PNEUMATIC AND HYDRAULIC MULTI-MOTION ACTUATOR

Major Benefits

- Provides independent rotary and linear motion from one output shaft.
- Ideal for part transfer, positioning, and orientation.
- Sealed shaft ball bearings on rotary section provide long life and low friction.
- Shear coupling prevents catastrophic damage to unit if maximum torque is exceeded.
- Simple construction allows easy field repairability.
**ORDERING DATA: 1000-8000 MULTI-MOTION ACTUATORS**

**TO ORDER SPECIFY:**
Type, Design No., Mounting Style, Series, Angle of Rotation, Stroke, Rod End Style, Cushions and/or Shock Pads, and Options.

**MOUNTING STYLE**
- B - Tapped holes in linear and rotary section (standard)
- RF - Rod Flange on linear section
- CF - Flange on rotary section
- F - Foot Mount thru holes on linear section

**ANGLE OF ROTATION**
- Standard Angles: 45°, 90°, 180°, 360°, and 450°
- For other available rotations, consult PHD.

**ROD END STYLE**
- PL - Plain rod end
- PK - Plain with Keyway and preload Keyway
- KY - Threaded with Keyway and preload Keyway
- MT - Male Thread only

**PORT CONTROL**
- Built-in Meter Out Flow Control Valve
Port Control is standard on both sections of Series 1000-4000 and rotary section only of Series 5000-8000 Actuators.

**ROTARY SECTION CUSHION**
- D1 - Cushion clockwise
- D2 - Cushion counterclockwise

**ROTARY SECTION SHOCK PADS**
- B1 - Shock Pad clockwise
- B2 - Shock Pad counterclockwise

**LINEAR SECTION CUSHION**
- DR - Cushion on rod end
- DC - Cushion on cap end

**LINEAR SECTION SHOCK PADS**
- BR - Shock Pad on rod end
- BC - Shock Pad on cap end

**LINEAR SECTION OPTIONS**
- R - PVA (1000-4000 only)
- S* - Port in Position #2
- T* - Port in Position #3
- U* - Port in Position #4
- Options -S, -T, and -U imply that mounting holes and flow control locations remain unchanged relative to new port position.
(Rotates with port. See options page 6-27.)

**ROTARY AND LINEAR OPTIONS**
- E - Magnetic Piston for Hall Effect Switch
- M - Magnetic Piston for Reed Switch
- N - SAE Ports
- V - Fluoro-Elastomer Seals
- W - Close Tolerance Stroke & Rotation
- Z1 - Electroless Nickel Plate, all ferrous parts

**PORT CONTROL OPTIONS**
- C - Port in Position 1 (Available only on Series 1000, 3000, 5000, and 7000. Not available on double rack units.)
- F - Port in Position 4
- K - PVA (1000-4000 only)
- I - Port Position 1 on top rack
- Port Position 3 on bottom rack

**SERIES**
- 1000 & 2000
- 3000 & 4000
- 5000 & 6000
- 7000 & 8000

**SIZE NO.**
- 17502-2-06 Sink or Source Type 4.5-24 VDC
- 17509-3-06 AC Type 110-120 VAC with Current Limit
- 17522-2 Sink or Source Type VDC, Quick Connect
- 17529-3 AC Type 110-120 VAC, Quick Connect with Current Limit

**COMPACT REED SWITCHES**

**COMPACT HALL EFFECT SWITCHES**

**CAD & Sizing Assistance**
Use PHD’s free online Product Sizing and CAD Configurator at www.phdinc.com/myphd
### ENGINEERING DATA: 1000-8000 MULTI-MOTION ACTUATORS

**SERIES 1000-8000**

- **PNEUMATIC OPERATING PRESSURE**: 20 to 150 psi [1.4 to 10 bar]
- **HYDRAULIC OPERATING PRESSURE**:
  - 40 to 1500 psi [2.8 to 103 bar]
- **OPERATING TEMPERATURE**: -20° to 180°F [-29° to 82°C]
- **ROTATIONAL TOLERANCE**: Nominal rotation +10°/-0°
- **STROKE TOLERANCE**: ±0.31 [.8 mm]
- **ROTATIONAL BACKLASH**: 2° (1000/2000), 1° 30' (3000/4000)
  - 1° 0' (5000/6000), 0° 30' (7000/8000)
- **LUBRICATION**: Factory lubricated for rated life
- **MAINTENANCE**: Field repairable

*See hydraulic pressure ratings for options chart below. All hydraulic ratings are based on non-shock hydraulic service.

### SPECIFICATIONS

<table>
<thead>
<tr>
<th>SERIES</th>
<th>WEIGHT</th>
<th>ROTARY BORE DIAMETER</th>
<th>LINEAR BORE DIAMETER</th>
<th>ROTARY BORE DISPLACEMENT</th>
<th>LINEAR DISPLACEMENT</th>
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### WORKING PRINCIPLE

The main components of the actuator consist of a cylinder and a rack-and-pinion type rotary actuator. Linear motion of the rod D is produced when port 1 or 2 is pressurized. Rotary motion of the rod D is produced when port 3 or 4 is pressurized causing pinion gear A and spline bar B, which are coupled together, to rotate coupled piston C.

### HYDRAULIC PRESSURE RATINGS FOR OPTIONS

#### ROTARY SECTION

<table>
<thead>
<tr>
<th>SERIES</th>
<th>OPTION psi [bar]</th>
<th>PLAIN</th>
<th>PORT CONTROLS</th>
<th>-Dx</th>
<th>-E or -M</th>
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#### LINEAR SECTION

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<th>-Dx</th>
<th>-E or -M</th>
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</table>

**Note:** — = Standard Rating

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**Sizing & Application Assistance**

Use PHD’s free online Product Sizing Application or view the Product Sizing Catalog at: www.phdinc.com/apps/sizing
All standard rod ends have four wrench flats.
### Rotary Section Option Location Reference

<table>
<thead>
<tr>
<th>Type</th>
<th>ACTUATOR</th>
<th>PORT &amp; NEEDLE LOCATIONS REFERENCED BY CIRCLED NUMBERS</th>
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<td>-P</td>
<td>-D</td>
</tr>
<tr>
<td></td>
<td>port</td>
<td>port</td>
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<tr>
<td>MA15 &amp; MA25</td>
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<td>2</td>
</tr>
<tr>
<td>MH15 &amp; MH25</td>
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</tbody>
</table>

### Linear Section

**Angular Adjustment at Linear Section Each Bottom & Back**

- **Standard 4X M Thread in Rotary Section**
- **Standard 4X NT Thread in Linear Section**

**Bullseye**

- **MM 2x EE BSpline Linear Section**
- **2X EE BSP Linear Section**

**Main Technical Specifications**

- **1000-8000 Multi-Motion Actuators**
- **Dimension Calculated Using Plain Cap Style**
- **Add 13 mm TO Respective “A” and “Y” Dimensions**
- **For Each Cushion**
- **Add Dimension “GC” to All (+ Stroke) Dimensions**
- **For Each Cushion**
- **Shocks Pads**: Linear Sections
  - Add 6.4 mm TO All (+ Stroke) Dimensions FOR Each Shock Pad

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**References**

- **For Each Stroke**
- **1000 & 2000 Series**
- **3000 & 4000 Series**
- **5000 & 6000 Series**
- **7000 & 8000 Series**

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**Contact Information**

- **Website**: www.phdinc.com
- **Phone**: (800) 624-8511

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**Additional Resources**

- **CAD & Sizing Assistance**
- **PHD Configurator at www.phdinc.com/myphd**
- **www.phdinc.com/18000m**
# Dimensions: Mounting Styles

## CF Mounting Style

![Diagram of CF Mounting Style]

### LETTER DIMENSION

<table>
<thead>
<tr>
<th>SERIES</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>7000 &amp; 8000</td>
<td>5.000 [127.0]</td>
<td>12.000 [304.8]</td>
<td>3.000 [76.2]</td>
<td>10.000 [254.0]</td>
<td>.781 [19.8]</td>
<td>.750 [19.1]</td>
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## RF Mounting Style

![Diagram of RF Mounting Style]

### LETTER DIMENSION

<table>
<thead>
<tr>
<th>SERIES</th>
<th>E</th>
<th>F</th>
<th>FB</th>
<th>R</th>
<th>C</th>
<th>D</th>
<th>RM</th>
<th>TF</th>
<th>UF</th>
<th>V</th>
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</table>

CYLINDER LENGTH IS NOT CHANGED BY RF MOUNTING

## F Mounting Style

![Diagram of F Mounting Style]

### LETTER DIMENSION

<table>
<thead>
<tr>
<th>SERIES</th>
<th>E</th>
<th>FB</th>
<th>SS</th>
<th>ST</th>
<th>SU</th>
<th>SY</th>
<th>TS</th>
<th>UF</th>
<th>XS</th>
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</thead>
</table>

CUSHIONS: ADD TO (+ STROKED) DIMENSION FOR EACH CUSHION:
- SERIES 1000, 2000, 3000, & 4000 = 1" [25 mm], SERIES 5000 & 6000 = 1-1/4" [32 mm], SERIES 7000 & 8000 = 1-1/2" [38 mm]

SHOCK PADS: ADD 1/4" [6.4 mm] TO (+ STROKED) DIMENSION FOR EACH SHOCK PAD

All dimensions are reference only unless specifically tolerated.

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Major Benefits

- Sealed shaft ball bearings on rotary section provide long life and low friction.
- Air-oil tandem multi-motion actuators provide smooth consistent rotary motion even at low speeds.
- Oil transfer is through a one-piece tandem cap eliminating external crossovers.
- Shear coupling prevents catastrophic damage to unit if maximum torque is exceeded.
- Built-in flow controls and angle adjustments are standard on most sizes.

Free floating aluminum pistons with pressure and wear compensating piston seals provide long life and low friction.

Oil transfer is through a one-piece tandem cap eliminating external crossover lines.

Body has threaded mounting holes on the back and bottom for versatile mounting locations.

Hardcoated aluminum body is impregnated with PTFE for wear resistance and lower friction.

Heavy-duty spline bar transmits rotary and linear motion.

Shear coupling prevents catastrophic damage to unit if maximum torque is exceeded.

Angle adjustments and port controls are built-in providing adjustment and control.

Heavy duty sealed ball bearings ensure shaft stability under heavy loading and high impact loading.

High strength alloy steel racks and pinions ensure long life.
ORDERING DATA: AIR/OIL TANDEM MULTI-MOTION ACTUATORS

TO ORDER SPECIFY:
Position, Type, Design No., Mounting Style, Series, Total Angle of Rotation, Stroke, Rod End Style, Cushions and/or Shock Pads, and Options.

MOUNTING STYLE
B - Tapped holes in linear and rotary section -(standard)
RF - Rod Flange on linear section
CF - Flange on rotary section
F - Foot Mount thru holes

TOTAL ANGLE OF ROTATION
STANDARD ANGLES
45°, 90°, 180°, 270°. 360°, and 450°
For other available rotations, consult PHD.

ROD END STYLE
PL - Plain rod end
PK - Plain with Keyway and preload Keyway
KY - Threaded with Keyway and preload Keyway
MT - Male Thread only

PORT CONTROL ©
BUILT-IN METER OUT
FLOW CONTROL VALVE
Port Control is standard on both sections of Series 2000 & 4000 and rotary section only of Series 6000 & 8000 Actuators.

PORT CONTROL® OPTIONS
D1 - Cushion clockwise
D2 - Cushion counterclockwise

CUSHION OPTIONS
DR - Cushion on rod end
DC - Cushion on cap end

SHOCK PAD OPTIONS
BR - Shock Pad on rod end
BC - Shock Pad on cap end
(Cushion and Shock Pads are not available on the same end. Shock Pads are not available for Hydraulic use.)

STROKE
1” to 12” [25 to 300 mm] in 1” [25 mm] increments
Other strokes available. Consult PHD.

LINEAR SECTION CUSHION
DR - Cushion on rod end
DC - Cushion on cap end

LINEAR SECTION SHOCK PADS
BR - Shock Pad on rod end
BC - Shock Pad on cap end
(Cushion and Shock Pads are not available on the same end. Shock Pads are not available for Hydraulic use.)

LINEAR SECTION OPTIONS
S* - Port in Position 2
T* - Port in Position 3
U* - Port in Position 4
*Options - S, - T, and - U imply that mounting holes and flow control locations remain unchanged relative to new port position. (Rotates with port. See options page 6-27.)

ROTARY SECTION OPTIONS
F - Port in Position 4
I - Port Position 1 on top rack
I - Port Position 3 on bottom rack
Y - Tandem cap rotated 180°

ROTOR AND LINEAR OPTIONS
E - Magnetic Piston for Hall Effect Switch
M - Magnetic Piston for Reed Switch
V - Fluoro-Elastomer Seals
W - Close Tolerance Stroke & Rotation
Z1 - Electroless Nickel Plate, all ferrous parts

COMPACT REED SWITCHES

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>DESCRIPTION</th>
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<tbody>
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<td>17502-2-06</td>
<td>Sink or Source Type 4.5-24 VDC</td>
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<td>17509-3-06</td>
<td>AC Type 110-120 VAC with Current Limit</td>
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<td>17522-2</td>
<td>Sink or Source Type VDC, Quick Connect</td>
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<tr>
<td>17529-3</td>
<td>AC Type 110-120 VAC, Quick Connect with Current Limit</td>
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COMPACT HALL EFFECT SWITCHES

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CAD & Sizing Assistance
Use PHD’s free online Product Sizing and CAD Configurator at www.phdinc.com/myphd

www.phdinc.com/28000aom • (800) 624-8511
SIZING & APPLICATION ASSISTANCE

Air/Oil Tandem rotary section provides the smooth control of hydraulics with the simplicity of air. The closed loop oil system gives smooth precise speed control throughout the rotation using built-in PHD Port Controls®. The illustration shows a Tandem Actuator with built-in Port Controls® in the crossover manifold. As air is applied to ports A and B, the unit rotates forcing oil from one rack to the other across the manifold. The reservoir serves as an accumulator to compensate for oil volume changes due to temperature variation.

NOTE: The reservoir should have 20 psi [1.4 bar] pressure at all times to ensure the system remains purged.

PHDV2

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USING PHD'S FREE ONLINE PRODUCT SIZING APPLICATION OR VIEW THE PRODUCT SIZING CATALOG AT: www.phdinc.com/apps/sizing
DIMENSIONS: AIR/OIL TANDEM MULTI-MOTION ACTUATORS

RESERVOIR ASSEMBLY IS INCLUDED WITH UNIT.
SERIES 2000, 4000, & 6000 UNITS USE PART NO. 13459-03-2.
SERIES 8000 UNITS USE PART NO. 13459-02-2.

NOTE: THE RESERVOIR SHOULD HAVE 1.4 bar PRESSURE AT ALL TIMES TO ENSURE THE SYSTEM REMAINS PURGED.

BULLSEYE: REFERENCE MARK. INDICATING ORIENTATION OF ROD END TO ROTARY SECTION
SHAFT KEYWAY & BULLSEYE: SHOWN AT MID-ROTATION
ROD END: STANDARD IS A "PL (PLAIN)" ROD END
PORT POSITIONS: INDICATED BY CIRCLED NUMBERS. LINEAR SECTION NEEDLE & MTG. HOLES REMAIN UNCHANGED RELATIVE TO PORTS WITH OPTIONAL PORT POSITIONS.
MTG. HOLES: CENTERED ON CENTERLINE OF UNIT
CUSHIONS: ADD DIMENSION "GC" TO ALL ( + STROKE ) DIMENSIONS FOR EACH CUSHION
SHOCK PADS: LINEAR SECTION: ADD 1/4" TO ALL ( + STROKE ) DIMENSIONS FOR EACH SHOCK PAD

For more detailed information, visit www.phdinc.com/myphd

PORT PRESSURIZED - E
FULL CW POSITION

PORT PRESSURIZED - C
FULL CW POSITION

All standard rod ends have four wrench flats.
### Tank Dimensions

<table>
<thead>
<tr>
<th>Reservoir Part No.</th>
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<th>AE</th>
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<td>38.9</td>
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</table>

**NOTE:** The reservoir should have 1.4 bar pressure at all times to ensure the system remains purged.

### Reservoir Assembly

- **Series 2000, 4000, & 6000 Units**: Use Part No. 13459-03-2.
- **Series 8000 Units**: Use Part No. 13459-02-2.

### Dimensions: 3 Position Air/Oil Tandem Multi-Motion Actuators

- **Series**: 2000-8000
- **Air/Oil Tandem**
- **Units**: Series 2000, 4000, & 6000
- **Units**: Series 8000

### Standard 4x NPT Thread in Linear Section

### Linear Section

**Shaft Keyway & Bullseye:** Shown at mid-rotation

**Rod End:** Standard is a "PL" (plain) rod end

**Port Positions:** Indicated by circled numbers. Linear section needle & mtg. holes remain unchanged relative to ports with optional port positions.

**Mtg. Holes:** Centered on centerline of unit

**Cushions:** Add dimension "GC" to all (+ stroke) + dimensions for each cushion

**Shock Pads:** Linear section:
- **Add 1/4" to all (+ stroke) + dimensions for each shock pad**

**Bullseye:** Reference mark indicating orientation of rod end to rotary section

**CAD & Sizing Assistance:** Use this CAD file to size the bore and stroke size:

- 2000-8000 - 3MR23 & 3MR23

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**All standard rod ends have four wrench flats.**
**DIMENSIONS: 3 POSITION AIR/OIL TANDEM MULTI-MOTION ACTUATORS**

**RESERVOIR PART NO.**

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<th>AF</th>
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<td>38.1</td>
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<td>88.9</td>
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</table>

**TANK DIMENSIONS**

**RESERVOIR ASSEMBLY IS INCLUDED WITH UNIT. SERIES 2000, 4000, & 8000 UNITS USE PART NO. 68397-02-2. SERIES 8000 UNITS USE PART NO. 68397-02-2.**

**NOTE:** THE RESERVOIR SHOULD HAVE 1.4 bar PRESSURE AT ALL TIMES TO ENSURE THE SYSTEM REMAINS PURGED.

**ROTARY SECTION**

**LETTER DIMENSION**

<table>
<thead>
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<th>SERIES</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>FA</th>
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<th>GA</th>
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<th>O</th>
<th>PH</th>
<th>D</th>
<th>R</th>
<th>S</th>
<th>TA</th>
<th>U1</th>
<th>U2</th>
<th>V</th>
<th>W</th>
<th>X</th>
<th>Y</th>
<th>YA</th>
<th>YB</th>
<th>Z</th>
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<tbody>
<tr>
<td>2000</td>
<td>76</td>
<td>51</td>
<td>38.1</td>
<td>13</td>
<td>13</td>
<td>19</td>
<td>19</td>
<td>0</td>
<td>19</td>
<td>35</td>
<td>36</td>
<td>73.0</td>
<td>44.5</td>
<td>6</td>
<td>6</td>
<td>50.8</td>
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<td>6</td>
<td>38.1</td>
<td>3</td>
<td>8</td>
<td>6</td>
<td>12.69</td>
<td>12.71</td>
<td>3.18</td>
<td>1.59</td>
<td>16</td>
<td>G1/8</td>
<td>85</td>
<td>152</td>
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<tr>
<td>4000</td>
<td>108</td>
<td>76</td>
<td>50.8</td>
<td>9</td>
<td>10</td>
<td>17</td>
<td>16</td>
<td>6</td>
<td>29</td>
<td>48</td>
<td>53</td>
<td>106.4</td>
<td>69.9</td>
<td>M8 x 1.25 x 13</td>
<td>92</td>
<td>48</td>
<td>76.2</td>
<td>16</td>
<td>13</td>
<td>50.8</td>
<td>3</td>
<td>14</td>
<td>22.22</td>
<td>22.23</td>
<td>4.75</td>
<td>2.36</td>
<td>38</td>
<td>G1/4</td>
<td>102</td>
<td>171</td>
</tr>
<tr>
<td>6000</td>
<td>127</td>
<td>102</td>
<td>63.5</td>
<td>10</td>
<td>10</td>
<td>18</td>
<td>18</td>
<td>5</td>
<td>29</td>
<td>57</td>
<td>58</td>
<td>119.1</td>
<td>69.9</td>
<td>M10 x 1.5 x 16</td>
<td>95.3</td>
<td>48</td>
<td>188.9</td>
<td>19</td>
<td>13</td>
<td>50.8</td>
<td>3</td>
<td>10</td>
<td>28.55</td>
<td>28.56</td>
<td>6.35</td>
<td>3.18</td>
<td>38</td>
<td>G1/4</td>
<td>118</td>
<td>186</td>
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<tr>
<td>8000</td>
<td>203</td>
<td>127</td>
<td>76.2</td>
<td>12</td>
<td>12</td>
<td>27</td>
<td>27</td>
<td>11</td>
<td>48</td>
<td>89</td>
<td>92</td>
<td>155.6</td>
<td>76.2</td>
<td>M20 x 2.5 x 32</td>
<td>159</td>
<td>89</td>
<td>127.0</td>
<td>38</td>
<td>32</td>
<td>63.5</td>
<td>25</td>
<td>19</td>
<td>44.42</td>
<td>44.45</td>
<td>9.53</td>
<td>2.36</td>
<td>76</td>
<td>G3/8</td>
<td>128</td>
<td>251</td>
</tr>
</tbody>
</table>

**LINEAR SECTION**

**LETTER DIMENSION**

| SERIES | CL | DL | EE | EL | GB | GC | GF | HV | LB | MM | NT | PL | RM | SN | TN | VM | XT | Y1 | ZB |
|--------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 2000   | 13 | 13 | 61/4 | 44 | 32 | 25 | 56 | 38 | 127 | 15.9 | M6 x 1.0 x 8 | 71 | 25.4 | 71.4 | 15.9 | 6 | 40 | 40 | 171 |
| 4000   | 13 | 16 | 63/8 | 57 | 35 | 25 | 67 | 41 | 141 | 19.0 | M8 x 1.25 x 13 | 75 | 31.8 | 74.6 | 22.2 | 6 | 49 | 49 | 189 |
| 6000   | 25 | 29 | 63/8 | 76 | 51 | 32 | 95 | 76 | 184 | 34.9 | M10 x 1.50 x 13 | 79 | 50.8 | 79.4 | 31.8 | 10 | 75 | 75 | 270 |
| 8000   | 31 | 41 | 61/2 | 102 | 73 | 38 | 133 | 102 | 257 | 50.8 | M12 x 1.25 x 19 | 117 | 69.9 | 117.5 | 47.6 | 13 | 100 | 100 | 371 |

**BULLSEYE:** REFERENCE MARK INDICATING ORIENTATION OF ROD END TO ROTARY SECTION

**SHAFT KEYWAY & BULLSEYE:** SHOWN AT MID-ROTATION

**ROD END:** STANDARD IS A “PL” (PLAIN) ROD END

**PORT POSITIONS:** INDICATED BY CIRCLED NUMBERS. LINEAR SECTION NEEDLE & MTG. HOLES REMAIN UNCHANGED RELATIVE TO PORTS WITH OPTIONAL PORT POSITIONS.

**MTG. HOLES:** CENTERED ON CENTERLINE OF UNIT

**CUSHIONS:** ADD DIMENSION “GC” TO ALL (+ STROKE) DIMENSIONS FOR EACH CUSHION

**SHOCK PADS:** LINEAR SECTION:

ADD 6.4 mm TO ALL (+ STROKE) DIMENSIONS FOR EACH SHOCK PAD

**PORTS PRESSURIZED**

**ROTARY SECTION OPTION LOCATION REFERENCE**

**LETTER OPTION REFERENCED BY TUBE NUMBER**

<table>
<thead>
<tr>
<th>ACTUATOR TYPE</th>
<th>-D</th>
<th>-P</th>
<th>-M</th>
<th>-E</th>
</tr>
</thead>
<tbody>
<tr>
<td>STANDARD</td>
<td>1 &amp; 11</td>
<td>11 &amp; 11</td>
<td>11 &amp; 11</td>
<td></td>
</tr>
<tr>
<td>PORT &amp; NEEDLE LOCATIONS REFERENCED BY CIRCLED NUMBERS</td>
<td>PORT</td>
<td>-D</td>
<td>PORT</td>
<td>-D</td>
</tr>
<tr>
<td>3MR/18 &amp; 3MR/28</td>
<td>II &amp; III</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
</tbody>
</table>

*All standard rod ends have four wrench flats.*
Major Benefits

- PHD multi-position units in 3, 4, or 5 rotary positions ideal for feeding and positioning applications.
- Pneumatically or hydraulically powered.
- Sealed shaft ball bearings on rotary section provide long life and low friction.
- Shear coupling prevents catastrophic damage to unit if maximum torque is exceeded.
- Multiple positioning design eliminates expensive and cumbersome fixturing and pinning.
- Options include built-in adjustable cushions, shock pads, rod end styles, and magnetic pistons for use with Hall and Reed Switches.
TO ORDER SPECIFY:
No. of Positions, Type, Design No., Mounting Style, Series, Total Angle of Rotation, Stroke, Rod End Style, Cushions and/or Shock Pads, and Options.

- **MOUNTING STYLE**
  - B - Tapped holes in linear and rotary section
  - RF - Rod Flange on linear section
  - CF - Flange on rotary section
  - F - Foot Mount thru holes

- **DESIGN NO.**
  - 1 = Imperial
  - 5 = Metric

- **NO. OF ROTARY POSITIONS**
  - 3 = 3 Position
  - 4 = 4 Position
  - 5 = 5 Position

- **TYPE**
  - MA1 - 150 psi [10 bar] Air
  - MH1 - 1500 psi [100 bar] Hyd.

- **SERIES**
  - 2 (000) 1-1/8” [29 mm] Bore linear section
  - 4 (000) 1-3/8” [35 mm] Bore linear & rotary section
  - 6 (000) 2” [50 mm] Bore linear & rotary section
  - 8 (000) 3” [75 mm] Bore linear & rotary section

- **NOTE:** Series 2000 available in 3 Position only.

- **PORT CONTROL**
  - BUILT-IN METER OUT FLOW CONTROL VALVE
  - Port Control is standard on both sections of Series 2000 & 4000 and rotary section only of Series 6000 & 8000 Actuators.

- **PROXIMITY SWITCH MOUNTING BRACKETS**
  - See Switches and Sensors section for complete ordering information.

- **COMPACT REED SWITCHES**
  - **PART NO.**
  - 17502-2-06: Sink or Source Type 4.5-24 VDC
  - 17509-3-06: AC Type 110-120 VAC with Current Limit
  - 17522-2: Sink or Source Type VDC, Quick Connect
  - 17529-3: AC Type 110-120 VAC, Quick Connect with Current Limit

- **COMPACT HALL EFFECT SWITCHES**
  - **PART NO.**
  - 17503-2-06: NPN Type 4.5-24 VDC
  - 17504-2-06: PNP Type 4.5-24 VDC
  - 17523-2: NPN Type 4.5-24 VDC, Quick Connect
  - 17524-2: PNP Type 4.5-24 VDC, Quick Connect

Refer to this product’s online catalog in the product section for complete information including related dimensions and additional specifications. See link at bottom of this page.

Options may affect unit length. See dimensional pages and option information details.

Solutions for Industry, Automation
www.phdinc.com/28000m • (800) 624-8511
**ENGINEERING DATA: MULTI-POSITION MULTI-MOTION ACTUATORS**

<table>
<thead>
<tr>
<th>SPECIFICATIONS</th>
<th>SERIES 2000-8000</th>
</tr>
</thead>
<tbody>
<tr>
<td>PNEUMATIC OPERATING PRESSURE</td>
<td>20 to 150 psi [1.4 to 10 bar]</td>
</tr>
<tr>
<td>HYDRAULIC OPERATING PRESSURE*</td>
<td>40 to 1500 psi [2.8 to 103 bar]</td>
</tr>
<tr>
<td>OPERATING TEMPERATURE</td>
<td>-20° to 180°F [-29° to 82°C]</td>
</tr>
<tr>
<td>ROTATIONAL TOLERANCE</td>
<td>Nominal rotation +10°/-0°</td>
</tr>
<tr>
<td>STROKE TOLERANCE</td>
<td>±0.031 [.8 mm]</td>
</tr>
<tr>
<td>END OF ROTATION BACKLASH</td>
<td>2° (2000), 1° 30' (4000), 1° 0' (6000), 0° 30' (8000)</td>
</tr>
<tr>
<td>LUBRICATION</td>
<td>Factory lubricated for rated life</td>
</tr>
<tr>
<td>MAINTENANCE</td>
<td>Field repairable</td>
</tr>
</tbody>
</table>

*See hydraulic pressure ratings for options chart below. All hydraulic ratings are based on non-shock service.

**INTERMEDIATE POSITION(S)***

<table>
<thead>
<tr>
<th>SERIES</th>
<th>2000**</th>
<th>4000</th>
<th>6000</th>
<th>8000</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROTATIONAL TOLERANCE - FROM ONE INTERMEDIATE POSITION TO ANOTHER MEASURED AT CENTERS OF BACKLASH</td>
<td>±1°</td>
<td>±0° 30'</td>
<td>±0° 30'</td>
<td>±0° 15'</td>
</tr>
<tr>
<td>ROTATIONAL BACKLASH</td>
<td>2°</td>
<td>1° 45'</td>
<td>1° 45'</td>
<td>1° 15'</td>
</tr>
</tbody>
</table>

**Available in 3-position units only**

**HYDRAULIC PRESSURE RATINGS FOR OPTIONS**

All pneumatic rotary actuators have a maximum pressure rating of 150 psi [10 bar] air. Most hydraulic rotary actuators have a maximum pressure rating of 1500 psi [100 bar], except as noted in the chart.

**ROTARY SECTION**

<table>
<thead>
<tr>
<th>HYD SERIES</th>
<th>OPTION psi [bar]</th>
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</thead>
<tbody>
<tr>
<td>-P</td>
<td>-D</td>
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<tr>
<td>-D</td>
<td>-E or -M</td>
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<tr>
<td>2000</td>
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<tr>
<td>4000</td>
<td>—</td>
</tr>
<tr>
<td>6000</td>
<td>—</td>
</tr>
<tr>
<td>8000</td>
<td>—</td>
</tr>
</tbody>
</table>

**LINEAR SECTION**

<table>
<thead>
<tr>
<th>SERIES</th>
<th>OPTION psi [bar]</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLAIN</td>
<td>-D</td>
</tr>
<tr>
<td>-D</td>
<td>-E or -M</td>
</tr>
<tr>
<td>2000</td>
<td>—</td>
</tr>
<tr>
<td>4000</td>
<td>—</td>
</tr>
<tr>
<td>6000</td>
<td>—</td>
</tr>
<tr>
<td>8000</td>
<td>—</td>
</tr>
</tbody>
</table>

**NOTE:** — = Standard Rating

**WORKING PRINCIPLE**

PHD Multi-Motion Actuators can be provided to yield three, four, or five rotary output positions. The various angle increments are fixed as specified and only the extreme positions can be adjusted in the field. Available for air or hydraulic service.

The schematic example shows a five position actuator. Pressurizing port A provides full clockwise rotation (position V). Pressurizing both ports B and C traps the racks between the rod ends of the outer pistons X and Y to rotate output shaft to position IV. Pressurizing ports C and D moves floating pistons in the inside upper rack cylinders against stop tubes to trap upper rack in position III. Similarly, positions II and I can be obtained by pressurizing ports D and D1, or E respectively. Output positions can be selected in any sequence, allowing the shaft to stop at, or pass, any of the intermediate positions (II, III, or IV).

**Sizing & Application Assistance**

Use PHD’s free online Product Sizing Application or view the Product Sizing Catalog at: www.phdinc.com/apps/sizing
DIMENSIONS: 3-POSITION MULTI-MOTION ACTUATORS

**CAP STYLE SERIES**

- **PLAIN**
  - 2000: 5.686
  - 4000: 7.906
  - 6000: 8.128
- **-A**
  - 2000: 6.198
  - 4000: 7.396
  - 6000: 8.128
- **-B**
  - 2000: 7.906
  - 4000: 7.396
  - 6000: 8.128

**LETTER DIMENSION**

- **LINEAR SECTION**
  - **LETTER DIMENSION**
    - **CAP STYLE SERIES**
      - **-A**
        - 2000: 5.686
        - 4000: 7.906
        - 6000: 8.128
      - **-B**
        - 2000: 6.198
        - 4000: 7.396
        - 6000: 8.128
      - **-B**
        - 2000: 7.906
        - 4000: 7.396
        - 6000: 8.128

**ROTOR SECTION**

- **LETTER DIMENSION**
  - **CAP STYLE SERIES**
    - **-A**
      - 2000: 5.686
      - 4000: 7.906
      - 6000: 8.128
    - **-B**
      - 2000: 6.198
      - 4000: 7.396
      - 6000: 8.128
    - **-B**
      - 2000: 7.906
      - 4000: 7.396
      - 6000: 8.128

**Quick Reference for: A + (T x B)**

- **Degree of Rotation**
  - **Series 45**
    - 2000: 6.481
    - 4000: 9.076
    - 6000: 10.296
  - **Series 90**
    - 4000: 14.500
  - **Series 180**
    - 5000: 16.840
  - **Series 360**
    - 2000: 8.830
    - 4000: 12.586
    - 6000: 19.606

**ACTUATOR TYPE**

- **-B**
  - 3MA11 & 3MA21: I & II
  - 3MH11 & 3MH21: I & II

**LETTER OPTION REFERENCED BY TUBE NUMBER**

- **-D**
  - 3MA11 & 3MA21: I & II
  - 3MH11 & 3MH21: I & II

**PORT & NEEDLE LOCATIONS REFERENCED BY CIRCLED NUMBERS**

- **-E**
  - 3MA11 & 3MA21: ALL
  - 3MH11 & 3MH21: ALL

---

All standard rod ends have four wrench flats.
**LINEAR SECTION**

| SERIES | CL | DL | EE | GB | GC | GF | HV | LB | MM | NT | PL | RM | SN | TN | VM | XT | Y1 | ZB |
|---------|----|----|----|----|----|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 2000    | 13 | 13 | G1/4 | 44 | 32 | 25 | 56 | 38 | 127 | 15.9 | M6 x 1.0 x 8 | 71 | 25.4 | 71.4 | 15.9 | 6 | 40 | 40 | 171 |
| 4000    | 13 | 16 | G3/8 | 57 | 35 | 25 | 67 | 41 | 141 | 19.0 | M8 x 1.25 x 13 | 75 | 31.8 | 74.6 | 22.2 | 6 | 49 | 49 | 189 |
| 6000    | 25 | 29 | G3/8 | 76 | 51 | 32 | 95 | 76 | 184 | 34.9 | M10 x 1.50 x 13 | 79 | 50.8 | 79.4 | 31.8 | 10 | 75 | 75 | 270 |
| 8000    | 31 | 41 | G1/2 | 102 | 73 | 38 | 133 | 102 | 257 | 50.8 | M12 x 1.25 x 19 | 117 | 69.9 | 117.5 | 47.6 | 13 | 100 | 100 | 371 |

**SHOCK KEYWAY & BULLSEYE**: SHOWN AT MID-ROTATION

**ROD END**: STANDARD IS A "PL" (PLAIN) ROD END

**PORT POSITIONS**: INDICATED BY CIRCLED NUMBERS. LINEAR SECTION NEEDLE & MTG. HOLES REMAIN UNCHANGED RELATIVE TO PORTS WITH OPTIONAL PORT POSITIONS.

**MTG. HOLES**: CENTERED ON CENTERLINE OF UNIT

**STOP TUBES**: LOCATED IN TUBES I & II

**CUSHIONS**: SERIES 2000 ROTARY SECTIONS ONLY:

- Add 13 mm TO RESPECTIVE "A" AND "Y" DIMENSIONS FOR EACH CUSHION

**ALL LINEAR SECTIONS**:

- Add dimension "GC" TO ALL (+ STROKE) DIMENSIONS FOR EACH CUSHION

**SHOCK PADS**: LINEAR SECTION:

- Add 6.4 mm TO ALL (+ STROKE) DIMENSIONS FOR EACH SHOCK PAD

**DEGREE OF ROTATION**

<table>
<thead>
<tr>
<th>SERIES</th>
<th>45</th>
<th>90</th>
<th>120</th>
<th>160</th>
<th>180</th>
<th>210</th>
<th>270</th>
<th>360</th>
<th>450</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>164.6</td>
<td>184.5</td>
<td>224.2</td>
<td>264.1</td>
<td>303.8</td>
<td>343.6</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>4000</td>
<td>230.5</td>
<td>260.2</td>
<td>319.8</td>
<td>379.1</td>
<td>438.6</td>
<td>498.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6000</td>
<td>261.5</td>
<td>291.1</td>
<td>340.8</td>
<td>390.5</td>
<td>469.5</td>
<td>529.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8000</td>
<td>368.3</td>
<td>427.7</td>
<td>539.6</td>
<td>546.6</td>
<td>784.4</td>
<td>903.2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*DIMENSIONS CALCULATED USING PLAIN CAP STYLE. ADD 6.3 TO DIMENSION FOR EACH -A STYLE CAP USED ON SERIES 2000 ONLY.*

**CAD & Sizing Assistance**

CAD Configurator at www.phdinc.com/myphd

All standard rod ends have four wrench flats.

**ALL LINEAR SECTIONS**:

- Add dimension "GC" TO ALL (+ STROKE) DIMENSIONS FOR EACH CUSHION

**SHOCK PADS**: LINEAR SECTION:

- Add 6.4 mm TO ALL (+ STROKE) DIMENSIONS FOR EACH SHOCK PAD

**DEGREE OF ROTATION**

<table>
<thead>
<tr>
<th>SERIES</th>
<th>45</th>
<th>90</th>
<th>120</th>
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<tr>
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<td>784.4</td>
<td>903.2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*DIMENSIONS CALCULATED USING PLAIN CAP STYLE. ADD 6.3 TO DIMENSION FOR EACH -A STYLE CAP USED ON SERIES 2000 ONLY.*
DIMENSIONS: 4 POSITION MULTI-MOTION ACTUATORS

PORTS PRESSURIZED – DI & DJ

PORTS PRESSURIZED – E
FULL CCW POSITION

PORTS PRESSURIZED – F
FULL CW POSITION

ROTATION SECTION

| LETTER DIMENSION | SERIES | C | D | E | F | FA | G | GA | H | JA | KA | L | M | O | PA | Q | R | S | TA | U | V | W | X | Y | YA | YB | Z | ZA |
|------------------|--------|---|---|---|---|----|---|----|---|----|----|---|---|---|----|---|---|---|----|---|---|---|----|---|----|----|
|                  | 4000   | 4.25 | 3.00 | 2.00 | .344 | .375 | .688 | .719 | .250 | 1.156 | 1.675 | 2.094 | 5/16-18 x .500 | 5.625 | 1.875 | 3.000 | .625 | 2.000 | .562 | .8748 | .8753 | 3/16 x 3/32 x 1.500 | 1/4 | 3.953 | 6.721 | 3.360 | .013 | 1.500 |
|                  | 6000   | 5.00 | 4.00 | 2.500 | .375 | .344 | .750 | .719 | .203 | 1.156 | 2.250 | 2.281 | 3/8 x 16 x .255 | 3.750 | 1.875 | 3.500 | .750 | 2.000 | .375 | 1.124 | 1.125 | 1/4 x 1/8 x 1.500 | 1/4 | 4.563 | 7.325 | 3.980 | .013 | 1.875 |
|                  | 8000   | 5.00 | 5.00 | 5.000 | .375 | .344 | .750 | .719 | .203 | 1.156 | 2.250 | 2.281 | 3/8 x 16 x .255 | 3.750 | 1.875 | 3.500 | .750 | 2.000 | .375 | 1.124 | 1.125 | 1/4 x 1/8 x 1.500 | 1/4 | 4.563 | 7.325 | 3.980 | .013 | 1.875 |

LINEAR SECTION

| LETTER DIMENSION | SERIES | CL | DL | EE | EL | GB | GC | GF | HV | LB | MM | NT | PL | RM | SN | TN | VM | XT | Y1 | ZB |
|------------------|--------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
|                  | 4000   | 5.30 | 5/8 | 3/8 | 2.250 | 1.375 | 1.000 | 1.625 | 1.625 | .750 | 5/16-24 x .500 | 5.000 | 2.937 | 2.937 | 2.937 | 2.937 | 2.937 | 2.937 | 2.937 | 2.937 | 2.937 | 2.937 | 2.937 | 2.937 | 2.937 |
|                  | 8000   | 12.11 | 5-5/8 | 1.250 | 4.000 | 2.875 | 1.500 | 5.250 | 5.250 | 4.000 | 1.125 | 2.000 | 1/2-20 x .750 | 4.625 | 2.750 | 2.750 | 2.750 | 2.750 | 2.750 | 2.750 | 2.750 | 2.750 | 2.750 | 2.750 | 2.750 | 2.750 | 2.750 |

All standard rod ends have four wrench flats.
BULLSEYE: REFERENCE MARK INDICATING ORIENTATION OF ROD END TO ROTARY SECTION
SHAFT KEYWAY & BULLSEYE: SHOWN AT MID-ROTATION
ROD END: STANDARD IS A "PL" (PLAIN) ROD END
PORT POSITIONS: INDICATED BY CIRCLED NUMBERS. LINEAR SECTION NEEDLE & MTG. HOLES REMAIN UNCHANGED RELATIVE TO PORTS WITH OPTIONAL PORT POSITIONS.

MTG. HOLES: CENTERED ON CENTERLINE OF UNIT
STOP TUBES: LOCATED IN TUBES I & II
CUSHIONS: ADD DIMENSION "GC" TO ALL (+ STROKE) DIMENSIONS FOR EACH CUSHION
SHOCK PADS: LINEAR SECTION:
ADD 6.4 mm TO ALL (+ STROKE) DIMENSIONS FOR EACH SHOCK PAD

PORTS PRESSURIZED – D1 & D2 FULL CCW POSITION
PORTS PRESSURIZED – E FULL CW POSITION
PORTS PRESSURIZED – C1 & C2 FULL CW POSITION

All standard rod ends have four wrench flats.
## Dimensions: 5 Position Multi-Motion Actuators

### Rotary Section Dimension Table

| Series | C | D | E | F | G | H | J | L | M | O | PA | Q | R | S | TA | U | V | W | X | YA | YB | Z | ZA |
| 4000   | 4.250 | 3.000 | 2.000 | 344 | .375 | .375 | .719 | 290 | 1.156 | 2.875 | 2.094 | 5/16-18 x .500 DP | 3.625 | 1.875 | 3.000 | .625 | .500 | 2.000 | 562 | .8748 | .8753 | 3/16 x 3/32 x 1.500 | 1/4 | 6.721 | 3.360 | .013 | 1.500 |
| 6000   | 5.000 | 4.000 | 2.500 | 375 | .344 | .750 | .719 | 203 | 1.156 | 2.250 | 2.281 | 3/8-16 x .625 DP | 3.750 | 1.875 | 3.500 | .750 | .500 | 2.000 | 375 | 1.124 | 1.125 | 1/4 x 1/8 x 1.500 | 1/4 | 7.325 | 3.980 | .013 | 1.875 |
| 8000   | 8.000 | 5.000 | 3.000 | 469 | .489 | 1.082 | 1.062 | 437 | 1.875 | 3.500 | 3.625 | 3/4-10 x 1.250 DP | 6.250 | 3.500 | 5.000 | 1.500 | 1.250 | 2.500 | 750 | 1.749 | 1.750 | 3/8 x 3/16 x 3.000 | 3/8 | 9.865 | 5.236 | .026 | 2.875 |

### Linear Section Dimension Table

| Series | C | D | E | F | G | H | J | L | M | O | PA | Q | R | S | TA | U | V | W | X | YA | YB | Z | ZA |
| 4000   | .330 | .5/8 | 3/8 | 2.250 | 1.375 | 1.000 | 2.625 | 1.625 | 5.625 | .750 | 5/16-24 x .500 DP | 2.937 | 1.250 | 2.937 | .875 | 2.937 | 1.875 | 250 | 1.837 | 1.837 | 1.437 |
| 8000   | 1.211 | 1-5/8 | 1/2 | 4.000 | 2.875 | 1.500 | 5.250 | 4.000 | 10.125 | 2.000 | 1/2-20 x .750 DP | 4.625 | 2.750 | 4.625 | 1.875 | .625 | 5.000 | 3.937 | 3.937 | 14.625 |

### Notes
- **Bullseye:** Reference mark indicating orientation of rod end to rotary section.
- **Shaft Keyway & Bullseye:** Shown at mid-rotation.
- **Rod End:** Standard is a “PL” (Plain) rod end.
- **Port Positions:** Indicated by circled numbers. Linear section needle & mtg. holes remain unchanged relative to ports with optional port positions.
- **Mtg. Holes:** Centered on centerline of unit.
- **Stop Tubs:** Located in tubs I & II.
- **Cushions:** Add dimension “GC” to all (+ stroke) dimensions for each cushion.
- **Shock pads:** Linear section:
  - Add 1/4” to all (+ stroke) dimensions for each shock pad.

### CAD & Sizing Assistance
Use PHD's free online Product Sizing and CAD Configurator at www.phdinc.com/myphd

All standard rod ends have four wrench flats.
### ROTARY SECTION

| LETTER DIMENSION | SERIES | C | D | E | F | FA | G | A | H | JA | KA | L | M | O | PA | Q | R | S | TA | U | V | W | X | YA | YB | Z | ZA |
|------------------|--------|---|---|---|---|----|---|---|---|----|----|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4000             | 108 | 76 | 50.8 | 9 | 10 | 17 | 18 | 6 | 29 | 48 | 53 | M8 x 1.25 x 13 | 92 | 48 | 76.2 | 16 | 13 | 50.8 | 14 | 22.22/22.23 | 4.75 x 2.36 x 38 | G1/4 | 171 | 85 | 0.33 | 38 |
| 6000             | 127 | 102 | 63.5 | 10 | 9 | 19 | 18 | 5 | 29 | 57 | 58 | M10 x 1.5 x 16 | 95.3 | 48 | 89.9 | 19 | 13 | 50.8 | 10 | 28.55/28.59 | 6.35 x 3.18 x 38 | G1/4 | 186 | 101 | 0.33 | 48 |
| 8000             | 203 | 127 | 76.2 | 12 | 12 | 27 | 27 | 11 | 48 | 89 | 92 | M20 x 2.5 x 32 | 159 | 89 | 127.0 | 38 | 32 | 63.5 | 19 | 44.44/44.45 | 9.53 x 3.18 x 76 | Q3/8 | 231 | 133 | 0.66 | 73 |

### LINEAR SECTION

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<th>LETTER DIMENSION</th>
<th>SERIES</th>
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<td>16</td>
<td>G3/8</td>
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**BULLSEYE:** Reference mark indicating orientation of rod end to rotary section

**SHAFT KEYWAY & BULLSEYE:** Shown at mid-rotation

**ROD END:** Standard is a “PL” (Plain) rod end

**PORT POSITIONS:** Indicated by circled numbers. Linear section needle & MTG. holes remain unchanged relative to ports with optional port positions.

**MTG. HOLES:** Centered on centerline of unit

**STOP TUBES:** Located in tubes I & II

**CUSHIONS:** Add dimension “GC” to all (+ stroke) dimensions for each cushion

**SHOCK PADS:** Linear section: add 6.4 mm to all (+ stroke) dimensions for each shock pad

### ROTARY SECTION OPTION LOCATION REFERENCE

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<tr>
<th>ACTUATOR TYPE</th>
<th>LETTER OPTION REFERENCED BY TUBE NUMBER</th>
<th>PORT &amp; NEEDLE LOCATIONS REFERENCED BY CIRCLED NUMBERS</th>
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<td>-M</td>
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<td>V &amp; V</td>
<td>VII &amp; V</td>
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<tr>
<td>BMA15 &amp; BMA25</td>
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<td>VII &amp; V</td>
</tr>
</tbody>
</table>

**CAD & Sizing Assistance**

PHD Configurator at www.phdinc.com/myphd

All standard rod ends have four wrench flats.

2000-8000 Metric

Rotary Section Multi-Motion Actuators

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PHDV2
**PORT CONTROL®**

The exclusive PHD Port Control®, based on the “meter-out” principle, features an adjustable needle and a separate ball check. Both are built into the linear and rotary section and are used to control the speed of the actuator over its entire cycle.

**LINEAR SECTION CUSHIONS**

Adjustable cushions, available on all PHD Multi-Motion Actuators, allow smooth deceleration at the end of stroke and rotation to eliminate mechanical shock and hammer effect.

Effective cushioning length (approximate)
- Rotary Section 1000-8000 = 30°
- Linear Section 1000-4000 = 3/4", 5000-6000 = 1", 7000-8000 = 1-1/4"

**ROTARY SECTION CUSHIONS**

**MAGNETIC PISTON FOR USE WITH PHD PROXIMITY SWITCHES**

Multi-Motion Actuators may be equipped with a magnetic band (specify -E) on the pistons which activates externally mounted PHD Hall Effect Switches. These switches allow the interfacing of the PHD Air or Hydraulic Multi-Motion Actuators to various logic systems. This option is for use with the following switches.

**LINEAR SECTION SHOCK PADS**

Polyurethane pads for absorption of shock and noise are available on each end of stroke and rotation on Series 1000-8000 Multi-Motion Actuators. Reducing shock permits higher piston velocities for shorter cycle times. Reducing noise levels provides improved environment for increased productivity. Pads eliminate metal-to-metal contact between piston and end caps.

**ROTARY SECTION SHOCK PADS**

**PILOT VALVE ACTUATOR (PVA) ROTARY SECTION**

The PVA functions as a built-in pneumatic limit switch. An air pressure signal is provided at the end-of-piston travel as the piston seal uncovers an orifice in the block. Upon reversal of piston travel the pilot pressure is shut off and the pilot line is vented through the rotary actuator housing.

Air pilot signal is provided approximately .03 inch (.8 mm) prior to end of piston travel (or 1 to 5 degrees prior to end of rotation). For pneumatic use only.

PVA ports are located in position 1 on linear section and position 2 on the rotary section unless otherwise specified. They are available on both linear and rotary sections of the Series 1000-4000 only.

Units with PVA are supplied without angle adjustments.

**LINEAR SECTION SHOCK PADS**

**PILOT VALVE ACTUATOR (PVA) LINEAR SECTION**

**TANDEM CAP ROTATED 180°**

This option rotates the cap of an Air/Oil Tandem Multi-Motion Actuator 180°. This places the Port Control (and Cushion) needles and the Tandem fitting in position 4. Standard position for these is position 2.

**REED SWITCHES**

The PHD Magnetic Reed Switches may be used in situations where the Hall Effect Switches are not applicable. As with the Hall Effect Switches, a magnetic band (specify -M) on the pistons activates the externally mounted PHD Reed Switches. The Reed Switches may be used to signal a programmable controller, sequencer, relay, or in some cases, a valve solenoid. This option is for use with the following switches.

**Options may affect unit length. See dimensional pages and option information details.**

Refer to this product’s online catalog in the product section for complete information including related dimensions and additional specifications. See link at bottom of this page.
OPTIONS: 1000-8000 MULTI-MOTION ACTUATORS

PORT POSITIONS

LINEAR SECTION
Port Position 1 is standard. NOTE: Options -S, -T, and -U imply that mounting holes and flow control needle locations remain unchanged relative to new port positions. (Rotates with port.)

PORT POSITION 2

PORT POSITION 3

PORT POSITION 4

ROTARY SECTION
Port Position 2 is standard.

PORT POSITION 1

PORT POSITION 4

PORT POSITION 1 TOP RACK
PORT POSITION 3 BOTTOM RACK
This option positions the ports in position 1 on tubes I and II and in position 3 on tubes III and IV. This allows access to the ports on the “Top” and “Bottom” sides of the actuator. Available on 2000, 4000, 6000, and 8000 actuators.

SAE PORTS FOR HYDRAULIC UNITS
SAE Ports are available on most PHD hydraulic Multi-Motion Actuators. The Series 1000 & 2000 Multi-Motion Actuators require a boss which is brazed to the rotary caps. All other sizes, the port remains in the standard location.

Consult PHD for optional port position or units with Port Controls.

ANGLE ADJUSTMENT (STANDARD)
SERIES 1000-8000
Adjusting screw(s) for reducing angle of rotation in either or both directions for use where exact degree of desired rotation cannot be predetermined or where requirements may vary during operation. Standard adjusting screw will reduce angle of rotation up to 30°. Available in conjunction with all other optional features.

Cushions are normally engaged over the last 30° of angle. The use of angle adjusting screws to reduce angle of rotation has a direct effect on the length of cushion engagement. Example: 10° angle reduction will reduce cushion engagement by 10°.

FLUORO-ELASTOMER SEALS
Fluoro-Elastomer seals are available to achieve seal compatibility with certain fluids. Seal compatibility should be checked with the fluid manufacturer for proper application. Consult PHD for high temperature use.

CLOSE TOLERANCE STROKE AND ROTATION
This option may be specified when a precise stroke and rotation is required and angle adjustment is not acceptable. By specifying this option, rotation will be within a tolerance of ±30 minutes, -0 minutes and stroke will be a tolerance of ±.005 [± 0.127 mm].

ELECTROLESS NICKEL PLATING
Electroless nickel plating is done on all externally exposed ferrous parts except the pinion shaft and rod end. This optional plating treatment gives an alternative method of protecting the unit from severe environments. NOTE: Standard plating is Zinc.

Options may affect unit length. See dimensional pages and option information details.

Refer to this product’s online catalog in the product section for complete information including related dimensions and additional specifications. See link at bottom of this page.

All dimensions are reference only unless specifically tolerated.

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### Optional Rod Ends

- **KY Threaded Rod End with Keyway and Pre-Load**

![Diagram of KY Threaded Rod End]

- **PK Plain Rod End with Keyway and Pre-Load**

![Diagram of PK Plain Rod End]

#### Notes:
- Keyway shown at mid-rotation

<table>
<thead>
<tr>
<th>LETTER</th>
<th>SERIES</th>
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<tbody>
<tr>
<td>A</td>
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<td>3.000</td>
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<td>O</td>
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#### Options: 1000-8000 Multi-motion Actuators

### 2000-8000 Multi-position

#### MT Male Thread Rod End

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<th>SERIES</th>
<th>ROD DIA.</th>
<th>LETTER DIMENSION</th>
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</thead>
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<td>1.375 [34.93]</td>
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<tr>
<td>7000 &amp; 8000</td>
<td>2.000 [50.80]</td>
<td>[.79.5] [.25.0] [.25.0]</td>
</tr>
</tbody>
</table>

Numbers in [ ] are metric and are in mm.

All standard rod ends have four wrench flats.

---

Numbers in [ ] are metric and are in mm.

All standard rod ends have four wrench flats.
PORT CONTROL®

The exclusive PHD Port Control®, based on the “meter-out” principle, features an adjustable needle and a separate ball check. Both are built into the linear and rotary section and are used to control the speed of the actuator over its entire cycle. The self-locking needle is adjustable under pressure. It determines the orifice size which controls the exhaust volume. The separate ball check is closed while fluid is exhausting from the actuator, but opens to permit full flow of incoming fluids. The PHD Port Control® provides the optimum in speed control for multi-motion actuators. It saves space and eliminates the cost of installation and fittings for external flow control valves.

Options: Multi-Motion Actuators

Pneumatic application only. Linear Section, add 1/4" [6.4 mm] to all (+ Stroke) dimensions for each shock pad. Rotary Section, no increase.

Active Cushions:

Adjustable cushions, available on all PHD Multi-Motion Actuators, allow smooth deceleration at the end of stroke and rotation to eliminate mechanical shock and hammer effect.

Polyurethane pads for absorption of shock and noise are available on each end of stroke and rotation on Series 1000-8000 Multi-Motion Actuators. Reducing shock permits higher piston velocities for shorter cycle times. Reducing noise levels provides improved environment for increased productivity. Pads eliminate metal-to-metal contact between piston and end caps.

The PVA functions as a built-in pneumatic limit switch. An air pressure signal is provided at the end-of-piston travel as the piston seal uncovers an orifice in the block. Upon reversal of piston travel the pilot pressure is shut off and the pilot line is vented through the rotary actuator housing.

Air pilot signal is provided approximately .03 inch [.8 mm] prior to end of piston travel (or 1 to 5 degrees prior to end of rotation). For pneumatic use only.

K R

PILOT VALVE ACTUATOR (PVA) ROTARY SECTION

The PVA functions as a built-in pneumatic limit switch. An air pressure signal is provided at the end-of-piston travel as the piston seal uncovers an orifice in the block. Upon reversal of piston travel the pilot pressure is shut off and the pilot line is vented through the rotary actuator housing.

Air pilot signal is provided approximately .03 inch [.8 mm] prior to end of piston travel (or 1 to 5 degrees prior to end of rotation). For pneumatic use only.

PVA ports are located in position 1 on linear section and position 2 on the rotary section unless otherwise specified. They are available on both linear and rotary sections of the Series 1000-4000 only.

Units with PVA are supplied without angle adjustments.

All dimensions are reference only unless specifically tolerated.
OPTIONS: MULTI-MOTION ACTUATORS

MAGNETIC PISTON FOR USE WITH PHD PROXIMITY SWITCHES

E HALL EFFECT SWITCHES

Multi-Motion Actuators may be equipped with a magnetic band (specify -E) on the pistons which activates externally mounted PHD Hall Effect Switches. These switches allow the interfacing of the PHD Air or Hydraulic Multi-Motion Actuators to various logic systems. This option is for use with the following switches.

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>DESCRIPTION</th>
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<tbody>
<tr>
<td>17503-2-06</td>
<td>NPN Type 4.5-24 VDC</td>
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<tr>
<td>17504-2-06</td>
<td>PNP Type 4.5-24 VDC</td>
</tr>
<tr>
<td>17523-2</td>
<td>NPN Type 4.5-24 VDC, Quick Connect</td>
</tr>
<tr>
<td>17524-2</td>
<td>PNP Type 4.5-24 VDC, Quick Connect</td>
</tr>
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</table>

The PHD Magnetic Reed Switches may be used in situations where the Hall Effect Switches are not applicable. As with the Hall Effect Switches, a magnetic band (specify -M) on the pistons activates the externally mounted PHD Reed Switches. The Reed Switches may be used to signal a programmable controller, sequencer, relay, or in some cases, a valve solenoid. This option is for use with the following switches.

<table>
<thead>
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<th>PART NO.</th>
<th>DESCRIPTION</th>
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<tr>
<td>17502-2-06</td>
<td>Sink or Source Type 4.5-24 VDC</td>
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<td>17509-3-06</td>
<td>AC Type 110-120 VAC with Current Limit</td>
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<td>17522-2</td>
<td>Sink or Source Type VDC, Quick Connect</td>
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<tr>
<td>17529-3</td>
<td>AC Type 110-120 VAC, Quick Connect with Current Limit</td>
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</table>

See engineering data page for Hydraulic Pressure Ratings with these options. See each ordering data for magnetic piston ordering information. See Switches and Sensors section for complete switch specifications. Switches and mounting brackets must be ordered separately.

M REED SWITCHES

COMPACT HALL EFFECT SWITCHES

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<th>PART NO.</th>
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<td>NPN Type 4.5-24 VDC, Quick Connect</td>
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COMPACT REED SWITCHES

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<td>NPN Type 4.5-24 VDC, Quick Connect</td>
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<tr>
<td>17504-2-06</td>
<td>PNP Type 4.5-24 VDC, Quick Connect</td>
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<tr>
<td>17523-2</td>
<td>NPN Type 4.5-24 VDC, Quick Connect with Current Limit</td>
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<tr>
<td>17524-2</td>
<td>PNP Type 4.5-24 VDC, Quick Connect with Current Limit</td>
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</table>

This option rotates the cap of an Air/Oil Tandem Multi-Motion Actuator 180°. This places the Port Control (and Cushion) needles and the Tandem fitting in position 4. Standard position for these is position 2.

TANDEM CAP ROTATED 180°
OPTIONS: MULTI-MOTION ACTUATORS

PORT POSITIONS

LINEAR SECTION
Port Position 1 is standard. **NOTE:** Options -S, -T, and -U imply that mounting holes and flow control needle locations remain unchanged relative to new port positions. (Rotates with port.)

PORT POSITION 2

PORT POSITION 3

PORT POSITION 4

ROTARY SECTION
Port Position 2 is standard.

PORT POSITION 1

PORT POSITION 4 (Available on all series actuators.)

PORT POSITION 1 TOP RACK
PORT POSITION 3 BOTTOM RACK

This option positions the ports in position 1 on tubes I and II and in position 3 on tubes III and IV. This allows access to the ports on the "Top" and "Bottom" sides of the actuator. Available on 2000, 4000, 6000, and 8000 actuators.

SAE PORTS FOR HYDRAULIC UNITS

SAE Ports are available on most PHD hydraulic Multi-Motion Actuators. The Series 1000 & 2000 Multi-Motion Actuators require a boss which is brazed to the rotary caps. All other sizes, the port remains in the standard location.

Consult PHD for optional port position or units with Port Controls.

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ANGLE ADJUSTMENT (STANDARD)
SERIES 1000-8000

Adjusting screw(s) for reducing angle of rotation in either or both directions for use where exact degree of desired rotation cannot be predetermined or where requirements may vary during operation. Standard adjusting screw will reduce angle of rotation up to 30°. Available in conjunction with all other optional features.

Cushions are normally engaged over the last 30° of angle. The use of angle adjusting screws to reduce angle of rotation has a direct effect on the length of cushion engagement. Example: 10° angle reduction will reduce cushion engagement by 10°.

All dimensions are reference only unless specifically tolerated.
**FLUORO-ELASTOMER SEALS**

Fluoro-Elastomer seals are available to achieve seal compatibility with certain fluids. Seal compatibility should be checked with the fluid manufacturer for proper application. Consult PHD for high temperature use.

**CLOSE TOLERANCE STROKE AND ROTATION**

This option may be specified when a precise stroke and rotation is required and angle adjustment is not acceptable. By specifying this option, rotation will be within a tolerance of +30 minutes, -0 minutes and stroke will be a tolerance of ± .005 [± 0.127 mm].

**ELECTROLESS NICKEL PLATING**

Electroless nickel plating is done on all externally exposed ferrous parts except the pinion shaft and rod end. This optional plating treatment gives an alternative method of protecting the unit from severe environments. **NOTE:** Standard plating is Zinc.

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**OPTIONAL ROD ENDS**

**-KY Threaded Rod End with Keyway and Pre-Load**

**-PK Plain Rod End with Keyway and Pre-Load**

**LETTER DIM. SERIES**

**A**

<table>
<thead>
<tr>
<th>Dim.</th>
<th>1000 &amp; 2000</th>
<th>3000 &amp; 4000</th>
<th>5000 &amp; 6000</th>
<th>7000 &amp; 8000</th>
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<td>2.375</td>
<td>5.187</td>
<td>7.156</td>
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<tr>
<td>[55.5]</td>
<td>[60.5]</td>
<td>[132.0]</td>
<td>[182.0]</td>
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**B**

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<td>[25]</td>
<td>[25]</td>
<td>[55.5]</td>
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**C**

- [14.3] [16] [41.3] [57]

**D**

- .852 [8.77] 2.313 3.250
- [21.6] [25] [36.7] [62.5]

**E**

- .210 [2.44] .470 [.702]

**F**


**G**

- 5/8-18 3/4-14 1-3/8-12 2-12
- [M16 x 1.5] [M18 x 1.5] [M33 x 2.0] [M48 x 2.0]

**H**

- 1/2-20 5/8-18 1-1/4-12 1-3/4-12
- [M12 x 1.25] [M16 x 1.5] [M30 x 2.0] [M42 x 2.0]

**J**

- 1/8 x 1/8 x 5/8 3/32 x 1/8 x 3/4 1/4 x 1/4 x 1-3/8 1/2 x 1/2 x 2
- [3.18 x 3.18 x 16] [4.75 x 4.75 x 19] [6.35 x 6.35 x 35] [12.7 x 12.7 x 50]

**K**

- .125 [.156] .422 [.594]
- [3] [4] [10.7] [15]

**L**

- .625 [.625] 1.346 1.675
- [16] [16] [34] [48]

**M**

- .500 [.625] 1.250 1.750
- [12.7] [15.88] [31.75] [44.45]

**N**

- .093 [.125] .156 [.187]
- [2.4] [3.2] [4] [5]

**- MT MALE THREAD ROD END**

**LETTER DIMENSION SERIES**

**A**

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<td>.1/2</td>
<td>7/16-20</td>
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<td>[15.0]</td>
<td>[20]</td>
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**B**

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<td>.375</td>
<td>1-1/4</td>
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<tr>
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<td>[6.35]</td>
<td>[10.7]</td>
<td>[15.0]</td>
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**C**

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<th>5000 &amp; 6000</th>
<th>7000 &amp; 8000</th>
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<td>.625</td>
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<td>1.675</td>
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<td>[16]</td>
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**MM**

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<th>7000 &amp; 8000</th>
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</thead>
<tbody>
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<td>.175</td>
<td>1.375</td>
<td>2.000</td>
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<td>[34.9]</td>
<td>[50.8]</td>
<td>[62.5]</td>
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</table>

All standard rod ends have four wrench flats.

**NOTE:** Keyway shown at mid-rotation

**CIRCLED NUMBERS:** INDICATE PORT POSITIONS

**KEY:** INCLUDED WITH ROD END OPTION

**- PK Plain Rod End with Keyway and Pre-Load**

All dimensions are reference only unless specifically toleranced.

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