

Stainless Steel Air Cylinders

Series SA



Parker

Schrader Bellows®

ENGINEERING YOUR SUCCESS.

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Cylinders for your unique need –

The Schrader Bellows Series SA stainless steel cylinder combines corrosion resistance with proven reliability. It is specifically designed to meet today's demand for cylinders in harsh chemical washdown environments.

Series SA premium quality air cylinders have many different options to meet your every need. With eight mounting styles, optional cushions, piston bumper seals, or magnetic piston, you can order exactly what you need. The Series SA cylinder is rated for Non-Lube service to keep the cylinder as low maintenance as possible. It is made completely of 303 and 304 stainless steel material with the exception of the aluminum piston, which resists many corrosive elements. This cylinder is also popular in the food processing industry when cleanliness and a bacteria free environment is of most importance.

Series SA non-lube premium quality air cylinders are available for quick delivery to minimize your downtime. The SA cylinder should be your next choice when specifying stainless steel cylinders.

Hydraulic Actuator Division and over 130 distributors provide the local personalized service customers demand. The Parker team ensures the right solution and product is in place to meet customer needs.

For further information on our cylinder products and capabilities, contact your local Parker distributor or visit us on the web at www.parker.com/schrader



Cylinder Weights In pounds (kilograms)

Bore	Rod	Mounting Code				
		T, F, C, JB, HB, & TE	J & H	[1]BB & BE	D & DB	Add Per Inch of Stroke
1 1/8" (28.58)	3/8" (9.53)	1.1 (.49)	1.5 (.68)	1.3 (.58)	- -	.13 (.05)
	1/2" (12.70)	1.2 (.54)	1.6 (.72)	1.4 (.63)	- -	.15 (.06)
1 1/2" (38.10)	5/8" (15.88)	3.3 (1.49)	4.0 (1.81)	3.8 (1.72)	3.8 (1.72)	.3 (.13)
	1" (25.40)	4.1 (1.85)	4.8 (2.17)	4.6 (2.08)	4.6 (2.08)	.4 (.18)
2" (50.80)	5/8" (15.88)	5.9 (2.67)	7.0 (3.17)	6.4 (2.90)	6.4 (2.90)	.5 (.22)
	1" (25.40)	6.3 (2.85)	7.4 (3.35)	6.8 (2.94)	6.8 (3.08)	.6 (.27)
2 1/2" (63.50)	5/8" (15.88)	8.0 (3.62)	9.5 (4.30)	8.7 (3.94)	8.5 (3.85)	.6 (.27)
	1" (25.40)	8.5 (3.85)	10.0 (4.53)	9.2 (4.17)	9.0 (4.08)	.7 (.31)
3 1/4" (82.55)	1" (25.40)	15.0 (6.80)	18.7 (8.48)	16.0 (7.25)	15.5 (7.03)	.8 (.36)
	1 3/8" (34.93)	15.5 (7.03)	19.2 (8.70)	16.5 (7.48)	16.0 (7.25)	1.0 (.45)
4" (101.60)	1" (25.40)	23.0 (10.43)	28.0 (12.70)	27.0 (12.24)	23.5 (10.65)	1.0 (.45)
	1 3/8" (34.93)	23.5 (10.65)	28.5 (12.92)	27.5 (12.47)	24.0 (10.88)	1.2 (.54)
5" (127.00)	1" (25.40)	34.5 (15.64)	42.0 (19.05)	41.0 (18.59)	35.0 (15.87)	1.1 (.49)
	1 3/8" (34.93)	35.0 (15.87)	42.5 (19.27)	41.5 (18.82)	35.5 (16.10)	1.3 (.58)
6" (152.40)	1 3/8" (34.93)	60.0 (27.21)	71.9 (32.61)	69.0 (31.29)	61.2 (27.76)	1.5 (.68)
	1 3/4" (44.45)	62.0 (28.12)	73.9 (33.52)	71.0 (32.20)	63.2 (28.66)	1.7 (.77)
8" (203.20)	1 3/8" (34.93)	79.0 (35.83)	- -	88.0 (39.91)	80.2 (36.37)	2.0 (.90)
	1 3/4" (44.45)	82.0 (37.19)	- -	91.0 (41.27)	83.2 (37.73)	2.3 (1.04)

[1] Weight includes pivot pin

Breakaway Pressure In PSI

Bore	SA Series	
	Extend	Retract
1 1/8"	6	7
1 1/2", 2", 2 1/2"	5	6
3 1/4", 4"	4	5
5", 6", 8"	3	4

Listed are the average breakaway pressures in PSI for all Series SA cylinder bore sizes.

Note: Breakaway pressures were established with the cylinders mounted horizontally and no load on the piston rod.

Cylinder Force and Volume Charts Extended Forces in pounds (newtons)

Bore	Piston Area in² (cm²)	PSI (bar)						Volume Cu Ft (cm³) Displacement Per Inch
		40 (3)	60 (4)	80 (6)	100 (7)	150 (10)	200 (14)	
1 1/8"	.99 (6.41)	40 (177)	60 (265)	80 (354)	99 (442)	149 (664)	200 (890)	.00057 (16)
1 1/2"	1.77 (11.40)	71 (315)	106 (472)	142 (629)	177 (786)	266 (1179)	353 (1570)	.00102 (29)
2"	3.14 (20.27)	126 (559)	189 (839)	251 (1119)	314 (1398)	471 (2097)	628 (2793)	.00182 (52)
2 1/2"	4.91 (31.67)	196 (874)	295 (1311)	393 (1748)	491 (2185)	737 (3277)	982 (4368)	.00284 (80)
3 1/4"	8.30 (53.32)	332 (1477)	498 (2215)	664 (2953)	830 (3692)	1245 (5538)	1659 (7379)	.00480 (136)
4"	12.57 (81.07)	503 (2237)	754 (3355)	1005 (4473)	1257 (5592)	1886 (8388)	2513 (11178)	.00727 (206)
5"	19.64 (126.71)	785 (3491)	1178 (5240)	1571 (6988)	1964 (8736)	2946 (13104)	3928 (17472)	.01137 (322)
6"	28.27 (182.39)	1130 (5026)	1696 (7544)	2262 (10061)	2827 (12574)	4240 (18860)	5654 (25149)	.01837 (520)
8"	50.26 (324.26)	2010 (8940)	3015 (13411)	4020 (17881)	5026 (22356)	7539 (33533)	10052 (44711)	.02227 (631)

Deduct these Forces for Retract Strokes in Pounds (newtons)

Rod	Rod Area in² (cm²)	PSI (bar)						Volume Cu Ft (cm³) Displacement Per Inch
		40 (3)	60 (4)	80 (6)	100 (7)	150 (10)	200 (14)	
3/8"	.112 (.72)	5 (20)	7 (30)	9 (40)	11 (50)	17 (75)	22 (100)	.00007 (2)
1/2"	.196 (1.26)	8 (35)	12 (52)	16 (70)	20 (87)	30 (131)	39 (174)	.00011 (3)
5/8"	.307 (1.98)	12 (53)	18 (80)	25 (111)	31 (138)	46 (205)	61 (271)	.00018 (5)
1"	.785 (5.06)	31 (138)	47 (209)	63 (280)	70 (351)	118 (525)	157 (698)	.00045 (13)
1 3/8"	1.485 (9.58)	59 (262)	89 (396)	119 (529)	149 (663)	222 (997)	297 (1321)	.00086 (24)
1 3/4"	2.404 (15.51)	95 (423)	144 (641)	192 (854)	240 (1068)	360 (1601)	480 (2135)	.00139 (39)

Features

1 Piston Seals: Nitrile lipseals are pressure energized and wear compensating. Their excellent lubrication retention characteristics lower seal friction and ensure long life.

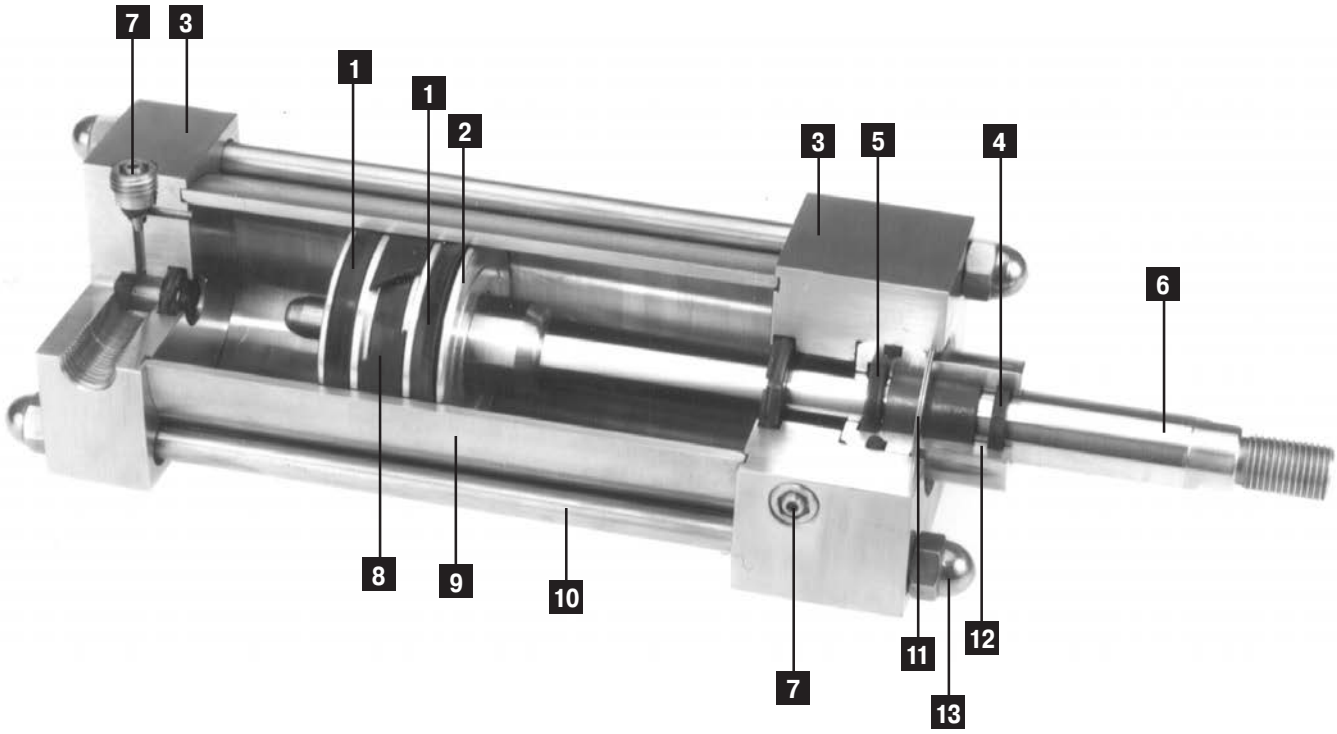
2 Piston: Solid aluminum alloy, lightweight for low inertia, yet strong. Optional stainless steel piston available at additional cost.

3 Head/Cap: Precision machined from solid corrosion-resistant 300 series stainless steel bar.

4 Rod Wiper: Urethane lipseals aggressively wipe foreign material from piston rod and enhance rod seal life.

5 Rod Seals: Rounded urethane lipseals are pressure energized and wear compensating.

6 Piston Rod: 303 stainless steel, 40,000 PSI minimum yield, hard chrome plated, ground and polished.



7 Adjustable Captive Cushion Needle: Allows for safe and precise adjustment under pressure.

8 Wear Strip: PTFE and graphite composition for minimum friction, maximum wear and side load resistance. (Magnetic band under wear strip optional.)

9 Tube: Corrosion-resistant 300 series stainless steel.

10 Tie Rods: High-strength 303 stainless steel maintains compression on tube end seals.

11 Retainer: Stainless steel snap ring securely retains bushing in head.

12 Rod Bearings: Machined from 304 stainless steel, with a PTFE composite wear band insert that eliminates metal-to-metal contact.

13 Acorn Nut: Tie rod threads are covered by stainless steel acorn nuts which eliminates a bacteria hiding place.

Operating Temperatures:

Standard Seals	-40°F to 200°F (-40°C to 93°C)
Fluorocarbon Seals	-20°F to 400°F (-29°C to 204°C)

Operating Pressure:

250 PSIG Air (17.2 Bar)
Bore Sizes: 1-1/8", 1-1/2", 2", 2-1/2", 3-1/4", 4", 5", 6", 8"

Supply:

Filtered compressed air to 250 PSI
Petroleum based hydraulic fluid to 400 PSI, 1-1/2"-8" bore only

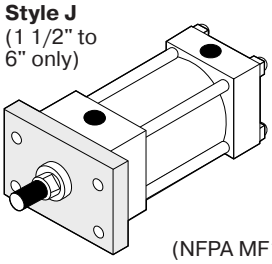
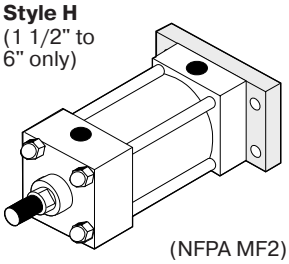
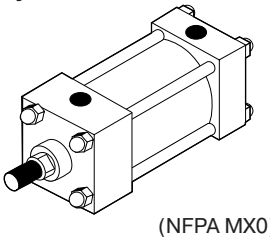
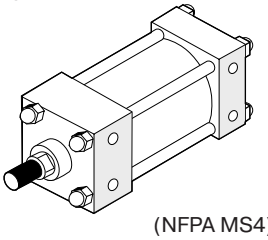
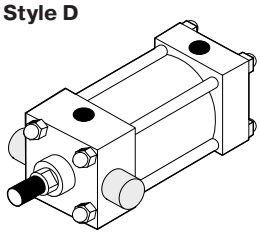
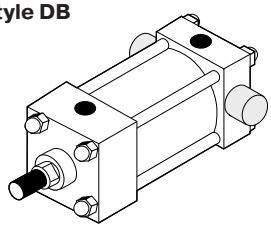
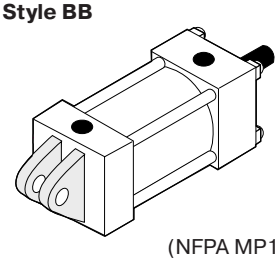
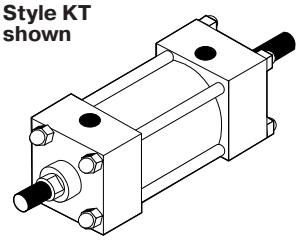
Lubrication:

None required
Series SA Cylinders are rated for “no lube added” service. All internal components are lubricated at time of assembly with a PTFE based grease.

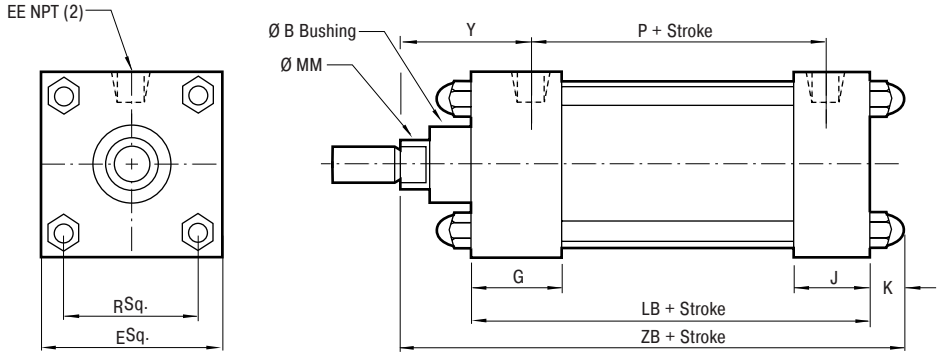
Materials:

Head and End Caps: 300 series stainless steel
Tube: 300 series stainless steel
Piston Rod: hard chrome plated 303 stainless steel
Piston: 6061 aluminum with PTFE composite wearband
Rod Bearings: 304 stainless steel with PTFE composite wearband
Seals: urethane rod seal and wiper, nitrile piston seals
Tie Rods: 303 stainless steel

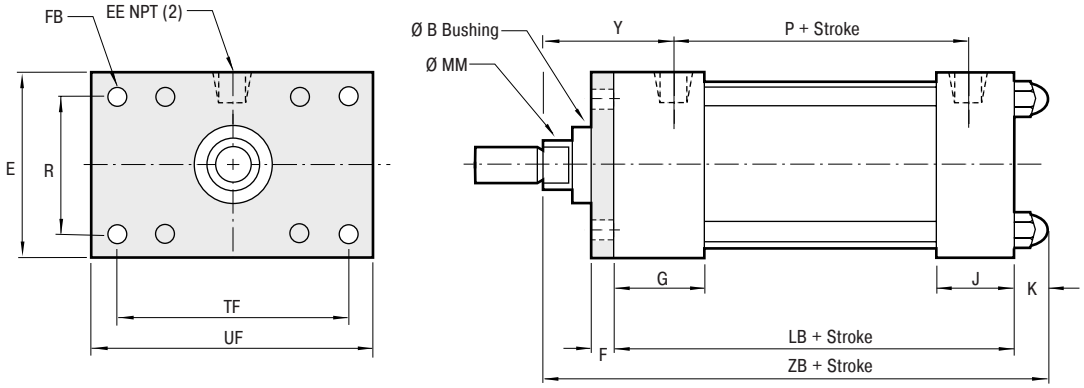
Available Mounting Styles 1 1/2" to 8" Bores

Head Rectangular Flange	Cap Rectangular Flange	No Mount (Basic)	Side Tap
Style J (1 1/2" to 6" only)  (NFPA MF1)	**Style H** (1 1/2" to 6" only)  (NFPA MF2)	**Style T**  (NFPA MX0)	**Style F**  (NFPA MS4)
Head Trunnion	**Cap Trunnion**	**Cap Fixed Clevis**	**Double Rod End**
Style D  (NFPA MT1)	**Style DB**  (NFPA MT2)	**Style BB**  (NFPA MP1)	**Style KT shown** 

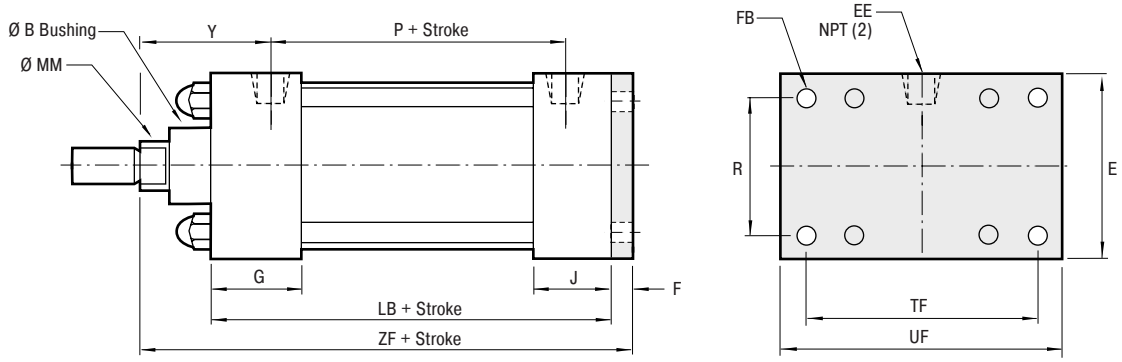
No Mount Basic (1 1/2" to 8" Bores)
Style T
(NFPA MX0)



Head Rectangular Flange (1 1/2" to 6" Bores)
Style J
(NFPA MF1)

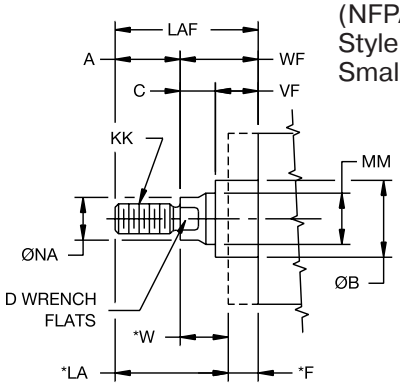


Cap Rectangular Flange (1 1/2" to 6" Bores)
Style H
(NFPA MF2)

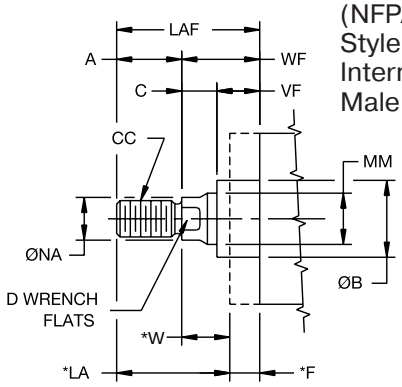


Rod End Dimensions – Basic Cylinder

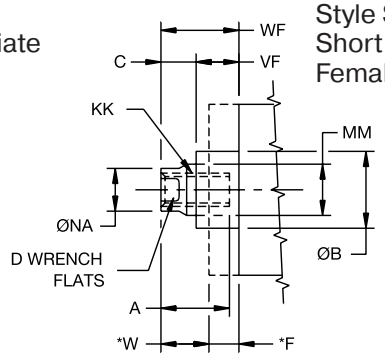
Thread Style 4 (NFPA Style SM) Small Male



Thread Style 8 (NFPA Style IM) Intermediate Male



Thread Style 9 (NFPA Style SF) Short Female



* FOR J (MF1) MOUNT ONLY

"Special Thread" Style 3

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

Table 1 – Envelope & Mounting Dimensions

Bore Size	E	EE	F	FB	G	J	K	R	TF	UF	Add Stroke LB	Add Stroke P
1 1/2	2	3/8[1]	3/8	5/16	1 1/2	1	15/32	1.43	2 3/4	3 3/8	3 5/8	2 1/8
2	2 1/2	3/8	3/8	3/8	1	1	17/32	1.84	3 3/8	4 1/8	3 5/8	2 1/8
2 1/2	3	3/8	3/8	3/8	1 1/2	1	17/32	2.19	3 7/8	4 5/8	3 3/4	2 1/4
3 1/4	3 3/4	1/2	5/8	7/16	1 3/4	1 1/4	5/8	2.76	4 11/16	5 1/2	4 1/4	2 1/2
4	4 1/2	1/2	5/8	7/16	1 3/4	1 1/4	5/8	3.32	5 7/16	6 1/4	4 1/4	2 1/2
5	5 1/2	1/2	5/8	9/16	1 3/4	1 1/2	27/32	4.10	6 5/8	7 5/8	4 1/2	2 3/4
6	6 1/2	3/4	3/4	9/16	2	1 1/2	27/32	4.88	7 5/8	8 5/8	5	3 1/8
8	8 1/2	3/4	-	-	2	1 1/2	1	6.44	-	-	5 1/8	3 1/4

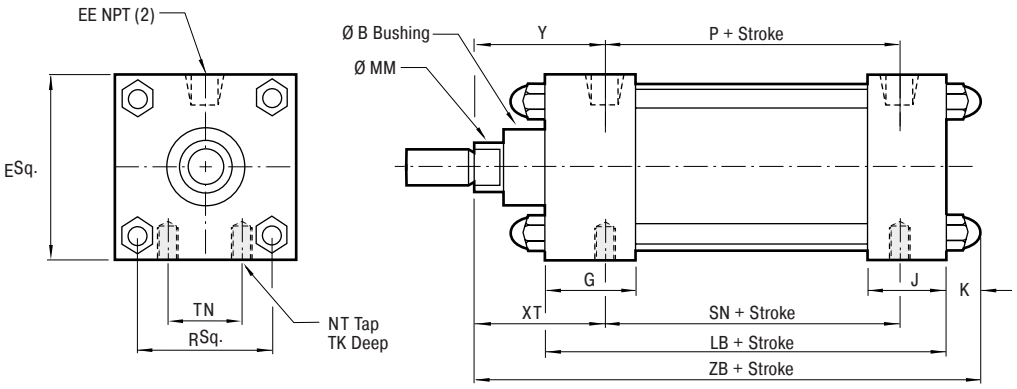
[1] On 1 1/2" bore with code 2 rod head end port is 1/4" NPT.

Table 2 – Rod Dimensions

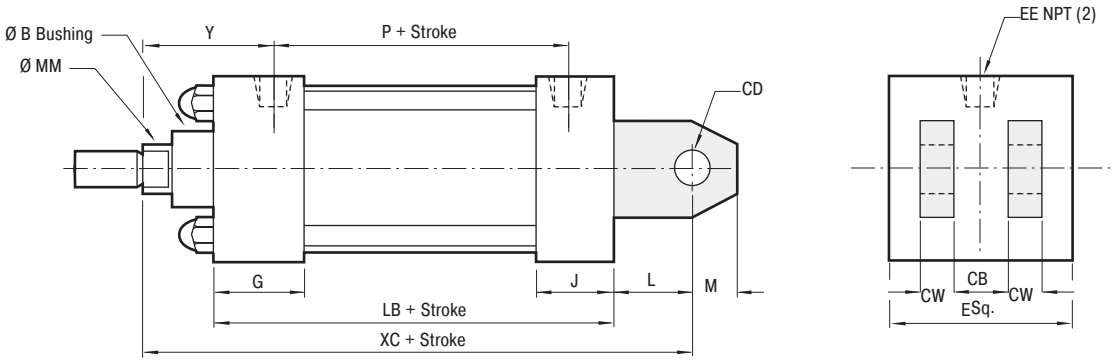
Table 3 – Envelope and Mounting Dimensions

Bore Size	Rod No.	Rod Dia. MM	Thread Style 8 CC	Thread Style 4,9 KK	A	B	C	D	LA	LAF	VF	W	WF	Y	Add Stroke ZB	Add Stroke ZF
1 1/2	1	5/8	1/2-20	7/16-20	3/4	1.125	3/8	1/2	1 3/8	1 3/4	5/8	5/8	1	2	5 3/32	5
	2	1	7/8-14	3/4-16	1 1/8	1.500	1/2	13/16	2 1/8	2 1/2	7/8	1	1 3/8	2 3/8	5 15/32	5 3/8
2	1	5/8	1/2-20	7/16-20	3/4	1.125	3/8	1/2	1 3/8	1 3/4	5/8	5/8	1	2	5 5/32	5
	3	1	7/8-14	3/4-16	1 1/8	1.500	1/2	13/16	2 1/8	2 1/2	7/8	1	1 3/8	2 3/8	5 17/32	5 3/8
2 1/2	1	5/8	1/2-20	7/16-20	3/4	1.125	3/8	1/2	1 3/8	1 3/4	5/8	5/8	1	2	5 9/32	5 1/8
	3	1	7/8-14	3/4-16	1 1/8	1.500	1/2	13/16	2 1/8	2 1/2	7/8	1	1 3/8	2 3/8	5 21/32	5 1/2
3 1/4	1	1	7/8-14	3/4-16	1 1/8	1.500	1/2	13/16	1 7/8	2 1/2	7/8	3/4	1 3/8	2 1/2	6 1/4	6 1/4
	3	1 3/8	1 1/4-12	1-14	1 5/8	2.000	5/8	1 1/8	2 5/8	3 1/4	1	1	1 5/8	2 3/4	6 1/2	6 1/2
4	1	1	7/8-14	3/4-16	1 1/8	1.500	1/2	13/16	1 7/8	2 1/2	7/8	3/4	1 3/8	2 1/2	6 1/4	6 1/4
	3	1 3/8	1 1/4-12	1-14	1 5/8	2.000	5/8	1 1/8	2 5/8	3 1/4	1	1	1 5/8	2 3/4	6 1/2	6 1/2
5	1	1	7/8-14	3/4-16	1 1/8	1.500	1/2	13/16	1 7/8	2 1/2	7/8	3/4	1 3/8	2 1/2	6 23/32	6 1/2
	3	1 3/8	1 1/4-12	1-14	1 5/8	2.000	5/8	1 1/8	2 5/8	3 1/4	1	1	1 5/8	2 3/4	6 31/32	6 3/4
6	1	1 3/8	1 1/4-12	1-14	1 5/8	2.000	5/8	1 1/8	2 1/2	3 1/4	1	7/8	1 5/8	2 13/16	7 15/32	7 3/8
	3	1 3/4	1 1/2-12	1 1/4-12	2	2.375	3/4	1 1/2	3 1/8	3 7/8	1 1/8	1 1/8	1 7/8	3 1/16	7 23/32	7 5/8
8	1	1 3/8	1 1/4-12	1-14	1 5/8	2.000	5/8	1 1/8	-	3 1/4	1	-	1 5/8	2 13/16	7 3/4	-
	3	1 3/4	1 1/2-12	1 1/4-12	2	2.375	3/4	1 1/2	-	3 7/8	1 1/8	-	1 7/8	3 1/16	8	-

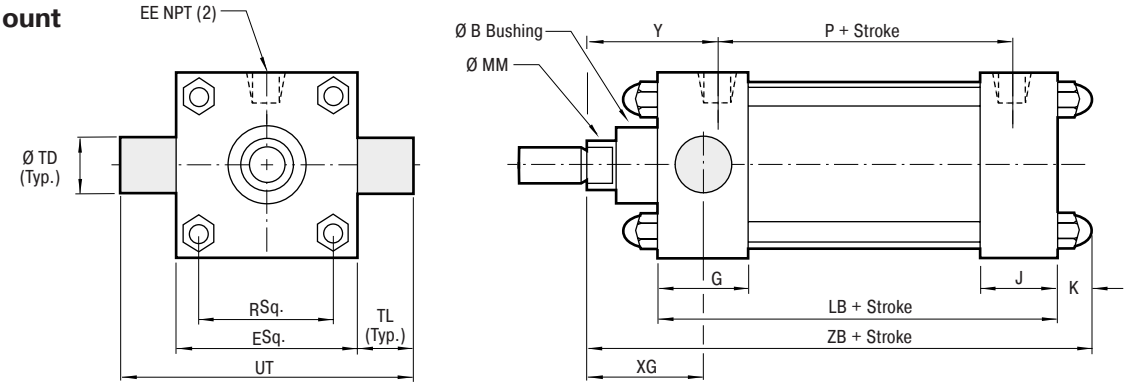
Side Tap Mount
Style F
(NFPA MS4)



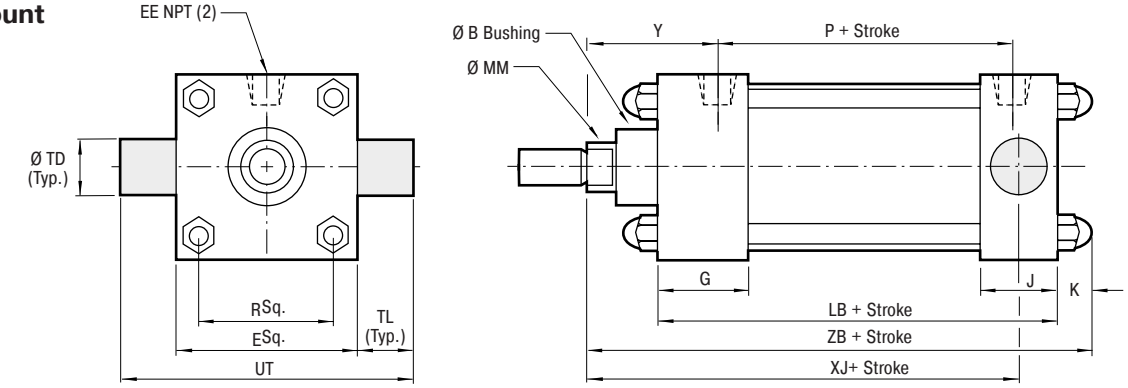
Cap Fixed Clevis Mount
Style BB
(NFPA MP1)



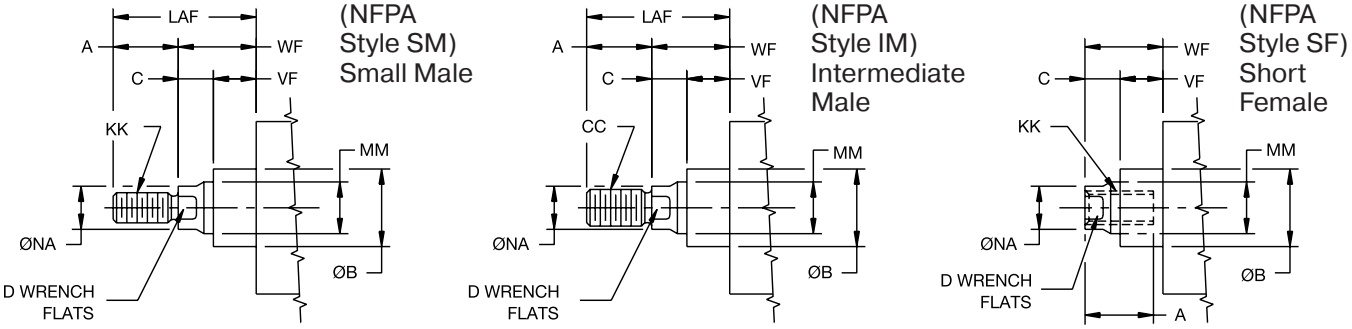
Head Trunnion Mount
Style D
(NFPA MT1)



Cap Trunnion Mount
Style DB
(NFPA MT2)



Rod End Dimensions – Basic Cylinder



Thread Style 4 (NFPA Style SM) Small Male

Thread Style 8 (NFPA Style IM) Intermediate Male

Thread Style 9 (NFPA Style SF) Short Female

"Special Thread" Style 3

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

Table 1 – Envelope & Mounting Dimensions

Bore Size	CB	CD	CW	E	EE	G	J	K	L	M	NT	R	TD	TK	TL	TN	UT	Add Stroke LB	P	SN
1 1/2	3/4	0.500	1/2	2	3/8[1]	1 1/2	1	15/32	3/4	5/8	1/4-20	1.43	1.000	3/8	1	5/8	4	3 5/8	2 1/8	2 1/4
2	3/4	0.500	1/2	2 1/2	3/8	1 1/2	1	17/32	3/4	5/8	5/16-18	1.84	1.000	3/8	1	7/8	4 1/2	3 5/8	2 1/8	2 1/4
2 1/2	3/4	0.500	1/2	3	3/8	1 1/2	1	17/32	3/4	5/8	3/8-16	2.19	1.000	1/2	1	1 1/4	5	3 3/4	2 1/4	2 3/8
3 1/4	1 1/4	0.750	5/8	3 3/4	1/2	1 3/4	1 1/4	5/8	1 1/4	7/8	1/2-13	2.76	1.000	3/4	1	1 1/2	5 3/4	4 1/4	2 1/2	2 5/8
4	1 1/4	0.750	5/8	4 1/2	1/2	1 3/4	1 1/4	5/8	1 1/4	7/8	1/2-13	3.32	1.000	3/4	1	2 1/16	6 1/2	4 1/4	2 1/2	2 5/8
5	1 1/4	0.750	5/8	5 1/2	1/2	1 3/4	1 1/4	27/32	1 1/4	7/8	5/8-11	4.10	1.000	15/16	1	2 11/16	7 1/2	4 1/2	2 3/4	2 7/8
6	1 1/2	1.000	3/4	6 1/2	3/4	2	1 1/2	27/32	1 1/2	1	3/4-10	4.88	1.375	1 1/8	1 3/8	3 1/4	9 1/4	5	3 1/8	3 1/8
8	1 1/2	1.000	3/4	8 1/2	3/4	2	1 1/2	1	1 1/2	1	3/4-10	6.44	1.375	1 1/8	1 3/8	4 1/2	11 1/4	5 1/8	3 1/4	3 1/4

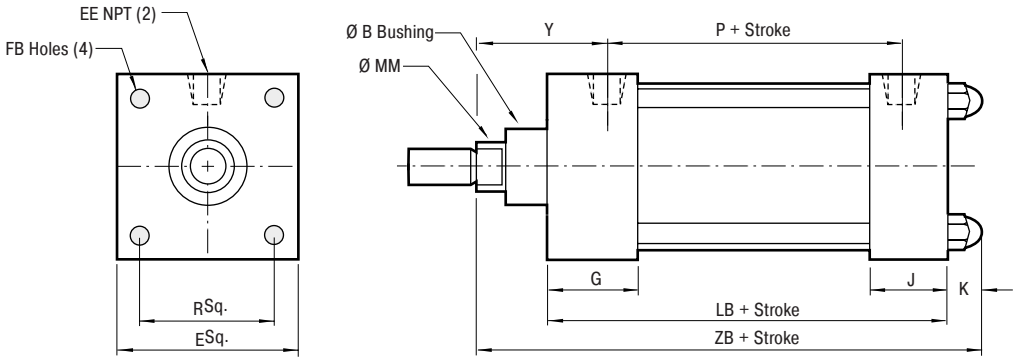
[1]On 1 1/2" bore with code 2 rod head end port is 1/4" NPT.

Table 2 – Rod Dimensions

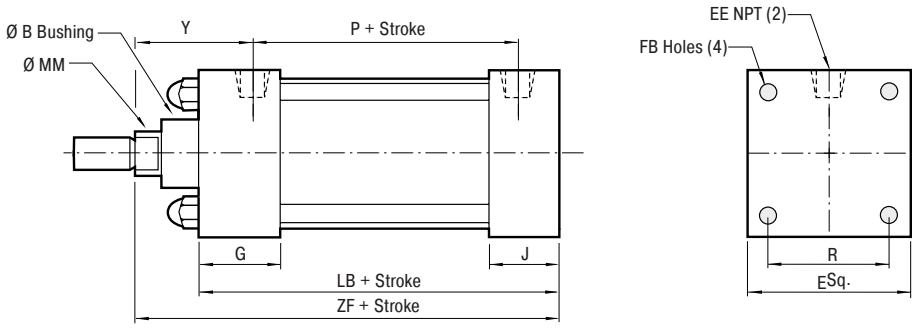
Bore Size	Rod No.	Rod Dia. MM	Thread Style 8 CC	Thread Style 4, 9 KK	A	B	C	D	LAF	VF	WF	XG	XT	Y	Add Stroke XC	XJ	ZB
1 1/2	1	5/8	1/2-20	7/16-20	3/4	1.125	3/8	1/2	1 3/4	5/8	1	1 3/4	1 15/16	2	5 3/8	4 1/8	5 3/32
	2	1	7/8-14	3/4-16	1 1/8	1.500	1/2	13/16	2 1/2	7/8	1 3/8	2 1/8	2 5/16	2 3/8	5 3/4	4 1/2	5 15/32
2	1	5/8	1/2-20	7/16-20	3/4	1.125	3/8	1/2	1 3/4	5/8	1	1 3/4	1 15/16	2	5 3/8	4 1/8	5 5/32
	3	1	7/8-14	3/4-16	1 1/8	1.500	1/2	13/16	2 1/2	7/8	1 3/8	2 1/8	2 5/16	2 3/8	5 3/4	4 1/2	5 17/32
2 1/2	1	5/8	1/2-20	7/16-20	3/4	1.125	3/8	1/2	1 3/4	5/8	1	1 3/4	1 15/16	2	5 1/2	4 1/4	5 9/32
	3	1	7/8-14	3/4-16	1 1/8	1.500	1/2	13/16	2 1/2	7/8	1 3/8	2 1/8	2 5/16	2 3/8	5 7/8	4 5/8	5 21/32
3 1/4	1	1	7/8-14	3/4-16	1 1/8	1.500	1/2	13/16	2 1/2	7/8	1 3/8	2 1/4	2 7/16	2 1/2	6 7/8	5	6 1/4
	3	1 3/8	1 1/4-12	1-14	1 5/8	2.000	5/8	1 1/8	3 1/4	1	1 5/8	2 1/2	2 11/16	2 3/4	7 1/8	5 1/4	6 1/2
4	1	1	7/8-14	3/4-16	1 1/8	1.500	1/2	13/16	2 1/2	7/8	1 3/8	2 1/4	2 7/16	2 1/2	6 7/8	5	6 1/4
	3	1 3/8	1 1/4-12	1-14	1 5/8	2.000	5/8	1 1/8	3 1/4	1	1 5/8	2 1/2	2 11/16	2 3/4	7 1/8	5 1/4	6 1/2
5	1	1	7/8-14	3/4-16	1 1/8	1.500	1/2	13/16	2 1/2	7/8	1 3/8	2 1/4	2 7/16	2 1/2	7 1/8	5 1/4	6 23/32
	3	1 3/8	1 1/4-12	1-14	1 5/8	2.000	5/8	1 1/8	3 1/4	1	1 5/8	2 1/2	2 11/16	2 3/4	7 3/8	5 1/2	6 31/32
6	1	1 3/8	1 1/4-12	1-14	1 5/8	2.000	5/8	1 1/8	3 1/4	1	1 5/8	2 5/8	2 13/16	2 13/16	8 1/8	5 7/8	7 15/32
	3	1 3/4	1 1/2-12	1 1/4-12	2	2.375	3/4	1 1/2	3 7/8	1 1/8	1 7/8	2 7/8	3 1/16	3 1/16	8 3/8	6 1/8	7 23/32
8	1	1 3/8	1 1/4-12	1-14	1 5/8	2.000	5/8	1 1/8	3 1/4	1	1 5/8	2 5/8	2 13/16	2 13/16	8 1/4	6	7 3/4
	3	1 3/4	1 1/2-12	1 1/4-12	2	2.375	3/4	1 1/2	3 7/8	1 1/8	1 7/8	2 7/8	3 1/16	3 1/16	8 1/2	6 1/4	8

Table 3 – Envelope and Mounting Dimensions

Head Square
Style JB
(NFPA ME3)
8" Bore only

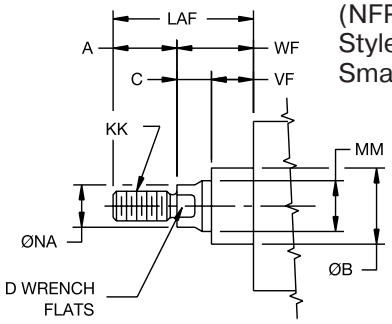


Cap Square
Style HB
(NFPA ME4)
8" Bore only

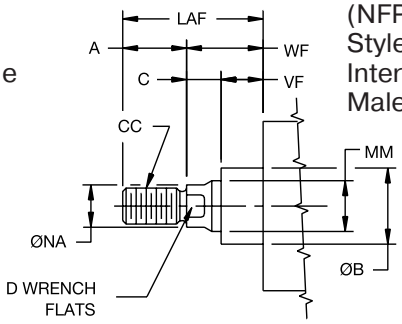


Standard & Optional Rod Ends

Thread Style 4 (NFPA Style SM) Small Male



Thread Style 8 (NFPA Style IM) Intermediate Male



Thread Style 9 (NFPA Style SF) Short Female

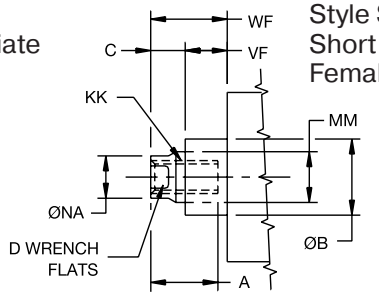


Table 1 – Envelope & Mounting Dimensions

	E	EE	FB	G	J	K	R	Add Stroke LB	Add Stroke P
JB (ME3)	8 1/2	3/4	11/16	2	1 1/2	1	7.57	5 1/8	3 1/8
HB (ME4)	8 1/2	3/4	11/16	2	1 1/2	1	7.57	5 1/8	3 1/8

Table 3 – Envelope and Mounting Dimensions

Table 2 – Rod Dimensions

	Rod Code	Rod Dia.	Thread Style 8 CC	Thread Style 4, 9 KK	A	B	C	D	LAF	VF	WF	Y	Add Stroke ZB	Add Stroke ZF
JB (ME3)	1	1 3/8	1-1/4-12	1-14	1 5/8	2.000	5/8	1 1/8	3 1/4	1	1 5/8	2 7/8	7 3/4	-
	3	1 3/4	1-1/2-12	1-1/4-12	2	2.375	3/4	1 1/2	3 7/8	1 1/8	1 7/8	3 1/8	8	-
HB (ME4)	1	1 3/8	1-1/4-12	1-14	1 5/8	2.000	5/8	1 1/8	3 1/4	1	1 5/8	2 7/8	-	6 3/4
	3	1 3/4	1-1/2-12	1-1/4-12	2	2.375	3/4	1 1/2	3 7/8	1 1/8	1 7/8	3 1/8	-	7

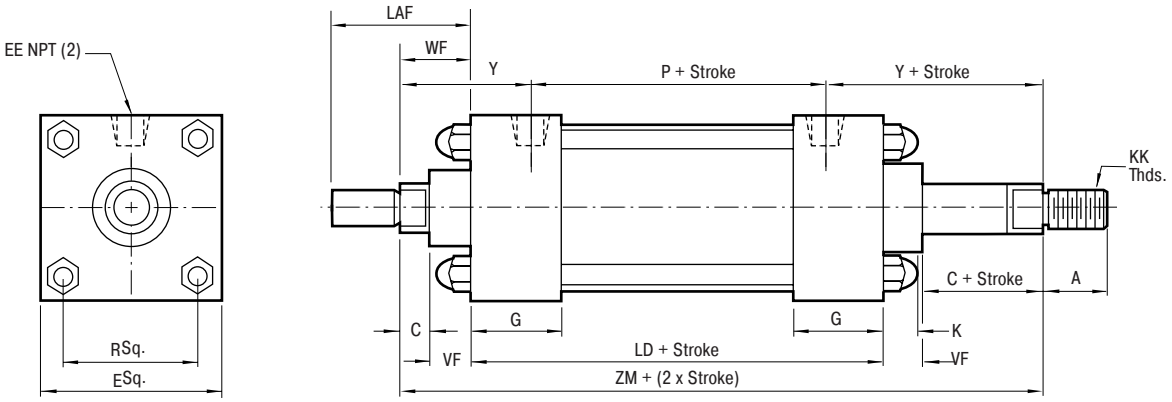


Table 1 – Envelope & Mounting Dimensions

Bore Size	E	EE	G	K	R	Add Stroke LD	Add Stroke P
1 1/2	2	3/8[1]	1 1/2	15/32	1.43	4 1/8	2 1/8
2	2 1/2	3/8	1 1/2	17/32	1.84	4 1/8	2 1/8
2 1/2	3	3/8	1 1/2	17/32	2.19	4 1/4	2 1/4
3 1/4	3 3/4	1/2	1 3/4	5/8	2.76	4 3/4	2 1/2
4	4 1/2	1/2	1 3/4	5/8	3.32	4 3/4	2 1/2
5	5 1/2	1/2	1 3/4	27/32	4.10	5	2 3/4
6	6 1/2	3/4	2	27/32	4.88	5 1/2	3 1/8
8	8 1/2	3/4	2	1	6.44	5 1/2	3 1/4

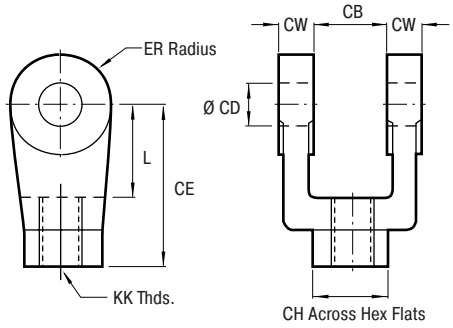
[1]On 1 1/2" bore with code 2 rod head end port is 1/4" NPT.

Table 3 – Envelope and Mounting Dimensions

Table 2 – Rod Dimensions

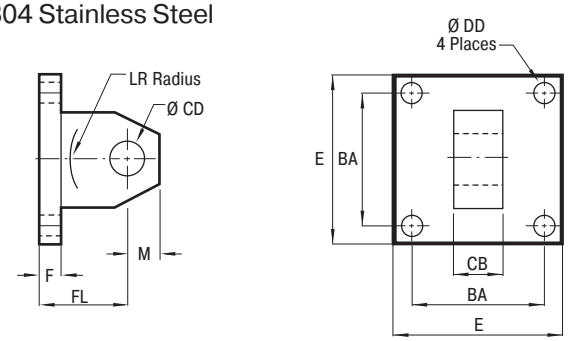
Bore Size	Rod No.	Rod Dia. MM	Thread Style 8 CC	Thread Style 4, 9 KK	A	B	C	D	LAF	VF	WF	Y	Add 2x Stroke ZM
1 1/2	1	5/8	1/2-20	7/16-20	3/4	1.125	3/8	1/2	1 3/4	5/8	1	2	6 1/8
	2	1	7/8-14	3/4-16	1 1/8	1.500	1/2	13/16	2 1/2	7/8	1 3/8	2 3/8	6 7/8
2	1	5/8	1/2-20	7/16-20	3/4	1.125	3/8	1/2	1 3/4	5/8	1	2	6 1/8
	3	1	7/8-14	3/4-16	1 1/8	1.500	1/2	13/16	2 1/2	7/8	1 3/8	2 3/8	6 7/8
2 1/2	1	5/8	1/2-20	7/16-20	3/4	1.125	3/8	1/2	1 3/4	5/8	1	2	6 1/4
	3	1	7/8-14	3/4-16	1 1/8	1.500	1/2	13/16	2 1/2	7/8	1 3/8	2 3/8	7
3 1/4	1	1	7/8-14	3/4-16	1 1/8	1.500	1/2	13/16	2 1/2	7/8	1 3/8	2 1/2	7 1/2
	3	1 3/8	1 1/4-12	1-14	1 5/8	2.000	5/8	1 1/8	3 1/4	1	1 5/8	2 3/4	8
4	1	1	7/8-14	3/4-16	1 1/8	1.500	1/2	13/16	2 1/2	7/8	1 3/8	2 1/2	7 1/2
	3	1 3/8	1 1/4-12	1-14	1 5/8	2.000	5/8	1 1/8	3 1/4	1	1 5/8	2 3/4	8
5	1	1	7/8-14	3/4-16	1 1/8	1.500	1/2	13/16	2 1/2	7/8	1 3/8	2 1/2	7 3/4
	3	1 3/8	1 1/4-12	1-14	1 5/8	2.000	5/8	1 1/8	3 1/4	1	1 5/8	2 3/4	8 1/4
6	1	1 3/8	1 1/4-12	1-14	1 5/8	2.000	5/8	1 1/8	3 1/4	1	1 5/8	2 13/16	8 3/4
	3	1 3/4	1 1/2-12	1 1/4-12	2	2.375	3/4	1 1/2	3 7/8	1 1/8	1 7/8	3 1/16	9 1/4
8	1	1 3/8	1 1/4-12	1-14	1 5/8	2.000	5/8	1 1/8	3 1/4	1	1 5/8	2 13/16	8 3/4
	3	1 3/4	1 1/2-12	1 1/4-12	2	2.375	3/4	1 1/2	3 7/8	1 1/8	1 7/8	3 1/16	9 1/4

Rod Clevis
303 Stainless Steel



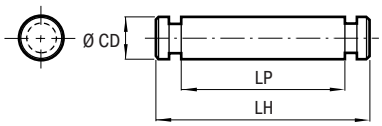
	1492220100	1492220200	1492220300	1492220400
CB	3/4	1 1/4	1 1/2	2
CD	0.500	0.750	1.000	1.375
CE	1 1/2	2 3/8	3 1/8	4 1/8
CH	1	1 1/4	1 1/2	2
CW	1/2	5/8	3/4	1
ER	1/2	3/4	1	1 3/8
KK	1/2-20	3/4-16	1-14	1 1/4-12
L	3/4	1 1/4	1 1/2	2 1/8

Eye Bracket
304 Stainless Steel



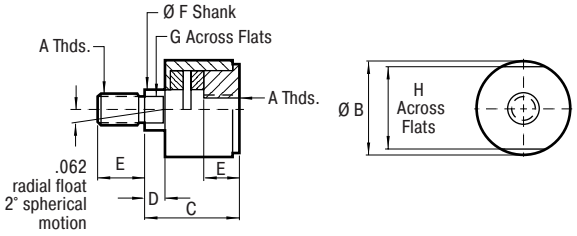
	1492230100	1492230200	1492230300
BA	1 5/8	2 9/16	3 1/4
CB	3/4	1 1/4	1 1/2
CD	0.500	0.750	1.000
DD	13/32	17/32	21/32
E	2 1/2	3 1/2	4 1/2
F	3/8	5/8	3/4
FL	1 1/8	1 7/8	2 1/4
LR	3/4	1 1/4	1 1/2
M	1/2	3/4	1

Pin
303 Stainless Steel



	0875600100	0875600200	0875600300	0875600400
CD	0.500	0.750	1.000	1.375
LH	2 7/32	3 1/8	3 3/4	5 5/8
LP	1 7/8	2 3/4	3 1/4	4 1/4

Rod Alignment Coupler



	1492240100	1492240200	1492240300
A	1/2-20	3/4-16	1-14
B	1 1/4	1 3/4	2 1/2
C	2	2 5/16	2 15/16
D	1/2	1/2	1/2
E	3/4	1 1/8	1 5/8
F	5/8	31/32	1 3/8
G	1/2	13/16	1 5/32
H	1 1/8	1 1/2	2 1/4
Maximum Pull (lbs.)	3,150	7,750	12,250

Made of 303 Stainless Steel, the Rod Alignment Coupler allows 1/16" of radial float and 2° of spherical movement. This prevents cylinder binding due to misalignment thus extending bearing and seal life, and permits greater tolerance between the center line of the cylinder and mating part for simplified installation.

Excellent operating performance in a 1 1/8" bore size

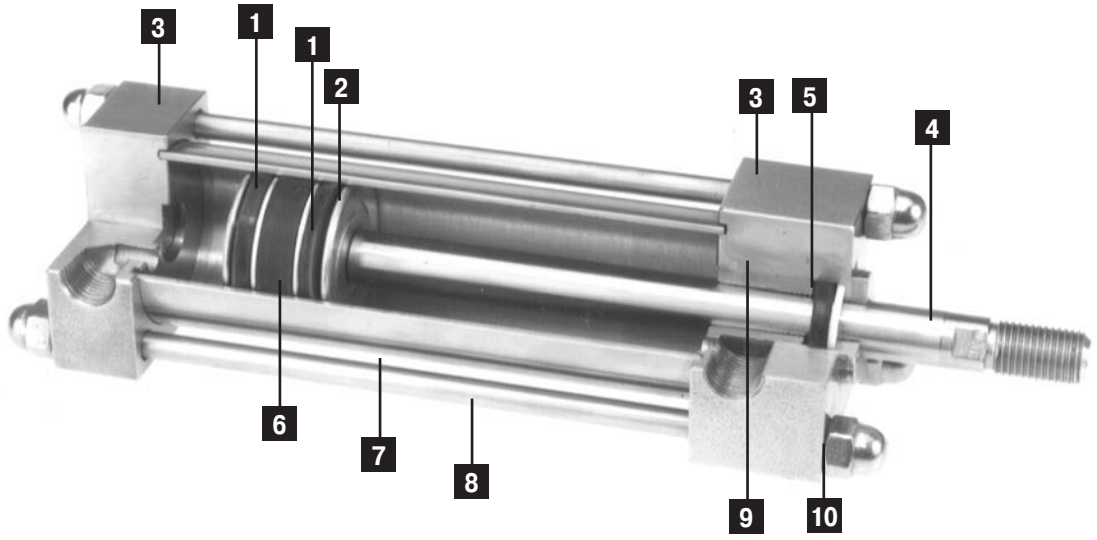
1 Piston Seals: Nitrile lipseals are pressure energized and wear compensating. Their excellent lubrication retention characteristics lower seal friction and ensure long life.

2 Piston: Solid aluminum alloy, light-weight for low inertia, yet strong.

3 Head/Cap: Precision machined from solid corrosion-resistant 304 stainless steel bar.

4 Piston Rods: 303 stainless steel, 40,000 PSI minimum yield, hard chrome plated, ground and polished.

5 Bearing Seal: PTFE rod wiper provides positive wiping action and low friction. Nitrile lipseals are pressure energized and wear compensating for long life.



6 Wear Strip: PTFE and graphite composition for minimum friction, maximum wear and side load resistance. (Magnetic band under wear strip optional.)

7 Tube: Corrosion-resistant 304 stainless steel.

8 Tie Rods: High-strength 303 stainless steel maintains compression on tube end seals.

9 Rod Bearing: Incorporates a sintered bronze rod bearing which is pressed into the cylinder head.

10 Acorn Nut: Tie rod threads are covered by stainless steel acorn nuts which eliminates a bacteria hiding place.

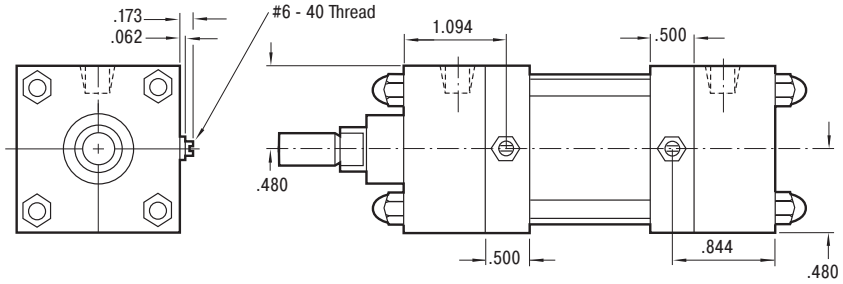
Optional Features

Cushions and bumpers are features also available on our 1 1/8" bore.

Cushions permit the trapping of cylinder exhaust volume prior to the completion of full rod extension or retraction. This volume is then metered through a finely tapered needle to deliver smooth, adjustable deceleration of the cylinder load.

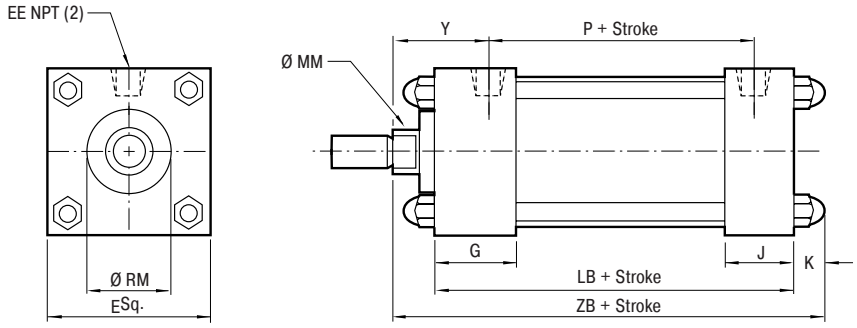
Note: Cushion block increases stroke related dimensions by .500 per end.

Cushions are not available on 1 1/8" bore with 1/2" diameter rod.



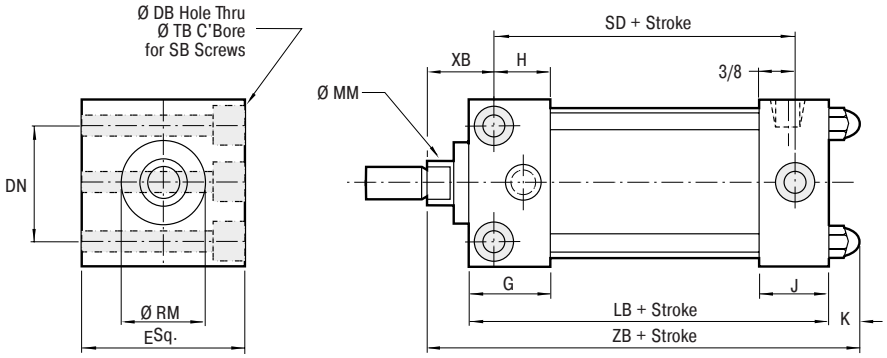
No Mount Basic
Style T
(NFPA MX0)





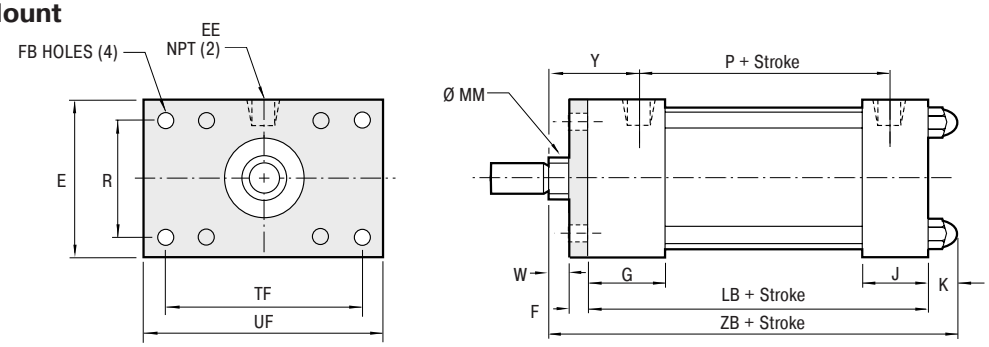
Bolt Through Mount
Style C
(NFPA MS8)





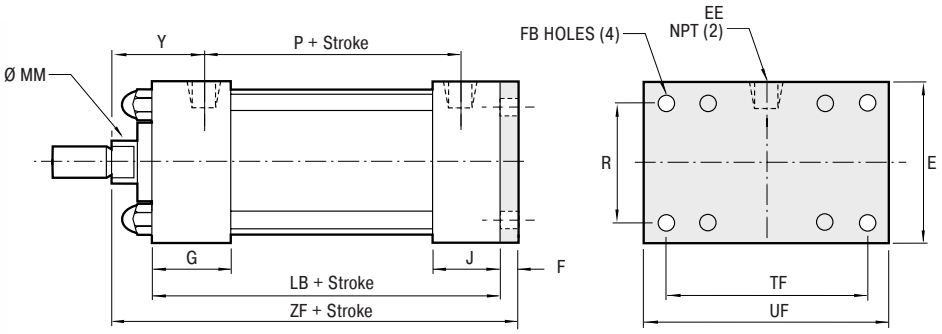
Head Rectangular Flange Mount
Style J
(NFPA MF7)





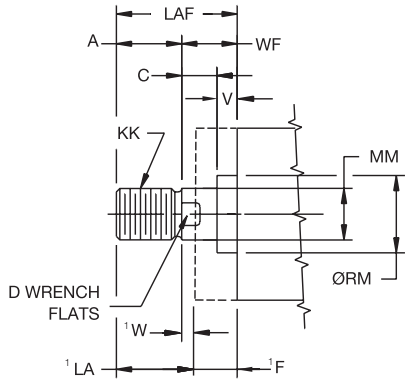
Cap Rectangular Flange Mount
Style H
(NFPA MF2)





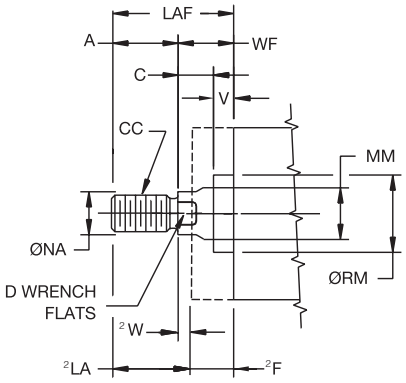
Rod End Dimensions

Thread Style 6
(NFPA Style FM)
Full Male



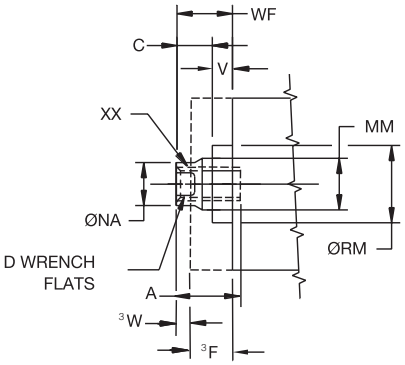
[1] FOR J (MF7) MOUNT ONLY

Thread Style 8
(NFPA Style IM)
Intermediate Male



[2] FOR J (MF7) MOUNT ONLY

Thread Style 9
(NFPA Style SF)
Short Female



[3] FOR J (MF7) MOUNT ONLY

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

Table 1 – Envelope & Mounting Dimensions

Bore	C	DB	DN	E	EE	FB	G	H	J
1 1/8	1/4	13/64	1	1 1/2	1/8	7/32	7/8	5/8	5/8

								Add Stroke		
Bore	K	R	TB	TF	UF	V	XB	SD	ZB	ZF
1 1/8	13/32	1	21/64	2	2 1/2	1/8	5/8	1 3/4	2 5/8	2 7/8

Table 2 – Rod Dimensions

Bore Size	Rod No.	Rod Dia. MM	Thread Style 6 KK	Thread Style 8 CC	Thread Style 9 XX	A	D	LAF	RM	SB	WF	Y	Add Stroke LB	Add Stroke P
1 1/8	1	3/8	3/8-24	5/16-24	1/4-28	5/8	5/16	1	.750	#10	3/8	15/16	2 1/4	1 3/8
	3	1/2	1/2-20	7/16-20	3/8-24	3/4	7/16	1 1/8	1.000	#10	3/8	15/16	2 1/4	1 3/8

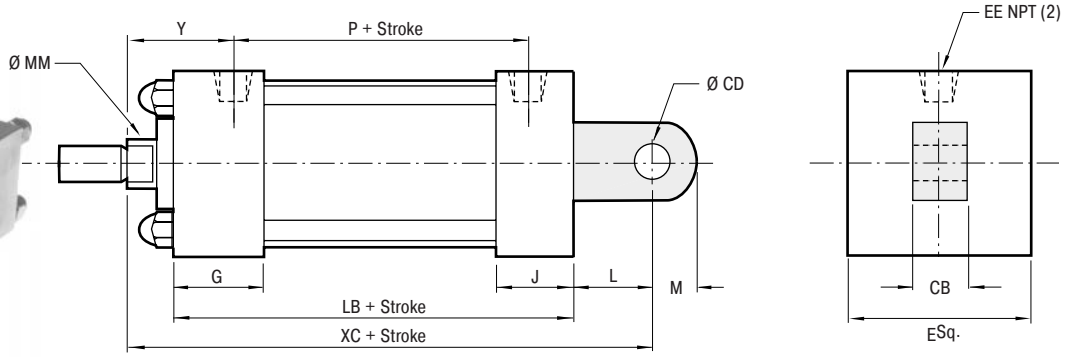
Table 3 – Envelope and Mounting Dimensions

For J (MF7) Mount Only

Bore Size	Rod No.	Rod Dia. MM	F	W	LA
1 1/8	1	3/8	1/4	1/8	3/4
	3	1/2	1/4	1/8	7/8

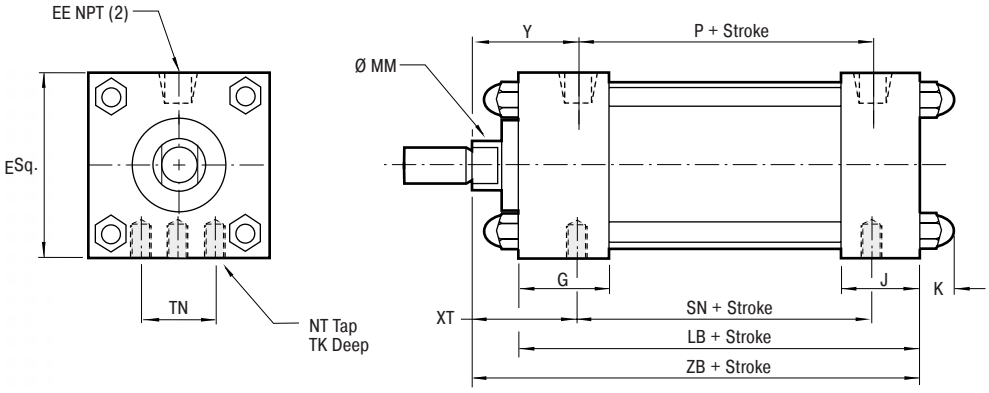
Fixed Eye Mount
Style BE
(NFPA MP3)





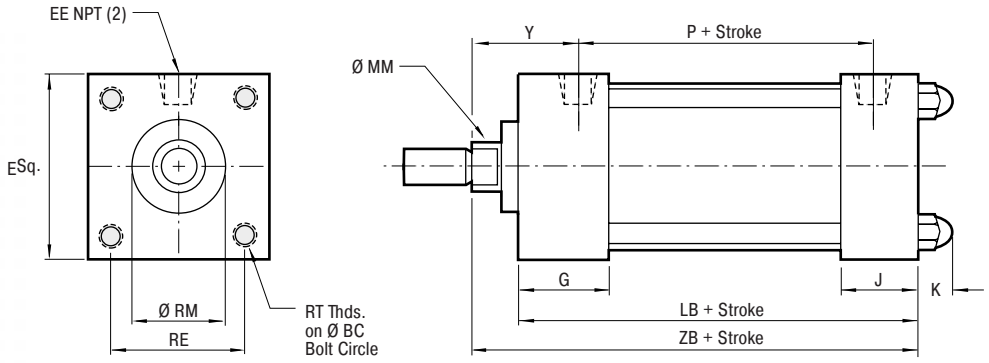
Side Tap Mount
Style F
(NFPA MS9)





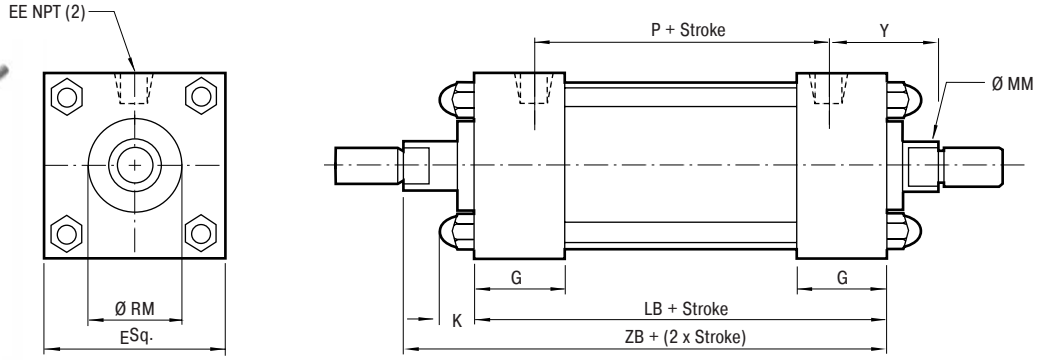
Head Face Mount
Style TE
(NFPA MR1)





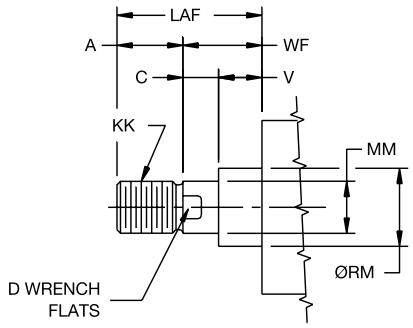
Double Rod End
Style KT
(NFPA MDX0)



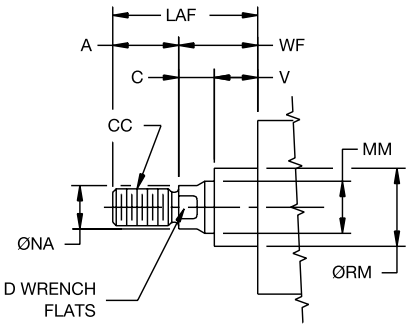


Rod End Dimensions

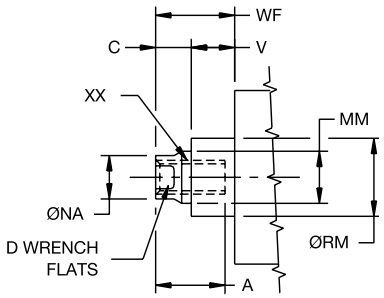
Thread Style 6
(NFPA Style FM)
Full Male



Thread Style 8
(NFPA Style IM)
Intermediate Male



Thread Style 9
(NFPA Style SF)
Short Female



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

Table 1 – Envelope & Mounting Dimensions

Bore	BC	C	CB	CD	E	EE	G	J	K	L
1 1/8	1 19/32	1/4	.375	.375	1 1/2	1/8	7/8	5/8	13/32	7/16

										Add Stroke		
Bore	M	NT	RE	RT	TK	TN	V	XT	Y	SN	XC	ZB*
1 1/8	3/8	10-32	1 1/8	10-32	1/4	1	1/8	5/8	15/16	1 3/4	3 1/16	2 5/8

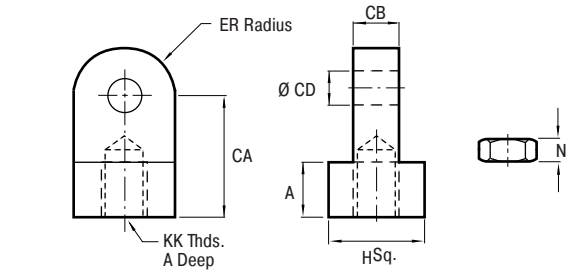
*ZB dimension for double rod cylinder is 3 1/4 + 2 x stroke

Table 2 – Rod Dimensions

Bore Size	Rod. No.	Rod Dia. MM	Style 6 KK	Style 8 CC	Style 9 XX	A	D	LAF	RM	WF	Add Stroke LB	Add Stroke P
1 1/8	1	3/8	3/8-24	5/16-24	1/4-28	5/8	5/16	1	.750	3/8	2 1/4	1 3/8
	3	1/2	1/2-20	7/16-20	3/8-24	3/4	7/16	1 1/8	1.000	3/8	2 1/4	1 3/8

Table 3 – Envelope and Mounting Dimensions

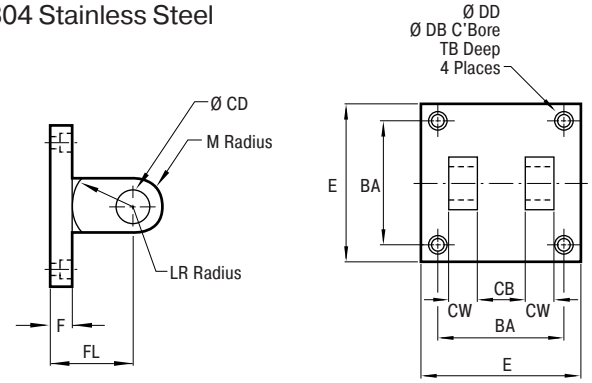
Rod Eye
303 Stainless Steel



	1492220037	1492220050
A	7/16	7/16
CA	7/8	7/8
CB	3/8	3/8
CD	0.375	0.375
ER	3/8	3/8
H	3/4	3/4
KK	3/8-24	1/2-20
N	7/32	5/16

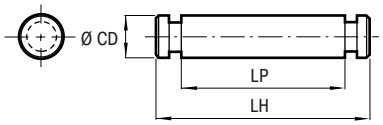
Includes Jam Nut

Clevis Bracket
304 Stainless Steel



	1492230050
BA	1 1/8
CB	3/8
CD	0.375
CW	1/4
DB	21/64
DD	13/64
E	1 1/2
F	1/2
FL	1 1/8
LR	5/8
M	3/8
TB	1/4

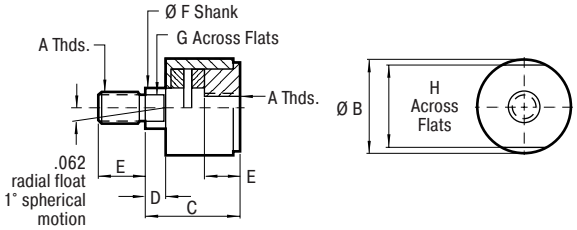
Pivot Pin
303 Stainless Steel



	0875600050
CD	0.375
LH	1 1/4
LP	1 1/32

Use with 1449220037,
1449220050, 1492230050

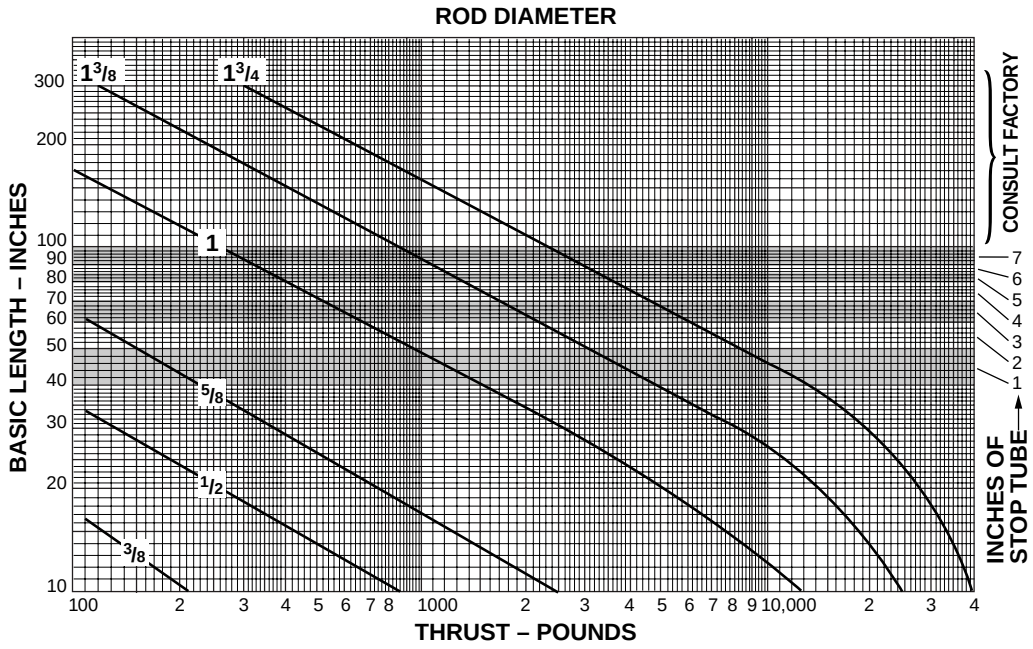
Rod Alignment Coupler



	1492240050
A	3/8-24
B	1 1/8
C	1 3/4
D	3/8
E	1/2
F	1/2
G	3/8
H	11/16
Maximum Pull (lbs.)	886

Made of 303 Stainless Steel, the Rod Alignment Coupler allows 1/16" of radial float and 1° of spherical movement. This prevents cylinder binding due to misalignment thus extending bearing and seal life, and permits greater tolerance between the center line of the cylinder and mating part for simplified installation.

Piston Rod – Stroke Selection Chart



How To Use The Chart

The selection of a piston rod for thrust (push) conditions requires the following steps:

1. Determine the type of cylinder mounting style and rod end connection to be used. Then consult the chart below and find the "stroke factor" that corresponds to the conditions used.
2. Using this stroke factor, determine the "basic length" from the equation:

   Basic Length = Actual Stroke x Stroke Factor

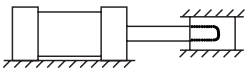
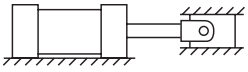
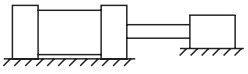
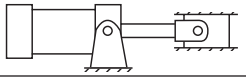
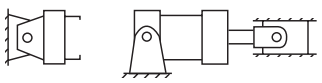
   The graph is prepared for standard rod extensions beyond the face of the gland retainer. For rod extensions greater than standard, add the increase to the stroke in arriving at the "basic length."
3. Find the load imposed for the thrust application by multiplying the full bore area of the cylinder by the system pressure.
4. Enter the graph along the values of "basic length" and "thrust" as found above and note the point of intersection:

a) The correct piston rod size is read from the diagonally curved line labeled "Rod Diameter" next *above* the point of intersection.

b) The required length of stop tube is read from the right of the graph by following the shaded band in which the point of intersection lies.

c) If required length of stop tube is in the region labeled "consult factory," submit the following information for an individual analysis.

   1) Cylinder mounting style.
   2) Rod end connection and method of guiding load.
   3) Bore, required stroke, length of rod extension (Dim. "LA") if greater than standard, and series of cylinder used.
   4) Mounting position of cylinder. (Note: if at an angle or vertical, specify direction of piston rod.)
   5) Operating pressure of cylinder if limited to less than standard pressure for cylinder selected.

Recommended Mounting Styles for Maximum Stroke and Thrust Loads	Rod End Connection	Case	Stroke Factor
Groups 1 or 3 Long stroke cylinders for thrust loads should be mounted using a heavy-duty mounting style at one end, firmly fixed and aligned to take the principal force. Additional mounting should be specified at the opposite end, which should be used for alignment and support. An intermediate support may also be desirable for long stroke cylinders mounted horizontally.	FIXED AND RIGIDLY GUIDED	I 	.50
	PIVOTED AND RIGIDLY GUIDED	II 	.70
	SUPPORTED BUT NOT RIGIDLY GUIDED	III 	2.00
Group 2 Style D-Trunnion on Head	PIVOTED AND RIGIDLY GUIDED	IV 	1.00
Style DB-Trunnion on Cap or Style BB-Clevis on Cap	PIVOTED AND RIGIDLY GUIDED	V 	2.00

Global Drop-In Solid State Switches

Wiring	PNP Switch	NPN Switch	PNP Switch ATEX Certified	PNP Switch High Temperature
3m Flying Leads	P8S-GPFAX	P8S-GNFAX	P8S-GPFLX/EX[1]	P8S-GPFLH[2]
10m Flying Leads	P8S-GPFDX	P8S-GNFDX	N/A	N/A
0.3m Lead with 8mm Connector	P8S-GPCHX	P8S-GNCHX		

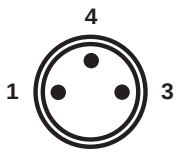
[1] ATEX switch is supplied with 2m Flying Leads. [2] High Temperature switch is not UL Listed.

Specifications

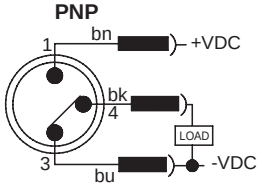
Switch Classification	Standard PNP or NPN	ATEX Certified PNP	High Temperature PNP
Type	Electronic	Electronic	Electronic
Output Function	Normally Open	Normally Open	Normally Open
Switch Output	PNP/NPN	PNP	PNP
Operating Voltage	10 - 30VDC	18 - 30VDC	10 - 30VDC
Continuous Current	100 mA max.	70 mA max.	200 mA max.
Magnetic Field Sensitivity	2.65 - 2.95mT	2.65 - 2.95mT	25 Gauss
Switching Frequency	5 kHz	1 kHz	10 KHz
Power Consumption	10 mA max.	10 mA max.	15 mA max.
Voltage Drop	2.2 VDC max.	2.2 VDC max.	3.1 VDC max.
Ripple	10% of Operating Voltage	10% of Operating Voltage	15% of Operating Voltage
Hysteresis	1.5 mm max.	1.5 mm max.	1.5 mm max.
Repeatability	0.1 mm max.	0.1 mm max.	0.1 mm max.
EMC	EN 60 947-5-2	EN 60 947-5-2	EN 60 947-5-2
Short-circuit Protection	Yes	Yes	Yes
Power-up Pulse Suppression	Yes	Yes	Yes
Reverse Polarity Protection	Yes	Yes	Yes
Enclosure Rating	IP67	IP68	IP67
Shock and Vibration Stress	30g, 11 ms, 10 to 55Hz, 1 mm	30g, 11 ms, 10 to 55Hz, 1 mm	30g, 11 ms, 10 to 55Hz, 1 mm
Operating Temperature Range	-25°C to +75°C (-13°F to +167°F)	-20°C to +45°C (-4°F to +113°F)	-25°C to +105°C (-13°F to +221°F)
Housing Material	PA 12 Black	PA 12 Black	Aluminum
Connector Cable	PUR	PVC	PUR
Connector	PUR	–	–
Approval for ATEX	–	3D/3G	–

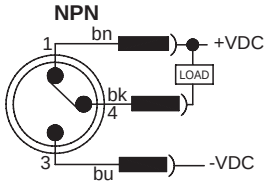
Global solid state switch outputs may be influenced by an external magnetic field. Care must be taken to avoid external magnetic field exposure.

Solid State Switch – Wiring Connection
Flying Lead or 8 mm Connector



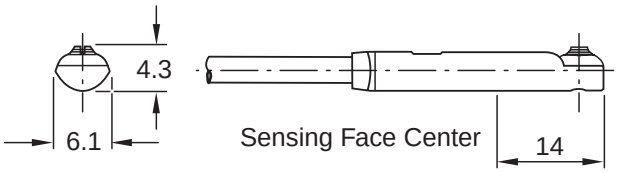
Pin	Wire	Function
1	Brown	Operating Voltage (+VDC)
4	Black	Output signal (N.O.)
3	Blue	-VDC





Global Drop-In Reed Switches

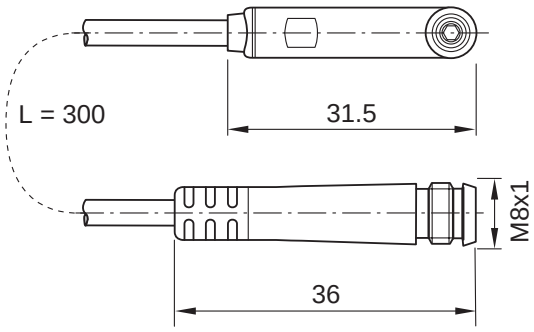
Wiring	Reed Switch
3m Flying Leads	P8S-GRFAX
10m Flying Leads	P8S-GRFDX
0.3m Lead with 8mm Connector	P8S-GRCHX



Specifications

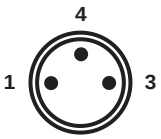
Type ..... 2-Wire Reed
Output Function ..... Normally Open
Operating Voltage ..... 10 - 30 VDC
Switching Power..... 10 W
Continuous Current ..... 100 mA max.
Response Sensitivity ..... 2.1 - 3.4mT
Switching Frequency ..... 400 Hz
Voltage Drop ..... 2.2 V max.
Ripple ..... 10% of Operating Voltage
Hysteresis..... 1.5 mm max.
Repeatability..... 0.2 mm max.
EMC ..... EN 60 947-5-2
Reverse Polarity Protection..... Yes
Enclosure Rating ..... IP 67
Shock and Vibration Stress..... 30g, 11 ms, 10 to 55 Hz, 1 mm
Operating Temperature Range... -25°C to +75°C (-13°F to 167°F)
Housing Material ..... PA 12 Black
Connector Cable ..... PUR
Connector ..... PUR

Global Reed Switch output may be influenced by external magnetic fields. Care must be taken to avoid external magnetic field exposure.



Reed Switch – Wiring Connection

Flying Lead or 8 mm Connector

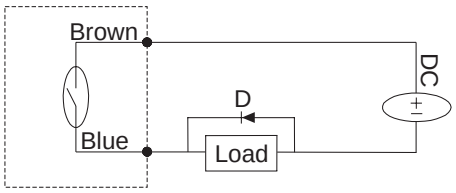


Pin	Wire	Function
1	Brown	Operating Voltage (+V)
4	Black	Not Used
3	Blue	Output Signal (-V or Ground)

Circuit for Switching Contact Protection (Inductive Loads)

(Required for proper operation 24V DC)

Put Diode parallel to loads following polarity as shown below.



D: Diode: select a Diode with the breakdown voltage and current rating according to the load.

Typical Example – 100 Volt, 1 Amp Diode

CR: Relay coil (under 0.5W coil rating)

⚠Caution

– Use an ampmeter to test reed switch current. Testing devices such as incandescent light bulbs may subject the reed sensor to high in-rush loads.

– **NOTE:** When checking an unpowered reed switch for continuity with a digital ohmmeter the resistance reading will change from infinity to a very large resistance (2 M ohm) when the sensor is activated. This is due to the presence of a diode in the reed switch.

– Anti-magnetic shielding is recommended for reed switches exposed to high external RF or magnetic fields.

– The magnetic field strength of the piston magnet is designed to operate with our switches. Other manufacturers' switches may not operate correctly in conjunction with these magnets.

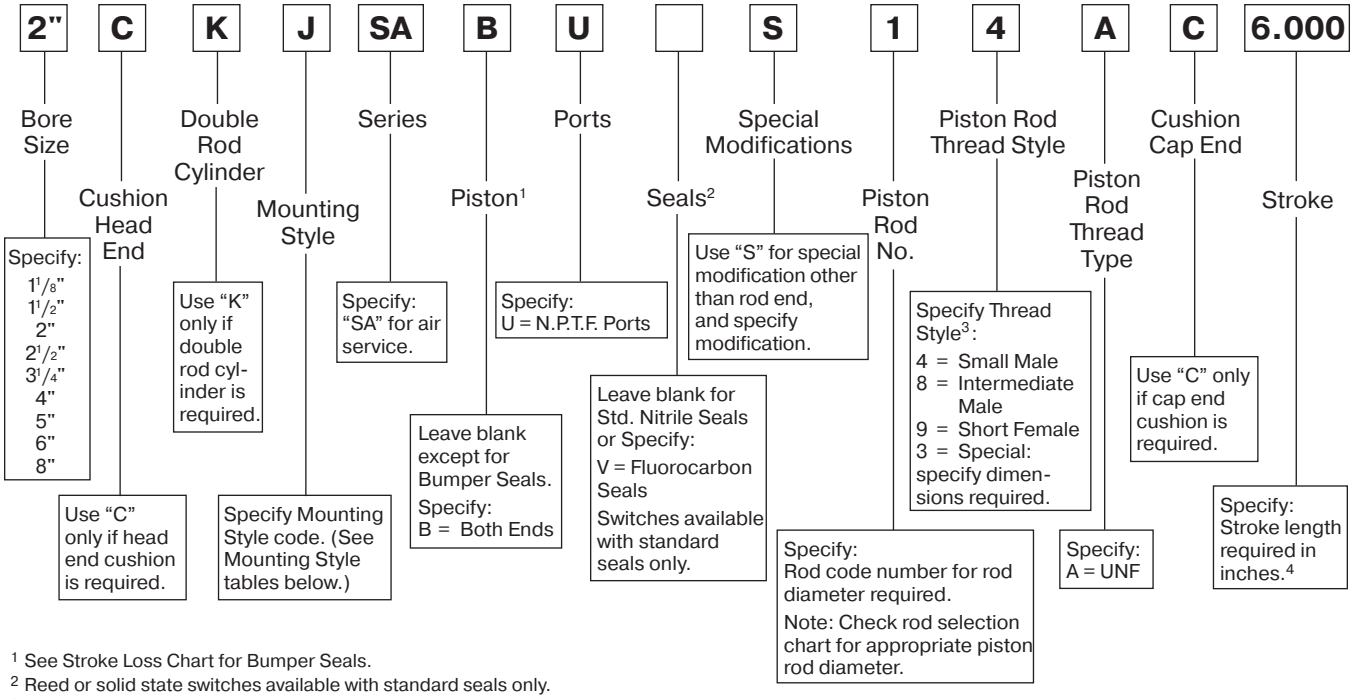
– Use relay coils for reed switch contact protection.

– Switches with long wire leads (greater than 15 feet) can cause capacitance build-up and sticking will result. Attach a resistor in series with the reed switches (the resistor should be installed as close as possible to the switches). The resistor should be selected such that R (ohms) >E/0.3.

– Global reed switch outputs may be influenced by an external magnetic field. Care must be taken to avoid external magnetic field exposure.

How to Order Series SA Cylinders

Parker Series SA pneumatic cylinders can be specified by model number by using the table below.



[1] See Stroke Loss Chart for Bumper Seals.
[2] Reed or solid state switches available with standard seals only.
[3] For 1 1/8" Bore Rod thread 4 not available, Rod thread 6 is full male option.
[4] In case of stop tube, call out gross stroke length (net stroke + stop tube length).

Cylinder Mounting Styles - 1 1/8" Bore

Mounting Style Code	N.F.P.A. Style	Mounting Description
T	MX0	No Mount (Basic)
C	MS8	Bolt Through
F	MS9	Side Tapped
TE	MR1	Head Face
J	MF7	Head Rectangular Flange
H	MF2	Cap Rectangular Flange
BE	MP3	Cap Fixed Eye

Cylinder Mounting Styles - 1 1/2" - 8" Bores

Mounting Style Code	N.F.P.A. Style	Mounting Description
T	MX0	No Mount (Basic)
F	MS4	Side Tapped
J	MF1	Head Rect. Flange (1 1/2"-8")
H	MF2	Cap Rect. Flange (1 1/2"-8")
D	MT1	Head Trunnion
DB	MT2	Cap Trunnion
BB	MP1	Cap Fixed Clevis
JB	ME3	Head Square (8" only)
HB	ME4	Cap Square (8" only)

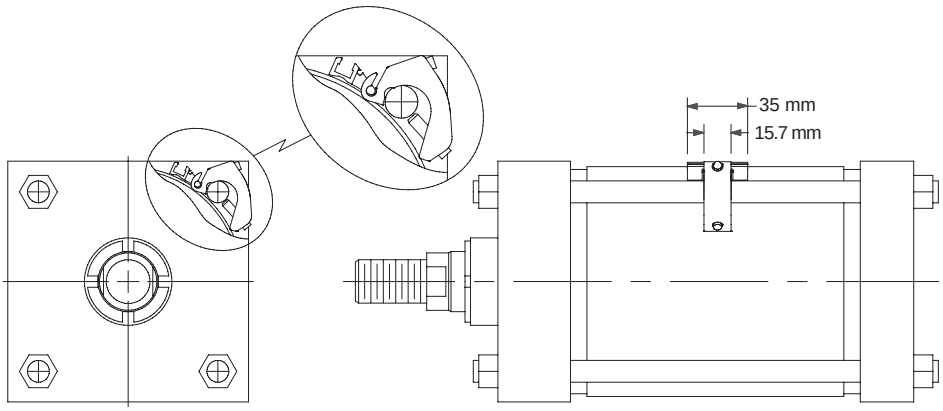
How to Order Schrader Bellows Series SA Cylinders with Switches

Switches are not mounted to the cylinder prior to shipment. When ordering a cylinder to accommodate a switch:

1. Derive a proper model number as shown in the table above.
2. Place an "S" in the special modification column of the model number.
3. Underneath the model number specify:
    1) Cylinder prepared for switch.
    2) If switches and switch bracket are required specify the switch part number from the Switch Pages, the required bracket part number P8S-TMA0X and the quantity required for each.

Tie Rod Bracket Assembly Part Number and Dimensions

Global switches and bracket assembles must be ordered separately.



Cordsets – 8mm Cordset for Global Switches 8mm Cordset with Female Quick Connect

A female connector is available for all sensors with the male 8mm quick connect option. The male plug will accept a snap-on or threaded connector. Cordset part numbers are listed at right.

Cable Length	Threaded Connector	Snap On Connector
5 meters	086620T005	086620S005
2 meters	086620T002	086620S002

Optional Piston Bumper Seals

Impact dampening Piston Bumper Seals are optional on Series SA cylinders from 1 1/8" through 8" bore. Piston Bumper Seals have a minimum effect on stroke length. The Stroke Loss Chart below gives typical overall stroke loss at various system pressures.

To determine the stroke loss at either end of the cylinder, divide the values by two. Bumper Seals are only available on both sides of the piston.

Stroke Loss Chart

Bore	0 PSI	20 PSI	40 PSI	60 PSI	80 PSI	100 PSI
1 1/8"	.12	.08	.06	.03	.02	0
1 1/2"[1]	.12	.04	.03	.02	.01	0
2"	.12	.10	.06	.03	.02	0
2 1/2"	.16	.10	.08	.04	.02	0
3 1/4"	.18	.10	.08	.04	.02	0
4"	.20	.14	.10	.06	.02	0
5"	.22	.14	.10	.06	.02	0
6"	.28	.20	.13	.07	.03	0
8"	.32	.22	.14	.08	.04	0

[1] Piston Bumper Seals are not available 1½" bore with rod code 2.

Notes

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

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

3.2 Mounting Recommendations

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

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

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

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

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

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

4.0 Cylinder and Accessories Maintenance, Troubleshooting and Replacement

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

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

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

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

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

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

4.2 Cylinder Trouble Shooting

4.2.1 – **External Leakage**

4.2.1.1 – Rod seal leakage can generally be traced to worn or damaged seals. Examine the piston rod for dents, gouges or score marks, and replace piston rod if surface is rough.

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

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

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

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

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

4.2.2 – **Internal Leakage**

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

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

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

4.2.3 – **Cylinder Fails to Move the Load**

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

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

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

4.3 Erratic or Chatter Operation

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

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 Hydraulic Actuator Division Engineering Department must be notified in the event of a mechanical fracture or permanent deformation of any cylinder component (excluding seals). This includes a broken piston rod, tie rod, mounting accessory or any other cylinder component. The notification should include all operation and application details. This information will be used to provide an engineered repair that will prevent recurrence of the failure.

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

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. All sales of Products by Seller will be governed by, and are expressly conditioned upon Buyer's assent to, these Terms. These Terms are incorporated into any Quote provided by Seller to Buyer. Buyer's order for any Products whether communicated to Seller verbally, in writing, by electronic data interface or other electronic commerce, shall constitute acceptance of these Terms. Seller objects to any contrary or additional terms or conditions of Buyer. Reference in Seller's order acknowledgement to Buyer's purchase order or purchase order number shall in no way constitute an acceptance of any of Buyer's terms or conditions of purchase. Any Quote made by Seller to Buyer shall be considered a firm and definite offer and shall not be deemed to be otherwise despite any language on the face of the Quote. Seller reserves all rights to accept or reject any purported acceptance by Buyer to Seller's Quote if such purported acceptance attempts to vary the terms of the Quote. If Seller ships Products after Buyer issues an acceptance to the Quote, any additional or different terms proposed by Buyer will not become part of the parties' business relationship unless agreed to in a writing that is signed by an authorized representative of Seller, excluding email correspondence. If the transaction proceeds without such agreement on the part of Seller, the business relationship will be governed solely by these Terms and the specific terms in Seller's Quote.

2. Price; Payment. The Products set forth in the Quote are offered for sale at the prices indicated in the Quote. Unless otherwise specifically stated in the Quote, prices are valid for thirty (30) days and do not include any sales, use, or other taxes or duties. Seller reserves the right to modify prices for any reason and at any time by giving ten (10) days prior written notice. Unless otherwise specified by Seller, all prices are F.C.A. Seller's facility (INCOTERMS 2020). All sales are contingent upon credit approval and full payment for all purchases is due thirty (30) days from the date of invoice (or such date as may be specified in the Quote). Under any circumstances, Buyer may not withhold or suspend payment of any amounts due and payable as a deduction, set-off or recoupment of any amount, claim or dispute with Seller. Unpaid invoices beyond the specified payment date incur interest at the rate of 1.5% per month or the maximum allowable rate under applicable law. Seller reserves the right to require advance payment or provision of securities for first and subsequent deliveries if there is any doubt, in Seller's sole determination, regarding the Buyer's creditworthiness or for other business reasons. If the requested advance payment or securities are not provided to Seller's satisfaction, Seller reserves the right to suspend performance or reject the purchase order, in whole or in part, without prejudice to Seller's other rights or remedies, including the right to full compensation. Seller may revoke or shorten any payment periods previously granted in Seller's sole determination. The rights and remedies herein reserved to Seller are cumulative and in addition to any other or further rights and remedies available at law or in equity. No waiver by Seller of any breach by Buyer of any provision of these terms will constitute a waiver by Seller of any other breach of such provision.

3. Shipment; Delivery; Title and Risk of Loss. All delivery dates are approximate, and Seller is not responsible for damages or additional costs resulting from any delay. All deliveries are subject to our ability to procure materials from our suppliers. Regardless of the manner of shipment, delivery occurs and title and risk of loss or damage pass to Buyer, upon placement of the Products with the carrier at Seller's facility. Unless otherwise agreed prior to shipment and for domestic delivery locations only, Seller will select and arrange, at Buyer's sole expense, the carrier and means of delivery. When Seller selects and arranges the carrier and means of delivery, freight and insurance costs for shipment to the designated delivery location will be prepaid by Seller and added as a separate line item to the invoice. Buyer shall be responsible for any additional shipping charges incurred by Seller due to Buyer's acts or omissions. Buyer shall not return or repackage any Products without the prior written authorization from Seller, and any return shall be at the sole cost and expense of Buyer.

4. Warranty. The warranty for the Products is as follows: (i) Goods are warranted against defects in material or workmanship for a period of eighteen (18) months from the date of delivery or 2,000 hours of use, whichever occurs first; (ii) Services shall be performed in accordance with generally accepted practices and using the degree of care and skill that is ordinarily exercised and customary in the field to which the Services pertain and are warranted for a period of six (6) months from the date of completion of the Services; and (iii) Software is only warranted to perform in accordance with applicable specifications provided by Seller to Buyer for ninety (90) days from the date of delivery or, when downloaded by a Buyer or end-user, from the date of the initial download. All prices are based upon the exclusive limited warranty stated above, and upon the following disclaimer: **EXEMPTION CLAUSE; DISCLAIMER OF WARRANTY, CONDITIONS, REPRESENTATIONS: THIS WARRANTY IS THE SOLE AND ENTIRE WARRANTY, CONDITION, AND REPRESENTATION, PERTAINING TO PRODUCTS. SELLER DISCLAIMS ALL OTHER WARRANTIES, CONDITIONS, AND REPRESENTATIONS, WHETHER STATUTORY, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THOSE RELATING TO DESIGN, NONINFRINGEMENT, MERCHANTABILITY, AND FITNESS FOR A PARTICULAR PURPOSE. SELLER DOES NOT WARRANT THAT THE SOFTWARE IS ERROR-FREE OR FAULT-TOLERANT, OR THAT BUYER'S USE THEREOF WILL BE SECURE OR UNINTERRUPTED, UNLESS OTHERWISE AUTHORIZED IN WRITING BY SELLER, THE SOFTWARE SHALL NOT BE USED IN CONNECTION WITH HAZARDOUS OR HIGH-RISK ACTIVITIES OR ENVIRONMENTS. EXCEPT AS EXPRESSLY STATED HEREIN, ALL PRODUCTS ARE PROVIDED "AS IS".**

5. Claims; Commencement of Actions. Buyer shall promptly inspect all Products upon receipt. No claims for shortages will be allowed unless reported to Seller within ten (10) days of delivery. Buyer shall notify Seller of any alleged breach of warranty within thirty (30) days after the date the non-conformance is or should have been discovered by Buyer. Any claim or action against Seller based upon breach of contract or any other theory, including tort, negligence, or otherwise must be commenced within twelve (12) months from the date of the alleged breach or other alleged event, without regard to the date of discovery.

6. LIMITATION OF LIABILITY. IN THE EVENT OF A BREACH OF WARRANTY, SELLER WILL, AT ITS OPTION, REPAIR OR REPLACE THE NON-CONFORMING PRODUCTS, RE-PERFORM THE SERVICES, OR REFUND THE PURCHASE PRICE PAID WITHIN A REASONABLE PERIOD OF TIME. IN NO EVENT IS SELLER LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES INCLUDING ANY LOSS OF REVENUE OR PROFITS, WHETHER BASED IN CONTRACT, TORT OR OTHER LEGAL THEORY. IN NO EVENT SHALL SELLER'S LIABILITY UNDER ANY CLAIM MADE BY BUYER EXCEED THE PURCHASE PRICE PAID FOR THE PRODUCTS.

7. Confidential Information. Buyer acknowledges and agrees that Confidential Information has been and will be received in confidence and will remain the property of Seller. Buyer further agrees that it will not use Seller's Confidential Information for any purpose other than for the benefit of Seller and shall return all such Confidential Information to Seller within thirty (30) days upon request.

8. Loss to Buyer's Property. Buyer's Property will be considered obsolete and may be destroyed by Seller after two (2) consecutive years have elapsed without Buyer ordering the Products manufactured using Buyer's Property. Also, Seller shall not be responsible for any loss or damage to Buyer's Property while it is in Seller's possession or control.

9. Special Tooling. Seller may impose a tooling charge for any Special Tooling. Special Tooling shall be and remain Seller's property. In no event will Buyer acquire any interest in the Special Tooling, even if such Special Tooling has been specially converted or adapted for manufacture of Goods for Buyer and notwithstanding any charges paid by Buyer. Unless otherwise agreed, Seller has the right to alter, discard or otherwise dispose of any Special Tooling or other property owned by Seller in its sole determination at any time.

10. Security Interest. To secure payment of all sums due from Buyer, Seller retains a security interest in all Products delivered to Buyer and, Buyer's acceptance of these Terms is deemed to be 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 Seller's security interest.

11. User Responsibility. Buyer, through its own analysis and testing, is solely responsible for making the final selection of the Products and assuring that all performance, endurance, maintenance, safety and warning requirements of the application of the Products are met. Buyer must analyze all aspects of the application and follow applicable industry standards, specifications, and any technical information provided with the Quote or the Products, such as Seller's instructions, guides and specifications. If Seller provides options of or for Products based upon data or specifications provided by Buyer, Buyer is responsible for determining that such data and specifications are suitable and sufficient for all applications and reasonably foreseeable uses of the Products. In the event Buyer is not the end-user of the Products, Buyer will ensure such end-user complies with this paragraph.

12. Use of Products, Indemnity by Buyer. Buyer shall comply with all instructions, guides and specifications provided by Seller with the Quote or the Products. If Buyer uses or resells the Products in any way prohibited by Seller's instructions, guides or specifications, or Buyer otherwise fails to comply with Seller's instructions, guides and specifications, Buyer acknowledges that any such use, resale, or non-compliance is at Buyer's sole risk. Further, Buyer shall indemnify, defend, and hold Seller harmless from any losses, claims, liabilities, damages, lawsuits, judgments and costs (including attorney fees and defense costs), whether for personal injury, property damage, intellectual property infringement or any other claim, arising out of or in connection with: (a) improper selection, design, specification, application, or any misuse of Products; (b) any act or omission, negligent or otherwise, of Buyer; (c) Seller's use of Buyer's Property; (d) damage to the Products from an external cause, repair or attempted repair by anyone other than Seller, failure to follow instructions, guides and specifications provided by Seller, use with goods not provided by Seller, or opening, modifying, deconstructing, tampering with or repackaging the Products; or (e) Buyer's failure to comply with these Terms, including any legal or administrative proceedings, collection efforts, or other actions arising from or relating to such failure to comply. Seller shall not indemnify Buyer under any circumstance except as otherwise provided in these Terms.

13. Cancellations and Changes. Buyer may not cancel or modify, including but not limited to movement of delivery dates for the Products, any order 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 and any additional expense. Seller, at any time, may change features, specifications, designs and availability of Products.

14. Assignment. Buyer may not assign its rights or obligations without the prior written consent of Seller.

15. Force Majeure. Seller is not liable for delay or failure to perform any of its obligations by reason of any events or circumstances beyond its reasonable control. Such circumstances include without limitation: accidents, labor disputes or stoppages, government acts or orders, acts of nature, pandemics, epidemics, other widespread illness, or public health emergency, cyber related disruptions, cyber-attacks, ransomware sabotage, delays or failures in delivery from carriers or suppliers, shortages of materials, sudden increases in the price of raw material or components, shutdowns or slowdowns affecting the supply of raw materials or components, or the transportation thereof, oil shortages or oil price increases, energy crisis, energy or fuel interruption, war (whether declared or not) or the serious threat of same, riots, rebellions, acts of terrorism, embargoes, fire or any reason whether similar to the foregoing or otherwise. Seller will resume performance as soon as practicable after the event of force majeure has been removed. All delivery dates affected by an event of force majeure shall be tolled for the duration of such event of force majeure and rescheduled for mutually agreed dates as soon as practicable after the event of force majeure ceases to exist. The right to allocate capacity is in the Seller's sole discretion. An event of force majeure shall not include financial distress, insolvency, bankruptcy, or other similar conditions affecting one of the parties, affiliates and/or sub¬contractors. An event of force majeure in the meaning of these Terms means any circumstances beyond Seller's control that permanently or temporarily hinders performance, even where that circumstance was already foreseen. Buyer shall not be entitled to cancel any orders following its claim of an event of force majeure.

16. Waiver and Severability. Failure to enforce any provision of these Terms will not invalidate that provision; nor will any such failure prejudice either party's right to enforce that provision in the future. Invalidation of any provision of these Terms shall not invalidate any other provision herein and, the remaining provisions will remain in full force and effect.

17. Duration. Unless otherwise stated in the Quote, any agreement governed by or arising from these Terms shall: (a) be for an initial duration of one (1) year; and (b) shall automatically renew for successive one-year terms unless terminated by Buyer with at least 180-days written notice to Seller or if Seller terminates the agreement pursuant to Section 19 of these Terms.

18. Termination. Seller may, without liability to Buyer, terminate any agreement governed by or arising from these Terms for any reason and at any time by giving Buyer thirty (30) days prior written notice. Seller may immediately terminate, in writing, if Buyer: (a) breaches any provision of these Terms, (b) becomes or is deemed insolvent, (c) appoints or has appointed a trustee, receiver or custodian for all or any part of Buyer's property,(d) files a petition for relief in bankruptcy on its own behalf, or one is filed against Buyer by a third party, (e) makes an assignment for the benefit of creditors; or (f) dissolves its business or liquidates all or a majority of its assets.

19. Ownership of Rights. Buyer agrees that (a) Seller (and/or its affiliates) owns or is the valid licensee of Seller's IP and (b) the furnishing of information, related documents or other materials by Seller to Buyer does not grant or transfer any ownership interest or license in or to Seller's IP to Buyer, unless expressly agreed in writing. Without limiting the foregoing, Seller retains ownership of all Software supplied to Buyer. In no event shall Buyer obtain any greater right in and to the Software than a right in a license limited to the use thereof and subject to compliance with any other terms provided with the Software. Buyer further agrees that it will not, directly or through intermediaries, reverse engineer, decompile, or disassemble any Software (including firmware) comprising or contained within a Product, except and only to the extent that such activity may be expressly permitted, either by applicable law or, in the case of open source software, the applicable open source license.

20. Indemnity for Infringement of Intellectual Property Rights. Seller is not liable for infringement of any Intellectual Property Rights except as provided in this Section. 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 a third-party claim that one or more of the Products infringes the Intellectual Property Rights of a third party in the country of delivery of the Products by Seller to Buyer. Seller's obligation to defend and indemnify Buyer is contingent on Buyer notifying Seller within ten (10) days after Buyer becomes aware of any such claim, and Seller having sole control over the defense of the claim including all negotiations for settlement or compromise. If one or more Products is subject to such a claim, Seller may, at its sole expense and option, procure for Buyer the right to continue using the Products, replace or modify the Products to render them non-infringing, or offer to accept return of the Products and refund the purchase price less a reasonable allowance for depreciation. Seller has no obligation or liability for any claim of infringement: (i) arising from information provided by Buyer (including Seller's use of Buyer's Property); or (ii) directed to any Products for which the designs are specified in whole or part by Buyer; or (iii) resulting from the modification, combination or use in a system of any Products. The foregoing provisions of this Section constitute Seller's sole and exclusive liability and Buyer's sole and exclusive remedy for claims of infringement of Intellectual Property Rights.

21. Governing Law. These Terms, the terms of any Quote, and the sale and delivery of all Products are 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 the sale and delivery of the Products.

22. Entire Agreement. These Terms, along with the terms set forth in the Quote, forms the entire agreement between the Buyer and Seller and constitutes the final, complete and exclusive expression of the terms of sale and purchase. In the event of a conflict between any term set forth in the Quote and these Terms, the terms set forth in the Quote shall prevail. All prior or contemporaneous written or oral agreements or negotiations with respect to the subject matter shall have no effect. No modification to these Terms will be binding on Seller unless agreed to in a writing that is signed by an authorized representative of Seller, excluding email correspondence, 'clickwrap' or other purported electronic assent to different or additional terms. Sections 2-25 of these Terms shall survive termination or cancellation of any agreement governed by or arising from these Terms.

23. No 'Wrap' Agreements/No Authority to Bind. Seller's clicking any buttons or any similar action, such as clicking "I Agree" or "Confirm," to utilize Buyer's software or webpage for the placement of orders, is NOT an agreement to Buyer's Terms and Conditions. NO EMPLOYEE, AGENT OR REPRESENTATIVE OF SELLER HAS THE AUTHORITY TO BIND SELLER BY THE ACT OF CLICKING ANY BUTTON OR SIMILAR ACTION ON BUYER'S WEBSITE OR PORTAL.

24. Compliance with Laws. Buyer agrees to comply with all applicable laws, regulations, and industry and professional standards, including those of the United States of America, and the country or countries in which Buyer may operate, including without limitation the U.S. Foreign Corrupt Practices Act ("FCPA"), the U.S. Anti-Kickback Act ("Anti-Kickback Act"), U.S. and E.U. export control and sanctions laws ("Export Laws"), the U.S. Food Drug and Cosmetic Act ("FDCA"), and the rules and regulations promulgated by the U.S. Food and Drug Administration ("FDA"), each as currently amended. Buyer agrees to indemnify, defend, and hold harmless Seller from the consequences of any violation of such laws, regulations and standards by Buyer, its employees or agents. Buyer represents that it is familiar with all applicable provisions of the FCPA, the Anti-Kickback Act, Export Laws, the FDCA and the FDA and certifies that Buyer will adhere to the requirements thereof and not take any action that would make Seller violate such requirements. Buyer represents and agrees that Buyer will not make any payment or give anything of value, directly or indirectly, to any governmental official, foreign political party or official thereof, candidate for foreign political office, or commercial entity or person, for any improper purpose, including the purpose of influencing such person to purchase Products or otherwise benefit the business of Seller. Buyer further represents and agrees that it will not receive, use, service, transfer or ship any Products from Seller in a manner or for a purpose that violates Export Laws or would cause Seller to be in violation of Export Laws. Buyer agrees to promptly and reliably provide Seller all requested information or documents, including end-user statements and other written assurances, concerning Buyer's ongoing compliance with Export Law. (9/22)

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Aerospace

Key Markets

Aftermarket services
Commercial transports
Engines
General & business aviation
Helicopters
Launch vehicles
Military aircraft
Missiles
Power generation
Regional transports
Unmanned aerial vehicles

Key Products

Control systems & actuation products
Engine systems & components
Fluid conveyance systems & components
Fluid metering, delivery & atomization devices
Fuel systems & components
Fuel tank inerting systems
Hydraulic systems & components
Thermal management
Wheels & brakes



Climate Control

Key Markets

Agriculture
Air conditioning
Construction Machinery
Food & beverage
Industrial machinery
Life sciences
Oil & gas
Precision cooling
Process
Refrigeration
Transportation

Key Products

Accumulators
Advanced actuators
CO_2 controls
Electronic controllers
Filter driers
Hand shut-off valves
Heat exchangers
Hose & fittings
Pressure regulating valves
Refrigerant distributors
Safety relief valves
Smart pumps
Solenoid valves
Thermostatic expansion valves



Electromechanical

Key Markets

Aerospace
Factory automation
Life science & medical
Machine tools
Packaging machinery
Paper machinery
Plastics machinery & converting
Primary metals
Semiconductor & electronics
Textile
Wire & cable

Key Products

AC/DC drives & systems
Electric actuators, gantry robots & slides
Electrohydrostatic actuation systems
Electromechanical actuation systems
Human machine interface
Linear motors
Stepper motors, servo motors, drives & controls
Structural extrusions



Filtration

Key Markets

Aerospace
Food & beverage
Industrial plant & equipment
Life sciences
Marine
Mobile equipment
Oil & gas
Power generation & renewable energy
Process
Transportation
Water Purification

Key Products

Analytical gas generators
Compressed air filters & dryers
Engine air, coolant, fuel & oil filtration systems
Fluid condition monitoring systems
Hydraulic & lubrication filters
Hydrogen, nitrogen & zero air generators
Instrumentation filters
Membrane & fiber filters
Microfiltration
Sterile air filtration
Water desalination & purification filters & systems



Fluid & Gas Handling

Key Markets

Aerial lift
Agriculture
Bulk chemical handling
Construction machinery
Food & beverage
Fuel & gas delivery
Industrial machinery
Life sciences
Marine
Mining
Mobile
Oil & gas
Renewable energy
Transportation

Key Products

Check valves
Connectors for low pressure fluid conveyance
Deep sea umbilicals
Diagnostic equipment
Hose couplings
Industrial hose
Mooring systems & power cables
PTFE hose & tubing
Quick couplings
Rubber & thermoplastic hose
Tube fittings & adapters
Tubing & plastic fittings



Hydraulics

Key Markets

Aerial lift
Agriculture
Alternative energy
Construction machinery
Forestry
Industrial machinery
Machine tools
Marine
Material handling
Mining
Oil & gas
Power generation
Refuse vehicles
Renewable energy
Truck hydraulics
Turf equipment

Key Products

Accumulators
Cartridge valves
Electrohydraulic actuators
Human machine interfaces
Hybrid drives
Hydraulic cylinders
Hydraulic motors & pumps
Hydraulic systems
Hydraulic valves & controls
Hydrostatic steering
Integrated hydraulic circuits
Power take-offs
Power units
Rotary actuators
Sensors



Pneumatics

Key Markets

Aerospace
Conveyor & material handling
Factory automation
Life science & medical
Machine tools
Packaging machinery
Transportation & automotive

Key Products

Air preparation
Brass fittings & valves
Manifolds
Pneumatic accessories
Pneumatic actuators & grippers
Pneumatic valves & controls
Quick disconnects
Rotary actuators
Rubber & thermoplastic hose & couplings
Structural extrusions
Thermoplastic tubing & fittings
Vacuum generators, cups & sensors



Process Control

Key Markets

Alternative fuels
Biopharmaceuticals
Chemical & refining
Food & beverage
Marine & shipbuilding
Medical & dental
Microelectronics
Nuclear Power
Offshore oil exploration
Oil & gas
Pharmaceuticals
Power generation
Pulp & paper
Steel
Water/wastewater

Key Products

Analytical Instruments
Analytical sample conditioning products & systems
Chemical injection fittings & valves
Fluoropolymer chemical delivery fittings, valves & pumps
High purity gas delivery fittings, valves, regulators & digital flow controllers
Industrial mass flow meters/controllers
Permanent no-weld tube fittings
Precision industrial regulators & flow controllers
Process control double block & bleeds
Process control fittings, valves, regulators & manifold valves



Sealing & Shielding

Key Markets

Aerospace
Chemical processing
Consumer
Fluid power
General industrial
Information technology
Life sciences
Microelectronics
Military
Oil & gas
Power generation
Renewable energy
Telecommunications
Transportation

Key Products

Dynamic seals
Elastomeric o-rings
Electro-medical instrument design & assembly
EMI shielding
Extruded & precision-cut, fabricated elastomeric seals
High temperature metal seals
Homogeneous & inserted elastomeric shapes
Medical device fabrication & assembly
Metal & plastic retained composite seals
Shielded optical windows
Silicone tubing & extrusions
Thermal management
Vibration dampening

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