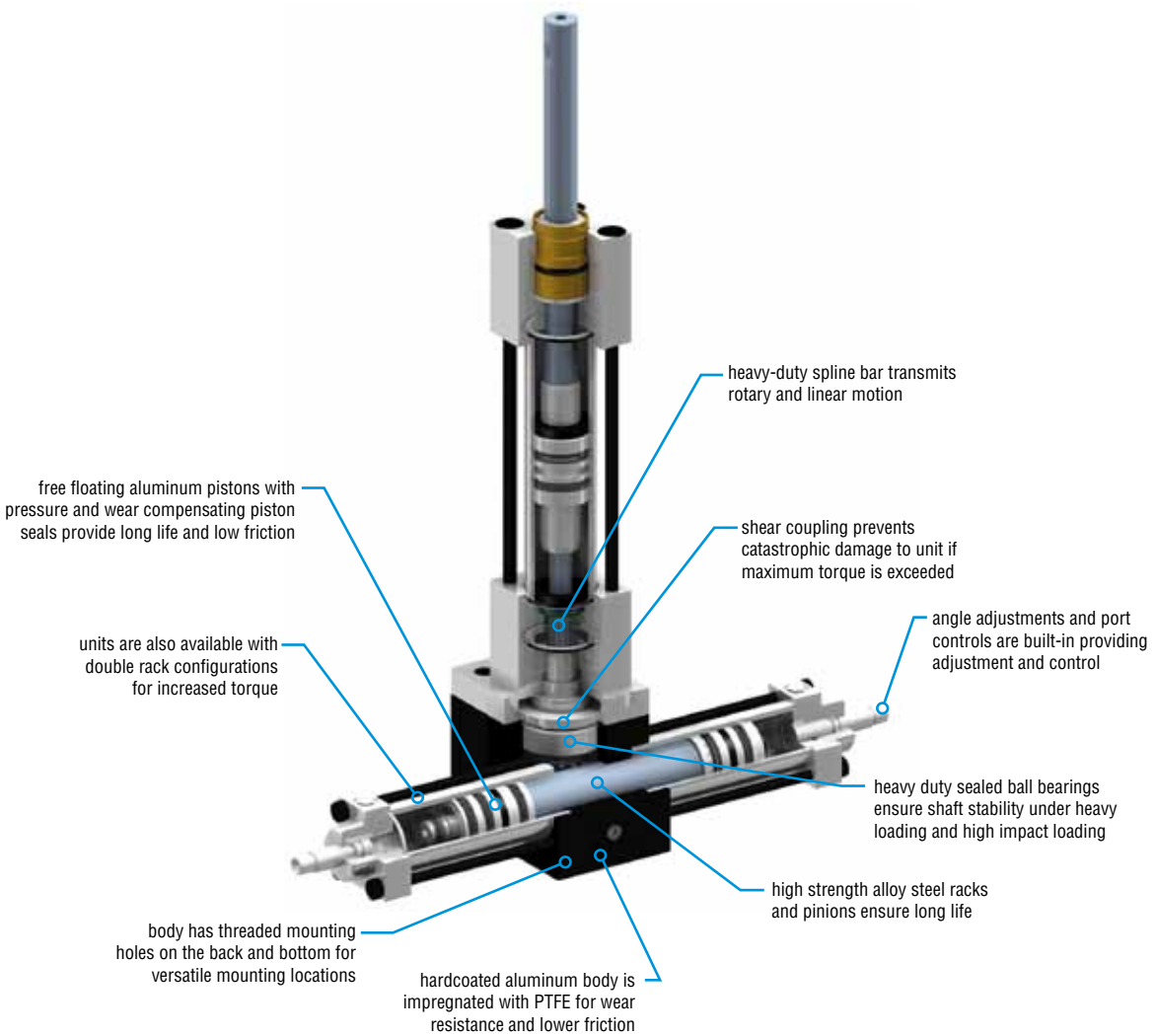
# 1000-8000

## *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°, 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

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

**ROTARY SECTION SHOCK PADS**
B1 - Shock Pad clockwise
B2 - Shock Pad counterclockwise
(Shock Pads are not available for Hydraulic use.)

**ROTARY SECTION 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)
H - Hall Sensor (Set Point Module is ordered separately). For rotations not exceeding 180°, see Switches & Sensors section. (N/A on Mx2x units)
I - Port Position 1 on top rack
Port Position 3 on bottom rack
**NOTE:** Sensor must be used with a PHD Set Point Module. See Switches and Sensors section for information and ordering data.

**MA1 1 F 3 180 x 3 - KY - DR-BC - D1-B2 - S - C - M**

**TYPE**
MA1 - 150 psi [10 bar] Air
MA2 - 150 psi [10 bar] Air with Aux. Shaft Ext.
MH1 - 1500 psi [100 bar] Hyd.
MH2 - 1500 psi [100 bar] Hyd. with Aux. Shaft Ext.

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

**STROKE**
1" [25 mm] to 12" [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**
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 (Hydraulic units only)
V - Fluoro-Elastomer Seals
W - Close Tolerance Stroke & Rotation
Z1 - Electroless Nickel Plate, all ferrous parts

**SERIES**
1 (000) 1-1/8" [29] Bore linear section, 1" [25] Bore rotary section - Single Rack
2 (000) 1-1/8" [29] Bore linear section, 1" [25] Bore rotary section - Double Rack
3 (000) 1-3/8" [35] Bore linear & rotary section - Single Rack
4 (000) 1-3/8" [35] Bore linear & rotary section - Double Rack
5 (000) 2" [50] Bore linear & rotary section - Single Rack
6 (000) 2" [50] Bore linear & rotary section - Double Rack
7 (000) 3" [75] Bore linear & rotary section - Single Rack
8 (000) 3" [75] Bore linear & rotary section - Double Rack

**NOTE:**
1) SAE Ports available. Consult PHD for specific port size.

**ANGLE ADJUSTMENT**
Angle Adjustment is standard on all Multi-Motion Actuators.

**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.

**SWITCH MOUNTING BRACKETS**

| SERIES | SIZE NO. LINEAR SECTION | SIZE NO. ROTARY SECTION |
|---|---|---|
| 1000 & 2000 | -36 | -32 |
| 3000 & 4000 | -37 | -34 |
| 5000 & 6000 | -40 | -38 |
| 7000 & 8000 | -41 | -39 |

See Switches and Sensors section for complete ordering information.

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.

## COMPACT REED SWITCHES

| PART NO. | DESCRIPTION |
|---|---|
| 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 |

## SET POINT MODULE

| PART NO. | DESCRIPTION |
|---|---|
| 9800-01-0300 | 4.5-24 VDC, Sink Type Output |
| 9800-01-0400 | 4.5-24 VDC, Source Type Output |

See Switches and Sensors section for information.

## COMPACT HALL EFFECT SWITCHES

| PART NO. | DESCRIPTION |
|---|---|
| 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 |

Designer's Resource myphd®

## CAD & Sizing Assistance

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

| SPECIFICATIONS | 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 | ±.031 [.8 mm] |
| ROTATIONAL BACKLASH | 2° (1000/2000), 1° 30' (3000/4000)<br>1° 0' (5000/6000), 0° 30' (7000/8000) |
| LUBRICATION | Factory lubricated for rated life |
| MAINTENANCE | Field repairable |

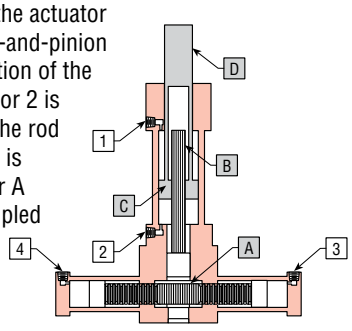
*See hydraulic pressure ratings for options chart below. All hydraulic ratings are based on non-shock hydraulic service.

| | WEIGHT | | | | | | ROTARY BORE DIAMETER | | LINEAR BORE DIAMETER | | ROTARY DISPLACEMENT | | LINEAR DISPLACEMENT | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | BASE | | ROT. ADDER | | LINEAR ADDER | | | | | | | | EXTEND | | RETRACT | |
| SERIES | lb | kg | lb/deg | kg/deg | lb/in | kg/mm | in | mm | in | mm | in³/° | cm³/° | in³/in | cm³/mm | in³/in | cm³/mm |
| 1000 | 6.3 | 2.9 | .0022 | .0010 | .38 | .0068 | 1.000 | 25.4 | 1.125 | 25.4 | .007 | 0.115 | .995 | 16.3 | .690 | 11.3 |
| 2000 | 7.3 | 3.3 | .0043 | .0020 | .38 | .0068 | 1.000 | 25.4 | 1.125 | 25.4 | .014 | 0.229 | .995 | 16.3 | .690 | 11.3 |
| 3000 | 13.9 | 6.3 | .0064 | .0029 | .25 | .0045 | 1.375 | 34.9 | 1.375 | 34.9 | .019 | 0.312 | 1.485 | 24.3 | 1.043 | 17.1 |
| 4000 | 16.7 | 7.6 | .0127 | .0058 | .25 | .0045 | 1.375 | 34.9 | 1.375 | 34.9 | .038 | 0.623 | 1.485 | 24.3 | 1.043 | 17.1 |
| 5000 | 32.3 | 14.7 | .0093 | .0042 | 1.39 | .0249 | 2.000 | 50.8 | 2.000 | 50.8 | .041 | 0.672 | 3.142 | 51.5 | 1.653 | 27.1 |
| 6000 | 37.3 | 16.9 | .0185 | .0084 | 1.39 | .0249 | 2.000 | 50.8 | 2.000 | 50.8 | .082 | 1.344 | 3.142 | 51.5 | 1.653 | 27.1 |
| 7000 | 94.0 | 42.6 | .0289 | .0131 | 2.50 | .0448 | 3.000 | 76.2 | 3.000 | 76.2 | .185 | 3.032 | 7.069 | 115.8 | 3.927 | 64.4 |
| 8000 | 107.0 | 48.5 | .0578 | .0262 | 2.50 | .0448 | 3.000 | 76.2 | 3.000 | 76.2 | .370 | 6.064 | 7.069 | 115.8 | 3.927 | 64.4 |

| | TORQUE OUTPUT | | THRUST FORCE EXTEND | | THRUST FORCE RETRACT | |
|---|---|---|---|---|---|---|
| SERIES | in-lb/psi | Nm/bar | lb/psi | N/bar | lb/psi | N/bar |
| 1000 | .39 | .64 | .99 | 63.9 | .69 | 44.5 |
| 2000 | .78 | 1.28 | | | | |
| 3000 | 1.11 | 1.82 | 1.48 | 95.5 | 1.04 | 67.0 |
| 4000 | 2.22 | 3.64 | | | | |
| 5000 | 2.36 | 3.87 | 3.14 | 202.5 | 1.65 | 106.5 |
| 6000 | 4.72 | 7.74 | | | | |
| 7000 | 10.60 | 17.37 | 7.06 | 455.4 | 3.93 | 253.5 |
| 8000 | 21.20 | 34.75 | | | | |

## 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

| | OPTION psi [bar] | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | PLAIN | | PORT CONTROLS | | -Dx | | -E or -M | |
| SERIES | psi | bar | psi | bar | psi | bar | psi | bar |
| 1000 | — | — | — | — | — | — | — | — |
| 2000 | 1000 | 69 | 750 | 52 | 750 | 52 | — | — |
| 3000 | — | — | — | — | — | — | — | — |
| 4000 | — | — | 750 | 52 | 750 | 52 | — | — |
| 5000 | — | — | — | — | — | — | 750 | 52 |
| 6000 | — | — | 750 | 52 | 750 | 52 | 750 | 52 |
| 7000 | — | — | — | — | — | — | 500 | 35 |
| 8000 | — | — | 750 | 52 | 750 | 52 | 500 | 35 |

LINEAR SECTION

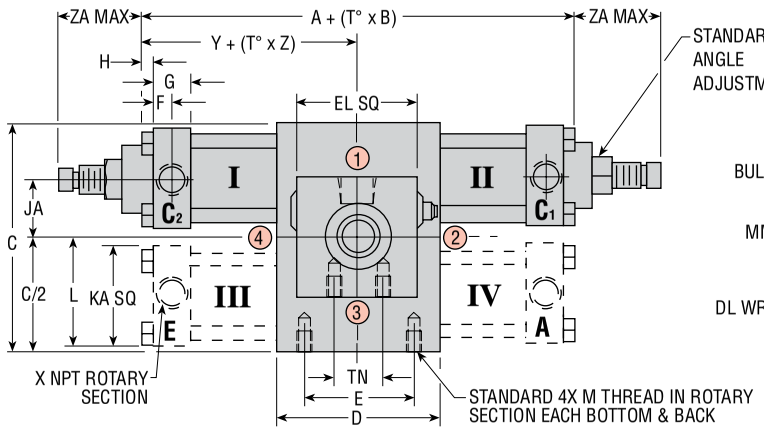
| | OPTION psi [bar] | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | PLAIN | | PORT CONTROLS | | -Dx | | -E or -M | |
| SERIES | psi | bar | psi | bar | psi | bar | psi | bar |
| 1000 | — | — | — | — | — | — | — | — |
| 2000 | — | — | — | — | — | — | — | — |
| 3000 | — | — | — | — | — | — | — | — |
| 4000 | — | — | — | — | — | — | — | — |
| 5000 | — | — | N/A | N/A | — | — | 750 | 52 |
| 6000 | — | — | N/A | N/A | — | — | 750 | 52 |
| 7000 | — | — | N/A | N/A | — | — | 500 | 35 |
| 8000 | — | — | N/A | N/A | — | — | 500 | 35 |

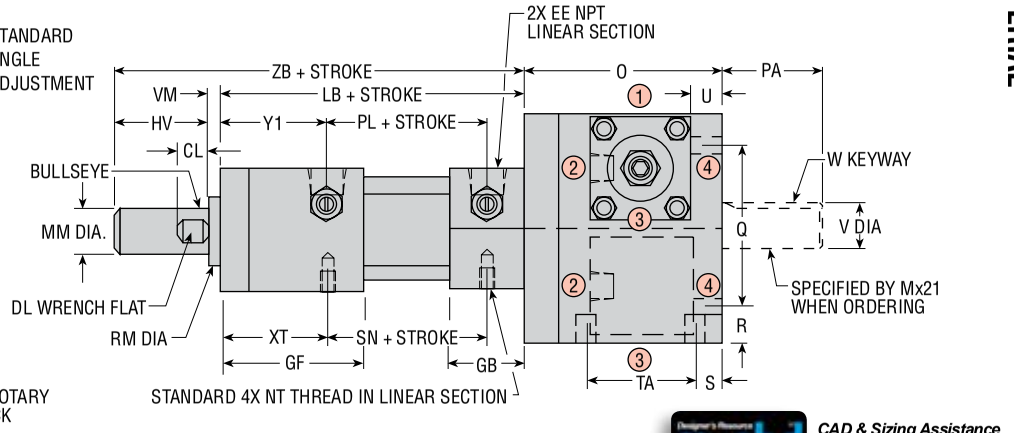
**Note:** — = Standard Rating

UNIT SIZING ONLINE

### *Sizing & Application Assistance*

Use PHD's free online Product Sizing Application or view the Product Sizing Catalog at: www.phdinc.com/apps/sizing






**ROTARY SECTION**

| CAP STYLE | SERIES | LETTER DIMENSION | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | A | B | C | D | E | F | G | H | JA | KA | L | M | O | PA | Q | R | S | TA | U | V | W | X | Y | Z | ZA |
| PLAIN | 2000 | 5.698 | .0174 | 3.000 | 2.000 | 1.500 | .250 | .500 | 0.00 | .750 | 1.375 | 1.437 | 1/4-20 x .312 DP | 2.500 | .875 | 2.000 | .500 | .250 | 1.500 | .312 | .4998/.5003 | 1/8 x 1/16 x .625 | 1/8 | 2.849 | .0087 | .000 |
| -A | 1000 & 2000 | 6.198 | .0174 | 3.000 | 2.000 | 1.500 | .500 | .750 | 0.00 | .750 | 1.375 | — | 1/4-20 x .312 DP | 2.500 | .875 | 2.000 | .500 | .250 | 1.500 | .312 | .4998/.5003 | 1/8 x 1/16 x .625 | 1/8 | 3.099 | .0087 | 1.125 |
| BOTH | 3000 & 4000 | 7.906 | .026 | 4.250 | 3.000 | 2.000 | .344 | .688 | .250 | 1.156 | 1.875 | 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 | 3.953 | .013 | 1.500 |
| BOTH | 5000 & 6000 | 9.126 | .026 | 5.000 | 4.000 | 2.500 | .375 | .750 | .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 | 4.563 | .013 | 1.875 |
| BOTH | 7000 & 8000 | 12.160 | .052 | 8.000 | 5.000 | 3.000 | .469 | 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 | 6.080 | .026 | 2.875 |

**LINEAR SECTION**

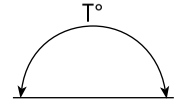
| SERIES | LETTER DIMENSION | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CL | DL | EE | EL | GB | GC | GF | HV | LB | MM | NT | PL | RM | SN | TN | VM | XT | Y1 | ZB |
| 1000 & 2000 | .530 | 1/2 | 1/4 | 1.750 | 1.250 | 1.000 | 2.187 | 1.500 | 5.000 | .625 | 1/4-28 x .312 DP | 2.812 | 1.000 | 2.812 | .625 | .250 | 1.562 | 1.562 | 6.750 |
| 3000 & 4000 | .530 | 5/8 | 3/8 | 2.250 | 1.375 | 1.000 | 2.625 | 1.625 | 5.562 | .750 | 5/16-24 x .500 DP | 2.937 | 1.250 | 2.937 | .875 | .250 | 1.937 | 1.937 | 7.437 |
| 5000 & 6000 | .987 | 1-1/8 | 3/8 | 3.000 | 2.000 | 1.250 | 3.750 | 3.000 | 7.250 | 1.375 | 3/8-24 x .500 DP | 3.125 | 2.000 | 3.125 | 1.250 | .375 | 2.937 | 2.937 | 10.625 |
| 7000 & 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 | .500 | 3.937 | 3.937 | 14.625 |

**QUICK REFERENCE FOR:** A + (T° x B)

| SERIES | DEGREE OF ROTATION | | | | | |
|---|---|---|---|---|---|---|
| | 45 | 90 | 180 | 270 | 360 | 450 |
| *1000 & 2000 | 6.481 | 7.264 | 8.830 | 10.396 | 11.962 | 13.528 |
| 3000 & 4000 | 9.076 | 10.246 | 12.586 | 14.926 | 17.266 | 19.606 |
| 5000 & 6000 | 10.296 | 11.466 | 13.806 | 16.146 | 18.486 | 20.826 |
| 7000 & 8000 | 14.500 | 16.840 | 21.520 | 26.200 | 30.880 | 35.560 |

*DIMENSIONS CALCULATED USING PLAIN CAP STYLE. ADD .250 TO DIMENSION FOR EACH -A STYLE CAP USED ON SERIES 1000/2000 ONLY.

**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.
**TUBES III & IV:** INCLUDED ON SERIES 2000, 4000, 6000, & 8000 ONLY
**MTG. HOLES:** CENTERED ON CENTERLINE OF UNIT
**CUSHIONS:** SERIES 1000 & 2000 ROTARY SECTIONS ONLY:
ADD 1/2" 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 1/4" TO ALL ( + STROKE) DIMENSIONS FOR EACH SHOCK PAD




PORT PRESSURIZED - FULL CCW POSITION
$C_1$ ON SERIES 1000, 3000, 5000, & 7000
OR $C_1$ & E ON SERIES 2000, 4000, 6000, & 8000

PORT PRESSURIZED - FULL CW POSITION
$C_2$ ON SERIES 1000, 3000, 5000, & 7000
OR $C_2$ & A ON SERIES 2000, 4000, 6000, & 8000

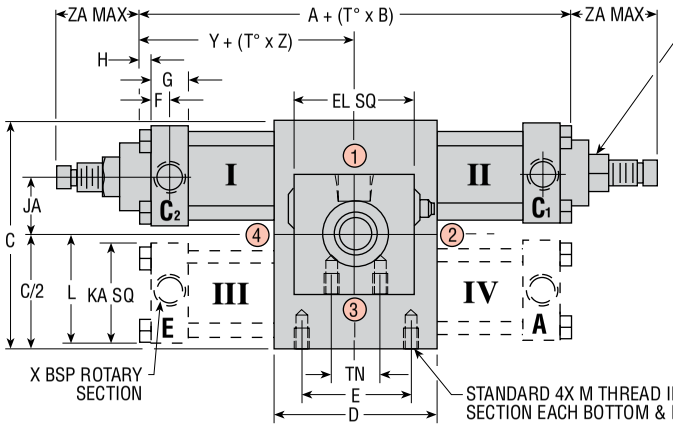
**ROTARY SECTION OPTION LOCATION REFERENCE**

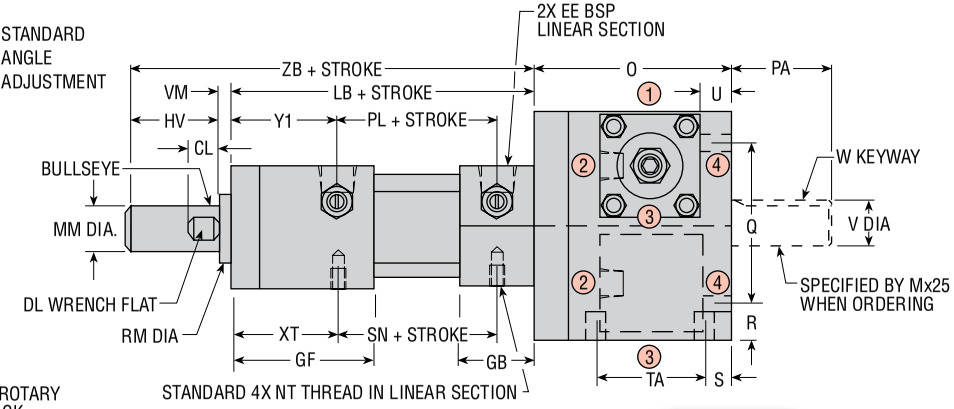
| ACTUATOR TYPE | LETTER OPTION REFERENCED BY TUBE NUMBER | | | | | | | PORT & NEEDLE LOCATIONS REFERENCED BY CIRCLED NUMBERS | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | -B | | -D | | -P | | | STANDARD | | | -C | | | -F | | | -I | | |
| | -B1 | -B2 | -D1 | -D2 | STANDARD | -M | -E | PORT | -P | -D | PORT | -P | -D | PORT | -P | -D | PORT | -P | -D |
| MA11 & MA21 | II | I | II | I | I & II | I & II | I & II | 2 | 1 | 1 | 1 | 2 | 2 | 4 | 1 | 1 | 1, 3 | 4 | 4 |
| MH11 & MH21 | — | — | II | I | I & II | I & II | I & II | 2 | 1 | 1 | 1 | 2 | 2 | 4 | 1 | 1 | 1, 3 | 4 | 4 |

All standard rod ends have four wrench flats.

All dimensions are reference only unless specifically toleranced.

# DIMENSIONS: 1000-8000 MULTI-MOTION ACTUATORS




**CAD & Sizing Assistance**
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**ROTARY SECTION**

| CAP STYLE | SERIES | LETTER DIMENSION | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | A | B | C | D | E | F | G | H | JA | KA | L | M | O | PA | Q | R | S | TA | U | V | W | X | Y | Z | ZA |
| PLAIN | 2000 | 145 | 0.44 | 76 | 51 | 38.1 | 6 | 13 | 0 | 19 | 35 | 36 | M6 x 1.0 x 8 | 63 | 22 | 50.8 | 13 | 6 | 38.1 | 8 | 12.69/12.71 | 3.18 x 1.59 x 16 | 1/8 | 72 | 0.22 | 0 |
| -A | 1000 & 2000 | 157 | 0.44 | 76 | 51 | 38.1 | 13 | 19 | 0 | 19 | 35 | 36 | M6 x 1.0 x 8 | 63 | 22 | 50.8 | 13 | 6 | 38.1 | 8 | 12.69/12.71 | 3.18 x 1.59 x 16 | 1/8 | 78 | 0.22 | 29 |
| BOTH | 3000 & 4000 | 201 | 0.66 | 108 | 76 | 50.8 | 9 | 17 | 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 | 1/4 | 100 | 0.33 | 38 |
| BOTH | 5000 & 6000 | 232 | 0.66 | 127 | 102 | 63.5 | 10 | 19 | 5 | 29 | 57 | 58 | M10 x 1.5 x 16 | 95.3 | 48 | 88.9 | 19 | 13 | 50.8 | 10 | 28.55/28.58 | 6.35 x 3.18 x 38 | 1/4 | 116 | 0.33 | 48 |
| BOTH | 7000 & 8000 | 309 | 1.33 | 203 | 127 | 76.2 | 12 | 27 | 11 | 48 | 89 | 92 | M20 x 2.5 x 32 | 159 | 89 | 127.0 | 38 | 32 | 63.5 | 19 | 44.42/44.45 | 9.53 x 2.36 x 76 | 3/8 | 154 | 0.66 | 73 |

**LINEAR SECTION**

| SERIES | LETTER DIMENSION | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CL | DL | EE | EL | GB | GC | GF | HV | LB | MM | NT | PL | RM | SN | TN | VM | XT | Y1 | ZB |
| 1000 & 2000 | 13 | 13 | 1/4 | 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 |
| 3000 & 4000 | 13 | 16 | 3/8 | 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 |
| 5000 & 6000 | 25 | 29 | 3/8 | 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 |
| 7000 & 8000 | 31 | 41 | 1/2 | 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 |

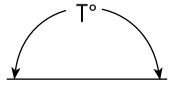
**QUICK REFERENCE FOR:** A + (T° x B)

| SERIES | DEGREE OF ROTATION | | | | | |
|---|---|---|---|---|---|---|
| | 45 | 90 | 180 | 270 | 360 | 450 |
| *1000 & 2000 | 164.6 | 184.5 | 224.3 | 264.1 | 303.8 | 343.6 |
| 3000 & 4000 | 230.5 | 260.2 | 319.7 | 379.1 | 438.6 | 498.0 |
| 5000 & 6000 | 261.5 | 291.1 | 351.4 | 350.7 | 469.5 | 529.0 |
| 7000 & 8000 | 368.3 | 427.7 | 548.0 | 546.6 | 784.4 | 903.2 |

*DIMENSIONS CALCULATED USING PLAIN CAP STYLE. ADD 6.3 TO DIMENSION FOR EACH -A STYLE CAP USED ON SERIES 1000/2000 ONLY.

**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.
**TUBES III & IV:** INCLUDED ON SERIES 2000, 4000, 6000, & 8000 ONLY
**MTG. HOLES:** CENTERED ON CENTERLINE OF UNIT
**CUSHIONS:** SERIES 1000 & 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 SECTIONS:
ADD 6.4 mm TO ALL ( + STROKE) DIMENSIONS FOR EACH SHOCK PAD

PORT PRESSURIZED - FULL CCW POSITION
$C_1$ ON SERIES 1000, 3000, 5000, & 7000
OR $C_1$ & E ON SERIES 2000, 4000, 6000, & 8000 **I**




PORT PRESSURIZED - FULL CW POSITION
$C_2$ ON SERIES 1000, 3000, 5000, & 7000
**II** OR $C_2$ & A ON SERIES 2000, 4000, 6000, & 8000

**ROTARY SECTION OPTION LOCATION REFERENCE**

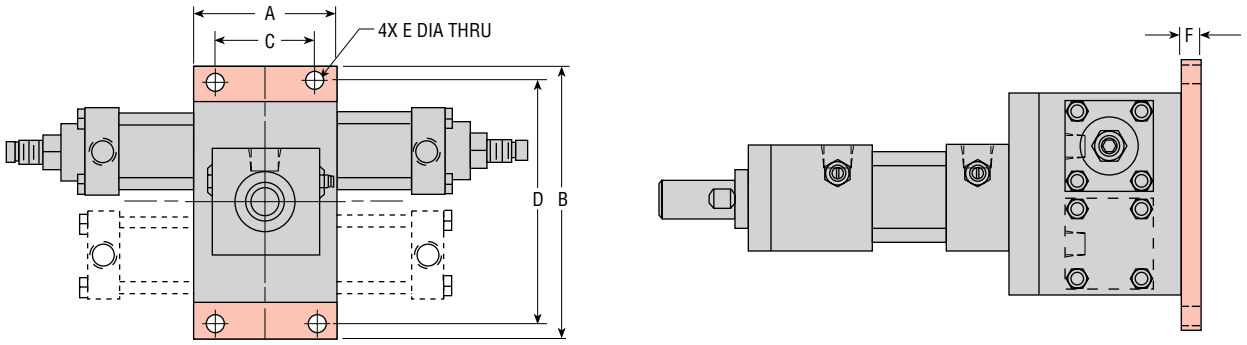
| ACTUATOR TYPE | LETTER OPTION REFERENCED BY TUBE NUMBER | | | | | | | PORT & NEEDLE LOCATIONS REFERENCED BY CIRCLED NUMBERS | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | -B | | -D | | -P | | | STANDARD | | | -C | | | -F | | | -I | | |
| | -B1 | -B2 | -D1 | -D2 | STANDARD | -M | -E | PORT | -P | -D | PORT | -P | -D | PORT | -P | -D | PORT | -P | -D |
| MA15 & MA25 | II | I | II | I | I & II | I & II | I & II | 2 | 1 | 1 | 1 | 2 | 2 | 4 | 1 | 1 | 1, 3 | 4 | 4 |
| MH15 & MH25 | — | — | II | I | I & II | I & II | I & II | 2 | 1 | 1 | 1 | 2 | 2 | 4 | 1 | 1 | 1, 3 | 4 | 4 |

All standard rod ends have four wrench flats.

All dimensions are reference only unless specifically toleranced.

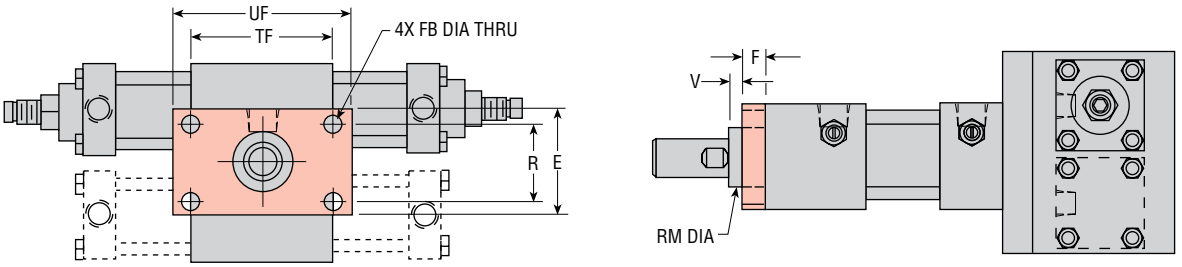
# DIMENSIONS: MOUNTING STYLES

## CF MOUNTING STYLE




| SERIES | LETTER DIMENSION | | | | | |
|---|---|---|---|---|---|---|
| | A | B | C | D | E | F |
| 1000 & 2000 | 2.000 [50.8] | 4.250 [108.0] | 1.375 [34.9] | 3.625 [92.1] | .281 [7.1] | .250 [6.4] |
| 3000 & 4000 | 3.000 [76.2] | 5.750 [146.1] | 2.125 [54.0] | 5.125 [130.2] | .406 [10.3] | .437 [11.1] |
| 5000 & 6000 | 4.000 [101.6] | 6.500 [165.1] | 3.375 [85.7] | 5.875 [149.2] | .406 [10.3] | .437 [11.1] |
| 7000 & 8000 | 5.000 [127.0] | 12.000 [304.8] | 3.000 [76.2] | 10.000 [254.0] | .781 [19.8] | .750 [19.1] |

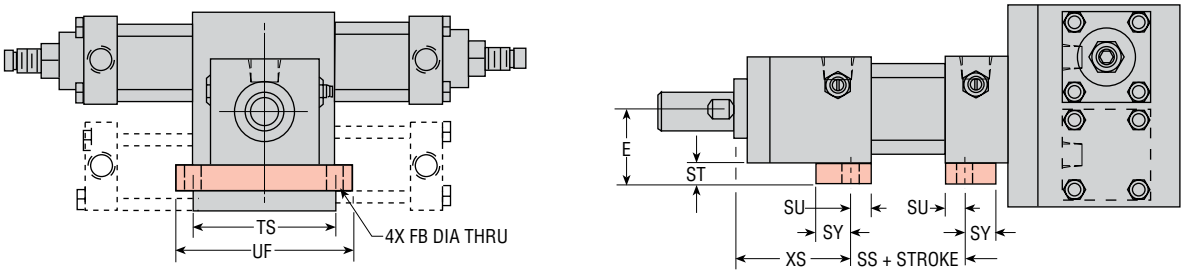
## RF MOUNTING STYLE




| SERIES | LETTER DIMENSION | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | E | F | FB | R | RM | TF | UF | V |
| 1000 & 2000 | 1.750 [44.5] | .500 [12.7] | .281 [7.1] | 1.250 [31.8] | 1.000 [25.4] | 2.500 [63.5] | 3.000 [76.2] | .250 [6.4] |
| 3000 & 4000 | 2.250 [57.2] | .500 [12.7] | .343 [8.7] | 1.625 [41.3] | 1.250 [31.8] | 3.000 [76.2] | 3.750 [95.3] | .250 [6.4] |
| 5000 & 6000 | 3.000 [76.2] | 1.000 [25.4] | .562 [14.3] | 2.000 [50.8] | 2.000 [50.8] | 4.125 [104.8] | 5.125 [130.2] | .375 [9.9] |
| 7000 & 8000 | 4.000 [101.6] | 1.125 [28.6] | .687 [17.4] | 2.750 [69.9] | 2.750 [69.9] | 5.875 [149.2] | 7.125 [181.0] | .500 [12.7] |

CYLINDER LENGTH IS NOT CHANGED BY RF MOUNTING

## F MOUNTING STYLE




| SERIES | LETTER DIMENSION | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | E | | FB | | SS | ST | SU | SY | TS | UF | XS |
| 1000 & 2000 | 1.250 [31.8] | .281 [7.1] | 2.187 [55.5] | .375 [9.5] | .312 [7.9] | .937 [23.8] | 2.500 [63.5] | 3.000 [76.2] | 2.125 [54.0 |
| 3000 & 4000 | 1.625 [41.3] | .344 [8.7] | 2.437 [61.9] | .500 [12.7] | .437 [11.1] | .937 [23.8] | 3.000 [76.2] | 3.750 [95.3] | 2.437 [61.9]] |
| 5000 & 6000 | 2.250 [57.2] | .562 [14.3] | 4.000 [101.6] | .750 [19.1] | 1.250 [31.8] | .500 [12.7] | 4.000 [101.6] | 5.000 [127.0] | 2.875 [73.0] |
| 7000 & 8000 | 3.000 [76.2] | .812 [20.6] | 5.000 [127.0] | 1.000 [25.4] | 1.500 [38.1] | 1.000 [25.4] | 5.875 [149.2] | 7.250 [184.2] | 4.250 [108.0] |

**CUSHIONS:** ADD TO ( + STROKE) 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 ( + STROKE) DIMENSION FOR EACH SHOCK PAD



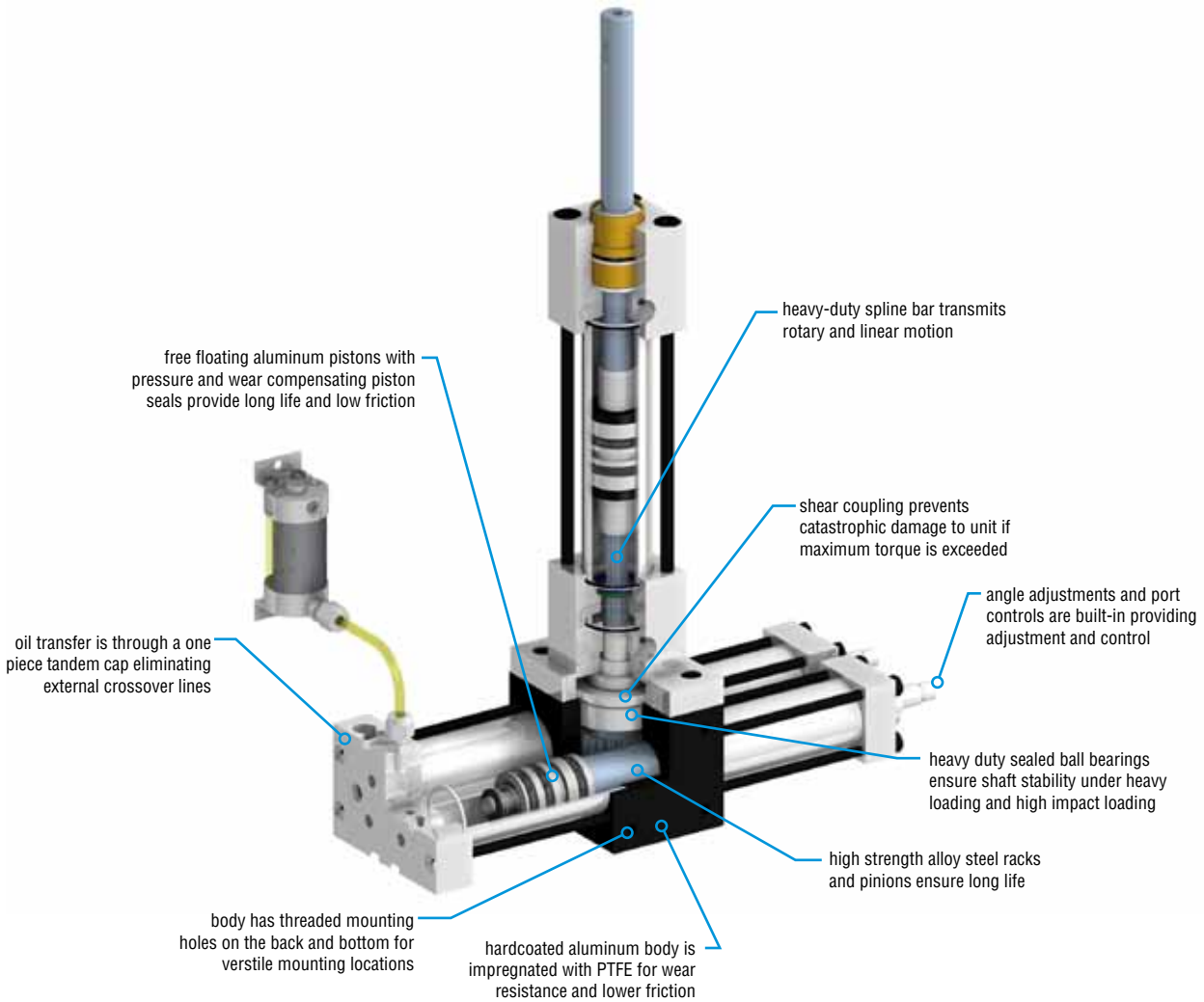


All dimensions are reference only unless specifically toleranced.

# 2000-8000
# air/oil tandem
## *MULTI-MOTION ACTUATOR*

### 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.



# 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.

**ANGLE OF ROTATION FROM POSITION I TO POSITION II. USED ON 3 POSITION ONLY.**

**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

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

**ROTARY SECTION OPTIONS**
F - Port in Position 4
H - Hall Sensor (Set Point Module is ordered separately). For rotations not exceeding 180°. (N/A on Mx2x units)
I - Port Position 1 on top rack
Port Position 3 on bottom rack
Y - Tandem cap rotated 180°
**NOTE:** Sensor must be used with a PHD Set Point Module. See Switches and Sensors section for information and ordering data.

| 3 | MR1 | 3 | F | 4 | 180 | - | 45 | x | 3 | - | KY | - | DR-BC | - | D1 | - | S | - | H | - | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

**ONLY FOR USE WITH 3 POSITION TANDEM**

**TYPE**
MR1 - 150 psi [10 bar] Air
MR2 - 150 psi [10 bar] Air with Aux. Shaft Ext.

**DESIGN NO.**
3 - Imperial
8 - Metric

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

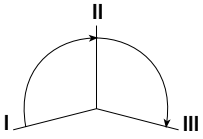
**LINEAR SECTION CUSHION**
DR - Cushion on rod end
DC - Cushion on cap end

**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 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

**SERIES**
2 (000) 1-1/8" [29 mm] Bore linear section, 1" [25 mm] Bore rotary section - Double Rack
4 (000) 1-3/8" [35 mm] Bore linear & rotary section - Double Rack
6 (000) 2" [50 mm] Bore linear & rotary section - Double Rack
8 (000) 3" [75 mm] Bore linear & rotary section - Double Rack




**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**

| SERIES | SIZE NO. LINEAR SECTION | SIZE NO. ROTARY SECTION |
|---|---|---|
| 2000 | -36 | -32 |
| 4000 | -37 | -34 |
| 6000 | -40 | -38 |
| 8000 | -41 | -39 |

See the Switches and Sensors section for complete ordering information.



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.

## SET POINT MODULE

| PART NO. | DESCRIPTION |
|---|---|
| 9800-01-0300 | 4.5-24 VDC, Sink Type Output |
| 9800-01-0400 | 4.5-24 VDC, Source Type Output |

See Switches and Sensors section for information.

## COMPACT REED SWITCHES

| PART NO. | DESCRIPTION |
|---|---|
| 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. | DESCRIPTION |
|---|---|
| 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 |

Designer's Resource myphd®

## CAD & Sizing Assistance

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

| SPECIFICATIONS | SERIES 2000-8000 |
|---|---|
| PNEUMATIC OPERATING PRESSURE | 40 to 150 psi [2.8 to 10 bar] |
| OPERATING TEMPERATURE | -20° to 180°F [-29° to 82°C] |
| ROTATIONAL TOLERANCE | Nominal rotation +10°/-0° |
| STROKE TOLERANCE | ±.031 [.8 mm] |
| ROTATIONAL BACKLASH | 2° (2000), 1° 30' (4000)<br>1° 0' (6000), 0° 30' (8000) |
| LUBRICATION | Factory lubricated for rated life |
| MAINTENANCE | Field repairable |

| 3-POSITION UNITS<br>INTERMEDIATE POSITION | SERIES<br>2000 | 4000 | 6000 | 8000 |
|---|---|---|---|---|
| ROTATIONAL TOLERANCE<br>MEASURED AT CENTER OF BACKLASH | ± 1° | ± 0° 30' | ± 0° 30' | ± 0° 15' |
| ROTATIONAL BACKLASH | 2° | 1° 45' | 1° 45' | 1° 15' |

| | WEIGHT | | | | | | ROTARY BORE DIAMETER | | LINEAR BORE DIAMETER | | ROTARY DISPLACEMENT | | LINEAR DISPLACEMENT | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | BASE | | ROT. ADDER | | LINEAR ADDER | | | | | | | | EXTEND | | RETRACT | |
| SERIES | lb | kg | lb/deg | kg/deg | lb/in | kg/mm | in | mm | in | mm | $in^3$/deg | $cm^3$/deg | $in^3$/in | $cm^3$/mm | $in^3$/in | $cm^3$/mm |
| 2000 | 7.3 | 3.3 | .0043 | .0020 | .38 | .0068 | 1.000 | 25.4 | 1.125 | 28.6 | .014 | 0.229 | .995 | 16.3 | .690 | 11.3 |
| 4000 | 16.7 | 7.6 | .0127 | .0058 | .25 | .0045 | 1.375 | 34.9 | 1.375 | 34.9 | .038 | 0.623 | 1.485 | 24.3 | 1.043 | 17.1 |
| 6000 | 37.3 | 16.9 | .0185 | .0084 | 1.39 | .0249 | 2.000 | 50.8 | 2.000 | 50.8 | .082 | 1.344 | 3.142 | 51.5 | 1.653 | 27.1 |
| 8000 | 107.0 | 48.5 | .0578 | .0262 | 2.50 | .0448 | 3.000 | 76.2 | 3.000 | 76.2 | .370 | 6.064 | 7.069 | 115.8 | 3.927 | 64.4 |

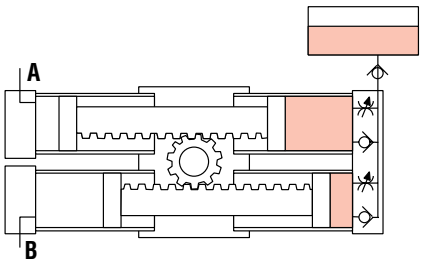
| | TORQUE OUTPUT | | THRUST FORCE EXTEND | | THRUST FORCE RETRACT | |
|---|---|---|---|---|---|---|
| SERIES | in-lb/psi | Nm/bar | lb/psi | N/bar | lb/psi | N/bar |
| 2000 | .39 | .64 | .99 | 63.9 | .69 | 44.5 |
| 4000 | 1.11 | 1.82 | 1.48 | 95.5 | 1.04 | 67.0 |
| 6000 | 2.36 | 3.87 | 3.14 | 202.5 | 1.65 | 106.5 |
| 8000 | 10.60 | 17.37 | 7.06 | 455.4 | 3.93 | 253.5 |



## WORKING PRINCIPLE

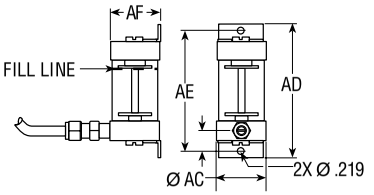
Air/Oil Tandem rotary section provides the smooth control of hydraulics with the simplicity of air. The closed loop oil system gives smooth precise speed control throughout the rotation using built-in PHD Port Controls®. The illustration shows a Tandem Actuator with built-in Port Controls® in the crossover 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.



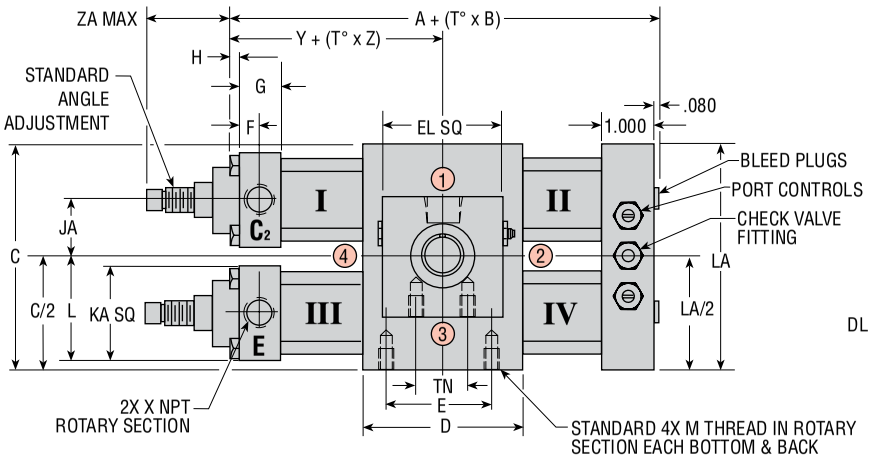
| RESERVOIR PART NO. | AB | AC | AD | AE | AF |
|---|---|---|---|---|---|
| 13459-02-2 | 16.4 | 63.5 | 139.7 | 130.2 | 64.3 |
| 13459-03-2 | 13.8 | 38.1 | 98.4 | 88.9 | 38.9 |

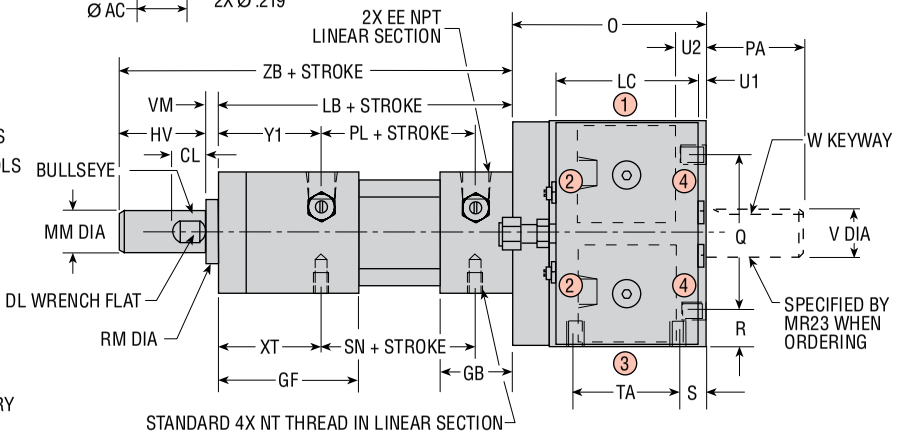
## TANK DIMENSIONS




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.




### ROTARY SECTION

| SERIES | LETTER DIMENSION | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | B | C | D | E | F | G | H | JA | KA | L | LA | LC | M | O | PA | Q | R | S | TA | U1 | U2 | V | W | X | Y | Z | ZA |
| 2000 | 6.215 | .0174 | 3.000 | 2.000 | 1.500 | .250 | .500 | 0.00 | .750 | 1.375 | 1.437 | 2.875 | 1.750 | 1/4-20 x .312 DP | 2.500 | .875 | 2.000 | .500 | .250 | 1.500 | .125 | .312 | .4998/.5003 | 1/8 x 1/16 x .625 | 1/8 | 2.849 | .0087 | 1.125 |
| 4000 | 7.986 | .026 | 4.250 | 3.000 | 2.000 | .344 | .688 | .250 | 1.156 | 1.875 | 2.094 | 4.187 | 2.750 | 5/16-18 x .500 DP | 3.625 | 1.875 | 3.000 | .625 | .500 | 2.000 | .125 | .562 | .8748/.8753 | 3/16 x 3/32 x 1.500 | 1/4 | 3.953 | .013 | 1.500 |
| 6000 | 9.190 | .026 | 5.000 | 4.000 | 2.500 | .375 | .750 | .203 | 1.156 | 2.250 | 2.281 | 4.687 | 2.750 | 3/8-16 x .625 DP | 3.750 | 1.875 | 3.500 | .750 | .500 | 2.000 | .125 | .375 | 1.124/1.125 | 1/4 x 1/8 x 1.500 | 1/4 | 4.563 | .013 | 1.875 |
| 8000 | 11.128 | .052 | 8.000 | 5.000 | 3.000 | .469 | 1.062 | .437 | 1.875 | 3.500 | 3.625 | 6.125 | 3.000 | 3/4-10 x 1.250 DP | 6.250 | 3.500 | 5.000 | 1.500 | 1.250 | 2.500 | 1.000 | .750 | 1.749/1.750 | 3/8 x 3/16 x 3.000 | 3/8 | 6.080 | .026 | 2.875 |

### LINEAR SECTION

| SERIES | LETTER DIMENSION | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CL | DL | EE | EL | GB | GC | GF | HV | LB | MM | NT | PL | RM | SN | TN | VM | XT | Y1 | ZB |
| 2000 | .530 | 1/2 | 1/4 | 1.750 | 1.250 | 1.000 | 2.187 | 1.500 | 5.000 | .625 | 1/4-28 x .312 DP | 2.812 | 1.000 | 2.812 | .625 | .250 | 1.562 | 1.562 | 6.750 |
| 4000 | .530 | 5/8 | 3/8 | 2.250 | 1.375 | 1.000 | 2.625 | 1.625 | 5.562 | .750 | 5/16-24 x .500 DP | 2.937 | 1.250 | 2.937 | .875 | .250 | 1.937 | 1.937 | 7.437 |
| 6000 | .987 | 1-1/8 | 3/8 | 3.000 | 2.000 | 1.250 | 3.750 | 3.000 | 7.250 | 1.375 | 3/8-24 x .500 DP | 3.125 | 2.000 | 3.125 | 1.250 | .375 | 2.937 | 2.937 | 10.625 |
| 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 | .500 | 3.937 | 3.937 | 14.625 |

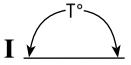
### QUICK REFERENCE FOR: A + (T° x B)

| SERIES | DEGREE OF ROTATION | | | | | |
|---|---|---|---|---|---|---|
| | 45 | 90 | 180 | 270 | 360 | 450 |
| 2000 | 6.998 | 7.781 | 9.347 | 10.913 | 12.479 | 14.045 |
| 4000 | 9.156 | 10.326 | 12.666 | 15.006 | 17.346 | 19.686 |
| 6000 | 10.360 | 11.530 | 13.870 | 16.210 | 18.550 | 20.890 |
| 8000 | 13.468 | 15.808 | 20.488 | 25.168 | 29.848 | 34.528 |

**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

### ROTARY SECTION OPTION LOCATION REFERENCE

| ACTUATOR TYPE | LETTER OPTION REFERENCED BY TUBE NUMBER | | | | | PORT & NEEDLE LOCATIONS REFERENCED BY CIRCLED NUMBERS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | -D | | -P | | | STANDARD | | | -F | | | -I | | |
| | -D1 | -D2 | STANDARD | -M | -E | PORT | -P | -D | PORT | -P | -D | PORT | -P | -D |
| MR13 & MR23 | II | IV | II & IV | I & III | I & III | 2 | 2 | 2 | 4 | 2 | 2 | 1, 3 | 2 | 2 |




PORT PRESSURIZED - E FULL CCW POSITION
PORT PRESSURIZED - C2 FULL CW POSITION

All standard rod ends have four wrench flats.

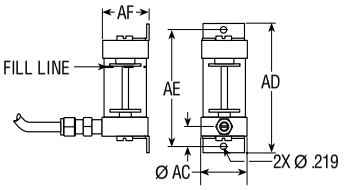
myphd CAD & Sizing Assistance
Use PHD's free online Product Sizing and CAD Configurator at www.phdinc.com/myphd

All dimensions are reference only unless specifically toleranced.

# DIMENSIONS: AIR/OIL TANDEM MULTI-MOTION ACTUATORS

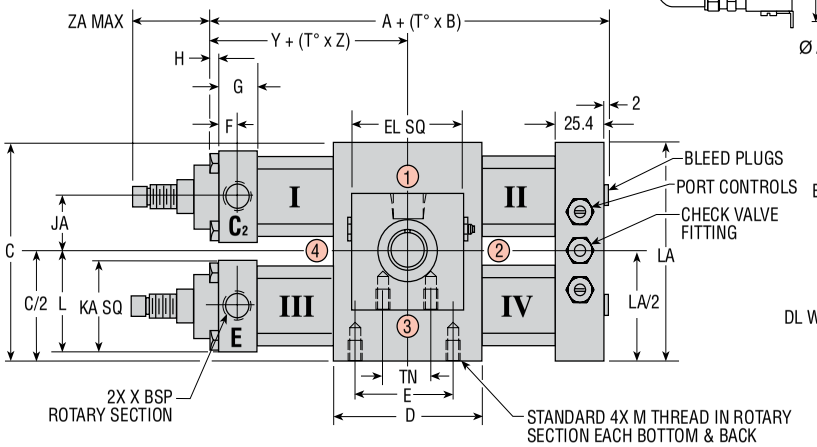
| RESERVOIR PART NO. | AB | AC | AD | AE | AF |
|---|---|---|---|---|---|
| 68397-02-2 | 16.4 | 63.5 | 139.7 | 130.2 | 64.3 |
| 68397-03-2 | 13.8 | 38.1 | 98.4 | 88.9 | 38.9 |

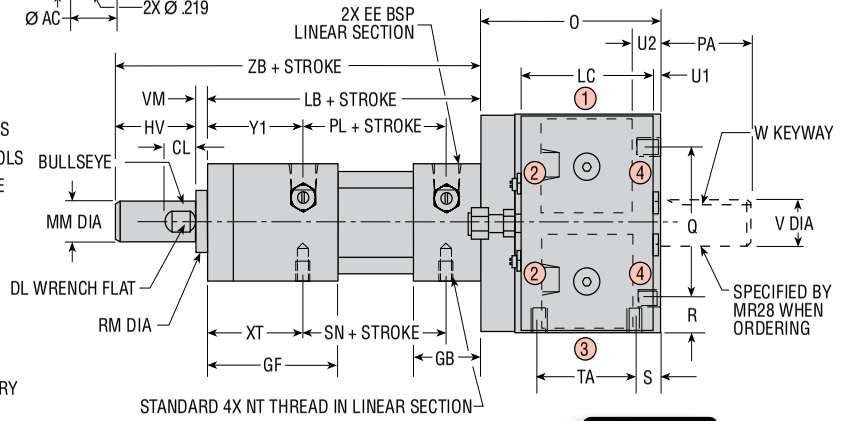
## TANK DIMENSIONS




RESERVOIR ASSEMBLY IS INCLUDED WITH UNIT.
SERIES 2000, 4000, & 6000 UNITS USE PART NO. 68397-03-2.
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.




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

### ROTARY SECTION

| SERIES | LETTER DIMENSION | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | B | C | D | E | F | G | H | JA | KA | L | LA | LC | M | O | PA | Q | R | S | TA | U1 | U2 | V | W | X | Y | Z | ZA |
| 2000 | 158 | 0.44 | 76 | 51 | 38.1 | 6 | 13 | 0 | 19 | 35 | 36 | 73 | 44 | M6 x 1.0 x 8 | 63 | 22 | 50.8 | 13 | 6 | 38.1 | 3 | 8 | 12.69/12.71 | 3.18 x 1.59 x 16 | G1/8 | 72 | 0.22 | 29 |
| 4000 | 203 | 0.66 | 108 | 76 | 50.8 | 9 | 17 | 6 | 29 | 48 | 53 | 106 | 70 | M8 x 1.25 x 13 | 92 | 48 | 76.2 | 16 | 13 | 50.8 | 3 | 14 | 22.22/22.23 | 4.75 x 2.36 x 38 | G1/4 | 100 | 0.33 | 38 |
| 6000 | 233 | 0.66 | 127 | 102 | 63.5 | 10 | 19 | 5 | 29 | 57 | 58 | 119 | 70 | M10 x 1.5 x 16 | 95.3 | 48 | 88.9 | 19 | 13 | 50.8 | 3 | 10 | 28.55/28.58 | 6.35 x 3.18 x 38 | G1/4 | 116 | 0.33 | 48 |
| 8000 | 283 | 1.32 | 203 | 127 | 76.2 | 12 | 27 | 11 | 48 | 89 | 92 | 156 | 76 | M20 x 2.5 x 32 | 159 | 89 | 127 | 38 | 32 | 63.5 | 25 | 19 | 44.42/44.45 | 9.53 x 2.36 x 76 | G3/8 | 154 | 0.66 | 73 |

### LINEAR SECTION

| SERIES | LETTER DIMENSION | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CL | DL | EE | EL | 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 |

### QUICK REFERENCE FOR: A + (T° x B)

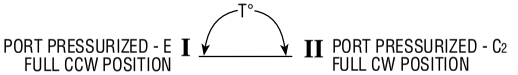
| SERIES | DEGREE OF ROTATION | | | | | |
|---|---|---|---|---|---|---|
| | 45 | 90 | 180 | 270 | 360 | 450 |
| 2000 | 177.7 | 197.6 | 237.4 | 277.2 | 317.0 | 356.7 |
| 4000 | 232.6 | 262.2 | 321.7 | 381.2 | 440.6 | 500.0 |
| 6000 | 263.1 | 292.9 | 352.3 | 411.7 | 471.2 | 530.9 |
| 8000 | 342.1 | 401.5 | 520.4 | 639.3 | 758.1 | 877.0 |

**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

### ROTARY SECTION OPTION LOCATION REFERENCE

| ACTUATOR TYPE | LETTER OPTION REFERENCED BY TUBE NUMBER | | | | | PORT & NEEDLE LOCATIONS REFERENCED BY CIRCLED NUMBERS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | -D | | -P | | | STANDARD | | | -F | | | -I | | |
| | -D1 | -D2 | STANDARD | -M | -E | PORT | -P | -D | PORT | -P | -D | PORT | -P | -D |
| MR18 & MR28 | II | IV | II & IV | I & III | I & III | 2 | 2 | 2 | 4 | 2 | 2 | 1, 3 | 2 | 2 |

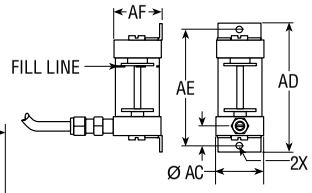
All standard rod ends have four wrench flats.




All dimensions are reference only unless specifically toleranced.

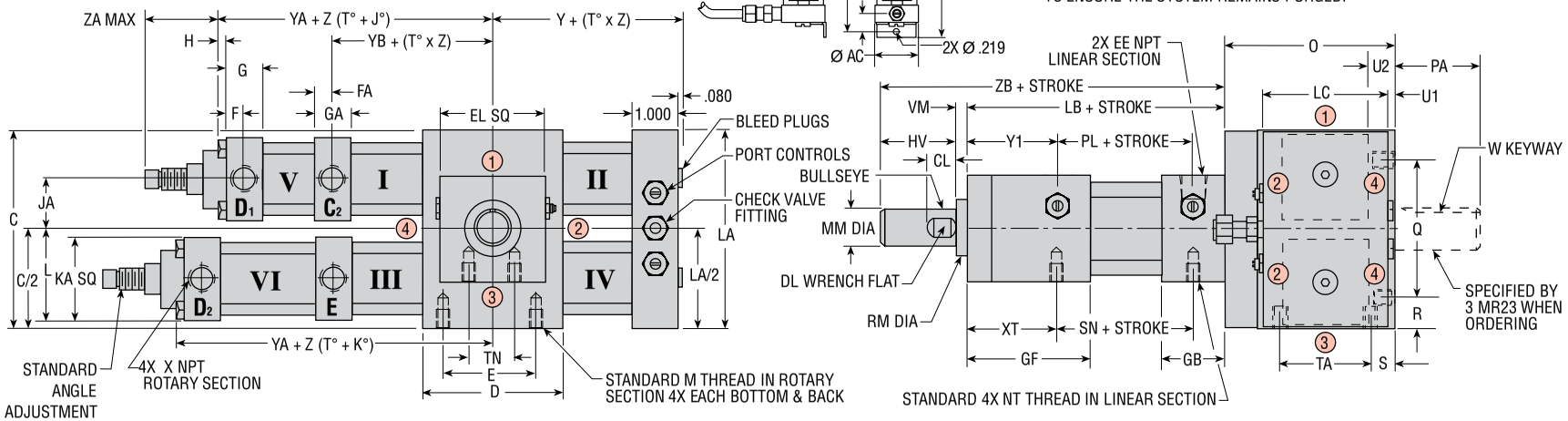
| RESERVOIR PART NO. | AB | AC | AD | AE | AF |
|---|---|---|---|---|---|
| 13459-02-2 | 16.4 | 63.5 | 139.7 | 130.2 | 64.3 |
| 13459-03-2 | 13.8 | 38.1 | 98.4 | 88.9 | 38.9 |

## TANK DIMENSIONS




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.

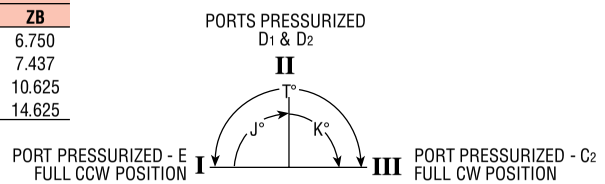



### ROTARY SECTION

| SERIES | LETTER DIMENSION | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | C | D | E | F | FA | G | GA | H | JA | KA | L | LA | LC | M | O | PA | Q | R | S | TA | U1 | U2 | V | W | X | Y | YA | YB | Z | ZA |
| 2000 | 3.000 | 2.000 | 1.500 | .500 | .500 | .750 | .750 | 0.00 | .750 | 1.375 | 1.437 | 2.875 | 1.750 | 1/4-20 x .312 DP | 2.500 | .875 | 2.000 | .500 | .250 | 1.500 | .125 | .312 | .4998/.5003 | 1/8 x 1/16 x .625 | 1/8 | 3.366 | 5.983 | 2.599 | .0087 | 1.125 |
| 4000 | 4.250 | 3.000 | 2.000 | .344 | .375 | .688 | .719 | .250 | 1.156 | 1.875 | 2.094 | 4.187 | 2.750 | 5/16-18 x .500 DP | 3.625 | 1.875 | 3.000 | .625 | .500 | 2.000 | .125 | .562 | .8748/.8753 | 3/16 x 3/32 x 1.500 | 1/4 | 4.033 | 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 | 4.687 | 2.750 | 3/8-16 x .625 DP | 3.750 | 1.875 | 3.500 | .750 | .500 | 2.000 | .125 | .375 | 1.124/1.125 | 1/4 x 1/8 x 1.500 | 1/4 | 4.627 | 7.325 | 3.980 | .013 | 1.875 |
| 8000 | 8.000 | 5.000 | 3.000 | .469 | .469 | 1.062 | 1.062 | .437 | 1.875 | 3.500 | 3.625 | 6.125 | 3.000 | 3/4-10 x 1.250 DP | 6.250 | 3.500 | 5.000 | 1.500 | 1.250 | 2.500 | 1.000 | .750 | 1.749/1.750 | 3/8 x 3/16 x 3.000 | 3/8 | 5.048 | 9.865 | 5.236 | .026 | 2.875 |

### LINEAR SECTION

| SERIES | LETTER DIMENSION | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CL | DL | EE | EL | GB | GC | GF | HV | LB | MM | NT | PL | RM | SN | TN | VM | XT | Y1 | ZB |
| 2000 | .530 | 1/2 | 1/4 | 1.750 | 1.250 | 1.000 | 2.187 | 1.500 | 5.000 | .625 | 1/4-28 x .312 DP | 2.812 | 1.000 | 2.812 | .625 | .250 | 1.562 | 1.562 | 6.750 |
| 4000 | .530 | 5/8 | 3/8 | 2.250 | 1.375 | 1.000 | 2.625 | 1.625 | 5.562 | .750 | 5/16-24 x .500 DP | 2.937 | 1.250 | 2.937 | .875 | .250 | 1.937 | 1.937 | 7.437 |
| 6000 | .987 | 1-1/8 | 3/8 | 3.000 | 2.000 | 1.250 | 3.750 | 3.000 | 7.250 | 1.375 | 3/8-24 x .500 DP | 3.125 | 2.000 | 3.125 | 1.250 | .375 | 2.937 | 2.937 | 10.625 |
| 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 | .500 | 3.937 | 3.937 | 14.625 |

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**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

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

### ROTARY SECTION OPTION LOCATION REFERENCE

| ACTUATOR TYPE | LETTER OPTION REFERENCED BY TUBE NUMBER | | | | | | | PORT & NEEDLE LOCATIONS REFERENCED BY CIRCLED NUMBERS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | -D | | -P | | -M | -E | | STANDARD | | | -F | | | -I | | |
| | -D1 | -D2 | STANDARD | | I & III | I & III | | PORT | -P | -D | PORT | -P | -D | PORT | -P | -D |
| 3MR13 & 3MR23 | II | IV | II & IV | | V & VI | V & VI | | 2 | 2 | 2 | 4 | 2 | 2 | 1, 3 | 2 | 2 |

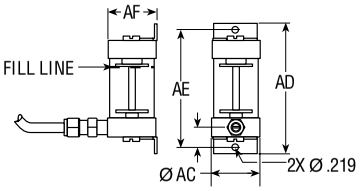
All standard rod ends have four wrench flats.

All dimensions are reference only unless specifically toleranced.

# DIMENSIONS: 3 POSITION AIR/OIL TANDEM MULTI-MOTION ACTUATORS

| RESERVOIR PART NO. | AB | AC | AD | AE | AF |
|---|---|---|---|---|---|
| 68397-02-2 | 16.4 | 63.5 | 139.7 | 130.2 | 64.3 |
| 68397-03-2 | 13.8 | 38.1 | 98.4 | 88.9 | 38.9 |

## TANK DIMENSIONS




RESERVOIR ASSEMBLY IS INCLUDED WITH UNIT.
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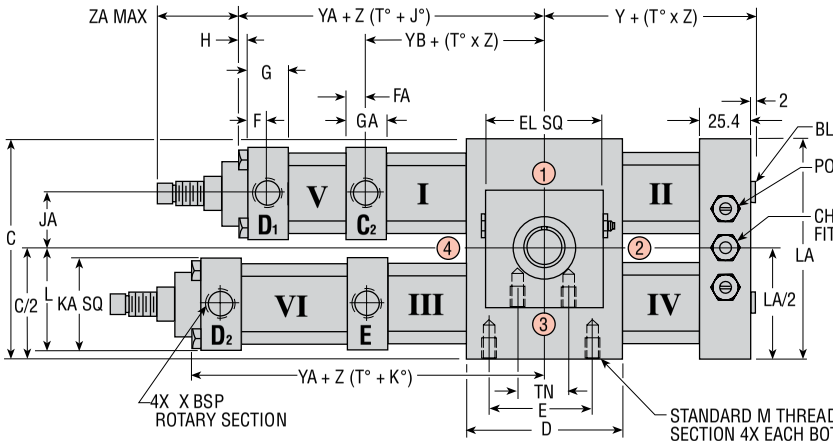
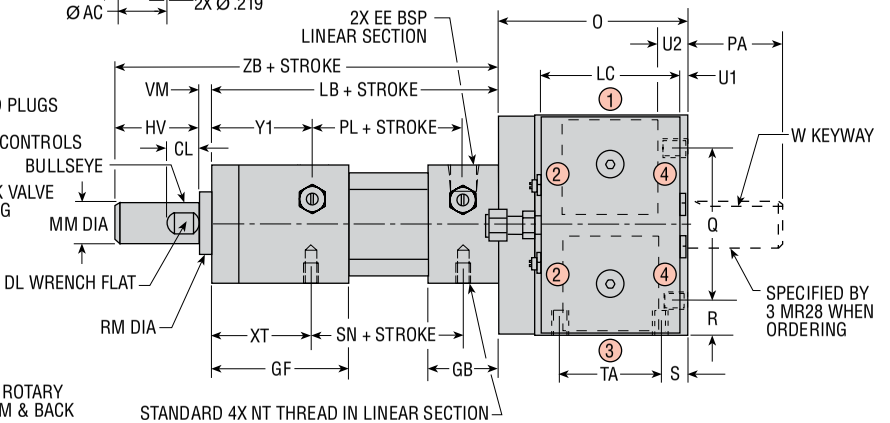
SERIES 8000 UNITS USE PART NO. 68397-02-2.

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



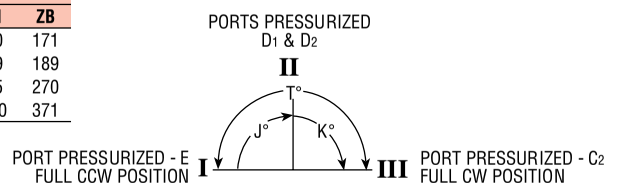




## ROTARY SECTION

| SERIES | LETTER DIMENSION | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | C | D | E | F | FA | G | GA | H | JA | KA | L | LA | LC | M | O | PA | Q | R | S | TA | U1 | U2 | V | W | X | Y | YA | YB | Z | ZA |
| 2000 | 76 | 51 | 38.1 | 13 | 13 | 19 | 19 | 0 | 19 | 35 | 36 | 73.0 | 44.5 | M6 x 1.0 x 8 | 63 | 22 | 50.8 | 13 | 6 | 38.1 | 3 | 8 | 12.69/12.71 | 3.18 x 1.59 x 16 | G1/8 | 85 | 152 | 66 | 0.22 | 29 |
| 4000 | 108 | 76 | 50.8 | 9 | 10 | 17 | 18 | 6 | 29 | 48 | 53 | 106.4 | 69.9 | M8 x 1.25 x 13 | 92 | 48 | 76.2 | 16 | 13 | 50.8 | 3 | 14 | 22.22/22.23 | 4.75 x 2.36 x 38 | G1/4 | 102 | 171 | 85 | 0.33 | 38 |
| 6000 | 127 | 102 | 63.5 | 10 | 9 | 19 | 18 | 5 | 29 | 57 | 58 | 119.1 | 69.9 | M10 x 1.5 x 16 | 95.3 | 48 | 88.9 | 19 | 13 | 50.8 | 3 | 10 | 28.55/28.58 | 6.35 x 3.18 x 38 | G1/4 | 118 | 186 | 101 | 0.33 | 48 |
| 8000 | 203 | 127 | 76.2 | 12 | 12 | 27 | 27 | 11 | 48 | 89 | 92 | 155.6 | 76.2 | M20 x 2.5 x 32 | 159 | 89 | 127.0 | 38 | 32 | 63.5 | 25 | 19 | 44.42/44.45 | 9.53 x 2.36 x 76 | G3/8 | 128 | 251 | 133 | 0.66 | 73 |

## LINEAR SECTION

| SERIES | LETTER DIMENSION | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CL | DL | EE | EL | 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 |

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**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



## ROTARY SECTION OPTION LOCATION REFERENCE

| ACTUATOR TYPE | LETTER OPTION REFERENCED BY TUBE NUMBER | | | | | | PORT & NEEDLE LOCATIONS REFERENCED BY CIRCLED NUMBERS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | -D | | -P | -M | -E | | STANDARD | | | -F | | | -I | | |
| | -D1 | -D2 | STANDARD | I & III | I & III | | PORT | -P | -D | PORT | -P | -D | PORT | -P | -D |
| 3MR18 & 3MR28 | II | IV | II & IV | V & VI | V & VI | | 2 | 2 | 2 | 4 | 2 | 2 | 1, 3 | 2 | 2 |

All standard rod ends have four wrench flats.

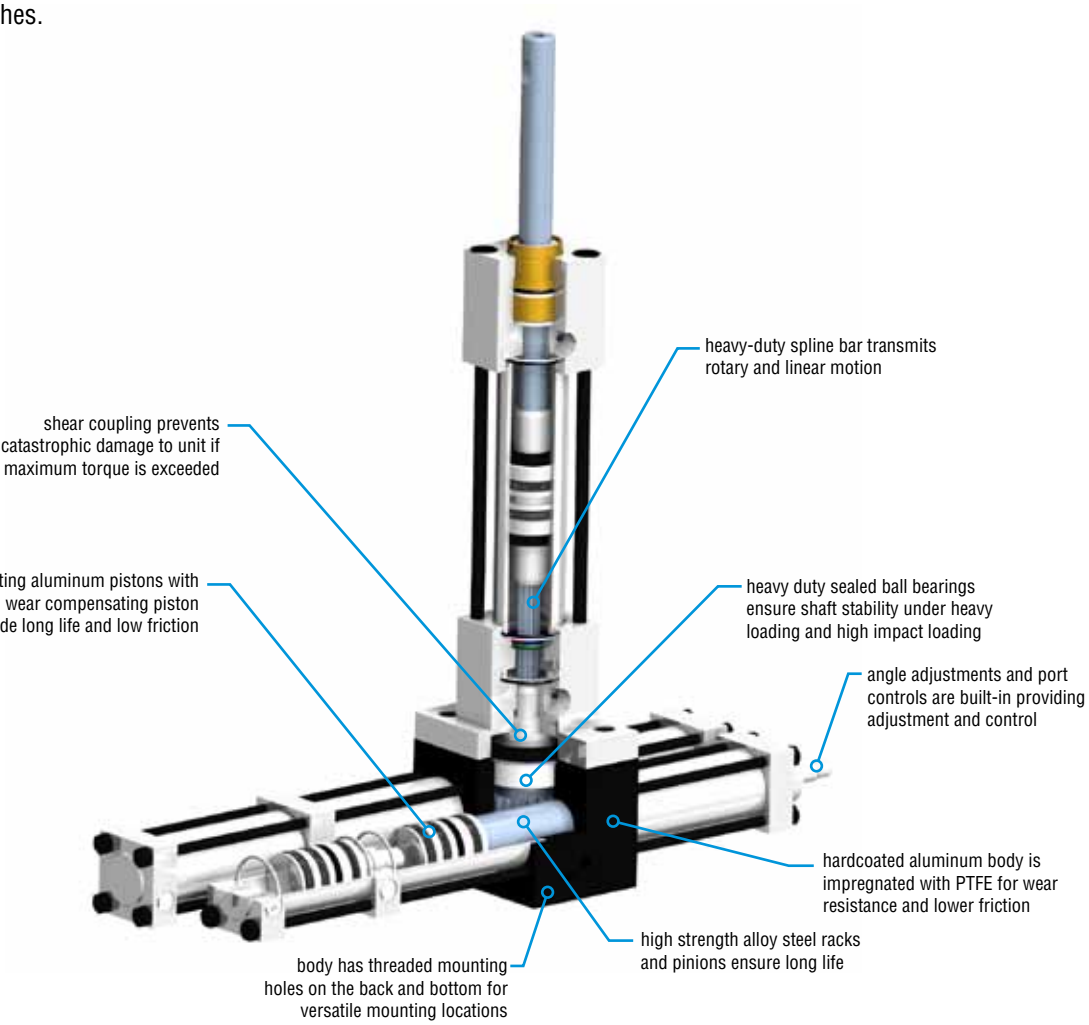
All dimensions are reference only unless specifically toleranced.

# 2000-8000 multi-position

## *MULTI-POSITION HYDRAULIC AND PNEUMATIC MULTI-MOTION ACTUATOR*

### 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.



# ORDERING DATA: MULTI-POSITION MULTI-MOTION ACTUATORS

**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.

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

**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.

**ANGLE OF ROTATION FROM POSITION I TO POSITION II.**

**ANGLE OF ROTATION FROM POSITION I TO POSITION IV. USED ON 5 POSITION ONLY.**

**ROD END STYLE**
PL - Plain rod end
KY - Keyed rod end
PK - Plain keyed rod end
MT - Male Thread

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

**ROTARY SECTION SHOCK PADS**
B1 - Shock Pad clockwise
B2 - Shock Pad counterclockwise
(Shock Pads are not available for Hydraulic use. Available on end positions only.)

**ROTARY SECTION OPTIONS**
F - Port in Position 4
H - Hall Sensor for units not exceedng 180°. (Set Point Module is ordered separately). See Switches and Sensors section. (N/A on Mx2x units)
I - Port Position 1 on top rack Port Position 3 on bottom rack

| 5 | MA1 | 1 | F | 4 | 180 | - | 45 | - | 90 | - | 135 | x | 3 | - | KY | - | DR-BC | - | D1-B2 | - | S | - | H | - | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

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

**TYPE**
MA1 - 150 psi [10 bar] Air
MA2 - 150 psi [10 bar] Air with Aux. Shaft Ext.
MH1 - 1500 psi [100 bar] Hyd.
MH2 - 1500 psi [100 bar] Hyd. with Aux. Shaft Ext.

**SERIES**
2 (000) 1-1/8" [29 mm] Bore linear section
1" [25 mm] Bore rotary section - Double Rack
4 (000) 1-3/8" [35 mm] Bore linear & rotary section - Double Rack
6 (000) 2" [50 mm] Bore linear & rotary section - Double Rack
8 (000) 3" [75 mm] Bore linear & rotary section - Double Rack
**NOTE:** Series 2000 available in 3 Position only.

**ANGLE OF ROTATION FROM POSITION I TO POSITION III. USED ON 4 & 5 POSITION ONLY.**

**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.)

**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.

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

**ANGLE ADJUSTMENT**
Angle Adjustment is standard on all Multi-Motion Actuators for end of rotation adjustment.

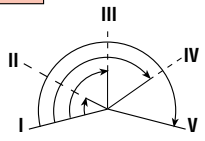
**ROTARY AND LINEAR OPTIONS**
E - Magnetic Piston for Hall Effect Switch
M - Magnetic Piston for Reed Switch
V - Fluoro-Elastomer Seals
Z1 - Electroless Nickel Plate, all ferrous parts

**PROXIMITY SWITCH MOUNTING BRACKETS**

| SERIES | SIZE NO. LINEAR SECTION | SIZE NO. ROTARY SECTION |
|---|---|---|
| 2000 | -36 | -32 |
| 4000 | -37 | -34 |
| 6000 | -40 | -38 |
| 8000 | -41 | -39 |

See Switches and Sensors section for complete ordering information.

**NOTES:**
1) Sensor must be used with a PHD Set Point Module. See Switches and Sensors section for information and ordering data.
2) SAE Ports available, consult PHD for specific port sizes.




2000-8000 multi-position

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.

## COMPACT REED SWITCHES

| PART NO. | DESCRIPTION |
|---|---|
| 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 |

## SET POINT MODULE

| PART NO. | DESCRIPTION |
|---|---|
| 9800-01-0300 | 4.5-24 VDC, Sink Type Output |
| 9800-01-0400 | 4.5-24 VDC, Source Type Output |

See Switches and Sensors section for information.

## COMPACT HALL EFFECT SWITCHES

| PART NO. | DESCRIPTION |
|---|---|
| 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 |

Designer's Resource myphd®

## CAD & Sizing Assistance

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

| SPECIFICATIONS | SERIES 2000-8000 |
|---|---|
| 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 | ±.031 [.8 mm] |
| END OF ROTATION BACKLASH | 2° (2000), 1° 30' (4000)<br>1° 0' (6000), 0° 30' (8000) |
| LUBRICATION | Factory lubricated for rated life |
| MAINTENANCE | Field repairable |

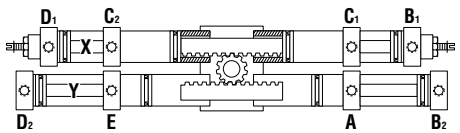
*See hydraulic pressure ratings for options chart below. All hydraulic ratings are based on non-shock service.

| | SERIES | | | |
|---|---|---|---|---|
| INTERMEDIATE POSITION(S) | 2000** | 4000 | 6000 | 8000 |
| ROTATIONAL TOLERANCE - FROM ONE INTERMEDIATE POSITION TO ANOTHER MEASURED AT CENTERS OF BACKLASH | ± 1° | ± 0° 30' | ± 0° 30' | ± 0° 15' |
| ROTATIONAL BACKLASH | 2° | 1° 45' | 1° 45' | 1° 15' |

** Available in 3-position units only

| | ROTARY BORE DIAMETER | | LINEAR BORE DIAMETER | | ROTARY DISPLACEMENT | | LINEAR DISPLACEMENT | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | EXTEND | | RETRACT | |
| SERIES | in | mm | in | mm | $in^3$/° | $cm^3$/° | $in^3$/in | $cm^3$/mm | $in^3$/in | $cm^3$/mm |
| 2000 | 1.000 | 25.4 | 1.125 | 28.6 | .014 | 0.229 | .995 | 16.3 | .690 | 11.3 |
| 4000 | 1.375 | 34.9 | 1.375 | 34.9 | .038 | 0.623 | 1.485 | 24.3 | 1.043 | 17.1 |
| 6000 | 2.000 | 50.8 | 2.000 | 50.8 | .082 | 1.344 | 3.142 | 51.5 | 1.653 | 27.1 |
| 8000 | 3.000 | 76.2 | 3.000 | 76.2 | .370 | 6.064 | 7.069 | 115.8 | 3.927 | 64.4 |

| | TORQUE OUTPUT | | THRUST FORCE EXTEND | | THRUST FORCE RETRACT | |
|---|---|---|---|---|---|---|
| SERIES | in-lb/psi | Nm/bar | lb/psi | N/bar | lb/psi | N/bar |
| 2000 | .39 | .64 | .99 | 63.9 | .69 | 44.5 |
| 4000 | 1.11 | 1.82 | 1.48 | 95.5 | 1.04 | 67.0 |
| 6000 | 2.36 | 3.87 | 3.14 | 202.5 | 1.65 | 106.5 |
| 8000 | 10.60 | 17.37 | 7.06 | 455.4 | 3.93 | 253.5 |




## 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 $B_1$ and $B_2$ traps the racks between the rod ends of the outer pistons X and Y to rotate output shaft to position IV. Pressurizing ports $C_1$ and $C_2$ 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 $D_1$ and $D_2$, 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).

## 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**

| HYD SERIES | OPTION psi [bar] -P | -D | -E or -M |
|---|---|---|---|
| 2000 | — — | — — | — — |
| 4000 | — — | — — | — — |
| 6000 | — — | — — | 750 [52] |
| 8000 | — — | — — | 500 [35] |

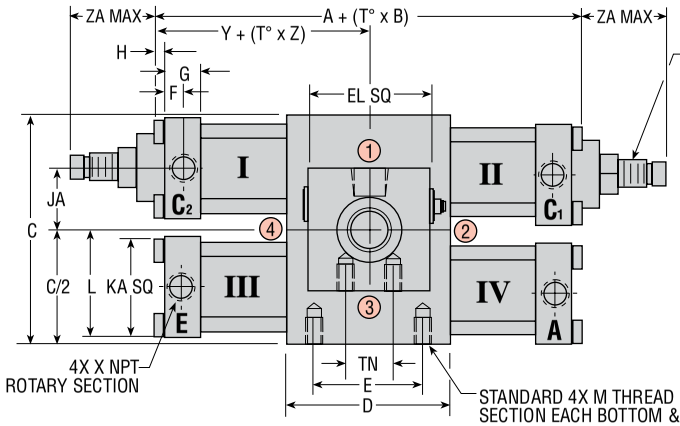
**LINEAR SECTION**

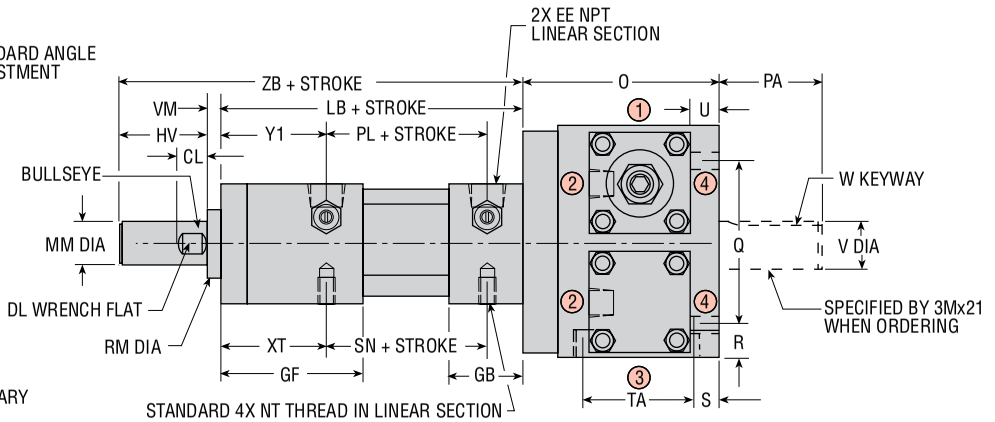
| | OPTION psi [bar] | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | PLAIN | | PORT CONTROLS | | -Dx | | -E or -M | |
| SERIES | psi | bar | psi | bar | psi | bar | psi | bar |
| 2000 | – | – | – | – | – | – | – | – |
| 4000 | – | – | – | – | – | – | – | – |
| 6000 | – | – | N/A | N/A | – | – | 750 | 52 |
| 8000 | – | – | N/A | N/A | – | – | 500 | 35 |

**NOTE:** — = Standard Rating


## *Sizing & Application Assistance*

Use PHD's free online Product Sizing Application or view the Product Sizing Catalog at: www.phdinc.com/apps/sizing




**ROTARY SECTION**

| CAP STYLE | SERIES | LETTER DIMENSION | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | A | B | C | D | E | F | G | H | JA | KA | L | M | O | PA | Q | R | S | TA | U | V | W | X | Y | Z | ZA |
| PLAIN | 2000 | 5.698 | .0174 | 3.000 | 2.000 | 1.500 | .250 | .500 | 0.00 | .750 | 1.375 | 1.437 | 1/4-20 x .312 DP | 2.500 | .875 | 2.000 | .500 | .250 | 1.500 | .312 | .4998/.5003 | 1/8 x 1/16 x .625 | 1/8 | 2.849 | .0087 | .000 |
| -A | 2000 | 6.198 | .0174 | 3.000 | 2.000 | 1.500 | .500 | .750 | 0.00 | .750 | 1.375 | 1.437 | 1/4-20 x .312 DP | 2.500 | .875 | 2.000 | .500 | .250 | 1.500 | .312 | .4998/.5003 | 1/8 x 1/16 x .625 | 1/8 | 3.099 | .0087 | 1.125 |
| BOTH | 4000 | 7.906 | .026 | 4.250 | 3.000 | 2.000 | .344 | .688 | .250 | 1.156 | 1.875 | 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 | 3.953 | .013 | 1.500 |
| BOTH | 6000 | 9.126 | .026 | 5.000 | 4.250 | 2.500 | .375 | .750 | .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 | 4.563 | .013 | 1.875 |
| BOTH | 8000 | 12.160 | .052 | 8.000 | 5.000 | 3.000 | .469 | 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 | 6.080 | .026 | 2.875 |

**LINEAR SECTION**

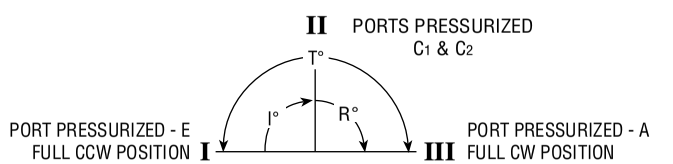
| SERIES | LETTER DIMENSION | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CL | DL | EE | EL | GB | GC | GF | HV | LB | MM | NT | PL | RM | SN | TN | VM | XT | Y1 | ZB |
| 2000 | .530 | 1/2 | 1/4 | 1.750 | 1.250 | 1.000 | 2.187 | 1.500 | 5.000 | .625 | 1/4-28 x .312 DP | 2.812 | 1.000 | 2.812 | .625 | .250 | 1.562 | 1.562 | 6.750 |
| 4000 | .530 | 5/8 | 3/8 | 2.250 | 1.375 | 1.000 | 2.625 | 1.625 | 5.562 | .750 | 5/16-24 x .500 DP | 2.937 | 1.250 | 2.937 | .875 | .250 | 1.937 | 1.937 | 7.437 |
| 6000 | .987 | 1-1/8 | 3/8 | 3.000 | 2.000 | 1.250 | 3.750 | 3.000 | 7.250 | 1.375 | 3/8-24 x .500 DP | 3.125 | 2.000 | 3.125 | 1.250 | .375 | 2.937 | 2.937 | 10.625 |
| 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 | .500 | 3.937 | 3.937 | 14.625 |

**QUICK REFERENCE FOR:** A + (T° x B)

| SERIES | DEGREE OF ROTATION | | | | | |
|---|---|---|---|---|---|---|
| | 45 | 90 | 180 | 270 | 360 | 450 |
| *2000 | 6.481 | 7.264 | 8.830 | 10.396 | 11.962 | 13.528 |
| 4000 | 9.076 | 10.246 | 12.586 | 14.926 | 17.266 | 19.606 |
| 6000 | 10.296 | 11.466 | 13.806 | 16.146 | 18.486 | 20.826 |
| 8000 | 14.500 | 16.840 | 21.520 | 26.200 | 30.880 | 35.560 |

*DIMENSIONS CALCULATED USING PLAIN CAP STYLE. ADD .250 TO DIMENSION FOR EACH -A STYLE CAP USED ON SERIES 2000 ONLY.

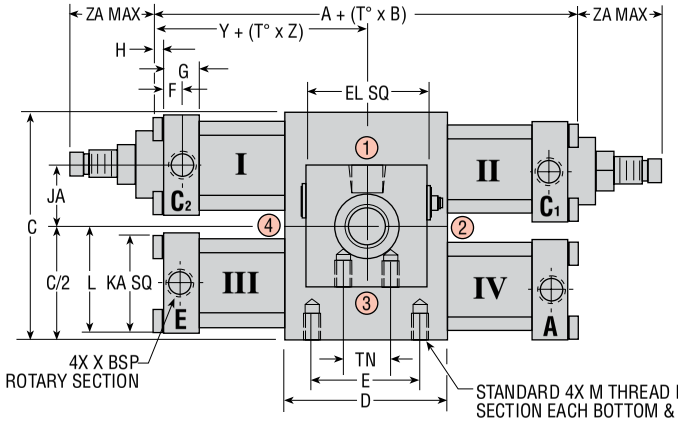
**BULLSEYE:** REFERENCE MARK INDICATING ORIENTATION OF ROD END TO ROTARY SECTION
**SHAFT KEYWAY & BULLSEYE:** SHOWN AT MID-ROTATION
**ROD END:** STANDARD IS A "PL" (PLAIN) ROD END
**PORT POSITIONS:** INDICATED BY CIRCLED NUMBERS. LINEAR SECTION NEEDLE & MTG. HOLES REMAIN UNCHANGED RELATIVE TO PORTS WITH OPTIONAL PORT POSITIONS.
**MTG. HOLES:** CENTERED ON CENTERLINE OF UNIT
**STOP TUBES:** LOCATED IN TUBES I & II
**CUSHIONS:** SERIES 2000 ROTARY SECTIONS ONLY:
ADD 1/2" 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 1/4" TO ALL ( + STROKE ) DIMENSIONS FOR EACH SHOCK PAD

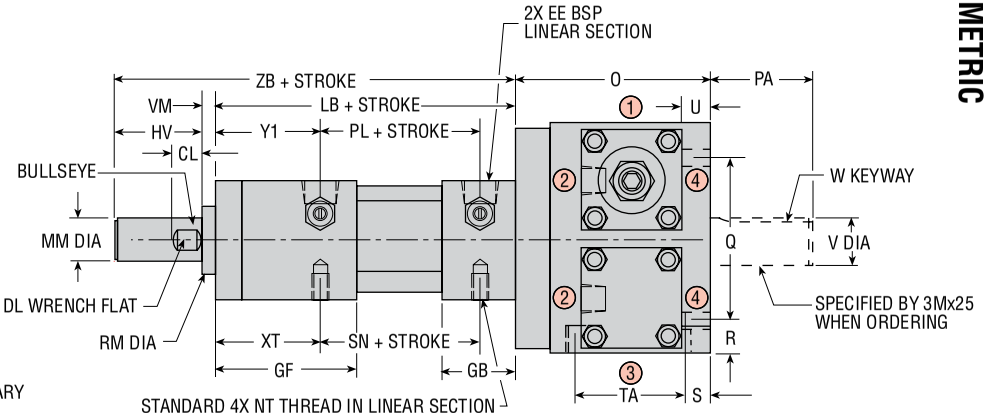



**ROTARY SECTION OPTION LOCATION REFERENCE**

| ACTUATOR TYPE | LETTER OPTION REFERENCED BY TUBE NUMBER | | | | | PORT & NEEDLE LOCATIONS REFERENCED BY CIRCLED NUMBERS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | -P | | | STANDARD | | | -F | | | -I | | |
| | -B | -D | STANDARD | -M | -E | PORT | -P | -D | PORT | -P | -D | PORT | -P | -D |
| 3MA11 & 3MA21 | I & II | I & II | ALL | ALL | ALL | 2 | 1 & 3 | 1 | 4 | 1 & 3 | 1 | 1, 3 | 2 | 2 |
| 3MH11 & 3MH21 | — | I & II | ALL | ALL | ALL | 2 | 1 & 3 | 1 | 4 | 1 & 3 | 1 | 1, 3 | 2 | 2 |

All standard rod ends have four wrench flats.




**ROTARY SECTION**

| CAP STYLE | SERIES | LETTER DIMENSION | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | A | B | C | D | E | F | G | H | JA | KA | L | M | O | PA | Q | R | S | TA | U | V | W | X | Y | Z | ZA |
| PLAIN | 2000 | 145 | 0.44 | 76 | 51 | 38.1 | 6 | 13 | 0 | 19 | 35 | 36 | M6 x 1.0 x 8 | 63 | 22 | 50.8 | 13 | 6 | 38.1 | 8 | 12.69/12.71 | 3.18 x 1.59 x 16 | G1/8 | 72 | 0.22 | 0 |
| -A | 2000 | 157 | 0.44 | 76 | 51 | 38.1 | 6 | 13 | 0 | 19 | 35 | 36 | M6 x 1.0 x 8 | 63 | 22 | 50.8 | 13 | 6 | 38.1 | 8 | 12.69/12.71 | 3.18 x 1.59 x 16 | G1/8 | 78 | 0.22 | 29 |
| BOTH | 4000 | 201 | 0.66 | 108 | 76 | 50.8 | 9 | 17 | 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 | 100 | 0.33 | 38 |
| BOTH | 6000 | 292 | 0.66 | 127 | 102 | 63.5 | 10 | 19 | 5 | 29 | 57 | 58 | M10 x 1.5 x 16 | 95.3 | 48 | 88.9 | 19 | 13 | 50.8 | 10 | 28.55/28.58 | 6.35 x 3.18 x 38 | G1/4 | 116 | 0.33 | 48 |
| BOTH | 8000 | 309 | 1.32 | 203 | 127 | 76.2 | 12 | 27 | 11 | 48 | 89 | 92 | M20 x 2.5 x 32 | 159 | 89 | 127.0 | 38 | 32 | 63.5 | 19 | 44.42/44.45 | 9.53 x 2.36 x 76 | G3/8 | 154 | 0.66 | 73 |

**LINEAR SECTION**

| SERIES | LETTER DIMENSION | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CL | DL | EE | EL | 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 |

**QUICK REFERENCE FOR:** A + (T° x B)

| SERIES | DEGREE OF ROTATION | | | | | |
|---|---|---|---|---|---|---|
| | 45 | 90 | 180 | 270 | 360 | 450 |
| *2000 | 164.6 | 184.5 | 224.2 | 264.1 | 303.8 | 343.6 |
| 4000 | 230.5 | 260.2 | 319.8 | 379.1 | 438.6 | 498.0 |
| 6000 | 261.5 | 291.1 | 410.8 | 350.7 | 469.5 | 529.0 |
| 8000 | 368.3 | 427.7 | 539.6 | 546.6 | 784.4 | 903.2 |

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

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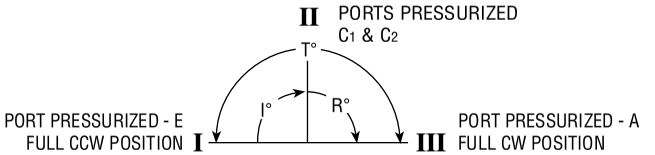
**MTG. HOLES:** CENTERED ON CENTERLINE OF UNIT
**STOP TUBES:** LOCATED IN TUBES I & II
**CUSHIONS:** SERIES 2000 ROTARY SECTIONS ONLY:
ADD 13 mm TO RESPECTIVE "A" AND "Y" DIMENSIONS FOR EACH CUSHION
ALL LINEAR SECTIONS:
ADD DIMENSION "GC" TO ALL ( + STROKE ) DIMENSIONS FOR EACH CUSHION
**SHOCK PADS:** LINEAR SECTION:
ADD 6.4 mm TO ALL ( + STROKE ) DIMENSIONS FOR EACH SHOCK PAD

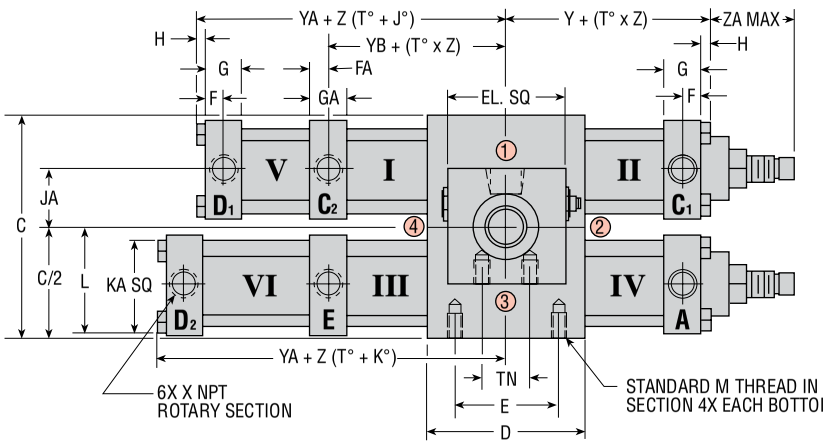


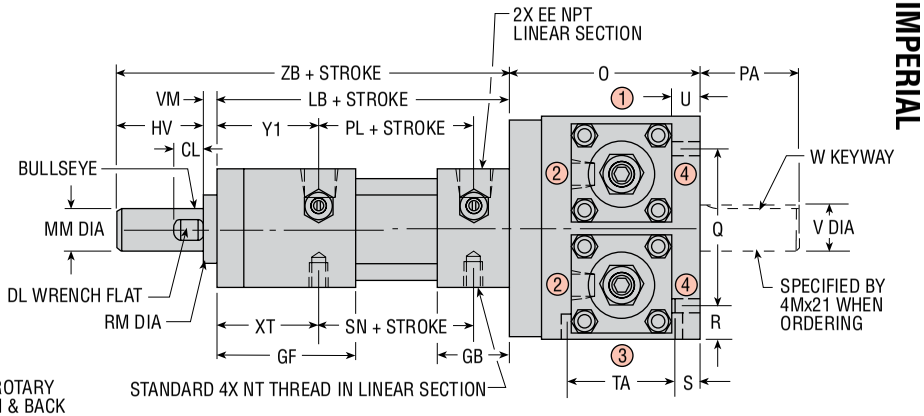

**ROTARY SECTION OPTION LOCATION REFERENCE**

| ACTUATOR TYPE | LETTER OPTION REFERENCED BY TUBE NUMBER | | | | | PORT & NEEDLE LOCATIONS REFERENCED BY CIRCLED NUMBERS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | -P | | | STANDARD | | | -F | | | -I | | |
| | -B | -D | STANDARD | -M | -E | PORT | -P | -D | PORT | -P | -D | PORT | -P | -D |
| 3MA15 & 3MA25 | I & II | I & II | ALL | ALL | ALL | 2 | 1 & 3 | 1 | 4 | 1 & 3 | 1 | 1, 3 | 2 | 2 |
| 3MH15 & 3MH25 | — | I & II | ALL | ALL | ALL | 2 | 1 & 3 | 1 | 4 | 1 & 3 | 1 | 1, 3 | 2 | 2 |



All standard rod ends have four wrench flats.




**ROTARY SECTION**

| SERIES | LETTER DIMENSION | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 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 | 4.250 | 3.000 | 2.000 | .344 | .375 | .688 | .719 | .250 | 1.156 | 1.875 | 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 | 3.953 | 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 | 4.563 | 7.325 | 3.980 | .013 | 1.875 |
| 8000 | 8.000 | 5.000 | 3.000 | .469 | .469 | 1.062 | 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 | 6.080 | 9.865 | 5.236 | .026 | 2.875 |

**LINEAR SECTION**

| SERIES | LETTER DIMENSION | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CL | DL | EE | EL | GB | GC | GF | HV | LB | MM | NT | PL | RM | SN | TN | VM | XT | Y1 | ZB |
| 4000 | .530 | 5/8 | 3/8 | 2.250 | 1.375 | 1.000 | 2.625 | 1.625 | 5.562 | .750 | 5/16-24 x .500 DP | 2.937 | 1.250 | 2.937 | .875 | .250 | 1.937 | 1.937 | 7.437 |
| 6000 | .987 | 1-1/8 | 3/8 | 3.000 | 2.000 | 1.250 | 3.750 | 3.000 | 7.250 | 1.375 | 3/8-24 x .500 DP | 3.125 | 2.000 | 3.125 | 1.250 | .375 | 2.937 | 2.937 | 10.625 |
| 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 | .500 | 3.937 | 3.937 | 14.625 |

myphd *CAD & Sizing Assistance*
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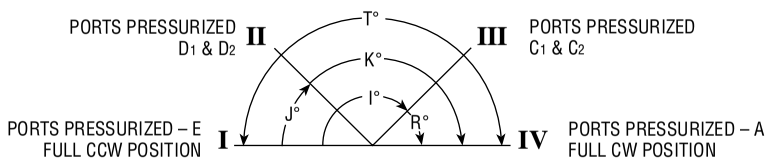


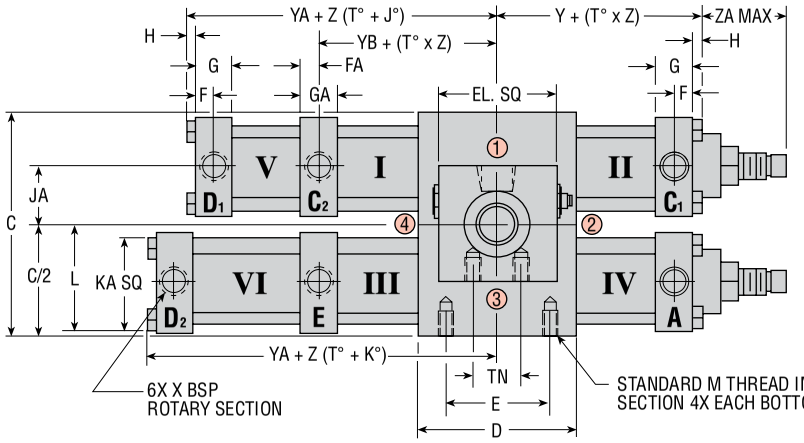

**BULLSEYE:** REFERENCE MARK INDICATING ORIENTATION OF ROD END TO ROTARY SECTION
**SHAFT KEYWAY & BULLSEYE:** SHOWN AT MID-ROTATION
**ROD END:** STANDARD IS A "PL" (PLAIN) ROD END
**PORT POSITIONS:** INDICATED BY CIRCLED NUMBERS. LINEAR SECTION NEEDLE & MTG. HOLES REMAIN UNCHANGED RELATIVE TO PORTS WITH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

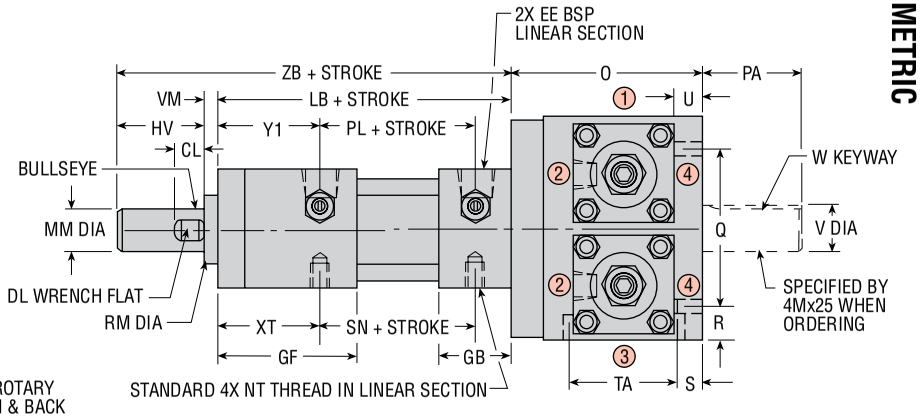
**ROTARY SECTION OPTION LOCATION REFERENCE**

| ACTUATOR TYPE | LETTER OPTION REFERENCED BY TUBE NUMBER | | | | | PORT & NEEDLE LOCATIONS REFERENCED BY CIRCLED NUMBERS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | -P | | | STANDARD | | | -F | | | -I | | |
| | -B | -D | STANDARD | -M | -E | PORT | -P | -D | PORT | -P | -D | PORT | -P | -D |
| 4MA11 & 4MA21 | II & IV | II & IV | ALL | ALL | ALL | 2 | 1 & 3 | 1 | 4 | 1 & 3 | 1 | 1, 3 | 2 | 2 |
| 4MH11 & 4MH21 | — | II & IV | ALL | ALL | ALL | 2 | 1 & 3 | 1 | 4 | 1 & 3 | 1 | 1, 3 | 2 | 2 |

All standard rod ends have four wrench flats.

All dimensions are reference only unless specifically toleranced.




**ROTARY SECTION**

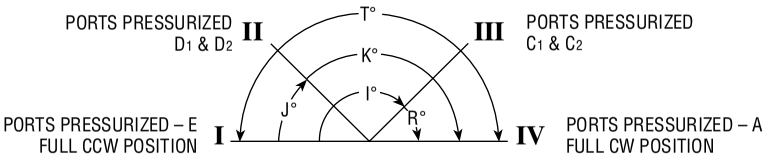
| SERIES | LETTER DIMENSION | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | C | D | E | F | FA | G | GA | H | JA | KA | L | M | O | PA | Q | R | S | TA | U | V | W | X | Y | YA | YB | Z | ZA |
| 4000 | 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 | 102 | 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 | 88.9 | 19 | 13 | 50.8 | 10 | 28.55/28.58 | 6.35 x 3.18 x 38 | G1/4 | 118 | 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 | 44.42/44.45 | 9.53 x 2.36 x 76 | G3/8 | 126 | 251 | 133 | 0.66 | 73 |

**LINEAR SECTION**

| SERIES | LETTER DIMENSION | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CL | DL | EE | EL | GB | GC | GF | HV | LB | MM | NT | PL | RM | SN | TN | VM | XT | Y1 | ZB |
| 4000 | 13 | 16 | G3/8 | 57 | 35 | 25 | 67 | 41 | 141 | 19.1 | 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 |

***CAD & Sizing Assistance***

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




**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

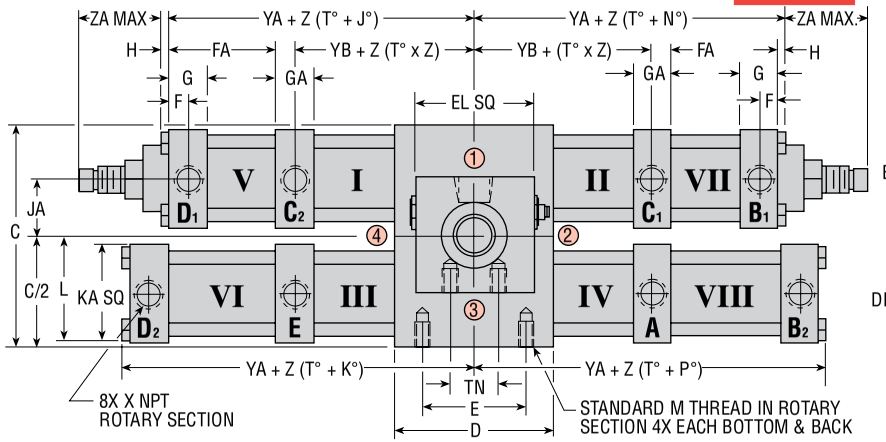
**ROTARY SECTION OPTION LOCATION REFERENCE**

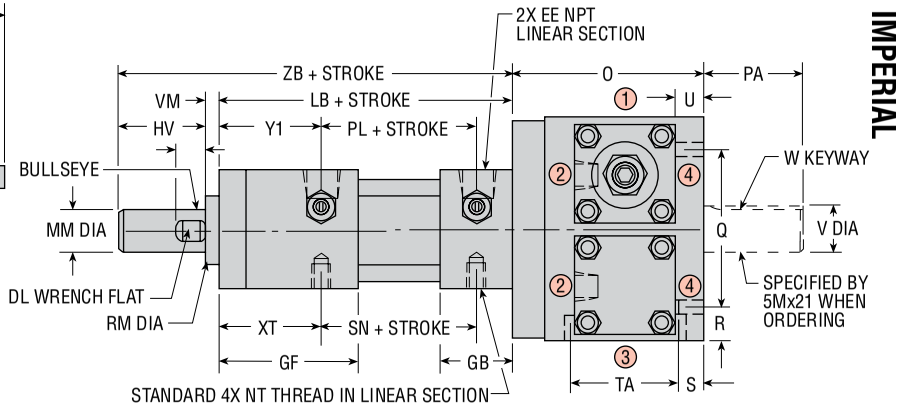
| ACTUATOR TYPE | LETTER OPTION REFERENCED BY TUBE NUMBER | | | | | PORT & NEEDLE LOCATIONS REFERENCED BY CIRCLED NUMBERS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | -P | | | STANDARD | | | -F | | | -I | | |
| | -B | -D | STANDARD | -M | -E | PORT | -P | -D | PORT | -P | -D | PORT | -P | -D |
| 4MA15 & 4MA25 | II & IV | II & IV | ALL | ALL | ALL | 2 | 1 & 3 | 1 | 4 | 1 & 3 | 1 | 1, 3 | 2 | 2 |
| 4MH15 & 4MH25 | — | II & IV | ALL | ALL | ALL | 2 | 1 & 3 | 1 | 4 | 1 & 3 | 1 | 1, 3 | 2 | 2 |

All standard rod ends have four wrench flats.

All dimensions are reference only unless specifically toleranced.

**2000-8000 multi-position**




IMPERIAL

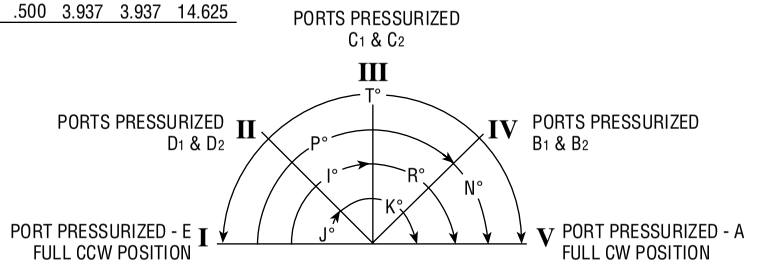
# DIMENSIONS: 5 POSITION MULTI-MOTION ACTUATORS

**ROTARY SECTION**

| SERIES | LETTER DIMENSION | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | C | D | E | F | FA | G | GA | H | JA | KA | 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 | .688 | .719 | .250 | 1.156 | 1.875 | 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 | .469 | 1.062 | 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**

| SERIES | LETTER DIMENSION | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CL | DL | EE | EL | GB | GC | GF | HV | LB | MM | NT | PL | RM | SN | TN | VM | XT | Y1 | ZB |
| 4000 | .530 | 5/8 | 3/8 | 2.250 | 1.375 | 1.000 | 2.625 | 1.625 | 5.562 | .750 | 5/16-24 x .500 DP | 2.937 | 1.250 | 2.937 | .875 | .250 | 1.937 | 1.937 | 7.437 |
| 6000 | .987 | 1-1/8 | 3/8 | 3.000 | 2.000 | 1.250 | 3.750 | 3.000 | 7.250 | 1.375 | 3/8-24 x .500 DP | 3.125 | 2.000 | 3.125 | 1.250 | .375 | 2.937 | 2.937 | 10.625 |
| 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 | .500 | 3.937 | 3.937 | 14.625 |




**BULLSEYE:** REFERENCE MARK INDICATING ORIENTATION OF ROD END TO ROTARY SECTION
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**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 1/4" TO ALL ( + STROKE ) DIMENSIONS FOR EACH SHOCK PAD

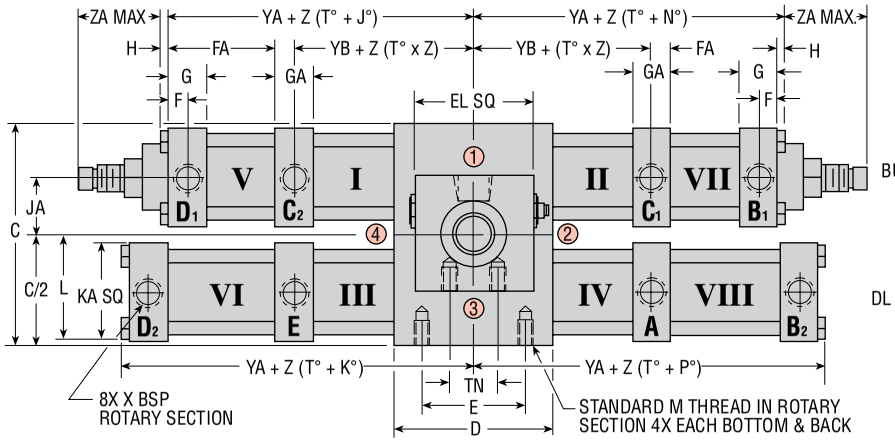
**ROTARY SECTION OPTION LOCATION REFERENCE**

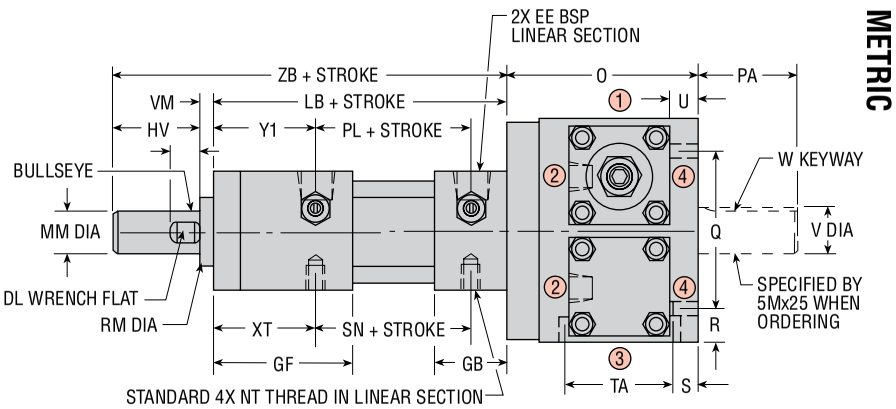
| ACTUATOR TYPE | LETTER OPTION REFERENCED BY TUBE NUMBER | | | | | PORT & NEEDLE LOCATIONS REFERENCED BY CIRCLED NUMBERS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | -P | | | STANDARD | | | -F | | | -I | | |
| | -B | -D | STANDARD | -M | -E | PORT | -P | -D | PORT | -P | -D | PORT | -P | -D |
| 5MA11 & 5MA21 | VII & V | VII & V | ALL | ALL | ALL | 2 | 1 & 3 | 1 | 4 | 1 & 3 | 1 | 1, 3 | 2 | 2 |
| 5MH11 & 5MH21 | — | VII & V | ALL | ALL | ALL | 2 | 1 & 3 | 1 | 4 | 1 & 3 | 1 | 1, 3 | 2 | 2 |



All standard rod ends have four wrench flats.

All dimensions are reference only unless specifically toleranced.



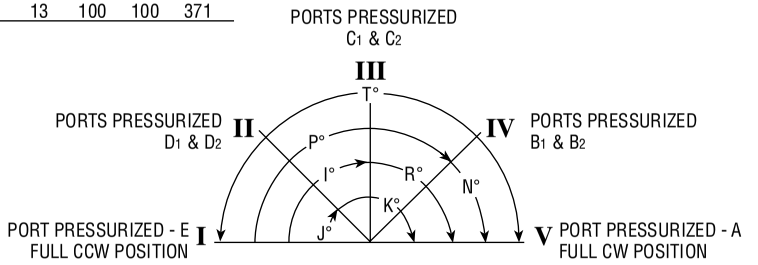




**ROTARY SECTION**

| | 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 | 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 | 88.9 | 19 | 13 | 50.8 | 10 | 28.55/28.58 | 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 | 44.42/44.45 | 9.53 x 2.36 x 76 | G3/8 | 251 | 133 | 0.66 | 73 |

**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 | 13 | 16 | G3/8 | 57 | 35 | 25 | 67 | 41 | 141 | 19.1 | 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 |

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



All standard rod ends have four wrench flats.

**ROTARY SECTION OPTION LOCATION REFERENCE**

| ACTUATOR TYPE | LETTER OPTION REFERENCED BY TUBE NUMBER | | | | | PORT & NEEDLE LOCATIONS REFERENCED BY CIRCLED NUMBERS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | -P | | | STANDARD | | | -F | | | -I | | |
| | -B | -D | STANDARD | -M | -E | PORT | -P | -D | PORT | -P | -D | PORT | -P | -D |
| 5MA15 & 5MA25 | VII & V | VII & V | ALL | ALL | ALL | 2 | 1 & 3 | 1 | 4 | 1 & 3 | 1 | 1, 3 | 2 | 2 |
| 5MH15 & 5MH25 | — | VII & V | ALL | ALL | ALL | 2 | 1 & 3 | 1 | 4 | 1 & 3 | 1 | 1, 3 | 2 | 2 |

## 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.

## DR DC LINEAR SECTION CUSHIONS

## D1 D2 ROTARY 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"

## MAGNETIC PISTON FOR USE WITH PHD PROXIMITY SWITCHES

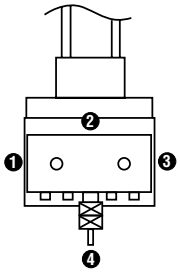
## E HALL EFFECT SWITCHES

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.



## Y 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.




## BR BC LINEAR SECTION SHOCK PADS

## B1 B2 ROTARY 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.

## K PILOT VALVE ACTUATOR (PVA) ROTARY SECTION

## R PILOT VALVE ACTUATOR (PVA) LINEAR 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.

## M 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.

## H HALL EFFECT SENSOR/TRANSDUCER

For use on all PHD Multi-Motion Actuators. The Hall Effect Sensor/Transducer provides up to four adjustable sensing positions throughout the 180° maximum sensing range. Minimum arc between two points is 1.5° of rotation. Can be used to signal ends of rotation in addition to multiple signals during rotation for indication of arc traveled.

Solid state electronics with Hall Effect sensing technology provide infinite trouble-free cycles.

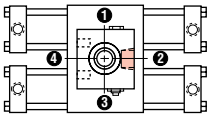
Wide signal range capability permits interfacing with most programmable controllers and logic systems.
Independent adjustment of each set point position from a single sensor.

## PORT POSITIONS

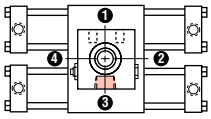
### LINEAR SECTION

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.)

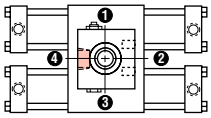
**S** **PORT POSITION 2**



**T** **PORT POSITION 3**



**U** **PORT POSITION 4**

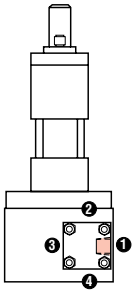


### ROTARY SECTION

Port Position 2 is standard.

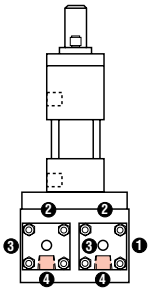
**C** **PORT POSITION 1**

Available only on Series 1000, 3000, 5000, and 7000 Actuators.



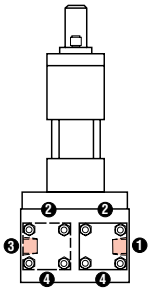
**F** **PORT POSITION 4**

Available on all series actuators.



**I** **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.



**N** **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.

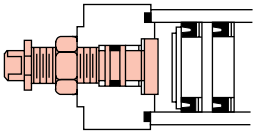
Consult PHD for optional port position or units with Port Controls.

### 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°.



**V** **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.

**W** **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].

**Z1** **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.

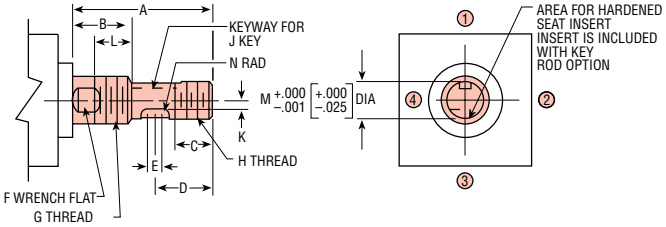
Refer to this product's online catalog in the product section for complete information including related dimensions and additional specifications. See link at bottom of this page.



All dimensions are reference only unless specifically toleranced.

## OPTIONAL ROD ENDS

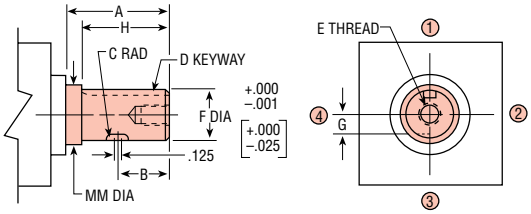
### -KY THREADED ROD END WITH KEYWAY AND PRE-LOAD




| LETTER DIM. | SERIES 1000 & 2000 | 3000 & 4000 | 5000 & 6000 | 7000 & 8000 |
|---|---|---|---|---|
| A | 2.187 [55.5] | 2.375 [60.5] | 5.187 [132.0] | 7.156 [182.0] |
| B | 1.000 [25] | 1.000 [25] | 2.187 [55.5] | 2.906 [74] |
| C | .562 [14.3] | .625 [16] | 1.625 [41.3] | 2.250 [57] |
| D | .852 [21.6] | .977 [25] | 2.313 [58.7] | 3.250 [82.5] |
| E | .215 [5.5] | .242 [6] | .437 [11] | .625 [16] |
| F | 1/2 [12.7] | 5/8 [16] | 1-1/8 [28.6] | 1-5/8 [41.2] |
| G | 5/8-18 [M16 x 1.5] | 3/4-16 [M18 x 1.5] | 1-3/8-12 [M33 x 2.0] | 2-12 [M48 x 2.0] |
| H | 1/2-20 [M12 x 1.25] | 5/8-18 [M16 x 1.5] | 1-1/4-12 [M30 x 2.0] | 1-3/4-12 [M42 x 2.0] |
| J | 1/8 x 1/8 x 5/8 [3.18 x 3.18 x 16] | 3/16 x 3/16 x 3/4 [4.75 x 4.75 x 19] | 1/4 x 1/4 x 1-3/8 [6.35 x 6.35 x 35] | 1/2 x 1/2 x 2 [12.7 x 12.7 x 50] |
| K | .125 [3] | .156 [4] | .422 [10.7] | .594 [15] |
| L | .625 [16] | .625 [16] | 1.345 [34] | 1.875 [48] |
| M | .500 [12.70] | .625 [15.88] | 1.250 [31.75] | 1.750 [44.45] |
| N | .093 [2.4] | .125 [3.2] | .156 [4] | .187 [5] |

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

### -PK PLAIN ROD END WITH KEYWAY AND PRE-LOAD



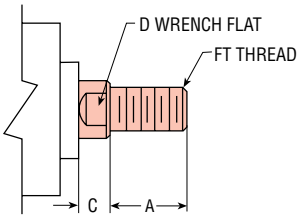

**CIRCLED NUMBERS:** INDICATE PORT POSITIONS
**KEY:** INCLUDED WITH ROD END OPTION

| LETTER DIM. | SERIES 1000 & 2000 | 3000 & 4000 | 5000 & 6000 | 7000 & 8000 |
|---|---|---|---|---|
| A | 1.500 [38] | 1.625 [41.3] | 3.000 [76.2] | 4.000 [101.6] |
| B | .375 [9.5] | .812 [20.6] | .812 [20.6] | 1.500 [38] |
| C | .156 [4] | .219 [5.6] | .250 [6.4] | .437 [11] |
| D | 1/8 x 1/16 x 1.00 [3.18 x 1.59 x 25] | 3/16 x 3/32 x 1.10 [4.76 x 2.38 x 28] | 1/4 x 1/8 x 1.50 [6.35 x 3.18 x 38] | 3/8 x 3/16 x 3.00 [9.52 x 4.75 x 76] |
| E | 10-32 x .31 DP [M5 x 0.8 x 7] | 5/16-24 x .44 DP [M8 x 1.25 x 11] | 3/8-24 x .56 DP [M10 x 1.5 x 14] | 1/2-20 x .68 DP [M12 x 1.75 x 17] |
| F | .500 [12.70] | .750 [19.05] | 1.125 [28.57] | 1.750 [44.45] |
| G | .094 [2.4] | .156 [4.0] | .312 [7.9] | .438 [11.1] |
| H | 1.375 [35] | — | 2.720 [69] | 3.695 [94] |
| MM | .625 [15.9] | — | 1.375 [34.9] | 2.000 [50.8] |

### - MT MALE THREAD ROD END

| SERIES | ROD DIA. | LETTER DIMENSION A | C | D | FT |
|---|---|---|---|---|---|
| 1000 & 2000 | .625 [15.87] | .750 [19] | .375 [9.5] | 1/2 [19.00] | 7/16-20 [M12 x 1.25] |
| 3000 & 4000 | .750 [19.05] | 1.000 [25] | .375 [9.5] | 5/8 [15.80] | 9/16-18 [M14 x 1.50] |
| 5000 & 6000 | 1.375 [34.93] | 2.375 [60.5] | .625 [15.9] | 1-1/8 [28.5] | 1-14 [M27 x 2.0] |
| 7000 & 8000 | 2.000 [50.80] | 2.938 [79.5] | .882 [22.2] | 1-5/8 [44.5] | 1-1/2-12 [M42 x 2.0] |

Numbers in [ ] are metric and are in mm.

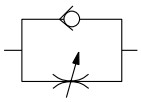



All standard rod ends have four wrench flats.

## 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.

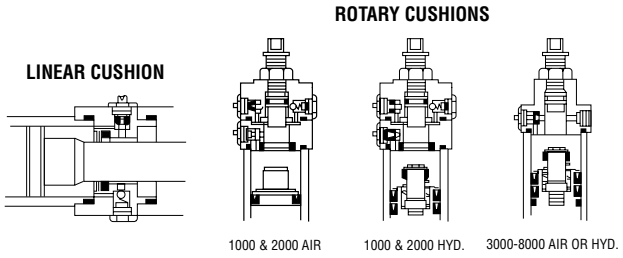


Standard on Series 1000-4000 and on the rotary section only of Series 5000-8000.

## DR DC LINEAR SECTION CUSHIONS

## D1 D2 ROTARY SECTION CUSHIONS

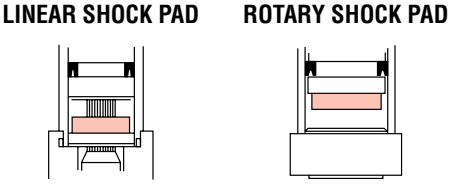
Adjustable cushions, available on all PHD Multi-Motion Actuators, allow smooth deceleration at the end of stroke and rotation to eliminate mechanical shock and hammer effect.




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

## BR BC LINEAR SECTION SHOCK PADS

## B1 B2 ROTARY SECTION SHOCK PADS



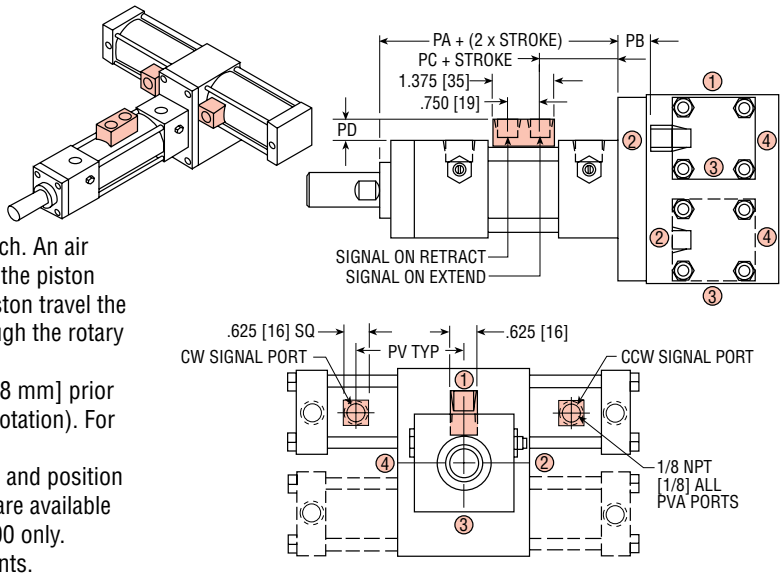

Polyurethane pads for absorption of shock and noise are available on each end of stroke and rotation on Series 1000-8000 Multi-Motion Actuators. Reducing shock permits higher piston velocities for shorter cycle times. Reducing noise levels provides improved environment for increased productivity. Pads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

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

1000-8000

## K PILOT VALVE ACTUATOR (PVA) ROTARY SECTION

## R PILOT VALVE ACTUATOR (PVA) LINEAR 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.

| SERIES | LETTER DIMENSION | | | | | |
|---|---|---|---|---|---|---|
| | PA | PB | PC | PD | PV STANDARD | PV W/-B |
| 1000 & 2000 | 4.500 [114] | .375 [9.5] | 1.281 [32.5] | .375 [9.5] | 2.191 [55.7] | 1.848 [46.9] |
| 3000 & 4000 | 5.125 [130] | .812 [20.6] | 1.406 [35.7] | .312 [7.9] | 2.847 [72.3] | 2.410 [61.2] |

Numbers in [ ] are mm—imperial equivalents are provided for convenience.

**PVA AVAILABILITY:** SERIES 1000-4000 WITH A MINIMUM ROTATION OF 45°
**CUSHIONS:** LINEAR SECTIONS:
ADD 1" [25 mm] TO "PA" DIMENSION FOR EACH CUSHION (-DR, -DC)
ADD 1" [25 mm] TO "PC" DIMENSION FOR -DC OPTION
**SHOCK PADS:** ADD 1/4" [6.4 mm] FOR EACH SHOCK PAD TO "PA" DIM. (-BR, -BC)
ADD 1/4" [6.4 mm] TO "PC" DIMENSION FOR -BC OPTION

All dimensions are reference only unless specifically toleranced.

# MAGNETIC PISTON FOR USE WITH PHD PROXIMITY SWITCHES

## E HALL EFFECT SWITCHES

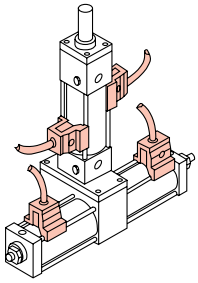
Multi-Motion Actuators may be equipped with a magnetic band (specify -E) on the pistons which activates externally mounted PHD Hall Effect Switches. These switches allow the interfacing of the PHD Air or Hydraulic Multi-Motion Actuators to various logic systems. This option is for use with the following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

### COMPACT HALL EFFECT SWITCHES

| PART NO. | DESCRIPTION |
|---|---|
| 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 |

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



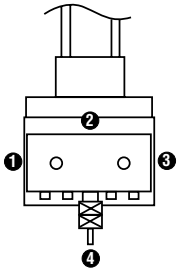
The PHD Magnetic Reed Switches may be used in situations where the Hall Effect Switches are not applicable. As with the Hall Effect Switches, a magnetic band (specify -M) on the pistons activates the externally mounted PHD Reed Switches. The Reed Switches may be used to signal a programmable controller,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

### COMPACT REED SWITCHES

| PART NO. | DESCRIPTION |
|---|---|
| 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 |

## Y 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.




## H HALL EFFECT SENSOR/ TRANSDUCER

For use on all PHD Multi-Motion Actuators. The Hall Effect Sensor/Transducer provides up to four adjustable sensing positions throughout the 180° maximum sensing range. Minimum arc between two points is 1.5° of rotation. Can be used to signal ends of rotation in addition to multiple signals during rotation for indication of arc traveled.

Solid state electronics with Hall Effect sensing technology provide infinite trouble-free cycles.

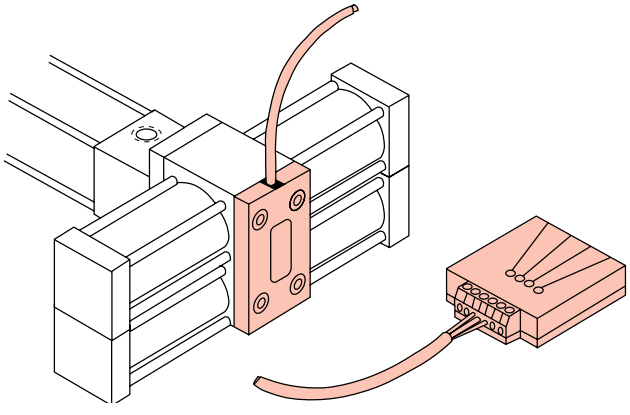
Wide signal range capability permits interfacing with most programmable controllers and logic systems.

Independent adjustment of each set point position from a single sensor.

LED indicators for visual confirmation of each output state.

Set Point Module is available for either current sinking or current sourcing models with 4.5 to 24 VDC output capability.

117 VAC interface module available to supply DC voltage to set point while providing 117 VAC output capability.



### SET POINT MODULE

| PART NO. | DESCRIPTION |
|---|---|
| 9800-01-0300 | 4.5-24 VDC, Sink Type Output |
| 9800-01-0400 | 4.5-24 VDC, Source Type Output |

See Switches and Sensors section for information.



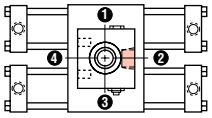
All dimensions are reference only unless specifically toleranced.

## PORT POSITIONS

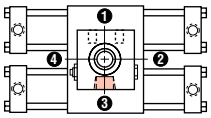
### LINEAR SECTION

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.)

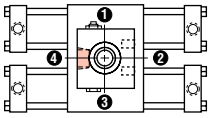
**S** **PORT POSITION 2**



**T** **PORT POSITION 3**



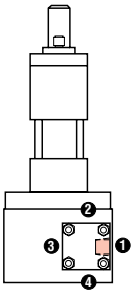
**U** **PORT POSITION 4**



### ROTARY SECTION

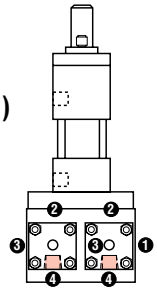
Port Position 2 is standard.

**C** **PORT POSITION 1**

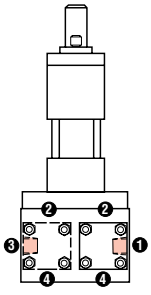


Available only on Series 1000, 3000, 5000, and 7000 Actuators.

**F** **PORT POSITION 4**
**(Available on all series actuators.)**



**I** **PORT POSITION 1 TOP RACK**
**PORT POSITION 3 BOTTOM RACK**



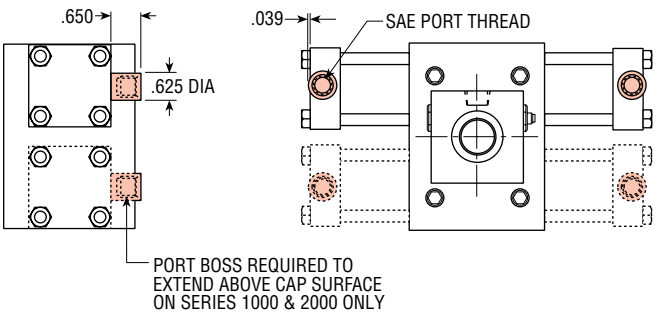
This option positions the ports in position 1 on tubes I and II and in position 3 on tubes III and IV. This allows access to the ports on the "Top" and "Bottom" sides of the actuator. Available on 2000, 4000, 6000, and 8000 actuators.

**N** **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.

| SERIES | PORT SIZE |
|---|---|
| 1000 & 2000 | 7/16 - 20 SAE |
| 3000 & 4000 | 7/16 - 20 SAE |
| 5000 & 6000 | 9/16 - 18 SAE |
| 7000 & 8000 | 3/4 - 16 SAE |

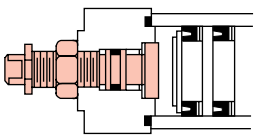



## ANGLE ADJUSTMENT (STANDARD)

### 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°.



# OPTIONS: MULTI-MOTION ACTUATORS

## V 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.

## W CLOSE TOLERANCE STROKE AND ROTATION

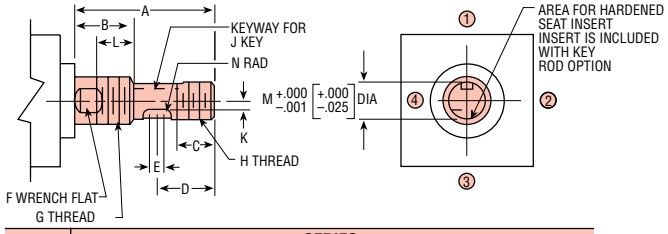
This option may be specified when a precise stroke and rotation is required and angle adjustment is not acceptable. By specifying this option, rotation will be within a tolerance of +30 minutes, -0 minutes and stroke will be a tolerance of ± .005 [± 0.127 mm].

## Z1 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.

## OPTIONAL ROD ENDS

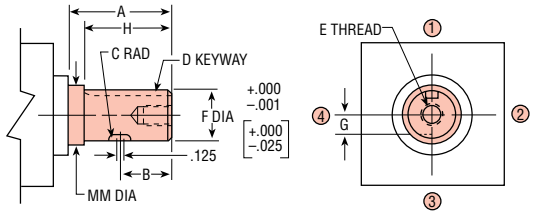
### -KY THREADED ROD END WITH KEYWAY AND PRE-LOAD




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

| LETTER DIM. | SERIES 1000 & 2000 | 3000 & 4000 | 5000 & 6000 | 7000 & 8000 |
|---|---|---|---|---|
| A | 2.187 [55.5] | 2.375 [60.5] | 5.187 [132.0] | 7.156 [182.0] |
| B | 1.000 [25] | 1.000 [25] | 2.187 [55.5] | 2.906 [74] |
| C | .562 [14.3] | .625 [16] | 1.625 [41.3] | 2.250 [57] |
| D | .852 [21.6] | .977 [25] | 2.313 [58.7] | 3.250 [82.5] |
| E | .215 [5.5] | .242 [6] | .437 [11] | .625 [16] |
| F | 1/2 [12.7] | 5/8 [16] | 1-1/8 [28.6] | 1-5/8 [41.2] |
| G | 5/8-18 [M16 x 1.5] | 3/4-16 [M18 x 1.5] | 1-3/8-12 [M33 x 2.0] | 2-12 [M48 x 2.0] |
| H | 1/2-20 [M12 x 1.25] | 5/8-18 [M16 x 1.5] | 1-1/4-12 [M30 x 2.0] | 1-3/4-12 [M42 x 2.0] |
| J | 1/8 x 1/8 x 5/8 [3.18 x 3.18 x 16] | 3/16 x 3/16 x 3/4 [4.75 x 4.75 x 19] | 1/4 x 1/4 x 1-3/8 [6.35 x 6.35 x 35] | 1/2 x 1/2 x 2 [12.7 x 12.7 x 50] |
| K | .125 [3] | .156 [4] | .422 [10.7] | .594 [15] |
| L | .625 [16] | .625 [16] | 1.345 [34] | 1.875 [48] |
| M | .500 [12.70] | .625 [15.88] | 1.250 [31.75] | 1.750 [44.45] |
| N | .093 [2.4] | .125 [3.2] | .156 [4] | .187 [5] |

### -PK PLAIN ROD END WITH KEYWAY AND PRE-LOAD



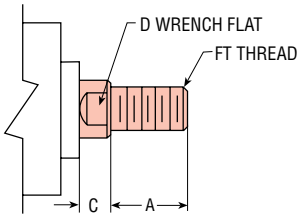

**CIRCLED NUMBERS:** INDICATE PORT POSITIONS
**KEY:** INCLUDED WITH ROD END OPTION

| LETTER DIM. | SERIES 1000 & 2000 | 3000 & 4000 | 5000 & 6000 | 7000 & 8000 |
|---|---|---|---|---|
| A | 1.500 [38] | 1.625 [41.3] | 3.000 [76.2] | 4.000 [101.6] |
| B | .375 [9.5] | .812 [20.6] | .812 [20.6] | 1.500 [38] |
| C | .156 [4] | .219 [5.6] | .250 [6.4] | .437 [11] |
| D | 1/8 x 1/16 x 1.00 [3.18 x 1.59 x 25] | 3/16 x 3/32 x 1.10 [4.76 x 2.38 x 28] | 1/4 x 1/8 x 1.50 [6.35 x 3.18 x 38] | 3/8 x 3/16 x 3.00 [9.52 x 4.75 x 76] |
| E | 10-32 x .31 DP [M5 x 0.8 x 7] | 5/16-24 x .44 DP [M8 x 1.25 x 11] | 3/8-24 x .56 DP [M10 x 1.5 x 14] | 1/2-20 x .68 DP [M12 x 1.75 x 17] |
| F | .500 [12.70] | .750 [19.05] | 1.125 [28.57] | 1.750 [44.45] |
| G | .094 [2.4] | .156 [4.0] | .312 [7.9] | .438 [11.1] |
| H | 1.375 [35] | — | 2.720 [69] | 3.695 [94] |
| MM | .625 [15.9] | — | 1.375 [34.9] | 2.000 [50.8] |

### - MT MALE THREAD ROD END

| SERIES | ROD DIA. | LETTER DIMENSION A | C | D | FT |
|---|---|---|---|---|---|
| 1000 & 2000 | .625 [15.87] | .750 [19] | .375 [9.5] | 1/2 [19.00] | 7/16-20 [M12 x 1.25] |
| 3000 & 4000 | .750 [19.05] | 1.000 [25] | .375 [9.5] | 5/8 [15.80] | 9/16-18 [M14 x 1.50] |
| 5000 & 6000 | 1.375 [34.93] | 2.375 [60.5] | .625 [15.9] | 1-1/8 [28.5] | 1-14 [M27 x 2.0] |
| 7000 & 8000 | 2.000 [50.80] | 2.938 [79.5] | .882 [22.2] | 1-5/8 [44.5] | 1-1/2-12 [M42 x 2.0] |

Numbers in [ ] are metric and are in mm.




All standard rod ends have four wrench flats.

All dimensions are reference only unless specifically toleranced.