Multi-Power® Cylinders

Available in 4 series
Bore sizes 1/2" thru 12"
Strokes 1/8" thru 12"

5

Original Series
(shown right)
- Bores 1-1/8" thru 12"
- Strokes 1/2" thru 12"
- Forces to 44,000 lbs. (22 tons!)

Pancake® Series
(see pages 5.13 to 5.17)
- Bores 1/2" thru 4"
- Strokes 1/8" thru 1-1/2"
- Forces to 7,186 lbs

Square1® Series
(see pages 5.18 to 5.22)
- Bores 3/4" thru 2"
- Strokes 1/8" thru 2-1/2"
- Forces to 870 lbs.

Longstroke™ Series
(see pages 5.23 to 5.28)
- Bores 2" thru 4"
- Strokes 1/2" thru 12"
- Forces to 7,186 lbs

Duralon® Rod Bearings Excel

Load Capacity (psi)

Machine Design 1972/73 Bearing Reference Issue

Porous Bronze	4,500
Porous iron	8,000
Phenolics	6,000
Nylon®	1,000
TFE	500
Reinforced Telfon®	2,500
*TFE fabric	60,000
Polycarbonate	1,000
Acetal	1,000
Carbon-graphite	600

Friction Properties

	Coefficient	Slip-stick
Steel-on-steel	.50	Yes
Bronze-on-steel	.35	Yes
Sintered Bronze-on-steel with mineral oil	.13	No
Bronze-on-steel with mineral oil	.16	No
Copper lead alloy-on-steel	.22	Yes
Acetal-on-steel	.20	No
Nylon-on-steel	.32	Yes
Duralon-on-steel	.05 - .16	No

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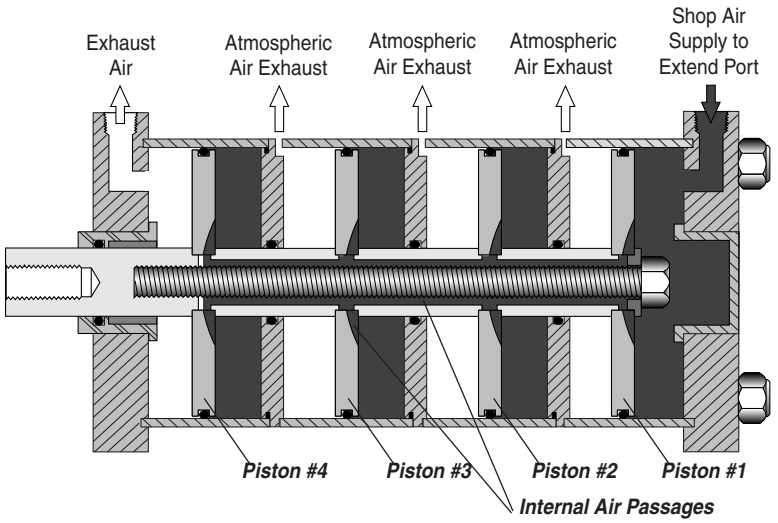
Features & Benefits

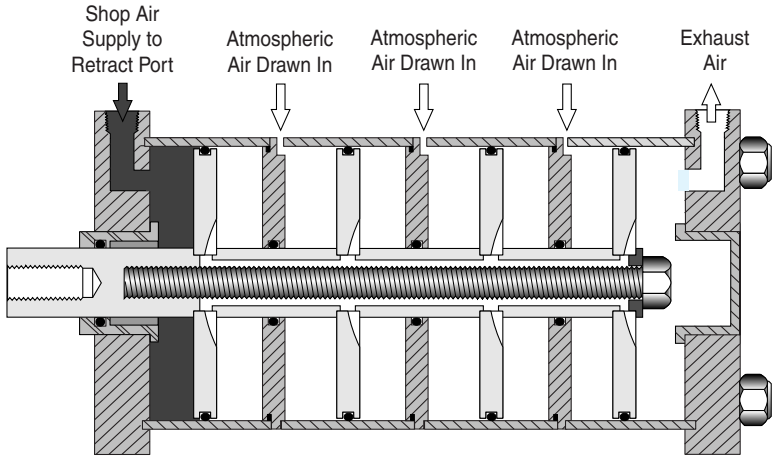
More force from available shop air	Eliminates hydraulics – stays clean
Multiple pistons on the power stroke	Saves mounting space (44 to 75%)
Single piston on the retract stroke	Saves air (22 to 37%)
Building block design	Low cost – Quick delivery – Specials
Wide range of models, sizes and options	Adapts to your application requirements
Corrosion resistant construction	Long life – clean appearance
Internally lubricated dynamic seals	Smooth operation and long product life
Duralon rod bearings	See chart above – extended product life
Hard anodized ID cylinder tubing	More cycles – less wear
2 Year warranty	Extended buyer protection

How it works

Fabco-Air attaches multiple pistons to a common shaft and provides ***internal*** air passages through the shaft to all pistons. Thus, when shop air pressure is applied to the extend port, all pistons are pressurized simultaneously enabling tremendous thrust forces to be obtained.

See the handy sizing guide below for available force multiplying factors (column 3 – Total Effective Piston Area) and maximum operating pressures for various cylinder bore sizes.





Sizing Example

MP3 X 1 X 3 X 1 FF

Piston Area is 20.3 sq. in.

Force = Pressure x Area

If Supply Air Pressure is 100 psi,

then Force = 100 psi x 20.3

or Force = 2030 lbs

Sizing Guide

Bore Inches	Stages (Number of Pistons)	Total Effective Piston Area-Square Inches ★	Equivalent Bore of a Single Piston Cylinder	Force @ 60 psi	Single Stage Retract Piston Area, sq. in.‡	Rod Diameter, in.	Rod Area, sq. in.	Base Weight, lb. Zero Stroke	Weight Per inch, lb. of Stroke	Max. Operating Pressure
1-1/8	2	1.8	1.5	108	0.8	0.50	0.2	0.9	0.3	150
	3	2.6	1.8	156				1.1	0.4	
	4	3.4	2.1	204				1.3	0.5	
1-5/8	2	3.8	2.2	228	1.7	0.62	0.3	1.7	0.4	150
	3	5.6	2.6	336				2.0	0.6	
	4	7.3	3.0	438				2.4	0.8	
2-1/2	2	9.4	3.5	564	4.5	0.75	0.4	3.6	0.8	150
	3	13.8	4.2	828				4.6	1.2	
	4	18.3	4.8	1098				5.5	1.5	
3	2	13.7	4.1	822	6.6	0.75	0.4	4.5	0.8	150
	3	20.3	5.1	1218				5.5	1.2	
	4	26.9	5.8	1614				6.6	1.5	
4	2	24.4	5.6	1464	11.8	1.00	0.8	7.8	1.2	150
	3	36.1	6.8	2166				9.5	1.6	
	4	47.9	7.9	2874				11.2	2.1	
5	2	38.0	7.0	2280	18.4	1.25	1.23	12.3	1.4	150
	3	56.4	8.5	3384				15.7	2.1	
	4	74.8	9.7	4488				19.0	2.8	
6	2	55.3	8.4	3318	27.0	1.25	1.23	14.7	1.5	150
	3	82.3	10.2	4938				18.1	2.2	
	4	109.4	11.8	6564				21.7	2.9	
8	2	98.6	11.2	5916	48.5	1.50	1.7	41.5	2.3	150
	3	147.0	13.7	8820				51.5	2.9	
	4	195.4	15.8	11724				61.4	3.6	
10	2	153.9	14.0	9234	75.4	2.00	3.1	85.1	5.4	150
	3	229.3	17.1	13758				110.3	8.1	
	4	304.7	19.7	18282				135.4	10.8	
12	2	222.9	16.8	13374	109.9	2.00	3.1	116.6	7.0	150
	3	332.8	20.6	19968				153.0	10.5	130
	4	442.7	23.7	26562				189.5	14.0	100

Notes

★ Areas given are for *Multiple* Stage Extend - Single Stage Retract with a Single Rod. For Single Stage Extend - *Multiple* Stage Retract and any Double Rod Models, deduct the rod area shown.

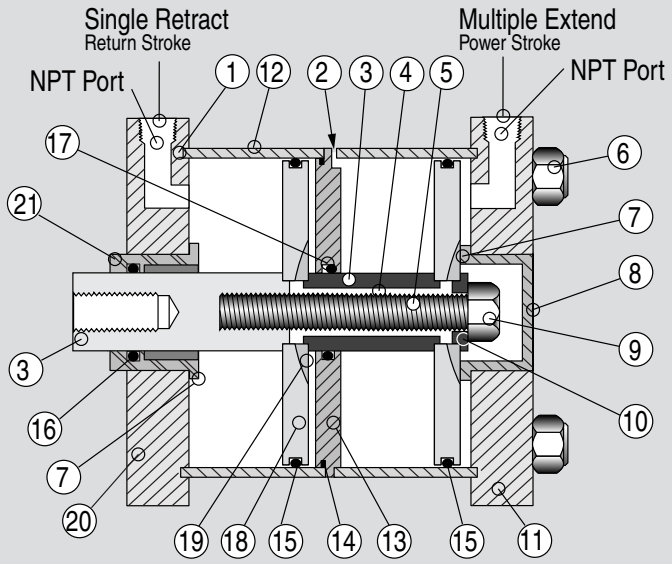
‡ Areas given are for Standard *Single* Stage Retract. For *Single* Stage Extend with a single rod, add the rod area shown.

Ratings – Standard Units

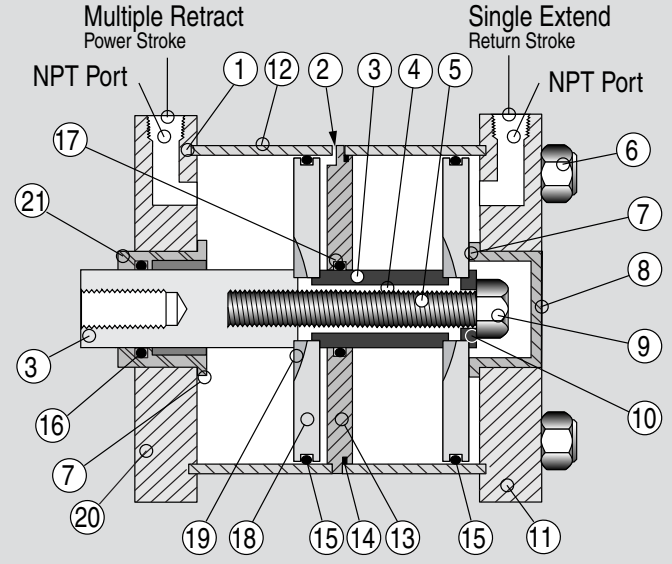
- Duralon® rod bushing. (see page 5.1 for table of physical properties)
- Female rod end with wrench flats
- Internally lubricated Buna-N O-ring piston and rod seals.
- Airline lubrication recommended
- Media . . . . . Air
- Max. operating pressure . . . . . See chart
- Min. pressure recommended . . . . . 20 psi
- Ambient & media temp.. . . . -25° to +250°F
- Prelubrication . . . . Magnalube®–G Grease

Basic Construction

Multiple Stage Extend with Single Stage Retract



Multiple Stage Retract with Single Stage Extend



Quick Reference to Components

No.	Description
1	Cylinder tube seal
2	Atmospheric vent
3	Piston rod
4	Air passage between stages
5	Center stud, high tensile, plated
6	Stainless steel tie rods and plated steel nuts
7	Piston stop
8	Cap End Plug, aluminum, black anodized
9	Nut, plated steel
10	Piston Rod Pilot Washer locates piston to maintain precise concentricity
11	Cap end head, aluminum, black anodized
12	Cylinder tube, aluminum
13	Baffle, aluminum
14	Baffle seal, Buna-N O'Rings, –25° to + 250°F
15	Piston seal, internally lubricated O'Ring
16	Piston rod seal, internally lubricated O'Ring
17	Center shaft seal, internally lubricated O'Ring
18	Piston, aluminum
19	Piston air slot, note direction of air flow
20	Rod end head, aluminum, black anodized
21	Piston rod bushing, anodized aluminum housing with Teflon® lined Duralon® insert

Cylinder OD – is clear anodized aluminum for corrosion resistance and an attractive appearance.

The Bore ID is Hard Anodized – Hard anodizing is an electrochemical process which provides a very dense surface of aluminum oxide that actually impregnates the base aluminum. It forms an extremely hard (60 Rc) surface with a low coefficient of friction. Hardness, corrosion resistance and wear resistance exceeds that of chrome plated steel.

An Extra Long Rod Bearing – provides long and rigid support for the piston rod. The bearing material is Duralon® on all bore sizes. See page 5.1 for a chart comparing the exceptional physical properties of Duralon® to other, less durable, bearing materials.

The Piston Rod – is Hard Chrome Plated Stainless Steel. Surface finish is 12 RMS or better. The standard rod end is fine female thread tapped and has long wrench flats.

Piston Construction – The piston is aluminum for light weight. The piston rod pilot end and a pilot washer enable bolting the assembly securely while maintaining precise concentricity for smooth cylinder performance.

Dynamic Seals – Internally lubricated O'Rings are compounded to provide extra long wear, lower breakaway (starting) and running friction, and smoother operation. In tests, cylinders with these seals have extended cycle life 2 to 3 times beyond cylinders with standard Buna-N seals.

Model Number Code

MP3 X 1 X 3 X 1 FF – MR

MP Series & Bore
1-1/8"
1-5/8"
2-1/2"
3"
4"
5"
6"
8"
10"
12"

Standard Strokes
1/2"
1"
1-1/2"
2"
2-1/2"
3"
4"
5"
6"
Optional Strokes
any other stroke 0" thru 12"

Stages Extend		Stages Retract
2	X	1
3	X	1
4	X	1
1	X	2‡
1	X	3‡
1	X	4‡

Standard available combinations are listed above. See page 5.7 for Multiple Extend–Multiple Retract Options.

‡***Note**: **Applicable only to 1-1/8" thru 8" bores.***

Bores	Mounting	
1-1/8" thru 6"	Front Face – Fabco Pattern	**FF**
	Front Face – NFPA (MF1) Pattern	**FFA**
	Rear Face – Fabco Pattern	**RF**
	Rear Face – NFPA (MF2) Pattern	**RFA**
	Foot	**FT**
	Clevis Mount NFPA (MP1) Dimensions	
	for single stage retract only	
	Ports in-line with slot	**PM**
	Ports 90° to slot	**SM**
	Extended Tie Rods	
	(See page 5.6 for non-standard lengths.)	
	Rod end only	**WF**
	Cap end only	**WR**
	Rod and Cap Ends	**WFR**
8" 10" 12"	Front Face – NFPA (ME3) Pattern	**FFA**
	Rear Face – NFPA (ME4) Pattern	**RFA**
	Extended Tie Rods	
	Rod end only	**WF**
	Cap end only	**WR**
	Rod and Cap Ends	**WFR**

How to Order

1. Specify Series and Bore
2. Specify Stroke in Inches and Fractions. Note standard strokes listed above. Strokes not listed are available to 12" maximum at a nominal increase in delivery time and cost.
3. Specify stages extend
4. Specify stages retract
5. Specify Mounting
6. Specify Options

Example

MP3 X 1 X 3 X 1 FF – MR

Multi-Power® Series, 3" bore, 1" stroke, 3 Stage Extend, 1 Stage Retract, Front Face (Fabco Pattern) Mount, Male Rod Thread.

OPTIONS

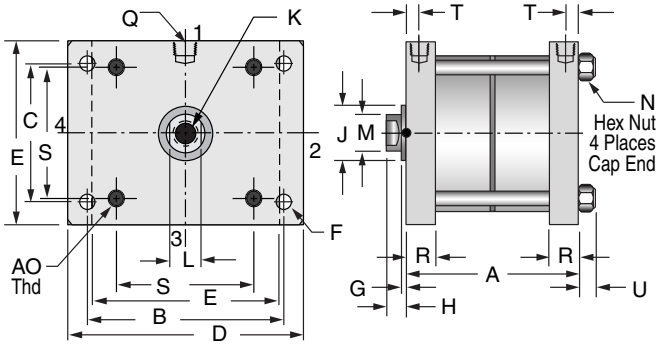
Description			Specify	See Page
1"–14 Rod thread – 8" bore only			**-KF**	5.5
Double Rod			**-DR**	5.8
Nonrotating Single Rod ‡			**-NR**	5.8
Nonrotating Double Rod ‡			**-NRDR**	5.8
Male Rod Thread				5.7
Single Rod			**-MR**	
Double Rod, Rod End			**-MR**	
Double Rod, Cap End			**-MR1**	
Double Rod, Both Ends			**-MR2**	
Viton Seals (-15° to +400°F)			**-V**	5.8
Shock & Speed Control using ‡ Hydraulics, 2-1/2" – 12" bores			**-HS**	5.11
Rubber Bumpers				5.9
Rod End			**-BF**	
Cap End			**-BR**	
Both Ends			**-BFR**	
Adjustable Extend Stroke 6" Stroke maximum. Full stroke adjustment is standard.			**-AS**	5.9
1/2" NPT Ports in Heads ‡ (2-1/2", 3", 4", 5" & 6" Bores only)				5.10
Rod End Head			**-TF**	
Cap End Head			**-TR**	
Both Heads			**-TFR**	
3/4 NPT Ports in Heads (8", 10" & 12" Bores only)			**-P34**	5.10
Extend Port Bushing				5.10
3/8 NPT (2-1/2" – 6" Bores)			**-E38**	
1/2 NPT (2-1/2" – 6" Bores)			**-E12**	
3/4 NPT (5" – 12" Bores)			**-E34**	
High Flow Vents			**-HF**	5.10
Port Positions				5.5 & 5.6
All Ports	Position #1	Standard		
	Position #2		**-PA2**	
	Position #3		**-PA3**	
	Position #4		**-PA4**	
Rod End	Position #1	Standard		
	Position #2		**-PR2**	
	Position #3		**-PR3**	
	Position #4		**-PR4**	
Cap End	Position #1	Standard		
	Position #2		**-PC2**	
	Position #3		**-PC3**	
	Position #4		**-PC4**	
Atmospheric Vent or Ported Baffle Port				
	Position #1	Standard		
	Position #2		**-PB2**	
	Position #3		**-PB3**	
	Position #4		**-PB4**	
Any port or vent not specified will be in Position #1 as shown on page 5.5 & 5.6				
Magnetic Piston ‡ for reed switches and Electronic Sensors (Order Sensors separately)			**-E**	5.12

‡ Note: Additional cylinder length required for Nonrotating Rods see page 5.8; for Option -HS see page 5.11; for 1/2 NPT Ports Option see page 5.10; for Option -E see page 5.12

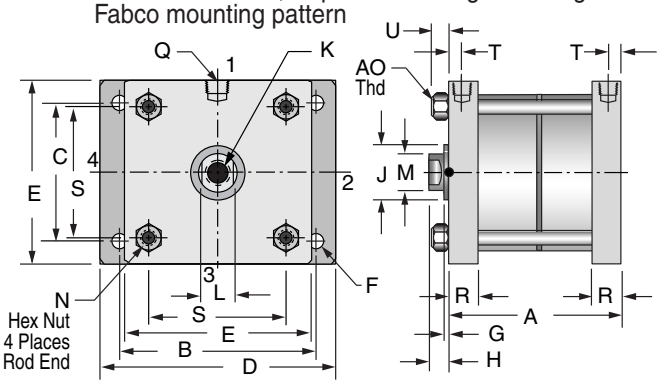
5

1-1/8", 1-5/8", 2-1/2", 3", 4", 5", & 6" Bores

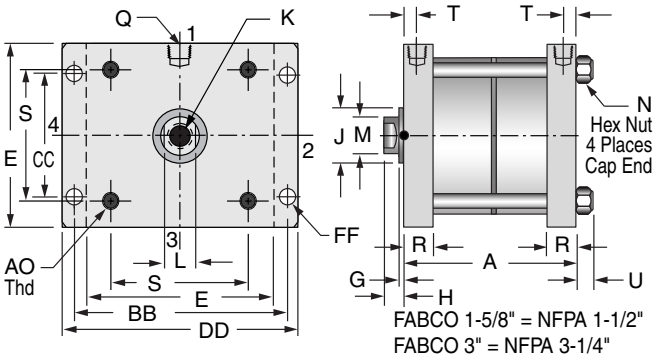
FF Front Face Mount; Rod End Rectangular Flange
Fabco mounting pattern



RF Rear Face Mount; Cap End Rectangular Flange
Fabco mounting pattern

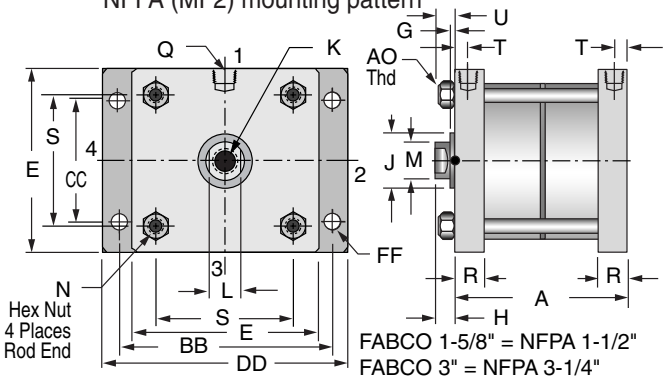


FFA Front Face Mount; Rod End Rectangular Flange
NFPA (MF1) mounting pattern



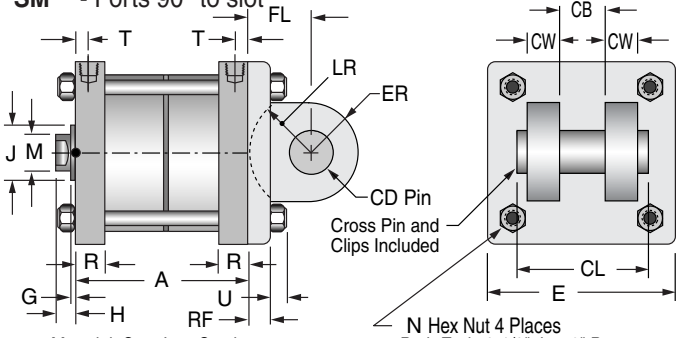
FABCO 1-5/8" = NFPA 1-1/2"
FABCO 3" = NFPA 3-1/4"

RFA Rear Face Mount; Cap End Rectangular Flange
NFPA (MF2) mounting pattern



FABCO 1-5/8" = NFPA 1-1/2"
FABCO 3" = NFPA 3-1/4"

For single stage retract only
Clevis Mount (NFPA MP1 Dimensions)
PM - Ports in-line with slot
SM - Ports 90° to slot



Fabco 1-1/8" = NFPA 1-1/2"
Fabco 1-5/8" = NFPA 1-1/2"
Fabco 3" = NFPA 3-1/4"

Material: Gray Iron Casting,
Black Oxide Finish

Dimensions (inches)

‡ Note:
The "Dimension Y" is for standard models: Multiple extend/single retract and Single extend/multiple retract. Optional Multiple extend/multiple retract models require additional cylinder length (see page 5.7).

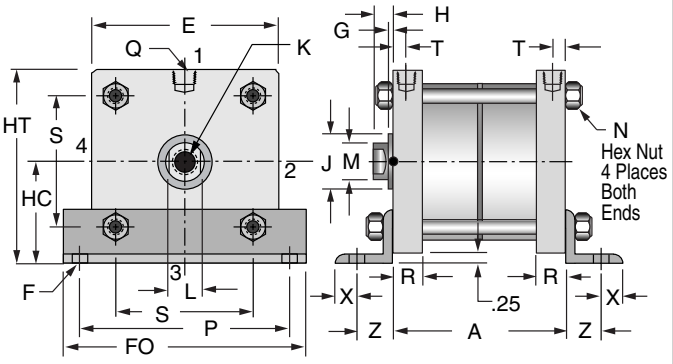
The following options also require additional cylinder length. See the respective option information pages for details. **-NR, –NRDR** (pg 5.8), **-HS** (pg 5.11), **-TF, -TR, -TFR** (pg 5.10), **-E** (pg 5.12).

† Note:
"Dimension K" for 8" Bore only, specify Option –KF for 1"-14 Rod Thread

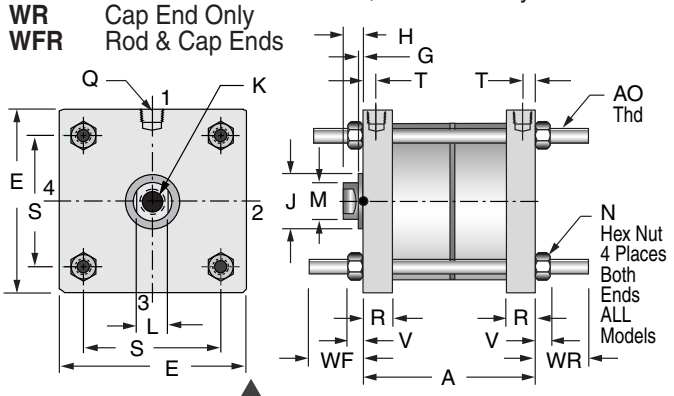
	A= (No. stages x stroke) + y‡										J			M			Q	
Bore	y‡ (2 stage)	y‡ (3 stage)	y‡ (4 stage)	B	C	D	E	F	G	H	±.002	K†	L	±.001	N	P	NPT	R
1-1/8	1.86	2.41	2.96	2.00	1.25	2.50	1.75	.28	.13	.50	0.752	5/16-24x.63	7/16	0.500	7/16	2.38	1/8	.50
1-5/8	2.42	3.08	3.75	2.50	1.75	3.00	2.25	.28	.13	.50	1.001	3/8-24x.63	1/2	0.625	7/16	2.88	1/8	.63
2-1/2	2.91	3.76	4.61	3.63	2.38	4.25	3.00	.34	.19	.50	1.127	1/2-20x.75	5/8	0.750	9/16	3.69	1/4	.75
3	2.91	3.76	4.61	3.88	2.75	4.50	3.50	.34	.19	.50	1.127	1/2-20x.75	5/8	0.750	9/16	4.13	1/4	.75
4	2.91	3.76	4.61	5.00	3.75	6.00	5.00	.41	.19	.50	1.502	1/2-20x.75	7/8	1.000	3/4	5.50	1/4	.75
5	3.81	5.15	6.50	6.00	4.50	7.00	6.00	.53	.19	.69	1.752	3/4-16x1.13	1	1.250	3/4	6.25	1/4	.75
6	3.46	4.55	5.65	7.00	5.25	8.00	7.00	.53	.19	.69	1.752	3/4-16x1.13	1	1.250	3/4	3.38	1/4	.75
8	6.25	8.25	10.25	7.57	NA	NA	9.00	.69	.25	1.00	2.001	1-12x1.50†	1-1/4	1.500	3/4	NA	1/2	1.50
10	7.75	10.75	13.75	9.40	NA	NA	12.00	.78	.25	1.00	2.751	1 1/2-12x1.75	1-3/4	2.000	1-1/8	NA	1/2	1.50
12	7.75	10.75	13.75	11.10	NA	NA	14.00	.78	.25	1.00	2.751	1 1/2-12x1.75	1-3/4	2.000	1-1/8	NA	1/2	1.50

1-1/8", 1-5/8", 2-1/2", 3", 4", 5", & 6" Bores

FT Foot Mount



WF Extended Tie Rod Mount, Rod End Only
WR Cap End Only
WFR Rod & Cap Ends



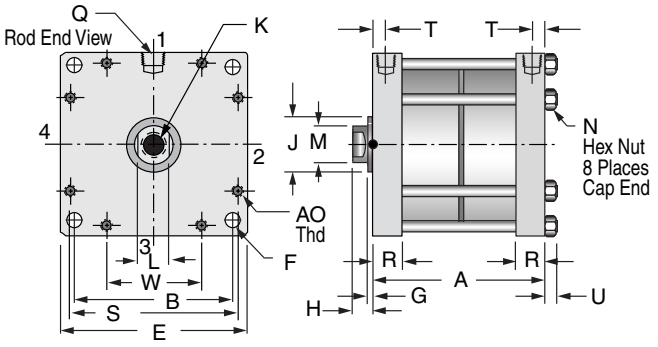
To Order
Extended Tie Rod Mount

	Specify Suffix
Rod End only	**WF**
Cap End only	**WR**
Rod & Cap Ends	**WFR**

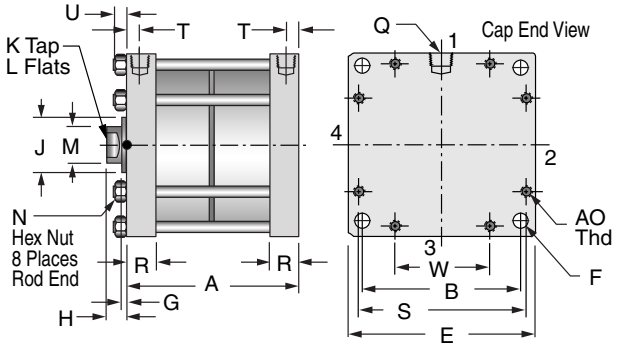
If a non-standard extension is required, specify by adding the required length to the suffix.
e.g. If **WF** length required is 2.5", Specify WF2.5"

8", 10", and 12" Bores

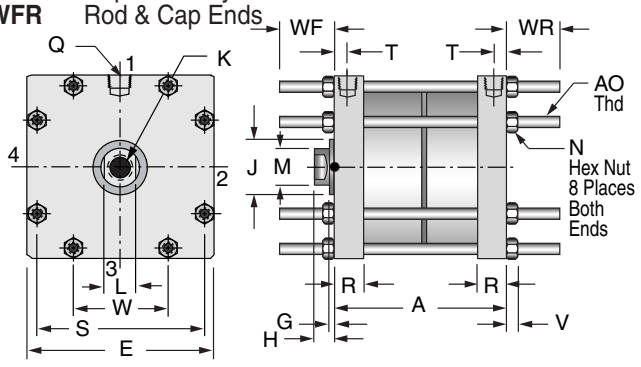
FFA Front Face Mount; Rod End Square Flange
NFPA (ME3) mounting pattern



RFA Rear Face Mount; Cap End Square Flange
NFPA (ME4) mounting pattern



WF Extended Tie Rod Mount, Rod End Only
WR Cap End Only
WFR Rod & Cap Ends



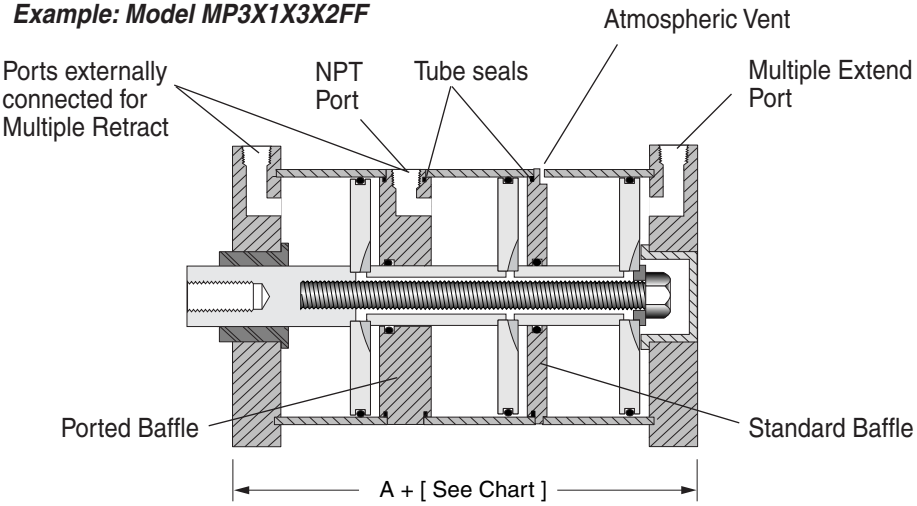
Bore	S	T	U	V	W	X	Z	AO	BB	CC	DD	FF	FO	HC	HT	WF	WR	CD	FL	RF	CB	CW	ER	LR	CL
1-1/8	1.19	.22	.27	.22	NA	.31	.44	1/4-20	2.00	1.00	2.50	.22	3.00	1.13	2.00	1.0	1.0	.500	.75	.38	.76	.50	.62	.62	2.09
1-5/8	1.62	.25	.27	.22	NA	.38	.63	1/4-20	2.75	1.43	3.25	.28	3.50	1.38	2.50	1.0	1.0	.500	.75	.38	.76	.50	.62	.62	2.09
2-1/2	2.31	.31	.38	.33	NA	.44	.56	3/8-16	3.88	2.19	4.50	.34	4.38	1.75	3.25	1.3	1.3	.500	.75	.38	.76	.50	.62	.62	2.09
3	2.69	.31	.38	.33	NA	.50	.75	3/8-16	4.69	2.76	5.31	.41	4.88	2.00	3.75	1.4	1.4	.750	1.25	.63	1.26	.62	.87	.87	2.88
4	3.50	.31	.50	.43	NA	.63	.88	1/2-13	5.44	3.32	6.38	.41	6.38	2.75	5.25	1.4	1.4	.750	1.25	.63	1.26	.62	.87	.87	2.88
5	4.25	.31	.50	.43	NA	.75	1.00	1/2-13	6.63	4.10	7.63	.53	7.25	3.25	6.25	1.8	1.8	.750	1.25	.63	1.26	.62	.87	.87	2.88
6	5.13	.31	.50	.43	NA	.75	1.00	1/2-13	7.63	4.88	8.63	.53	7.00	3.75	7.25	1.8	1.8	1.000	1.50	.75	1.51	.75	1.25	1.13	3.38
8	7.90	.75	.50	.43	4.56	NA	NA	1/2-13	NA	NA	NA	NA	NA	NA	NA	2.3	2.3	NA	NA	NA	NA	NA	NA	NA	NA
10	10.63	.75	.80	.66	5.00	NA	NA	3/4-10	NA	NA	NA	NA	NA	NA	NA	2.68	2.68	NA	NA	NA	NA	NA	NA	NA	NA
12	12.46	.75	.80	.66	5.81	NA	NA	3/4-10	NA	NA	NA	NA	NA	NA	NA	2.68	2.68	NA	NA	NA	NA	NA	NA	NA	NA

Multiple Stages Extend & Multiple Stages Retract
(Not available on 10" and 12" bores)

When required return forces (Extend or Retract) are greater than the standard single piston can provide, multiple stages (pistons) can be pressurized. This is accomplished by replacing one or more of the standard baffles with a ported baffle as shown in the illustration. When these thicker baffles are used, the overall length ("Dimension A") increases. See the chart below for port size and dimension details.

See pages 5.5 for Dimension "A"

Example: Model MP3X1X3X2FF



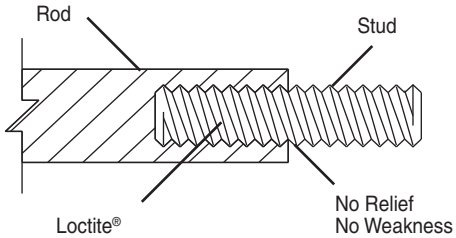
Bore	Port	Add to Dimension "A" for each Ported Baffle
1-1/8"	1/8 NPT	.50"
1-5/8"	1/8 NPT	.50"
2-1/2"	1/4 NPT	.50"
3"	1/4 NPT	.50"
4"	1/4 NPT	.50"
5"	1/4 NPT	.50"
6"	1/4 NPT	.50"
8"	1/2 NPT	1.00"

Available Combinations	No. of Ported Baffles	Total No. of Stages
2 X 2	1	2
3 X 2	1	3
3 X 3	2	3
2 X 3	1	3
4 X 2	1	4
4 X 3	2	4
4 X 4	3	4
3 X 4	2	4
2 X 4	1	4

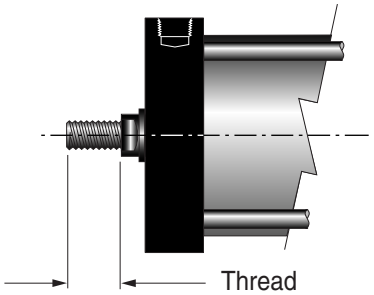
Notes:
When any of these combinations are ordered, the proper number of ported baffles are included.
As standard, the largest number of stages are internally connected.
On models with the same number of extend and retract stages, the extend stages are internally connected.

Applications that may dictate the use of Ported Baffles	
• Clean rooms, Vacuum Chambers, Wash Down Areas, Under Liquid, Dirty or Corrosive Environments	Filters can be installed in the ports of stages not requiring pressurization, or they can be plumbed to a common filter or point outside the critical environment.
• Increase Cycle Speeds	The ports have higher air flow capacity than the vents in the standard baffle.
• Selective Force Application	With control circuitry, the number of stages that are pressurized (thus the amount of force being applied) at any given time can be selected and varied. Consult engineering with application details.

Male Rod Thread	Option
Single Rod	**-MR**
Double Rod, Rod End Only	**-MR**
Double Rod, Cap End Only	**-MR1**
Double Rod, Rod & Cap Ends	**-MR2**



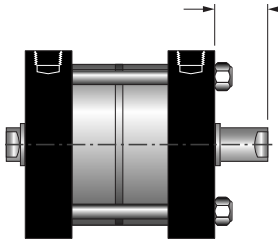
For bores 1-1/8" thru 8", a high strength stud is threaded into the standard female rod end and retained with Loctite®. This method eliminates the small diameter thread relief area normally required when machining male threads. This provides a much stronger rod end which can be repaired, rather than replacing the complete rod, should the thread be damaged. For 10" and 12", the thread is machined integral with the rod.



BORE	THREAD
1-1/8"	5/16–24 x .63
1-5/8"	3/8–24 x .88
2-1/2"	1/2–20 x 1.00
3"	1/2–20 x 1.00
4"	1/2–20 x 1.00
5"	3/4–16 x 1.50
6"	3/4–16 x 1.50
8" standard	1–12 x 1.50
8" optional‡	1–14 x 1.50
10"	1-1/2–12 x 2.25
12"	1-1/2–12 x 2.25

‡Note: Male rod callout must be preceeded by "-KF"

Double Rod **Option -DR**



Standard piston rod and rod bushing on both ends of the cylinder.

For 8" bore only, when -KF is specified, 1"–14 threads will be applied at both ends.

Note: 10" & 12" Bores for Position Indication Only– Rod Thread 3/8-16 x 5/8 Deep

Use when attachment to both ends of the cylinder is required, or to indicate piston position. Also see Option –E on page 5.12.

Viton Seals **Option -V**

Use for elevated temperatures (–15° to + 400°F) or compatibility with exotic media. Consult engineering for compatibility information.

Nonrotating Rod **Option -NR**

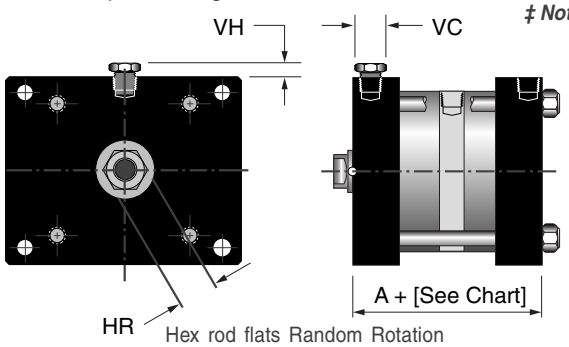
A stainless steel hex rod and a hex broached bushing of SAE 660 bearing bronze replaces the standard round rod and bushing.

A ported baffle is used so the piston assembly can be retracted by the next piston back from the rod end. The normal rod head port becomes an atmospheric vent. The tolerance on rotation is ±1°.

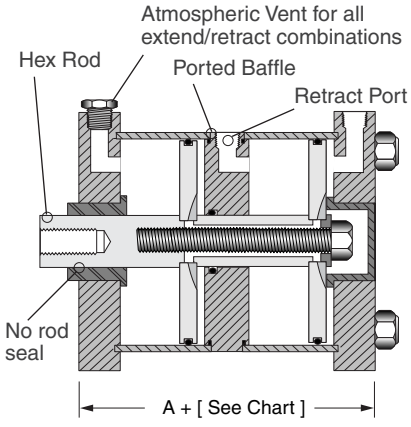
The hex rod design does allow for some torque loading on the shaft. However, torque loads that induce side loading should be minimized for best overall life and performance.

Available Combinations	No. of Ported Baffles	Total No. of Stages
2 X 1	1	2
3 X 1	1	3
3 X 2‡	2	3
4 X 1	1	4
4 X 2‡	2	4
4 X 3‡	3	4

‡ Note: Not applicable to 10" and 12" bores



See page 5.5 for Dimension "A"



Bore	Retract Port	Add to Dimension "A" for each Ported Baffle	HR	St'd Ports VC	St'd Ports VH max	1/2 NPT Ports (–TF or –TFR) VC	1/2 NPT Ports (–TF or –TFR) VH max	3/4 NPT Ports (–P34) VC	3/4 NPT Ports (–P34) VH max
1-1/8"	1/8 NPT	.50"	.50"	.51	.50	–	–	–	–
1-5/8"	1/8 NPT	.50"	.63"	.51	.50	–	–	–	–
2-1/2"	1/4 NPT	.50"	.75"	.65	.69	1.01	1.88	–	–
3"	1/4 NPT	.50"	.75"	.65	.69	1.01	1.88	–	–
4"	1/4 NPT	.50"	1.00"	.65	.69	1.01	1.88	–	–
5"	1/4 NPT	.50"	1.38"	.65	.69	1.01	1.88	–	–
6"	1/4 NPT	.50"	1.38"	.65	.69	1.01	1.88	–	–
8"	1/2 NPT	1.00"	1.50"	1.01	1.88	–	–		
10"	1/2 NPT	.50"	2.00"	1.01	1.88	–	–	1.32	2.28
12"	1/2 NPT	.50"	2.00"	1.01	1.88	–	–	1.32	2.28

Nonrotating Double Rod **Option -NRDR**

A combination of the Options –NR and –DR as shown above. The rod end rod is Hex and the cap end rod is round. The ported baffles are included and the "Dimension A" adjustments shown for Option –NR must be made. Extended piston areas must also be reduced by the rod area.

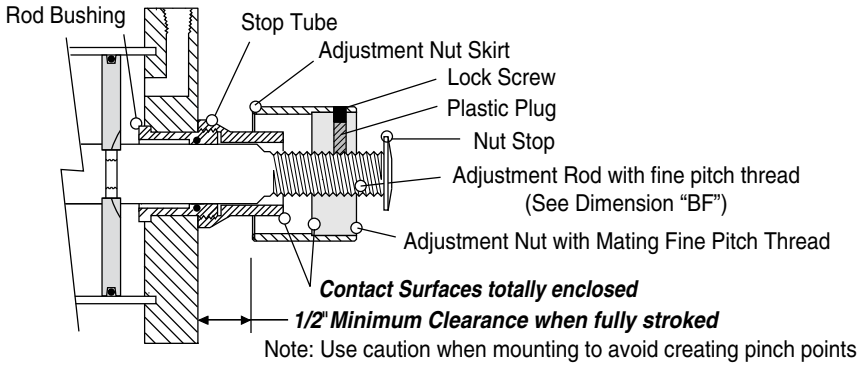
Adjustable extend stroke

Option -AS

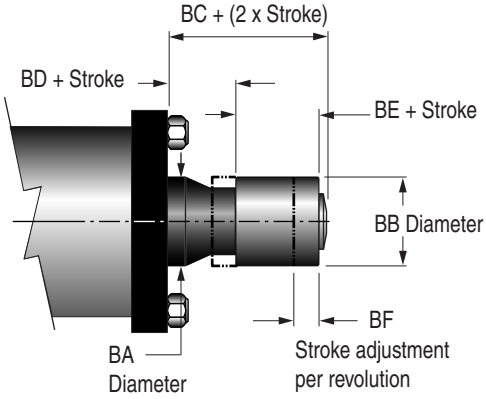
For strokes through 6"
Full stroke adjustment is standard.

Note!
To maintain operator safety features of this option, it is NOT available with mounting styles: WR and WFR. Use caution when mounting to avoid creating pinch points.

Not available with mounting styles PM and SM.
Not available for 10" & 12" bores



Note: Use caution when mounting to avoid creating pinch points



5

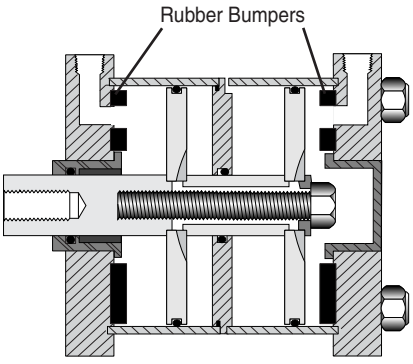
Dial-A-Stroke® provides a rugged and precision adjustment of the extend stroke of the cylinder. The stop tube, adjustment nut with skirt, and minimum clearances combine to eliminate pinch points, thus providing operator safety. **Note!** Use caution when mounting to avoid creating pinch points with other parts of your machine design.

The stop tube is black anodized aluminum, the adjustment nut is blackened steel with a black anodized aluminum skirt, and the nut stop is red anodized aluminum; all for corrosion resistance and appearance. The adjustment nut, steel for long life, includes a lock screw with a plastic plug so that the adjustment nut can be locked in place without damaging the threads. The nut stop is mounted on the end of the adjustment rod so that the nut cannot come off. The fine pitch threads on the adjustment rod and nut provide precision adjustment. (See dimension "BF"). Adjustment settings are simplified by convenient scale markings applied to nut skirt and stop tube.

Bore	1-1/8"	1-5/8"	2-1/2"	3"	4"	5"	6"	8"	
BA	1.13	1.25	1.50	1.50	2.00	2.25	2.25	2.50	
BB	1.50	1.50	2.00	2.00	2.00	2.25	2.25	2.75	
BC	1.67	1.67	1.90	1.90	1.67	1.67	1.67	2.54	+ (2 x Stroke)
BD	1.00	1.00	1.00	1.00	.75	.75	.75	1.13	+ Stroke
BE	.50	.50	.75	.75	.75	.75	.75	1.16	
BF	.050	.050	.063	.063	.063	.071	.071	.071	

Rubber Bumpers **Option**

Rod End only	**-BF**
Cap End only	**-BR**
Both Rod & Cap Ends	**-BFR**



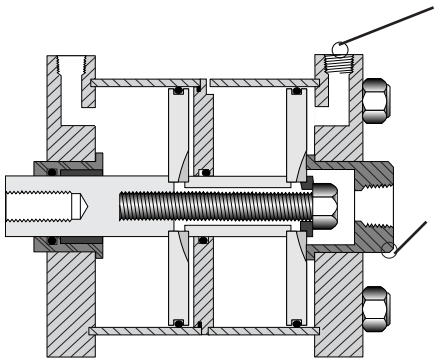
A rubber doughnut is bonded to the cylinder head to act as the piston stop and absorb the impact of the piston. This reduces noise and absorbs energy, thus reducing damage to the cylinder and tooling due to pounding. The amount of rubber that extends beyond the normal piston stop is designed to compress and allow full stroke of the cylinder at 60 to 80 psi. If your application uses lower pressure or has high energy, consult engineering with application details so that rubber mass can be adjusted to meet your specific requirements.

Because of the temperature limitations of the adhesives involved (-25° to +225°F), rubber bumpers are available in cylinders with standard internally lubricated Buna-N seals only.

Use where noise reduction and impact absorption is desired.

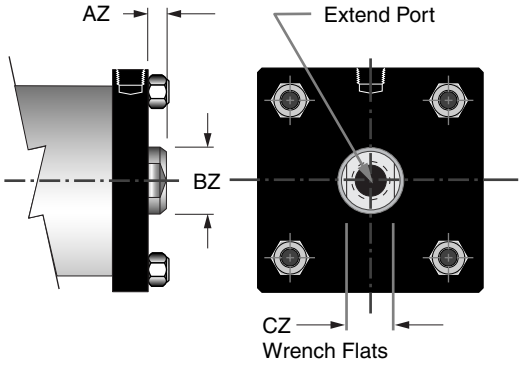
Note! On applications such as punching, shearing, setting blind rivets, etc., where high forces are built up and then released VERY quickly, the proper method of "catching" this type of load is to adjust the cylinder piston and the tooling so that at the point of breakthrough the piston is very close to the bumper. This reduces the dynamic load that the piston and bumper are required to absorb.

Extend Port Bushing		Option
3/8 NPT	(2-1/2" – 6" bores)	**-E38**
1/2 NPT	(2-1/2" – 6" bores)	**-E12**
3/4 NPT	(5" – 12" bores)	**-E34**



The cap end plug is replaced with an extended plug of black anodized aluminum with a female NPT port. The standard cap end port is plugged.

Use for plumbing convenience, or when higher air flows are required for higher cycle speeds.



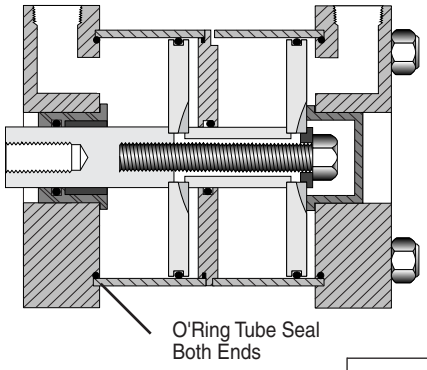
Dimensions (inches)

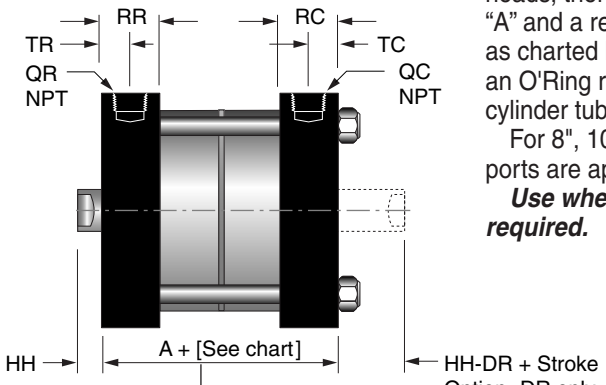
Bore	AZ	BZ	CZ	Availability E38	E12	E34
2-1/2	.38	1.13	.94	✓	✓	–
3	.38	1.13	.94	✓	✓	–
4	.38	1.50	1.26	✓	✓	–
5	.38	1.75	1.50	✓	✓	✓
6	.38	1.75	1.50	✓	✓	✓
8	.38	2.00	1.75	–	–	✓
10	.50	2.75	2.25	–	–	✓
12	.50	2.75	2.25	–	–	✓

5

1/2 NPT Ports in Heads	Option
2-1/2", 3", 4", 5", & 6" Bores only	
Rod End Head	**-TF**
Cap End Head	**-TR**
Both Heads	**-TFR**

3/4 NPT Ports in BOTH Heads
8", 10" & 12" Bores only **-P34**





For 2-1/2" thru 6" bores, thicker heads (to accept 1/2 NPT ports) replace the standard heads. Because of the thicker heads, there is an increase in Dimension "A" and a reduction of the rod extension as charted below. With this construction, an O'Ring replaces the fiber gasket cylinder tube seal.

For 8", 10" and 12" bores, 3/4 NPT ports are applied to standard heads.

Use when higher cycle speeds are required.

See pages 5.5 & 5.6 for Dimension "A"

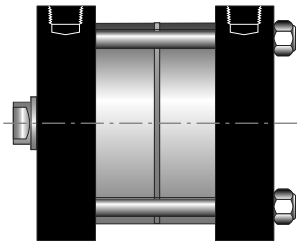
Option	Add to A	QC	QR	RC 2-1/2 & 3" Bore	RC 4, 5 & 6" Bore	RC 8, 10 & 12" Bore	RR 2-1/2 & 3" Bore	RR 4, 5 & 6" Bore	RR 8, 10 & 12" Bore	HH 2-1/2, 3 & 4" Bore	HH 5 & 6" Bore	HH 8, 10 & 12" Bore	HH-DR 2-1/2, 3 & 4" Bore	HH-DR 5 & 6" Bore	HH-DR 8, 10 & 12" Bore	TC	TR
TF	.38	1/4	1/2	0.75	0.75	–	1.00	1.25	–	0.12	0.31	–	0.50	0.69	–	.31	.50
TR	.38	1/2	1/4	1.00	1.25	–	0.75	0.75	–	0.50	0.69	–	0.12	0.31	–	.50	.31
TFR	.76	1/2	1/2	1.00	1.25	–	1.00	1.25	–	0.12	0.31	–	0.12	0.31	–	.50	.50
P34	0.00	3/4	3/4	–	–	1.50	–	–	1.50	–	–	1.00	–	–	1.00	.63	.63

High Flow Vents	Option -HF	The atmospheric vent in the baffle is cut larger to provide less resistance to the air flow. ***Use when higher cycle speeds are required.***

Speed & Shock Control Using Hydraulics **Option -HS**

Available in 2-1/2" through 12" Bore
Temperature range: –25° to + 250°F
Available with Viton seals Add **-V**
Temperature range: –15° to +400°F

Note!!!
All 4-Stage Units 2-1/2" thru 10" Bores are rated at 120 psi maximum air input!
12" Bore, 3-Stage is rated at 130 psi max.
12" Bore, 4-Stage is rated at 100 psi max.



	Bore	Add to "A" Pg 5.5 & 5.6
Series MP	2-1/2", 3", 4"	0.50"
	5"	0.25"
	6"	0.50"
	8"	0.25"
	10", 12"	0.00"
	Bore	**Add to "B" Pg 5.24**
MLR, MLS	2, 2-1/2", 3", 4	0.50"

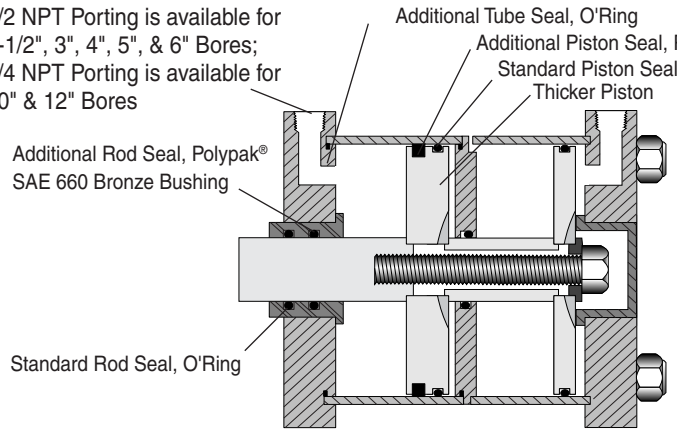
When Multi-Power® cylinders are applied to applications such as punching or shearing, high inertial and impact forces are often encountered. To capture these potentially destructive forces, and prevent possible damage to tooling and cylinder specify Option –˙HS.

The seals on the piston, piston rod and tube are increased in the ***single return stage*** (retract or extend) and fluid is used to control speed and shock. Fluid from an air-over-oil tank is used for the return media. This fluid passes through a resistance, such as a flow control, which provides speed control of the cylinder. When the material shears and the cylinder tries to complete its stroke, the non-compressible fluid resists rapid movement, providing shock and speed control. Note the circuits shown below.

For less fluid restriction and larger plumbing on 2-1/2" through 6" bores, see the 1/2 NPT porting options –TF, –TR, and –TFR on page 5.10. Also for 10" & 12" bores, 3/4 NPT Port Option -P34 is available. See page 5.10.

Note!! The fluid pressure in the return stage is limited to 500 psi. This dictates that all 4-stage units thru 10" bore be limited to 120 psi maximum air input! 12" bore, 3 stage units are limited to 130 psi; 4 stage units are limited to 100 psi.

Use when smooth, rigid, and precision speed control is required. Also with applications such as punching, shearing, setting blind rivets, etc., where high forces are built up and then released very quickly. The fluid, being incompressible, "catches" these forces, both static and dynamic, dissipating them before the cylinder reaches the end of its stroke – and before the piston can pound on the piston stop.



The Polypak® seals combine an automatic lip seal with an O'spring energizer for excellent sealing from 0 to 500 psi.

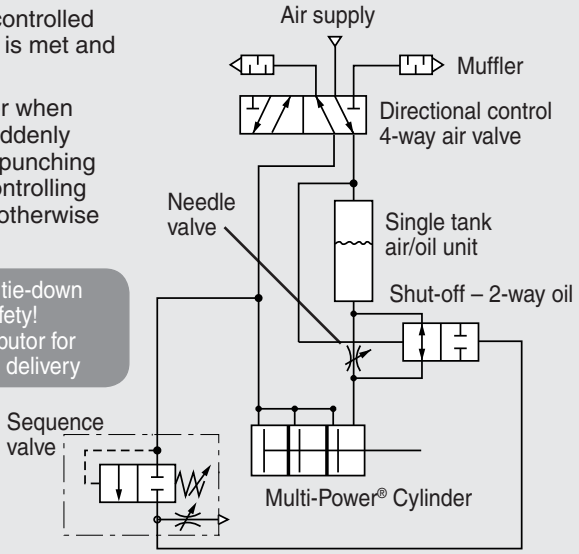
Application Tips

Two Speed & Shock Control

Single air/oil tank with sequence, needle and shut-off valves give:

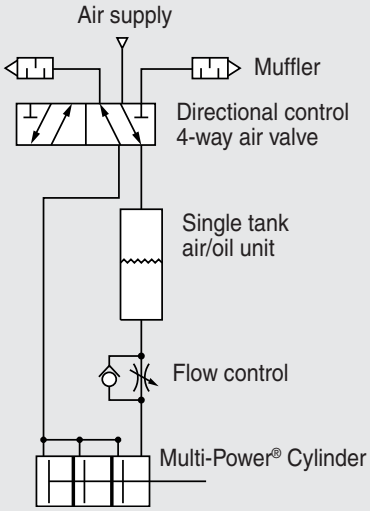
1. Rapid "Extend" stroke.
2. Automatic switch to controlled rate when resistance is met and pressure builds up.
3. Fluid catches cylinder when built-up forces are suddenly released (such as in punching applications), thus controlling the shock that could otherwise occur.
4. Automatic return to rapid rate on "Retract" stroke.

Always use 2-hand anti tie-down systems for operator safety! Consult your local distributor for information and product delivery



One Speed Circuit

Single air/oil tank and flow control valve give hydraulic control with speed control on "Extend" stroke with rapid rate on "Retract" stroke.

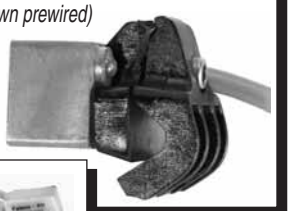


9-2A197 Series Sensor & Clamp for 1-1/8" to 3" Bores

Socket Head Screw

Quick Disconnect Sensor Shown

749 Series Sensor with Integral Clamp for 4" to 12" Bore Cylinders
(shown prewired)



9 foot prewired sensor

Female Cordsets available in 1, 2, & 5 meter lengths

WARNING
This cylinder is equipped with a Magnetic Piston for use with Magnetically Operated Sensors. Other Magnetic Sensitive Devices Should be Kept at a Distance to Avoid Inadvertent Operation.

Magnetic Piston Option -E

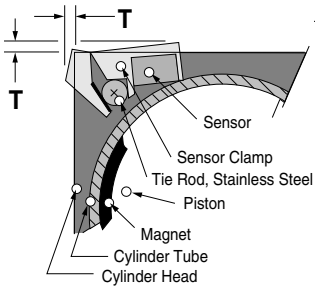
Specifies Magnetic Piston

(Order Sensors and Sensor Clamps Separately)

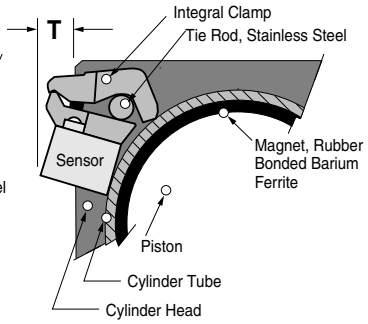
- ***Option -E*** consists of a magnet bonded into the piston head. When the piston magnet moves past an external sensor, the magnetic field activates the sensor without physical contact.
- ***Mounting*** – The sensor is attached to a 2-part clamp that attaches rigidly to a tie rod and can be positioned anywhere along the length of the cylinder for very precise signaling.
- Two sensor styles are used – (a) the ***9-2A197 Series*** for 1-1/8" thru 3" bores requires a tie rod clamp, and (b) the ***749 Series*** which accommodates the larger diameter tie rods of the 4" thru 12" bores with an integral clamp.
- ***Reliability*** – The annular piston magnet is permanently bonded into a groove in the piston. It is a polarized permanent magnet of rubber bonded barium ferrite that is very stable and is not affected by shock. Under normal usage it will remain magnetized indefinitely.
- ***Warning*** – External magnetic fields and/or ferrous objects may affect the strength of the piston magnet therefore affecting sensor actuation and piston position indication. Labels noting this are affixed to the cylinder.
- ***Please note there is an increase in base length of the cylinder to accomodate the magnet. Using the table below add 'L' to Dimension 'A' on pages 5.5 & 5.6***

(T) Clamp Stick Out & (L) Length Adder to Dim. 'A' Pgs. 5.5 & 5.6										
Bore	1-1/8"	1-5/8"	2-1/2"	3"	4"	5"	6"	8"	10"	12"
T	.38	.38	.38	.38	.36	.25	.14	.10	.38	.38
L	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

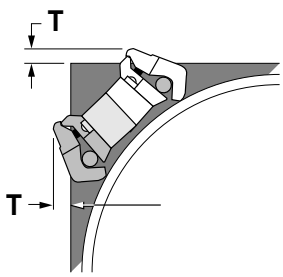
1-1/8" – 3" Bores



4" – 6" Bores



8", 10", 12" Bores



Sensor & Clamp Ordering Guide

Warning! Do not exceed sensor ratings. Permanent damage to sensor may occur. Power supply polarity ***MUST*** be observed for proper operation of sensors. See wiring diagrams included with each sensor. Sensor housing rated NEMA 6/IP67.

Temperature Range: –20° to + 80°C (–4° to + 176°F)

LED Lighted Magnetic Piston Position Sensors: Bores 1-1/8" – 3"			
Product	**9 ft. Prewired P/N**	**Quick Discon. P/N**	**Electrical Characteristics**
Reed Switch	9-2A197-1004	9-2A197-1304	5-120 VDC/VAC, 0.5 Amp Max., 10 Watt Max., SPST N.O., 3.5 Voltage Drop
Electronic	9-2A197-1033	9-2A197-1333	Sourcing, PNP, 6-24 VDC, 0.5Amp Max., 1.0 Voltage Drop
Electronic	9-2A197-1034	9-2A197-1334	Sinking, NPN, 6-24VDC, 0.5Amp Max., 1.0 Voltage Drop
9-2A197 Series Sensor Mounting Clamps – **Part Number 800-200-000**			
LED Lighted Magnetic Piston Position Sensors: Bores 4" – 8"			
Reed Switch	749-000-004	749-000-504	5-240 VDC/VAC, 1 Amp Max., 30 Watt Max., SPST N.O., 3.0 Voltage Drop
Electronic	749-000-031	749-000-531	Sourcing, PNP, 6-24 VDC, 1.0 Amp Max., 0.5 Voltage Drop
Electronic	749-000-032	749-000-532	Sinking, NPN, 6-24 VDC, 1.0 Amp Max., 0.5 Voltage Drop
LED Lighted Magnetic Piston Position Sensors: Bores 10" & 12"			
Reed Switch	749-111-004	749-111-504	5-240 VDC/VAC, 1 Amp Max., 30 Watt Max., SPST N.O., 3.0 Voltage Drop
Electronic	749-111-031	749-111-531	Sourcing, PNP, 6-24 VDC, 1.0 Amp Max., 0.5 Voltage Drop
Electronic	749-111-032	749-111-532	Sinking, NPN, 6-24 VDC, 1.0 Amp Max., 0.5 Voltage Drop

Female Cordsets for 9-2A197 Series Quick Disconnect Sensors			
Length	1 Meter	2 Meter	5 Meter
Part No.	CFC-1M	CFC-2M	CFC-5M

Female Cordsets for 749 Series Quick Disconnect Sensors		
Length	2 Meter	5 Meter
Part No.	CFC-2M-12	CFC-5M-12

Specifications

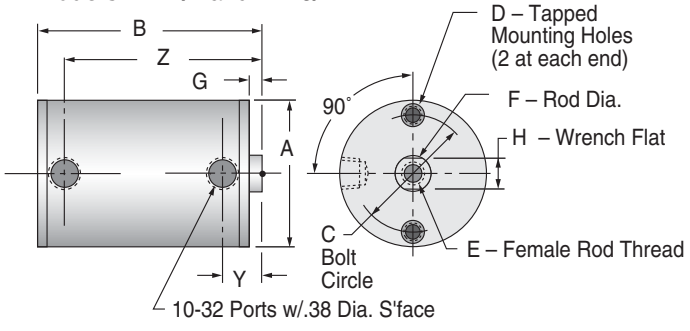
Media ..... Air
Recommended Minimum Pressure ..... 20 psi
Duralon® rod bushing. ..... See chart pg. 5.1
Maximum Operating Pressure ..... 150 psi
Ambient & Media Temperature ..... -25° to + 250°F
Prelubrication ..... Magnalube®-G Grease
Airline Lubrication ..... Recommended

Sizing *Pancake® – Multi-Power®* Cylinders

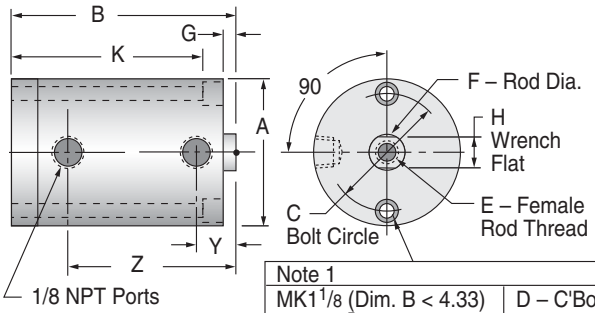
Series Bore	Stages (Pistons)	Area ‡	Equivalent Bore †	Force @ 60 psi	Retract Area	Body O. D.	Available Strokes 1/8"	1/4"	1/2"	3/4"	1"	1-1/2"
MK 1/2	2	.35	.6	20	.15	1.13	•	•	•		•	•
	3	.50	.7	30			•	•	•	•		
	4	.65	.9	35				•	•			
MK 3/4	2	.80	1.0	45	.36	1.50	•	•	•		•	•
	3	1.16	1.1	70			•	•	•	•		
	4	1.52	1.3	90				•	•			
MK 1-1/8	2	1.79	1.5	105	.80	1.99	•	•	•		•	•
	3	2.59	1.8	155			•	•	•	•		
	4	3.39	2.0	200				•	•			
MK 1-5/8	2	3.83	2.2	230	1.76	2.74		•	•		•	•
	3	5.59	2.6	335					•	•		
	4	7.35	3.0	440				•	•			
MK 2	2	5.84	2.6	350	2.70	3.24		•	•		•	•
	3	8.54	3.2	510				•		•		
	4	11.24	3.7	670				•				
MK 2-1/2	2	9.38	3.3	560	4.47	3.74		•	•		•	•
	3	13.85	4.0	830				•		•		
	4	18.32	4.7	1095				•				
MK 3	2	13.70	4.0	820	6.63	4.24		•	•		•	•
	3	20.33	5.0	1215				•		•		
	4	26.96	5.7	1615				•				
MK 4	2	24.35	5.5	1461	11.78	5.50		•	•		•	•
	3	36.13	6.7	2168				•		•		
	4	47.91	7.7	2875				•				

‡ Area = Total effective piston area, square inches. † Equivalent Bore = Bore required for a single piston cylinder.

Models MK 1/2 and **MK 3/4**



Models MK 1-1/8 and **MK 1-5/8**



Note 1	
MK1 1/8 (Dim. B < 4.33) All MK1 5/8	D – C'Bored J – Thru Holes
MK1 1/8 (Dim. B 4.33)	D-Tapped Mtg. Holes (2 at each end)

Fixed Dimensions

Series Bore	A	C	D	J Dia	E	F	G	H	Y
MK 1/2	1.13	0.88	#6-32 x .44 dp	–	8-32 x .38 dp	.25	0.13	3/16 x .11	0.46
MK 3/4	1.50	1.19	#8-32 x .44 dp	–	10-32 x .38 dp	.31	0.13	1/4 x .11	0.46
MK 1-1/8 (Dim. B < 4.33)	1.99	1.69	.32 C'Bore x .19 dp	0.20	5/16-24 x .63 dp	.50	0.14	7/16 x .11	–
MK 1-1/8 (Dim. B ≥ 4.33)	1.99	1.69	#10-32 x .50 dp	–	5/16-24 x .63 dp	.50	0.14	7/16 x .11	–
MK 1-5/8	2.74	2.38	.32 C'Bore x .19 dp	0.20	3/8-24 x .75 dp	.62	0.14	1/2 x .11	0.52
MK 2	3.24	2.81	.38 C'Bore x .26 dp	0.27	1/2-20 x .88 dp	.75	0.14	5/8 x .11	0.52
MK 2-1/2	3.74	3.25	.38 C'Bore x .26 dp	0.27	1/2-20 x .88 dp	.75	0.14	5/8 x .11	0.64
MK 3	4.24	3.81	.38 C'Bore x .26 dp	0.27	1/2-20 x .88 dp	.75	0.14	5/8 x .11	0.64
MK 4	5.50	5.00	.38 C'Bore x .26 dp	0.27	5/8-18 x .88 dp	1.00	0.20	7/8 x .18	0.70

Model Number Code

MK 1-1/8 x **1** x **3 X 1** – **MR**

Series

Bore

1/2"
3/4"
1-1/8"
1-5/8"
2"
2-1/2"
3"
4"

Stroke

See available strokes in the sizing guide on page 5.13

Stages Extend		Stages Retract
2	X	1
3	X	1
4	X	1
1	X	2
1	X	3
1	X	4

Standard available combinations are listed above. Consult factory for Multiple Extend–Multiple Retract Options.

Suffix Options - See pages 5.15 - 5.17

Stroke Collars:	1/8" **-C1**; 1/4" **-C2**; 3/8"	**-C3**
Threaded Nose Mount: Single Rod		**-F**
Double rod, rod end		**-F**
Double rod, cap end		**-F1**
Double rod, both ends		**-F2**
Double Rod		**-DR**
Male rod thread: Single rod		**-MR**
Double rod, rod end		**-MR**
Double rod, cap end		**-MR1**
Double rod, both ends		**-MR2**
Viton seals		**-V**
External guide, nonrotating for load guiding		**-G**
Finish: **ProCoat™**		**-N**
Rubber Bumpers: 1-1/8 Bores & Larger	Rod end	**-BF**
	Cap end	**-BR**
	Both ends	**-BFR**
Adjustable extend stroke 1-1/8 Bores & Larger		**-AS**
Clevis mount:	Ports in-line with slot	**-PM**
	Ports 90° to slot	**-SM**
Eye mount:	Ports in-line with tang	**-EPM**
	Ports 90° to tang	**-ESM**
Magnetic piston & sensor mounting slot(s) Order sensors separately.		**-E**
Extend Port Bushing 3/8 NPT for 2" Bores and Larger		**-E38**
1/4 NPT Ports for 1-5/8" Bores and Larger		**-P14**

Ordering Examples

Model No: Series Bore x Stroke – Stages Extend – Stages Retract

MK 2 X 1 X 2 X 1

Pancake®-Multi-Power®

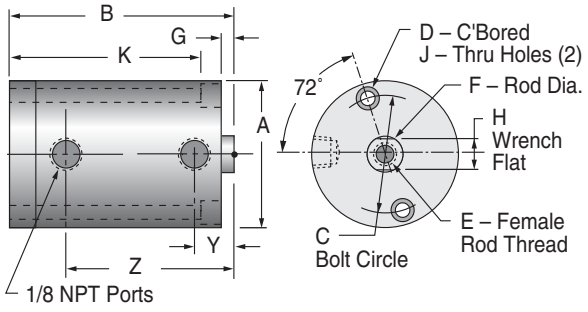
2" Bore, 1" Stroke, 2 Stage Extend, 1 Stage Retract

MK 1-1/8 X 1/2 X 4 X 1-MR

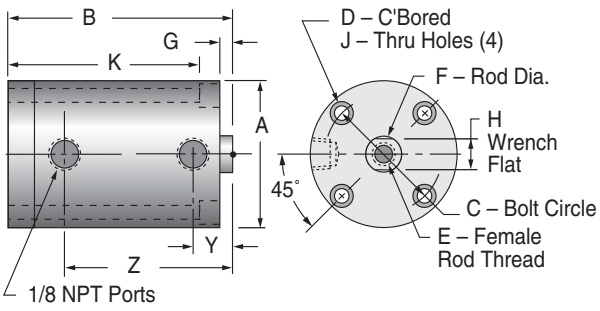
Pancake®-Multi-Power®

1 1/8" Bore, 1/2" Stroke, 4 Stage Extend, 1 Stage Retract, Male Rod

Model MK 2



Models MK 2-1/2, MK 3, and **MK4**

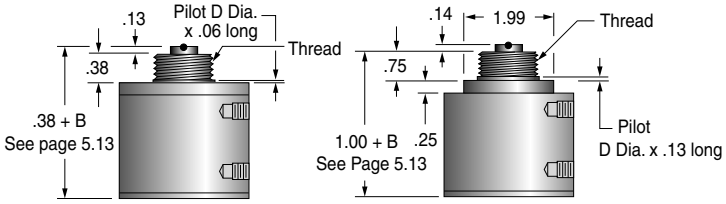


Variable Dimensions

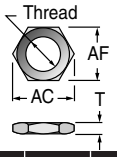
Series Bore		MK 1/2		MK 3/4		MK 1-1/8				MK 1-5/8			MK 2			MK 2-1/2			MK 3			MK 4		
	Stroke	B	Z	B	Z	B	K	Y	Z	B	K	Z	B	K	Z	B	K	Z	B	K	Z	B	K	Z
2 Stages extend	1/8	1.88	1.55	1.88	1.55	2.36	2.03	0.52	1.52	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	1/4	2.13	1.80	2.13	1.80	2.61	2.28	0.52	1.77	3.30	2.97	2.96	3.52	3.13	3.02	3.39	3.00	2.89	3.45	3.10	2.96	3.70	3.25	3.21
	1/2	2.88	2.55	2.88	2.55	3.30	2.96	0.70	2.45	3.80	3.47	3.46	4.02	3.63	3.52	3.89	3.50	3.39	3.95	3.55	3.46	4.20	3.75	3.71
	1	3.88	3.55	3.88	3.55	4.33	note1	0.99	3.49	4.80	4.47	4.46	5.02	4.63	4.52	4.89	4.50	4.39	4.95	4.55	4.46	5.20	4.75	4.71
	1-1/2	4.88	4.55	4.88	4.55	5.33	note1	0.99	4.49	5.80	5.47	5.46	6.02	5.63	5.52	5.89	5.50	5.39	5.95	5.55	5.46	6.20	5.75	5.71
3 Stages extend	1/8	2.38	2.05	2.38	2.05	2.86	2.53	0.52	2.02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	1/4	2.88	2.55	2.88	2.55	3.74	3.40	0.89	2.89	NA	NA	NA	5.02	4.63	4.52	4.89	4.50	4.39	4.95	4.55	4.46	5.20	4.75	4.71
	1/2	3.88	3.55	3.88	3.55	4.33	note1	0.99	3.49	4.80	4.47	4.46	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	3/4	4.88	4.55	4.88	4.55	5.33	note1	0.99	4.49	5.80	5.47	5.46	6.02	5.63	5.52	5.89	5.50	5.39	5.95	5.55	5.46	6.20	5.75	5.71
4 Stages extend	1/4	3.88	3.55	3.88	3.55	4.33	note1	0.99	3.49	4.80	4.47	4.46	6.02	5.63	5.52	5.89	5.50	5.39	5.95	5.55	5.46	6.20	5.75	5.71
	1/2	4.88	4.55	4.88	4.55	5.33	note1	0.99	4.49	5.80	5.47	5.46	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Threaded Nose Mount **Option -F** *Available on 1/2" to 1-5/8" Bore Models*

1/2" & 3/4" Bores **1-1/8" & 1-5/8" Bore**



Nut is included.

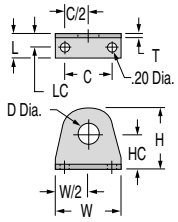


Bore	D Pilot	Thread	Nut Part No.	AC	AF	T
1/2"	.495-.491	1/2" – 20	**MC-500-195**	0.72	0.63	.25
3/4"	.620-.615	5/8" –18	**MC-700-195**	0.88	0.75	.25
1-1/8"	1.000 -.995	1" –14	**12100-195**	1.59	1.38	.19
1-5/8"	1.250-1.245	$1\frac{1}{4}$"-12	**22100-195**	1.88	1.63	.25

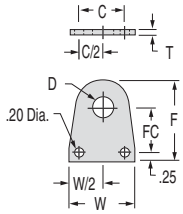
Plated steel nose mounting brackets *Must be ordered separately*

Bore	Part No.	C	D	F	FC	H	HC	L	LC	T	W
1/2"	**BRK-201**	1.13	.50	–	–	1.31	.75	.63	.38	.09	1.50
1/2"	**BRK-202**	1.13	.50	1.80	0.99	–	–	–	–	.09	1.50
3/4"	**BRK-301**	1.25	.63	–	–	1.75	1.00	.69	.44	.12	1.80
3/4"	**BRK-302**	1.25	.63	2.25	1.25	–	–	–	–	.12	1.80

BRK-201 & BRK-301

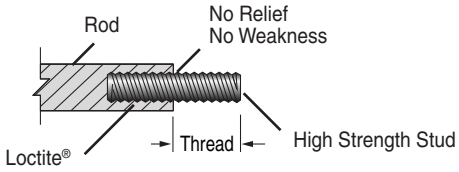


BRK-202 & BRK-302



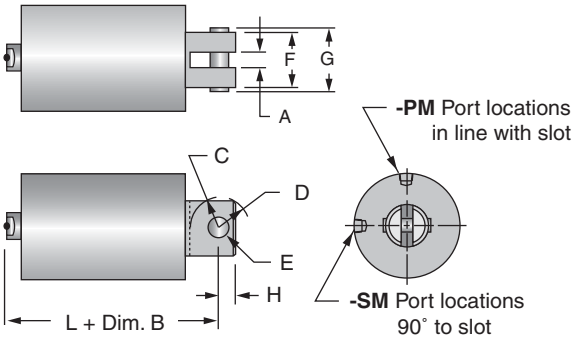
Male Rod Thread **Option**

Single Rod	**-MR**
Double Rod, Rod End Only	**-MR**
Double Rod, Cap End Only	**-MR1**
Double Rod, Both Ends	**-MR2**



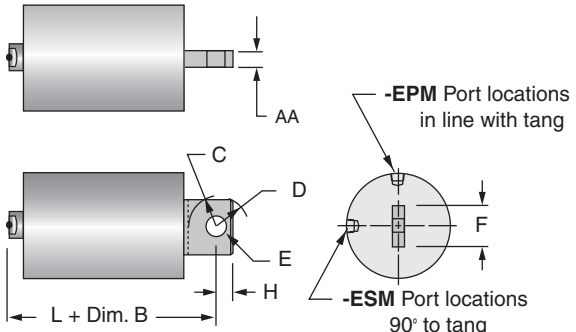
Bore	Thread
1/2"	8-32 x .50
3/4"	10-32 x .50
1-1/8"	5/16–24 x .75
1-5/8"	3/8–24 x .88
2"	1/2–20 x 1.00
2-1/2"	1/2–20 x 1.00
3"	1/2–20 x 1.00
4"	5/8-18 X 1.25

Clevis Mount **Option -PM & -SM**



See pages 5.13 & 5.14

Pivot Mount Option -EPM & -ESM (Available 1/2" thru 2" Bore)



See pages 5.13 & 5.14

Bore	A	AA	C	D	E Hole	E Pin	F	G	H	L
1/2"	.25	.23	0.41	0.34	.251	.250	0.63	0.83	.25	0.56
3/4"	.25	.23	0.41	0.34	.251	.250	0.63	0.83	.25	0.56
1-1/8"	.31	.30	0.69	0.56	.3135	.3125	1.00	1.21	.37	0.94
1-5/8"	.38	.35	0.69	0.68	.376	.3750	1.25	1.48	.37	1.00
2"	.38	.36	0.69	0.68	.376	.3750	1.25	1.48	.37	1.00
2-1/2"	.50	NA	0.97	0.90	.501	.500	1.63	1.86	.50	1.38
3"	.50	NA	0.97	0.90	.501	.500	1.63	1.86	.50	1.38
4"	.63	NA	1.22	1.06	.626	.625	2.00	2.24	.63	1.75

Pro-Coat™ **Option -N**

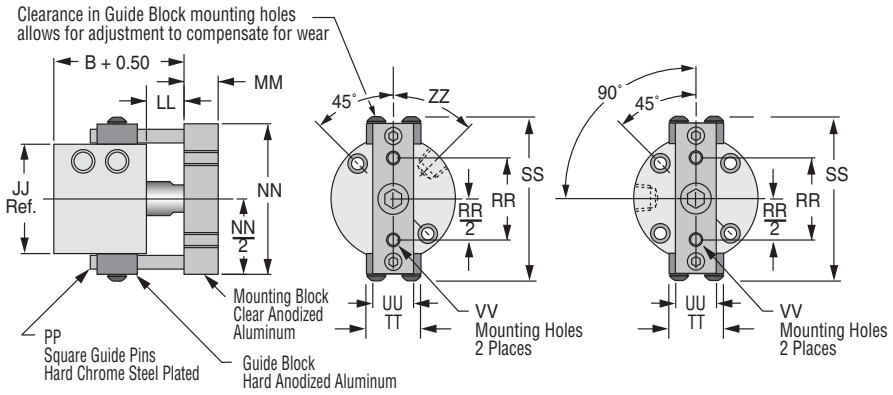
Electroless Nickel plating

Consult Engineering for specific application requirements

Electroless Nickel plating is a hard, smooth, corrosion & wear resistant coating that will often suffice for applications where stainless steel is specified. The coating is a high nickel low phosphorous alloy deposited by chemical reduction without electric current that is more corrosion resistant than plated nickel. Its lasting luster provides high eye appeal. It has natural lubricity & high resistance to abrasion. Standard hardness of the coating is approximately 49 Rockwell C. Heat treating can increase hardness to 60 Rockwell C.

External Guide, Nonrotating

Option -G



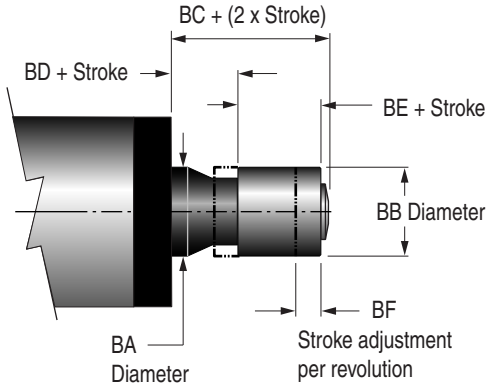
Superior nonrotating piston rod feature for applications such as package placement, figure stamping, and any application where anti-rotation and registration are critical as the piston is extended and retracted.

A mounting block is bolted to the piston rod. This block has two square pins mounted to it which in turn pass through guide blocks mounted on the sides of the cylinder.

Bore	3/4"	1-1/8"	1-5/8"	2"	2-1/2"	3 "	4"
JJ	1.50	1.99	2.74	3.24	3.74	4.24	5.50
LL	0.63	0.64	0.64	0.64	0.64	0.64	0.70
MM	0.63	0.63	0.63	0.75	0.75	1.00	1.25
NN	2.20	2.75	3.50	4.00	4.56	5.06	6.32
PP	0.19	0.25	0.25	0.25	0.31	0.31	0.31
RR	0.88	1.06	1.50	1.88	1.88	1.88	1.88
SS	2.30	3.13	3.85	4.37	4.88	5.38	7.09
TT	0.75	1.00	1.00	1.00	1.00	1.00	1.00
UU	0.63	0.63	0.75	1.00	1.00	1.00	1.25
VV	#6-32	#8-32	1/4-20	5/16-18	5/16-18	5/16-18	5/16-18
ZZ	45°	45°	45°	63°	–	–	–

Adjustable Extend Stroke Option -AS

Available on bores 1-1/8" and larger. See description on page 5.9.



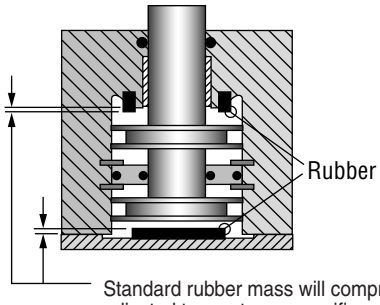
Bore	1-1/8"	1-5/8"	2"	2-1/2"	3"	4"	
BA	1.13	1.13	1.50	1.50	1.50	1.50	
BB	1.50	1.50	2.00	2.00	2.00	2.00	
BC	1.16	1.16	1.41	1.41	1.41	1.41	+ (2 x Stroke)
BD	.50	.50	.50	.50	.50	.50	+ Stroke
BE	.50	.50	.75	.75	.75	.75	
BF	.050	.050	.063	.063	.063	.063	

Note! Use caution when mounting to avoid creating pinch points with other parts of your machine design.

Rubber Bumpers

Rod End Only	**-BF**
Cap End Only	**-BR**
Both Ends	**-BFR**

Temperature Range
(-25° to + 220°F)



A donut or pad of rubber is bonded in place to reduce noise and absorb energy, thus reducing destruction of the cylinder and tooling due to pounding. See complete description of benefits on page 5.9.

Standard rubber mass will compress and give full stroke at 60 to 80 psi. This mass can be adjusted to meet your specific pressure and/or dynamic load requirements.

Extend Port Bushing **-E38**
3/8 NPT for 2" Bores & Larger

Use when higher cycle speeds are required.

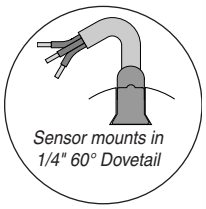
1/4 NPT Ports **-P14**
for 1-5/8" Bores & Larger

Series MK Option Specifications

Magnetic Piston **Option -E**

For 1-1/8" Bore and larger
Includes Dovetail Mounting Slots

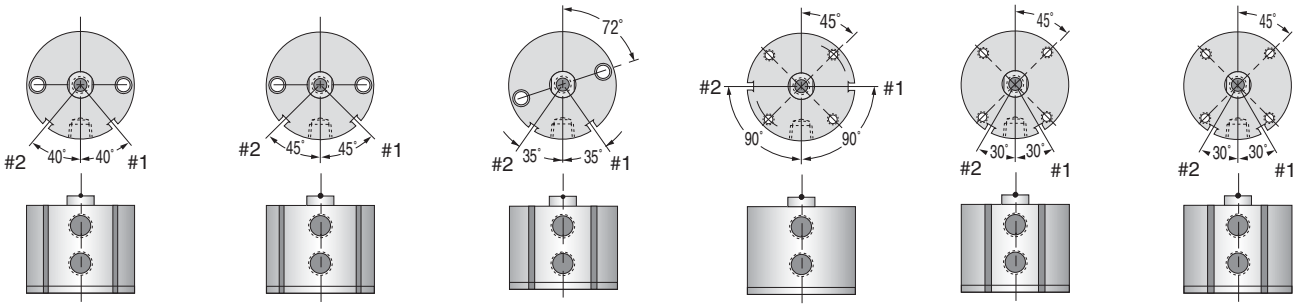
Order Sensors Separately



A single slot on longer stroke models has room to accommodate multiple sensors.

Shorter stroke cylinders are furnished with two dovetail mounting slots when Suffix Option "E" is specified.

MK1-1/8 **MK1-5/8** **MK2** **MK2-1/2** **MK3** **MK4**

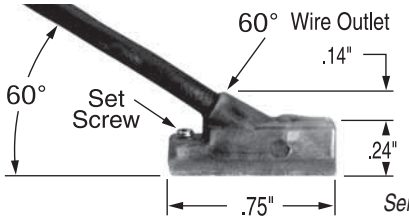


1/8" to 1" stroke models have 2 mounting slots. 1-1/2" stroke models have 1 slot at position #1. Ports are in-line for all Bores, all Strokes.

Low Profile, Solid State,
Magnetic Piston Position Sensors

Temperature Range:
–20° to +80°C (–4° to +176°F)

Female Cordsets for Quick Disconnect	Length	Part No.
	1 Meter	CFC-1M
	2 Meters	CFC-2M
	5 Meters	CFC-5M



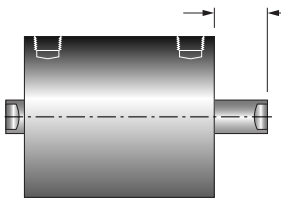
Sensor housing rated NEMA 6/IP67. Encased in plastic housing, dovetail style sensors are corrosion resistant. 60° wire outlet allows close mounting. Profile shown here is typical.

Ordering Guide – Dovetail Style Magnetic Sensors

Cylinder Model	Sensor Type	Prewired 9 ft. Part No.	Quick Disconnect Part No.*	LED	Electrical Characteristics
Series MK	Electronic	949-000-031	949-000-331	Yes	Sourcing, PNP, 5-28 VDC, 0.20 Amp Max current, 1.0 Voltage Drop
	Electronic	949-000-032	949-000-332	Yes	Sinking, NPN, 5-28 VDC, 0.20 Amp Max current, 1.0 Voltage Drop

Note: Quick disconnect style sensors are supplied with 6" pigtail. Order female cordsets separately.*

Double Rod **Option -DR**



Standard piston rod and rod bushing on both ends of the cylinder.

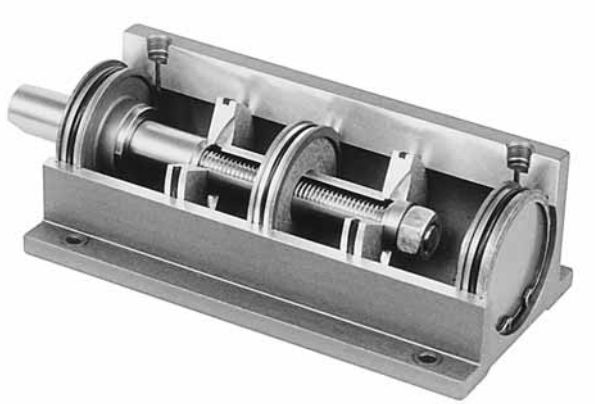
Bore	1/2"	3/4"	1-1/8"	1-5/8"	2"	2-1/2"	3"	4"
G	0.13	0.13	0.14	0.14	0.14	0.14	0.14	0.20

Viton Seals **Option -V**

Use for elevated temperatures (–15° to + 400°F) or compatibility with exotic media. Consult engineering for compatibility information.

Series MQ, MQF, MQL

Square 1®–Multi-Power®



Specifications

Media ..... Air
Recommended Minimum Pressure ..... 20 psi
Maximum Operating Pressure ..... 150 psi
Ambient & Media Temperature ..... -25° to +250°F
Prelubrication ..... Magnalube®-G Grease
Airline Lubrication ..... Recommended

Sizing *Square 1® – Multi-Power®* Cylinders

Series	Bore	Stages (Piston)	Area ‡	Equivalent Bore †	Force @ 60 psi	Retract Area	Available Strokes							
							1/8"	1/4"	1/2"	3/4"	1"	1-1/2"	2"	2-1/2"
MQ MQW MQF MQFW MQL MQLW	3/4"	2	.80	1	48	.36		•	•	•	•	•		
	7/8"	2	1.12	1-3/16	67	.52		•	•	•	•	•		
	1-1/8"	2	1.79	1-1/2	107	.80	•	•	•		•	•	•	•
	1-5/8"	2	3.83	2-1/8	229	1.76	•	•	•		•	•	•	•
	2"	2	5.84	2-5/8	350	2.70		•	•		•	•	•	•

‡ Area = Total effective piston area, square inches. † Equivalent Bore = Bore required for a single piston cylinder.

5

How to Order

Model Number Code

MQL GW 1-1/8 X 1 X 2 X 1 – DR - MR1

Mounting

MQ Side Tap

MQF Face

MQL Side Lug

Rod Extension

Single Rod Models

Blank –for **standard** extension per dimension "G"
W - for **Extension** to dimension "W"

Double Rod Models

Blank –"G" extension both ends
W –"W" extension both ends
GW – "G" extension on rod end; "W" extension on cap end
WG – "W" extension on rod end; "G" extension on cap end

Bore

3/4"
7/8"
1-1/8"
1-5/8"
2"

Standard Strokes Inches

For strokes available See chart above

Stages Extend Stages Retract

2 X 1
1 X 2

Standard available combinations are listed above.

OPTIONS

See pages 5.20 - 5.22

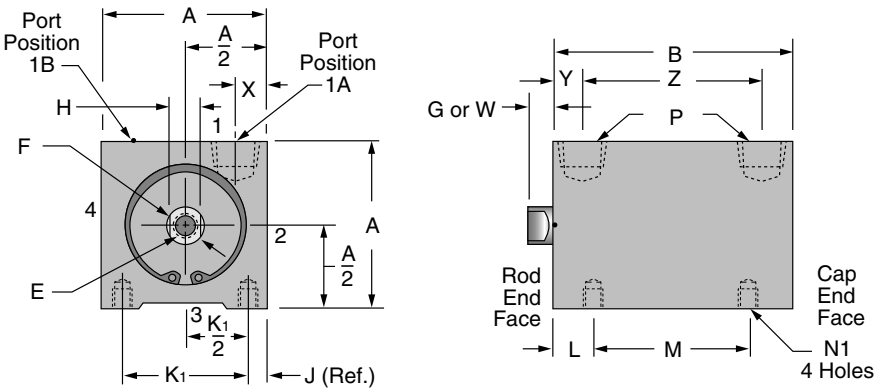
Description	Specify
Male Rod Thread	
Single Rod	-MR
Double Rod, Rod End	-MR
Double Rod, Cap End	-MR1
Double Rod, Both Ends	-MR2
Viton Seals:-15° to + 400°F	-V
Metric Rod Thread	-M
Port Positions (page 5.19)	-1B
External Guide, Nonrotating	-G
Double Rod	-DR
Magnetic piston and sensor mounting slot(s) Order sensors separately.	-E

Ordering Example: MQL GW 1-1/8 X 1 X 2 X 1 - DR - MR1

Model number code above describes Square 1® Multi-Power® side lug mount cylinder with "G" rod extension on rod end; "W" rod extension on cap end; 1-1/8" bore; 1" stroke; 2 stages extend; 1 stage retract; double rod; male rod on cap end.

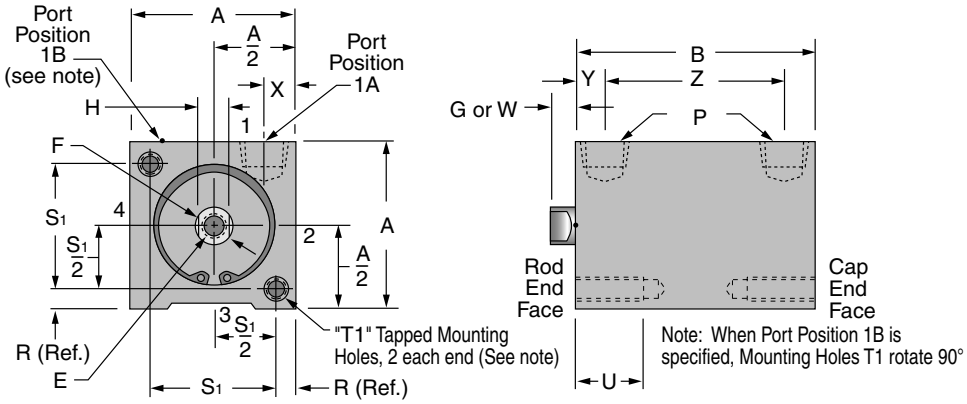
MQ Series: Side Tap Mounting

Bore availability:
3/4", 1-1/8", 1-5/8", 2"



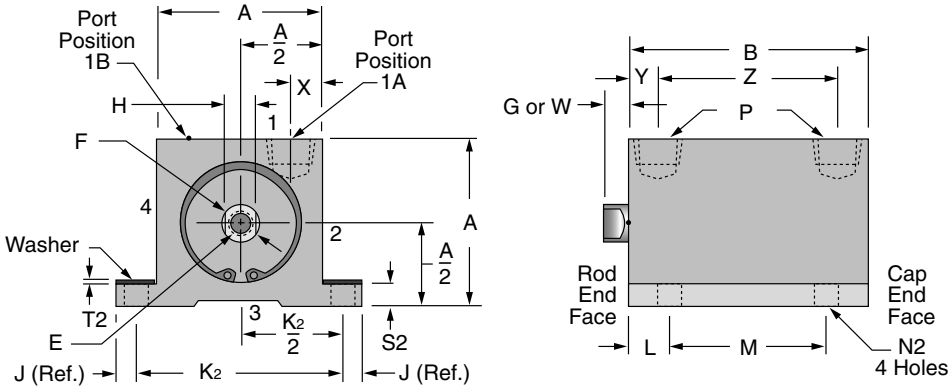
MQF Series: Face Mounting

Bore availability:
3/4", 1-1/8", 1-5/8", 2"



MQL Series: Side Lug Mounting

Bore availability:
7/8", 1-1/8", 1-5/8", 2"



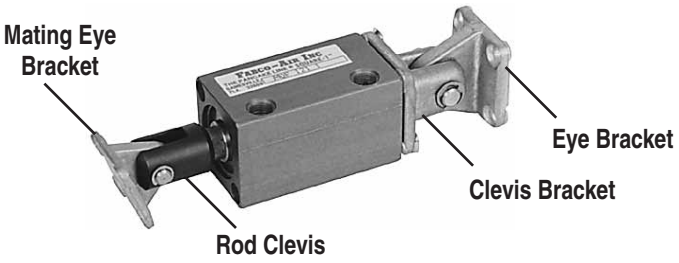
Variable Dimensions

	3/4" & 7/8" Bores			1-1/8" Bore			1-5/8" Bore			2" Bore		
Stroke	B	Z	M	B	Z	M	B	Z	M	B	Z	M
1/8"	–	–	–	2.69	1.69	1.50	2.94	1.88	1.63	–	–	–
1/4"	2.27	1.49	1.25	3.19	2.19	2.00	3.44	2.38	2.13	3.61	2.38	2.25
1/2"	2.77	1.99	1.75	3.69	2.69	2.50	3.94	2.88	2.63	4.11	2.88	2.75
3/4"	3.27	2.49	2.25	–	–	–	–	–	–	–	–	–
1"	4.27	3.49	3.25	4.69	3.69	3.50	4.94	3.88	3.63	5.11	3.88	3.75
1-1/2"	5.27	4.49	4.25	5.69	4.69	4.50	5.94	4.88	4.63	6.11	4.88	4.75
2"	–	–	–	6.69	5.69	5.50	6.94	5.88	5.63	7.11	5.88	5.75
2-1/2	–	–	–	7.69	6.69	6.50	7.94	6.88	6.63	8.11	6.88	6.75

Fixed Dimensions

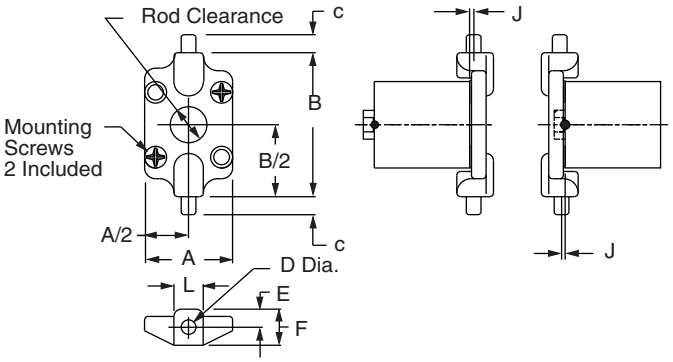
Bore	A	E	F Dia.	G	H	J	K1	K2	L	N1	N2	P	R	S1	S2	T1	T2	U	W	X	Y
3/4"	1.25	10-32x.38dp	.31	.13	1/4	.19	.88	–	.51	10-24x.25	–	10-32	.19	.88	–	1/4-20x.75dp	–	.75	.38	.31	.39
7/8"	1.25	10-32x.38dp	.31	.13	1/4	.19	–	1.63	.51	–	.21	10-32	–	–	.19	–	.02	–	.38	.31	.39
1-1/8"	1.50	5/16-24x.63dp	.50	.19	7/16	.19	1.13	1.88	.59	10-24x.25	.21	1/8	.19	1.13	.19	1/4-20x.75dp‡	.02	.75	.38	.28	.50
1-5/8"	2.00	3/8-24x.75dp	.62	.19	1/2	.25	1.50	2.50	.66	1/4-20x.31	.27	1/8	.25	1.50	.25	1/4-20x.75dp‡	.03	.75	1.00	.31	.54
2"	2.50	1/2-20x.88dp	.75	.19	5/8	.25	2.00	3.00	.68	5/16-18x.38	.27	1/8	.25	2.00	.31	5/16-18x.75dp*	.03	.75	1.00	.38	.62

‡Note: 1-1/8" & 1-5/8" bores,1/8 stroke only: .20 Dia. thru, .32 dia. C'Bore x .19 deep for #10 SHCS and 1/4-20 x .75 deep tapped mounting holes, 2 places each end
*Note: 2" bore,1/4 stroke only: .27 Dia. thru, .38 dia. C'Bore x .26 deep for 1/4" SHCS and 5/16-18 x .75 deep tapped mounting holes, 2 places each end



Bore	Rod End Stroke	Rod End Rod Clevis English	Rod End Rod Clevis Metric	Rod End Mating Eye Bkt.	Cap End Clevis Bracket	Cap End Eye Bracket
3/4"	All	RC-19	MRC-19	EM-02	PM-04	EM-04
1-1/8"	All	RC-31	MRC-31	EM-04	PM-121	EM-121
1-5/8"	All	RC-38	MRC-38	EM-121	PM-221	EM-221
2"	1/4	RC-54	MRC-54	EM-121	PM-321	EM-321
2"	1/2 Up	RC-56	MRC-56	EM-121	PM-321	EM-321

Trunnion Mount Kit

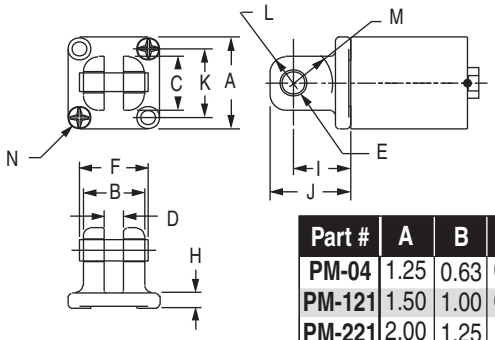


Materials
Bracket: High strength Zinc die casting
Pivot Pins: Precision dowel pins
Mounting screws: 4, Steel, plated or black oxided

Bore	Kit No.	A	B	C	D	E	F	J	L
3/4"	TR-04	1.25	2.00	.25	.1253	.25	.50	.07	.38
1-1/8"	TR-121	1.50	2.50	.31	.2503	.31	.63	.06	.50
1-5/8"	TR-221	2.00	3.00	.31	.2503	.44	.81	.06	.63
2"	TR-321	2.50	3.75	.31	.2503	.44	.94	.06	.75

5

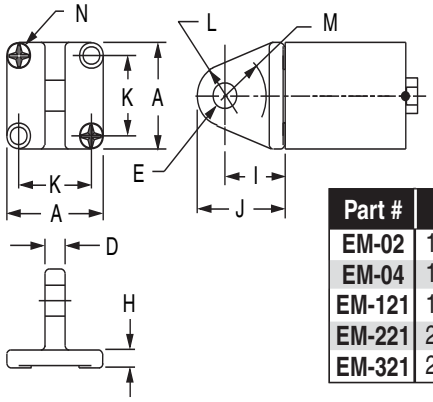
Clevis Bracket Kit



Materials
Bracket: High strength Zinc die casting
Bushings: Oil filled powdered metal
Pin: 416 Stainless Steel
Clips: 2, Plated steel
Screws: 4, Steel, plated or black oxided

Part #	A	B	C	D	E Pin	E Hole	F	H	I	J	K	L	M	N
PM-04	1.25	0.63	0.63	0.25	.250	.251	0.83	.16	0.56	0.81	0.88	.30	.41	1/4-20x.75
PM-121	1.50	1.00	0.88	0.31	.3125	.3135	1.21	.25	0.94	1.32	1.13	.46	.69	1/4-20x.75
PM-221	2.00	1.25	1.25	0.38	.375	.376	1.48	.31	1.00	1.38	1.50	.52	.69	1/4-20x1.00
PM-321	2.50	1.25	1.25	0.38	.375	.376	1.48	.31	1.00	1.38	2.00	.52	.69	5/16-18x1.00

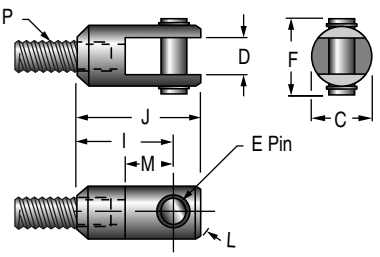
Eye Bracket Kit



Materials
Bracket: High strength Zinc die casting
Bushings: Oil filled powdered metal
Screws: 4, Steel, plated or black oxided.
*Special 1/4-20 with #13 Phillips Head

Part #	A	D	E	H	I	J	K	L	M	N
EM-02	1.25	.18	.1885	.16	0.56	0.87	0.88	.31	.36	1/4-20x.75 FHMS*
EM-04	1.25	.23	.251	.16	0.56	0.87	0.88	.31	.41	1/4-20x.75 FHMS*
EM-121	1.50	.30	.3135	.25	0.94	1.38	1.13	.44	.69	1/4-20x.75 FHMS*
EM-221	2.00	.36	.376	.31	1.13	1.69	1.50	.56	.81	1/4-20x1.00 FHMS*
EM-321	2.50	.36	.376	.31	1.13	1.69	2.00	.56	.81	5/16-18x1.00 FHSCS

Rod Clevises

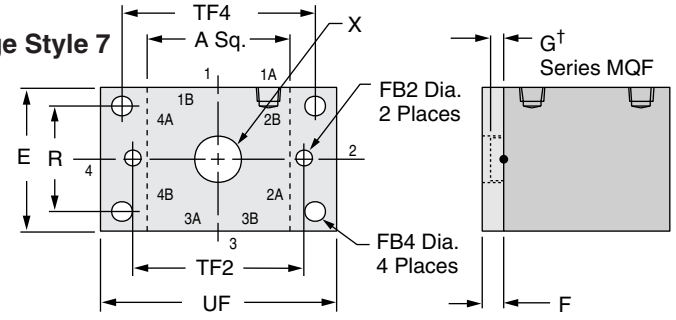


Materials
Clevis and Stud: Steel, black oxided
Pin: 416 Stainless Steel
Clips: Steel, plated

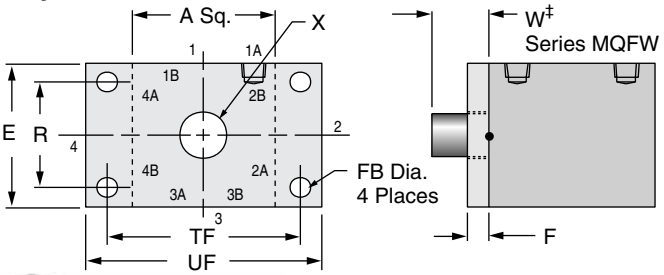
Part #	C	D	E PIN	F	I	J	L	M	P English	P Metric
RC-19,MRC-19	0.50	.19	.1870	0.70	0.75	1.00	.33	.38	10-32x.25	M5x6.3mm
RC-31, MRC-31	0.75	.25	.2495	0.96	0.88	1.16	.39	.50	5/16-24x.38	M8x9.7mm
RC-38, MRC-38	1.00	.32	.3120	1.21	1.25	1.63	.61	.63	3/8-24x.37	M10x9.4mm
RC-54, MRC-54	1.00	.32	.3120	1.21	1.31	1.69	.61	.63	1/2-20x.39	M12x9.9mm
RC-56, MRC-56	1.00	.32	.3120	1.21	1.31	1.69	.61	.63	1/2-20x.62	M12x15.7mm

Flange Mounting Kits for Series MQF and MQFW

Flange Style 7



Flange Style 8 & 9



Flange Style	Bore Size	Fabco Kit No.	Mounting Hole Pattern Interchange Information
7	3/4"	H7-04	**4 Hole Pattern** C&C: 1-1/8" Bore, Series T, F, & R Mosier: 1-1/8" Bore, Series TAV, 8 & 9 PHD: 1-1/8" Bore, Series AV, RF, & CF **2 Hole Pattern** Compact Air: 3/4" Bore, Style S, FF, & RF
7	1-1/8"	H7-121	**4 Hole Pattern** C&C: 1-1/8" Bore, Series T, F, & R Mosier: 1-1/8" Bore, Series TAV, 8 & 9 PHD: 1-1/8" Bore, Series AV, RF, & CF **2 Hole Pattern** Compact Air: 1-1/8" Bore, Style S, FF, & RF
7	1-5/8	H7-221	**4 Hole Pattern** NFPA COde MF1 & MF2 for 1-1/2" Bore All brands conforming to this code **2 Hole Pattern** Compact Air:1-5/8" Bore, Style S, FF, & RF
8	2"	H8-321	**4 Hole Pattern** NFPA COde MF1 & MF2 for 2" Bore All brands conforming to this code
9	2"	H9-321	**4 Hole Pattern** Compact Air:2" Bore, Style S, FF, & RF
Kits include Flange and 2 Flange Mounting Screws			

SQFW-121X1-1/2
with H7-121

Port Positions 1A Standard all models. • To achieve 2A, 3A or 4A, rotate flange.
• For 1B, specify Option -1B • For 2B, 3B, or 4B: Specify Option -1B and rotate flange

Bore	Model	Style	Kit #	A	E	F	FB	FB2	FB4	G†	R	TF	TF2	TF4	UF	W‡	X
3/4"	04	7	H7-04	1.25	1.50	.25	NA	.22	.22	.13	1.00	NA	1.75	2.00	2.50	.38	.38
1-1/8"	121	7	H7-121	1.50	1.50	.25	NA	.22	.22	.19	1.00	NA	2.00	2.00	2.50	.38	.56
1-5/8"	221	7	H7-221	2.00	2.00	.38	NA	.22	.31	.19	1.43	NA	2.50	2.75	3.38	1.00	.69
2"	321	8	H8-321	2.50	2.50	.38	.38	NA	NA	.19	1.84	3.38	NA	NA	4.13	1.00	.81
2"	321	9	H9-321	2.50	2.50	.38	.38	NA	NA	.19	2.00	3.00	NA	NA	3.50	1.00	.81

External Guide, Nonrotating

Option -G

Superior nonrotating piston rod feature for applications such as package placement, figure stamping, and any application where anti-rotation and registration are critical as the piston is extended and retracted.

A mounting block is bolted to the piston rod. This block has two square pins mounted to it which in turn pass through guide blocks mounted on the sides of the cylinder.

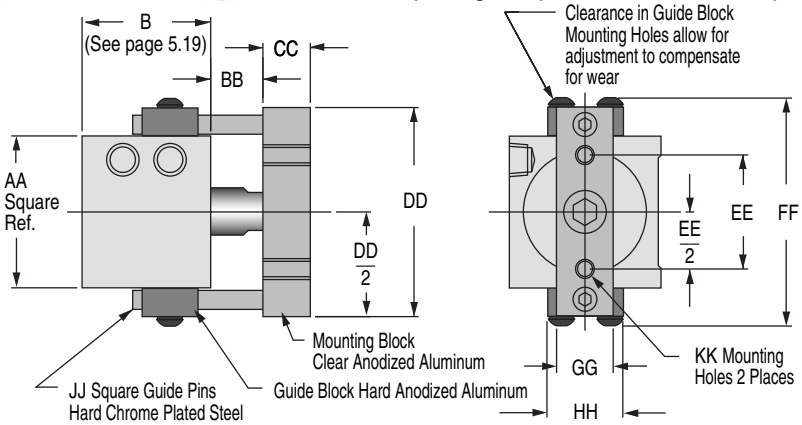
• Square guide pins are hard chrome plated steel for long wear and corrosion resistance.

• Guide blocks are hard anodized aluminum for long wear and corrosion resistance.

• Clearance in guide block mounting holes provide for adjustment and backlash control, compensation for wear, and minimal rotation.

• Extended distance between guides provides superior nonrotation and support.

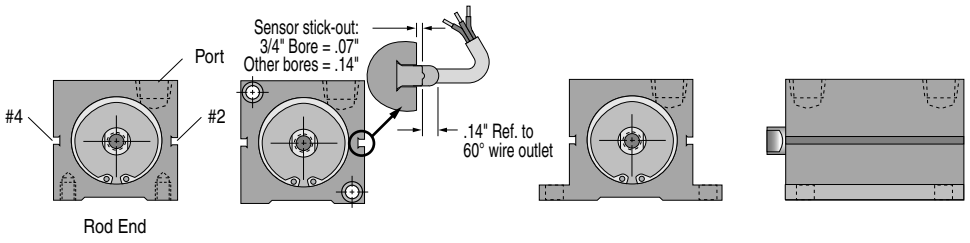
• Extended piston rod provides clearance between cylinder and guide bar mounting block to eliminate pinch points.



Mounting Series MQ or MQF				
Bore	3/4"	1 1/8"	1 5/8"	2"
AA	1.25	1.50	2.00	2.50
BB	.63	.69	.69	.69
CC	.63	.63	.63	.75
DD	1.94	2.26	2.75	3.25
EE	.87	1.06	1.50	1.88
FF	2.19	2.50	3.00	3.50
GG	.63	.63	.75	1.00
HH	1.00	1.00	1.00	1.00
JJ	.19	.25	.25	.25
KK	#6-32	#8-32	1/4-20	5/16-18

Magnetic Piston Option-E
Includes Dovetail Mounting Slots
Order Sensors Separately

- ***Dovetail style sensors*** are actuated by a magnetic piston.
- Sensor dovetail slides into a mating slot on the cylinder body, is positioned as desired, and locked in place with a slotted set screw.
- Magnetic piston and 1/4" Dovetail mounting slot(s) are specified with Suffix Option "E" in the model number.
- ***Order sensors separately.***



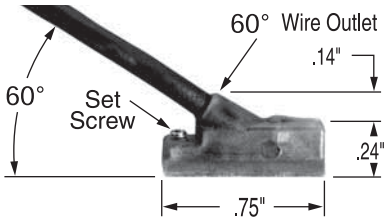
MQ Profile ***MQF Profile*** ***MQL Profile***

Standard Stroke & Slot Location Guide

	Stroke	MQ (Side Tap) 3/4"	MQ 1 1/8"	MQ 1 5/8"	MQ 2"	MQF (Face Mount) 3/4"	MQF 1 1/8"	MQF 1 5/8"	MQF 2"	MQL (Side Lug) 7/8"	MQL 1 1/8"	MQL 1 5/8"	MQL 2"
Sensor slots at positions #2 and #4	1/8	–	✓	✓	–	–	✓	✓	–	–	✓	✓	–
	1/4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	1/2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	3/4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Sensor slot at position #2 only	1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	1-1/2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	2	–	✓	✓	✓	–	✓	✓	✓	–	✓	✓	✓
	2-1/2	–	✓	✓	✓	–	✓	✓	✓	–	✓	✓	✓

Low Profile, Solid State,
Magnetic Piston Position Sensors

Female Cordsets for Quick Disconnect	Length	Part No.
	1 Meter	CFC-1M
	2 Meters	CFC-2M
	5 Meters	CFC-5M



Sensor housing rated NEMA 6/IP67. Encased in plastic housing, dovetail style sensors are corrosion resistant. 60° wire outlet allows close mounting. Profile shown here is typical.

Dovetail Style Magnetic Sensors

Temperature Range: 20° to +80°C (–4° to +176°F)

Cylinder Model	Sensor Type	Prewired 9 ft. Part No.	Quick Disconnect Part No.*	LED	Electrical Characteristics
Series MQ, MQF & MQL	Electronic	949-000-031	949-000-331	Yes	Sourcing PNP 5-28 VDC, 0.20 Amp Max current, 1.0 Voltage Drop
	Electronic	949-000-032	949-000-332	Yes	Sinking NPN 5-28 VDC, 0.20 Amp Max current, 1.0 Voltage Drop

Note: Quick disconnect styles are supplied with 6 inch pigtail with male connector. Order female cordsets separately.*

Male Rod Thread Option

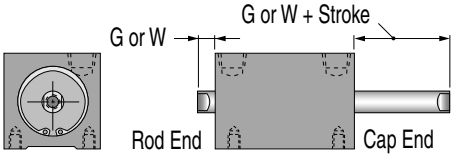
Single Rod	**-MR**
Double Rod, Rod End Only	**-MR**
Double Rod, Cap End Only	**-MR1**
Double Rod, Both Ends	**-MR2**

Metric Rod Thread Option -M

St'd Inch Thread	Bore	Female Rod Thread	Pitch	Male Rod Thread x Length
10-32 x .50	3/4	M5	0.8	M5 x 12.7
10-32 x .50	7/8	M5	0.8	M5 x 12.7
5/16-24 x .75	1-1/8	M8	1.25	M8 x 19.0
3/8-24 x .88	1-5/8	M10	1.50	M10 x 22.2
1/2-20 x 1.00	2	M12	1.75	M12 x 25.4

Double Rod Option -DR

Blank– "G" both ends.
W– "W" extension both ends.
GW– "G" extension rod end; "W" extension cap end.
WG– "W" extension rod end; "G" extension cap end.



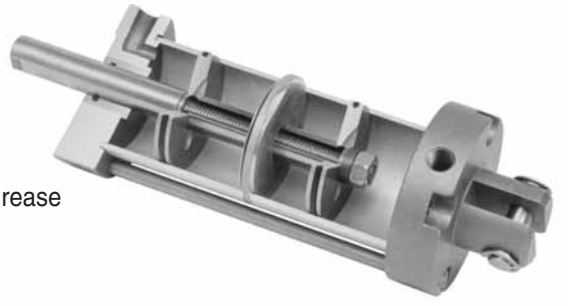
Rod Extension Dimensions					
Bore	3/4"	7/8"	1 1/8"	1 5/8"	2"
G	.13	.13	.19	.19	.19
W	.38	.38	.38	1.00	1.00

Series MLR & MLS

How to Order

Specifications

Media.....Air
Recommended Minimum Pressure .....20 psi
Maximum Operating Pressure.....150 psi
Ambient & Media Temperature .....–25° to +250°F
Prelubrication .....Magnalube®-G Grease
Airline Lubrication.....Recommended



Model Number Code

MLR 2 X 3 X 2 X 1 PM – MR

Series / Bore

Series	Bore
MLR Round head	2
	2-1/2"
	3"
MLS Square head	4"

Stroke

Standard strokes: 1/2", 1", 1-1/2", 2", 2-1/2", 3", 4", 5", 6"

(Optional – any other stroke 0" thru 12")

Stages Extend / Stages Retract

Stages Extend		Stages Retract
2	X	1
3	X	1
4	X	1
1	X	2
1	X	3
1	X	4

Standard available combinations are listed above. Consult factory for Multiple Extend–Multiple Retract Options.

Mounting

Extended Tie Rods
- Rod end only . . . . . **WF**
- Cap end only . . . . . **WR**
- Rod and Cap Ends. . . . . **WFR**

Clevis Mount
Round head only
- Ports in-line with slot . . . . . **PM**
- Ports 90° to slot . . . . . **SM**

OPTIONS

See pages 5.11, 5.25 - 5.28

Description	Specify
Double Rod	-DR
Nonrotating Single Rod ‡	-NR
Nonrotating Double Rod ‡	-NRDR
Male Rod Thread	
Single Rod	-MR
Double Rod, Rod End	-MR
Double Rod, Cap End	-MR1
Double Rod, Both Ends	-MR2
Viton Seals (-15° to +400°F)	-V
Shock & Speed Control using hydraulics ‡	-HS
Rubber Bumpers	
Rod End	-BF
Cap End	-BR
Both Ends	-BFR
Adjustable Extend Stroke	-AS
3/8 NPT Ports in Heads	-P38
High Flow Vents	-HF
Port Positions All Ports	
Position #1	Standard
Position #2	-PA2
Position #3	-PA3
Position #4	-PA4
Rod End Position #1	Standard
Position #2	-PR2
Position #3	-PR3
Position #4	-PR4
Cap End Position #1	Standard
Position #2	-PC2
Position #3	-PC3
Position #4	-PC4
Atmospheric Vent or Ported Baffle Port	
Position #1	Standard
Position #2	-PB2
Position #3	-PB3
Position #4	-PB4
Any port or vent not specified will be in Position #1 as shown on page 5.24	
Magnetic Piston ‡ for reed switches and Electronic Sensors (Order Sensors separately)	-E

‡ Note: Additional cylinder length required
for Nonrotating Rods. . . . . 0.50"
for Option -HS (see page 5.11) . . . . . 0.50"
for Option -E . . . . . 1.00"

Ordering Example

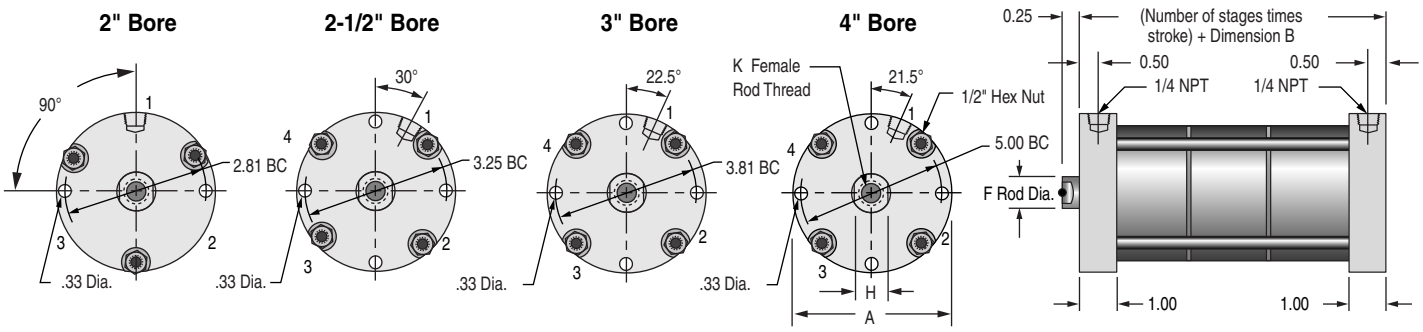
MLS3 X 3 X 2 X 1 PM – MR
Square head series, 3" bore, 3" stroke, 2 stages extend, 1 stage retract, clevis mount ports in-line with slot , male rod thread

Sizing *Longstroke™ – Multi-Power® Cylinders*

Series	Bore	Stages (Pistons)	Area ‡	Equivalent Bore †	Force @ 60 psi	Retract Area
MLR MLS	2"	2	5.84	2.6	350	2.7
		3	8.54	3.2	512	
		4	11.24	3.7	674	
	2 1/2"	2	9.38	3.3	562	4.47
		3	13.85	4.0	831	
		4	18.32	4.7	1099	
	3"	2	13.70	4.0	822	6.63
		3	20.33	5.2	1219	
		4	26.96	5.7	1617	
	4"	2	24.35	5.5	1461	11.78
		3	36.13	6.7	2167	
		4	47.91	7.7	2874	

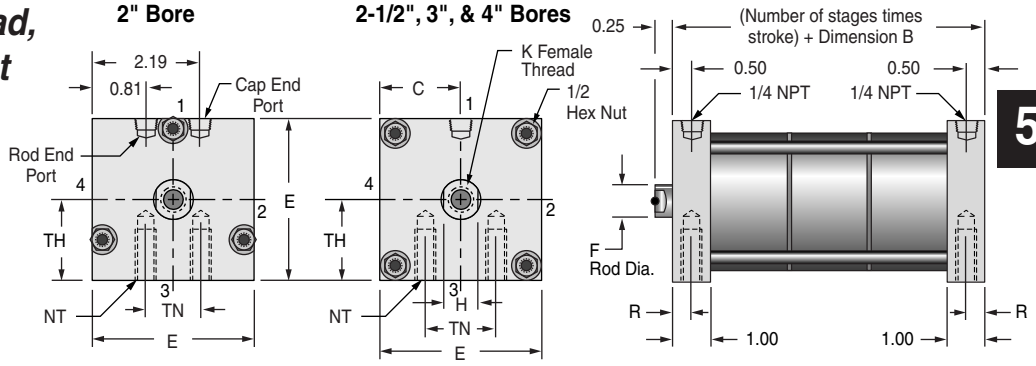
‡ Area = Total effective piston area, square inches.
† Equivalent Bore = Bore required for single piston cylinder.

Series MLR – Round Head, Standard, Face Mount, Rod and Cap End



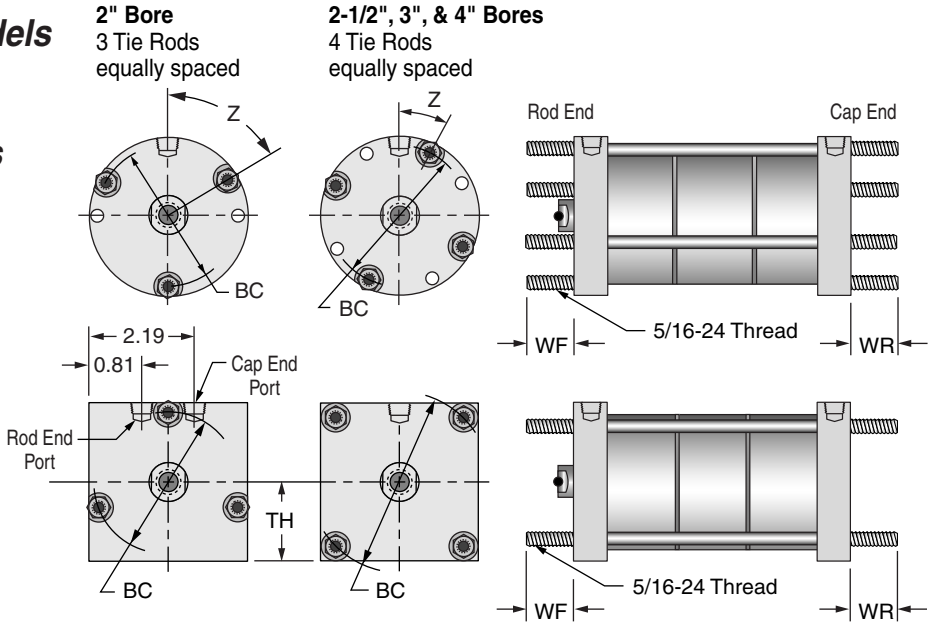
Series MLS – Square Head, Standard, Side Tap Mount

Note:
1) 2"Bore – Ports at Position #3 NOT available.
2) 2-1/2, 3 & 4 Bores – 3/8 NPT Ports (-P38) at Position #3 NOT available.



Extended Tie Rod Mount for Round and Square Head Models

WF Rod End Only
WR Cap End Only
WFR Rod and Cap Ends



Dimensions

Bore	A	B 2 stage	B 3 stage	B 4 stage	BC	C	E	F	H	K	NT	R	TH	TN	WF	WR	Z
2"	3.25	3.42	4.27	5.12	2.81	NA	3.00	0.75	5/8 x .25	1/2-20 x .75 dp	5/16-18 x .62 dp	0.44	1.38	0.88	1.3	1.3	60°
2-1/2"	3.75	3.42	4.27	5.12	3.25	1.75	3.50	0.75	5/8 x .25	1/2-20 x .75 dp	3/8-16 x .75 dp	0.38	1.75	1.25	1.3	1.3	30°
3"	4.25	3.42	4.27	5.12	3.81	1.75	3.50	0.75	5/8 x .25	1/2-20 x .75 dp	1/2-13 x 1.00 dp	0.50	1.75	1.50	1.4	1.4	22.5°
4"	5.50	3.42	4.27	5.12	4.63	2.25	4.50	1.00	7/8 x .25	1/2-20 x .75 dp	1/2-13 x 1.00 dp	0.50	2.25	2.06	1.4	1.4	23.5°

Round Head Clevis Mount **Option**

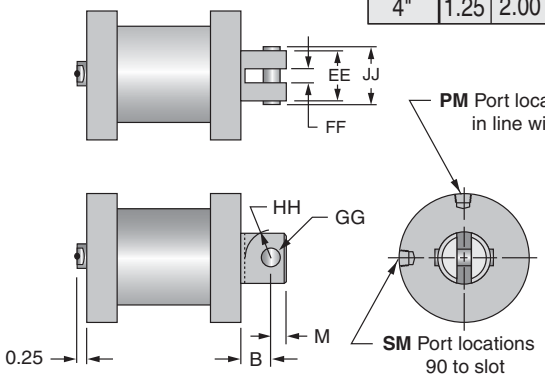
Specify mounting option

Ports in line with slot	**PM**
Ports 90° to slot	**SM**

Pivot pin and retaining lockrings are included as standard.

Accessories: See page 5.27
- Eye Bracket Kits
- Rod Clevises

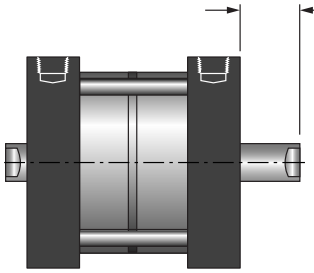
Bore	B	EE	FF	GG Pin	GG Hole	HH	JJ	M
2"	0.75	1.25	.38	.3745	.376	0.69	1.48	.38
2-1/2"	1.00	1.63	.50	.4995	.501	0.97	1.86	.50
3"	1.00	1.63	.50	.4995	.501	0.97	1.86	.50
4"	1.25	2.00	.63	.6245	.626	1.22	2.24	.63



Oil filled powdered metal Pivot Pin Bushings are standard.
Pivot Pin, 416 stainless steel
Lockrings, plated steel

5

Double Rod **Option -DR**

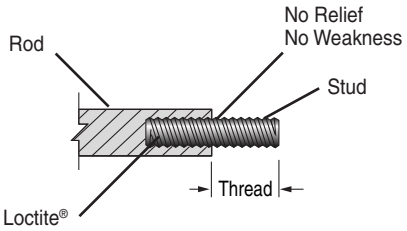


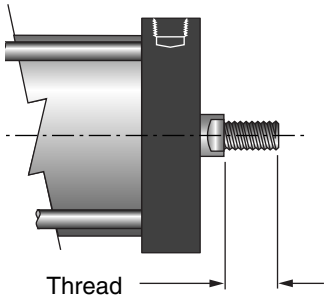
Standard piston rod and rod bushing on both ends of the cylinder.

Use when attachment to both ends of the cylinder is required, or to indicate piston position location. Also see Option –E on page 5.28.

Male Rod Thread **Option**

Single Rod	**-MR**
Double Rod, Rod End Only	**-MR**
Double Rod, Cap End Only	**-MR1**
Double Rod, Rod & Cap Ends	**-MR2**



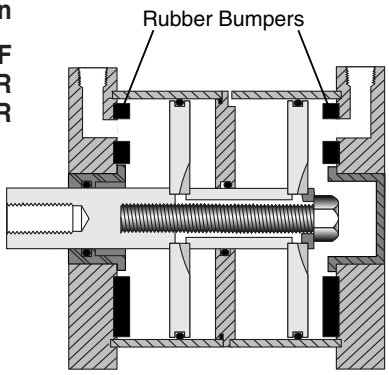


A high strength stud is threaded into the standard female rod end and retained with Loctite®. This method eliminates the small diameter thread relief area normally required when machining male threads. This provides a much stronger rod end which can be repaired, rather than replacing the complete rod, should the thread be damaged.

Bore	Thread
2"	1/2–20 x 1.00
2 1/2"	1/2–20 x 1.00
3"	1/2–20 x 1.00
4"	1/2–20 x 1.00

Rubber Bumpers **Option**

Rod End only	**-BF**
Cap End only	**-BR**
Both Rod & Cap Ends	**-BFR**



A rubber doughnut is bonded to the cylinder head to act as the piston stop and absorb the impact of the piston. This reduces noise and absorbs energy, thus reducing damage to the cylinder and tooling due to pounding.

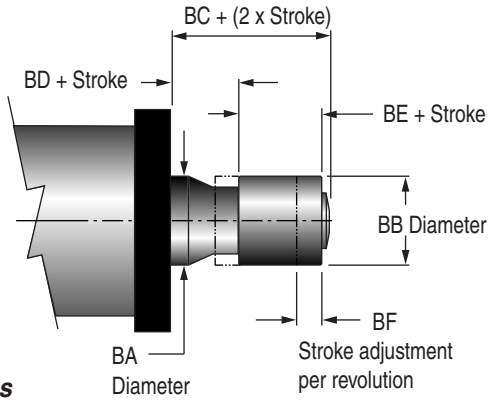
Standard rubber mass will compress and give full stroke at 60 to 80 psi. This mass can be adjusted to meet your specific pressure and/or dynamic load requirements requirements

Adjustable extend stroke **Option -AS**

Available all Bores.
For strokes through 6"
Full stroke adjustment is standard.

Note!
To maintain operator safety features of this option, it is NOT available with mounting styles: WR and WFR.
Use caution when mounting to avoid creating pinch points.

Note: NOT available with mounting styles PM and SM



See complete description on page 5.9.

Bore	2"	2-1/2"	3"	4"	
BA	1.50	1.50	1.50	2.00	
BB	2.00	2.00	2.00	2.00	
BC	1.65	1.65	1.65	1.42	+ (2 x Stroke)
BD	0.75	0.75	0.75	0.50	+ Stroke
BE	0.75	0.75	0.75	0.75	
BF	.063	.063	.063	.063	

5

3/8 NPT Ports in Heads **Option -P38**

Use 3/8 NPT ports for higher flows, air over oil systems, etc.

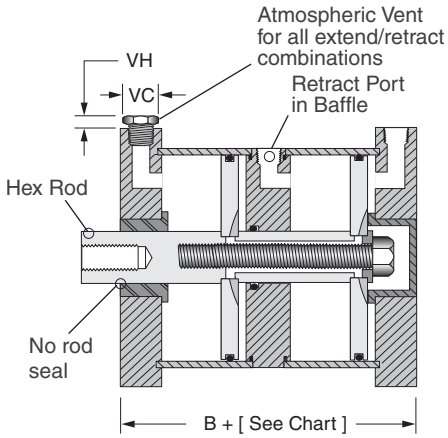
Nonrotating Rod **Option -NR**

A stainless steel hex rod and a hex broached bushing of SAE 660 bearing bronze replaces the standard round rod and bushing.

A ported baffle is used so the piston assembly can be retracted by the next piston back from the rod end. The normal rod head port becomes an atmospheric vent. The tolerance on rotation is ±1°.

The hex rod design does allow for some torque loading on the shaft. However, torque loads that induce side loading should be minimized for best overall life and performance.

Hex rod flats have Random Rotation relative to Mounting Pattern



See page 5.24 for Dimension "B".

Available Combinations	No. of Ported Baffles	Total No. of Stages
2 X 1	1	2
3 X 1	1	3
3 X 2	2	3
4 X 1	1	4
4 X 2	2	4
4 X 3	3	4

Bore	Retract Port	Add to Dimension "B" for each Ported Baffle	Hex Rod Across Flats	St'd Ports VC	St'd Ports VH max	3/8 NPT Ports (–P38) VC	3/8 NPT Ports (–P38) VH max
2"	1/4 NPT	.50"	.75"	.65	.69	.80	1.56
2-1/2"	1/4 NPT	.50"	.75"	.65	.69	.80	1.56
3"	1/4 NPT	.50"	.75"	.65	.69	.80	1.56
4"	1/4 NPT	.50"	1.00"	.65	.69	.80	1.56

Nonrotating Double Rod **Option -NRDR**

A combination of the Options –NR and –DR as shown above. The rod end rod is Hex and the cap end rod is round. The ported baffles are included and the "Dimension B" adjustments shown for Option –NR must be made. Extend piston areas must also be reduced by the rod area.

High Flow Vents **Option -HF**

The atmospheric vent in the baffle is cut larger to provide less resistance to the air flow.

Use when higher cycle speeds are required.

Viton Seals **Option -V**

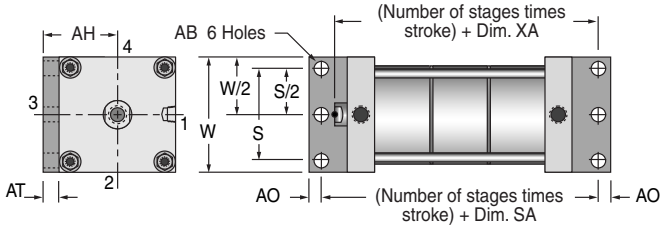
Use for elevated temperatures (–15° to + 400°F) or compatibility with exotic media.

Consult engineering for compatibility information.

End Lug Mount Kit

Kit includes:
2 Brackets and
4 bolts for attaching
the brackets to the
cylinder heads.

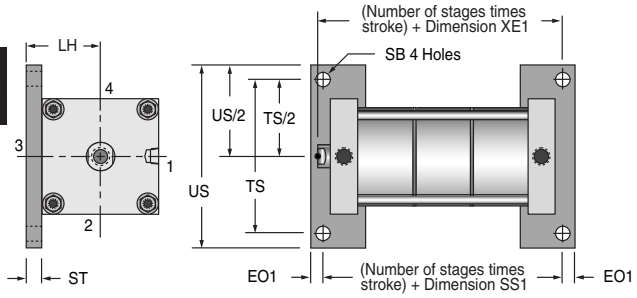
Materials:
Brackets, steel, plated
Screws, steel, black oxide



Bore	Kit No.	S	W	AB	AH	AO	AT	SA 2 stage	SA 3 stage	SA 4 stage	XA 2 stage	XA 3 stage	XA 4 stage
2"	**EL-20**	1.75	2.50	.41	1.63	.44	.25	4.04	4.89	5.74	3.98	4.83	5.68
2-1/2"	**EL-25**	2.25	3.00	.41	2.00	.44	.25	4.16	5.01	5.86	4.04	4.89	5.74
3"	**EL-30**	2.75	3.50	.53	2.13	.56	.38	4.66	5.51	6.36	4.29	5.14	5.99
4"	**EL-40**	3.50	4.50	.53	2.63	.56	.38	4.66	5.51	6.36	4.29	5.14	5.99

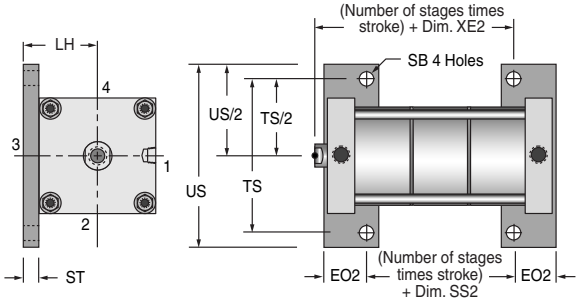
Side Lug Mount Kit

– Brackets may be mounted in two different positions as shown –



Kit includes:
2 Brackets and
4 bolts for attaching
the brackets to the
cylinder heads.

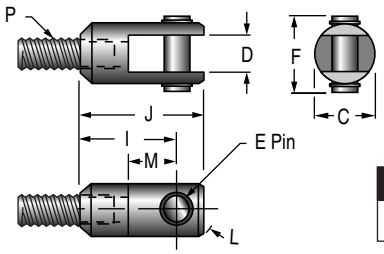
Materials:
Brackets, steel, plated
Screws, steel, black
oxide



Position #1 **Position #2**

Bore	Kit No.	EO1	EO2	LH	SB	SS1 2 stage	SS1 3 stage	SS1 4 stage	XE1 2 stage	XE1 3 stage	XE1 4 stage	ST	TS	US	SS2 2 stage	SS2 3 stage	SS2 4 stage	XE2 2 stage	XE2 3 stage	XE2 4 stage
2"	**SL-20**	.50	0.50	1.63	.41	2.66	3.51	4.36	3.29	4.14	4.99	.25	3.75	4.50	2.42	3.27	4.12	3.17	4.02	4.87
2-1/2"	**SL-25**	.50	0.63	2.00	.41	2.92	3.77	4.62	3.42	4.27	5.12	.25	4.25	5.00	2.42	3.27	4.12	3.17	4.02	4.87
3"	**SL-30**	.56	1.19	2.13	.53	3.54	4.39	5.24	3.73	4.58	5.43	.38	4.75	5.88	1.29	2.14	2.99	2.60	3.45	4.30
4"	**SL-40**	.56	1.19	2.63	.53	3.54	4.39	5.24	3.73	4.58	5.43	.38	5.50	6.63	1.29	2.14	2.99	2.60	3.45	4.30

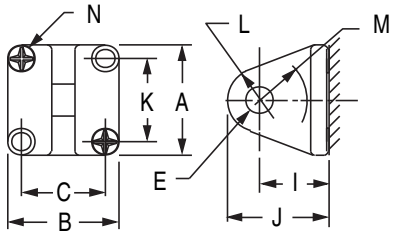
Rod Clevises

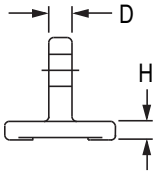


Materials
Clevis and Stud: Steel, black oxided
Pin: 416 Stainless Steel
Clips: Steel, plated

Bore	Part #	C	D	E PIN	F	I	J	L	M	P	Mating Eye Bkt
2", 2-1/2", 3" & 4"	**RC-56**	1.00	.32	.3120	1.21	1.31	1.69	.61	.63	1/2-20x.62	EM-121

Eye Bracket Kits mate with Option -PM or -SM and Rod Clevis





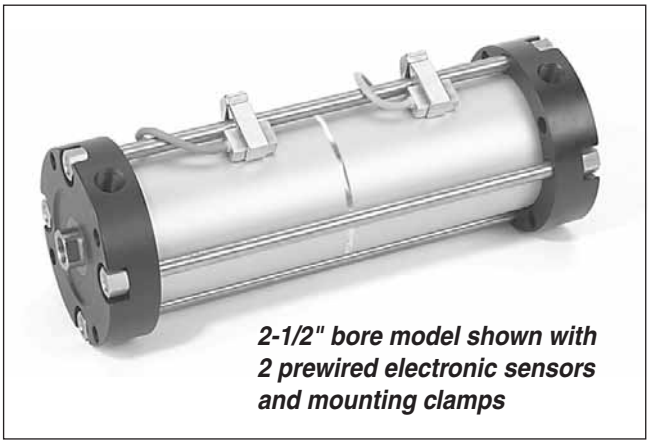
Materials
Bracket: High strength Zinc die casting
Bushings: Oil filled powdered metal
Screws: 4, Steel, plated or black oxided

Bore	Part #	A	B	C	D	E	H	I	J	K	L	M	N
2"	**EM-321**	2.50	2.50	2.00	.36	.376	.31	1.13	1.69	2.00	0.56	0.81	5/16-18x1.00FHSCS
2-1/2", 3"	**EM-521**	2.00	2.00	1.38	.47	.501	.38	1.50	2.25	1.38	0.75	1.13	5/16-18x1.00FHSCS
4"	**EM-1221**	2.50	2.25	1.50	.58	.626	.38	1.63	2.63	1.75	1.00	1.10	5/16-18x1.00FHSCS
Rod Clevis RC-56	**EM-121**	1.50	1.50	1.13	.30	.3135	.25	0.94	1.38	1.13	0.44	0.69	1/4-20X.75 FH(#12)MS

Magnetic Piston

Option -E

(Order Sensors and Sensor Clamps Separately)



2-1/2" bore model shown with 2 prewired electronic sensors and mounting clamps

- ***Option -E*** consists of a magnet bonded into the piston head. When the piston magnet moves past an external sensor, the magnetic field activates the sensor without physical contact.
- ***Mounting*** – The sensor snaps into a 2-part clamp that attaches rigidly to any of the tie rods and can be positioned anywhere along the length of the cylinder.
- ***Reliability*** – The annular piston magnet is permanently bonded into a groove in the piston. It is a polarized permanent magnet of rubber bonded barium ferrite that is very stable and is not affected by shock. Under normal usage it will remain magnetized indefinitely.
- ***Warning*** – External magnetic fields and/or ferrous objects may affect the strength of the piston magnet therefore affecting sensor actuation and piston position indication. Warning labels (shown left) are affixed to the cylinder.
- ***Please note there is an increase in base length of the cylinder to accomodate the magnet. Add 1.00" to Dimension 'B' on pages 5.24.***

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2-Piece Sensor Clamp shown with quick disconnect sensor snapped in place

Quick Disconnect Sensor Shown

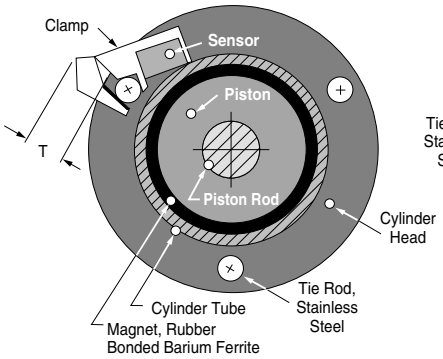
Socket Head Screw

WARNING
This cylinder is equipped with a Magnetic Piston for use with Magnetically Operated Sensors. Other Magnetic Sensitive Devices Should be Kept at a Distance to Avoid Inadvertent Operation.

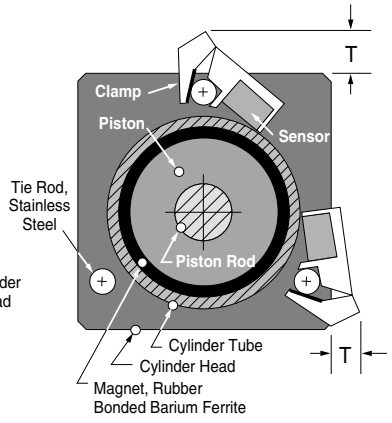
Female Cordsets available in 1, 2, & 5 meter lengths

9 foot prewired sensor

Sensor Clamp Stick Out Dimensions								
Model	MLR2	MLS2	MLR2-1/2	MLS2-1/2	MLR3	MLS3	MLR4	MLS4
T	.50"	.50"	.50"	.10"	.50"	.30	.30"	.30"



Top View Round Head Style



Top View Square Head Style

Sensor & Clamp Ordering Guide

Temperature Range: –20° to + 80°C (–4° to + 176°F)
Sensor housing rated NEMA 6/IP67.

LED Lighted Magnetic Piston Position Sensors			
Product Type	**Prewired 9 ft. Part No.**	**Quick Disconnect Part Number.**	**Electrical Characteristics**
Reed Switch	9-2A197-1004	9-2A197-1304	5-120 VDC/VAC, 0.5 Amp Max., 10 Watt Max., SPST N.O., 3.5 Voltage Drop
Electronic	9-2A197-1033	9-2A197-1333	Sourcing, PNP, 6-24 VDC, 0.5 Amp Max., 1.0 Voltage Drop
Electronic	9-2A197-1034	9-2A197-1334	Sinking, NPN, 6-24VDC, 0.5 Amp Max., 1.0 Voltage Drop

Female Cordsets for Quick Disconnect			
Length	1 Meter	2 Meter	5 Meter
Part Number	CFC-1M	CFC-2M	CFC-5M

Sensor Mounting Clamp - for all MLS & MLR Models
For all MLS & MLR Models Order **Part Number 800-200-000**

Warning!

Do not exceed sensor ratings. Permanent damage to sensor may occur.

Power supply polarity ***MUST*** be observed for proper operation of sensors.

See wiring diagrams included with each sensor.