ROTARY ACTUATORS

MINIATURE, AIR/OIL TANDEM, AND MULTI-POSITION

Specialty Actuators Provide Solutions to Unique Rotary Motion Requirements

INDEX:

SERIES 1000-8000

SERIES 2000-8000
AIR/OIL TANDEM

MINIATURE
ROTARY
ACTUATORS

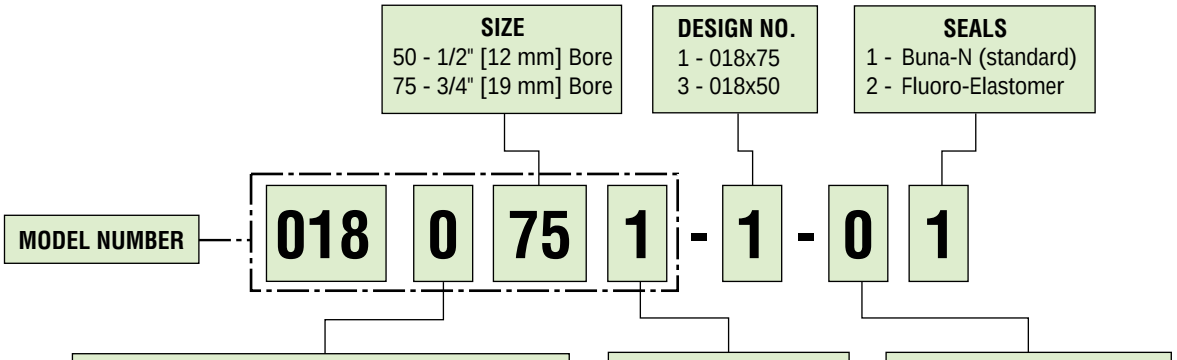
SERIES 2000-8000
MULTI-POSITION

phd SOLUTIONS FOR INDUSTRIAL AUTOMATION
(800) 624-8511
www.phdinc.com

ORDERING DATA: MINIATURE ROTARY ACTUATORS

UNITS WITH IMPERIAL SHAFTS AND KEYWAYS

TO ORDER SPECIFY:
Series, Size, Type, Design No.,
Options, and Seals.



SERIES NUMBER FOR PORT & MTG. HOLE TYPE		
IMPERIAL	METRIC	POSITION
0	5	2 Position Actuator
3	8	3 Position Actuator -(Not available on Size 50)

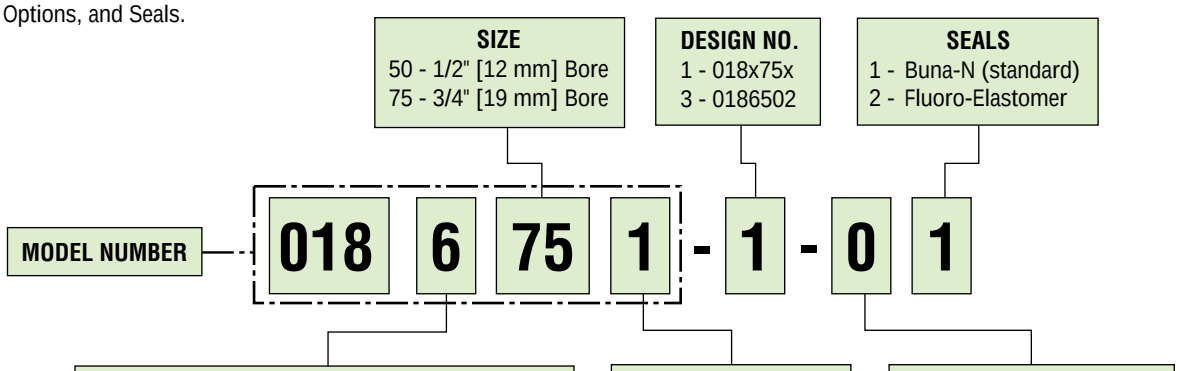
TYPE
1 - Single Rack
2 - Double Rack
T - Tandem
NOTE: 018x50, 018375, and 018875 are available in -2 double rack only.

OPTIONS
0 - No Sensor
3 - Sensor Transducer with Transition Plate

NOTES:
1) Sensor must be used with a PHD Set Point Module. See Switches and Sensors section for information and ordering data.

UNITS WITH METRIC SHAFTS AND KEYWAYS

TO ORDER SPECIFY:
Series, Size, Type, Design No.,
Options, and Seals.



SERIES NUMBER FOR PORT & MTG. HOLE TYPE		
IMPERIAL	METRIC	POSITION
—	6	2 Position Actuator
—	9	3 Position Actuator -(Not available on Size 50)

TYPE
1 - Single Rack
2 - Double Rack
T - Tandem
NOTE: 018x50, and 018975 are available in -2 double rack only.

OPTIONS
0 - No Sensor
3 - Sensor Transducer with Transition Plate

NOTES:
1) Sensor must be used with a PHD Set Point Module. See Switches and Sensors section for information and ordering data.

(800) 624-8511
www.phdinc.com

MINIATURE ROTARY ACTUATORS:

SERIES 018x502 & 018x75x

BENEFITS

- PHD Miniature Rotary Actuators provide an infinite choice of rotation between 0 and 180° in a very small package which is ideal for small part orientation and turnover.
- Two bore sizes, single and double rack, air-oil tandem, and 3 position models are offered for a wide range of application requirements.
- Standard external angle adjustments provide easy adjustment of rotation between 0 and 180°.
- Zero backlash at ends of rotation provide precise positioning of attached load.
- One piece pinion gear with sealed ball bearings give maximum output shaft support, low friction, and long unit life.
- Built-in flow controls are standard on most models for precise control of rotation speed.
- Optional Hall Effect Sensor/Set Point Module is available for sensing multiple position throughout rotation.

UNIT 018x752

OUTPUT TORQUES TO 33 in-lb [3.7 Nm]

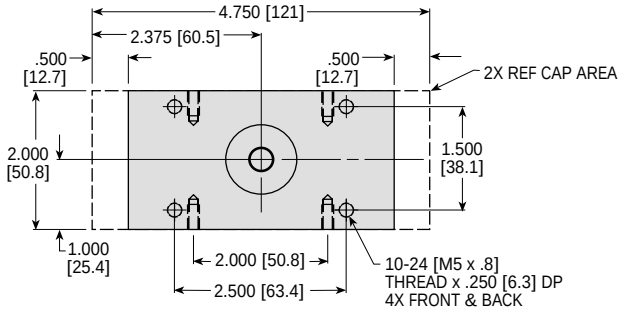
SPECIFICATIONS	SERIES 018x50	SERIES 018x75
PISTON SEALS	(1 Per Piston) Block Vee	(2 Per Piston) Block Vee
PISTONS	Part of the Rack	Free Floating Aluminum
PINION SHAFT	One Piece Alloy Steel	
RACK	Alloy Steel	
END CAPS	—	Zinc Plated Steel
BODY	Hardcoated Aluminum	
BEARINGS	(2) Steel Ball Bearings	
PORTS	10-32 [M5 x .8] with Barb Fittings	1/8 NPT [1/8 BSP]
LUBRICATION	Permanently Lubricated for Non-Lube Air	
ANGLE ADJUSTMENT	0° to 180° (Fully Adjustable)	
BACKLASH	0° at Both End Positions	
ROTATION	180° Total	
FLOW CONTROLS	Not Available	Built-in Standard*

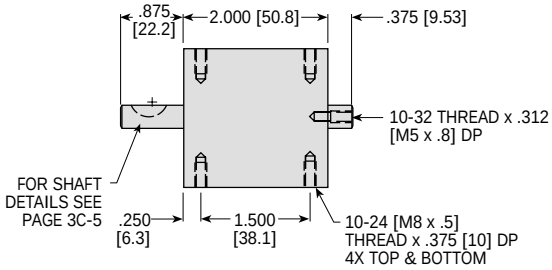
*Not available on 018375, 018875, or 018975 3 position units.

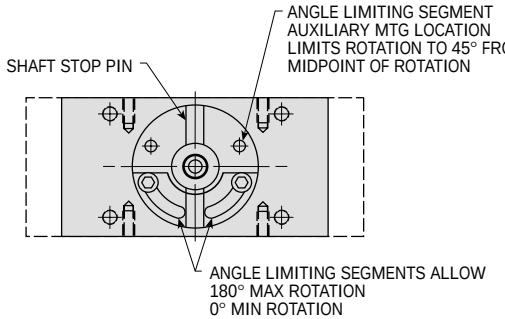
THEORETICAL TORQUE in-lb/psi [Nm/bar]

MODEL				
0180502	0180751	0180752	018075T	0183752
.065 [.09]	.11 [.18]	.22 [.36]	.11 [.18]	.11 [.18]

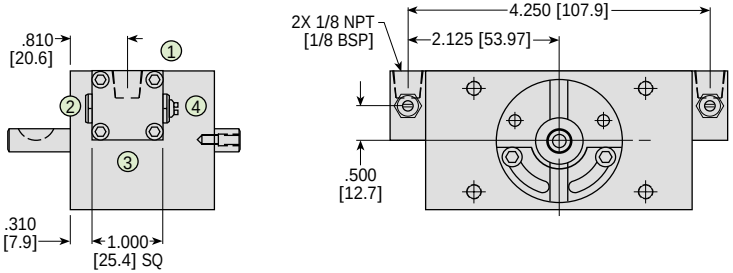
BASIC DIMENSIONS
SERIES 018x75x & 018x752 UNITS



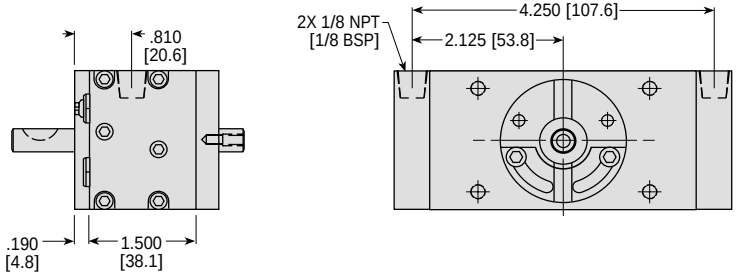




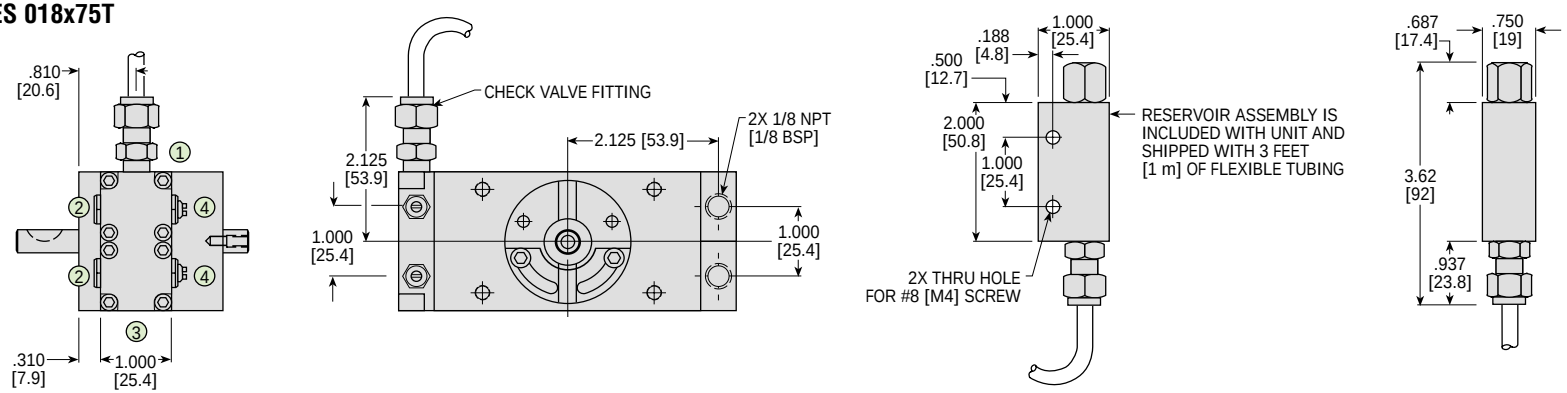
SINGLE RACK UNIT
SERIES 018x751



DOUBLE RACK UNIT
SERIES 018x752



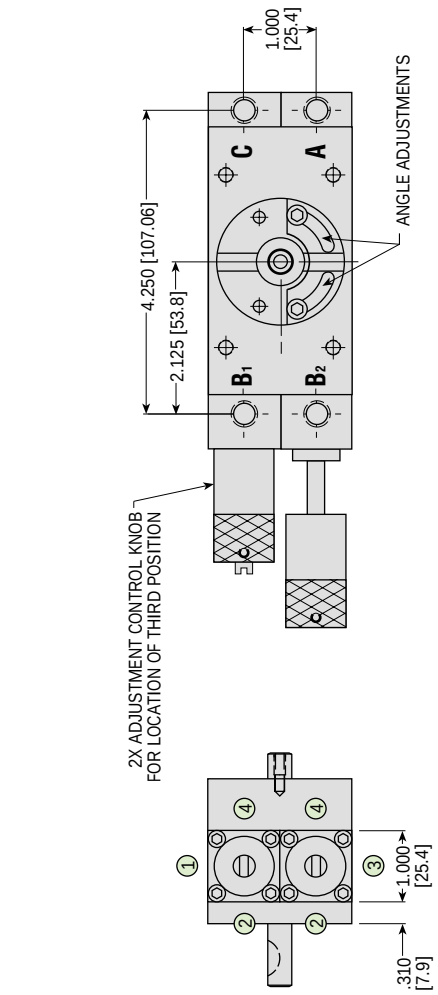
AIR/OIL TANDEM UNIT
SERIES 018x75T

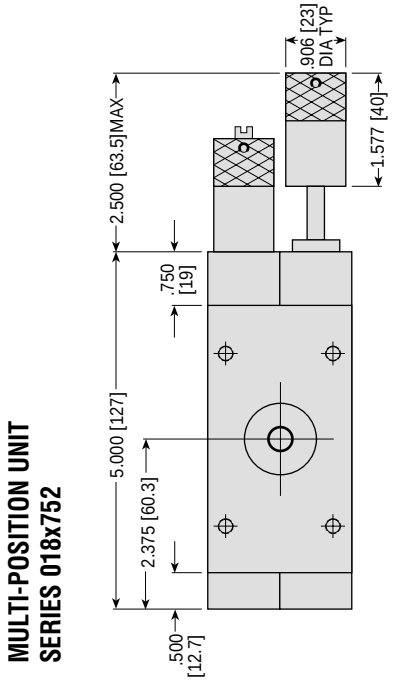


NOTES:
1) ALL DETAILS SHOW UNITS AT MID-ROTATION
2) NUMBERS IN [ ] ARE FOR METRIC UNITS AND ARE IN mm.

(800) 624-8511
www.phdinc.com

DIMENSIONS: SERIES 018x752 3 POSITION MINIATURE





MULTI-POSITION UNIT SERIES 018x752

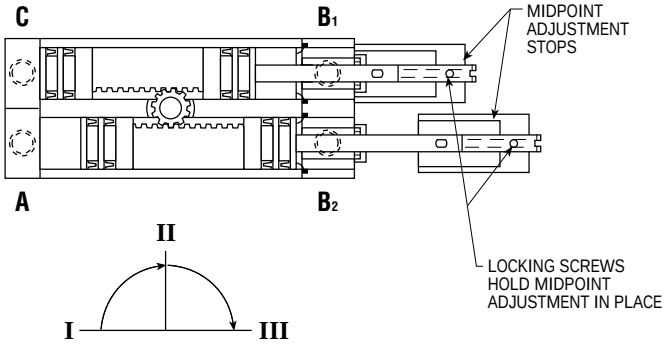
NOTES:
1) ALL DETAILS SHOW UNITS AT MID-ROTATION
2) NUMBERS IN [ ] ARE FOR METRIC UNITS AND ARE IN mm.

OPERATING PRINCIPLE

The PHD Three Position Rotary Actuator yields three output shaft positions. Both the extreme positions and the midposition can be adjusted in the field allowing a total rotation from 0° to 180° with the midpoint anywhere between. Pressurizing port C provides full counterclockwise rotation (position I). Pressurizing ports B_1 and B_2 at the same time causes the unit to rotate to position II and to hold at that position. The racks are trapped by the piston and rods (B_1 and B_2) and hold the pinion from rotating, creating the positive midposition. The midpoint adjustment stops allow the midpoint to be set by changing the lengths that each piston and rod can stroke. Position III is obtained by pressurizing port A driving the pinion shaft to a full clockwise position.

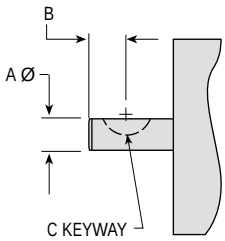
Output positions can be selected in any sequence allowing the actuator to stop at or pass by the midposition.

VIEW FROM FRONT OF UNIT

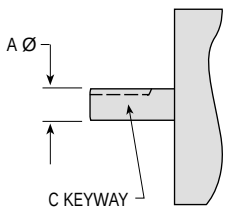


SHAFT DETAIL FOR 018x75x

SERIES	DIMENSION A	DIMENSION B	DIMENSION C
018075x 018375x	.375 + .000 - .001	.375	204 Woodruff Keyway
018575x 018875x	[9.53 + .000 - .025]	[9.53]	
018675x 018975x	.3939 + .0000 - .0003 [10 + .000 - .007]	—	3 mm SQ x 16 mm LG

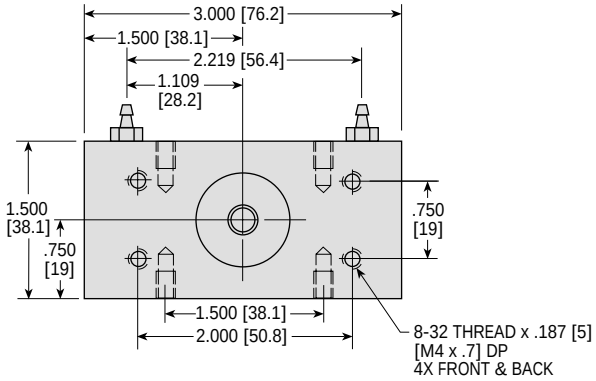


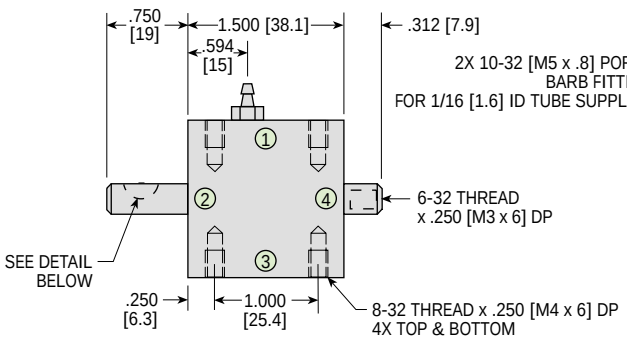
IMPERIAL SHAFTS

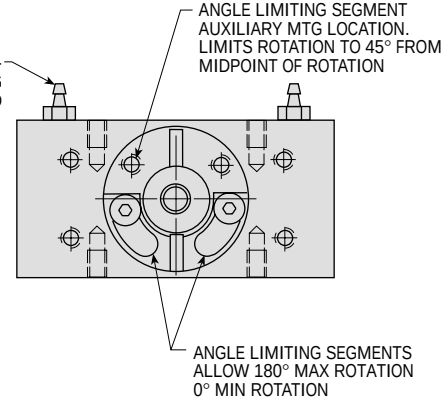


METRIC SHAFTS

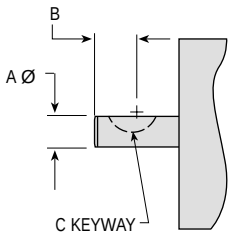
DOUBLE RACK UNITS
SERIES 0180502



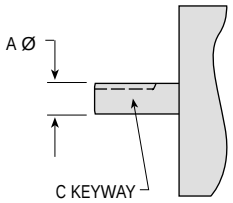




SHAFT KEYWAY: SHOWN AT MID-ROTATION - WOODRUFF KEY IS SUPPLIED WITH ALL ACTUATORS
ROTATION: 180° MAXIMUM
PORT POSITIONS: INDICATED BY CIRCLED NUMBERS
PORT CONTROLS: NOT AVAILABLE ON SERIES 0183752, 0188752 & 018x502 UNITS. PORT CONTROLS ARE STANDARD ON ALL OTHER ACTUATORS.
MTG. HOLES: CENTERED ON CENTERLINE OF ACTUATOR BODY



IMPERIAL SHAFTS



METRIC SHAFTS

SERIES	DIMENSION A	B	C
018050 018550	.250 $^{+.000}_{-.001}$ [6.35 $^{+.000}_{-.025}$]	.312 [7.92]	203 Woodruff Keyway
018650	.2362 $^{+.0000}_{-.0003}$ [6.0 $^{+.000}_{-.007}$]	—	2 mm SQ x 14 mm LG

NOTE: NUMBERS IN [ ] ARE FOR METRIC UNITS AND ARE IN mm.

(800) 624-8511
www.phdinc.com

NOTES

(800) 624-8511
www.phdinc.com

UNITS WITH IMPERIAL SHAFTS AND KEYWAY

TO ORDER SPECIFY:
Type, Design No., Series, Angle of Rotation, and Options.

SERIES
1 (000) 1" Bore Single Rack
2 (000) 1" Bore Double Rack
3 (000) 1-3/8" Bore Single Rack
4 (000) 1-3/8" Bore Double Rack
5 (000) 2" Bore Single Rack
6 (000) 2" Bore Double Rack
7 (000) 3" Bore Single Rack
8 (000) 3" Bore Double Rack

PORT CONTROL©

BUILT-IN METER OUT FLOW CONTROL VALVE
P - Flow control both directions
P1 - Flow control clockwise
P2 - Flow control counterclockwise

ANGLE ADJUSTMENT
A - Angle adjustment both ends
A1 - Angle adjustment clockwise 30°
A2 - Angle adjustment counterclockwise 30° (20° for Series 8000)

DESIGN NO.
1 - Imperial - Ports and mounting holes are imperial.
5 - Metric - Ports and mounting holes are metric. Pinion shafts and keyway are imperial.

R1 1 A 2 180 - P - D - A - K-M-V

TYPE

IMPERIAL	METRIC
R11A - Single Shaft Ext. 150 psi Air Max.	R15A - Single Shaft Ext. 10 bar Air Max.
R21A - Double Shaft Ext. 150 psi Air Max.	R25A - Double Shaft Ext. 10 bar Air Max.
R11H - Single Shaft Ext. 1500 psi Hyd. Max.	R15H - Single Shaft Ext. 100 bar Hyd. Max.
R21H - Double Shaft Ext. 1500 psi Hyd. Max.	R25H - Double Shaft Ext. 100 bar Hyd. Max.

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

CUSHION OR SHOCK PAD
D - Cushions both directions
D1 - Cushion clockwise
D2 - Cushion counterclockwise
B - Shock Pads both directions
B1 - Shock Pad clockwise
B2 - Shock Pad counterclockwise
(Cushions and Shock Pads are not available on the same end of actuator. Shock Pads are not available for Hydraulic use.)

OPTIONS
C - Cross Key Pinion Shaft
E - Magnetic Piston for Hall Effect Switch
G - Shaft Seal both sides
H - Hollow Pinion Shaft (not available on type R21)
I - Port Position 1 on top rack
Port Position 3 on bottom rack
(Available on Series 2000, 4000, 6000, and 8000 only.)
J - Hall Sensor (Set Point Module is ordered separately) for rotations not exceeding 180°
K - Preload Keyway Pinion Shaft
L - Counterclockwise Unidirectional Clutch
M - Magnetic Piston for Reed Switch
N - Pilot Valve Actuator (PVA)
O - Ports in Position 1*
Q - Ports in Position 3*
R - Clockwise Unidirectional Clutch
S - SAE Ports (Hydraulic Units Only)
T - Ports in Position 4
V - Fluoro-Elastomer Seals
W - Close Tolerance Rotation, +30 minutes, -0
Z1 - Electroless Nickel Plate

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

NOTES:
1) Sensor must be used with a PHD Set Point Module. See Switches and Sensors section for information and ordering data.
2) Mounting flanges must be ordered separately.
3) SAE Ports available. Consult PHD for sizes.

PROXIMITY SWITCH MOUNTING BRACKETS

SERIES	SIZE NO.
1000 & 2000	-32
3000 & 4000	-34
5000 & 6000	-38
7000 & 8000	-39

See Switches and Sensors section for complete ordering information.

Options may affect unit length. See unit dimension and options pages for adders.

(800) 624-8511
www.phdinc.com

UNITS WITH METRIC SHAFTS AND KEYWAY

TO ORDER SPECIFY:
Type, Design No., Series, Angle of Rotation, and Options.

SERIES
1 (000) 1" Bore Single Rack
2 (000) 1" Bore Double Rack
3 (000) 1-3/8" Bore Single Rack
4 (000) 1-3/8" Bore Double Rack
5 (000) 2" Bore Single Rack
6 (000) 2" Bore Double Rack
7 (000) 3" Bore Single Rack
8 (000) 3" Bore Double Rack

PORT CONTROL©

BUILT-IN METER OUT FLOW CONTROL VALVE
P - Flow control both directions
P1 - Flow control clockwise
P2 - Flow control counterclockwise

ANGLE ADJUSTMENT
A - Angle adjustment both ends
A1 - Angle adjustment clockwise 30°
A2 - Angle adjustment counterclockwise 30°
(20° for Series 8000)

DESIGN NO.
6 - Metric - Ports and mounting holes, pinion shafts and keyway are metric.

R16A-2180-P-D-A-M-V

TYPE METRIC
R16A - Single Shaft Ext. 10 bar Air Max.
R26A - Double Shaft Ext. 10 bar Air Max.
R16H - Single Shaft Ext. 100 bar Hyd. Max.
R26H - Double Shaft Ext. 100 bar Hyd. Max.

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

CUSHION OR SHOCK PAD
D - Cushions both directions
D1 - Cushion clockwise
D2 - Cushion counterclockwise
B - Shock Pads both directions
B1 - Shock Pad clockwise
B2 - Shock Pad counterclockwise
(Cushions and Shock Pads are not available on the same end of actuator. Shock Pads are not available for Hydraulic use.)

OPTIONS
E - Magnetic Piston for Hall Effect Switch
I - Port Position 1 on top rack
Port Position 3 on bottom rack
(Available on Series 2000, 4000, 6000, and 8000 only.)
M - Magnetic Piston for Reed Switch
O - Ports in Position 1*
Q - Ports in Position 3*
T - Ports in Position 4
V - Fluoro-Elastomer Seals
W - Close Tolerance Rotation, +30 minutes, -0
Z1 - Electroless Nickel Plate

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

NOTES:
1) Sensor must be used with a PHD Set Point Module. See Switches and Sensors section for information and ordering data.
2) Mounting flanges must be ordered separately.

PROXIMITY SWITCH MOUNTING BRACKETS

SERIES	SIZE NO.
1000 & 2000	-32
3000 & 4000	-34
5000 & 6000	-38
7000 & 8000	-39

See Switches and Sensors section for complete ordering information.

Options may affect unit length. See unit dimension and options pages for adders.

BENEFITS

- PHD Series 1000-8000 Rotary Actuators are pneumatically or hydraulically powered providing output torques up to 31,800 in-lb [3595 Nm].
- Rugged design and construction makes these actuators ideal for heavy duty service in tough working environments.
- Four bore sizes are available in single and double rack models with standard rotations from 45° to 450°.
- Free floating pistons with rack and pinion design eliminates binding for low breakaway and long unit life.
- Sealed shaft ball bearings provide long life and maximum shaft stability for heavy payloads.
- Available with a wide range of options including built-in flow controls, cushions, angle adjustments, shock pads, and pinion shaft options for specifying the exact actuator for your application.
- Simple construction allows easy field repairability.

OUTPUT TORQUES TO 31,800 in-lb [3595 Nm]

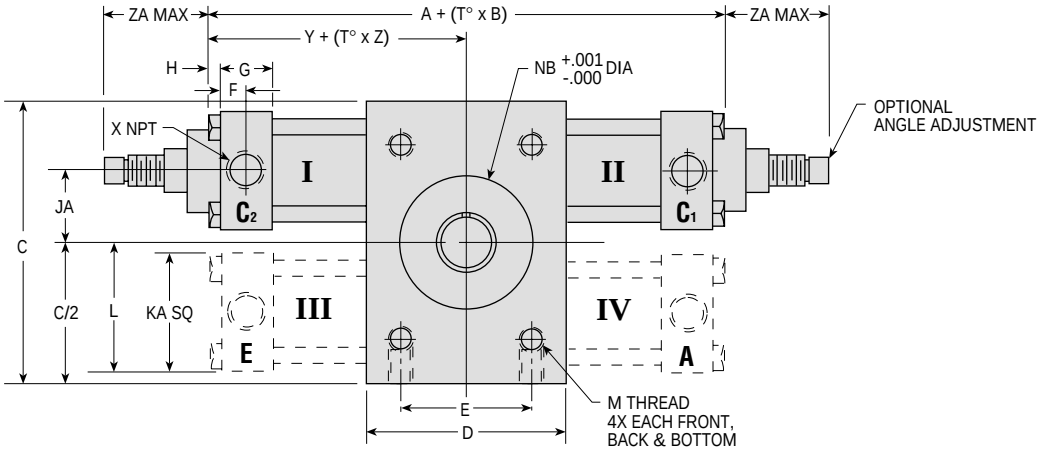
SPECIFICATIONS	TYPE	
	R1xA & R2xA	R1xH & R2xH
PISTON SEALS	(3 Per Piston) Block Vee with Back-up Ring	
PISTONS	Free Floating Aluminum	
TIERODS	High Tensile Steel	
TUBE SEALS	Square Cut	
PINION SHAFTS	One Piece Alloy Steel	
RACK	Alloy Steel	
END CAPS	Zinc Plated Alloy Steel	
BODY	Hardcoated Aluminum	
TUBES	Hardcoated Aluminum	Hardcoated Aluminum on Series 1000-4000
	—	Honed Steel on Series 5000-8000
BEARINGS	(2) Steel Ball Bearings	
PORTS	NPT [BSP]	
LUBRICATION	Permanent for Non-Lube Air	—
	150 psi [10 bar] Air Max	1500 psi [100 bar] Hyd. Max.
STANDARD ROTATIONS	45°, 90°, 180°, 270°, 360°, 450°	
OPTIONS	Port Controls®, Cushions, Angle Adjustment, Magnetic Pistons, Fluoro-Elastomer Seals	

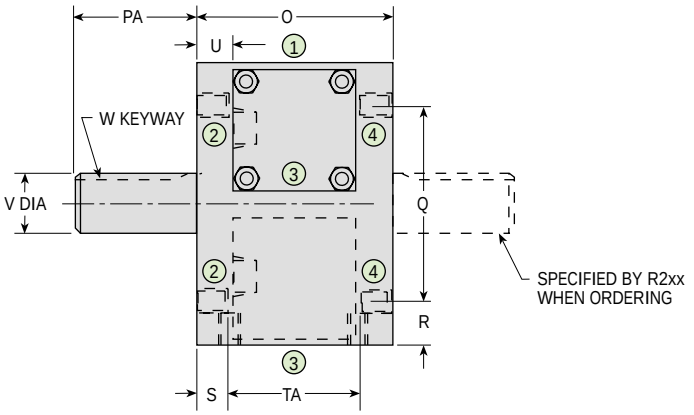
THEORETICAL TORQUE in-lb/psi [Nm/bar]

SERIES							
1000	2000	3000	4000	5000	6000	7000	8000
.38 [.63]	.77 [1.28]	1.1 [1.83]	2.2 [3.66]	2.3 [3.82]	4.7 [7.82]	10.6 [17.61]	21.2 [35.21]

(800) 624-8511
www.phdinc.com

IMPERIAL





SERIES	LETTER DIMENSION																								
	A	B	C	D	E	F	G	H	JA	KA	L	M	NB	O	PA	Q	R	S	TA	U	V	W	X	Y	Z	ZA
1000 & 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	1.125 x .056 DP	2.000	.875	2.000	.500	.250	1.500	.312	.4998/.5003	1/8 x 1/16 x .625	1/8	2.849	.0087	1.125
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	2.000 x .039 DP	3.000	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
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	2.1654 x .052 DP	3.000	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
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	3.3465 x .120 DP	5.000	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

OPTION LOCATION REFERENCE

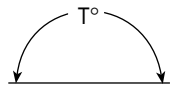
ACTUATOR TYPE	LETTER OPTION REFERENCED BY TUBE NUMBER											PORT & NEEDLE LOCATIONS REFERENCED BY CIRCLED NUMBERS											
	-A		-B		-D		-P					STANDARD			-O			-Q			-T		
	-A1	-A2	-B1	-B2	-D1	-D2	-P1	-P2	-M	-E	-N	PORT	-P	-D	PORT	-P	-D	PORT	-P	-D	PORT	-P	-D
R1xA & R2xA	II	I	II	I	II	I	II	I	I & II	I & II	I & II	2	1	1	1	2	2	3	2	2	4	1	1
R1xH & R2xH	II	I	N/A	N/A	II	I	II	I	I & II	I & II	N/A	2	1	1	1	2	2	3	2	2	4	1	1

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

SHAFT KEYWAY: SHOWN AT MID-ROTATION
PORT POSITION: INDICATED BY CIRCLED NUMBERS
-O & -Q AVAILABLE ON SERIES 1000, 3000, 5000, & 7000 ONLY
TUBES III & IV: INCLUDED ON SERIES 2000, 4000, 6000, & 8000 UNITS ONLY
MTG. HOLES: CENTERED ON CENTERLINE OF ACTUATOR BODY
CUSHIONS: SERIES 1000 & 2000 ACTUATORS
ADD 1/2" TO RESPECTIVE "A" AND "Y" DIMENSIONS FOR EACH CUSHION

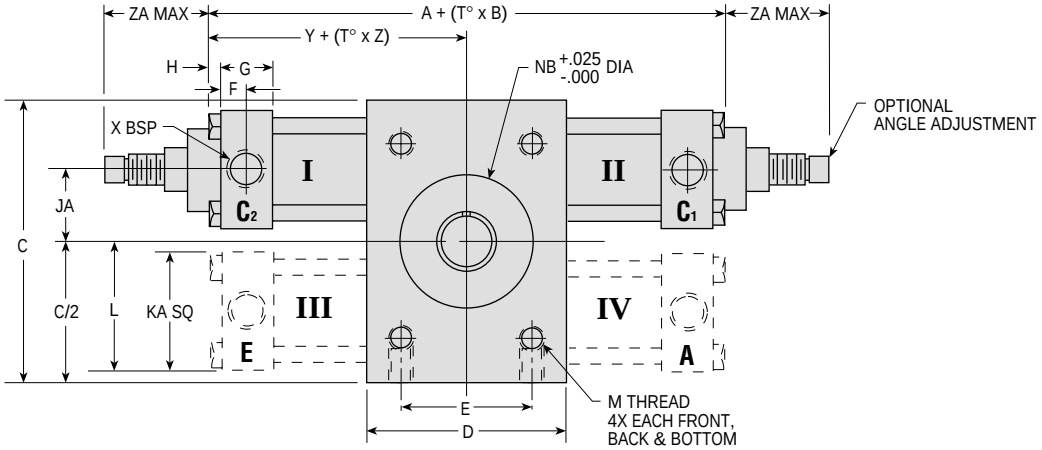
PORT PRESSURIZED - FULL CCW POSITION
C_1 ON SERIES 1000, 3000, 5000, & 7000
OR C_1 & E ON SERIES 2000, 4000, 6000, & 8000

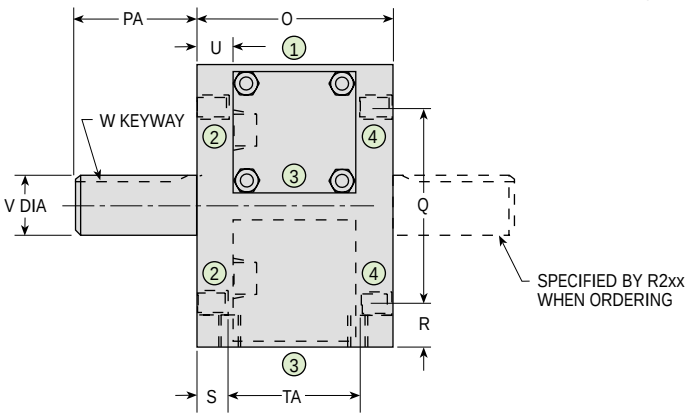


PORT PRESSURIZED - FULL CW POSITION
C_2 ON SERIES 1000, 3000, 5000, & 7000
OR C_2 & A ON SERIES 2000, 4000, 6000, & 8000

DIMENSIONS: SERIES 1000-8000 ROTARY ACTUATORS

METRIC





SERIES	LETTER DIMENSION																			IMPERIAL SHAFTS*		METRIC SHAFTS*				
	A	B	C	D	E	F	G	H	JA	KA	L	M	NB	O	PA	Q	R	S	TA	U	V	W	V	W	X	Y	Z	ZA
1000 & 2000	145	0.44	76	51	38.1	6	13	0	19	35	36	M6 x 1.0 x 8	28.58 x 1.4 DP	50.8	22	50.8	13	6	38.1	8	12.69/12.71	3.15 x 1.59 x 16	12.00/11.97	4 x 2.5 x 15	1/8	72	0.22	29
3000 & 4000	201	0.66	108	76	50.8	9	17	6	29	48	53	M8 x 1.0 x 13	50.80 x 1.0 DP	76.2	48	76.2	16	13	50.8	14	22.22/22.23	4.75 x 2.36 x 38	22.00/21.96	6 x 3.5 x 32	1/4	100	0.33	38
5000 & 6000	232	0.66	127	102	63.5	10	19	5	29	57	58	M10 x 1.5 x 16	55.00 x 1.3 DP	76.2	48	88.9	19	13	50.8	10	28.55/28.58	6.35 x 3.18 x 38	28.00/27.96	8 x 5 x 40	1/4	116	0.33	48
7000 & 8000	302	1.33	203	127	76.2	12	27	11	48	89	92	M20 x 2.5 x 32	85.00 x 3.0 DP	127.0	89	127.0	38	32	63.5	19	44.42/44.45	9.53 x 2.36 x 78	44.00/43.96	12 x 5 x 56	3/8	154	0.66	73

OPTION LOCATION REFERENCE

ACTUATOR TYPE	LETTER OPTION REFERENCED BY TUBE NUMBER											PORT & NEEDLE LOCATIONS REFERENCED BY CIRCLED NUMBERS											
	-A		-B		-D		-P					STANDARD			-O			-Q			-T		
	-A1	-A2	-B1	-B2	-D1	-D2	-P1	-P2	-M	-E	-N	PORT	-P	-D	PORT	-P	-D	PORT	-P	-D	PORT	-P	-D
R1xA & R2xA	II	I	II	I	II	I	II	I	I & II	I & II	I & II	2	1	1	1	2	2	3	2	2	4	1	1
R1xH & R2xH	II	I	—	—	II	I	II	I	I & II	I & II	N/A	2	1	1	1	2	2	3	2	2	4	1	1

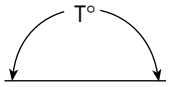
QUICK REFERENCE FOR: A + (T° x B)

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	410.1	469.5	529.0
7000 & 8000	368.3	427.7	548.0	665.5	784.4	903.2

* BOTH IMPERIAL AND METRIC SHAFT OPTIONS AVAILABLE ON METRIC BODY
(IMPERIAL SHAFT = DESIGN 5, AND METRIC SHAFT = DESIGN 6).
NUMBERS ARE FOR METRIC UNITS AND ARE IN mm.

SHAFT KEYWAY: SHOWN AT MID-ROTATION
PORT POSITION: INDICATED BY CIRCLED NUMBERS
-O & -Q AVAILABLE ON SERIES 1000, 3000, 5000, & 7000 ONLY
TUBES III & IV: INCLUDED ON SERIES 2000, 4000, 6000, & 8000 UNITS ONLY
MTG. HOLES: CENTERED ON CENTERLINE OF ACTUATOR BODY
CUSHIONS: SERIES 1000 & 2000 ACTUATORS
ADD 13 mm TO RESPECTIVE "A" AND "Y" DIMENSIONS FOR EACH CUSHION

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



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

(800) 624-8511
www.phdinc.com
All dimensions are reference only unless specifically toleranced.

UNITS WITH IMPERIAL SHAFTS AND KEYWAY

TO ORDER SPECIFY:
Type, Design No., Series,
Angle of Rotation, and Options.

DESIGN NO.
3 - Imperial - Ports and mounting holes are imperial
8 - Metric - Ports and mounting holes are metric.
Pinon shaft and keyway are imperial.

SERIES
2 (000) 1" Bore Double Rack
4 (000) 1-3/8" Bore Double Rack
6 (000) 2" Bore Double Rack
8 (000) 3" Bore Double Rack
(Oil Section is 2" Bore)

CUSHION
D - Cushions both directions
D1 - Cushion clockwise
D2 - Cushion counterclockwise

ANGLE ADJUSTMENT
A - Angle adjustment both ends
A1 - Angle adjustment clockwise 30°
A2 - Angle adjustment counterclockwise 30°

3 | R1 3 R | - | 2 | 180 | - | 90 | - | D | - | A | - | M-V

3 ROTARY POSITIONS
Use this digit for 3 Position Tandems only.

TYPE

IMPERIAL	METRIC
R13R - Single Shaft Ext. Air/Oil Tandem	R18R - Single Shaft Ext. Air/Oil Tandem
R23R - Double Shaft Ext. Air/Oil Tandem	R28R - Double Shaft Ext. Air/Oil Tandem

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

OPTIONS
C - Cross Key Pinion Shaft
E - Magnetic Piston for Hall Effect Switch
G - Shaft Seal both sides
H - Hollow Pinion Shaft (not available on type R23R)
I - Port Position 1 top rack
Port Position 3 bottom rack
J - Hall Sensor (Set Point Module is ordered separately) for units not exceeding 180°
K - Preload Keyway Pinion Shaft
L - Counterclockwise Unidirectional Clutch
M - Magnetic Piston for Reed Switch
N - Pilot Valve Actuator (PVA)
R - Clockwise Unidirectional Clutch
T - Port in Position 4
V - Fluoro-Elastomer Seals
W - Close Tolerance Rotation, +30 minutes, -0
Y - Tandem Cap rotated 180°
Z1- Electroless Nickel Plate

NOTE: Sensor must be used with a PHD Set Point Module. See Switches and Sensors section for information and ordering data.

PORT CONTROL©

BUILT-IN METER OUT FLOW CONTROL VALVE
Port Control is standard on all Air/Oil Tandem Actuators.

PROXIMITY SWITCH MOUNTING BRACKETS

SERIES	SIZE NO.
2000	-32
4000	-34
6000	-38
8000	-39

See Switches and Sensors section for complete ordering information.

ANGLE OF ROTATION FROM POSITION I TO POSITION II
Use this digit for 3 Position Tandems only.

Options may affect unit length. See unit dimension and options pages for adders.

UNITS WITH METRIC SHAFTS AND KEYWAY

TO ORDER SPECIFY:
Type, Design No., Series,
Angle of Rotation, and Options.

DESIGN NO.
9 - Metric - Ports, mounting holes, pinion shaft and keyway are metric.

SERIES
2 (000) 1" Bore Double Rack
4 (000) 1-3/8" Bore Double Rack
6 (000) 2" Bore Double Rack
8 (000) 3" Bore Double Rack
(Oil Section is 2" Bore)

CUSHION
D - Cushions both directions
D1 - Cushion clockwise
D2 - Cushion counterclockwise

ANGLE ADJUSTMENT
A - Angle adjustment both ends
A1 - Angle adjustment clockwise 30°
A2 - Angle adjustment counterclockwise 30°

3	R1	9	R	-	2	180	-	90	-	D	-	A	-	M-V

3 ROTARY POSITIONS
Use this digit for 3 Position Tandems only.

TYPE
R19R - Single Shaft Ext. Air/Oil Tandem
R29R - Double Shaft Ext. Air/Oil Tandem

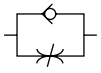
ANGLE OF ROTATION STANDARD ANGLES
45°, 90°, 180°, 270°, 360°, and 450°
For other available rotations, consult PHD.

ANGLE OF ROTATION FROM POSITION I TO POSITION II
Use this digit for 3 Position Tandems only.

OPTIONS
E - Magnetic Piston for Hall Effect Switch
I - Port Position 1 top rack
Port Position 3 bottom rack
M - Magnetic Piston for Reed Switch
T - Port in Position 4
V - Fluoro-Elastomer Seals
W - Close Tolerance Rotation, +30 minutes, -0
Y - Tandem Cap rotated 180°
Z1- Electroless Nickel Plate

NOTE: Sensor must be used with a PHD Set Point Module. See Switches and Sensors section for information and ordering data.

PORT CONTROL©



BUILT-IN METER OUT FLOW CONTROL VALVE
Port Control is standard on all Air/Oil Tandem Actuators.

PROXIMITY SWITCH MOUNTING BRACKETS

SERIES	SIZE NO.
2000	-32
4000	-34
6000	-38
8000	-39

See Switches and Sensors section for complete ordering information.

Options may affect unit length. See unit dimension and options pages for adders.

(800) 624-8511
www.phdinc.com

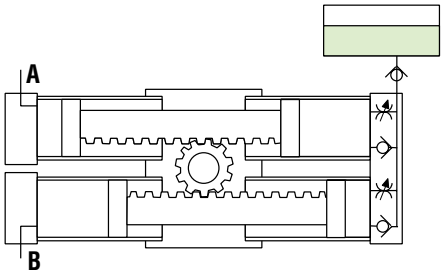
AIR/OIL TANDEM ROTARY ACTUATORS:

SERIES 2000-8000

BENEFITS

- PHD Air/Oil Tandem Actuators provide smooth consistent rotary motion even at low speeds for applications requiring positive control of payload.
- Design provides simplicity and economics of air power with the smooth control of hydraulics.
- Oil transfer is accomplished through a one-piece tandem cap eliminating external crossovers.
- Four bore sizes are available in both 2 and 3 position models with standard rotations up to 450° to fit a variety of application requirements.
- Built-in flow controls are standard for precise control of rotation speed.
- Free floating pistons with rack and pinion design eliminate binding for low breakaway and long unit life.
- Sealed shaft ball bearings provide long life and maximum shaft stability for heavy payloads.
- Available with a wide range of options including cushions, angle adjustments, shock pads, and pinion shaft options for specifying the exact actuator for your application.
- Simple construction allows easy field repairability.

OUTPUT TORQUES TO 1,590 in-lb [179 Nm]



OPERATING PRINCIPLE

This feature is available on Series 2000, 4000, 6000, and 8000. One end functions as a control member only, reducing the effective output torque to match 1000, 3000, 5000, and 7000 respectively.

The illustration shows a Tandem Actuator with built-in Port Controls®, crossover manifold and oil reservoir. The latter serves as an accumulator to compensate for oil volume changes due to temperature variation.

NOTE: The Reservoir should have 20 psi [1.3 bar] pressure at all times to ensure the system remains purged.

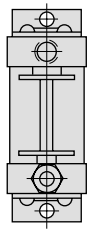
THEORETICAL TORQUE in-lb/psi [Nm/bar]

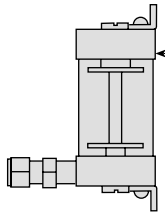
SERIES			
2000	**4000**	**6000**	**8000**
.38	1.1	2.3	10.6
[.63]	[1.83]	[3.62]	[17.61]

SPECIFICATIONS	R1xR & R2xR
PISTON SEALS	(3 Per Piston) Block Vee with Back-up Ring
PISTONS	Free Floating Aluminum
PINION SHAFTS	One Piece Alloy Steel
RACK	Alloy Steel
END CAPS	Zinc Plated Steel
BODY	Hardcoated Aluminum
TUBES	Hardcoated Aluminum on Air side, Honed Steel on Oil side
BEARINGS	Two Steel Ball Bearings
PORTS	NPT [BSP]
LUBRICATION	Permanent for Non-Lube Air
WORKING PRESSURE	150 psi [10 bar] Air Max.
STANDARD ROTATIONS	45°, 90°, 180°, 270°, 360°, 450°
OPTIONS	Cushions, Angle Adjustments, Magnetic Pistons, Fluoro-Elastomer Seals (Port Controls® are standard)
HYDRAULIC FLUID	Rykon 32 (Viscosity at 100°F [38°C] is 158 SSU; at 250°F [126°C] is 45.1)

DIMENSIONS: AIR/OIL TANDEM ROTARY ACTUATORS

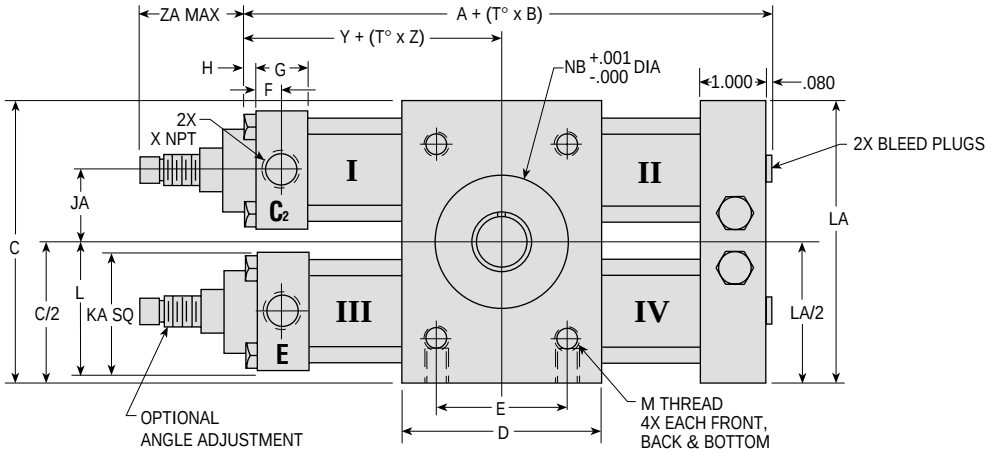
IMPERIAL

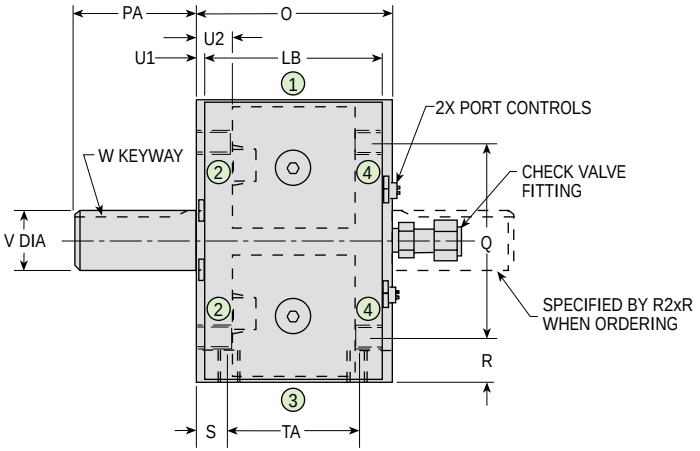




RESERVOIR ASSEMBLY IS INCLUDED WITH UNIT.
DIMENSIONAL DATA IS IN AIR/OIL & RESERVOIR SECTION 10.
SERIES 2000, 4000, & 6000 UNITS USE PART NO. 13459-03-2.
SERIES 8000 UNITS USE PART NO. 13459-02-2.

NOTE: THE RESERVOIR SHOULD HAVE 20 PSI PRESSURE AT ALL TIMES TO ENSURE THE SYSTEM REMAINS PURGED.





SERIES	LETTER DIMENSION																												
	A	B	C	D	E	F	G	H	JA	KA	L	LA	LB	M	NB	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	1.125 x .056 DP	2.000	.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	2.000 x .039 DP	3.000	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	2.1654 x .052 DP	3.000	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	3.3465 x .120 DP	5.000	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

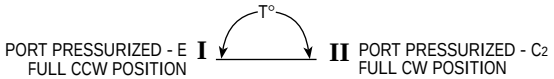
OPTION LOCATION REFERENCE

ACTUATOR TYPE	LETTER OPTION REFERENCED BY TUBE NUMBER							PORT & NEEDLE LOCATIONS REFERENCED BY CIRCLED NUMBERS					
	-A		-D		-P			STANDARD			-T		
	-A1	-A2	-D1	-D2	-P1	-P2	-M	-E	PORT	-P	-D	PORT	-P	-D
R1xR & R2xR	III	I	II	IV	STANDARD		I & III	I & III	2	4	4	4	4	4

QUICK REFERENCE FOR: A + (T° x B)

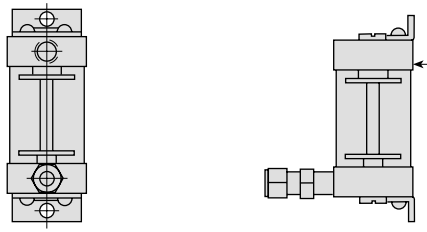
SERIES	DEGREE OF ROTATION					
	45	90	180	270	360	450
2000	6.998	7.781	9.347	10.913	12.479	14.045
4000	9.156	10.326	12.666	15.006	17.346	19.686
6000	10.360	11.530	13.870	16.210	18.550	20.890
8000	13.468	15.808	20.488	25.168	29.848	34.528

SHAFT KEYWAY: SHOWN AT MID-ROTATION
PORT POSITION: INDICATED BY CIRCLED NUMBERS
MTG. HOLES: CENTERED ON CENTERLINE OF ACTUATOR BODY



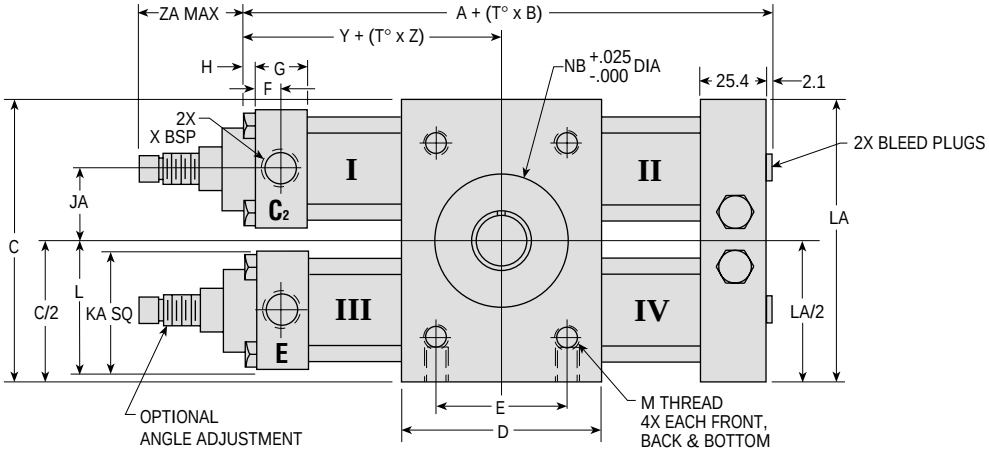
(800) 624-8511
www.phdinc.com

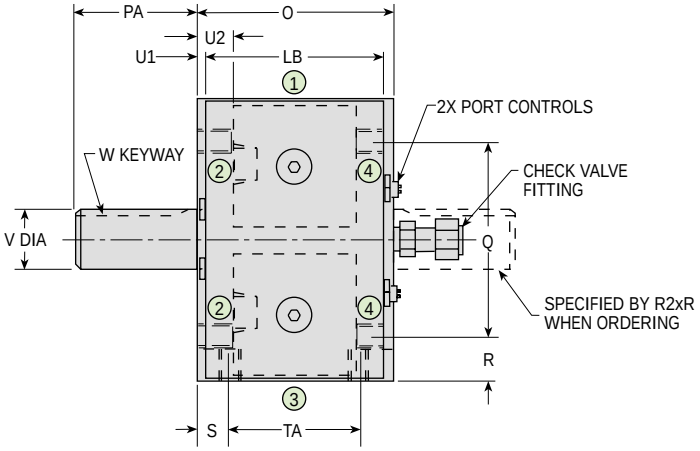
All dimensions are reference only unless specifically toleranced.



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.





SERIES	LETTER DIMENSION																											
																					IMPERIAL SHAFTS*		METRIC SHAFTS*						
	A	B	C	D	E	F	G	H	JA	KA	L	LA	LB	M	NB	O	PA	Q	R	S	TA	V	W	V	W	U1	U2	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	28.58 X 1.4	50.8	22	50.8	13	6	38.1	12.69/12.71	3.15 x 1.59 x 16	12.00/11.97	4 x 2.5 x 15	3	8	G1/8	72	0.22	29
4000	203	0.66	108	76	50.8	9	17	6	29	48	53	106	70	M8 x 1.0 x 13	50.80 X 1.0	76.2	48	76.2	16	13	50.8	22.22/22.23	4.75 x 2.36 x 38	22.00/21.96	6 x 3.5 x 32	3	14	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	55.00 X 1.3	76.2	48	88.9	19	13	50.8	28.55/28.58	6.35 x 3.18 x 38	28.00/27.96	8 x 5 x 40	3	10	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	85.00 X 3.0	127.0	89	127	38	32	63.5	44.42/44.45	9.53 x 2.36 x 78	44.00/43.96	12 x 5 x 56	25	19	G3/8	154	0.66	73

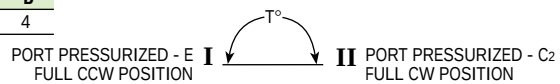
* BOTH IMPERIAL AND METRIC SHAFT OPTIONS AVAILABLE ON METRIC BODY
(IMPERIAL SHAFT = DESIGN 8, AND METRIC SHAFT = DESIGN 9).
NUMBERS FOR METRIC UNITS AND ARE IN mm.

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

OPTION LOCATION REFERENCE

ACTUATOR TYPE	LETTER OPTION REFERENCED BY TUBE NUMBER								PORT & NEEDLE LOCATIONS REFERENCED BY CIRCLED NUMBERS					
	-A		-D		-P				STANDARD			-T		
	-A1	-A2	-D1	-D2	-P1	-P2	-M	-E	PORT	-P	-D	PORT	-P	-D
R1xR & R2xR	III	I	II	IV	STANDARD		I & III	I & III	2	4	4	4	4	4



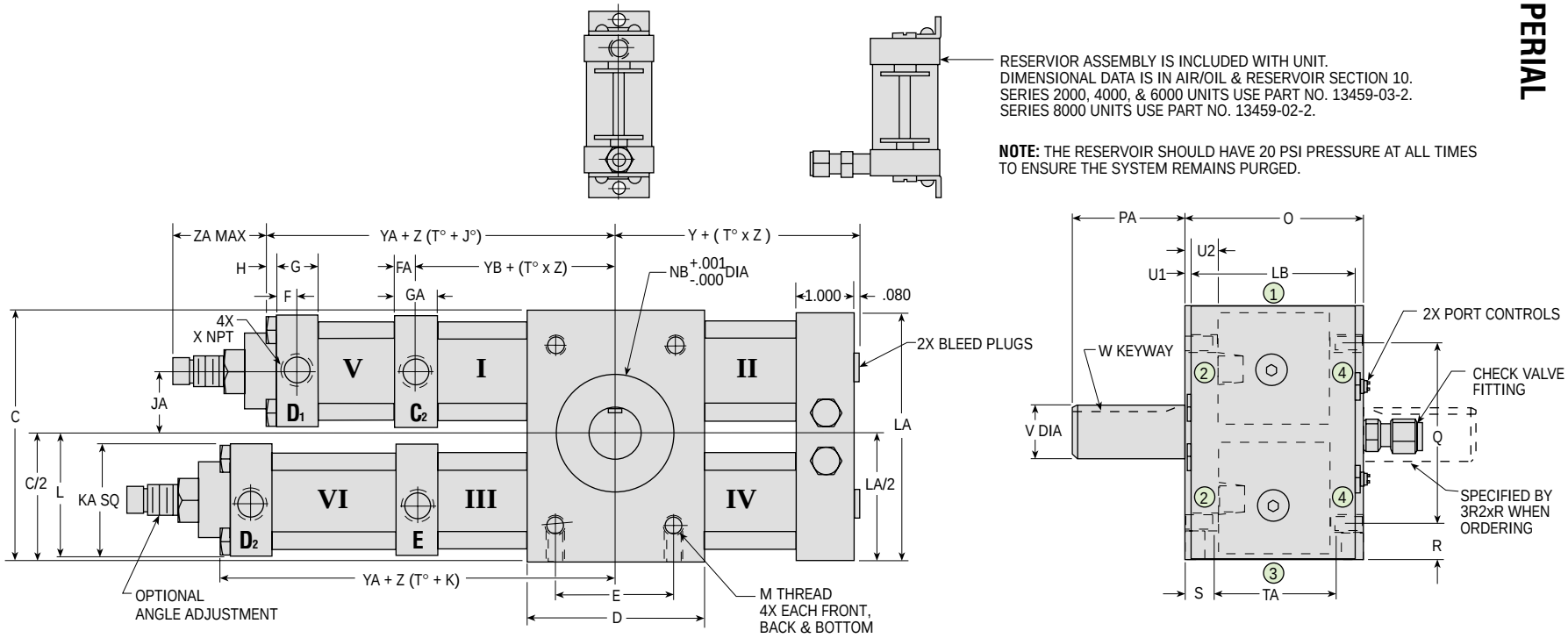
PORT PRESSURIZED - E
FULL CCW POSITION

PORT PRESSURIZED - C_2
FULL CW POSITION

SHAFT KEYWAY: SHOWN AT MID-ROTATION
PORT POSITION: INDICATED BY CIRCLED NUMBERS
MTG. HOLES: CENTERED ON CENTERLINE OF ACTUATOR BODY

DIMENSIONS: 3 POSITION AIR/OIL TANDEM

IMPERIAL

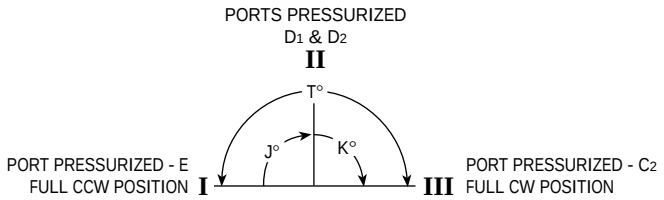


SERIES	LETTER DIMENSION																													
	C	D	E	F	FA	G	GA	H	JA	KA	L	LA	LB	M	NB	O	PA	Q	R	S	TA	U1	U2	V	W	X	Y	YA	YB	Z	ZA
2000	3.000	2.000	1.500	.500	.500	.750	.750	0.00	.750	1.375	1.437	2.875	1.750	1/4-20 x .312 DP	1.125 x .056 DP	2.000	.875	2.000	.500	.250	1.500	.125	.312	.4998/.5003	1/8 x 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	2.000 x .039 DP	3.000	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	2.1654 x .052 DP	3.000	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	3.3465 x .120 DP	5.000	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

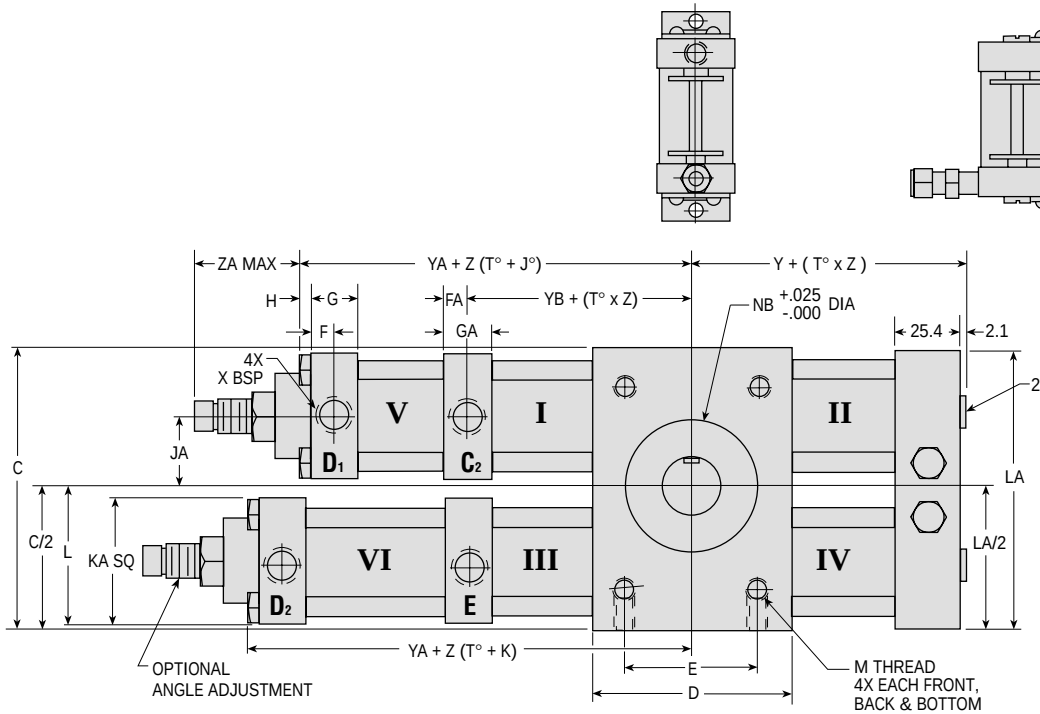
OPTION LOCATION REFERENCE

ACTUATOR TYPE	LETTER OPTION REFERENCED BY TUBE NUMBER							PORT & NEEDLE LOCATIONS REFERENCED BY CIRCLED NUMBERS					
		-D		-P		-M	-E	STANDARD			-T		
	-A	-D1	-D2	-P1	-P2	I & III	I & III	PORT	-P	-D	PORT	-P	-D
3R1xR & 3R2xR	STANDARD	II	IV	STANDARD		V & VI	V & VI	2	4	4	4	4	4

SHAFT KEYWAY: SHOWN AT MID-ROTATION
PORT POSITIONS: INDICATED BY CIRCLED NUMBERS
MTG. HOLES: CENTERED ON CENTERLINE OF ACTUATOR BODY
PLUMBING SCHEMATIC: LOCATED IN ENGINEERING DATA SECTION

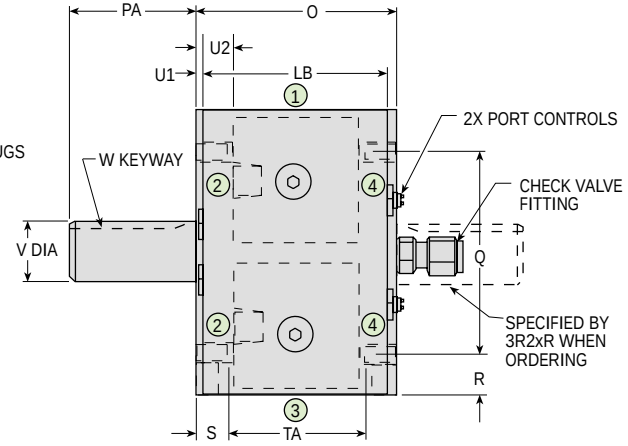


(800) 624-8511
www.phdinc.com
All dimensions are reference only unless specifically toleranced.



RESERVIOR 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.



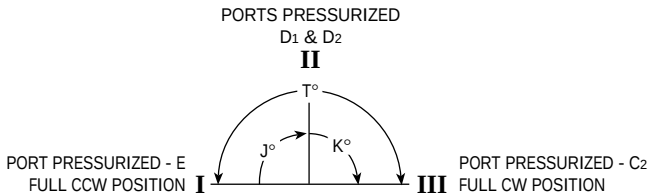
SERIES	LETTER DIMENSION																					IMPERIAL SHAFTS*		METRIC SHAFTS*						
	C	D	E	F	FA	G	GA	H	JA	KA	L	LA	LB	M	NB	O	PA	Q	R	S	TA	U1	U2	V	W	V	W	X	Y	YA	YB	Z	ZA
2000	76	51	38.1	13	13	19	19	0	19	35	36	73.0	44.5	M6 x 1.0 x 8	28.58 x 1.4 DP	50.8	22	50.8	13	6	38.1	3	8	12.69/12.71	3.15 x 1.59 x 16	12.00/11.97	4 x 2.5 x 15	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 1.0 x 13	50.80 x 1.0 DP	76.2	48	76.2	16	13	50.8	3	14	22.22/22.23	4.75 x 2.36 x 38	22.00/21.96	6 x 3.5 x 32	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	55.00 x 1.3 DP	76.2	48	88.9	19	13	50.8	3	10	28.55/28.58	6.35 x 3.18 x 38	28.00/27.96	8 x 5 x 40	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	85.00 x 3.0 DP	127.0	89	127.0	38	32	63.5	25	19	44.42/44.45	9.53 x 2.36 x 78	44.00/43.96	12 x 5 x 56	G3/8	128	251	133	0.66	73

* BOTH IMPERIAL AND METRIC SHAFT OPTIONS AVAILABLE ON METRIC BODY
(IMPERIAL SHAFT = DESIGN 8, AND METRIC SHAFT = DESIGN 9).
NUMBERS FOR METRIC UNITS AND ARE IN mm.

OPTION LOCATION REFERENCE

ACTUATOR TYPE	LETTER OPTION REFERENCED BY TUBE NUMBER							PORT & NEEDLE LOCATIONS REFERENCED BY CIRCLED NUMBERS					
		-D		-P		-M	-E	STANDARD			-T		
	-A	-D1	-D2	-P1	-P2	I & III	I & III	PORT	-P	-D	PORT	-P	-D
3R1xR & 3R2xR	STANDARD	II	IV	STANDARD		V & VI	V & VI	2	4	4	4	4	4

SHAFT KEYWAY: SHOWN AT MID-ROTATION
PORT POSITIONS: INDICATED BY CIRCLED NUMBERS
MTG. HOLES: CENTERED ON CENTERLINE OF ACTUATOR BODY
PLUMBING SCHEMATIC: LOCATED IN ENGINEERING DATA SECTION



UNITS WITH IMPERIAL SHAFTS AND KEYWAY

TO ORDER SPECIFY:
No. of Rotary Positions, Type, Design No., Series, Total Angle of Rotation, Various Angle Positions, and Options.

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

DESIGN NO.
1 - Imperial - Port and mounting holes are imperial.
5 - Metric - Port and mounting holes are metric. Pinion shafts and keyway are imperial.

SERIES
2 (000) 1" Bore Double Rack
4 (000) 1-3/8" Bore Double Rack
6 (000) 2" Bore Double Rack
8 (000) 3" Bore Double Rack
NOTE: 2000 Series available in 3 Position only.

ANGLE OF ROTATION FROM POSITION I TO POSITION II

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

5	-	R1	1	A	-	4	180	-	45	-	90	-	135	-	P-D

TYPE

IMPERIAL	METRIC
R11A - Single Shaft Ext. 150 psi Air Max.	R15A - Single Shaft Ext. 10 bar Air Max.
R21A - Double Shaft Ext. 150 psi Air Max.	R25A - Double Shaft Ext. 10 bar Air Max.
R11H - Single Shaft Ext. 1500 psi Hyd. Max.	R15H - Single Shaft Ext. 100 bar Hyd. Max.
R21H - Double Shaft Ext. 1500 psi Hyd. Max.	R25H - Double Shaft Ext. 100 bar Hyd. Max.

TOTAL ANGLE OF ROTATION STANDARD ANGLES

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

OPTIONS
B - Shock Pads on extreme positions (not available on hydraulic units)
C - Cross Key Pinion Shaft
D - Cushions on extreme positions
E - Magnetic Piston (All) or Hall Effect Switch
G - Shaft Seal both sides
H - Hollow Pinion Shaft (not available on type R21x)
I - Port Position 1 on top rack
Port Position 3 on bottom rack
J - Hall Sensor for rotations not exceeding 180° (Set Point Module is ordered separately)
K - Preload Keyway Pinion Shaft
M - Magnetic Piston (All) for Reed Switch
P - Port Controls on all caps
T - Port in Position 4
V - Fluoro-Elastomer Seals

Options may affect unit length. See unit dimension and options pages for adders.

NOTES:
1) Angle Adjustments are standard on all Multi-Position Rotary Actuators.
2) Sensor must be used with a PHD Set Point Module. See Switches and Sensors section for information and ordering data.

PROXIMITY SWITCH MOUNTING BRACKETS

SERIES	SIZE NO.
2000	-32
4000	-34
6000	-38
8000	-39

See Switches and Sensors section for complete ordering information.

(800) 624-8511
www.phdinc.com

UNITS WITH METRIC SHAFTS AND KEYWAY

TO ORDER SPECIFY:
No. of Rotary Positions, Type, Design No., Series, Total Angle of Rotation, Various Angle Positions, and Options.

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

DESIGN NO.
6 - Metric - Ports, mounting holes, pinion shafts and keyway are metric.

SERIES
2 (000) 1" Bore Double Rack
4 (000) 1-3/8" Bore Double Rack
6 (000) 2" Bore Double Rack
8 (000) 3" Bore Double Rack
NOTE: 2000 Series available in 3 Position only.

ANGLE OF ROTATION FROM POSITION I TO POSITION II

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

5 - R16A - 4 180 - 45 - 90 - 135 - P-D

TYPE
R16A - Single Shaft Ext. 10 bar Air Max.
R26A - Double Shaft Ext. 10 bar Air Max.
R16H - Single Shaft Ext. 100 bar Hyd. Max.
R26H - Double Shaft Ext. 100 bar Hyd. Max.

TOTAL ANGLE OF ROTATION STANDARD ANGLES

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

OPTIONS
B - Shock Pads on extreme positions (not available on hydraulic units)
D - Cushions on extreme positions
E - Magnetic Piston (All) or Hall Effect Switch
G - Shaft Seal both sides
M - Magnetic Piston (All) for Reed Switch
P - Port Controls on all caps
T - Port in Position 4
V - Fluoro-Elastomer Seals

PROXIMITY SWITCH MOUNTING BRACKETS

SERIES	SIZE NO.
2000	-32
4000	-34
6000	-38
8000	-39

See Switches and Sensors section for complete ordering information.

Options may affect unit length. See unit dimension and options pages for adders.

NOTES:
1) Angle Adjustments are standard on all Multi-Position Rotary Actuators.
2) Sensor must be used with a PHD Set Point Module. See Switches and Sensors section for information and ordering data.

MULTI-POSITION ROTARY ACTUATORS:

SERIES 2000-8000

BENEFITS

- PHD Multi-Position Rotary Actuators are offered in 3, 4, or 5 output shaft positions ideal for feeding and positioning applications.
- Multiple positioning design eliminates expensive and cumbersome fixturing and pinning.
- PHD Multi-Position Actuators are pneumatically or hydraulically powered providing output torques up to 15,900 in-lb [1797 Nm].
- Four bore sizes are available with extreme position rotation up to 450° to fit a variety of requirements.
- Free floating pistons with rack and pinion design eliminate binding for low breakaway and long unit life.
- Sealed shaft ball bearings provide long life and maximum shaft stability for heavy payloads.
- Available with a wide range of options including built-in flow controls, cushions, shock pads, and pinion shaft options specifying the exact actuator for your application.
- Simple construction allows easy field repairability.

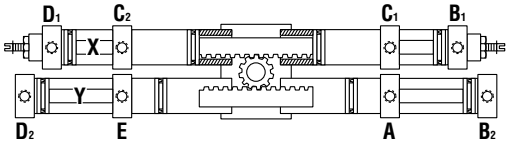
OUTPUT TORQUES TO 15,900 in-lb [1797 Nm]

OPERATING PRINCIPLE

PHD Rotary Actuators and Multi-Motion Actuators can be provided to yield three, four, or five output shaft positions. The intermediate angle increments are fixed as specified and only the extreme positions can be adjusted in the field.

Units are available for air or hydraulic service. The schematic example shows a five position rotary actuator. Pressurizing Port E provides full counter clockwise rotation (Position I). Pressurizing Ports D_1 and D_2 traps the rack between the rod ends of the two outer pistons X and Y to rotate output shaft to Position II. Pressurizing Ports C_1 and C_2 moves floating pistons in the inside upper cylinders against stop tubes to trap the rack in Position III. Similarly, Positions IV and V can be obtained by pressurizing Ports B_1, B_2 and A respectively.

Output positions can be selected in any sequence allowing the actuator to stop at, or pass, any of the intermediate positions (II, III, or IV).

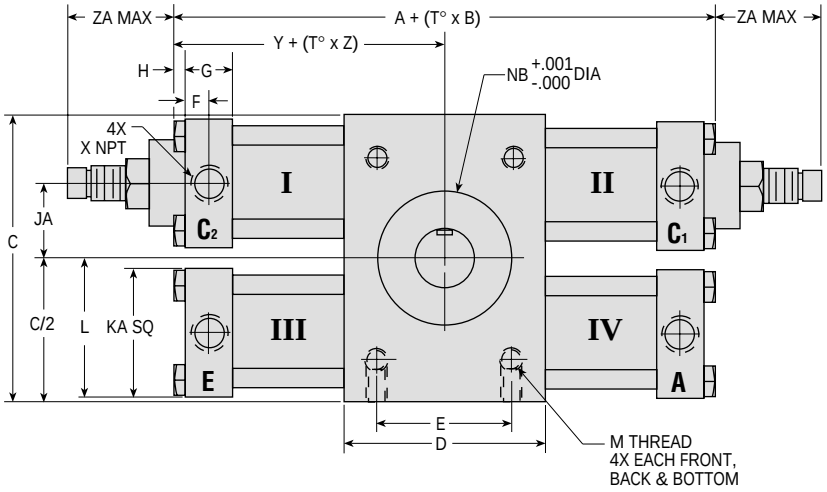


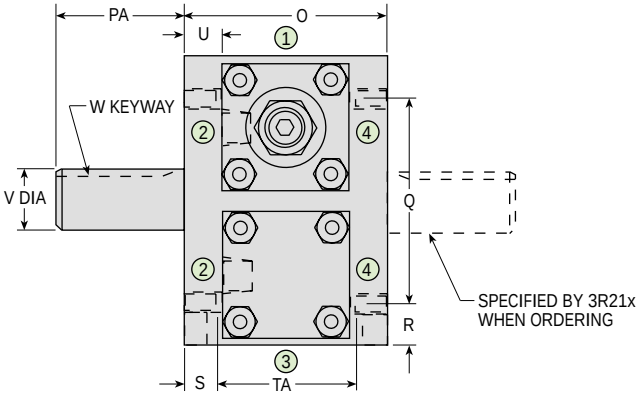
THEORETICAL TORQUE in-lb/psi [Nm/bar]

SERIES			
2000	**4000**	**6000**	**8000**
.38	1.1	2.3	10.6
[.63]	[1.83]	[3.62]	[17.61]

SPECIFICATIONS	TYPE	
	R1xA & R2xA	**R1xH & R2xH**
PISTON SEALS	(3 Per Piston) Block Vee with Back-up Ring	
PISTONS	Free Floating Aluminum	
TUBE SEALS	Square Cut	
PINION SHAFTS	One Piece Alloy Steel	
RACKS	Alloy Steel	
END CAPS	Zinc Plated Steel	
BODY	Hardcoated Aluminum	
TUBES	Hardcoated Aluminum	Hardcoated Aluminum on Series 2000 & 4000
	—	Honed Steel on Series 6000 & 8000
BEARINGS	(2) Steel Ball Bearings	
PORTS	NPT [BSP]	
LUBRICATION	Permanent for Non-Lube Air	—
WORKING PRESSURE	150 psi [10 bar] Air Max.	1500 psi [100 bar] Hyd. Max.
STANDARD ROTATIONS	45°, 90°, 180°, 270°, 360°, 450°	
OPTIONS	Port Controls®, Cushions, Magnetic Pistons, Fluoro-Elastomer Seals (Angle Adjustment is standard)	

(800) 624-8511
www.phdinc.com





SERIES	LETTER DIMENSION																									
	A	B	C	D	E	F	G	H	JA	KA	L	M	NB	O	PA	Q	R	S	TA	U	V	W	X	Y	Z	ZA
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	1.125 x .056 DP	2.000	.875	2.000	.500	.250	1.500	.312	.4998/.5003	1/8 x 1/16 x .625	1/8	2.849	.0087	1.125
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	2.000 x .039 DP	3.000	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
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	2.1654 x .052 DP	3.000	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
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	3.3465 x .120 DP	5.000	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

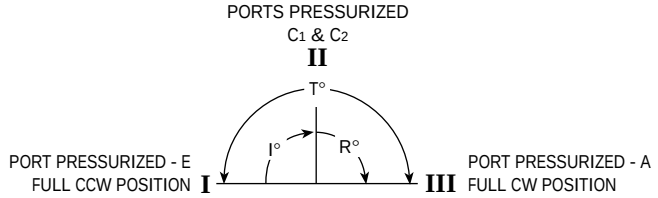
OPTION LOCATION REFERENCE

ACTUATOR TYPE	LETTER OPTION REFERENCED BY TUBE NUMBER						PORT & NEEDLE LOCATIONS REFERENCED BY CIRCLED NUMBERS					
							STANDARD			-T		
	-A	-B	-D	-P	-M	-E	PORT	-P	-D	PORT	-P	-D
3R11A & 3R21A	STANDARD	I & II	I & II	ALL	ALL	ALL	2	1 & 3	1	4	1 & 3	1
3R11H & 3R21H	STANDARD	N/A	I & II	ALL	ALL	ALL	2	1 & 3	1	4	1 & 3	1

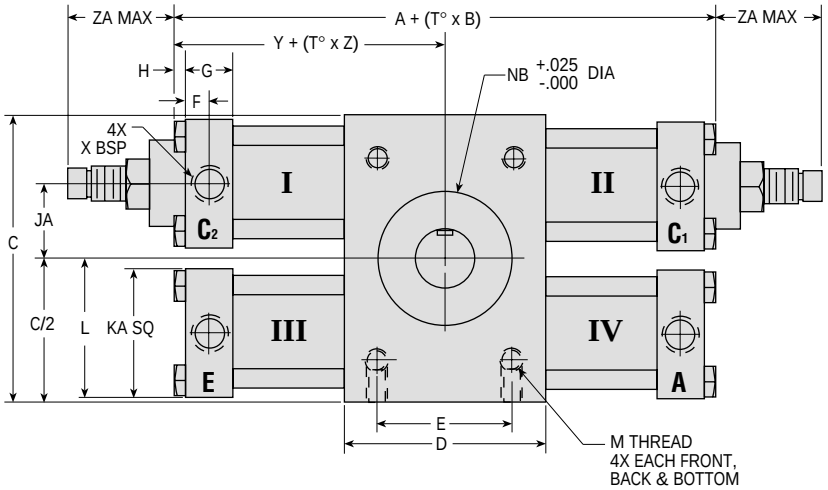
QUICK REFERENCE FOR: A + (T° x B)

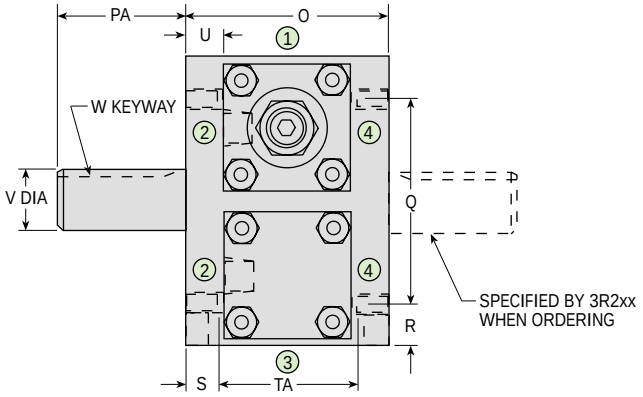
SERIES	DEGREE OF ROTATION					
	45	90	180	270	360	450
2000	6.481	7.264	8.830	10.396	11.962	13.528
4000	9.076	10.246	12.586	14.926	17.266	19.606
6000	10.296	11.466	13.806	16.146	18.486	20.826
8000	14.500	16.840	21.520	26.200	30.880	35.560

SHAFT KEYWAY: SHOWN AT MID-ROTATION
PORT POSITIONS: INDICATED BY CIRCLED NUMBERS
CUSHIONS: SERIES 2000 ACTUATORS:
ADD 1/2" TO RESPECTIVE "A" AND "Y" DIMENSION FOR EACH CUSHION
MTG. HOLES: CENTERED ON CENTERLINE OF ACTUATOR BODY
STOP TUBES: LOCATED IN TUBES I & II
PLUMBING SCHEMATIC: LOCATED IN ENGINEERING DATA SECTION



DIMENSIONS: 3 POSITION ROTARY ACTUATORS





SERIES	LETTER DIMENSION																											
																				IMPERIAL SHAFTS*		METRIC SHAFTS*						
	A	B	C	D	E	F	G	H	JA	KA	L	M	NB	O	PA	Q	R	S	TA	U	V	W	V	W	X	Y	Z	ZA
2000	145	0.44	76	51	38.1	6	13	0	19	35	36	M6 x 1.0 x 8	28.58 x 1.4 DP	50.8	22	50.8	13	6	38.1	8	12.69/12.71	3.15 x 1.59 x 16	12.00/11.97	4 x 2.5 x 15	G1/8	72	0.22	29
4000	201	0.66	108	76	50.8	9	17	6	29	48	53	M8 x 1.0 x 13	50.80 x 1.0 DP	76.2	48	76.2	16	13	50.8	14	22.22/22.23	4.75 x 2.36 x 38	22.00/21.96	6 x 3.5 x 32	G1/4	100	0.33	38
6000	292	0.66	127	102	63.5	10	19	5	29	57	58	M10 x 1.5 x 16	55.00 x 1.3 DP	76.2	48	88.9	19	13	50.8	10	28.55/28.58	6.35 x 3.18 x 38	28.00/27.96	8 x 5 x 40	G1/4	116	0.33	48
8000	302	1.32	203	127	76.2	12	27	11	48	89	92	M20 x 2.5 x 32	85.00 x 3.0 DP	127.0	89	127.0	38	32	63.5	19	44.42/44.45	9.53 x 2.36 x 78	44.00/43.96	12 x 5 x 56	G3/8	154	0.66	73

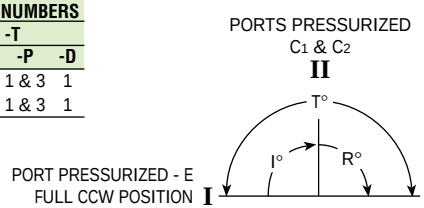
* BOTH IMPERIAL AND METRIC SHAFT OPTIONS AVAILABLE ON METRIC BODY
(IMPERIAL SHAFT = DESIGN 5, AND METRIC SHAFT = DESIGN 6).
NUMBERS FOR METRIC UNITS AND ARE IN mm.

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

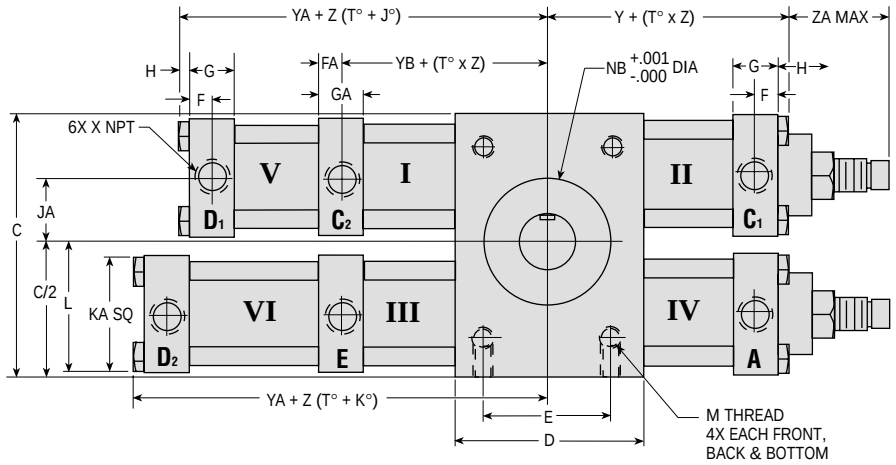
OPTION LOCATION REFERENCE

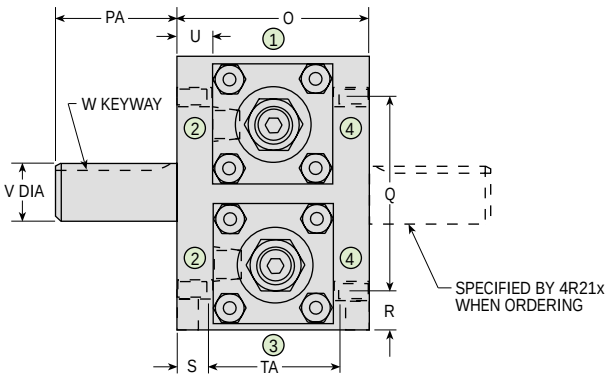
ACTUATOR TYPE	LETTER OPTION REFERENCED BY TUBE NUMBER						PORT & NEEDLE LOCATIONS REFERENCED BY CIRCLED NUMBERS					
							STANDARD			-T		
	-A	-B	-D	-P	-M	-E	PORT	-P	-D	PORT	-P	-D
3R1xA & 3R2xA	STANDARD	I & II	I & II	ALL	ALL	ALL	2	1 & 3	1	4	1 & 3	1
3R1xH & 3R2xH	STANDARD	N/A	I & II	ALL	ALL	ALL	2	1 & 3	1	4	1 & 3	1



SHAFT KEYWAY: SHOWN AT MID-ROTATION
PORT POSITIONS: INDICATED BY CIRCLED NUMBERS
CUSHIONS: SERIES 2000 ACTUATORS:
ADD 13.0 mm TO RESPECTIVE "A" AND "Y" DIMENSION FOR EACH CUSHION
MTG. HOLES: CENTERED ON CENTERLINE OF ACTUATOR BODY
STOP TUBES: LOCATED IN TUBES I & II
PLUMBING SCHEMATIC: LOCATED IN ENGINEERING DATA SECTION

(800) 624-8511
www.phdinc.com



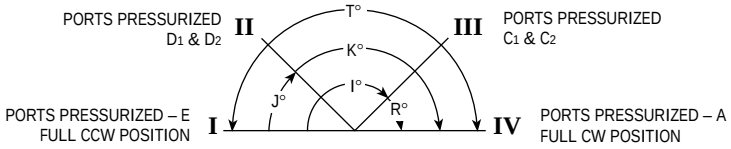


SERIES	LETTER DIMENSION																											
	C	D	E	F	FA	G	GA	H	JA	KA	L	M	NB	O	PA	Q	R	S	TA	U	V	W	X	Y	YA	YB	Z	ZA
4000	4.250	3.000	2.000	.344	.375	.688	.719	.250	1.156	1.875	2.094	5/16-18 x .500 DP	2.000 x .039	3.000	1.875	3.000	.625	.500	2.000	.562	.8748/.8753	3/16 x 3/32 x 1.500	1/4	3.953	6.721	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	2.1654 x .052	3.000	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	3.3465 x .120	5.000	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

OPTION LOCATION REFERENCE

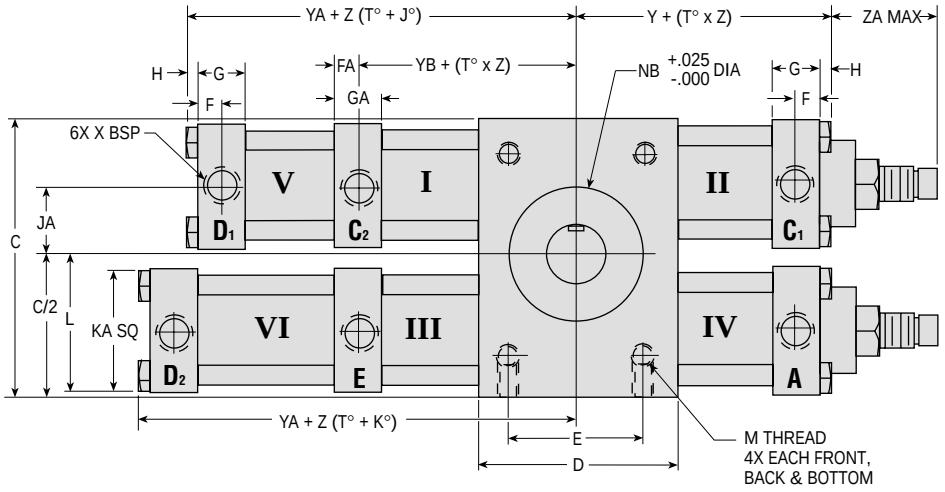
ACTUATOR TYPE	LETTER OPTION REFERENCED BY TUBE NUMBER						PORT & NEEDLE LOCATIONS REFERENCED BY CIRCLED NUMBERS					
							STANDARD			-T		
	-A	-B	-D	-P	-M	-E	PORT	-P	-D	PORT	-P	-D
4R11A & 4R21A	STANDARD	II & IV	II & IV	ALL	ALL	ALL	2	1 & 3	1 & 3	4	1 & 3	1 & 3
4R11H & 4R21H	STANDARD	N/A	II & IV	ALL	ALL	ALL	2	1 & 3	1 & 3	4	1 & 3	1 & 3

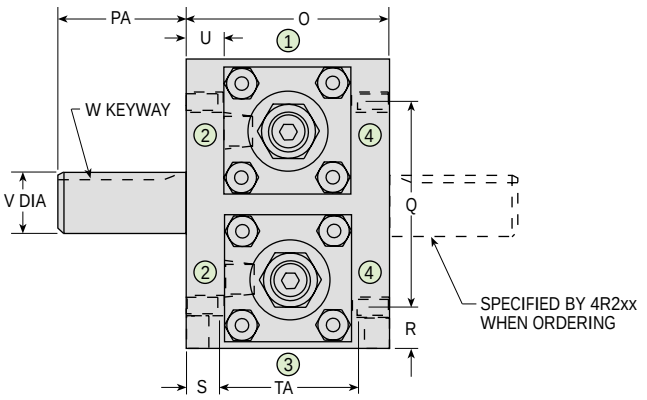
SHAFT KEYWAY: SHOWN AT MID-ROTATION
PORT POSITIONS: INDICATED BY CIRCLED NUMBERS
MTG. HOLES: CENTERED ON CENTERLINE OF ACTUATOR BODY
STOP TUBES: LOCATED IN TUBES I & II
PLUMBING SCHEMATIC: LOCATED IN ENGINEERING DATA SECTION



All dimensions are reference only unless specifically toleranced.

DIMENSIONS: 4 POSITION ROTARY ACTUATORS



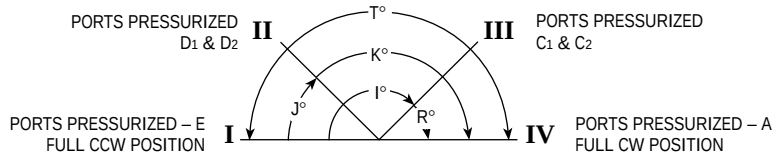


SERIES	LETTER DIMENSION																													
																				IMPERIAL SHAFTS*		METRIC SHAFTS*								
	C	D	E	F	FA	G	GA	H	JA	KA	L	M	NB	O	PA	Q	R	S	TA	U	V	W	V	W	X	Y	YA	YB	Z	ZA
4000	108	76	50.8	9	10	17	18	6	29	48	53	M8 x 1.25 x 13	50.80 x 1.0 DP	76.2	48	76.2	16	13	50.8	14	22.22/22.23	4.75 x 2.36 x 38	22.00/21.96	6 x 3.5 x 32	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	55.00 x 1.3 DP	76.2	48	88.9	19	13	50.8	10	28.55/28.58	6.35 x 3.18 x 38	28.00/27.96	8 x 5 x 40	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	85.00 x 3.0 DP	127.0	89	127.0	38	32	63.5	19	44.42/44.45	9.53 x 2.36 x 78	44.00/43.96	12 x 5 x 56	G3/8	126	251	133	0.66	73

* BOTH IMPERIAL AND METRIC SHAFT OPTIONS AVAILABLE ON METRIC BODY
(IMPERIAL SHAFT = DESIGN 5, AND METRIC SHAFT = DESIGN 6).
NUMBERS FOR METRIC UNITS AND ARE IN mm.

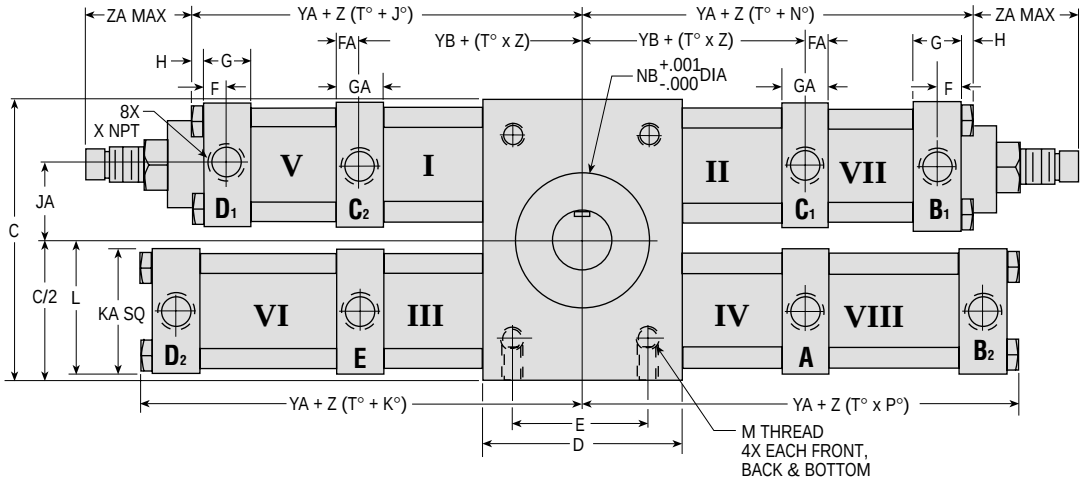
OPTION LOCATION REFERENCE

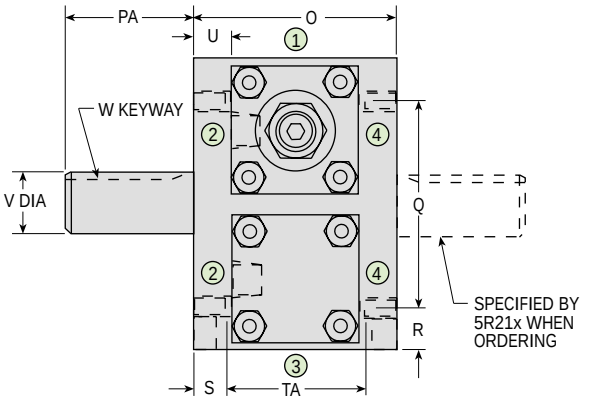
ACTUATOR TYPE	LETTER OPTION REFERENCED BY TUBE NUMBER						PORT & NEEDLE LOCATIONS REFERENCED BY CIRCLED NUMBERS					
							STANDARD			-T		
	-A	-B	-D	-P	-M	-E	PORT	-P	-D	PORT	-P	-D
4R1xA & 4R2xA	STANDARD	II & IV	II & IV	ALL	ALL	ALL	2	1 & 3	1 & 3	4	1 & 3	1 & 3
4R15xH & 4R2xH	STANDARD	N/A	II & IV	ALL	ALL	ALL	2	1 & 3	1 & 3	4	1 & 3	1 & 3



SHAFT KEYWAY: SHOWN AT MID-ROTATION
PORT POSITIONS: INDICATED BY CIRCLED NUMBERS
MTG. HOLES: CENTERED ON CENTERLINE OF ACTUATOR BODY
STOP TUBES: LOCATED IN TUBES I & II
PLUMBING SCHEMATIC: L0CATED IN ENGINEERING DATA SECTION

(800) 624-8511
www.phdinc.com



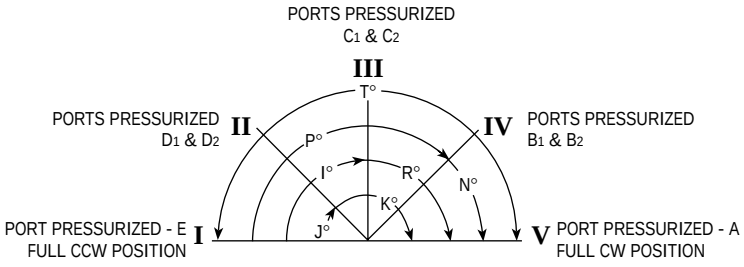


SERIES	LETTER DIMENSION																										
	C	D	E	F	FA	G	GA	H	JA	KA	L	M	NB	O	PA	Q	R	S	TA	U	V	W	X	YA	YB	Z	ZA
4000	4.250	3.000	2.000	.344	.375	.688	.719	.250	1.156	1.875	2.094	5/16-18 x .500 DP	2.000 x .039 DP	3.000	1.875	3.000	.625	.500	2.000	.562	.8748/.8753	3/16 x 3/32 x 1.500	1/4	6.721	3.360	.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	2.1654 x .052 DP	3.000	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	3.3465 x .120 DP	5.000	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

OPTION LOCATION REFERENCE

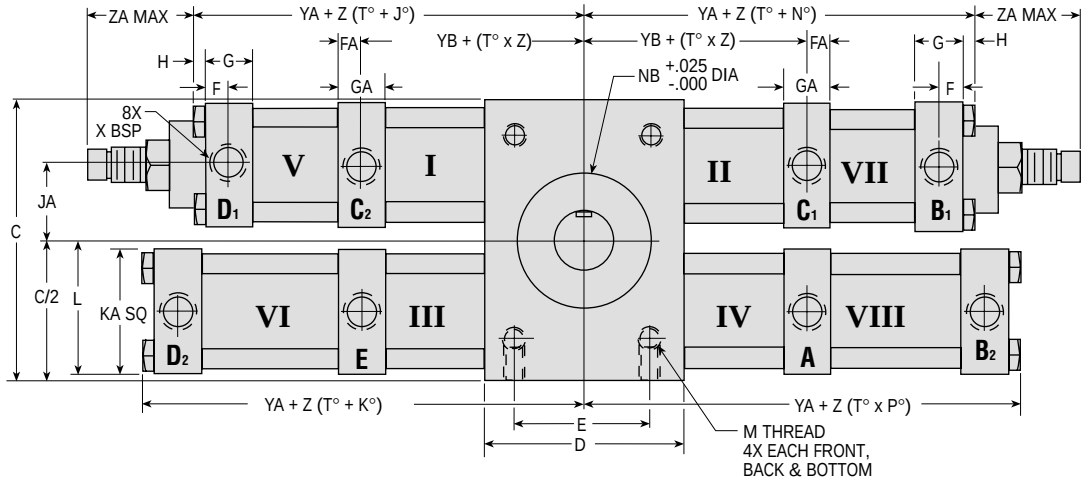
ACTUATOR TYPE	LETTER OPTION REFERENCED BY TUBE NUMBER						PORT & NEEDLE LOCATIONS REFERENCED BY CIRCLED NUMBERS					
							STANDARD			-T		
	-A	-B	-D	-P	-M	-E	PORT	-P	-D	PORT	-P	-D
5R11A & 5R21A	STANDARD	VII & V	VII & V	ALL	ALL	ALL	2	1 & 3	1	4	1 & 3	1
5R11H & 5R21H	STANDARD	N/A	VII & V	ALL	ALL	ALL	2	1 & 3	1	4	1 & 3	1

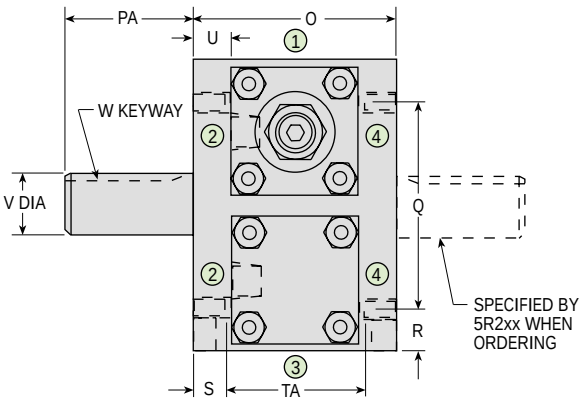
SHAFT KEYWAY: SHOWN AT MID-ROTATION
PORT POSITIONS: INDICATED BY CIRCLED NUMBERS
MTG. HOLES: CENTERED ON CENTERLINE OF ACTUATOR BODY
STOP TUBES: LOCATED IN TUBES I & II
PLUMBING SCHEMATIC: LOCATED IN ENGINEERING DATA SECTION



All dimensions are reference only unless specifically toleranced.

DIMENSIONS: 5 POSITION ROTARY ACTUATORS



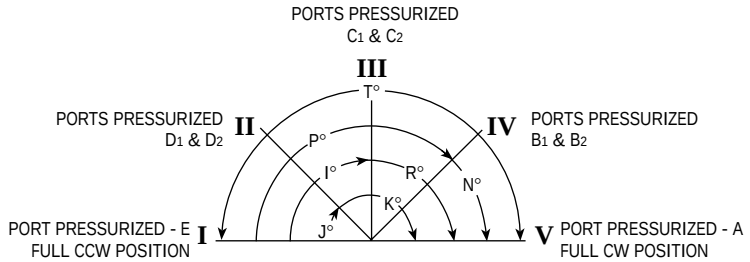


	LETTER DIMENSION																										
																				IMPERIAL SHAFTS*		METRIC SHAFTS*					
SERIES	C	D	E	F	FA	G	GA	H	JA	KA	L	M	NB	O	PA	Q	R	S	TA	U	V	W	V	W	X	YA	YB	Z	ZA
4000	108	76	50.8	9	10	17	18	6	29	48	53	M8 x 1.25 x 13	50.80 x 1.0 DP	76.2	48	76.2	16	13	50.8	14	22.22/22.23	4.75 x 2.36 x 38	22.00/21.96	6 x 3.5 x 32	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	55.00 x 1.3 DP	76.2	48	88.9	19	13	50.8	10	28.55/28.58	6.35 x 3.18 x 38	28.00/27.96	8 x 5 x 40	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	85.00 x 3.0 DP	127.0	89	127.0	38	32	63.5	19	44.42/44.45	9.53 x 2.36 x 78	44.00/43.96	12 x 5 x 56	G3/8	251	133	0.66	73

* BOTH IMPERIAL AND METRIC SHAFT OPTIONS AVAILABLE ON METRIC BODY
(IMPERIAL SHAFT = DESIGN 5, AND METRIC SHAFT = DESIGN 6).
NUMBERS FOR METRIC UNITS AND ARE IN mm.

OPTION LOCATION REFERENCE

ACTUATOR TYPE	LETTER OPTION REFERENCED BY TUBE NUMBER						PORT & NEEDLE LOCATIONS REFERENCED BY CIRCLED NUMBERS					
							STANDARD			-T		
	-A	-B	-D	-P	-M	-E	PORT	-P	-D	PORT	-P	-D
5R1xA & 5R2xA	STANDARD	VII & V	VII & V	ALL	ALL	ALL	2	1 & 3	1	4	1 & 3	1
5R1xH & 5R2xH	STANDARD	N/A	VII & V	ALL	ALL	ALL	2	1 & 3	1	4	1 & 3	1



SHAFT KEYWAY: SHOWN AT MID-ROTATION
PORT POSITIONS: INDICATED BY CIRCLED NUMBERS
MTG. HOLES: CENTERED ON CENTERLINE OF ACTUATOR BODY
STOP TUBES: LOCATED IN TUBES I & II
PLUMBING SCHEMATIC: LOCATED IN ENGINEERING DATA SECTION

(800) 624-8511
www.phdinc.com

RATINGS

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 chart below.*

HYD SERIES	OPTION psi [bar]							
	*PLAIN		-P		-D		-E OR -M	
1000	—	—	—	—	—	—	—	—
2000	1000	[69]	750	[52]	750	[52]	—	—
3000	—	—	—	—	—	—	—	—
4000	—	—	750	[52]	750	[52]	—	—
5000	—	—	—	—	—	—	1100	[76]
6000	—	—	750	[52]	750	[52]	1100	[76]
7000	—	—	—	—	—	—	500	[35]
8000	—	—	750	[52]	750	[52]	500	[35]

Minimum factor of safety at maximum rated hydraulic pressure for output shaft is 2:1, and for hydraulic chambers is 3:1. Consult PHD for proof pressure data.

BREAKAWAY

All RxxA units will breakaway at 20 psi [1.4 bar]. RxxH units will breakaway at 40 psi [2.8 bar]. All tandem RxxR units will breakaway at 40 psi [2.8 bar]. 018x air units will breakaway at 20 psi [1.4 bar], 018x tandem units will breakaway at 30 psi [2.1 bar].

TEMPERATURE LIMITS AND FLUIDS

Rotary Actuator units are equipped with Buna-N piston seals suitable for use in temperatures ranging from -20° to +180°F [-28° to 82°C] and may be used with air, water, petroleum-based hydraulic fluid, or fuel oil.

Seals for other fluids or temperature requirements are available, but must be specified. All Rotary Actuators have teflon back-up rings for universal use (except Miniature Rotary Actuators Series 018x).

NOTE: For applications where water-based fluids are used, the units must be modified. Consult PHD for specifications.

LUBRICATION

Gear racks and pinion are lubricated at the factory and may never need lubrication. However, if lubrication should be needed due to adverse conditions, use high grade bearing grease.

NOTE: Port for grease nipple provided in top of actuator body. Lubricate only while ports are pressurized except on 018x75 and 018x50, which have no lube ports.

Approximately 1/2 in^3 [8 cm^3] of grease is sufficient for any series actuator, each 250,000 cycles of 360° duration.

CONTROLS

Rotary Actuator units are operated by directional valves in the same manner as air and hydraulic cylinders.

Control of piston speeds is extremely important as inertia force is a function of rotational speed and distance from load to output shaft center.

ANGLE OF ROTATION

Series 1000-8000 Rotary Actuators are furnished in 6 stock angles: 45°, 90°, 180°, 270°, 360°, and 450°. Other angles are available as specified.

Series 018x Miniature Rotary Actuators are all furnished with 180° rotation, but can be adjusted anywhere from 180° to 0°.

TOTAL ROTATIONAL TOLERANCES & BACKLASH

SERIES	ROTATIONAL TOLERANCE	BACKLASH
1000 & 2000	-0°, +10°	*±30 minutes
3000 & 4000	-0°, +10°	*±15 minutes
5000 & 6000	-0°, +10°	*±15 minutes
7000 & 8000	-0°, +10°	*±7.5 minutes
018x75x	-0°, +10°	±1.25 degrees during rotation, ±0° at end
018x50x	-0°, +10°	±2 degrees during rotation, ±0° at end

*Double rack actuators are available with 0° backlash at ends of rotation, if -A option is used.

Total rotational tolerance may be on both or either sides of mid-rotation minimum.

MULTI-POSITION MID-POSITION TOLERANCES & BACKLASH

SERIES	TOLERANCE**	BACKLASH
2000	±1°	± 1-1/2°
4000 & 6000	±1/2°	± 1-1/4°
8000	±1/4°	± 1°
018x752 (3 pos.)	Adjustable	Adjustable to 0°

**Rotational position from one intermediate position to another (measured at centers of backlash).

NOTE: 3 position and 5 position have 0° backlash at ends of rotation. 4 position will have up to stated figure at ends of rotation.

THEORETICAL TORQUE OUTPUT in-lb [Nm]

MODEL	INPUT PRESSURE psi [bar]												
	40 [2.7]	50 [3.4]	60 [4.1]	70 [4.8]	80 [5.5]	90 [6.2]	100 [6.9]	120 [8.3]	150 [10.3]	250 [17.2]	500 [34.4]	1000 [68.9]	1500 [103.4]
1000	15 [1.7]	19 [2.1]	23 [2.6]	27 [3.0]	31 [3.5]	35 [4.0]	39 [4.4]	47 [5.3]	58 [6.6]	98 [11.1]	196 [22.2]	392 [44.3]	588 [66.5]
2000	31 [3.5]	39 [4.4]	47 [5.3]	54 [6.1]	62 [7.1]	70 [8.0]	78 [8.8]	94 [16.6]	117 [13.2]	196 [22.2]	392 [44.3]	784 [88.6]	— [—]
3000	44 [4.9]	55 [6.2]	66 [7.4]	77 [8.7]	88 [10.0]	100 [11.3]	111 [12.6]	133 [15.0]	166 [18.8]	277 [31.3]	555 [62.7]	1110 [125.5]	1665 [188.2]
4000	88 [10.0]	111 [12.6]	133 [15.0]	155 [17.5]	177 [20.0]	200 [22.6]	222 [25.1]	266 [30.1]	333 [37.7]	555 [62.7]	1110 [125.5]	2200 [248.8]	3330 [376.5]
5000	94 [10.6]	118 [13.3]	141 [15.9]	165 [18.7]	189 [21.4]	212 [23.9]	236 [26.7]	283 [32.0]	354 [4.0]	590 [66.7]	1180 [133.4]	2360 [266.9]	3540 [400.3]
6000	189 [21.4]	236 [26.7]	282 [31.9]	330 [37.3]	378 [42.7]	424 [47.9]	472 [53.4]	564 [63.8]	708 [80.1]	1180 [133.4]	2360 [266.9]	4720 [533.7]	7080 [800.6]
7000	424 [47.9]	530 [59.9]	635 [71.8]	740 [83.7]	848 [95.9]	950 [107.4]	1060 [179.9]	1270 [143.4]	1590 [179.8]	2650 [299.7]	5300 [599.5]	10600 [1198.6]	15900 [1297.4]
8000	848 [95.5]	1060 [119.9]	1270 [143.6]	1480 [167.4]	1696 [191.8]	1900 [214.8]	2120 [239.7]	2540 [287.2]	3180 [359.6]	5300 [599.3]	10600 [1198.6]	21200 [2397.3]	31800 [3595.9]
018x751	4.4 [.49]	5.5 [.62]	6.6 [.74]	7.7 [.87]	8.8 [.99]	9.9 [1.12]	11.0 [1.24]	13.2 [1.49]	16.5 [1.87]	— —	— —	— —	— —
0180752 0185752 0186752	8.8 [.99]	11.0 [1.24]	13.2 [1.49]	15.4 [1.74]	17.6 [1.99]	19.8 [2.24]	22.0 [2.48]	26.4 [2.98]	33.0 [3.73]	— —	— —	— —	— —
018x75T	4.4 [.49]	5.5 [.62]	6.6 [.74]	7.7 [.87]	8.8 [.99]	9.9 [1.12]	11.0 [1.24]	13.2 [1.49]	16.5 [1.87]	— —	— —	— —	— —
0183752 0188752 0189752	4.4 [.49]	5.5 [.62]	6.6 [.74]	7.7 [.87]	8.8 [.99]	9.9 [1.12]	11.0 [1.24]	13.2 [1.49]	16.5 [1.87]	— —	— —	— —	— —
018x502	2.6 [.29]	3.3 [.37]	3.9 [.44]	4.6 [.52]	5.2 [.59]	5.9 [.66]	6.5 [.74]	7.8 [.88]	9.8 [1.11]	— —	— —	— —	— —

Use the single rack torques for all Air/Oil Tandem and Multi-Position Rotary Actuators. Torques shown are theoretical. Allow 10% for friction loss. Allow 20% for friction loss on all Air/Oil Tandem Rotary Actuators.

(800) 624-8511
Web Site: http://www.phdinc.com

PHYSICAL DATA

SERIES	GEAR RACKS	DISPLACEMENT in³ [cm³]/DEG. ROT.	AXIAL BEARING LOAD CAPACITY lb [N]*	RADIAL BEARING LOAD CAPACITY lb [N]*	DISTANCE BETWEEN SHAFT BEARINGS in [mm]	PISTON DIAMETER in [mm]
1000	1	.007 [.115]	50 [222]	100 [444]	1.375 [34.9]	1 [25.4]
2000	2	.014 [.229]				
3000	1	.019 [.312]	125 [556]	250 [1112]	2.188 [55.6]	1-3/8 [35]
4000	2	.038 [.623]				
5000	1	.041 [.672]	200 [890]	400 [1779]	2.235 [56.8]	2 [50]
6000	2	.082 [13.44]				
7000	1	.185 [3.032]	500 [2224]	1000 [4448]	3.750 [95.3]	3 [76]
8000	2	.370 [6.064]				
018x751	1	.002 [0.032]	15 [67]	25 [111]	1.060 [26.9]	3/4 [19]
018x752	2	.004 [0.064]				
018x75T	2	.002 [0.032]	15 [67]	25 [111]	1.060 [26.9]	3/4 [19]
018x502	2	.0012 [0.020]	5 [22]	15 [22]	.916 [23.3]	1/2 [13]

* Always support rotating member on external bearings whenever possible.

WEIGHT TABLES lb [kg] SINGLE SHAFT EXTENSION ACTUATORS

SERIES	45°	90°	180°	270°	360°	450°	PER 90°	ADD FOR SHAFT EXT.
1000	2.1 [.95]	2.3 [1.04]	2.6 [1.18]	2.9 [1.31]	3.3 [1.49]	3.6 [1.64]	.3 [.14]	.1 [.04]
2000	3.1 [1.40]	3.3 [1.50]	3.9 [1.78]	4.5 [2.09]	5.1 [2.32]	5.7 [2.58]	.6 [.28]	.1 [.04]
3000	7.2 [3.26]	7.5 [3.40]	8.3 [3.76]	9.0 [4.08]	9.8 [4.45]	10.5 [4.76]	.8 [.36]	.4 [.18]
4000	9.6 [4.35]	10.2 [4.62]	11.4 [5.17]	12.6 [5.71]	13.8 [6.26]	15.0 [6.80]	1.2 [.54]	.4 [.18]
5000	11.5 [5.22]	11.9 [5.42]	12.8 [5.80]	13.5 [6.13]	14.3 [6.49]	15.1 [6.86]	.8 [.37]	.5 [.27]
6000	15.8 [7.7]	16.8 [7.63]	18.3 [8.3]	19.8 [8.99]	21.3 [9.67]	22.8 [10.35]	1.5 [.68]	.5 [.27]
7000 Air	37.9 [17.19]	39.1 [12.25]	41.7 [18.91]	44.2 [20.05]	46.8 [21.20]	49.4 [22.43]	2.6 [1.19]	2.4 [1.08]
7000 Hyd.	39.1 [17.75]	41.0 [18.60]	44.8 [20.32]	48.5 [22.00]	52.3 [23.71]	56.0 [25.41]	3.8 [1.72]	2.4 [1.08]
8000 Air	49.6 [22.52]	52.1 [23.65]	57.4 [26.03]	62.6 [28.41]	67.9 [30.80]	73.1 [33.18]	5.3 [2.40]	2.4 [1.08]
8000 Hyd.	52.1 [23.65]	55.9 [25.35]	63.4 [28.75]	70.9 [32.16]	78.4 [35.56]	85.9 [38.96]	7.5 [3.40]	2.4 [1.08]

MINIATURE ROTARY ACTUATORS WEIGHTS lb [kg]

SERIES										
018x751		018x752		018x75T		0183752, 0188752, & 0189752		018x502		
2.1	[.95]	2.6	[1.18]	2.6	[1.18]	3.1	[1.41]	.8	[.36]	

AIR/OIL TANDEM MAXIMUM SPEEDS (NO LOAD CONDITION)

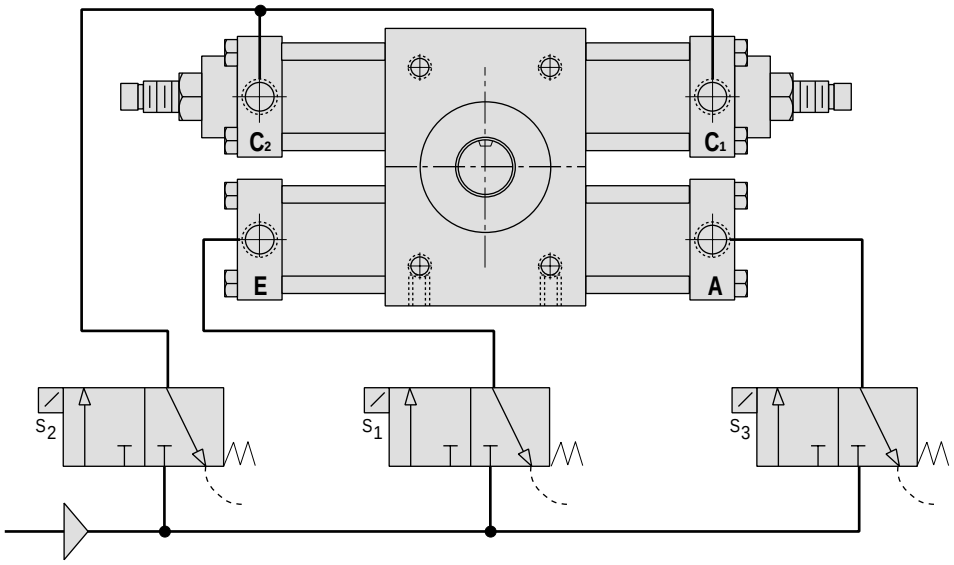
SERIES	OPERATING PRESSURE psi [bar]	OIL TEMPERATURE*	MAX. SPEED (DEGREES/SEC)	SERIES	OPERATING PRESSURE psi [bar]	OIL TEMPERATURE*	MAX. SPEED (DEGREES/SEC)
2000	50 [3.4]	95°F [35°C]	270	6000	50 [3.4]	105°F [40.5°C]	156
	60 [4.1]		294		60 [4.1]		180
	70 [4.8]		336		70 [4.8]		210
	80 [5.5]		366		80 [5.5]		216
4000	50 [3.4]	95°F [35°C]	258	8000	50 [3.4]	135°F [57.2°C]	132
	60 [4.1]		288		60 [4.1]		144
	70 [4.8]		324		70 [4.8]		150
	80 [5.5]		348		80 [5.5]		156

MODEL	OPERATING PRESSURE psi [bar]	OIL TEMPERATURE*	SECONDS/ 180° ROTATION
018x75T	50 [3.4]	95°F [35°C]	.31
	60 [4.1]		.27
	70 [4.8]		.25
	80 [5.5]		.22

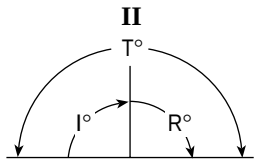
*Ambient Temperature 87°F [30°C] Standard Oil No. 15
Reservoir Pressure = 20 psi [1.3 bar]
Speed decreases with increase in reservoir pressure.

phd SOLUTIONS FOR INDUSTRIAL AUTOMATION
(800) 624-8511
Web Site: http://www.phdinc.com

3 POSITION UNITS
SERIES 2000-8000

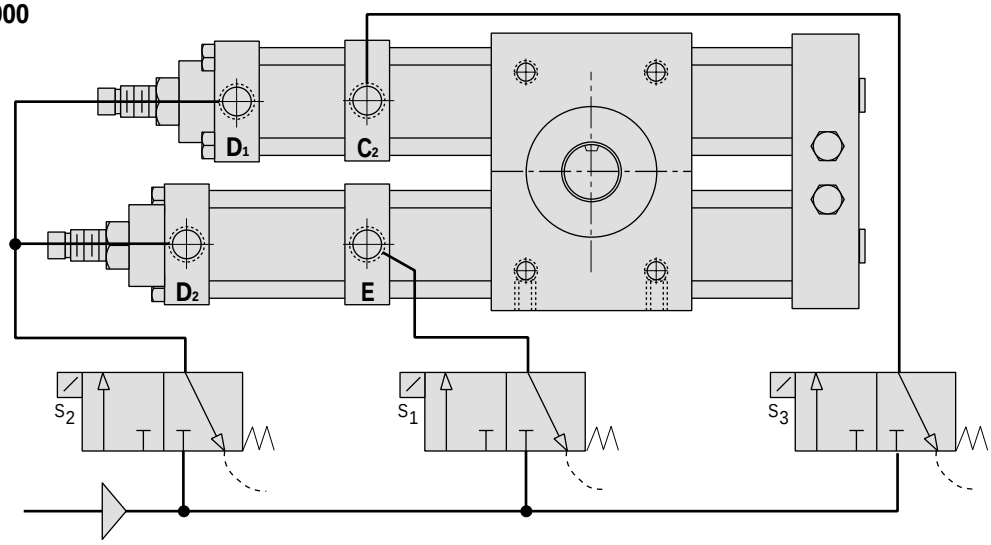


PORTS PRESSURIZED
C1 & C2

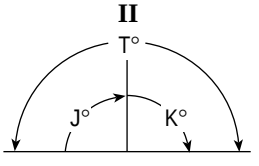


PORT PRESSURIZED - E
FULL CCW POSITION
I
III
PORT PRESSURIZED - A
FULL CW POSITION

3 POSITION TANDEM UNITS
SERIES 2000-8000



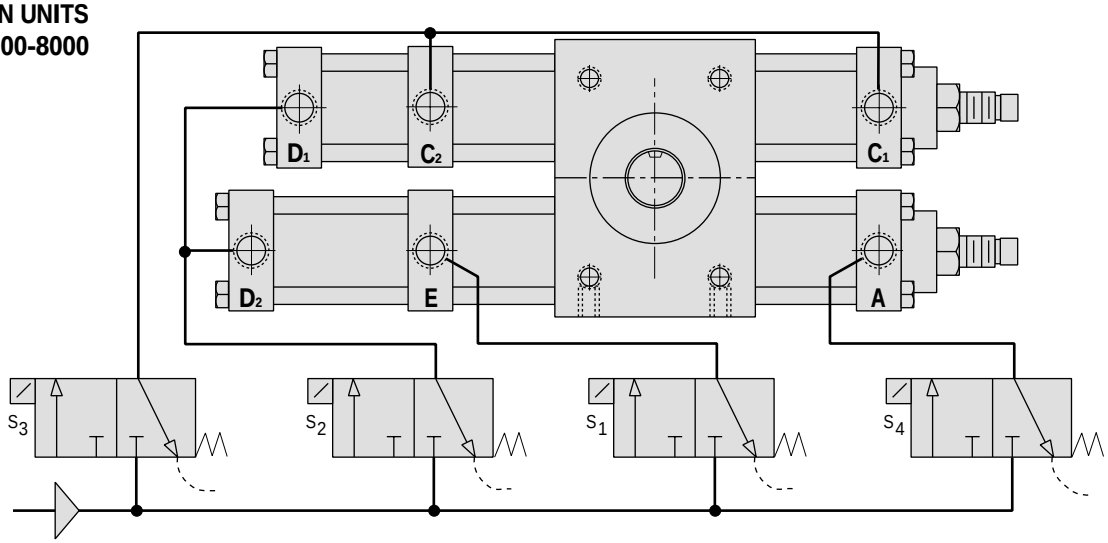
PORTS PRESSURIZED
D1 & D2

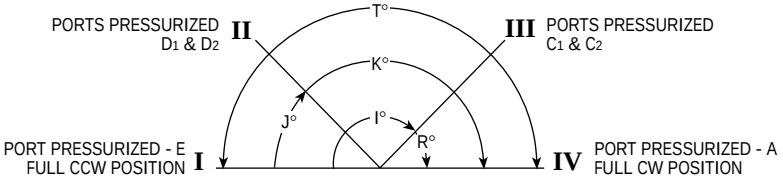


PORT PRESSURIZED - E
FULL CCW POSITION
I
III
PORT PRESSURIZED - C2
FULL CW POSITION

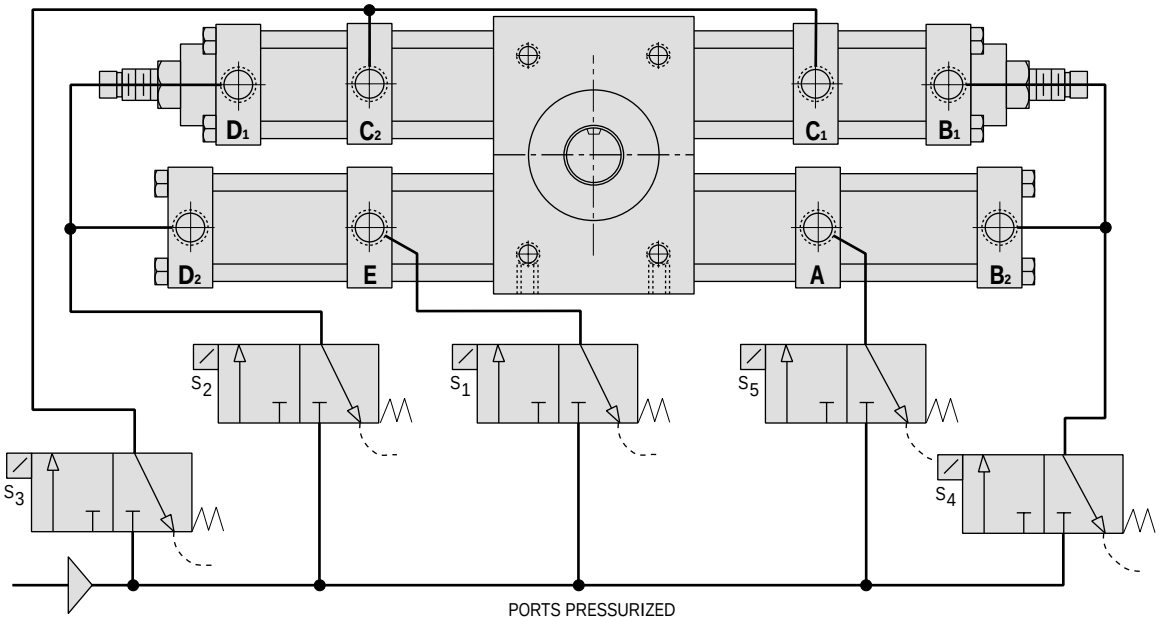
(800) 624-8511
Web Site: http://www.phdinc.com

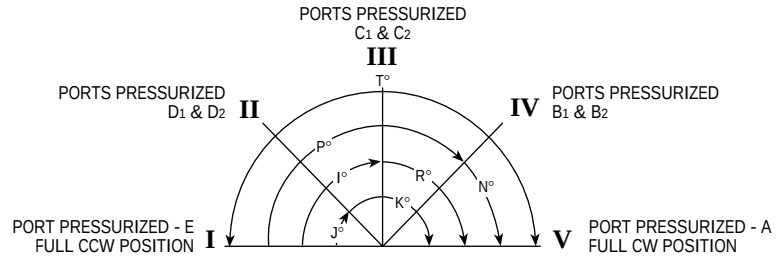
4 POSITION UNITS
SERIES 2000-8000





5 POSITION UNITS
SERIES 2000-8000





phd SOLUTIONS FOR INDUSTRIAL AUTOMATION
(800) 624-8511
Web Site: http://www.phdinc.com

START-UP PROCEDURE: SERIES 1000-8000 ACTUATORS

ROTARY ACTUATORS

CAUTION: Angular velocity and deceleration of actuators are normally controlled with Port Control® valves and cushions.

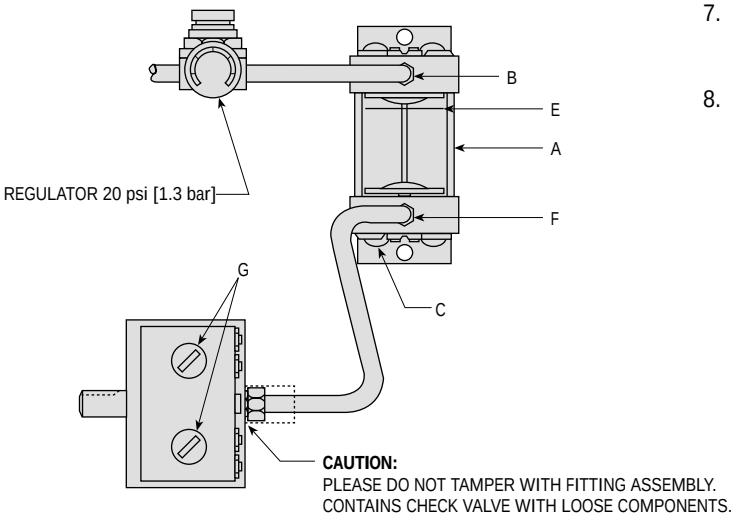
At start-up, the actuator cylinders are often empty or not pressurized. To prevent damage due to lack of governing media and to assure a controlled start-up, the following procedure should be used.

1. After installation of actuator and auxiliary tooling (arms, jaws, fixtures, etc.), manually turn output shaft fully clockwise prior to start up. Actuator should be started-up with typical work piece or load.

2. Apply pressure to rotary chamber in same direction as shaft is turned (clockwise port).

3. Apply pressure to opposite port and slowly open speed control valve governing counterclockwise direction. This will allow the actuator to rotate under control. Follow the same procedure in opposite direction. Several cycles may be needed to obtain proper speed adjustment.

4. On units with adjustable cushions, set needle adjustment for optimum effectiveness to minimize shock at end of rotation.



AIR/OIL TANDEM ROTARY ACTUATORS

1. Mount Reservoir "A" vertically above actuator hydraulic section. (Approximately 12 feet [3.6 m] of flexible tubing has been provided to allow reservoir to be mounted in convenient location.) Excess may be coiled up or cut off. Shortening of tube should take place by disconnecting tube from tank taking care that minimum amount is allowed to drain from reservoir and that tube is kept full of oil at all times. A small air bubble may form at end of tube when reassembled. This is not detrimental and will disappear during operation of actuator.

2. Provide constant air supply regulated to 20 psi [1.3 bar] to port B on reservoir.

3. Apply air pressure to reservoir. Next, LOOSEN (do not remove) drain plug C. Allow oil to drain until level reaches line E. Retighten plug securely.

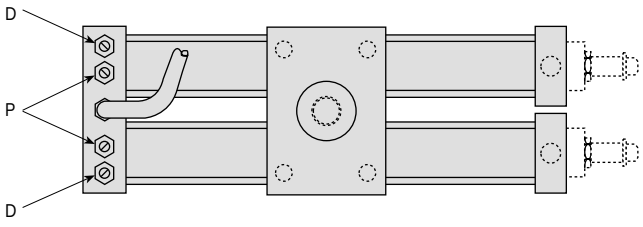
4. If actuator is equipped with cushions, open needle valves marked D approximately 1/8 turn.

5. Follow same procedure with port control needles marked P.

6. Air pressure may now be applied to actuator. Take care to keep clear from any tooling attached to the actuator shaft as it may start rotating.

7. Adjust control needles to achieve proper velocities (and decelerations).

8. Bleed plug G must not be loosened or removed as actuator will lose oil charge.



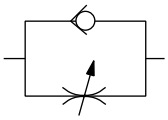
MAINTENANCE VIDEOS

Field Maintenance Videos on filling and bleeding Air/Oil Tandem Actuators are now available. Contact your local PHD distributor or call our toll free number: 1-800-624-8511.

(800) 624-8511
Web Site: http://www.phdinc.com

OPTIONS: SERIES 1000-8000 ROTARY ACTUATORS

P PORT CONTROL®

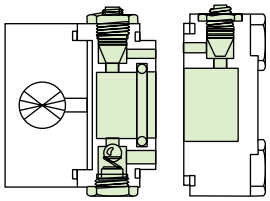


The "built-in" speed control valve.

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 rotary actuator end cap and are used to control the speed of the actuator over its entire rotation.

The self-locking needle has micrometer threads and is adjustable under pressure. It determines the orifice size which controls the exhaust volume only of the actuator proper. 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 rotary actuators. It saves space and eliminates the cost of fittings and installation for external flow control valves.

D ADJUSTABLE CUSHIONS



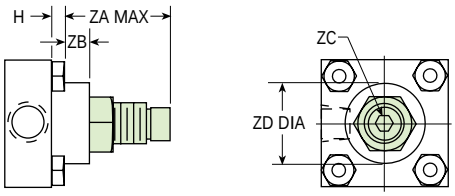
PHD Cushions are designed for smooth deceleration at the end of rotation. When the cushion is activated, the remaining volume in the cylinder must exhaust past an adjustable needle which controls the amount of deceleration. Effective cushion length is approximately 30° of rotation, except on the 8000 Tandem which has 20° of cushion length.

Cushions on Series 2000, 4000, 6000 and 8000 are furnished on one of two racks only.

A ANGLE ADJUSTMENT

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.

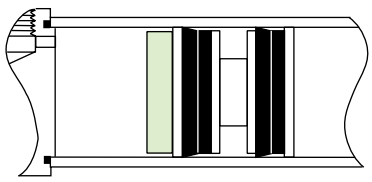
Cushions are normally engaged over the last 30° of angle. The use of angle adjusting screws to reduce angle of rotation has a direct effect on the length of cushion engagement. Example: 10° angle reduction will reduce cushion engagement by 10°. Angle adjustments are standard on all Multi-Position Rotary Actuators.



SERIES	LETTER DIMENSION				
	H	ZA	ZB	ZC	ZD
1000 & 2000	0.00 [0]	1.125 [29]	.312 [8]	3/16 HEX —	.875 [22]
3000 & 4000	.250 [6]	1.500 [38]	.375 [10]	1/4 HEX —	1.250 [32]
5000 & 6000	.203 [5]	1.875 [48]	.750 [19]	1/4 HEX —	1.250 [32]
7000 & 8000	.437 [11]	2.875 [73]	.937 [24]	3/4 FLAT [19 mm]	1.750 [45]

NUMBERS IN [ ] ARE FOR METRIC UNITS AND ARE IN mm.

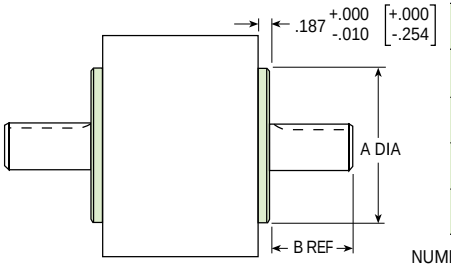
B SHOCK PADS



Polyurethane pads for absorption of shock and noise are available on each end of Series 1000-8000 Rotary 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:** Air application only.

G SHAFT SEAL COVERS
Not available on Rx6x and Rx9x models

Fits all PHD Series 1000-8000, except when ordering hollow shafts. Isolates internal or external pressures. Maximum pressure differential is 500 psi [34.4 bar]. Furnished installed on actuator only (both sides). Covers are made of hard anodized aluminum. Not to be used as a pilot.

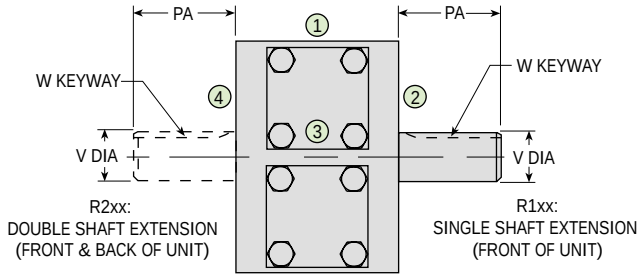


SERIES	LETTER	
	A	B
1000 & 2000	1.875 [47.63]	.688 [17.5]
3000 & 4000	3.000 [76.20]	1.688 [42.9]
5000 & 6000	3.250 [82.55]	1.688 [42.9]
7000 & 8000	4.480 [113.79]	3.312 [84.1]

NUMBERS IN [ ] ARE FOR METRIC UNITS AND ARE IN mm.

OPTIONS: SERIES 1000-8000 ROTARY ACTUATORS

BASIC SHAFT DIMENSIONS: R1xx and R2xx

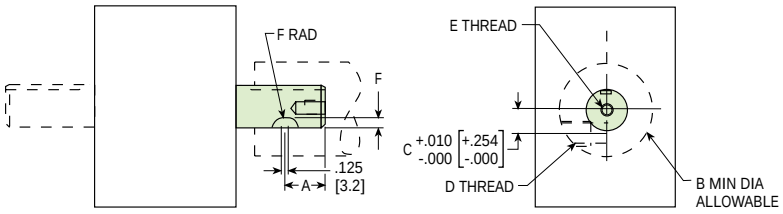


SERIES	LETTER DIMENSION				
		IMPERIAL*		METRIC**	
	PA	V	W	V	W
1000 & 2000	.875 [22]	.4998/.5003 [12.69/12.71]	1/8 x 1/16 x .625 [3.18 x 1.56 x 16]	— [12.00/11.97]	— [4 x 2.5 x 15]
3000 & 4000	1.875 [48]	.8748/.8753 [22.22/22.23]	3/16 x 3/32 x 1.500 [4.75 x 2.36 x 38]	— [22.00/21.96]	— [6 x 3.5 x 32]
5000 & 6000	1.875 [48]	1.124/1.125 [28.55/28.58]	1/4 x 1/8 x 1.500 [6.35 x 3.18 x 38]	— [28.00/27.96]	— [8 x 5 x 40]
7000 & 8000	3.500 [89]	1.749/1.750 [44.42/44.45]	3/8 x 3/16 x 3.000 [9.53 x 2.36 x 76]	— [44.00/43.96]	— [12 x 5 x 56]

NOTES:
1) **SHAFT KEYWAY:** SHOWN AT MID-ROTATION
2) *IMPERIAL SHAFT UNITS (Rx1x, Rx3x, Rx5x. Rx8x)
3) **METRIC SHAFT UNITS (Rx6x, Rx9R)

K PRELOADED KEYWAY SHAFT
Not available on Rx6x and Rx9x models

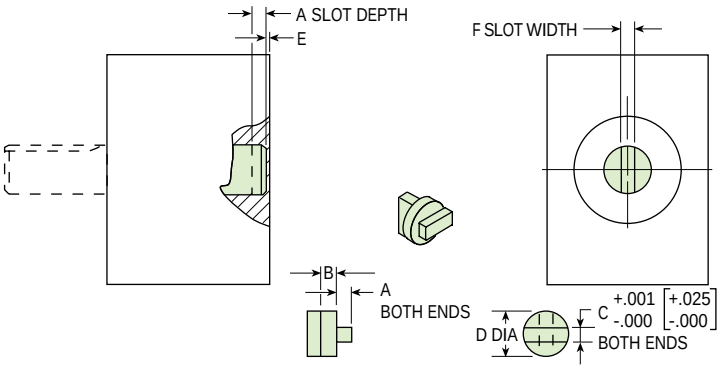
For use with Hub Adaptors. See Transition Plates & Stanchions section.



SERIES	LETTER DIMENSION					
	A	B	C	D	E	F
1000 & 2000	.375 [9.5]	1.500 [38.1]	.250 [6.35]	3/8-24 [M10]	10-32 x .312 DP [M5 x 8]	.156 [4]
3000 & 4000	.812 [20.6]	2.000 [50.8]	.437 [11.11]	1/2-20 [M12]	5/16-24 x .440 DP [M8 x 11]	.220 [6]
5000 & 6000	.812 [20.6]	3.000 [76.2]	.563 [14.28]	5/8-11 [M16]	3/8-24 x .560 DP [M10 x 14]	.251 [6]
7000 & 8000	1.500 [38.1]	4.000 [101.6]	.875 [22.22]	1-8 [M24]	1/2-20 x .687 DP [M12 x 17.5]	.438 [11]

SHAFT KEYWAY: SHOWN AT MID-ROTATION
R2xx UNITS: WHEN ORDERING SPECIFY -K-K FOR PRELOAD ON BOTH SHAFT EXTENSIONS. PRELOAD WILL BE ON OPPOSITE SIDES OF SHAFT.
SET SCREW: INCLUDED WITH UNIT

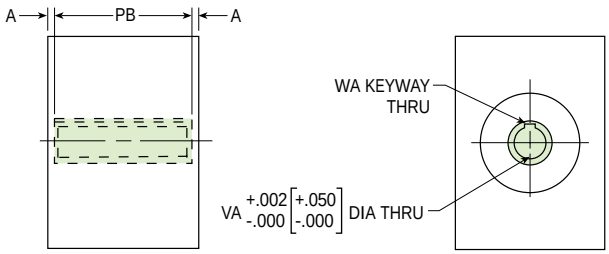
C CROSS KEY SHAFT
Not available on Rx6x and Rx9x models



SERIES	LETTER DIMENSION					
	A	B	C	D	E	F
1000 & 2000	.250 [6.4]	.215 [5.5]	.230 [5.8]	.500 [12.7]	.118 [3]	.250 [6.3]
3000 & 4000	.250 [6.4]	.265 [6.7]	.248 [6.3]	.875 [22.2]	.120 [3]	.248 [6.3]
5000 & 6000	.437 [11]	.485 [12.3]	.500 [12.7]	1.125 [28.6]	.150 [3.8]	.5002 [12.7]
7000 & 8000	.437 [11]	.805 [20.4]	.875 [22.2]	1.750 [44.5]	.245 [6.2]	.8752 [22.2]

SHAFT KEYWAY: SHOWN AT MID-ROTATION
R2xx UNITS: WHEN ORDERING SPECIFY -C-C FOR CROSSKEY ON BOTH SHAFT EXTENSIONS
CROSSKEY: INCLUDED WITH UNIT

H HOLLOW SHAFT
Not available on Rx6x and Rx9x models



SERIES	LETTER DIMENSION			
	A	PB	VA	WA
1000 & 2000	.042 [1.1]	1.920 [48.76]	.250 [6.35]	— —
3000 & 4000	.042 [1.1]	2.917 [74.09]	.500 [12.7]	1/8 x 1/16 [3.18 x 1.58]
5000 & 6000	.135 [3.4]	2.730 [69.34]	.687 [17.46]	3/16 x 3/32 [4.76 x 2.38]
7000 & 8000	.240 [6.1]	4.520 [114.80]	1.125 [28.57]	1/4 x 1/8 [6.35 x 2.38]

SHAFT KEYWAY: SHOWN AT MID-ROTATION

All dimensions are reference only unless specifically toleranced.
(800) 624-8511
Web Site: http://www.phdinc.com

MAGNETIC PISTON FOR USE WITH PHD PROXIMITY SWITCHES

See page 3C-29 for Hydraulic Pressure Ratings with these options.
See each ordering data for magnetic piston ordering information.
Switches and brackets must be ordered separately.
See Switches and Sensors section for complete switch information.

E HALL EFFECT SWITCHES

Series 1000-8000 Rotary 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 Actuators to various logic systems. This option is for use with the following switches.

COMPACT HALL EFFECT SWITCHES

PART NO.	COLOR	DESCRIPTION
17503-2-06	Yellow	NPN (Sink) Type 4.5-24 VDC, 6 foot cable
17504-2-06	Red	PNP (Source) Type 4.5-24 VDC, 6 foot cable
17523-2	Yellow	NPN (Sink) Type 4.5-24 VDC, Quick Connect
17524-2	Red	PNP (Source) Type 4.5-24 VDC, Quick Connect

LIQUID RESISTANT HALL EFFECT SWITCH

PART NO.	DESCRIPTION
15902-1	NPN (Sink) or PNP (Source) 4.5-24 VDC

SWITCH BRACKETS

SERIES	PART NO.	
	COMPACT SWITCH	LIQUID RESISTANT
1000 & 2000	17000-32-5	5142-32-3
3000 & 4000	17000-34-5	5142-34-3
5000 & 6000	17000-38-0	5142-38-3
7000 & 8000	17000-39-0	5142-39-3

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	White	NPN (Sink) or PNP (Source) 4.5-24 VDC, 6 foot cable
17509-3-06	Green	AC Type 110-120 VAC with Current Limit, 6 foot cable
17522-2	White	NPN (Sink) or PNP (Source) 4.5-24 VDC, Quick Connect
17529-3	Green	AC Type 110-120 VAC, Quick Connect with Current Limit

LIQUID RESISTANT REED SWITCHES

PART NO.	DESCRIPTION
15900-1	10 Watt 4.5-24 VDC or 110-120 VAC
15901-1	3 Amp 65-120 VAC

J SENSOR/SET POINT MODULE

Not available on Rx6x and Rx9x models

PHD offers a solid state sensor transducer along with a Set Point Module which provides up to four adjustable sensing positions throughout the 180° maximum sensing range. These signals can be used as inputs to a programmable controller to signal ends of rotation in addition to multiple signals during rotation for indication of arc travelled.

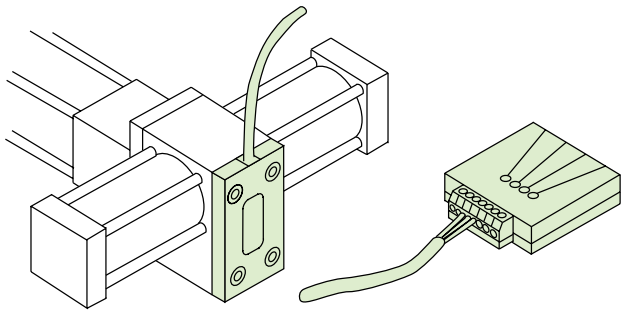
The Set Point Module allows independent adjustment of each sensing position and is available for 4.5 to 24 VDC current sinking or current sourcing.

To order, specify -J option on Series 1000-8000 and -3 in the appropriate option space for 018x50x and 018x75x.

SET POINT MODULE

PART NO.	DESCRIPTION
9800-01-0300	NPN (Sink) 4.5-24 VDC
9800-01-0400	PNP (Source) 4.5-24 VDC

See Switches and Sensors section for information.



phd SOLUTIONS FOR INDUSTRIAL AUTOMATION
(800) 624-8511
Web Site: http://www.phdinc.com

OPTIONS: SERIES 1000-8000 ROTARY ACTUATORS

L COUNTERCLOCKWISE UNIDIRECTIONAL CLUTCH

Not available on Rx6x and Rx9x models

Output hub will only rotate in counterclockwise direction at specific rotation ordered.

R CLOCKWISE UNIDIRECTIONAL CLUTCH

Not available on Rx6x and Rx9x models

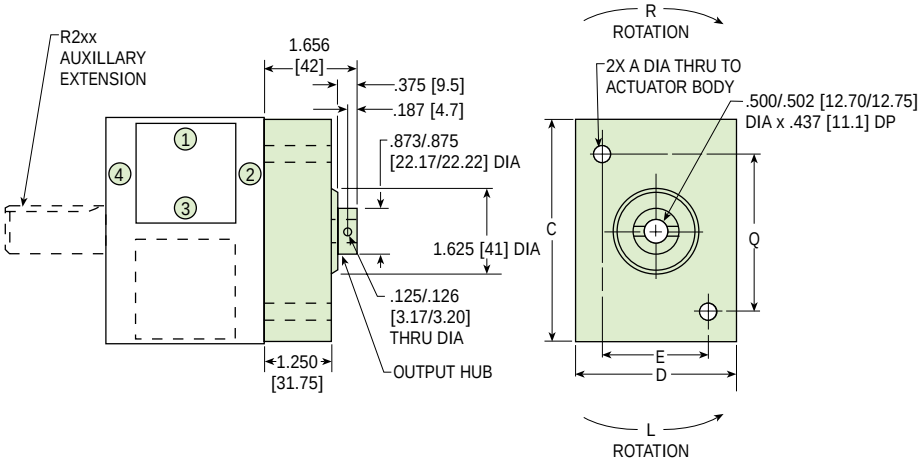
Output hub will only rotate in clockwise direction at specific rotation ordered.

Overrun clutch for intermittent unidirectional shaft output, available for Series 1000 through 6000.

Output hub rotates in one direction only. It remains motionless while rack and pinion reverse. Clutch repeats within ±1/2°.

Assembly features a Torrington roller clutch. Spring loaded brake shoes limit output shaft free wheeling, but are not intended for stopping external loads.

CAUTION: Any angular error will accumulate; therefore, shot pins or similar locators are necessary on index applications. Maintain shot pin location during reversal of Rotary Actuator to guarantee that clutch shaft does not move due to external forces or slight internal friction in clutch.



SERIES	LETTER DIMENSION				
	A	C	D	E	Q
1000 & 2000	.281 [7.2]	2.938 [74.6]	2.000 [51]	1.500 [38]	2.000 [50.8]
3000 & 4000	.344 [8.7]	4.188 [106.3]	3.000 [76]	2.000 [50.8]	3.000 [76.2]
5000 & 6000	.406 [10.3]	4.938 [125.4]	4.000 [102]	2.500 [63.5]	3.500 [88.9]

SERIES	LIMITING FACTORS	
	MAX. INLET PRESSURE(psi)[bar]	MAX. RADIAL OR AXIAL LOAD (lb) [N]
1000	1052 [72]	5 [22]
2000	526 [36]	5 [22]
3000	372 [25]	10 [44]
4000	186 [13]	10 [44]
5000	174 [12]	15 [66]
6000	87 [6]	15 [66]

ABOVE INLET PRESSURES PROVIDE A MAXIMUM TORQUE OF 414 in-lb [46.8 Nm] ALLOWED BY THE CLUTCH

N PILOT VALVE ACTUATOR

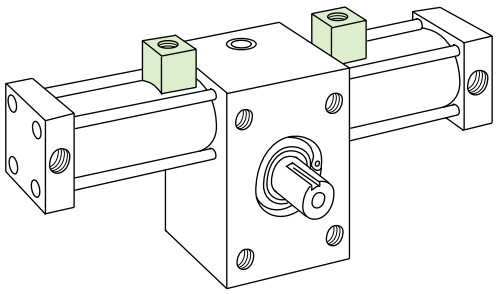
Not available on Rx6x and Rx9x models

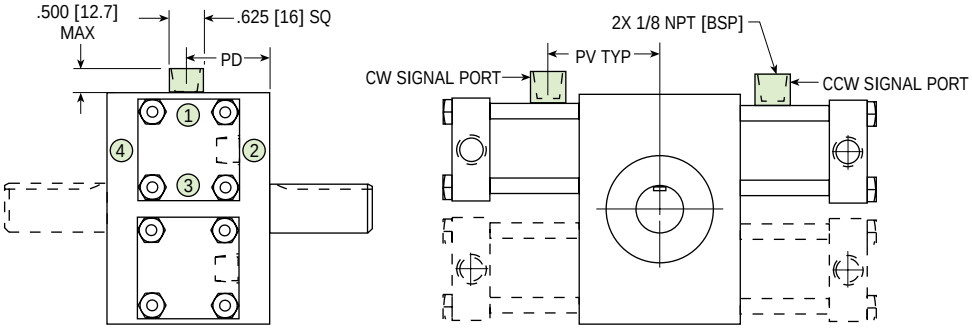
The PVA functions as a built-in pneumatic limit switch. An air pressure signal is provided at the end-of-piston travel as the piston seal uncovers an orifice in the block. Upon reversal of piston travel, the pilot pressure is shut off and the pilot line is vented through the rotary actuator housing.

Air pilot signal is provided approximately .03 inch [1 mm] prior to end of piston travel (or 10 to 15 degrees prior to end of rotation). For pneumatic use only.

PVA ports are located in position 1 unless otherwise specified.

Not available in conjunction with angle adjustment -A option.





SERIES	LETTER DIMENSION		
	PD	PV STANDARD	PV W/-B
1000 & 2000	1.000 [25.4]	2.191 [55.7]	1.848 [46.9]
3000 & 4000	1.500 [38.1]	2.847 [72.3]	2.410 [61.2]
5000 & 6000	1.500 [38.1]	3.436 [87.3]	2.978 [75.6]
7000 & 8000	2.500 [63.5]	4.409 [112]	3.770 [95.8]

PVA UNITS WILL REQUIRE A MINIMUM ROTATION OF 45°

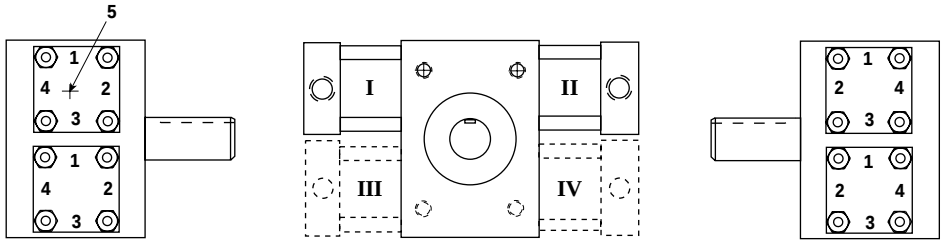
All dimensions are reference only unless specifically toleranced.

(800) 624-8511
Web Site: http://www.phdinc.com

PORT & PORT CONTROL LOCATIONS

STANDARD PORT LOCATION on all Series 1000-8000 Actuators is position 2. STANDARD PVA (-N) LOCATIONS are tubes I & II in position 1. STANDARD PORT CONTROL® AND CUSHION ADJUSTMENT NEEDLES are located in end caps I & II in position 1. Other port and adjusting needle locations are available as specified.

Needles may not be located in same position as ports. See page 3C-16 for needle positions Air/Oil Tandem Actuators. See 3C-4 for port and Port Control® positions on Miniature Rotary Actuators.



I PORT POSITION 1 TOP RACK PORT POSITION 3 BOTTOM RACK

This option positions the ports in position 1 on racks I & II and in position 3 on racks III and IV. This allows access to the ports on the "Top" and "Bottom" sides of the actuator.

Y TANDEM CAP ROTATED 180°

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

V FLUORO-ELASTOMER SEALS

Fluoro-Elastomer seals are available for service up to 400°F [204°C]. They may also be used to achieve seal compatibility with certain fluids. Seal compatibility should be checked with the fluid manufacturer for proper application.

W CLOSE TOLERANCE ROTATION

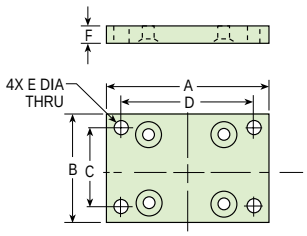
This option may be specified when a precise rotation is required and angle adjustment (see page 3C-35) is not acceptable. By specifying this option, rotation will be within a tolerance of +30, -0 minutes. Standard tolerance is -0°, +10° of rotation.

Z1 ELECTROLESS NICKEL PLATING

Electroless nickel plating is done on all externally exposed ferrous parts except the pinion shaft. This optional plating treatment gives an alternative method of protecting the unit from severe environments.

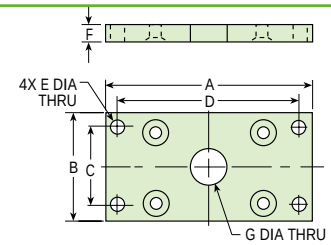
NOTE: Standard plating is Zinc & Black Oxide.

MOUNTING FLANGE (HARDWARE INCLUDED)



BOTTOM MOUNTING FLANGE

SERIES	KIT NO. IMPERIAL	KIT NO. METRIC	LETTER DIMENSION A	B	C	D	E	F
1000 & 2000	13756	14320	4.250 [108]	2.000 [51]	1.625 [41.3]	2.625 [66.7]	.281 [7.1]	.250 [6.3]
3000 & 4000	13757	14321	4.500 [114]	3.000 [76]	2.375 [60.3]	3.875 [98.4]	.406 [10.3]	.437 [11.1]
5000 & 6000	13758	14322	4.500 [114]	4.000 [102]	3.375 [85.7]	3.875 [98.4]	.406 [10.3]	.437 [11.1]



SIDE MOUNTING FLANGE

SERIES	KIT NO. IMPERIAL	KIT NO. METRIC	LETTER DIMENSION A	B	C	D	E	F	G
1000 & 2000	13759	14316	4.250 [108]	2.000 [51]	1.375 [34.9]	3.625 [92.1]	.281 [7.1]	.250 [6.3]	.625 [15.9]
3000 & 4000	13760	14317	5.750 [146]	3.000 [76]	2.125 [54.0]	5.125 [130.2]	.406 [10.3]	.437 [11.1]	1.000 [25.4]
5000 & 6000	13761	14318	6.500 [165]	4.000 [102]	3.375 [85.7]	5.875 [149.2]	.406 [10.3]	.437 [11.1]	1.250 [31.8]
7000 & 8000	13762	14319	12.000 [305]	5.000 [127]	3.000 [76.2]	10.000 [254.0]	.781 [19.8]	.750 [19.1]	1.875 [47.6]

All dimensions are reference only unless specifically toleranced.

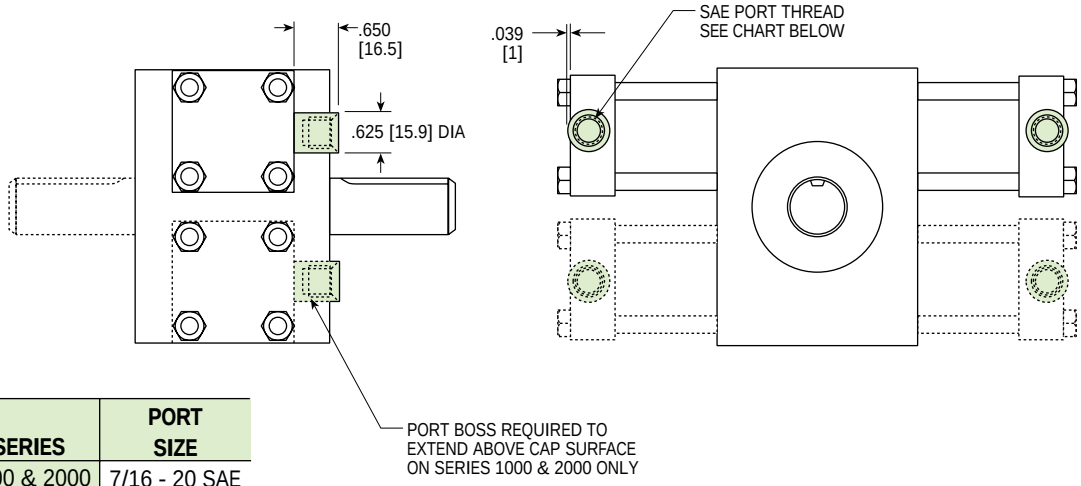
phd SOLUTIONS FOR INDUSTRIAL AUTOMATION
(800) 624-8511
Web Site: http://www.phdinc.com

S SAE PORTS FOR HYDRAULIC FLUID

Not available on Rx6x and Rx9x models

SAE Ports are available on most PHD hydraulic Rotary Actuators. The Series 1000 & 2000 Rotary Actuators require a boss which is brazed to the caps.

Dimensions for this boss are shown below. 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