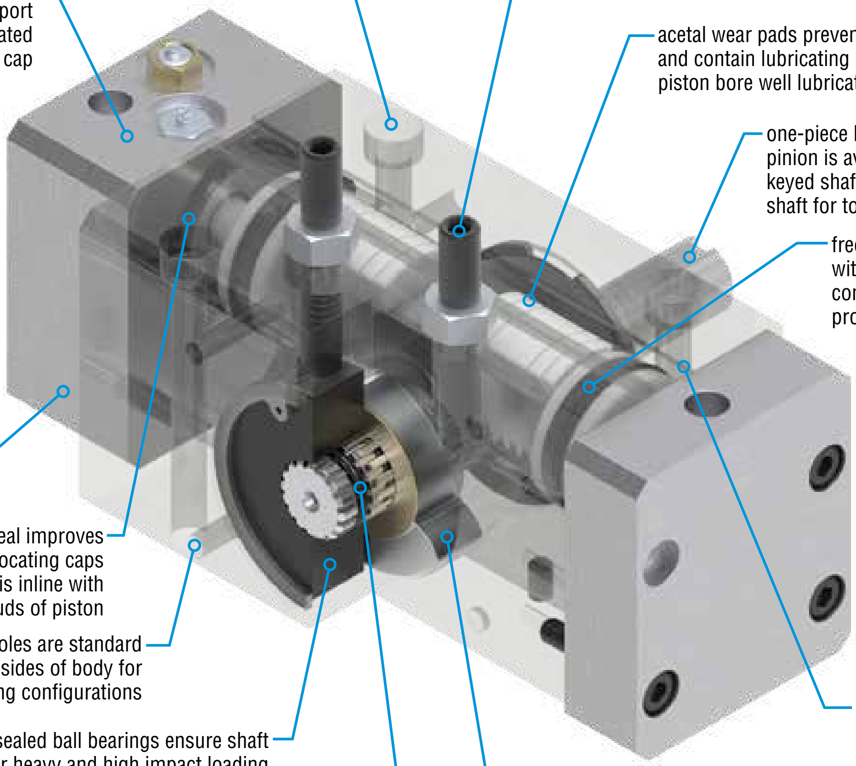
RA

Major Benefits

- Full featured rotary
- High axial and radial bearing loads
- Zero backlash at ends of rotation
- Wide variety of options and accessories



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

R A S 1 20 x 180 - PB - NB - E-Q10

PRODUCT
R- Rotary Actuator

SERIES
A - Standard Duty

TYPE
S - 150 psi [10 bar] Air Max.

DESIGN NO.
1 - Imperial
5 - Metric

BORE SIZE
20 mm (0.78")
25 mm (1.0")
32 mm (1.25")
40 mm (1.5")
50 mm (2.0")

ANGLE OF ROTATION
45°, 90°, 135°, 180°, 225°, 270°

PORT CONTROL
PB - Both directions
PC - Counterclockwise
PW - Clockwise

CUSHION CONTROL
DB - Cushion both directions
DC - Cushion counterclockwise
DW - Cushion clockwise

SHOCK ABSORBER
NB - Shock installed both directions
NC - Shock installed counterclockwise
NW - Shock installed clockwise
GS - Shock ready both directions
GT - Shock ready counterclockwise
GU - Shock ready clockwise

Shock absorbers must be ordered separately for -GS, -GT, and -GU options. 225° and 270° units are standard shock ready.

SWITCH READY
E - Magnets for Series 5360 Solid State Hall Effect Switches
I - Magnets for Series 5360 Magnetoresistive Switches
M - Magnets for Series 5360 Reed Switches

Switches must be ordered separately. See below or page 33.

OUTPUT TYPES
Q10 - Output hub
Q19 - Output hub with hollow pinion shaft (Available on 32 mm - 50 mm units only)
Q22 - Splined output shaft only

SHOCK ABSORBERS

BORE SIZE	PHD SHOCK ABSORBER NO.
20 mm	56722-01
25 mm	56722-02
32 mm	56722-03
40 mm	56722-04
50 mm	56722-05

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

SERIES 5360 MAGNETORESISTIVE SWITCHES

PART NO.	COLOR	DESCRIPTION
53605-1-02	Black	NPN 6-24 VDC, 2 meter cable
53606-1-02	Orange	PNP 6-24 VDC, 2 meter cable
53625-1	Black	NPN 6-24 VDC, Quick Connect
53626-1	Orange	PNP 6-24 VDC, Quick Connect

SERIES 5360 HALL EFFECT SWITCHES

PART NO.	COLOR	DESCRIPTION
53603-1-02	Yellow	NPN (Sink) 4.5-24 VDC, 2 meter cable
53604-1-02	Red	PNP (Source) 4.5-24 VDC, 2 meter cable
53623-1	Yellow	NPN (Sink) 4.5-24 VDC, Quick Connect
53624-1	Red	PNP (Source) 4.5-24 VDC, Quick Connect

SERIES 5360 REED SWITCHES

PART NO.	COLOR	DESCRIPTION
53602-2-02	White	Sink or Source Type 4.5-24 VDC, 2 meter cable
53622-2	White	Sink or Source Type VDC, Quick Connect

NOTE: See Switches and Sensors catalog for additional switch information and complete specification. Switches must be ordered separately.

CAD & Sizing Assistance

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

SPECIFICATIONS	SERIES RA
OPERATING PRESSURE	20 to 150 psi max [1.4 to 10 bar]
OPERATING TEMPERATURE	-20° to 180°F [-29° to 82°C]
RATED LIFE	5 million cycles
ROTATIONAL TOLERANCE	Nominal rotation +10° to -45° with angle adjustments
BACKLASH AT END OF ROTATION*	0°
LUBRICATION	Factory lubricated for rated life
MAINTENANCE	Field repairable

NOTE: *Angle adjustment screw must be engaged or adjusted to achieve 0° backlash.

SIZE	ROTATION	BASE WEIGHT		BORE DIAMETER		DISPLACEMENT VOLUME/deg		THEORETICAL TORQUE OUTPUT		ROTATIONAL VELOCITY MAX	MAX AXIAL BEARING LOAD		MAX RADIAL BEARING LOAD		DISTANCE BETWEEN BEARINGS	
		lb	kg	in	mm	in³/deg	mm³/deg	in-lb/psi	Nm/bar	deg/sec	lb	N	lb	N	in	mm
20	45°/90°	1.80	0.82	0.787	20	0.002	32.77	0.097	0.16	180/0.05	97	431	376	1672	1.34	34.0
	135°/180°	1.80	0.82													
	225°/270°	2.30	1.04													
25	45°/90°	2.40	1.09	0.984	25	0.004	65.55	0.190	0.31	180/0.05	118	524	453	2015	1.61	40.9
	135°/180°	2.80	1.27													
	225°/270°	3.60	1.63													
32	45°/90°	4.30	1.95	1.260	32	0.007	114.71	0.415	0.68	180/0.05	182	809	640	2846	1.94	49.3
	135°/180°	4.90	2.22													
	225°/270°	6.50	2.94													
40	45°/90°	7.70	3.49	1.575	40	0.014	229.42	0.779	1.28	180/0.075	237	1054	746	3318	2.56	65.0
	135°/180°	8.80	3.99													
	225°/270°	11.80	5.35													
50	45°/90°	11.60	5.26	1.969	50	0.027	442.45	1.522	2.49	180/0.075	325	1445	966	4296	2.90	73.6
	135°/180°	12.80	5.81													
	225°/270°	17.70	8.03													

CUSHION AND OUTPUT HUB WEIGHTS

BORE SIZE	ADDER WITH CUSHION OPTION -DB		ADDER WITH HUB OPTION -Q10 OR -Q19	
	lb	kg	lb	kg
20 mm	0.3	0.13	0.03	0.01
25 mm	0.4	0.16	0.03	0.01
32 mm	0.6	0.24	0.04	0.02
40 mm	0.8	0.34	0.12	0.05
50 mm	1.1	0.47	0.23	0.11

Application & Sizing Assistance

Use PHD's free online Product Sizing and
Application at **www.phdinc.com/apps/sizing**

STANDARD ANGLE ADJUSTMENT

All PHD Series RA Rotary Actuators are supplied as standard with built-in adjustable angle stops. Together these mechanical positive stops provide an adjustment range of +10°, -45° on each nominal angle of rotation (see Table 1). (+5°, -22-1/2° from each end.)

Units with rotations of 180° or less utilize adjusting screws in the top of the actuator which stop against a stop cam attached to the pinion shaft (see Illustration A). Units with rotations of 225° and 270° use angle adjustment screws located in the end caps which stop against the auxiliary lower rack (see Illustration B). When 225° or 270° units are ordered with optional shock absorbers, the shock absorbers double as the angle adjustment screws.

The ability to adjust over such a wide range eliminates the need to order special units for specific angles of rotation. The range of nominal rotations and the +10°, -45° adjustments provide a total rotation range of 0° to 280° across the Series RA Rotary Actuator line.

NOTE: Cushions are effective for approximately the last 40° of rotation each direction. The cushion angle will decrease by the same amount that the nominal rotation is reduced by the angle adjustment. Consult PHD for non-standard angles of rotation if cushions are required.

TABLE 1

ROTATION ORDERED	STANDARD ADJUSTMENT RANGE
45°	0° through 55°
90°	45° through 100°
135°	90° through 145°
180°	135° through 190°
225° or 270°	180° through 280°

ILLUSTRATION A
0°-180° ROTATIONS

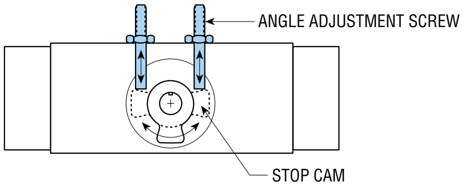
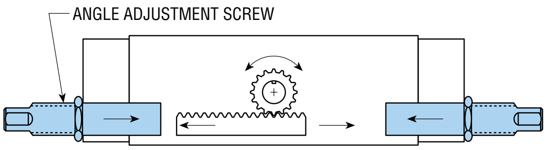


ILLUSTRATION B
181°-270° ROTATIONS



To select the appropriate RA rotary actuator, it is crucial to consider several factors including bearing capacity, torque requirements and stopping capacity of the actuator. The bearing capacities are listed on previous page. To determine the required torque to rotate the load in a given time, the rotational mass moments of inertia, gravity, time and acceleration must be taken into account. To stop an actuator, all of the same required information for torque is needed plus kinetic energy. Follow the steps below to select the appropriate RA actuator.

1) **Review previous page to make sure RA rotary actuator bearings can withstand axial and radial bearing loads.**

2) **Determine the torque requirements of the actuator.**

a) Determine Mass Moment of Inertia.
Select the illustration from the application types on the following page that most resembles your specific application. Several separate calculations may be necessary to fully describe your application. Using the appropriate application equation, calculate the mass moment of inertia for each type of illustration. The total mass moment of inertia will be the sum of the individual calculations.

b) Determine the necessary acceleration.
Acceleration (α) = (2 x (Rotation angle in radians)) / (Time of Rotation in Seconds)^2
Acceleration (α) = (0.035 x (Rotation angle in degrees)) / (Time of Rotation in Seconds)^2

c) Calculate the required torque.
Select the illustration from the application types on the following page that most resembles your specific application. Several separate calculations may be necessary to fully describe your application. Using the appropriate application equation, calculate the mass moment of inertia for each type of illustration. The total torque will be the sum of the individual calculations. **NOTE:** Torque calculations are theoretical, an appropriate safety factor should be considered. PHD recommends a minimum safety factor of 2 to account for friction loss, airline and valve size, and attached accessories.

3) **Determine the stopping capacity of the actuator by using the equation given below.**

KINETIC ENERGY BASIC EQUATIONS
KE = 1 / 2 Jm ω^2

a) Determine the rotational velocity by using equation A.

ROTATIONAL VELOCITY EQUATION
EQUATION A
Estimated Peak Velocity (rad/sec)
Uniformly accelerated from rest

ω = rad / sec =
(0.035 x Degrees of Rotation) / Time of Rotation in seconds

b) Using Jm from step 2a and velocity from step 3a, calculate the kinetic energy of the application.

c) Use the KE Energy Table below to select appropriate RA actuator.

KINETIC ENERGY TABLE

BORE SIZE	KE MAX. PLAIN UNIT		KE MAX. WITH CUSHION		KE MAX. WITH SHOCK ABSORBER	
	in-lb	Nm	in-lb	Nm	in-lb	Nm
20 mm	0.25	0.0282	0.88	0.0994	3.30	0.373
25 mm	0.49	0.0553	1.73	0.1954	9.30	1.051
32 mm	0.96	0.1085	3.96	0.4474	21.30	2.407
40 mm	1.77	0.1999	6.75	0.7626	45.00	5.084
50 mm	2.89	0.2259	10.12	1.1434	89.00	10.056

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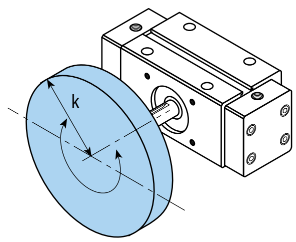
IMPERIAL UNITS:
Jm = Rotational Mass Moment of Inertia (in-lb-sec^2) (Dependent on physical size of object and weight)
g = Gravitational Constant = 386.4 in/sec^2 | F_g = Weight of Load (lb) | k = Radius of Gyration (in)
T = Torque required to rotate load (in-lbs) | α = Acceleration (rad/sec^2) | t = time (sec)
SF = Safety Factor

METRIC UNITS:
Jm = Rotational Mass Moment of Inertia (N-m-sec^2) (Dependent on physical size of object and weight)
g = Gravitational Constant = 9.81 m/sec^2 | F_g = Weight of Load (N) | k = Radius of Gyration (m)
T = Torque required to rotate load (N-m) | α = Acceleration (rad/sec^2) | t = time (sec)
M = Mass = F_g / g (kg) | SF = Safety Factor

BALANCED LOADS

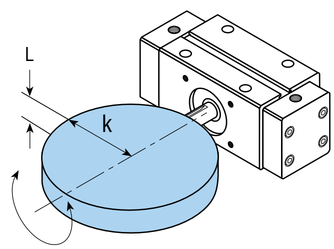
$$T = Jm \times \alpha \times SF$$

Disk
Mounted on center



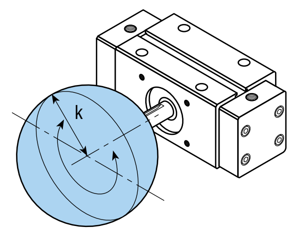
$$Jm = \frac{F_g}{g} \times \frac{k^2}{2}$$

Disk
End mounted on center



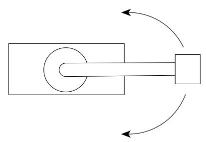
$$Jm = \frac{F_g}{g} \times \frac{1}{4} \times \left(\frac{L^2}{3} + k^2\right)$$

Solid Sphere
Mounted on center

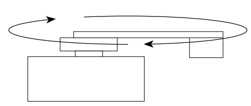


$$Jm = \frac{2}{5} \times \frac{F_g}{g} \times k^2$$

LOAD ORIENTATION

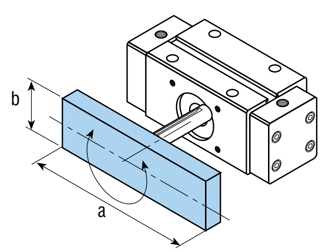


T_g = Rotating Vertically (with gravity)



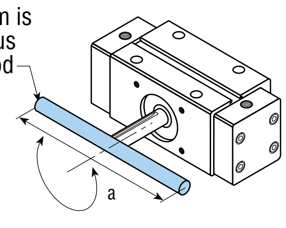
T = Rotating Horizontally (without gravity)

Rectangular Plate
Mounted on center



$$Jm = \frac{F_g}{g} \times \frac{a^2 + b^2}{12}$$

Rod
Mounted on center

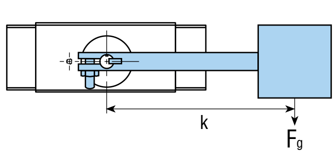


$$Jm = \frac{F_g}{g} \times \frac{a^2 + 3k^2}{12}$$

UNBALANCED LOADS

$$T_g = [(Jm \times \alpha) + (F_g \times k)] \times SF$$
$$T = Jm \times \alpha \times SF$$

Point Load

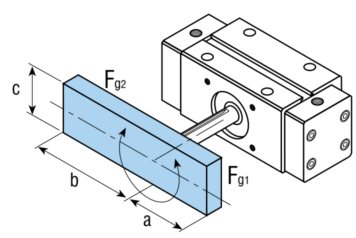


$$Jm = \frac{F_g}{g} \times k^2$$

UNBALANCED LOADS

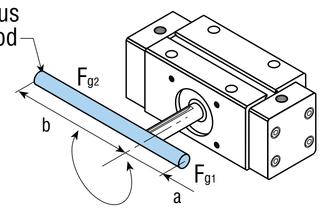
$$T_g = [(Jm \times \alpha) + [(F_{g2} - F_{g1}) \times (a + (\frac{b-a}{2}))]] \times SF$$
$$T = Jm \times \alpha \times SF$$

Rectangular Plate
Mounted off center



$$Jm = \frac{F_{g1}}{g} \times \frac{4a^2 + c^2}{12} + \frac{F_{g2}}{g} \times \frac{4b^2 + c^2}{12}$$

Rod
Mounted off center



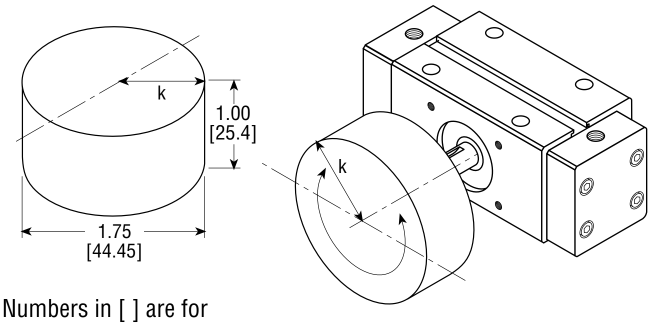
$$Jm = \left(\frac{F_{g1}}{g} \times \frac{(4a^2 + 3k^2)}{12}\right) + \left(\frac{F_{g2}}{g} \times \frac{(4b^2 + 3k^2)}{12}\right)$$

APPLICATION EXAMPLE A

Disk rotating about centerline of unit.

1) Determine load information:

	IMPERIAL	METRIC
ROTATION ANGLE / TIME	180° / 0.10 sec	180° / 0.10 sec
LOAD	Aluminum Disk	Aluminum Disk
WEIGHT	0.236 lb	1.05 N
MASS		0.107 Kg
PRESSURE	87 psi	6 bar
SAFETY FACTOR	2	2



Numbers in [ ] are for metric units and are in mm.

2) Determine torque requirement for the application:

a) Calculate Rotational Mass Moment of Inertia (Jm) using equations given on page 27.

IMPERIAL

Jm = (F_g / g) x (k^2 / 2)

Jm = (0.236 lb / 386.4) x ((0.875 in)^2 / 2)

Jm = 0.000234 in-lb-sec^2

METRIC

Jm = (F_g / g) x (k^2 / 2)

Jm = (1.05 N / 9.81) x ((0.0222 m)^2 / 2)

Jm = 2.64 x 10^{-5} N-m-sec^2

b) Determine required acceleration of the load:

α = 0.035 x (rotational angle (deg)) / (time of rotation (sec)^2)

α = 0.035 x (180° / (0.1 sec)^2) = 630 rad/sec^2

c) Calculate required torque:

IMPERIAL

T = Jm x α x SF

T = 0.000234 x 630 x 2 = 0.29 in-lbs

METRIC

T = Jm x α x 2

T = 2.64 x 10^{-5} x 630 x 2 = 0.03 N-m

To select minimum actuator based on torque, calculate theoretical torque for 87 psi [6 bar] by using table on page 25.

3) Determine the stopping capacity of the actuator for the application:

a) Determine the estimated peak rotational velocity using Equation A on page 26.

ω = rad / sec = 0.035 x (rotation angle (deg)) / (rotational time (sec))

ω = 0.035 x (180° / 0.1 sec) = 63 rad/sec

b) Using Jm from step 2a and velocity from step 3a, determine KE of the system from the basic KE equation:

IMPERIAL

KE = 1/2 x Jm x ω^2

KE = 0.5 x 0.000234 x 63^2

KE = 0.464 in-lbs

METRIC

KE = 1/2 x Jm x ω^2

KE = 0.5 x 2.64 x 10^{-5} x 63^2

KE = 0.052 N-m

c) Use the KE Energy table on page 26 to select the appropriate RA actuator. The following units satisfy the requirements. 32 mm plain and a 25 or 20 mm with cushions.

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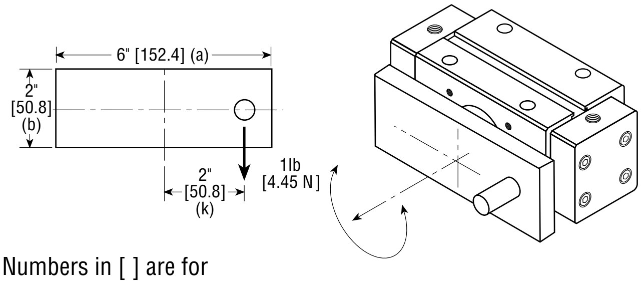
APPLICATION EXAMPLE B

Combination of rectangular plate mounted on center and a point load mounted off center.



Numbers in [ ] are for metric units and are in mm.

1) Determine load information:

	IMPERIAL	METRIC
ROTATION ANGLE / TIME	180° / 0.5 sec	180° / 0.5 sec
RECTANGULAR PLATE	Steel Plate	Steel Plate
WEIGHT	1.698 lb	7.55 N
MASS		0.77 Kg
POINT LOAD	1 lb (2" off center)	4.45 N (50.8 mm off center)
PRESSURE	87 psi	6 bar
SAFETY FACTOR	2	2

2) Determine torque requirement for the application:

a) Calculate Rotational Mass Moment of Inertia (Jm) using equations given on page 27.

POINT LOAD

IMPERIAL

$Jm = (F_g / g) \times k^2$

$Jm = (1 \text{ lb} / 386.4) \times (2 \text{ in})^2$

$Jm = 0.0104 \text{ in-lb-sec}^2$

METRIC

$Jm = (F_g / g) \times k^2$

$Jm = (4.45 \text{ N} / 9.81) \times (0.0508 \text{ m})^2$

$Jm = 0.00117 \text{ N-m-sec}^2$

RECTANGULAR PLATE

IMPERIAL

$Jm = (F_g / g) \times ((a^2 + b^2) / 12)$

$Jm = (1.698 / 386.4) \times ((6^2 + 2^2) / 12)$

$Jm = 0.0146 \text{ in-lb-sec}^2$

Total $Jm = 0.0146 + 0.0104 = 0.025 \text{ in-lb-sec}^2$

METRIC

$Jm = (F_g / g) \times ((a^2 + b^2) / 12)$

$Jm = (7.55 / 9.81) \times ((0.1524^2 + 0.0508^2) / 12)$

$Jm = 0.00165 \text{ N-m-sec}^2$

Total $Jm = 0.00165 + 0.00117 = 0.00282 \text{ N-m-sec}^2$

b) Determine required acceleration of the load:

$\alpha = 0.035 \times (\text{rotational angle (deg)}) / (\text{time (sec)}^2)$

$\alpha = 0.035 \times (180° / (0.5 \text{ sec})^2) = 25.2 \text{ rad/sec}^2$

c) Calculate required torque:

POINT LOAD

IMPERIAL

$T = ((Jm \times \alpha) + (F_g \times k)) \times 2$

$T = ((0.0140 \times 25.2) + (1 \times 2)) \times 2$

$T = 4.5 \text{ in-lbs}$

METRIC

$T = ((Jm \times \alpha) + (F_g \times k)) \times SF$

$T = ((0.00117 \times 25.2) + (4.45 \times 0.0508)) \times 2$

$T = 0.51 \text{ N-m}$

RECTANGULAR PLATE

IMPERIAL

$T = Jm \times \alpha \times SF$

$T = 0.0146 \times 25.2 \times 2 = 0.74 \text{ in-lbs}$

Total $T = 4.5 + 0.74 = 5.24 \text{ in-lbs}$

METRIC

$T = Jm \times \alpha \times SF$

$T = 0.00166 \times 25.2 \times 2 = 0.084 \text{ N-m}$

Total $T = 0.51 + 0.084 = 0.594 \text{ N-m}$

To select minimum actuator based on torque, calculate theoretical torque for 87 psi [6 bar] by using table on page 25.

3) Determine the stopping capacity of the actuator for the application:

a) Determine the estimated peak rotational velocity using Equation A on page 26.

$\omega = 0.035 \times (\text{rotation angle (deg)}) / (\text{rotational time (sec)})$

$\omega = 0.035 \times (180° / 0.5 \text{ sec}) = 12.6 \text{ rad/sec}$

b) Using Jm from step 2a and velocity from step 3a, determine KE of the system from the basic KE equation:

IMPERIAL

$KE = 1/2 \times Jm \times \omega^2$

$KE = 0.5 \times 0.025 \times 12.6^2$

$KE = 1.98 \text{ in-lbs}$

METRIC

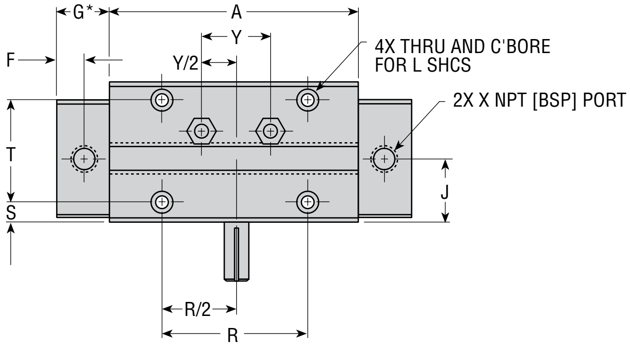
$KE = 1/2 \times Jm \times \omega^2$

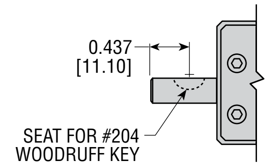
$KE = 0.5 \times 0.00282 \times 12.6^2$

$KE = 0.224 \text{ N-m}$

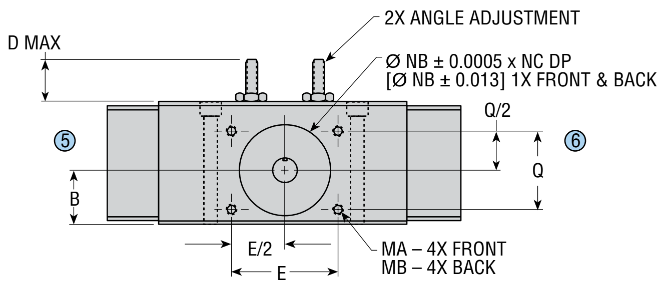
c) Use the KE Energy Table on page 26 to select the appropriate RA actuator. The following units satisfy the requirements: 50 mm plain, 40 or 32 mm with cushions, and a 25 or 20 mm with shock absorbers.

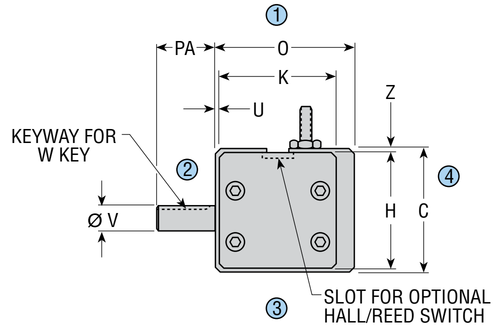
45°, 90°, 135°, or 180° ROTATION UNITS





FOR RAS120 ONLY





NOTES:
1) *G DIMENSION INCREASES WITH CUSHION OPTION. SEE PAGE 32.
2) KEYWAY SHOWN AT MID-ROTATION
3) NUMBERS IN [ ] ARE FOR METRIC UNITS AND ARE IN mm.
4) CIRCLED NUMBERS INDICATE POSITION

BORE SIZE	NOMINAL ROTATION	A	B	C	D	E	F	G	H	J	K	L	MA
20 mm	45° or 90°	3.524 [89.5]	0.807	1.831	0.604	1.574	0.394	0.768	1.712	0.906	1.732	#10	10-24 x 0.281
	135° or 180°	3.760 [95.0]	[20.5]	[46.5]	[15.34]	[40.0]	[10.0]	[19.5]	[43.5]	[23.0]	[44.0]	[M5]	[M5 x 0.8 x 7]
25 mm	45° or 90°	3.819 [97.0]	0.983	2.224	0.724	1.772	0.394	0.768	2.087	1.008	1.929	#10	10-24 x 0.285
	135° or 180°	4.508 [114.5]	[25.0]	[56.5]	[18.39]	[45.0]	[10.0]	[19.5]	[53.0]	[25.6]	[49.0]	[M5]	[M5 x 0.8 x 7]
32 mm	45° or 90°	4.606 [117.0]	1.161	2.697	0.920	2.166	0.394	0.768	2.559	1.179	2.264	1/4	1/4-20 x 0.250
	135° or 180°	5.650 [143.5]	[29.5]	[68.5]	[23.37]	[55.0]	[10.0]	[19.5]	[65.0]	[30.0]	[57.5]	[M6]	[M6 x 1.0 x 7.5]
40 mm	45° or 90°	5.256 [133.5]	1.516	3.366	0.977	2.558	0.472	0.945	3.228	1.566	3.071	5/16	5/16-18 x 0.437
	135° or 180°	6.476 [164.5]	[38.5]	[85.5]	[24.82]	[65.0]	[12.0]	[24.0]	[82.0]	[39.78]	[78.0]	[M8]	[M8 x 1.25 x 12]
50 mm	45° or 90°	6.300 [160.0]	1.674	3.918	1.191	2.952	0.472	0.945	3.720	1.743	3.346	3/8	3/8-16 x 0.375
	135° or 180°	7.343 [186.5]	[42.5]	[99.5]	[30.25]	[75.0]	[12.0]	[24.0]	[94.5]	[44.27]	[85.0]	[M10]	[M10 x 1.5 x 10]

BORE SIZE	MB	NB	NC	O	PA	Q	R	S	T	U	V	W KEY	X NPT [BSP]	Y	Z
20 mm	10-24 x 0.375 [M5 x 0.8 x 12.5]	1.3785 [35.014]	0.085 [2.16]	2.047 [52.0]	1.000 [25.0]	1.180 [30.0]	2.166 [55.0]	0.276 [7.0]	1.496 [38.0]	0.04 [1.0]	0.375/0.374 [10 (h8)]	SEE ABOVE [3 mm SQ x 20 mm]	1/8 [1/8]	1.004 [25.5]	0.06 [1.5]
25 mm	10-24 x 0.500 [M5 x 0.8 x 12.5]	1.4572 [37.013]	0.080 [2.03]	2.362 [60.0]	1.250 [30.0]	1.378 [35.0]	2.362 [60.0]	0.295 [7.5]	1.772 [45.0]	0.044 [1.1]	0.4727/0.4714 [12 (h8)]	1/8 SQ x 1.125 [4 mm SQ x 25 mm]	1/8 [1/8]	1.124 [28.5]	0.08 [2.0]
32 mm	1/4-20 x 0.500 [M6 x 1.0 x 15]	1.8509 [47.013]	0.100 [2.54]	2.835 [72.0]	1.500 [40.0]	1.772 [45.0]	2.952 [75.0]	0.335 [8.5]	2.165 [55.0]	0.05 [1.2]	0.625/0.624 [16 (h8)]	3/16 SQ x 1.250 [5 mm SQ x 32 mm]	1/8 [1/8]	1.458 [37.0]	0.08 [2.0]
40 mm	5/16-18 x 0.750 [M8 x 1.25 x 20]	2.0477 [52.012]	0.115 [2.92]	3.544 [90.0]	1.750 [42.5]	2.164 [55.0]	3.346 [85.0]	0.394 [10.0]	2.756 [70.0]	0.031 [0.8]	0.750/0.749 [17 (h8)]	3/16 SQ x 1.500 [5 mm SQ x 35 mm]	1/8 [1/8]	1.598 [40.6]	0.08 [2.0]
50 mm	3/8-16 x 0.750 [M10 x 1.5 x 20]	2.4414 [62.012]	0.125 [3.17]	3.976 [101.0]	2.000 [55.0]	2.362 [60.0]	3.936 [100.0]	0.452 [11.5]	3.071 [78.0]	0.07 [1.8]	0.875/0.874 [22 (h8)]	3/16 SQ x 1.750 [6 mm SQ x 45 mm]	1/4 [1/4]	1.984 [50.4]	0.10 [2.5]

CAD & Sizing Assistance

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

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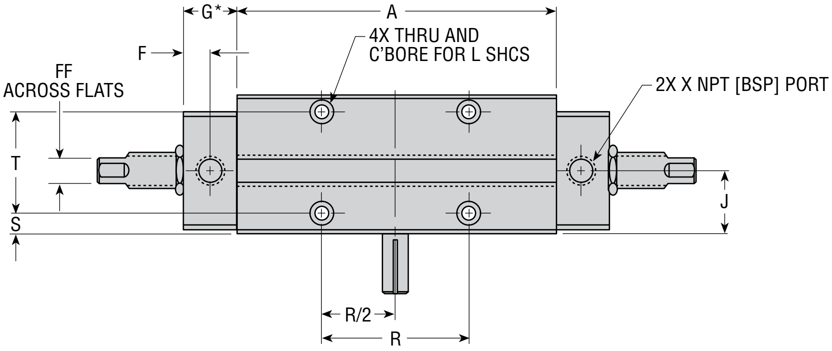
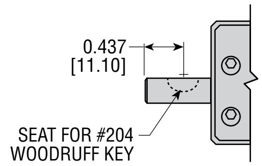
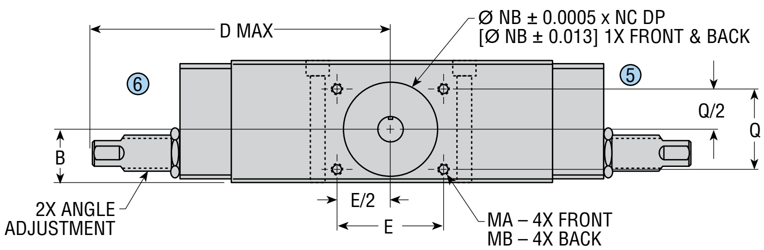
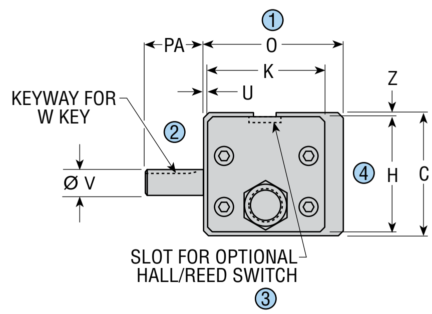
225° or 270° ROTATION UNITS





FOR RAS120 ONLY





NOTES:
1) *G DIMENSION INCREASES WITH CUSHION OPTION. SEE PAGE 32.
2) KEYWAY SHOWN AT MID-ROTATION
3) NUMBERS IN [ ] ARE FOR METRIC UNITS AND ARE IN mm.
4) CIRCLED NUMBERS INDICATE POSITION

BORE SIZE	NOMINAL ROTATION	A	B	C	D	E	F	G	H	J	K	L	MA	MB
20 mm	225° or 270°	4.390 [111.5]	0.807 [20.5]	1.831 [46.5]	4.39 [111.5]	1.574 [40.0]	0.394 [10.0]	0.768 [19.5]	1.712 [43.5]	0.906 [23.0]	1.732 [44.0]	#10 [M5]	10-24 x 0.281 [M5 x 0.8 x 7]	10-24 x 0.375 [M5 x 0.8 x 12.5]
25 mm	225° or 270°	5.295 [134.5]	0.983 [25.0]	2.224 [56.5]	5.06 [128.5]	1.772 [45.0]	0.394 [10.0]	0.768 [19.5]	2.087 [53.0]	1.008 [25.6]	1.929 [49.0]	#10 [M5]	10-24 x 0.285 [M5 x 0.8 x 7]	10-24 x 0.500 [M5 x 0.8 x 12.5]
32 mm	225° or 270°	6.693 [170.0]	1.161 [29.5]	2.697 [68.5]	5.87 [149.1]	2.166 [55.0]	0.394 [10.0]	0.768 [19.5]	2.559 [65.0]	1.179 [30.0]	2.264 [57.5]	1/4 [M6]	1/4-20 x 0.250 [M6 x 1.0 x 7.5]	1/4-20 x 0.500 [M6 x 1.0 x 15]
40 mm	225° or 270°	7.736 [196.5]	1.516 [38.5]	3.366 [85.5]	6.66 [169.1]	2.558 [65.0]	0.472 [12.0]	0.945 [24.0]	3.228 [82.0]	1.566 [39.78]	3.071 [78.0]	5/16 [M8]	5/16-18 x 0.437 [M8 x 1.25 x 12]	5/16-18 x 0.750 [M8 x 1.25 x 20]
50 mm	225° or 270°	8.917 [226.5]	1.674 [42.5]	3.918 [99.5]	7.32 [186.0]	2.952 [75.0]	0.472 [12.0]	0.945 [24.0]	3.720 [94.5]	1.743 [44.27]	3.346 [85.0]	3/8 [M10]	3/8-16 x 0.375 [M10 x 1.5 x 10]	3/8-16 x 0.750 [M10 x 1.5 x 20]

BORE SIZE	NB	NC	O	PA	Q	R	S	T	U	V	W KEY	X NPT [BSP]	Z	FF
20 mm	1.3785 [35.014]	0.085 [2.16]	2.047 [52.0]	1.000 [25.0]	1.180 [30.0]	2.166 [55.0]	0.276 [7.0]	1.496 [38.0]	0.04 [1.0]	0.375/0.374 [10 (h8)]	SEE ABOVE [3 mm SQ x 20 mm]	1/8 [1/8]	0.06 [1.5]	0.39 [10.0]
25 mm	1.4572 [37.013]	0.080 [2.03]	2.362 [60.0]	1.250 [30.0]	1.378 [35.0]	2.362 [60.0]	0.295 [7.5]	1.772 [45.0]	0.044 [1.1]	0.4727/0.4714 [12 (h8)]	1/8 SQ x 1.125 [4 mm SQ x 25 mm]	1/8 [1/8]	0.08 [2.0]	0.47 [12.0]
32 mm	1.8509 [47.013]	0.100 [2.54]	2.835 [72.0]	1.500 [40.0]	1.772 [45.0]	2.952 [75.0]	0.335 [8.5]	2.165 [55.0]	0.05 [1.2]	0.625/0.624 [16 (h8)]	3/16 SQ x 1.250 [5 mm SQ x 32 mm]	1/8 [1/8]	0.08 [2.0]	0.71 [18.0]
40 mm	2.0477 [52.012]	0.115 [2.92]	3.544 [90.0]	1.750 [42.5]	2.164 [55.0]	3.346 [85.0]	0.394 [10.0]	2.756 [70.0]	0.031 [0.8]	0.750/0.749 [17 (h8)]	3/16 SQ x 1.500 [5 mm SQ x 35 mm]	1/8 [1/8]	0.08 [2.0]	0.91 [23.0]
50 mm	2.4414 [62.012]	0.125 [3.17]	3.976 [101.0]	2.000 [55.0]	2.362 [60.0]	3.936 [100.0]	0.452 [11.5]	3.071 [78.0]	0.07 [1.8]	0.875/0.874 [22 (h8)]	3/16 SQ x 1.750 [6 mm SQ x 45 mm]	1/4 [1/4]	0.10 [2.5]	0.91 [23.0]

All dimensions are reference only unless specifically toleranced.

PB PORT CONTROL® BOTH DIRECTIONS

PC PORT CONTROL® COUNTERCLOCKWISE DIRECTION

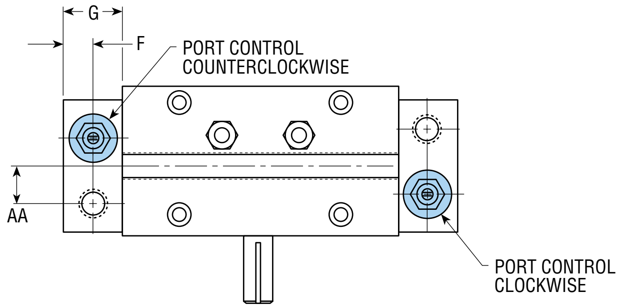
PW PORT CONTROL® CLOCKWISE DIRECTION

PHD Port Control® is a built-in flow control valve for controlling the speed through complete shaft rotation. The Port Control® is based on the "meter-out" principle and features an adjustable needle in a cartridge with an external check seal. The self-locking needle has micrometer threads and is adjustable under pressure. It determines the orifice size which controls the exhaust flow rate of the actuator. The check seal expands while air is exhausting from the actuator, forcing the air to exhaust past the adjustable needle. The check seal collapses to allow a free flow of incoming air. The PHD Port Control® saves space and eliminates the cost of fittings and installation for external flow control valves.

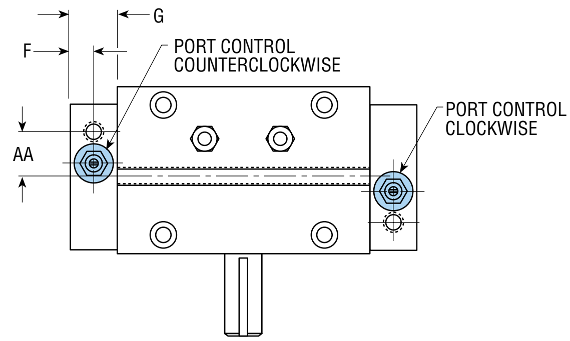
NOTE: Port Control® may not be effective below operating pressures of 10 psi [0.7 bar].

BORE SIZE	F	G	AA
20 mm	0.394 [10.0]	0.768 [19.5]	0.374 [9.5]
25 mm	0.394 [10.0]	0.768 [19.5]	0.374 [9.5]
32 mm	0.394 [10.0]	0.768 [19.5]	0.374 [9.5]
40 mm	0.472 [12.0]	0.945 [24.0]	0.965 [24.5]
50 mm	0.472 [12.0]	0.945 [24.0]	1.083 [27.5]

Numbers in [ ] are for metric units and are in mm.



RASx20, RASx25, RASx32



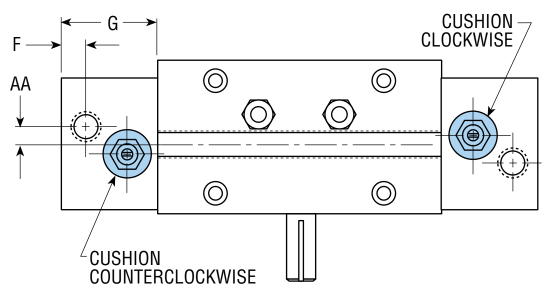
RASx40 & RASx50

DB CUSHION BOTH DIRECTIONS

DC CUSHION COUNTERCLOCKWISE DIRECTION

DW CUSHION CLOCKWISE DIRECTION

PHD Cushions allow for smooth deceleration at the end of rotation. When the cushion operates, the remaining volume of air in the actuator must exhaust past an adjustable needle, which controls the deceleration of the pinion shaft. The effective length of the cushion is approximately 40° of rotation at the end of full nominal rotation. The use of angle adjustment screws to reduce the angle of rotation has a direct effect on the length of cushion engagement. Example: 5° of angle reduction on one end will reduce cushion engagement by 5° on that end of rotation.



BORE SIZE	F	G	AA
20 mm	0.315 [8.0]	1.280 [32.5]	0.118 [3.0]
25 mm	0.315 [8.0]	1.280 [32.5]	0.118 [3.0]
32 mm	0.315 [8.0]	1.280 [32.5]	0.118 [3.0]
40 mm	0.394 [10.0]	1.378 [35.0]	—
50 mm	0.394 [10.0]	1.378 [35.0]	—

Numbers in [ ] are for metric units and are in mm.

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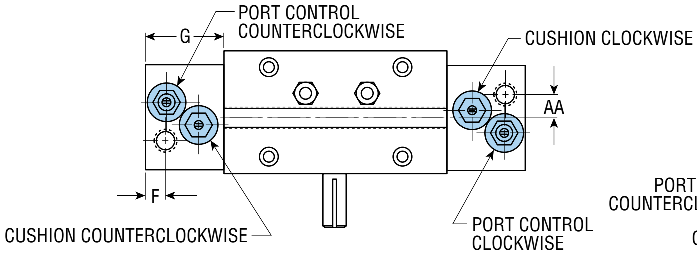
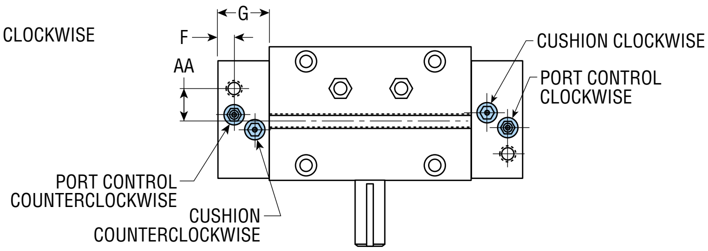
PORT CONTROL® AND CUSHION LOCATIONS



RASx20, RASx25, RASx32, RASx40



RASx50

BORE SIZE	F	G	AA
20 mm	0.335 [8.5]	1.280 [32.5]	0.374 [9.5]
25 mm	0.335 [8.5]	1.280 [32.5]	0.374 [9.5]
32 mm	0.335 [8.5]	1.280 [32.5]	0.374 [9.5]
40 mm	0.394 [10.0]	1.378 [35.0]	0.453 [11.5]
50 mm	0.453 [11.5]	1.378 [35.0]	1.083 [27.5]

Numbers in [ ] are for metric units and are in mm.

E MAGNETS FOR PHD SOLID STATE HALL EFFECT SWITCHES

This option equips the rotary actuator with magnets on the rack for use with PHD Series 5360 Hall Effect Switches. These switches mount easily to the actuator using the "T" slot in the top of the body.

SERIES 5360 HALL EFFECT SWITCHES

PART NO.	COLOR	DESCRIPTION
53603-1-02	Yellow	NPN (Sink) 4.5-24 VDC, 2 meter cable
53604-1-02	Red	PNP (Source) 4.5-24 VDC, 2 meter cable
53623-1	Yellow	NPN (Sink) 4.5-24 VDC, Quick Connect
53624-1	Red	PNP (Source) 4.5-24 VDC, Quick Connect

M MAGNETS FOR PHD REED SWITCHES

This option equips the rotary actuator with magnets on the rack for use with PHD Series 5360 Reed Switches. These switches mount easily to the actuator using the "T" slot in the top of the body.

SERIES 5360 REED SWITCHES

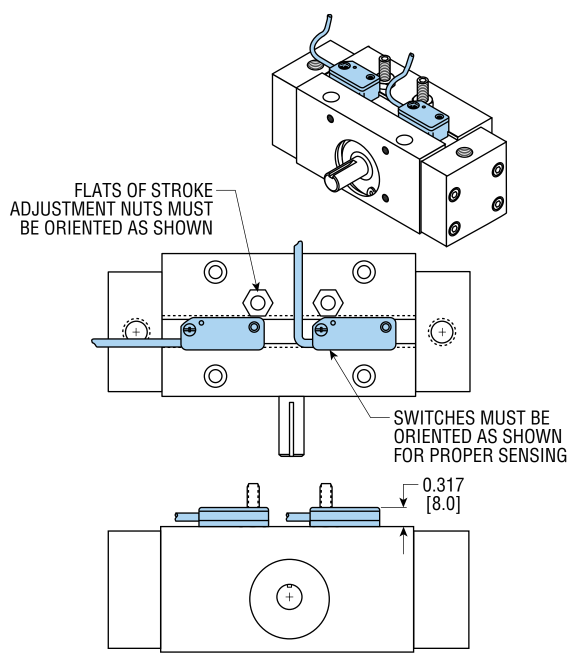
PART NO.	COLOR	DESCRIPTION
53602-2-02	White	Sink or Source Type 4.5-24 VDC, 2 meter cable
53622-2	White	Sink or Source Type VDC, Quick Connect

I MAGNETS FOR PHD SOLID STATE MAGNETORESISTIVE SWITCHES

This option equips the rotary actuator with magnets on the rack for use with PHD Magnetoresistive Switches. These switches mount easily to the actuator using the "T" slot in the top of the body.

SERIES 5360 MAGNETORESISTIVE SWITCHES

PART NO.	COLOR	DESCRIPTION
53605-1-02	Black	NPN 6-24 VDC, 2 meter cable
53606-1-02	Orange	PNP 6-24 VDC, 2 meter cable
53625-1	Black	NPN 6-24 VDC, Quick Connect
53626-1	Orange	PNP 6-24 VDC, Quick Connect



PHD Series 5360 Hall Effect and Reed Switches are designed specifically to provide an input signal to various types of programmable controllers or logic systems. **See Switches and Sensors catalog for information on the Series 5360 Switches.**

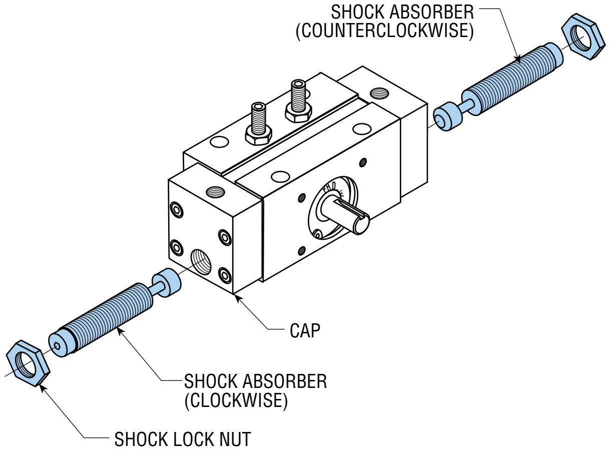
NOTE: When mounting switches on the 20 mm and 25 mm bore units with rotations up to 180°, see the drawing above. Minimum rotation on a 20 mm bore unit with two switches is 45°.

All dimensions are reference only unless specifically toleranced.

NB SHOCK ABSORBER INSTALLED BOTH DIRECTIONS

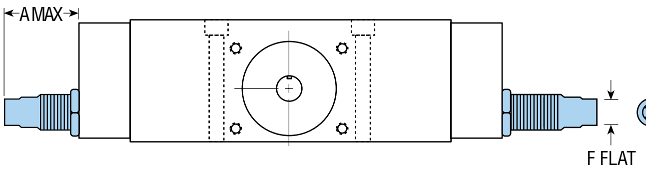
NC SHOCK ABSORBER INSTALLED COUNTERCLOCKWISE DIRECTION

NW SHOCK ABSORBER INSTALLED CLOCKWISE DIRECTION



The hydraulic shock absorber options are designed for the maximum in deceleration control and rotational stopping ability. The -NB, -NC, and -NW options provide the rotary actuator with the hydraulic shock absorber installed in the appropriate location(s). See page 26 for details on unit stopping capacity with built-in shock absorbers. Shock absorbers are nominally effective for 45° of rotation each direction.

NOTE: The shock absorber doubles as the rotation adjustment on units with rotations greater than 180°.



SHOCK ABSORBER SPECIFICATIONS

BORE SIZE	PHD SHOCK ABSORBER NO.	THREAD TYPE	STROKE		SHOCK ABSORBER WEIGHT		KINETIC ENERGY LOAD		A MAX.		F FLATS	
			in	mm	lb	kg	in-lb	Nm	in	mm	in	mm
20 mm	56722-01	M12 x 1	0.39	10.0	0.11	0.05	3.3	0.36	2.25	57.2	0.31	8
25 mm	56722-02	M14 x 1.5	0.42	10.7	0.13	0.06	9.3	1.05	2.37	60.2	0.47	11.9
32 mm	56722-03	M20 x 1.5	0.25	6.35	0.34	0.15	21.3	1.71	2.41	61.2	0.69	17.5
40 mm	56722-04*	M25 x 1.5	0.5	12.7	0.67	0.3	45.0	5.1	3.38	85.7	0.88	22.4
50 mm	56722-05*	M25 x 1.5	0.5	12.7	0.67	0.3	87.9	9.94	3.44	87.4	0.88	22.4

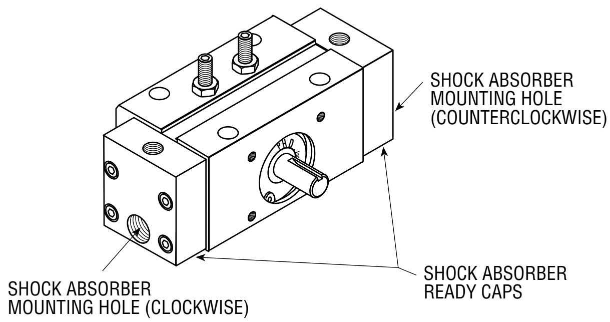
*These shock absorbers have an adjustment feature. See Engineering Data pages for details.

GS SHOCK ABSORBER READY BOTH DIRECTIONS

GT SHOCK ABSORBER READY COUNTERCLOCKWISE DIRECTION

GU SHOCK ABSORBER READY CLOCKWISE DIRECTION

The -GS, -GT, and -GU options should only be used if the shock absorber(s) is to be supplied separately from the rotary actuator. These options provide a unit that has provisions for installing hydraulic shock absorbers but have no shock absorbers included. See page 26 for details on unit stopping capacity with built-in shock absorbers.



NOTE: The shock absorber doubles as the rotation adjustment on units with rotations greater than 180°. Shock absorbers must be installed in the rotary actuator prior to operating the unit. Operation of units with shock absorber ready options without installed shocks can damage the units and void any and all warranties. Only shock absorbers specified by PHD should be used in Series RA Rotary Actuators. The use of any other shock absorbers will affect actuator performance and life expectancy.

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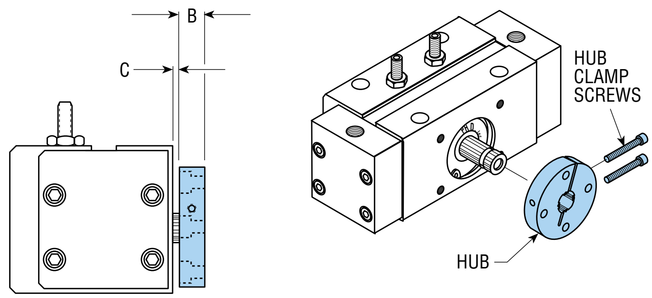
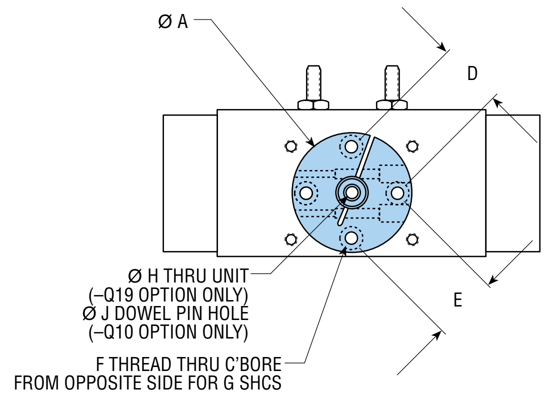
Q10 OUTPUT HUB

This option provides an output hub in place of the conventional pinion shaft. The hub includes four thru holes counterbored from one surface and threaded from the other, allowing easy mounting of fixturing, tooling, or other actuators requiring a flat surface area. The hub is manufactured from alloy aluminum and comes assembled to a specially designed low profile pinion shaft. The hub can be removed to allow custom machining for specific mounting needs. The hub hole pattern can be oriented in 22.5° increments. Separate hubs are available in a kit complete with all hardware. See chart below.





Q19 OUTPUT HUB WITH HOLLOW PINION SHAFT

This option provides an output hub with a hollow pinion shaft in place of the standard pinion shaft. The hub has four thru holes counterbored from one surface and threaded from the other, allowing easy mounting of fixturing, tooling, or other actuators requiring a flat surface area. The pinion shaft is hollow for feeding pneumatic or electrical lines from the back of the rotary actuator to the output hub. The hub is manufactured from alloy aluminum and comes assembled to a specially designed low profile pinion shaft. The hub can be removed to allow custom machining for specific mounting needs. It can also be rotated in 22.5° rotations. Kinetic energy ratings are reduced by 10% for this option.

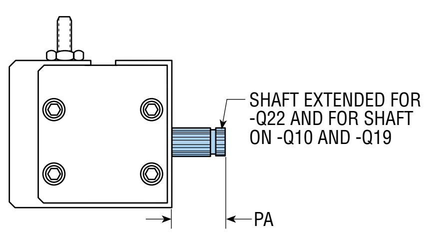
NOTE: Available on 32 mm, 40 mm, and 50 mm units.

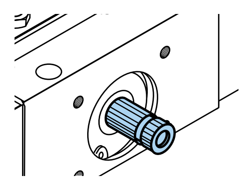
HUB REPLACEMENT KITS

BORE SIZE	FINISHED HUB KIT	
	IMPERIAL	METRIC
20 mm	57651-2721-1	57658-2771-1
25 mm	57652-2731-1	57659-2781-1
32 mm	57653-2741-1	57660-2791-1
40 mm	57654-2751-1	57661-2801-1
50 mm	57655-2761-1	57662-2811-1

Q22 SPLINED OUTPUT SHAFT ONLY

This option provides a splined pinion shaft that is ready to attach output hubs as in -Q10 option. (No hub supplied).





Q22 - Splined Output Shaft

BORE SIZE	A	B	C	D	E	F	G	H	J	PA
20 mm	1.535 [39.0]	0.374 [9.5]	0.100 [2.5]	0.787 [20.0]	0.787 [20.0]	8-32 [M4 x 0.7]	#4 [M3]	—	0.1264 x 0.25 DP [3.21 x 6.4 DP]	0.474 [12.0]
25 mm	1.772 [45.0]	0.374 [9.5]	0.100 [2.5]	0.945 [24.0]	0.945 [24.0]	10-32 [M5 x 0.8]	#6 [M4]	—	0.1264 x 0.25 DP [3.21 x 6.4 DP]	0.474 [12.0]
32 mm	2.165 [55.0]	0.492 [12.5]	0.100 [2.5]	1.102 [28.0]	1.102 [28.0]	1/4-28 [M6 x 1.0]	#10 [M4]	0.276 [7.0]	0.2514 x 0.50 DP [6.39 x 12.7 DP]	0.592 [15.0]
40 mm	2.717 [69.0]	0.492 [12.5]	0.100 [2.5]	1.398 [35.5]	1.398 [35.5]	1/4-28 [M8 x 1.25]	#10 [M6]	0.315 [8.0]	0.2514 x 0.50 DP [6.39 x 12.7 DP]	0.590 [15.0]
50 mm	2.953 [75.0]	0.748 [19.0]	0.100 [2.5]	1.575 [40.0]	1.575 [40.0]	7/16-20 [M10 x 1.5]	3/8 [M8]	0.394 [10.0]	0.2514 x 0.50 DP [6.39 x 12.7 DP]	0.848 [21.5]

Numbers in [ ] are for metric units and are in mm.

All dimensions are reference only unless specifically toleranced.

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