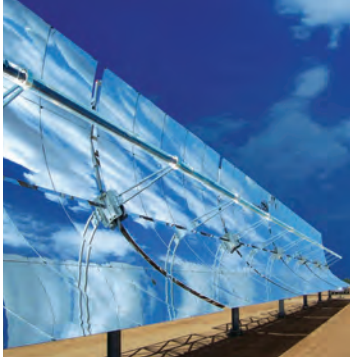
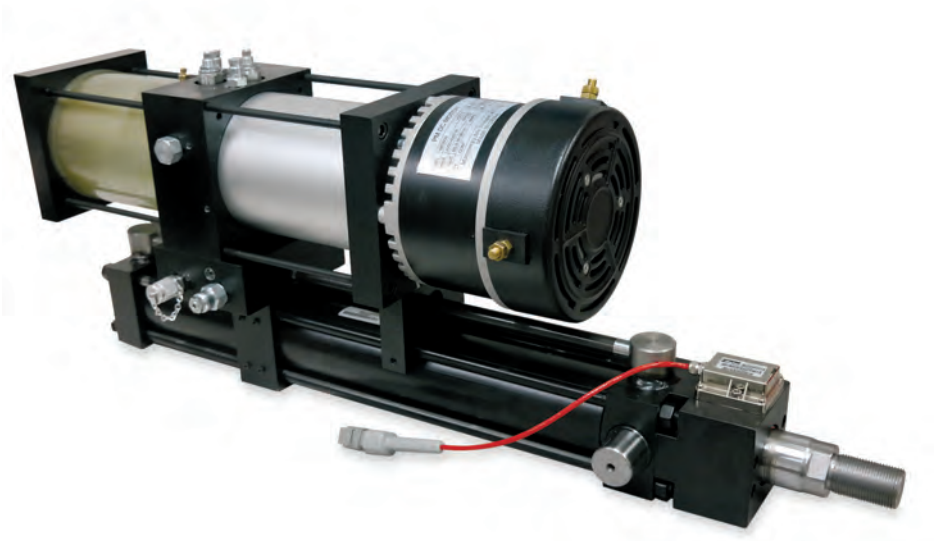
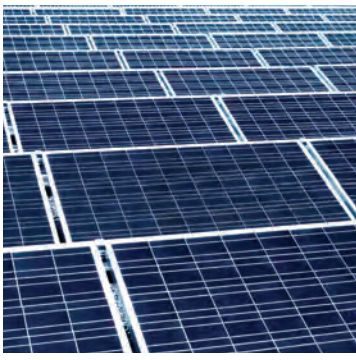




HAS
Hybrid Actuation System

Solar Tracking Solutions



Parker

ENGINEERING YOUR SUCCESS.

HAS Hybrid Actuation System for Single and Dual Axis Tracking

Photo courtesy of GMI Solar.

Actuation systems must be efficient, precise, and durable enough to withstand harsh power-generation environments. Parker Hannifin Corporation has developed a hybrid actuation system (HAS) that is ideal for renewable-energy actuation applications, such as those used with solar panels, wind turbines, and hydro-electric dams.

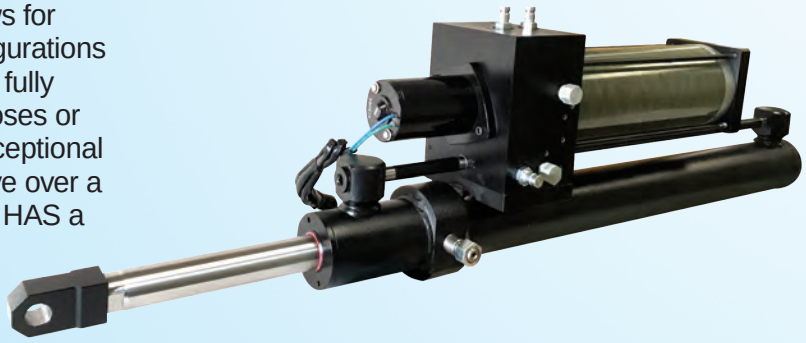
The new hybrid design combines the controllability of traditional electromechanical actuators with the power density, longer life, and resistive-force capabilities of traditional hydraulic systems. The result is an improved actuation system for single and dual axis tracking and other renewable energy systems, with a wider range of capabilities.

More efficiency, less maintenance

This high-efficiency, modular system allows for various traditional cylinder mounting configurations and stroke lengths. The hybrid design is a fully self-contained system with no hydraulic hoses or power units. Hybrid hydraulics achieve exceptional economies of scale, with the ability to move over a megawatt from a single point. This makes HAS a good choice for large or small arrays.

Solar applications

For solar panels, HAS is a ultra-efficient, completely self-contained reversible hydraulic pump and electric motor that eliminate nearly all leak paths into or out of the package. Parker engineers designed a hybrid actuator into the pitch system so designers can move more photo-voltaic panels with fewer actuators and controls, resulting in lower installation costs and longer service over the life of the solar field. The design offers clear advantages over comparable electromechanical actuator (EMA) systems because all the internal-wear items are permanently lubricated for extended life. The power density of HAS is typically three times that of a comparable electric cylinder.



Parker Hannifin Corporation
Cylinder Division
Des Plaines, Illinois USA

Model Ordering Code

How to Order Basic Model with HAS Pump Motor Code:

1. Specify the complete Parker Cylinder Model Number.

2. Specify the Pump Motor Code.

Basic Model Numbers

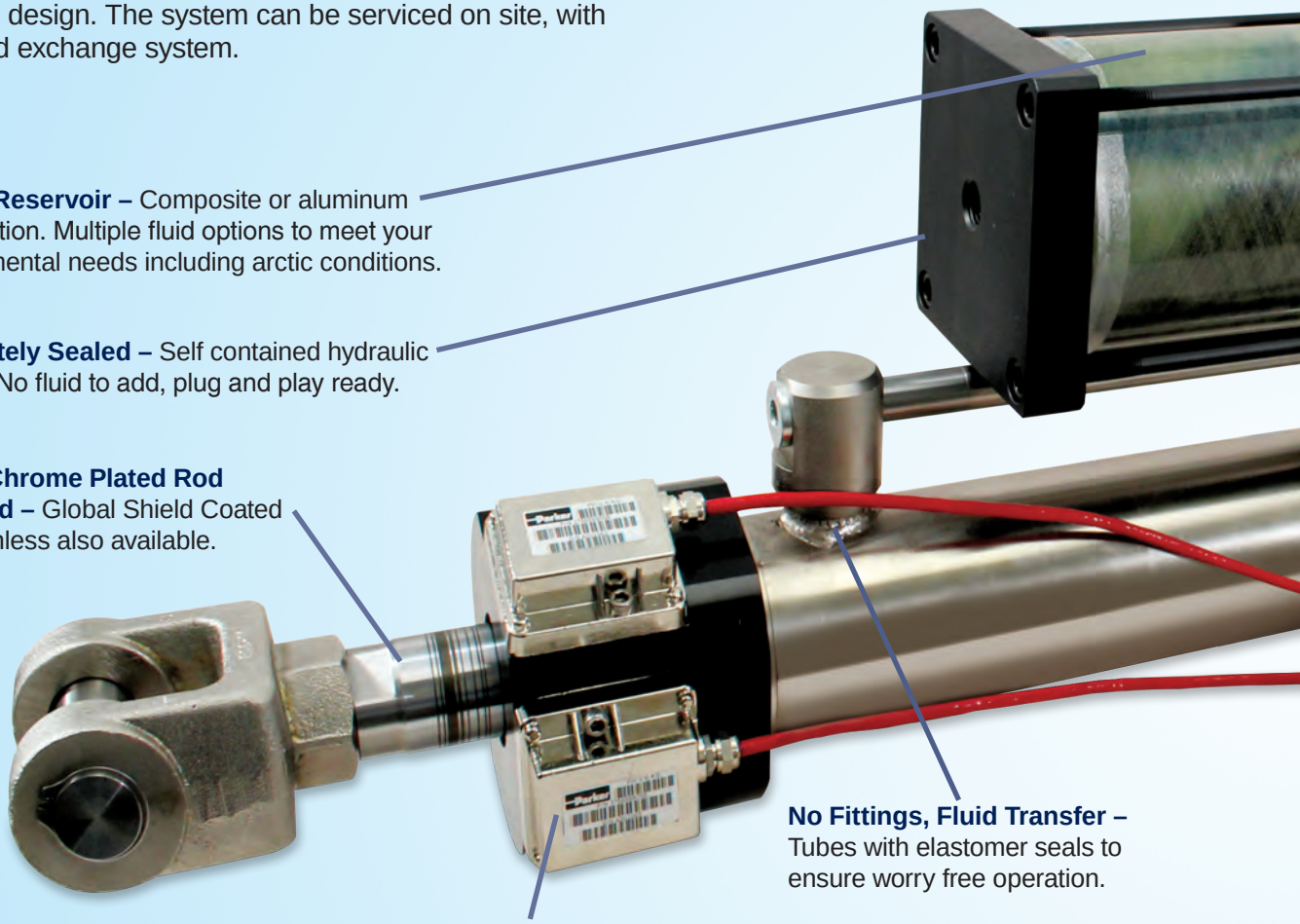
4.00	_	BB	B	X	BB		S	1	A	x24.00
Bore Dia.	Double Rod	Mounting Style	Piston	Ports	Seals	Special Modifi-cations	Piston Rod Number	Rod End Thread Style	Thread Type	Stroke
2" (50 mm) 2-1/2" (63 mm) 3-1/4" 4" (101 mm) 5" (127 mm) 6"	Blank= Single Rod K = Double Rod	B = Eye BB = Clevis SE = Spherical Bearing SBM = Spherical Bearing (M) TT = Crosstube DD = Intermediate Fixed Trunnion	B= Standard seal package See specific catalog for seal selection*	X = no ports sealed actuator	Blank = Standard -10°F to 130°F 4 = Cold Temperature -20°F to 130°F See catalog* for other seal options	Specify an "S" for HAS modification	Specify rod code number. Consult current catalog*	Specify Style 4, Small Male. Style 8, Intermediate Male. Style 3, Special. Specify KK, A, W or WF dimension required.	Specify A = UNF W = BSF M = Metric	Standard Stroke length: 20", 30" 36" and 48" Others available on request

*Consult current RDH catalog for complete dimensions, specifications and model number information.

M010	15	M24L	PD00	C30	KB	A
Pump Displacement	Relief Pressure	Motor	Circuit	Reservoir	Fluid	Orientation
M010 = 0.010 in^3/rev (0.16 cc/rev) M019 = 0.019 in^3/rev (0.31 cc/rev) M025 = 0.025 in^3/rev (0.41 cc/rev) M032 = 0.032 in^3/rev (0.53 cc/rev) XXXX = other specify	10 = 1000 psi 15 = 1500 psi 30 = 3000 psi _ _ = x 100 psi	M12L = 12V 245W M12H = 12V 560W M24L = 24V 245W M24H = 24V 560W XXXX = other specify	BD00 = No load holding PA00 = A port PO check PB00 = B port PO check PD00 = Dual PO Check CAH0 = A port counterbalance, 1000-4000 psi, 3K setting CBH0 = B port counterbalance, 1000-4000 psi, 3K setting CDH0 = Dual counterbalance 1000-4000 psi 3K setting XXXX = other specify	A30 = Aluminum 3X Rod Area C30 = Composite 3X Rod Area	DC = Parker DuraClean XX = other specify	A = Reservoir Cap End B = Reservoir Head End

Parker HAS actuators offer low cost, ease of maintenance and durable choice for large and small arrays

HAS Solar Actuators are built for maintenance free operation for several years. Oil volumes are reduced minimal amounts, generally less than 1 gallon reservoir sizes. Serviceability is built into the design. The system can be serviced on site, with Parker's fluid exchange system.



Sealed Reservoir – Composite or aluminum construction. Multiple fluid options to meet your environmental needs including arctic conditions.

Completely Sealed – Self contained hydraulic system. No fluid to add, plug and play ready.

Heavy Chrome Plated Rod Standard – Global Shield Coated and stainless also available.

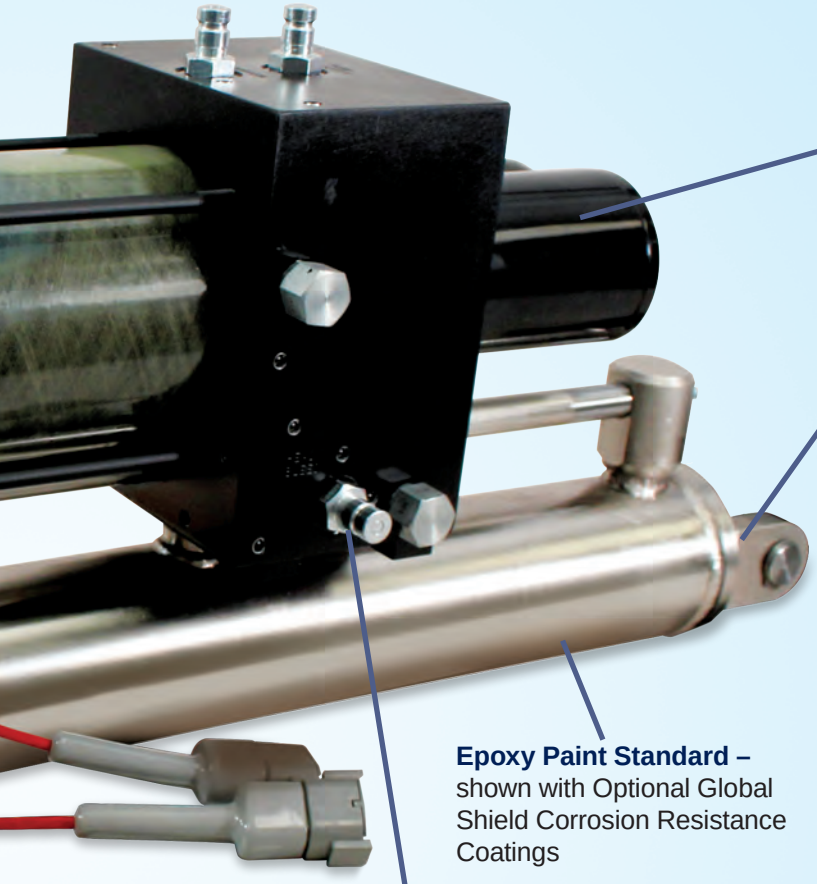
No Fittings, Fluid Transfer – Tubes with elastomer seals to ensure worry free operation.

Optional Absolute Linear Feedback – Parker's Intellinder, optical reader and bar coded rod for piston position measurements. Shown with dual sensors for redundant measurements.

Product Features

- Simple two wire operation
- AC and DC supply voltages available
- Low amp draw, 50% duty cycle, high efficiency tracking solutions
- No hydraulic hoses, no hydraulic power unit, self contained system
- High locked hold force to withstand wind gusts
- No reduction in life commonly found with screw-type actuators when loaded
- Modular system allows for various traditional cylinder mounting configurations and stroke lengths
- Surface preparation for outdoor installations
- Heavy chrome plated rods are standard, Global Shield™ rod coating and stainless steel rods for extreme corrosion prevention are optional
- Available with Intellinder™ continuous feedback or end of stroke, stroke to go switch options

Parker Hannifin Corporation
Cylinder Division
Des Plaines, Illinois USA



Low Amp Draw – 12 and 24V DC permanent magnet motors

Seven Mounting Styles

Epoxy Paint Standard – shown with Optional Global Shield Corrosion Resistance Coatings

Fluid Exchange Connections – on solar panel servicing when required

Other highlights include

- Complete actuator ready for operation
- Robust steel hydraulic cylinder, welded round line or tie rod construction
- Thrust forces to 676 kN standard
- Anodized aluminum pump manifold, weight savings
- Load holding (PO checks) standard with optional counterbalance valves
- Custom circuits available
- Virtually maintenance free for low operating costs
- 25 year product life*
- Industry leading warranty**

* Based upon typical solar tracking cycles
** Extended warranty available

Locked (Wind Loading) Values

Bore	Rod	lbs		Kn	
		Push	Pull	Push	Pull
2.5	1.375	17,671	12,326	79	55
3.25	1.75	29,865	21,206	133	94
4	2	45,239	33,929	201	151
5	2.5	70,686	53,014	314	236
6	3	101,788	76,341	453	340

Please consult factory for specific bore, mount and rod conditions.

HAS-RDH Series Cylinders from Parker

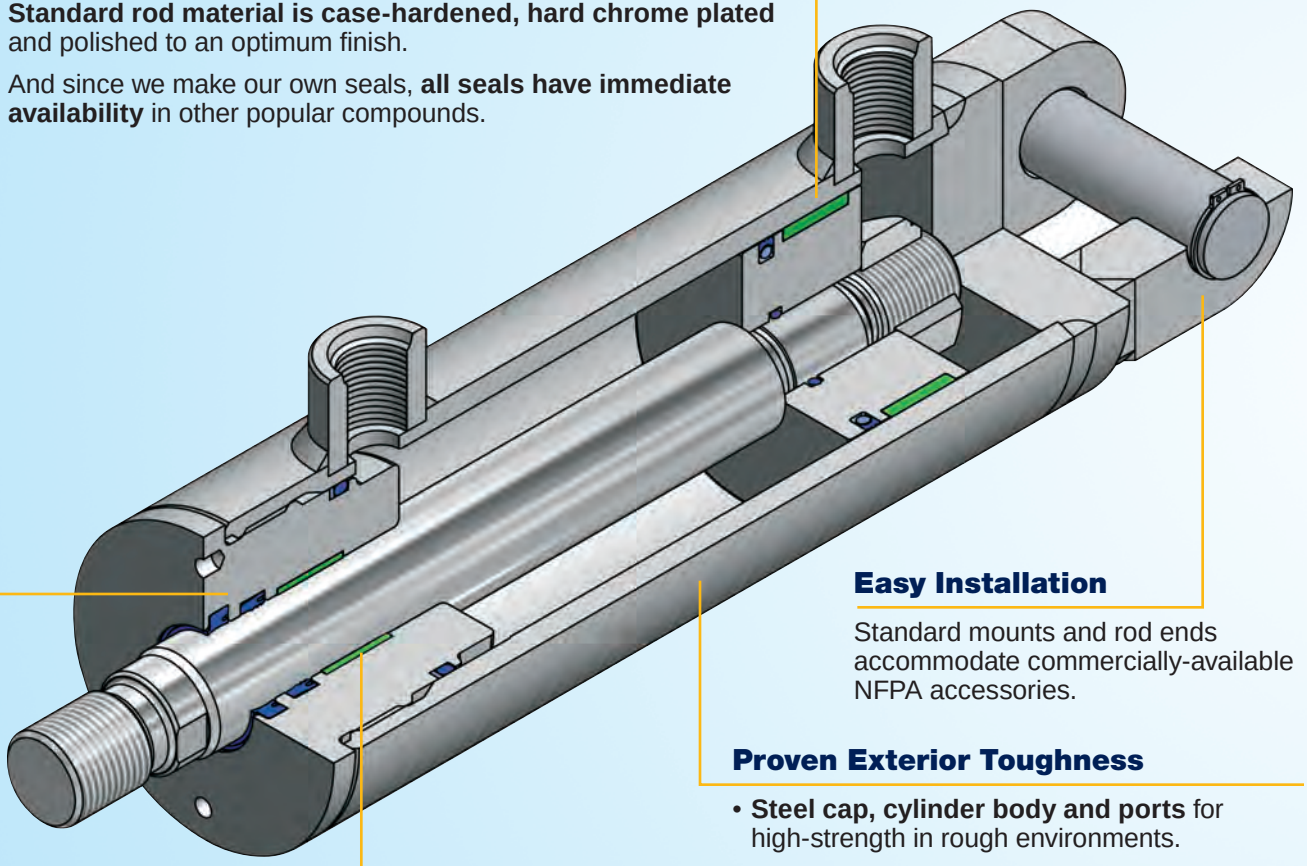
Advanced Sealing Technology

All components are manufactured by Parker and designed for high performance, long service life, low friction and zero leakage.

- **Tri-lip rod seal** (3 sealing edges!) and bi-directional piston seal feature proven leak-free performance.
- **Durable polyurethane** material is used to maximize seal life.
- **Nitrile end seals** and backup rings on a smooth bore of the cylinder body for optimal sealing and elimination of extrusion problems.
- **Composite rod and piston wear rings** are internally lubricated for reduced friction and formulated for heavy-duty, load-bearing applications.
- **Standard rod material is case-hardened, hard chrome plated** and polished to an optimum finish.
- And since we make our own seals, **all seals have immediate availability** in other popular compounds.

Switch-Ready

- **The Parker ALS Switch is the lowest cost point feedback solution** for carbon steel cylinders with a piston magnet ring.
- **Switches can be located anywhere along the stroke** and in any orientation.
- **Unique round body brackets** minimize installation time.
- **EPS & CLS threaded switches** are available for end-of-stroke sensing.



Easy Installation

Standard mounts and rod ends accommodate commercially-available NFPA accessories.

Proven Exterior Toughness

- **Steel cap, cylinder body and ports** for high-strength in rough environments.
- **Case-hardened, hard chrome plated** and polished carbon steel piston rod for damage resistance, long rod seal life and low friction.
- **Outboard urethane rod wiper seal** to remove external debris and adherents from the piston rod.
- **High quality paint coating** for interior or exterior applications.

Composite Wear Rings

Parker WearGard™ bearing materials are backed by over 30 years of manufacturing expertise.

- Heat stabilized and internally lubricated for **low friction and maximum service** life in any application.
- Strength characteristics meet or exceed most metals traditionally used in wear rings.

Environmentally Friendly

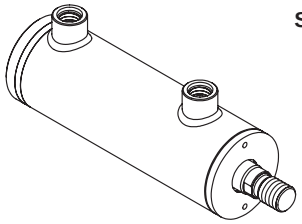
RoHS-compliant materials

Parker Hannifin Corporation
Cylinder Division
Des Plaines, Illinois USA

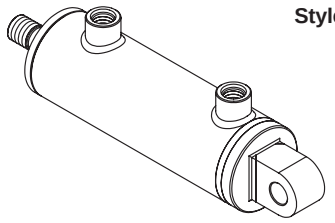
HAS-RDH Series Mounting Styles and Specifications

Available Mounting Styles

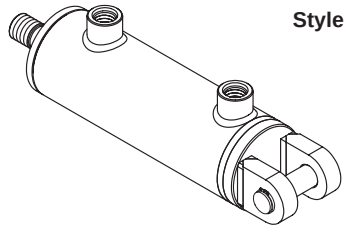
Basic, No Mount
Style T



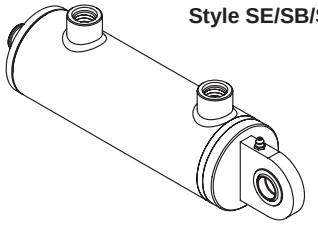
Cap Fixed Eye
Style B



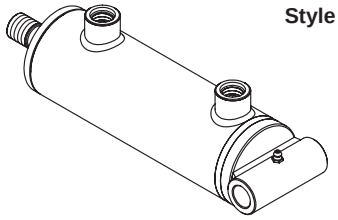
Cap Fixed Clevis
Style BB



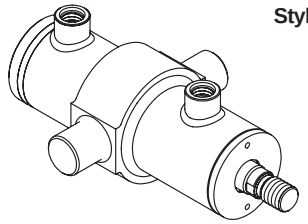
Spherical Bearing Cap End
Style SE/SB/SBM



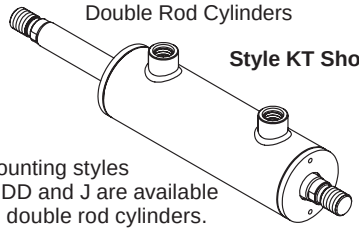
Crosstube Cap End
Style TT



Intermediate Fixed Trunnion
Style DD



Double Rod Cylinders
Style KT Shown



Mounting styles
T, DD and J are available
as double rod cylinders.

Specifications

Actuator

Type: Hydraulic, double and single acting, (power up gravity down)

Bore Size: 2" thru 6" bore

Motors

Motor Types:

12V DC, 245W (M12L)
12V DC, 560W (M12H)
24V DC, 245W (M24L)
24V DC, 560W (M24H)
Other voltages available, consult factory

Pumps

Type: Gear Reversible

Displacements:

M010 - 0.010 in^3/rev (0.16 cc/rev)
M019 - 0.019 in^3/rev (0.31 cc/rev)
M025 - 0.025 in^3/rev (0.41 cc/rev)
M032 - 0.032 in^3/rev (0.53 cc/rev)

Reservoir

Style: Sealed, (standard) Optional Vented

Construction: Aluminum, Composite

Capacity: 3 times piston rod area

Fluid: Parker Duraclean™, other available

Manifolds

Circuits:

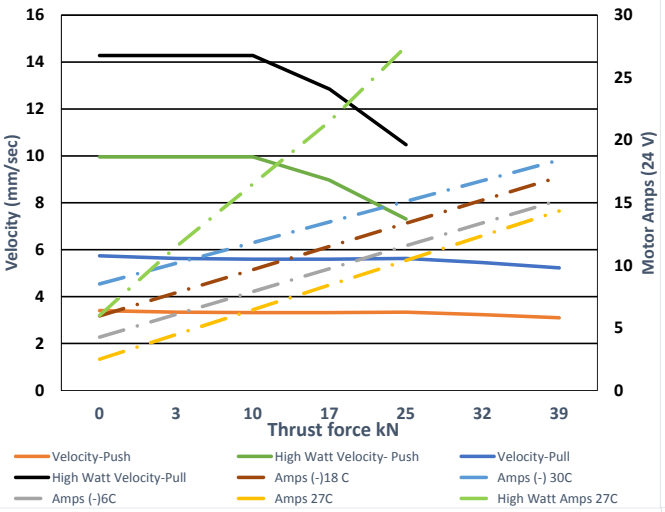
Load holding single and dual pilot operated checks
Load holding single and dual counterbalance valve
Power up, gravity down
Custom solutions available

Temperature

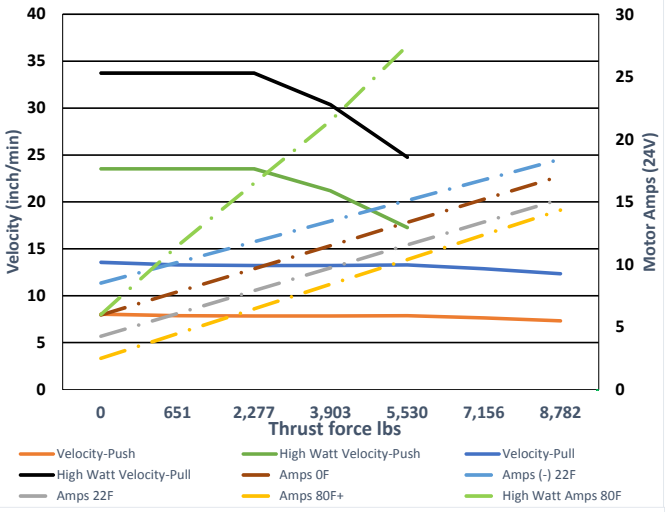
*-20°F to 130°F

*Consult factory for Arctic Fluid Options

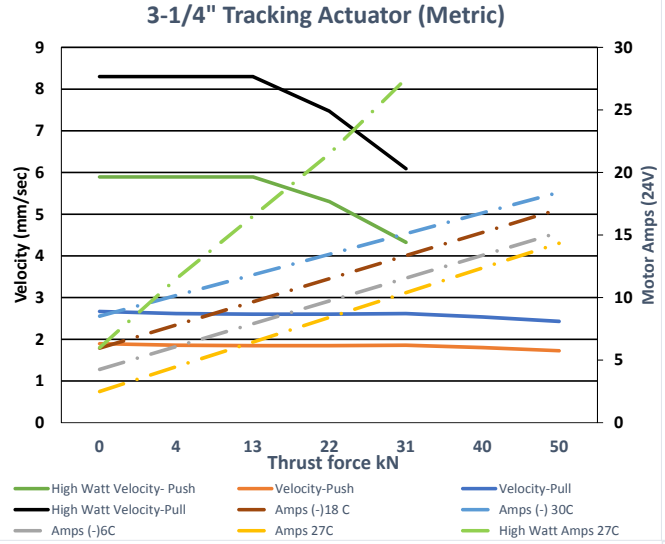
2.5" Bore Tracking Actuator (Metric)



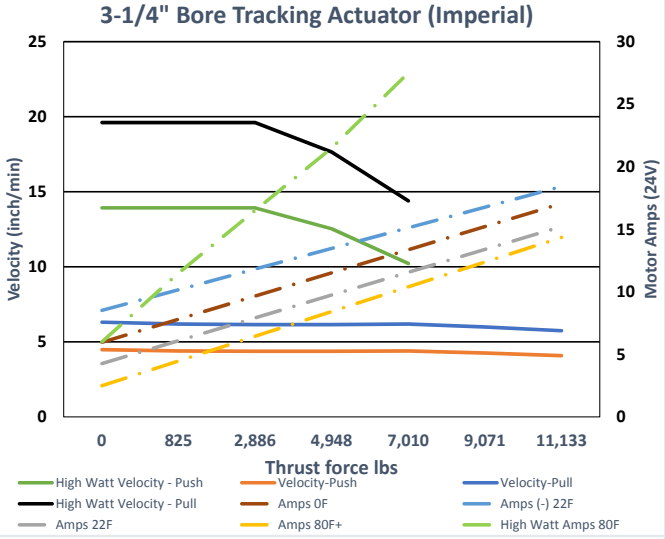
2.5" Bore Tracking Actuator (Imperial)



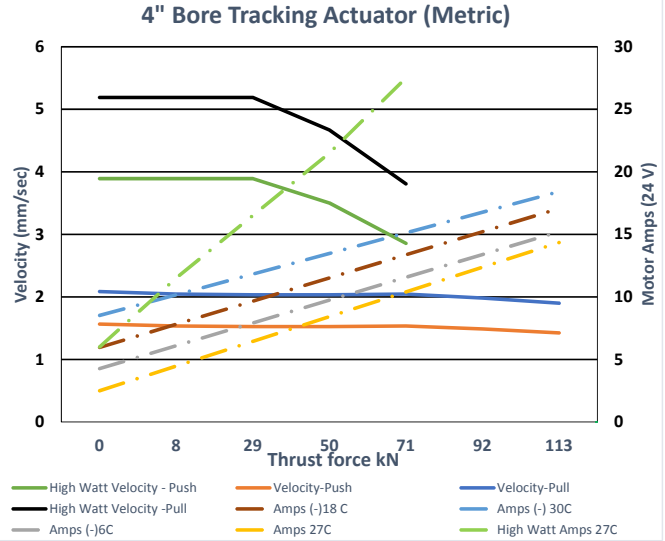
3-1/4" Tracking Actuator (Metric)



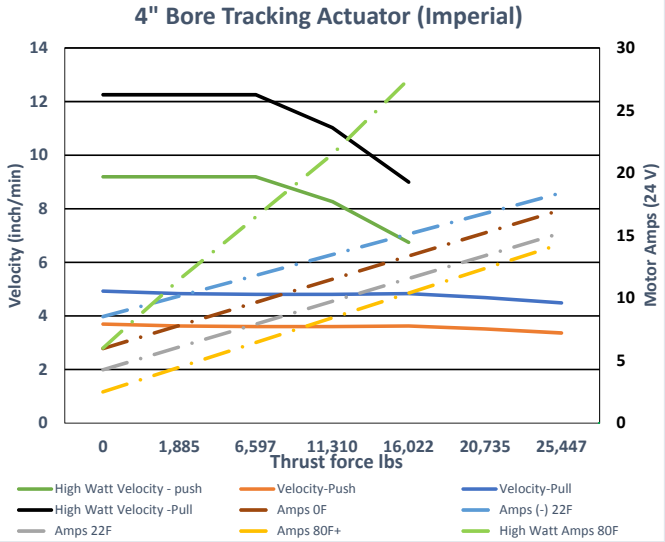
3-1/4" Bore Tracking Actuator (Imperial)



4" Bore Tracking Actuator (Metric)

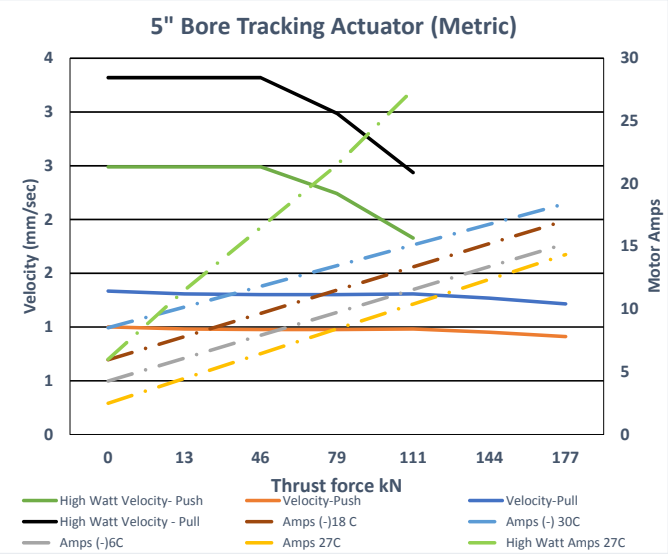


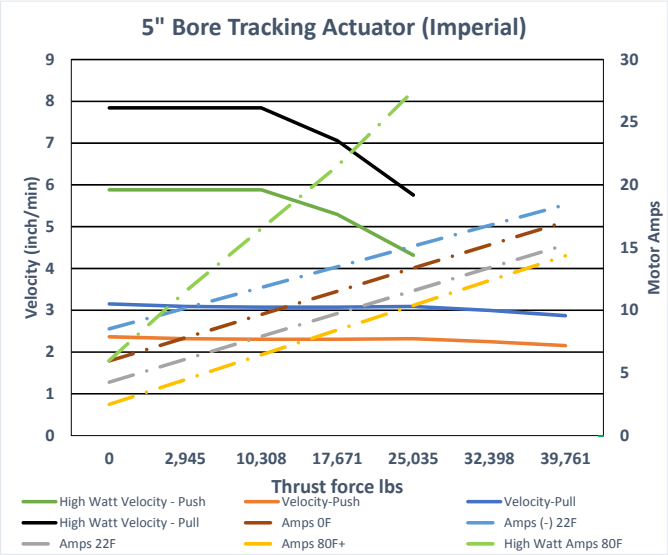
4" Bore Tracking Actuator (Imperial)



Performance Graphs based upon number 3 rod sizes, Size 10 pumps with 24 V Low Watt motors
High Watt values based upon 19 Pump and 24 V High Watt Motor options

Please consult factory for other sizes
Amp draw shown is based upon Pull Values, Push amp draw will be less
Theoretical Values, actual may vary

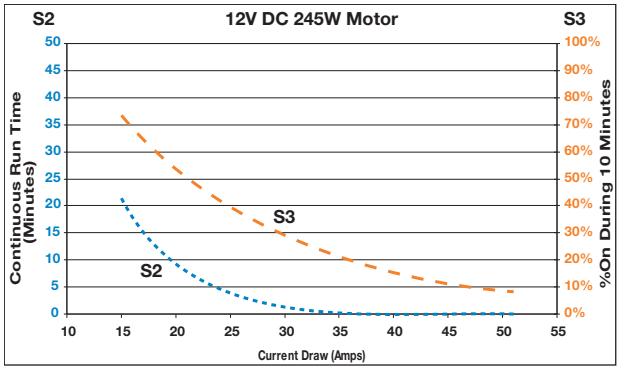


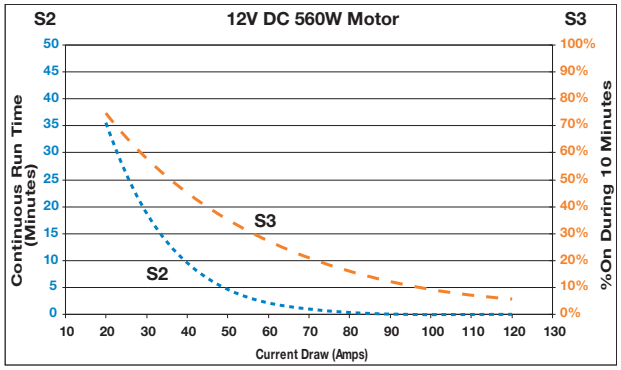


Performance Graphs based upon number 3 rod sizes, Size 10 pumps with 24 V Low Watt motors
High Watt values based upon 19 Pump and 24 V High Watt Motor options

Please consult factory for other sizes
Amp draw shown is based upon Pull Values, Push amp draw will be less
Theoretical Values, actual may vary

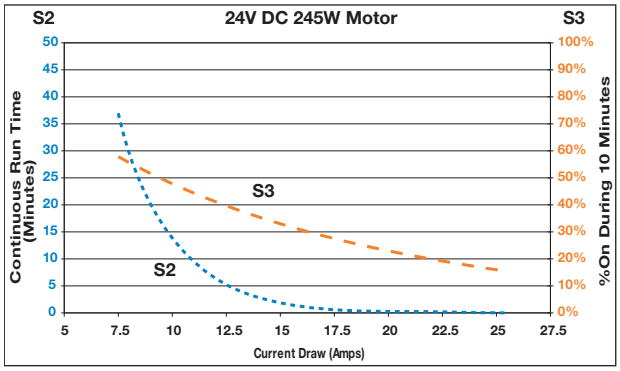
Standard Duty Cycle Characteristics

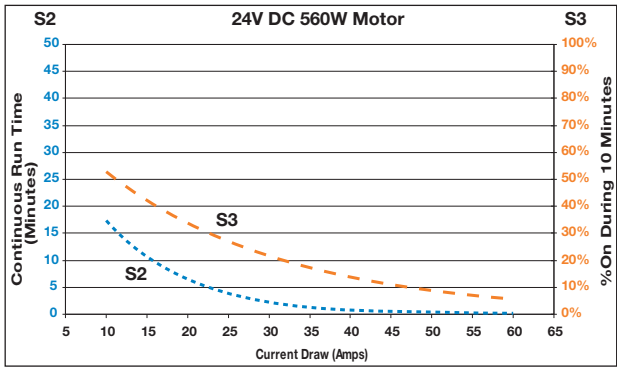




S2
Time at constant load followed by "off" time to allow the motor to cool to ambient temperature

S3
Percentage of "on" time in a repetitive 10 minute cycle





Crosstube Cap End Mounting
Style TT

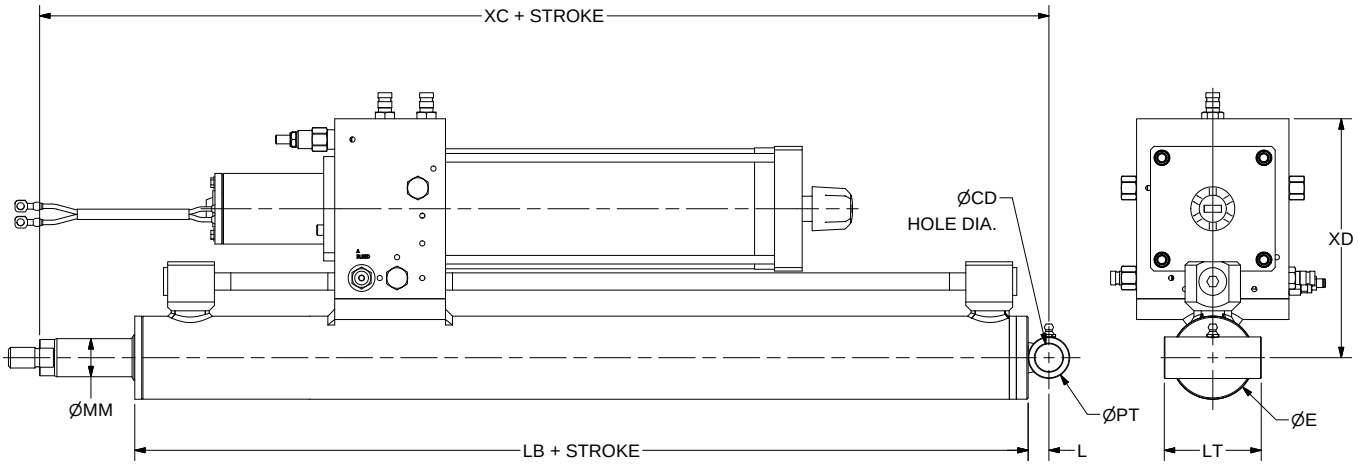


Table 1 – Dimensional and Mounting Data

Bore Ø	Rod No.	CD Ø +.002 -.000	E Ø (Body Diameter)	L	LT	PT Ø	XD Dimensions	Add Stroke LB
2.00	All	0.752	2.38	0.63	2.88	1.25	8.31	4.81
2.50	All	1.002	3.00	0.75	3.50	1.50	8.63	5.25
3.25	All	1.252	3.88	0.94	4.38	1.88	9.00	6.00
4.00	All	1.377	4.61	1.00	5.13	2.00	10.38	6.50
5.00	All	1.752	5.75	1.38	6.25	2.75	11.00	7.12
6.00	All	2.002	7.00	1.50	7.50	3.00	11.94	8.37

Table 2 – Dimensional and Mounting Data

Bore Ø	Rod No.	MM Rod Ø	Add Stroke	
			XC	ZC
2.00	1 (std)	1.000	6.13	6.75
	2	1.375	6.25	6.87
2.50	1 (std)	1.000	6.69	7.44
	2	1.750	6.94	7.69
	3	1.375	6.81	7.56
3.25	1 (std)	1.375	7.75	8.69
	2	2.000	7.94	8.88
	3	1.750	7.88	8.81
4.00	1 (std)	1.750	8.44	9.44
	2	2.500	8.56	9.56
	3	2.000	8.50	9.50
5.00	1 (std)	2.000	9.49	10.87
	2	3.500	9.55	10.93
	3	2.500	9.55	10.93
	4	3.000	9.55	10.93
6.00	1 (std)	2.500	10.93	12.43
	2	4.000	10.93	12.43
	3	3.000	10.93	12.43
	4	3.500	10.93	12.43

For other mounting options see catalog HY08-1320 Series RDH

Cap Fixed Clevis Mounting
Style BB

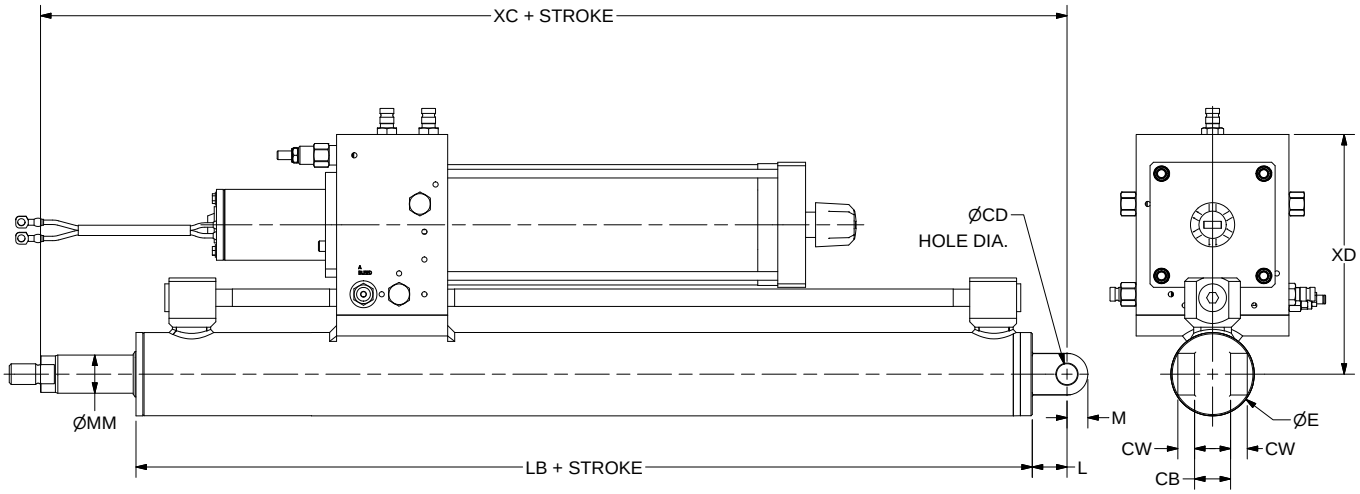


Table 1 – Dimensional and Mounting Data

Bore Ø	Rod No.	CB min.	CD[1] Ø +.000 -.002	CW	E Ø (Body Diameter)	HD	L	LR min.	M	XD Dimensions	Add Stroke
											LB
2.00	All	1.09	.751	0.50	2.38	2.04	1.25	0.88	0.75	8.31	4.81
2.50	All	1.28	.751	0.63	3.00	2.37	1.25	0.88	0.75	8.63	5.25
3.25	All	1.53	1.001	0.75	3.88	2.81	1.50	1.13	1.00	9.00	6.00
4.00	All	2.06	1.376	1.00	4.61	3.20	2.13	1.81	1.38	10.38	6.50
5.00	All	2.56	1.751	1.25	5.75	3.79	2.25	1.88	1.75	11.00	7.12
6.00	All	2.56	2.001	1.25	7.00	4.58	2.50	2.13	2.00	11.94	8.37

[1] Diameter CD is the Pivot Pin diameter (included)

Table 2 – Dimensional and Mounting Data

Bore Ø	Rod No.	MM Rod Ø	Add Stroke	
			XC	ZC
2.00	1 (std)	1.000	6.75	7.50
	2	1.375	6.87	7.62
2.50	1 (std)	1.000	7.19	7.94
	2	1.750	7.44	8.19
	3	1.375	7.31	8.06
3.25	1 (std)	1.375	8.31	9.31
	2	2.000	8.50	9.50
	3	1.750	8.44	9.44
4.00	1 (std)	1.750	9.56	10.94
	2	2.500	9.69	11.06
	3	2.000	9.62	11.00
5.00	1 (std)	2.000	10.37	12.12
	2	3.500	10.43	12.18
	3	2.500	10.43	12.18
	4	3.000	10.43	12.18
6.00	1 (std)	2.500	11.93	13.93
	2	4.000	11.93	13.93
	3	3.000	11.93	13.93
	4	3.500	11.93	13.93

Intermediate Fixed Mounting
Style DD

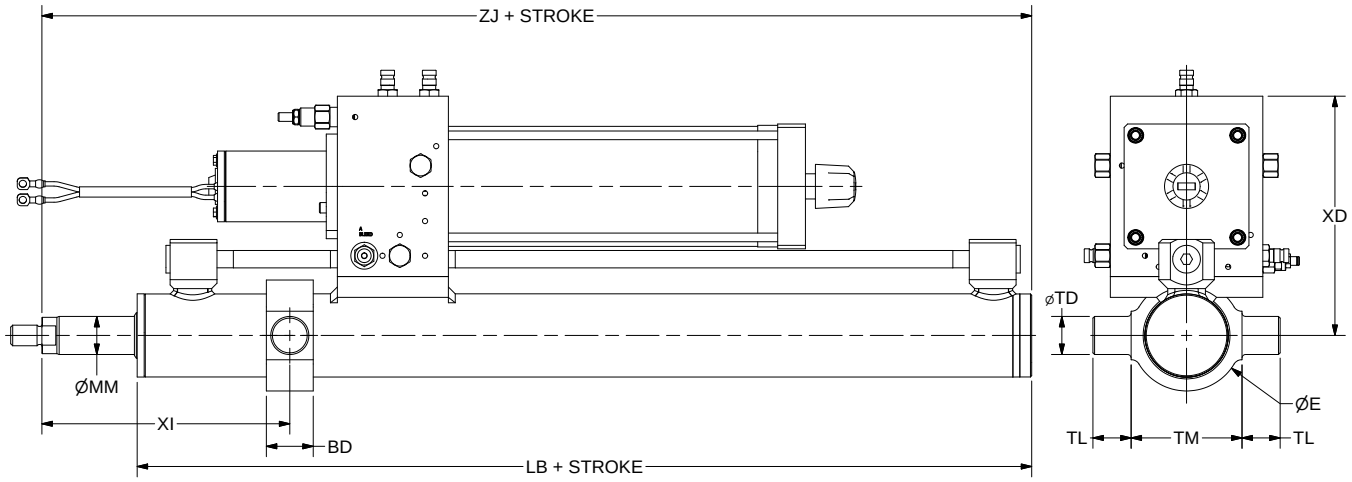


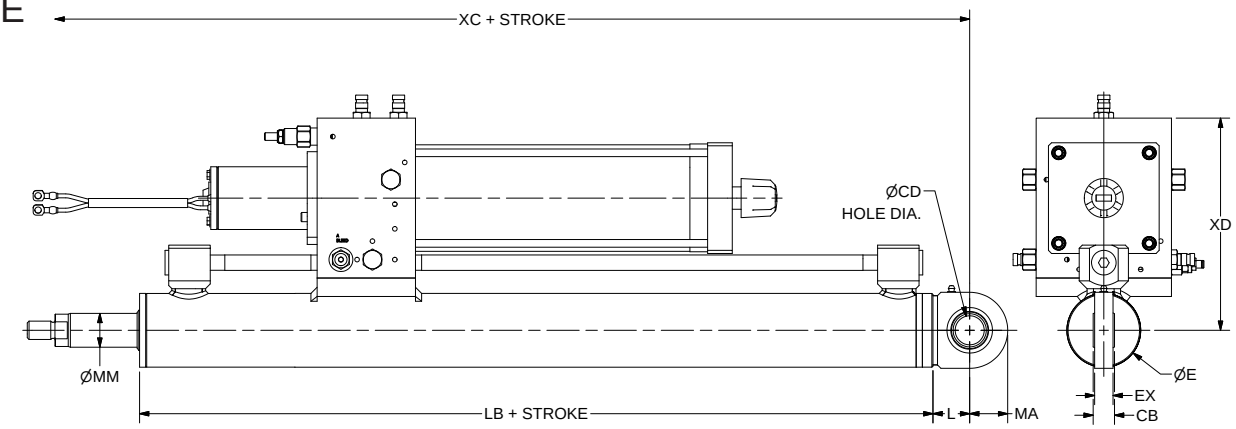
Table 1 – Dimensional and Mounting Data

Bore Ø	Rod No.	BD	E Ø (Body Diameter)	TD Ø +.000 -.001	TL	TM	XD Dimensions	Add Stroke LB
2.00	All	1.69	2.38	1.375	1.38	3.50	8.31	4.81
2.50	All	1.69	3.00	1.375	1.38	4.00	8.63	5.25
3.25	All	2.19	3.88	1.750	1.75	5.00	9.00	6.00
4.00	All	2.44	4.61	2.000	1.75	5.50	10.38	6.50
5.00	All	2.88	5.75	2.500	1.75	7.00	11.00	7.12
6.00	All	3.38	7.00	3.000	2.00	8.50	11.94	8.37

Table 2 – Dimensional and Mounting Data

Bore Ø	Rod No.	MM Rod Ø	Min. Stroke[4]	Min. XI[5]	Add Stroke	
					Max. XI[6]	ZJ
2.00	1 (std)	1.000	3.12	4.95	2.00	5.50
	2	1.375	3.12	5.07	2.12	5.62
2.50	1 (std)	1.000	2.98	5.13	2.13	5.94
	2	1.750	2.98	5.38	2.38	6.19
	3	1.375	2.98	5.25	2.25	6.06
3.25	1 (std)	1.375	3.61	5.87	2.31	6.81
	2	2.000	3.61	6.06	2.50	7.00
	3	1.750	3.61	6.00	2.44	6.94
4.00	1 (std)	1.750	3.52	6.33	2.96	7.44
	2	2.500	3.52	6.46	3.08	7.56
	3	2.000	3.52	6.40	3.02	7.50
5.00	1 (std)	2.000	3.88	6.89	3.07	8.12
	2	3.500	3.88	6.95	3.13	8.18
	3	2.500	3.88	6.95	3.13	8.18
	4	3.000	3.88	6.95	3.13	8.18
6.00	1 (std)	2.500	4.46	7.87	3.62	9.43
	2	4.000	4.46	7.87	3.62	9.43
	3	3.000	4.46	7.87	3.62	9.43
	4	3.500	4.46	7.87	3.62	9.43

Cap Fixed Mounting
Style SE



Style SE — Dimensional and Mounting Data

Bore Ø	CD[1] Ø	E	MA	EX	XD Dimensions	Add Stroke LB
2.00	1.0000$^{-0.0005}$	2.38	1.25	0.88	8.31	4.81
2.50	1.2500$^{-0.0005}$	3.00	1.50	1.09	8.63	5.25
3.25	1.5000$^{-0.0005}$	3.88	2.00	1.31	9.00	6.00
4.00	2.0000$^{-0.0005}$	4.61	2.25	1.75	10.38	6.50
5.00	2.5000$^{-0.0006}$	5.75	3.00	2.19	11.00	7.38
6.00	3.0000$^{-0.0006}$	7.00	3.50	2.63	11.94	8.50

[1] Diameter CD is hole diameter.
[2] Maximum operating pressure at 4:1 design factor is based on tensile strength of material. Pressure ratings are based on standard bearing ratings.

Style SE – Dimensional and Mounting Data

Bore Ø	Rod No.	MM Rod Ø	Thread Style 8 CC[3]	Add Stroke XC
2.00	1 (std.)	1.000	7/8-14	7.56
	2	1.375	[3]	7.81
2.50	1 (std.)	1.000	7/8-14	7.75
	2	1.750	[3]	8.25
	3	1.375	[3]	8.00
3.25	1 (std.)	1.375	1 1/4-12	9.25
	2	2.000	[3]	9.63
	3	1.750	[3]	9.50
4.00	1 (std.)	1.750	1 1/2-12	10.13
	2	2.500	[3]	10.50
	3	2.000	[3]	10.25
5.00	1 (std.)	2.000	1 3/4-12	11.50
	2	3.500	[3]	11.75
	3	2.500	[3]	11.75
	4	3.000	[3]	11.75
6.00	1 (std.)	2.500	2 1/4-12	13.38
	2	4.000	[3]	13.38
	3	3.000	[3]	13.38
	4	3.500	[3]	13.38

[3] To match pin diameter in rod eye and cap, when an oversize rod is required, specify rod end style '3', 'CC' thread and 'A' thread length for the standard rod diameter (Rod No. 1 for the bore), and 'W' for the oversize rod.

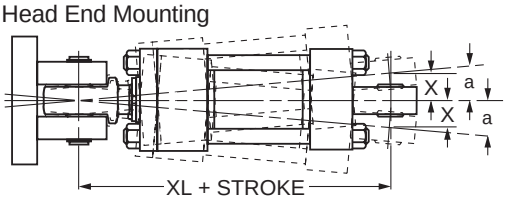
Style SE – Recommended maximum swivel angle on each side of the cylinder centerline.

Bore Ø	Head End Mounted		Cap End Mounted	
	Angle a	Tan. of a	Angle a	Tan. of a
2.00	3.00°	0.052	3.00°	0.052
2.50	3.00°	0.052	3.00°	0.052
3.25	3.00°	0.052	2.75°	0.048
4.00	3.00°	0.052	3.00°	0.052
5.00	3.00°	0.052	3.00°	0.052
6.00	3.00°	0.052	3.00°	0.052

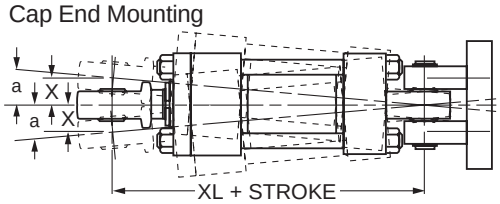
Note: Dimension X is the maximum off center mounting of the cylinder. To determine dimension X for various stroke lengths multiply the distance between pivot pin holes by tangent of angle a. For extended position use X = XL + 2X stroke.

Mounting Information

Head End Mounting

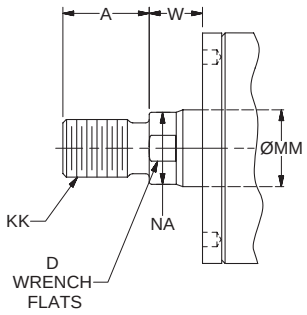


Cap End Mounting

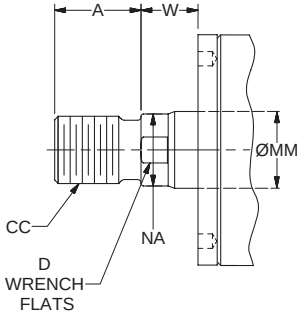


Rod End Dimensions

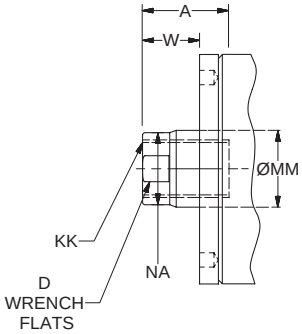
Thread Style 4
(NFPA Style SM)
Small Male



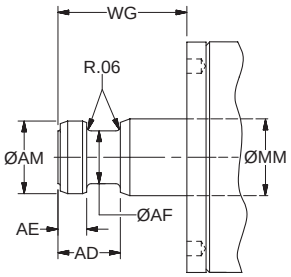
Thread Style 8
(NFPA Style IM)
Intermediate Male



Thread Style 9[1]
(NFPA Style SF)
Small Female



Style 55[2]
Flanged Rod End



Rod End Dimensions

Bore Ø	Rod No.	MM Rod Ø	Thread		A	AD	AE +.001 -.001	AF Ø	AM Ø	D	NA	W	WG
			Style 8 CC	Style 4 & 9 KK									
2.00	1 (std)	1.000	7/8-14	3/4-16	1.13	0.94	0.374	0.69	0.95	0.88	0.94	0.69	1.50
	2	1.375	1 1/4-12	1-14	1.63	1.06	0.374	0.88	1.32	1.13	1.31	0.81	1.75
2.50	1 (std)	1.000	7/8-14	3/4-16	1.13	0.94	0.374	0.69	0.95	0.88	0.94	0.69	1.50
	2	1.750	1 1/2-12	1 1/4-12	2.00	1.31	0.499	1.13	1.70	1.50	1.69	0.94	2.00
	3	1.375	1 1/4-12	1-14	1.63	1.06	0.374	0.88	1.32	1.13	1.31	0.81	1.75
3.25	1 (std)	1.375	1 1/4-12	1-14	1.63	1.06	0.374	0.88	1.32	1.13	1.31	0.81	1.75
	2	2.000	1 3/4-12	1 1/2-12	2.25	1.69	0.624	1.38	1.95	1.69	1.94	1.00	2.63
	3	1.750	1 1/2-12	1 1/4-12	2.00	1.31	0.499	1.13	1.70	1.50	1.69	0.94	2.00
4.00	1 (std)	1.750	1 1/2-12	1 1/4-12	2.00	1.31	0.499	1.13	1.70	1.50	1.69	0.94	2.00
	2	2.500	2 1/4-12	1 7/8-12	3.00	1.94	0.749	1.75	2.45	2.06	2.38	1.06	3.25
	3	2.000	1 3/4-12	1 1/2-12	2.25	1.69	0.624	1.38	1.95	1.69	1.94	1.00	2.63
5.00	1 (std)	2.000	1 3/4-12	1 1/2-12	2.25	1.69	0.624	1.38	1.95	1.69	1.94	1.00	2.63
	2	3.500	3 1/4-12	2 1/2-12	3.50	2.69	0.999	2.50	3.45	3.00	3.38	1.06	4.38
	3	2.500	2 1/4-12	1 7/8-12	3.00	1.94	0.749	1.75	2.45	2.06	2.38	1.06	3.25
	4	3.000	2 3/4-12	2 1/4-12	3.50	2.44	0.874	2.25	2.95	2.63	2.88	1.06	3.63
6.00	1 (std)	2.500	2 1/4-12	1 7/8-12	3.00	1.94	0.749	1.75	2.45	2.06	2.38	1.06	3.25
	2	4.000	3 3/4-12	3-12	4.00	2.69	0.999	3.00	3.95	3.38	3.88	1.06	4.50
	3	3.000	2 3/4-12	2 1/4-12	3.50	2.44	0.874	2.25	2.95	2.63	2.88	1.06	3.63
	4	3.500	3 1/4-12	2.1/2-12	3.50	2.69	0.999	2.50	3.45	3.00	3.38	1.06	4.38

"Special" Thread Style 3
Special thread, extension, rod eye, blank, welded rod end accessory, etc. are also available.

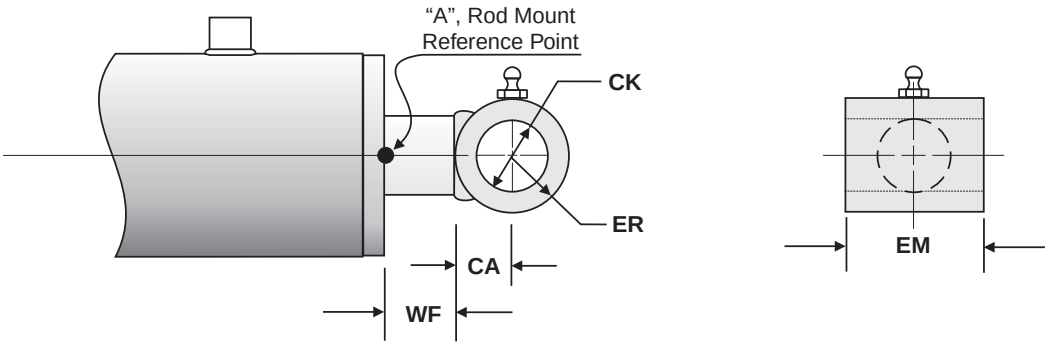
To order, specify "Style 3" and give desired dimensions for KK, A, W or WF. If otherwise special, furnish dimensioned sketch.

[1] Style 9 stroke restrictions may apply. See Minimum Stroke for Style 9 Rod End in table on How To Order page for details.

[2] For any special Style 55 dimensions, specify "Style 3" and provide the desired dimensions for AD, AE, AF, AM and WG. For other changes, specify "S" in the model code, and describe the rod end with a dimensioned sketch.

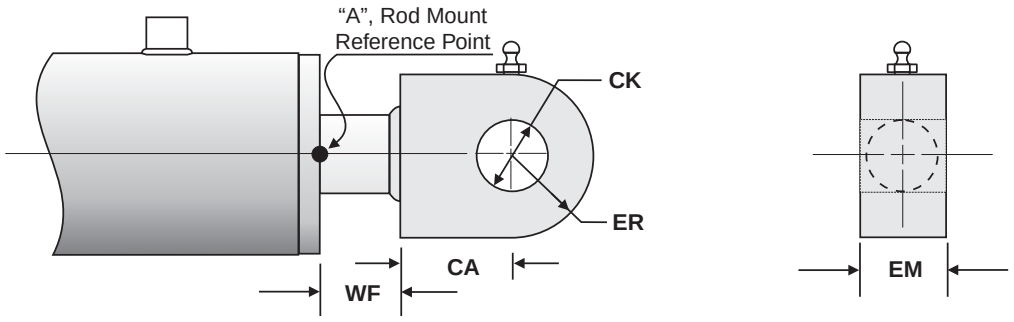
[3] These piston rods have four 0.515" dia. x 0.5" deep spanner wrench holes instead of wrench flats on diameter NA.

"D" Rod Mount Code, Cross Tube Rod Mounts



Rod Code	Rod Diameter	Rod Mount Code	Nominal Pin Size	Actual CK	Width EM	Length CA	Radius ER	Rod Ext. WF	Max Pull at Yield *
13	1.38" OD	D102509	1.00"	1.015"	2.50"	0.81"	0.88"	0.88"	35,300#
13	1.38" OD	D122510	1.25"	1.265"	2.50"	0.94"	1.00"	0.88"	35,300#
17	1.75" OD	D102509	1.00"	1.015"	2.50"	0.81"	0.88"	0.88"	42,300#
17	1.75" OD	D102709	1.00"	1.015"	2.75"	0.81"	0.88"	0.88"	42,300#
17	1.75" OD	D122710	1.25"	1.265"	2.75"	0.94"	1.00"	0.88"	42,300#
17	1.75" OD	D123210	1.25"	1.265"	3.25"	0.94"	1.00"	0.88"	42,300#
17	1.75" OD	D152711	1.50"	1.505"	2.75"	1.00"	1.12"	0.88"	42,300#
17	1.75" OD	D153011	1.50"	1.505"	3.00"	1.00"	1.12"	0.88"	42,300#
17	1.75" OD	D172514	1.75"	1.765"	2.50"	1.25"	1.38"	0.88"	42,300#
17	1.75" OD	D173014	1.75"	1.765"	3.00"	1.25"	1.38"	0.88"	42,300#
17	1.75" OD	D173214	1.75"	1.765"	3.25"	1.25"	1.38"	0.88"	42,300#
17	1.75" OD	D203515	2.00"	2.015"	3.50"	1.38"	1.50"	0.88"	42,300#
17	1.75" OD	D223515	2.25"	2.265"	3.50"	1.38"	1.50"	0.88"	42,300#
20	2.00" OD	D102509	1.00"	1.015"	2.50"	0.81"	0.88"	0.88"	49,700#
20	2.00" OD	D102709	1.00"	1.015"	2.75"	0.81"	0.88"	0.88"	49,700#
20	2.00" OD	D122710	1.25"	1.265"	2.75"	0.94"	1.00"	0.88"	49,700#
20	2.00" OD	D123210	1.25"	1.265"	3.25"	0.94"	1.00"	0.88"	49,700#
20	2.00" OD	D152711	1.50"	1.515"	2.75"	1.00"	1.12"	0.88"	49,700#
20	2.00" OD	D153011	1.50"	1.515"	3.00"	1.00"	1.12"	0.88"	49,700#
20	2.00" OD	D172514	1.75"	1.765"	2.50"	1.25"	1.38"	0.88"	49,700#
20	2.00" OD	D173014	1.75"	1.765"	3.00"	1.25"	1.38"	0.88"	49,700#
20	2.00" OD	D173214	1.75"	1.765"	3.25"	1.25"	1.38"	0.88"	49,700#
20	2.00" OD	D203515	2.00"	2.015"	3.50"	1.38"	1.50"	0.88"	49,700#
20	2.00" OD	D223515	2.25"	2.265"	3.50"	1.38"	1.50"	0.88"	49,700#

"C" Rod Mount Code, Lug Rod Mounts

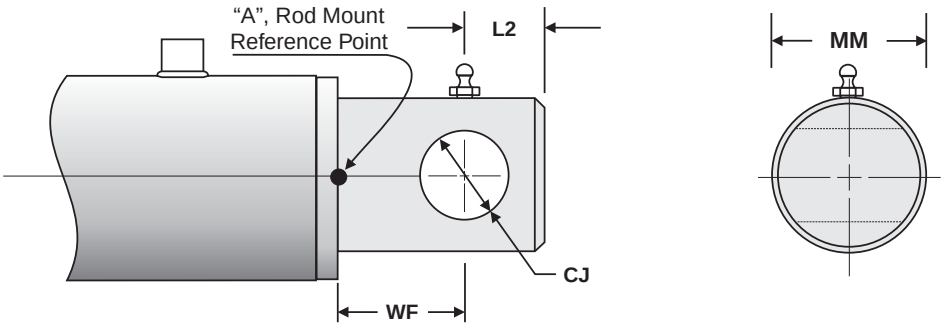


Rod Code	Rod Diameter	Rod Mount Code	Nominal Pin Size	Actual CK	Width EM	Lenght CA	Radius ER	Rod Ext. WF	Max Pull at Yield *
13	1.38" OD	C101520	1.00"	1.015"	1.50"	2.00"	1.00"	0.88"	35,000#
13	1.38" OD	C121520	1.25"	1.265"	1.50"	2.00"	1.25"	0.88"	33,000#
13	1.38" OD	C151520	1.50"	1.515"	1.50"	2.00"	1.50"	0.88"	40,000#
17	1.75" OD	C101720	1.00"	1.015"	1.75"	2.00"	1.00"	0.88"	40,000#
17	1.75" OD	C121720	1.25"	1.265"	1.75"	2.00"	1.25"	0.88"	50,000#
17	1.75" OD	C151725	1.50"	1.515"	1.75"	2.50"	1.50"	0.88"	45,000#
17	1.75" OD	C171725	1.75"	1.765"	1.75"	2.50"	1.75"	0.88"	50,000#
20	2.00" OD	C102020	1.00"	1.015"	2.00"	2.00"	1.00"	0.88"	50,000#
20	2.00" OD	C122020	1.25"	1.265"	2.00"	2.00"	1.25"	0.88"	60,000#
20	2.00" OD	C152025	1.50"	1.515"	2.00"	2.50"	1.50"	0.88"	50,000#
20	2.00" OD	C152525	1.50"	1.515"	2.50"	2.50"	1.50"	0.88"	60,000#
20	2.00" OD	C172025	1.75"	1.765"	2.00"	2.50"	1.75"	0.88"	60,000#
20	2.00" OD	C172525	1.75"	1.765"	2.50"	2.50"	1.75"	0.88"	60,000#
20	2.00" OD	C202025	2.00"	2.015"	2.00"	2.50"	2.00"	0.88"	60,000#
20	2.00" OD	C202525	2.00"	2.015"	2.50"	2.50"	2.00"	0.88"	60,000#
20	2.00" OD	C222025	2.25"	2.265"	2.00"	2.50"	2.25"	0.88"	60,000#
20	2.00" OD	C222525	2.25"	2.265"	2.50"	2.50"	2.25"	0.88"	60,000#
20	2.00" OD	C252027	2.50"	2.515"	2.00"	2.75"	2.50"	0.88"	60,000#
20	2.00" OD	C252527	2.50"	2.515"	2.50"	2.75"	2.50"	0.88"	60,000#
20	2.00" OD	C302030	3.00"	3.067"	2.00"	3.00"	3.00"	0.88"	60,000#
20	2.00" OD	C302530	3.00"	3.067"	2.50"	3.00"	3.00"	0.88"	60,000#

*Max Pull Yield is based on a 2:1 safety factor

*Max Pull Yield is based on a 2:1 safety factor

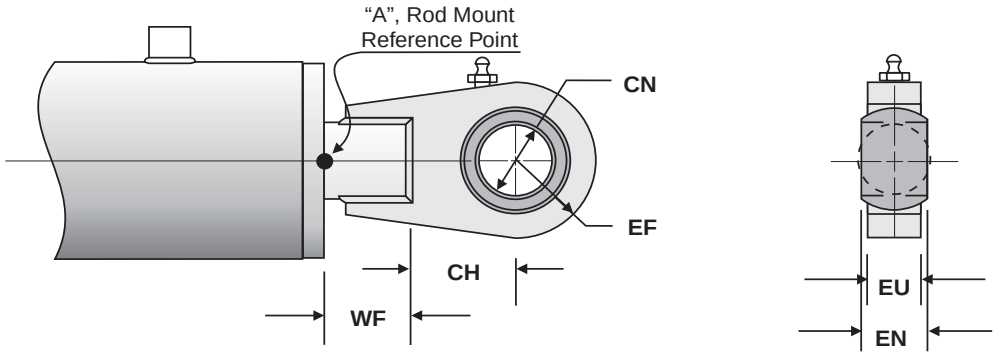
"B" Rod Mount Code, Drill Thru Rod Mounts



Rod Code	Rod Diameter	Rod Mount Code	Nominal Pin Size	Actual CJ	Diameter MM	Length WF	Length L2	Max Pull at Yield *
13	1.38" OD	B071900	0.75"	0.760"	1.38"	1.88"	0.75"	24,750#
17	1.75" OD	B071900	0.75"	0.760"	1.75"	1.88"	0.75"	55,900#
17	1.75" OD	B102100	1.00"	1.015"	1.75"	2.12"	1.00"	36,700#
20	2.00" OD	B071900	0.75"	0.760"	2.00"	1.88"	0.75"	77,000#
20	2.00" OD	B102100	1.00"	1.015"	2.00"	2.12"	1.00"	60,000#
20	2.00" OD	B122100	1.25"	1.265"	2.00"	2.12"	1.25"	39,500#
25	2.50" OD	B102100	1.00"	1.015"	2.50"	2.12"	1.00"	77,000#
25	2.50" OD	B122100	1.25"	1.265"	2.50"	2.12"	1.25"	77,000#
25	2.50" OD	B152400	1.50"	1.515"	2.50"	2.37"	1.50"	68,000#

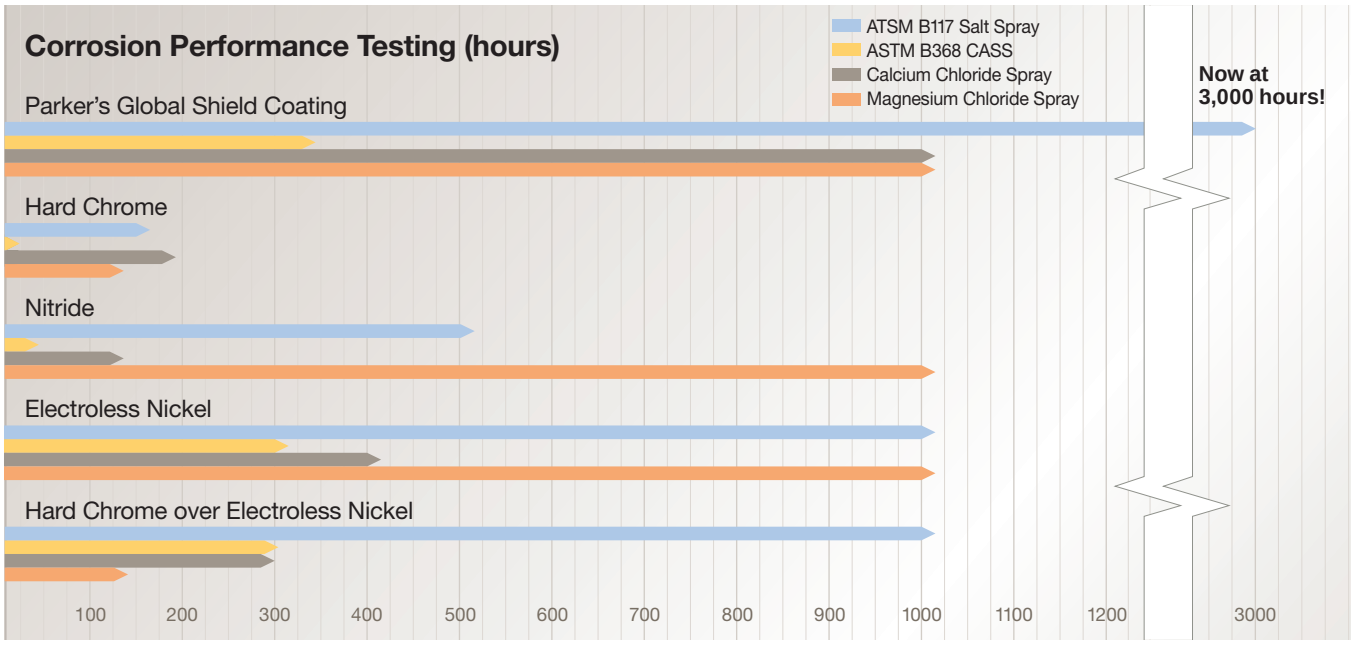
*Max Pull Yield is based on a 2:1 safety factor

"SN" Rod Mount Code, Spherical Bearing Narrow Rod Mounts



Rod Code	Rod Diameter	Rod Mount Code	Nominal Pin Size	Actual CN	Bearing Width EN	Lug Width EU	Length CH	Length L1	Radius EF	Rod Ext. WF	Max Pull at Yield*
13	1.38" OD	SN120922	1.25"	1.25"	1.09"	0.94"	2.25"	3.00"	1.50"	1.62"	20,000#
17	1.75" OD	SN120922	1.25"	1.25"	1.09"	0.94"	2.25"	3.00"	1.50"	1.62"	20,000#
17	1.75" OD	SN151125	1.50"	1.50"	1.31"	1.12"	2.50"	3.25"	1.88"	1.62"	35,000#
17	1.75" OD	SN171327	1.75"	1.75"	1.53"	1.31"	2.75"	3.75"	2.00"	1.88"	35,000#
20	2.00" OD	SN120922	1.25"	1.25"	1.09"	0.94"	2.25"	3.00"	1.50"	1.62"	20,000#
20	2.00" OD	SN151125	1.50"	1.50"	1.31"	1.12"	2.50"	3.25"	1.88"	1.88"	35,000#
20	2.00" OD	SN171327	1.75"	1.75"	1.53"	1.31"	2.75"	3.75"	2.00"	1.88"	35,000#
20	2.00" OD	SN201530	2.00"	2.00"	1.75"	1.50"	3.00"	4.00"	2.38"	1.88"	55,000#
25	2.50" OD	SN151125	1.50"	1.50"	1.31"	1.12"	2.50"	3.25"	1.88"	1.62"	35,000#
25	2.50" OD	SN171327	1.75"	1.75"	1.53"	1.31"	2.75"	3.75"	2.00"	1.88"	35,000#
25	2.50" OD	SN201530	2.00"	2.00"	1.75"	1.50"	3.00"	4.00"	2.38"	1.88"	55,000#
25	2.50" OD	SN251935	2.50"	2.50"	2.19"	1.88"	3.50"	4.75"	3.00"	2.12"	95,000#

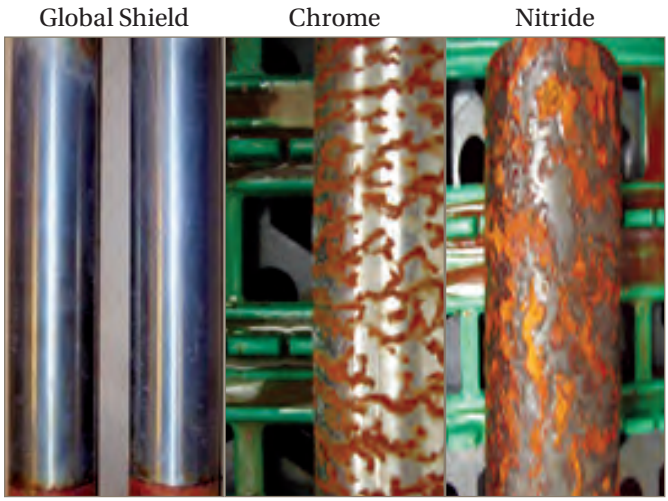
*Max Pull Yield is based on a 2:1 safety factor



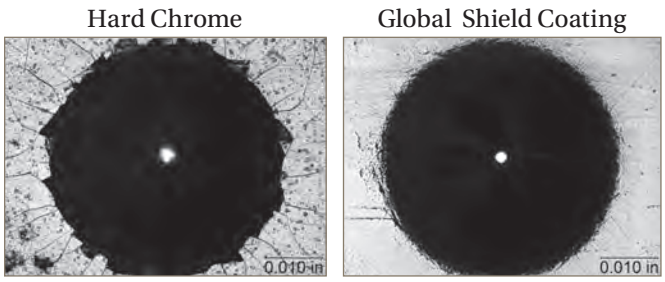
Performance Validated through Extensive Testing

This breakthrough technology has been thoroughly tested in laboratory and field environments. Independent testing has proven Global Shield's superior performance in comparison to other common corrosion resistant coatings.

ASTM B368 Corrosion Test



Indentation & Delamination Testing



In comparison to Hard Chrome, Parker's Global Shield coating exhibited superior interfacial adhesion and outstanding impact resistance with almost no micro-cracking, chipping, spalling or delamination.

Standard Applications

- Rod Diameters: ½" to 15" (12 to 380mm)
- Rod Lengths: up to 15' (3.96m)
- Thicknesses: .0006" (15µ) and .001" (25µ)
- Substrates: 1018/1045/1050 carbon steel

Other applications available upon customer request

Safer for the Environment – the **Global Shield**™ edge

- **No Chromium** in the coating or process
- **RoHS Compliant** (Directive 2011/65/EU)
- **No hexavalent** and no hazardous waste stream
- **Recyclable** coating materials
- **No PEL** (Personal Exposure Limits) concerns

Parker Hannifin Corporation
Cylinder Division
Des Plaines, Illinois USA

Stroke Data

Series RDH cylinders are available in any practical stroke length.

Stroke Length Tolerance

Stroke length tolerances are required due to buildup of tolerances of the piston, head, cap and cylinder tube.

Standard stroke length tolerances are:

for strokes up to 43" = -0/+.040"

for strokes greater than 43" = -0/+.062"

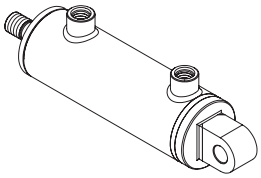
For closer tolerances on stroke length, it is necessary to specify the required tolerance plus the pressure and temperature at which the cylinder will operate. Stroke tolerances smaller than .015" are not generally practical due to elasticity of cylinders. If machine design requires such close tolerances, use of a stroke adjuster or special endcap ties may achieve the desired result. Please consult factory.

Fatigue Life

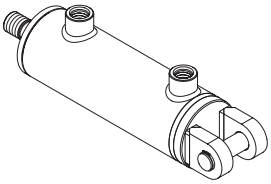
Although each application is unique, all cylinders have a finite life. In general, welded cylinders have a limited fatigue life when used at the maximum pressure rating. Series RDH cylinders are rated for industrial-grade service but for the maximum possible fatigue life in severe duty applications, Parker cylinders with another construction style (tie-rod, mill-type or bolted) should be considered. If necessary, consult the factory for assistance.

Note: 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.

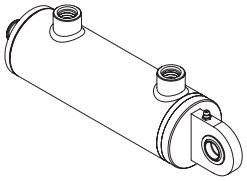
Mounting Groups



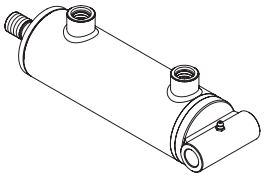
Style B



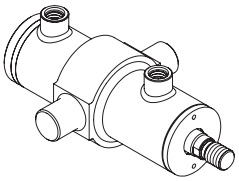
Style BB



Style SE/SBM



Style TT

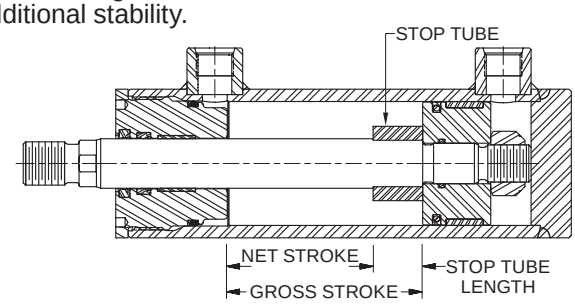


Style DD

The cylinder's mounting directly affects the maximum pressure at which the cylinder can be used. Stroke length, piston rod connection to load, extra piston rod length over standard, etc. should be considered for thrust loads. See Stop Tubing and Piston Rod Selection Data on the following pages to first determine whether stop tubing is recommended and then determine the correct piston rod diameter for an application. Alloy steel mounting bolts are recommended for all mounting styles.

Stop Tubing

Stop tube is recommended to lengthen the distance between the rod bearing and piston bearing to reduce bearing loads on long push stroke cylinders when the cylinder is fully extended. This is especially true of horizontally mounted cylinders. As part of the piston assembly and positioned between the piston and head, a stop tube restricts the extended position of the rod using the increased distance to achieve additional stability.



Use the following steps to determine the need for stop tube and, if required, how long it should be.

1. Examine the groups of cylinder illustrations below and determine which mounting and rod guiding group type match the required cylinder application.
2. Establish the Basic Length (L), with the piston rod fully extended, for the selected illustration by using the dimensional tables on previous pages of this catalog. For pivot mounted cylinders, the pin-to-pin dimension with the piston rod fully extended must be used. Regardless of mounting style, be sure to include any extended piston rod length beyond the catalog standard.
3. In the Stop Tube Table select the column for the appropriate mounting style and rod end guiding type. In the Basic Length (L) column, find the row with the range that includes the value calculated in Step 2. The next respective column to the right has the required length of stop tube.

Note: Mounting Styles B, BB, SB/SBM, TT and H that are mounted horizontally should also be checked for turning moments and loads between the rod bearing and piston to ensure they are not excessive. Weight of oil must be included in determining bearing loads.

When specifying cylinders with stop tube be sure to call out the net stroke and the length of the stop tube. Machine design can be continued without delay by laying in a cylinder equivalent in length to the NET STROKE PLUS STOP TUBE LENGTH, which is referred to as GROSS STROKE.

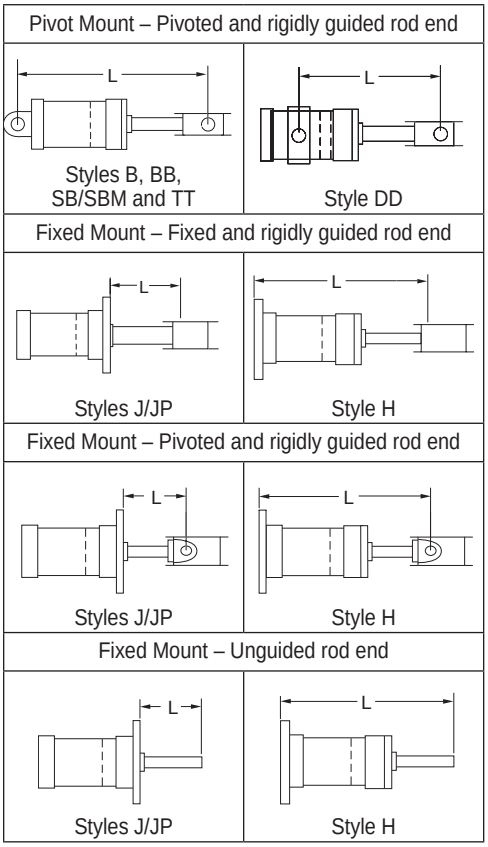
Stop Tube Table

Pivot Mounts (B, BB, SB/SBM, TT and DD)		Fixed Mounts (J/JP and H)					
Pivoted and Rigidly Guided Rod End		Fixed and Rigidly Guided Rod End		Pivoted and Rigidly Guided Rod End		Unguided Rod End	
Basic Length (L)	Stop Tube Length	Basic Length (L)	Stop Tube Length	Basic Length (L)	Stop Tube Length	Basic Length (L)	Stop Tube Length
0 - 40	0	0 - 80	0	0 - 57	0	0 - 20	0
41 - 50	1	81 - 100	1	58 - 71	1	21 - 25	1
51 - 60	2	101 - 120	2	72 - 86	2	26 - 30	2
61 - 70	3	121 - 140	3	87 - 100	3	31 - 35	3
71 - 80	4	141 - 160	4	101 - 114	4	36 - 40	4
81 - 90	5	161 - 180	5	115 - 129	5	41 - 45	5
91 - 100	6	181 - 200	6	130 - 143	6	46 - 50	6
101 - 110	7	201 - 220	7	144 - 157	7	51 - 55	7
111 - 120	8	221 - 240	8	158 - 171	8	56 - 60	8
121 - 130	9	241 - 260	9	172 - 186	9	61 - 65	9
131 - 140	10	261 - 280	10	187 - 200	10	66 - 70	10
141 - 150	11	281 - 300	11	201 - 214	11	71 - 75	11
151 - 160	12	Consult Factory		215 - 229	12	76 - 80	12
161 - 170	13			230 - 243	13	81 - 85	13
171 - 180	14			244 - 257	14	86 - 90	14
181 - 190	15			258 - 271	15	91 - 95	15
191 - 200	16			272 - 286	16	96 - 100	16
201 - 210	17			287 - 300	17	101 - 105	17
211 - 220	18			Consult Factory		106 - 110	18
221 - 230	19					111 - 115	19
231 - 240	20					116 - 120	20
241 - 250	21					121 - 125	21
251 - 260	22					126 - 130	22
261 - 270	23					131 - 135	23
271 - 280	24					136 - 140	24
281 - 290	25					141 - 145	25
291 - 300	26					146 - 150	26
Consult Factory						Consult Factory	

Maximum Basic Lengths (L_A) (all dimensions in inches)

Bore Ø	Rod Ø	Intermediate Pivot Mount (DD)						Rear Pivot Mounts (B, BB, SB[1], SBM and TT)					
		Pivoted and Rigidly Guided Rod End Max. Allowable Basic Length (L_A) at psi:						Pivoted and Rigidly Guided Rod End Max. Allowable Basic Length (L_A) at psi:					
		500	1000	1500	2000	2500	3000	500	1000	1500	2000	2500	3000
2.00	1.000	48	34	28	24	22	20	66	47	38	33	29	27
	1.375	91	64	53	45	41	37	116	82	67	58	52	47
2.50	1.000	38	27	22	19	17	16	54	38	31	27	24	22
	1.375	73	51	42	36	33	30	99	70	57	49	44	40
	1.750	118	83	68	59	53	48	151	106	87	75	67	61
3.25	1.375	56	40	32	28	25	23	78	55	45	39	35	32
	1.750	91	64	52	45	41	37	123	87	71	62	55	50
	2.000	118	84	68	59	53	48	157	111	90	78	70	64
4.00	1.750	74	52	43	37	33	30	102	72	59	51	45	41
	2.000	96	68	56	48	43	39	131	92	75	65	58	53
	2.500	150	106	87	75	67	61	194	137	112	97	87	79
5.00	2.000	77	54	44	38	34	31	107	76	62	53	48	44
	2.500	120	85	69	60	54	49	163	115	94	82	73	67
	3.000	173	122	100	87	77	71	226	160	130	113	101	92
	3.500	236	167	136	118	105	96	289	204	167	145	129	118
6.00	2.500	100	71	58	50	45	41	139	98	80	70	62	57
	3.000	144	102	83	72	65	59	197	139	114	98	88	80
	3.500	196	139	113	98	88	80	260	184	150	130	116	106
	4.000	257	181	148	128	115	105	300	231	188	163	146	133

Cylinder Mounting and Rod Guiding Groups



Piston Rod Diameter Selection

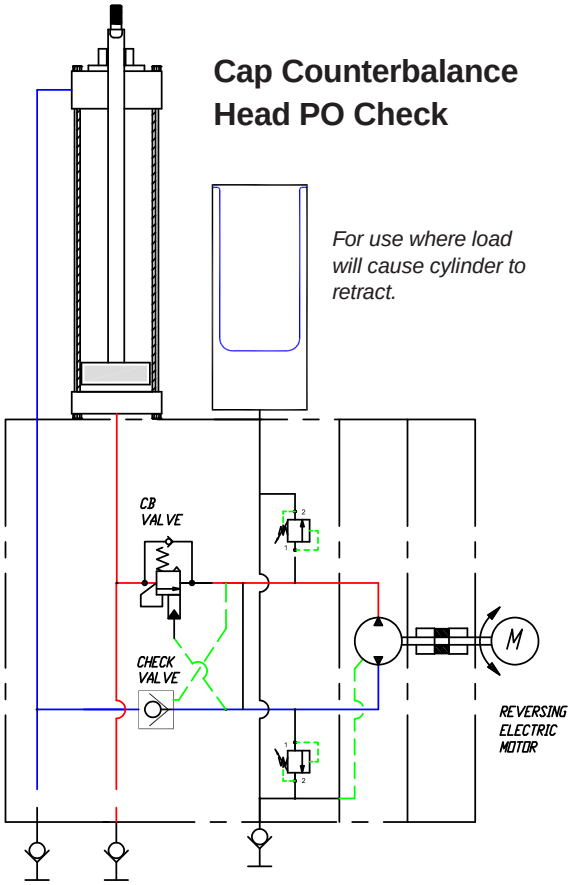
Long stroke cylinders that work on push with the piston rod loaded in compression should be checked, using the following steps, to ensure an appropriate piston rod diameter is specified.

1. First, determine whether stop tubing is required as described on the previous page.
2. Use the Basic Length (L) that was established for determining the stop tube length and then add the required stop tube length to the Basic Length to obtain an Adjusted Basic Length (L_A).
3. In the table below, for the mounting style and rod end guiding condition that will be used, find the row for the Bore and Rod combination that is required.
4. Follow the Bore and Rod row to the right and find the Operating Pressure column that is closest, but exceeds the system pressure. The intersection of the Bore and Rod row and Operating Pressure column displays the maximum allowable L_A. If L_A in the table is greater than or equal to the calculated L_A, the rod diameter selected is satisfactory for the application.
5. If L_A in the table is less than the calculated Adjusted Basic Length move down the column to a rod diameter with an L_A that exceeds the requirement.
6. If the L_A specifies a rod diameter in a larger bore then restart the process of sizing the stop tube and re-check the rod diameter. Contact the factory if L_A exceeds 300 inches.

Note: Data in these tables assume standard rod extension (W dimension) and standard rod end accessories. If different, consult factory.

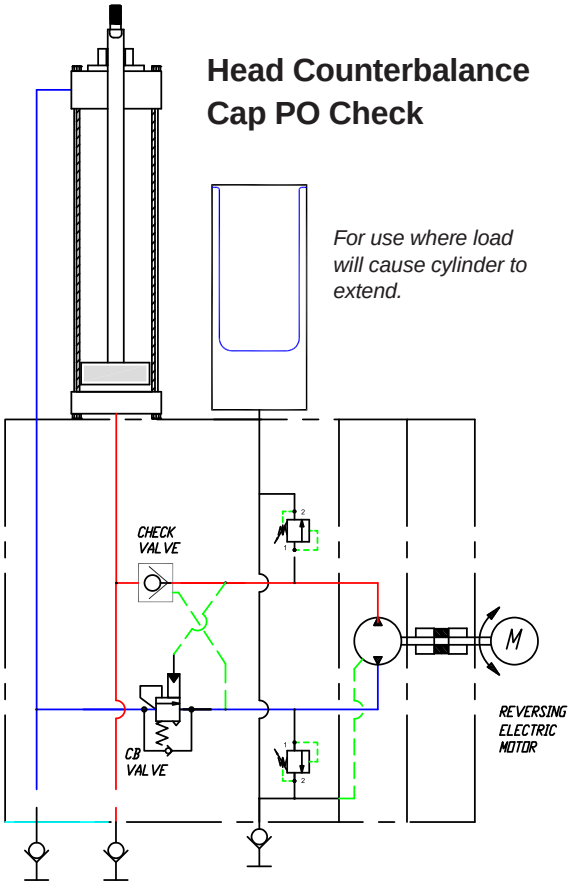
Cap Counterbalance Head PO Check

For use where load will cause cylinder to retract.



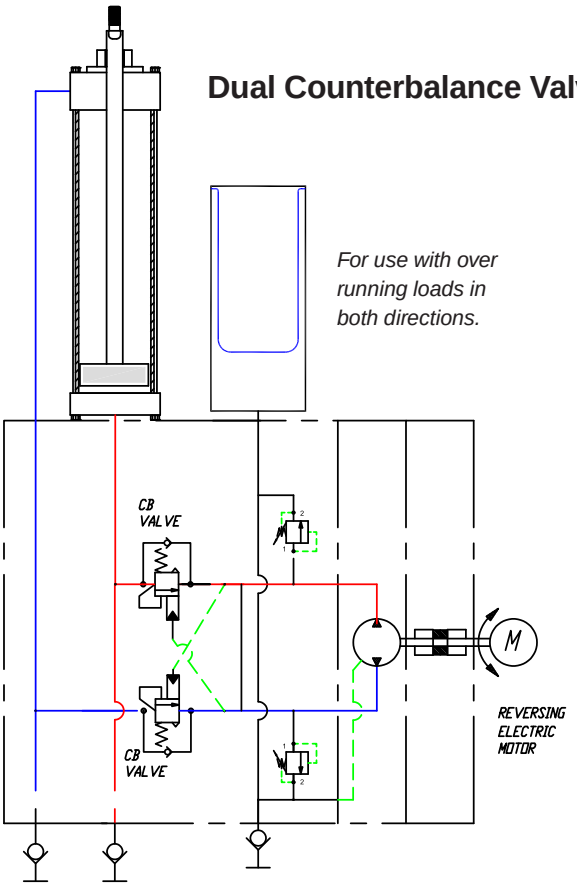
Head Counterbalance Cap PO Check

For use where load will cause cylinder to extend.



Dual Counterbalance Valve

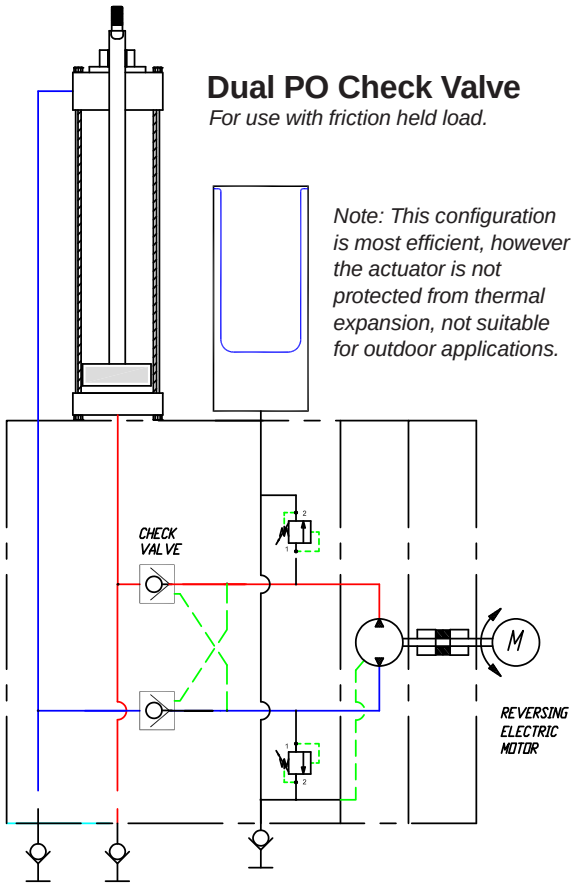
For use with over running loads in both directions.



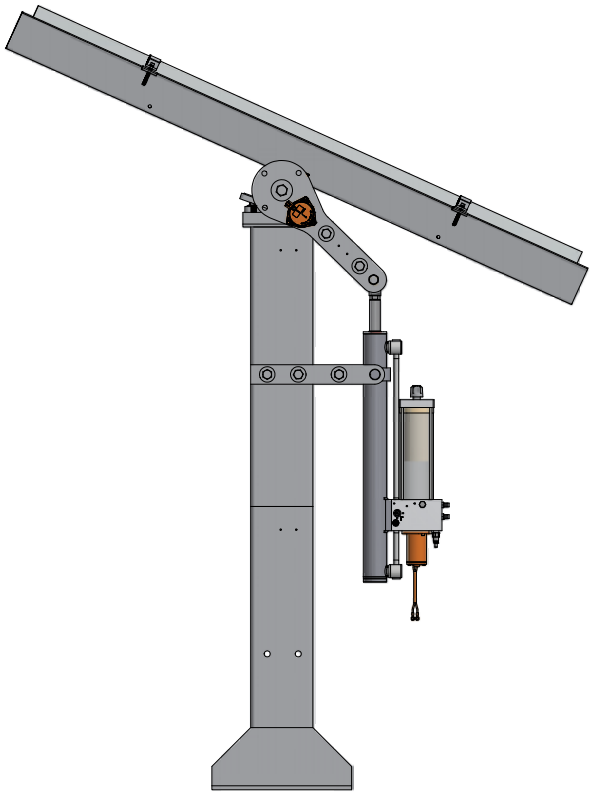
Dual PO Check Valve

For use with friction held load.

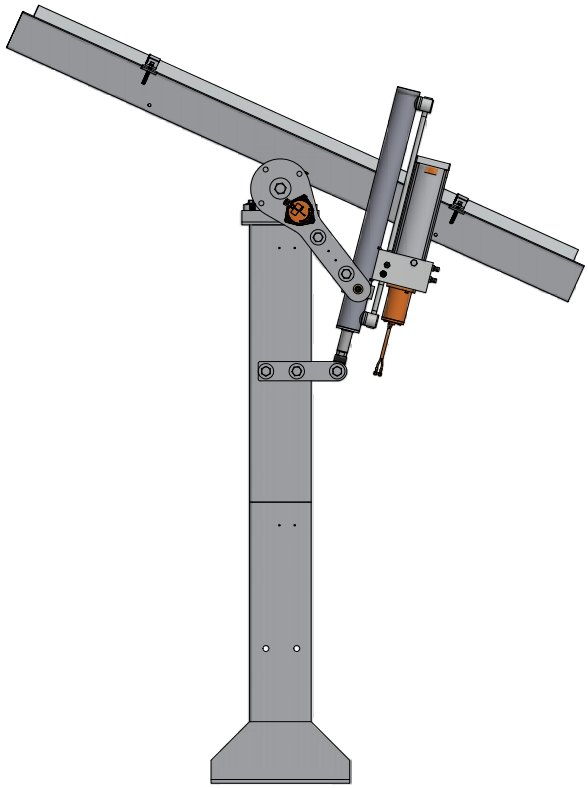
Note: This configuration is most efficient, however the actuator is not protected from thermal expansion, not suitable for outdoor applications.



Single Row Tracker

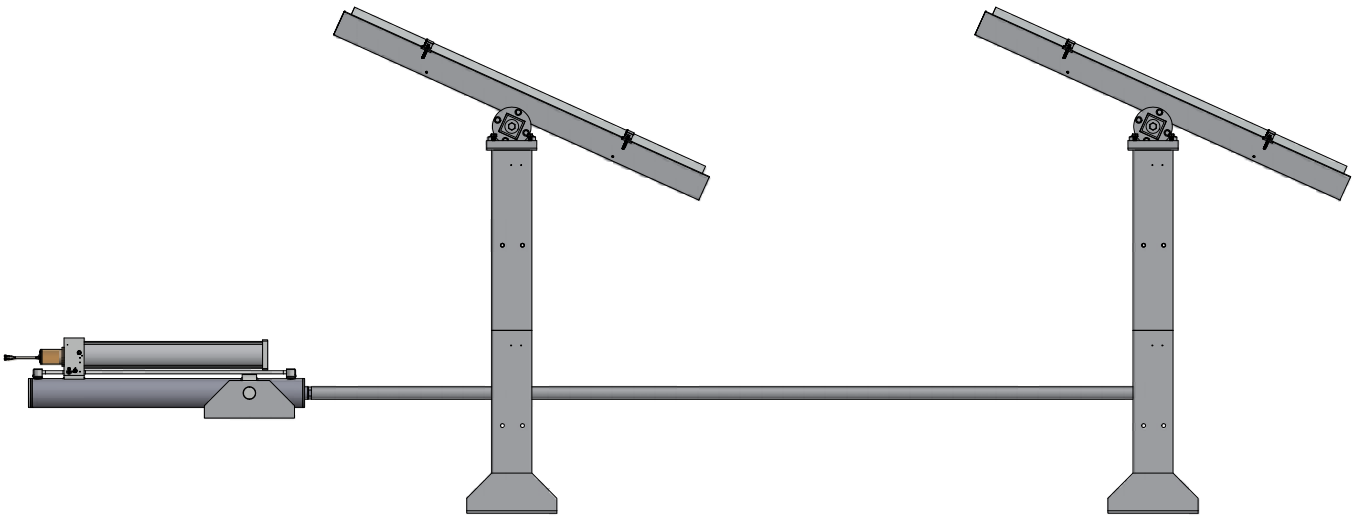


Standard Rod Up Configuration



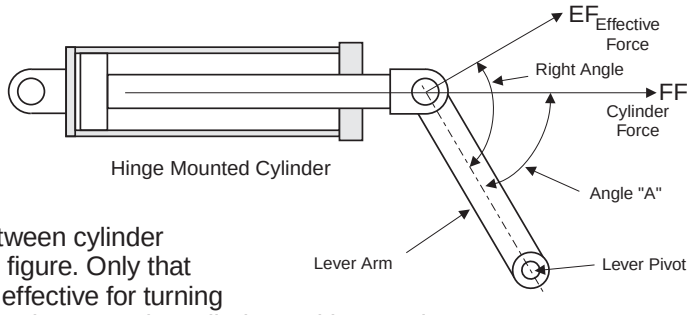
Low Profile Rod Down Configuration

Multi-Row Tracker



Horizontal Mounting

Cylinder Working a Rotating Lever:



A cylinder working a hinged lever can exert its maximum force on the lever only when the lever axis and cylinder axis are at right angles. When Angle "A" is greater or less than a right angle, only part of the cylinder force is effective on the lever. The cylinder force is found by multiplying the full cylinder force times the sine (sin) of the least angle between cylinder and lever axes. Cylinder Force, FF, is horizontal in this figure. Only that portion, EF, which is at right angles to the lever axis is effective for turning the lever. The value of EF varies with the acute angle “A” between the cylinder and lever axis.

Example: Find the effective force exerted by a 2.5-inch bore cylinder against a lever when the cylinder is operating at 3000 PSI and when its axis at an angle of 55 degrees with the lever axis.

First, find the full force developed by the cylinder: FF (full force) = 4.9 (piston area) x 3000 PSI = 14,700 lbs.

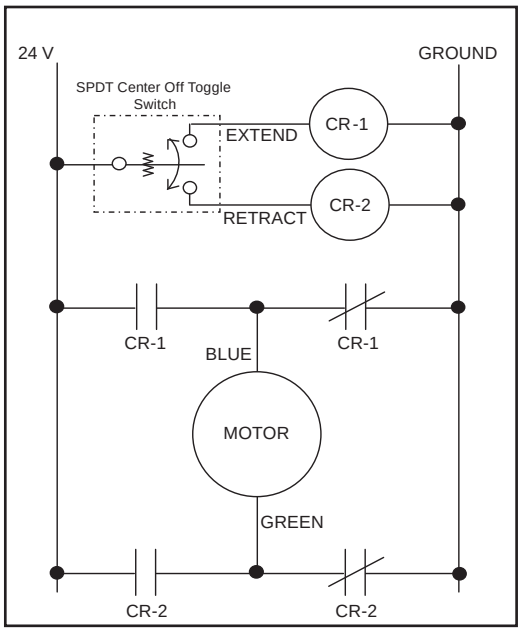
Next, find the effective force at 55°EF (effective force) = 14,700 x 0.819 = 12,039 lbs.

Since maximum cylinder force is delivered in the right angle position, the hinge points for the cylinder and lever should be lcoated, if possible, so the right angle falls close to the lever position which requires the greatest torque (force).

POWER FACTOR TABLE
Trigonometric Sines and Cosines

Angle, Degrees	Sine (sin)	Cosine (cos)	Angle, Degrees	Sine (sin)	Cosine (cos)	Angle, Degrees	Sine (sin)	Cosine (cos)
1	0.0175	0.9998	31	0.5150	0.8572	61	0.8746	0.4848
2	0.0349	0.9994	32	0.5299	0.8480	62	0.8829	0.4695
3	0.0523	0.9986	33	0.5446	0.8387	63	0.8910	0.4540
4	0.0698	0.9976	34	0.5592	0.8290	64	0.8988	0.4384
5	0.0872	0.9962	35	0.5736	0.8192	65	0.9063	0.4226
6	0.1045	0.9945	36	0.5878	0.8090	66	0.9135	0.4067
7	0.1219	0.9925	37	0.6018	0.7986	67	0.9205	0.3907
8	0.1392	0.9903	38	0.6157	0.7880	68	0.9272	0.3746
9	0.1564	0.9877	39	0.6293	0.7771	69	0.9336	0.3584
10	0.1736	0.9848	40	0.6428	0.7660	70	0.9397	0.3420
11	0.1908	0.9816	41	0.6561	0.7547	71	0.9455	0.3256
12	0.2079	0.9781	42	0.6691	0.7431	72	0.9511	0.3090
13	0.2250	0.9744	43	0.6820	0.7314	73	0.9563	0.2924
14	0.2419	0.9703	44	0.6947	0.7193	74	0.9613	0.2756
15	0.2588	0.9659	45	0.7071	0.7071	75	0.9659	0.2588
16	0.2756	0.9613	46	0.7193	0.6947	76	0.9703	0.2419
17	0.2924	0.9563	47	0.7314	0.6820	77	0.9744	0.2250
18	0.3090	0.9511	48	0.7431	0.6691	78	0.9781	0.2079
19	0.3256	0.9455	49	0.7547	0.6561	79	0.9816	0.1908
20	0.3420	0.9397	50	0.7660	0.6428	80	0.9848	0.1736
21	0.3584	0.9336	51	0.7771	0.6293	81	0.9877	0.1564
22	0.3746	0.9272	52	0.7880	0.6157	82	0.9903	0.1392
23	0.3907	0.9205	53	0.7986	0.6018	83	0.9925	0.1219
24	0.4067	0.9135	54	0.8090	0.5878	84	0.9945	0.1045
25	0.4226	0.9063	55	0.8192	0.5736	85	0.9962	0.0872
26	0.4384	0.8988	56	0.8290	0.5592	86	0.9976	0.0698
27	0.4540	0.8910	57	0.8387	0.5446	87	0.9986	0.0523
28	0.4695	0.8829	58	0.8480	0.5299	88	0.9994	0.0349
29	0.4848	0.8746	59	0.8572	0.5150	89	0.9998	0.0175
30	0.5000	0.8660	60	0.8660	0.5000	90	1	0

Electrical Schematic



Reversing Relay

Part No: CYLE000000112

24 VDC, 75 amps

5 Minutes On-time Max

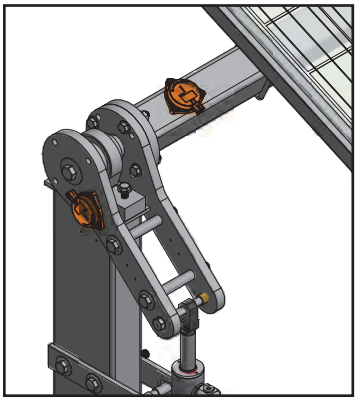
-40C to 60C

Part No:
CYLE000000112

Simplified Electrical Wiring Schematic

Function	Positive	Ground
Extend	Blue	Green
Retract	Green	Blue

With pump on cylinder cap end



Panel Inclinometer

Part No: CYLE000000113

Dual Axis, +/-90 degrees

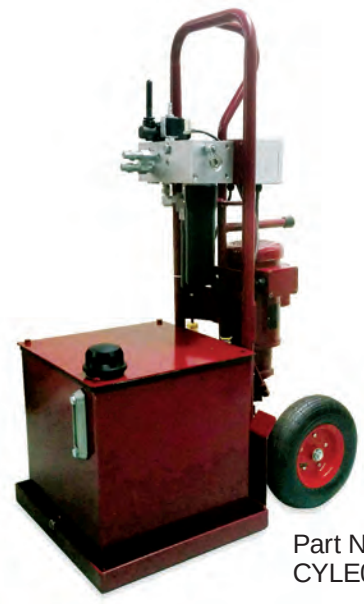
Mount on arm or Beam

Measure angle in reference to ground

SAE J1939 CAN bus

Ethernet convertor available

Part No:
CYLE000000113



Fluid Exchange System

Part No: CYLE000000114

15 Gallon Capacity

120V-1 PH, 15 Amps supply

25 Feet of hose

Oil Scrubbing / Exchange / Waste Functions

With Optional Particle Counter

Part No:
CYLE000000114

Please provide as much information as possible

Completed form can be returned via email to cylproductinfo@parker.com or faxed to (800) 892-1008.

Customer Information

Company Name: _____

Contact: _____

Phone: _____ **Fax:** _____

E-Mail: _____

Address: _____

_____

Cylinder Information: Quantity: _____

Move Distance: _____ in. _____ mm
or
Overall Stroke: _____ in. _____ mm

Rod End: Male English
Female Metric
Rod Eye
Other: _____

Mounting
Primary: _____

Secondary: _____

Rod Orientation: Horizontal Up Down
Angle: _____ Degrees

Application Information:

Dynamic Force Required: _____ lbs / kN

Resistive (locked) Force: _____ lbs / kN

Load/Fixture Weight: _____ lbs / kN

Speed:
Maximimum: _____ in./sec. _____ mm/sec.

Minimum: _____ in./sec. _____ mm/sec.

Move Time: _____ seconds

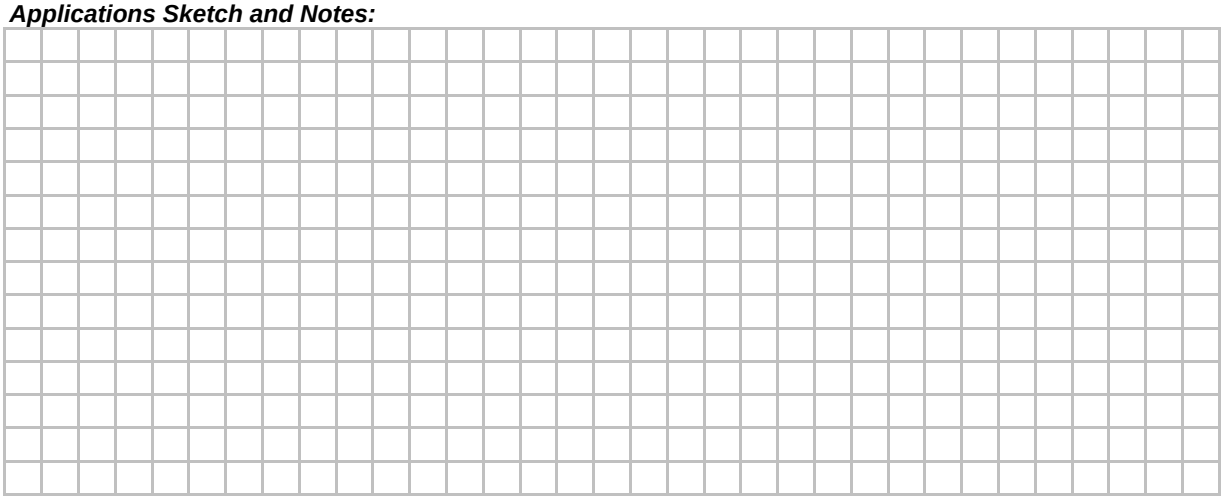
Total Cycle Time: _____ seconds

Environmental:
Ambient Temp: _____

Humidity: _____

Drive Power: 12 VDC 24 VDC
Other _____

Applications Sketch and Notes:



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

WARNING: ⚠ 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 Hannifin Corporation (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 1-847-298-2400, or go to www.parker.com, 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 rod 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 reviewed 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:

$$\frac{\text{operating pressure x effective cap end area}}{\text{effective rod end piston area}}$$

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 head and loosen it from the cylinder body. Confirm that this condition is not occurring. If it does, re-tighten the head firmly against the cylinder body.

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. 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 bearing wear. If clearance is excessive, replace rod bearing 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 a loose head. Torque the head 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 head 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 head 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 bearing or piston bearing due to load misalignment – Correct cylinder-to-load alignment.

4.3.2 – Cylinder sized too close to load requirements – 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 Industrial 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, head, 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, services or work described will be referred to as "Products".

1. Terms and Conditions. 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. Price Adjustments; Payments. 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. Warranty. Seller warrants that the Products sold hereunder shall be free from defects in material or workmanship for a period of eighteen months from the date of delivery to Buyer. The prices charged for Seller's products are based upon the exclusive limited warranty stated above, and upon the following disclaimer: **DISCLAIMER OF WARRANTY: 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. Claims; Commencement of Actions. 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 is discovered.

6. LIMITATION OF LIABILITY. 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, will 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 in Seller's possession or control.

9. Special Tooling. 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. Improper use and Indemnity. 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. Cancellations and Changes. 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. Limitation on Assignment. Buyer may not assign its rights or obligations under this agreement without the prior written consent of Seller.

14. Force Majeure. 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. Waiver and Severability. 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. Termination. 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) dissolves or liquidates all or a majority of its assets.

17. Governing Law. 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 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.

Notes

Notes

View the full line of Localized Power Products

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Parker Hannifin Corporation
Cylinder Division
500 South Wolf Road
Des Plaines, IL 60016 USA
phone (847) 298-2400
fax (800) 892-1008
www.parker.com/cylinder