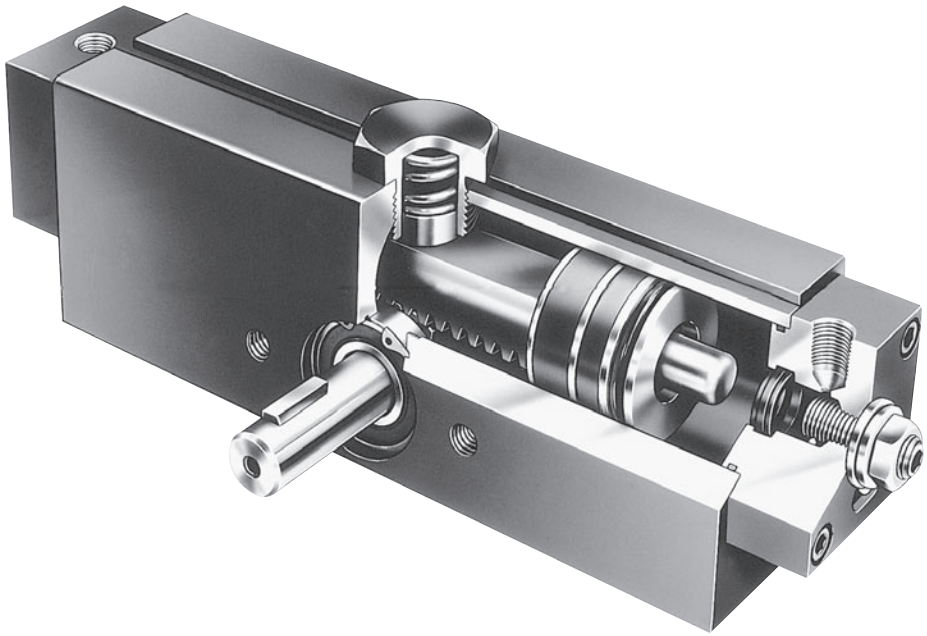
XR Series

Small Pneumatic Rack & Pinion Rotary Actuators



Contents

For installation, maintenance and replacement parts information, go to www.parker.com.

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A076

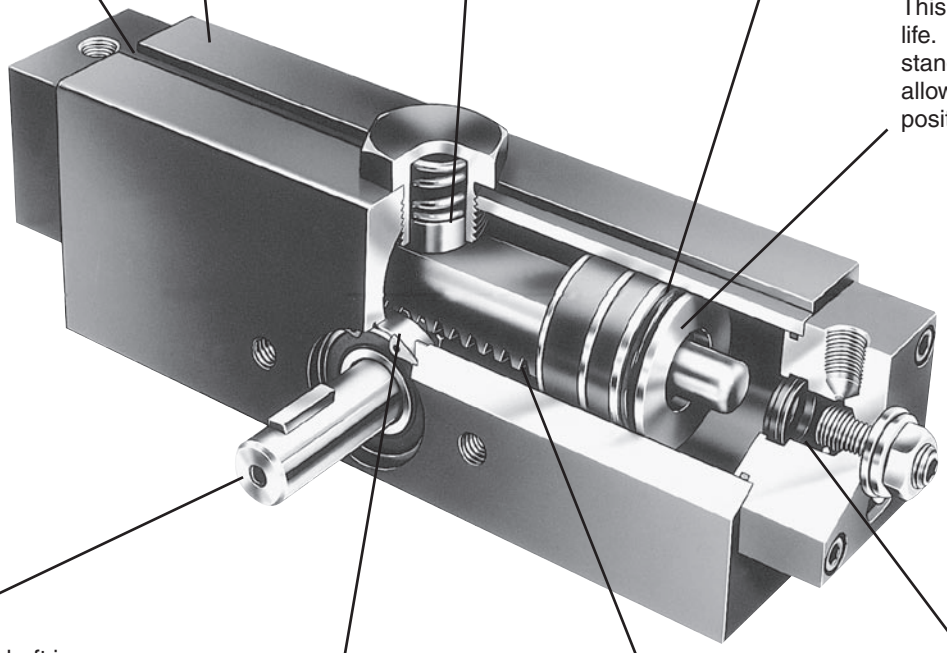
Housing
Manufactured from a precision alumunim extrusion, the body is hard coat anodized and permanently sealed, providing long seal life and corrosion resistance in a simple one-piece package.

Piston Seals
A self-lubricated, abrasion resistant nitrile compound propvides low breakaway pressures and long seal life – with or wirhout added lubrication.

Sensor Mounting
All housings incorporate a unique "T" slot designed for attaching reed or Hall Effect sensors.

Anti-Backlash Option
A spring loaded Delrin AF shoe preloads the rack into the pinion providing a simple and cost effective means of eliminating backlash throughout the stroke of the actuator.

Piston
Precision machined from aluminum, the piston incorporates a PTFE wear band which eliminates metal-to-metal contact. This greatly increases seal life. A magnet groove is standard on all pistons, allowing field conversion to position sensing.



Shaft
The output shaft is machined from tempered stainless steel providing strength and corrosion resistance for the most demanding applications.

Sealed Ball Bearings
Precision ball bearings reduce friction and provide rugged pinion and shaft support.

Rack & Pinion Gear
Manufactured from carborized and tempered steel, the rack and pinion offer maximum strength and shock resistance.

Cushions
Flow paths molded on the circumference of the seal allow exceptionally rapid return stroke without the use of spring-loaded ball checks. Cushion screw is held captive.

3D CAD FILES
available for download at
parker.com/pneumatics

Model Code and Ordering Information

Example: XR151 - 0903FP - AB21MV - A

XR	15	1	–	090	3	F	P	–	A	B	2	1	M	V	–	A	

Actuator Bore Size

05	0.56 inch
07	0.75 inch
10	1.06 inch
15	1.50 inch
20	2.00 inch

Configuration

1	STD
7	Antibacklash Unit

Rotation

090	90° [1]
100	100°
180	180° [1]
190	190°
270	270° [1]
280	280°
360	360° [1]
370	370°

Cushions/Bumpers

Omit	None
1	Cushioned CW Rotation[2]
2	Cushioned CCW Rotation[2]
3	Cushioned Both Rotations
5	Bumper CW Rotation[2]
6	Bumper CCW Rotation[2]
7	Bumper Both Rotations
9	Special

Cushions not available on Model 05.
Bumpers available in 90°, 180°, 270° and 360° only.

Stroke Adjuster/Shock Absorber

Omit	None
D	Stroke Adj. Only CW Rotation[2]
E	Stroke Adj. Only CCW Rotation[2]
F	Stroke Adj. Only Both Rotations
H	Shock/Stroke Adj. CW Rotation[2]
K	Shock/Stroke Adj. CCW Rotation[2]
L	Shock/Stroke Adj. Both Rotations
X	Special

Shock/Stroke adjust option not available with cushions, bumpers, or Models 05 & 07.

Right Angle Flow Control (External)

Omit	None
P	NPTF (Sizes 10,15 & 20 only)
T	Presto-lok Tube Fitting

Mounting

A	Front Face/Base (STD)
R	Rear Face/Base
X	Special

Shaft

B	Single Male Keyed (STD)
C	Double Male Keyed
R	Preload Keyway (Sizes 10,15 & 20 only)
P	Milled Flat (Sizes 05 & 07 only)
X	Special

Port Thread

2	NPTF (10-32/M5 on Sizes 05 and 07)
9	Special

Port Location

1	Side: Position 1 [3]
2	Side: Position 2
3	Side: Position 3
4	Side: Position 4
5	End: Position 5 (STD)[4]
9	Special

Position 5 not possible with cushion or stroke adjust options.

Magnet Option

Omit	None (STD)
M	Magnetic Piston Ring

Seals[5]

Omit	Nitrile (STD)
V	Fluorocarbon
X	Special

Design Series

A	Current design

Special Options

Omit - STD

Two digit code assigned by factory when any "X"or "9" appears in the model number or when special options or features are required. Detail special options in clear text.

NOTES:

1 To obtain equal rotation both sides of midstroke (theoretical 12:00), order 10° longer rotation than standard with stroke adjusters.
2 Viewed from shaft end.
3 Standard position whenever stroke adjusters and/or cushions are specified.
4 Standard position for units without stroke adjusters and/or cushions.
5 With Fluorocarbon option please review temperature limitations of other options.

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Specifications

- Maximum operating pressure: 150 psi
- Output torque at 100 psi: 6 to 236 lb-in
- Standard rotations: 90°, 100°, 180°, 190°, 270°, 280°, 360°, 370°
- Maximum breakaway pressure:

XR05	10 psi
XR07	7 psi
XR10, 15, 20	5 psi

- Zero internal and external leakage
- Mounting orientation: unrestricted
- Timing: keyway located at 12:00 position at midstroke of actuator.
- Operating temperature:

Standard seals	0° to 180°F (-18° to 82°C)
Fluorocarbon seals	0° to 250°F (-18° to 121°C)

- Filtration requirement: 40 micron filtered, dry air

Unit Weights (lb)

Model	Rotation Degrees			
	90/100	180/190	270/280	360/370
05	0.43	0.51	0.58	0.65
07	1.1	1.3	1.6	1.8
10	1.7	2.0	2.5	2.8
15	3.6	4.3	5.2	6.0
20	7.2	8.8	10.7	12.3

Quick Reference Data

Model	Theoretical Output Torque (lb-in) at Various Inlet Pressures[1]			Displacement Per Degree Rotation (in^3/°)	Maximum Angular Backlash (min)[2]	Maximum Rotational Tolerance (°)
	50	75	100			
05	3	4.5	6	0.001	90	-0, +8
07	8	12	17	0.003	60	-0, +6
10	20	30	40	0.007	50	-0, +5
15	49	74	99	0.017	40	-0, +4
20	118	177	236	0.041	30	-0, +3

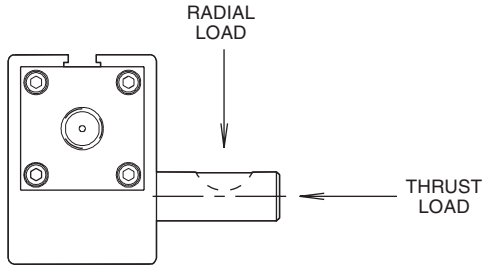
1 Allow 10% for frictional losses.
2 Backlash is zero when anti-backlash option is specified.

A076

Bearing Load Capacities & Kinetic Energy Ratings

Model	Bearing Load Capacities (lb)*		Distance Between Bearings	Maximum Kinetic Energy Rating for Models Based on Configuration (in-lb)			
	Radial	Thrust		Standard/Stroke Adj.	Bumpers	Cushions	Shock Absorbers
05	100	25	0.51	0.06	0.12	N/A	N/A
07	250	75	0.72	0.21	0.41	0.83	N/A
10	375	100	0.94	0.46	0.92	1.84	3.69 / 6300 cycles/hr
15	500	125	1.34	0.96	1.91	3.83	9.57 / 10,600 cycles/hr
20	750	175	1.63	2.63	5.25	10.50	26.26 / 13,000 cycles/hr

* Bearing capacities only. Check Kinetic Energy ratings to determine if actuator will stop load.



Kinetic Energy Calculations

In many cases, the size and life of a rotary actuator is determined not by its torque output, but rather by its energy dissipation capability. This is based on the assumption that if the actuator is capable of stopping the load, it is certainly capable of starting the load.

Both torque output and kinetic energy absorption must be considered if the actuator physically stops the load.

To calculate Kinetic Energy, the following variables are required:

1. Rotational Mass Moment of Inertia (J_m) - See next page.
2. Total Rotation (Degrees)
3. Rotation Time (Seconds)

KINETIC ENERGY BASIC FORMULA

$KE = 1/2\ J_m\omega^2$

$$\omega = 0.035 \times \frac{\text{Angle Traveled (deg.)}}{\text{Rotation Time (sec.)}}$$

where

KE = Kinetic Energy (in-lb)

J_m = Rotational Mass Moment of Inertia (in-lb-sec^2)
See next page for formulas.

ω = Peak Velocity (rad/sec)
(Assuming twice average velocity)

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Kinetic Energy Basic Formula

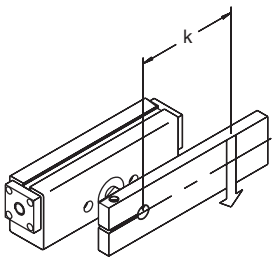
$KE = 1/2\ Jm\omega^2$

$$\omega = 0.035 \times \frac{\text{Angle Traveled (Deg.)}}{\text{Rotation Time (Sec.)}}$$

where
KE = Kinetic Energy (in-lb)
Jm = Rotational mass moment of inertia (in-lb-sec^2)
(Dependent on physical size of object and weight)
ω = Peak Velocity (rad/sec) (Assuming twice average velocity)
W = Weight of load (lb)
g = Gravitational constant = 386.4 in/sec^2
k = Radius of gyration (in)

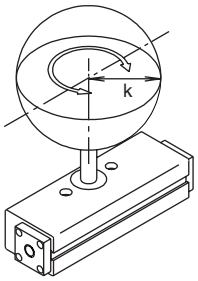
Moments of Inertia

POINT LOAD



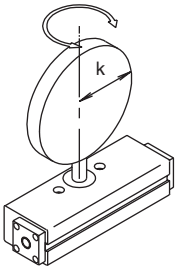
$$Jm = \frac{W}{g} \times k^2$$

SOLID SPHERE -
Mounted on center



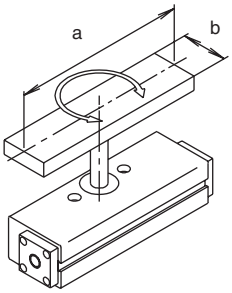
$$Jm = \frac{2}{5} \times \frac{W}{g} \times k^2$$

THIN DISK-
End mounted on center



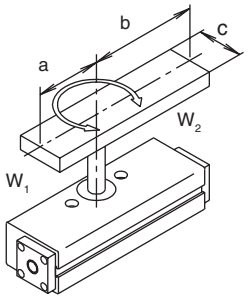
$$Jm = \frac{W}{g} \times \frac{k^2}{4}$$

THIN RECTANGULAR PLATE -
Mounted on center



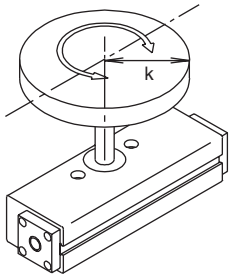
$$Jm = \frac{W}{g} \times \frac{a^2 + b^2}{12}$$

THIN RECTANGULAR PLATE -
Mounted off center



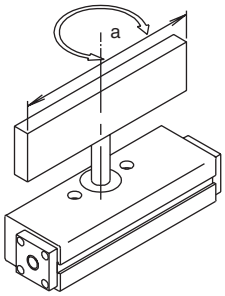
$$Jm = \frac{W_1}{g} \times \frac{4a^2 + c^2}{12} + \frac{W_2}{g} \times \frac{4b^2 + c^2}{12}$$

THIN DISK-
Mounted on center



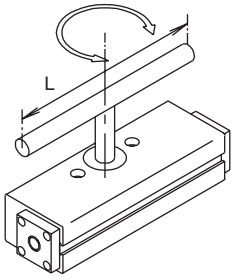
$$Jm = \frac{W}{g} \times \frac{k^2}{2}$$

THIN RECTANGULAR PLATE-
End mounted on center



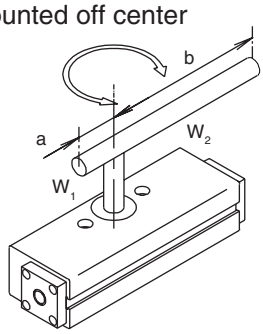
$$Jm = \frac{W}{g} \times \frac{a^2}{12}$$

SLENDER ROD-
Mounted on center



$$Jm = \frac{W}{g} \times \frac{L^2}{12}$$

SLENDER ROD -
Mounted off center



$$Jm = \frac{W_1}{g} \times \frac{a^2}{3} + \frac{W_2}{g} \times \frac{b^2}{3}$$

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Standard Face/Base Mount (A) and Single Male Keyed Shaft (B)

Double Male Keyed Shaft (C) shown in phantom. Keyway shown in midstroke.

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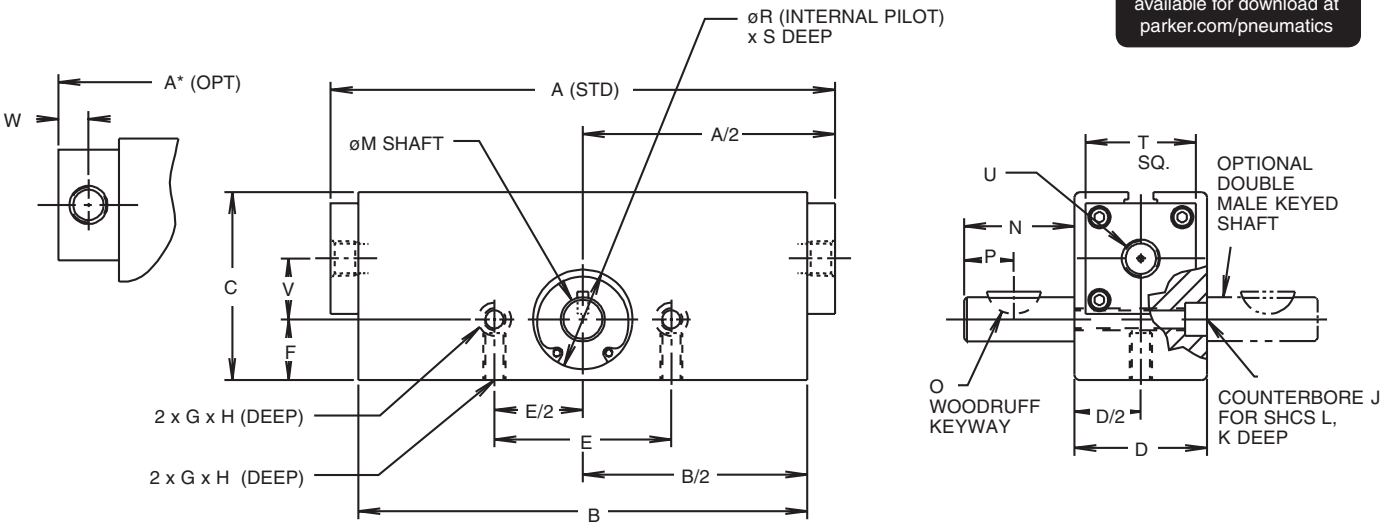


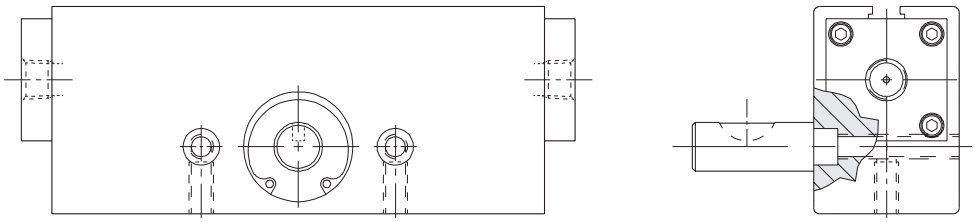
Model	90/100° Rotation			180/190° Rotation			270/280° Rotation			360/370° Rotation		
	A STD	A* OPT	B	A STD	A* OPT	B	A STD	A* OPT	B	A STD	A* OPT	B
05	4.00	4.50	3.62	4.78	5.28	4.41	5.57	6.07	5.19	6.35	6.85	5.98
07	4.89	5.52	4.39	6.00	6.63	5.50	7.38	8.00	6.88	8.49	9.11	7.99
10	5.71	6.46	5.08	7.04	7.79	6.41	8.69	9.43	8.06	10.03	10.77	9.40
15	7.11	7.86	6.24	8.78	9.53	7.90	10.84	11.59	9.97	12.51	13.26	11.63
20	8.66	9.67	7.54	10.89	11.89	9.76	13.64	14.64	12.51	15.86	16.87	14.74

*When cushions, stroke adjusters or shock absorbers are specified, A (OPT) dimensions apply.

Model	C	D	E	F	G	H	J	K	L	M	N	O	P	R	S	T	U	V	W
05	1.30	0.88	1.000	0.41	#8-32	0.31	0.22	0.13	#5	.2500 .2495	0.75	#202.5	0.31	0.625 0.624	0.04	0.75	10-32 (M5)	0.39	0.19
07	1.75	1.25	1.500	.56	#10- 32	0.38	0.25	0.31	#6	.3750 .3745	1.00	#304	0.44	0.875 0.874	0.07	1.00	10-32 (M5)	0.56	0.31
10	2.13	1.50	2.000	.69	1/4- 20	0.53	0.38	0.38	#10	.5000 .4995	1.25	#405	0.56	1.125 1.124	0.07	1.25	1/8 NPTF	0.69	0.34
15	2.75	2.00	2.500	.81	5/16- 18	0.63	0.41	0.25	1/4	.6250 .6245	1.50	#606	0.62	1.375 1.374	0.10	1.75	1/8 NPTF	0.94	0.41
20	3.56	2.50	3.000	1.06	3/8- 16	0.75	0.50	0.38	5/16	.8750 .8745	2.00	#608	0.75	1.875 1.874	0.12	2.25	1/4 NPTF	1.25	0.56

Optional Rear Face/Base Mount (R)

The optional Rear Face/Base mount incorporates the through bolt counterbore on the same side as the shaft thus providing a rear face mounting for the actuator. All other dimensions remain the same as the standard Face/Base mounting.



Rear Face/ Base (R)

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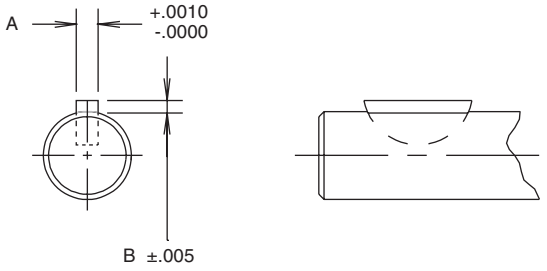
Shaft Type (B, C, P, R)

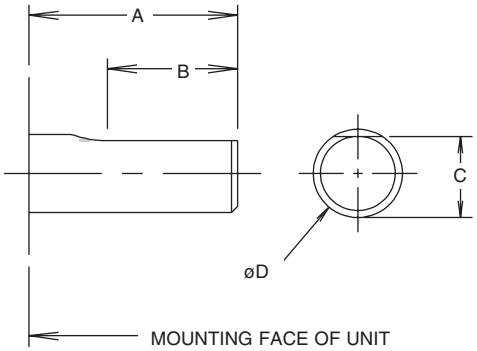
Units are equipped standard with single male woodruff keyed shaft (B). A double male keyed shaft (C) is also available as shown in phantom on the previous page. A milled flat (P) and preload keyway (R) are also available.

Size	Available Option			
	B	C	P	R
05	●	●	●	
07	●	●	●	
10	●	●		●
15	●	●		●
20	●	●		●



Woodruff Key (B, C)

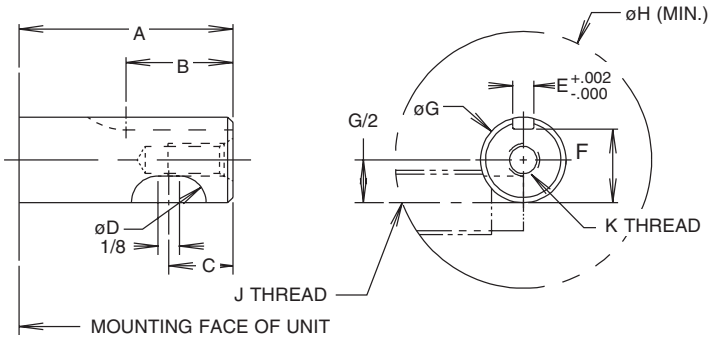
Model	A	B
05	0.0625	0.031
07	0.0938	0.046
10	0.1250	0.063
15	0.1875	0.094
20	0.1875	0.094



Milled Flat (P)

(Available on Sizes 05 & 07 only)

Model	A	B	C	∅D
05	0.75	0.50	0.219	0.2500 0.2495
07	1.00	0.63	0.344	0.3750 0.3745



Preload Keyway (R)

(Available on Sizes 10, 15, 20 only)

Model	A	B	C	∅D	E	F	G	H	J	K
10	1.25	0.625	0.375	0.156	0.125	0.430 0.425	0.5000 0.4995	1.50	10-32	10-32 x 3/8 DP
15	1.50	1.00	0.563	0.188	0.188	0.517 0.512	0.6250 0.6245	1.75	1/4-28	1/4-28 x 1/2 DP
20	2.00	1.50	0.813	0.219	0.188 0.190	0.771 0.761	0.8750 0.8745	2.00	5/16-24	5/16-24 x 1/2 DP

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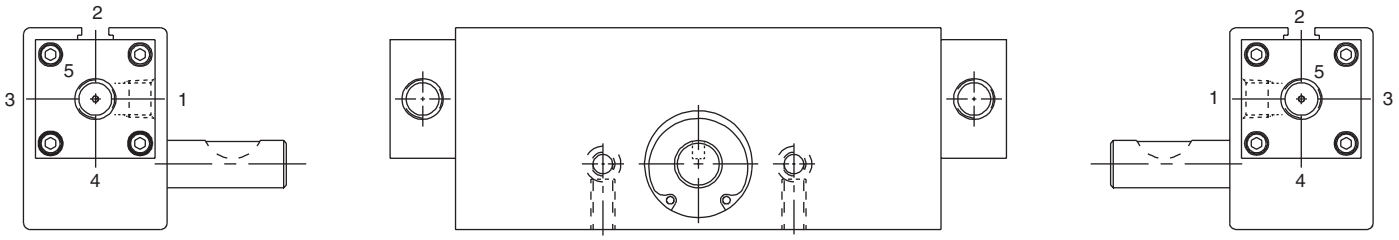
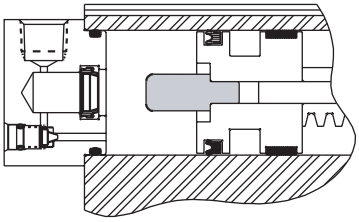
Port Location (1, 2, 3, 4, 5)



NOTES: 1. Port position 1 is standard whenever stroke adjusters and/or cushions are specified. Port positions 2, 3 and 4 are available at no additional cost.
2. Port position 5 is standard for units without stroke adjusters and/or cushions.

Cushions* (1, 2, 3)

Cushions decelerate loads at the end of rotation in either or both directions. A fluted floating check seal cushion prevents binding of the cushion spear, ensures effective deceleration and provides a rapid response on the return stroke. A cushion adjustment needle is provided for easy, precise control of the cushion speed. The adjustment needle is located in position (5) regardless of the port position.

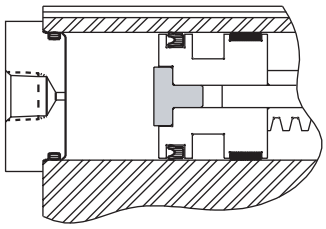


*Cushions are not available on Model 05.
Cushions are not available with shock absorbers.

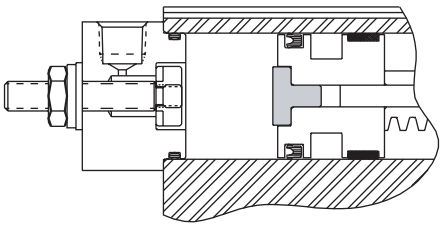
Bumpers (5, 6, 7)

Built in polyurethane bumper pads absorb noise, thus permitting faster cycle times and increased production rates.

NOTES: 1. Available with or without stroke adjusters
2. Not available with cushions
3. Available in 90°, 180°, 270° & 360° rotations only



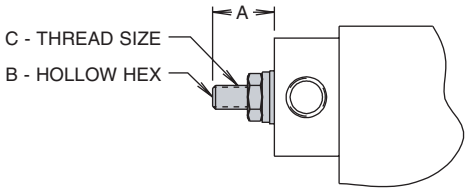
Standard Bumper



Bumper with Stroke Adjuster
(Port position 1, 2, 3, 4 only)

Stroke Adjusters (D, E, F)

Stroke adjusters reduce angle of rotation by 45° (10° when cushions are specified) in either or both directions. Typical applications are for initial set-up purposes where exact rotation cannot be predetermined or when rotation requirements may change between various operations.



Model	(1) Turn Adj.	45° Adjustment w/o Cushioned End Cap A (Max)	10° Adjustment with Cushioned End Cap A (Max)	B Hex	C Thread Size
05	7°	0.50	—	5/64	#8-32
07	5°	0.56	0.38	3/32	#10-32
10	5°	0.69	0.44	1/8	1/4-28
15	4°	0.94	0.53	3/16	3/8-24
20	4°	1.13	0.69	1/4	1/2-20

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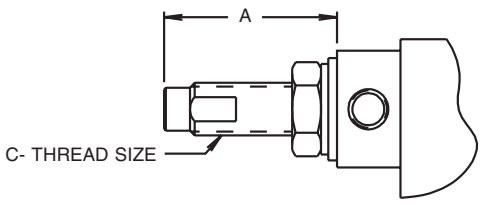
Shock/Stroke Adjusters* (H, K, L)

Hydraulic shock absorbers dissipate energy, allowing increased operating speeds. Shocks also provide adjustability for end of rotation position. Shocks are fixed orifice self-compensating type and will provide constant deceleration despite changing energy conditions. This option is available on models 10, 15 & 20 only.

*Shocks are not available with cushions.



Model	(1) Turn Adjustment	A (Max)	Max Adjustment	C Thread Size
10	7°	2.16	110°	9/16-18
15	6°	2.44	100°	3/4-16
20	6°	3.44	140°	1-12

Anti-Backlash Actuator (7)

The Anti-backlash option is used to obtain precise positioning throughout the rotation of the unit. Backlash normally associated with rack & pinion actuators is eliminated by this unique option.

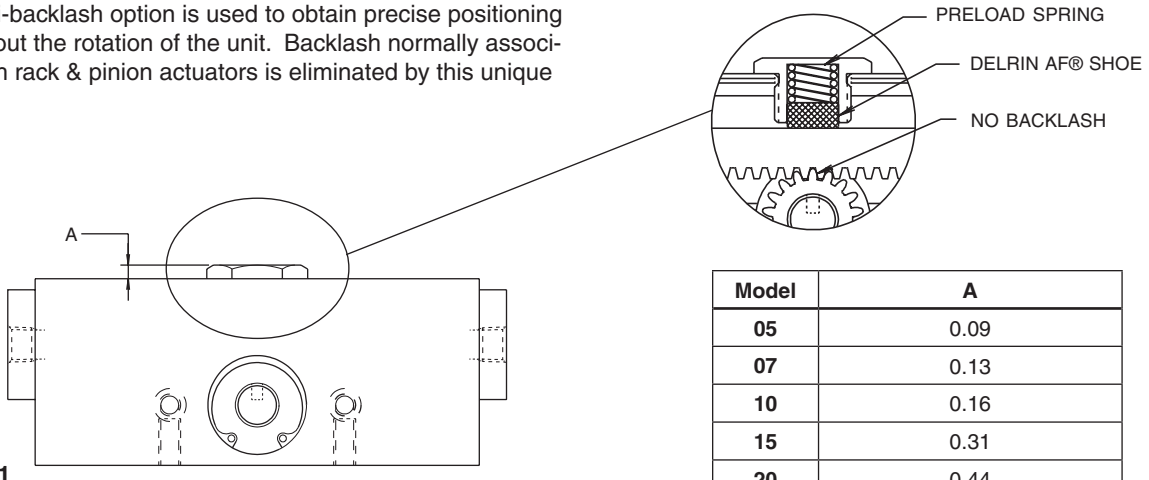


Figure 1

Model	A
05	0.09
07	0.13
10	0.16
15	0.31
20	0.44

Operation:

A standard unit is modified to accept a pre-load assembly located directly above the rack and pinion. (See Figure 1.) The assembly contains a preload spring and Delrin AF® shoe which exerts a constant force against the rack. This "pre-load" force eliminates the backlash by pressing the teeth of the rack and pinion together thus eliminating play between the two mating parts.

This option provides a very cost effective means of eliminating backlash and offers an alternative to more costly double rack units that traditionally provide anti-backlash.

Dimensional Data:

The anti-backlash actuator contains a preload assembly which increases the height. See table and corresponding drawing for dimensional information.

Breakaway Pressure:

The anti-backlash option increases the breakaway pressure as follows:

Model	Breakaway Pressure
05	20 psi
07	20 psi
10	15 psi
15	15 psi
20	10 psi

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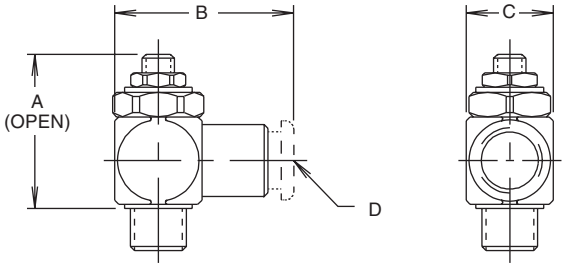
Right Angle Flow Controls (P, T)

Right angle flow control valves allow precise adjustment of cylinder speed by metering exhaust air flow. Presto-Lok push-in or NPT ports provide 360° orientation capability.



Model	A	B	C	D	
				Presto-Lok	NPT
05	0.69	0.91	0.40	5/32	N/A
07	0.69	0.91	0.40	5/32	N/A
10	1.19	1.18	0.67	1/4	1/8
15	1.19	1.18	0.67	1/4	1/8
20	1.63	1.40	0.91	1/4	1/4

Fluorocarbon Seals (V)

Standard abrasion resistant nitrile seals should be used for general purpose applications with temperatures of 0 - 180°F (-18 to 74°C).

Fluorocarbon seals are recommended for high temperature applications up to 250°F (121°C).

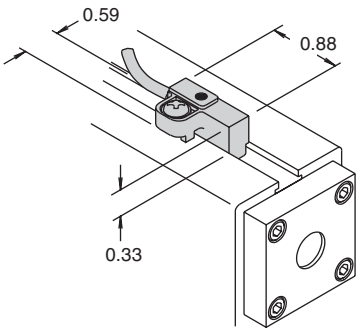
Option	Temperature Range*
Shock Absorbers	32° - 150°F (0° - 66°C)
Bumpers	0° - 200°F (-18° to 93°C)
Magnets	0° - 155°F (-18° to 74°C)
Sensors	14° - 185°F (-10° to 85°C)

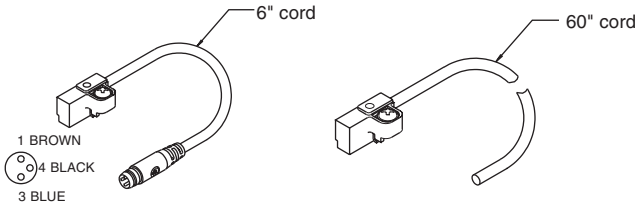
*Consult factory for higher temperature operation.

Magnetic Piston (M)

This option prepares the actuator for use with reed and Hall Effect sensors. The "M" option should be specified to provide a magnet on the cylinder piston.

Order sensors separately from the Electronic Sensors section.





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