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Pneumatic Actuator Products

Cylinders, Guided Cylinders and Rotary Actuators

Catalog 0900P-E





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Application Engineering Data		Α	Engineering Data
Tie Rod Cylinders	3MA/4MA Series, 3MAJ/4MAJ Series, 4MNR Series, ACVB Option, LPSO Option, S Series, C Series	В	Tie Rod Cylinders
ISO Cylinders	P1D Series, P1A Series	С	ISO Cylinders
Round Body Cylinders	SR Series, SRM Series, SRD/SRDM Series, SRX Series, P1L Series, P Series	D	Round Body Cylinders
Compact Cylinders	P1M Series, P1M Series with Tooling Plate, P1M Series Swing Clamp, LP/LPM Series, C05 Series, P1G Series	Ε	Compact Cylinders
Guided Cylinders	P5T Series, P5T2 Series, P5L Series, HB Series, P5E Series	F	Guided Cylinders
Rodless Cylinders	OSP-P, P1X Series, P1Z Series, RC Series, GDL	G	Rodless Cylinders
Rotary Actuators	PV Series, PRN(A) Series, WR Series, PTR Series, B671/F672 Series, HP Series, P5W Series	Н	Rotary Actuators
Pneumatic Grippers	For Complete Information, Refer to Catalog 1900-2	J	Pneumatic Grippers
Air Motors	P1V-S Series For Complete Information, Refer to Catalog PDE2554TCUK-ul	Κ	Air Motors
Complementary Products	Linear Alignment Couplers, Flow Controls, 4TK Air Oil Tanks, PRL Series, Transition Kits	L	Complementary Products
Electronic Sensors	Solid State, Reed and Proximity Sensors	Μ	Electronic Sensors
Industrial Shock Absorbers	Industrial Shock Absorbers (Linear Decelerators)	Ν	Industrial Shock Absorbers
Fax Forms, Safety Guide, Offer of Sale	Application FAX Forms	Ρ	Fax Forms, Safety Guide, Offer of Sale





Rotary Actuators

Section H





Section H – Rotary Actuators

Vane Actuators

PV Series

- 8 Model Sizes
- Single and Double Vane Models
- 2 Standard Rotations
- 7 to 1800 lb-in Output Torque at 100 PSIG
- Pressures to 150 PSI

PRN(A) Series

- 5 Miniature and 4 Standard Models
- Rotation Angles 90°, 100°, 270° and 280°
- Oscillating Reference Points of 40°, 45° and 90°
- 1.33 to 2355 in-lb torque at 100 PSI

WR Series

- 2 Models
- Adjustable Rotation from 30° to 205°
- 15 and 65 lb-in Output Torque at 100 PSIG

Rack & Pinion Actuators

PTR Series

- 5 Bore Sizes from 1" to 3-1/4"
- 5 Standard Rotations
- 39 to 2250 lb-in Output Torque at 100 PSIG
- Pressure to 250 PSI

B671 / F672 Series

- 4 Bore Sizes from 1-1/2" to 5"
- Hydro-Check Option
- 100 to 2500 lb-in Output Torque at 100 PSI
- Pressures to 140 PSI

HP Series

- 2 Large Bore Models
- 3 Standard Rotations
- 4,500 and 10,000 lb-in Output at 100 PSI



Selection Guide

Basic performance features of the rotator product line are shown below. See product sections for greater detail and ordering information.

Туре			Vane			Rack & Pinion			
Series		PV	PRN(A)	WR	PTR	B671	HP		
Standard Rotation	S	95°/100° ¹ 275°/280° ²	90°/100° ¹ 180° ² 270°/280° ²	210°	90° 180° 270° 360°	90° 180°	90° 180°		
Maximum Torque a	at 100 PSI (Ib-in)	1800	2540	65	2000	2500	10,000		
Maximum Air Pres	sure Rating (PSI)	150	100/140	150	250	140	100		
Shaft Bearing Type	9	Ball or Composite Bushing	Composite	Radial Ball Bushing	Radial Ball Bushing	Bronze Bushing	Bronze Bushing		
Non-Lube Service		•	•	•	•	•	•		
Metric (M) or Impe	rial (I)	I	М	l	M,I	I	I		
	Hall Effect	•	•	С	•				
Switch Options	Reed	•	•	С	•	С			
	Proximity Sensor			٠	•		•		
	Double End	•	•		٠				
Shoft Options	Female				•	•	•		
Shart Options	Preload Keyway				•				
	Special	С		С	С	С	С		
	Stroke Adjust	•	•	•	•		•		
Detetion Options	Cushions				•	•	•		
Rotation Options	Bumpers	•	•	•	•				
	Shock Absorbers		•	•	•				
Port Relocation		•	•		•	С	•		
3-Position		С			•				
Air / Oil					•	• 3			
Zero Backlash		•	•	٠	•				
Fluorocarbon Seal	s	•	•		•		•		
Flange Mount		•	•		•				
Washdown		•	С		С				
Clean Room			С						

= Available from catalogC = Consult Factory

- ¹ Double vane
- ² Single vane

³ Hydro-check option

Η







PV Series Pneumatic Vane Rotary Actuators



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Body The precision body extrusion is hard-coat anodized and permanently Heads sealed, resulting in a smooth, slick seal Solid stock heads are precision surface. This guarantees minimum machined from aluminum, **Shoulder Seal** breakaway and maximum seal life. then hard-coat anodized and A nitrile energized, glass-The unitized body incorporates the permanently sealed to ensure filled Teflon® seal is utilized. It stator(s) for superior rigidity. long seal life and low breakaway reduces bypass flow and friction, pressure. Solid stock heads providing superior performance eliminate cavities where and long life. contaminants may collect and also allow rear porting. Shaft Seal The high quality, selflubricated, abrasion resistant nitrile seal is a multiple lobe construction for leakfree operation and greater reliability. (Cleanroom option available on sizes 22, 42, 44 and 46.) Vane A hard-coat anodized, precision aluminum Shaft extrusion is permanently Stainless steel provides affixed to shaft. The high strength and corrosion lightweight vane reduces resistance for demanding inertia allowing very fast applications. rotational speeds. Vane Seal A special self-lubricated, abrasion resistant nitrile compound is Shaft Bearing molded into a one-piece vane Thermoplastic journal bearing seal, providing low breakaway provides washdown capability pressure and long life, even with and low cost. Optional radial no lubrication. ball bushing offers greater precision.

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



Model Code and Ordering Information Example: PV22D - 090BS - BB2V - B



- 1. Switches can be used with stroke adjusters or bumpers (example: PV22D-090BS-BB2-B).
- 2. Not available with switches or stroke adjusters.
- 3. No tapped mounting holes in face opposite the flange.
- 4. 90° bumpers (090B) not available on PV10/11 sizes.

Note:

Order Hall effect sensors and reed switches separately from the Electronic Sensors section.



Specifications

- Maximum operating pressure: 150 psi air
- Output torque @ 100 psi: 8 to 1800 lb-in
- Standard rotations: Single vane units: 280° ± 1° (except size 10 & 11: 275° ± 2.5°) Double vane units: 100° ± 1° (except size 10 & 11: 95° ± 2.5°) Also available with stroke adjusters and internal stops to provide 90° and 180° rotation
- Maximum breakaway pressure and bypass leakage: see table
- Mounting orientation: unrestricted
- Operating temperature range[†]: Nitrile seals 30 to 180°F

Fluorocarbon seals* 30 to 250°F

• Filtration requirement: 40 micron filtered, dry air

* See Fluorocarbon seal option for high temperature applications.

[†] For low temperature version, please consult factory.

Quick Reference Data

Model	Maximum Rotation	Actual C at Specifie	Output Torqu d Input Pre	ue (Ib-in) ssure (PSI)	Displacement	Maximum Breakaway	Maximum Bypass Leakage @100 PSI	Unit Weight
	(Deg)	50	75	100	(11°)	Pressure (PSI)	(cfm)	(lb)
10	275	4	6	8	0.52	25	0.15	0.38
10D	95	8	12	16	0.37	20	0.20	0.38
11	275	8	12	16	1.04	20	0.15	0.50
11D	95	17	25	33	0.74	15	0.20	0.50
22	280	32	48	64	3.67	15	0.20	0.50
22D	100	68	101	135	2.62	10	0.25	1.75
33	280	75	112	150	8.70	15	0.20	3.44
33D	100	155	235	315	6.20	10	0.25	3.56
36	280	150	220	300	17.40	15	0.20	5.19
36D	100	315	470	630	12.40	10	0.25	5.50
42	280	140	210	285	17.80	15	0.20	7.13
42D	100	300	450	600	14.58	10	0.25	7.50
44	280	285	425	570	35.61	15	0.20	8.81
44D	100	600	900	1200	29.17	10	0.25	9.38
46	280	425	640	850	53.41	15	0.20	10.50
46D	100	900	1350	1800	43.75	10	0.25	10.75

Kinetic Energy Ratings and Bearing Load Capacities

Model	Composit Load Capa	Composite Bushing Load Capacities (Ib)*		all Bushing acities (lb)*	Distance Between	Maximum Ki Based	netic Energy Rating I on Configuration (i	for Models in-lb)
	Radial	Thrust	Radial	Thrust	Centerline bearings	Standard	Stroke Adjusters	Bumpers
10	15	7	50	15	0.88	0.03	0.12	0.05
11	15	7	50	15	1.50	0.06	0.12	0.09
22	50	25	Consul	t Factory	2.38	0.25	0.50	0.38
33	100	50	Consul	t Factory	3.50	0.75	1.50	1.13
36	100	50	Consul	t Factory	6.50	1.00	1.50	1.50
42	200	75	Consul	t Factory	2.75	2.00	4.00	3.00
44	200	75	Consult Factory		4.75	2.50	4.00	3.75
46	200	75	Consul	t Factory	6.75	3.00	4.00	4.75

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





Kinetic Energy Basic Formula

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

ω = 0.035 x Angle Traveled (Deg.) Rotation Time (Sec.)

Moments of Inertia

Rotary Actuators **PV Series**

where:

- KE = Kinetic Energy (in-lb)
- Jm = Rotational mass moment of inertia (in-lb-sec²) (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/sec²
- k = Radius of gyration (in)



Rotary Actuators **PV Series**

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



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Model	Α	В	С	D	Е	F	G	н	I	J	к	L	м	N	0	Р	R
10	2.280	1.38	0.88	0.312 0.311	0.258 0.253	0.094 0.095	0.63	0.19	1.00	0.19	1.000	1.62	0.810	1.220	0.750	10-32	8-32 x 0.25 DP
11	2.905	2.00	0.88	0.312 0.311	0.258 0.253	0.094 0.095	0.63	0.19	1.63	0.19	1.625	1.62	0.810	1.220	0.750	10-32	8-32 x 0.25 DP
22	4.340	3.06	1.25	0.500 0.499	0.423 0.418	0.125 0.126	0.94	0.25	2.56	0.25	2.560	2.50	1.250	2.000	1.250	1/8 NPTF	1/4-20NC x 0.38 DP
33	6.180	4.40	1.75	0.749 0.748	0.644 0.639	0.188 0.189	1.38	0.35	3.70	0.26	3.875	3.00	1.500	2.436	1.500	1/4 NPTF	5/16-18NC x 0.47 DP
36	9.180	7.40	1.75	0.749 0.748	0.644 0.639	0.188 0.189	1.38	0.35	6.70	0.26	6.875	3.00	1.500	2.436	1.500	1/4 NPTF	5/16-18NC x 0.47 DP
42	6.280	4.00	2.25	0.999 0.998	0.859 0.854	0.250 0.251	2.00	0.50	3.00	0.50	3.000	4.50	2.250	3.500	2.375	1/4 NPTF	3/8-16NC x 0.75 DP
44	8.280	6.00	2.25	0.999 0.998	0.859 0.854	0.250 0.251	2.00	0.50	5.00	0.50	5.000	4.50	2.250	3.500	2.375	1/4 NPTF	3/8-16NC x 0.75 DP
46	10.280	8.00	2.25	0.999 0.998	0.859 0.854	0.250 0.251	2.00	0.50	7.00	0.50	7.000	4.50	2.250	3.500	2.375	1/4 NPTF	3/8-16NC x 0.75 DP

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Flange Mount (F, R)*



Model	Α	В	С	D	Е	F	G	Н
10	2.50	1.62	2.000	1.250	0.203	0.19	0.41	N/A
11	2.50	1.62	2.000	1.250	0.203	0.19	0.41	N/A
22	3.50	2.50	3.000	2.000	0.281	0.25	0.66	2.875
33	4.50	3.00	3.750	2.000	0.344	0.38	0.84	N/A
36	4.50	3.00	3.750	2.000	0.344	0.38	0.84	N/A
42	7.32	4.51	5.905	2.953	0.551	0.63	1.61	N/A
44	7.32	4.51	5.905	2.953	0.551	0.63	1.61	N/A
46	7.32	4.51	5.905	2.953	0.551	0.63	1.61	N/A

Note: The face opposite the flange mount does not contain tapped mounting holes. Consult factory if needed.

Double End Male Keyed Shaft (C)



Note: Not available with switches or stroke adjustment. Consult factory for rear port option.

Model	А	В	С	D	E	F
10	2.75	0.88	0.50	0.312 0.311	0.28	#302.5
11	3.38	0.88	0.50	0.312 0.311	0.28	#302.5
22	5.06	1.25	0.75	0.500 0.499	0.44	#404
33	7.15	1.75	1.00	0.749 0.748	0.56	#606
36	10.15	1.75	1.00	0.749 0.748	0.56	#606
42	7.53	2.25	1.28	0.999 0.998	0.72	#808
44	9.53	2.25	1.28	0.999 0.998	0.72	#808
46	11.53	2.25	1.28	0.999 0.998	0.72	#808

HP B671 PTR WR PRN(A) PV I



Adjustable Rotation Stop (090A, 180A)

An adjustable positive stop is available to provide end of rotation adjustability in a compact package. Total adjustment range is 60° to 190° on single vane actuators, and 60° to 100° on double vane actuators (95° on PV10/11 sizes). The rotation is factory preset to a nominal 90° or 180° (090A or 180A) for convenient installation.

NOTE:

- 1. Not available with double end shaft.
- 2. Not available with rear ports.





Model	Α	В	С	D	E	F
10	1.62	0.63	0.47	0.24	0.75	3/32
11	1.62	0.63	0.47	0.24	0.75	3/32
22	2.50	1.00	0.72	0.36	1.25	5/32
33	3.00	1.16	0.97	0.48	1.56	3/16
36	3.00	1.16	0.97	0.48	1.56	3/16
42	4.50	1.38	1.25	0.56	2.25	7/32
44	4.50	1.38	1.25	0.56	2.25	7/32
46	4.50	1.38	1.25	0.56	2.25	7/32



90° or 180° Bumpers (090B, 180B)

Bumpers are available to reduce noise and dissipate energy. This permits faster cycle times and increased production rates. Single vane units are available with 90° or 180° bumpers and double vane units are available with 90° bumpers.



180° BUMPERS (180B)



90° or 180° Magnet (S)

Option "S" provides a magnet(s) attached to the actuator shaft. Hall effect or reed switches sense the position of these magnets. The switches are available in two nominal rotations, 90° or 180°, and the adjustment is $\pm 20^{\circ}$ for each switch to provide a total adjustment of $\pm 40^{\circ}$. Adjustable stops, "A", or bumpers, "B", can be supplied in addition to magnets. Order switches separately.

Example Ordering Codes, Keyway Positions

and Switch Sensing Locations:

Please note the following keyway position and switch sensing locations, with respect to ordering codes and options, with porting at the 12:00 position as viewed from the output shaft end (as shipped from the factory).

180S,180AS, 180BS - Single vane actuator with magnet or with magnet and stroke adjusters and/or bumpers: Keyway midstroke position at 6:00, magnet positioned to sense at 3:00 and 9:00.

090S, 090AS - Single vane actuator with magnet or with magnet and stroke adjusters: Keyway midstroke position at 6:00, magnet positioned to sense at 4:30 and 7:30.

090S, 090AS, 090BS - Double vane actuator with magnet or with magnet and stroke adjusters or bumpers; or single vane actuator with magnet and bumpers: Keyway midstroke position at 9:00, magnet positioned to sense at 7:30 and 10:30.







Rear Port (7)

Rear porting provides convenience for confined mounting on very small units being face mounted.

This option is not available with switches or stroke adjustment. Consult factory for double end shaft option.



Model	А	В	С
10	0.54	0.50	10-32
11	0.54	0.50	10-32
22	0.88	0.75	1/8 NPTF
33	1.09	0.90	1/8 NPTF
36	1.09	0.90	1/8 NPTF
42	1.68	1.00	1/4 NPTF
44	1.68	1.00	1/4 NPTF
46	1.68	1.00	1/4 NPTF

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Bearings - Radial Ball Bushings (L)

Composite bushings should be used for washdown, highly contaminated, and low priced applications. Radial ball bushings provide greater precision. For bearing load capacities, reference the Engineering Data section of the catalog.

Consult factory for pricing and availability.





Fluorocarbon Seals (V)

Standard self-lubricating, abrasion resistant nitrile seals should be used for general purpose applications with temperatures of 0 to 180°F. Fluorocarbon seals are recommended for high temperature applications up to 250°F.

Option	Temperature Range* (°F)
Bumpers	0 - 200
Magnets	0 - 155
Switches	14 - 185

*Consult factory for higher temperature operation.

Solid State (Hall Effect) and Reed Sensors

Sensors are available in a normally open or normally closed configuration. The low amp reed sensor is suitable for connection to PLCs or other low current devices. The high amp sensor can be used to drive sequencers, relays, coils or other devices directly.

Sensors must be ordered separately from the Electronic Sensors section.





Seal Kit Ordering Information



Seal Kit Installation Tool

Model (S)	Items	Seal Guide Kit Number
PV10 &11 (D)	21, 22	ATS-PV1
PV22 (D)	21, 22	ATS-PV2
PV33 & 36 (D)	21, 22	ATS-PV3



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PRNA/PRN Series Vane Rotary Actuators



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PRN(A)

Model Code and Ordering Information Example: PRNA20S - 90 - 90S



Reference Point and Rotation Orientations



Specifications

- Maximum Operating Pressure: See tables on pages H21-H22
- Output Torque @ 0.7 MPa: 16 to 1120 N•cm (1.4 to 99 in-lb)
- Standard Rotations: 90°, 180°, or 270° (See ordering information for limitations)
- Operating Temperature Range: -5 to 80°C (-23 to 176°)
- Filtration Requirement: 40 Micron Filtered, Dry Air

Quick Reference Data – PRNA Miniature

				Theo	oretical O	utput To	rque			Maximum			a.14
Мос	del	0.3 (45	Mpa PSI)	0.5 MPa (75 PSI)		0.7 (100	MPa PSI)	1.0 MPa (145 PSI)		Breakaway Pressure		Weight	
		Ncm	(in-lb)	Ncm	(in-lb)	Ncm	(in-lb)	Ncm	(in-lb)	MPa	PSI	kg	lb
	PRNA1S	8	(0.7)	13	(1.2)	19	(1.6)	-	-	0.08	(12)	0.04	(0.08)
Single Vana	PRNA3S	17	(1.5)	31	(3)	45	(4.0)	4.0) —		0.10	(15)	0.07	(0.15)
Single vane	PRNA10S	46	(4.1)	86	(7.6)	127	(11)	—		0.10	(15)	0.14	(0.31)
	PRNA20S	80	(7.1)	159	(14)	240	(21)	350	(31)	0.10	(15)	0.25	(0.55)
	PRNA1D	17	(1.5)	28	(2.5)	41	(3.6)	_	-	0.10	(15)	0.04	(0.09)
Double Vana	PRNA3D	32	(2.9)	54	(4.8)	76	(6.7)	_		0.07	(10)	0.07	(0.16)
	PRNA10D	101	(8.9)	168	(15)	235	(21)	-	-	0.07	(10)	0.15	(0.33)
	PRNA20D	165	(15)	330	(29)	530	(47)	800	(71)	0.06	(9)	0.26	(0.57)

Quick Reference Data – PRN

				Theo	oretical C	utput To	rque			Maxi	mum		ait
Мо	del	0.3 (45	Mpa PSI)	0.5 (75	MPa PSI)	0.7 I (100	MPa PSI)	1.0 (145	MPa PSI)	Break Pres	away sure	Wei	ight
		Ncm	(in-lb)	Ncm	(in-lb)	Ncm	(in-lb)	Ncm	(in-lb)	MPa	PSI	kg	(lb)
	PRN30S	180	(16)	319	(28)	480	(42)	720	(64)	0.10	(15)	0.47	(1.04)
	PRN50S	259	(23)	479	(42)	700	(62.0)	1060	(94)	0.10	(15)	0.8	(1.8)
Single Vane	PRN150S	850	(75)	1500	(133)	2100	(186)	3050	(270)	0.08	(12)	2.0	(4.4)
	PRN300S	1650	(146)	2850	(252)	4050	(358)	5750	(509)	0.08	(12)	3.7	(8.2)
F	PRN800S	5910	(523)	10200	(903)	14400	(1274)	20500	(1814)	0.05	(7)	13	(28)
	PRN30D	440	(39)	770	(68)	1120	(99)	1660	(147)	0.08	(12)	0.48	(1.06)
	PRN50D	579	(51)	1040	(92.0)	1510	(134)	2250	(199)	0.08	(12)	0.8	(1.8)
Double Vane	PRN150D	1900	(168)	3500	(310)	4800	(425)	6900	(611)	0.06	(9)	2.0	(4.4)
	PRN300D	3900	(345)	6800	(602)	9700	(858)	1370	(121)	0.06	(9)	4.3	(9.5)
	PRN800D	12000	(1062)	20600	(1823)	28800	(2549)	41100	(3637)	0.05	(7)	13	(28)



Catalog 0900P-E Engineering Data – Sizes 1 to 30

Rotary Actuators **PRNA / PRN Series**

												A076				
Model	Unit	P	RNA1	s	P	RNA3	S	P	RNA10	S	Р	RNA20	IS	P	RN30	3
Vane								Sir	ngle Va	ne						
Rotation	Degree	90	180	270	90	180	270	90	180	270	90	180	270	90	180	270
Rotational Tolerance	Degree	+4, -0														
Reference Point	Degree		90		45,	90	45	45,	90	45	45,	90	45		45	
Port Size			M5			M5			M5			M5			i i	
Operating Processo Range	MPa	0	.3 to 0.	7	0.2 to 0.7								0.2	to 1		
Operating Pressure Range	psi	4	5 to 10	0			30 to	0100					30 to	150		
Tomporatura Dongo	°C						-5 to	o 80						-	5 to 60)
remperature Range	°F						23 to	176						2	3 to 14	0
Maximum Frequency*	cycle/min	300	180	70	260	160	60	240	150	100	210	120	60	180	90	60
Dianlagament	cm ³	1.4	1.4	1.5	3.4	3.4	4	9.8	9.8	12	17	17	21	3	7	43
Displacement	in ³	0.09	0.09	0.09	0.2	0.2	0.2	0.6	0.6	0.7	1.0	1.0	1.3	2.	3	2.6

Model	Unit	PRNA1D	PRNA3D	PRNA10D	PRNA20D	PRNA30D
Vane			Λ	Double Vane		
Rotation	Degree	90	90	90	90	90
Rotational Tolerance	Degree		^	+4, -0		<u></u>
Reference Point	Degree	45	45	45	45	45
Port Size		M5	M5	M5	M5	R _c 1/8
	MPa	0.3 to 0.7	0.2 t	o 0.7	0.2	to 1
Operating Pressure Range	psi	45 to 100	30 to	0 100	30 to	o 150
Tama anatura Danana	°C		-5 te	o 80	-	-5 to 60
Temperature Range	°F		23 to	0 176		23 to 140
Maximum Frequency*	cycle/min	240	240	240	200	200
Displacement	cm ³	2	2.4	5	10	34
Displacement	in ³	0.12	0.1	0.3	0.6	2.1

Kinetic Energy Ratings and Bearing Load Capacities

		Bearing Loa	d Capacities		Distance	Between	Maximum Kinetic Energy Rating		
Model Number	Thrus	t Load	Radia	l Load	Centerline	Bearings			
	N	lb	N Ib		mm	in	mJ	in-lb	
PRNA1S	1	0.2	10	2	15	0.6	0.8	0.01	
PRNA3S	4	0.9	40	9	20	0.8	4	0.03	
PRNA10S	4	0.9	50	11	30	1.2	8	0.07	
PRNA20S	25	5.6	300	67	42	1.7	40	0.35	
PRN30S	30	6.7	400	90	48	1.9	67	0.60	

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Catalog 0900P-E Engineering Data – Sizes 50 to 800

Rotary Actuators PRNA / PRN Series

		A076											
Model	Unit		PRN	50S			PRN1	50S			PRN3	00S	
Vane						Do	ouble Vane	e					
Rotation	Degree	90	180	270	280	90	180	270	280	90	180	270	280
Rotational Tolerance	Degree						+3	-0					
Reference Point	Degree	45	40, 45	45	40	45	40, 45	45	40	45	40, 45	45	40
Port Size		Rc 1/8 Rc 1/4 Rc 3/8											
Onerating Pressure Dange	MPa						0.2 t	o 1.0					
Operating Pressure Range	psi		30 to 150										
Tomporatura Danga	°C						5 to	o 60					
Temperature Range	°F						41 to	o 140					
Maximum Frequency*	cycle/min	in 180 90 60 120 80 50 90 60 40								0			
Diaplacement	cm ³		51	61	62	1	46	179	185	244	283	352	365
Displacement	in ³	3.1 3.7 3.8 8.9 10.9 11.3 14.9 17 21								22			

Model	Unit		PRN8	800S		PRN	50D	PRN	150D	PRN	1300D	PRN	300D
Vane							Double	e Vane					
Rotation	Degree	90	180	270	280	90	100	90	100	90	100	90	100
Rotational Tolerance	Degree						+3,	-0					
Reference Point	Degree	45	40, 45	45	40	40, 45	40	45	40	45	40, 45	45	40
Port Size		Rc 1/2 Rc 1/8 Rc 1/4 Rc 3/8 Rc 1/2									1/2		
Operating Dressure Dange	MPa						0.2 to	o 1.0					
Operating Pressure Range	psi						30 to	150					
Tomporatura Danga	°C						5 to	60					
Temperature Range	°F						41 to	140					
Maximum Frequency*	cycle/min	65	45	3	0								
Dianlocomont	cm ³ 754 869 1036 1046 42 43 127 123 244 271 75							754	774				
Displacement	in ³	46	53	63	64	2.6	2.6	7.7	7.5	14.9	16.5	46	47

* Maximum frequency value given at a pressure of 0.5 MPa (73 psi) and under no load.

Kinetic Energy Ratings and Bearing Load Capacities

	Bea	ring Loa	d Capac	ities	Diston	oo Botwoon	Maximum Kinetic Energy Rating							
Model	Thrus	t Load	Radia	l Load	Centerli	ne Bearings	Standa	rd Unit	Shock Absorber (per cycle)		Shock Absorber (per cycle)			
	N	lb	N	lb	mm	in	J	in-lb	J	in-lb	J/hr	in-lb/hr		
PRN50S/D	44.1	9.9	588	132	66	2.6	0.13	1.2	7.8	69	3100	27000		
PRN150S/D	88.2	19.8	1176	264	79.5	3.1	0.6	5.3	10	231	11300	100000		
PRN300S/D	147	33.0	1960	441	97.5	3.8	8.0	70	20	462	22000	194000		
PRN800S/D	490	110.2	4900	1102	138.5	5.5	10.5	92	156	1387	56500	500000		







PRNA3S/D





Dimensions are in mm (Inches)



Parker Hannifin Corporation Pneumatic Division Wadsworth, Ohio www.parker.com/pneumatics PRN(A)

PRNA20S/D



PRN30S/D



Dimensions are in mm (Inches)



PRN Sizes 50 to 800



Model No.	Α	В	С	D	Е	F	G	Н	J	к	L	М	Ν	Р	Q	R	S
PRN50	79 (3.11)	145 (5.71)	19.5 (0.77)	86 (3.39)	39.5 (1.56)	12 (0.47)	25 (0.98)	29 (1.14)	2.5 (0.10)	10 (0.39)	13 (0.51)	36 (1.42)	16 (0.63)	Rc1/8	45 (1.77)	M6 x 1, Depth 9	5 (0.20)
PRN150	110 (4.33)	180 (7.09)	23.5 (0.93)	103 (4.06)	53.5 (2.11)	17 (0.67)	30 (1.18)	34.5 (1.36)	3 (0.12)	13 (0.51)	16 (0.63)	51 (2.01)	24 (0.94)	Rc1/4	70 (2.76)	M8 x 1.25, Depth 12	5 (0.20)
PRN300	141.5 (5.57)	220 (8.66)	30 (1.18)	125 (4.92)	65 (2.56)	25 (0.98)	45 (1.77)	41.5 (1.63)	3.5 (0.14)	19 (0.75)	22 (0.87)	66 (2.60)	32 (1.26)	Rc3/8	80 (3.15)	M10 x 1.5, Depth 15	5 (0.20)
PRN800	196 (7.72)	285 (11.22)	44.5 (1.75)	171 (6.73)	69.5 (2.74)	40 (1.57)	70 (2.76)	53.5 (2.11)	4.5 (0.18)	32 (1.26)	35 (1.38)	90 (3.54)	44 (1.73)	Rc1/2	120 (4.72)	M12 x 1.75, Depth 18	10 (0.39)
		1													Keywa	ay Width x D	epth x
Model No.	Т	U	V	Y	Z	AA	BB	CC	DD	EE	FF	G	G	нн		Length	
PRN50	28 (1.10)	29 (1.14)	58 (2.28)	11 (0.43)	14 (0.55)	6 (0.24)	20 (0.79)	46 (1.81)	51 (2.01)	44 (1.73	57 (2.24	4) (2.6	3 58) M	5 x 30	4 0 -0.03	x 2.5 +0.1	x 20
PRN150	34 (1.34)	34.5 (1.36)	85.2 (3.35)	10.5 (0.41)	15.5 (0.61)	8 (0.31)	23.5 (0.93)	56 (2.20)	75 (2.95)	61 (2.40) (3.35	5) (3.8	7 32) M	6 x 35	5 ⁰ -0.03	x 3 ^{+0.1}	x 36
PRN300	42 (1.65)	41.5 (1.63)	110 (4.33)	13 (0.51)	17.5 (0.69)	10 (0.39)	27.5 (1.08)	70 (2.76)	88.5 (3.48)	78 (3.07	98.9 (3.88	5 12 8) (4.9	5 92) M	8 x 45	7 ⁰ -0.03	x 4 +0.2 0	x 40
PRN800	64 (2.52)	53.5 (2.11)	152 (5.98)	14.5 (0.57)	21.1 (0.83)	11.4 (0.45)	32.5 (1.28)	106 (4.17)	130 (5.12)	110 (4.33) (5.7 <i>°</i>	5 17 1) (6.8	3 31) M ²	l2 x 70	12 ⁰ -0.04	x 5 +0.2 3 0	x 40

mm (Inches)



2

Flange Mount – Sizes 1 to 30

Note: • Should not be used on rear face when rear ports (S) or switches are specified.



Dimensions

Part No.	A	В	С	D	E	F	G	н
PRNA1-P	24	30	4	3.4	1	14	16	2
	(0.94)	(1.18)	(0.16)	(0.13)	(0.04)	(0.55)	(0.63)	(0.08)
PRNA3-P	30	37	4	3.4	1.5	16.5	19	2.5
	(1.18)	(1.46)	(0.16)	(0.13)	(0.06)	(0.65)	(0.75)	(0.10)
PRNA10-P	34	42	4	3.5	1.8	19.8	23	3.2
	(1.34)	(1.65)	(0.16)	(0.14)	(0.07)	(0.78)	(0.91)	(0.13)
PRNA20-P	41	50	4	5.5	1.9	24.9	28.5	3.6
	(1.61)	(1.97)	(0.16)	(0.22)	(0.07)	(0.98)	(1.12)	(0.14)
PRNA30-P	52	64	4	5.5	1.9	27.9	31.5	3.6
	2.05)	(2.52)	(0.16)	(0.22)	(0.07)	(1.10)	(1.24)	(0.14)

mm (Inches)

Foot Mount – Sizes 1 to 30

- **Note:** A foot plate can be rotated in intervals of 90°.
 - Only one plate included. Two plates must be purchased to mount from both sides (as shown).
 - Should not be used on rear face when rear ports (S) or switches are specified.



Dimensions

Part No.	Α	В	С	D	E	F	G	н	к	L	М	Ν	Р
PRNA1-L	20	30	2	4.8	22	37	2	14	10.3	5	10	40	50
	(0.79)	(1.18)	(0.08)	(0.19)	(0.87)	(1.46)	(0.08)	(0.55)	(0.41)	(0.20)	(0.39)	(1.57)	(1.97)
PRNA3-L	26	36	2	4.8	25	43	2.6	16.4	12.7	7	11	48	62
	(1.02)	(1.41)	(0.08)	(0.19)	(0.98)	(1.69)	(0.10)	(0.65)	(0.50)	(0.28)	(0.43)	(1.89)	(2.44)
PRNA10-L	30	42	2	5.8	30	51	3.2	19.8	16.1	8	12	64	80
	(1.18)	(1.65)	(0.08)	(0.23)	(1.18)	(2.01)	(0.13)	(0.78)	(0.63)	(0.31)	(0.47)	(2.52)	(3.15)
PRNA20-L	36	49	2	7	34	58.5	3.6	24.9	18.6	10	15	85	105
	(1.42)	(1.93)	(0.08)	(0.28)	(1.34)	(2.30)	(0.14)	(0.98)	(0.73)	(0.39)	(0.59)	(3.35)	(4.13)
PRNA30-L	48	66	2	6.5	42	75	4.5	27	20.7	12	18	96	120
	(1.89)	(2.60)	(0.08)	(0.26)	(1.65)	(2.95)	(0.18)	(1.06)	(0.81)	(0.47)	(0.71)	(3.78)	(4.72)

mm (Inches)



Flange Mount – Sizes 50 and 150

Note: A flange plate can be rotated in intervals of 60°





Dimensions

Part No.	А	В	С	D	E	F
PRN50-P	64	80	7	39.5	35	4.5
	(2.52)	(3.15)	(0.28)	(1.56)	(1.38)	(0.18)
PRN150-P	88	110	9	53.5	47.5	6
	(3.46)	(4.33)	(0.35)	(2.11)	(1.87)	(0.24)

mm (Inches)

Foot Mount - Sizes 50 to 800

- Note: A foot plate can be rotated in intervals of 60° .
 - Two foot plates (L2) are not available with the







Dimensions

Part No.	Α	В	С	D	E	F	G	Н	J	К	L	N
PRN50-L	55	75	11	45	82.5	35	27.5	4.5	10	25	136	156
	(2.17)	(2.95)	(0.43)	(1.77)	(3.25)	(1.38)	(1.08)	(0.18)	(0.39)	(0.98)	(5.35)	(6.14)
PRN150-L	80	110	13	65	115	43.5	33.5	10	12	28	159	183
	(3.15)	(4.33)	(0.51)	(2.56)	(4.53)	(1.71)	(1.32)	(0.39)	(0.47)	(1.10)	(6.26)	(7.20)
PRN300-L	100	140	15	80	135	53	40.5	12	13	32	189	215
	(3.94)	(5.51)	(0.59)	(3.15)	(5.31)	(2.09)	(1.59)	(0.47)	(0.51)	(1.26)	(7.44)	(8.46)
PRN800-L	140	200	15	110	200	54.5	39.5	15	15	35	241	271
	(5.51)	(7.87)	(0.59)	(4.33)	(7.87)	(2.15)	(1.56)	(0.59)	(0.59)	(1.38)	(9.49)	(10.67)

mm (Inches)



Shock Absorber

The CRN Series Shock Absorber should be used in applications involving high inertial loads. Inertial loads are a result of any or all of the following:

- High cycle speeds
- · Heavy loads
- Physically / dimensionally large loads

When any of these characteristics are present, it is important that some means of deceleration, such as the CRN, is used.

Note:

- It is critical not to exceed the maximum kinetic energy values of the CRN. See chart below for kinetic energy calculations.
- When ordering a CRN, the shock absorber and the shock arm must be ordered separately.
- When a CRN is specified, maintain a minimum working pressure of 0.3 MPa.

90 90°

100 100°

180 180°

270 270° **280** 280°



A076

Dimensions

Model No.	А	в	с	D	E	F	G	н
CRN50	136.5	30	20.5	56	50	54	R38	34
	(5.37)	(1.18)	(0.81)	(2.20)	(1.97)	(2.13)	(1.50)	(1.34)
CRN150	159.5	34	22.5	80	62	71.5	R51	46
	(6.28)	(1.34)	(0.89)	(3.15)	(2.44)	(2.81)	(2.01)	(1.81)
CRN300	187.5	37	25.5	95	87	96	R68	62
	(7.38)	(1.46)	(1.00)	(3.74)	(3.43)	(3.78)	(2.68)	(2.44)
CRN800	244	42	31	130	118	135	R78	90
	(9.61)	(1.65)	(1.22)	(5.12)	(4.65)	(5.31)	(3.07)	(3.54)

mm (Inches)



40 40°

45 45°

Relationship Between Rotation and Reference Point

Γ	Reference	Rotation						
	Point Options	90°	180°	270°	280°			
Γ	40°	Х	Х	N/A	Х			
	45°	Х	N/A	Х	N/A			

Note: Select a shock arm based on the reference point and rotation of the PRN to be used.

Model No.	Unit	CRN50	CRN150	CRN300	CRN800			
Kinotia Energy (per avela)	J	7.8	10	20	156			
Kinetic Energy (per cycle)	in-lb	68	85	170	1356			
Maximum Angular Velocity	Degree/s	850	750	650	550			
Kingtig Energy (nor hour)	J/hr	3100	11300	22000	56500			
Kinetic Energy (per nour)	in-lb/hr	26939	98197	191180	490985			
Temperature Dance	°C	5 to 50						
Temperature Range	°F	41 to 122						
Deceleration Angle	Degree	11	12	14	15			
Woight	g	240	420	780	1620			
veight	lb	0.528	0.924	1.716	3.564			



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CRN50

CRN150

CRN300

CRN800

for PRN50

for PRN150

for PRN300

for PRN800

Variable Position Solid State (FR Series) Sensor

The FR Series variable position sensor provides the ability to adjust the sensor to sense along the full travel of the actuator. All switches and sensors must be ordered separately.

See the Electronic Sensors section for part numbers and sensor specifications.

Note: Not to be used in conjunction with rear ports (S).





FR Switch Unit

D

SR Switch Unit

LED2

LED1

CT-3R



FU Switch Unit

Dimensions

Model	A	В	С
PRNA1	31.9	1000	29
	(1.26)	(39.37)	(1.14)
PRNA3	30.7	1000	35
	(1.21)	(39.37)	(1.38)
PRNA10	34	1000	42
	(1.34)	(39.37)	(1.65)
PRNA20	34	1000	42
	(1.34)	(39.37)	(1.65)
PRNA30	34	1000	42
	(1.34)	(39.37)	(1.65)

mm (Inches)

Fixed Position Solid State (SR / SU Series) Sensor

The SR or SU Series fixed position sensor senses the end of stroke only. All switches and sensors must be ordered separately.

See the Electronic Sensors section for part numbers and sensor specifications.

Note: Not to be used in conjunction with rear ports (S).



Dimensions

Model	A	В	С	D
PRNA1	N/A	N/A	N/A	N/A
PRNA3	18	1000	36	30
	(0.71)	(39.37)	(1.42)	(1.18)
PRNA10	18.3	1000	42	25
	(0.72)	(39.37)	(1.65)	(0.98)
PRNA20	18.3	1000	49	20
	(0.72)	(39.37)	(1.93)	(0.79)
PRNA30	21.8	1000	49	20
	(0.86)	(39.37)	(1.93)	(0.79)

mm (Inches)





D

SU Switch Unit

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6

PRN800

D

Variable Position Solid State (FR / FC Series) Sensor

The FR and FC Series variable position sensor provides the ability to adjust the sensor to sense along the full travel of the actuator. The FR Series sensor is to be used with the standard PRN sizes 50-800, and the FC Series sensor is to be used when a CRN Series shock absorber is specified.

See the Electronic Sensors section for part numbers and sensor specifications.



Dimensions

Model No.	А	В	С	D	E
PRN50	115	87.2	27.5	R47	69
	(4.53)	(3.43)	(1.08)	(1.85)	(2.72)
PRN150	131.7	104.2	27.5	R61	97
	(5.19)	(4.10)	(1.08)	(2.40)	(3.82)
PRN300	161.2	126.2	35	R69	113
	(6.35)	(4.97)	(1.38)	(2.72)	(4.45)
PRN800	215.5	174.2	41.3	R60	108
	(8.48)	(6.86)	(1.63)	(2.36)	(4.25)

mm (Inches)



Dimensions

Model No.	А	В	С	D
PRN50	137.7	87.2	50.5	R58.2
	(5.42)	(3.43)	(1.99)	(2.29)
PRN150	160.7	104.2	56.5	R72.2
	(6.33)	(4.10)	(2.22)	(2.84)
PRN300	188.7	126.2	62.5	R88.2
	(7.43)	(4.97)	(2.46)	(3.47)
PRN800	244	174.2	69.8	R118.5
	(9.61)	(6.86)	(2.75)	(4.67)
	(9.61)	(0.86)	(2.75)	(4.67)

mm (Inches)









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WR Series Wrist Rotator

The Wrist Rotate Series rotary actuator provides added features to allow use as a modular pick-and-place component or as a precision pneumatic rotary actuator. Rotation stops provide adjustable rotation from 30° to 205° and feature hydraulic shock absorbers or polyurethane bumpers. Optional plug-in style inductive proximity sensors provide an end of rotation signal. Piston magnet option is available for use with Hall Effect and reed sensors for full rotation position sensing. The body features anodized aluminum and stainless steel construction for corrosion resistance.



Ordering Information





Specifications

- Maximum operating pressure: 150 psi air
- Output torque @ 100 psi: 15 or 65 lb-in
- Rotation range: 30 to 205°
- Mounting orientation: unrestricted
- Operating temperature range: 0 to 180°F
- Filtration requirement: 40 micron filtered, dry air

Quick Reference

Model	Actual Output Torque (Ib-in) at Specified Input Pressure (PSI)			Displacement	Maximum Breakaway	Unit Weight
	50	75	100	(IN°)	Pressure	(0)
WR1	5	10	15	1.04	20	1.5
WR2	25	45	65	3.67	15	3.5

Sizing Information



Model		Maximum Dynan	Max. Kinetic Energy (Ib-in)			
	Radial Load (Ibs)	Compressive Load (Ibs)	Tensile Load (Ibs)	Moment Load (Ib-in)	With Bumpers	With Shock Absorbers
WR1	5	10	5	25	.11	6.00
WR2	25	50	25	125	.57	30.10

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)
- 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-sec²)
- ω = Peak Velocity (rad/sec)
 - (Assuming twice average velocity)








A076

G

Dimensions

Model	Α	В	С	D	ØE	F	G	н	J ¹	J ²	J ³
WR1	3.97	3.00	2.00	0.88	0.312 0.311	0.352 0.347	0.094 0.093	3.63	1.89	2.54	2.30
WR2	5.65	4.75	3.06	1.25	0.499 0.498	0.548 0.543	0.125 0.124	5.25	2.61	4.26	_

Model	К	L	М	N	0	Р	S	Т	U
WR1	0.19	1.625	1.62	0.810	1.220	0.750 8-32 UNC x 0.25 DEEP		5/32	5/32
WR2	0.25	2.560	2.50	1.250	2.000	1.250	50 1/4-20 UNC x 0.38 DEEP		1/4



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PTR Series Pneumatic Rack & Pinion **Rotary Actuator**



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Piston Seals

Unique geometry of lipseal provides low breakaway pressure and long life. The specially formulated Nitroxile ELF compound incorporates a unique internal lubricant to provide the lowest breakaway and running friction, while maintaining the best wear resistance available. Can be operated with no added lubrication.

Tubing & Body

Aluminum is hard-coat anodized and permanently sealed for maximum wear resistance and long life. Rack & Pinion

Heavy duty gear design is made from

The gear chamber is prelubricated to

provide millions of trouble-free cycles.

through hardened chrome alloy steel for

maximum strength and shock resistance.

-

Sealed Ball Bearings

Reduce friction and breakaway pressure while providing substantial pinion and shaft support. This ensures a rigid and long lasting assembly, even for high cycle applications.

Standard Male Keyed Shaft

Is as large as possible to ensure superior strength; pinion and output shaft are one- piece to provide long life. A female shaft is available.

Pistons

Floating Wear-Tech® aluminum pistons are supported at both ends by rugged filled PTFE wear bands which prevent cylinder scoring, galling, and binding. A magnet groove is standard on all pistons, allowing field conversion to position sensors.

Optional "Check Seal" Cushions

Unique molded flow passages combine the benefits of floating cushions with check valve action, providing effective cushioning and quick stroke reversal for higher cycle and production rates. This proven design eliminates failure-prone springs and ensures minimum wear. An adjustable needle valve and springless check valve allow exact "tailoring" of the cushion to match the application.

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



Model Code and Ordering Information Example: PTR251 - 0903FP - AB21MV - C





1 Cylinder bore size. See appropriate tables for torque output.

- 2 For 3-position units, specify middle and total rotation separated by a "/", ie 090/180. To obtain equal rotation both sides of midstroke (theoretical 12:00), order unit with 5° longer rotation than standard with stroke adjusters.
- 3 Viewed from shaft end.
- 4 Double rack models only.
- 5 Reduces to 10° with cushions.
- 6 Not available with cushions or stroke adjusters.
- 7 Refer to page H45 for option configuration compatibility.



Parker Hannifin Corporation Pneumatic Division Wadsworth, Ohio www.parker.com/pneumatics PTR

Specifications

- Maximum operating pressure: 250 PSI
- Output torque @ 100 psi: 39 lb-in to 2281 lb-in
- Standard rotations: 90°, 180°, 270°, 360°, 450°
- Maximum breakaway pressure: 5 PSI
- Zero internal and external leakage
- Mounting orientation: unrestricted
- Timing: keyway located at 12:00 position at midstroke of actuator
- Operating temperature range:
 - Standard seals 0 to 180°F

Fluorocarbon seals 0 to 250°F

• Filtration requirement: 40 micron filtered, dry air

Medal		Rota	ation	
Iviodei	90°	180°	270°	360°
PTR101	2-1/4	2-1/2	2-3/4	3
PTR102	3-1/2	3-7/8	4-1/4	4-5/8
PTR151	8-1/4	8-3/4	9-1/4	9-3/4
PTR152	11-3/8	12-3/8	13-3/8	14-3/8
PTR201	13-5/8	14-5/8	15-5/8	16-3/4
PTR202	19-3/4	21-7/8	24	26-1/8
PTR251	21-1/8	22-3/4	24-3/8	26
PTR252	30-3/4	34	37-1/4	40-1/2
PTR321	44-1/4	46-5/8	49	51-3/8
PTR322	61-7/8	66-5/8	71-3/8	76-1/8

Unit Weights (lb)

Quick Reference Data

Мо	odel	Typ. Actual Output Torque	Theore ver	etical Outp sus Input I	ut Torque* Pressure (p	(lb-in) osi)	Displacement per Degree	Maximum Angular	Tolerance
Single Rack	Double Rack	@ 100 psi (lb-in)	50	75	100	250	Rotation (in ³ /°)	Backlash (minutes)	(degrees)
101		35	19	29	39	98	0.007	60	-0, +5
	102	70	39	59	79	197	0.014	60	-0, +5
151		100	59	88	118	294	0.021	45	-0, +4
	152	200	118	177	236	590	0.042	45	-0, +4
201		250	141	212	282	705	0.049	35	-0, +3
251		375	215	322	430	1074	0.075	35	-0, +3
	202	500	282	423	565	1410	0.099	35	-0, +3
	252	750	430	644	859	2148	0.150	35	-0, +3
321		1000	570	856	1141	2852	0.199	25	-0, +2
	322	2000	1141	1711	2281	5703	0.398	25	-0, +2

Rotary Actuators

PTR Series

* Allow 10% for friction loss. Allow 20% on air/oil units. Use the single rack torque values for all air/oil, three position, and anti-backlash actuators.



Bearing Load Capacities and Kinetic Energy Ratings

Model	Bearing Load	Capacities* (lb)	Distance	Maximum Kinetic Energy absorption Rating for Models Based on Configuration (lb-in)								
Model	Radial	Radial Thrust Bearing	Between Bearings	Standard or Stroke Adjusters	Bumper	Cushion**	Shock Absorbers (per Cycle/per Hour)					
10	100	50	1.40	0.5	0.75	5.00	15/150,000					
15	250	125	2.15	1.50	2.25	15.00	35/200,000					
20	500	250	2.15	3.00	4.50	35.00	140/350,000					
25	750	375	2.50	5.50	8.25	55.00	140/300,000					
32	1000	500	3.75	12.00	18.00	155.00	N/A					

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

** Assuming positive back pressure provided by meter-out flow control.

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:

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

KINETIC ENERGY BASIC FORMULA

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

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

Rotation I

where

KE = Kinetic Energy (in-lb)

 J_m = Rotational Mass Moment of Inertia (in-lb-sec²)

See next page for formulas.

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



Rotary Actuators PTR Series

Kinetic Energy Basic Formula

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

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

Moments of Inertia

where

k

KE = Kinetic Energy (in-lb)

Jm = Rotational mass moment of inertia (in-lb-sec²) (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/sec²
 - = Radius of gyration (in)





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H

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

Double Male Keyed Shaft (C) shown in phantom



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Model	Rotation Degrees	А	в	с	D	E	F	н	J	К	L	М	Ν
10	90 180 360	6-11/16 8-1/4 11-7/16	2	3	2	1.500	2.000	1.500	1/4-20 x 3/8 DP	0.500 0.499	7/8	0.125 0.127	0.430 0.425
15	90 180 360	9-1/8 11-3/16 15-3/8	3	4-1/4	3	2.000	3.000	2.000	5/16-18 x 1/2 DP	0.875 0.874	1-7/8	0.188 0.190	0.771 0.761
20	90 180 360	11-3/16 14-1/16 19-11/16	3	5	4	2.500	3.500	2.000	3/8-16 x 1/2 DP	1.125 1.124	1-7/8	0.250 0.252	0.986
25	90 180 360	12-9/16 15-1/2 20-5/8	3-1/2	6	4	2.500	4.500	2.000	1/2-13 x 3/4 DP	1.375 1.374	2-1/4	0.313 0.315	1.201 1.191
32	90 180 360	16-5/8 21-1/8 29-3/8	5	8	5	3.000	5.000	2. 500	3/4-10 x 1 DP	1.750 1.749	3-1/2	0.375 0.377	1.542 1.532
Madal	0	P			6			V	1				
	О	P	K	,	3	0.21	1/0	2/4	-				
10	0/0 1 1/2	0.09	1-1/2	-	5/16	0.31	1/0	3/4 1 1/16	{				
20	1 1/2	1.19	2 1/	<u>,</u>	2/0	0.41	1/4	1 1/4	///				
20	1-1/2	1.10	3	2-1/2 3/8		0.41	1/4	1-1/2	4				
32	3	1.77	3-3/4	1 T	7/16	0.56	3/8	1-15/16	1				

*To obtain equal rotation both sides of midstroke (theoretical 12:00), order 5° longer rotation than standard with stroke adjusters.



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PTR

Mounting Options (F, G, P, R)

Foot Flange (G)



Model	A B		С	D	E	F
10	3.25	3.25 2.00		1.375	0.250	0.281
15	4.50	3.00	3.875	2.125	0.438	0.406
20	4.50	4.00	3.875	3.375	0.438	0.406
25	5.50	4.00	4.500	3.000	0.438	0.531
32	8.00	5.00	6.500	3.500	0.750	0.781

Note: Actuators are shipped with mounting flange installed unless otherwise noted.

Pilot Ring (P)



Model	Α	В
10	1.124	0.125
15	2.000	0.25
20	2.167	0.25
25	2.679	0.25
32	3.348	0.25

Front Flange (F) Rear Flange (R)



Model	Α	в С		D	Е	F	G
10	4.25	2.00	3.625	1.375	0.250	0.281	0.625
15	5.75	3.00	5.125	2.125	0.438	0.406	1.000
20	6.50	4.00	5.875	3.375	0.438	0.406	1.250
25	8.25	4.00	7.250	3.000	0.438	0.531	1.625
32	12.00	5.00	10.000	3.000	0.750	0.781	2.000



Shaft Options (C, A, R)

Units are equipped standard with single male keyed shaft (B). Double male keyed (C) also available as shown on page H37. Also available in female keyed and preload keyway options.



Note: Female keyed pinion designed primarily for pneumatic service. Review shaft stresses before applying on hydraulic service.

Female Keyed (A)



PRELOAD KEY (R)

Model	Α	В	С	D	E	Model	Α	В	С	D	E	F	G	н	J	К
10	0.375 0.377	0.093 0.095	0.417 0.422	1-13/32	0.59	10	7/8	5/8	0.375	0.156	0.125 0.127	0.430 0.425	0.500 0.499	1-1/2	3/8-24	10-32 x 3/8 DP
15	0.500 0.502	0.125 0.127	0.560 0.565	2-11/16	0.98	15	1-7/8	1-1/2	0.812	0.219	0.188 0.190	0.771 0.761	0.875 0.874	2	1/2-20	5/16-24 x 1/2 DP
20	0.750 0.752	0.187 0.189	0.837 0.847	2-23/32	1.18	20	1-7/8	1-1/2	0.812	0.250	0.250 0.252	0.986 0.976	1.125 1.124	3	5/8-11	3/8-24 x 9/16 DP
25	1.000 1.002	0.250 0.252	1.083 1.093	3-1/8	1.38	25	2-1/4	1-3/4	1.000	0.250	0.313 0.315	1.201 1.191	1.375 1.374	3-1/2	3/4-10	3/8-24 x 9/16 DP
32	1.250 1.252	0.250 0.252	1.367 1.377	4-9/16	1.77	32	3-1/2	3	1.500	0.437	0.375 0.377	1.542 1.532	1.750 1.749	4	1-8	1/2-20 x 3/4 DP

Port Size and Location (1, 2, 3, 4)



Notes:

- 1. Port position 1 is standard.
- 2. Port positions 2, 3 and 4 are standard options available at no additional cost.
- 3. Port position 4 is for single rack only.
- Port position 5 is not available with cushions or stroke adjusters.

Model	Optional SAE Straight Thread (1)	Standard NPT (2)
10	7/16 - 20 (SAE 4)	1/8
15	7/16 - 20 (SAE 4)	1/4
20	9/16 - 18 (SAE 6)	1/4
25	9/16 - 18 (SAE 6)	1/4
32	3/4 - 16 (SAE 8)	3/8



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PTR

Cushions (1, 2, 3, 4)

The standard cushions operate over the last 30° of rotation in either or both directions. A floating bushing ensures no binding of the cushion spear. For severe operating conditions, four cushions can be fitted on double rack units. All cushions are fully adjustable. On double rack units, cushions will be located on the upper cylinder.



Standard Cushion Needle Locations

(Reference diagram on previous page)

Port Position	Cushion Position
1	2
2	3
3	2
4*	3
5	N/A

*Single Rack only

Bumpers (5, 6, 7)

Built-in polyurethane bumper pads absorb shock and noise, thus permitting faster cycle times and increased production rates. Bumpers are available for pneumatic service only.



- **Notes:** 1. Available with or without stroke adjusters
 - 2. Not available with cushions

Bumper Thickness

Add the bumper thickness to overall unit length "A" for each bumper specified.

Model	Bumper Only	Bumper with Stroke Adjuster
10	0.13	0.44
15	0.19	0.63
20	0.25	0.75
25	0.25	0.75
32	0.25	1.00



Stroke Adjusters (D, E, F) 30°

Stroke adjusters will reduce angle of rotation by 30° in either or both directions. Typical applications are for initial set-up purposes where exact rotation cannot be pre-determined or when rotation requirements may change between various operations. Not available with port position 5.

Notes:

- Standard cushions operate over the last 30° of rotation. Stroke adjusters will decrease the effective cushion length by the same amount. For example, reducing the rotation by 5° yields a 25° cushion length. For effective cushions it is recommended that stroke adjustment not exceed 10° when used in conjunction with cushions.
- 2. Maximum unit rotation is equal to rotation specified in model code. Adjusters allow rotational positioning equal to or less than the maximum rotation.
- 30° Stroke Adjusters are available with or without cushions. Double rack units will have cushions on upper rack and adjusters on lower rack. Single rack units with cushions (and double rack units with four cushions) and stroke adjusters will require additional "A" length.
- 4. Antibacklash can be achieved on double rack units with stroke adjusters as long as extra rotation is ordered.
- 5. When ordering cushions and stroke adjusters, the maximum adjustment is 10° per side.



Model	(1) Turn Adj.	30° Adjustment w/o Cushioned End Cap, A (Max)	10° Adjustment w/Cushioned End Cap, A (Max)	в	с
10	4.0°	0.63	0.38	1/8	1/4-28 UNF
15	4.6°	0.88	1.13	1/4	1/2-20 UNF
20	3.2°	1.13	1.13	1/4	1/2-20 UNF
25	3.2°	1.13	1.18	1/4	1/2-20 UNF
32	2.4°	1.50	2.13	3/8	3/4-16 UNF

Shock / Stroke Adjusters (H, K, L)

Hydraulic shock absorbers reduce noise and allow increased operating speeds and loads while also providing adjustability for end of rotation position. Shocks are fixed orifice selfcompensating type and will provide constant deceleration despite changing energy conditions.

Notes:

- 1. Not available on Model 32 or with port position 5.
- When specified with DOUBLE RACK UNITS: As a result of high energy levels and driving forces obtained with double rack units, all double rack actuators will contain four shock absorbers.
- 3. This option is not available in combination with the following options:
 - a. Air/Oil (6)
 - b. External Air/Oil (Q)
 - c. Bumpers (5, 6, 7)
 - d. Cushions (1, 2, 3, 4)
 - e. Port Flow Controls (P, R, S)
 - f. End Cap Mounted Proximity Sensors

(Tie rod mounted reed and Hall effect sensors can be specified.)



Model	(1) Turn Adjustment	A (Max)	Max. Adjustment	C Thread Size
10	6°	2.20	110°	9/16 - 18 UNF
15	5°	2.40	80°	3/4 - 16 UNF
20	5°	3.66	130°	1 - 12 UNF
25	5°	3.66	130°	1 - 12 UNF

Three Position Actuator (3)

In addition to the standard two position actuators, three position units are also available. All standard options are also available.



Operation:

A standard double rack unit is fitted with stop tubes on the upper rack. Pressurizing port C-2 (with ports C-1, C-3 exhausted) causes counter-clockwise pinion rotation to angular position A. Alternately applying pressure to C-1 (with C-2, and C-4 exhausted) will cause clockwise rotation to angular position C. Both positions A and C are at end of stroke, thus typical end cap options such as cushions, bumpers, and stroke adjusters will operate at these positions only.

Position B is obtained by pressurizing all ports. Pressure applied to the upper floating pistons centers the rack between the stop tubes, rotating the pinion to position B. The lower rack is free floating as the forces are equal on both ends.

Dimensional Data:

Three position actuator dimensions are identical to the standard double rack units. If stroke adjusters are specified they will be fitted to the upper rack, flow controls and cushions will be on the lower rack. Rotational tolerances are given in the chart at the right.

Output Torque:

Output torque of the multiple position actuator is equivalent to the torque output of the same size single rack unit. The chart to the right gives selected torque values for specified pressures.

Ordering Information:

Three position actuators can be ordered by inserting a 3 into the "configuration" space in the model code. The desired middle and total rotation should be stated in the model code separated by a "/". The beginning position, 0° , need not be specified.

For example: **PTR153-045/180F-AB21-C** is a standard pneumatic actuator, three position, with an output torque of 118 lb-in at 100 psi. Position A is 0°, position B is 45°, and position C is 180°. Both positions A and C are adjustable by 30°, as the stroke adjuster option "F" was ordered.



Rotational Tolerances

Model	Total Rotation, Degrees	Between Posi- tions, Degrees ¹	Backlash, Minutes²
103	-0, +5	±1	50
153	-0, +4	±1/2	40
203	-0, +3	±1/2	30
253	-0, +2	±1/2	30
323	-0, +2	±1/4	15

1. Measured from centers of backlash.

2. Zero backlash can be achieved at positions A and C by using optional stroke adjusters.

Theoretical Output Torque (lb-in) at Specified Pressure

Model	50 psi	100 psi	250 psi
103	19	39	98
153	59	118	294
203	141	282	705
253	215	430	1074
323	570	1141	2852

Note: When magnetic piston ring option "M" is ordered, all pistons will be so equipped.



Antibacklash Actuator (7)

An antibacklash actuator is used to obtain precision positioning at the end of rotation. The backlash normally associated with rack and pinion actuators is eliminated by this unique configuration.

Operation:

A double rack unit is modified for actuation on one end only.

Alternately pressurizing C-1 or C-2 causes clockwise and counter-clockwise rotation, respectively. Backlash in the rack & pinion is eliminated as the pinion is tightly "trapped" between both racks at the end of stroke, preventing any further motion.

Dimensional Data:

Antibacklash actuators are similar in size and configuration to standard double rack units with one set of shorter cylinders. The table to the right shows dimensions for this shorter side. If cushions, stroke adjusters or port flow controls are ordered, they will be fitted to the powered rack side.

Output Torque:

Output torque of the antibacklash actuator is equivalent to the torque output of the same size single rack unit. The chart to the right gives selected torque valves for specified pressures.

Theoretical Output Torque, Ib-in, at Specified Pressure

Model	50 psi	100 psi	250 psi
107	19	39	98
157	59	118	294
207	141	282	705
257	215	430	1074
327	570	1141	2852

Ordering Information:

Antibacklash actuators can be ordered by inserting a "7" into the "configuration" space in the model code. For example: **PTR157-180F-AR21-C** is a pneumatic antibacklash actuator with a theoretical output torque of 118 lb-in at 100 psi.

The optional stroke adjusters make the rotation variable between 120° and 180°. The preload key option on the shaft is also specified to eliminate any backlash in the key and coupling interface.

Note:

Antibacklash can also be obtained on double rack actuators by implementing stroke adjusters at end of stroke. This will enable you to maintain double rack output torque. A076





Dimensions

Model	Rotation	А	В
	90°	3-3/4	2-3/4
107	180°	4-1/8	3-3/4
	360°	5-3/4	5
	90°	4-9/16	3-5/16
157	180°	5-5/8	4-9/16
	360°	7-11/16	6-5/8
	90°	5-5/8	4-1/8
207	180°	7-1/16	5-5/8
	360°	9-7/8	8-1/2
	90°	6-5/16	4-3/8
257	180°	7-3/4	6-5/16
	360°	10-5/16	8-13/16
	90°	8-5/16	5-13/16
327	180°	10-9/16	8-5/16
	360°	14-11/16	12-7/16



Self-Contained Tandem Air / Oil Operation (6)

The Air-Oil Tandem actuator allows precise speed and motion control using standard pneumatic controls. This is possible through the use of a completely sealed oil system which effectively meters and controls actuator movement with no slipping, jerking, or bouncing.



Operation:

A standard double rack unit is equipped with a built in hydraulic reservoir and flow controls. Air pressure is alternately applied to ports C-2 and C-1 to cause rotation in either direction. As oil is displaced from the opposite end of the drive rack it is metered precisely by the needle valve. A check valve allows free flow in the opposite direction so that independent speeds for rotation can be set.

The reservoir is directly attached to the actuator, eliminating plumbing and leakage paths. It is spring loaded to compensate for oil volume changes due to temperature variations and has built in fill port.

Dimensional Data:

Air / Oil Actuators are identical in size and configuration to standard double rack units, with the addition of the integral reservoir as shown.



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Model	D	E
106	1.00	3.63
156	1.00	4.38
206	1.25	4.91
256	1.25	4.91
326	1.25	6.29

Note: When magnetic piston ring option "M" is ordered, only the pneumatic pistons will be so equipped.

Output Torque:

Theoretical output torques are shown in the table below. For design and sizing purposes an actuator should be selected with 20%-50% reserve capacity.

For maximum speed of the Air/Oil actuators please consult the factory or local representative.

Ordering Information:

Air / Oil Tandem actuators can be ordered by placing a "6" into the "configuration" space in the model code. All Air / Oil Tandem actuators include as standard port flow controls and Quad-ring piston seals (oil side only), thus it is not necessary to include a "P" and/or "Q" in the model code. Other options, such as cushions, stroke adjusters and magnetic piston ring are also available. For example: **PTR206-180F-AB21-C** is a standard Air/Oil actuator, with a theoretical output torque of 282 lb-in at 100 psi. Rotation of the unit is 180°, with optional cushions and stroke adjusters.



Theoretical Output Torque, Ib-in, at Specified Pressure

Model	50 psi	100 psi	250 psi
106	19	39	98
156	59	118	294
206	141	282	705
256	215	430	1074
326	570	1141	2852



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External Air / Oil Operation (Q)

The External Air/Oil actuator allows for connection to a separate air over oil control system. It can also be used for low pressure (less than 150 psi) non-shock hydraulic systems.

Operation:

A standard pneumatic rotary actuator is equipped with special piston seals for all pistons to ensure low breakaway pressure and no leakage. This allows smooth, jerk-free operation, even at very low pressures.

Output Torque:

Theoretical output torques are identical to the ones given at the beginning of the PTR section. For design and sizing purposes, an actuator should be selected with 20% - 50% reserve capacity.

Port Flow Controls (P, R, S)

Built in meter-out flow controls provide precise adjustment of actuator speed and eliminate the cost and space of externally plumbed components. A separate ball check is used to provide free flow in the opposite direction. Flow controls may be ordered in conjunction with cushions, bumpers, or stroke adjusters.



Shaft Seal Covers (S)

Fluorocarbon Seals (V)

temperatures of 0 to 180°F.

Shaft seal covers are designed to prolong bearing life by isolating them from external contamination and pressure. They are designed for use with standard male shafts only (not hollow shafts).



Fluorocarbon seals are recommended for high temperature applications up to 250°F. Standard abrasion resistant nitrile seals should be used for general purpose applications with

Specifications

Max. Pressure Differential: 500 psi Material: Anodized Aluminum Shaft Seal: Double Lip Wiper Body Seal: O-Ring

Dimensions

Model	А	В	С	D
10	7/8	1/2	1.875	0.25
15	1-7/8	1-5/16	3.000	0.38
20	1-7/8	1-5/16	3.250	0.38
25	2-1/4	1-5/8	3.625	0.38
32	3-1/2	2-7/8	4.480	0.38

Option	Temperature Range (°F)
Shock Absorbers	32 - 150
Bumpers	0 - 200
Piston Magnets	0 - 165
Proximity Sensors	-4 - 150
Reed/Hall Effect Sensors	14 - 140



NOTE: When cushions are specified, the actuator will be equipped with bronze cushion bushings in place of the standard nitrile cushion bushings.

Standard Adjustment Needle Locations

Port Position	Needle Position
1	2
2	3
3	2
4*	3

*Single rack only

Note: When both cushions and port flow controls are specified they will be stamped "C" and "P" respectively.



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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.





Model	A	В
10	0.84	1.22
15	0.99	1.46
20	1.27	1.68
25	1.45	1.89
32	1.71	2.20

Proximity Sensors (Namco Cylindicators or Balluff Cylinder Indicator Sensor)

The inductive type proximity sensor provides end of rotation indication. The non-contact probe senses the presence of the ferrous cushion spear and has no springs, plungers, cams or dynamic seals that can wear out or go out of adjustment. The sensor is solid state and meets NEMA 1, 12 & 13 specifications. For ease of wiring the connector housing is rotatable through 360°. To rotate, lift the cover latch, position and release.

The sensor make/break activation point may occur at 0.125" to ± 0.125 " from the end of stroke. Depending on the actuator size, this distance may cause activation at 2° to 15° from end of stroke.

The standard proximity sensor controls 50-230 VAC/DC loads from 5 to 500 mA. The low 1.7 mA off-state leakage current can allow use for direct PLC input. The standard short circuit protection (SCP) protects the sensor from a short in the load or line upon sensing such a condition (5 amp or greater current) by assuming a non-conductive mode. The fault condition must be corrected and the power removed to reset the sensor preventing automatic restarts.

The low voltage DC sensor is also available for use with 10-30 VDC. The sensor is in a non-rotatable housing, but does incorporates the short circuit protection.

Both sensors are equipped with two LEDs, "Ready" and "Target". The "Ready" LED is lit when power is applied and the cushion spear is not present. The "Target" LED will light and the "Ready" LED will go out when the sensor is closed, indicating the presence of the cushion spear. Both LEDs flashing indicates a short circuit condition.

NOTES:

- 1. Available with or without cushions.
- 2. Not available with stroke adjusters.
- 3. Pressure rating: 3000 psi
- 4. Operating temperature: $-4^\circ F$ to $158^\circ F$
- 5. Specify sensor type, orientation and voltage when ordering.
- The low voltage DC sensor is available in non-rotatable style only; consult factory for further information.









EPS-7

Medel	A						
woder	EPS-5	EPS-6 & 7					
15	1.88	2.17					
20	2.44	2.75					
25	2.16	2.48					
32	1.94	2.25					

Order proximity sensors separately. See Electronic Sensors section for specifications and ordering information.



Seal Kit Ordering Information

- Standard units are equipped with Nitrile seals.
- Optional seal compounds are available.
- See parts list for items contained in seal kit.
- Seal kit part numbers as shown:



- Q = Quad Ring Piston Seals
 - $\mathsf{W}=\mathsf{Carboxilated}\;\mathsf{Nitrile}\;\mathsf{Piston}\;\mathsf{Seals}$



A076

Η





B671 / F672 Series

Heavy Duty Pneumatic Rack and Pinion Rotary Actuator



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Rotary Actuators

The Rotary Actuator / Hydro-Check combination provides consistent torque with adjustable hydraulic resistance for a smooth controlled rotational feed rate. Axial coupling of these units eliminates eccentric loading of component parts.

These actuators are available in three torque ranges to comply with varying load requirements. The Hydro-Check is capable of checking axial loads to 3,000 lbs. and is available with many controlling options (see Ordering Information). For information on Hydro-Checks not shown in this catalog, consult factory.





Catalog 0900P-E

Model Code and Ordering Information Example: B6712308



F172 Inline Hydro-Check Ordering Information For Use with F672 Rotary Actuator

Example: F172-20103



Notes:

- 1. Hydro-Check must be ordered separately.
- 2. When both Actuator and Hydro-Check are ordered from Actuator Division, they will be assembled together.
- 3. Specify voltage with stop and skip function 12, 115, 220 or 440 VAC.
- 4. For availability of other Hydro-Check options not listed here, please consult factory.



H55

Overview

The B671 Series Pneumatic Rotary Actuator is designed to provide force in a reciprocating, rotational motion. It is ideal for any application requiring constant torque through a rotational distance: rotating or lifting heavy objects, positioning or bending operations.

The F672 Series utilizes the same high quality construction found on the B671 Series with the addition of a coupling arrangement for a Hydro-Check. An F672 / Hydro-Check assembly will provide controlled feed rates and excellent rotational control with pneumatic power through adjustable hydraulic resistance.

The B671 / F672 Series Pneumatic Rotary Actuator can be powered by shop air or inert gas. The actuators are pre-lubricated at assembly with NLG1 grade 2 grease with outstanding oxidation stability and corrosion resistant additives. This pre-lubrication is intended for use in pneumatic systems where airline lubrication is not used. However, to assure maximum service life of the cylinder, the air supply should be properly filtered and moisture free.

The pneumatic rotary actuator can be controlled by any conventional 4-way valve - hand, foot, mechanically or electrically controlled. All four sizes of rotary actuators are designed for direct on-shaft installation - no flexible couplings, cam and roller or chain and sprocket combinations are required.

B671 / F672 Series Cushion Option

The standard cushions operate at the end of rotation to decelerate the actuator. A floating polyurethane cushion seal provides maximum sealing effectiveness going into the cushion. This durable material ensures millions of trouble free cycles with no wear. The cushion seal also acts as a check valve, allowing full air flow around the seal during outstroke, providing excellent break-away. Cushions, when so ordered, are installed both directions. They are available on both the B671 and F672 Series.

Quick Reference Data

Actual Output Torque (lb-in) Maximum Displacement Cylinder Maximum Bore versus Specified Pressure (PSI) Model per Degree Rotational Angular Backlash (in) Rotation (in³/°) (minutes) Tolerance (°) 50 75 100 125 1-1/2 50 75 100 125 1 0.021 40 -0, +5 2 3-1/4 250 375 500 625 40 0.116 -0, +4 3 4 500 750 1000 1250 0.219 40 -0, +3 4 5 1250 2500 3125 0.514 30 1875 -0, +2

Rotary Actuators B671 / F672 Series

Specifications

- Maximum Operating Pressure: 140 psi
- Standard Rotations: 90°, 180°, 360°
- Output Torque @ 100 psi: 100 lb-in to 2500 lb-in
- Maximum Break-away Pressure: 10 psi
- Mounting Orientation: Unrestricted
- Operating Temperature: 0° F to 180° F
- Leakage: External: 0 cfm
 Internal: 0 cfm
- Theoretical Timing: Keyway located at 12:00
 position at mid-stroke position of actuator



B671 Series



Model	Rotation	Α	В	С	D	Е	F	G	н	J	к	L	М	Ν	Р	R	S	Т	U		
	90°	2.16	6.45	3.36	3.42					0 500	0.40				0.500						
1	180°	3.35	7.53	4.44	4.50	2.19	0.62	2.94	1.92	0.500	0.12 X	1/4-20	0.38	3/8	0.560	0.16	1.00	1.69	2.00		
	360°	5.35	9.68	6.60	6.66					0.002	1.01				0.010						
	90°	2.50	7.95	3.9 2	3.99					0.075											
2	180°	3.75	9.21	5.17	5.25	2.81	1.50	4.44	3.12	0.875	0.19 X	1/2-13	0.75	1/2	0.964	0.22	1.25	3.12	3.75		
	360°	6.25	11.72	7.69	7.76					0.077	0.077 2.02	.02			0.07 1						
	90°	3.00	8.46	4.23	4.30					4 000	0.05										
3	180°	4.56	10.03	5.80	5.87	3.00	2.06	5.25	3.69	1.000	0.25 X	1/2-13	0.75	1/2	1.117	0.24	1.62	3.38	4.50		
	360°	7.96	13.17	8.94	9.01							1.002	2.00				1.121				
	90°	3.56	10.51	5.28	5.35					4 500	0.00				4 000						
4	180°	5.75	12.87	7.63	7.71	3.88	2.69	6.88	4.75	1.500	0.38 x	5/8-11	0.94	1/2	1.668	0.31	2.50	4.12	5.50		
	360°	10.75	17.58	12.34	12.42					1.502	0.00				1.570						

F672 Series



Model	Rotation	Α	В	С	D	Е	F	G	н	J	к	L	М	Ν	Р	R	S	Т	U	v			
	90°	2.50	7.80	3.92	4.05					0.075	0.40				0.004								
2	180°	3.75	9.06	5.17	5.31	2.81	1.50	4.44	3.12	0.875	0.19 X	1/2-13	0.75	1/2	0.964	0.22	1.25	3.12	3.75	2.50			
	360°	6.25	11.57	7.69	7.82				0.	0.077		2.02			0.374								
	90°	3.00	8.30	4.23	4.36					4 000													
3	180°	4.56	9.87	5.80	5.93	3.00	2.06	5.25	3.69	1.000	0.25 x	1/2-13	0.75	1/2	1.117	0.24	1.62	3.38	4.50	2.50			
	360°	7.96	13.01	8.94	9.07								1.002	2.00				1.127					
	90°	3.56	10.22	5.28	5.41																		
4	180°	5.75	12.58	7.63	7.77	3.88	2.69	6.88	4.75	1.500	0.38 x	5/8-11	0.94	1/2	1.668	0.31	2.50	4.12	5.50	2.50			
	360°	10.75	17.29	12.34	12.48					1.502	5.50				1.070								



Parker Hannifin Corporation Pneumatic Division Wadsworth, Ohio www.parker.com/pneumatics B671

A076

B671 / F672 Series*									
Actuator Size (Cushioned or Non-Cushioned)	Seal Kit Number								
100 lb-in	B732904								
500 lb-in	B732905								
1,000 lb-in	B732906								
2,500 lb-in	B732907								

* Does not include Hydro-Check Seal Kit



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HP Series Large Pneumatic Rack & Pinion Rotary Actuator



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Mounting Mounting threaded inserts (4) each side. **Housing & Pistons** High strength aluminum with maximum ductility, hard coated and permanently lubricated for Large Female Pinion Keyway long life. Fits customer's shaft, In vertical position at eliminates need for coupling. midstroke of actuator.* Cylinders Precision micro finish honed **Bushings** seamless alloy steel tubing, High strength bronze chrome plated bore. for long life. Rack & Pinion Specially heat treated and hardened chrome alloy steel Cushion for maximum shock resistance; Adjustable optional **Tie Rods** heavy duty gear design is cushion (clockwise and/or Medium alloy cold prelubricated. counterclockwise). worked steel with precision threads. Seals Heavy-duty seals for long, trouble-free life.



Model Code and Ordering Information Example: HP10-0903C-AA2V-14



1 To obtain equal rotation both sides of midstroke (theoretical 12:00), order 5° longer rotation than standard with stroke adjusters.

2 Viewed from shaft end.

3 Cannot combine with cushions.



ЧH

Specifications

- Maximum operating pressure: 100 psi
- Standard rotations: 90°, 180°, 360° *
- Standard output torque at 100 psi: 4,500 and 10,000 lb-in
- Operating temperature range: Nitrile seals 0° to 180°F Fluorocarbon seals 0° to 250°F
- Filtration requirement: 40 micron filtration

Quick Reference Data

Model	Rotation* (degrees)	Displacement (cubic inches)	Weight (lb)	Bore Size	Actual Torque Output at 100 PSI (Ib-in)	Maximum Rotational Tolerance (degrees)	Maximum Angular Backlash (minutes)	
	90	79.93	63					
4.5	180	159.86	75	6"	4,500	-0, +2	15	
	360	319.72	95					
	90	177.64	125					
10	180	355.28	147	8"	10,000	-0, +2	15	
	360	710.56	190					

* To obtain equal rotation both sides of midstroke (theoretical 12:00), order 5° longer rotation than standard with stroke adjusters.

Bearing Load Capacities and Kinetic Energy Ratings

Model	Radial Load (lb) per Bearing		Thrust Load (Ib)		Distance between	Maximum Kinetic Energy Rating for Models Based on Configuration (in-lb)			
	Dynamic	Static	Dynamic	Static	Bearings (in.)	Standard	Stroke Adjusters	Cushion	
4.5	2,000	3,000	300	450	2.77	45	45	650	
10	2,000	3,000	500	750	3.63	100	100	1450	



Standard Face Mount (A) and Female Keyed Shaft (A) Shown



Note: Numbers above represent possible mounting and port positions.

Dimensions

Model	Rotation	А	В	С	D	E	F	G		J	к
	90°	15-5/8									
4.5	180°	22-1/4	6.525	8-1/4	6.063	3.750	3.750	5.615	7/16-14	x 21/32 DP	2.000 2.003
	360°	33									2.000
	90°	18									
10	180°	26-3/4	8.525	10-1/2	7.813	5.000	5.000	7.265	5/8-11 x	15/16 DP	2.250 2.253
	360°	39-5/8									2.200
Model	L	М	N	0	Р	Q	R	S	т	U	V
4.5	3-7/8	0.500 0.502	2.223 2.233	1-5/16	3-1/2	4-1/8	6-1/2	5/8	0.69	3/4 NPTF	2.35
10	5	0.625 0.628	2.525 2.535	1-3/4	4-1/2	5-1/4	8-1/2	3/4	0.69	3/4 NPTF	3.00

Note:

Pressure on C-1 port gives clockwise rotation.

Pressure on C-2 port gives counterclockwise rotation.



Cushions (1, 2, 3)

Catalog 0900P-E

Options

The standard cushions operate over the last 20° of rotation in either direction. A floating bushing ensures no binding of cushion spear. All cushions are fully adjustable and are located on the side opposite the port. For other cushion locations specify "9" and describe.

Stroke Adjusters (A - F)

5° Stroke Adjust Option with Cushion Option



5° or 30° Stroke Adjust Option without Cushion Option



	Model		Cushione	Non-Cushioned End Cap						
		(1) Turn Adjust	А	В	с	(1) Turn Adjust	Α		в	
							5°	30°	D	C
	4.5	2.5°	2.50	5/8	1.00-14	2.0°	2.00	2.81	3/8	3/4-16
	10	2.0°	2.50	15/16	1.50-12	1.5°	2.56	3.50	15/16	1-/2-12

Male Shaft (B)



Model	А	В	С	D	E	
4.5	2.61	2.20	0.561	1.928	2.249	
4.5	2.01	2.30	0.562	1.933	2.250	
40	4.38	0.00	0.625	1.888	2.249	
10		3.38	0.627	1.893	2.250	

Additional Shaft Options (D, E)

Hollowed key shaft is standard. Additional shaft options available are available as a special. Consult factory for information.

Male splined (E) Female splined (D)





Fluorocarbon Seals (V)

Standard abrasion resistant nitrile seals should be used for general purpose applications with temperatures of 0 to 180°F. Fluorocarbon seals are recommended for high temperature applications up to 250°F.

Proximity Sensors

(Namco Cylindicators or Balluff Cylinder Indicator Sensor)

The inductive type proximity sensor provides end of rotation indication. The non-contact probe senses the presence of the ferrous cushion spear and has no springs, plungers, cams or dynamic seals that can wear out or go out of adjustment. The sensor is solid state and meets NEMA 1, 12 & 13 specifications. For ease of wiring the connector housing is rotatable through 360°. To rotate, lift the cover latch, position and release.

The sensor make/break activation point may occur at 0.125" to ± 0.125 " from the end of stroke. Depending on the actuator size, this distance may cause activation at 2° to 15° from end of stroke.

The standard proximity sensor controls 50-230 VAC/DC loads from 5 to 500 mA. The low 1.7 mA off-state leakage current can allow use for direct PLC input. The standard short circuit protection (SCP) protects the sensor from a short in the load or line upon sensing such a condition (5 amp or greater current) by assuming a non-conductive mode. The fault condition must be corrected and the power removed to reset the sensor preventing automatic restarts.

The low voltage DC sensor is also available for use with 10-30 VDC. The sensor is in a non-rotatable housing, but does incorporates the short circuit protection.

Both sensors are equipped with two LEDs, "Ready" and "Target". The "Ready" LED is lit when power is applied and the cushion spear is not present. The "Target" LED will light and the "Ready" LED will go out when the sensor is closed, indicating the presence of the cushion spear. Both LEDs flashing indicates a short circuit condition.

NOTES:

- 1. Available with or without cushions.
- 2. Not available with stroke adjusters.
- 3. Pressure rating: 3000 psi
- 4. Operating temperature: -4°F to 158°F
- 5. Specify sensor type, orientation and voltage when ordering.
- 6. The low voltage DC sensor is available in non-rotatable style only; consult factory for further information.





Rotary Actuators

HP Series



Medal	A (max)				
woder	EPS-5	EPS-6 & 7			
4.5	1.48	1.59			
10	2.17	2.28			

EPS-7

Order proximity sensors separately. See Electronic Sensors section for specifications and ordering information.



Seal Kit Ordering Information

- Standard units are equipped with Nitrile seals.
- Optional seal compounds are available.
- See parts list for items contained in seal kit.
- Seal kit part numbers as shown:





Safety Guide for Selecting and Using Hydraulic, Pneumatic Cylinders and Their Accessories

WARNING: \triangle FAILURE OF THE CYLINDER, ITS PARTS, ITS MOUNTING, ITS CONNECTIONS TO OTHER OBJECTS, OR ITS CONTROLS CAN RESULT IN:

- Unanticipated or uncontrolled movement of the cylinder or objects connected to it.
- Falling of the cylinder or objects held up by it.
- Fluid escaping from the cylinder, potentially at high velocity.

THESE EVENTS COULD CAUSE DEATH OR PERSONAL INJURY BY, FOR EXAMPLE, PERSONS FALLING FROM HIGH LOCATIONS, BEING CRUSHED OR STRUCK BY HEAVY OR FAST MOVING OBJECTS, BEING PUSHED INTO DANGEROUS EQUIPMENT OR SITUATIONS, OR SLIPPING ON ESCAPED FLUID.

Before selecting or using Parker (The Company) cylinders or related accessories, it is important that you read, understand and follow the following safety information. Training is advised before selecting and using The Company's products.

1.0 General Instructions

1.1 Scope – This safety guide provides instructions for selecting and using (including assembling, installing, and maintaining) cylinder products. This safety guide is a supplement to and is to be used with the specific Company publications for the specific cylinder products that are being considered for use.

1.2 Fail Safe – Cylinder products can and do fail without warning for many reasons. All systems and equipment should be designed in a fail-safe mode so that if the failure of a cylinder product occurs people and property won't be endangered.

1.3 Distribution – Provide a free copy of this safety guide to each person responsible for selecting or using cylinder products. Do not select or use The Company's cylinders without thoroughly reading and understanding this safety guide as well as the specific Company publications for the products considered or selected.

1.4 User Responsibility – Due to very wide variety of cylinder applications and cylinder operating conditions, The Company does not warrant that any particular cylinder is suitable for any specific application. This safety guide does not analyze all technical parameters that must be considered in selecting a product. The hydraulic and pneumatic cylinders outlined in this catalog are designed to The Company's design guidelines and do not necessarily meet the design guideline of other agencies such as American Bureau of Shipping, ASME Pressure Vessel Code etc. The user, through its own

analysis and testing, is solely responsible for:

- Making the final selection of the cylinders and related accessories.
- Determining if the cylinders are required to meet specific design requirements as required by the Agency(s) or industry standards covering the design of the user's equipment.
- Assuring that the user's requirements are met, OSHA requirements are met, and safety guidelines from the applicable agencies such as but not limited to ANSI are followed and that the use presents no health or safety hazards.
- Providing all appropriate health and safety warnings on the equipment on which the cylinders are used.

1.5 Additional Questions – Call the appropriate Company technical service department if you have any questions or require any additional information. See the Company publication for the product being considered or used, or call 1-800-CPARKER, or go to <u>www.parker.com</u>, for telephone numbers of the appropriate technical service department.

2.0 Cylinder and Accessories Selection

2.1 Seals – Part of the process of selecting a cylinder is the selection of seal compounds. Before making this selection, consult the "seal information page(s)" of the publication for the series of cylinders of interest.

The application of cylinders may allow fluids such as cutting fluids, wash down fluids etc. to come in contact with the external area of the cylinder. These fluids may attack the piston rod wiper and or the primary seal and must be taken into account when selecting and specifying seal compounds.

Dynamic seals will wear. The rate of wear will depend on many operating factors. Wear can be rapid if a cylinder is mis-aligned or if the cylinder has been improperly serviced. The user must take seal wear into consideration in the application of cylinders.

2.2 Piston Rods – Possible consequences of piston rod failure or separation of the piston rod from the piston include, but are not limited to are:

- · Piston rod and or attached load thrown off at high speed.
- High velocity fluid discharge.
- Piston rod extending when pressure is applied in the piston retract mode.

Piston rods or machine members attached to the piston rod may move suddenly and without warning as a consequence of other conditions occurring to the machine such as, but not limited to:

- · Unexpected detachment of the machine member from the piston rod.
- Failure of the pressurized fluid delivery system (hoses, fittings, valves, pumps, compressors) which maintain cylinder position.
- Catastrophic cylinder seal failure leading to sudden loss of pressurized fluid.
- Failure of the machine control system.

Follow the recommendations of the "Piston Rod Selection Chart and Data" in the publication for the series of cylinders of interest. The suggested piston rod diameter in these charts must be followed in order to avoid piston rod buckling.

Piston rods are not normally designed to absorb bending moments or loads which are perpendicular to the axis of piston rod motion. These additional loads can cause the piston rod to fail. If these types of additional loads are expected to be imposed on the piston rod, their magnitude should be made known to our engineering department.

The cylinder user should always make sure that the piston rod is securely attached to the machine member.

On occasion cylinders are ordered with double rods (a piston rod extended from both ends of the cylinder). In some cases a stop is threaded on to one of the piston rods and used as an external stroke adjuster. On occasions spacers are attached to the machine member connected to the piston rod and also used as a stroke adjuster. In both cases the stops will create a pinch point and the user should consider appropriate use of guards. If these external stops are not perpendicular to the mating contact surface, or if debris is trapped between the contact surfaces, a bending moment will be placed on the piston rod, which can lead to piston rod failure. An external stop will also negate the effect of cushioning and will subject the piston rod to impact loading. Those two (2) conditions can cause piston of failure. Internal stroke adjusters are available with and without cushions. The use of external stroke adjusters should be reviewed with our engineering department.

The piston rod to piston and the stud to piston rod threaded connections are secured with an anaerobic adhesive. The strength of the adhesive decreases with increasing temperature. Cylinders which can be exposed to temperatures above +250°F (+121°C) are to be ordered with a non studded piston rod and a pinned piston to rod joint.

2.3 Cushions – Cushions should be considered for cylinder applications when the piston velocity is expected to be over 4 inches/second.

Cylinder cushions are normally designed to absorb the energy of a linear applied load. A rotating mass has considerably more energy than the same mass moving in a linear mode. Cushioning for a rotating mass application should be review by our engineering department.

2.4 Cylinder Mountings – Some cylinder mounting configurations may have certain limitations such as but not limited to minimum stroke for side or foot mounting cylinders or pressure de-ratings for certain mounts. Carefully review the catalog for these types of restrictions.

Always mount cylinders using the largest possible high tensile alloy steel socket head cap screws that can fit in the cylinder mounting holes and torque them to the manufacturer's recommendations for their size.

2.5 Port Fittings – Hydraulic cylinders applied with meter out or deceleration circuits are subject to intensified pressure at piston rod end. The rod end pressure is approximately equal to:

operating pressure x effective cap end area

effective rod end piston area

Contact your connector supplier for the pressure rating of individual connectors.

3.0 Cylinder and Accessories Installation and Mounting

3.1 Installation

3.1.1 – Cleanliness is an important consideration, and cylinders are shipped with the ports plugged to protect them from contaminants entering the ports. These plugs should not be removed until the piping is to be installed. Before making the connection to the cylinder ports, piping should be thoroughly cleaned to remove all chips or burrs which might have resulted from threading or flaring operations.



3.1.2 – Cylinders operating in an environment where air drying materials are present such as fast-drying chemicals, paint, or weld splatter, or other hazardous conditions such as excessive heat, should have shields installed to prevent damage to the piston rod and piston rod seals.

3.1.3 – Proper alignment of the cylinder piston rod and its mating component on the machine should be checked in both the extended and retracted positions. Improper alignment will result in excessive rod gland and/or cylinder bore wear. On fixed mounting cylinders attaching the piston rod while the rod is retracted will help in achieving proper alignment.

3.1.4 – Sometimes it may be necessary to rotate the piston rod in order to thread the piston rod into the machine member. This operation must always be done with zero pressure being applied to either side of the piston. Failure to follow this procedure may result in loosening the piston to rod-threaded connection. In some rare cases the turning of the piston rod may rotate a threaded piston rod gland and loosen it from the

cylinder head. Confirm that this condition is not occurring. If it does, re-tighten the piston rod gland firmly against the cylinder head.

For double rod cylinders it is also important that when attaching or detaching the piston rod from the machine member that the torque be applied to the piston rod end of the cylinder that is directly attaching to the machine member with the opposite end unrestrained. If the design of the machine is such that only the rod end of the cylinder opposite to where the rod attaches to the machine member can be rotated, consult the factory for further instructions.

3.2 Mounting Recommendations

3.2.1 – Always mount cylinders using the largest possible high tensile alloy steel socket head screws that can fit in the cylinder mounting holes and torque them to the manufacturer's recommendations for their size.

3.2.2 – Side-Mounted Cylinders – In addition to the mounting bolts, cylinders of this type should be equipped with thrust keys or dowel pins located so as to resist the major load.

3.2.3 – Tie Rod Mounting – Cylinders with tie rod mountings are recommended for applications where mounting space is limited. The standard tie rod extension is shown as BB in dimension tables. Longer or shorter extensions can be supplied. Nuts used for this mounting style should be torqued to the same value as the tie rods for that bore size.

3.2.4 – Flange Mount Cylinders – The controlled diameter of the rod gland extension on head end flange mount cylinders can be used as a pilot to locate the cylinders in relation to the machine. After alignment has been obtained, the flanges may be drilled for pins or dowels to prevent shifting.

3.2.5 – Trunnion Mountings – Cylinders require lubricated bearing blocks with minimum bearing clearances. Bearing blocks should be carefully aligned and rigidly mounted so the trunnions will not be subjected to bending moments. The rod end should also be pivoted with the pivot pin in line and parallel to axis of the trunnion pins.

3.2.6 – Clevis Mountings – Cylinders should be pivoted at both ends with centerline of pins parallel to each other. After cylinder is mounted, be sure to check to assure that the cylinder is free to swing through its working arc without interference from other machine parts.

4.0 Cylinder and Accessories Maintenance, Troubleshooting and Replacement

4.1 Storage – At times cylinders are delivered before a customer is ready to install them and must be stored for a period of time. When storage is required the following procedures are recommended.

4.1.1 – Store the cylinders in an indoor area which has a dry, clean and noncorrosive atmosphere. Take care to protect the cylinder from both internal corrosion and external damage.

4.1.2 – Whenever possible cylinders should be stored in a vertical position (piston rod up). This will minimize corrosion due to possible condensation which could occur inside the cylinder. This will also minimize seal damage.

4.1.3 – Port protector plugs should be left in the cylinder until the time of installation.

4.1.4 – If a cylinder is stored full of hydraulic fluid, expansion of the fluid due to temperature changes must be considered. Installing a check valve with free flow out of the cylinder is one method.

4.1.5 – When cylinders are mounted on equipment that is stored outside for extended periods, exposed unpainted surfaces, e.g. piston rod, must be coated with a rust-inhibiting compound to prevent corrosion.

4.2 Cylinder Trouble Shooting

4.2.1 – External Leakage

4.2.1.1 - Rod seal leakage can generally be traced to worn or

damaged seals. Examine the piston rod for dents, gouges or score marks, and replace piston rod if surface is rough.

Rod seal leakage could also be traced to gland wear. If clearance is excessive, replace rod bushing and seal. Rod seal leakage can also be traced to seal deterioration. If seals are soft or gummy or brittle, check compatibility of seal material with lubricant used if air cylinder, or operating fluid if hydraulic cylinder. Replace with seal material, which is compatible with these fluids. If the seals are hard or have lost elasticity, it is usually due to exposure to temperatures in excess of 165°F. (+74°C). Shield the cylinder from the heat source to limit temperature to 350°F. (+177°C.) and replace with fluorocarbon seals.

4.2.1.2 – Cylinder body seal leak can generally be traced to loose tie rods. Torque the tie rods to manufacturer's recommendation for that bore size.

Excessive pressure can also result in cylinder body seal leak. Determine maximum pressure to rated limits. Replace seals and retorque tie rods as in paragraph above. Excessive pressure can also result in cylinder body seal leak. Determine if the pressure rating of the cylinder has been exceeded. If so, bring the operating pressure down to the rating of the cylinder and have the tie rods replaced.

Pinched or extruded cylinder body seal will also result in a leak. Replace cylinder body seal and retorque as in paragraph above.

Cylinder body seal leakage due to loss of radial squeeze which shows up in the form of flat spots or due to wear on the O.D. or I.D. – Either of these are symptoms of normal wear due to high cycle rate or length of service. Replace seals as per paragraph above.

4.2.2 – Internal Leakage

4.2.2.1 – Piston seal leak (by-pass) 1 to 3 cubic inches per minute leakage is considered normal for piston ring construction. Virtually no static leak with lipseal type seals on piston should be expected. Piston seal wear is a usual cause of piston seal leakage. Replace seals as required.

4.2.2.2 – With lipseal type piston seals excessive back pressure due to over-adjustment of speed control valves could be a direct cause of rapid seal wear. Contamination in a hydraulic system can result in a scored cylinder bore, resulting in rapid seal wear. In either case, replace piston seals as required.

4.2.2.3 – What appears to be piston seal leak, evidenced by the fact that the cylinder drifts, is not always traceable to the piston. To make sure, it is suggested that one side of the cylinder piston be pressurized and the fluid line at the opposite port be disconnected. Observe leakage. If none is evident, seek the cause of cylinder drift in other component parts in the circuit.

4.2.3 - Cylinder Fails to Move the Load

4.2.3.1 – Pneumatic or hydraulic pressure is too low. Check the pressure at the cylinder to make sure it is to circuit requirements.

4.2.3.2 – Piston Seal Leak – Operate the valve to cycle the cylinder and observe fluid flow at valve exhaust ports at end of cylinder stroke. Replace piston seals if flow is excessive.

4.2.3.3-Cylinder is undersized for the load – Replace cylinder with one of a larger bore size.

4.3 Erratic or Chatter Operation

4.3.1 – Excessive friction at rod gland or piston bearing due to load misalignment – Correct cylinder-to-load alignment.

 $\label{eq:alpha} \textbf{4.3.2} - \text{Cylinder sized too close to load requirements} - \text{Reduce load or install larger cylinder.}$

4.3.3 – Erratic operation could be traced to the difference between static and kinetic friction. Install speed control valves to provide a back pressure to control the stroke.

4.4 Cylinder Modifications, Repairs, or Failed Component – Cylinders as shipped from the factory are not to be disassembled and or modified. If cylinders require modifications, these modifications must be done at company locations or by The Company's certified facilities. The Cylinder Division Engineering Department must be notified in the event of a mechanical fracture or permanent deformation of any cylinder component (excluding seals). This includes a broken piston rod, tie rod, mounting accessory or any other cylinder component. The notification should include all operation and application details. This information will be used to provide an engineered repair that will prevent recurrence of the failure.

It is allowed to disassemble cylinders for the purpose of replacing seals or seal assemblies. However, this work must be done by strictly following all the instructions provided with the seal kits.



Offer of Sale

The items described in this document and other documents and descriptions provided by Parker Hannifin Corporation, its subsidiaries and its authorized distributors ("Seller") are hereby offered for sale at prices to be established by Seller. This offer and its acceptance by any customer ("Buyer") shall be governed by all of the following Terms and Conditions. Buyer's order for any item described in its document, when communicated to Seller verbally, or in writing, shall constitute acceptance of this offer. All goods or work described will be referred to as "Products".

1. <u>Terms and Conditions</u>. Seller's willingness to offer Products, or accept an order for Products, to or from Buyer is subject to these Terms and Conditions or any newer version of the terms and conditions found on-line at www.parker.com/saleterms/. Seller objects to any contrary or additional terms or conditions of Buyer's order or any other document issued by Buyer.

2. <u>Price Adjustments; Payments.</u> Prices stated on Seller's quote or other documentation offered by Seller are valid for 30 days, and do not include any sales, use, or other taxes unless specifically stated, Unless otherwise specified by Seller, all prices are F.C.A. Seller's facility (INCOTERMS 2010). Payment is subject to credit approval and is due 30 days from the date of invoice or such other term as required by Seller's Credit Department, after which Buyer shall pay interest on any unpaid invoices at the rate of 1.5% per month or the maximum allowable rate under applicable law.

3. Delivery Dates; Title and Risk; Shipment. All delivery dates are approximate and Seller shall not be responsible for any damages resulting from any delay. Regardless of the manner of shipment, title to any products and risk of loss or damage shall pass to Buyer upon placement of the products with the shipment carrier at Seller's facility. Unless otherwise stated, Seller may exercise its judgment in choosing the carrier and means of delivery. No deferment of shipment at Buyers' request beyond the respective dates indicated will be made except on terms that will indemnify, defend and hold Seller harmless against all loss and additional expense. Buyer shall be responsible for any additional shipping charges incurred by Seller due to Buyer's acts or omissions.

4. <u>Warranty.</u> Seller warrants that the Products sold hereunder shall be free from defects in material or workmanship for a period of twelve months from the date of delivery to Buyer or 2,000 hours of normal use, whichever occurs first. The prices charged for Seller's products are based upon the exclusive limited warranty stated above, and upon the following disclaimer: <u>DISCLAIMER OF WARRANTY</u>: THIS WARRANTY COMPRISES THE SOLE AND ENTIRE WARRANTY PERTAINING TO PRODUCTS PROVIDED HEREUNDER. SELLER DISCLAIMS ALL OTHER WARRANTIES, EXPRESS AND IMPLIED, INCLUDING DESIGN, MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

5. <u>Claims; Commencement of Actions.</u> Buyer shall promptly inspect all Products upon delivery. No claims for shortages will be allowed unless reported to the Seller within 10 days of delivery. No other claims against Seller will be allowed unless asserted in writing within 30 days after delivery. Buyer shall notify Seller of any alleged breach of warranty within 30 days after the date the defect is or should have been discovered by Buyer. Any action based upon breach of this agreement or upon any other claim arising out of this sale (other than an action by Seller for an amount due on any invoice) must be commenced within 12 months from the date of the breach without regard to the date breach.

6. <u>LIMITATION OF LIABILITY.</u> UPON NOTIFICATION, SELLER WILL, AT ITS OPTION, REPAIR OR REPLACE A DEFECTIVE PRODUCT, OR REFUND THE PURCHASE PRICE. IN NO EVENT SHALL SELLER BE LIABLE TO BUYER FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF, OR AS THE RESULT OF, THE SALE, DELIVERY, NON-DELIVERY, SERVICING, USE OR LOSS OF USE OF THE PRODUCTS OR ANY PART THEREOF, OR FOR ANY CHARGES OR EXPENSES OF ANY NATURE INCURRED WITHOUT SELLER'S WRITTEN CONSENT, EVEN IF SELLER HAS BEEN NEGLIGENT, WHETHER IN CONTRACT, TORT OR OTHER LEGAL THEORY. IN NO EVENT SHALL SELLER'S LIABILITY UNDER ANY CLAIM MADE BY BUYER EXCEED THE PURCHASE PRICE OF THE PRODUCTS.

7. User Responsibility. The user, through its own analysis and testing, is solely responsible for making the final selection of the system and Product and assuring that all performance, endurance, maintenance, safety and warning requirements of the application are met. The user must analyze all aspects of the application and follow applicable industry standards and Product information. If Seller provides Product or system options, the user is responsible for determining that such data and specifications are suitable and sufficient for all applications and reasonably foreseeable uses of the Products or systems.

8. Loss to Buyer's Property. Any designs, tools, patterns, materials, drawings, confidential information or equipment furnished by Buyer or any other items which become Buyer's property, may be considered obsolete and may be destroyed by Seller after two consecutive years have elapsed without Buyer ordering the items manufactured using such property. Seller shall not be responsible for any loss or damage to such property while it is Seller's possession or control.

9. <u>Special Tooling.</u> A tooling charge may be imposed for any special tooling, including without limitation, dies, fixtures, molds and patterns, acquired to manufacture Products. Such special tooling shall be and remain Seller's property notwithstanding payment of any charges by Buyer. In no event will Buyer acquire any interest in apparatus belonging to Seller which is utilized in the manufacture of the Products, even if such apparatus has been specially converted or adapted for such manufacture and notwithstanding any charges paid by Buyer. Unless otherwise agreed, Seller shall have the right to alter, discard or otherwise dispose of any special tooling or other property in its sole discretion at any time.

10. Buyer's Obligation; Rights of Seller. To secure payment of all sums due or otherwise, Seller shall retain a security interest in the goods delivered and this agreement shall be deemed a Security Agreement under the Uniform Commercial Code. Buyer authorizes Seller as its attorney to execute and file on Buyer's behalf all documents Seller deems necessary to perfect its security interest.

11. <u>Improper use and Indemnity.</u> Buyer shall indemnify, defend, and hold Seller harmless from any claim, liability, damages, lawsuits, and costs (including attorney fees), whether for personal injury, property damage, patent, trademark or copyright

infringement or any other claim, brought by or incurred by Buyer, Buyer's employees, or any other person, arising out of: (a) improper selection, improper application or other misuse of Products purchased by Buyer from Seller; (b) any act or omission, negligent or otherwise, of Buyer; (c) Seller's use of patterns, plans, drawings, or specifications furnished by Buyer to manufacture Product; or (d) Buyer's failure to comply with these terms and conditions. Seller shall not indemnify Buyer under any circumstance except as otherwise provided.

12. <u>Cancellations and Changes.</u> Orders shall not be subject to cancellation or change by Buyer for any reason, except with Seller's written consent and upon terms that will indemnify, defend and hold Seller harmless against all direct, incidental and consequential loss or damage. Seller may change product features, specifications, designs and availability with notice to Buyer.

13. <u>Limitation on Assignment.</u> Buyer may not assign its rights or obligations under this agreement without the prior written consent of Seller.

14. <u>Force Majeure.</u> Seller does not assume the risk and shall not be liable for delay or failure to perform any of Seller's obligations by reason of circumstances beyond the reasonable control of Seller (hereinafter "Events of Force Majeure") Events of Force Majeure shall include without limitation: accidents, strikes or labor disputes, acts of any government or government agency, acts of nature, delays or failures in delivery from carriers or suppliers, shortages of materials, or any other cause beyond Seller's reasonable control.

15. <u>Waiver and Severability</u>. Failure to enforce any provision of this agreement will not waive that provision nor will any such failure prejudice Seller's right to enforce that provision in the future. Invalidation of any provision of this agreement by legislation or other rule of law shall not invalidate any other provision herein. The remaining provisions of this agreement will remain in full force and effect.

16. <u>Termination</u>. Seller may terminate this agreement for any reason and at any time by giving Buyer thirty (30) days written notice of termination. Seller may immediately terminate this agreement, in writing, if Buyer: (a) commits a breach of any provision of this agreement (b) appointments a trustee, receiver or custodian for all or any part of Buyer's property (c) files a petition for relief in bankruptcy on its own behalf, or by a third party (d) makes an assignment for the benefit of creditors, or (e) the dissolves or liquidates all or a majority of its assets.

17. <u>Governing Law.</u> This agreement and the sale and delivery of all Products hereunder shall be deemed to have taken place in and shall be governed and construed in accordance with the laws of the State of Ohio, as applicable to contracts executed and wholly performed therein and without regard to conflicts of laws principles. Buyer irrevocably agrees and consents to the exclusive jurisdiction and venue of the courts of Cuyahoga County, Ohio with respect to any dispute, controversy or claim arising out of or relating to this agreement.

18. Indemnity for Infringement of Intellectual Property Rights. Seller shall have no liability for infringement of any patents, trademarks, copyrights, trade dress, trade secrets or similar rights except as provided in this Section. Seller will defend and indemnify Buyer against allegations of infringement of U.S. patents, U.S. trademarks, copyrights, trade dress and trade secrets ("Intellectual Property Rights"). Seller will defend at its expense and will pay the cost of any settlement or damages awarded in an action brought against Buyer based on an allegation that a Product sold pursuant to this Agreement infringes the Intellectual Property Rights of a third party. Seller's obligation to defend and indemnify Buyer is contingent on Buyer notifying Seller within ten (10) days after Buyer becomes aware of such allegations of infringement, and Seller having sole control over the defense of any allegations or actions including all negotiations for settlement or compromise. If a Product is subject to a claim that it infringes the Intellectual Property Rights of a third party, Seller may, at its sole expense and option, procure for Buyer the right to continue using the Product, replace or modify the Product so as to make it noninfringing, or offer to accept return of the Product and return the purchase price less a reasonable allowance for depreciation. Notwithstanding the foregoing, Seller shall have no liability for claims of infringement based on information provided by Buyer, or directed to Products delivered hereunder for which the designs are specified in whole or part by Buyer, or infringements resulting from the modification, combination or use in a system of any Product sold hereunder. The foregoing provisions of this Section shall constitute Seller's sole and exclusive liability and Buyer's sole and exclusive remedy for infringement of Intellectual Property Rights.

19. Entire Agreement. This agreement contains the entire agreement between the Buyer and Seller and constitutes the final, complete and exclusive expression of the terms of sale. All prior or contemporaneous written or oral agreements or negotiations with respect to the subject matter are herein merged.

20. Compliance with Law, U. K. Bribery Act and U.S. Foreign Corrupt Practices Act. Buyer agrees to comply with all applicable laws and regulations, including both those of the United Kingdom and the United States of America, and of the country or countries of the Territory in which the Buyer may operate, including without limitation the U. K. Bribery Act, the U.S. Foreign Corrupt Practices Act ("FCPA") and the U.S. Anti-Kickback Act (the "Anti-Kickback Act"), and agrees to indemnify and hold harmless Seller from the consequences of any violation of such provisions by Buyer, its employees or agents. Buyer acknowledges that they are familiar with the provisions of the U. K. Bribery Act, the FCPA and the Anti-Kickback Act, and certifies that Buyer will adhere to the requirements thereof. In particular, Buyer represents and agrees that Buyer shall not make any payment or give anything of value, directly or indirectly to any governmental official, any foreign political party or official thereof, any candidate for foreign political office, or any commercial entity or person, for the purpose of influencing such person to purchase products or otherwise benefit the business of Seller.

02/12

