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Find the *PHD MA1Bx-11/2-MT-M-H* at our website: *Click HERE*

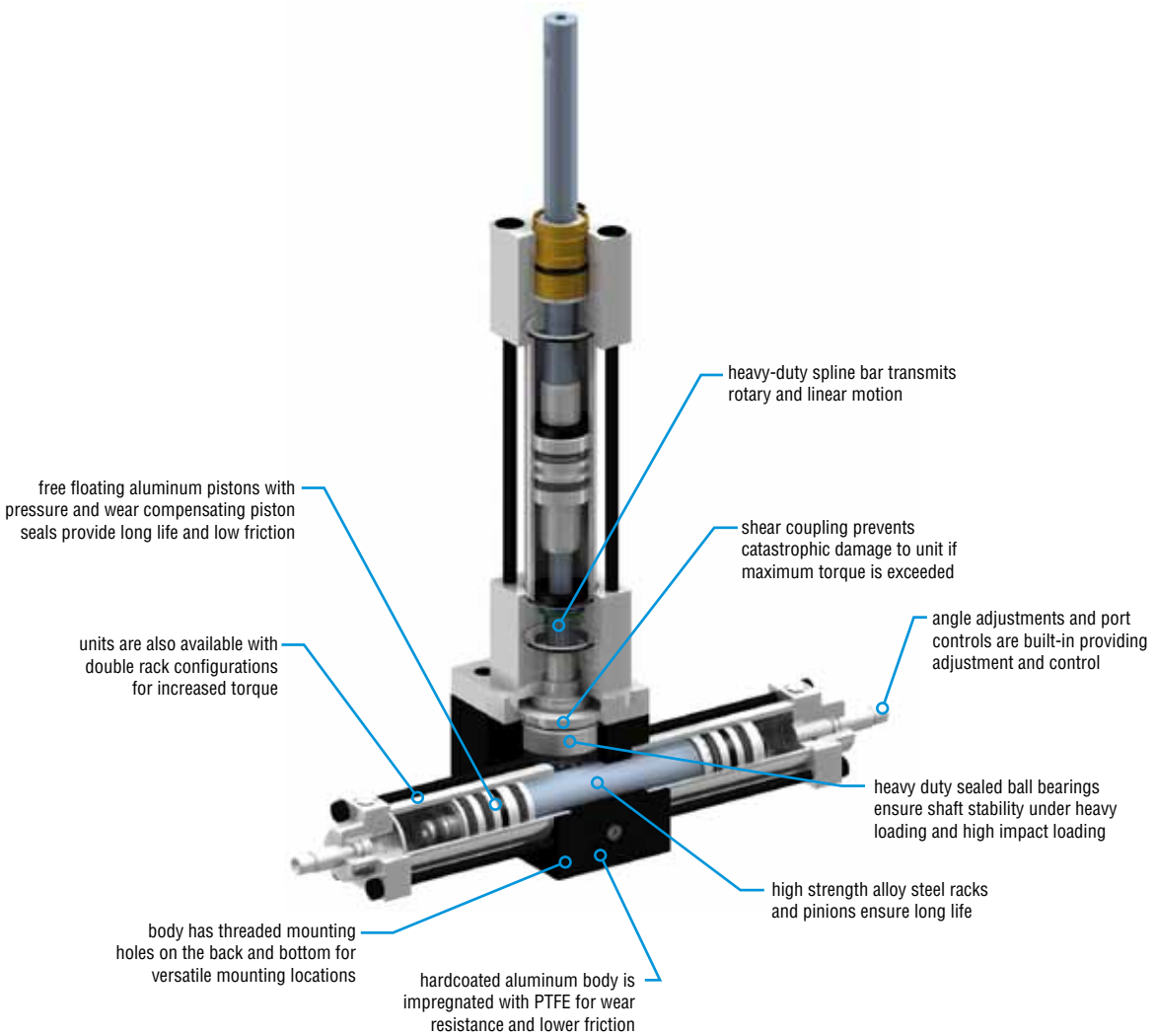
1000-8000

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) 1° 0' (5000/6000), 0° 30' (7000/8000)
LUBRICATION	Factory lubricated for rated life
MAINTENANCE	Field repairable

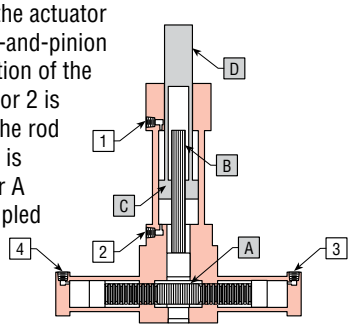
*See hydraulic pressure ratings for options chart below. All hydraulic ratings are based on non-shock hydraulic service.

	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

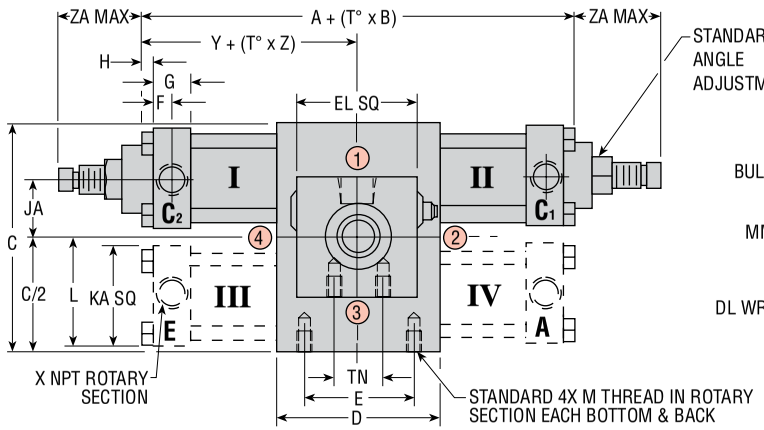
	OPTION psi [bar]							
	PLAIN		PORT CONTROLS		-Dx		-E or -M	
SERIES	psi	bar	psi	bar	psi	bar	psi	bar
1000	—	—	—	—	—	—	—	—
2000	—	—	—	—	—	—	—	—
3000	—	—	—	—	—	—	—	—
4000	—	—	—	—	—	—	—	—
5000	—	—	N/A	N/A	—	—	750	52
6000	—	—	N/A	N/A	—	—	750	52
7000	—	—	N/A	N/A	—	—	500	35
8000	—	—	N/A	N/A	—	—	500	35

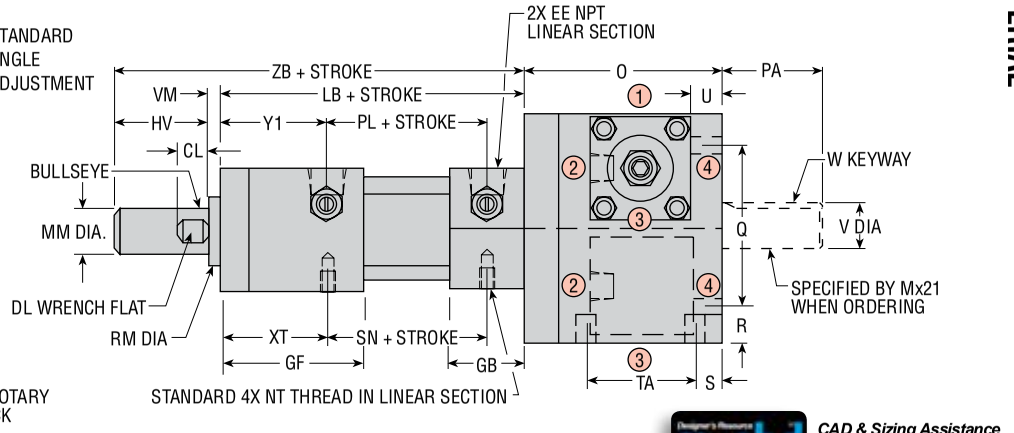
Note: — = Standard Rating

UNIT SIZING ONLINE

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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	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

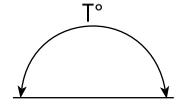
SERIES	LETTER DIMENSION																		
	CL	DL	EE	EL	GB	GC	GF	HV	LB	MM	NT	PL	RM	SN	TN	VM	XT	Y1	ZB
1000 & 2000	.530	1/2	1/4	1.750	1.250	1.000	2.187	1.500	5.000	.625	1/4-28 x .312 DP	2.812	1.000	2.812	.625	.250	1.562	1.562	6.750
3000 & 4000	.530	5/8	3/8	2.250	1.375	1.000	2.625	1.625	5.562	.750	5/16-24 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

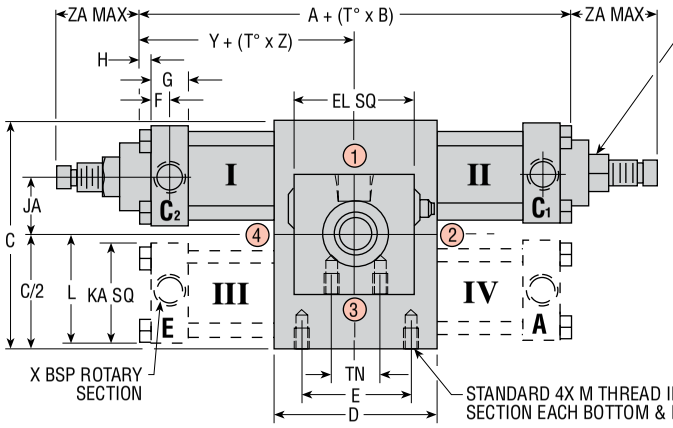
ROTARY SECTION OPTION LOCATION REFERENCE

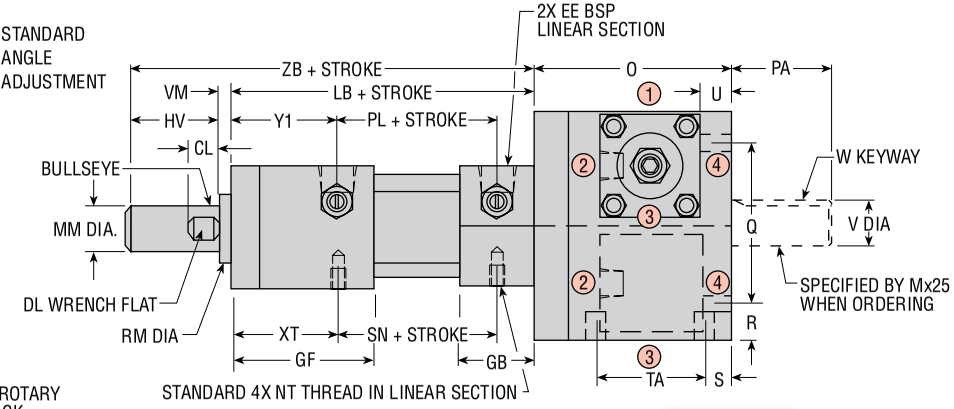
ACTUATOR TYPE	LETTER OPTION REFERENCED BY TUBE NUMBER							PORT & NEEDLE LOCATIONS REFERENCED BY CIRCLED NUMBERS											
	-B		-D		-P			STANDARD			-C			-F			-I		
	-B1	-B2	-D1	-D2	STANDARD	-M	-E	PORT	-P	-D	PORT	-P	-D	PORT	-P	-D	PORT	-P	-D
MA11 & MA21	II	I	II	I	I & II	I & II	I & II	2	1	1	1	2	2	4	1	1	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
Use PHD's free online Product Sizing and CAD Configurator at www.phdinc.com/myphd

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

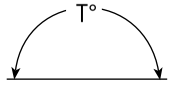
QUICK REFERENCE FOR: A + (T° x B)

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

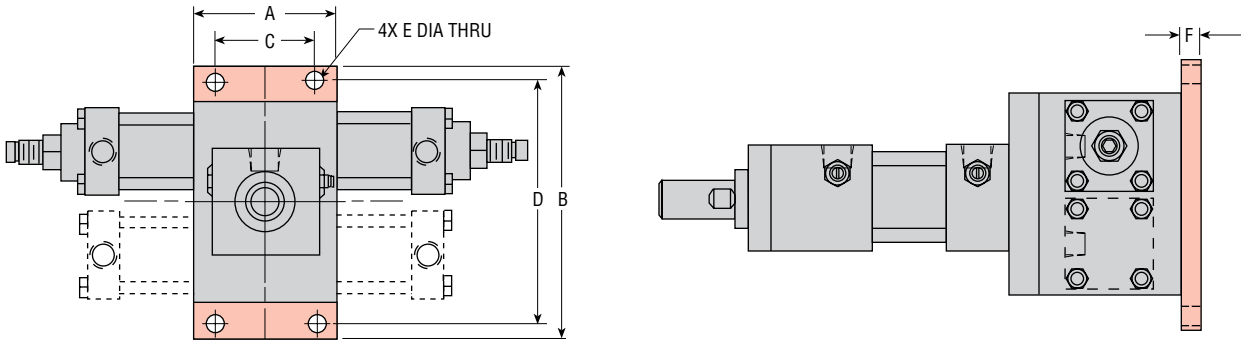
ACTUATOR TYPE	LETTER OPTION REFERENCED BY TUBE NUMBER							PORT & NEEDLE LOCATIONS REFERENCED BY CIRCLED NUMBERS												
	-B		-D		-P			STANDARD			-C			-F			-I		
	-B1	-B2	-D1	-D2	STANDARD	-M	-E	PORT	-P	-D	PORT	-P	-D	PORT	-P	-D	PORT	-P	-D
MA15 & MA25	II	I	II	I	I & II	I & II	I & II	2	1	1	1	2	2	4	1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

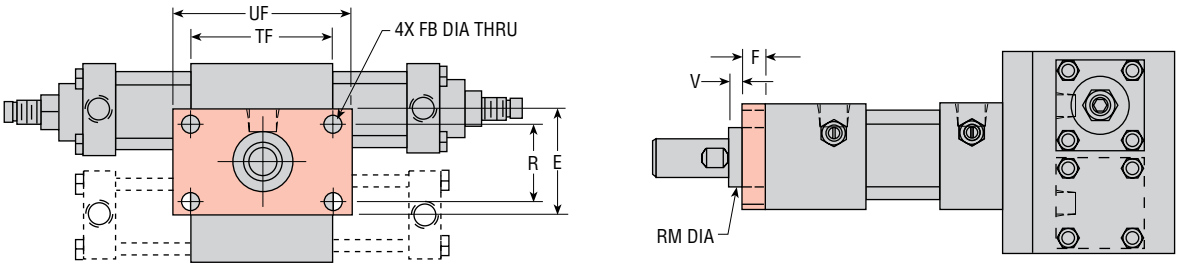
DIMENSIONS: MOUNTING STYLES

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]

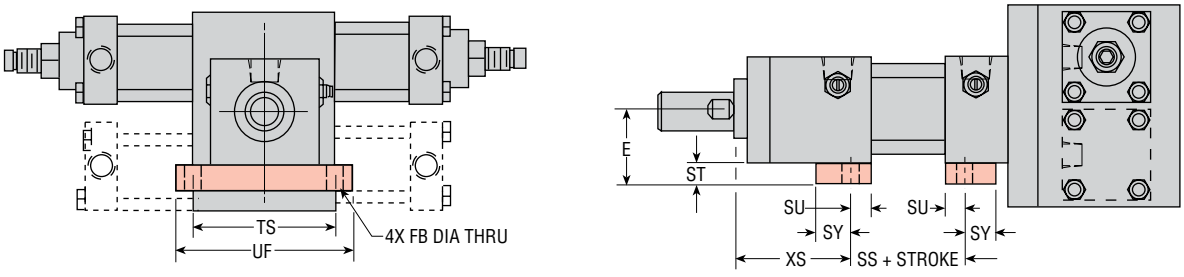
RF MOUNTING STYLE



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

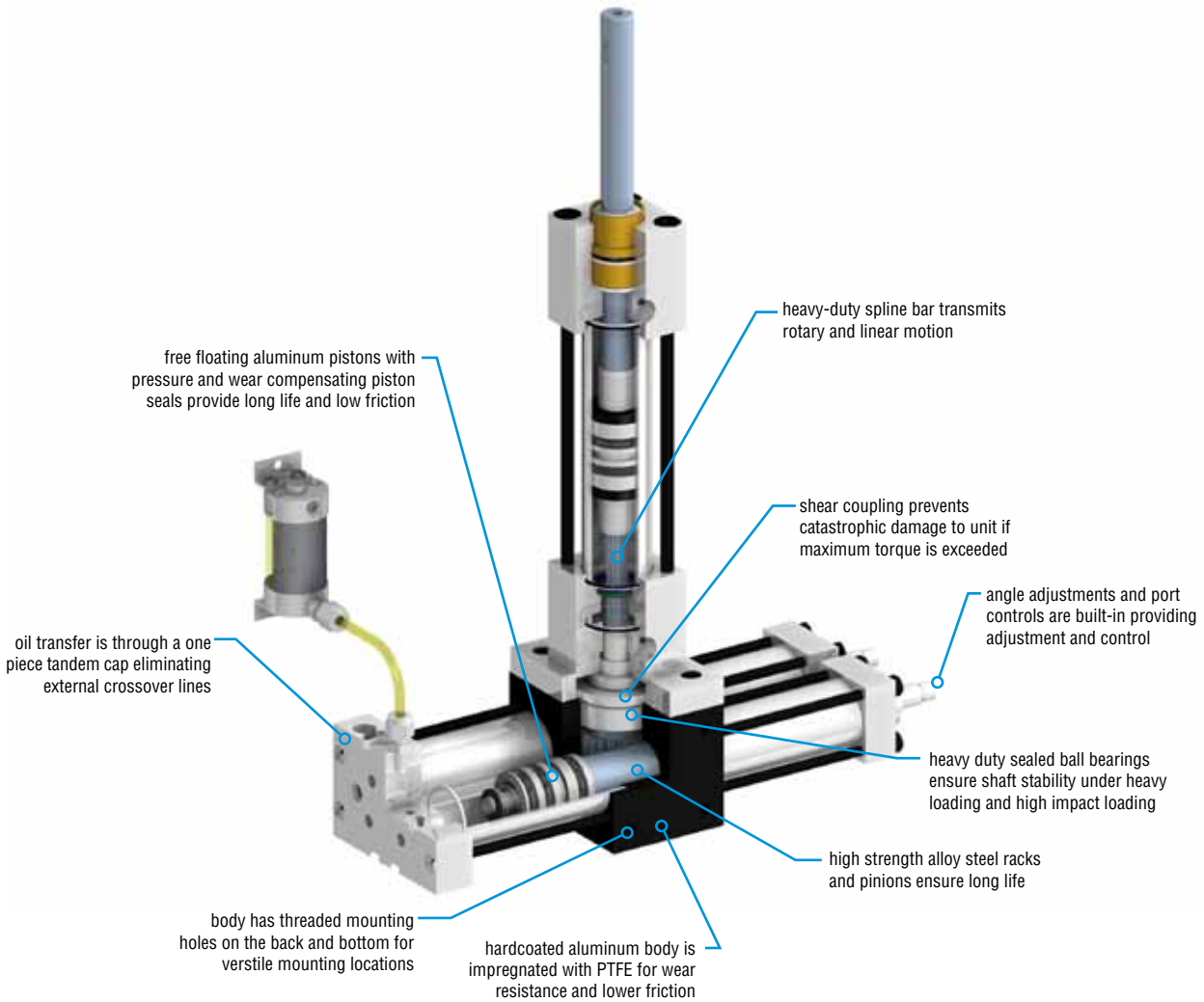
All dimensions are reference only unless specifically toleranced.

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.

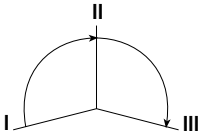
LINEAR SECTION CUSHION
DR - Cushion on rod end
DC - Cushion on cap end

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

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CAD & Sizing Assistance

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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) 1° 0' (6000), 0° 30' (8000)
LUBRICATION	Factory lubricated for rated life
MAINTENANCE	Field repairable

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

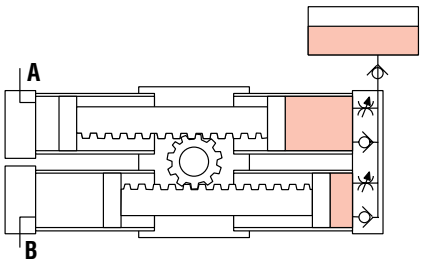
	WEIGHT						ROTARY BORE DIAMETER		LINEAR BORE DIAMETER		ROTARY DISPLACEMENT		LINEAR DISPLACEMENT			
	BASE		ROT. ADDER		LINEAR ADDER								EXTEND		RETRACT	
SERIES	lb	kg	lb/deg	kg/deg	lb/in	kg/mm	in	mm	in	mm	in^3/deg	cm^3/deg	in^3/in	cm^3/mm	in^3/in	cm^3/mm
2000	7.3	3.3	.0043	.0020	.38	.0068	1.000	25.4	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.



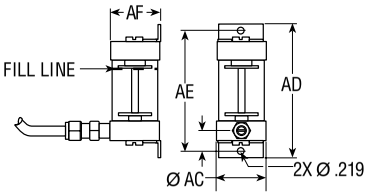
UNIT SIZING ONLINE

Sizing & Application Assistance

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

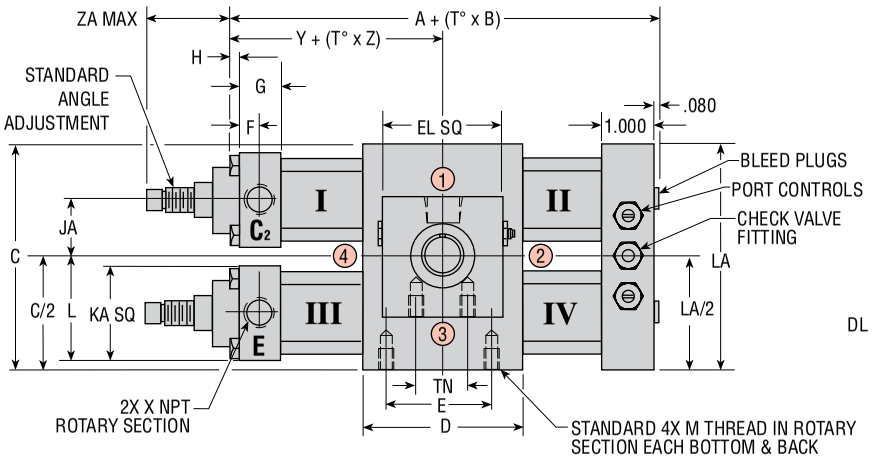
RESERVOIR PART NO.	AB	AC	AD	AE	AF
13459-02-2	16.4	63.5	139.7	130.2	64.3
13459-03-2	13.8	38.1	98.4	88.9	38.9

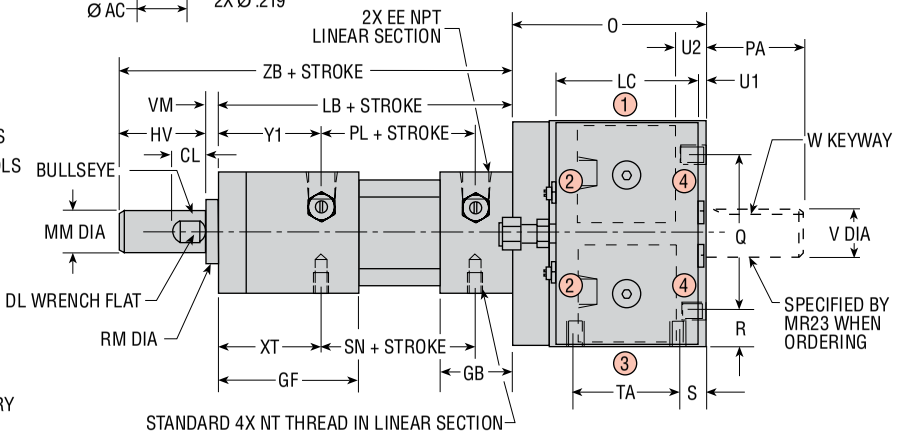
TANK DIMENSIONS



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

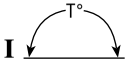
QUICK REFERENCE FOR: A + (T° x B)

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.

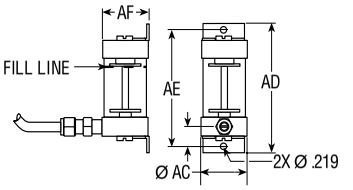
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All dimensions are reference only unless specifically toleranced.

DIMENSIONS: AIR/OIL TANDEM MULTI-MOTION ACTUATORS

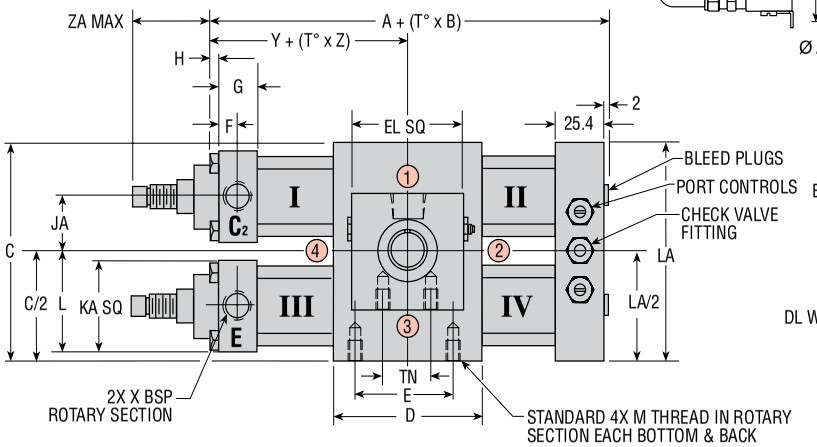
RESERVOIR PART NO.	AB	AC	AD	AE	AF
68397-02-2	16.4	63.5	139.7	130.2	64.3
68397-03-2	13.8	38.1	98.4	88.9	38.9

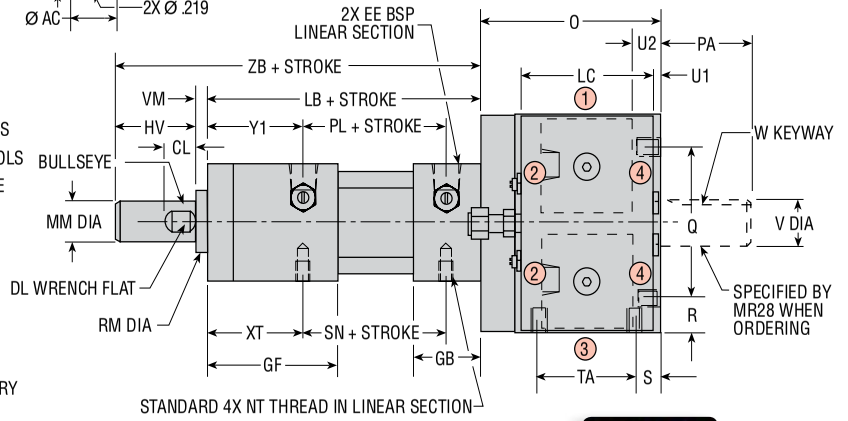
TANK DIMENSIONS



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.





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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)

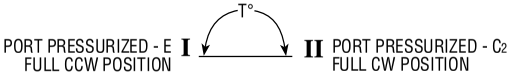
SERIES	DEGREE OF ROTATION					
	45	90	180	270	360	450
2000	177.7	197.6	237.4	277.2	317.0	356.7
4000	232.6	262.2	321.7	381.2	440.6	500.0
6000	263.1	292.9	352.3	411.7	471.2	530.9
8000	342.1	401.5	520.4	639.3	758.1	877.0

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

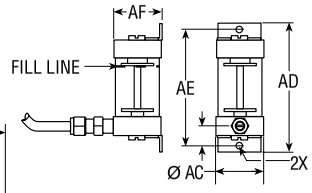
All standard rod ends have four wrench flats.



All dimensions are reference only unless specifically toleranced.

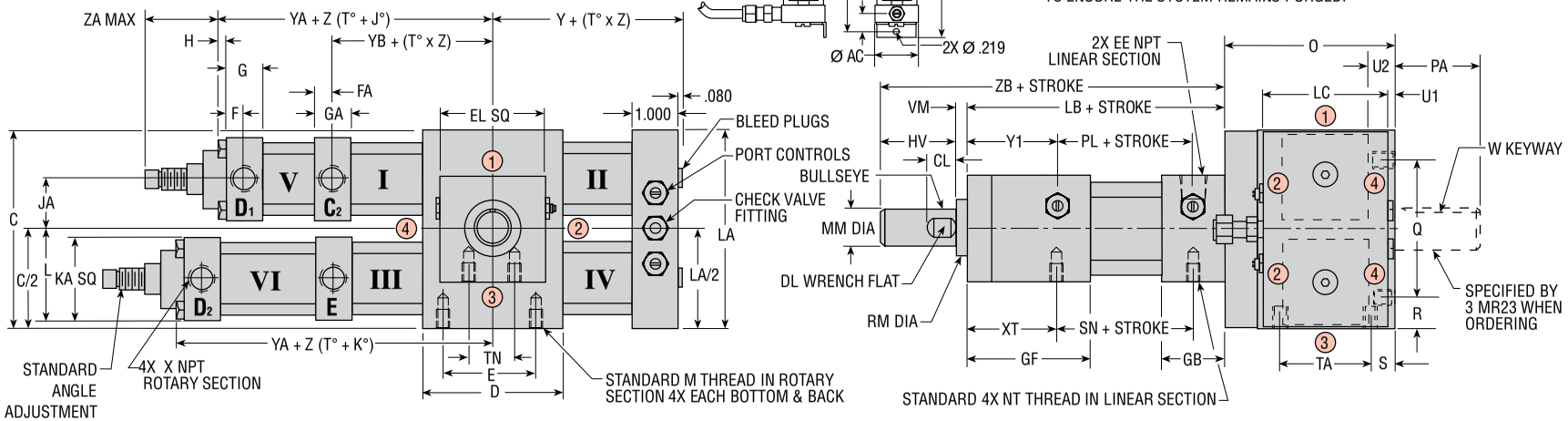
RESERVOIR PART NO.	AB	AC	AD	AE	AF
13459-02-2	16.4	63.5	139.7	130.2	64.3
13459-03-2	13.8	38.1	98.4	88.9	38.9

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.

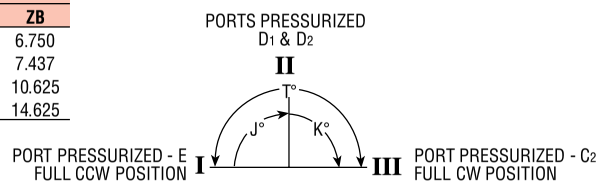


ROTARY SECTION

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



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

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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

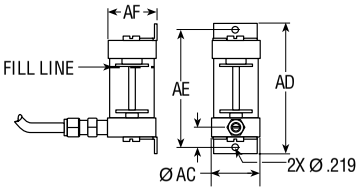
All standard rod ends have four wrench flats.

All dimensions are reference only unless specifically toleranced.

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

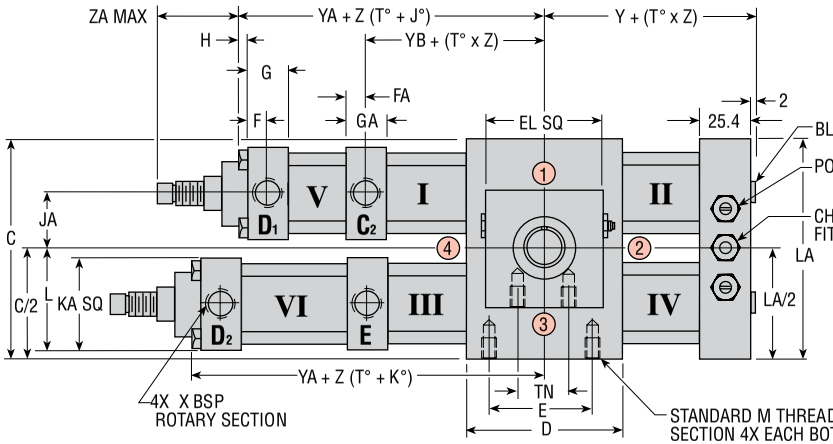
RESERVOIR PART NO.	AB	AC	AD	AE	AF
68397-02-2	16.4	63.5	139.7	130.2	64.3
68397-03-2	13.8	38.1	98.4	88.9	38.9

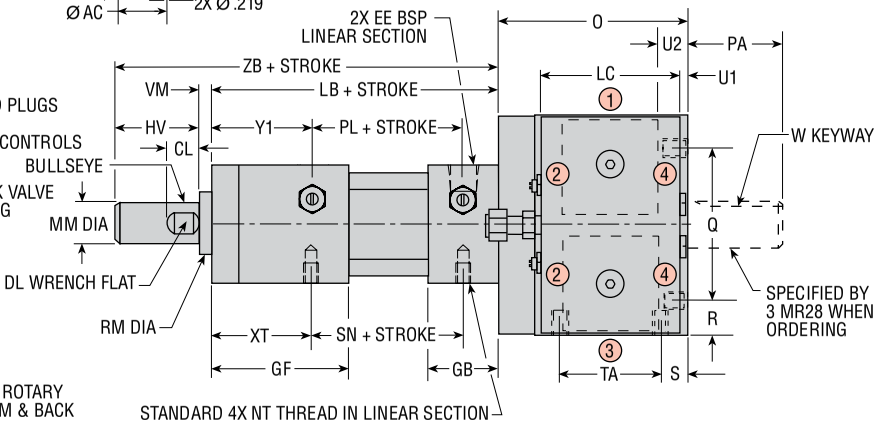
TANK DIMENSIONS



RESERVOIR ASSEMBLY IS INCLUDED WITH UNIT.
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.



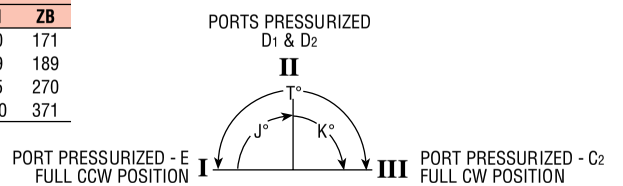


ROTARY SECTION

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



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

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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.

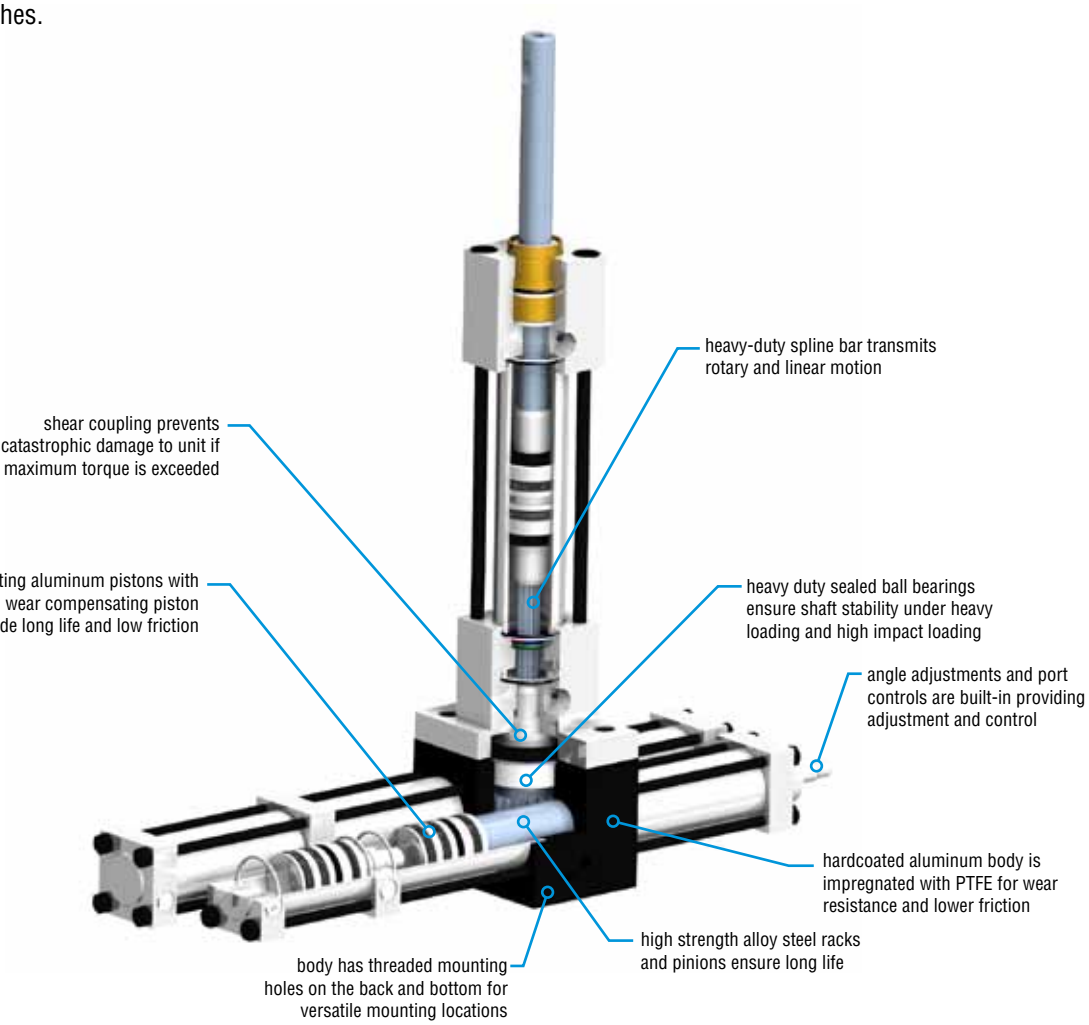
2000-8000 multi-position

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.

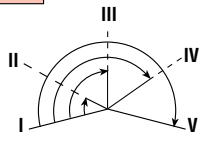
ROTARY AND LINEAR OPTIONS
E - Magnetic Piston for Hall Effect Switch
M - Magnetic Piston for Reed Switch
V - Fluoro-Elastomer Seals
Z1 - Electroless Nickel Plate, all ferrous parts

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

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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) 1° 0' (6000), 0° 30' (8000)
LUBRICATION	Factory lubricated for rated life
MAINTENANCE	Field repairable

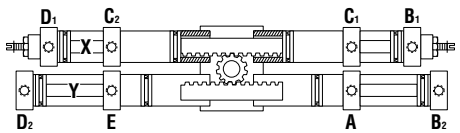
*See hydraulic pressure ratings for options chart below. All hydraulic ratings are based on non-shock service.

	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

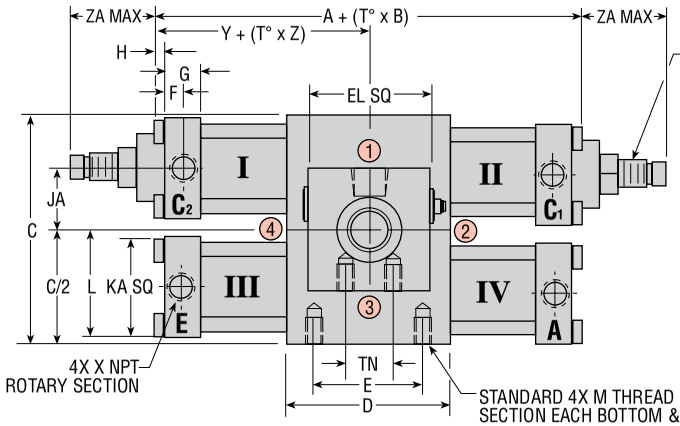
	OPTION psi [bar]							
	PLAIN		PORT CONTROLS		-Dx		-E or -M	
SERIES	psi	bar	psi	bar	psi	bar	psi	bar
2000	–	–	–	–	–	–	–	–
4000	–	–	–	–	–	–	–	–
6000	–	–	N/A	N/A	–	–	750	52
8000	–	–	N/A	N/A	–	–	500	35

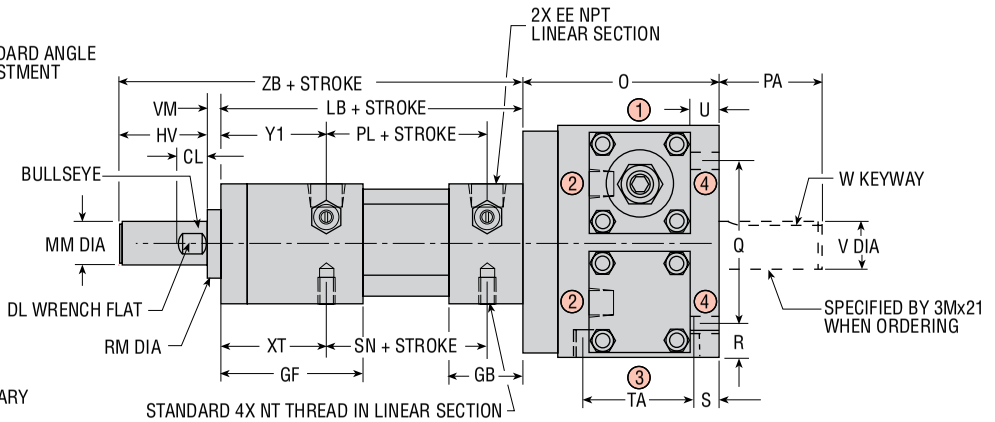
NOTE: — = Standard Rating



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

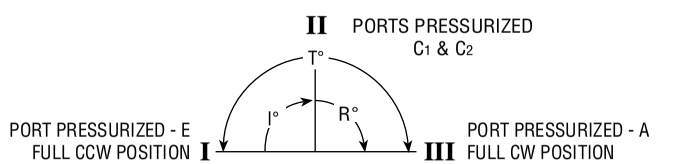
SERIES	LETTER DIMENSION																		
	CL	DL	EE	EL	GB	GC	GF	HV	LB	MM	NT	PL	RM	SN	TN	VM	XT	Y1	ZB
2000	.530	1/2	1/4	1.750	1.250	1.000	2.187	1.500	5.000	.625	1/4-28 x .312 DP	2.812	1.000	2.812	.625	.250	1.562	1.562	6.750
4000	.530	5/8	3/8	2.250	1.375	1.000	2.625	1.625	5.562	.750	5/16-24 x .500 DP	2.937	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

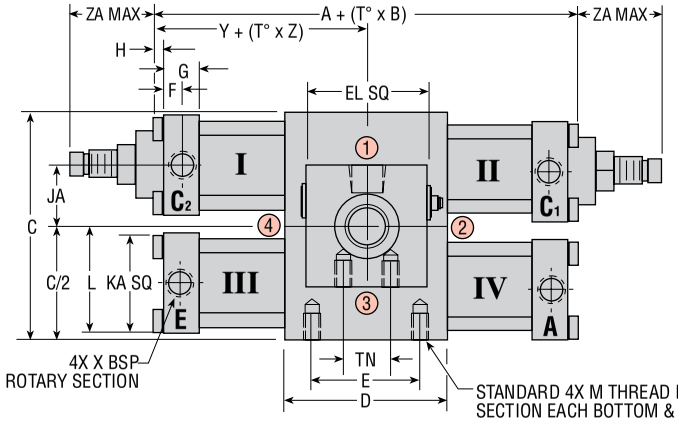


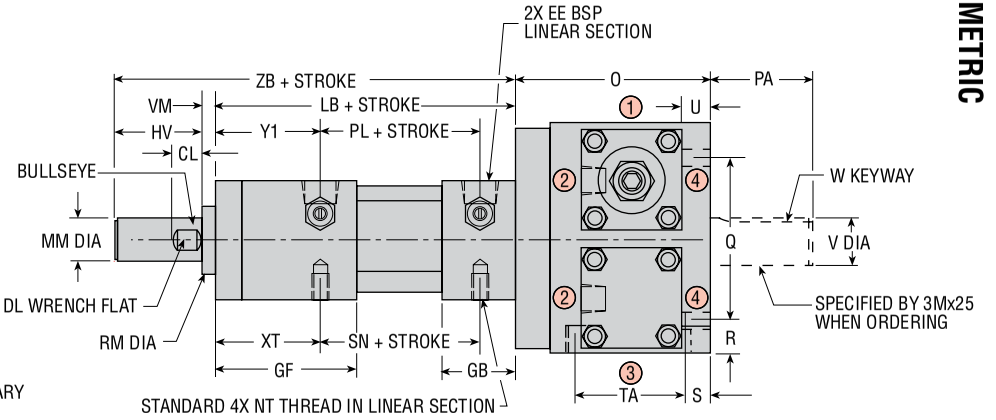
ROTARY SECTION OPTION LOCATION REFERENCE

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.

All dimensions are reference only unless specifically toleranced.
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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	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

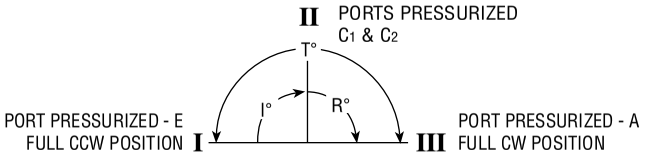
SERIES	LETTER DIMENSION																		
	CL	DL	EE	EL	GB	GC	GF	HV	LB	MM	NT	PL	RM	SN	TN	VM	XT	Y1	ZB
2000	13	13	G1/4	44	32	25	56	38	127	15.9	M6 x 1.0 x 8	71	25.4	71.4	15.9	6	40	40	171
4000	13	16	G3/8	57	35	25	67	41	141	19.0	M8 x 1.25 x 13	75	31.8	74.6	22.2	6	49	49	189
6000	25	29	G3/8	76	51	32	95	76	184	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.

BULLSEYE: REFERENCE MARK INDICATING ORIENTATION OF ROD END TO ROTARY SECTION
SHAFT KEYWAY & BULLSEYE: SHOWN AT MID-ROTATION
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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



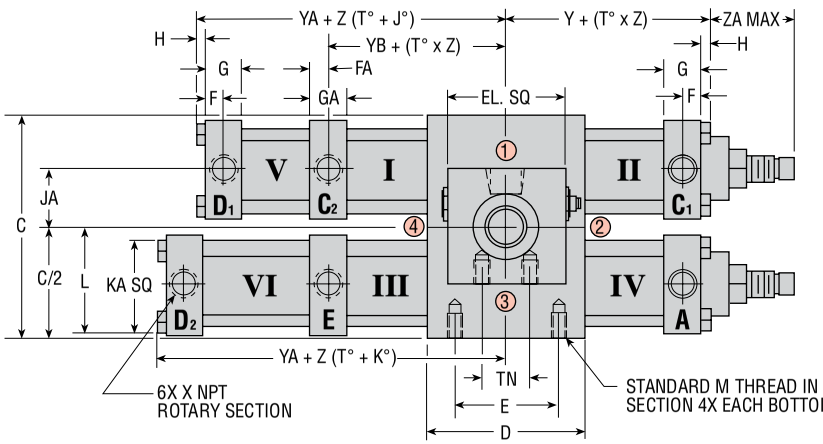
ROTARY SECTION OPTION LOCATION REFERENCE

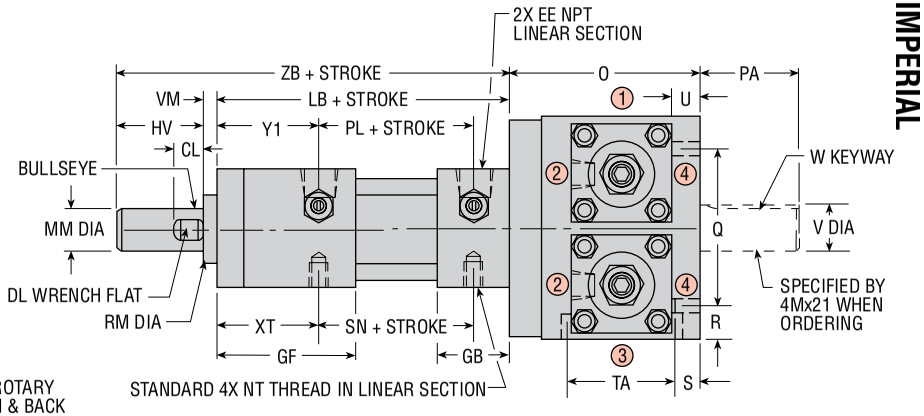
ACTUATOR TYPE	LETTER OPTION REFERENCED BY TUBE NUMBER					PORT & NEEDLE LOCATIONS REFERENCED BY CIRCLED NUMBERS								
			-P			STANDARD			-F			-I		
	-B	-D	STANDARD	-M	-E	PORT	-P	-D	PORT	-P	-D	PORT	-P	-D
3MA15 & 3MA25	I & II	I & II	ALL	ALL	ALL	2	1 & 3	1	4	1 & 3	1	1, 3	2	2
3MH15 & 3MH25	—	I & II	ALL	ALL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

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All standard rod ends have four wrench flats.

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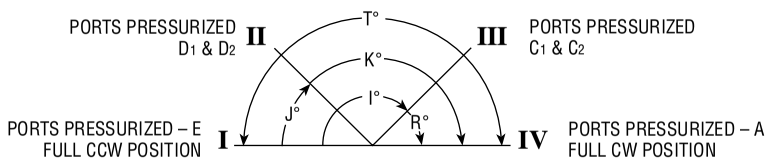
ROTARY SECTION

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

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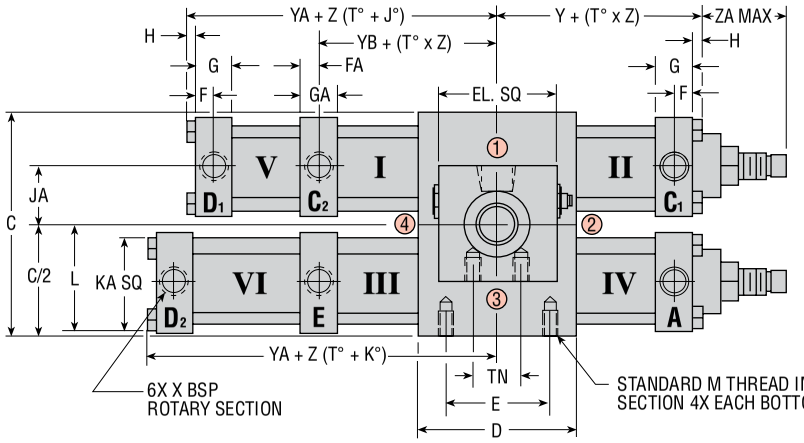
BULLSEYE: REFERENCE MARK INDICATING ORIENTATION OF ROD END TO ROTARY SECTION
SHAFT KEYWAY & BULLSEYE: SHOWN AT MID-ROTATION
ROD END: STANDARD IS A "PL" (PLAIN) ROD END
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MTG. HOLES: CENTERED ON CENTERLINE OF UNIT
STOP TUBES: LOCATED IN TUBES I & II
CUSHIONS: ADD DIMENSION "GC" TO ALL (+ STROKE) DIMENSIONS FOR EACH CUSHION
SHOCK PADS: LINEAR SECTION:
ADD 1/4" TO ALL (+ STROKE) DIMENSIONS FOR EACH SHOCK PAD

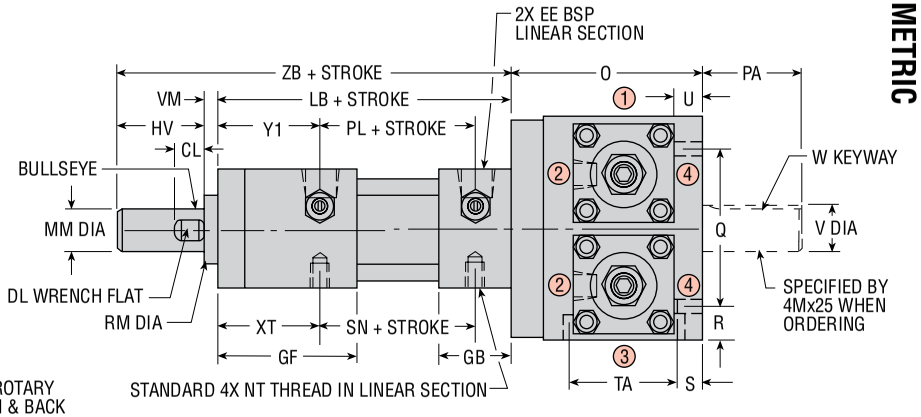
ROTARY SECTION OPTION LOCATION REFERENCE

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

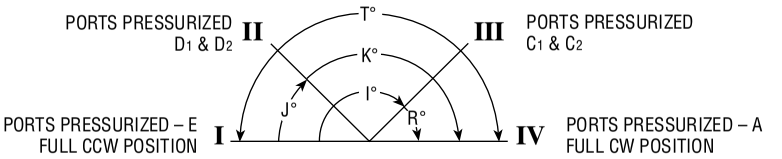
LINEAR SECTION

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

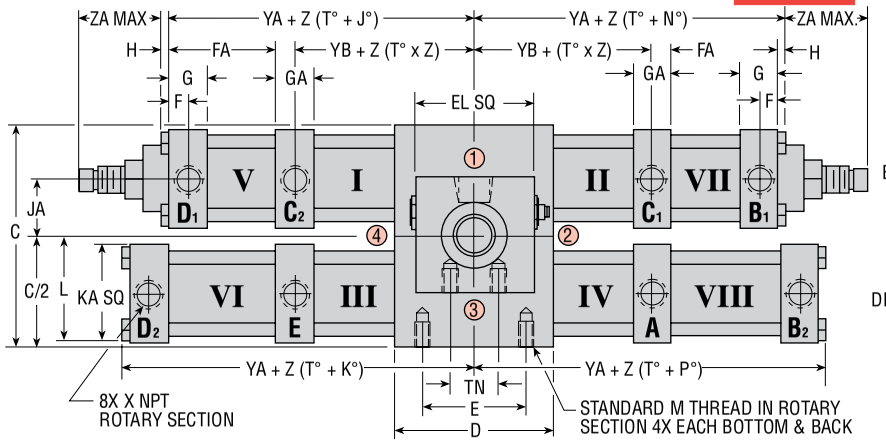
ROTARY SECTION OPTION LOCATION REFERENCE

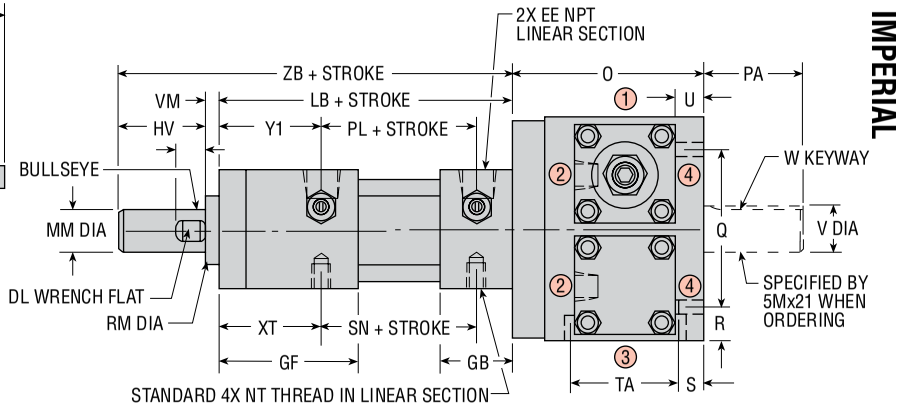
ACTUATOR TYPE	LETTER OPTION REFERENCED BY TUBE NUMBER					PORT & NEEDLE LOCATIONS REFERENCED BY CIRCLED NUMBERS								
			-P			STANDARD			-F			-I		
	-B	-D	STANDARD	-M	-E	PORT	-P	-D	PORT	-P	-D	PORT	-P	-D
4MA15 & 4MA25	II & IV	II & IV	ALL	ALL	ALL	2	1 & 3	1	4	1 & 3	1	1, 3	2	2
4MH15 & 4MH25	—	II & IV	ALL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

All standard rod ends have four wrench flats.

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2000-8000 multi-position





IMPERIAL

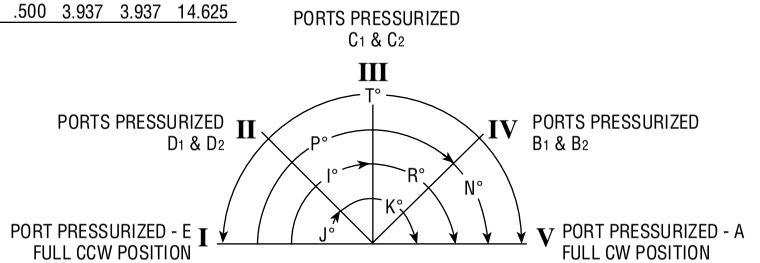
DIMENSIONS: 5 POSITION MULTI-MOTION ACTUATORS

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
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

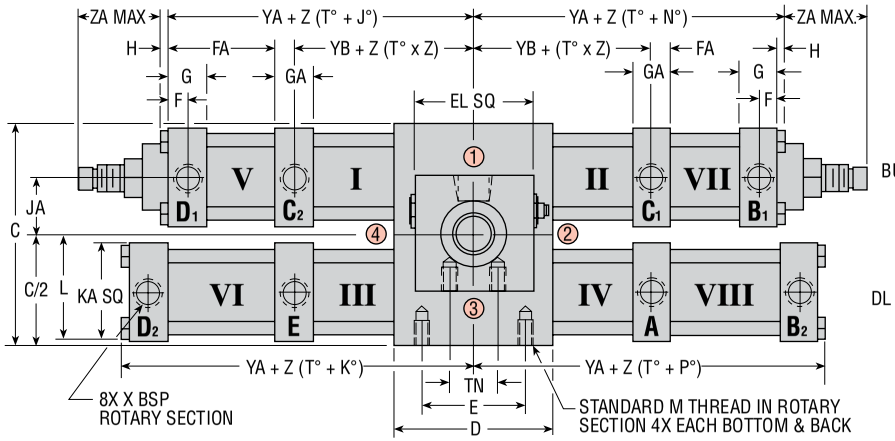
ROTARY SECTION OPTION LOCATION REFERENCE

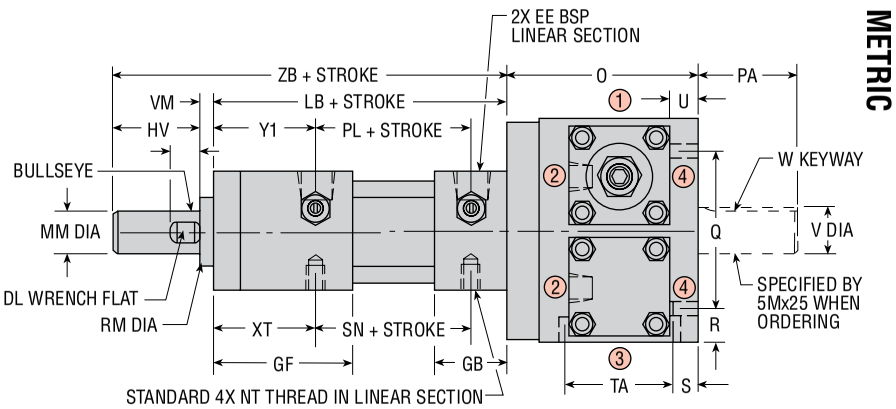
ACTUATOR TYPE	LETTER OPTION REFERENCED BY TUBE NUMBER					PORT & NEEDLE LOCATIONS REFERENCED BY CIRCLED NUMBERS								
			-P			STANDARD			-F			-I		
	-B	-D	STANDARD	-M	-E	PORT	-P	-D	PORT	-P	-D	PORT	-P	-D
5MA11 & 5MA21	VII & V	VII & V	ALL	ALL	ALL	2	1 & 3	1	4	1 & 3	1	1, 3	2	2
5MH11 & 5MH21	—	VII & V	ALL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

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All standard rod ends have four wrench flats.

All dimensions are reference only unless specifically toleranced.



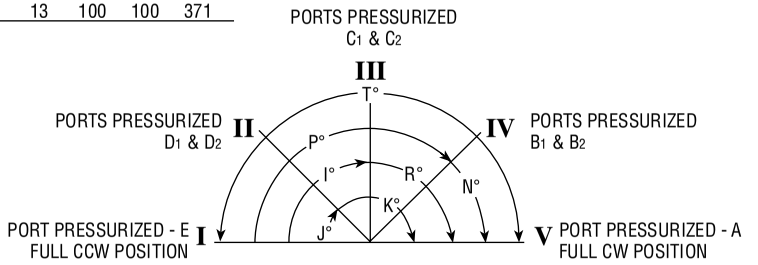


ROTARY SECTION

	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



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

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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

All dimensions are reference only unless specifically toleranced.

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"

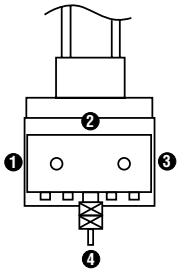
MAGNETIC PISTON FOR USE WITH PHD PROXIMITY SWITCHES

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.

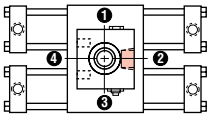
Wide signal range capability permits interfacing with most programmable controllers and logic systems.
Independent adjustment of each set point position from a single sensor.

PORT POSITIONS

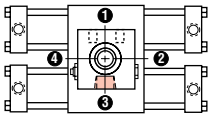
LINEAR SECTION

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.)

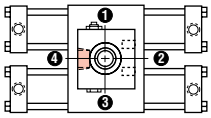
S **PORT POSITION 2**



T **PORT POSITION 3**



U **PORT POSITION 4**

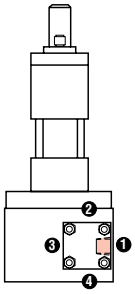


ROTARY SECTION

Port Position 2 is standard.

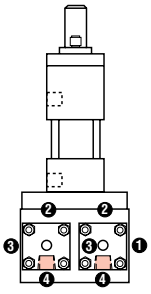
C **PORT POSITION 1**

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



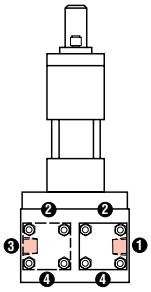
F **PORT POSITION 4**

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.

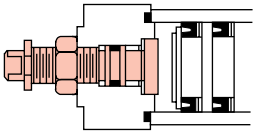
Consult PHD for optional port position or units with Port Controls.

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.

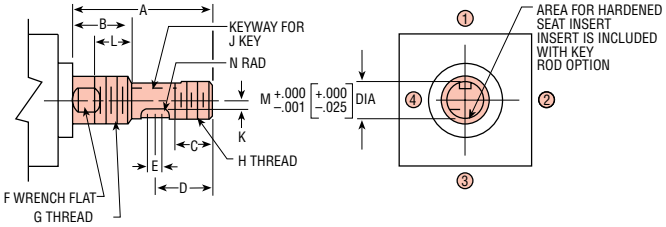
Options may affect unit length. See dimensional pages and option information details.

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

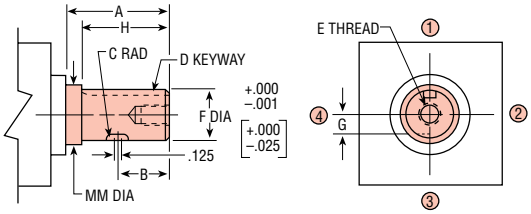
-KY THREADED ROD END WITH KEYWAY AND PRE-LOAD



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



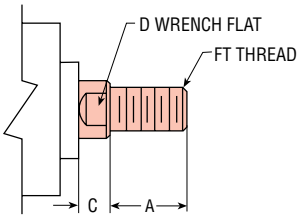
CIRCLED NUMBERS: INDICATE PORT POSITIONS
KEY: INCLUDED WITH ROD END OPTION

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.

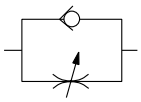


All standard rod ends have four wrench flats.

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.

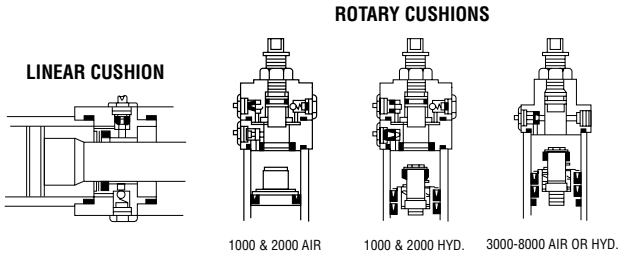


Standard on Series 1000-4000 and on the rotary section only of Series 5000-8000.

DR DC LINEAR SECTION CUSHIONS

D1 D2 ROTARY SECTION CUSHIONS

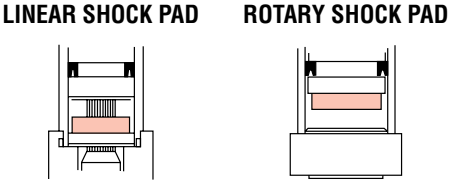
Adjustable cushions, available on all PHD Multi-Motion Actuators, allow smooth deceleration at the end of stroke and rotation to eliminate mechanical shock and hammer effect.



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



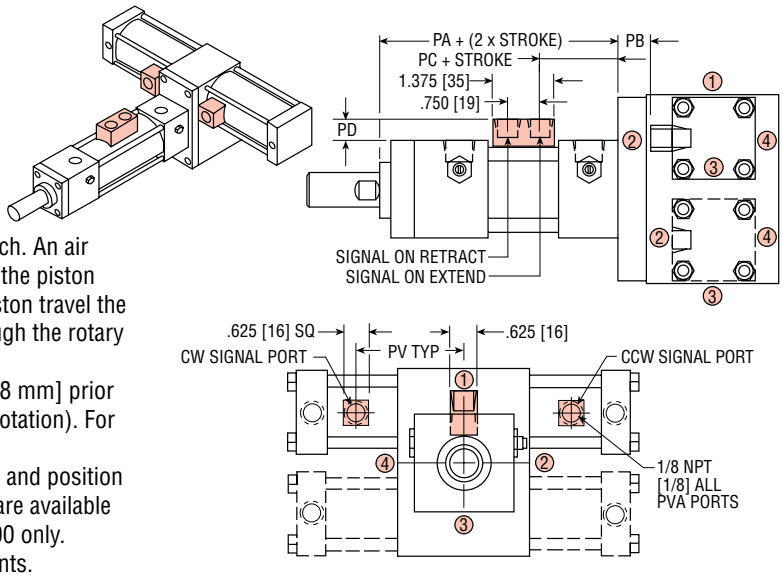
Polyurethane pads for absorption of shock and noise are available on each end of stroke and rotation on Series 1000-8000 Multi-Motion Actuators. Reducing shock permits higher piston velocities for shorter cycle times. Reducing noise levels provides improved environment for increased productivity. Pads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

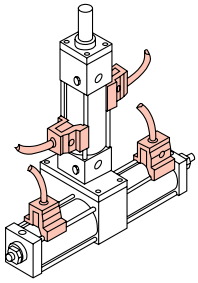
Multi-Motion Actuators may be equipped with a magnetic band (specify -E) on the pistons which activates externally mounted PHD Hall Effect Switches. These switches allow the interfacing of the PHD Air or Hydraulic Multi-Motion Actuators to various logic systems. This option is for use with the following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



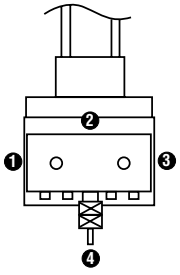
The PHD Magnetic Reed Switches may be used in situations where the Hall Effect Switches are not applicable. As with the Hall Effect Switches, a magnetic band (specify -M) on the pistons activates the externally mounted PHD Reed Switches. The Reed Switches may be used to signal a programmable controller, 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.

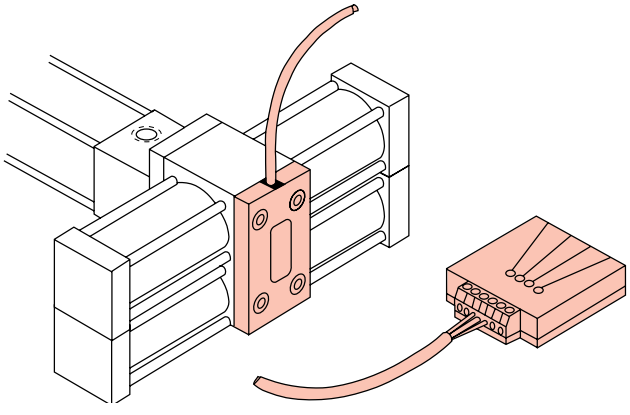
Wide signal range capability permits interfacing with most programmable controllers and logic systems.

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.

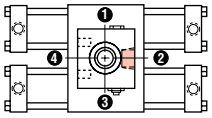
All dimensions are reference only unless specifically toleranced.

PORT POSITIONS

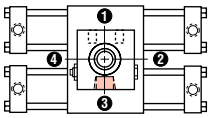
LINEAR SECTION

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.)

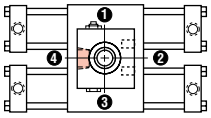
S **PORT POSITION 2**



T **PORT POSITION 3**



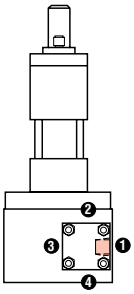
U **PORT POSITION 4**



ROTARY SECTION

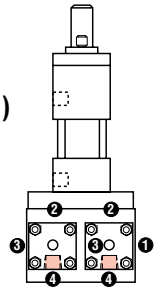
Port Position 2 is standard.

C **PORT POSITION 1**

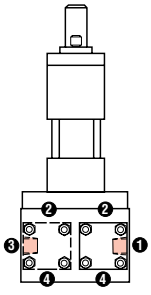


Available only on Series 1000, 3000, 5000, and 7000 Actuators.

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



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



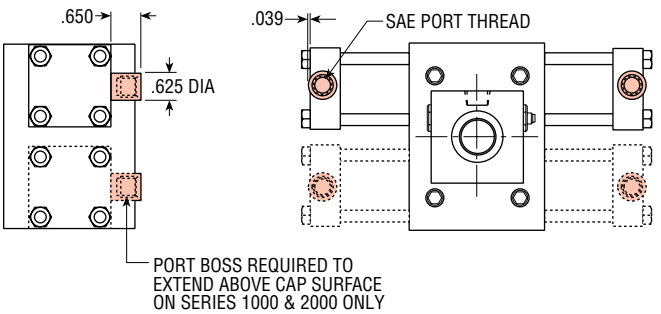
This option positions the ports in position 1 on tubes I and II and in position 3 on tubes III and IV. This allows access to the ports on the "Top" and "Bottom" sides of the actuator. Available on 2000, 4000, 6000, and 8000 actuators.

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

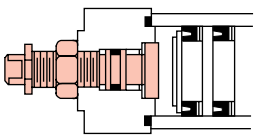


ANGLE ADJUSTMENT (STANDARD)

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

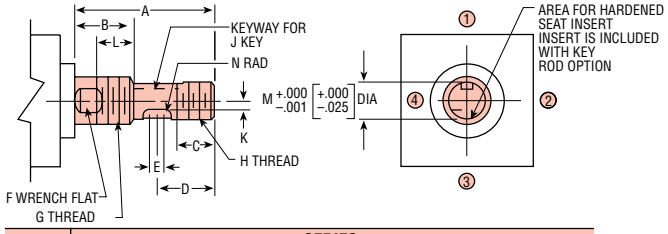
This option may be specified when a precise stroke and rotation is required and angle adjustment is not acceptable. By specifying this option, rotation will be within a tolerance of +30 minutes, -0 minutes and stroke will be a tolerance of ± .005 [± 0.127 mm].

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

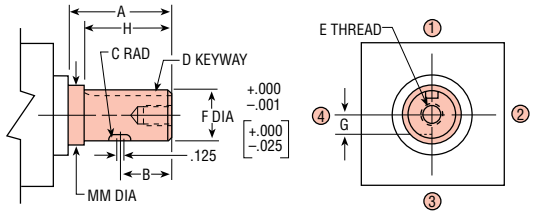
-KY THREADED ROD END WITH KEYWAY AND PRE-LOAD



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



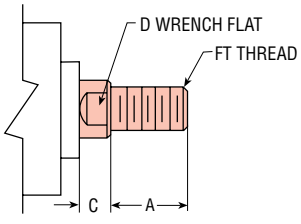
CIRCLED NUMBERS: INDICATE PORT POSITIONS
KEY: INCLUDED WITH ROD END OPTION

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.

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