

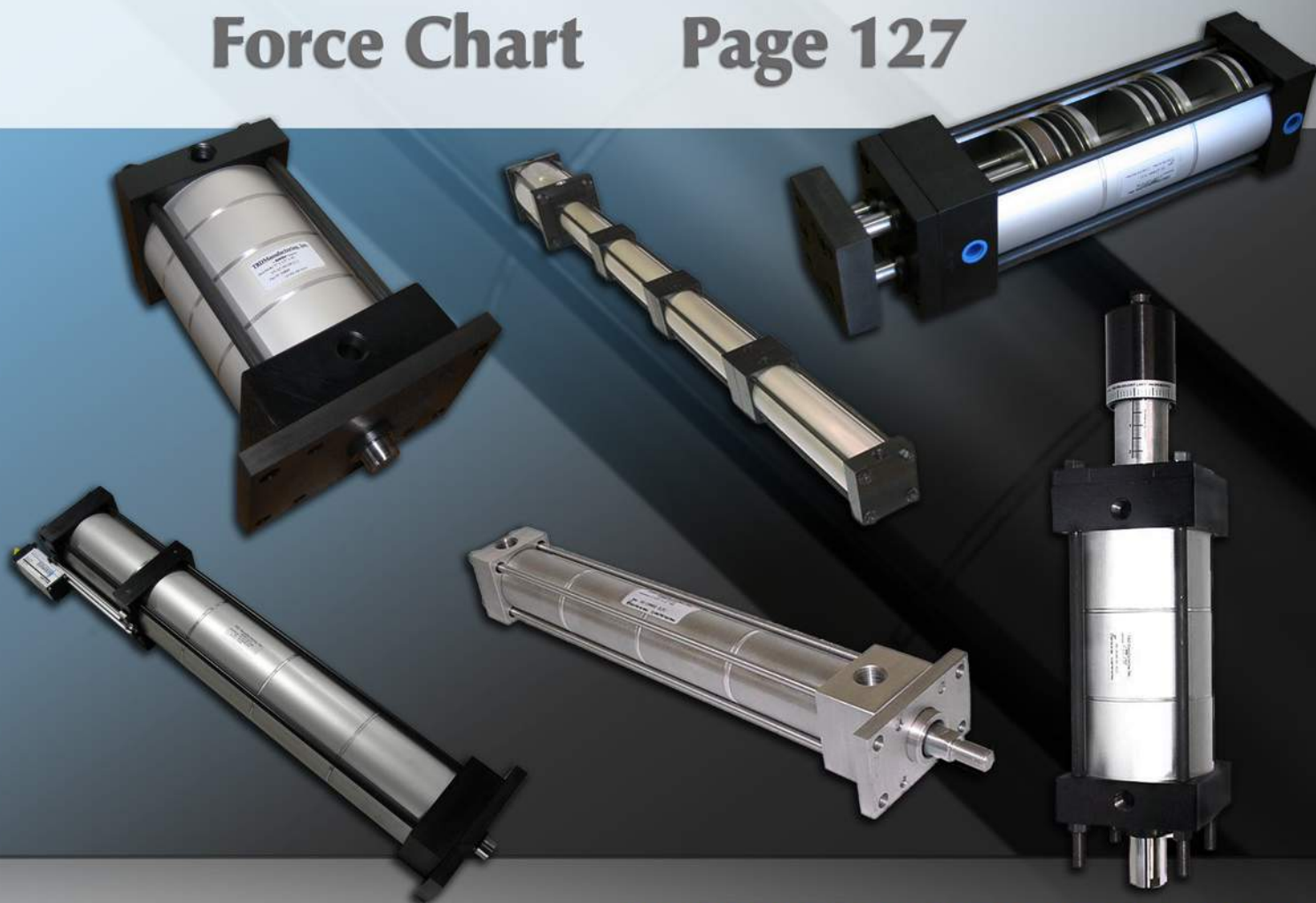
MSE MSR Series NFPA *MULTI-STAGE* Aluminum Cylinders 1.50" to 8.00" Bore

Single Rod End

Page 118

Force Chart

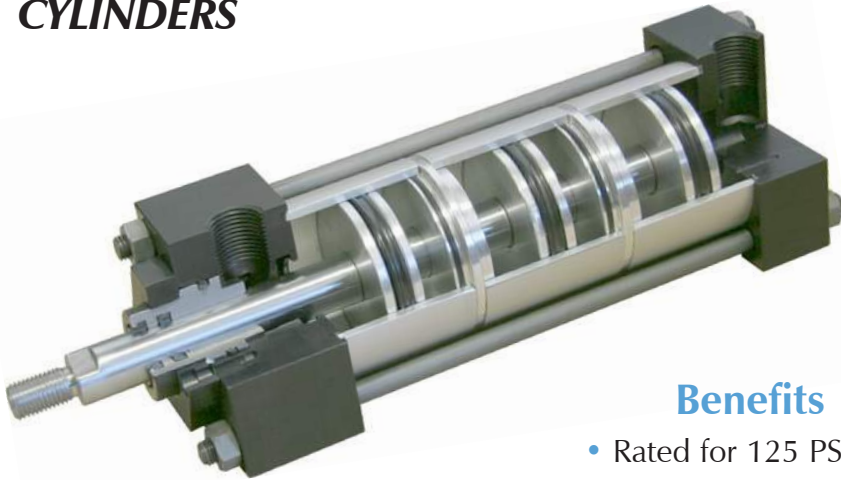
Page 127



**95% OF OUR CYLINDERS SHIP IN 2-3 DAYS!
ONE DAY RUSH SERVICE AVAILABLE ON ALL CATALOGED CYLINDER MODELS!**

SERIES 'MS': MULTI-STAGE

FORCE MULTIPLYING CYLINDERS



The TRD MSE and MSR Series are double acting, single rod end cylinders that multiply the force output by supplying air to multiple pistons.

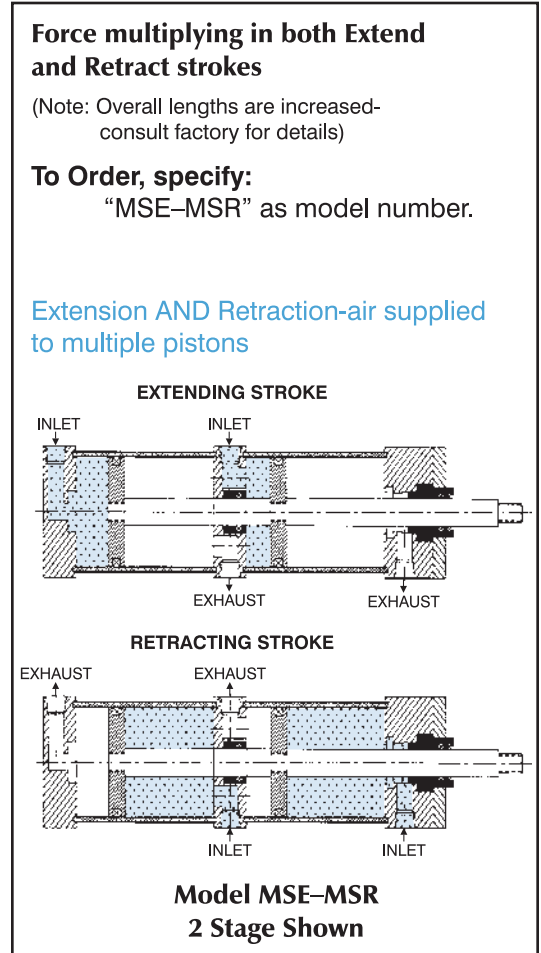
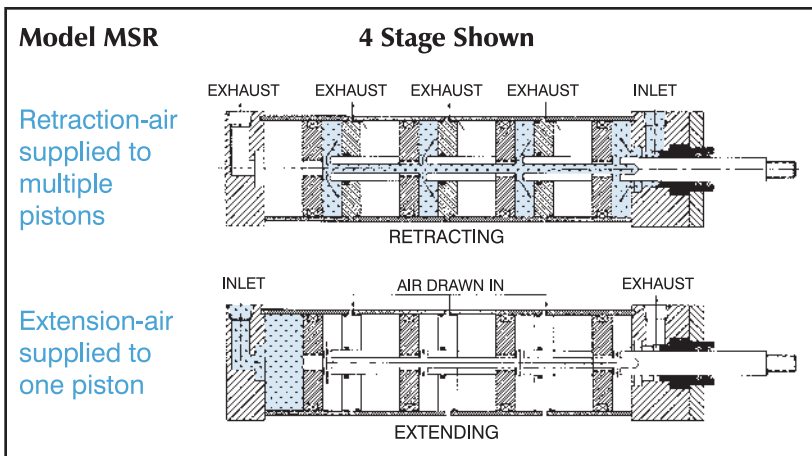
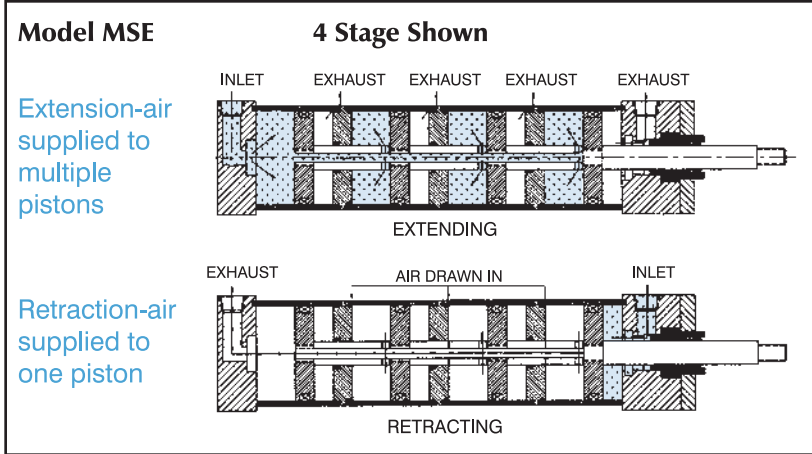
The MSE multiplies the force on the extend stroke, the MSR multiplies the force on the retract stroke. Both models use only one piston on the opposite stroke, saving air volume and operating costs.

Benefits

- Rated for 125 PSI Air, or Hydraulic (non-shock)
- Eliminates the need for high pressure systems
- Heavy Duty construction
- Bore size vs. output force saves space
- 2 Stage, 3 Stage, 4 Stage & 5 Stage models
- Optional Double Rod End Models available
- Optional force multiplying in both extend and retract strokes available

Note: Models MSR & MSE are not field repairable – units must be returned to factory for service or repair.

How They Work



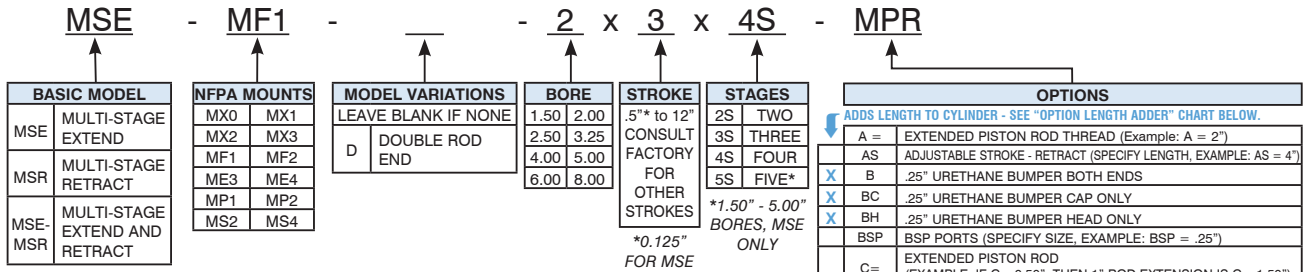
MS - How to Order
MS - Base Dimensions
MS - Single Rod Mounts
MS - Piston Area Force Chart
Options Page 189
Accessories Page 227
Switches Page 241
Technical Data Page 277

HOW TO ORDER: SERIES 'MS' (MULTI-STAGE)

- Force Multiplier Air and Non-Shock Hydraulic Cylinders 125 PSI
- Eight Bore Sizes 1.50" - 8.00"

- Extend 2, 3, 4 or 5 Stages through 5.00" Bores
- Extend or Retract 2, 3 or 4 Stages through 8.00" Bores

- Exposed Tie Rod and Nut Construction (similar to 'TA')
- 'FM' Flush Mount construction available as an option



ORDERING EXAMPLES:

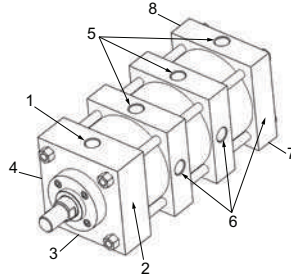
- EXAMPLE 1:** MSE-MSR MF1 3.25" Bore, 2.00" Stroke, 3 Stage:
MSE-MSR MF1 3.25" x 2 x 3S=Extend ports 5, 5, and 5 Retract ports 1, 6, and 6
- EXAMPLE 2:** Double Rod End MS4 Mount, 2 Stage, 6.00" Bore, 3.00" Stroke, Force Multiplied in RETRACT with Magnetic Piston for REED Switches is:
MSR MS4D 6 x 3 x 2S - MPR (Note: MPR Option adds 0.750" to Cylinder Length)

OPTION LENGTH ADDER (ADD TO CATALOG BASIC OVERALL LENGTH DIMENSIONS)						
BORE	OPTION					
	B	BC	BH	MPR or MPH	NR	ST* (STOP TUBE) EXAMPLE: ST=2
1.50	0.500	0.250	0.250	0.625	0.625	2
2.00	0.500	0.250	0.250	0.625	0.625	2
2.50	0.500	0.250	0.250	0.750	0.750	2
3.25	0.500	0.250	0.250	0.625	0.625	2
4.00	0.500	0.250	0.250	0.625	0.625	2
5.00	0.500	0.250	0.250	0.875	0.875	2
6.00	0.500	0.250	0.250	0.750	0.750	2
8.00	0.500	0.250	0.250	0.875	0.875	2

*Note: The desired stop tube length adds directly to the overall cylinder length. Specify stop tube location. Example: Stop tube on rear stage only.

MSE-MSR STANDARD PORT AND CUSHION ADJUSTMENT POSITIONS

- Extend Ports - Positions 5, 5, 5
- Retract Ports - Positions 1, 6, 6
- Cushion Adjustment - Positions 2 & 6
- Always specify standard and non-standard port locations when ordering



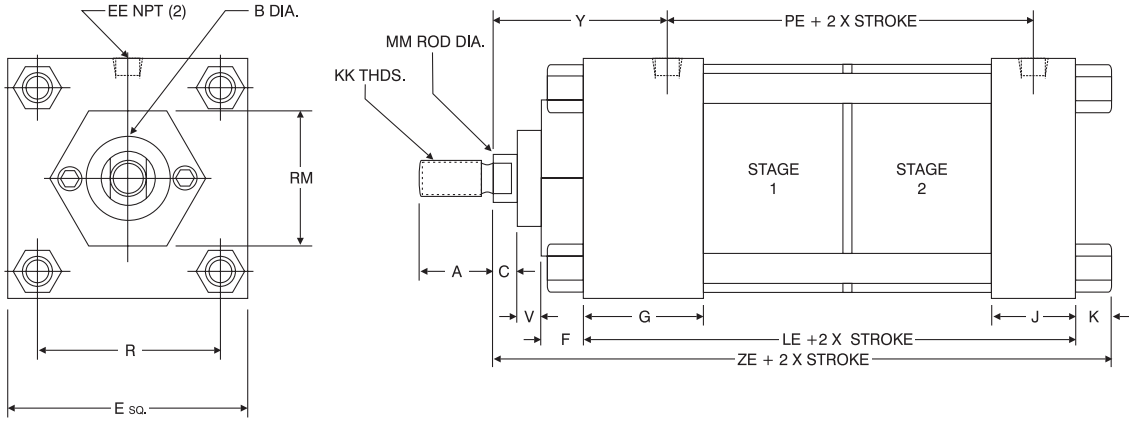
Note: Refer to Options for specifications.
*Steel tubes do not work with MPR magnetic pistons. Refer to Balluff end of stroke sensors within Switches.

SERIES 'MS' CYLINDERS: NFPA MOUNTS

 1.50"-8.00" Bores	 1.50"-8.00" Bores	 1.50"-6.00" Bores	 1.50"-4.00" Bores	 1.50"-8.00" Bores
 1.50"-8.00" Bores	 1.50"-8.00" Bores	 1.50"-6.00" Bores	 1.50"-6.00" Bores	 8.00" Bores (Consult factory)
 8.00" Bores (Consult factory)	 1.50"-8.00" Bores	 1.50"-8.00" Bores	 1.50"-8.00" Bores	

SERIES 'MS' DIMENSIONS: 2 STAGE EXTEND OR RETRACT

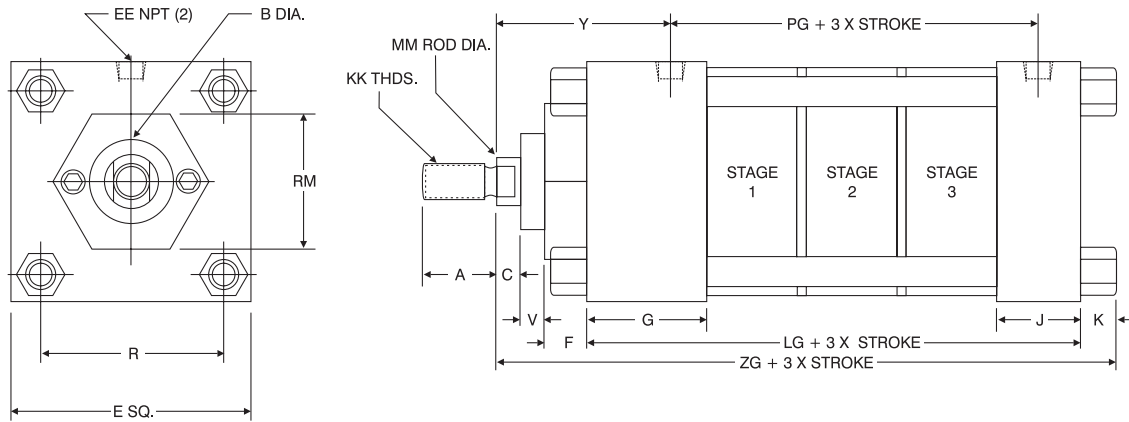
STANDARD ROD DIAMETER BASIC DIMENSIONS 'MX0' (NO MOUNT)



BORE	A	B	C	E	EE	F	G	J	K	KK	LE	MM	PE	R	RM	V	Y	ZE
1.50	0.750	1.125	0.375	2.000	0.375	0.375	1.500	1.000	0.250	7/16-20	4.000	0.625	2.750	1.438	2.00 SQ.	0.250	1.875	5.250
2.00	0.750	1.125	0.375	2.500	0.375	0.375	1.500	1.000	0.313	7/16-20	4.000	0.625	2.750	1.844	1.75 HEX	0.250	1.875	5.313
2.50	0.750	1.125	0.375	3.000	0.375	0.375	1.500	1.000	0.313	7/16-20	4.000	0.625	2.750	2.188	1.75 HEX	0.250	1.875	5.313
3.25	1.125	1.500	0.500	3.750	0.500	0.625	1.750	1.250	0.388	3/4-16	4.875	1.000	3.375	2.760	2.75 DIA.	0.250	2.375	6.625
4.00	1.125	1.500	0.500	4.500	0.500	0.625	1.750	1.250	0.388	3/4-16	4.875	1.000	3.375	3.320	2.75 DIA.	0.250	2.375	6.625
5.00	1.125	1.500	0.500	5.500	0.500	0.625	1.750	1.250	0.438	3/4-16	4.875	1.000	3.375	4.100	2.75 DIA.	0.250	2.375	6.688
6.00	1.625	2.000	0.625	6.500	0.750	0.625	2.000	1.500	0.438	1-14	5.750	1.375	4.000	4.875	3.50 DIA.	0.375	2.750	7.813
8.00	1.625	2.000	0.625	8.500	0.750	0.625	2.000	1.500	0.563	1-14	5.750	1.375	4.000	6.438	3.50 DIA.	0.375	2.750	7.938

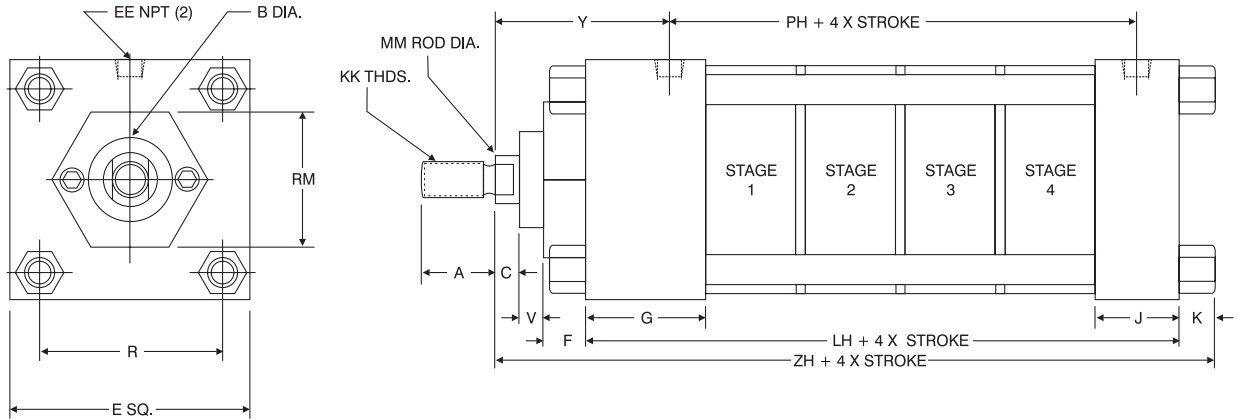
3 STAGE EXTEND OR RETRACT

STANDARD ROD DIAMETER BASIC DIMENSIONS 'MX0' (NO MOUNT)



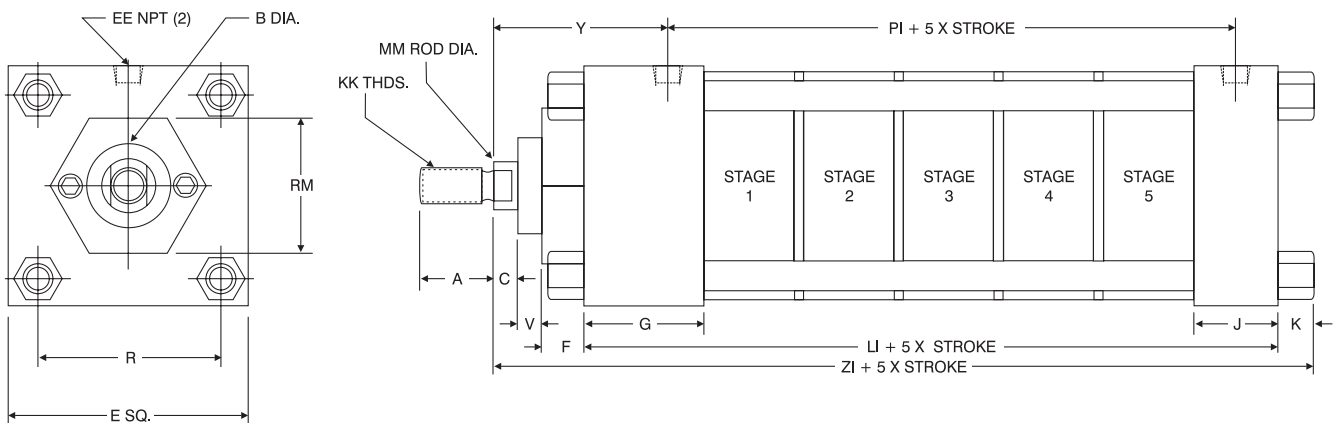
BORE	A	B	C	E	EE	F	G	J	K	KK	LG	MM	PG	R	RM	V	Y	ZG
1.50	0.750	1.125	0.375	2.000	0.375	0.375	1.500	1.000	0.250	7/16-20	5.000	0.625	3.750	1.438	2.00 SQ.	0.250	1.875	6.250
2.00	0.750	1.125	0.375	2.500	0.375	0.375	1.500	1.000	0.313	7/16-20	5.000	0.625	3.750	1.844	1.75 HEX	0.250	1.875	6.313
2.50	0.750	1.125	0.375	3.000	0.375	0.375	1.500	1.000	0.313	7/16-20	5.000	0.625	3.750	2.188	1.75 HEX	0.250	1.875	6.313
3.25	1.125	1.500	0.500	3.750	0.500	0.625	1.750	1.250	0.375	3/4-16	6.125	1.000	4.625	2.760	2.75 DIA.	0.250	2.375	7.875
4.00	1.125	1.500	0.500	4.500	0.500	0.625	1.750	1.250	0.375	3/4-16	6.125	1.000	4.625	3.320	2.75 DIA.	0.250	2.375	7.875
5.00	1.125	1.500	0.500	5.500	0.500	0.625	1.750	1.250	0.438	3/4-16	6.125	1.000	4.625	4.100	2.75 DIA.	0.250	2.375	7.938
6.00	1.625	2.000	0.625	6.500	0.750	0.625	2.000	1.500	0.438	1-14	7.250	1.375	5.500	4.875	3.50 DIA.	0.375	2.750	9.313
8.00	1.625	2.000	0.625	8.500	0.750	0.625	2.000	1.500	0.563	1-14	7.250	1.375	5.500	6.438	3.50 DIA.	0.375	2.750	9.438

'MS' SERIES CYLINDERS: 4 STAGE EXTEND OR RETRACT STANDARD ROD DIAMETER BASIC DIMENSIONS 'MX0' (NO MOUNT)



BORE	A	B	C	E	EE	F	G	J	K	KK	LH	MM	PH	R	RM	V	Y	ZH
1.50	0.750	1.125	0.375	2.000	0.375	0.375	1.500	1.000	0.250	7/16-20	6.000	0.625	4.750	1.438	2.00 SQ.	0.250	1.875	7.250
2.00	0.750	1.125	0.375	2.500	0.375	0.375	1.500	1.000	0.313	7/16-20	6.000	0.625	4.750	1.844	1.75 HEX	0.250	1.875	7.313
2.50	0.750	1.125	0.375	3.000	0.375	0.375	1.500	1.000	0.313	7/16-20	6.000	0.625	4.750	2.188	1.75 HEX	0.250	1.875	7.313
3.25	1.125	1.500	0.500	3.750	0.500	0.625	1.750	1.250	0.375	3/4-16	7.375	1.000	5.875	2.760	2.75 DIA.	0.250	2.375	9.125
4.00	1.125	1.500	0.500	4.500	0.500	0.625	1.750	1.250	0.375	3/4-16	7.375	1.000	5.875	3.320	2.75 DIA.	0.250	2.375	9.125
5.00	1.125	1.500	0.500	5.500	0.500	0.625	1.750	1.250	0.438	3/4-16	7.375	1.000	5.875	4.100	2.75 DIA.	0.250	2.375	9.188
6.00	1.625	2.000	0.625	6.500	0.750	0.625	2.000	1.500	0.438	1-14	8.750	1.375	7.000	4.875	3.50 DIA.	0.375	2.750	10.813
8.00	1.625	2.000	0.625	8.500	0.750	0.625	2.000	1.500	0.563	1-14	8.750	1.375	7.000	6.438	3.50 DIA.	0.375	2.750	10.938

5 STAGE EXTEND OR RETRACT (1.50" - 5.00" BORES ONLY) STANDARD ROD DIAMETER BASIC DIMENSIONS 'MX0' (NO MOUNT)



BORE	A	B	C	E	EE	F	G	J	K	KK	LI	MM	PI	R	RM	V	Y	ZI
1.50	0.750	1.125	0.375	2.000	0.375	0.375	1.500	1.000	0.250	7/16-20	7.000	0.625	5.750	1.438	2.00 SQ.	0.250	1.875	8.250
2.00	0.750	1.125	0.375	2.500	0.375	0.375	1.500	1.000	0.313	7/16-20	7.000	0.625	5.750	1.844	1.75 HEX	0.250	1.875	8.313
2.50	0.750	1.125	0.375	3.000	0.375	0.375	1.500	1.000	0.313	7/16-20	7.000	0.625	5.750	2.188	1.75 HEX	0.250	1.875	8.313
3.25	1.125	1.500	0.500	3.750	0.500	0.625	1.750	1.250	0.375	3/4-16	8.625	1.000	7.125	2.760	2.75 DIA.	0.250	2.375	10.375
4.00	1.125	1.500	0.500	4.500	0.500	0.625	1.750	1.250	0.375	3/4-16	8.625	1.000	7.125	3.320	2.75 DIA.	0.250	2.375	10.375
5.00	1.125	1.500	0.500	5.500	0.500	0.625	1.750	1.250	0.438	3/4-16	8.625	1.000	7.125	4.100	2.75 DIA.	0.250	2.375	10.438

SERIES 'MS' DIMENSIONS: MULTI-STAGE

EASY FLIP OUT PAGE FOR REFERENCE

About Rod End Styles

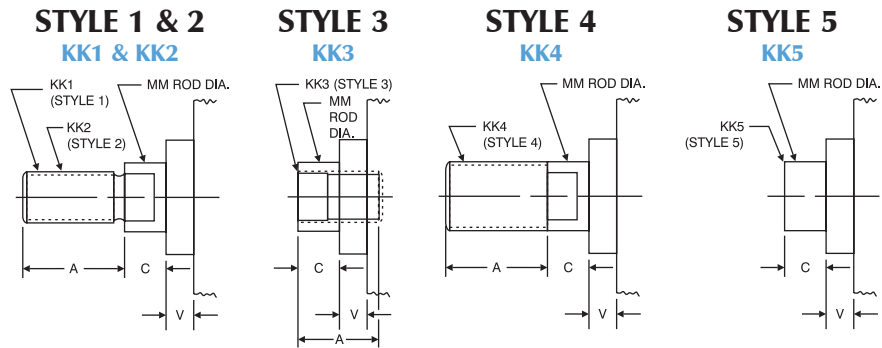
Style 1 Male Rod End is STANDARD

Other NFPA Styles can be specified (see chart).

Need a rod end not listed? NO PROBLEM! Each Piston Rod is made-to-order and does not delay shipment. Coarse UNC threads, Metric threads or just plain rod ends are common. Thread lengths are also made-to-order (Specify: "A"=Length).

NEED SOMETHING NOT LISTED? Just send us a sketch. In most cases, quotes are turned around in one day!

PISTON ROD END STYLES



BORE	MM ROD DIAMETER	STANDARD		OPTIONAL							C	V
		Style 1 - Male		Style 2 - Male		Style 3 - Female		Style 4 - Male		Style 5 - Blank		
		KK1	A	KK2	A	KK3	A	KK4	A	KK5		
1.50, 2.00, 2.50	0.625 Standard	7/16-20	0.750	1/2-20	0.750	7/16-20	0.750	5/8-18	0.750	No Threads	0.375	0.250
	1.000 Oversize	3/4-16	1.125	7/8-14	1.125	3/4-16	1.125	1-14	1.125	No Threads	0.500	0.500
3.25, 4.00, 5.00	1.000 Standard	3/4-16	1.125	7/8-14	1.125	3/4-16	1.125	1-14	1.125	No Threads	0.500	0.250
	1.375 Oversize	1-14	1.625	1 1/4-12	1.625	1-14	1.625	1 3/8-12	1.625	No Threads	0.625	0.375
6.00 & 8.00	1.375 Standard	1-14	1.625	1 1/4-12	1.625	1-14	1.625	1 3/8-12	1.625	No Threads	0.625	0.375
	1.750 Oversize	1 1/4-12	2.000	1 1/2-12	2.000	1 1/4-12	2.000	1 3/4-12	2.000	No Threads	0.750	0.500



SERIES 'MS' DIMENSIONS: MULTI-STAGE

About Rod End Styles

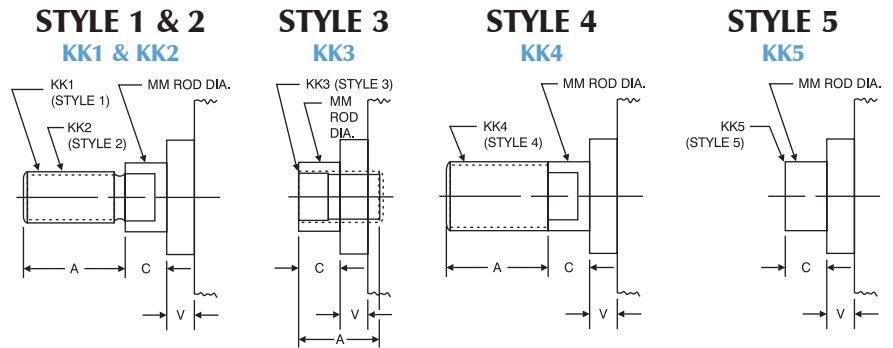
Style 1 Male Rod End is STANDARD

Other NFPA Styles can be specified (see chart).

Need a rod end not listed? NO PROBLEM! Each Piston Rod is made-to-order and does not delay shipment. Coarse UNC threads, Metric threads or just plain rod ends are common. Thread lengths are also made-to-order (Specify: "A"=Length).

NEED SOMETHING NOT LISTED? Just send us a sketch. In most cases, quotes are turned around in one day!

PISTON ROD END STYLES

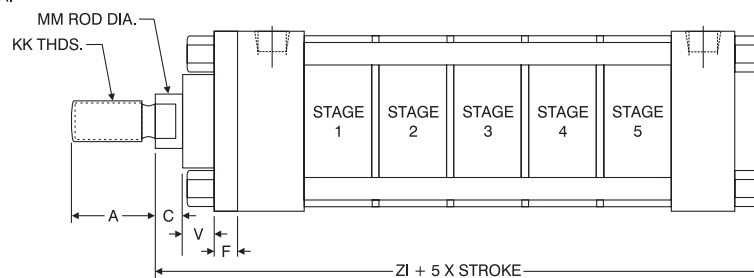
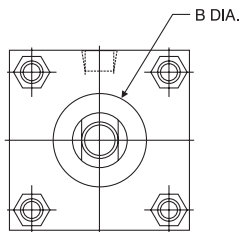
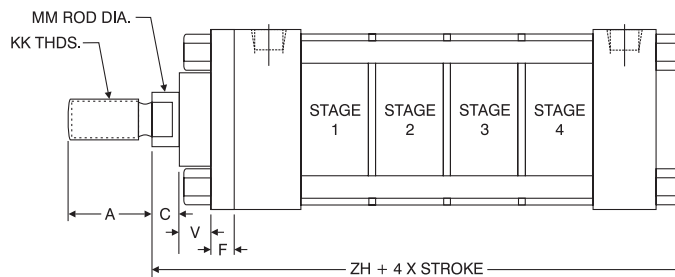
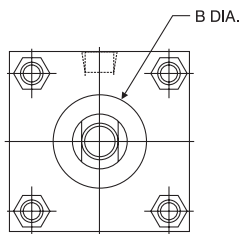
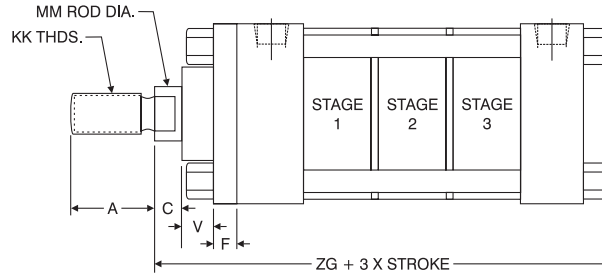
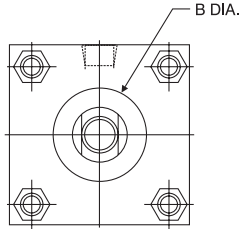
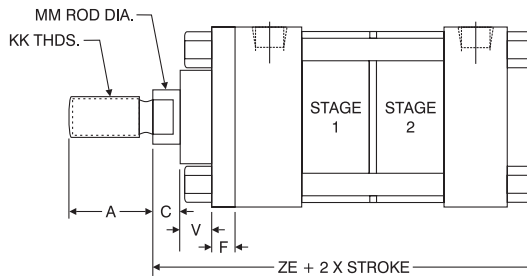
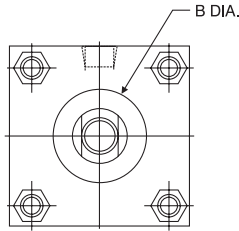


BORE	MM ROD DIAMETER	STANDARD		OPTIONAL							C	V
		Style 1 - Male		Style 2 - Male		Style 3 - Female		Style 4 - Male		Style 5 - Blank		
		KK1	A	KK2	A	KK3	A	KK4	A	KK5		
1.50, 2.00, 2.50	0.625 Standard	7/16-20	0.750	1/2-20	0.750	7/16-20	0.750	5/8-18	0.750	No Threads	0.375	0.250
	1.000 Oversize	3/4-16	1.125	7/8-14	1.125	3/4-16	1.125	1-14	1.125	No Threads	0.500	0.500
3.25, 4.00, 5.00	1.000 Standard	3/4-16	1.125	7/8-14	1.125	3/4-16	1.125	1-14	1.125	No Threads	0.500	0.250
	1.375 Oversize	1-14	1.625	1 1/4-12	1.625	1-14	1.625	1 3/8-12	1.625	No Threads	0.625	0.375
6.00 & 8.00	1.375 Standard	1-14	1.625	1 1/4-12	1.625	1-14	1.625	1 3/8-12	1.625	No Threads	0.625	0.375
	1.750 Oversize	1 1/4-12	2.000	1 1/2-12	2.000	1 1/4-12	2.000	1 3/4-12	2.000	No Threads	0.750	0.500



SERIES 'MS' CYLINDERS: EXTEND OR RETRACT

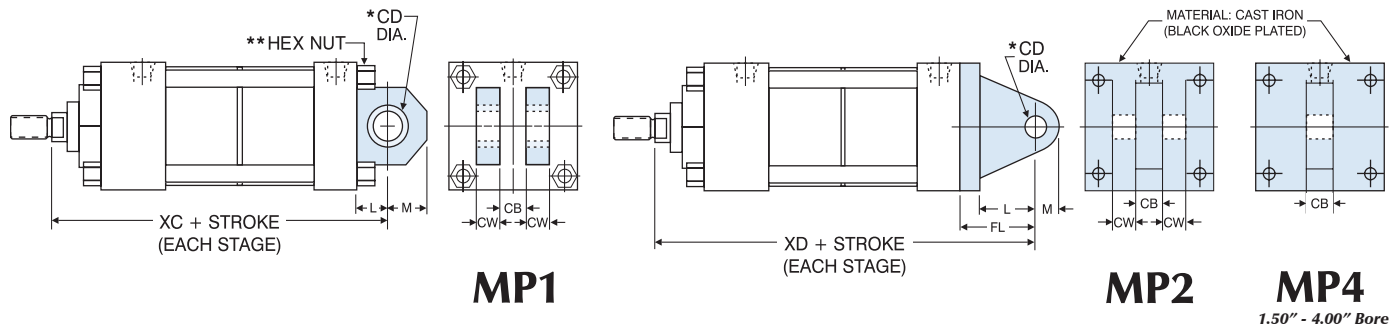
Oversize Rod Diameter Basic Dimension 'MX0' (NO MOUNT)



MULTI-STAGE OVERSIZE ROD DIAMETER								ADD STROKE PER STAGE			
BORE	A	B	C	F	V	KK	MM	ZE	ZG	ZH	ZI
1.50	1.125	1.500	0.500	0.375	0.500	3/4-16	1.000	5.625	6.625	7.625	8.625
2.00	1.125	1.500	0.500	0.375	0.500	3/4-16	1.000	5.688	6.688	7.688	8.688
2.50	1.125	1.500	0.500	0.375	0.500	3/4-16	1.000	5.688	6.688	7.688	8.688
3.25	1.625	2.000	0.625	0.625	0.375	1-14	1.375	6.875	8.125	9.375	10.625
4.00	1.625	2.000	0.625	0.625*	0.375	1-14	1.375	6.875	8.125	9.375	10.625
5.00	1.625	2.000	0.625	0.625*	0.375	1-14	1.375	6.938	8.188	9.438	10.688
6.00	2.000	2.375	0.750	0.625*	0.500	1 1/4-12	1.750	8.063	9.563	11.063	—
8.00	2.000	2.375	0.750	0.625*	0.500	1 1/4-12	1.750	8.188	9.688	11.188	—

*Round retainer 4.00" through 8.00" bore (square retainer shown).
For dimensions not shown, see pages 120 & 121.

'MS' SERIES CYLINDERS: PIVOT MOUNTS



MULTI-STAGE 'MP1' & 'MP2' CLEVIS AND 'MP4' EYE MOUNT DIMENSIONS								ADD STROKE PER STAGE							
BORE	ROD DIAMETER	CB	CD	CW	FL	L	M	2 STAGE		3 STAGE		4 STAGE		5 STAGE	
								XC	XD	XC	XD	XC	XD	XC	XD
1.50	0.625 Standard	0.750	0.500	0.500	1.125	0.750	0.625	5.750	6.125	6.750	7.125	7.750	8.125	8.750	9.125
	1.000 Oversize							6.125	6.500	7.125	7.500	8.125	8.500	9.125	9.500
2.00	0.625 Standard	0.750	0.500	0.500	1.125	0.750	0.625	5.750	6.125	6.750	7.125	7.750	8.125	8.750	9.125
	1.000 Oversize							6.125	6.500	7.125	7.500	8.125	8.500	9.125	9.500
2.50	0.625 Standard	0.750	0.500	0.500	1.125	0.750	0.625	5.750	6.125	6.750	7.125	7.750	8.125	8.750	9.125
	1.000 Oversize							6.125	6.500	7.125	7.500	8.125	8.500	9.125	9.500
3.25	1.000 Standard	1.250	0.750	0.625	1.875	1.250	0.875	7.500	8.125	8.750	9.375	10.000	10.625	11.250	11.875
	1.375 Oversize							7.750	8.375	9.000	9.625	10.250	10.875	11.500	12.125
4.00	1.000 Standard	1.250	0.750	0.625	1.875	1.250	0.875	7.500	8.125	8.750	9.375	10.000	10.625	11.250	11.875
	1.375 Oversize							7.750	8.375	9.000	9.625	10.250	10.875	11.500	12.125
5.00	1.000 Standard	1.250	0.750	0.625	1.875	1.250	0.875	7.500	8.125	8.750	9.375	10.000	10.625	11.250	11.875
	1.375 Oversize							7.750	8.375	9.000	9.625	10.250	10.875	11.500	12.125
6.00	1.375 Standard	1.500	1.000	0.750	2.250	1.500	1.000	8.875	9.625	10.375	11.125	11.875	12.625	N/A	N/A
	1.750 Oversize							9.125	9.875	10.625	11.375	12.125	12.875	N/A	N/A
8.00	1.375 Standard	1.500	1.000	0.750	N/A	1.500	1.000	8.875	N/A	10.375	N/A	11.875	N/A	N/A	N/A
	1.750 Oversize							9.125	N/A	10.625	N/A	11.875	N/A	N/A	N/A

For dimensions not shown, see pages 120 & 121.

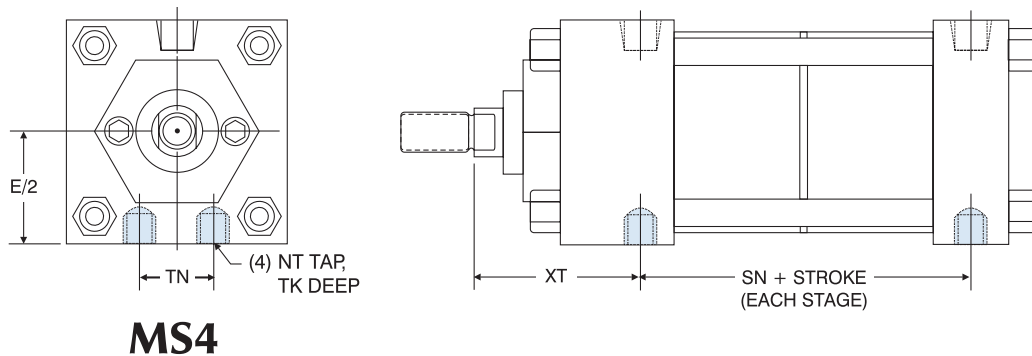
*Pin included, two (2) pressed in bearings.

**Hex nuts are located on cap end (3.25"-8.00" bores).

Note: Extruded MP1 mounts are standard (1.50"-8.00" bores).

Cast Iron removable mounts are optional and must be requested when ordering (1.50"-6.00" bores).

SERIES 'MS' DIMENSIONS: BASE MOUNTS

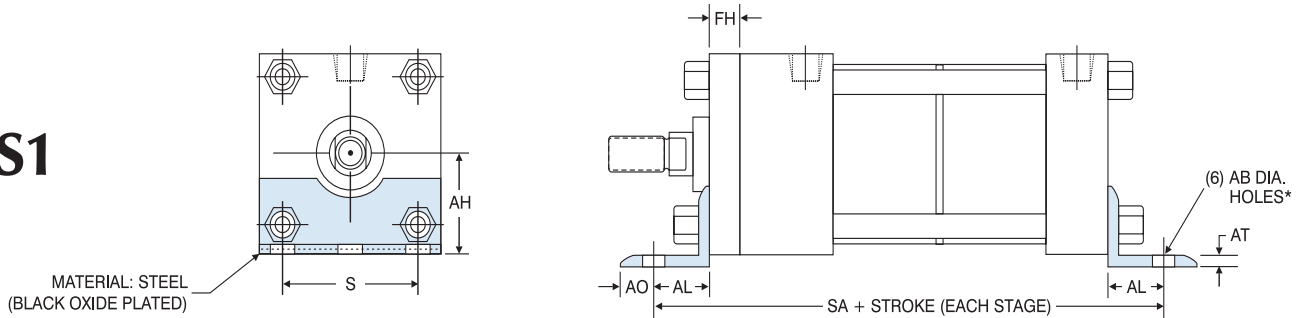


MULTI-STAGE 'MS4' BOTTOM TAPPED MOUNT DIMENSIONS										
BORE	ROD DIAMETER	E/2	NT	TK	TN	XT	SN + STROKE PER STAGE			
							2 STAGE	3 STAGE	4 STAGE	5 STAGE
1.50	0.625 Standard	1.000	1/4 -20	0.375	0.625	1.938	2.625	3.625	4.625	5.625
	1.000 Oversize					2.313				
2.00	0.625 Standard	1.250	5/16 -18	0.500	0.875	1.938	2.625	3.625	4.625	5.625
	1.000 Oversize					2.313				
2.50	0.625 Standard	1.500	3/8 -16	0.625	1.250	1.938	2.625	3.625	4.625	5.625
	1.000 Oversize					2.313				
3.25	1.000 Standard	1.875	1/2 -13	0.750	1.500	2.438	3.250	4.500	5.750	7.000
	1.375 Oversize					2.688				
4.00	1.000 Standard	2.250	1/2 -13	0.750	2.063	2.438	3.250	4.500	5.750	7.000
	1.375 Oversize					2.688				
5.00	1.000 Standard	2.750	5/8 -11	1.000	2.688	2.438	3.250	4.500	5.750	7.000
	1.375 Oversize					2.688				
6.00	1.375 Standard	3.250	3/4 -10	1.125	3.250	2.813	3.875	5.375	6.875	N/A
	1.750 Oversize					3.063				
8.00	1.375 Standard	4.250	3/4 -10	1.125	4.500	2.813	3.875	5.375	6.875	N/A
	1.750 Oversize					3.063				

For dimensions not shown, see pages 120 & 121.

SERIES 'MS' DIMENSIONS: BASE MOUNTS

MS1



MATERIAL: STEEL
(BLACK OXIDE PLATED)

MULTI-STAGE 'MS1' ANGLE MOUNT DIMENSIONS

BORE	ROD DIAMETER	AB	AH	AL	AO	AT	FH	S	**SA + STROKE PER STAGE			
									2-STAGE	3-STAGE	4-STAGE	5-STAGE
1.50	0.625 Standard	0.438	1.188	1.000	0.375	0.188	0.375	1.250	6.375	7.375	8.375	9.375
	1.000 Oversize											
2.00	0.625 Standard	0.438	1.438	1.000	0.375	0.188	0.375	1.750	6.375	7.375	8.375	9.375
	1.000 Oversize											
2.50	0.625 Standard	0.438	1.625	1.000	0.375	0.188	0.375	2.250	6.375	7.375	8.375	9.375
	1.000 Oversize											
3.25	1.000 Standard	0.563	1.938	1.250	0.500	0.125	0.625	2.750	8.000	9.250	10.500	11.750
	1.375 Oversize											
4.00	1.000 Standard	0.563	2.250	1.250	0.500	0.125	0.625	3.500	8.000	9.250	10.500	11.750
	1.375 Oversize											
5.00	1.000 Standard	0.688	2.750	1.375	0.625	0.188	0.625	4.250	8.250	9.500	10.750	12.000
	1.375 Oversize											
6.00	1.375 Standard	0.813	3.250	1.375	0.625	0.188	0.750	5.250	9.250	10.750	12.250	N/A
	1.750 Oversize											
8.00	1.375 Standard	0.813	4.250	1.813	0.688	0.250	0.625***	7.125	9.375	10.875	12.375	N/A
	1.750 Oversize											

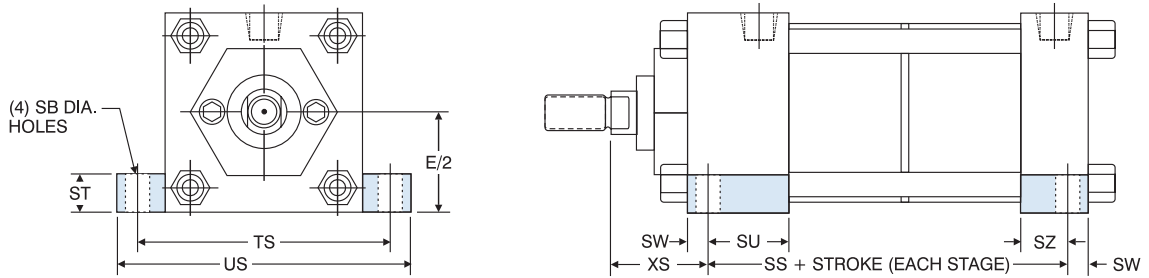
*Note: 1.50" bore has four (4) "AB" holes on "S" dimension.

**SA dimensions increase 0.500" and one FH on double rod cylinders.

***3.50" diameter round retainer on 8.00" bore.

For dimensions not shown, see pages 120 & 121.

MS2



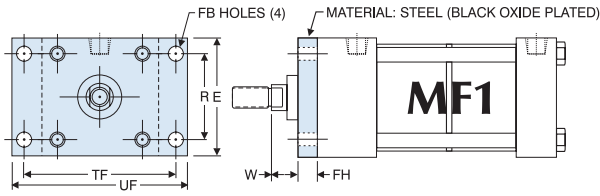
MULTI-STAGE 'MS2' SIDE LUG MOUNT DIMENSIONS

BORE	ROD DIAMETER	SB	E/2	ST	SU	SW	SZ	TS	US	XS	SS + STROKE PER STAGE			
											2-STAGE	3-STAGE	4-STAGE	5-STAGE
1.50	0.625 Standard	0.438	1.000	0.500	1.125	0.375	0.625	2.750	3.500	1.375	3.250	4.250	5.250	6.250
	1.000 Oversize													
2.00	0.625 Standard	0.438	1.250	0.500	1.125	0.375	0.625	3.250	4.000	1.375	3.250	4.250	5.250	6.250
	1.000 Oversize													
2.50	0.625 Standard	0.438	1.500	0.500	1.125	0.375	0.625	3.750	4.500	1.375	3.250	4.250	5.250	6.250
	1.000 Oversize													
3.25	1.000 Standard	0.563	1.875	0.750	1.250	0.500	0.750	4.750	5.750	1.875	3.875	5.125	6.375	7.625
	1.375 Oversize													
4.00	1.000 Standard	0.563	2.250	0.750	1.250	0.500	0.750	5.500	6.500	1.875	3.875	5.125	6.375	7.625
	1.375 Oversize													
5.00	1.000 Standard	0.813	2.750	1.000	1.063	0.688	0.563	6.875	8.250	2.063	3.500	4.750	6.000	7.250
	1.375 Oversize													
6.00	1.375 Standard	0.813	3.250	1.000	1.313	0.688	0.813	7.875	9.250	2.313	4.375	5.875	7.375	N/A
	1.750 Oversize													
8.00	1.375 Standard	0.813	4.250	1.000	1.313	0.688	0.813	9.875	11.250	2.313	4.375	5.875	7.375	N/A
	1.750 Oversize													

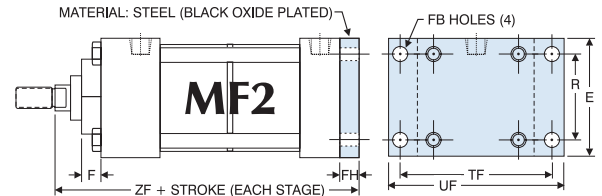
*SS dimensions increase 0.500" on double rod cylinders.

For dimensions not shown, see pages 120 & 121.

SERIES 'MS' DIMENSIONS: FLANGE MOUNTS



1.50" - 6.00" BORES

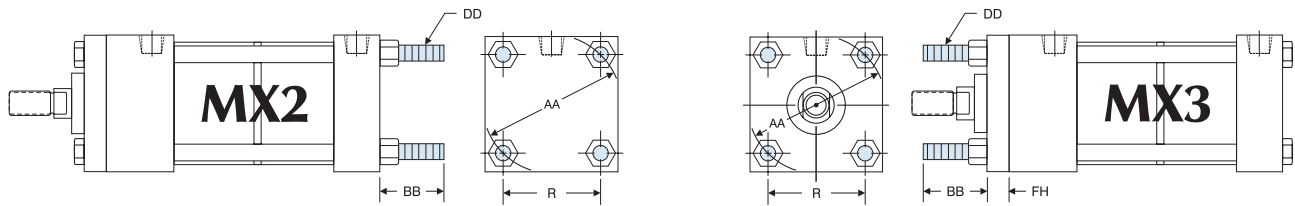
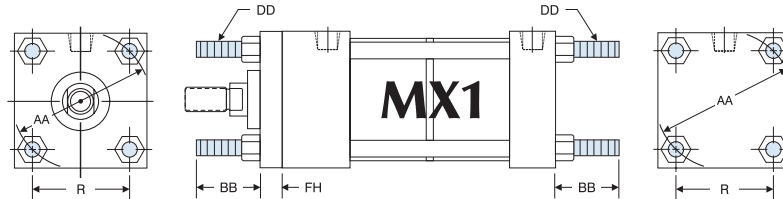


1.50" - 6.00" BORES

MULTI-STAGE 'MF1' AND 'MF2' FLANGE MOUNT DIMENSIONS													
BORE	ROD DIAMETER	E	F	FB	FH	R	TF	UF	W	ZF-STROKE PER STAGE			
										2-STAGE	3-STAGE	4-STAGE	5-STAGE
1.50	0.625 Standard	2.000	0.375	0.313	0.375	1.438	2.750	3.375	0.625	5.375	6.375	7.375	8.375
	1.000 Oversize									5.750	6.750	7.750	8.750
2.00	0.625 Standard	2.500	0.375	0.375	0.375	1.844	3.375	4.125	0.625	5.375	6.375	7.375	8.375
	1.000 Oversize									5.750	6.750	7.750	8.750
2.50	0.625 Standard	3.000	0.375	0.375	0.375	2.188	3.875	4.625	0.625	5.375	6.375	7.375	8.375
	1.000 Oversize									5.750	6.750	7.750	8.750
3.25	1.000 Standard	3.750	0.625	0.438	0.625	2.760	4.688	5.500	0.750	6.875	8.125	9.375	10.625
	1.375 Oversize								1.000	7.125	8.375	9.625	10.875
4.00	1.000 Standard	4.500	0.625	0.438	0.625	3.320	5.438	6.250	0.750	6.875	8.125	9.375	10.625
	1.375 Oversize								1.000	7.125	8.375	9.625	10.875
5.00	1.000 Standard	5.500	0.625	0.563	0.625	4.100	6.625	7.625	0.750	6.875	8.125	9.375	10.625
	1.375 Oversize								1.000	7.125	8.375	9.625	10.875
6.00	1.375 Standard	6.500	0.625	0.563	0.750	4.875	7.625	8.625	0.875	8.125	9.625	11.125	N/A
	1.750 Oversize								1.125	8.375	9.875	11.375	N/A

For dimensions not shown, see pages 120 & 121.

SERIES 'MS' DIMENSIONS: TIE ROD MOUNTS



TIE ROD EXTENDED 'MX1', 'MX2' & 'MX3' MOUNT DIMENSIONS						
BORE	ROD DIAMETER	AA	BB	DD	FH	R
1.50	0.625 Standard	2.020	1.000	1/4 -28	0.375	1.438
	1.000 Oversize					
2.00	0.625 Standard	2.600	1.125	5/16 -24	0.375	1.844
	1.000 Oversize					
2.50	0.625 Standard	3.100	1.125	5/16 -24	0.375	2.188
	1.000 Oversize					
3.25	1.000 Standard	3.900	1.375	3/8 -24	0.625	2.760
	1.375 Oversize					

TIE ROD EXTENDED 'MX1', 'MX2' & 'MX3' MOUNT DIMENSIONS						
BORE	ROD DIAMETER	AA	BB	DD	FH	R
4.00	1.000 Standard	4.700	1.375	3/8 -24	0.625	3.320
	1.375 Oversize					
5.00	1.000 Standard	5.800	1.813	1/2 -20	0.625	4.100
	1.375 Oversize					
6.00	1.375 Standard	6.900	1.813	1/2 -20	0.750	4.875
	1.750 Oversize					
8.00	1.375 Standard	9.100	2.313	5/8 -18	*0.625	6.438
	1.750 Oversize					

Full square bushing retainer on 1.50" - 6.00" bores.
 *Round retainer on 8.00" bore. BB dimension from face of head.
 For dimensions not shown, see pages 120 & 121.

SERIES 'MS' EFFECTIVE PISTON AREA/FORCE CHART*

BORE	STAGES	EFF. PISTON AREA (SQ. IN.)				FORCE IN LBS. AT 60 PSI				FORCE IN LBS. AT 100 PSI			
		EXTEND (MSE)		RETRACT (MSR)		EXTEND (MSE)		RETRACT (MSR)		EXTEND (MSE)		RETRACT (MSR)	
		STD. ROD Ø	O' SIZE Ø	STD. ROD Ø	O' SIZE Ø	STD. ROD Ø	O' SIZE Ø	STD. ROD Ø	O' SIZE Ø	STD. ROD Ø	O' SIZE Ø	STD. ROD Ø	O' SIZE Ø
1.50	2	3.228	2.749	2.922	1.964	193	164	175	117	322	274	292	196
	3	4.687	3.731	4.383	2.946	281	223	262	176	468	373	438	294
	4	6.150	4.713	5.844	3.928	369	282	350	235	615	471	584	392
	5	7.607	5.695	N/A	N/A	456	342	N/A	N/A	761	570	N/A	N/A
2.00	2	5.974	5.499	5.668	4.714	358	329	340	282	597	549	566	471
	3	8.808	7.856	8.502	7.071	528	471	510	424	880	785	850	707
	4	11.642	10.213	11.336	9.428	698	612	680	565	1164	1021	1133	942
	5	14.482	12.568	N/A	N/A	869	754	N/A	N/A	1448	1257	N/A	N/A
2.50	2	9.490	9.033	9.188	8.248	569	541	551	494	949	903	918	824
	3	14.080	13.157	13.782	12.372	844	789	826	742	1408	1315	1378	1237
	4	18.680	17.281	18.376	16.496	1120	1036	1102	989	1868	1728	1837	1649
	5	23.312	21.405	N/A	N/A	1398	1284	N/A	N/A	2330	2140	N/A	N/A
3.25	2	15.807	15.107	15.022	13.622	948	906	901	817	1580	1510	1502	1362
	3	23.317	21.918	22.532	20.433	1399	1315	1351	1225	2331	2191	2253	2043
	4	30.828	28.729	30.043	27.244	1849	1723	1802	1634	3082	2872	3004	2724
	5	38.340	35.540	N/A	N/A	2300	2132	N/A	N/A	3834	3554	N/A	N/A
4.00	2	24.347	23.647	23.562	22.166	1460	1418	1413	1329	2434	2364	2356	2216
	3	36.127	34.728	35.342	33.243	2167	2083	2120	1994	3612	3472	3534	3324
	4	47.908	45.809	47.123	44.324	2874	2748	2827	2659	4790	4580	4712	4432
	5	59.690	56.890	N/A	N/A	3581	3413	N/A	N/A	5969	5689	N/A	N/A
5.00	2	38.485	37.785	37.700	36.3	2309	2267	2262	2178	3848	3778	3770	3630
	3	57.334	55.935	56.549	54.45	3440	3356	3392	3267	5733	5593	5654	5445
	4	76.184	74.085	75.399	72.6	4571	4445	4523	4356	7618	7408	7539	7260
	5	95.035	92.235	N/A	N/A	5701	5534	N/A	N/A	9503	9223	N/A	N/A
6.00	2	55.065	54.143	53.582	51.736	3303	3248	3214	3104	5506	5414	5358	5136
	3	81.854	80.012	80.370	77.607	4911	4800	4822	4656	8185	8001	8037	7760
	4	108.644	105.881	107.16	103.476	6518	6352	6429	6208	10864	10588	10716	10347
8.00	2	99.047	98.125	97.564	95.72	5942	5887	5853	5743	9904	9812	9756	9572
	3	147.834	145.985	146.35	143.58	8870	8759	8781	8614	14783	14598	14635	14358
	4	196.611	193.845	195.13	191.44	11796	11630	11707	11486	19661	19384	19513	19144

*Theoretical force: actual force will be reduced due to seal friction.