

LTR Series

Hydraulic Rack & Pinion Rotary Actuator



Design Series "C" actuators include improved features to provide greater strength and increased service life over previous designs.

LTR Series Features

■ ROLLING ELEMENT BEARINGS

Parker uses high capacity rolling element bearings to support the pinion gear and shaft. The LTR shaft and bearings can support, relative to the actuator's size and weight, good sized axial and radial loads. Consider using the LTR actuator as a motorized pillow block bearing.

■ ALUMINUM HOUSING

The high strength aluminum housing is standard for LTR101 through LTR322 actuators. Mounting options such as pilot, front and back face, or base installations are available.

■ SAE SIDE PORTS

Parker uses the SAE style ports as standard because they do not leak *when properly installed*. SAE side ports eliminate the need for an elbow fitting. This can be a cost saving convenience for most applications. SAE end ports also are available.

■ WEAR-PAK® PISTON AND SEALS

Parker floats the high strength aluminum pistons that drive the rack gear. The floating piston allows for a low cost, three position actuator solution. The LTR piston uses PTFE filled wear bands as the piston bearing for reduced cylinder wear. Most applications can use the self energizing deep Polypak seal as the general purpose piston seal for long service life.

■ CHROME ALLOY STEEL PINION AND RACK GEARS

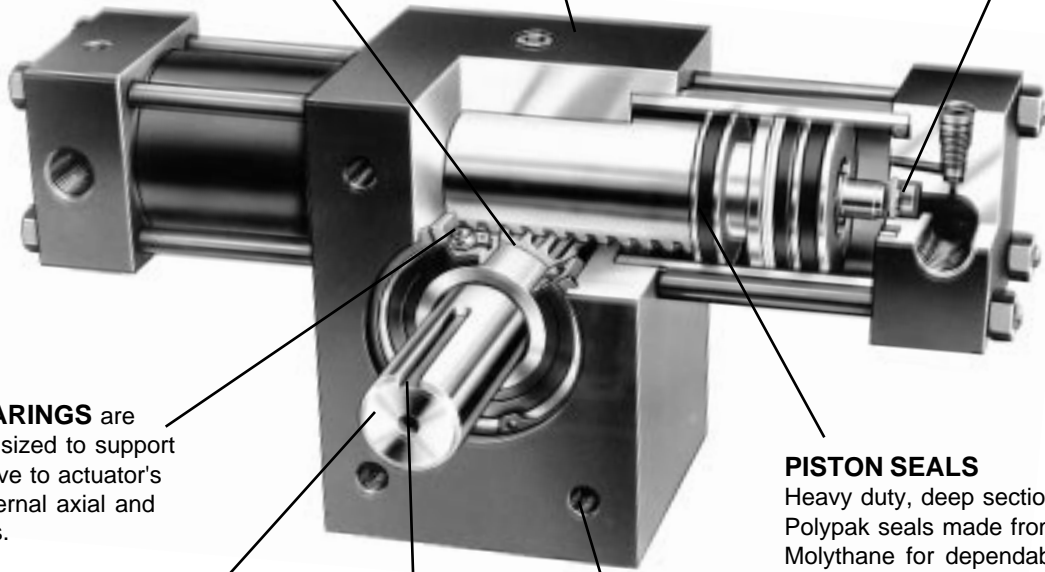
The LTR gear set uses high strength, through hardened gear steels for good shock resistance and bending strength, to provide long life in many applications.

RACK & PINION made from through hardened, high strength alloy steels for long and durable service life in most applications.

HOUSING
High strength housing serves as a firm base to drive large torque requirements.

OPTIONAL CUSHIONS

If properly adjusted, cushions can serve as a braking device for most industrial applications. The proven Parker "floating cushion bushing" serves as a high performance check valve for "quick get away" and the needle valve can be adjusted to regulate the exhaust flow from the piston. Our design uses no springs or check valve seats that can break under normal usage.



BALL BEARINGS are generously sized to support large (relative to actuator's weight) external axial and radial loads.

PISTON SEALS

Heavy duty, deep section Polypak seals made from Molythane for dependable service in most applications. Options: Fluorocarbon seals for certain synthetic fluids; and carboxylated nitrile seals for water based fluids. Piston seals can be inspected and replaced without disconnecting the load from the shaft. (Employ proper safety practices to prevent damage to people or equipment.)

STANDARD MALE KEYED SHAFT is made integral with the pinion gear and is suitable for most applications. Options: double male key, hollow bore keyed and splined shafts are available.

KEYWAY mid stroke at 12:00 position is standard.

THREADED MOUNTING HOLES

Our standard mounting has four bolt holes drilled and tapped on the front and back of the housing. Options: pilot ring or base mount.

LTR Series

The LTR series actuator is suitable for low pressure hydraulic applications. The LTR Series actuator combines an alloy steel gear set with a high strength aluminum housing and Parker 3L or 2A Series cylinder components into a machine suitable for years of trouble free service. The actuator maximizes volumetric efficiency by using self-energizing PolyPak seals. Mechanical efficiency is maximized by using antifriction bearings and Wear-pak® piston technology.

The LTR actuator has a variety of options such as:

- Hydraulic cushions to minimize noise, vibration shock and assist deceleration control
- Reed, Hall Effect or proximity switches for position sensing
- End-of-rotation stroke adjusters for load position control and accurate rotation adjustment
- Built-in meter out flow control valves with reverse flow check valves provide a neat package
- Three position option can be used with many special machine and material handling applications

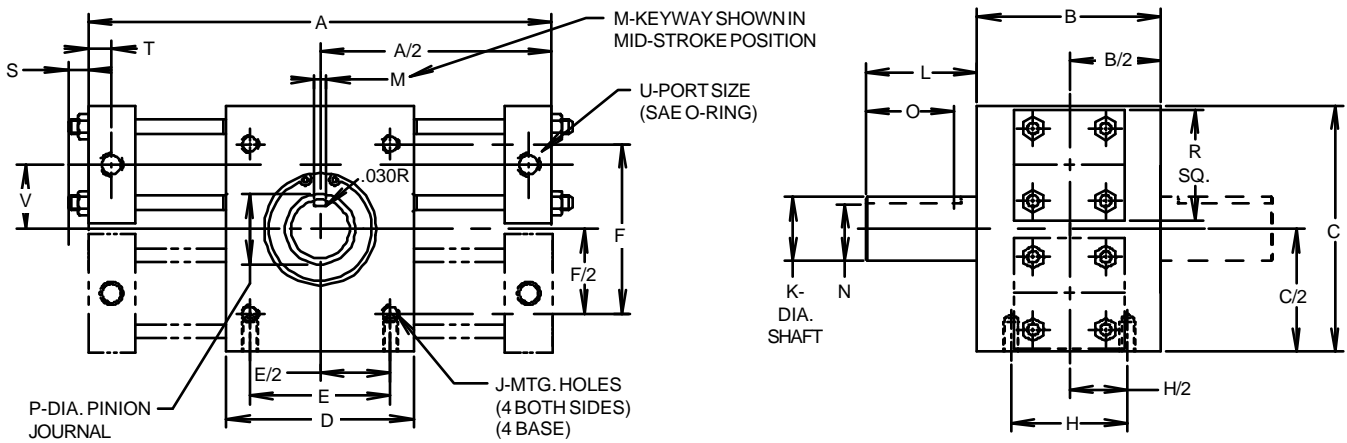
SPECIFICATIONS

- Standard rotations: 90°, 180°, 270°, 360°, 450°
- Maximum breakaway pressure: 30 psig (2 Bar)
- Mounting orientation: unrestricted
- Operating temperature range: Nitrile seals -40 to 180° F (-40 to 82°C)
 Fluorocarbon seals -20 to 250°F (-29 to 121°C)
- Standard timing: Keyway in 12:00 position at midstroke
- Recommended filtration: ISO class 17/14 or better
- Nominal pressure: 1000 psig (68 Bar) (3L cylinder pressure ratings apply)

Single Rack	Double Rack ³	Theoretical Output Torque ¹ , lb-in Versus Input Pressure, psi (Bar)					Gear Train Rating Pitting Life Estimate 1 million cycles		Displacement per degree of rotation in ³ /deg.	Maximum angular backlash Minutes	Maximum rotational tolerance Degrees
		100 (7)	250 (17)	500 (34)	1000 (69)	1500 (103)	lbf-inch ⁵	PSID ⁶			
101		39	98	197	395	592	270	800	.007	60	-0/+5
	102 ⁴	79	197	395	592 ²	-	580	800	.014	60	-0/+5
151		118	294	590	1180	1770	665	650	.021	45	-0/+4
	152	236	590	1180	2360	3530	1400	650	.042	45	-0/+4
201		282	705	1410	2830	4240	1790	750	.049	35	-0/+3
251		430	1074	2148	4295	6443	2100	550	.075	35	-0/+3
	202	565	1410	2820	5650	8470	3790	750	.099	35	-0/+3
	252	859	2148	4295	8590	12885	4250	550	.150	35	-0/+3
321		1141	2852	5703	11407	-	3880	400	.199	25	-0/+2
	322	2281	5703	11407	22813	-	6160	300	.398	25	-0/+2

1. As a precaution, consult factory whenever using the LTR with port flow controls, cushions, or stroke adjusters on double rack units. Reduce LTR Series pressure rating by 50% when specifying a magnetic piston with aluminum cylinder tubes, option "M".
2. Torque at 750 psi (maximum pressure rating)
3. Double rack actuators should specify type 4 or 8 cushions and four stroke adjusters and four flow controls(one per end cap) to balance the gear tooth forces on the pinion. Contact the factory for ordering code information. Type 1, 2, or 3 cushions, type A, B, or C stroke adjusters and type P, R, and S port flow controls may cause a destructive bending couple upon the pinion gear under some operating conditions.
4. Limit LTR102 actuator to 750 PSIG to avoid pinion shaft damage.
5. Durability rated output torque.
6. Pressure differential between the inlet and outlet ports (non-shock).

STANDARD INCH UNIT WITH FACE/BASE MOUNT (A) AND MALE KEYED SHAFT (B)
STANDARD METRIC UNIT WITH FACE/BASE MOUNT (B) AND MALE KEYED SHAFT (D)
 Double Male Keyed Shaft (C, F) shown in phantom



Dimensions for Inch Unit (inches)

Model	Rotation	A	B	C	D	E	F	H	J	K	L	M	N	O	P	R	S	T	U	V
10	90°	6 ¹¹ / ₁₆	2	3	2	1.50	2.00	1.50	1/4-20 x 3/8 DP	.500	7/8	1.25	.430	5/8	.59	1 1/2	1/4	.31	7/16-20	3/4
	180°	8 1/4								.499		.425	SAE #4							
	360°	11 ⁷ / ₁₆																		
15	90°	9 ¹ / ₈	3	4 1/4	3	2.00	3.00	2.00	5/16-18 x 1/2 DP	.875	1 ⁷ / ₈	.188	.771	1 1/2	.98	2	5/16	.44	7/16-20	1 ¹ / ₁₆
	180°	11 ³ / ₁₆								.874		.761	SAE #4							
	360°	15 ³ / ₈																		
20	90°	11 ³ / ₁₆	3	5	4	2.50	3.50	2.00	3/8-16 x 1/2 DP	1.125	1 ⁷ / ₈	.250	.986	1 1/2	1.18	2 1/2	3/8	.44	9/16-18	1 ¹ / ₄
	180°	14 ¹ / ₁₆								1.124		.976	SAE #6							
	360°	19 ¹¹ / ₁₆																		
25	90°	12 ⁹ / ₁₆	3 1/2	6	4	2.50	4.50	2.00	1/2-13 x 3/4 DP	1.375	2 1/4	.313	1.201	1 3/4	1.38	3	3/8	.44	9/16-18	1 1/2
	180°	15 1/2								1.374		1.191	SAE #6							
	360°	20 ⁵ / ₈																		
32	90°	16 ⁵ / ₈	5	8	5	3.00	5.00	2.50	3/4-10 x 1 DP	1.750	3 1/2	.375	1.542	3	1.77	3 3/4	7/16	.56	3/4-16	1 ¹⁵ / ₁₆
	180°	21 ¹ / ₈								1.749		1.532	SAE #8							
	360°	29 ³ / ₈																		

Dimensions for Metric Unit (mm)

Model	Rotation	A	B	C	D	E	F	H	J	K	L	M	N	O	P	R	S	T	U*	V
10	90°	169.9	50.8	76.2	50.8	40	50	40	M6 x 1 x 10 DP	12.00	22	4	9.5	15	15	38.1	6.4	7.9	1/8	19.1
	180°	209.6								11.98		9.4								
	360°	290.5																		
15	90°	231.8	76.2	108.0	76.2	50	80	50	M8 x 1.25 x 13 DP	22.00	46	6	18.5	38	25	50.8	7.9	11.2	1/4	27.0
	180°	284.2								21.98		18.4								
	360°	390.5																		
20	90°	284.2	76.2	127.0	101.6	63	90	50	M10 x 1.5 x 13 DP	28.00	46	10	24.0	38	30	63.5	9.5	11.2	1/4	31.8
	180°	357.2								27.98		23.8								
	360°	500.1																		
25	90°	319.1	88.9	152.4	101.6	63	115	50	M12 x 1.75 x 19 DP	34.00	56	10	29.0	44	35	76.2	9.5	11.2	1/4	38.1
	180°	393.7								33.98		28.8								
	360°	523.9																		
32	90°	422.3	127.0	203.2	127.0	80	125	63	M20 x 2.5 x 25 DP	42.00	88	12	37.0	76	45	95.3	11.1	14.2	1/2	49.2
	180°	536.6								41.98		36.8								
	360°	746.1																		

* BSPP/G

MOUNTING OPTIONS

Inch Units (F, G, P, R)

Metric Units (H, K, S, T)

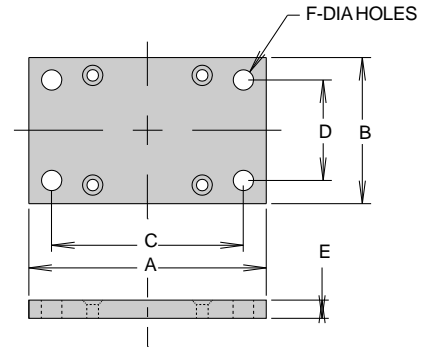
Flanged and Pilot Mountings

LTR Series rotary actuators are available with options such as face/base, pilot or flanged mounting styles to suit the requirements of different applications.

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

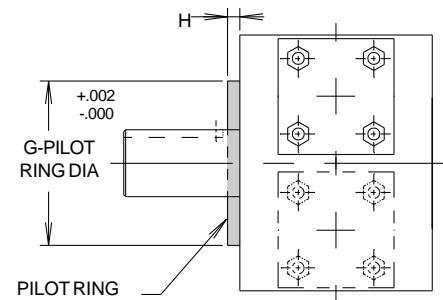
Foot Flange (G, K)

Model	Inch (G)						Metric (K)					
	A	B	C	D	E	F	A	B	C	D	E	F
10	3.25	2.00	2.625	1.375	.250	.281	82	51	67	35	7	6.5
15	4.50	3.00	3.875	2.125	.438	.406	114	76	98	54	11	11
20	4.50	4.00	3.875	3.375	.438	.406	114	102	98	86	11	11
25	5.50	4.00	4.500	3.000	.438	.531	140	102	114	76	11	13.5
32	8.00	5.00	6.500	3.500	.750	.781	NA	NA	NA	NA	NA	NA



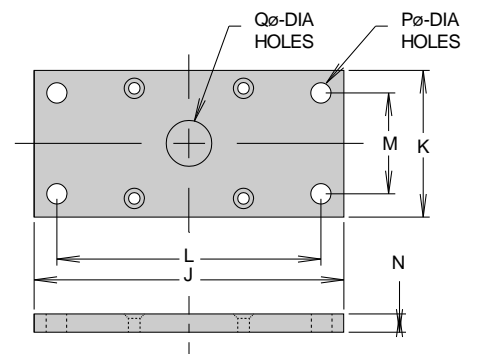
Pilot Ring (P, S)

Model	Inch (P)		Metric (S)	
	G	H	G	H
10	1.124	.125	28.60	3.2
15	2.000	.25	50.85	6.4
20	2.167	.25	55.09	6.4
25	2.679	.25	68.10	6.4
32	3.348	.25	85.09	6.4



Front (F, H) or Rear Flange (R, T)

Model	Inch (F, R)							Metric (H, T)						
	J	K	L	M	N	P	Q	J	K	L	M	N	P	Q
10	4.25	2.00	3.625	1.375	.250	.281	.625	108	51	92	35	7	6.5	15
15	5.75	3.00	5.125	2.125	.438	.406	1.000	146	76	130	54	11	11	25
20	6.50	4.00	5.875	3.375	.438	.406	1.250	165	102	149	86	11	11	31
25	8.25	4.00	7.250	3.000	.438	.531	1.625	210	102	184	76	11	13.5	40
32	12.00	5.00	10.000	3.000	.750	.781	2.000	305	127	254	76	19	22	48

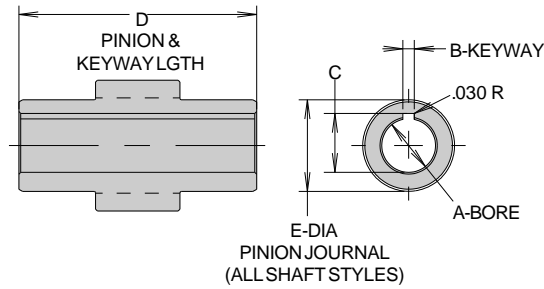


SHAFT OPTIONS (A, E, R)

Units are equipped standard with single male keyed shaft (B, D). Double male keyed (C,F) also available as shown on [page 4](#).

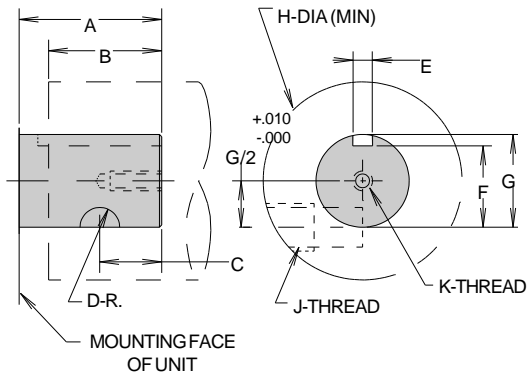
Also available:

Female Keyed (A) Metric Female Keyed (E)



NOTE: Female keyed pinions are designed primarily for pneumatic service. Review shaft stresses before using in a hydraulic application.

Preload Key (R)*



Dimensions, inches (A)

Model	A	B	C	D	E
10	.375 .377	.093 .095	.417 .422	1-13/16	.59
15	.500 .502	.125 .127	.560 .565	2-11/16	.98
20	.750 .752	.187 .189	.837 .847	2-23/32	1.18
25	1.000 1.002	.250 .252	1.083 1.093	3-1/8	1.38
32	1.250 1.252	.250 .252	1.367 1.377	4-9/16	1.77

Dimensions, mm (E)

Model	A	B P9	C	D	E
10	9.05 9.00	3	10.65 10.40	46.0	15.0
15	12.05 12.00	4	14.05 13.80	68.3	24.9
20	20.05 20.00	6	23.05 22.80	69.1	30.0
25	25.05 25.00	8	28.55 28.30	79.4	35.1
32	32.05 32.00	10	35.55 35.30	115.9	45.0

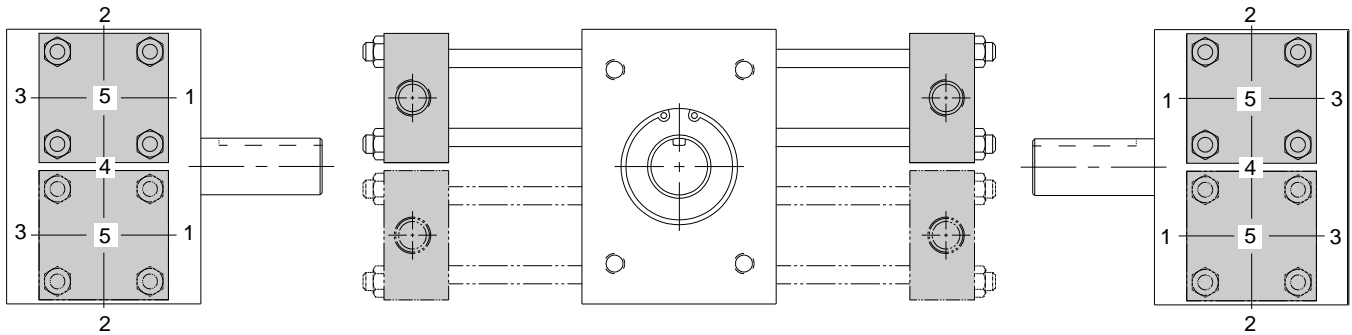
The preload key option is recommended for use with available Parker transition coupler flanges or any time coupling backlash is not desired.

* Metric preload key option not available as a standard option.

Dimensions, inches (R)

Model	A	B	C	D	E	F	G	H	J	K
10	7/8	5/8	.375	.156	.125 .127	.430 .425	.500 .499	1-1/2	3/8-24	10-32 x 3/8 DP
15	1-7/8	1-1/2	.812	.219	.188 .190	.771 .761	.875 .874	2	1/2-20	5/16-24 x 1/2 DP
20	1-7/8	1-1/2	.812	.250	.250 .252	.986 .976	1.125 1.124	3	5/8-11	3/8-24 x 9/16 DP
25	2-1/4	1-3/4	1.000	.250	.313 .315	1.201 1.191	1.375 1.374	3-1/2	3/4-10	3/8-24 x 9/16 DP
32	3-1/2	3	1.500	.437	.375 .377	1.542 1.532	1.750 1.749	4	1-8	1/2-20 x 3/4 DP

PORT SIZE & LOCATION (1, 2, 3, 4, 5)

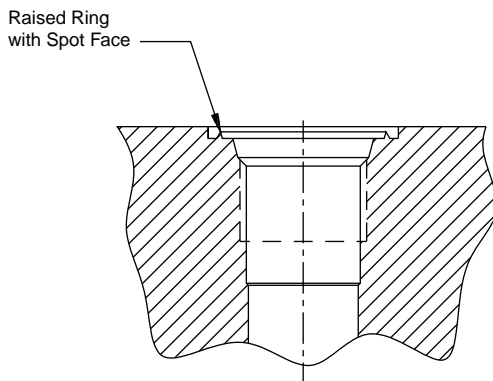


- NOTE:**
1. Port position 1 is standard.
 2. Port positions 2, 3 and 4 are standard options available at no additional cost.
 3. Port position 4 available with single rack actuators only.
 4. For port position 5, consult factory.

PORT THREADS (1, 2, 4, 5, 6)

Model	Standard SAE Straight Thread (1)	NPT (2)	BSPP/G (4)	Metric DIN (5) & ISO (6)
10	7/16 - 20 (SAE 4)	1/8	1/8	M10 x 1
15	7/16 - 20 (SAE 4)	1/4	1/4	M14 x 1.5
20	9/16 - 18 (SAE 6)	1/4	1/4	M14 x 1.5
25	9/16 - 18 (SAE 6)	1/4	1/4	M14 x 1.5
32	3/4 - 16 (SAE 8)	3/8	1/2	M22 x 1.5

ISO 6149/1 Port Identification



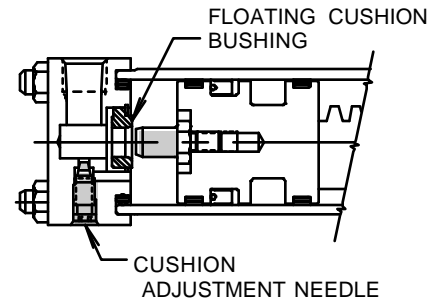
CUSHIONS (1, 2, 3, 4) *

The standard cushions operate over the last 30° of rotation in either CW, CCW or both directions. A floating bushing ensures no binding of the cushion spear. For severe operating conditions, four cushions should be fitted on double rack units. All cushions are fully adjustable. On double rack units with type 1, 2 or 3, cushion adjustment will be located on the upper cylinder.

STANDARD CUSHION NEEDLE LOCATIONS

Port Position	Cushion Position
1	2
2	3
3	2
4 **	3
5	Consult Factory

**Single rack only



* For gear train durability, see table below.

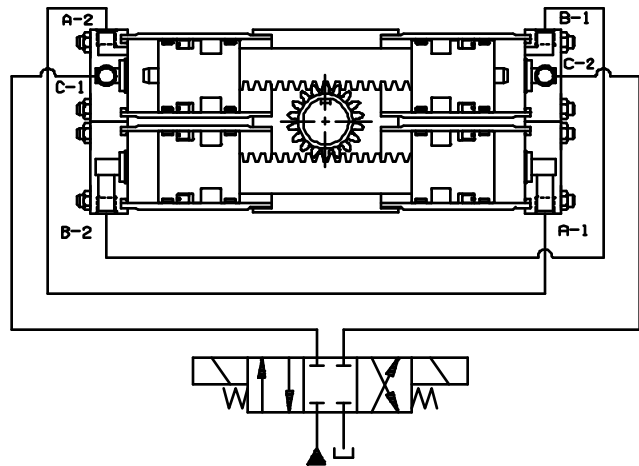
HIGH PERFORMANCE CUSHION (8)

(This option available with double rack units only)

By combining the output/exhaust flow from two cylinders, then routing it across a single cushion needle, cushion performance is improved. The increased volume passing over the needle provides better control. This unique circuit eliminates two pipe or tubing tees.

OPERATION:

The work ports of a standard directional valve are plumbed to ports C-1 and C-2. Port A-1 is plumbed directly to A-2, and port B-1 is plumbed to B-2. When pressure is applied to port C-1 (clockwise shaft rotation), fluid is also directed through line A to the other rack. Exhaust flow from B-1 through B-2 is directed through the cushion bushing and cushion adjustment. When the cushion spear closes off the main passage, total flow from both end caps is directed across one cushion adjustment needle, equalizing back pressure and improving control. Alternatively, pressurizing C-2 and exhausting C-1 reverses the operation.



Work Ports C-1, C-2 Port Position	Cushion Adjustment Position	Connection Ports A-1, A-2 & B-1, B-2 Port Position
1	2	3
2	3	1
3	2	1

DIMENSIONAL INFORMATION:

Units are identical to standard double rack and pinion units, with the exception of porting location. This chart describes the location of the ports.

Suggestion: Use Type 4 or Type 8 cushion arrangements for double rack actuators. Use Type 1, 2 or 3 cushion arrangements exclusively for single rack actuators.

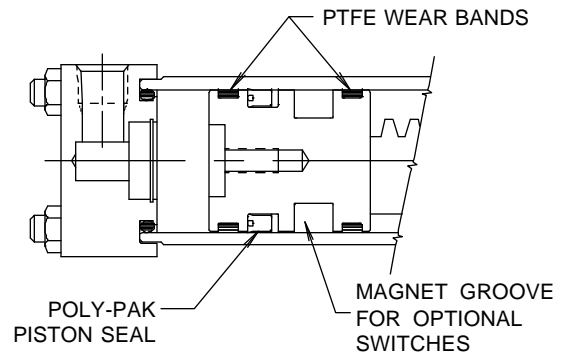
GEAR SET DURABILITY

The gear set durability total energy capacity for the LTR Series is approximately .52 times the durability torque capacity. The table to the right provides energy ratings based on gear train durability when using various cushion options.

Model	Total Energy Capacity (in-lb)		Port to Port ΔP (PSID)	
	Code 1,2,3	Code 8	Code 1,2,3	Code 8
LTR101	141	N/A	800	N/A
LTR102	141	303	400	800
LTR151	348	N/A	650	N/A
LTR152	348	732	325	650
LTR201	936	N/A	750	N/A
LTR202	936	1982	375	750
LTR251	1098	N/A	550	N/A
LTR252	1098	2223	275	550
LTR321	2029	N/A	400	N/A
LTR322	2029	3222	200	400

PISTON SEALS (V,W)

The floating Wear-Pak piston fitted as standard to all LTR Series rotary actuator employs a filled PTFE wear ring to prevent metal-to-metal contact. The hydraulic LTR Series actuator uses a Molythane Polypak seal, which is self-energizing for improved sealing. The Molythane seal is wear, roll and extrusion resistant. For higher temperatures or use with synthetic fluids, Fluorocarbon seals should be specified; for water glycol or high water content fluids, carboxylated nitrile seals are available.



FILTRATION

Effective filtration is vital to the long life and satisfactory performance of a rotary actuator. If the piston seals of a rack and pinion rotary actuator are worn or damaged, fluid leaks past the piston and will enter the gear housing.

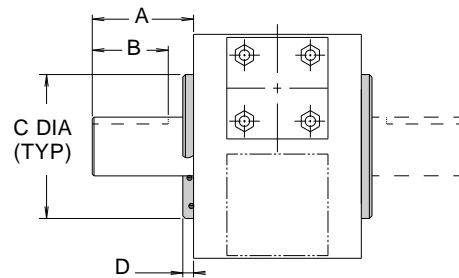
Any external leakage from the gear housing indicates worn or damaged piston seals. Seals and tubes should be examined and, if necessary, be replaced at the earliest opportunity.

SEAL OPTIONS

Seal Option Code	Seal Type	Wear Ring Type	Fluid Medium	Temperature Range	Hydraulic Filtration
Omit (Standard)	Molythane	Filled PTFE	General purpose applications, petroleum-based fluids	-40° to 180°F (-40° to 82°C)	ISO Class 17/14 Cleanliness Level
Option V	Fluorocarbon	Filled PTFE	High temperature operation, special synthetic fluids	-20° to 250°F (-29° to 121°C)	
Option W	Carboxylated Nitrile	Filled PTFE	Water-based fluids	30° to 180°F (0° to 82°C)	

SHAFT SEAL COVER (S)

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).



SPECIFICATIONS

Max. Pressure Differential: 500 psi (34 Bar)

Material: Anodized Aluminum

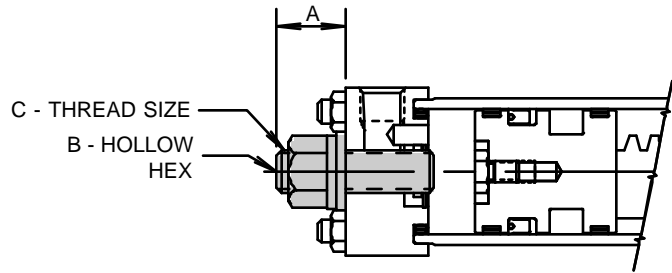
Shaft Seal: Double Lip Wiper

Body Seal: O-Ring

Model	A		B		C		D	
	Inch	mm	Inch	mm	Inch (+.000, -.002)	mm (+.00, -.05)	Inch	mm
10	7/8	22	1/2	12	1.875	48	.25	7
15	17/8	46	15/16	33	3.000	76	.38	10
20	17/8	46	15/16	33	3.250	83	.38	10
25	2 1/4	56	15/8	41	3.625	92	.38	10
32	3 1/2	88	27/8	73	4.480	114	.38	10

STROKE ADJUSTERS (D, E, F) 30°

Fine control of the end of travel points of the rotary actuator can be obtained by specifying stroke adjusters. These operate by reducing the maximum travel of the actuator by up to 30° in each direction. Adjustment within this range made by the user. Several types of stroke adjuster are available. The design illustrated is suitable for applications requiring infrequent adjustment.



STROKE ADJUSTERS AND CUSHIONS

The addition of stroke adjusters requires an increase in build length. On double rack units with cushions, the cushion is fitted to the upper rack and the stroke adjuster to the lower. (Consult factory.)

The increase in build length, for both single and double rack units, is shown as dimension A in the table. Cushion performance may be affected by the addition of a stroke adjuster. Please consult the factory in critical applications.

Model	(1) Turn Adj.	A (max) – Increased Build Length				B	C UNF
		30° Adjustment without Cushioned End Cap		10° Adjustment* with Cushioned End Cap			
		Inch	mm	Inch	mm		
10	4.0°	.63	16	.38	10	1/8	1/4-28
15	4.6°	.88	23	1.13	29	1/4	1/2-20
20	3.2°	1.13	29	1.13	29	1/4	1/2-20
25	3.2°	1.13	29	1.13	29	1/4	1/2-20
32	2.4°	1.50	38	2.13	54	3/8	3/4-16

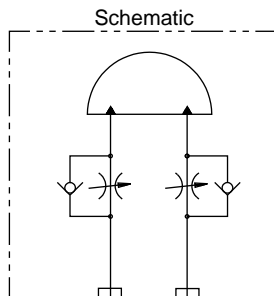
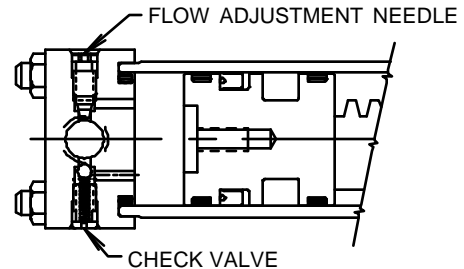
* Standard cushions operate over the last 30° of standard rotation. Stroke adjuster will decrease the effective cushion length by the amount of inward adjustment.

CAUTION: Due to end of stroke loading on some applications, four stroke adjusters may be needed with double rack actuators to avoid pinion gear damage.

PORT FLOW CONTROLS (P, R, S)

Built in meter-out flow controls provide adjustment of actuator speed and eliminate the cost and space needed for 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.

Four port flow controls are suggested with double rack actuators to avoid pinion gear damage.



STANDARD ADJUSTMENT NEEDLE LOCATIONS

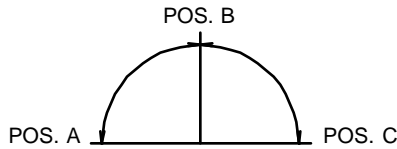
Port Position	Needle Position
1	2
2	3
3	2
4*	3

*Single rack only

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

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.

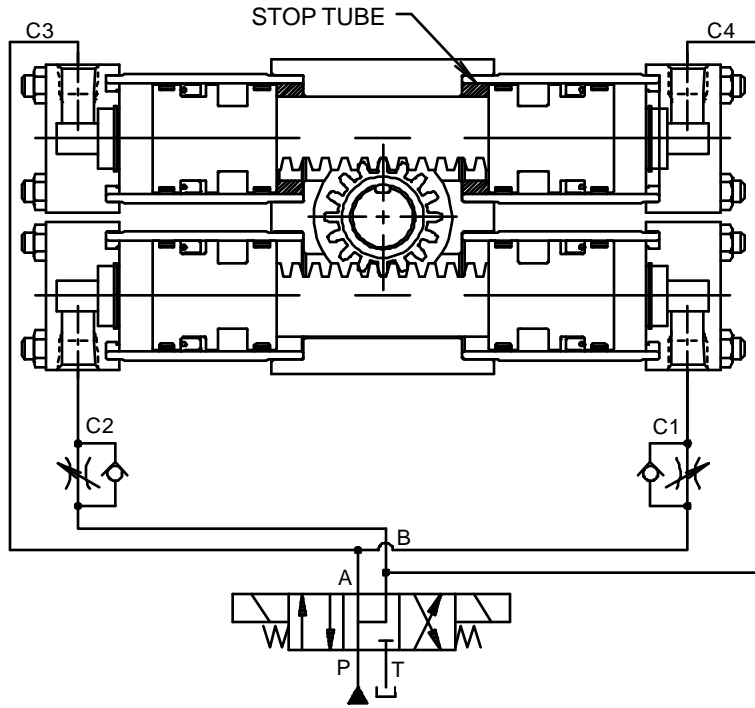
OUTPUT TORQUE:

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: **LTR153-045/180-AB21-C** is a standard, three position actuator. Position A is 0°, position B is 45°, and position C is 180°.

CAUTION: Keep loop pressure drops low for proper operation.



Suggested Circuit

Rotation Tolerances			
Model	Total Rotation, Degrees	Between Positions, Degrees ¹	Backlash Minutes ²
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	100 psi (6.8 Bar)	500psi (34 Bar)	1000 psi (68 Bar)
103	39	195	390
153	118	590	1180
203	282	1410	2820
253	430	2148	4295
323	1141	5703	11407

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:

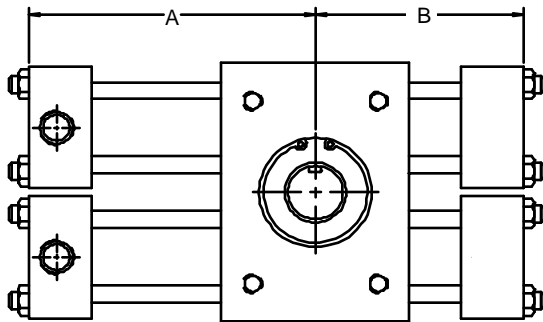
A double rack unit is modified for actuation on one end only. Alternately pressurizing C-1 or C-2 causes clockwise and counter-clockwise rotation, respectively. Backlash in the rack & pinion is eliminated as the pinion is tightly "trapped" between both racks at the end of stroke, preventing any further 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:

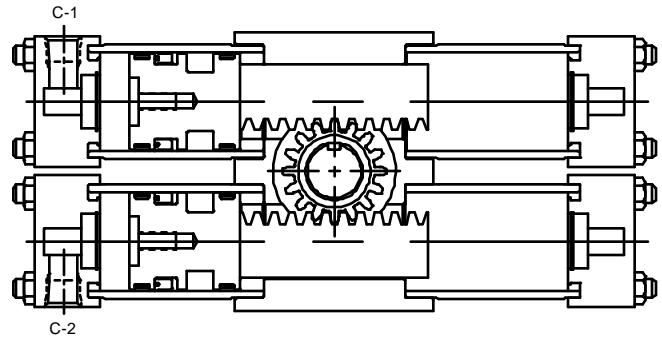
Output torque of the antibacklash actuator is equivalent to the torque output of the same size single rack unit. The chart to the right gives selected torque valves for specified pressures.



ORDERING INFORMATION:

Antibacklash actuators can be ordered by inserting a "7" into the "configuration" space in the model code. For example: **LTR157-180F-AR21-C** is a hydraulic antibacklash actuator with a theoretical output torque of 1000 lb-in at 1000 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 flange coupling interface.



Model	Rotation	A		B	
		Inch	mm	Inch	mm
107	90	3 ³ / ₄	95	2 ³ / ₄	70
	180	4 ¹ / ₈	105	3 ³ / ₄	95
	360	5 ³ / ₄	146	5	127
157	90	4 ⁹ / ₁₆	116	3 ⁵ / ₁₆	84
	180	5 ⁵ / ₈	143	4 ⁹ / ₁₆	116
	360	7 ¹¹ / ₁₆	195	6 ⁵ / ₈	168
207	90	5 ⁵ / ₈	143	4 ¹ / ₈	105
	180	7 ¹ / ₁₆	179	5 ⁵ / ₈	143
	360	9 ⁷ / ₈	251	8 ¹ / ₂	216
257	90	6 ⁵ / ₁₆	160	4 ⁻³ / ₈	111
	180	7 ³ / ₄	197	6 ⁻⁵ / ₁₆	160
	360	10 ⁵ / ₁₆	262	8 ⁻¹³ / ₁₆	224
327	90	8 ⁵ / ₁₆	211	5 ⁻¹³ / ₁₆	148
	180	10 ⁹ / ₁₆	268	8 ⁻⁵ / ₁₆	211
	360	14 ¹¹ / ₁₆	373	12 ⁻⁷ / ₁₆	316

Theoretical Output Torque, (lb-in) at Specified Pressure			
Model	100 psi (6.8 Bar)	500psi (34 Bar)	1000 psi (68 Bar)
103	39	195	390
153	118	590	1180
203	282	1410	2820
253	430	2148	4295
323	1141	5703	11407

SWITCH CHARACTERISTICS

Proximity Switches

- End Cap Mounted
- Solid State Electronics
- LED Indicator
- 10-30 VDC or 50-230 VAC/DC
- PNP and NPN Available
- Senses Cushion Spear on piston
- Highest Cost
- Long Life

Hall Effect Switches

- Fully Adjustable Travel
- Solid State Electronics
- LED Indicator
- 5-30 VDC
- PNP and NPN Available
- Senses magnet band on piston (Aluminum cylinders required)
- Medium Cost
- Long Life

Reed Switches

- Fully Adjustable Travel
- Mechanical Reed
- LED Indicator
- 5-30 VDC or 85-150 VAC
- Senses magnet band on piston (Aluminum cylinders required)
- Lowest Cost
- Medium Life

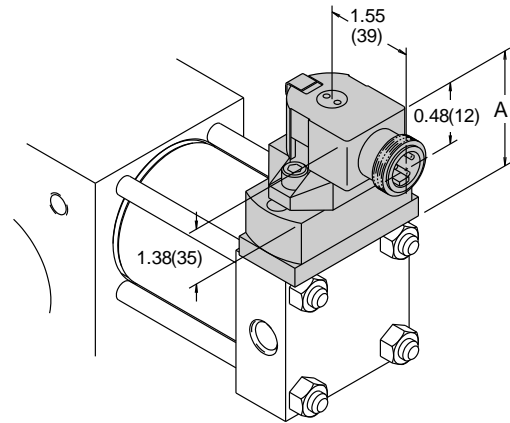
PROXIMITY SWITCHES

The inductive type proximity switch 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 switch is solid state and meets NEMA 4, 12 & 13 specifications. For ease of wiring, the connector housing is rotatable through 360°. To rotate, lift the cover latch, position, and release.

A standard proximity switch 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 switch 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 switch preventing automatic restarts.

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

Both switches 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 switch is closed, indicating the presence of the cushion spear. Both LEDs flashing indicates a short circuit condition.

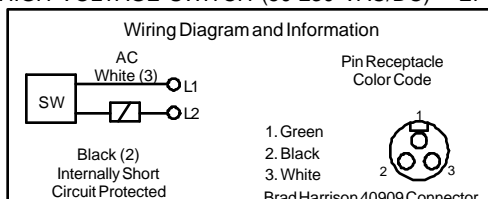


Model	A, inch (mm)
15	1.88 (48)
20	2.44 (62)
25	2.16 (55)
32	1.94 (49)

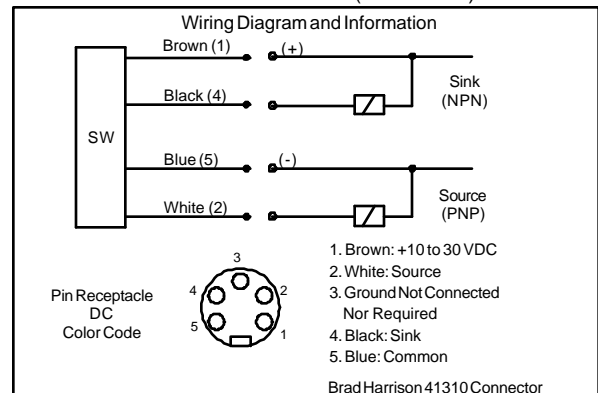
NOTES:

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 switch type, orientation and voltage when ordering.
6. Not available on 10 size units.
7. The low voltage DC switch is available in non-rotatable style only, consult representative for further information.

HIGH VOLTAGE SWITCH (50-230 VAC/DC) – EPS5



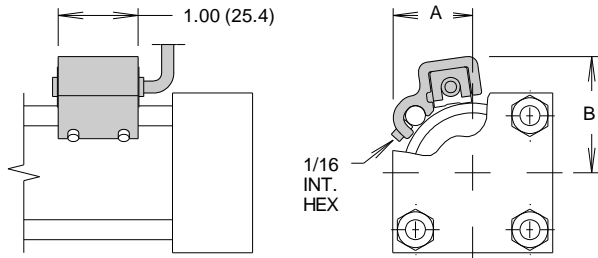
LOW VOLTAGE DC SWITCH (10-30 VDC) – EPS6



Euchner (EPS7) switch available as option (20-250 VAC/DC).

MAGNETIC PISTON (M)

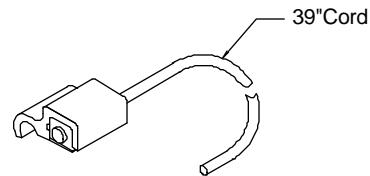
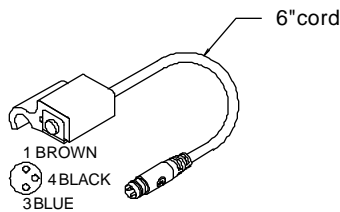
This option prepares the actuator for use with reed and Hall Effect switches. The "M" option should be specified to provide a magnet on the cylinder piston and aluminum cylinder tubes. Order switches separately.



Model	A inch (mm)	B inch (mm)
10	.84 (21)	1.22 (30)
15	.99 (25)	1.46 (37)
20	1.27 (32)	1.68 (43)
25	1.45 (37)	1.89 (48)
32	1.71 (43)	2.20 (56)

SWITCH PART NUMBERS

Model	PNP Hall Effect		NPN Hall Effect		Reed	
	With 6" Male Quick Connect	With 39" Potted-in Leads	With 6" Male Quick Connect	With 39" Potted-in Leads	With 6" Male Quick Connect	With 39" Potted-in Leads
10	SWH-1PC	SWH-1P	SWH-1NC	SWH-1N	SWR-1C	SWR-1
15	SWH-1PC	SWH-1P	SWH-1NC	SWH-1N	SWR-1C	SWR-1
20	SWH-2PC	SWH-2P	SWH-2NC	SWH-2N	SWR-2C	SWR-2
25	SWH-2PC	SWH-2P	SWH-2NC	SWH-2N	SWR-2C	SWR-2
32	SWH-2PC	SWH-2P	SWH-2NC	SWH-2N	SWR-2C	SWR-2



**CORDSET WITH FEMALE
 QUICK CONNECT**

(order separately)

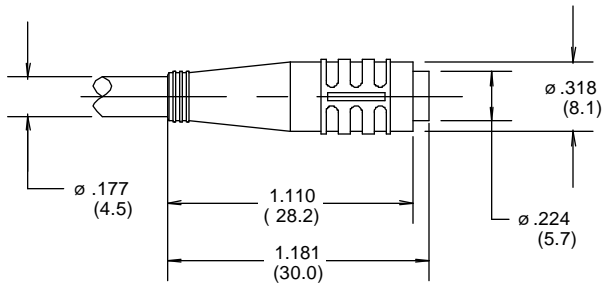
A female connector is available for all switches with the male quick connect option. The male plug will accept a snap-on or threaded connector. Parker's cordset part numbers and other manufacturer's part numbers are listed in the chart to the right:

Manufacturer	Threaded Connector	Snap-On Connector
Parker	B8786	B8785
Brad Harrison	45310-102	45300-102
Lumberg	RKMV3-61/5m	RKM3-61/5m
Hirschmann	-	ELKA-K308PUR014
Turck	PKG 3M-6/S90	PKG3M-6/S90

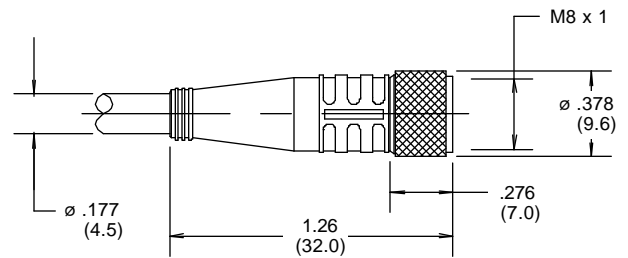
Cordset Specifications:

- Connector: Oil resistant polyurethane body material, PA 6 (Nylon) contact carrier, spacings to VDE 0110 Group C, (30 VAC / 36 VDC)
- Contacts: Gold plated beryllium copper, machined from solid stock
- Coupling Method: Snap-Lock or chrome plated brass nut
- Cord Construction: Oil resistant black PUR jacket, non-wicking, non-hygroscopic, 300V. Cable end is stripped and tinned.
- Conductors: Extra high flex stranding, PVC insulation
- Temperature: -40 to 194°F (-40 to 90°C)
- Protection: NEMA 1,3,4,6P and IEC IP67
- Cable Length: 20 ft. (6m)

**Snap-On
 Straight Plug**



**Threaded
 Straight Plug**

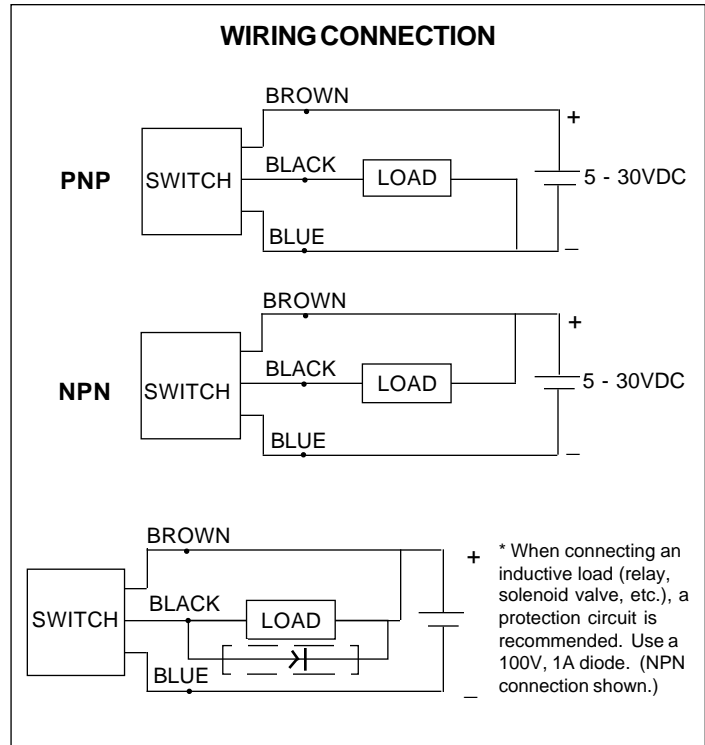


Note: Dimensions in inches (mm).

HALL EFFECT SWITCHES

SPECIFICATIONS

Type:	Solid State (PNP or NPN)
Switching Logic:	Normally Open
Supply Voltage Range:	5 - 30VDC
Current Output Range:	Up to 100 mA at 5 VDC, Up to 200 mA at 12 VDC and 24 VDC
Current Consumption:	7 mA at 5 VDC, 15 mA at 12 VDC, and 30 mA at 24 VDC
Switching Response:	1000 Hz Maximum
Residual Voltage:	1.5V Maximum
Leakage Current:	10uA Maximum
Breakdown Voltage:	1.8kVACrms for 1 sec., lead to case
Min. Current for LED:	1mA
Operating Temperature:	14 to 140°F (-10 to 60°C)
Enclosure Protection:	Meets IEC IP67, fully encapsulated
Lead Wire:	3 conductor, 24 gauge
Lead Wire Length:	39 in (1 m)
Vibration Resistance:	10-55 Hz, 1.5mm double amplitude



REED SWITCHES

SPECIFICATIONS

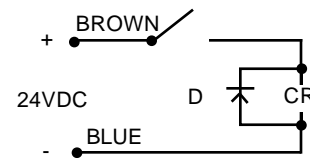
Switching Logic:	Normally Open
Voltage Rating:	85-125 VAC or 5-30 VDC*
Power Rating:	10 Watts AC or DC/Resistive Load 5 Watts AC or DC/Inductive Load
Switching Current Range:	10-200 mA/Resistive Load (PC, Sequencer) 10-100 mA/Inductive Load (Relay)
Switching Response:	300 Hz Maximum
Breakdown Voltage:	1.8kVACrms for 1 sec., lead to case
Min. Current for LED:	18mA
Operating Temperature:	14 to 140°F (-10 to 60°C)
Enclosure Protection:	Meets IEC IP67, fully encapsulated
Lead Wire:	2 conductor, 22 Gauge
Lead Wire Length:	39 in (1 m)
Vibration Resistance:	10-55 Hz, 1.5mm double amplitude

* Polarity is restricted for DC operation
(+) to Brown
(-) to Blue
If these connections are reversed the contacts will close, but the LED will not light.

* Not compatible with TTL level logic.

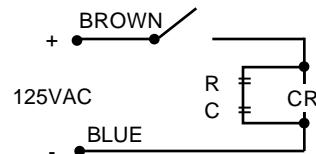
PROTECTION CIRCUIT (INDUCTIVE LOADS)

(Required for proper operation 24VDC)
Select a diode with a breakdown voltage and current rating according to the load. Place a diode in parallel to the load with the polarity as indicated:



CR: Relay coil (under 0.5W coil rating)

(Recommended for longer switch life 125VAC)
Select a resistor and capacitor according to the load. Place a resistor and capacitor in parallel to the load:



CR: Relay coil (under 2W coil rating)
R: Resistor under 1 K ohm
C: Capacitor 0.1 μF

BEARING LOAD CAPACITIES & GEAR TRAIN AVAILABLE

Model	Bearing Load Capacities*				Distance		Available Stopping Work per Endcap / Cushion			
	Radial		Thrust		Between Bearings		Strength Criteria		Durability Criteria	
	lb	kN	lb	kN	inch	mm	in-lb	Nm	in-lb	Nm
10	100	0.4	50	0.2	1.40	35	300	34	141	16
15	250	1.1	125	0.5	2.15	54	900	102	348	39
20	500	2.2	250	1.1	2.15	54	1500	169	936	106
25	750	3.3	375	1.6	2.50	63	2250	254	1098	124
32	1000	4.4	500	2.2	3.75	95	5000	565	2029	229

* Bearing capacities only. Check total stopping torque ratings to determine if actuator will stop load. Double rack actuators should use Type 4 or Type 8 cushion option for table data to remain correct.

CUSHION DECELERATION CONTROL

The cushion causes the resisting torque that can be used to decelerate a rotational load. Please note the cushion has to provide enough resistance to control: drive torque caused by the hydraulic system pressure; plus the torque caused by gravity pulling on the rotational load; and the kinetic energy associated with the motion of the inertia load. Since the actuator's cushion has to be able to control the sum of all three torque factors, we suggest including cushion capacity as one of the actuator selection criteria.

It is strongly suggested that proportional valves be used instead of cushions to control (decelerate) high inertial loads. This provides the ability to reduce inlet pressure while generating deceleration pressure. It also allows for longer ramp times, thus increasing deceleration stroke.

**SUPPLEMENTAL INFORMATION
 KINETIC ENERGY BASIC FORMULA**

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

$$\omega = 0.0175 \times \frac{2\Theta_A + \Theta_C + 2\Theta_D}{\text{Rotation Time (sec.)}}$$

where:

KE = Kinetic Energy (in-lb)

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

See Page 19 for formulas.

ω = Peak Velocity (rad/sec)

(Assuming twice average velocity)

Θ_A = Acceleration Angle (deg)

Θ_C = Constant Velocity Angle (deg)

Θ_D = Deceleration Angle (deg)

KINETIC ENERGY CAPACITY

The energy values below assume drive pressure is maintained through cushion stroke.

Single Rack Units with Single Set of Cushions (30°)

Model	Kinetic Energy Rating(in-lb) of Cushion at Specified Drive Pressure*											
	0 psi		250 psi		500 psi		750 psi		1000 psi		1500 psi	
	Max.	Durability	Max.	Durability	Max.	Durability	Max.	Durability	Max.	Durability	Max.	Durability
LTR101	310	141	258	141	207	141	155	141	103	103	0	0
LTR151	927	348	772	348	618	348	463	348	309	309	0	0
LTR201	2220	936	1850	936	1480	936	1110	936	740	740	0	0
LTR251	3373	1098	2811	1098	2248	1098	1686	1098	1124	1098	0	0
LTR321	11945	2029	8959	2029	5973	2029	2986	2029	0	0	na	na

Double Rack Units with Single Set of Cushions (30°)

Model	Kinetic Energy Rating(in-lb) of Cushion at Specified Drive Pressure*											
	0 psi		250 psi		500 psi		750 psi		1000 psi		1500 psi	
	Max.	Durability	Max.	Durability	Max.	Durability	Max.	Durability	Max.	Durability	Max.	Durability
LTR102	310	141	207	141	103	103	0	0	0	0	0	0
LTR152	924	348	616	348	308	308	0	0	0	0	0	0
LTR202	2217	936	1478	936	739	739	0	0	0	0	0	0
LTR252	3373	1098	2249	1098	1124	1098	0	0	0	0	0	0
LTR322	5971	2029	2986	2029	0	0	0	0	0	0	0	0

Double Rack Units with Double Set of Cushions (30°)**

Model	Kinetic Energy Rating(in-lb) of Cushion at Specified Drive Pressure*											
	0 psi		250 psi		500 psi		750 psi		1000 psi		1500 psi	
	Max.	Durability	Max.	Durability	Max.	Durability	Max.	Durability	Max.	Durability	Max.	Durability
LTR102	310	303	206	206	103	103	0	0	0	0	0	0
LTR152	1848	732	1540	732	1232	732	924	732	616	616	0	0
LTR202	4434	1982	3695	1982	2956	1982	2217	1982	1478	1478	0	0
LTR252	6745	2223	5621	2223	4496	2223	3373	2223	2248	2223	0	0
LTR322	11943	3222	8957	3222	5971	3222	2986	2986	5235	3222	0	0

* Must deduct work (energy) done to overcome potential energy effects of load. $W_{PE} = T_{PE} \times \theta$, where θ is in radians.

** Extreme care must be exercised so that both cushions are adjusted equally for each direction or dangerous pressure intensification and gear train stresses could result. (Suggest high performance cushion option.)

UNIT WEIGHTS

Model	Rotation							
	90°		180°		270°		360°	
	lb	kg	lb	kg	lb	kg	lb	kg
LTR101	2 ¹ / ₄	1	2 ¹ / ₂	1.1	2 ³ / ₄	1.2	3	1.3
LTR102	3 ¹ / ₂	1.6	3 ⁷ / ₈	1.8	4 ¹ / ₄	1.7	4 ⁵ / ₈	2.1
LTR151	8 ⁷ / ₈	4	9 ⁵ / ₈	4.3	10 ³ / ₈	4.7	11 ¹ / ₈	5
LTR152	12 ⁵ / ₈	5.7	14 ¹ / ₈	6.4	15 ⁵ / ₈	7.1	19 ¹ / ₂	8.8
LTR201	14 ⁵ / ₈	6.6	16	7.2	17 ³ / ₈	7.9	18 ⁷ / ₈	8.6
LTR202	21 ³ / ₄	9.9	24 ¹ / ₂	11.1	27 ¹ / ₂	12.5	30 ¹ / ₂	13.8
LTR251	22 ⁵ / ₈	10.3	24 ³ / ₄	11.2	27 ¹ / ₄	12.4	29 ³ / ₈	13.3
LTR252	33 ⁵ / ₈	15.2	38 ¹ / ₈	16.8	42 ³ / ₄	19.4	47 ¹ / ₈	21.4
LTR321	46 ⁵ / ₈	21.1	50 ¹ / ₈	22.7	53 ¹ / ₂	24.3	56 ⁷ / ₈	25.8
LTR322	66 ⁵ / ₈	30.2	73 ⁵ / ₈	33.4	78 ³ / ₈	35.5	87 ¹ / ₈	39.5

KINETIC ENERGY BASIC FORMULA

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

$$\omega = 0.0175 \times \frac{2\Theta_A + \Theta_C + 2\Theta_D}{\text{Rotation Time (Sec.)}}$$

where:

KE = Kinetic Energy (in-lb)

J_m = 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)

Θ_A = Acceleration Angle (deg)

Θ_C = Constant Velocity Angle (deg)

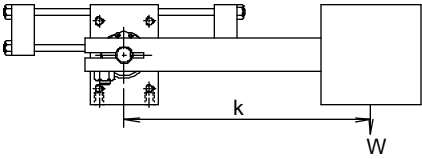
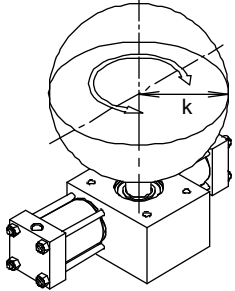
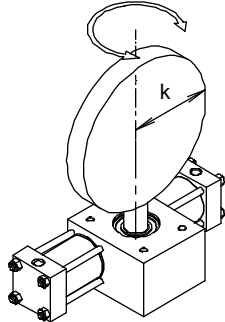
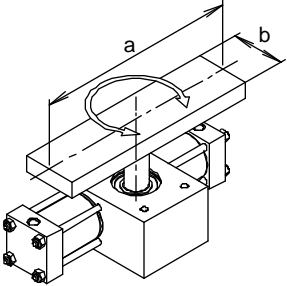
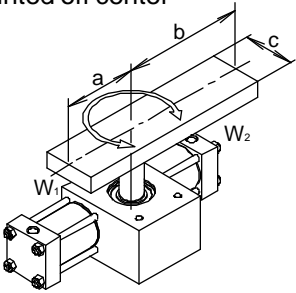
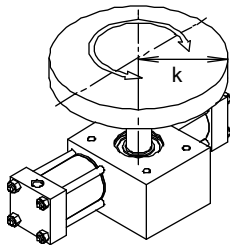
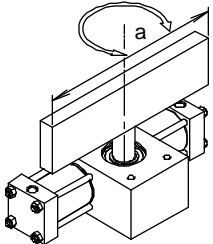
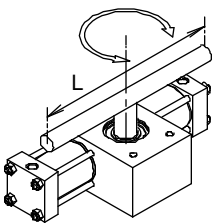
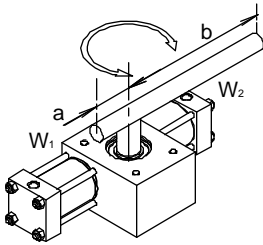
Θ_D = Deceleration Angle (deg)

W = Weight of load (lb)

g = Gravitational constant = 386.4 in/sec²

k = Radius of gyration (in)

**MASS MOMENTS OF INERTIA
 MODELS & FORMULAS**

<p>POINT LOAD</p>  $J_m = \frac{W}{g} \times k^2$	<p>SOLID SPHERE - Mounted on center</p>  $J_m = \frac{2}{5} \times \frac{W}{g} \times k^2$	<p>THIN DISK - End mounted on center</p>  $J_m = \frac{W}{g} \times \frac{k^2}{4}$
<p>THIN RECTANGULAR PLATE Mounted on center</p>  $J_m = \frac{W}{g} \times \frac{a^2 + b^2}{12}$	<p>THIN RECTANGULAR PLATE Mounted off center</p>  $J_m = \frac{W_1}{g} \times \frac{4a^2 + c^2}{12} + \frac{W_2}{g} \times \frac{4b^2 + c^2}{12}$	<p>THIN DISK Mounted on center</p>  $J_m = \frac{W}{g} \times \frac{k^2}{2}$
<p>THIN RECTANGULAR PLATE End mounted on center</p>  $J_m = \frac{W}{g} \times \frac{a^2}{12}$	<p>SLENDER ROD Mounted on center</p>  $J_m = \frac{W}{g} \times \frac{L^2}{12}$	<p>SLENDER ROD Mounted off center</p>  $J_m = \frac{W_1}{g} \times \frac{a^2}{3} + \frac{W_2}{g} \times \frac{b^2}{3}$

Ordering Information – Inch

MODEL CODE & ORDERING INFORMATION

Example: LTR251 - 0903FP - AB21MV - CXX



Series

LTR - Light duty hydraulic tie rod series

Model (Cylinder bore size) See appropriate tables for torque output.

10 - 1 inch 20 - 2 inch 32 - 3¼ inch
15 - 1½ inch 25 - 2½ inch

Configuration

1 - Single rack 3 - Three position actuator
2 - Double rack 7 - Antibacklash

Rotation (Or specify any other rotation)

090 = 90° 270 = 270°
180 = 180° 360 = 360°
(For three position units, specify middle and total rotation separated by a "/". ie 090/180)

Cushions

Omit - None 4 - Four cushions**
1 - Cushioned CW rotation* 8 - High performance cushion
2 - Cushioned CCW rotation* 9 - Special
3 - Cushioned both rotations

Stroke Adjusters

Omit - None F - 0-30° both rotations
D - 0-30° CW rotation* X - Special
E - 0-30° CCW rotation*

Port Flow Controls

Omit - None R - Flow control CW rotation*
P - Flow control, both rotations S - Flow control CCW rotation*

Mounting

A - Face/Base (STD) G - Foot flange R - Rear flange
F - Front flange P - Pilot ring X - Special

Shaft

A - Female keyed C - Double male keyed X - Special
B - Single male keyed (STD) R - Preload keyway

Port Threads

1 - SAE Straight Thread (STD) 2 - NPTF 9 - Special

Port Location

1 - Position 1 (STD) 3 - Position 3 9 - Special
2 - Position 2 4 - Position 4

Standard Options

Omit - None S - Shaft seal cover
M - Magnetic piston ring

Seals

Omit - Nitrile (STD) V - Fluorocarbon W - Carboxilated Nitrile X - Special

Other Options (Detail in clear text.)

Proximity switches
Close tolerance rotation

Design Series

Assigned by factory

Special Options

Omit - (STD)
(Two digit code assigned by factory and applies when any "X" or "9" appears in the model number or when special options or features are required.)

*Viewed from shaft end **Double rack models only

MODEL CODE & ORDERING INFORMATION

Example: LTR251 - 0903FP - BD41MV - CXX



Series

LTR - Light duty hydraulic tie rod series

Model (Cylinder bore size) See appropriate tables for torque output.

10 - 1 inch (25.4 mm)	25 - 2½ inch (63.5 mm)
15 - 1½ inch (38.1 mm)	32 - 3¼ inch (82.6 mm)
20 - 2 inch (50.8 mm)	

Configuration

1 - Single rack	3 - Three position actuator
2 - Double rack	7 - Antibacklash

Rotation (Or specify any other rotation)

090 = 90°	270 = 270°
180 = 180°	360 = 360°

(For three position units, specify middle and total rotation separated by a "/". ie 090/180)

Cushions

Omit - None	3 - Cushioned both rotations	9 - Special
1 - Cushioned CW rotation*	4 - Four cushions**	
2 - Cushioned CCW rotation*	8 - High performance cushion	

Stroke Adjusters

Omit - None	F - 0-30° both rotations
D - 0-30° CW rotation*	X - Special
E - 0-30° CCW rotation*	

Port Flow Controls

Omit - None	R - Flow control CW rotation*
P - Flow control, both rotations	S - Flow control CCW rotation*

Mounting

B - Face/Base (STD)	K - Foot flange	T - Rear flange
H - Front flange	S - Pilot ring	X - Special

Shaft

D - Single male keyed (STD)	F - Double male keyed
E - Female keyed	X - Special

Port Threads

4 - BSPP (STD)	6 - ISO 6149/1	2 - NPTF
5 - DIN 3852/1	1 - SAE straight thread	9 - Special

Port Location

1 - Position 1 (STD)	3 - Position 3	9 - Special
2 - Position 2	4 - Position 4	

Standard Options

Omit - None	S - Shaft seal cover
M - Magnetic piston ring	

Seals

Omit - Nitrile (STD)	V - Fluorocarbon	W - Carboxylated Nitrile	X - Special
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Other Options (Detail in clear text.)

Proximity switches
Close tolerance rotation

Design Series

Assigned by factory

Special Options

Omit - (STD)
(Two digit code assigned by factory and applies when any "X" or "9" appears in the model number or when special options or features are required.)

*Viewed from shaft end

**Double rack models only

Fax completed form to (330)334-3335

CONTACT INFORMATION:

Name: _____ Phone Number: _____

Company: _____ Fax Number: _____

Address: _____

APPLICATION DETAILS:

1. Torque Requirement: _____ lb-in. 2. Operating Pressure: _____ psi

3. Required Rotation: _____ ° (i.e. 90°, 180° etc.) 4. Cycle Time: _____ sec.
(Time to complete rotation in one direction)

5. End of Stroke Options Required: _____ (i.e. Cushions, Stroke Adjusters)

6. Bearing Support Required - Include weight of external load and direction in which it will be applied. (i.e. radial, thrust)

7. Operating Temperature: _____ °F 8. Type of Fluid Used: _____

9. Brief Description of Application (If needed, sketch can be submitted using the space provided at the bottom of this page.)

ACTUATOR DETAILS:

1. Type of Mounting Style Preferred: _____

2. Type of Shaft Connection Preferred: _____

3. Any Special Options Desired? _____

SKETCH:

