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.

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www.electromate.com
sales@electromate.com
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
BEARING SELECTION

Two types of bearings, self-aligning recirculating ball bearings and engineered plastic bearings, are available from PIC. The designer must 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,

\[ L = \left( \frac{f_w \cdot C}{P} \right)^{3/4} \cdot 2 \cdot 10^6 \]

For metric calculations,

\[ L (\text{km}) = \left( \frac{f_w \cdot C}{P} \right)^{3/4} \cdot 50 \]

With:

- \( f_h \) = 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:

\[ L_h = \frac{2 \cdot L \cdot n_1 \cdot 60}{L_s} \]

With:

- \( L_s \) = 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,

\[ C = \sqrt[3]{\frac{2 \cdot 10^6}{f_h \cdot P}} \]

For distances in kilometers,

\[ C = \sqrt[3]{\frac{1.2 \cdot 10^9}{f_h \cdot P}} \]

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:

\[ L_h = \frac{2 \cdot L \cdot n_1 \cdot 60}{L_s} \]

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

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 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 total load in pounds on the bearing by the PV for a particular application, divide the effective area in square inches, and multiply by the average bearing velocity in inches. To calculate PV, use the following equations:

\[ PV = \frac{P \cdot V}{A} \]

Example of Calculation:

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

\[ P = \frac{\text{Load (lb.)}}{1D \cdot L} = \frac{43.75}{1 \cdot 2.25} = 19.44 \text{ PSI} \]

\[ PV = 19.44 \cdot 83.33 = 1620 \text{ PSI/FPM} \]
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

<table>
<thead>
<tr>
<th>Diameter (inch)</th>
<th>PIC Series</th>
<th>Tolerance (inch)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4</td>
<td>A10L-4</td>
<td>0.2495 / 0.2490</td>
</tr>
<tr>
<td>3/8</td>
<td>A10L-6</td>
<td>0.3745 / 0.3740</td>
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<td>1/2</td>
<td>A10L-8</td>
<td>0.4995 / 0.4990</td>
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<tr>
<td>5/8</td>
<td>A10L-10</td>
<td>0.6245 / 0.6240</td>
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<td>3/4</td>
<td>A10L-12</td>
<td>0.7495 / 0.7490</td>
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<tr>
<td>1</td>
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</tr>
<tr>
<td>1 1/4</td>
<td>A10L-20</td>
<td>1.2495 / 1.2490</td>
</tr>
<tr>
<td>1 1/2</td>
<td>A10L-24</td>
<td>1.4994 / 1.4989</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Shaft Diameter (inches)</th>
<th>Length Of Unsupported Section (inches)</th>
<th>4</th>
<th>6</th>
<th>8</th>
<th>10</th>
<th>12</th>
<th>16</th>
<th>20</th>
<th>24</th>
<th>30</th>
<th>36</th>
<th>42</th>
<th>48</th>
<th>72</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4</td>
<td>5.85 x 10^-5</td>
<td>1.98 x 10^-4</td>
<td>4.68 x 10^-4</td>
<td>9.15 x 10^-4</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>3/8</td>
<td>1.20 x 10^-5</td>
<td>4.05 x 10^-5</td>
<td>9.63 x 10^-5</td>
<td>1.79 x 10^-4</td>
<td>3.25 x 10^-4</td>
<td>7.68 x 10^-4</td>
<td>1.43 x 10^-3</td>
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<td>4.83 x 10^-3</td>
<td>8.33 x 10^-3</td>
<td>1.32 x 10^-2</td>
<td>1.98 x 10^-2</td>
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<td></td>
</tr>
<tr>
<td>1/2</td>
<td>3.63 x 10^-6</td>
<td>1.23 x 10^-5</td>
<td>2.90 x 10^-5</td>
<td>5.68 x 10^-5</td>
<td>9.83 x 10^-5</td>
<td>2.33 x 10^-4</td>
<td>4.50 x 10^-4</td>
<td>7.85 x 10^-4</td>
<td>1.53 x 10^-3</td>
<td>2.65 x 10^-3</td>
<td>4.20 x 10^-3</td>
<td>6.28 x 10^-3</td>
<td>2.12 x 10^-2</td>
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<tr>
<td>5/8</td>
<td>7.15 x 10^-7</td>
<td>2.42 x 10^-6</td>
<td>5.73 x 10^-6</td>
<td>1.12 x 10^-5</td>
<td>1.94 x 10^-5</td>
<td>4.58 x 10^-5</td>
<td>8.95 x 10^-5</td>
<td>1.55 x 10^-4</td>
<td>3.02 x 10^-4</td>
<td>5.23 x 10^-4</td>
<td>8.30 x 10^-4</td>
<td>1.24 x 10^-3</td>
<td>4.18 x 10^-3</td>
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</tr>
<tr>
<td>3/4</td>
<td>2.25 x 10^-7</td>
<td>7.70 x 10^-6</td>
<td>1.76 x 10^-5</td>
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<td>6.15 x 10^-5</td>
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<td>3.93 x 10^-4</td>
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<td>2.01 x 10^-4</td>
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<td>1.08 x 10^-4</td>
<td>1.61 x 10^-4</td>
<td>5.43 x 10^-4</td>
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</tr>
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<td>1 1/4</td>
<td>4.48 x 10^-8</td>
<td>1.51 x 10^-6</td>
<td>3.58 x 10^-6</td>
<td>7.00 x 10^-6</td>
<td>1.21 x 10^-5</td>
<td>2.88 x 10^-5</td>
<td>5.60 x 10^-6</td>
<td>9.68 x 10^-6</td>
<td>1.89 x 10^-5</td>
<td>3.28 x 10^-5</td>
<td>5.18 x 10^-5</td>
<td>7.75 x 10^-5</td>
<td>2.58 x 10^-4</td>
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<tr>
<td>1 1/2</td>
<td>1.42 x 10^-8</td>
<td>4.78 x 10^-6</td>
<td>1.13 x 10^-5</td>
<td>2.21 x 10^-5</td>
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<td>1.64 x 10^-5</td>
<td>2.45 x 10^-5</td>
<td>8.25 x 10^-5</td>
<td></td>
</tr>
</tbody>
</table>

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

Using the formula:

\[
\text{Deflection} = \frac{W \cdot L^3}{192EI}
\]

\(W\) = 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 x 10^-4 inches/pound
Deflection = 9.15 x 10^-4 x 8 = 0.073 inches

**Note:**
If deflection is greater than 1/2\(^\circ\), suggest using shaft supports and open bearings.

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

<table>
<thead>
<tr>
<th>Shaft Diameter (mm)</th>
<th>Length Of Unsupported Section (mm)</th>
<th>125</th>
<th>250</th>
<th>500</th>
<th>750</th>
<th>1000</th>
<th>1250</th>
<th>1500</th>
<th>2000</th>
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<tbody>
<tr>
<td>12</td>
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<td>3.80 x 10^-4</td>
<td>3.04 x 10^-2</td>
<td>1.02 x 10^-1</td>
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<td>4.75 x 10^-1</td>
<td>8.21 x 10^-1</td>
<td>1.95</td>
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<tr>
<td>16</td>
<td>1.50 x 10^-4</td>
<td>1.20 x 10^-3</td>
<td>9.62 x 10^-3</td>
<td>3.25 x 10^-2</td>
<td>7.7 x 10^-2</td>
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<tr>
<td>20</td>
<td>6.15 x 10^-5</td>
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<td>1.06 x 10^-1</td>
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<tr>
<td>25</td>
<td>2.52 x 10^-5</td>
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<td>1.62 x 10^-3</td>
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<td>4.36 x 10^-2</td>
<td>1.03 x 10^-1</td>
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<tr>
<td>30</td>
<td>1.21 x 10^-5</td>
<td>9.72 x 10^-4</td>
<td>7.78 x 10^-4</td>
<td>2.63 x 10^-3</td>
<td>6.23 x 10^-3</td>
<td>1.21 x 10^-2</td>
<td>2.10 x 10^-2</td>
<td>4.98 x 10^-2</td>
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<tr>
<td>40</td>
<td>3.84 x 10^-6</td>
<td>3.07 x 10^-3</td>
<td>2.45 x 10^-3</td>
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<td>3.84 x 10^-3</td>
<td>6.64 x 10^-3</td>
<td>1.57 x 10^-2</td>
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</tr>
</tbody>
</table>

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

Using the formula:

\[
\text{Deflection} = \frac{W \cdot L^3}{192EI}
\]

\(W\) = 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 x 10^-4 mm/kg
Deflection = 3.15 x 10^-4 x 25 = 0.7875 mm

**Note:**
If deflection is greater than 1/2\(^\circ\), suggest using shaft supports and open bearings.
### Bill of Material — Systems 3 / Inch

| Shaft Dia. (in) | Bearing | Part | QTY | Bearing Housing | Part | QTY | Shafting | Part | QTY | Shaft Support Rail | Part | QTY *
<table>
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<td>SS-15S</td>
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<td>SS-15</td>
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<td>SS-16S</td>
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### Bill of Material — Systems 3 / Metric

| Shaft Dia. (mm) | Bearing | Part | QTY | Bearing Housing | Part | QTY | Shafting | Part | QTY | Shaft Support Rail | Part | QTY *
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<td>MPL-20</td>
<td>2</td>
<td>303 Stainless</td>
<td>MA11-20D-**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>25</td>
<td>Self-Aligning</td>
<td>MPFLO-25</td>
<td>2</td>
<td>MSO-25</td>
<td>2</td>
<td>1060 Steel</td>
<td>MA10-25D-**</td>
<td>MPSR-25-PD</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>Self-Aligning</td>
<td>MPFLO-30</td>
<td>2</td>
<td>MSO-30</td>
<td>2</td>
<td>1060 Steel</td>
<td>MA10-30D-**</td>
<td>MPSR-30-PD</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Engr. Plastic</td>
<td>MPL-30</td>
<td>2</td>
<td>303 Stainless</td>
<td>MA11-30D-**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>40</td>
<td>Self-Aligning</td>
<td>MPFLO-40</td>
<td>2</td>
<td>MSO-40</td>
<td>2</td>
<td>1060 Steel</td>
<td>MA10-40D-**</td>
<td>MPSR-40-PD</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Engr. Plastic</td>
<td>MPL-40</td>
<td>2</td>
<td>303 Stainless</td>
<td>MA11-40D-**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**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 SS-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-aligning 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**

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:** ± .0006 in./in.
- **Coeff. 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 Loads — Load Centered On Carriage Top (pounds)

<table>
<thead>
<tr>
<th>Travel (Inches)</th>
<th>20</th>
<th>16</th>
<th>12</th>
<th>8</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recirculating Ball Linear Bearings</td>
<td>Loads Static &amp; Dynamic*</td>
<td>190</td>
<td>220</td>
<td>270</td>
<td>350</td>
</tr>
<tr>
<td>Engineered Plastic Linear Bearings</td>
<td>Loads Static</td>
<td>190</td>
<td>220</td>
<td>270</td>
<td>350</td>
</tr>
<tr>
<td></td>
<td>Loads Dynamic**</td>
<td>360</td>
<td>360</td>
<td>360</td>
<td>360</td>
</tr>
</tbody>
</table>

### Deflection — Load Centered On Carriage Top

<table>
<thead>
<tr>
<th>Travel (Inches)</th>
<th>20</th>
<th>16</th>
<th>12</th>
<th>8</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deflection (Inch/100 lb.)</td>
<td>.013</td>
<td>.008</td>
<td>.005</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

### Maximum Moments — Ft. - lbs.

| 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:

<table>
<thead>
<tr>
<th>LS</th>
<th>9</th>
<th>XX</th>
<th>X</th>
<th>XX</th>
<th>X</th>
<th>X</th>
<th>X</th>
</tr>
</thead>
</table>

- **LS** = Linear system
- **9** = System number (9)

<table>
<thead>
<tr>
<th>Travel in Inches Standard Travel</th>
<th>Overall Length Not Including Motor Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>04</td>
<td>12</td>
</tr>
<tr>
<td>08</td>
<td>16</td>
</tr>
<tr>
<td>12</td>
<td>20</td>
</tr>
<tr>
<td>16</td>
<td>24</td>
</tr>
<tr>
<td>20</td>
<td>28</td>
</tr>
</tbody>
</table>

**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)

<table>
<thead>
<tr>
<th>Code</th>
<th>Lead Nut Style</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>.05 V &amp; Z</td>
</tr>
<tr>
<td>41</td>
<td>.1 A, P, V &amp; Z</td>
</tr>
<tr>
<td>42</td>
<td>.2 A, B, P, V &amp; Z</td>
</tr>
<tr>
<td>43</td>
<td>.5 B, C, V &amp; Z</td>
</tr>
<tr>
<td>44</td>
<td>1.0 V &amp; Z</td>
</tr>
</tbody>
</table>

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

- **LS904**
  - **A** = 1/4-20 UNC-2B
  - **B** = 10-32 UNF-2B
  - **C** = 281 Thru 6 Places
  - **D** = 10-32 UNF-2B
  - **E** = 281 Thru C Bore .44 x .25
  - **F** = 2.25 sq.
  - **G** = 1.500 Typ.
  - **H** = 1.375 Typ.
  - **J** = 1.625 Typ.
  - **K** = 1.625 Typ.
  - **L** = 2.87
  - **M** = .25
  - **N** = 6.37
  - **O** = 10-32 UNF-2B
  - **P** = 2.25 sq.
  - **Q** = 3.500 Ref.
  - **R** = 3.03
  - **S** = .38
  - **T** = 1.625

- **LS912**
- **LS916**
- **LS920**

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

- Flattness: ± .0002 in/in
- Straightness: ± .0002 in/in
- Positional Repeatability: ± .0005 in.
- Positional Accuracy: ± .0006 in/in
- Coefficient of Friction: .01 recirculating ball 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**

<table>
<thead>
<tr>
<th></th>
<th>Recirculating Ball Ft-Lb</th>
<th>Engineered Plastic Ft-Lb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roll Axis — Static</td>
<td>44</td>
<td>44</td>
</tr>
<tr>
<td>Dynamic</td>
<td>15</td>
<td>12</td>
</tr>
<tr>
<td>Pitch Axis — Static</td>
<td>52</td>
<td>52</td>
</tr>
<tr>
<td>Dynamic</td>
<td>17</td>
<td>14</td>
</tr>
<tr>
<td>Yaw Axis — Static</td>
<td>110</td>
<td>110</td>
</tr>
<tr>
<td>Dynamic</td>
<td>28</td>
<td>22</td>
</tr>
</tbody>
</table>

**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?

\[
L = \left(\frac{300}{200}\right)^3(50 \text{ million}) = 168 \text{ million inches or about 2660 miles.}
\]

**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:

![Ordering Code Diagram](image)

### Model LS1021 Thru LS1041 - Two Piece Construction

<table>
<thead>
<tr>
<th>A (Inches)</th>
<th>B (Inches)</th>
<th>C (Inches)</th>
<th>D (Inches)</th>
<th>E (Inches)</th>
<th>F (Inches)</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>28.00</td>
<td>11.98</td>
<td>15.98</td>
<td>6.00</td>
<td>8.00</td>
<td>12</td>
<td>LS1021</td>
</tr>
<tr>
<td>32.00</td>
<td>11.98</td>
<td>15.98</td>
<td>6.00</td>
<td>8.00</td>
<td>12</td>
<td>LS1025</td>
</tr>
<tr>
<td>36.00</td>
<td>11.98</td>
<td>15.98</td>
<td>8.00</td>
<td>8.00</td>
<td>10</td>
<td>LS1029</td>
</tr>
<tr>
<td>40.00</td>
<td>11.98</td>
<td>15.98</td>
<td>10.00</td>
<td>10.00</td>
<td>12</td>
<td>LS1033</td>
</tr>
<tr>
<td>44.00</td>
<td>11.98</td>
<td>23.98</td>
<td>12.00</td>
<td>10.00</td>
<td>12</td>
<td>LS1037</td>
</tr>
<tr>
<td>48.00</td>
<td>11.98</td>
<td>23.98</td>
<td>12.00</td>
<td>12.00</td>
<td>12</td>
<td>LS1041</td>
</tr>
</tbody>
</table>

### Model LS1005 Thru LS1017 - One Piece Construction

<table>
<thead>
<tr>
<th>A (Inches)</th>
<th>D (Inches)</th>
<th>F (Inches)</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.00</td>
<td>6.00</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>16.00</td>
<td>8.00</td>
<td>6</td>
<td>9</td>
</tr>
<tr>
<td>20.00</td>
<td>10.00</td>
<td>6</td>
<td>13</td>
</tr>
<tr>
<td>24.00</td>
<td>12.00</td>
<td>6</td>
<td>17</td>
</tr>
</tbody>
</table>

Note:

- Can be shipped as one piece construction
- ** Used for two piece construction or one piece 21" travel only

**Electromate**

Toll Free Phone (877) SERVO98
Toll Free Fax (877) SERV099
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sales@electromate.com

Sold & Serviced By:

![Electromate Logo](image)
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.

Specifications
Same as systems without Bellows Covers.

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

<table>
<thead>
<tr>
<th>Code</th>
<th>Travel Code</th>
<th>Overall Length Code</th>
<th>System Number Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>04</td>
<td>2.88</td>
<td>12</td>
<td>(9)</td>
</tr>
<tr>
<td>08</td>
<td>6.10</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>8.86</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>12.20</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>15.44</td>
<td>28</td>
<td></td>
</tr>
</tbody>
</table>

Model LS9B04 Thru LS9B20

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

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 10B ordering code is as follows:

<table>
<thead>
<tr>
<th>Code</th>
<th>Travel Code</th>
<th>Overall Length Code</th>
<th>System Number Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>04</td>
<td>2.88</td>
<td>12</td>
<td>(9)</td>
</tr>
<tr>
<td>08</td>
<td>6.10</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>8.86</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>12.20</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>15.44</td>
<td>28</td>
<td></td>
</tr>
</tbody>
</table>

Model LS9B04 Thru LS9B20

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

Model LS9B Dimensions

<table>
<thead>
<tr>
<th>'A'</th>
<th>'B'</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.00</td>
<td>—</td>
<td>LS9B04</td>
</tr>
<tr>
<td>16.00</td>
<td>—</td>
<td>LS9B08</td>
</tr>
<tr>
<td>20.00</td>
<td>—</td>
<td>LS9B12</td>
</tr>
<tr>
<td>24.00</td>
<td>—</td>
<td>LS9B16</td>
</tr>
<tr>
<td>28.00</td>
<td>11.98</td>
<td>LS9B20</td>
</tr>
</tbody>
</table>

Shown with NEMA 23 motor adapter plate.
LINEAR MOTION SYSTEMS WITH INTEGRAL BELLOWS

Systems 9B and 10B

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

**A** = Anti Backlash — Acme style

**B** = Ball Screw Power Nut

**CC** = Ball Screw Anti Backlash Nut

**P** = Acme Power Nut — Acme style

**V** = Anti Backlash — PV style

**W** = Anti Backlash — PW style

**H** = Hand crank

**T** = PTFE (Teflon) coated lead screw

Model LS10B05 Thru LS10B41

**A** = 1/4-20 UNC-2B

**B** = 10-32 UNC-2B

**C** = x .47 Deep

**D** = (4) PLCS

**E** = A

**F** = .625

**G** = Typ

**H** = 1.750

**I** = Typ

**J** = 1.375

**K** = Typ

**L** = .825

**M** = Typ

**N** = 1.625

**O** = Typ

**P** = 2.87

**Q** = 1.12

**R** = .38

**S** = 3.75

**T** = 3.500

**U** = 1.500

**V** = .38

**W** = .56

**X** = .25

**Y** = 10-32 UNF-2B

**Z** = (12) PLCS

**AA** = 1.500

**BB** = .38

**CC** = 1.605

**DD** = 1.605

**EE** = 1.605

**FF** = 1.605

**GG** = 3.050

**HH** = 3.050

**II** = 3.050

**JJ** = 3.050

**KK** = 2.498

**LL** = 2.498

**MM** = 625

**NN** = Typ

**OO** = 1.750

**PP** = Typ

**QQ** = 1.375

**QQ** = Typ

**RR** = .625

**SS** = Typ

**TT** = Typ

**UU** = Typ

**VV** = Typ

**WW** = Typ
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 XYX Style

### Maximum Loads —

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

<table>
<thead>
<tr>
<th>Loads (lbs.)</th>
<th>Travel (in.)</th>
<th>2</th>
<th>4</th>
<th>6</th>
<th>8</th>
<th>10</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ball Slide</td>
<td></td>
<td>30</td>
<td>40</td>
<td>50</td>
<td>60</td>
<td>80</td>
<td>100</td>
</tr>
<tr>
<td>Crossed Roller</td>
<td></td>
<td>240</td>
<td>312</td>
<td>408</td>
<td>672</td>
<td>744</td>
<td>840</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Loads (lbs.)</th>
<th>Travel (in.)</th>
<th>2</th>
<th>4</th>
<th>6</th>
<th>8</th>
<th>10</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ball Slide</td>
<td></td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>30</td>
<td>40</td>
</tr>
<tr>
<td>Crossed Roller</td>
<td></td>
<td>153</td>
<td>138</td>
<td>147</td>
<td>309</td>
<td>318</td>
<td>324</td>
</tr>
</tbody>
</table>

### Maximum Moments —

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

<table>
<thead>
<tr>
<th>Ball Slide</th>
<th>Travel (in.)</th>
<th>2</th>
<th>4</th>
<th>6</th>
<th>8</th>
<th>10</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roll Axis, X</td>
<td></td>
<td>30</td>
<td>41</td>
<td>51</td>
<td>61</td>
<td>82</td>
<td>102</td>
</tr>
<tr>
<td>Pitch Axis, Y</td>
<td></td>
<td>20</td>
<td>33</td>
<td>47</td>
<td>62</td>
<td>91</td>
<td>121</td>
</tr>
<tr>
<td>Yaw Axis, Z</td>
<td></td>
<td>10</td>
<td>16</td>
<td>23</td>
<td>31</td>
<td>45</td>
<td>60</td>
</tr>
<tr>
<td>Crossed Roller</td>
<td></td>
<td>246</td>
<td>320</td>
<td>418</td>
<td>699</td>
<td>763</td>
<td>861</td>
</tr>
<tr>
<td>Roll Axis, X</td>
<td></td>
<td>126</td>
<td>184</td>
<td>262</td>
<td>479</td>
<td>538</td>
<td>617</td>
</tr>
<tr>
<td>Pitch Axis, Y</td>
<td></td>
<td>63</td>
<td>92</td>
<td>131</td>
<td>239</td>
<td>269</td>
<td>308</td>
</tr>
</tbody>
</table>

### 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.
## Ordering Code

<table>
<thead>
<tr>
<th>Positioning Code</th>
<th>Slide Type</th>
<th>Mount</th>
<th>Travel</th>
<th>Overall Length</th>
<th>Lead Screw Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>Ball Slide</td>
<td>C</td>
<td>2</td>
<td>7</td>
<td>PB2 / PB2</td>
</tr>
<tr>
<td>R</td>
<td>Crossed Roller Slide</td>
<td>M</td>
<td>4</td>
<td>9</td>
<td>PB4 / PB4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6</td>
<td>12</td>
<td>PB6 / PB6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>8</td>
<td>17</td>
<td>PB8 / PB8</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<td>20</td>
<td>PB10 / PB10</td>
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<td></td>
<td></td>
<td>12</td>
<td>23</td>
<td>PB12 / PB12</td>
</tr>
</tbody>
</table>

### 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

### Motor Mount For NEMA 23 Motor

![Motor Mount Diagram]

### PBM/PRM With Hand Crank

![Hand Crank Diagram]

### PCB/PRC With NEMA 23 Motor Adapter

![Motor Adapter Diagram]
ROTARY TABLE

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

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 PBX & PRX Positioning Stages.

Material

<table>
<thead>
<tr>
<th>Body</th>
<th>Black Anodized Aluminum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Worm</td>
<td>303 Stainless Steel</td>
</tr>
<tr>
<td>Gear</td>
<td>464 Bronze</td>
</tr>
<tr>
<td>Bearings</td>
<td>Stainless Steel ABEC 7 + Thrust</td>
</tr>
<tr>
<td>Shafts</td>
<td>303 Stainless Steel</td>
</tr>
</tbody>
</table>

Specifications

- Backlash: 4 arc-min
- Positional Accuracy: 4 arc-min
- Run out (wobble): 0.03°
- 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

<table>
<thead>
<tr>
<th>Ratio</th>
<th>Motor Mount**</th>
<th>Hand Crank Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>45:1</td>
<td>RT4-45-M</td>
<td>RT4-45-H</td>
</tr>
<tr>
<td>90:1</td>
<td>RT4-90-M</td>
<td>RT4-90-H</td>
</tr>
<tr>
<td>180:1</td>
<td>RT4-180-M</td>
<td>RT4-180-H</td>
</tr>
</tbody>
</table>

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

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ELECTROMATE
Toll Free Phone  (877) SERVO98
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www.electromate.com
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