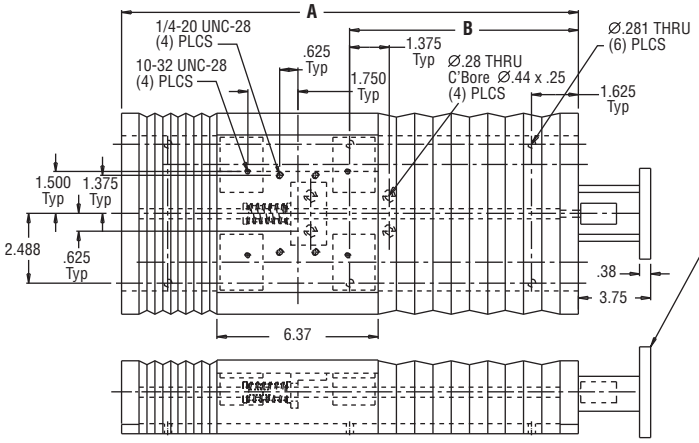
Blank = Self aligning recirculating linear ball bearings & 1060 shafting

E = Engineered plastic linear bearings & 303 stainless steel shafting

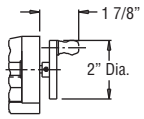
T = PTFE (Teflon) coated lead screw

(If lubrication is not desired, PTFE coated lead screw and PV or PZ style nut is recommended)

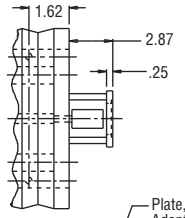
Model LS9B04 Thru LS9B20

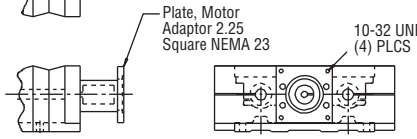


Models LS9B04 Thru LS9B20
(Shown with NEMA 34 Motor Adaptor Plate)

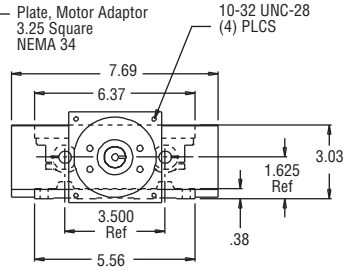


Hand Crank (W3-5)





Models LS9B04 Thru LS9B20
(Shown with NEMA 23 Motor Adaptor Plate)



Model LS9B Dimensions

'A' Inches	'B' Inches	Part Number
12.00	—	**LS9B04**
16.00	—	**LS9B08**
20.00	—	**LS9B12**
24.00	—	**LS9B16**
28.00	11.98	**LS9B20**

Shown with NEMA 23 motor adapter plate.

LINEAR MOTION SYSTEMS WITH INTEGRAL BELLOWS

System Ordering Code — System 10B ordering code is as follows:

LS	10	B	XX	X	XX	X	X	X

LS = Linear system

System number (10)

B = Bellows Cover

Code	Travel In Inches	Overall Length Not Including Motor Mount
05	3.48	12
09	6.34	16
13	9.20	20
17	12.06	24
21	14.92	28
25	17.78	32
29	20.64	36
33	23.88	40
37	26.74	44
41	29.60	48

Style of Lead Screw & Nut

A = Anti Backlash — Acme style

B = Ball Screw Power Nut

C = Ball Screw Anti Backlash Nut

P = Acme Power Nut — Acme style

V = Anti Backlash — PV style

Z = Anti Backlash — PZ style

Lead Screw Code: 1/2" Diameter Screw

Code	Lead	Nut Style
40	.05	V & Z
41	.1	A, P, V & Z
42	.2	A, B, P, V & Z
43	.5	B, C, V & Z
44	1.0	V & Z

Motor Code

2 = NEMA 23 motor adapter & coupling

3 = NEMA 34 motor adapter & coupling

H = Hand crank

Blank = Self aligning recirculating linear ball bearings & 1060 Shafting

E = Engineered plastic linear bearings & 303 stainless steel shafting

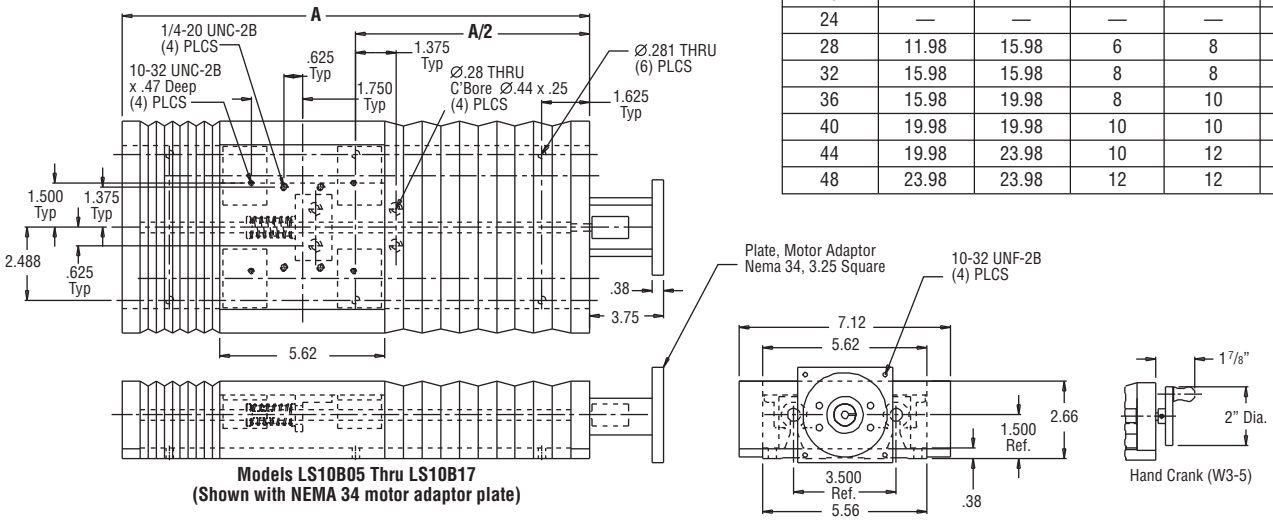
T = PTFE (Teflon) coated lead screw

(If lubrication is not desired, PTFE coated lead screw and PV or PZ style nut is recommended)

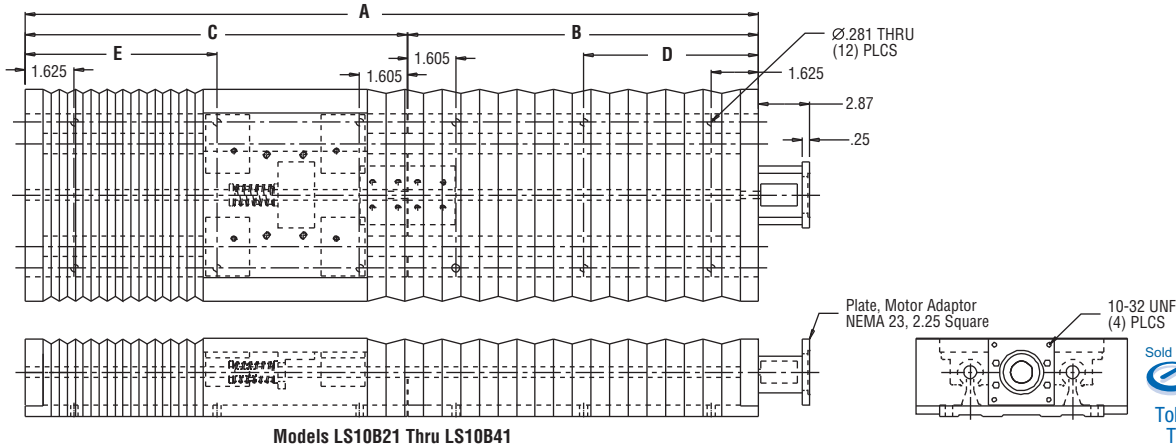
Model LS10B Dimensions

A Inches	B Inches	C Inches	D Inches	E Inches	Part Number
12	—	—	—	—	**LS10B05**
16	—	—	—	—	**LS10B09**
20	—	—	—	—	**LS10B13**
24	—	—	—	—	**LS10B17**
28	11.98	15.98	6	8	**LS10B21**
32	15.98	15.98	8	8	**LS10B25**
36	15.98	19.98	8	10	**LS10B29**
40	19.98	19.98	10	10	**LS10B33**
44	19.98	23.98	10	12	**LS10B37**
48	23.98	23.98	12	12	**LS10B41**

Model LS10B05 Thru LS10B41



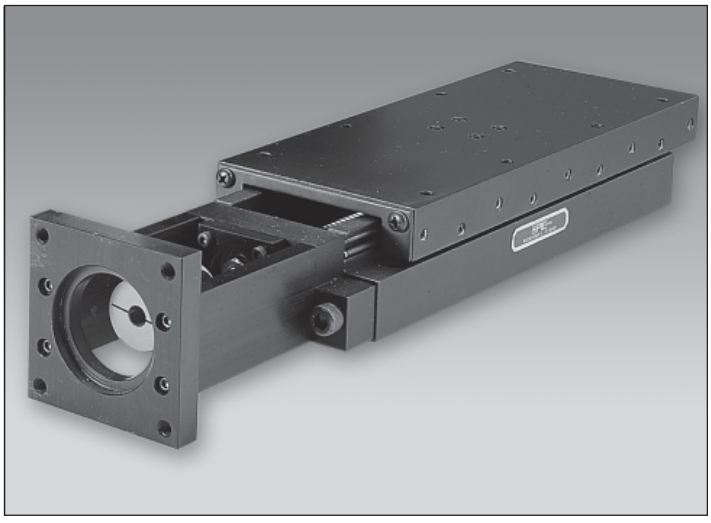
Models LS10B05 Thru LS10B17
(Shown with NEMA 34 motor adaptor plate)



Models LS10B21 Thru LS10B41
(Shown with NEMA 23 motor adaptor plate)

POSITIONING STAGES

Ball or Crossed Roller



PIC's industrial grade stages (tables) provide solutions for indexing where the strict requirements of scientific stages are not needed. Mounting holes in top and base are located to easily allow two stages to be configured as an X-Y positioner. For optional Z bracket configuration, consult factory.

- Ball or Crossed Roller
- Acme or Ball Screw
- NEMA 23 Motor Mount or Hand Crank
- X, XY or XYZ Style

Maximum Loads —

Load centered on carriage top, carriage centered on base (lbs.)

Loads (lbs.)	Travel (in.)					
	2	4	6	8	10	12
Ball Slide	30	40	50	60	80	100
Crossed Roller	240	312	408	672	744	840

Load centered on carriage top, carriage at full travel position (lbs.)

Loads (lbs.)	Travel (in.)					
	2	4	6	8	10	12
Ball Slide	20	20	20	20	30	40
Crossed Roller	153	138	147	309	318	324

Maximum Moments —

Load centered on carriage top (lbs.-in.)

Ball Slide	Travel (in.)					
	2	4	6	8	10	12
Roll Axis, X	30	41	51	61	82	102
Pitch Axis, Y	20	33	47	62	91	121
Yaw Axis, Z	10	16	23	31	45	60
Crossed Roller	**2**	**4**	**6**	**8**	**10**	**12**
Roll Axis, X	246	320	418	689	763	861
Pitch Axis, Y	126	184	262	479	538	617
Yaw Axis, Z	63	92	131	239	269	308

Specifications

Flatness (no load):	±.0002 in/in
Straightness:	±.0002 in/in
Repeatability:	Within .0004 inches
Positional Accuracy:	±.0006 in/in
Break-a-way Torque:	10 to 15 oz-in* **ACME Anti-backlash Nut*

Material

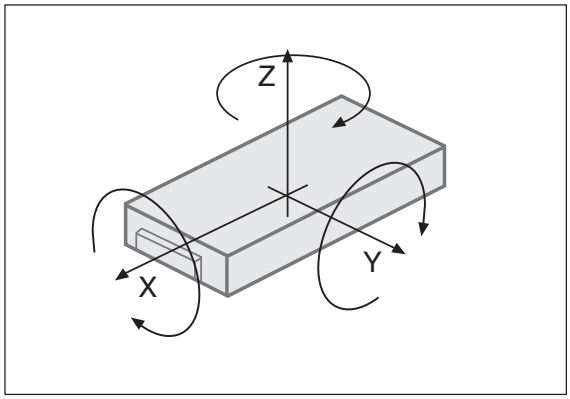
Carriage and Base:	Black, Anodized Aluminum
Rolling Elements:	Hardened Steel

Lead Screw and Nut:

Acme	303 Stainless Steel Screw
Acetal	Teflon & Silicon filled nut
Ball	17-4PH Stainless Steel Rc 40 screw and nut

Optional Configurations

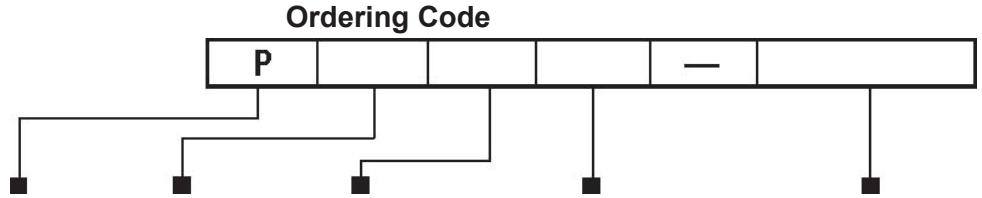
For manual applications the tables are supplied without motor mount and coupling — just substitute "M" for "C" in the part number. Manual units will be fitted with a hand crank.



POSITIONING STAGES

Ball or Crossed Roller

Ordering Code



Positioning	Code	Slide Type	Mount	
	B	Ball Slide	C	NEMA 23 Mount
	R	Crossed Roller Slide	M	Less motor Mount (see optional configuration)

Travel	Overall Length
2	7
4	9
6	12
8	17
10	20
12	23

Lead Screw Code

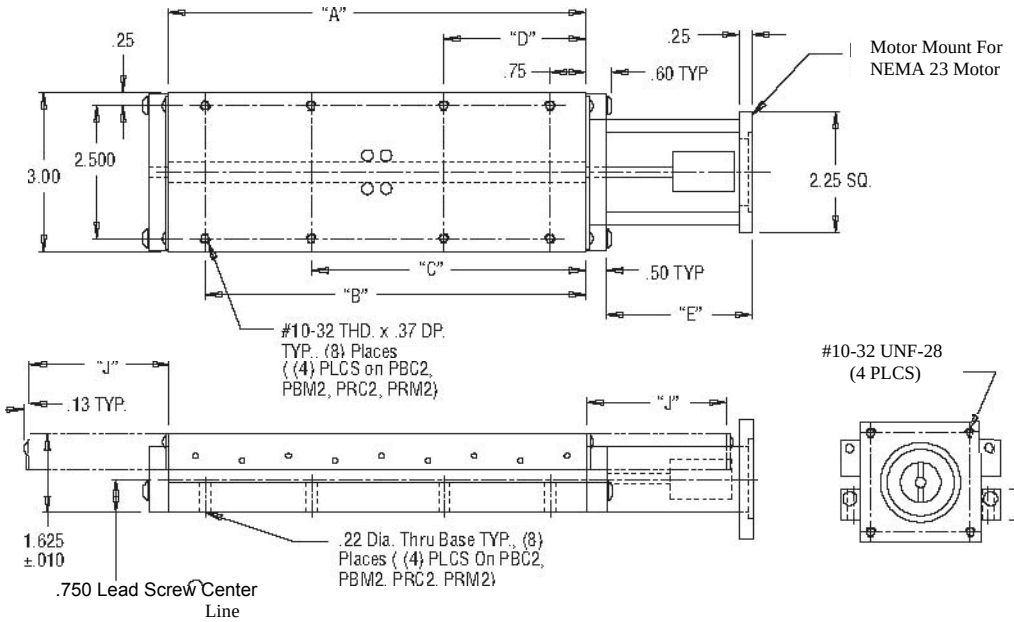
Code	Screw Thread	Advance Per Turn
1X3710	3/8-10 acme	0.100 in
2X3710	2/8-10 (2 start)	0.200 in
5X3705	3/8-5 (5 start)	1.000 in
1X102M	10 X 2 mm acme	2.000 mm
1B3708	3/8 Ball Screw	0.125 in

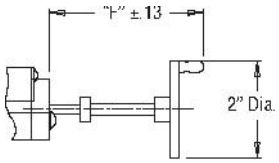
Example

Standard Version: PBC2-1X310 is a ball slide with a motor mount and coupling, a 2-inch travel table, and a .1-inch lead.

Optional Version: PBM2-1X310 is the same table and lead less the motor mount and coupling, but includes hand crank

Outline Dimensions

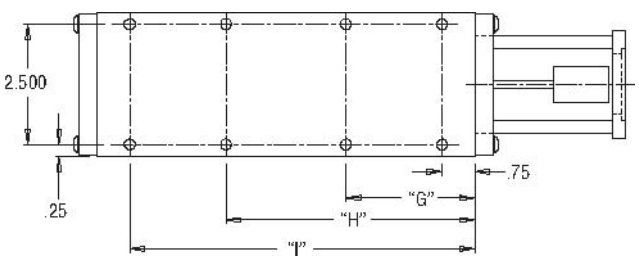




PBM/PRM With Hand Crank

A	B	C	D	E	F	G	H	I	J	Part Number
4.00	N/A	3.25	0.75	2.00	2.75	0.75	3.25	N/A	1.00	**PB 2 / PR 2**
6.0	5.25	4.25	1.75	2.00	2.75	1.75	4.25	5.25	2.00	**PB 4 / PR 4**
8.00	7.25	5.25	2.75	3.00	3.75	2.75	5.25	7.25	3.00	**PB 6 / PR 6**
12.00	11.25	7.25	4.75	4.00	4.75	3.75	8.25	11.25	4.00	**PB 8 / PR 8**
14.00	13.25	8.25	5.75	5.00	5.75	4.75	9.25	13.25	5.00	**PB 10 / PR 10**
16.00	15.25	9.25	6.75	6.00	6.75	5.75	10.25	13.25	6.00	**PB 12 / PR 12**

PCB/PRC With NEMA 23 Motor Adapter



ROTARY TABLE

Ratios 45:1, 90:1, 180:1

Ratio*	Motor Mount** Part Number	Hand Crank Part Number
45:1	**RT4-45-M**	**RT4-45-H**
90:1	**RT4-90-M**	**RT4-90-H**
180:1	**RT4-180-M**	**RT4-180-H**

* For special ratios consult factory
** Use of NEMA 17 motor eliminates hand crank

Features

- PIC's Rotary Tables provide smooth precise rotational positioning
- No Lube required.
- Can be mounted in any plane.
- Hand Crank or NEMA 17 motor mount.
- Will mount to PIC's line of Systems 9, 10 and PB*X* & PR*X* Positioning Stages.

Material

Body:	Black Anodized Aluminum
Worm:	303 Stainless Steel
Gear:	464 Bronze
Bearings:	Stainless Steel ABEC 7 + Thrust
Shafting :	303 Stainless Steel

Specifications

Backlash:	4 arc-min
Positional Accuracy:	4 arc-min
Run out (wobble):	0.03º
Start up torque at no load:	Negligible
Start up at 50 pound load:	1 oz-in
Maximum input speed:	1750 RPM
Maximum vertical load:	100 pounds