

**NEW Expanded
Products and Options**

TRD Manufacturing, Inc.

A BIMBA Company

CYLINDERS

NFPA Interchangeable • 1.50" thru 12" Bores
250 PSI Pneumatic • Strokes to 120 Inches
Permanent Lubrication • Temperatures: 200°F Standard
Double Acting • Multi-Stage • Multi-Position
Triple Rod • Flush Mount • Back-To-Back
Air/Oil • Tandem

Quick 2-3 Day Delivery

OPTIONS

Low Friction • Non-Rotating
400 PSI Hydraulic • Corrosion Resistant
Quiet Operation (BP) • Adjustable Retract Stroke
BSP or SAE Ports • 400°F Temperatures
Oversize Piston Rods • Piston Wear Bands
Micro-Adjust Stroke (Extend)

BALLUFF  **ICROPULSE**

Transducers

(More Options Inside)

ACCESSORIES

Air/Oil Tanks • Switches
Clevis & Brackets • Air Boosters
Alignment Couplers

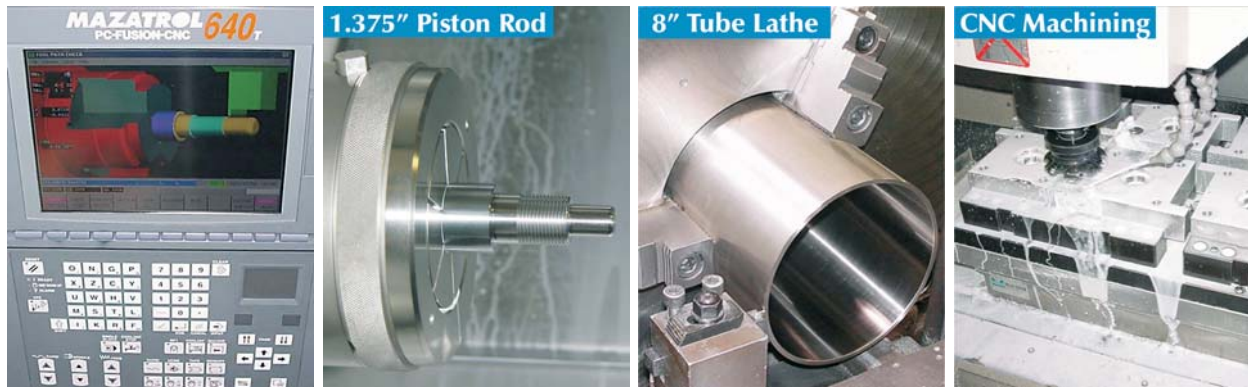
BALLUFF  **TROKEMASTER**

Sensors



The TRD difference...

Precision machined throughout. We started in business as precision machinists. Every component is machined in a manner to enhance the performance of our products. Cylinder tubes are lathe cut, not sawed. Heads and caps are 100% CNC machined to tight tolerances in jig bored fixtures. Piston and rod diameters and concentricity are held to within two thousandths of an inch, in CNC lathes. The results: cylinders that have a consistent performance and long life. Our cylinders are truly “square”, which eliminates shimming! **Try the TRD difference!**



On time, consistent delivery. Every customer’s order is important. Our business is managed so large orders do not disrupt our published delivery schedules.

Cylinder Options and Custom Modifications - Since every cylinder is made to order, you can customize each cylinder to best fit your application. You can choose from our extensive list of standard options, or send us a sketch for a custom solution!

- **Port size, type or location along with cushion locations can be made to your specifications.** (*All NFPA, BSP or SAE Sizes available*)
- **Rod End Styles and Designs:**
 - (5) NFPA Standard rod end styles available
 - Custom or other thread lengths available
 - Metric or other thread styles available
 - Custom rod end styles available - *just send us a sketch!*
 - “Hollow” Rod designs can be gun-drilled to your specifications
- **Most Cylinder Options Ship in 2-3 Days!**

Quick response on all requests. Most requests are answered the day they are received.

Visit us on the web: <http://www.trdmfg.com> e-mail: sales@trdmfg.com

2D DXF & DWG CAD files available 3D Step files available for download

NEW 3 YEAR WARRANTY

TRD Manufacturing Incorporated, A Bimba Company, is an employee owned company. We take great pride in our products. TRD Manufacturing, Inc. warrants its cylinders for a full 3 years to be free from defects in material and workmanship. TRD Manufacturing, Inc. must be notified prior to returning product for warranty evaluation. Contact your local TRD distributor to obtain an RGA (Returned Goods Authorization Number) for proper tracking and expedite service on all warranty evaluations. TRD will repair or replace free of charge any products returned to the factory within 3 years of shipment that is proven to be defective in material and/or workmanship.

A complete explanation of defects is required with the returned product. The TRD warranty applies only to products used properly and under normal operating conditions. All products are to be used in a safe manner, in properly designed systems. Safeguards to prevent personal injury or equipment damage must be used and are the sole responsibility of the user.

In no event shall TRD Manufacturing, Inc. be liable for any consequential damages or installation costs resulting from delay or failure of delivery, defective material or workmanship or out of a breach by TRD Manufacturing, Inc. of any contract.

TABLE OF CONTENTS

What's **NEW** in this Catalog:

	<u>PAGE</u>
• "FIXED" Cushions (Non-Adjustable)	5
• New Part Numbers for 'FM' Series Mounting Kits	30
• Nitrotech Plated Clevis Pins	101
• ACH250	104
• AC1875 and AC2000	104
• Flow Controls	105-106
• Extended Temperature (-40°F to 260°F, -40°C to 125°C) Reed Switches	107-113

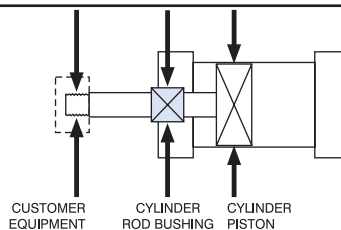
	<u>PAGE</u>
WARRANTY & RETURN INFO	2
SERIES 'TA' (Standard Cylinders)	4-16
SERIES 'TD' (Tough-Duty)	17-18
SERIES 'FM' (Flush Mount)	19-30
SERIES 'Back-To-Back'	31-35
SERIES '3-Position'	36-41
SERIES 'Tandem'	42-48
SERIES 'TRA' (Triple Rod)	49-70
SERIES 'MSE/MSR' (Multi-Stage)	71-79
'EN' Electroless Nickel	84
'LF' Low Friction	84
'NR' Non-Rotating	86
'TH' 400 PSI Hydraulic	90
Cylinder Options	80-90
Special Cylinders & Options	91-92
Balluff Transducers	93-94
Reciprocating Air Booster	95-97
Single-Shot Air Booster	98-99
Air/Oil Tanks	100
Rod Clevis, Pins & Mounts	101-103
Alignment Couplers	104
Flow Controls	105-106
TRD Magnetic Switches	107-113
Balluff Switches	114-117
Help in Choosing a Cylinder	118-120
Cylinder Weights	121
Seal Kits	122-123
Cylinder Parts Lists	124-136
Application Help (Fax Form)	137
Custom Cylinders	138
DELIVERY SCHEDULE	Back Cover

SERIES 'TA' (NFPA) CYLINDER

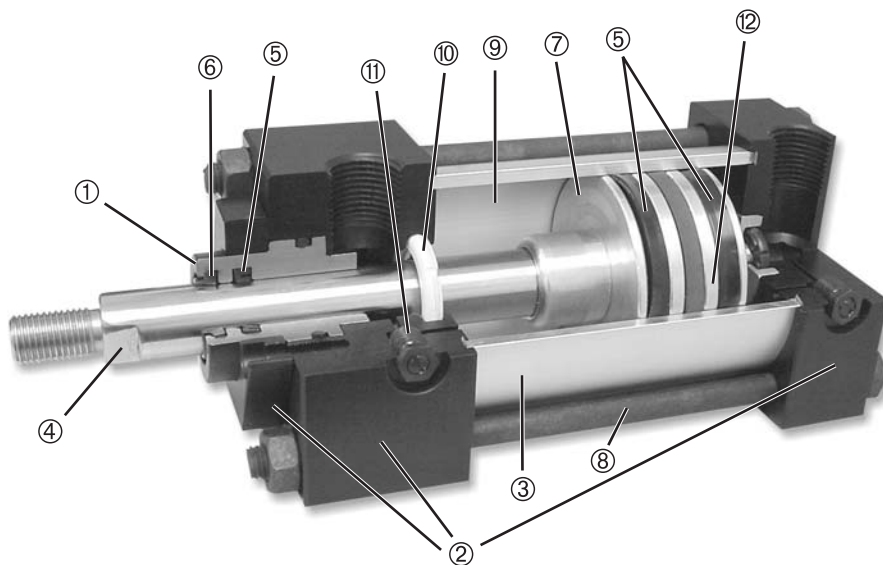
Floating Rod Bushing

SELF ALIGNMENT FEATURE

Rod Bushing is designed to float .002", improving bearing surface alignment.



- Reduces cylinder drag and erratic operation
- Reduces cylinder wear
- Provides a minimum of 25% longer life than "fixed" Rod Bushing designs



HEAVY-DUTY DESIGN FOR RELIABLE, CONSISTENT OPERATION

- ① **FLOATING ROD BUSHING** – Precision machined from 150,000 PSI rated graphite filled cast iron and PTFE coated to reduce friction and extend cycle life. Bushing design "traps" lubrication in effective bearing area.
- ② **HEAD, CAP & RETAINER** – Precision machined from high strength 6061-T6 aluminum alloy. Black anodized for corrosion resistance.
- ③ **CYLINDER TUBE** – Precision machined from 6063-T6832 high tensile aluminum alloy and hard coat to 60 Rc for wear resistance and extended cycle life.
- ④ **PISTON ROD** – Precision machined from high yield, polished and hard chrome plated steel.
- ⑤ **PISTON & ROD SEALS** – Heavy lip design Carboxylated Nitrile construction. Seals are pressure activated and wear compensating for long life. (Self lubricating material).
- ⑥ **ROD WIPER** – Abrasion resistant urethane provides aggressive wiping action in all environments. External lip design prevents debris from entering cylinder.
- ⑦ **PISTON** – Precision machined from 6061-T651 alloy aluminum, provides an excellent bearing surface for extended cylinder life.
- ⑧ **TIE RODS** – Prestressed high carbon steel tie rod construction eliminates axial loading of cylinder tube and maintains compression on tube and end seals.
- ⑨ **PERMANENT LUBRICATION** – Permanently lubricated with Magna-Lube G PTFE based grease on all internal components. This is a non-migratory type high performance grease providing outstanding service life. No additional lubrication is required.
- ⑩ **CUSHIONS** – (Options H & C) Floating cushion seal designed for maximum cushion performance, quick return stroke break-away and extended life.
- ⑪ **CUSHION ADJUSTMENT NEEDLE** – Adjustable steel needle design has fine thread metering and is positively captured to prevent needle ejection during adjustment.
- ⑫ **PISTON MAGNET** – (Option MPR) for TRD magnetically operated reed and solid state switches (refer to pages 107-113).

OPERATING PRESSURE

250 PSI AIR (17 BAR)

OPERATING TEMPERATURE

Carboxylated Nitrile: -20°F to 200°F (-25°C to 90°C)
Fluorocarbon: 0°F to 400°F (-20°C to 200°C)

Performance options:

- **WB** – PTFE piston wear band, recommended for pivot mounted, long strokes or cylinders that may see side loads.
- **ST** – Stop tubes are used to reduce rod bearing and piston stress (refer to page 89 for cylinder design guidance).
- **MA** – Micro-Adjust provides a precision adjustment on the cylinder extend stroke, providing quick and accurate cylinder positioning, reducing set-up time.
- **SSA** – Stainless Steel Piston Rod, Tie Rods, Nuts, and Fasteners provide corrosion resistance in outdoor applications and wet environments.
- **LF** – Low Friction seals reduce breakaway and running friction. Effective at all operating pressures.
- **NR** – Non-Rotating option incorporates (2) internal guide rods preventing rod rotation (NFPA dimensions).

HOW TO ORDER: SERIES 'TA' (STANDARD CYLINDER)

TA - MF1 - 2.50 x 10 - HC - MPR

SERIES		BORE		STROKE		CUSHIONS		OPTIONS	
TA	250 PSI AIR	1.50	2	0"	120"	H	HEAD CUSHION POSITION 2 IS STANDARD SPECIFY FOR POSITIONS: 1, 3 & 4	A =	EXTENDED PISTON ROD THREAD (Example: A = 2")
NFPA MOUNTS MF1 FRONT FLANGE (1.50"-6" Bore) MF2 REAR FLANGE (1.50"-6" Bore) ME3 FRONT MOUNTING HOLES (8"-12" Bore) ME4 REAR MOUNTING HOLES (8"-12" Bore) MP1 REAR PIVOT CLEVIS (1.50"-12" Bore) MP2 REAR PIVOT CLEVIS (1.50"-8" Bore) MP4 REAR PIVOT EYE (1.50"-6" Bore) MS1 FRONT & REAR END ANGLE (1.50"-8" Bore) MS2 SIDE LUG (1.50"-8" Bore) MS4 BOTTOM TAPPED HOLES (1.50"-12" Bore) MT1 FRONT TRUNNION (1.50"-8" Bore) MT2 REAR TRUNNION (1.50"-8" Bore) MT4 INTERMEDIATE TRUNNION (1.50"-8" Bore) MXO NO MOUNT (1.50"-12" Bore) MX1 EXTENDED TIE RODS - HEAD & CAP (1.50"-12" Bore) MX2 EXTENDED TIE RODS (CAP) (1.50"-12" Bore) MX3 EXTENDED TIE RODS (HEAD) (1.50"-12" Bore)		2.50	3.25	0"	120"	LH	LONG HEAD CUSHION POSITION 2 IS STANDARD SPECIFY FOR POSITIONS: 1, 3 & 4	X B	.25" URETHANE BUMPER BOTH ENDS
		4	5	0"	120"	ELH	EXTRA LONG HEAD CUSHION POSITION 2 IS STANDARD SPECIFY FOR POSITIONS: 1, 3 & 4	X BH	.25" URETHANE BUMPER HEAD ONLY
		6	8	0"	120"	C	CAP CUSHION POSITION 6 IS STANDARD SPECIFY FOR POSITIONS: 5, 7 & 8	BP	BUMPER PISTON SEALS (1.50" - 8" Bore)
STYLE SINGLE ROD (LEAVE BLANK) D = DOUBLE ROD END		10	12	0"	120"	LC	LONG CAP CUSHION POSITION 6 IS STANDARD SPECIFY FOR POSITIONS: 5, 7 & 8	BSP	BSP PORTS (SPECIFY SIZE, Example: BSP = .25")
		10	12	0"	120"	ELC	EXTRA LONG CAP CUSHION POSITION 6 IS STANDARD SPECIFY FOR POSITIONS: 5, 7 & 8	C	EXTENDED PISTON ROD (Example: IF C = 0.50", THEN 1" ROD EXTENSION IS C = 1.50")
		10	12	0"	120"	FIXED CUSHIONS		EN	ELECTROLESS NICKEL PLATED (Refer to page 84 for specifications)
About our Part Number System <ul style="list-style-type: none"> Simple, easy to understand No excessive codes! Eliminates mistakes when ordering <p>Example: A 2.50" Bore by 10" Stroke NFPA cylinder, Front Flange Mount, Head & Cap Cushions, Magnetic Piston for Switches.</p> <p>Part Number: TA-MF1-2.50 x 10-HC-MPR</p>						FCH	FIXED HEAD CUSHION (NON-ADJUSTABLE, NO ADJUSTMENT NEEDLE)	KK2	LARGE MALE ROD THREAD
						FCC	FIXED CAP CUSHION (NON-ADJUSTABLE, NO ADJUSTMENT NEEDLE)	KK3	FEMALE ROD THREAD
						FC	FIXED HEAD AND CAP CUSHION (NON-ADJUSTABLE, NO ADJUSTMENT NEEDLE)	KK3S	STUDDED PISTON ROD (KK3 with Stud, Loctite in place)
								MA	MICRO-ADJUST (6" MAX. STROKE) Available on Double Rod End Models
								MAB	MICRO-ADJUST WITH SOUND DAMPENING BUMPER (6" MAX. STROKE)
								MPR	MAGNETIC PISTON FOR REED OR SOLID STATE SWITCHES - TRD MODELS: R10, R10P RAC, RHT & MSS (Refer to pages 107-113 for selection)
								MS	METALLIC ROD SCRAPER (BRASS CONSTRUCTION)
								NR	NON-ROTATING (Refer to page 86 for specifications)
								OP	OPTIONAL PORT LOCATION (Example: Ports @ 3 & 7)
								OS	OVERSIZE ROD DIAMETER (SPECIFY SIZE, Example: OS = 1.38")
						SAE	SAE PORTS (SPECIFY SIZE, Example: SAE #10)		
						X SE	SPRING EXTEND (1.50, 2, 2.50 bore)		
						X SR	SPRING RETURN (1.50, 2, 2.50 bore)		
						SSA	STAINLESS STEEL PISTON ROD, TIE RODS & NUTS, AND FASTENERS		
						SSF	STAINLESS STEEL FASTENERS		
						SSR	STAINLESS STEEL PISTON ROD		
						SST	STAINLESS STEEL TIE RODS & NUTS		
						X ST	STOP TUBE (SPECIFY STOP TUBE LENGTH AND EFFECTIVE STROKE) (Example: TA MS4 2 X 24" EFFECTIVE STROKE-ST=3)		
						STEEL TUBE	STEEL CYLINDER TUBE, BLACK EPOXY PAINT FINISH		
						TH	400 PSI HYDRAULIC NON-SHOCK (Refer to page 90 for specifications)		
						VS	FLUOROCARBON SEALS		
						WB	PISTON WEAR BAND		
						XX	SPECIAL VARIATION (SPECIFY)		

About our Part Number System

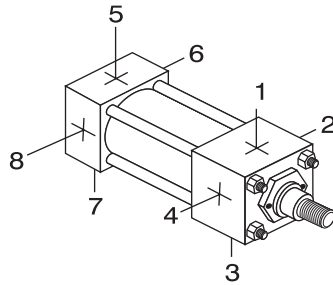
- Simple, easy to understand
- No excessive codes!
- Eliminates mistakes when ordering

Example: A 2.50" Bore by 10" Stroke NFPA cylinder, Front Flange Mount, Head & Cap Cushions, Magnetic Piston for Switches.

Part Number: TA-MF1-2.50 x 10-HC-MPR

STANDARD PORT AND CUSHION ADJUSTMENT POSITIONS

- Ports - Positions 1 and 5
- Cushion Adjustment - Positions 2 and 6
- Specify Non-Standard Positions When Ordering



NFPA MOUNTS

 1.50"-6" Bores Page 9	 1.50"-6" Bores Page 9	 8"-12" Bores Page 9	 8"-12" Bores Page 9	 1.50"-12" Bores Page 7	 1.50"-6" Bores Page 7
 1.50"-6" Bores Page 7	 1.50"-8" Bores Page 10	 1.50"-8" Bores Page 10	 1.50"-12" Bores Page 11	 1.50"-8" Bores Page 8	 1.50"-8" Bores Page 8
 1.50"-8" Bores Page 8	 1.50"-12" Bores Page 6	 1.50"-12" Bores Page 9	 1.50"-12" Bores Page 9	 1.50"-12" Bores Page 9	

OPTION LENGTH ADDER (ADD TO CATALOG BASIC OVERALL LENGTH DIMENSIONS)							
BORE	OPTION						
	B	BC	BH	ELC	ELH	SE	SR
1.50	.50	.25	.25	1	1	Refer to page 88 for length adders and available bore sizes and strokes	2
2	.50	.25	.25	1	1		2
2.50	.50	.25	.25	1	1		2
3.25	.50	.25	.25	1.25	1.25		2
4	.50	.25	.25	1.25	1.25		2
5	.50	.25	.25	1.25	1.25		2
6	.50	.25	.25	1.50	1.50		2
8	.50	.25	.25	1.50	1.50		2
10	.50	.25	.25	2	2		2
12	.50	.25	.25	2	2		2

*Note: The desired Stop Tube length adds directly to the overall cylinder length.

SERIES 'TA' DIMENSIONS: BASIC CYLINDER (NO MOUNT)

About Rod End Styles

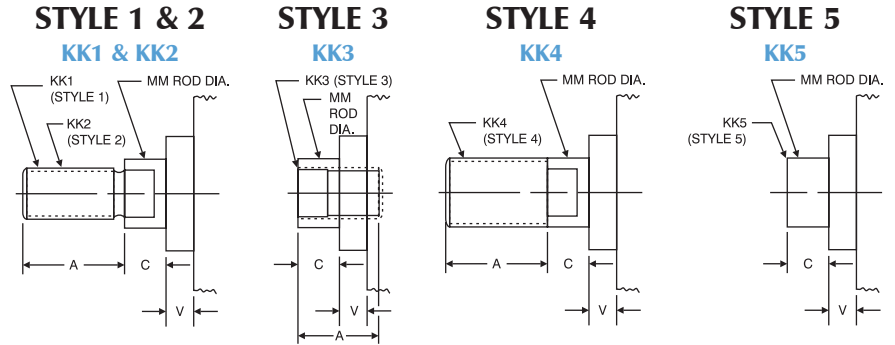
Style 1 Male Rod End is STANDARD

Other NFPA Styles can be specified (See Chart).

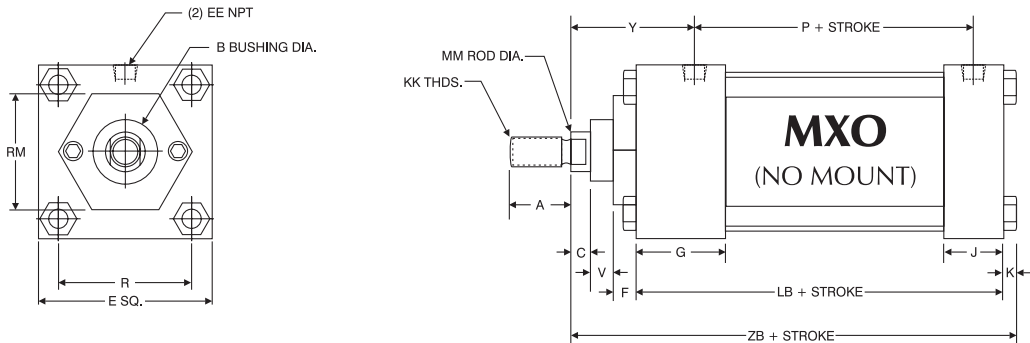
Need a rod end not listed? NO PROBLEM! Each Piston Rod is made to order and does not delay shipment. Coarse (UNC) threads, Metric threads or just plain rod ends are common. Thread lengths are also made to order (Specify: "A"=Length).

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

PISTON ROD END STYLES

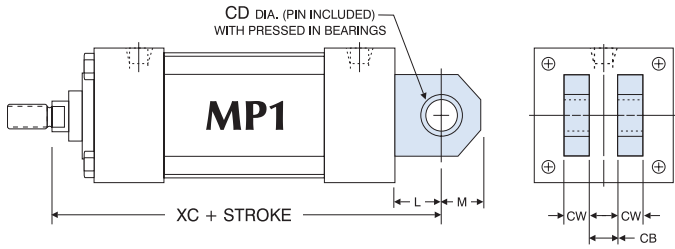


BORE	MM ROD DIAMETER	STANDARD					OPTIONAL					C	V
		Style 1 - Male		Style 2 - Male		Style 3 - Female		Style 4 - Male		Style 5 - Blank			
		KK1	A	KK2	A	KK3	A	KK4	A	KK5			
1.50, 2, 2.50	.63 Standard	.44-20	.75	.50-20	.75	.44-20	.75	.63-18	.75	No Threads	.38	.25	
	1 Oversize	.75-16	1.13	.88-14	1.13	.75-16	1.13	1-14	1.13	No Threads	.50	.50	
3.25, 4, 5	1 Standard	.75-16	1.13	.88-14	1.13	.75-16	1.13	1-14	1.13	No Threads	.50	.25	
	1.38 Oversize	1-14	1.63	1.25-12	1.63	1-14	1.63	1.38-12	1.63	No Threads	.63	.38	
6 & 8	1.38 Standard	1-14	1.63	1.25-12	1.63	1-14	1.63	1.38-12	1.63	No Threads	.63	.38	
	1.75 Oversize	1.25-12	2	1.50-12	2	1.25-12	2	1.75-12	2	No Threads	.75	.50	
10	1.75 Standard	1.25-12	2	1.50-12	2	1.25-12	2	1.75-12	2	No Threads	.75	.50	
	2 Oversize	1.50-12	2.25	1.75-12	2.25	1.50-12	2.25	2-12	2.25	No Threads	.88	.38	
12	2 Standard	1.50-12	2.25	1.75-12	2.25	1.50-12	2.25	2-12	2.25	No Threads	.88	.38	
	2.50 Oversize	1.88-12	3	2.25-12	3	1.88-12	3	2.50-12	3	No Threads	1	.50	



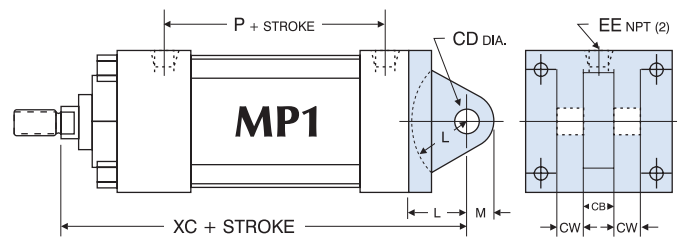
BASIC DIMENSIONS 'MXO' STANDARD & OVERSIZE RODS																			
BORE	ROD DIAMETER	A	B	C	E	EE	F	G	J	K	KK	LB	MM	P	R	RM	V	Y	ZB
1.50	.63 Standard	.75	1.13	.38	2	.38	.38	1.50	1	.25	.44-20	3.63	.63	2.38	1.43	2 SQ.	.25	1.88	4.88
	1 Oversize	1.13	1.50	.50							.75-16		1				.50		
2	.63 Standard	.75	1.13	.38	2.50	.38	.38	1.50	1	.31	.44-20	3.63	.63	2.38	1.84	1.75 HEX	.25	1.88	4.94
	1 Oversize	1.13	1.50	.50							.75-16		1			2.50	5.31		
2.50	.63 Standard	.75	1.13	.38	3	.38	.38	1.50	1	.31	.44-20	3.75	.63	2.50	2.19	1.75 HEX	.25	1.88	5.06
	1 Oversize	1.13	1.50	.50							.75-16		1			2.50	5.44		
3.25	1 Standard	1.13	1.50	.50	3.75	.50	.63	1.75	1.25	.38	.75-16	4.25	1	2.75	2.76	2.75 DIA.	.25	2.38	6
	1.38 Oversize	1.63	2	.63							1-14		1.38			3.75 SQ.	.38		
4	1 Standard	1.13	1.50	.50	4.50	.50	.63	1.75	1.25	.38	.75-16	4.25	1	2.75	3.32	2.75 DIA.	.25	2.38	6
	1.38 Oversize	1.63	2	.63							1-14		1.38			3.50 DIA.	.38		
5	1 Standard	1.13	1.50	.50	5.50	.50	.63	1.75	1.25	.44	.75-16	4.50	1	3	4.10	2.75 DIA.	.25	2.38	6.31
	1.38 Oversize	1.63	2	.63							1-14		1.38			3.50 DIA.	.38		
6	1.38 Standard	1.63	2	.63	6.50	.75	.63	2	1.50	.44	1-14	5	1.38	3.25	4.88	3.50 DIA.	.38	2.75	7.06
	1.75 Oversize	2	2.38	.75							1.25-12		1.75			.50	3		
8	1.38 Standard	1.63	2	.63	8.50	.75	.63	2	1.50	.56	1-14	5.13	1.38	3.38	6.44	3.50 DIA.	.38	2.75	7.31
	1.75 Oversize	2	2.38	.75							1.25-12		1.75			.50	3		
10	1.75 Standard	2	2.38	.75	10.63	1	.63	2.25	2	.69	1.25-12	6.38	1.75	4.31	7.92	3.50 DIA.	.50	3.06	8.94
	2 Oversize	2.25	2.63	.88			.75				1.50-12		2			.38	3.19		
12	2 Standard	2.25	2.63	.88	12.75	1	.75	2.25	2	.69	1.50-12	6.88	2	4.81	9.40	5 DIA.	.38	3.19	9.56
	2.50 Oversize	3	3.13	1							1.88-12		2.50			.50	3.44		

SERIES 'TA' DIMENSIONS: PIVOT MOUNTS



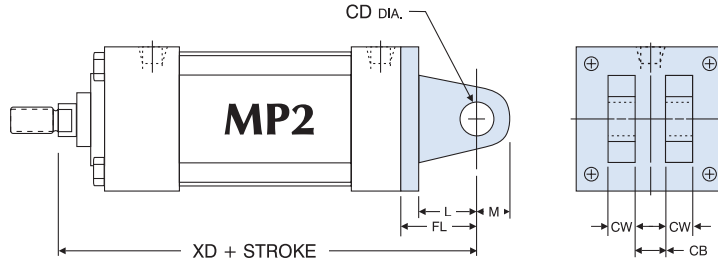
EXTRUDED MP1 MOUNT

(EXTRUDED: 1.50" - 8" BORES, WELDMENT: 10" & 12" BORES)



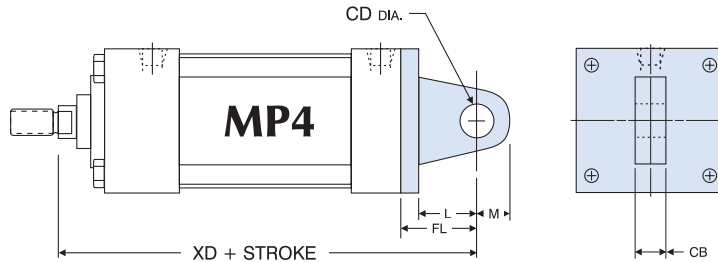
IRON CASTING MP1 MOUNT

(OPTIONAL)**



MP2 MOUNT

(IRON CASTING)



MP4 MOUNT

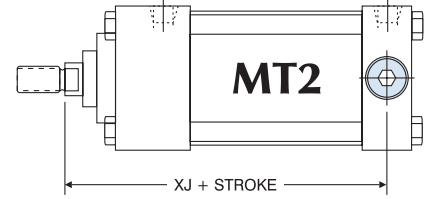
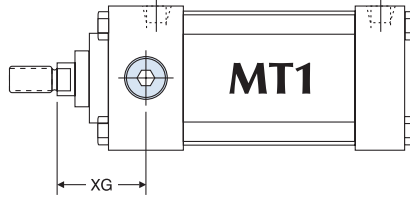
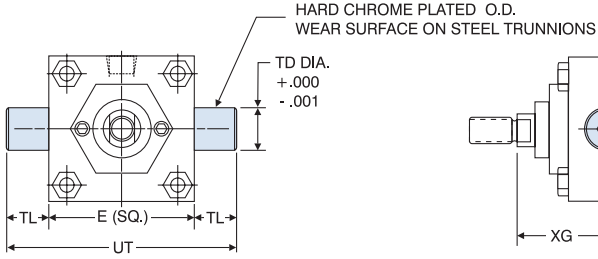
(IRON CASTING: 1.50" - 4" BORES, WELDMENT: 5" - 6" BORES*)

'MP1', 'MP2' CLEVIS AND 'MP4' EYE MOUNT DIMENSIONS									ACCESSORIES (SEE PAGES 101-102 FOR DIMENSIONS)					
BORE	ROD DIAMETER	CB	CD	CW	FL	L	M	XC	XD	ROD CLEVIS	ROD EYE	CLEVIS PIN	EYE BRACKET (FOR MP1)	CLEVIS BRKT (FOR MP4)
1.50	.63 Standard	.75	.50	.50	1.13	.75	.63	5.38	5.75	RC437	RE437	CP500	EB500	CB500
	5.75							6.13	RC750	RE750	CP750			
2	.63 Standard	.75	.50	.50	1.13	.75	.63	5.38	5.75	RC437	RE437	CP500	EB500	CB500
	5.75							6.13	RC750	RE750	CP750			
2.50	.63 Standard	.75	.50	.50	1.13	.75	.63	5.50	5.88	RC437	RE437	CP500	EB500	CB500
	5.88							6.25	RC750	RE750	CP750			
3.25	1 Standard	1.25	.75	.63	1.88	1.25	.88	6.88	7.50	RC750	RE750	CP750	EB750	CB750
	1.38 Oversize							7.13	7.75	RC1000	RE1000	CP1000		
4	1 Standard	1.25	.75	.63	1.88	1.25	.88	6.88	7.50	RC750	RE750	CP750	EB750	CB750
	1.38 Oversize							7.13	7.75	RC1000	RE1000	CP1000		
5*	1 Standard	1.25	.75	.63	1.88	1.25	.88	7.13	7.75	RC750	RE750	CP750	EB750	CB750
	1.38 Oversize							7.38	8	RC1000	RE1000	CP1000		
6*	1.38 Standard	1.50	1	.75	2.25	1.50	1	8.13	8.88	RC1000	RE1000	CP1000	EB1000	CB1000
	1.75 Oversize							8.38	9.13	RC1250	RE1250	CP1375		
8	1.38 Standard	1.50	1	.75	N/A	1.50	1	8.25	N/A	RC1000	RE1000	CP1000	EB1000	CB1000
	1.75 Oversize							8.50	N/A	RC1250	RE1250	CP1375		
10	1.75 Standard	2	1.38	1	N/A	2.13	1.38	10.38	N/A	RC1250	RE1250	CP1375	EB1375	CB1375
	2 Oversize							10.50	N/A	RC1500	RE1500	CP1750		
12	2 Standard	2.50	1.75	1.25	N/A	2.25	1.75	11.13	N/A	RC1500	RE1500	CP1750	EB1750	CB1750
	2.50 Oversize							11.38	N/A	RC1875	N/A	CP2000		

Clevis pins are provided with pivot mounts.
 *MP4 5"-6" bores are 5-7 day delivery.
 For dimensions not shown, see page 6.

**Extruded MP1 mounts are standard (1.50"-8" bores). Cast Iron removable mounts are optional, and must be requested when ordering (1.50"-6" bores). Specify "CAST MP1" when ordering.

SERIES 'TA' DIMENSIONS: PIVOT MOUNTS

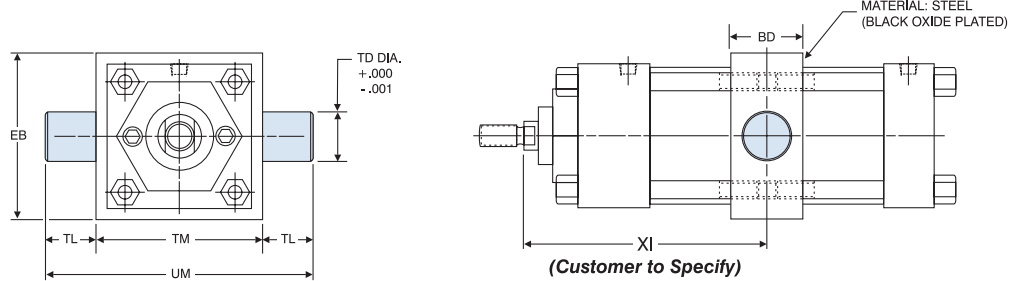


MT1 / MT2

Note: MT1 and MT2 Trunnions are bolt on, non-removable design.
Optional: One-piece solid steel trunnion available.

'MT1' HEAD TRUNNION AND 'MT2' CAP TRUNNION MOUNT DIMENSIONS							ACCESSORIES (SEE PAGES 101-102 FOR DIMENSIONS)			
BORE	ROD DIAMETER	E	TD	TL	UT	XG	ADD STROKE	ROD CLEVIS	ROD EYE	CLEVIS PIN
							XJ			
1.50	.63 Standard	2	1	1	4	1.75	4.13	RC437	RE437	CP500
	1.75					4.50	RC750	RE750	CP750	
2	.63 Standard	2.50	1	1	4.50	1.75	4.13	RC437	RE437	CP500
	2.13					4.50	RC750	RE750	CP750	
2.50	.63 Standard	3	1	1	5	1.75	4.25	RC437	RE437	CP500
	2.13					4.63	RC750	RE750	CP750	
3.25	1 Standard	3.75	1	1	5.75	2.25	5	RC750	RE750	CP750
	2.50					5.25	RC1000	RE1000	CP1000	
4	1 Standard	4.50	1	1	6.50	2.25	5	RC750	RE750	CP750
	2.50					5.25	RC1000	RE1000	CP1000	
5	1 Standard	5.50	1	1	7.50	2.25	5.25	RC750	RE750	CP750
	2.50					5.50	RC1000	RE1000	CP1000	
6	1.38 Standard	6.50	1.38	1.38	9.25	2.63	5.88	RC1000	RE1000	CP1000
	2.88					6.13	RC1250	RE1250	CP1375	
8	1.38 Standard	8.50	1.38	1.38	11.25	2.63	6	RC1000	RE1000	CP1000
	2.88					6.25	RC1250	RE1250	CP1375	

*No oversize rod available on 1.50" bore MT1.
For dimensions not shown, see page 6.



MT4

Example: TA - MT4 4 X 12
XI = 6"

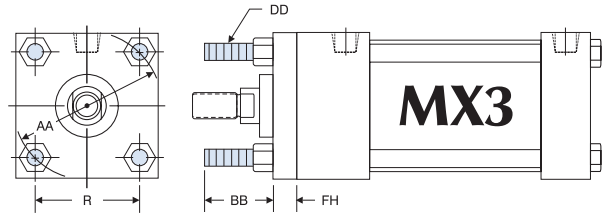
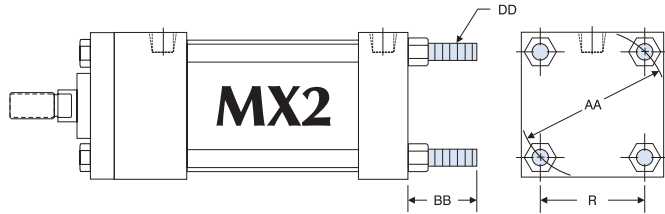
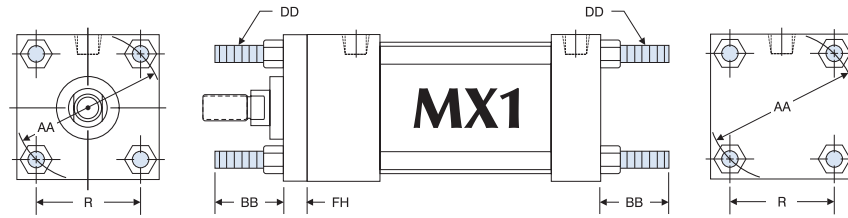
Note: MT4 Trunnions and Intermediate Section are one-piece steel construction.

'MT1', 'MT2', 'MT4' STANDARD CUSHION LOCATIONS		
MOUNT	HEAD CUSHION	CAP CUSHION
MT1	3	6
MT2	2	7
MT4	2	6

Note: Ports or cushions cannot be on same side as MT1 & MT2 Trunnions.

'MT4' INTERMEDIATE TRUNNION MOUNT DIMENSIONS							
BORE	BD	EB	TD	TL	TM	UM	XI
1.50	1.25	2.50	1	1	2.50	4.50	CUSTOMER TO SPECIFY
2	1.50	3	1	1	3	5	
2.50	1.50	3.50	1	1	3.50	5.50	
3.25	2	4.25	1	1	4.50	6.50	
4	2	5	1	1	5.25	7.25	
5	2	6	1	1	6.25	8.25	
6	2	7	1.38	1.38	7.63	10.38	
8	2.50	9.50	1.38	1.38	9.75	12.50	

SERIES 'TA' DIMENSIONS: TIE ROD & FLANGE MOUNTS



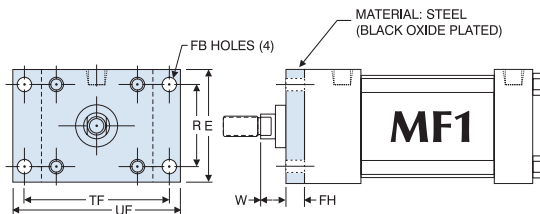
TIE ROD EXTENDED 'MX1', 'MX2' & 'MX3' MOUNT DIMENSIONS						
BORE	ROD DIAMETER	AA	BB	DD	FH	R
1.50	.63 Standard	2.02	1	.25-28	.38	1.43
	1 Oversize					
2	.63 Standard	2.6	1.13	.31-24	.38	1.84
	1 Oversize					
2.50	.63 Standard	3.1	1.13	.31-24	.38	2.19
	1 Oversize					
3.25	1 Standard	3.9	1.38	.38-24	.63	2.76
	1.38 Oversize					
4	1 Standard	4.7	1.38	.38-24	.63	3.32
	1.38 Oversize					

TIE ROD EXTENDED 'MX1', 'MX2' & 'MX3' MOUNT DIMENSIONS						
BORE	ROD DIAMETER	AA	BB	DD	FH	R
5	1 Standard	5.8	1.81	.50-20	.63	4.10
	1.38 Oversize					
6	1.38 Standard	6.9	1.81	.50-20	.75	4.88
	1.75 Oversize					
8	1.38 Standard	9.1	**2.31	.63-18	*.63	6.44
	1.75 Oversize					
10	1.75 Oversize	11.2	**2.69	.75-16	*.63	7.92
	2 Oversize					
12	2 Standard	13.3	**2.69	.75-16	*.75	9.40
	2.50 Oversize					

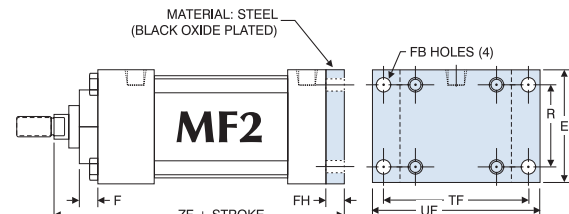
*MX1 & MX3 have full square bushing retainer on 1.50" - 6" bores, round retainers on 8" - 12" bores.

**BB dimension from face of head.

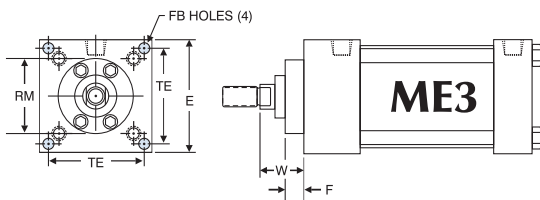
For dimensions not shown, see page 6.



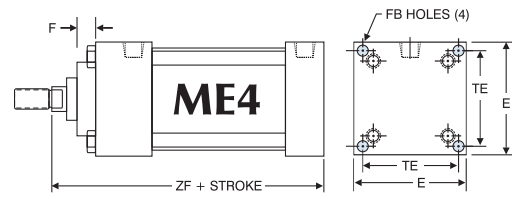
1.50" - 6" BORES



1.50" - 6" BORES



8" - 12" BORES



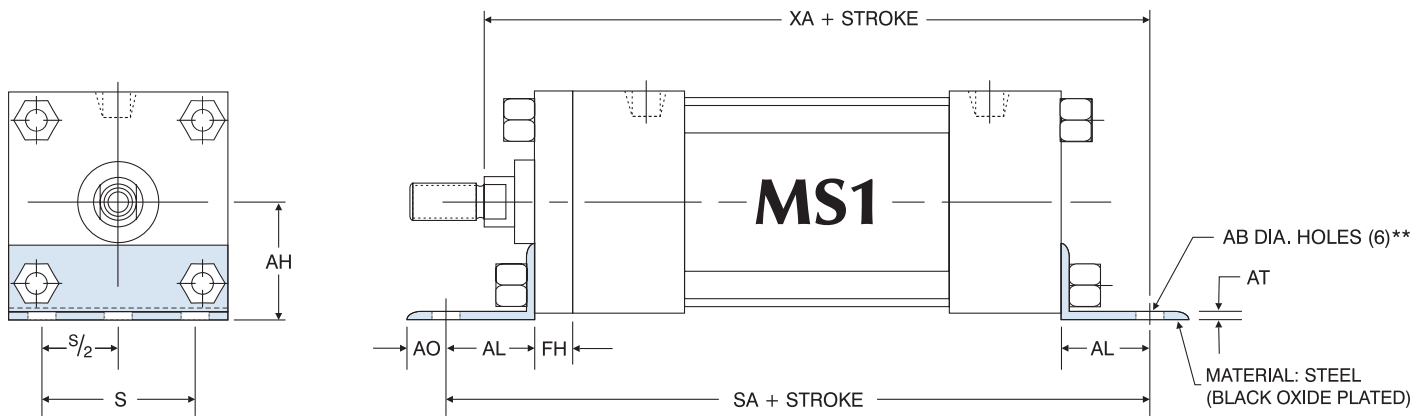
8" - 12" BORES

'MF1', 'MF2' FLANGE & 'ME3', 'ME4' CAP MOUNT DIMENSIONS												
BORE	ROD DIAMETER	E	F	FB	FH	R	RM	TE	TF	UF	W	ZF
1.50	.63 Standard	2	.38	.31	.38	1.43	—	—	2.75	3.38	.63	5
	1 Oversize											
2	.63 Standard	2.50	.38	.38	.38	1.84	—	—	3.38	4.13	.63	5
	1 Oversize											
2.50	.63 Standard	3	.38	.38	.38	2.19	—	—	3.88	4.63	.63	5.13
	1 Oversize											
3.25	1 Standard	3.75	.63	.44	.63	2.76	—	—	4.69	5.50	.75	6.25
	1.38 Oversize											
4	1 Standard	4.50	.63	.44	.63	3.32	—	—	5.44	6.25	.75	6.25
	1.38 Oversize											

'MF1', 'MF2' FLANGE & 'ME3', 'ME4' CAP MOUNT DIMENSIONS												
BORE	ROD DIAMETER	E	F	FB	FH	R	RM	TE	TF	UF	W	ZF
5	1 Standard	5.50	.63	.56	.63	4.10	—	—	6.63	7.63	.75	6.50
	1.38 Oversize											
6	1.38 Standard	6.50	.63	.56	.75	4.88	—	—	7.63	8.63	.88	7.38
	1.75 Oversize											
8	1.38 Standard	8.50	.63	.69	N/A	N/A	3.50	7.57	N/A	N/A	1.63	6.75
	1.75 Oversize											
10	1.75 Standard	10.63	.63	.81	N/A	N/A	3.50	9.40	N/A	N/A	1.88	8.25
	2 Oversize											
12	2 Standard	12.75	.75	.81	N/A	N/A	5	11.1	N/A	N/A	2	8.88
	2.50 Oversize											

For dimensions not shown, see page 6.

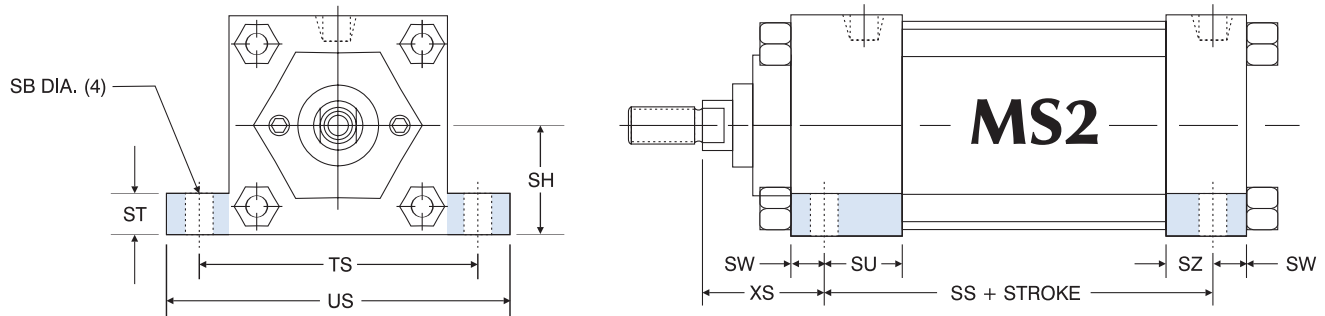
SERIES 'TA' DIMENSIONS: BASE MOUNTS



'MS1' ANGLE MOUNT DIMENSIONS										
BORE	ROD DIAMETER	AB	AH	AL	AO	AT	FH	S	ADD STROKE	
									SA	XA
1.50	.63 Standard	.44	1.19	1	.38	.19	.38	1.25	6	5.63
	1 Oversize									6
2	.63 Standard	.44	1.44	1	.38	.19	.38	1.75	6	5.63
	1 Oversize									6
2.50	.63 Standard	.44	1.63	1	.38	.19	.38	2.25	6.13	5.75
	1 Oversize									6.13
3.25	1 Standard	.56	1.94	1.25	.50	.13	.63	2.75	7.38	6.88
	1.38 Oversize									7.13
4	1 Standard	.56	2.25	1.25	.50	.13	.63	3.50	7.38	6.88
	1.38 Oversize									7.13
5	1 Standard	.69	2.75	1.38	.63	.19	.63	4.25	7.88	7.25
	1.38 Oversize									7.50
6	1.38 Standard	.81	3.25	1.38	.63	.19	.75	5.25	8.50	8
	1.75 Oversize									8.25
8	1.38 Standard	.81	4.25	1.81	.69	.25	.63*	7.13	8.75	8.56
	1.75 Oversize									8.81

*3.50" diameter round retainer on 8" bore. (MS1 BRACKET BOLTED DIRECTLY TO HEAD)

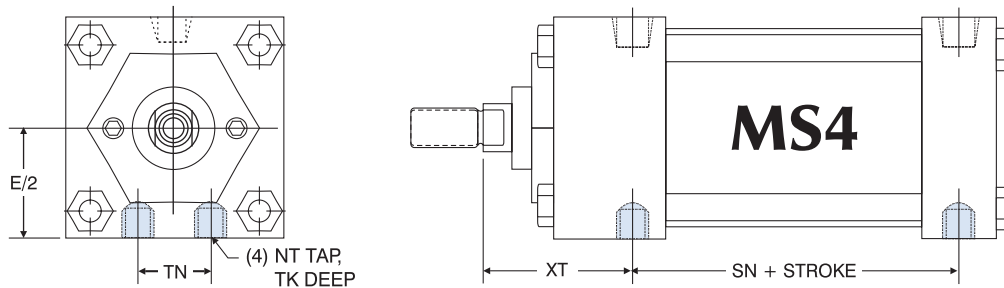
**1.50" bore has (4) AB diameter holes.



'MS2' SIDE LUG MOUNT DIMENSIONS											
BORE	ROD DIAMETER	SB	SH	ST	SU	SW	SZ	TS	US	XS	ADD STROKE
											SS
1.50	.63 Standard	.44	1	.50	1.13	.38	.63	2.75	3.50	1.38	2.88
	1.75										
2	.63 Standard	.44	1.25	.50	1.13	.38	.63	3.25	4	1.38	2.88
	1.75										
2.50	.63 Standard	.44	1.50	.50	1.13	.38	.63	3.75	4.50	1.38	3
	1.75										
3.25	1 Standard	.56	1.88	.75	1.25	.50	.75	4.75	5.75	1.88	3.25
	1.38 Oversize										2.13
4	1 Standard	.56	2.25	.75	1.25	.50	.75	5.50	6.50	1.88	3.25
	1.38 Oversize										2.13
5	1 Standard	.81	2.75	1	1.06	.69	.56	6.88	8.25	2.06	3.13
	1.38 Oversize										2.31
6	1.38 Standard	.81	3.25	1	1.31	.69	.81	7.88	9.25	2.31	3.63
	1.75 Oversize										2.56
8	1.38 Standard	.81	4.25	1	1.31	.69	.81	9.88	11.25	2.31	3.75
	1.75 Oversize										2.56

For dimensions not shown, see page 6.

SERIES 'TA' DIMENSIONS: BASE MOUNTS



'MS4' BOTTOM TAPPED MOUNT DIMENSIONS

BORE	ROD DIAMETER	E/2	NT	TK	TN	XT	ADD STROKE
							SN
1.50	.63 Standard	1	.25-20	.38	.63	1.94	2.25
	1 Oversize						
2	.63 Standard	1.25	.31-18	.50	.88	1.94	2.25
	1 Oversize						
2.50	.63 Standard	1.50	.38-16	.63	1.25	1.94	2.38
	1 Oversize						
3.25	1 Standard	1.88	.50-13	.75	1.50	2.44	2.63
	1.38 Oversize						
4	1 Standard	2.25	.50-13	.75	2.06	2.44	2.63
	1.38 Oversize						
5	1 Standard	2.75	.63-11	1	2.69	2.44	2.88
	1.38 Oversize						
6	1.38 Standard	3.25	.75-10	1.13	3.25	2.81	3.13
	1.75 Oversize						
8	1.38 Standard	4.25	.75-10	1.13	4.50	2.81	3.25
	1.75 Oversize						
10	1.75 Standard	5.31	1-8	1.50	5.50	3.13	4.13
	2 Oversize						
12	2 Standard	6.38	1-8	1.50	7.25	3.25	4.63
	2.50 Oversize						

For dimensions not shown, see page 6.

COMBINATION MOUNTS

Cylinders can be ordered with a combination of mounts for added design flexibility.

How to Order:

Combination mount part numbers can be constructed by adding a dash (-) in between the desired mounts in the part number.

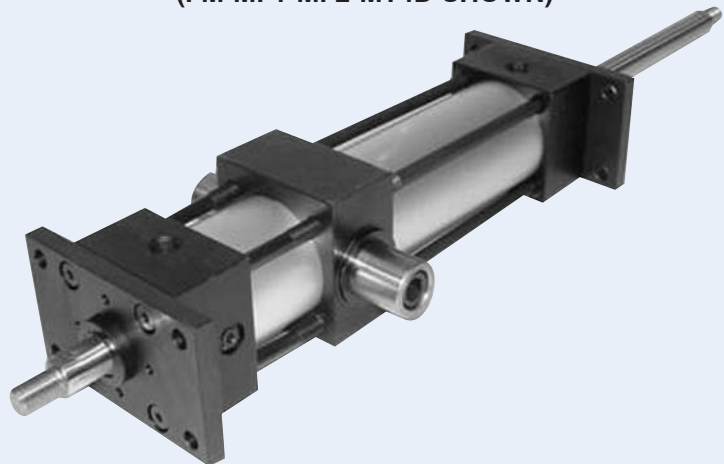
Example:

5" Bore 'TA' Series cylinder with 12" Stroke, Head and Cap Cushions, Magnetic Piston for Reed Switches and having an MS4 and MF1 Mount:

Part Number:

TA-MS4-MF1-5 X 12-HC-MPR

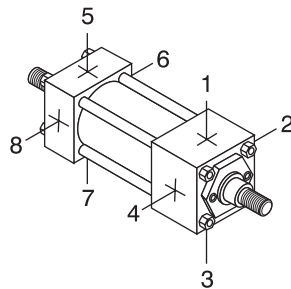
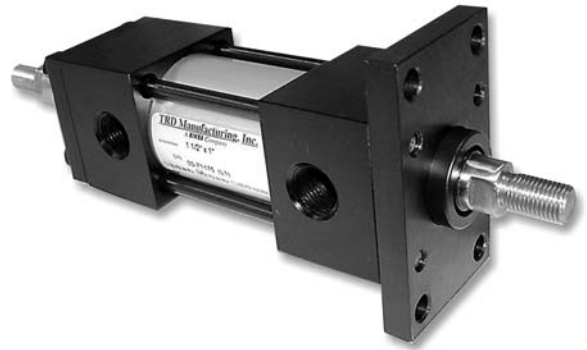
(FM-MF1-MF2-MT4D SHOWN)



SERIES 'TA' DIMENSIONS: DOUBLE ROD END

Benefits

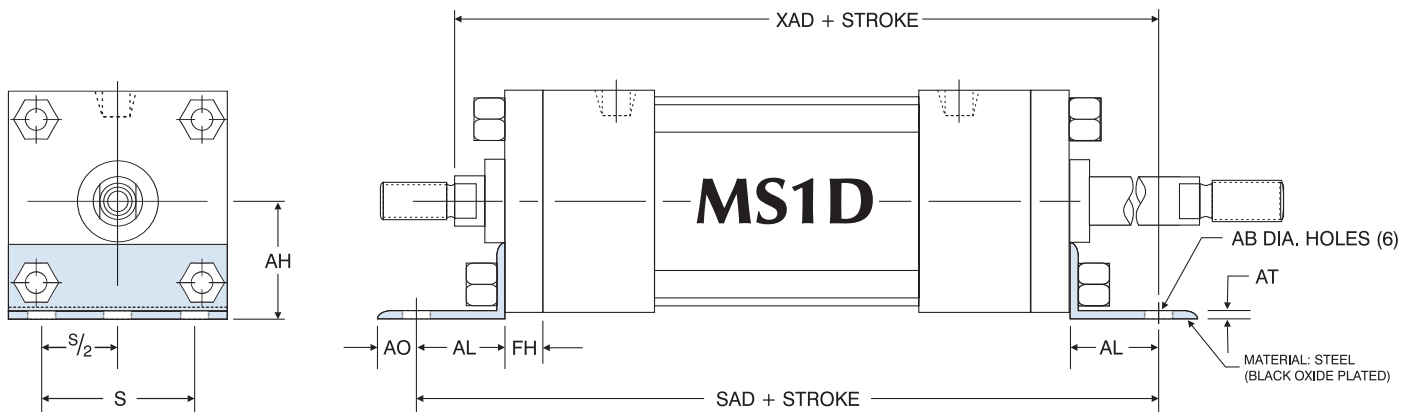
- Standard and Oversize Piston Rods available.
- Full range of Standard Options.
- Durable design. Full Rod Bearing at each end of cylinder.
- Can be provided with Hollow Piston Rods (gun-drilled through, to your size requirements).
- Can be used in adjustable extend stroke applications (by adding a stop collar on one rod end, or option "MA" - Refer to page 85).



STANDARD PORT AND CUSHION ADJUSTMENT POSITIONS

- Ports - Positions 1 and 3
- Cushion Adjustment - Positions 2 and 4
- Specify Non-Standard Positions When Ordering

SERIES 'TA' DIMENSIONS: DOUBLE ROD END BASE MOUNTS



'MS1D' ANGLE MOUNT DIMENSIONS										
BORE	ROD DIAMETER	AB	AH	AL	AO	AT	FH	S	ADD STROKE	
									SAD	XAD
1.50	.63 Standard	.44	1.19	1	.38	.19	.38	1.25	6.88	6.50
	1 Oversize									6.88
2	.63 Standard	.44	1.44	1	.38	.19	.38	1.75	6.88	6.50
	1 Oversize									6.88
2.50	.63 Standard	.44	1.63	1	.38	.19	.38	2.25	7	6.63
	1 Oversize									7
3.25	1 Standard	.56	1.94	1.25	.50	.13	.63	2.75	8.50	8
	1.38 Oversize									8.25
4	1 Standard	.56	2.25	1.25	.50	.13	.63	3.50	8.50	8
	1.38 Oversize									8.25
5	1 Standard	.69	2.75	1.38	.63	.19	.63	4.25	9	8.38
	1.38 Oversize									8.63
6	1.38 Standard	.81	3.25	1.38	.63	.19	.75	5.25	9.75	9.25
	1.75 Oversize									9.50
8	1.38 Standard	.81	4.25	1.81	.69	.25	.63*	7.13	9.25	9.06
	1.75 Oversize									9.31

*3.50 diameter round retainer on 8" bore. (MS1 BRACKETS BOLTED DIRECTLY TO HEAD)

SERIES 'TA' DIMENSIONS: DOUBLE ROD END

About Rod End Styles

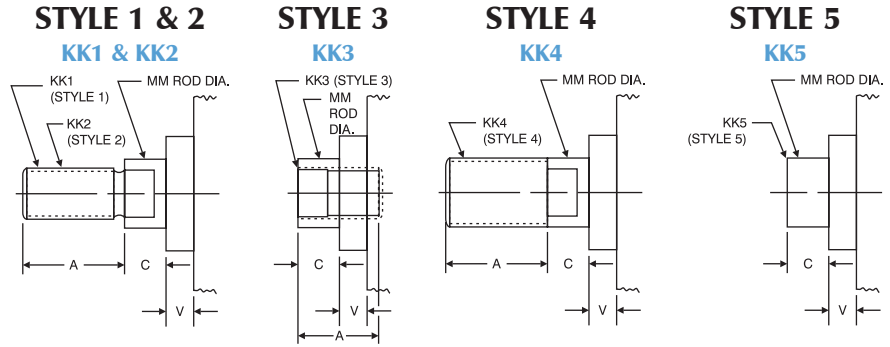
Style 1 Male Rod End is STANDARD

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).

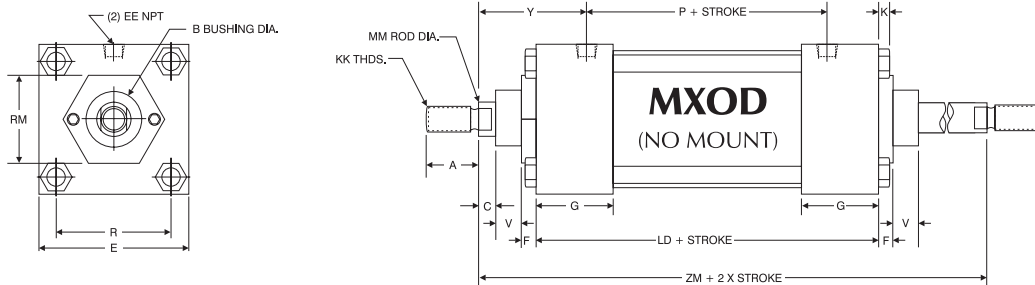
NEED SOMETHING NOT LISTED? Just send us a sketch. In most cases, quotes are turned around in one day!

PISTON ROD END STYLES



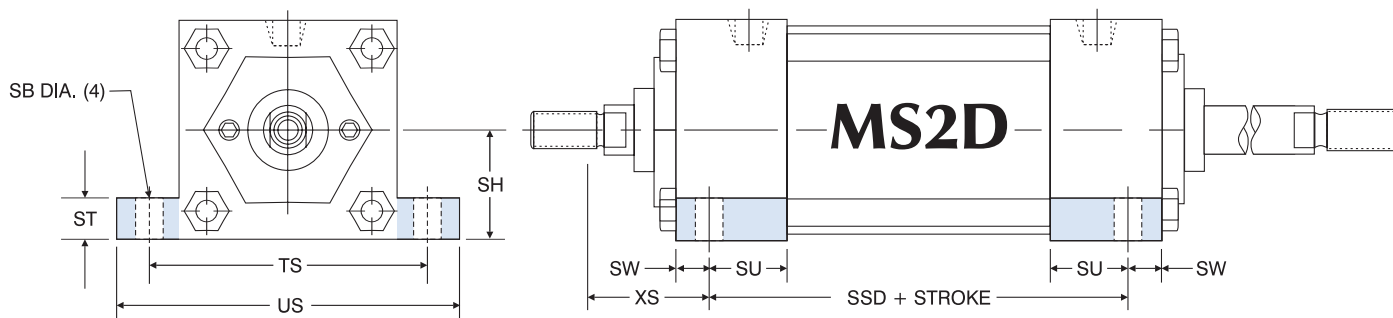
BORE	MM ROD DIAMETER	STANDARD					OPTIONAL					C	V
		Style 1 - Male		Style 2 - Male		Style 3 - Female		Style 4 - Male		Style 5 - Blank			
		KK1	A	KK2	A	KK3	A	KK4	A	KK5			
1.50, 2, 2.50	.63 Standard	.44-20	.75	.50-20	.75	.44-20	.75	.63-18	.75	No Threads	.38	.25	
	1 Oversize	.75-16	1.13	.88-14	1.13	.75-16	1.13	1-14	1.13	No Threads	.50	.50	
3.25, 4, 5	1 Standard	.75-16	1.13	.88-14	1.13	.75-16	1.13	1-14	1.13	No Threads	.50	.25	
	1.38 Oversize	1-14	1.63	1.25-12	1.63	1-14	1.63	1.38-12	1.63	No Threads	.63	.38	
6 & 8	1.38 Standard	1-14	1.63	1.25-12	1.63	1-14	1.63	1.38-12	1.63	No Threads	.63	.38	
	1.75 Oversize	1.25-12	2	1.50-12	2	1.25-12	2	1.75-12	2	No Threads	.75	.50	
10	1.75 Standard	1.25-12	2	1.50-12	2	1.25-12	2	1.75-12	2	No Threads	.75	.50	
	2 Oversize	1.50-12	2.25	1.75-12	2.25	1.50-12	2.25	2-12	2.25	No Threads	.88	.38	
12	2 Standard	1.50-12	2.25	1.75-12	2.25	1.50-12	2.25	2-12	2.25	No Threads	.88	.38	
	2.50 Oversize	1.88-12	3	2.25-12	3	1.88-12	3	2.50-12	3	No Threads	1	.50	

DOUBLE ROD END DIMENSIONS: 'MXOD' (NO MOUNT)



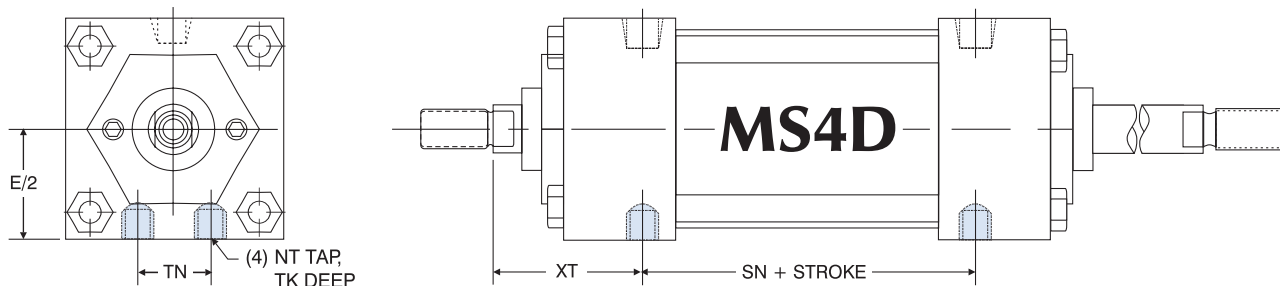
DOUBLE ROD END BASIC DIMENSIONS 'MXOD' STANDARD & OVERSIZE RODS																		
BORE	ROD DIAMETER	A	B	C	E	EE	F	G	K	KK	LD	MM	P	R	RM	V	Y	ZM
1.50	.63 Standard	.75	1.13	.38	2	.38	.38	1.50	.25	.44-20	4.13	.63	2.38	1.43	2 SQ.	.25	1.88	6.13
	1 Oversize	1.13	1.50	.50						.75-16								
2	.63 Standard	.75	1.13	.38	2.50	.38	.38	1.50	.31	.44-20	4.13	.63	2.38	1.84	1.75 HEX	.25	1.88	6.13
	1 Oversize	1.13	1.50	.50						.75-16					1			
2.50	.63 Standard	.75	1.13	.38	3	.38	.38	1.50	.31	.44-20	4.25	.63	2.50	2.19	1.75 HEX	.25	1.88	6.25
	1 Oversize	1.13	1.50	.50						.75-16					1			
3.25	1 Standard	1.13	1.50	.50	3.75	.50	.63	1.75	.38	.75-16	4.75	1	2.75	2.76	2.75 DIA.	.25	2.38	7.50
	1.38 Oversize	1.63	2	.63						1-14					1.38			
4	1 Standard	1.13	1.50	.50	4.50	.50	.63	1.75	.38	.75-16	4.75	1	2.75	3.32	2.75 DIA.	.25	2.38	7.50
	1.38 Oversize	1.63	2	.63						1-14					1.38			
5	1 Standard	1.13	1.50	.50	5.50	.50	.63	1.75	.44	.75-16	5	1	3	4.10	2.75 DIA.	.25	2.38	7.75
	1.38 Oversize	1.63	2	.63						1-14					1.38			
6	1.38 Standard	1.63	2	.63	6.50	.75	.63	2	.44	1-14	5.50	1.38	3.25	4.88	3.50 DIA.	.38	2.75	8.75
	1.75 Oversize	2	2.38	.75						1.25-12					1.75			
8	1.38 Standard	1.63	2	.63	8.50	.75	.63	2	.56	1-14	5.63	1.38	3.38	6.44	3.50 DIA.	.38	2.75	8.88
	1.75 Oversize	2	2.38	.75						1.25-12					1.75			
10	1.75 Standard	2	2.38	.75	10.63	1	.63	2.25	.69	1.25-12	6.63	1.75	4.31	7.92	3.50 DIA.	.50	3.06	10.38
	2 Oversize	2.25	2.63	.88			.75			1.50-12					2			
12	2 Standard	2.25	2.63	.88	12.75	1	.75	2.25	.69	1.50-12	7.13	2	4.81	9.40	5 DIA.	.38	3.19	11.13
	2.50 Oversize	3	3.13	1						1.88-12					2.50			

SERIES 'TA' DIMENSIONS: DOUBLE ROD END BASE MOUNTS



DOUBLE ROD END 'MS2D' SIDE LUG MOUNT DIMENSIONS										
BORE	ROD DIAMETER	SB	SH	ST	SU	SW	TS	US	XS	ADD STROKE
										SSD
1.50	.63 Standard	.44	1	.50	1.13	.38	2.75	3.50	1.38	3.38
	1 Oversize									1.75
2	.63 Standard	.44	1.25	.50	1.13	.38	3.25	4	1.38	3.38
	1 Oversize									1.75
2.50	.63 Standard	.44	1.50	.50	1.13	.38	3.75	4.50	1.38	3.50
	1 Oversize									1.75
3.25	1 Standard	.56	1.88	.75	1.25	.50	4.75	5.75	1.88	3.75
	1.38 Oversize									2.13
4	1 Standard	.56	2.25	.75	1.25	.50	5.50	6.50	1.88	3.75
	1.38 Oversize									2.13
5	1 Standard	.81	2.75	1	1.06	.69	6.88	8.25	2.06	3.63
	1.38 Oversize									2.31
6	1.38 Standard	.81	3.25	1	1.31	.69	7.88	9.25	2.31	4.13
	1.75 Oversize									2.56
8	1.38 Standard	.81	4.25	1	1.56	.69	9.88	11.25	2.31	4.25
	1.75 Oversize									2.56

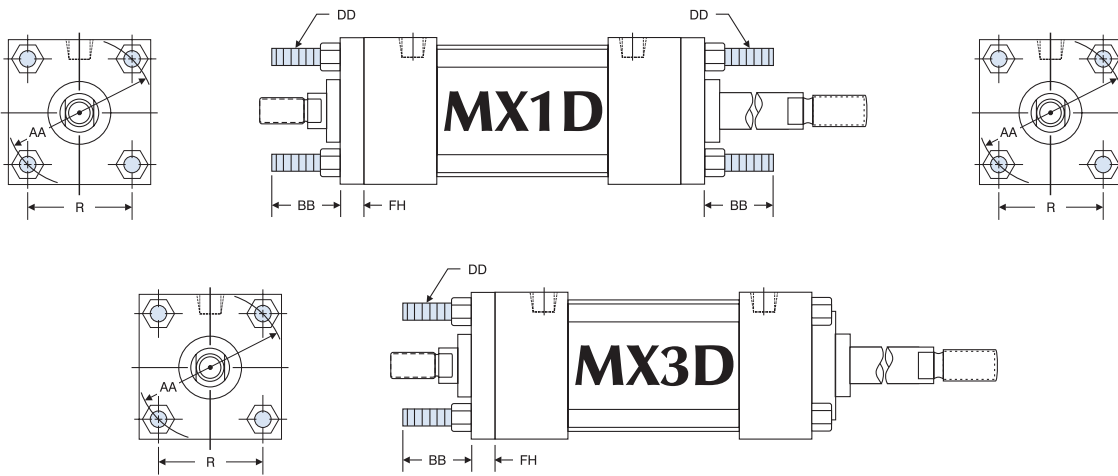
For dimensions not shown, see page 13.



DOUBLE ROD END 'MS4D' BOTTOM TAPPED MOUNT DIMENSIONS							
BORE	ROD DIAMETER	E/2	NT	TK	TN	XT	ADD STROKE
							SN
1.50	.63 Standard	1	.25-20	.38	.63	1.94	2.25
	1 Oversize						2.31
2	.63 Standard	1.25	.31-18	.50	.88	1.94	2.25
	1 Oversize						2.31
2.50	.63 Standard	1.50	.38-16	.63	1.25	1.94	2.38
	1 Oversize						2.31
3.25	1 Standard	1.88	.50-13	.75	1.50	2.44	2.63
	1.38 Oversize						2.69
4	1 Standard	2.25	.50-13	.75	2.06	2.44	2.63
	1.38 Oversize						2.69
5	1 Standard	2.75	.63-11	1	2.69	2.44	2.88
	1.38 Oversize						2.69
6	1.38 Standard	3.25	.75-10	1.13	3.25	2.81	3.13
	1.75 Oversize						3.06
8	1.38 Standard	4.25	.75-10	1.13	4.50	2.81	3.25
	1.75 Oversize						3.06
10	1.75 Standard	5.31	1-8	1.50	5.50	3.13	4.13
	2 Oversize						3.25
12	2 Standard	6.38	1-8	1.50	7.25	3.25	4.63
	2.50 Oversize						3.50

For dimensions not shown, see page 13.

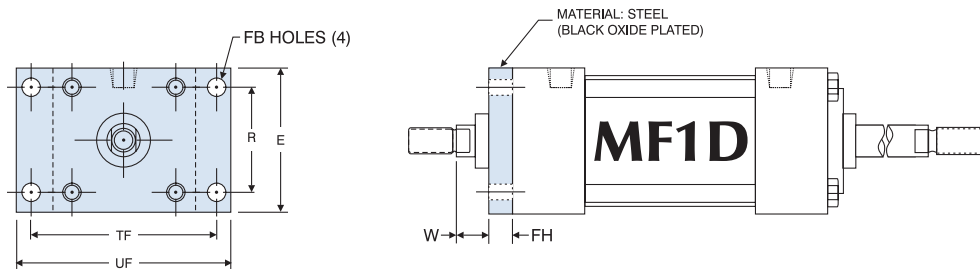
SERIES 'TA' DIMENSIONS: DOUBLE ROD END TIE ROD & FLANGE MOUNTS



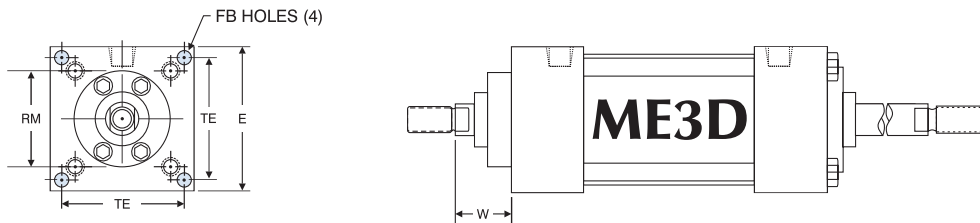
TIE ROD EXTENDED 'MX1D' & 'MX3D' MOUNT DIMENSIONS						
BORE	ROD DIAMETER	AA	BB	DD	FH	R
1.50	.63 Standard	2.02	1	.25-28	.38	1.43
	1 Oversize					
2	.63 Standard	2.6	1.13	.31-24	.38	1.84
	1 Oversize					
2.50	.63 Standard	3.1	1.13	.31-24	.38	2.19
	1 Oversize					
3.25	1 Standard	3.9	1.38	.38-24	.63	2.76
	1.38 Oversize					
4	1 Standard	4.7	1.38	.38-24	.63	3.32
	1.38 Oversize					

TIE ROD EXTENDED 'MX1D' & 'MX3D' MOUNT DIMENSIONS						
BORE	ROD DIAMETER	AA	BB	DD	FH	R
5	1 Standard	5.8	1.81	.50-20	.63	4.10
	1.38 Oversize					
6	1.38 Standard	6.9	1.81	.50-20	.75	4.88
	1.75 Oversize					
8	1.38 Standard	9.1	**2.31	.63-18	*.63	6.44
	1.75 Oversize					
10	1.75 Oversize	11.2	**2.69	.75-16	*.63	7.92
	2 Oversize					
12	2 Standard	13.3	**2.69	.75-16	*.75	9.40
	2.50 Oversize					

*Full square bushing retainer on 1.50" - 6" bores, round retainers on 8" - 12" bores.
 **"BB" dimension from head on 8", 10" & 12" bores.



1.50" - 6" BORES



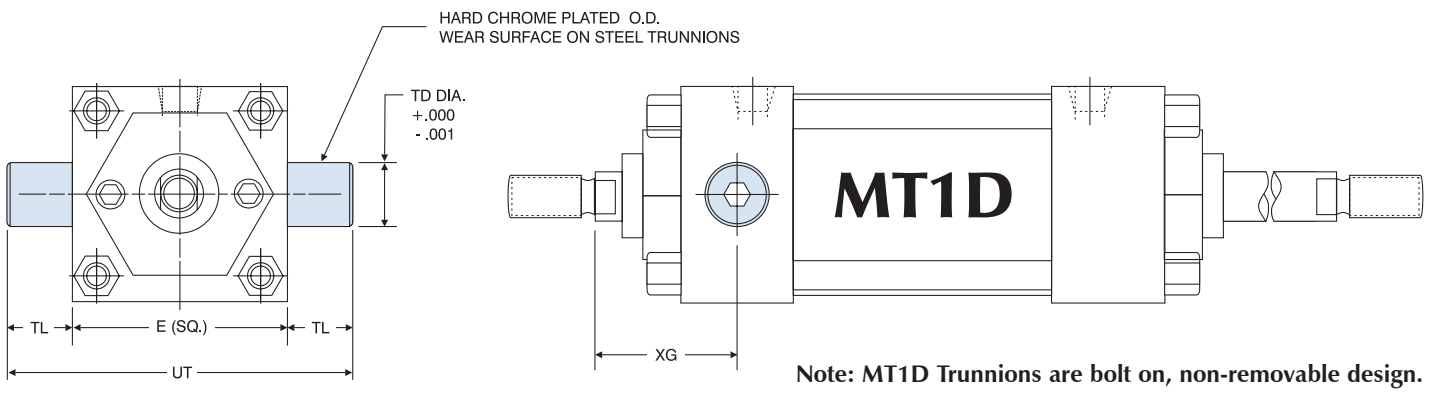
8" - 12" BORES ONLY

'MF1D' FLANGE & 'ME3D' CAP MOUNT DIMENSIONS										
BORE	ROD DIAMETER	E	FB	FH	R	RM	TE	TF	UF	W
1.50	.63 Standard	2	.31	.38	1.43	—	—	2.75	3.38	.63
	1 Oversize									1
2	.63 Standard	2.50	.38	.38	1.84	—	—	3.38	4.13	.63
	1 Oversize									1
2.50	.63 Standard	3	.38	.38	2.19	—	—	3.88	4.63	.63
	1 Oversize									1
3.25	1 Standard	3.75	.44	.63	2.76	—	—	4.69	5.50	.75
	1.38 Oversize									1
4	1 Standard	4.50	.44	.63	3.32	—	—	5.44	6.25	.75
	1.38 Oversize									1

'MF1D' FLANGE & 'ME3D' CAP MOUNT DIMENSIONS										
BORE	ROD DIAMETER	E	FB	FH	R	RM	TE	TF	UF	W
5	1 Standard	5.50	.56	.63	4.10	—	—	6.63	7.63	.75
	1.38 Oversize									1
6	1.38 Standard	6.50	.56	.75	4.88	—	—	7.63	8.63	.88
	1.75 Oversize									1.13
8	1.38 Standard	8.50	.69	N/A	N/A	3.50	7.57	N/A	N/A	1.63
	1.75 Oversize									1.88
10	1.75 Standard	10.63	.81	N/A	N/A	3.50	9.40	N/A	N/A	1.88
	2 Oversize									2
12	2 Standard	12.75	.81	N/A	N/A	5	11.1	N/A	N/A	2
	2.50 Oversize									2.25

For dimensions not shown, see page 13.

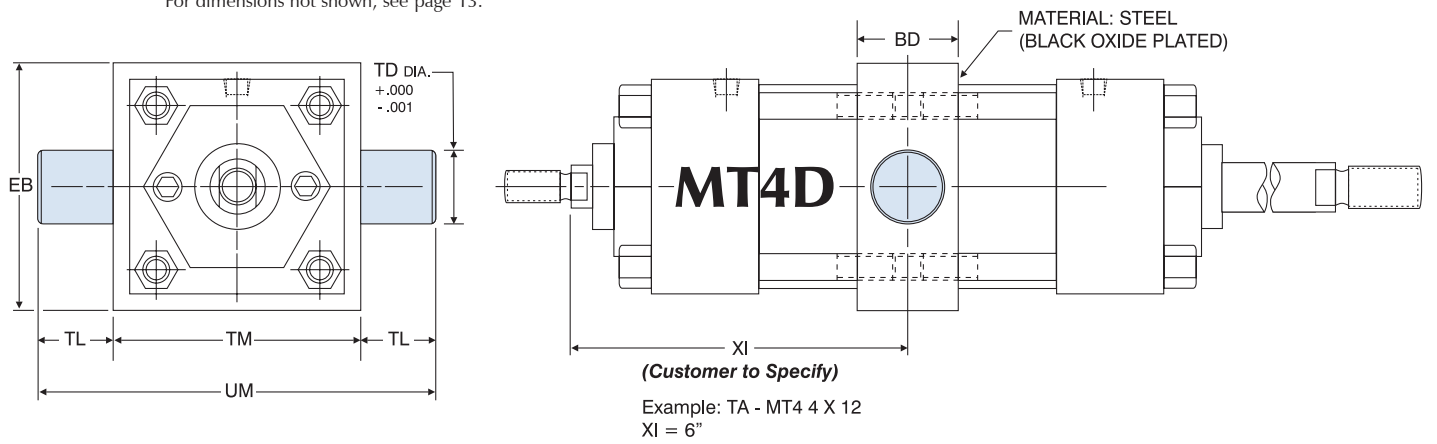
SERIES 'TA' DIMENSIONS: DOUBLE ROD END PIVOT MOUNTS



Note: MT1D Trunnions are bolt on, non-removable design.

DOUBLE ROD END 'MT1D' HEAD TRUNNION MOUNT DIMENSIONS						
BORE	ROD DIAMETER	E	TD	TL	UT	XG
1.50	.63 Standard	2	1	1	4	1.75
	N/A*					N/A
2	.63 Standard	2.50	1	1	4.50	1.75
	1 Oversize					2.13
2.50	.63 Standard	3	1	1	5	1.75
	1 Oversize					2.13
3.25	1 Standard	3.75	1	1	5.75	2.25
	1.38 Oversize					2.50
4	1 Standard	4.50	1	1	6.50	2.25
	1.38 Oversize					2.50
5	1 Standard	5.50	1	1	7.50	2.25
	1.38 Oversize					2.50
6	1.38 Standard	6.50	1.38	1.38	9.25	2.63
	1.75 Oversize					2.88
8	1.38 Standard	8.50	1.38	1.38	11.25	2.63
	1.75 Oversize					2.88

*No oversize rod available on 1.50" bore MT1D. For dimensions not shown, see page 13.



Note: MT4D Trunnions and Intermediate Section are one-piece steel construction.

DOUBLE ROD END 'MT4D' INTERMEDIATE TRUNNION MOUNT DIMENSIONS							
BORE	BD	EB	TD	TL	TM	UM	XI
1.50	1.25	2.50	1	1	2.50	4.50	CUSTOMER TO SPECIFY
2	1.50	3	1	1	3	5	
2.50	1.50	3.50	1	1	3.50	5.50	
3.25	2	4.25	1	1	4.50	6.50	
4	2	5	1	1	5.25	7.25	
5	2	6	1	1	6.25	8.25	
6	2	7	1.38	1.38	7.63	10.38	
8	2.50	9.50	1.38	1.38	9.75	12.50	

'MT1D', 'MT4D' STANDARD CUSHION LOCATIONS		
MOUNT	HEAD CUSHION	CAP CUSHION
MT1D	3	6
MT4D	2	6

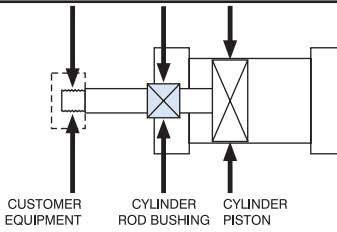
Note: Ports or cushions cannot be on same side as MT1D Trunnions.

SERIES 'TD' TOUGH-DUTY

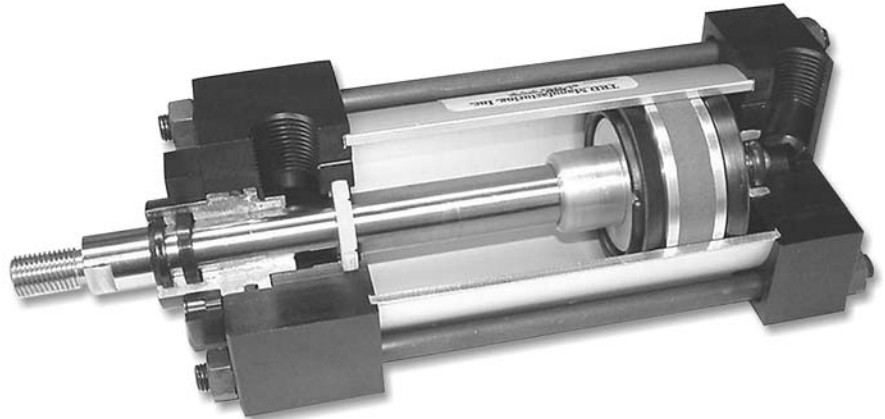
Floating Rod Bushing

SELF ALIGNMENT FEATURE

Rod Bushing is designed to float .002", improving bearing surface alignment.



- Reduces cylinder drag and erratic operation
- Reduces cylinder wear
- Provides a minimum of 25% longer life than "fixed" Rod Bushing designs



TOUGH-DUTY DESIGN - Same construction as 'TA' Series with these performance features, STANDARD:

- **Impact Dampening Piston Seals** – "BP" Seals are designed to reduce machine vibration and noise. Higher piston velocities can be achieved due to the rapid deceleration feature, increasing productivity. Bumper Seals are rated for tough-duty, yet offer quieter operation than standard cylinder designs. (Refer to page 81 in options section, "BP" Seals for performance considerations).
- **Fixed Cushions** - Head and Cap Cushions are *standard*. The "fixed" design utilizes an internal orifice for a predetermined flow rate, eliminating the need for adjustments. The "fixed" cushion design provides tamper-free operation and guarantees a cushion function at each end of full stroke.
- **PTFE Piston Wear Band** - 90% Virgin PTFE with performance additives to increase Compressive Modulus to 65,000 PSI. Wear Band material is designed to provide low-friction, long life operation even in the most demanding applications.

Performance options (Refer to pages 80-91 for details):

- **H or C** - Adjustable Cushions allow the cylinder to be adjusted to each application, providing the optimum cushion performance and harmonious motion.
- **Extended Cushion Lengths** - Longer cushions increase the capacity of air cushions, eliminating costly hydraulic shock absorbers in some cases. Choose from three different cushion lengths for maximum performance.
- **MPR** - Magnetic Piston (for position sensing switches).
- **EN** - Electroless Nickel Plated and Stainless Steel Fasteners provide corrosion resistance.
- **BSP or SAE Ports** - Special ports are available and do not increase delivery time.
- **Any English or Metric Piston Rod Thread** - Non-standard rod threads are available and do not increase delivery time.
- **STEEL TUBE** - Hydraulic grade chrome plated I.D. and honed steel tubing, black epoxy paint finish O.D.

SELF-LUBRICATING CYLINDER DESIGN

PTFE coated cast iron bushing, PTFE Wear Band, Hard-Chrome Plated Piston Rod, Hard-Coated Aluminum Tube and PTFE based grease provide permanent lubrication and long cylinder life.

OPERATING PRESSURE

250 PSI AIR (17 BAR)

OPERATING TEMPERATURE

Carboxilated Nitrile: -20°F to 200°F (-25°C to 90°C)
Fluorocarbon: 0°F to 400°F (-20°C to 200°C)

HOW TO ORDER: SERIES 'TD' (TOUGH-DUTY)

Basic Cylinders

'TA'

'TD'

'FM'

Back-To-Back

3-Position

Tandem

TD - **MF1** - **2.50** x **10** - **MPR**

SERIES	
TD	250 PSI AIR

BORE	
1.50	2
2.50	3.25
4	5
6	8

STROKE
0" to 120"
Made to Order

CUSHIONS	
NON-ADJUSTABLE (FIXED) HEAD & CAP CUSHIONS ARE STANDARD (LEAVE BLANK)	
OPTIONAL ADJUSTABLE CUSHIONS	
H	ADJUSTABLE HEAD CUSHION POSITION 2 IS STANDARD SPECIFY FOR POSITIONS: 1, 3 & 4
LH	ADJUSTABLE LONG HEAD CUSHION POSITION 2 IS STANDARD SPECIFY FOR POSITIONS: 1, 3 & 4
ELH	ADJUSTABLE EXTRA LONG HEAD CUSHION POSITION 2 IS STANDARD SPECIFY FOR POSITIONS: 1, 3 & 4
C	ADJUSTABLE CAP CUSHION POSITION 6 IS STANDARD SPECIFY FOR POSITIONS: 5, 7 & 8
LC	ADJUSTABLE LONG CAP CUSHION POSITION 6 IS STANDARD SPECIFY FOR POSITIONS: 5, 7 & 8
ELC	ADJUSTABLE EXTRA LONG CAP CUSHION POSITION 6 IS STANDARD SPECIFY FOR POSITIONS: 5, 7 & 8

OPTIONS	
ADDS LENGTH TO CYLINDER - SEE "OPTION LENGTH ADDER" CHART BELOW.	
A =	EXTENDED PISTON ROD THREAD (Example: A = 2")
AS	ADJUSTABLE STROKE - RETRACT (SPECIFY LENGTH, Example: AS = 4")
BSP	BSP PORTS (SPECIFY SIZE, Example: BSP = .25")
C =	EXTENDED PISTON ROD (Example: IF C = 0.50", THEN 1" ROD EXTENSION IS C = 1.50")
EN	ELECTROLESS NICKEL PLATED (Refer to page 84 for specifications)
KK2	LARGE MALE ROD THREAD
KK3	FEMALE ROD THREAD
KK3S	STUDDED PISTON ROD (KK3 with Stud, Loctite in place)
KK4	FULL DIAMETER MALE ROD THREAD
KK5	BLANK ROD END (NO THREADS, "A" = 0")
MA	MICRO-ADJUST (6" MAX. STROKE) Available on Double Rod End Models
MAB	MICRO-ADJUST WITH SOUND DAMPENING BUMPER (6" MAX. STROKE)
MPR	MAGNETIC PISTON FOR REED OR SOLID STATE SWITCHES - TRD MODELS: R10, R10P, RAC, RHT & MSS (Refer to pages 107-113 for selection)
MS	METALLIC ROD SCRAPER (BRASS CONSTRUCTION)
OP	OPTIONAL PORT LOCATION (Example: Ports @ 3 & 7)
OS	OVERSIZE ROD DIAMETER (SPECIFY SIZE, Example: OS = 1.38")
SAE	SAE PORTS (SPECIFY SIZE, Example: SAE #10)
SSA	STAINLESS STEEL PISTON ROD, TIE RODS & NUTS, AND FASTENERS
SSF	STAINLESS STEEL FASTENERS
SSR	STAINLESS STEEL PISTON ROD
SST	STAINLESS STEEL TIE RODS & NUTS
X ST	STOP TUBE (SPECIFY STOP TUBE LENGTH AND EFFECTIVE STROKE) (Example: TD MS4 2 X 24" EFFECTIVE STROKE-ST=4)
STEEL TUBE*	STEEL CYLINDER TUBE, BLACK EPOXY PAINT FINISH
VS	FLUOROCARBON SEALS
XX	SPECIAL VARIATION (SPECIFY)

STYLE	
SINGLE ROD (LEAVE BLANK)	D = DOUBLE ROD END

Notes: 1) Ordering example for adjustable cushions in non-standard locations: H3C7
2) Refer to page 83 for assistance in cushion length selection.
3) Cushions can be ordered on same side as ports. Refer to page 87 for dimensions.

About our Part Number System

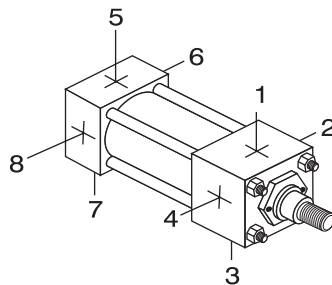
- Simple, easy to understand
- No excessive codes!
- Eliminates mistakes when ordering

Example: A 2.50" Bore by 10" Stroke NFPA cylinder, Front Flange Mount, (NON-ADJUSTABLE Head & Cap Cushions), and Magnetic Piston for Switches.

Part Number: TD-MF1-2.50 x 10-MPR

STANDARD PORT AND CUSHION ADJUSTMENT POSITIONS

- Ports - Positions 1 and 5
- Fixed Cushions - No Adjustment Needle Required
- Cushion Adjustment - Positions 2 and 6
- Specify Non-Standard Positions When Ordering



OPTION LENGTH ADDER (ADD TO CATALOG BASIC OVERALL LENGTH DIMENSIONS)			
BORE	ELC	ELH	ST* (STOP TUBE) Example: ST=2
1.50	1	1	2
2	1	1	2
2.50	1	1	2
3.25	1.25	1.25	2
4	1.25	1.25	2
5	1.25	1.25	2
6	1.50	1.50	2
8	1.50	1.50	2

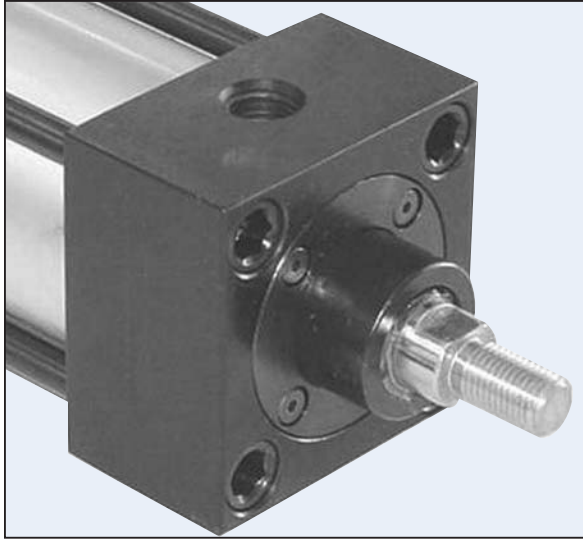
*Note: The desired Stop Tube length adds directly to the overall cylinder length.

NFPA MOUNTS

(Refer to pages 6-16 for mounting dimensions)

 1.50" - 6" Bores Page 9	 1.50" - 6" Bores Page 9	 8" Bores Page 9	 8" Bores Page 9	 1.50" - 8" Bores Page 7	 1.50" - 6" Bores Page 7
 1.50" - 4" Bores Page 7	 1.50" - 8" Bores Page 10	 1.50" - 8" Bores Page 10	 1.50" - 8" Bores Page 11	 1.50" - 8" Bores Page 8	 1.50" - 8" Bores Page 8
 1.50" - 8" Bores Page 8	 1.50" - 8" Bores Page 6	 1.50" - 8" Bores Page 9	 1.50" - 8" Bores Page 9	 1.50" - 8" Bores Page 9	

SERIES 'FM': FLUSH MOUNT (WITH SLEEVE NUT CONSTRUCTION)



Benefits

- Same construction as 'TA' series with the added benefit of "Sleeve Nut" construction.
- Four tapped holes in Head and Cap-Standard. Optional (4) additional tapped holes in base (MS4 Mount).
- No exposed tie rods or nuts at head and cap provides a "Clean" design.
- Interchanges with many older style NFPA manufacturers' cylinders out in the field.
- Can easily add a multiple of NFPA Mounts by simply bolting in place (refer to page 30 for mount selection).
- Available in Single & Double Rod End models.

Performance options:

- **LF** - Low Friction Seals reduce breakaway and running friction. Effective at all operating pressures.
- **Extended Cushion Lengths** - Longer cushions increase the capacity of air cushions, eliminating costly hydraulic shock absorbers in some cases. Choose from three different cushion lengths for maximum performance.
- **MPR** - Magnetic Piston (for position sensing switches).
- **EN** - Electroless Nickel Plated and Stainless Steel Fasteners provide corrosion resistance.
- **SSA** - Stainless Steel Piston Rod, Tie Rods, Sleeve Nuts, and Fasteners provide corrosion resistance in outdoor applications and wet environments.
- **WB** - Piston Wear Band, recommended for pivot mounted, long strokes or cylinders that may see side loads.
- **MA** - Micro-Adjust provides a precision adjustment on the cylinder extend stroke, providing quick and accurate cylinder positioning, reducing set-up time.
- **AS** - Adjustable Retract Stroke allows for accurate adjustment on the cylinder return stroke.
- **BSP or SAE Ports** - Special ports are available and do not increase delivery time.
- **NR** - Non-Rotating option incorporates (2) internal guide rods preventing rod rotation (NFPA dimensions).

SELF-LUBRICATING CYLINDER DESIGN

PTFE coated cast iron bushing, PTFE Wear Band, Hard-Chrome Plated Piston Rod, Hard-Coated Aluminum Tube and PTFE based grease provide permanent lubrication and long cylinder life.

STANDARD PORT SIZES (ONE SIZE LESS THAN 'TA' SERIES)

(Optional Port Sizes Available - Refer to page 20 for ordering instructions)

BORE	1.50	2	2.50	3.25	4	5	6
PORT SIZE	.25 NPT	.25 NPT	.25 NPT	.38 NPT	.38 NPT	.38 NPT	.50 NPT

OPERATING PRESSURE

250 PSI AIR (17 BAR)

OPERATING TEMPERATURE

Carboxilated Nitrile: -20°F to 200°F (-25°C to 90°C)
Fluorocarbon: 0°F to 400°F (-20°C to 200°C)

HOW TO ORDER: SERIES 'FM' (FLUSH MOUNT)

Basic Cylinders

'TA'

'TD'

'FM'

Back-To-Back

3-Position

Tandem

FM - MS4 - 2.50 x 10 - HC - MPR

SERIES	
FM	250 PSI AIR

NFPA MOUNTS	
MF1	FRONT FLANGE (1.50"-6" Bore)
MF2	REAR FLANGE (1.50"-6" Bore)
MP1	REAR PIVOT CLEVIS (1.50"-6" Bore)
MP2	REAR PIVOT CLEVIS (1.50"-6" Bore)
MP4	REAR PIVOT EYE (1.50"-6" Bore)
MS1	FRONT & REAR END ANGLE (1.50"-6" Bore)
MS2	SIDE LUG (1.50"-6" Bore)
MS4	BOTTOM TAPPED HOLES (1.50"-6" Bore)
MT1	FRONT TRUNNION (1.50"-6" Bore)
MT2	REAR TRUNNION (1.50"-6" Bore)
MXO	NO MOUNT (1.50"-6" Bore)
BASE BAR	NON-NFPA (1.50"-4" Bore)

BORE	
1.50	2
2.50	3.25
4	5
6	

STROKE
0" to 120"
Made to Order

STYLE	
	SINGLE ROD (LEAVE BLANK)
	D = DOUBLE ROD END

CUSHIONS	
H	HEAD CUSHION POSITION 2 IS STANDARD SPECIFY FOR POSITIONS: 1, 3 & 4
LH	LONG HEAD CUSHION POSITION 2 IS STANDARD SPECIFY FOR POSITIONS: 1, 3 & 4
ELH	EXTRA LONG HEAD CUSHION POSITION 2 IS STANDARD SPECIFY FOR POSITIONS: 1, 3 & 4
C	CAP CUSHION POSITION 6 IS STANDARD SPECIFY FOR POSITIONS: 5, 7 & 8
LC	LONG CAP CUSHION POSITION 6 IS STANDARD SPECIFY FOR POSITIONS: 5, 7 & 8
ELC	EXTRA LONG CAP CUSHION POSITION 6 IS STANDARD SPECIFY FOR POSITIONS: 5, 7 & 8
FIXED CUSHIONS	
FCH	FIXED HEAD CUSHION (NON-ADJUSTABLE, NO ADJUSTMENT NEEDLE)
FCC	FIXED CAP CUSHION (NON-ADJUSTABLE, NO ADJUSTMENT NEEDLE)
FC	FIXED HEAD AND CAP CUSHION (NON-ADJUSTABLE, NO ADJUSTMENT NEEDLE)

Note: "L" AND "EL" CUSHION OPTIONS CAN BE ORDERED AS FIXED CUSHIONS.

Example: FCLH, FCELH

- Notes:
- Ordering example for non-standard cushion locations: H3C7
 - Refer to page 83 for assistance in cushion length selection.
 - Cushions can be ordered on same side as ports. Refer to page 87 for dimensions.

OPTIONS	
ADDS LENGTH TO CYLINDER - SEE "OPTION LENGTH ADDER" CHART BELOW.	
A =	EXTENDED PISTON ROD THREAD (Example: A = 2")
AS	ADJUSTABLE STROKE - RETRACT (SPECIFY LENGTH, Example: AS = 4")
A / O	AIR / OIL PISTON
X B	.25" URETHANE BUMPER BOTH ENDS
X BC	.25" URETHANE BUMPER CAP ONLY
X BH	.25" URETHANE BUMPER HEAD ONLY
BP	BUMPER PISTON SEALS (1.50" - 6" Bore)
BSP	BSP PORTS (SPECIFY SIZE, Example: BSP = .25")
C =	EXTENDED PISTON ROD (Example: IF C = 0.50", THEN 1" ROD EXTENSION IS C = 1.50")
EN	ELECTROLESS NICKEL PLATED (Refer to page 84 for specifications)
KK2	LARGE MALE ROD THREAD
KK3	FEMALE ROD THREAD
KK3S	STUDDED PISTON ROD (KK3 with Stud, Loctite in place)
KK4	FULL DIAMETER MALE ROD THREAD
KK5	BLANK ROD END (NO THREADS, "A" = 0")
LF	LOW FRICTION SEALS (Refer to page 84 for specifications)
MA	MICRO-ADJUST (6" MAX. STROKE) Available on Double Rod End Models
MAB	MICRO-ADJUST WITH SOUND DAMPENING BUMPER (6" MAX. STROKE)
MPR	MAGNETIC PISTON FOR REED OR SOLID STATE SWITCHES - TRD MODELS: R10, R10P, RAC, RHT & MSS (Refer to pages 107-113 for selection)
MS	METALLIC ROD SCRAPER (BRASS CONSTRUCTION)
NR	NON-ROTATING (Refer to page 86 for specifications)
OP	OPTIONAL PORT LOCATION OR SIZE (Example: Ports @ 3 & 7)
OS	OVERSIZE ROD DIAMETER (SPECIFY SIZE, Example: OS = 1.38")
SAE	SAE PORTS (SPECIFY SIZE, Example: SAE #10)
X SE	SPRING EXTEND (1.50", 2", 2.50" bore)
X SR	SPRING RETURN (1.50", 2", 2.50" bore)
SSA	STAINLESS STEEL PISTON ROD, TIE RODS & SLEEVE NUTS, AND FASTENERS
SSF	STAINLESS STEEL FASTENERS
SSR	STAINLESS STEEL PISTON ROD
SST	STAINLESS STEEL TIE RODS & SLEEVE NUTS
X ST	STOP TUBE (SPECIFY STOP TUBE LENGTH AND EFFECTIVE STROKE) (Example: TA MS4 2 X 24" EFFECTIVE STROKE-ST=3)
STEEL TUBE*	STEEL CYLINDER TUBE, BLACK EPOXY PAINT FINISH
TH	400 PSI HYDRAULIC NON-SHOCK (Refer to page 90 for specifications)
VS	FLUOROCARBON SEALS
WB	PISTON WEAR BAND
XX	SPECIAL VARIATION (SPECIFY)

*STEEL TUBES do not work with MPR magnetic pistons. Refer to pages 114-117 for Balluff end of stroke sensors.

About our Part Number System

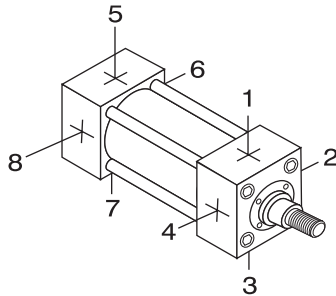
- Simple, easy to understand
- No excessive codes!
- Eliminates mistakes when ordering

Example: A 2.50" Bore by 10" Stroke NFPA cylinder, Bottom Tap Mount, Head & Cap Cushions, and Magnetic Piston for Switches.

Part Number: FM-MS4-2.50 x 10-HC-MPR

STANDARD PORT AND CUSHION ADJUSTMENT POSITIONS

- Ports - Positions 1 and 5
- Cushion Adjustment - Positions 2 and 6
- Specify Non-Standard Positions When Ordering



OPTION LENGTH ADDER								
(ADD TO CATALOG BASIC OVERALL LENGTH DIMENSIONS)								
BORE	OPTION							
	B	BC	BH	ELC	ELH	SE	SR	ST* (STOP TUBE) Example: ST=2
1.50	.50	.25	.25	1	1	Refer to page 86 for length adders and available bore sizes and strokes		2
2	.50	.25	.25	1	1		2	
2.50	.50	.25	.25	1	1		2	
3.25	.50	.25	.25	1.25	1.25		2	
4	.50	.25	.25	1.25	1.25		2	
5	.50	.25	.25	1.25	1.25		2	
6	.50	.25	.25	1.50	1.50	2		

*Note: The desired Stop Tube length adds directly to the overall cylinder length.

'FM' NFPA MOUNTS

<p>MF1 1.50" - 6" Bores Page 23</p>	<p>MF2 1.50" - 6" Bores Page 23</p>	<p>MP1 1.50" - 6" Bores Page 22</p>	<p>MP2 1.50" - 6" Bores Page 22</p>	<p>MP4 1.50" - 4" Bores Page 23</p>	<p>MS1 1.50" - 6" Bores Page 23</p>
<p>MS2 1.50" - 6" Bores Page 24</p>	<p>MS4 1.50" - 6" Bores Page 25</p>	<p>MT1 1.50" - 6" Bores Page 22</p>	<p>MT2 1.50" - 6" Bores Page 22</p>	<p>MXO 1.50" - 6" Bores Page 21</p>	<p>BASE BAR 1.50" - 4" Bores Page 24</p>

SERIES 'FM' DIMENSIONS: BASIC CYLINDER (MXO MOUNT) FLUSH MOUNT (WITH SLEEVE NUT CONSTRUCTION)

About Rod End Styles

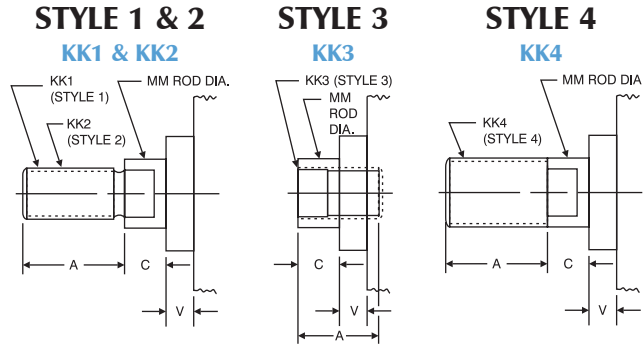
Style 1 Male Rod End is STANDARD

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).

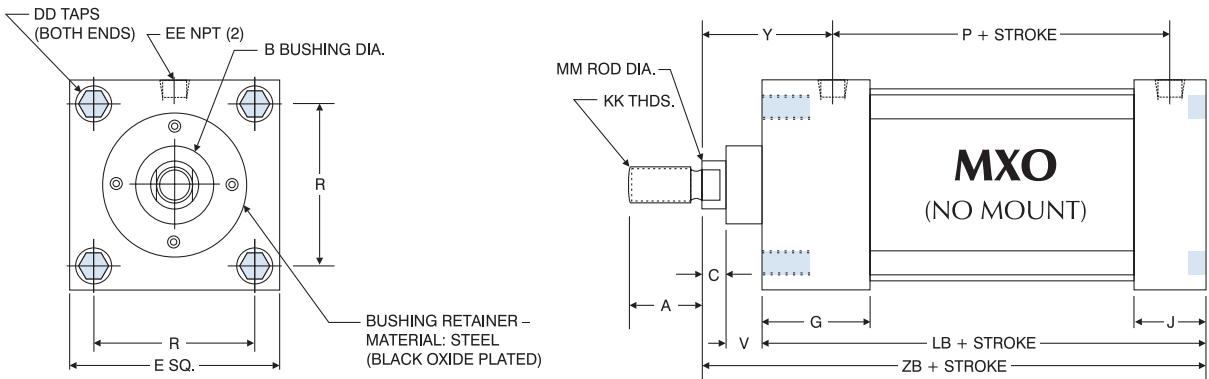
NEED SOMETHING NOT LISTED?
Just send us a sketch.
In most cases, quotes are turned around in one day!

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						
1.50, 2, 2.50	.63 Standard	.44-20	.75	.50-20	.75	.44-20	.75	.63-18	.75	No Threads	.38	.63
	1 Oversize	.75-16	1.13	.88-14	1.13	.75-16	1.13	1-14	1.13	No Threads	.50	.50
3.25, 4, 5	1 Standard	.75-16	1.13	.88-14	1.13	.75-16	1.13	1-14	1.13	No Threads	.50	.88
	1.38 Oversize	1-14	1.63	1.25-12	1.63	1-14	1.63	1.38-12	1.63	No Threads	.63	.38
6	1.38 Standard	1-14	1.63	1.25-12	1.63	1-14	1.63	1.38-12	1.63	No Threads	.63	1
	1.75 Oversize	1.25-12	2	1.50-12	2	1.25-12	2	1.75-12	2	No Threads	.75	.50

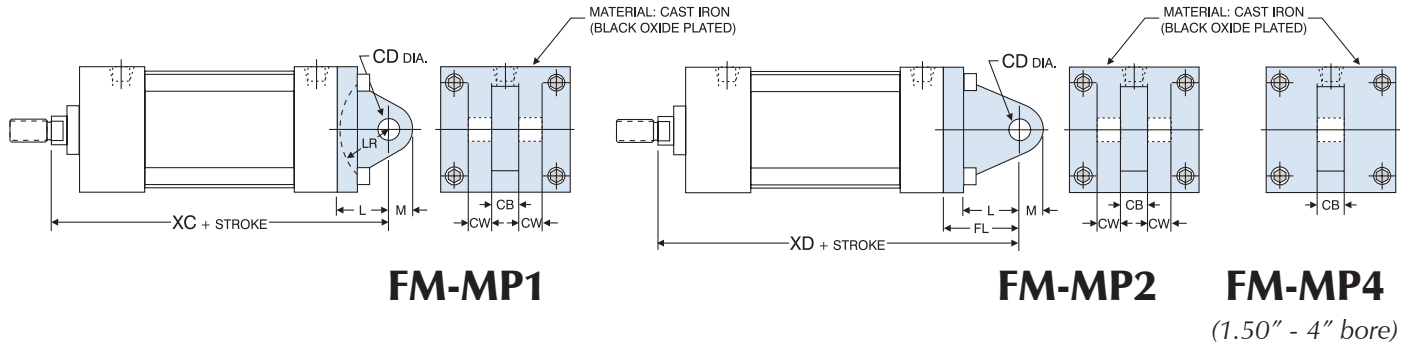
BASIC DIMENSIONS: 'MXO' (NO MOUNT)



'FM' SERIES BASIC DIMENSIONS 'MXO'																
BORE	A	B	C	DD	E	EE	G	J	KK	LB	MM	P	R	V	Y	ZB
1.50	.75	1.13	.38	.25-28	2	.25	1.50	1	.44-20	3.63	.63	2.38	1.43	.63	1.88	4.63
2	.75	1.13	.38	.31-24	2.50	.25	1.50	1	.44-20	3.63	.63	2.38	1.84	.63	1.88	4.63
2.50	.75	1.13	.38	.31-24	3	.25	1.50	1	.44-20	3.75	.63	2.50	2.19	.63	1.88	4.75
3.25	1.13	1.50	.50	.38-24	3.75	.38	1.75	1.25	.75-16	4.25	1	2.75	2.76	.88	2.38	5.63
4	1.13	1.50	.50	.38-24	4.50	.38	1.75	1.25	.75-16	4.25	1	2.75	3.32	.88	2.38	5.63
5	1.13	1.50	.50	.50-20	5.50	.38	1.75	1.25	.75-16	4.50	1	3	4.10	.88	2.38	5.88
6	1.63	2	.63	.50-20	6.50	.50	2	1.50	1-14	5	1.38	3.25	4.88	1	2.75	6.63

For oversize rod dimensions, see page 25.

SERIES 'FM' DIMENSIONS: PIVOT MOUNTS FLUSH MOUNT (WITH SLEEVE NUT CONSTRUCTION)



FM-MP1

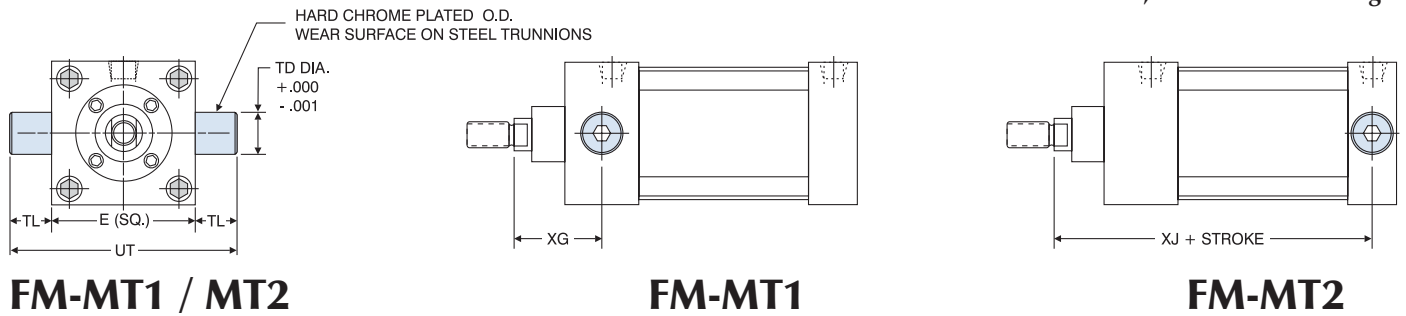
FM-MP2

FM-MP4
(1.50" - 4" bore)

'FM' SERIES 'MP1' & 'MP2' CLEVIS AND 'MP4' ROD EYE MOUNT DIMENSIONS										
BORE	ROD DIAMETER	CB	CD	CW	FL	L	LR	M	ADD STROKE	
									XC	XD
1.50	.63 Standard	.75	.50	.50	1.13	.75	.75	.63	5.38	5.75
	1 Oversize								5.75	6.13
2	.63 Standard	.75	.50	.50	1.13	.75	.75	.63	5.38	5.75
	1 Oversize								5.75	6.13
2.50	.63 Standard	.75	.50	.50	1.13	.75	.75	.63	5.50	5.88
	1 Oversize								5.88	6.25
3.25	1 Standard	1.25	.75	.63	1.88	1.25	1.25	.88	6.88	7.50
	1.38 Oversize								7.13	7.75
4	1 Standard	1.25	.75	.63	1.88	1.25	1.25	.88	6.88	7.50
	1.38 Oversize								7.13	7.75
5	1 Standard	1.25	.75	.63	1.88	1.25	1.25	.88	7.13	7.75
	1.38 Oversize								7.38	8
6	1.38 Standard	1.50	1	.75	2.25	1.50	1.50	1	8.13	8.88
	1.75 Oversize								8.38	9.13

For dimensions not shown, see page 21.

Note: MT1 and MT2 Trunnions are bolt on, non-removable design.



FM-MT1 / MT2

FM-MT1

FM-MT2

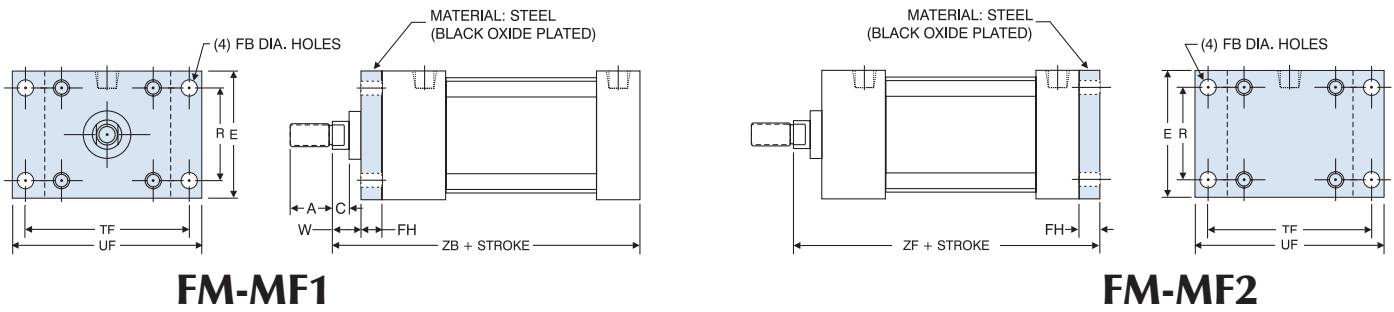
Note: MT1 standard cushion locations at 3 and 6
MT2 standard cushion locations at 2 and 7

'FM' SERIES 'MT1' HEAD TRUNNION AND 'MT2' CAP TRUNNION MOUNT DIMENSIONS							
BORE	ROD DIAMETER	E	TD	TL	UT	XG	ADD STROKE
							XJ
1.50	.63 Standard	2	1	1	4	1.75	4.13
	1 Oversize					N/A*	4.50
2	.63 Standard	2.50	1	1	4.50	1.75	4.13
	1 Oversize					2.13	4.50
2.50	.63 Standard	3	1	1	5	1.75	4.25
	1 Oversize					2.13	4.63
3.25	1 Standard	3.75	1	1	5.75	2.25	5
	1.38 Oversize					2.50	5.25
4	1 Standard	4.50	1	1	6.50	2.25	5
	1.38 Oversize					2.50	5.25
5	1 Standard	5.50	1	1	7.50	2.25	5.25
	1.38 Oversize					2.50	5.50
6	1.38 Standard	6.50	1.38	1.38	9.25	2.63	5.88
	1.75 Oversize					2.88	6.13

*No oversize rod available on 1.50" bore MT1.
For dimensions not shown, see page 21.

SERIES 'FM' DIMENSIONS: FLANGE MOUNTS

FLUSH MOUNT (WITH SLEEVE NUT CONSTRUCTION)



FM-MF1

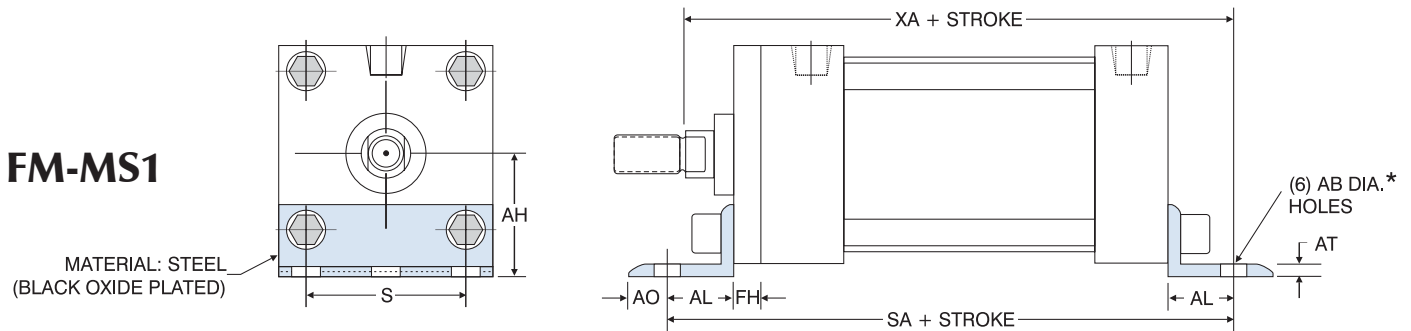
FM-MF2

'FM' SERIES 'MF1' AND 'MF2' FLANGE MOUNT DIMENSIONS												
BORE	ROD DIAMETER	A	C	E	FB	FH	R	TF	UF	W	ZB	ZF
1.50	.63 Standard	.75	.38	2	.31	.38	1.43	2.75	3.38	.63	4.63	5
	1 Oversize	1.13	.50							1	5	5.38
2	.63 Standard	.75	.38	2.50	.38	.38	1.84	3.38	4.13	.63	4.63	5
	1 Oversize	1.13	.50							1	5	5.38
2.50	.63 Standard	.75	.38	3	.38	.38	2.19	3.88	4.63	.63	4.75	5.13
	1 Oversize	1.13	.50							1	5.13	5.50
3.25	1 Standard	1.13	.50	3.75	.44	.63	2.76	4.69	5.50	.75	5.63	6.25
	1.38 Oversize	1.63	.63							1	5.88	6.50
4	1 Standard	1.13	.50	4.50	.44	.63	3.32	5.44	6.25	.75	5.63	6.25
	1.38 Oversize	1.63	.63							1	5.88	6.50
5	1 Standard	1.13	.50	5.50	.56	.63	4.10	6.63	7.63	.75	5.88	6.50
	1.38 Oversize	1.63	.63							1	6.13	6.75
6	1.38 Standard	1.63	.63	6.50	.56	.75	4.88	7.63	8.63	.88	6.63	7.38
	1.75 Oversize	2	.75							1.13	6.88	7.63

For dimensions not shown, see page 21.

SERIES 'FM' DIMENSIONS: BASE MOUNTS

FLUSH MOUNT (WITH SLEEVE NUT CONSTRUCTION)



FM-MS1

'FM' SERIES 'MS1' ANGLE MOUNT DIMENSIONS										
BORE	ROD DIAMETER	AB	AH	AL	AO	AT	FH	S	ADD STROKE	
									SA	XA
1.50	.63 Standard	.44	1.19	1	.38	.13	.38	1.25	6	5.63
	1 Oversize									6
2	.63 Standard	.44	1.44	1	.38	.13	.38	1.75	6	5.63
	1 Oversize									6
2.50	.63 Standard	.44	1.63	1	.38	.13	.38	2.25	6.13	5.75
	1 Oversize									6.13
3.25	1 Standard	.56	1.94	1.25	.50	.13	.63	2.75	7.38	6.88
	1.38 Oversize									7.13
4	1 Standard	.56	2.25	1.25	.50	.13	.63	3.50	7.38	6.88
	1.38 Oversize									7.13
5	1 Standard	.69	2.75	1.38	.63	.19	.63	4.25	7.88	7.25
	1.38 Oversize									7.50
6	1.38 Standard	.81	3.25	1.38	.63	.19	.75	5.25	8.50	8
	1.75 Oversize									8.25

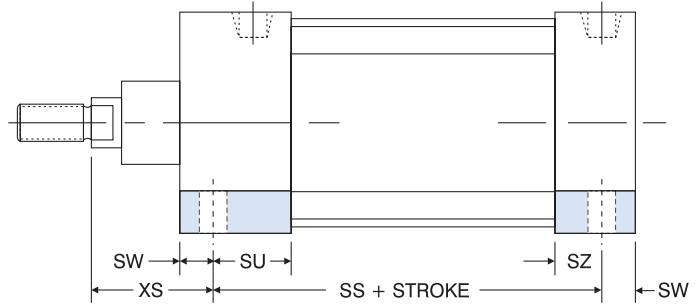
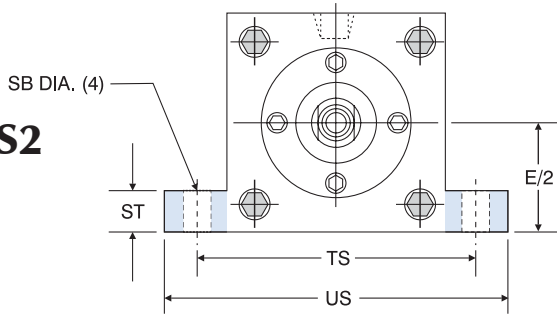
*Note: 1.50" bore has (4) "AB" holes on "S" dimension.
For dimensions not shown, see page 21.

NEW

SERIES 'FM' DIMENSIONS: BASE MOUNTS FLUSH MOUNT (WITH SLEEVE NUT CONSTRUCTION)

NEW

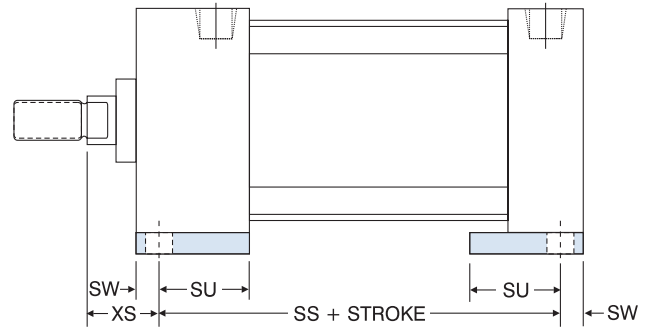
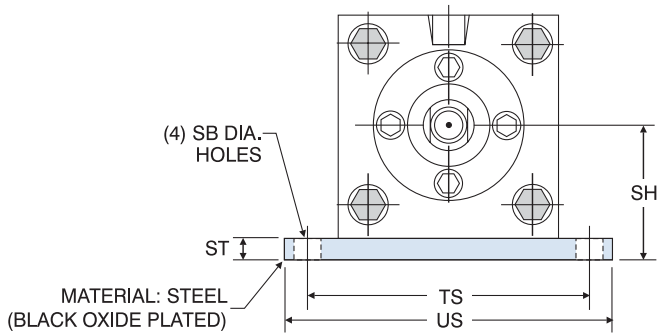
FM-MS2



'FM' SERIES 'MS2' SIDE LUG MOUNT DIMENSIONS											
BORE	ROD DIAMETER	SB	E/2	ST	SU	SW	SZ	TS	US	XS	ADD STROKE
											SS
1.50	.63 Standard	.44	1	.50	1.13	.38	.63	2.75	3.50	1.38	2.88
	1 Oversize										
2	.63 Standard	.44	1.25	.50	1.13	.38	.63	3.25	4	1.38	2.88
	1 Oversize										
2.50	.63 Standard	.44	1.50	.50	1.13	.38	.63	3.75	4.50	1.38	3
	1 Oversize										
3.25	1 Standard	.56	1.88	.75	1.25	.50	.75	4.75	5.75	1.88	3.25
	1.38 Oversize										
4	1 Standard	.56	2.25	.75	1.25	.50	.75	5.50	6.50	1.88	3.25
	1.38 Oversize										
5	1 Standard	.81	2.75	1	1.06	.69	.56	6.88	8.25	2.06	3.13
	1.38 Oversize										
6	1.38 Standard	.81	3.25	1	1.31	.69	.81	7.88	9.25	2.31	3.63
	1.75 Oversize										

For dimensions not shown, see page 21.

FM-BASE BAR (Non-NFPA)



'FM' SERIES BASE BAR MOUNT (Non-NFPA) DIMENSIONS											
BORE	ROD DIAMETER	SB	SH	ST	SU	SW	TS	US	XS	ADD STROKE	
										SS	
1.50	.63 Standard	.44	1.25	.25	1.13	.38	2.75	3.50	1.38	2.88	
	1 Oversize										1.75
2	.63 Standard	.44	1.50	.25	1.13	.38	3.25	4	1.38	2.88	
	1 Oversize										1.75
2.50	.63 Standard	.44	1.88	.38	1.13	.38	3.75	4.50	1.38	3	
	1 Oversize										1.75
3.25	1 Standard	.56	2.38	.50	1.25	.50	4.75	5.75	1.88	3.25	
	1.38 Oversize										2.13
4	1 Standard	.56	2.75	.50	1.25	.50	5.50	6.50	1.88	3.25	
	1.38 Oversize										2.13

For dimensions not shown, see page 21.

Basic Cylinders

'TA'

'TD'

'FM'

Back-To-Back

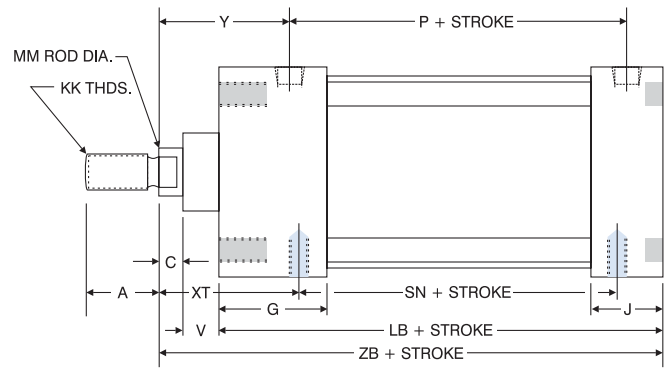
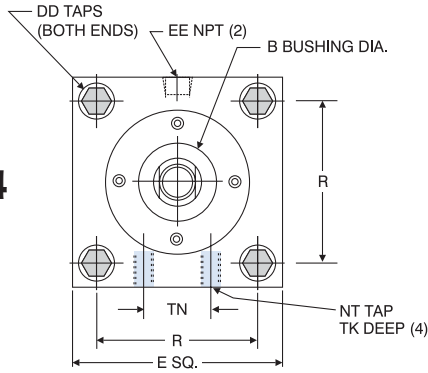
3-Position

Tandem

SERIES 'FM' DIMENSIONS: BASE MOUNTS

FLUSH MOUNT (WITH SLEEVE NUT CONSTRUCTION)

FM-MS4

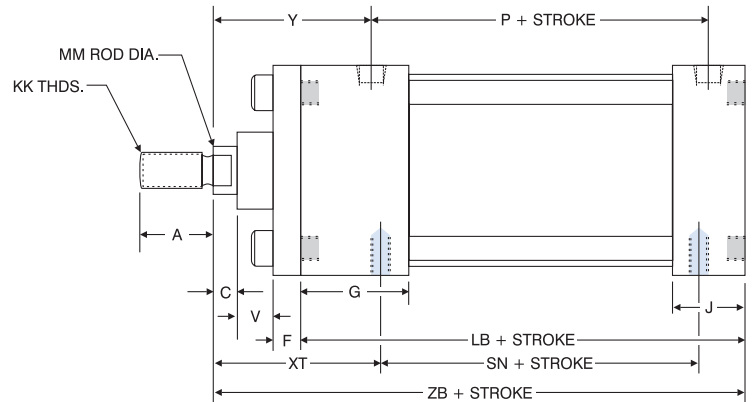
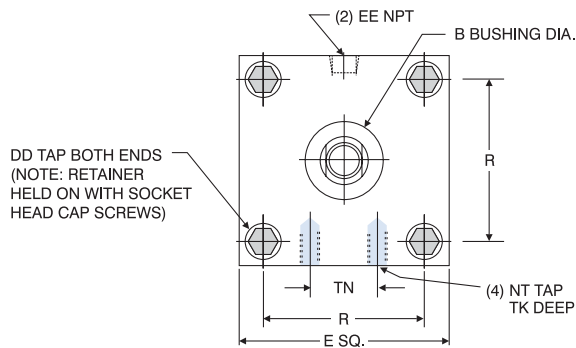


'FM' SERIES 'MS4' FLUSH MOUNT DIMENSIONS

BORE	A	B	C	DD	E	EE	G	J	KK	LB	MM	P	R	V	Y	ZB	NT	TK	TN	SN	XT
1.50	.75	1.13	.38	.25-28	2	.25	1.50	1	.44-20	3.63	.63	2.38	1.43	.63	1.88	4.63	.25-20	.38	.63	2.25	1.94
2	.75	1.13	.38	.31-24	2.50	.25	1.50	1	.44-20	3.63	.63	2.38	1.84	.63	1.88	4.63	.31-18	.50	.88	2.25	1.94
2.50	.75	1.13	.38	.31-24	3	.25	1.50	1	.44-20	3.75	.63	2.50	2.19	.63	1.88	4.75	.38-16	.63	1.25	2.38	1.94
3.25	1.13	1.50	.50	.38-24	3.75	.38	1.75	1.25	.75-16	4.25	1	2.75	2.76	.88	2.38	5.63	.50-13	.75	1.50	2.63	2.44
4	1.13	1.50	.50	.38-24	4.50	.38	1.75	1.25	.75-16	4.25	1	2.75	3.32	.88	2.38	5.63	.50-13	.75	2.06	2.63	2.44
5	1.13	1.50	.50	.50-20	5.50	.38	1.75	1.25	.75-16	4.50	1	3	4.10	.88	2.38	5.88	.63-11	1	2.69	2.88	2.44
6	1.63	2	.63	.50-20	6.50	.50	2	1.50	1-14	5	1.38	3.25	4.88	1	2.75	6.63	.75-10	1.13	3.25	3.13	2.81

For dimensions not shown, see page 21.

FM-MS4: Oversize Rod Diameter

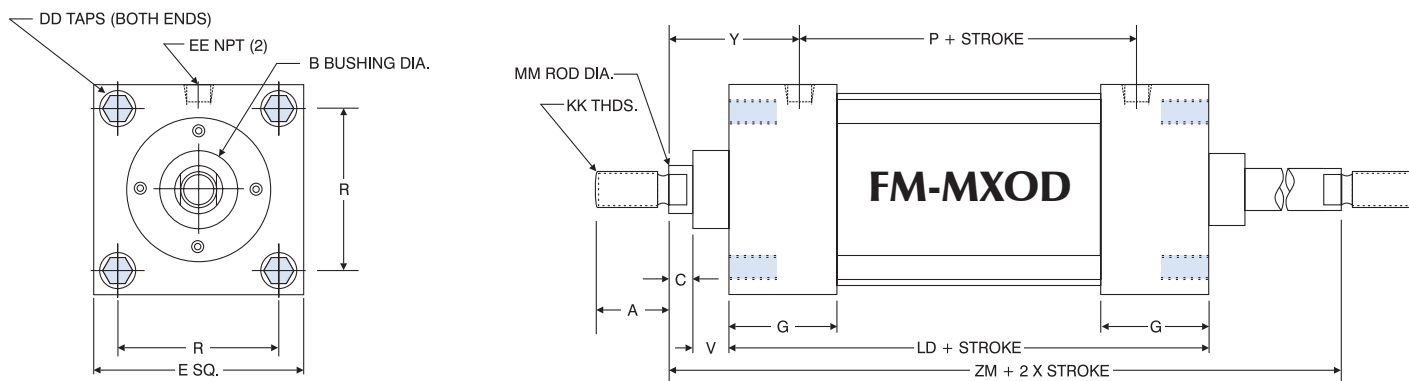


'FM' SERIES OVERSIZE ROD 'MS4' FLUSH MOUNT DIMENSIONS

BORE	A	B	C	DD	E	EE	F	G	J	KK	LB	MM	P	R	V	Y	NT	TK	TN	SN	XT	ZB
1.50	1.13	1.50	.50	.25-28	2	.25	.38	1.50	1	.75-16	3.63	1	2.38	1.43	.50	2.25	.25-20	.38	.63	2.25	2.31	5
2	1.13	1.50	.50	.31-24	2.50	.25	.38	1.50	1	.75-16	3.63	1	2.38	1.84	.50	2.25	.31-18	.50	.88	2.25	2.31	5
2.50	1.13	1.50	.50	.31-24	3	.25	.38	1.50	1	.75-16	3.75	1	2.50	2.19	.50	2.25	.38-16	.63	1.25	2.38	2.31	5.13
3.25	1.63	2	.63	.38-24	3.75	.38	.63	1.75	1.25	1-14	4.25	1.38	2.75	2.76	.38	2.63	.50-13	.75	1.50	2.63	2.69	5.88
4	1.63	2	.63	.38-24	4.50	.38	.63	1.75	1.25	1-14	4.25	1.38	2.75	3.32	.38	2.63	.50-13	.75	2.06	2.63	2.69	5.88
5	1.63	2	.63	.50-20	5.50	.38	.63	1.75	1.25	1-14	4.50	1.38	3	4.10	.38	2.63	.63-11	1	2.69	2.88	2.69	6.13
6	2	2.38	.75	.50-20	6.50	.50	.75	2	1.50	1.25-12	5	1.75	3.25	4.88	.50	3	.75-10	1.13	3.25	3.13	3.06	6.88

SERIES 'FM' DIMENSIONS: DOUBLE ROD END (NO MOUNT) FLUSH MOUNT (WITH SLEEVE NUT CONSTRUCTION)

BASIC DIMENSIONS: DOUBLE ROD END 'MXOD' (NO MOUNT)



'FM' SERIES DOUBLE ROD END BASIC DIMENSIONS 'MXOD'

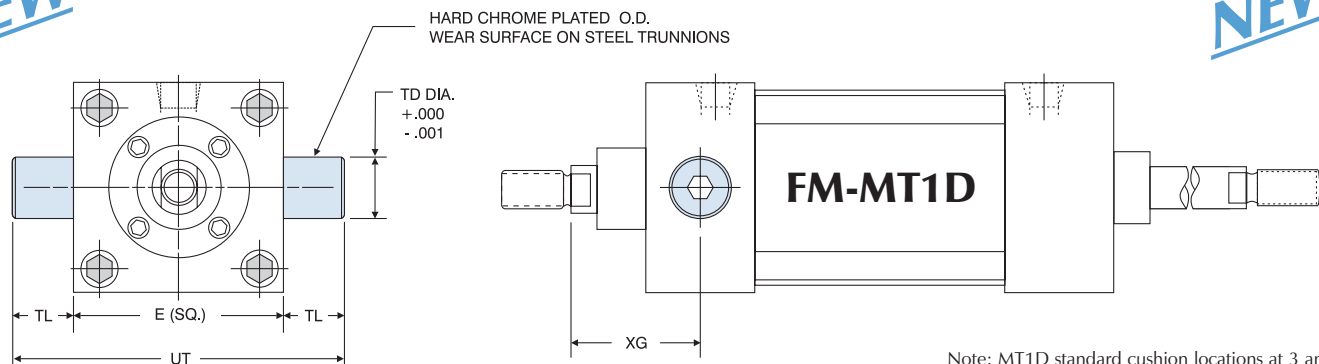
BORE	A	B	C	DD	E	EE	G	KK	LD	MM	P	R	V	Y	ZM
1.50	.75	1.13	.38	.25-28	2	.25	1.50	.44-20	4.13	.63	2.38	1.43	.63	1.88	6.13
2	.75	1.13	.38	.31-24	2.50	.25	1.50	.44-20	4.13	.63	2.38	1.84	.63	1.88	6.13
2.50	.75	1.13	.38	.31-24	3	.25	1.50	.44-20	4.25	.63	2.50	2.19	.63	1.88	6.25
3.25	1.13	1.50	.50	.38-24	3.75	.38	1.75	.75-16	4.75	1	2.75	2.76	.88	2.38	7.50
4	1.13	1.50	.50	.38-24	4.50	.38	1.75	.75-16	4.75	1	2.75	3.32	.88	2.38	7.50
5	1.13	1.50	.50	.50-20	5.50	.38	1.75	.75-16	5	1	3	4.10	.88	2.38	7.75
6	1.63	2	.63	.50-20	6.50	.50	2	1-14	5.50	1.38	3.25	4.88	1	2.75	8.75

For oversize rod dimensions, refer to page 29.

SERIES 'FM' DIMENSIONS: DOUBLE ROD END PIVOT MOUNT

NEW

NEW



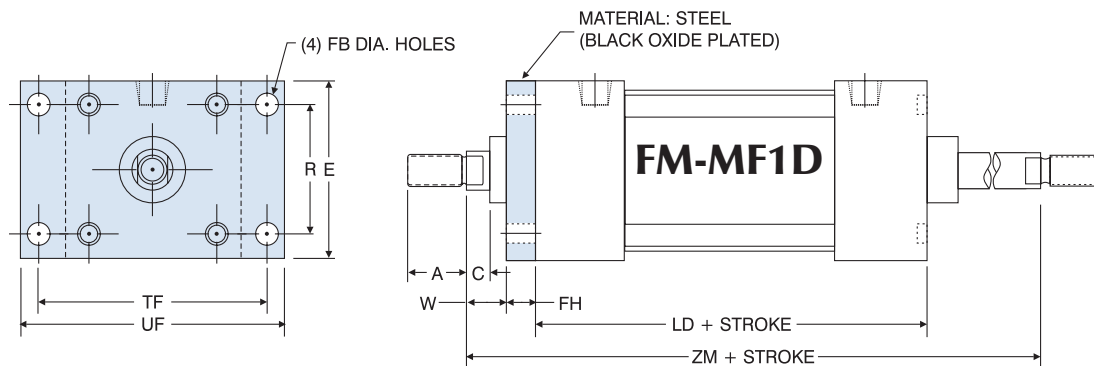
Note: MT1D standard cushion locations at 3 and 6

'FM' SERIES DOUBLE ROD END 'MT1D' HEAD TRUNNION MOUNT DIMENSIONS

BORE	ROD DIAMETER	E	TD	TL	UT	XG
1.50	.63 Standard	2	1	1	4	1.75
	1 Oversize					N/A*
2	.63 Standard	2.50	1	1	4.50	1.75
	1 Oversize					2.13
2.50	.63 Standard	3	1	1	5	1.75
	1 Oversize					2.13
3.25	1 Standard	3.75	1	1	5.75	2.25
	1.38 Oversize					2.50
4	1 Standard	4.50	1	1	6.50	2.25
	1.38 Oversize					2.50
5	1 Standard	5.50	1	1	7.50	2.25
	1.38 Oversize					2.50
6	1.38 Standard	6.50	1.38	1.38	9.25	2.63
	1.75 Oversize					2.88

*No oversize rod available on 1.50" bore MT1D.
For dimensions not shown, see chart above.

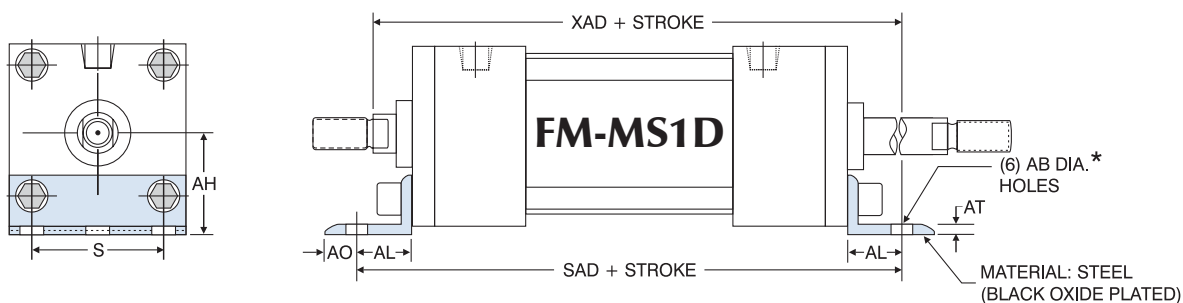
SERIES 'FM' DIMENSIONS: DOUBLE ROD END FLANGE MOUNT FLUSH MOUNT (WITH SLEEVE NUT CONSTRUCTION)



'FM' SERIES DOUBLE ROD END 'MF1D' FLANGE MOUNT DIMENSIONS												
BORE	ROD DIAMETER	A	C	E	FB	FH	R	TF	UF	W	ADD STROKE	
											LD	ZM
1.50	.63 Standard	.75	.38	2	.31	.38	1.43	2.75	3.38	.63	4.13	6.13
	1 Oversize	1.13	.50									6.88
2	.63 Standard	.75	.38	2.50	.38	.38	1.84	3.38	4.13	.63	4.13	6.13
	1 Oversize	1.13	.50									6.88
2.50	.63 Standard	.75	.38	3	.38	.38	2.19	3.88	4.63	.63	4.25	6.25
	1 Oversize	1.13	.50									7
3.25	1 Standard	1.13	.50	3.75	.44	.63	2.76	4.69	5.50	.75	4.75	7.50
	1.38 Oversize	1.63	.63									8
4	1 Standard	1.13	.50	4.50	.44	.63	3.32	5.44	6.25	.75	4.75	7.50
	1.38 Oversize	1.63	.63									8
5	1 Standard	1.13	.50	5.50	.56	.63	4.10	6.63	7.63	.75	5	7.75
	1.38 Oversize	1.63	.63									8.25
6	1.38 Standard	1.63	.63	6.50	.56	.75	4.88	7.63	8.63	.88	5.50	8.75
	1.75 Oversize	2	.75									9.25

For dimensions not shown, see page 26.

SERIES 'FM' DIMENSIONS: DOUBLE ROD END BASE MOUNTS FLUSH MOUNT (WITH SLEEVE NUT CONSTRUCTION)



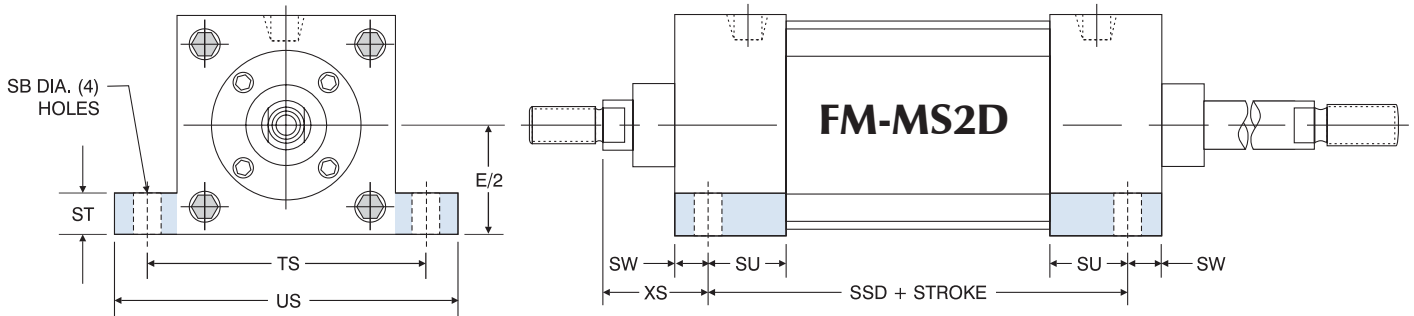
'FM' SERIES DOUBLE ROD END 'MS1D' ANGLE MOUNT DIMENSIONS										
BORE	ROD DIAMETER	AB	AH	AL	AO	AT	S	ADD STROKE		
								SAD	XAD	
1.50	.63 Standard	.44	1.19	1	.38	.13	1.25	6.88	6.50	
	1 Oversize								6.88	
2	.63 Standard	.44	1.44	1	.38	.13	1.75	6.88	6.50	
	1 Oversize								6.88	
2.50	.63 Standard	.44	1.63	1	.38	.13	2.25	7	6.63	
	1 Oversize								7	
3.25	1 Standard	.56	1.94	1.25	.50	.13	2.75	8.50	8	
	1.38 Oversize								8.25	
4	1 Standard	.56	2.25	1.25	.50	.13	3.50	8.50	8	
	1.38 Oversize								8.25	
5	1 Standard	.69	2.75	1.38	.63	.19	4.25	9	8.38	
	1.38 Oversize								8.63	
6	1.38 Standard	.81	3.25	1.38	.63	.19	5.25	9.75	9.25	
	1.75 Oversize								9.50	

*Note: 1.50" bore has (4) "AB" holes on "S" dimension.
For dimensions not shown, see page 26.

SERIES 'FM' DIMENSIONS: DOUBLE ROD END BASE MOUNTS FLUSH MOUNT (WITH SLEEVE NUT CONSTRUCTION)

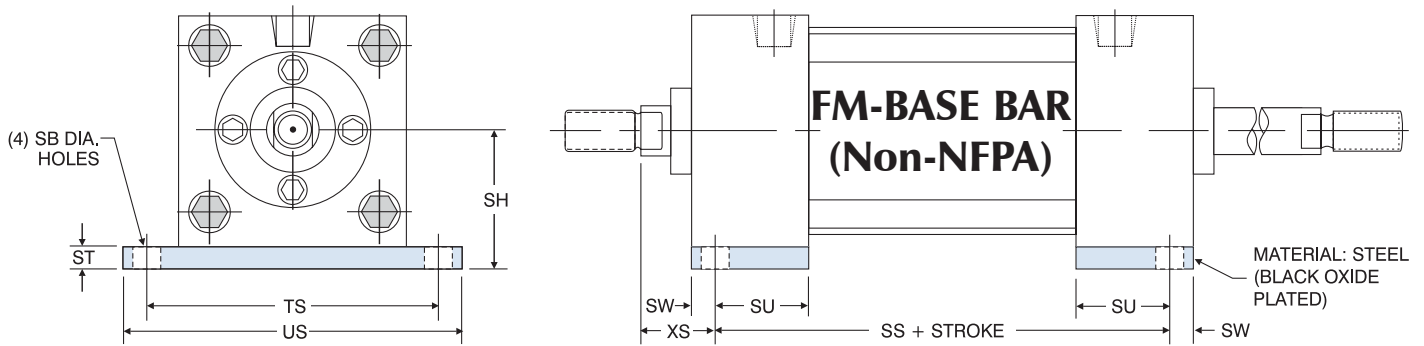
NEW

NEW



'FM' SERIES DOUBLE ROD END 'MS2D' SIDE LUG MOUNT DIMENSIONS										
BORE	ROD DIAMETER	SB	E/2	ST	SU	SW	TS	US	XS	ADD STROKE
										SSD
1.50	.63 Standard	.44	1	.50	1.13	.38	2.75	3.50	1.38	3.38
	1 Oversize									
2	.63 Standard	.44	1.25	.50	1.13	.38	3.25	4	1.38	3.38
	1 Oversize									
2.50	.63 Standard	.44	1.50	.50	1.13	.38	3.75	4.50	1.38	3.50
	1 Oversize									
3.25	1 Standard	.56	1.88	.75	1.25	.50	4.75	5.75	1.88	3.75
	1.38 Oversize								2.13	
4	1 Standard	.56	2.25	.75	1.25	.50	5.50	6.50	1.88	3.75
	1.38 Oversize								2.13	
5	1 Standard	.81	2.75	1	1.06	.69	6.88	8.25	2.06	3.63
	1.38 Oversize								2.31	
6	1.38 Standard	.81	3.25	1	1.31	.69	7.88	9.25	2.31	4.13
	1.75 Oversize								2.56	

For dimensions not shown, see page 26.

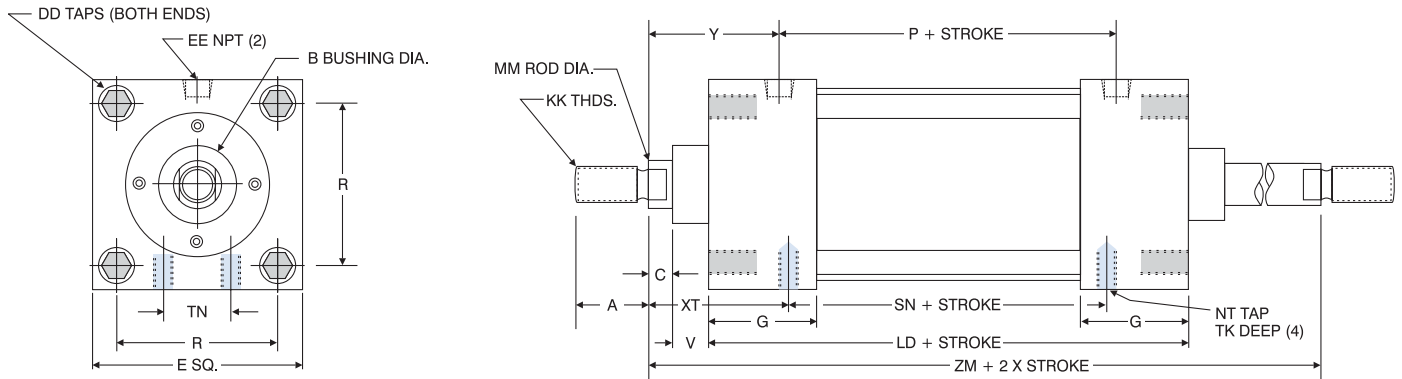


'FM' SERIES DOUBLE ROD END BASE BAR MOUNT (Non-NFPA) DIMENSIONS										
BORE	ROD DIAMETER	SB	SH	ADD STROKE	ST	SU	SW	TS	US	XS
				SS						
1.50	.63 Standard	.44	1.25	3.38	.25	1.13	.38	2.75	3.50	1.38
	1 Oversize									
2	.63 Standard	.44	1.50	3.38	.25	1.13	.38	3.25	4	1.38
	1 Oversize									
2.50	.63 Standard	.44	1.88	3.50	.38	1.13	.38	3.75	4.50	1.38
	1 Oversize									
3.25	1 Standard	.56	2.38	3.75	.50	1.25	.50	4.75	5.75	1.88
	1.38 Oversize									2.13
4	1 Standard	.56	2.75	3.75	.50	1.25	.50	5.50	6.50	1.88
	1.38 Oversize									2.13

For dimensions not shown, see page 26.

SERIES 'FM' DIMENSIONS: DOUBLE ROD END BASE MOUNT FLUSH MOUNT (WITH SLEEVE NUT CONSTRUCTION)

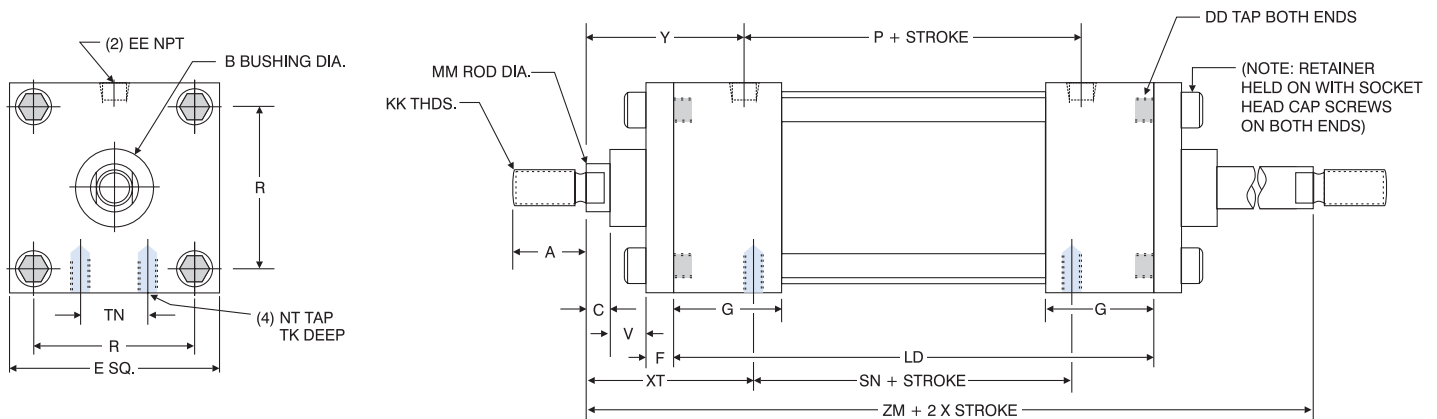
FM-MS4D: Standard Rod Diameter



'FM' SERIES DOUBLE ROD END 'MS4D' FLUSH MOUNT DIMENSIONS

BORE	A	B	C	DD	E	EE	G	KK	LD	MM	P	R	V	Y	NT	TK	TN	SN	XT	ZM
1.50	.75	1.13	.38	.25-28	2	.25	1.50	.44-20	4.13	.63	2.38	1.43	.63	1.88	.25-20	.38	.63	2.25	1.94	6.13
2	.75	1.13	.38	.31-24	2.50	.25	1.50	.44-20	4.13	.63	2.38	1.84	.63	1.88	.31-18	.50	.88	2.25	1.94	6.13
2.50	.75	1.13	.38	.31-24	3	.25	1.50	.44-20	4.25	.63	2.50	2.19	.63	1.88	.38-16	.63	1.25	2.38	1.94	6.25
3.25	1.13	1.50	.50	.38-24	3.75	.38	1.75	.75-16	4.75	1	2.75	2.76	.88	2.38	.50-13	.75	1.50	2.63	2.44	7.50
4	1.13	1.50	.50	.38-24	4.50	.38	1.75	.75-16	4.75	1	2.75	3.32	.88	2.38	.50-13	.75	2.06	2.63	2.44	7.50
5	1.13	1.50	.50	.50-20	5.50	.38	1.75	.75-16	5	1	3	4.10	.88	2.38	.63-11	1	2.69	2.88	2.44	7.75
6	1.63	2	.63	.50-20	6.50	.50	2	1-14	5.50	1.38	3.25	4.88	1	2.75	.75-10	1.13	3.25	3.13	2.81	8.75

FM-MS4D: Oversize Rod Diameter



'FM' SERIES DOUBLE ROD END OVERSIZE ROD 'MS4D' FLUSH MOUNT DIMENSIONS

BORE	A	B	C	DD	E	EE	F	G	KK	LD	MM	P	R	V	Y	NT	TK	TN	SN	XT	ZM
1.50	1.13	1.50	.50	.25-28	2	.25	.38	1.50	.75-16	4.13	1	2.38	1.43	.50	2.25	.25-20	.38	.63	2.25	2.31	6.88
2	1.13	1.50	.50	.31-24	2.50	.25	.38	1.50	.75-16	4.13	1	2.38	1.84	.50	2.25	.31-18	.50	.88	2.25	2.31	6.88
2.50	1.13	1.50	.50	.31-24	3	.25	.38	1.50	.75-16	4.25	1	2.50	2.19	.50	2.25	.38-16	.63	1.25	2.38	2.31	7
3.25	1.63	2	.63	.38-24	3.75	.38	.63	1.75	1-14	4.75	1.38	2.75	2.76	.38	2.63	.50-13	.75	1.50	2.63	2.69	8
4	1.63	2	.63	.38-24	4.50	.38	.63	1.75	1-14	4.75	1.38	2.75	3.32	.38	2.63	.50-13	.75	2.06	2.63	2.69	8
5	1.63	2	.63	.50-20	5.50	.38	.63	1.75	1-14	5	1.38	3	4.10	.38	2.63	.63-11	1	2.69	2.88	2.69	8.25
6	2	2.38	.75	.50-20	6.50	.50	.75	2	1.25-12	5.50	1.75	3.25	4.88	.50	3.13	.75-10	1.13	3.25	3.13	3.06	9.25

SERIES 'FM' FLUSH MOUNT: MOUNTING KITS

Most 'FM' cylinders are shipped ready to accept any 'FM' Series mounting kits. 'FM' cylinders can be used in different applications simply by changing the mount. In addition, the 'FM' Flush Mount feature can be used for mounting—just use the (4) tapped holes in head or cap to mount cylinder. The 'FM' Series is one of the most versatile cylinders on the market. Choose from (6) mounting kits. Each kit comes complete with fasteners.



SERIES 'FM' MOUNTING KITS

BORE	MP1	MP2	MP4	MF1	MF2	MS1	Base Bar	
	Part Number	Part Number	Part Number	Part Number	Part Number	Part Number	Part Number	SH Dimension
1.50	A85-15D	A81-15D	A83-15D	FM61-15	FM62-15	A75-15 (H) A77-15 (C)	BB-15-HC	1.25
2	A85-20D	A81-20D	A83-20D	FM61-20	FM62-20	A75-20 (H) A77-20 (C)	BB-20-HC	1.50
2.50	A85-25D	A81-25D	A83-25D	FM61-25	FM62-25	A77-25	BB-25-HC	1.88
3.25	A85-32D	A81-32D	A83-32D	FM61-32	FM62-32	A75-32	BB-32-HC	2.38
4	A85-40D	A81-40D	A83-40D	FM61-40	FM62-40	A77-40	BB-40-HC	2.75
5	A85-50D	A81-50D	N/A	FM61-50	FM62-50	A77-50	N/A	—
6	A85-60D	A81-60D	N/A	FM61-60	FM62-60	A77-60	N/A	—

*Base Bar "SH" dimension is not NFPA. Refer to pages 24 and 28.
All other dimensions are NFPA.

BACK-TO-BACK CYLINDERS:

You can back-to-back **any** series of cylinder together — mixed or matched, to provide unlimited design possibilities. Back-to-back cylinders consist of (2) individual cylinders having common bore sizes, built as one unit utilizing common tie-rods. Mounts include a full range of base, tie-rod and head or cap trunnions for pivot mounting. (Tip: You can use a rod clevis on each piston rod to create additional pivot mounting styles. Refer to page 89 for stop tube considerations in combined strokes over 40 inches.)

BACK-TO-BACK BENEFITS:

- **MULTIPLE POSITION CYLINDER** — The back-to-back design creates a true four-position cylinder. By varying stroke lengths, a multitude of positions can be created. (Example: CYL 1 has a 1" stroke; CYL 2 has a 2" stroke. The stroke positions would be: 0", 1", 2" and 3", depending on how the cylinder is cycled.)
- **"HARD" POSITION STOPS** — Unlike a three-position cylinder, a back-to-back cylinder provides "hard" stop positioning. (Note: 3-position cylinders rely on the back piston rod to push against the front piston rod to create the intermediate position. Care must be used to prevent the front piston rod from "extending" in the intermediate position.)
- **ECONOMICAL DESIGN** — The back-to-back design uses standard parts, reducing overall costs.

HOW TO ORDER: BACK-TO-BACK CYLINDERS

CYL. #1

BTB - TA - MS4 - 2 x 10 - HC

WITH

CYL. #2

TA - MXO - 2 X 5 - MPR - HC

SERIES

TA	250 PSI AIR
TD	250 PSI AIR, TOUGH-DUTY
SS	STAINLESS STEEL (Refer to Cat. # CAT-TRDSS-704 for ordering information)
FM	FLUSH MOUNT (Add-A-Mount)
TRA	TRIPLE ROD

NFPA MOUNTS

MXO	NO MOUNT
MT1	FRONT TRUNNION
MT2	REAR TRUNNION
MX1	EXTENDED TIE RODS - HEAD & CAP
MX3	EXTENDED TIE RODS - HEAD
MF1	FRONT FLANGE (1.50"-6" Bore)
ME3	FRONT MOUNTING HOLES (8" Bore)
MS1	FRONT & REAR END ANGLE
MS2	SIDE LUG (1.50"-4" Std., 5" and above consult factory)
MS4	BOTTOM TAPPED HOLES

BORE (CYL. #1)

1.50
2
2.50
3.25
4
5
6
8

STROKE (CYL. #1)

0" to 50"
Made to Order

CUSHIONS

H	HEAD CUSHION POSITION 2 IS STANDARD SPECIFY FOR POSITIONS: 1, 3 & 4
LH	LONG HEAD CUSHION POSITION 2 IS STANDARD SPECIFY FOR POSITIONS: 1, 3 & 4
ELH	EXTRA LONG HEAD CUSHION POSITION 2 IS STANDARD SPECIFY FOR POSITIONS: 1, 3 & 4
C	CAP CUSHION POSITION 6 IS STANDARD SPECIFY FOR POSITIONS: 5, 7 & 8
LC	LONG CAP CUSHION POSITION 6 IS STANDARD SPECIFY FOR POSITIONS: 5, 7 & 8
ELC	EXTRA LONG CAP CUSHION POSITION 6 IS STANDARD SPECIFY FOR POSITIONS: 5, 7 & 8
FIXED CUSHIONS	
FCH	FIXED HEAD CUSHION (NON-ADJUSTABLE, NO ADJUSTMENT NEEDLE)
FCC	FIXED CAP CUSHION (NON-ADJUSTABLE, NO ADJUSTMENT NEEDLE)
FC	FIXED HEAD AND CAP CUSHION (NON-ADJUSTABLE, NO ADJUSTMENT NEEDLE)

Note: "L" AND "EL" CUSHION OPTIONS CAN BE ORDERED AS FIXED CUSHIONS.
Example: FCLH, FCELH

OPTIONS

ADDS LENGTH TO CYLINDER - SEE "OPTION LENGTH ADDER" CHART, PAGE 5.

A =	EXTENDED PISTON ROD THREAD (Example: A = 2")
A/O	AIR / OIL PISTON
X B	.25" URETHANE BUMPER BOTH ENDS
X BC	.25" URETHANE BUMPER CAP ONLY
X BH	.25" URETHANE BUMPER HEAD ONLY
BP	BUMPER PISTON SEALS (1.50" - 8" Bore)
BSP	BSP PORTS (SPECIFY SIZE, Example: BSP = .25")
C =	EXTENDED PISTON ROD (Example: IF C = 0.50", THEN 1" ROD EXTENSION IS C = 1.50")
EN	ELECTROLESS NICKEL PLATED (Refer to page 84 for specifications)
KK2	LARGE MALE ROD THREAD
KK3	FEMALE ROD THREAD
KK3S	STUDDER PISTON ROD (KK3 with Stud, Loctite in place)
KK4	FULL DIAMETER MALE ROD THREAD
KK5	BLANK ROD END (NO THREADS, "A" = 0")
LF	LOW FRICTION SEALS (Refer to page 84 for specifications)
MPR	MAGNETIC PISTON FOR REED OR SOLID STATE SWITCHES - TRD MODELS: R10, R10P, RAC, RHT & MSS (Refer to pages 107-113 for selection)
MS	METALLIC ROD SCRAPER (BRASS CONSTRUCTION)
NR	NON-ROTATING (Refer to page 86 for specifications)
OP	OPTIONAL PORT LOCATION (Example: Ports @ 3 & 7)
OS	OVERSIZE ROD DIAMETER (SPECIFY SIZE, Example: OS = 1.38")
SAE	SAE PORTS (SPECIFY SIZE, Example: SAE #10)
X SE	SPRING EXTEND (CONSULT FACTORY)
X SP	SPACER PLATE (Refer to page 34 for dimensions)
X SR	SPRING RETURN (CONSULT FACTORY)
SSA	STAINLESS STEEL PISTON ROD, TIE RODS & NUTS, AND FASTENERS
SSF	STAINLESS STEEL FASTENERS
SSR	STAINLESS STEEL PISTON ROD
SST	STAINLESS STEEL TIE RODS & NUTS
X ST	STOP TUBE (SPECIFY STOP TUBE LENGTH AND EFFECTIVE STROKE) (Example: TA MS4 2 X 24" EFFECTIVE STROKE-ST=3)
STEEL TUBE	STEEL CYLINDER TUBE, BLACK EPOXY PAINT FINISH
TH	400 PSI HYDRAULIC NON-SHOCK (Refer to page 90 for specifications)
VS	FLUOROCARBON SEALS
WB	PISTON WEAR BAND
XX	SPECIAL VARIATION (SPECIFY)

STANDARD PORT AND CUSHION ADJUSTMENT POSITIONS

- Ports - Positions 1 and 5
- Cushion Adjustment - Positions 2 and 6 on both cylinders (opposite sides from one another)
- Specify Non-Standard Positions When Ordering

About our Part Number System

- Simple, easy to understand
- No excessive codes!
- Eliminates mistakes when ordering

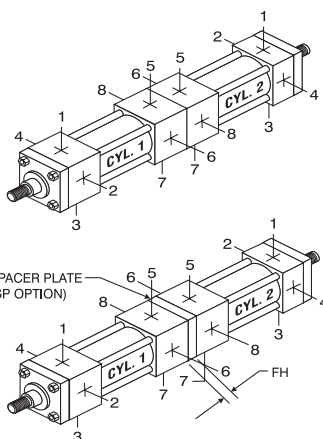
Example: Back-To-Back

Cyl. 1 is a 'TA' series, MS4 mount, 2" bore X 10" stroke.

Cyl. 2 is a 'TA' series, MXO (no mount), 2" bore X 5" stroke, with a magnet (for Reed Switches), and Head & Cap cushions.

Part Number:

BTB-TA-MS4-2 x 10 with
TA-MXO-2 x 5-MPR-HC



Ports are in-line when using standard port locations. To add space between ports (for larger air fittings), a spacer plate can be added as an option. (SPECIFY "SP" OPTION)

"SP" OPTION WILL INCREASE OVERALL LENGTH BY "FH" DIMENSION. (See page 32 for "FH" dimensions)

Tip: If overall length is tight, specify rotating the ports on one of the cylinders in lieu of a spacer plate.

BACK-TO-BACK DIMENSIONS: BASIC CYLINDER (NO MOUNT)

About Rod End Styles

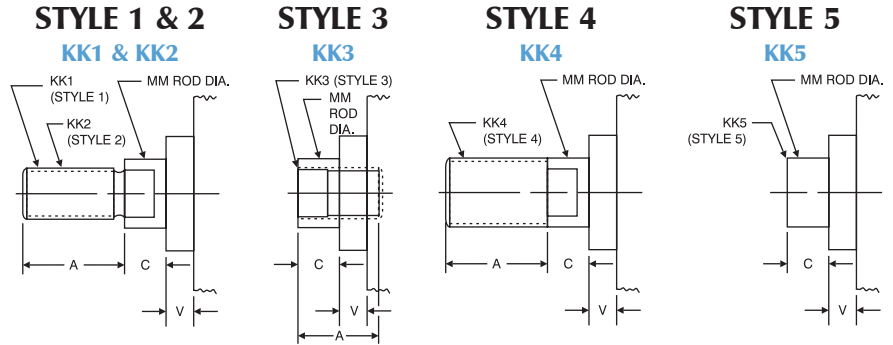
Style 1 Male Rod End is STANDARD

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!

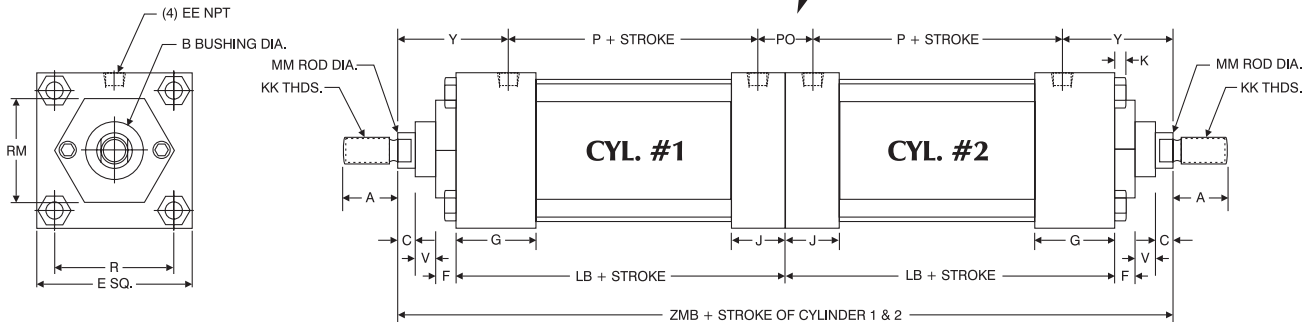
PISTON ROD END STYLES



BORE	MM ROD DIAMETER	STANDARD		OPTIONAL							C	V
		Style 1 - Male	Style 2 - Male	Style 3 - Female	Style 4 - Male	Style 5 - Blank	KK1	KK2	KK3	KK4		
1.50, 2, 2.50	.63 Standard	.44-20	.75	.50-20	.75	.44-20	.75	.63-18	.75	No Threads	.38	.25
	1 Oversize	.75-16	1.13	.88-14	1.13	.75-16	1.13	1-14	1.13	No Threads	.50	.50
3.25, 4, 5	1 Standard	.75-16	1.13	.88-14	1.13	.75-16	1.13	1-14	1.13	No Threads	.50	.25
	1.38 Oversize	1-14	1.63	1.25-12	1.63	1-14	1.63	1.38-12	1.63	No Threads	.63	.38
6 & 8	1.38 Standard	1-14	1.63	1.25-12	1.63	1-14	1.63	1.38-12	1.63	No Threads	.63	.38
	1.75 Oversize	1.25-12	2	1.50-12	2	1.25-12	2	1.75-12	2	No Threads	.75	.50

MXO/MXO

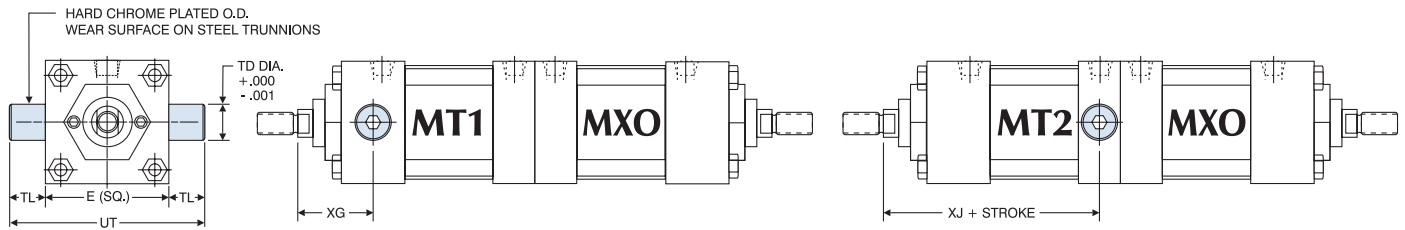
(NO MOUNT)



BACK-TO-BACK BASIC DIMENSIONS 'MXO' STANDARD & OVERSIZE RODS																					
BORE	ROD DIAMETER	A	B	C	E	EE	F	FH	G	J	K	KK	LB	MM	P	PO	R	RM	V	Y	ZMB*
1.50	.63 Standard	.75	1.13	.38	2	.38	.38	.38	1.50	1	.25	.44-20	3.63	.63	2.38	.75	1.43	2 SQ.	.25	1.88	9.25
	1 Oversize	1.13	1.50	.50								.75-16	1	1				2.50 SQ.	.50	2.25	10
2	.63 Standard	.75	1.13	.38	2.50	.38	.38	.38	1.50	1	.31	.44-20	3.63	.63	2.38	.75	1.84	1.75 HEX.	.25	1.88	9.25
	1 Oversize	1.13	1.50	.50								.75-16	1	1				2.50 SQ.	.50	2.25	10
2.50	.63 Standard	.75	1.13	.38	3	.38	.38	.38	1.50	1	.31	.44-20	3.75	.63	2.50	.75	2.19	1.75 HEX.	.25	1.88	9.50
	1 Oversize	1.13	1.50	.50								.75-16	1	1				3 SQ.	.50	2.25	10.25
3.25	1 Standard	1.13	1.50	.50	3.75	.50	.63	.63	1.75	1.25	.38	.75-16	4.25	1	2.75	1	2.76	2.75 DIA.	.25	2.38	11.25
	1.38 Oversize	1.63	2	.63								1-14	1.38	1				3.75 SQ.	.38	2.63	11.75
4	1 Standard	1.13	1.50	.50	4.50	.50	.63	.63	1.75	1.25	.38	.75-16	4.25	1	2.75	1	3.32	2.75 DIA.	.25	2.38	11.25
	1.38 Oversize	1.63	2	.63								1-14	1.38	1				3.50 DIA.	.38	2.63	11.75
5	1 Standard	1.13	1.50	.50	5.50	.50	.63	.63	1.75	1.25	.44	.75-16	4.50	1	3	1	4.10	2.75 DIA.	.25	2.38	11.75
	1.38 Oversize	1.63	2	.63								1-14	1.38	1				3.50 DIA.	.38	2.63	12.25
6	1.38 Standard	1.63	2	.63	6.50	.75	.63	.75	2	1.50	.44	1-14	5	1.38	3.25	1.25	4.88	3.50 DIA.	.38	2.75	13.25
	1.75 Oversize	2	2.38	.75								1.25-12	1.75	1					.50	3	13.75
8	1.38 Standard	1.63	2	.63	8.50	.75	.63	—	2	1.50	.56	1-14	5.13	1.38	3.38	1.25	6.44	3.50 DIA.	.38	2.75	13.50
	1.75 Oversize	2	2.38	.75								1.25-12	1.75	1					.50	3	14

*Overall length of "ZMB" will increase by "FH" dimension when using spacer plate option "SP".

BACK-TO-BACK DIMENSIONS: PIVOT MOUNTS



MT1 / MT2

Note: MT1 and MT2 Trunnions are bolt on, non-removable design.
Optional: One-piece solid steel trunnion available.

'MT1' HEAD TRUNNION AND 'MT2' CAP TRUNNION MOUNT DIMENSIONS							
BORE	ROD DIAMETER	E	TD	TL	UT	XG	ADD STROKE
							XJ
1.50	.63 Standard	2	1	1	4	1.75	4.13
	1 Oversize						N/A*
2	.63 Standard	2.50	1	1	4.50	1.75	4.13
	1 Oversize						2.13
2.50	.63 Standard	3	1	1	5	1.75	4.25
	1 Oversize						2.13
3.25	1 Standard	3.75	1	1	5.75	2.25	5
	1.38 Oversize						2.50
4	1 Standard	4.50	1	1	6.50	2.25	5
	1.38 Oversize						2.50
5	1 Standard	5.50	1	1	7.50	2.25	5.25
	1.38 Oversize						2.50
6	1.38 Standard	6.50	1.38	1.38	9.25	2.63	5.88
	1.75 Oversize						2.88
8	1.38 Standard	8.50	1.38	1.38	11.25	2.63	6
	1.75 Oversize						2.88

*No oversize rod available on 1.50" bore MT1.

BACK-TO-BACK CYLINDERS: SCHEMATICS

The following schematic is commonly used for back-to-back applications.

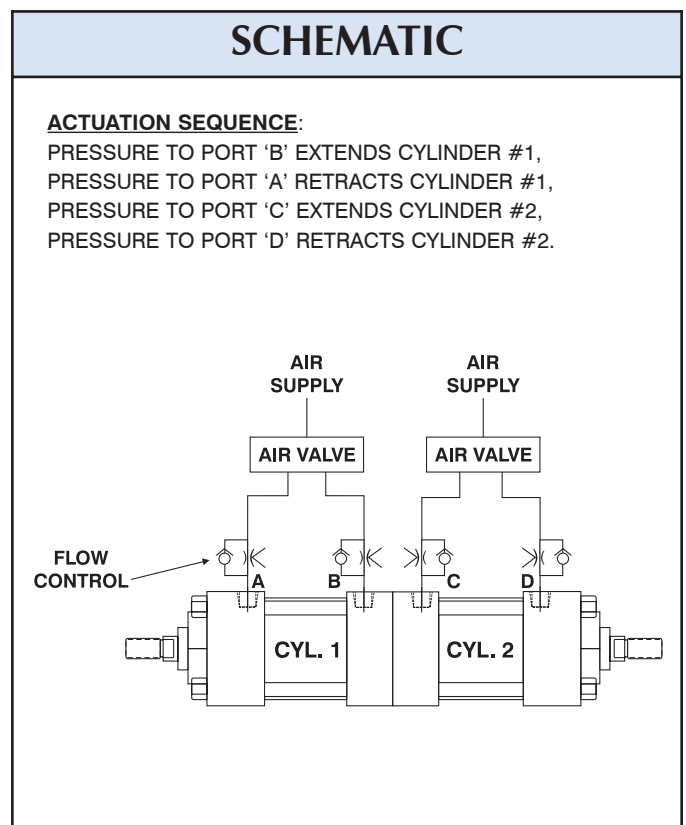
Cylinder strokes can be the same or different.

Back-to-Back cylinders are designed and built with (2) separate piston rods. Cylinders operate independently of one another.

Tip: Before ordering, check the air fitting sizes to be sure you have adequate room at the ports "B" and "C" to install fittings. Ports can be rotated on one cylinder or a spacer plate can be added (between cylinder caps) to provide clearance for fittings.

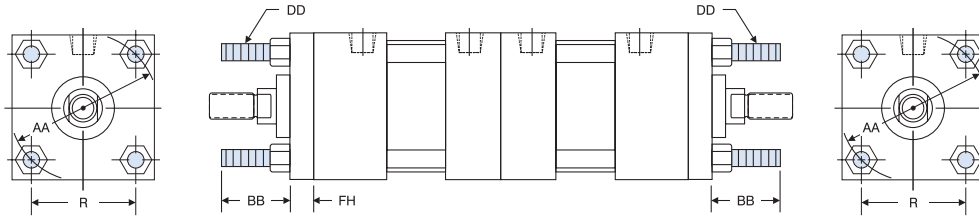
EXAMPLE:

Shown is a back-to-back cylinder with each cylinder operated with an independent air valve & (2) flow controls used to regulate cylinder speed.

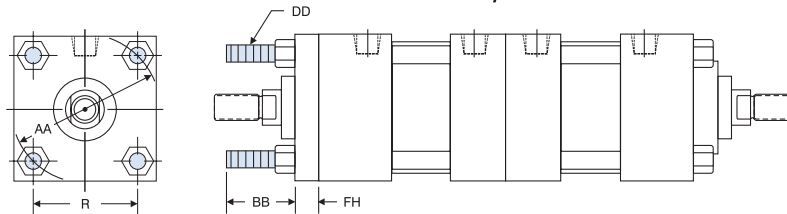


BACK-TO-BACK DIMENSIONS: TIE ROD & FLANGE MOUNTS

MX1



MX3/MXO



TIE ROD EXTENDED 'MX1' & 'MX3' MOUNT DIMENSIONS						
BORE	ROD DIAMETER	AA	BB	DD	FH	R
1.50	.63 Standard	2.02	1	.25-28	.38	1.43
	1 Oversize					
2	.63 Standard	2.6	1.13	.31-24	.38	1.84
	1 Oversize					
2.50	.63 Standard	3.1	1.13	.31-24	.38	2.19
	1 Oversize					
3.25	1 Standard	3.9	1.38	.38-24	.63	2.76
	1.38 Oversize					

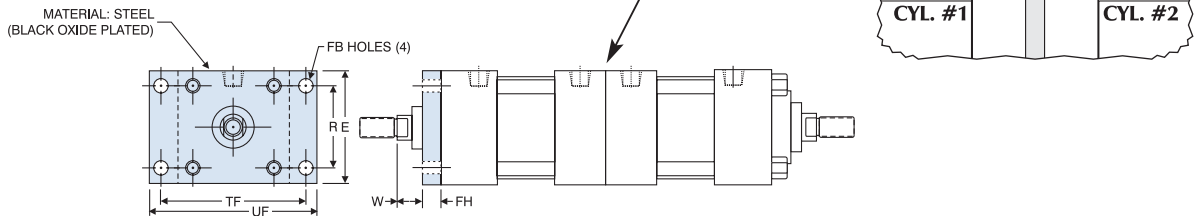
TIE ROD EXTENDED 'MX1' & 'MX3' MOUNT DIMENSIONS						
BORE	ROD DIAMETER	AA	BB	DD	FH	R
4	1 Standard	4.7	1.38	.38-24	.63	3.32
	1.38 Oversize					
5	1 Standard	5.8	1.81	.50-20	.63	4.10
	1.38 Oversize					
6	1.38 Standard	6.9	1.81	.50-20	.75	4.88
	1.75 Oversize					
8	1.38 Standard	9.1	**2.31	.63-18	*.63	6.44
	1.75 Oversize					

*Round retainer used to retain bushing, not a full front plate as other bores.

**"BB" dimension from head on 8" bore.

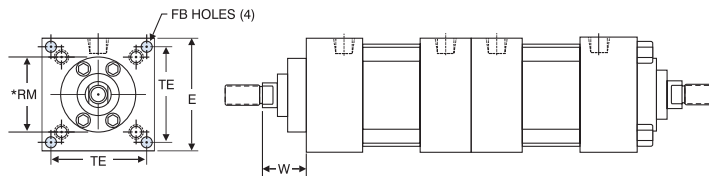
MF1/MXO

(1/2" - 6" BORES)



ME3/MXO

(8" BORE ONLY)



'MF1' FLANGE & 'ME3' CAP MOUNT DIMENSIONS										
BORE	ROD DIAMETER	E	FB	FH	R	RM	TE	TF	UF	W
1.50	.63 Standard	2	.31	.38	1.43	—	—	2.75	3.38	.63
	1 Oversize									1
2	.63 Standard	2.50	.38	.38	1.84	—	—	3.38	4.13	.63
	1 Oversize									1
2.50	.63 Standard	3	.38	.38	2.19	—	—	3.88	4.63	.63
	1 Oversize									1
3.25	1 Standard	3.75	.44	.63	2.76	—	—	4.69	5.50	.75
	1.38 Oversize									1

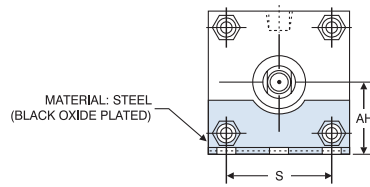
'MF1D' FLANGE & 'ME3D' CAP MOUNT DIMENSIONS												
BORE	ROD DIAMETER	E	FB	FH	R	RM	TE	TF	UF	W		
4	1 Standard	4.50	.44	.63	3.32	—	—	5.44	6.25	.75		
	1.38 Oversize									1		
5	1 Standard	5.50	.56	.63	4.10	—	—	6.63	7.63	.75		
	1.38 Oversize									1		
6	1.38 Standard	6.50	.56	.75	4.88	—	—	7.63	8.63	.88		
	1.75 Oversize									1.13		
8	1.38 Standard	8.50	.69	N/A	N/A	*3.50	7.57	N/A	N/A	1.63		
	1.75 Oversize									1.88		

*Round retainer used to retain bushing, not a rectangular flange plate as other bores.

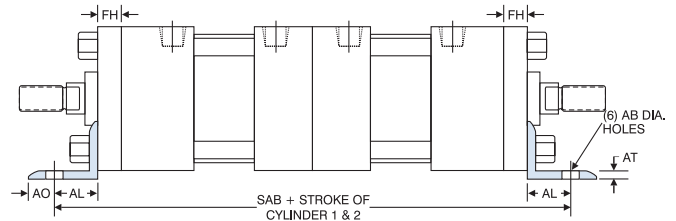
BACK-TO-BACK DIMENSIONS: BASE MOUNTS

'MS1' ANGLE MOUNT DIMENSIONS									
BORE	ROD DIAMETER	AB	AH	AL	AO	AT	FH	S	ADD STROKE
									SAB
1.50	.63 Standard	.44	1.19	1	.38	.13	.38	1.25	10
	1 Oversize								
2	.63 Standard	.44	1.44	1	.38	.13	.38	1.75	10
	1 Oversize								
2.50	.63 Standard	.44	1.63	1	.38	.13	.38	2.25	10.25
	1 Oversize								
3.25	1 Standard	.56	1.94	1.25	.50	.13	.63	2.75	12.25
	1.38 Oversize								
4	1 Standard	.56	2.25	1.25	.50	.13	.63	3.50	12.25
	1.38 Oversize								
5	1 Standard	.69	2.75	1.38	.63	.19	.63	4.25	13
	1.38 Oversize								
6	1.38 Standard	.81	3.25	1.38	.63	.19	.75	5.25	14.25
	1.75 Oversize								
8	1.38 Standard	.81	4.25	1.81	.69	.25	.63*	7.13	13.88
	1.75 Oversize								

*3.50" diameter round retainer on 8" bore.



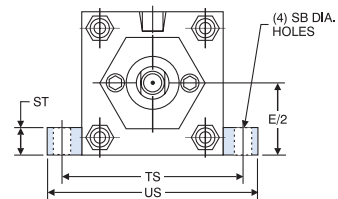
MS1



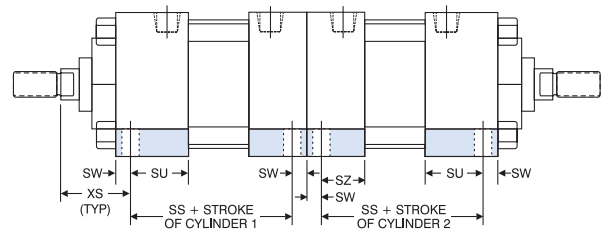
'MS2' SIDE LUG MOUNT DIMENSIONS												
BORE	ROD DIAMETER	SB	E/2	ST	SU	SW	SZ	TS	US	XS	ADD STROKE	
											SS	
1.50	.63 Standard	.44	1	.50	1.13	.38	.63	2.75	3.50	1.38	2.88	
	1.75											
2	.63 Standard	.44	1.25	.50	1.13	.38	.63	3.25	4	1.38	2.88	
	1.75											
2.50	.63 Standard	.44	1.50	.50	1.13	.38	.63	3.75	4.50	1.38	3	
	1.75											
3.25	1 Standard	.56	1.88	.75	1.25	.50	.75	4.75	5.75	1.88	3.25	
	1.38 Oversize											
4	1 Standard	.56	2.25	.75	1.25	.50	.75	5.50	6.50	1.88	3.25	
	1.38 Oversize											
5	1 Standard	.81	2.75	1	1.06	.69	.56	6.88	8.25	2.06	3.13	
	1.38 Oversize											
6	1.38 Standard	.81	3.25	1	1.31	.69	.81	7.88	9.25	2.31	3.63	
	1.75 Oversize											
8	1.38 Standard	.81	4.25	1	1.31	.69	.81	9.88	11.25	2.31	3.75	
	1.75 Oversize											

Note: The option not to have side lugs on center (2) caps is available. Use the "XX" option in the "How To Order" section (specify).

Example: BTB-TA-MS2-4 X 5-MPR with TA-MS2-4 X 3-BP-"XX"
"XX" = No side lugs on center (2) caps



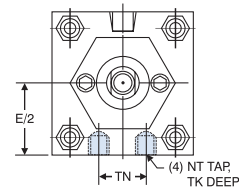
MS2



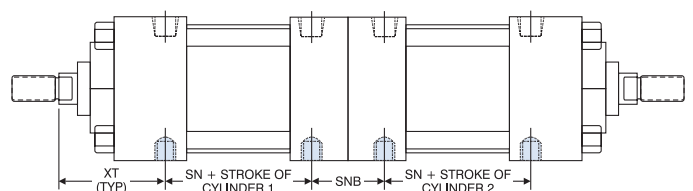
'MS4' BOTTOM TAPPED MOUNT DIMENSIONS								
BORE	ROD DIAMETER	E/2	NT	TK	TN	XT	SNB	ADD STROKE
								SN
1.50	.63 Standard	1	.25-20	.38	.63	1.94	.88	2.25
	2.31							
2	.63 Standard	1.25	.31-18	.50	.88	1.94	.88	2.25
	2.31							
2.50	.63 Standard	1.50	.38-16	.63	1.25	1.94	.88	2.38
	2.31							
3.25	1 Standard	1.88	.50-13	.75	1.50	2.44	1.13	2.63
	1.38 Oversize							
4	1 Standard	2.25	.50-13	.75	2.06	2.44	1.13	2.63
	1.38 Oversize							
5	1 Standard	2.75	.63-11	1	2.69	2.44	1.13	2.88
	1.38 Oversize							
6	1.38 Standard	3.25	.75-10	1.13	3.25	2.81	1.38	3.13
	1.75 Oversize							
8	1.38 Standard	4.25	.75-10	1.13	4.50	2.81	1.38	3.25
	1.75 Oversize							

Note: The option not to have 'MS4' taps on center (2) caps is available. Use the "XX" option in the "How To Order" section (specify).

Example: BTB-TA-MS4-6 X 7-H with TA-MS4-6 X 4-C-"XX"
"XX" = No 'MS4' taps on center (2) caps



MS4



3-POSITION CYLINDERS:

You can create a 3-Position cylinder from **any** single stage series of cylinder. (Note: not available on multi-stage products)

3-Position cylinders consist of multiple cylinders built as **one** unit having **ONE** exposed working rod end, capable of delivering 3 rod positions.

3-POSITION BENEFITS:

- **3-POSITIONS IN ONE CYLINDER** — One cylinder produces three different rod end positions. By varying stroke lengths, a multitude of positions can be created.
- **SIMPLIFIES MACHINE DESIGNS** — Eliminates the need for an additional cylinder to create a third position. 3-Position cylinders reduce space and the cost to mount multiple cylinders.

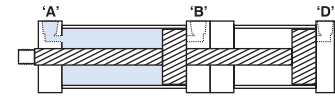
3-POSITION CYLINDERS

HOW THEY WORK

■ = PRESSURE

POSITION 1 (RETRACT)

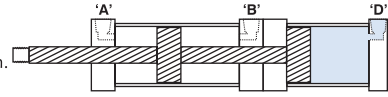
Pressure to port 'A' fully retracts cylinder.



(RETRACT)

POSITION 2 (MID-STROKE)

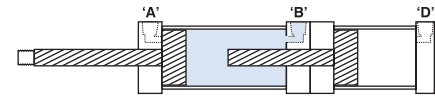
Pressure to port 'D' advances cylinder to mid-stroke position.



(MID-STROKE)

POSITION 3 (EXTEND)

Pressure to port 'B' fully extends cylinder.



(EXTEND)

HOW TO ORDER: 3-POSITION CYLINDERS

3P - TA - MS4 - 2 x 10 - H - MPR WITH TA - MXO - 2 X 5 - MPR

SERIES		BORE		STROKE (CYL. #1)		CUSHIONS		OPTIONS	
TA	250 PSI AIR	1.50	2	0" to 50"	H	HEAD CUSHION	A =	EXTENDED PISTON ROD THREAD (Example: A = 2")	
TD	250 PSI AIR, TOUGH-DUTY	2.50	3.25	Made to Order	LH	LONG HEAD CUSHION	AS	ADJUSTABLE STROKE - RETRACT (SPECIFY LENGTH, Example: AS = 4")	
SS	STAINLESS STEEL (Refer to Cat. # CAT-TRDSS-704 for ordering information)	4	5		ELH	EXTRA LONG HEAD CUSHION	A/O	AIR / OIL PISTON	
FM	FLUSH MOUNT (Add-A-Mount)	6			C	CAP CUSHION	X B	.25" URETHANE BUMPER BOTH ENDS	
TRA	TRIPLE ROD (CYL. #1 Only)	8			LC	LONG CAP CUSHION	X BC	.25" URETHANE BUMPER CAP ONLY	
						ELC	EXTRA LONG CAP CUSHION	BH	.25" URETHANE BUMPER HEAD ONLY
						FCH	FIXED HEAD CUSHION	BP	BUMPER PISTON SEALS (1.50" - 8" Bore)
						FCC	FIXED CAP CUSHION	BSP	BSP PORTS (SPECIFY SIZE, Example: BSP = .25")
						FC	FIXED HEAD AND CAP CUSHION	C =	EXTENDED PISTON ROD (Example: IF C = 0.50", THEN 1" ROD EXTENSION IS C = 1.50")
								EN	ELECTROLESS NICKEL PLATED (Refer to page 84 for specifications)
								KK2	LARGE MALE ROD THREAD
								KK3	FEMALE ROD THREAD
								KK3S	STUDDED PISTON ROD (KK3 with Stud, Loctite in place)
								KK4	FULL DIAMETER MALE ROD THREAD
								KK5	BLANK ROD END (NO THREADS, "A" = 0")
								LF	LOW FRICTION SEALS (Refer to page 84 for specifications)
								MA	MICRO-ADJUST (6" MAX. STROKE) Available on Double Rod End Models
								MAB	MICRO-ADJUST WITH SOUND DAMPENING BUMPER (6" MAX. STROKE)
								MPR	MAGNETIC PISTON FOR REED OR SOLID STATE SWITCHES - TRD MODELS: R10, R10P, RAC, RHT & MSS (Refer to pages 107-113 for selection)
								MS	METALLIC ROD SCRAPER (BRASS CONSTRUCTION)
								NR	NON-ROTATING (Refer to page 86 for specifications)
								OP	OPTIONAL PORT LOCATION (Example: Ports @ 3 & 7)
								OS	OVERSIZE ROD DIAMETER (SPECIFY SIZE, Example: OS = 1.38")
								SAE	SAE PORTS (SPECIFY SIZE, Example: SAE #10)
								X SE	SPRING EXTEND (1.50", 2, 2.50" bore)
								X SR	SPRING RETURN (1.50", 2, 2.50" bore)
								SSA	STAINLESS STEEL PISTON ROD, TIE RODS & NUTS, AND FASTENERS
								SSF	STAINLESS STEEL FASTENERS
								SSR	STAINLESS STEEL PISTON ROD
								SST	STAINLESS STEEL TIE RODS & NUTS
								X ST	STOP TUBE (SPECIFY STOP TUBE LENGTH AND EFFECTIVE STROKE) (Example: TA MS4 2 X 24" EFFECTIVE STROKE-ST=3)
								STEEL TUBE	STEEL CYLINDER TUBE, BLACK EPOXY PAINT FINISH
								TH	400 PSI HYDRAULIC NON-SHOCK (Refer to page 90 for specifications)
								VS	FLUOROCARBON SEALS
								WB	PISTON WEAR BAND
								XX	SPECIAL VARIATION (SPECIFY)

ADD LENGTH TO CYLINDER - SEE "OPTION LENGTH ADDER" CHART, PAGE 5.

Note: "L" and "EL" cushion options can be ordered as fixed cushions.
Example: FCLH, FCELH

About our Part Number System

- Simple, easy to understand
- No excessive codes!
- Eliminates mistakes when ordering

Example: 3-Position

Application calls for a 2" bore cylinder with stroke positions of 0", 5" and 10", base mount on rod end cylinder only, with magnetic piston for position (switch) sensors.

Part Number:

3P-TA-MS4-2 x 10-H-MPR with
TA-MXO-2 x 5-MPR

HOW TO ORDER:

3 Position Cylinder:

Position 1 (Full Retract) - This position is always 0.00"

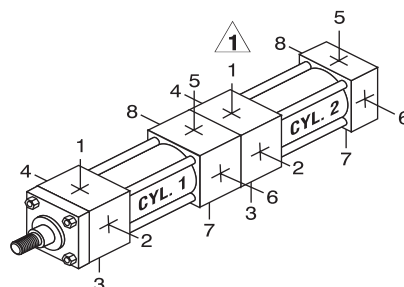
Position 2 (Mid-Stroke) - This will be the stroke of Cyl. #2

Position 3 (Full-Extend) - This will be the stroke of Cyl. #1

Multi-Position Model Available

- 3 Position (Model 3P)
- 4 Position (Model 4P)
- 5 Position (Model 5P)

(Consult factory for dimensions on 4P & 5P)



STANDARD PORT AND CUSHION ADJUSTMENT POSITIONS

- Ports - Positions 1 and 5
- Cushion Adjustment - Positions 2 and 6 (Cushions not available on CYL. 1 Cap)
- Specify Non-Standard Positions When Ordering

△ Note: The "Head" port of CYL. 2 can be used as a "vent". (Single Acting) or "Powered" (Double Acting).

3-POSITION DIMENSIONS: BASIC CYLINDER (NO MOUNT)

About Rod End Styles

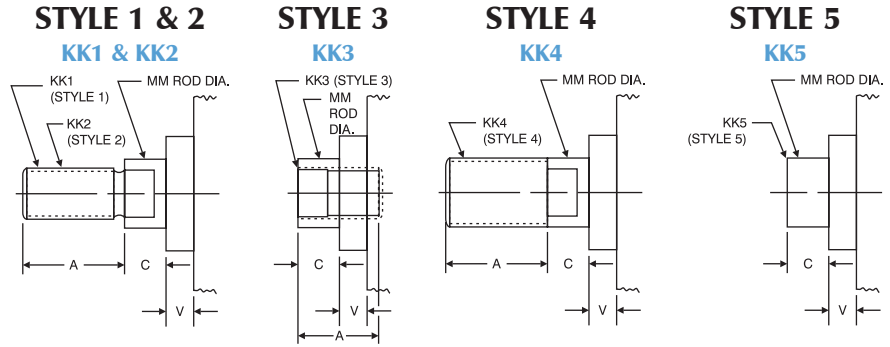
Style 1 Male Rod End is STANDARD

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).

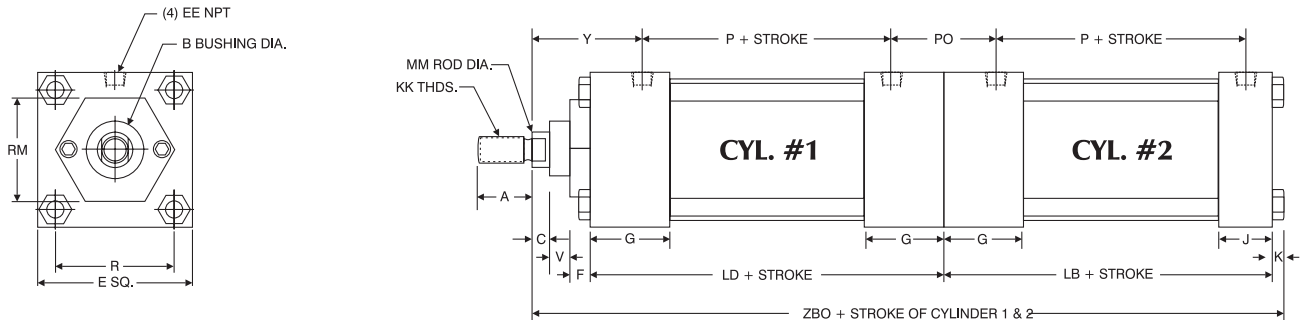
NEED SOMETHING NOT LISTED?
Just send us a sketch.
In most cases, quotes are turned around in one day!

PISTON ROD END STYLES



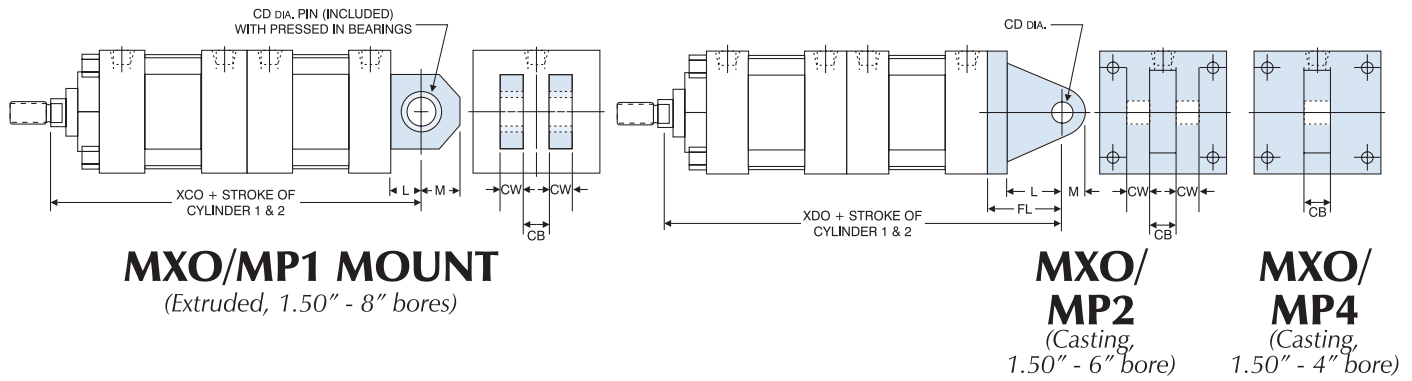
BORE	MM ROD DIAMETER	STANDARD					OPTIONAL					C	V
		Style 1 - Male		Style 2 - Male		Style 3 - Female		Style 4 - Male		Style 5 - Blank			
		KK1	A	KK2	A	KK3	A	KK4	A	KK5			
1.50, 2, 2.50	.63 Standard	.44-20	.75	.50-20	.75	.44-20	.75	.63-18	.75	No Threads	.38	.25	
	1 Oversize	.75-16	1.13	.88-14	1.13	.75-16	1.13	1-14	1.13	No Threads	.50	.50	
3.25, 4, 5	1 Standard	.75-16	1.13	.88-14	1.13	.75-16	1.13	1-14	1.13	No Threads	.50	.25	
	1.38 Oversize	1-14	1.63	1.25-12	1.63	1-14	1.63	1.38-12	1.63	No Threads	.63	.38	
6 & 8	1.38 Standard	1-14	1.63	1.25-12	1.63	1-14	1.63	1.38-12	1.63	No Threads	.63	.38	
	1.75 Oversize	1.25-12	2	1.50-12	2	1.25-12	2	1.75-12	2	No Threads	.75	.50	

MXO/MXO (NO MOUNT)



3-POSITION BASIC DIMENSIONS 'MXO' STANDARD & OVERSIZE RODS																					
BORE	ROD DIAMETER	A	B	C	E	EE	F	G	J	K	KK	LB	LD	MM	P	PO	R	RM	V	Y	ZBO
1.50	.63 Standard	.75	1.13	.38	2	.38	.38	1.50	1	.25	.44-20	3.63	4.13	.63	2.38	1.75	1.43	2 SQ.	.25	1.88	9
	1 Oversize	1.13	1.50	.50							.75-16			1				1.75 HEX	.50	2.25	9.38
2	.63 Standard	.75	1.13	.38	2.50	.38	.38	1.50	1	.31	.44-20	3.63	4.13	.63	2.38	1.75	1.84	2.50 SQ.	.25	1.88	9.06
	1 Oversize	1.13	1.50	.50							.75-16			1				2.50 SQ.	.50	2.25	9.44
2.50	.63 Standard	.75	1.13	.38	3	.38	.38	1.50	1	.31	.44-20	3.75	4.25	.63	2.50	1.75	2.19	1.75 HEX	.25	1.88	9.31
	1 Oversize	1.13	1.50	.50							.75-16			1				3 SQ.	.50	2.25	9.69
3.25	1 Standard	1.13	1.50	.50	3.75	.50	.63	1.75	1.25	.38	.75-16	4.25	4.75	1	2.75	2	2.76	2.75 DIA.	.25	2.38	10.75
	1.38 Oversize	1.63	2	.63							1-14			1.38				3.75 SQ.	.38	2.63	11
4	1 Standard	1.13	1.50	.50	4.50	.50	.63	1.75	1.25	.38	.75-16	4.25	4.75	1	2.75	2	3.32	2.75 DIA.	.25	2.38	10.75
	1.38 Oversize	1.63	2	.63							1-14			1.38				3.50 DIA.	.38	2.63	11
5	1 Standard	1.13	1.50	.50	5.50	.50	.63	1.75	1.25	.44	.75-16	4.50	5	1	3	2	4.10	2.75 DIA.	.25	2.38	11.31
	1.38 Oversize	1.63	2	.63							1-14			1.38				3.50 DIA.	.38	2.63	11.56
6	1.38 Standard	1.63	2	.63	6.50	.75	.63	2	1.50	.44	1-14	5	5.50	1.38	3.25	2.25	4.88	3.50 DIA.	.38	2.75	12.56
	1.75 Oversize	2	2.38	.75							1.25-12			1.75					.50	3	12.81
8	1.38 Standard	1.63	2	.63	8.50	.75	.63	2	1.50	.56	1-14	5.13	5.63	1.38	3.38	2.25	6.44	3.50 DIA.	.38	2.75	12.81
	1.75 Oversize	2	2.38	.75							1.25-12			1.75					.50	3	13.19

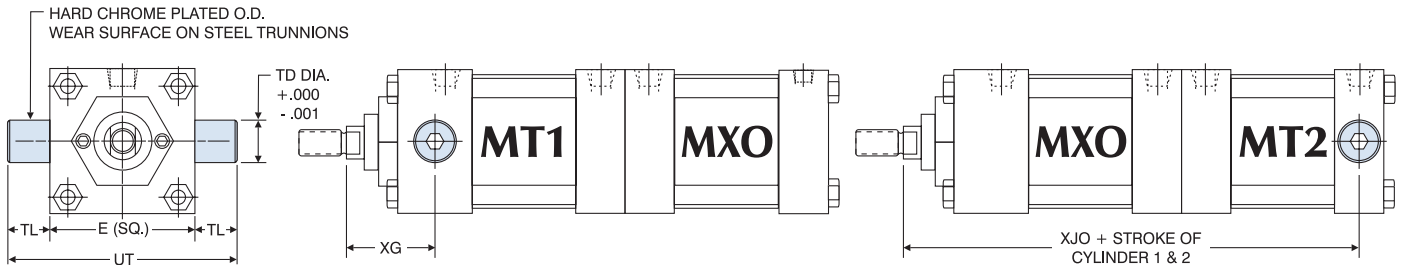
3-POSITION DIMENSIONS: PIVOT MOUNTS



'MP1' & 'MP2' CLEVIS AND 'MP4' ROD EYE MOUNT DIMENSIONS

BORE	ROD DIAMETER	CB	CD	CW	FL	L	M	ADD STROKE	
								XCO	XDO
1.50	.63 Standard	.75	.50	.50	1.13	.75	.63	9.50	9.88
	1 Oversize							9.88	10.25
2	.63 Standard	.75	.50	.50	1.13	.75	.63	9.50	9.88
	1 Oversize							9.88	10.25
2.50	.63 Standard	.75	.50	.50	1.13	.75	.63	9.75	10.13
	1 Oversize							10.13	10.50
3.25	1 Standard	1.25	.75	.63	1.88	1.25	.88	11.63	12.25
	1.38 Oversize							11.88	12.50
4	1 Standard	1.25	.75	.63	1.88	1.25	.88	11.63	12.25
	1.38 Oversize							11.88	12.50
5	1 Standard	1.25	.75	.63	1.88	1.25	.88	12.13	12.75
	1.38 Oversize							12.38	13
6	1.38 Standard	1.50	1	.75	2.25	1.50	1	13.63	14.50
	1.75 Oversize							13.88	14.75
8	1.38 Standard	1.50	1	.75	N/A	1.50	1	13.88	N/A
	1.75 Oversize							14.13	

Clevis pins are provided with pivot mounts.
 *MP4 mount not available as standard on 5" bores and above.
 Note: Extruded MP1 mounts are standard (1.50" - 8" bores).
 Cast iron removable mounts are optional and must be requested when ordering (1.50" - 6" bores).



MT1 / MT2

Note: MT1 and MT2 Trunnions are bolt on, non-removable design.
 Optional: One-piece solid steel trunnion available.

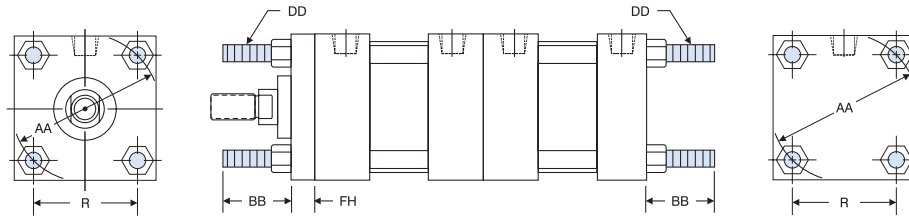
'MT1' HEAD TRUNNION AND 'MT2' CAP TRUNNION MOUNT DIMENSIONS

BORE	ROD DIAMETER	E	TD	TL	UT	XG	ADD STROKE	
							XJO	
1.50	.63 Standard	2	1	1	4	1.75	8.25	
	1 Oversize						N/A*	8.63
2	.63 Standard	2.50	1	1	4.50	1.75	8.25	
	1 Oversize						2.13	8.63
2.50	.63 Standard	3	1	1	5	1.75	8.50	
	1 Oversize						2.13	8.88
3.25	1 Standard	3.75	1	1	5.75	2.25	9.75	
	1.38 Oversize						2.50	10
4	1 Standard	4.50	1	1	6.50	2.25	9.75	
	1.38 Oversize						2.50	10
5	1 Standard	5.50	1	1	7.50	2.25	10.25	
	1.38 Oversize						2.50	10.50
6	1.38 Standard	6.50	1.38	1.38	9.25	2.63	11.38	
	1.75 Oversize						2.88	11.63
8	1.38 Standard	8.50	1.38	1.38	11.25	2.63	11.63	
	1.75 Oversize						2.88	11.88

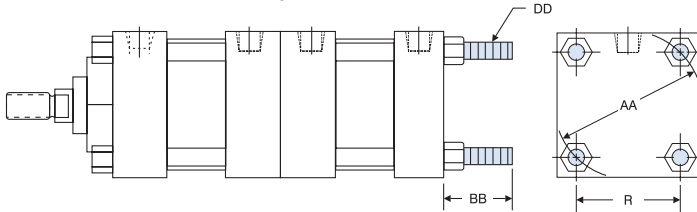
*No oversize rod available on 1.50" bore MT1.

3-POSITION DIMENSIONS: TIE ROD & FLANGE MOUNTS

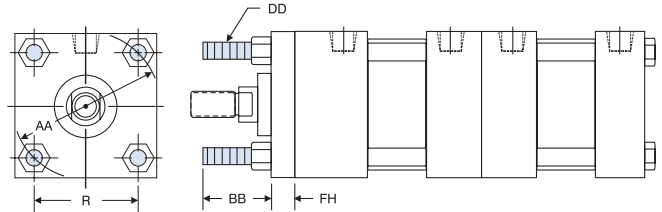
MX1



MXO/MX2



MX3/MXO



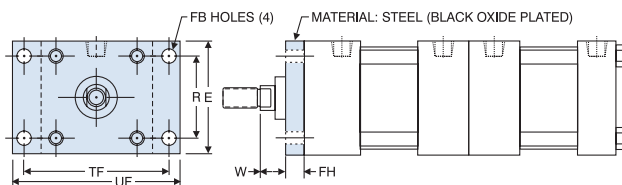
BORE	ROD DIAMETER	AA	BB	DD	FH	R
1.50	.63 Standard	2.02	1	.25-28	.38	1.43
	1 Oversize					
2	.63 Standard	2.6	1.13	.31-24	.38	1.84
	1 Oversize					
2.50	.63 Standard	3.1	1.13	.31-24	.38	2.19
	1 Oversize					
3.25	1 Standard	3.9	1.38	.38-24	.63	2.76
	1.38 Oversize					

BORE	ROD DIAMETER	AA	BB	DD	FH	R
4	1 Standard	4.7	1.38	.38-24	.63	3.32
	1.38 Oversize					
5	1 Standard	5.8	1.81	.50-20	.63	4.10
	1.38 Oversize					
6	1.38 Standard	6.9	1.81	.50-20	.75	4.88
	1.75 Oversize					
8	1.38 Standard	9.1	**2.31	.63-18	*.63	6.44
	1.75 Oversize					

*MX1 & MX3 have full square bushing retainer on 1.50" - 6" bores, round retainers on 8" bores.
**BB dimension from head on 8" bore.

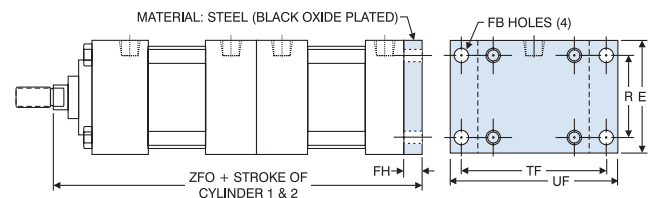
MF1/MXO

(1.50" - 6" BORES)



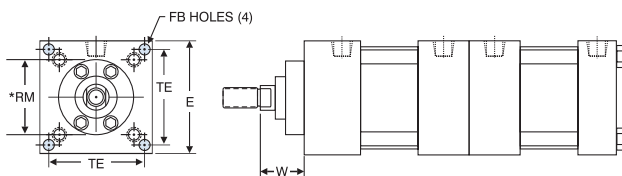
MXO/MF2

(1.50" - 6" BORES)



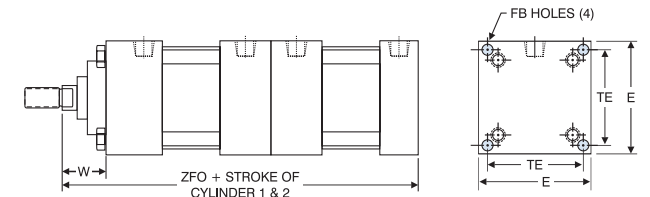
ME3/MXO

(8" BORE ONLY)



MXO/ME4

(8" BORE ONLY)



BORE	ROD DIAMETER	E	FB	FH	R	RM	TE	TF	UF	W	ZFO
1.50	.63 Standard	2	.31	.38	1.43	—	—	2.75	3.38	.63	9.13
	1 Oversize										
2	.63 Standard	2.50	.38	.38	1.84	—	—	3.38	4.13	.63	9.13
	1 Oversize										
2.50	.63 Standard	3	.38	.38	2.19	—	—	3.88	4.63	.63	9.38
	1 Oversize										
3.25	1 Standard	3.75	.44	.63	2.76	—	—	4.69	5.50	.75	11
	1.38 Oversize										

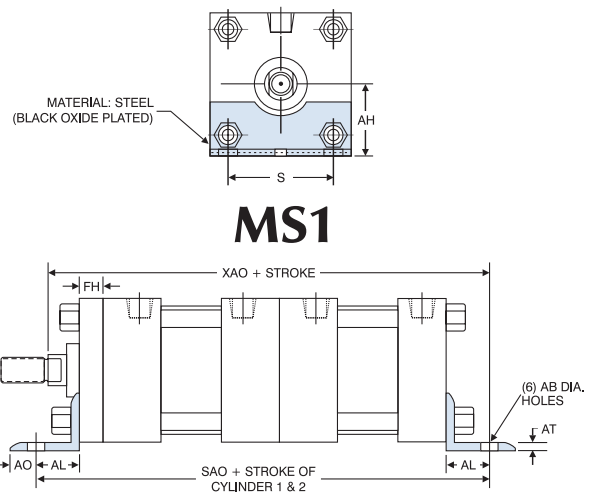
BORE	ROD DIAMETER	E	FB	FH	R	RM	TE	TF	UF	W	ZFO
4	1 Standard	4.50	.44	.63	3.32	—	—	5.44	6.25	.75	11
	1.38 Oversize										
5	1 Standard	5.50	.56	.63	4.10	—	—	6.63	7.63	.75	11.50
	1.38 Oversize										
6	1.38 Standard	6.50	.56	.75	4.88	—	—	7.63	8.63	.88	12.88
	1.75 Oversize										
8	1.38 Standard	8.50	.69	N/A	N/A	*3.50	7.57	N/A	N/A	1.63	12.38
	1.75 Oversize										

*Round retainer used to retain bushing, not a rectangle flange plate as other bores.

3-POSITION DIMENSIONS: BASE MOUNTS

'MS1' ANGLE MOUNT DIMENSIONS										
BORE	ROD DIAMETER	AB	AH	AL	AO	AT	FH	S	ADD STROKE	
									SAO	XAO
1.50	.63 Standard	.44	1.19	1	.38	.13	.38	1.25	10.13	9.75
	1 Oversize									10.13
2	.63 Standard	.44	1.44	1	.38	.13	.38	1.75	10.13	9.75
	1 Oversize									10.13
2.50	.63 Standard	.44	1.63	1	.38	.13	.38	2.25	10.38	10
	1 Oversize									10.38
3.25	1 Standard	.56	1.94	1.25	.50	.13	.63	2.75	12.13	11.63
	1.38 Oversize									11.88
4	1 Standard	.56	2.25	1.25	.50	.13	.63	3.50	12.13	11.63
	1.38 Oversize									11.88
5	1 Standard	.69	2.75	1.38	.63	.19	.63	4.25	12.88	12.25
	1.38 Oversize									12.50
6	1.38 Standard	.81	3.25	1.38	.63	.19	.75	5.25	14	13.50
	1.75 Oversize									13.75
8	1.38 Standard	.81	4.25	1.81	.69	.25	.63*	7.13	14.38	14.19
	1.75 Oversize									14.44

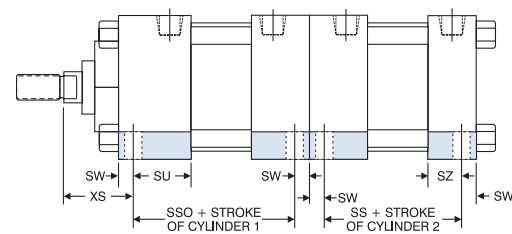
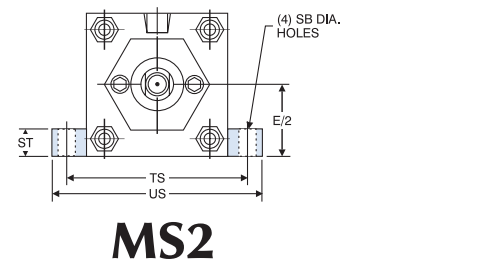
*Round retainer on 8" bore.



'MS2' SIDE LUG MOUNT DIMENSIONS												
BORE	ROD DIAMETER	SB	E/2	ST	SU	SW	SZ	TS	US	XS	ADD STROKE	
											SSO	SS
1.50	.63 Standard	.44	1	.50	1.13	.38	.63	2.75	3.50	1.38	3.38	2.88
	1 Oversize									1.75		
2	.63 Standard	.44	1.25	.50	1.13	.38	.63	3.25	4	1.38	3.38	2.88
	1 Oversize									1.75		
2.50	.63 Standard	.44	1.50	.50	1.13	.38	.63	3.75	4.50	1.38	3.50	3
	1 Oversize									1.75		
3.25	1 Standard	.56	1.88	.75	1.25	.50	.75	4.75	5.75	1.88	3.75	3.25
	1.38 Oversize									2.13		
4	1 Standard	.56	2.25	.75	1.25	.50	.75	5.50	6.50	1.88	3.75	3.25
	1.38 Oversize									2.13		
5	1 Standard	.81	2.75	1	1.06	.69	.56	6.88	8.25	2.06	3.63	3.13
	1.38 Oversize									2.31		
6	1.38 Standard	.81	3.25	1	1.31	.69	.81	7.88	9.25	2.31	4.13	3.63
	1.75 Oversize									2.56		
8	1.38 Standard	.81	4.25	1	1.31	.69	.81	9.88	11.25	2.31	4.25	3.75
	1.75 Oversize									2.56		

Note: The option not to have side lugs on center (2) caps is available. Use the "XX" option in the "How To Order" section (specify).

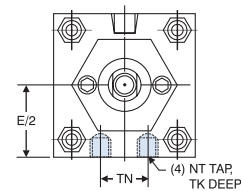
Example: 3P-TA-MS2-4 X 5-MPR with TA-MS2-4 X 3-BP-"XX"
 "XX" = No side lugs on center (2) caps



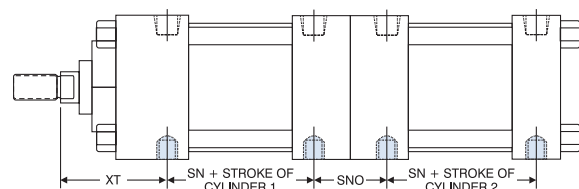
'MS4' BOTTOM TAPPED MOUNT DIMENSIONS									
BORE	ROD DIAMETER	E/2	NT	TK	TN	XT	SNO	ADD STROKE	
								SN	
1.50	.63 Standard	1	.25-20	.38	.63	1.94	1.88	2.25	
	1 Oversize					2.31			
2	.63 Standard	1.25	.31-18	.50	.88	1.94	1.88	2.25	
	1 Oversize					2.31			
2.50	.63 Standard	1.50	.38-16	.63	1.25	1.94	1.88	2.38	
	1 Oversize					2.31			
3.25	1 Standard	1.88	.50-13	.75	1.50	2.44	2.13	2.63	
	1.38 Oversize					2.69			
4	1 Standard	2.25	.50-13	.75	2.06	2.44	2.13	2.63	
	1.38 Oversize					2.69			
5	1 Standard	2.75	.63-11	1	2.69	2.44	2.13	2.88	
	1.38 Oversize					2.69			
6	1.38 Standard	3.25	.75-10	1.13	3.25	2.81	2.38	3.13	
	1.75 Oversize					3.06			
8	1.38 Standard	4.25	.75-10	1.13	4.50	2.81	2.38	3.25	
	1.75 Oversize					3.06			

Note: The option not to have 'MS4' taps on center (2) caps is available. Use the "XX" option in the "How To Order" section (specify).

Example: 3P-TA-MS4-6 X 7-Hwith TA-MS4-6 X 4-C-"XX"
 "XX" = No 'MS4' taps on center (2) caps



MS4



3-POSITION CYLINDERS: DESIGN TIPS & SCHEMATIC

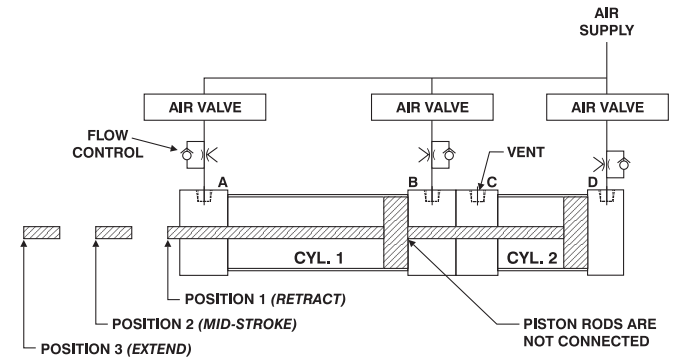
Design Tips

- Order CYL 1 with “MPR” (magnetic piston option) and use (3) switches to sense each stroke position. See pages 107-113 for switch ordering information.
- You can use “MA” (micro-adjust option) on CYL 2 to create an adjustable mid-stroke position cylinder.
- During the mid-stroke position, the piston rod on CYL 1 is held in place by seal friction and can “extend” in vertical applications when the cylinder rod end is mounted down. To prevent this from happening, a lower air pressure can be applied to cylinder port “A” to offset cylinder rod or tooling weight. See your local TRD distributor for help in designing on air circuit that’s right for your application.
- For non-rotating applications, you can use a “NR” (non-rotating) or “TR” (triple rod) Series cylinder as CYL 1 and a standard “TA” Series as CYL 2.

3-POSITION CYLINDER SCHEMATIC

ACTUATION SEQUENCE:

- PRESSURE TO PORT ‘A’ RETRACTS THE CYLINDER TO POSITION 1
- PRESSURE TO PORT ‘D’ EXTENDS THE CYLINDER TO POSITION 2
- PRESSURE TO PORT ‘B’ EXTENDS THE CYLINDER TO POSITION 3



The above basic schematic demonstrates how (3) 3-way air solenoid valves and flow controls can operate a 3-position cylinder. See your local TRD distributor for help in designing an air circuit that’s right for your application.

Application Possibilities:

LANE DIVERTER WITH THREE LANES	
POSITION 1: RETRACT: FILL FIRST LANE	
POSITION 2: MID-STROKE: FILL SECOND LANE	
POSITION 3: EXTEND: FILL THIRD LANE	

CASE PACKER WITH DIFFERENT HEIGHT BOTTLES	
POSITION 1: RETRACT: LOAD CASES	
POSITION 2: MID-STROKE: RAISE CASE FOR TALL BOTTLES	
POSITION 3: EXTEND: RAISE CASE FOR SHORT BOTTLES	

AUTOMATE SIMPLE ASSEMBLY OPERATIONS	
POSITION 1: RETRACT: LOAD HAMMER HANDLE	
POSITION 2: MID-STROKE: ASSEMBLE HEAD	
POSITION 3: EXTEND: INSERT WEDGE TO EXPAND HANDLE	

AUTOMATE SIMPLE MACHINING AND ASSEMBLY	
POSITION 1: RETRACT: LOAD SHAFT	
POSITION 2: MID-STROKE: DRILL	
POSITION 3: EXTEND: PRESS PIN	

TANDEM CYLINDERS:

You can tandem **any** series of cylinder together to provide unlimited design possibilities.

The **“air over oil”** design is the most common use of tandem cylinders today. Choose from different designs to gain maximum benefit for your application.

AIR OVER OIL BENEFITS:

- Air typically provides the “force” to extend and retract the cylinder. Oil provides the precise control of the stroke.
- **CONSTANT VELOCITY** — By metering the flow of the oil cylinder, a constant velocity is achieved throughout the stroke - even at very slow velocities that air cylinders typically “chatter”.
- **SMOOTH OPERATION IN PIVOT APPLICATIONS** — Pivot applications usually have varying loads throughout the stroke. Typically, you are supporting a load till it reaches “top center”, and then the load tends to “run-away” with the influence of gravity. Air-oil cylinders minimize the effect of gravity, providing a smooth stroke.
- Three basic designs to choose from to satisfy most applications:
 - Dual tank design for maximum flexibility and speed
 - Single tank design for slower cycle rates, reducing component cost
 - Air/Oil piston with single tank provides force multiplication (2:1 ratio minimum depending on bore and rod sizes)

HOW TO ORDER: TANDEM CYLINDERS

CYL. #1

TM - TA - MF1 - 2 x 10 - TH

TANDEM

WITH

CYL. #2

TA - MXO - 2 X 10 - MPR - HC

SERIES	
TA	250 PSI AIR
SS	STAINLESS STEEL (Refer to Cat. # CAT-TRDSS-704 for ordering information)
FM	FLUSH MOUNT (Add-A-Mount)
TRA	TRIPLE ROD (CYL. #1 Only)

NFPA MOUNTS	
MXO	NO MOUNT
MP1	REAR PIVOT CLEVIS (CYL. 2 ONLY)
MP2	REAR PIVOT CLEVIS (1.50"-6" Bore) (CYL. 2 ONLY)
MP4	REAR PIVOT EYE (1.50" - 4" Bore) (CYL. 2 ONLY)
MT1	FRONT TRUNNION (SPECIFY CYL. 1 OR 2)
MT2	REAR TRUNNION (SPECIFY CYL. 1 OR 2)
MX1	EXTENDED TIE RODS (HEAD & CAP)
MX2	EXTENDED TIE RODS (CAP END)
MX3	EXTENDED TIE RODS (HEAD END)
MF1	FRONT FLANGE (1.50"-6" Bore) (CYL. 1 ONLY)
MF2	REAR FLANGE (1.50"-6" Bore) (CYL. 2 ONLY)
ME3	FRONT MOUNTING HOLES (8" Bore) (CYL. 1 ONLY)
ME4	REAR MOUNTING HOLES (8" Bore) (CYL. 2 ONLY)
MS1	FRONT & REAR END FOOT
MS2	SIDE LUG (1.50"- 8")
MS4	BOTTOM TAPPED HOLES

BORE
1.50
2
2.50
3.25
4
5
6
8

STROKE (CYL. #1)
0" to 50"
Made to Order

NOTE: CYL. #1 and CYL. #2 strokes must be the same. (PISTON RODS ARE CONNECTED)

COMMON OPTIONS FOR 'OIL' (CYL. 1)*	
"A" =	EXTENDED PISTON ROD THREAD (SPECIFY)
"C" =	EXTENDED PISTON ROD (Example: IF C = 0.50", THEN 1" ROD EXTENSION IS C = 1.50")
H	HEAD CUSHION
C	CAP CUSHION (CYL. 2 ONLY)
EN	ELECTROLESS NICKEL PLATED (Refer to page 84 for specifications)
KK2	LARGE MALE ROD THREAD
KK3	FEMALE ROD THREAD
KK3S	STUDDED PISTON ROD (KK3 with Stud, Loctite in place)
KK4	FULL DIAMETER MALE ROD THREAD
KK5	BLANK ROD END (NO THREADS, "A" = 0")
MS	METALLIC ROD SCRAPER (BRASS CONSTRUCTION)
OP	OPTIONAL PORT LOCATION (SPECIFY, Example: Ports @ 3 & 7)
OS	OVERSIZE ROD DIAMETER (SPECIFY SIZE, Example: OS = 1.38")
TH	400 PSI HYDRAULIC, NON-SHOCK (Refer to page 90 for specifications)
WB	PISTON WEAR BAND
XX	SPECIAL VARIATION (SPECIFY)
BSP	BSP PORTS (SPECIFY SIZE, Example: BSP = .25")
SAE	SAE PORTS (SPECIFY SIZE, Example: SAE #10)
SSA	STAINLESS STEEL PISTON ROD, TIE RODS & NUTS, AND FASTENERS
SSF	STAINLESS STEEL FASTENERS
SSR	STAINLESS STEEL PISTON ROD
SST	STAINLESS STEEL TIE RODS & NUTS

*Refer to series TA, SS, FM, or TRA for complete list of options.

OPTIONS*

ADDS LENGTH TO CYLINDER - SEE "OPTION LENGTH ADDER" CHART, PAGE 5.

COMMON OPTIONS FOR 'AIR' (CYL. 2)	
X	B .25" URETHANE BUMPER BOTH ENDS
X	BC .25" URETHANE BUMPER CAP ONLY
X	BH .25" URETHANE BUMPER HEAD ONLY
	BP BUMPER PISTON SEAL
	H HEAD CUSHION
	C CAP CUSHION (CYL. 2 ONLY)
	EN ELECTROLESS NICKEL PLATED (Refer to page 84 for specifications)
	MPR MAGNETIC PISTON FOR REED OR SOLID STATE SWITCHES - TRD MODELS: R10, R10P, RAC, RHT & MSS (Refer to pages 107-113 for selection)
	MA MICRO-ADJUST (6" MAX. STROKE) Available on Double Rod End Models
	TH 400 PSI HYDRAULIC, NON-SHOCK (Refer to page 90 for specifications)
	OP OPTIONAL PORT LOCATION (Example: Ports @ 3 & 7)
	OS OVERSIZE ROD DIAMETER (SPECIFY SIZE, Example: OS = 1.38")
	VS FLUOROCARBON SEALS
	WB PISTON WEAR BAND
	XX SPECIAL VARIATION (SPECIFY)
	BSP BSP PORTS (SPECIFY SIZE, Example: BSP = .25")
	SAE SAE PORTS (SPECIFY SIZE, Example: SAE #10)
	SSA STAINLESS STEEL PISTON ROD, TIE RODS & NUTS, AND FASTENERS
	SSF STAINLESS STEEL FASTENERS
	SSR STAINLESS STEEL PISTON ROD
	SST STAINLESS STEEL TIE RODS & NUTS

STANDARD PORT AND CUSHION ADJUSTMENT POSITIONS

- Ports - Positions 1 and 5
- Cushion Adjustment - Positions 2 and 6
- Specify Non-Standard Positions When Ordering

About our Part Number System

- Simple, easy to understand
- No excessive codes!
- Eliminates mistakes when ordering

Example: Air/Oil Tandem
 Cyl. 1 is a 'TA' series, MF1 mount, 2" bore X 10" stroke, 400 PSI Hydraulic.
 Cyl. 2 is a 'TA' series, MXO (no mount), 2" bore X 10" stroke, with a magnet (for Reed Switches), and Head & Cap cushions.

Part Number:
 TM-TA-MF1-2 x 10-TH with
 TA-MXO-2 x 10-MPR-HC

TANDEM DIMENSIONS: BASIC CYLINDER (NO MOUNT)

Basic Cylinders

'A'

'TD'

'FM'

Back-To-Back

3-Position

Tandem

About Rod End Styles

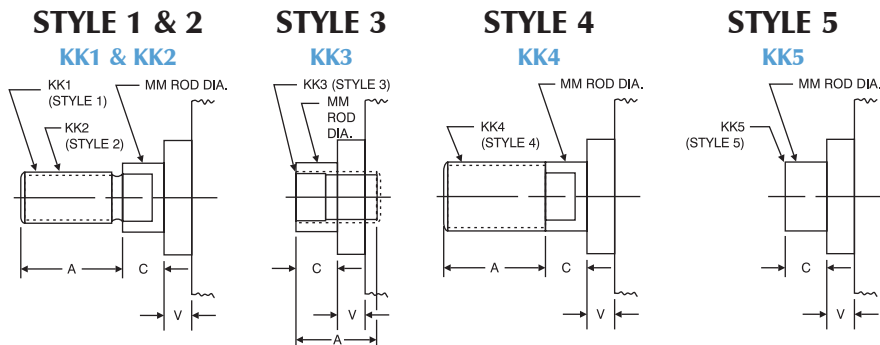
Style 1 Male Rod End is STANDARD (CYL. #1)

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).

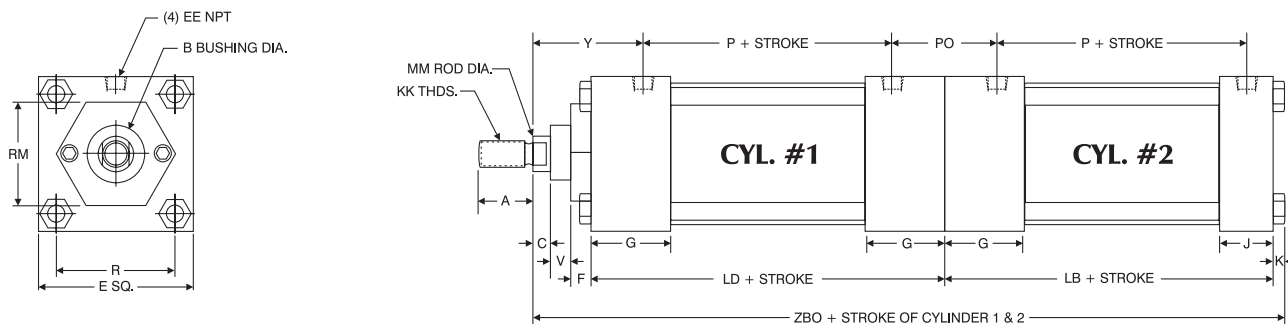
NEED SOMETHING NOT LISTED? Just send us a sketch. In most cases, quotes are turned around in one day!

PISTON ROD END STYLES



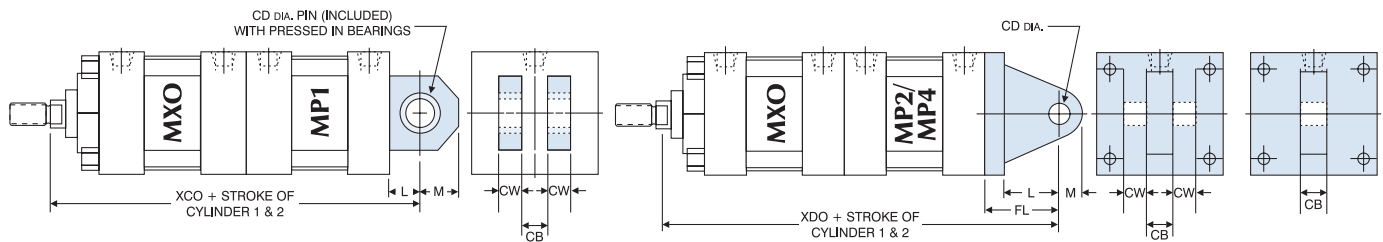
BORE	MM ROD DIAMETER	STANDARD		OPTIONAL							C	V
		Style 1 - Male	Style 2 - Male	Style 3 - Female	Style 4 - Male	Style 5 - Blank						
1.50, 2, 2.50	.63 Standard	.44-20	.75	.50-20	.75	.44-20	.75	.63-18	.75	No Threads	.38	.25
	1 Oversize	.75-16	1.13	.88-14	1.13	.75-16	1.13	1-14	1.13	No Threads	.50	.50
3.25, 4, 5	1 Standard	.75-16	1.13	.88-14	1.13	.75-16	1.13	1-14	1.13	No Threads	.50	.25
	1.38 Oversize	1-14	1.63	1.25-12	1.63	1-14	1.63	1.38-12	1.63	No Threads	.63	.38
6 & 8	1.38 Standard	1-14	1.63	1.25-12	1.63	1-14	1.63	1.38-12	1.63	No Threads	.63	.38
	1.75 Oversize	1.25-12	2	1.50-12	2	1.25-12	2	1.75-12	2	No Threads	.75	.50

MXO/MXO (NO MOUNT)



BASIC DIMENSIONS 'MXO' STANDARD & OVERSIZE RODS																					
BORE	ROD DIAMETER	A	B	C	E	EE	F	G	J	K	KK	LB	LD	MM	P	PO	R	RM	V	Y	ZBO
1.50	.63 Standard	.75	1.13	.38	2	.38	.38	1.50	1	.25	.44-20	3.63	4.13	.63	2.38	1.75	1.43	2 SQ.	.25	1.88	9
	1 Oversize	1.13	1.50	.50							.75-16			1				1.75 HEX	.50	2.25	9.38
2	.63 Standard	.75	1.13	.38	2.50	.38	.38	1.50	1	.31	.44-20	3.63	4.13	.63	2.38	1.75	1.84	2.50 SQ.	.25	1.88	9.06
	1 Oversize	1.13	1.50	.50							.75-16			1				3 SQ.	.50	2.25	9.44
2.50	.63 Standard	.75	1.13	.38	3	.38	.38	1.50	1	.31	.44-20	3.75	4.25	.63	2.50	1.75	2.19	1.75 HEX	.25	1.88	9.31
	1 Oversize	1.13	1.50	.50							.75-16			1				3 SQ.	.50	2.25	9.69
3.25	1 Standard	1.13	1.50	.50	3.75	.50	.63	1.75	1.25	.38	.75-16	4.25	4.75	1	2.75	2	2.76	2.75 DIA.	.25	2.38	10.75
	1.38 Oversize	1.63	2	.63							1-14			1.38				3.75 SQ.	.38	2.63	11
4	1 Standard	1.13	1.50	.50	4.50	.50	.63	1.75	1.25	.38	.75-16	4.25	4.75	1	2.75	2	3.32	2.75 DIA.	.25	2.38	10.75
	1.38 Oversize	1.63	2	.63							1-14			1.38				3.50 DIA.	.38	2.63	11
5	1 Standard	1.13	1.50	.50	5.50	.50	.63	1.75	1.25	.44	.75-16	4.50	5	1	3	2	4.10	2.75 DIA.	.25	2.38	11.31
	1.38 Oversize	1.63	2	.63							1-14			1.38				3.50 DIA.	.38	2.63	11.56
6	1.38 Standard	1.63	2	.63	6.50	.75	.63	2	1.50	.44	1-14	5	5.50	1.38	3.25	2.25	4.88	3.50 DIA.	.38	2.75	12.56
	1.75 Oversize	2	2.38	.75							1.25-12			1.75					.50	3	12.81
8	1.38 Standard	1.63	2	.63	8.50	.75	.63	2	1.50	.56	1-14	5.13	5.63	1.38	3.38	2.25	6.44	3.50 DIA.	.38	2.75	12.94
	1.75 Oversize	2	2.38	.75							1.25-12			1.75					.50	3	13.19

TANDEM DIMENSIONS: PIVOT MOUNTS



MXO/MP1 MOUNT
(Extruded, 1.50" - 8" bores)

MXO/MP2
(Casting, 1.50" - 6" bore)

MXO/MP4
(Casting, 1.50" - 4" bore)

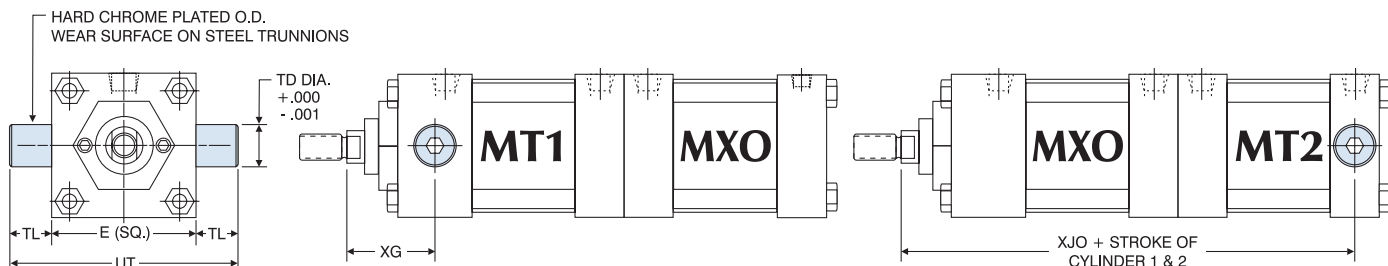
'MP1' & 'MP2' CLEVIS AND 'MP4' ROD EYE MOUNT DIMENSIONS									
BORE	ROD DIAMETER	CB	CD	CW	FL	L	M	ADD STROKE	
								XCO	XDO
1.50	.63 Standard	.75	.50	.50	1.13	.75	.63	9.50	9.88
	1 Oversize							9.88	10.25
2	.63 Standard	.75	.50	.50	1.13	.75	.63	9.50	9.88
	1 Oversize							9.88	10.25
2.50	.63 Standard	.75	.50	.50	1.13	.75	.63	9.75	10.13
	1 Oversize							10.13	10.50
3.25	1 Standard	1.25	.75	.63	1.88	1.25	.88	11.63	12.25
	1.38 Oversize							11.88	12.50
4	1 Standard	1.25	.75	.63	1.88	1.25	.88	11.63	12.25
	1.38 Oversize							11.88	12.50
5	1 Standard	1.25	.75	.63	1.88	1.25	.88	12.13	12.75
	1.38 Oversize							12.38	13
6	1.38 Standard	1.50	1	.75	2.25	1.50	1	13.63	14.50
	1.75 Oversize							13.88	14.75
8	1.38 Standard	1.50	1	.75	N/A	1.50	1	13.88	N/A
	1.75 Oversize							14.13	

Clevis pins are provided with pivot mounts.

*MP4 mount not available as standard on 5" bores and above.

Note: Extruded MP1 mounts are standard (1.50" - 8" bores).

Cast iron removable mounts are optional and must be requested when ordering (1.50" - 6" bores).



MT1 / MT2

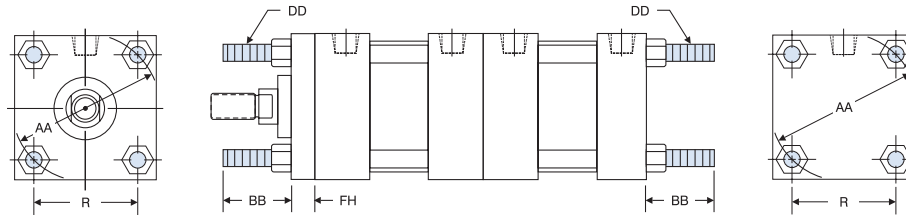
Note: MT1 and MT2 Trunnions are bolt on, non-removable design.
Optional: One-piece solid steel trunnion available.

'MT1' HEAD TRUNNION AND 'MT2' CAP TRUNNION MOUNT DIMENSIONS							
BORE	ROD DIAMETER	E	TD	TL	UT	XG	ADD STROKE
							XJO
1.50	.63 Standard	2	1	1	4	1.75	8.25
	1 Oversize						N/A*
2	.63 Standard	2.50	1	1	4.50	1.75	8.25
	1 Oversize						2.13
2.50	.63 Standard	3	1	1	5	1.75	8.50
	1 Oversize						2.13
3.25	1 Standard	3.75	1	1	5.75	2.25	9.75
	1.38 Oversize						2.50
4	1 Standard	4.50	1	1	6.50	2.25	9.75
	1.38 Oversize						2.50
5	1 Standard	5.50	1	1	7.50	2.25	10.25
	1.38 Oversize						2.50
6	1.38 Standard	6.50	1.38	1.38	9.25	2.63	11.38
	1.75 Oversize						2.88
8	1.38 Standard	8.50	1.38	1.38	11.25	2.63	11.63
	1.75 Oversize						2.88

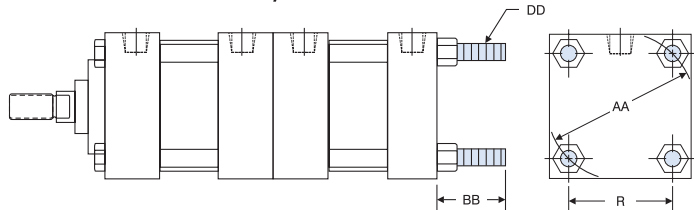
*No oversize rod available on 1.50" bore MT1.

TANDEM DIMENSIONS: TIE ROD & FLANGE MOUNTS

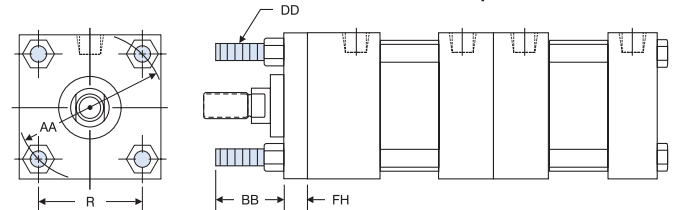
MX1



MXO/MX2



MX3/MXO



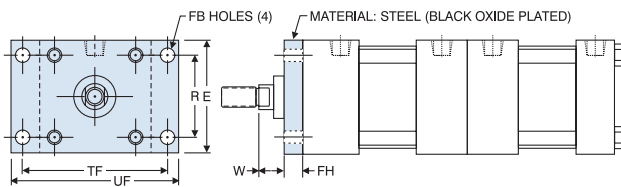
BORE	ROD DIAMETER	AA	BB	DD	FH	R
1.50	.63 Standard	2.02	1	.25-28	.38	1.43
	1 Oversize					
2	.63 Standard	2.6	1.13	.31-24	.38	1.84
	1 Oversize					
2.50	.63 Standard	3.1	1.13	.31-24	.38	2.19
	1 Oversize					
3.25	1 Standard	3.9	1.38	.38-24	.63	2.76
	1.38 Oversize					

BORE	ROD DIAMETER	AA	BB	DD	FH	R
4	1 Standard	4.7	1.38	.38-24	.63	3.32
	1.38 Oversize					
5	1 Standard	5.8	1.81	.50-20	.63	4.10
	1.38 Oversize					
6	1.38 Standard	6.9	1.81	.50-20	.75	4.88
	1.75 Oversize					
8	1.38 Standard	9.1	**2.31	.63-18	*.63	6.44
	1.75 Oversize					

*MX1 & MX3 have full square bushing retainer on 1.50" - 6" bores, round retainers on 8" bores.
 **"BB" dimension from head on 8" bore.

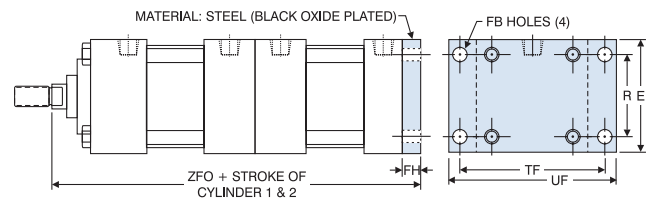
MF1/MXO

(1.50" - 6" BORES)



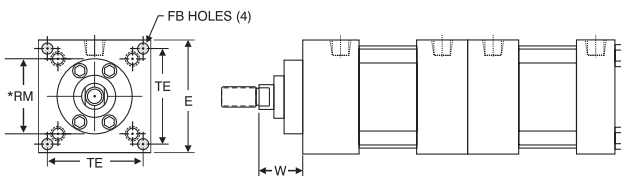
MXO/MF2

(1.50" - 6" BORES)



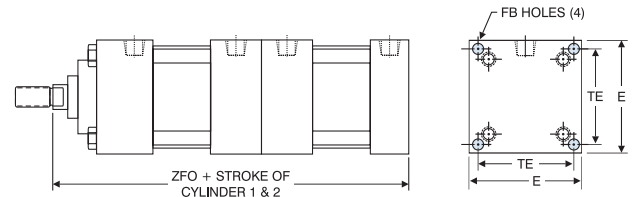
ME3/MXO

(8" BORE ONLY)



MXO/ME4

(8" BORE ONLY)



BORE	ROD DIAMETER	E	FB	FH	R	RM	TE	TF	UF	W	ZFO
1.50	.63 Standard	2	.31	.38	1.43	—	—	2.75	3.38	.63	9.13
	1 Oversize										
2	.63 Standard	2.50	.38	.38	1.84	—	—	3.38	4.13	.63	9.13
	1 Oversize										
2.50	.63 Standard	3	.38	.38	2.19	—	—	3.88	4.63	.63	9.38
	1 Oversize										
3.25	1 Standard	3.75	.44	.63	2.76	—	—	4.69	5.50	.75	11
	1.38 Oversize										

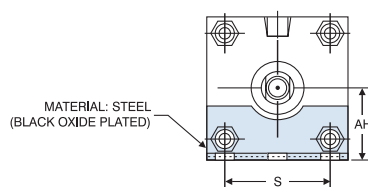
BORE	ROD DIAMETER	E	FB	FH	R	RM	TE	TF	UF	W	ZFO
4	1 Standard	4.50	.44	.63	3.32	—	—	5.44	6.25	.75	11
	1.38 Oversize										
5	1 Standard	5.50	.56	.63	4.10	—	—	6.63	7.63	.75	11.50
	1.38 Oversize										
6	1.38 Standard	6.50	.56	.75	4.88	—	—	7.63	8.63	.88	12.88
	1.75 Oversize										
8	1.38 Standard	8.50	.69	N/A	N/A	*3.50	7.57	N/A	N/A	1.63	12.38
	1.75 Oversize										

*Round retainer used to retain bushing, not a rectangular flange plate as other bores.

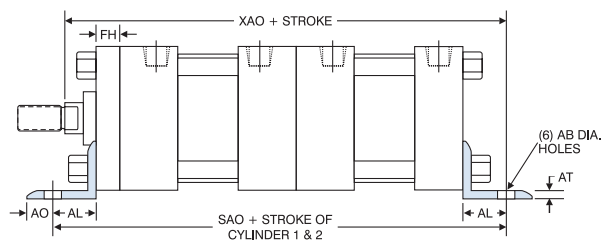
TANDEM DIMENSIONS: BASE MOUNTS

'MS1' ANGLE MOUNT DIMENSIONS										
BORE	ROD DIAMETER	AB	AH	AL	AO	AT	FH	S	ADD STROKE	
									SAO	XAO
1.50	.63 Standard	.44	1.19	1	.38	.13	.38	1.25	10.13	9.75
	1 Oversize								10.13	10.13
2	.63 Standard	.44	1.44	1	.38	.13	.38	1.75	10.13	9.75
	1 Oversize								10.13	10.13
2.50	.63 Standard	.44	1.63	1	.38	.13	.38	2.25	10.38	10
	1 Oversize								10.38	10.38
3.25	1 Standard	.56	1.94	1.25	.50	.13	.63	2.75	12.13	11.63
	1.38 Oversize								12.13	11.88
4	1 Standard	.56	2.25	1.25	.50	.13	.63	3.50	12.13	11.63
	1.38 Oversize								12.13	11.88
5	1 Standard	.69	2.75	1.38	.63	.19	.63	4.25	12.88	12.25
	1.38 Oversize								12.88	12.50
6	1.38 Standard	.81	3.25	1.38	.63	.19	.75	5.25	14	13.50
	1.75 Oversize								14	13.75
8	1.38 Standard	.81	4.25	1.81	.69	.25	.63*	7.13	14.38	14.19
	1.75 Oversize								14.38	14.44

*Round retainer on 8" bore.



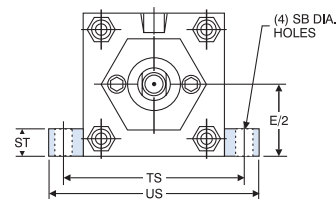
MS1



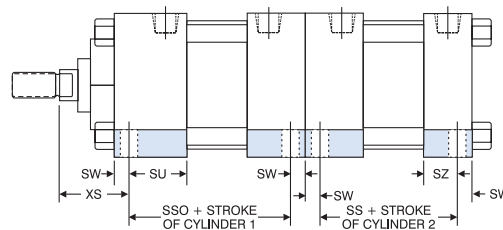
'MS2' SIDE LUG MOUNT DIMENSIONS												
BORE	ROD DIAMETER	SB	E/2	ST	SU	SW	SZ	TS	US	XS	ADD STROKE	
											SSO	SS
1.50	.63 Standard	.44	1	.50	1.13	.38	.63	2.75	3.50	1.38	3.38	2.88
	1 Oversize									1.75		
2	.63 Standard	.44	1.25	.50	1.13	.38	.63	3.25	4	1.38	3.38	2.88
	1 Oversize									1.75		
2.50	.63 Standard	.44	1.50	.50	1.13	.38	.63	3.75	4.50	1.38	3.50	3
	1 Oversize									1.75		
3.25	1 Standard	.56	1.88	.75	1.25	.50	.75	4.75	5.75	1.88	3.75	3.25
	1.38 Oversize									2.13		
4	1 Standard	.56	2.25	.75	1.25	.50	.75	5.50	6.50	1.88	3.75	3.25
	1.38 Oversize									2.13		
5	1 Standard	.81	2.75	1	1.06	.69	.56	6.88	8.25	2.06	3.63	3.13
	1.38 Oversize									2.31		
6	1.38 Standard	.81	3.25	1	1.31	.69	.81	7.88	9.25	2.31	4.13	3.63
	1.75 Oversize									2.56		
8	1.38 Standard	.81	4.25	1	1.31	.69	.81	9.88	11.25	2.31	4.25	3.75
	1.75 Oversize									2.56		

Note: The option not to have side lugs on center (2) caps is available. Use the "XX" option in the "How To Order" section (specify).

Example: TM-TA-MS2-4 X 5-TH with TA-MS2-4 X 5-BP-"XX"
"XX" = No side lugs on center (2) caps



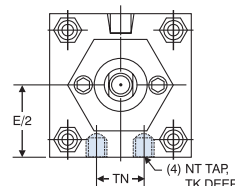
MS2



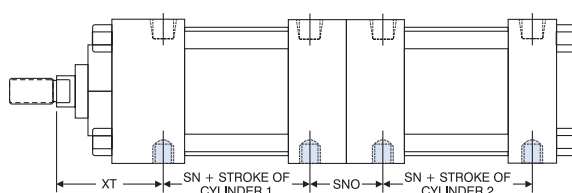
'MS4' BOTTOM TAPPED MOUNT DIMENSIONS									
BORE	ROD DIAMETER	E/2	NT	TK	TN	XT	SNO	ADD STROKE	
								SN	
1.50	.63 Standard	1	.25 -20	.38	.63	1.94	1.88	2.25	
	1 Oversize					2.31			
2	.63 Standard	1.25	.31-18	.50	.88	1.94	1.88	2.25	
	1 Oversize					2.31			
2.50	.63 Standard	1.50	.38-16	.63	1.25	1.94	1.88	2.38	
	1 Oversize					2.31			
3.25	1 Standard	1.88	.50-13	.75	1.50	2.44	2.13	2.63	
	1.38 Oversize					2.69			
4	1 Standard	2.25	.50-13	.75	2.06	2.44	2.13	2.63	
	1.38 Oversize					2.69			
5	1 Standard	2.75	.63-11	1	2.69	2.44	2.13	2.88	
	1.38 Oversize					2.69			
6	1.38 Standard	3.25	.75-10	1.13	3.25	2.81	2.38	3.13	
	1.75 Oversize					3.06			
8	1.38 Standard	4.25	.75-10	1.13	4.50	2.81	2.38	3.25	
	1.75 Oversize					3.06			

Note: The option not to have 'MS4' taps on center (2) caps is available. Use the "XX" option in the "How To Order" section (specify).

Example: TM-TA-MS4-6 X 7-TH with TA-MS4-6 X 7-C-"XX"
"XX" = No 'MS4' taps on center (2) caps



MS4

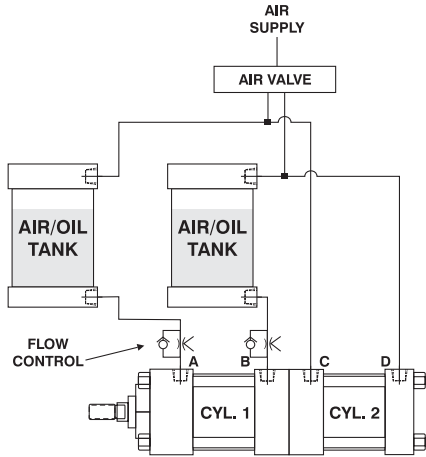
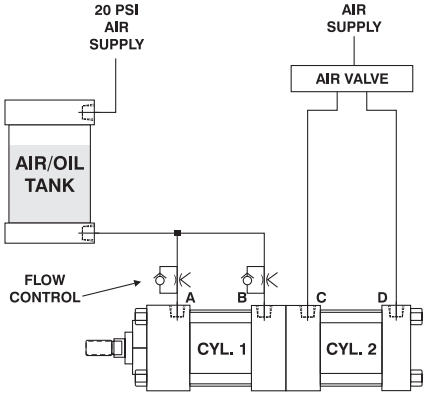
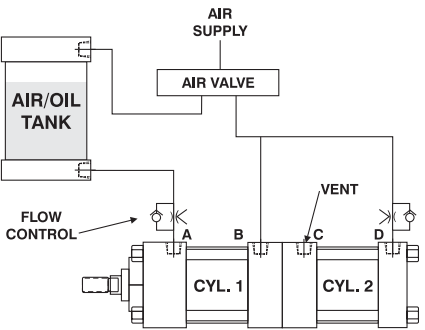


TANDEM CYLINDERS: SCHEMATICS

The following schematics are commonly used for air/oil applications.

In each application, a 'TA' Series (with "TH" option - 400 max. psi Hyd.) is used in tandem with a 'TA' Series (250 max* psi air) cylinder. CYL. #1 represents the 'TH' Option, and CYL. #2 represents the 'TA' Series.

*Tandem cylinders are designed and built with piston rods connected. Cylinders operate as one unit. Refer to page 48 for maximum air inlet pressures!

SCHEMATIC "A"	SCHEMATIC "B"	SCHEMATIC "C"
<p>ACTUATION SEQUENCE: PRESSURE TO PORTS 'B' & 'D' EXTENDS CYLINDER PRESSURE TO PORTS 'A' & 'C' RETRACTS CYLINDER</p> 	<p>ACTUATION SEQUENCE: PRESSURE TO PORT 'D' EXTENDS CYLINDER PRESSURE TO PORT 'C' RETRACTS CYLINDER</p> 	<p>ACTUATION SEQUENCE: PRESSURE TO PORTS 'B' & 'D' EXTENDS CYLINDER PRESSURE TO PORT 'A' RETRACTS CYLINDER</p> 
<p>AIR TO OIL RATIO Extend: 1.8:1 or greater (standard rod) 1.4:1 or greater (oversize rod) Retract: 2:1 (for both standard and oversize rods) <i>(Refer to charts on page 48 for more details)</i></p> <p>CYCLE RATES Extend: Moderate to high speed Retract: Moderate to high speed</p> <p>NUMBER OF AIR/OIL TANKS: 2 RECOMMENDED TANK SIZE: 130% - 150% of CYL. #1 total volume, filled approximately 80% full. <i>(Refer to page 42 for ordering information)</i></p>	<p>AIR TO OIL RATIO Extend: 1:1 (for both standard and oversize rods) Retract: 2:1 (for both standard and oversize rods) <i>(Refer to charts on page 48 for more details)</i></p> <p>CYCLE RATES Extend: Slow to moderate speed Retract: Slow to moderate speed</p> <p>NUMBER OF AIR/OIL TANKS: 1 RECOMMENDED TANK SIZE: 130% - 150% of CYL. #1 total volume, filled approximately 50% full. <i>(Refer to page 42 for ordering information)</i></p>	<p>AIR TO OIL RATIO Extend: 1.8:1 or greater (standard rod) 1.4:1 or greater (oversize rod) Retract: 1:1 (for both standard and oversize rods) <i>(Refer to charts on page 48 for more details)</i></p> <p>CYCLE RATES Extend: Moderate to high speed Retract: Slow to moderate speed</p> <p>NUMBER OF AIR/OIL TANKS: 1 RECOMMENDED TANK SIZE: 130% - 150% of CYL. #1 total volume, filled approximately 80% full. <i>(Refer to page 42 for ordering information)</i></p>
<p>DESIGN BENEFITS</p> <ul style="list-style-type: none"> • Highest cycle rates per minute in both extend and retract strokes. • Higher cylinder output force in both extend and retract strokes. • Offers greatest range of speed control. • Can handle higher loads in extend and retract strokes. 	<p>DESIGN BENEFITS</p> <ul style="list-style-type: none"> • Air to Oil extend ratio is 1:1. • Compact design (uses one small Air/Oil tank). • Greater range of speed control at slow speed. • More economical design. 	<p>DESIGN BENEFITS</p> <ul style="list-style-type: none"> • Highest cylinder force in extend stroke, moderate cylinder force in retract stroke. • Compact design (uses one full size Air/Oil tank). • Economical design.

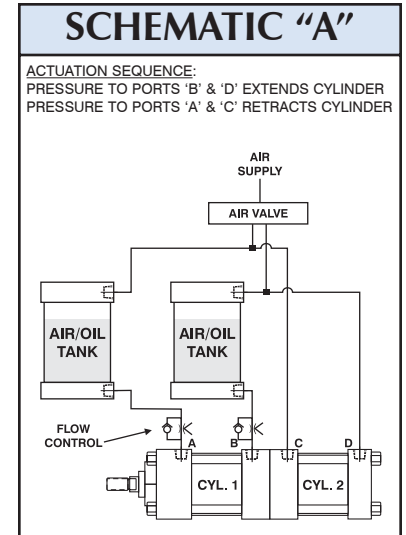
Note: Air directional control valves, flow controls, fittings and tubing not provided. Order separately from your local distributor. Refer to page 100 to order Air/Oil tanks (A/T).

TANDEM CYLINDERS: TECHNICAL DATA

FORCE CHARTS

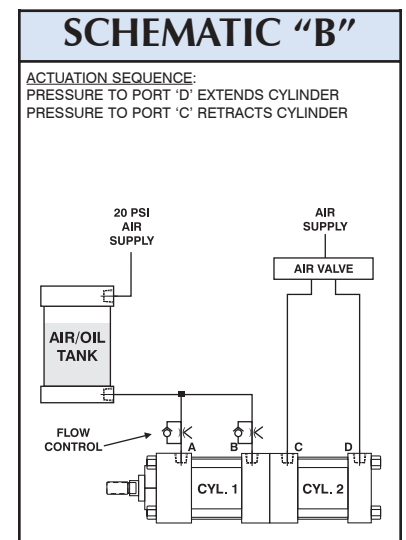
SCHEMATIC "A" - TANDEM CYLINDER THEORETICAL* FORCE CHART								
BORE	ROD	EXTEND EFFECTIVE PISTON AREA (IN/SQ.)	RETRACT EFFECTIVE PISTON AREA (IN/SQ.)	EXTEND FORCE AT 100 PSI (IN POUNDS)	RETRACT FORCE AT 100 PSI (IN POUNDS)	MAXIMUM AIR INLET PRESSURE	EXTEND OIL/AIR RATIO	RETRACT OIL/AIR RATIO
1.50	.63	3.227	2.920	323	292	181	1.83	2.00
	1	2.749	1.964	275	196	143	1.56	2.00
2	.63	5.977	5.670	598	567	190	1.90	2.00
	1	5.499	4.714	550	471	171	1.75	2.00
2.50	.63	9.511	9.204	951	920	194	1.94	2.00
	1	9.033	8.248	903	825	183	1.84	2.00
3.25	1	15.807	15.022	1581	1502	190	1.91	2.00
	1.38	15.107	13.622	1511	1362	180	1.82	2.00
4	1	24.347	23.562	2435	2356	194	1.94	2.00
	1.38	23.647	22.162	2365	2216	187	1.88	2.00
5	1	38.485	37.700	3849	3770	196	1.96	2.00
	1.38	37.785	36.300	3779	3630	192	1.92	2.00
6	1.38	55.063	53.578	5506	5358	195	1.95	2.00
	1.75	54.143	51.738	5414	5174	191	1.91	2.00
8	1.38	99.045	97.560	9905	9756	197	1.97	2.00
	1.75	98.125	95.720	9813	9572	195	1.95	2.00

*Theoretical force only. Actual net force will be reduced by seal friction.



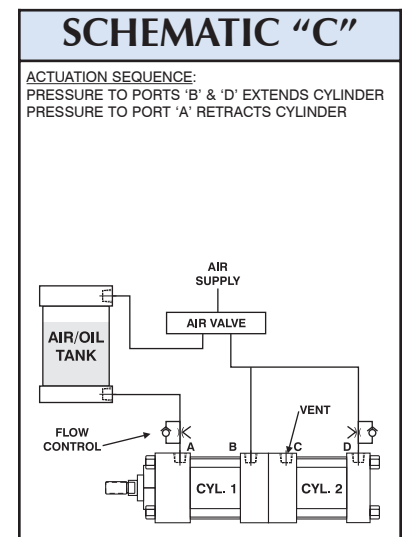
SCHEMATIC "B" - TANDEM CYLINDER THEORETICAL* FORCE CHART								
BORE	ROD	EXTEND EFFECTIVE PISTON AREA (IN/SQ.)	RETRACT EFFECTIVE PISTON AREA (IN/SQ.)	EXTEND FORCE AT 100 PSI (IN POUNDS)	RETRACT FORCE AT 100 PSI (IN POUNDS)	MAXIMUM AIR INLET PRESSURE	EXTEND OIL/AIR RATIO	RETRACT OIL/AIR RATIO
1.50	.63	1.767	1.460	177	146	250	1.00	1.00
	1	1.767	0.982	177	98	222	1.00	1.00
2	.63	3.142	2.835	314	284	250	1.00	1.00
	1	3.142	2.357	314	236	250	1.00	1.00
2.50	.63	4.909	4.602	491	460	250	1.00	1.00
	1	4.909	4.124	491	412	250	1.00	1.00
3.25	1	8.296	7.511	830	751	250	1.00	1.00
	1.38	8.296	6.811	830	681	250	1.00	1.00
4	1	12.566	11.781	1257	1178	250	1.00	1.00
	1.38	12.566	11.081	1257	1108	250	1.00	1.00
5	1	19.635	18.850	1964	1885	250	1.00	1.00
	1.38	19.635	18.150	1964	1815	250	1.00	1.00
6	1.38	28.274	26.789	2827	2679	250	1.00	1.00
	1.75	28.274	25.869	2827	2587	250	1.00	1.00
8	1.38	50.265	48.780	5027	4878	250	1.00	1.00
	1.75	50.265	47.860	5027	4786	250	1.00	1.00

*Theoretical force only. Actual net force will be reduced by seal friction.



SCHEMATIC "C" - TANDEM CYLINDER THEORETICAL* FORCE CHART								
BORE	ROD	EXTEND EFFECTIVE PISTON AREA (IN/SQ.)	RETRACT EFFECTIVE PISTON AREA (IN/SQ.)	EXTEND FORCE AT 100 PSI (IN POUNDS)	RETRACT FORCE AT 100 PSI (IN POUNDS)	MAXIMUM AIR INLET PRESSURE	EXTEND OIL/AIR RATIO	RETRACT OIL/AIR RATIO
1.50	.63	3.227	1.460	323	146	181	1.83	1.00
	1	2.749	0.982	275	98	143	1.56	1.00
2	.63	5.977	2.835	598	284	190	1.90	1.00
	1	5.499	2.357	550	236	171	1.75	1.00
2.50	.63	9.511	4.602	951	460	194	1.94	1.00
	1	9.033	4.124	903	412	183	1.84	1.00
3.25	1	15.807	7.511	1581	751	190	1.91	1.00
	1.38	15.107	6.811	1511	681	180	1.82	1.00
4	1	24.347	11.781	2435	1178	194	1.94	1.00
	1.38	23.647	11.081	2365	1108	187	1.88	1.00
5	1	38.485	18.850	3849	1885	196	1.96	1.00
	1.38	37.785	18.150	3779	1815	192	1.92	1.00
6	1.38	55.063	26.789	5506	2679	195	1.95	1.00
	1.75	54.143	25.869	5414	2587	191	1.91	1.00
8	1.38	99.045	48.780	9905	4878	197	1.97	1.00
	1.75	98.125	47.860	9813	4786	195	1.95	1.00

*Theoretical force only. Actual net force will be reduced by seal friction.



NEW
DESIGN

SERIES 'TRA' TRIPLE ROD

NEW 'HEAVY-DUTY' TRIPLE ROD DESIGN

TRD's 'TR' Series has been redesigned. The new series, 'TRA' is a *Heavy-Duty* version of the 'TR' Series. The new series is a drop-in replacement of the previous model. Overall dimensions are not affected.



Universal mount, Sleeve Nut design
Same overall materials as 'TA' & 'FM' Series

Benefits

- **Extended Heavy-Duty Rod Bearings** — Cast Iron material is rated at 150,000 PSI compressive strength. Extended bearing design maximizes load handling abilities without compromising design.
- **Piston Wear Band Standard** — PTFE material rated for high loads and non-lube service.
- **Non Lube Service** — PTFE coated bushings, Carboxilated Nitrile Seal material, and PTFE based lube provide permanent lubrication for long life.
- **Longer Strokes Available** — The heavy-duty design allows for longer strokes. (see page 61 for details)
- **Load and End Play Charts Available** — Refer to pages 62-68 for charts.
- **'TRA' Series is a Drop-In Replacement to 'TR' Series** — New design does not require a redesign by customers since the overall dimensions are not affected.
- **Existing "TR" Series units can be upgraded to the 'TRA' Series** — Replacement parts can be ordered to field upgrade an existing 'TR' model to the new 'TRA' Series. (see page 70 for details)

'TR' Series — Design Upgrade

'TR' Series (250 PSI Air) is obsolete and superseded by 'TRA' Series (effective 5-12-03)

'TR-TH' Series (400 PSI Hyd.) is obsolete and superseded by 'TRA' Series with 'TH' option (effective 5-12-03)

Other Models Available:

'TRA' (with 'EN' option)

Electroless Nickel Plated with Stainless Steel fasteners, Tie-Rods, and Sleeve Nuts



'SS-TRA'

303/304, or 316 Stainless Steel
(Consult factory for details and delivery)



(Optional Delrin Rod Bushings Shown)

'MA' Option (Micro-Adjust)

Available on all "D1" Double Rod End models.

Allows for extended stroke adjustment in .001" increments.

(Note: up to 6" strokes)



HOW TO ORDER: SERIES 'TRA' (TRIPLE PISTON ROD)

TRA - MF1 - 3.25 x 10 - HC - MPR

SERIES	
TRA	250 PSI AIR

BORE	
1.50	2
2.50	3.25
4	5
6	8

STROKE	
SEE STROKE OPTIONS ON PAGE 61 Made to Order	

CUSHIONS	
H	HEAD CUSHION POSITION 2 IS STANDARD SPECIFY FOR POSITIONS: 1 & 4
C	CAP CUSHION POSITION 6 IS STANDARD SPECIFY FOR POSITIONS: 5, 7 & 8

OPTIONS	
ADDS LENGTH TO CYLINDER - SEE "OPTION LENGTH ADDER" CHART BELOW.	
A / O	AIR / OIL PISTON

X	B	.25" URETHANE BUMPER BOTH ENDS
X	BC	.25" URETHANE BUMPER CAP ONLY
X	BH	.25" URETHANE BUMPER HEAD ONLY
	BSP	BSP PORTS (SPECIFY SIZE, Example: BSP = .25")
	C =	EXTENDED PISTON ROD (Example: IF C = 0.50", THEN 1" ROD EXTENSION IS C = 1.50")
	EN	ELECTROLESS NICKEL PLATED (Refer to page 84 for specifications)
	MA	MICRO-ADJUST (6" MAX. STROKE)
	MAB	MICRO-ADJUST WITH SOUND DAMPENING BUMPER (6" MAX. STROKE)
	MPR*	MAGNETIC PISTON FOR REED OR SOLID STATE SWITCHES - TRD MODELS: R10, R10P, RAC, RHT & MSS (Refer to pages 107-113 for selection)
X	MPR-WB	COMBINATION MAGNETIC PISTON & WEARBAND (SPECIFY ON 1.50"-2.50" BORES ONLY)
	OP	OPTIONAL PORT LOCATION (Example: Ports @ 2 & 6)
	SAE	SAE PORTS (SPECIFY SIZE, Example: SAE #10)
	SSA	STAINLESS STEEL PISTON ROD, TIE RODS & NUTS, AND FASTENERS
	SSF	STAINLESS STEEL FASTENERS
	SSR	STAINLESS STEEL PISTON ROD
	SST	STAINLESS STEEL TIE RODS & NUTS
X	ST	STOP TUBE (SPECIFY STOP TUBE LENGTH AND EFFECTIVE STROKE) (Example: TA MS4 2 X 24" EFFECTIVE STROKE-ST=3)
	STEEL TUBE	STEEL CYLINDER TUBE, BLACK EPOXY PAINT FINISH
	TH	400 PSI HYDRAULIC NON-SHOCK (Refer to page 90 for specifications)
	VS	FLUOROCARBON SEALS
	AS	ADJUSTABLE STROKE (RETRACT) (SPECIFY LENGTH, Example: AS = 3")
	XX	SPECIAL VARIATION (SPECIFY)

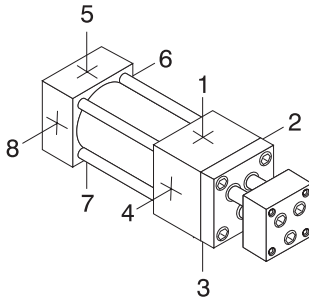
NFPA MOUNTS	
MX0	NO MOUNT
MS4	BOTTOM TAPPED HOLES (1.50"-8" Bore)
MS2	SIDE LUG (1.50"-8" Bore)
BASE BAR	SIDE LUG (1.50"-4" Bore)
MP1	REAR PIVOT CLEVIS (EXTRUDED)
MP2	REAR PIVOT CLEVIS (CASTING) (1.50"-6" Bore)
MP4	REAR PIVOT EYE (CASTING) (1.50"-4" Bore)
MF1	FRONT FLANGE (1.50"-6" Bore)
MF2	REAR FLANGE (1.50"-6" Bore)
ME4	REAR MOUNTING HOLES (8" Bore)
ME5	FRONT MOUNTING HOLES (8" Bore)

STYLE	
	SINGLE END (LEAVE BLANK)
D3	DOUBLE END - 3 RODS
D1	DOUBLE END - 1 ROD (KK1 STANDARD ROD END - SEE OPTIONS FOR OTHER ROD END STYLES)

STANDARD PORT AND CUSHION ADJUSTMENT POSITIONS

- Ports - Positions 1 and 5 (Ports not available at position 3)
- Cushion Adjustment - Positions 2 and 6 (Cushions not available at position 3)
- Specify Non-Standard Positions When Ordering

PORT & CUSHION POSITIONS



Note: Ports or Cushions **NOT** available at position 3

*STEEL TUBES do not work with MPR magnetic pistons. Refer to pages 114-117 for Balluff end of stroke sensors.

OPTIONS FOR "D1" DOUBLE ROD END MODEL - SINGLE ROD	
KK2	LARGE MALE ROD THREAD
KK3	FEMALE ROD THREAD
KK3S	STUDD PISTON ROD (KK3 with Stud, Loctite in place)
KK4	FULL DIAMETER MALE ROD THREAD
KK5	BLANK ROD END (NO THREADS. "A" = 0")

*If "MPR" option is ordered on 1.50"-2.50" bore models, the wearband is eliminated and must be ordered separately if needed (see "MPR-WB" option).

OPTION LENGTH ADDER (ADD TO CATALOG BASIC OVERALL LENGTH DIMENSIONS)								
BORE	OPTION							
	B	BC	BH	ELC	ELH	MPR (WITHOUT "WB" WEARBAND)	MPR-WB (MAGNET & WEARBAND)	ST* (STOP TUBE) Example: ST=2
1.50	.50	.25	.25	1	1	0	.50	2
2	.50	.25	.25	1	1	0	.50	2
2.50	.50	.25	.25	1	1	0	.50	2
3.25	.50	.25	.25	1.25	1.25	NOTE: There is no length adder for MPR Option and Wear Band on 3.25" - 8" Bore.		2
4	.50	.25	.25	1.25	1.25			2
5	.50	.25	.25	1.25	1.25			2
6	.50	.25	.25	1.50	1.50			2
8	.50	.25	.25	1.50	1.50			2

*Note: The desired Stop Tube length adds directly to the overall cylinder length.

Note: If a stop tube is used on 1.50" - 2.50" bore, there is no length adder for "MPR-WB" option other than the stop tube length.

About our Part Number System

- Simple, easy to understand
- No excessive codes!
- Eliminates mistakes when ordering

Example: A Triple Rod Cylinder with a 3.25" Bore, 10" Stroke, Front Flange Mount, Head & Cap Cushions, Magnetic Piston for TRD Reed or Solid State Switches.

Part Number: TRA-MF1-3.25 x 10-HC-MPR

OPERATING TEMPERATURE

Carboxylated Nitrile: -20°F to 200°F (-25°C to 90°C)
Fluorocarbon: 0°F to 400°F (-20°C to 200°C)

STAINLESS STEEL 'TRA'

Consult factory for available models and delivery.

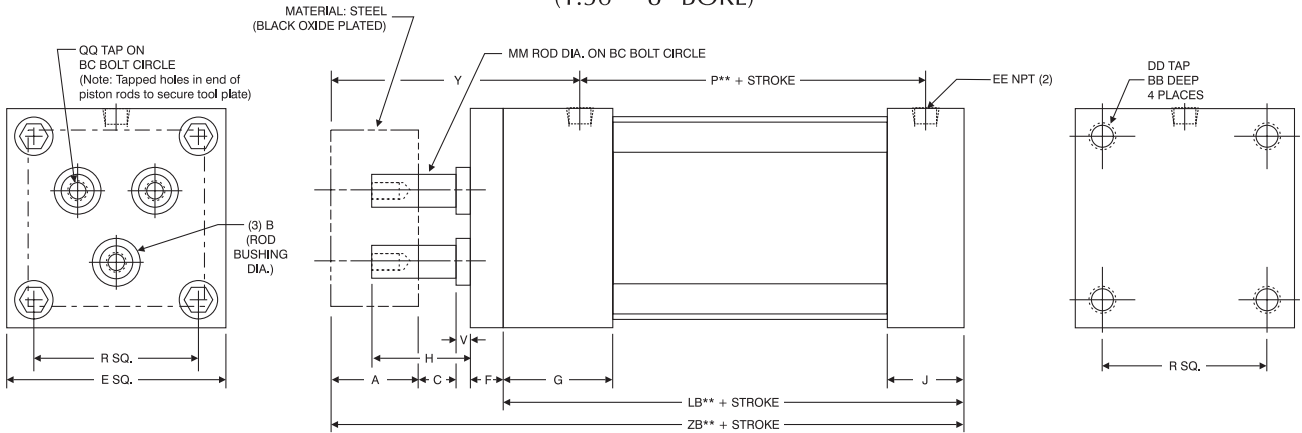
'TRA-MSE' & 'TRA-MSR'

Triple Rod Cylinders can be furnished in multi-stage designs. (Consult factory for available models and delivery.)

SERIES 'TRA' HEAVY-DUTY: TRIPLE PISTON ROD

MXO (NO MOUNT)

(1.50" - 8" BORE)



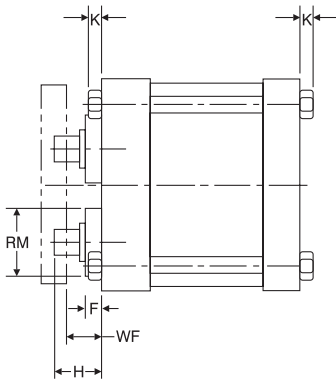
'TRA' SERIES BASIC DIMENSIONS 'MXO'																				
BORE	A	B	BB	BC	C	DD	E	EE	F	G	H	J	LB	MM	P	QQ	R	V	Y	ZB
1.50	.75	.56	.50	.89	.50	.25-28	2	.25	.38	1.50	1.1	1	3.63**	.31	2.38**	10-32	1.43	.25	2.75	5.50**
2	.75	.81	.50	1.195	.50	.31-24	2.50	.25	.38	1.50	1.1	1	3.63**	.50	2.38**	.25-28	1.84	.25	2.75	5.50**
2.50	1	1.02	.50	1.50	.50	.31-24	3	.25	.38	1.50	1.35	1	3.75**	.63	2.50**	.31-24	2.19	.25	3	5.88**
3.25	1	1.13	.63	2.075	.50	.38-24	3.75	.38	.63	1.75	1.1	1.25	4.25	.63	2.75	.38-24	2.76	.25	3.38	6.63
4	1	1.13	.63	2.825	.50	.38-24	4.50	.38	.63	1.75	1.1	1.25	4.25	.63	2.75	.38-24	3.32	.25	3.38	6.63
5	1	1.50	.63	3.375	1	.50-20	5.50	.38	.63	1.75	1.84	1.25	4.50	1	3	.50-20	4.10	.25	3.88	7.38
6	1	1.50	.75	3.937	1	.50-20	6.50	.50	.75	2	1.84	1.50	5	1	3.25	.50-20	4.88	.25	4.13	8
8	1	1.50	—	5.75	1.38	—	8.50	.75	—	2	2.84	1.50	5.13	1	3.38	.50-20	6.44	.25	4.38	8.38*

*"ZB" does not include "K" hex nut dimension. (See below for dimensions.)

**Option "MPR-WB" will add .50" to overall cylinder length - 1.50", 2" & 2.50" bores only.

MXO (NO MOUNT)

(8" BORE)



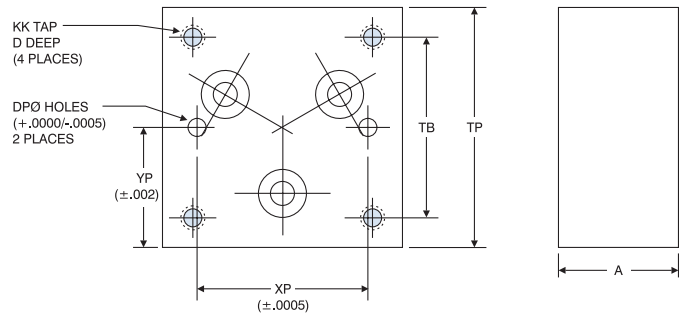
'TRA' SERIES BASIC DIMENSIONS 'MXO'					
BORE	F	H	K	RM	WF
8	.63	2.84	.56	2.75	2.25

*8" bore has (3) round retainers, .63" thick, 2.75" dia., and uses hex nuts on both ends for MXO mount.

Tooling Plate

Material: Steel (Black Oxide Plated)

Note: Standard Tool Plate includes (2) dowel pin holes included with cylinder (dowel pins not included)

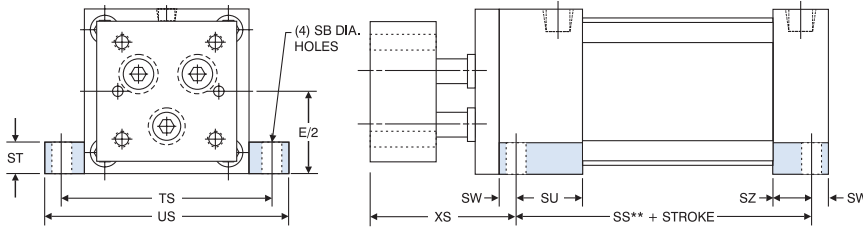


'TRA' SERIES TOOLING PLATE DIMENSIONS									
STANDARD						DOWEL PIN DIMENSIONS			
BORE	A	D	KK	TB	TP	BORE	DP Ø	XP	YP
1.50	.75	.75	10-32	1.13	1.50	1.50	.13	1.125	.750
2	.75	.75	.25-28	1.44	2	2	.13	1.375	1.00
2.50	1	1	.31-24	1.84	2.50	2.50	.19	1.750	1.250
3.25	1	1	.38-24	2.19	3.25	3.25	.25	2.250	1.625
4	1	1	.38-24	2.76	4	4	.25	2.750	2.00
5	1	1	.50-20	3.31	5	5	.31	3.250	2.50
6	1	1	.50-20	4.10	6	6	.31	4.00	3.00
8	1	1	.50-20	4.88	8	8	.38	4.875	4.00

SERIES 'TRA' DIMENSIONS: BASE & PIVOT MOUNTS

BASE MOUNTS (1.50"-8" BORE)

MS2

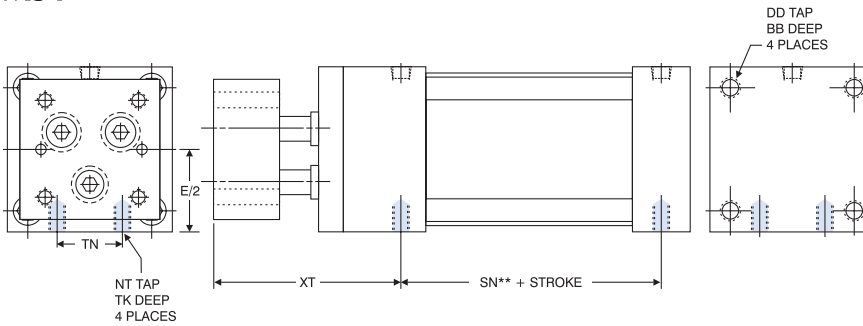


'TRA' SERIES 'MS2' DIMENSIONS										
BORE	SB	E/2	SS	ST	SU	SW	SZ	TS	US	XS
1.50	.44	1	2.88**	.50	1.13	.38	.63	2.75	3.50	2.25
2	.44	1.25	2.88**	.50	1.13	.38	.63	3.25	4	2.25
2.50	.44	1.50	3**	.50	1.13	.38	.63	3.75	4.50	2.50
3.25	.56	1.88	3.25	.75	1.25	.50	.75	4.75	5.75	2.88
4	.56	2.25	3.25	.75	1.25	.50	.75	5.50	6.50	2.88
5	.81	2.75	3.13	1	1.06	.69	.56	6.88	8.25	3.56
6	.81	3.25	3.63	1	1.31	.69	.81	7.88	9.25	3.69
8	.81	4.25	3.75	1	1.31	.69	.81	9.88	11.25	3.94

**Option "MPR-WB" will add .50" to overall cylinder length - 1.50", 2" & 2.50" bores only.

For dimensions not shown, see page 51.

MS4

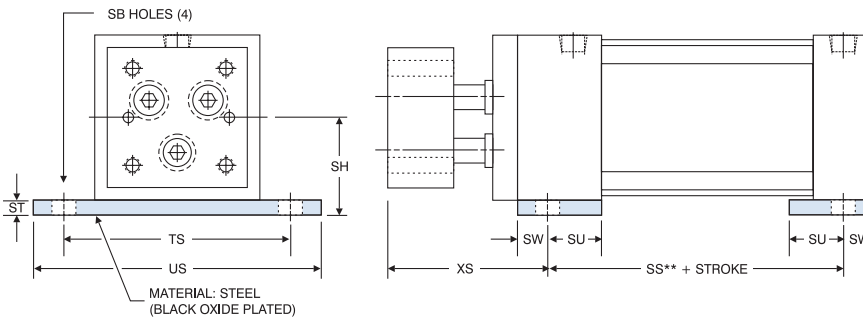


'TRA' SERIES 'MS4' DIMENSIONS						
BORE	E/2	NT	TK	TN	XT	SN
1.50	1	.25-20	.38	.63	2.81	2.25**
2	1.25	.31-18	.50	.88	2.81	2.25**
2.50	1.50	.38-16	.63	1.25	3.06	2.38**
3.25	1.88	.50-13	.75	1.50	3.44	2.63
4	2.25	.50-13	.75	2.06	3.44	2.63
5	2.75	.63-11	1	2.69	3.94	2.88
6	3.25	.75-10	1.13	3.25	4.19	3.13
8	4.25	.75-10	1.13	4.50	4.44	3.25

**Option "MPR-WB" will add .50" to overall cylinder length - 1.50", 2" & 2.50" bores only.

For dimensions not shown, see page 51.

BASE BAR (Non-NFPA)



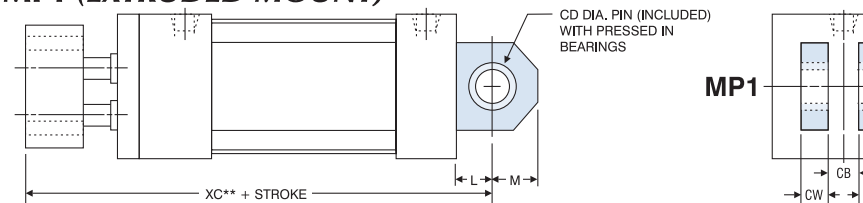
'TRA' SERIES BASE BAR (Non-NFPA) DIMENSIONS									
BORE	SB	SH	SS	ST	SU	SW	TS	US	XS
1.50	.44	1.25	2.88**	.25	1.13	.38	2.75	3.50	2.25
2	.44	1.50	2.88**	.25	1.13	.38	3.25	4	2.25
2.50	.44	1.88	3**	.38	1.13	.38	3.75	4.50	2.50
3.25	.56	2.38	3.25	.50	1.25	.50	4.75	5.75	2.88
4	.56	2.75	3.25	.50	1.25	.50	5.50	6.50	2.88

**Option "MPR-WB" will add .50" to overall cylinder length - 1.50", 2" & 2.50" bores only.

For dimensions not shown, see page 51.

PIVOT MOUNTS (1.50"-8" BORE)

MP1 (EXTRUDED MOUNT)



'TRA' SERIES 'MP1'-'MP2'-'MP4' DIMENSIONS									
BORE	CB	CD	CW	FL	L	M	XC	XD	
1.50	.75	.50	.50	1.13	.75	.63	6.25**	6.63**	
2	.75	.50	.50	1.13	.75	.63	6.25**	6.63**	
2.50	.75	.50	.50	1.13	.75	.63	6.63**	7**	
3.25	1.25	.75	.63	1.88	1.25	.88	7.88	8.50	
4	1.25	.75	.63	1.88	1.25	.88	7.88	8.50	
5	1.25	.75	.63	1.88	1.25	.88	8.63	9.25	
6	1.50	1	.75	2.25	1.50	1	9.63	10.25	
8	1.50	1	.75	N/A	1.50	1	9.88	N/A	

**Option "MPR-WB" will add .50" to overall cylinder length - 1.50", 2" & 2.50" bores only.

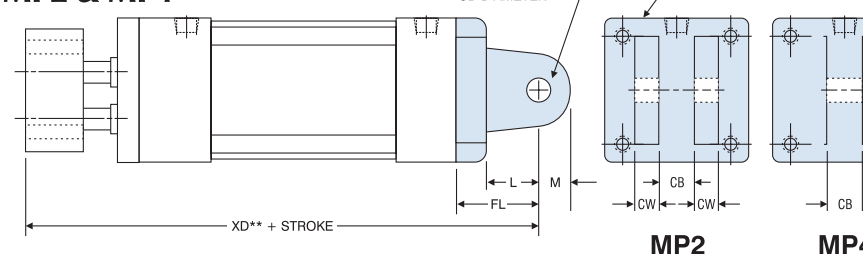
Note: 8" bore is a welded mount with through holes and tie rod nuts.

△ MP4 available as specials in 5", 6" & 8" bores.

Note: Extruded MP1 mounts are standard (1.50"-8" bores) Cast Iron removable mounts are optional, and must be requested when ordering (1.50"-6" bores).

For dimensions not shown, see page 51.

MP2 & MP4



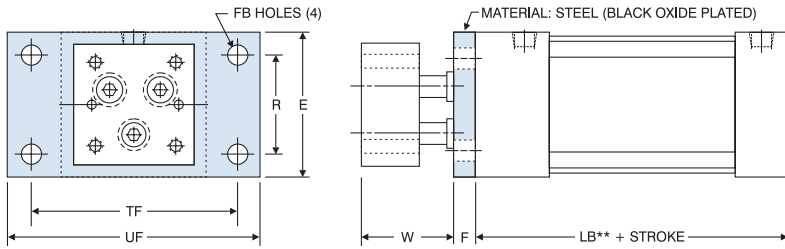
Clevis Pin included with MP1, MP2 & MP4 mounts

SERIES 'TRA' DIMENSIONS: FLANGE MOUNTS

FLANGE MOUNTS

(1.50" - 6" BORE)

MF1

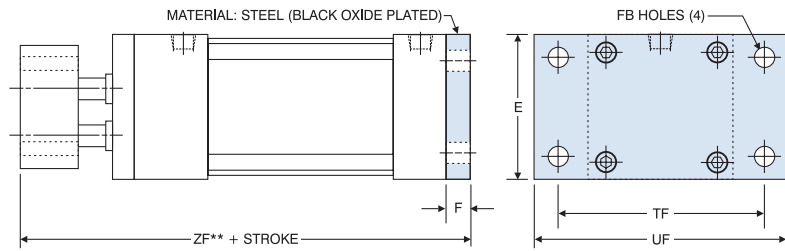


'TRA' SERIES 'MF1' & 'MF2' DIMENSIONS									
BORE	E	F	FB	LB	R	TF	UF	W	ZF
1.50	2	.38	.31	3.63**	1.43	2.75	3.38	1.50	5.88**
2	2.50	.38	.38	3.63**	1.84	3.38	4.13	1.50	5.88**
2.50	3	.38	.38	3.75**	2.19	3.88	4.63	1.75	6.25**
3.25	3.75	.63	.44	4.25	2.76	4.69	5.50	1.75	7.25
4	4.50	.63	.44	4.25	3.32	5.44	6.25	1.75	7.25
5	5.50	.63	.56	4.50	4.10	6.63	7.63	2.25	8
6	6.50	.75	.56	5	4.88	7.63	8.63	2.25	8.75

**Option "MPR-WB" will add .50" to overall cylinder length - 1.50", 2" & 2.50" bores only.

For dimensions not shown, see page 51.

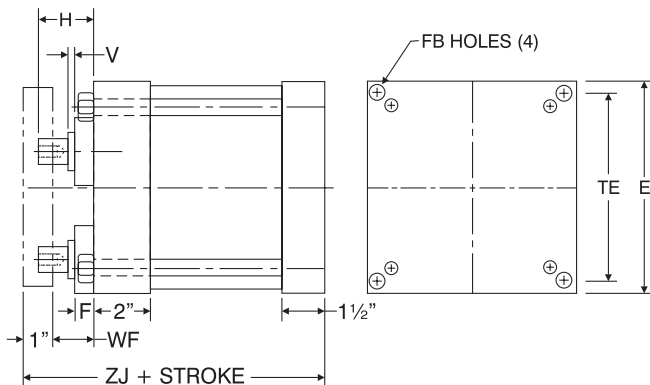
MF2



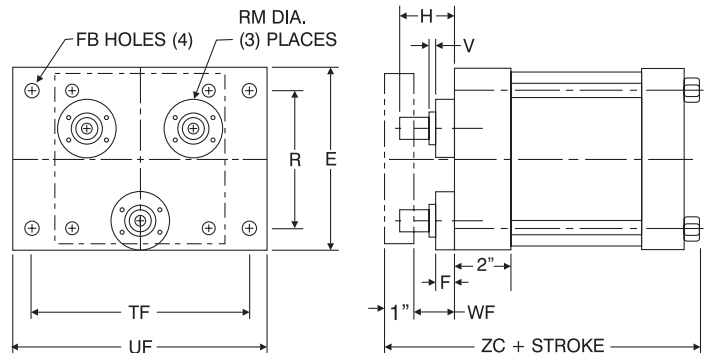
FLANGE MOUNTS

(8" BORE)

ME4



ME5 (Non-NFPA)



'TRA' SERIES 'ME4' & 'ME5' DIMENSIONS													
BORE	E	F	FB	H	R	RM	TE	TF	UF	V	WF	ZC	ZJ
8	8.50	.63	.69	2.84	6.44	2.75	7.57	10.25	12	.25	2.25	8.94	8.38

Note: (3) 1" diameter rods on 5.750 B.C.

For dimensions not shown, see page 51.

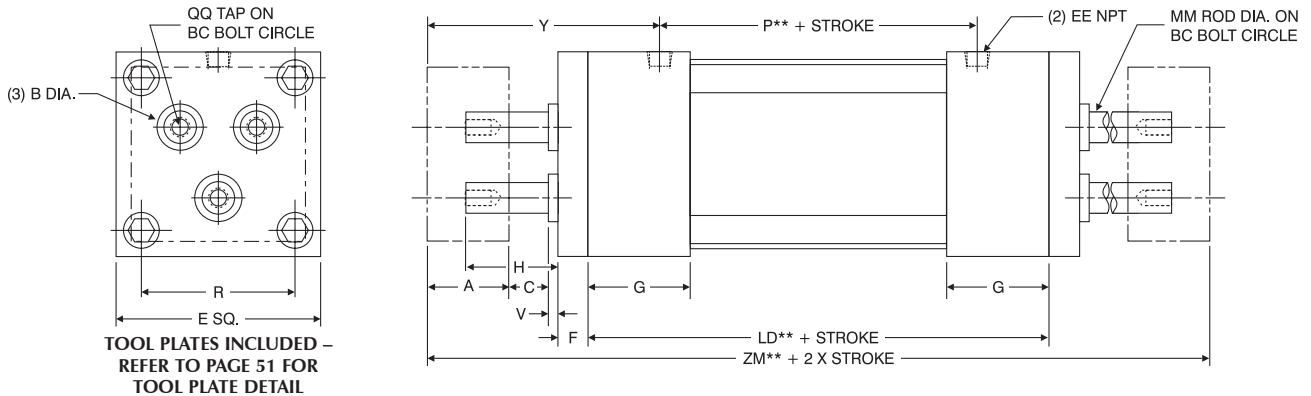
SERIES 'TRA' DIMENSIONS: DOUBLE ROD END

Benefits

- Durable Design. Full rod bearing(s) at each end of cylinder.
- Single Rod (D1) and Triple Rod (D3) models available.
- Full range of options available.
- Reduces Tool Plate "End Play"
- Increases Load Ratings.

MXOD3 (TRIPLE ROD BOTH ENDS) BASIC DIMENSIONS

(NO MOUNT)



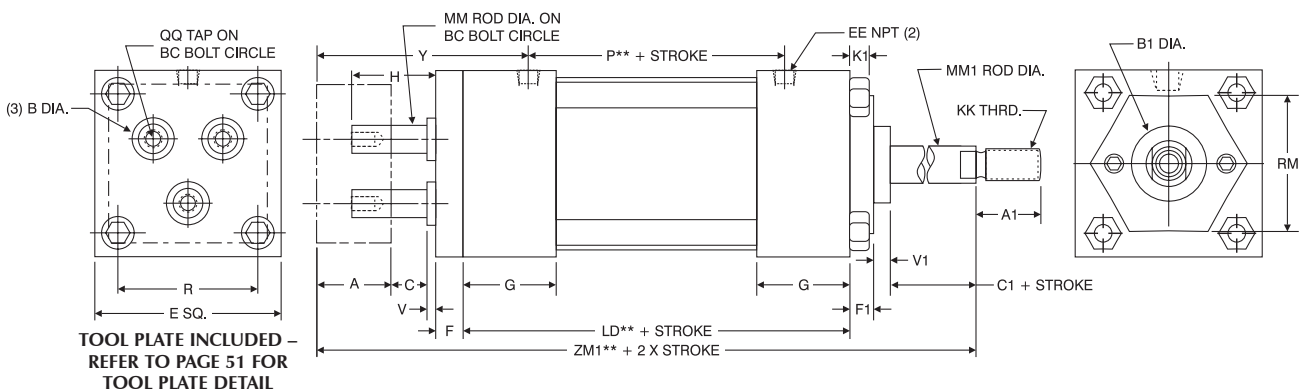
'TRA' SERIES TWIN TOOLING PLATE BASIC DIMENSIONS 'MXOD3'																	
BORE	A	B	BC	C	E	EE	F	G	H	LD	MM	P	QQ	R	V	Y	ZM
1.50	.75	.56	.89	.50	2	.25	.38	1.50	1.1	4.13**	.31	2.38**	10-32	1.43	.25	2.75	7.88**
2	.75	.81	1.195	.50	2.50	.25	.38	1.50	1.1	4.13**	.50	2.38**	.25-28	1.84	.25	2.75	7.88**
2.50	1	1.02	1.50	.50	3	.25	.38	1.50	1.35	4.25**	.63	2.50**	.31-24	2.19	.25	3	8.50**
3.25	1	1.13	2.075	.50	3.75	.38	.63	1.75	1.1	4.75	.63	2.75	.38-24	2.76	.25	3.38	9.50
4	1	1.13	2.825	.50	4.50	.38	.63	1.75	1.1	4.75	.63	2.75	.38-24	3.32	.25	3.38	9.50
5	1	1.50	3.375	1	5.50	.38	.63	1.75	1.84	5	1	3	.50-20	4.10	.25	3.88	10.75
6	1	1.50	3.937	1	6.50	.50	.75	2	1.84	5.50	1	3.25	.50-20	4.88	.25	4.13	11.50
8	1	1.50	5.75	1.38	8.50	.75	.63*	2	2.84	5.63	1	3.38	.50-20	6.44	.25	4.38	12.13

*8" bore has (3) round retainers, .63" thick, 2.75" dia., and uses hex nuts on ends. (See page 51)

**Option "MPR-WB" will add .50" to overall cylinder length - 1.50", 2" & 2.50" bores only.

MXOD1 (TRIPLE ROD WITH SINGLE ROD) BASIC DIMENSIONS

(NO MOUNT)



'TRA' SERIES TWIN TOOLING PLATE BASIC DIMENSIONS 'MXOD1'																										
BORE	A	A1	B	B1	BC	C	C1	E	EE	F	F1	G	H	K1	KK	LD	MM	MM1	P	QQ	R	RM	V	V1	Y	ZM1
1.50	.75	.75	.56	1.13	.89	.50	.38	2	.25	.38	.38	1.50	1.1	.25	44-20	4.13**	.31	.63	2.38**	10-32	1.43	2 Sq.	.25	.25	2.75	7**
2	.75	.75	.816	1.13	1.195	.50	.38	2.50	.25	.38	.38	1.50	1.1	.31	44-20	4.13**	.50	.63	2.38**	.25-28	1.84	1.75 Hex.	.25	.25	2.75	7**
2.50	1	.75	1.02	1.13	1.50	.50	.38	3	.25	.38	.38	1.50	1.35	.31	44-20	4.25**	.63	.63	2.50**	.31-24	2.19	1.75 Hex.	.25	.25	3	7.38**
3.25	1	1.13	1.13	1.50	2.075	.50	.50	3.75	.38	.63	.63	1.75	1.1	.38	75-16	4.75	.63	1	2.75	.38-24	2.76	2.75 Dia.	.25	.25	3.38	8.50
4	1	1.13	1.13	1.50	2.825	.50	.50	4.50	.38	.63	.63	1.75	1.1	.38	75-16	4.75	.63	1	2.75	.38-24	3.32	2.75 Dia.	.25	.25	3.38	8.50
5	1	1.13	1.50	1.50	3.375	1	.50	5.50	.38	.63	.63	1.75	1.84	.44	75-16	5	1	1	3	.50-20	4.10	2.75 Dia.	.25	.25	3.88	9.25
6	1	1.63	1.50	2	3.937	1	.63	6.50	.50	.75	.63	2	1.84	.44	1-14	5.50	1	1.38	3.25	.50-20	4.88	3.50 Dia.	.25	.38	4.13	10.13
8	1	1.63	1.50	2	5.75	1.38	.63	8.50	.75	.63*	.63	2	2.84	.56	1-14	5.63	1	1.38	3.38	.50-20	6.44	3.50 Dia.	.25	.38	4.38	10.50

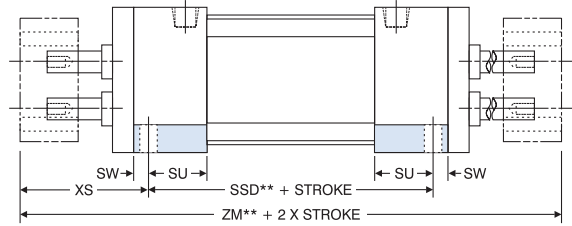
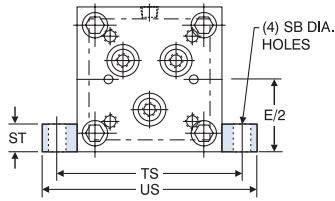
*8" bore has (3) round retainers, .63" thick, 2.75" dia., and uses hex nuts on ends. (See page 51)

**Option "MPR-WB" will add .50" to overall cylinder length - 1.50", 2" & 2.50" bores only.

SERIES 'TRA' DIMENSIONS: DOUBLE ROD END BASE MOUNTS

NEW

MS2D3

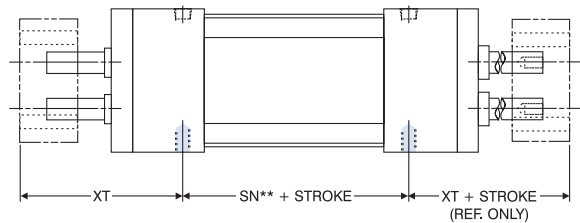
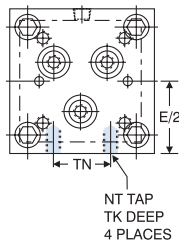


'TRA' SERIES 'MS2D' DIMENSIONS										
BORE	SB	E/2	SSD	ST	SU	SW	TS	US	XS	ZM
1.50	.44	1	3.38**	.50	1.13	.38	2.75	3.50	2.25	7.88**
2	.44	1.25	3.38**	.50	1.13	.38	3.25	4	2.25	7.88**
2.50	.44	1.50	3.50**	.50	1.13	.38	3.75	4.50	2.50	8.50**
3.25	.56	1.88	3.75	.75	1.25	.50	4.75	5.75	2.88	9.50
4	.56	2.25	3.75	.75	1.25	.50	5.50	6.50	2.88	9.50
5	.81	2.75	3.63	1	1.06	.69	6.88	8.25	3.56	10.75
6	.81	3.25	4.13	1	1.31	.69	7.88	9.25	3.69	11.50
8	.81	4.25	4.25	1	1.31	.69	9.88	11.25	3.94	12.13

**Option "MPR-WB" will add .50" to overall cylinder length - 1.50", 2" & 2.50" bores only.

For dimensions not shown, see page 54.

MS4D3

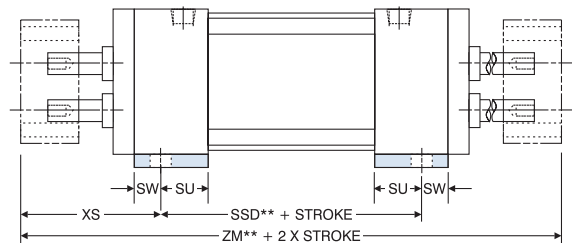
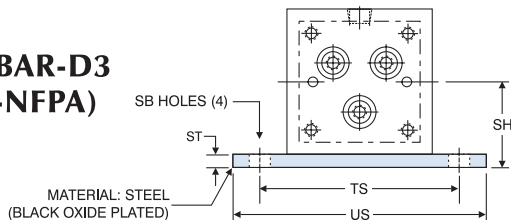


'TRA' SERIES 'MS4D1' DIMENSIONS							
BORE	E/2	NT	TK	TN	XT	SN	
1.50	1	.25-20	.38	.63	2.81	2.25**	
2	1.25	.31-18	.50	.88	2.81	2.25**	
2.50	1.50	.38-16	.63	1.25	3.06	2.38**	
3.25	1.88	.50-13	.75	1.50	3.44	2.63	
4	2.25	.50-13	.75	2.06	3.44	2.63	
5	2.75	.63-11	1	2.69	3.94	2.88	
6	3.25	.75-10	1.13	3.25	4.19	3.13	
8	4.25	.75-10	1.13	4.50	4.44	3.25	

**Option "MPR-WB" will add .50" to overall cylinder length - 1.50", 2" & 2.50" bores only.

For dimensions not shown, see page 54.

BASEBAR-D3 (Non-NFPA)



'TRA' SERIES BASEBAR-D3 (Non-NFPA) DIMENSIONS										
BORE	SB	SH	SSD	ST	SU	SW	TS	US	XS	ZM
1.50	.44	1.25	3.38**	.25	1.13	.38	2.75	3.50	2.25	7.88**
2	.44	1.50	3.38**	.25	1.13	.38	3.25	4	2.25	7.88**
2.50	.44	1.88	3.50**	.38	1.13	.38	3.75	4.50	2.50	8.50**
3.25	.56	2.38	3.75	.50	1.25	.50	4.75	5.75	2.88	9.50
4	.56	2.75	3.75	.50	1.25	.50	5.50	6.50	2.88	9.50

**Option "MPR-WB" will add .50" to overall cylinder length - 1.50", 2" & 2.50" bores only.

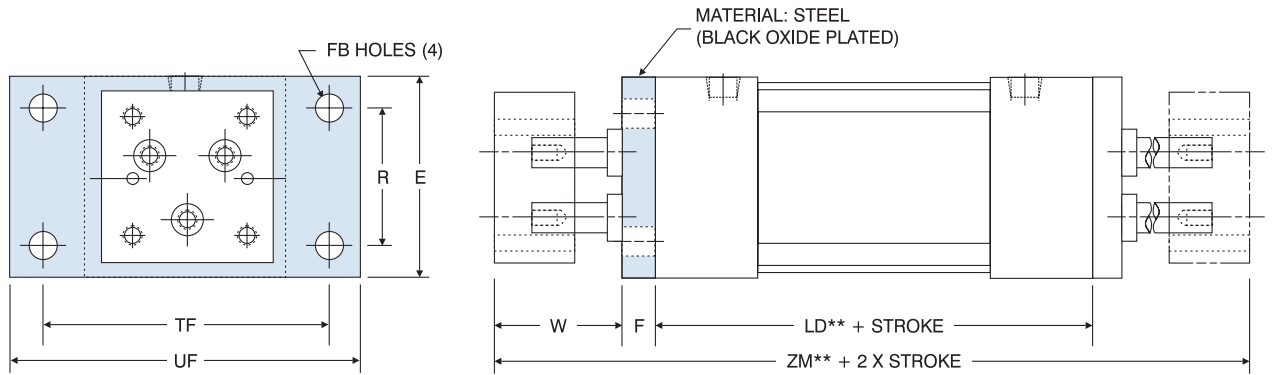
For dimensions not shown, see page 54.

SERIES 'TRA' DIMENSIONS: DOUBLE ROD END

FLANGE MOUNTS

(1.50" - 6" BORE)

MF1D3



'TRA' SERIES 'MF1D3' DIMENSIONS									
BORE	E	F	FB	LD	R	TF	UF	W	ZM
1.50	2	.38	.31	4.13**	1.43	2.75	3.38	1.50	7.88**
2	2.50	.38	.38	4.13**	1.84	3.38	4.13	1.50	7.88**
2.50	3	.38	.38	4.25**	2.19	3.88	4.63	1.75	8.50**
3.25	3.75	.63	.44	4.75	2.76	4.69	5.50	1.75	9.50
4	4.50	.63	.44	4.75	3.32	5.44	6.25	1.75	9.50
5	5.50	.63	.56	5	4.10	6.63	7.63	2.25	10.75
6	6.50	.75	.56	5.50	4.88	7.63	8.63	2.25	11.50

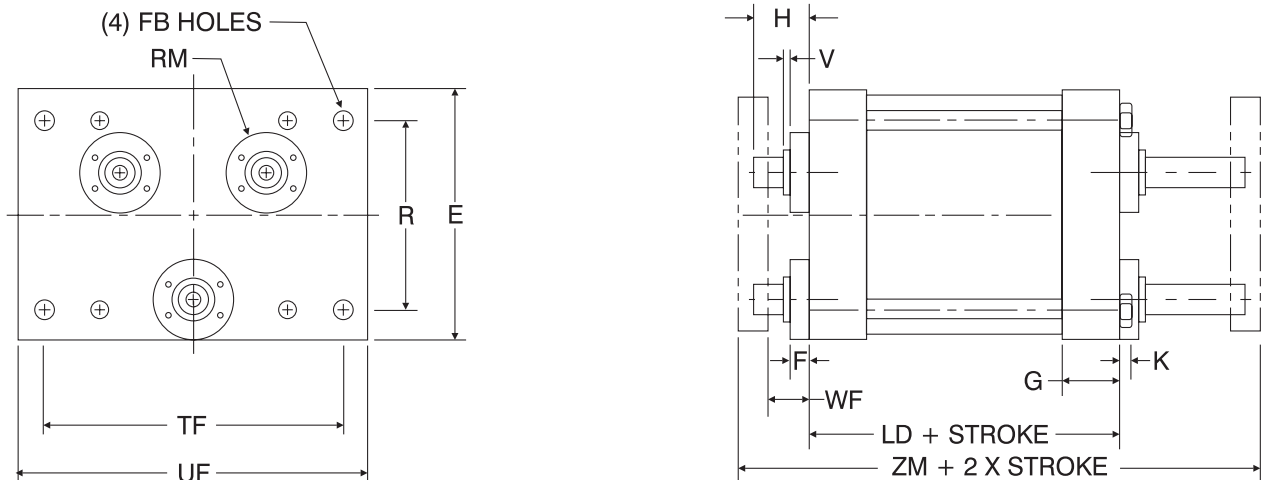
**Option "MPR-WB" will add .50" to overall cylinder length - 1.50", 2" & 2.50" bores only.

For dimensions not shown, see page 54.

FLANGE MOUNTS

(8" BORE)

ME5D3

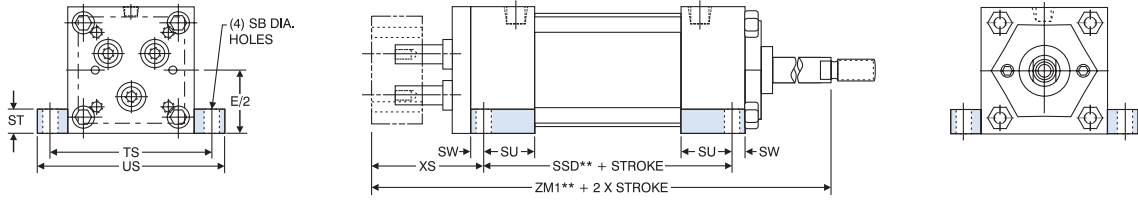


'TRA' SERIES 'ME5D3' DIMENSIONS															
BORE	E	F	FB	G	H	K	LD	R	RM	TE	TF	UF	V	WF	ZM
8	8.50	.63	.69	2	2.84	.56	5.63	6.44	2.75	7.57	10.25	12	.38	2.25	12.13

Note: (3) 1" diameter rods on 5.750 B.C.

For dimensions not shown, see page 54.

SERIES 'TRA' DIMENSIONS: DOUBLE ROD END (WITH SINGLE ROD) BASE MOUNTS

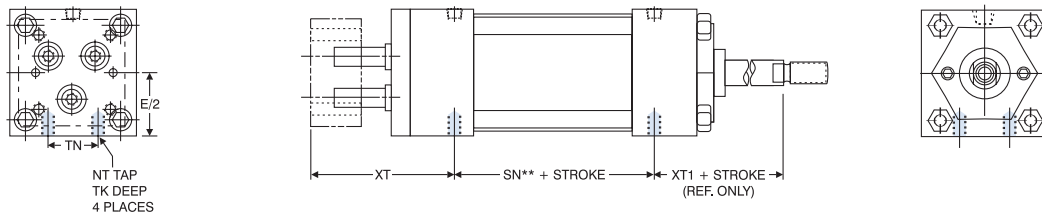


MS2D1 (TRIPLE ROD WITH SINGLE ROD)

'TRA' SERIES 'MS2D1' DIMENSIONS										
BORE	SB	E/2	SSD	ST	SU	SW	TS	US	XS	ZM1
1.50	.44	1	3.38**	.50	1.13	.38	2.75	3.50	2.25	7**
2	.44	1.25	3.38**	.50	1.13	.38	3.25	4	2.25	7**
2.50	.44	1.50	3.50**	.50	1.13	.38	3.75	4.50	2.50	7.38**
3.25	.56	1.88	3.75	.75	1.25	.50	4.75	5.75	2.88	8.50
4	.56	2.25	3.75	.75	1.25	.50	5.50	6.50	2.88	8.50
5	.81	2.75	3.63	1	1.06	.69	6.88	8.25	3.56	9.25
6	.81	3.25	4.13	1	1.31	.69	7.88	9.25	3.69	10.13
8	.81	4.25	4.25	1	1.31	.69	9.88	11.25	3.94	10.50

**Option "MPR-WB" will add .50" to overall cylinder length - 1.50", 2" & 2.50" bores only.

For single rod end dimensions not shown, see pages 54 or 61.

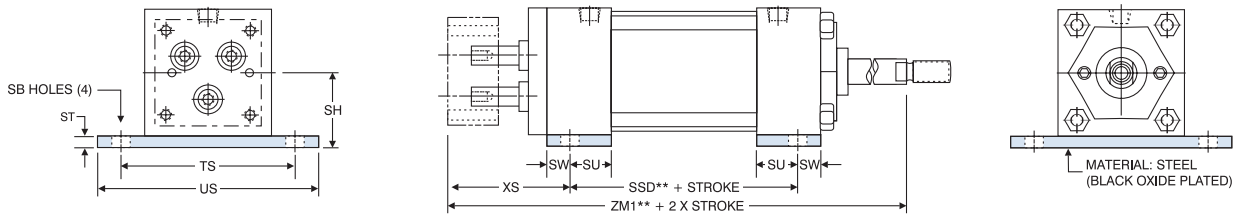


MS4D1 (TRIPLE ROD WITH SINGLE ROD)

'TRA' SERIES 'MS4D1' DIMENSIONS							
BORE	E/2	NT	TK	TN	XT	SN	XT1
1.50	1	.25-20	.38	.63	2.81	2.25**	1.94
2	1.25	.31-18	.50	.88	2.81	2.25**	1.94
2.50	1.50	.38-16	.63	1.25	3.06	2.38**	1.94
3.25	1.88	.50-13	.75	1.50	3.44	2.63	2.44
4	2.25	.50-13	.75	2.06	3.44	2.63	2.44
5	2.75	.63-11	1	2.69	3.94	2.88	2.44
6	3.25	.75-10	1.13	3.25	4.19	3.13	2.81
8	4.25	.75-10	1.13	4.50	4.44	3.25	2.81

**Option "MPR-WB" will add .50" to overall cylinder length - 1.50", 2" & 2.50" bores only.

For single rod end dimensions not shown, see pages 54 or 61.



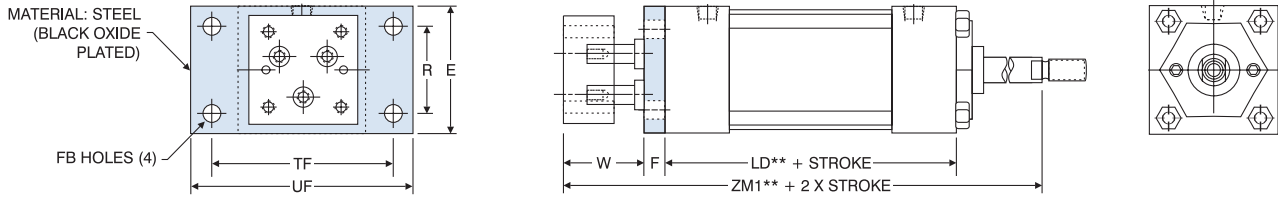
BASEBAR-D1 (TRIPLE ROD WITH SINGLE ROD) (Non-NFPA)

'TRA' SERIES BASEBAR-D1 (Non-NFPA) DIMENSIONS										
BORE	SB	SH	SSD	ST	SU	SW	TS	US	XS	ZM1
1.50	.44	1.25	3.38**	.25	1.13	.38	2.75	3.50	2.25	7**
2	.44	1.50	3.38**	.25	1.13	.38	3.25	4	2.25	7**
2.50	.44	1.88	3.50**	.38	1.13	.38	3.75	4.50	2.50	7.38**
3.25	.56	2.38	3.75	.50	1.25	.50	4.75	5.75	2.88	8.50
4	.56	2.75	3.75	.50	1.25	.50	5.50	6.50	2.88	8.50

**Option "MPR-WB" will add .50" to overall cylinder length - 1.50", 2" & 2.50" bores only.

For single rod end dimensions not shown, see pages 54 or 61.

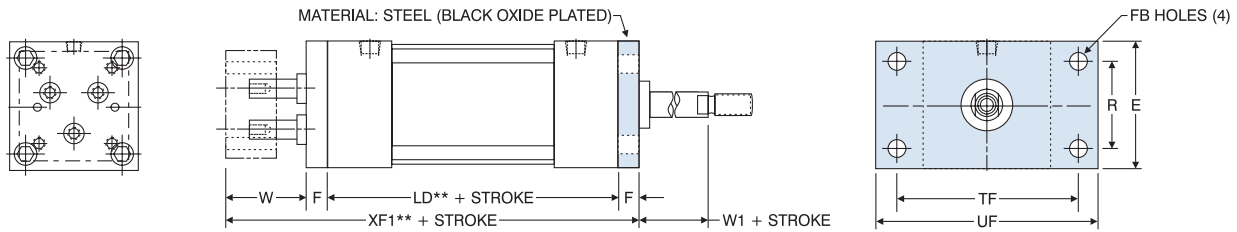
SERIES 'TRA' DIMENSIONS: DOUBLE ROD END (WITH SINGLE ROD) BASE MOUNTS



MF1D1 (TRIPLE ROD WITH SINGLE ROD)

'TRA' SERIES 'MF1D1' DIMENSIONS									
BORE	E	F	FB	LD	R	TF	UF	W	ZM1
1.50	2	.38	.31	4.13**	1.43	2.75	3.38	1.50	7**
2	2.50	.38	.38	4.13**	1.84	3.38	4.13	1.50	7**
2.50	3	.38	.38	4.25**	2.19	3.88	4.63	1.75	7.38**
3.25	3.75	.63	.44	4.75	2.76	4.69	5.50	1.75	8.50
4	4.50	.63	.44	4.75	3.32	5.44	6.25	1.75	8.50
5	5.50	.63	.56	5	4.10	6.63	7.63	2.25	9.25
6	6.50	.75	.56	5.50	4.88	7.63	8.63	2.25	10.13

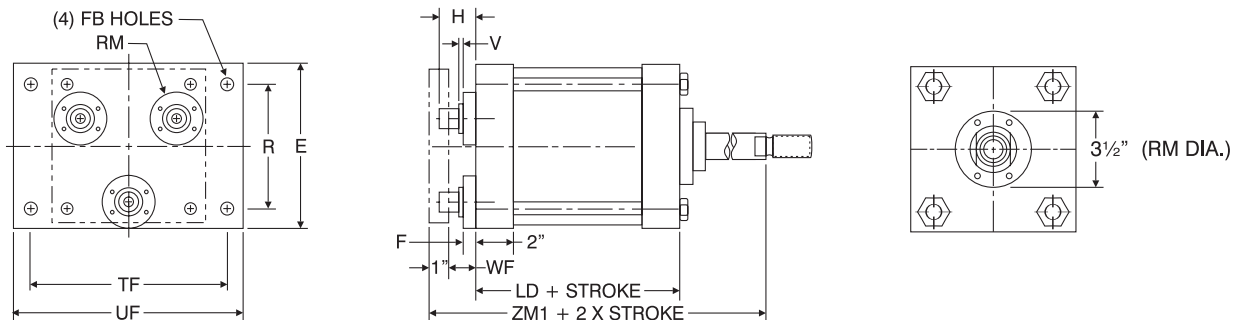
**Option "MPR-WB" will add .50" to overall cylinder length - 1.50", 2" & 2.50" bores only.
For single rod end dimensions not shown, see pages 54 or 61.



MF2D1 (TRIPLE ROD WITH SINGLE ROD)

'TRA' SERIES 'MF2D1' DIMENSIONS										
BORE	E	F	FB	LD	R	TF	UF	W	XF1	W1
1.50	2	.38	.31	4.13**	1.43	2.75	3.38	1.50	6.38**	.63
2	2.50	.38	.38	4.13**	1.84	3.38	4.13	1.50	6.38**	.63
2.50	3	.38	.38	4.25**	2.19	3.88	4.63	1.75	6.75**	.63
3.25	3.75	.63	.44	4.75	2.76	4.69	5.50	1.75	7.75	.75
4	4.50	.63	.44	4.75	3.32	5.44	6.25	1.75	7.75	.75
5	5.50	.63	.56	5	4.10	6.63	7.63	2.25	8.50	.75
6	6.50	.75	.56	5.50	4.88	7.63	8.63	2.25	9.25	.88

**Option "MPR-WB" will add .50" to overall cylinder length - 1.50", 2" & 2.50" bores only.
For single rod end dimensions not shown, see pages 54 or 61.



ME5D1 (TRIPLE ROD WITH SINGLE ROD)

'TRA' SERIES 'ME5D1' DIMENSIONS											
BORE	E	F	FB	H	R	RM	TF	UF	V	WF	ZM1
8	8.50	.63	.69	2.84	6.44	2.75	10.25	12	.25	2.25	10.50

Note: (3) 1" diameter rods on 5.750 B.C.
For single rod end dimensions not shown, see pages 54 or 61.

SERIES 'TRA': OPTIONS

B

BC

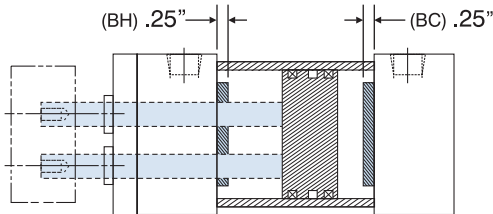
BH

Bumpers

Urethane impact dampening bumpers, used when cylinder speeds do not allow for standard cushions.

BC=Cap Bumper **BH**=Head Bumper **B**=Head & Cap Bumper

(Note: Each bumper adds .25" to cylinder length)

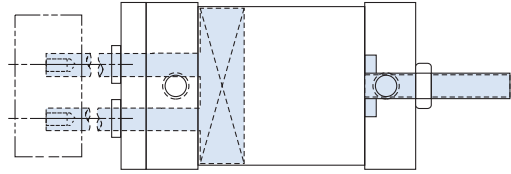


AS

Adjustable Stroke (Retract)

Consists of a threaded rod in the cylinder cap, non-removable. Provides an adjustable positive stop on the cylinder retract.

To order, specify "AS" and length of adjustment (Example: AS=3")



H

C

Cushions

TRD's advanced cushion design features a unique, one piece seal that is allowed to float in a precision machined groove. This type of seal design provides consistent cushion performance and maximum seal life. Oversized flow paths molded in the periphery of the seal provide "full flow" on the return stroke without the use of ball checks.

H=Head Cushion **C**=Cap Cushion

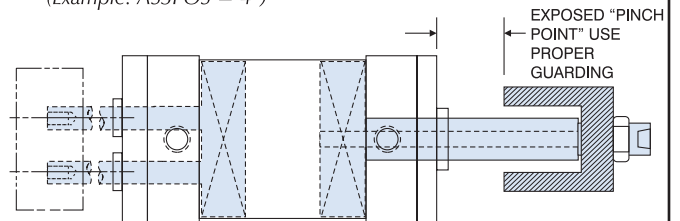


AS3POS

Adjustable Mid Stroke (3 Position Cyl.)

Double piston design allows for adjustment of the mid stroke position. Three ported cylinder with adjustable stop collar.

To order, specify "AS3POS" and length of adjustment. (Example: AS3POS = 4")

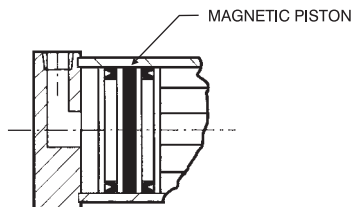


MPR

Magnetic Piston

Magnetic Pistons are used in conjunction with Reed and Solid State Switches. (R10, RAC & MSS Style Switches)

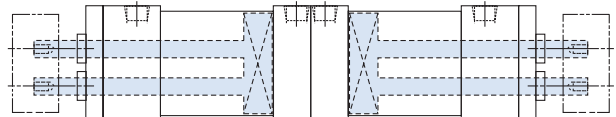
(Note: Option "MPR-WB" will add .50" to overall cylinder length - 1.50", 2" & 2.50" bores only.)



BACK TO BACK

The Back to Back option consists of two separate cylinders assembled with common tie rods. For use when three or four rod positions are required, and a "double rod" style is acceptable.

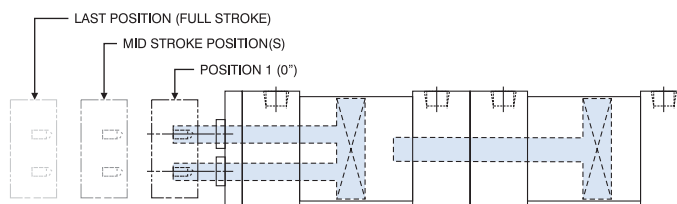
To order, specify each cylinder model, with "Back to Back" note. (See page 31 for ordering information.)



MULTIPLE POSITION

The Multi-Position option is used when three, four or five rod positions are required in a "single rod" design. Piston rods are not connected. The back cylinder(s) achieve the mid-stroke positions.

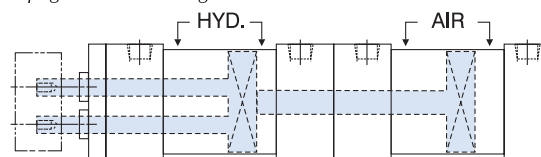
(See page 36 for ordering information.)



AIR/OIL TANDEM

The Air/Oil Tandem cylinder consists of a hydraulic cylinder coupled with an air cylinder. Piston rods are connected. (Note: hydraulic unit is in front, having the exposed piston rod). Used to provide smooth, controlled stroke, even at slow speeds.

To order, specify standard model number, with "Air/Oil Tandem" note. (See page 42 for ordering information.)

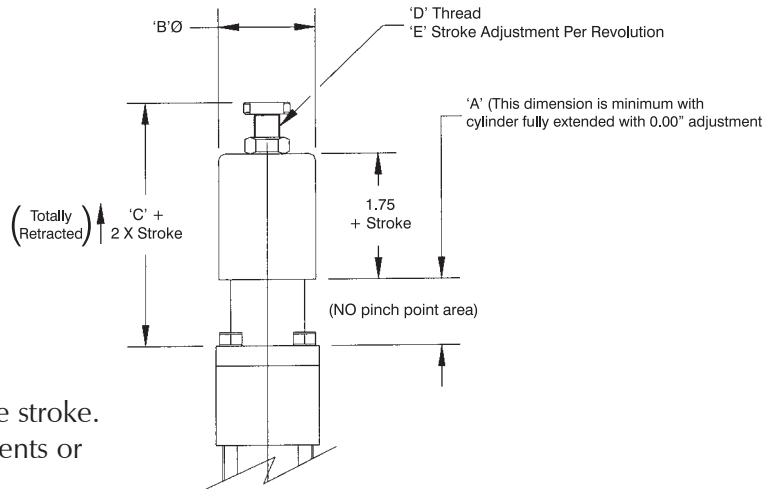


NOTE: 'TH' (400 PSI Hydraulic) option available, see page 90 for details.

SERIES 'TRA': OPTIONS

MA Micro-Adjust

- Allows precise adjustment of cylinder extend stroke
- Easy to read precision scale (.001" calibration)
- Enclosed, no "pinch point" design
- Available on all cylinder models with "D1" Double Rod End option
- Up to 6" stroke and adjustment*



*Note: The adjustment range is throughout entire stroke. Consult factory for longer stroke requirements or modifications not listed.

MICRO-ADJUST DIMENSIONS					
BORE	A	B	C	D	E
1.50	1.00	1.88	3.71	.50-20	.050
2	1.00	1.88	3.71	.50-20	.050
2.50	1.00	1.88	3.71	.50-20	.050
3.25	1.00	2.81	3.71	.75-16	.063
4	.75	2.81	3.47	.75-16	.063
5	.75	2.81	3.47	.75-16	.063
6	.75	3.75	3.47	.75-16	.063
8	.75	3.75	3.47	.75-16	.063

Note: See page 54 for other dimensions for model 'TRAD1'.

Sample Micro-Adjust (Photos)



(TRA-MF1 - 2 x 3 - MA Shown)



(TA-MF1 - 1.50 x 2 - MA Shown)

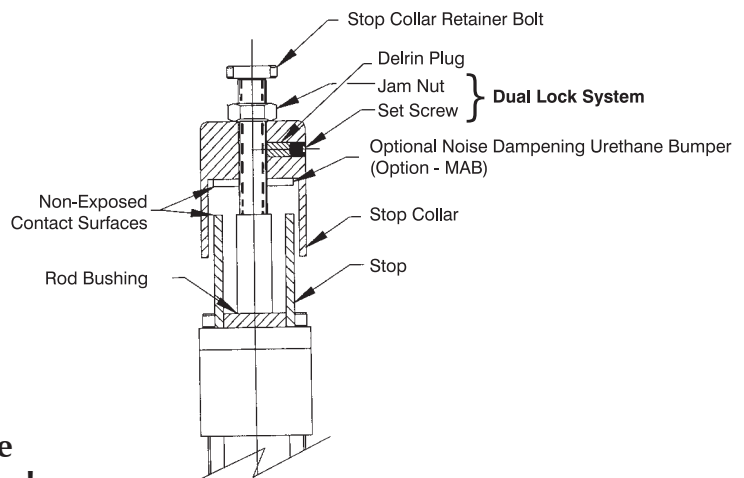
MICRO-ADJUST SET-UP INSTRUCTIONS:

- 1) Set actuator to desired stroke
- 2) Turn stop collar until it makes contact with stop
- 3) Tighten set screw
- 4) Tighten jam nut for positive lock of stop collar

NOTE: Do NOT apply torque to stop collar retainer bolt.

Hold stop collar by hand to tighten jam nut.

Stroke adjustments to be made while cylinder is in the "retract" position only.



If the option you need isn't listed, just call TRD! We can accommodate most requests.

SERIES 'TRA': OPTIONS

ST=2

ST=4

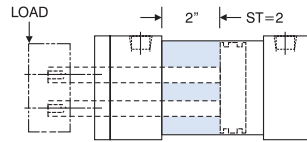
Stop Tubes

Stop Tubes are designed to reduce the piston rod bushing stress to within the designed range of the bearing material. This will insure proper cylinder performance, in any given application. Stop Tubes lower cylinder bearing stress by adding length to the piston, which increases the overall length of the cylinder.

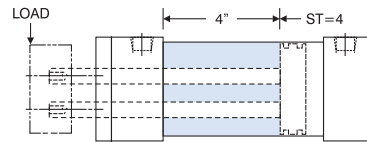
Ordering Example: TRA MS4 2 x 10 Effective Stroke-ST=2

The effective stroke must be included when ordering.

ST=2



ST=4



STROKES

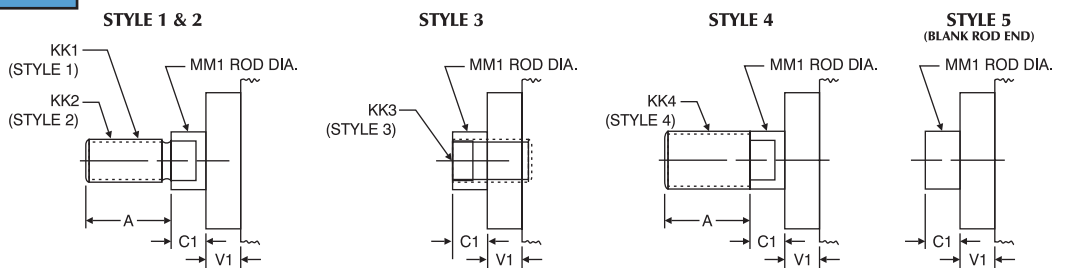
Recommended Maximum* Stroke Lengths

BORE	SINGLE ROD END MODELS			DOUBLE ROD END MODELS		
	TRA	TRA ST=2"	TRA ST=4"	TRA "D"	TRA "D" ST=2"	TRA "D" ST=4"
1.50	10	12	14	12	14	16
2	14	18	24	18	24	30
2.50	20	24	30	30	38	40
3.25	24	28	36	34	42	46
4	24	30	38	36	44	48
5	26	34	42	40	52	56
6	28	36	44	42	54	58
8	30	38	46	42	54	60

*MAXIMUM STROKE FOR HORIZONTAL APPLICATIONS.

"D1" ROD END OPTIONS

KK1 is standard (leave blank). Specify at end of part number for -KK2, -KK3, -KK4, or -KK5. Piston rod end styles apply to single rod end of cylinder only.



BORE	MM ROD DIAMETER	STANDARD					OPTIONAL					C1*	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, 2.50	.63 Standard	.44-20	.75	.50-20	.75	.44-20	.75	.63-18	.75	No Threads	.38	.25	
3.25, 4, 5	1 Standard	.75-16	1.13	.88-14	1.13	.75-16	1.13	1-14	1.13	No Threads	.50	.25	
6 & 8	1.38 Standard	1-14	1.63	1.25-12	1.63	1-14	1.63	1.38-12	1.63	No Threads	.63	.38	

C1* dimension is with single rod fully retracted.

CUSTOM SOLUTIONS

Still don't see what you need? No Problem! With our extensive machining abilities, our engineering staff can assist with the design of a cylinder for your application. Call, fax or e-mail your specifications for a quick response! When it comes to delivery, TRD has the reputation as being one of the fastest. *No more long waits for your customized products!*

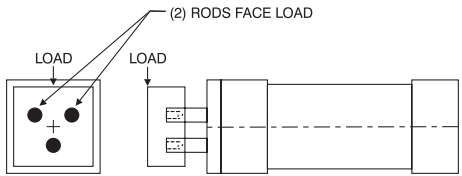
SERIES 'TRA': TECHNICAL DATA

LOAD CHARTS: 1.50" - 4" BORE

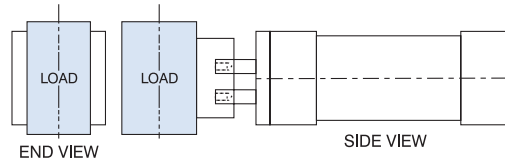
How to use LOAD CHARTS:

- 1.) Determine weight of LOAD (pounds)
- 2.) Refer to Load Charts for model selection

"Triple Rod" mounting to LOAD:

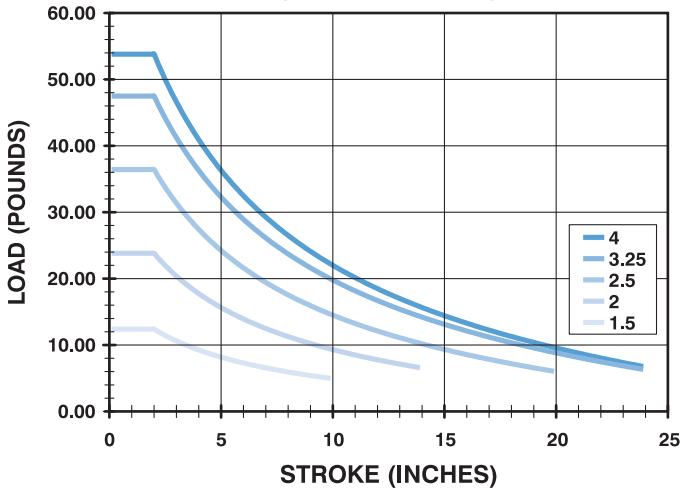


EXAMPLE 1

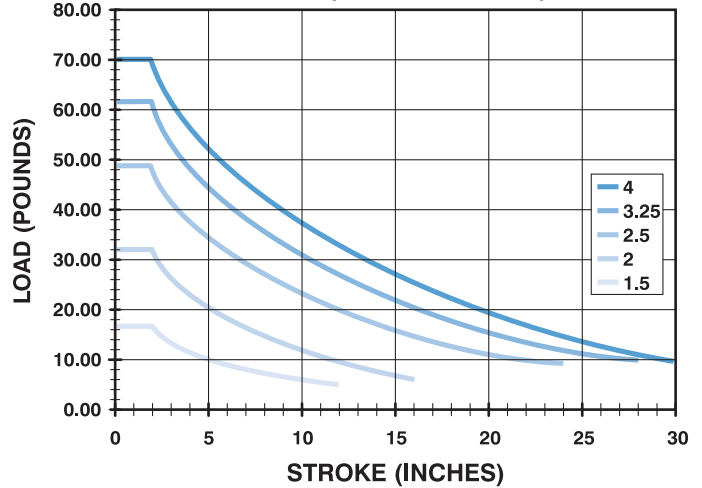


SINGLE ROD END: 1.50" - 4" Bore MAXIMUM RECOMMENDED LOAD

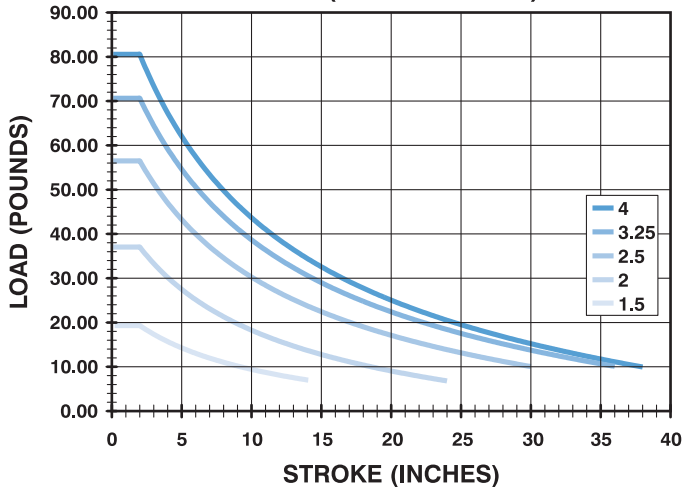
(NO STOP TUBE)



ST=2 (2" STOP TUBE)



ST=4 (4" STOP TUBE)



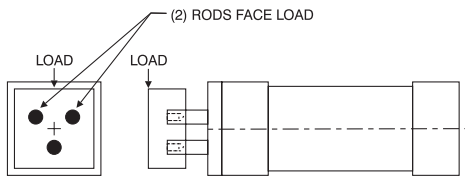
SERIES 'TRA': TECHNICAL DATA

LOAD CHARTS: 5" - 8" BORE

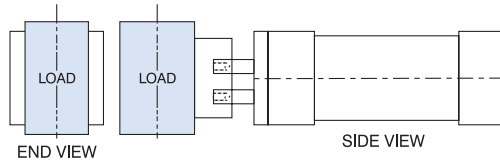
How to use LOAD CHARTS:

- 1.) Determine weight of LOAD (pounds)
- 2.) Refer to Load Charts for model selection

"Triple Rod" mounting to LOAD:

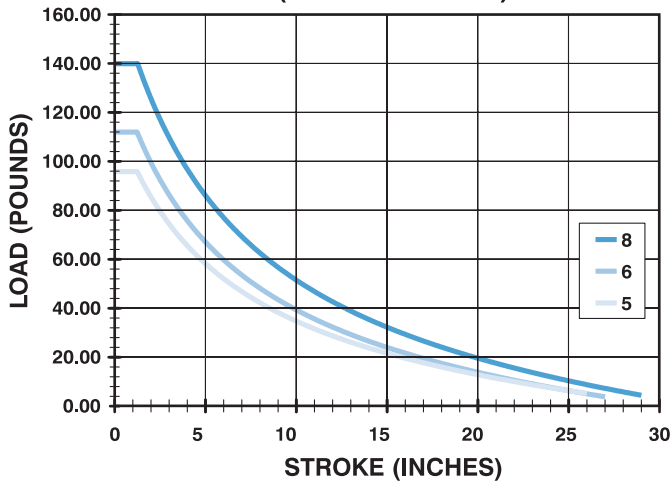


EXAMPLE 1

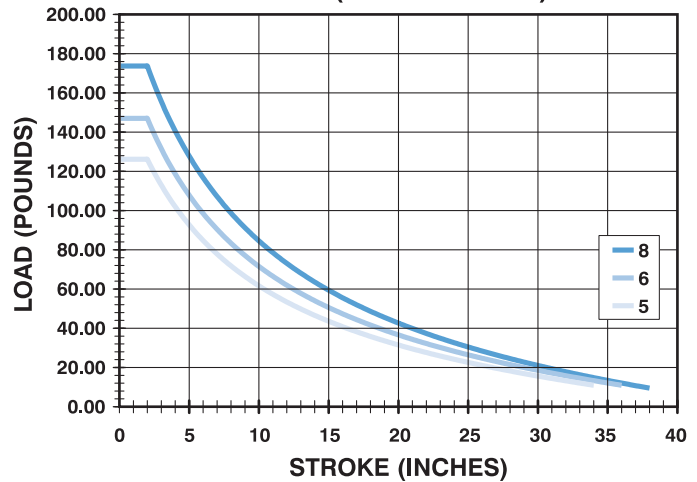


SINGLE ROD END: 5" - 8" Bore MAXIMUM RECOMMENDED LOAD

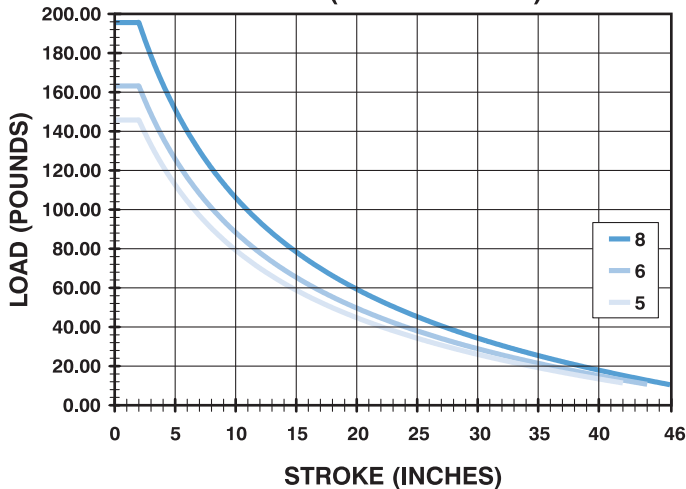
(NO STOP TUBE)



ST=2 (2" STOP TUBE)



ST=4 (4" STOP TUBE)



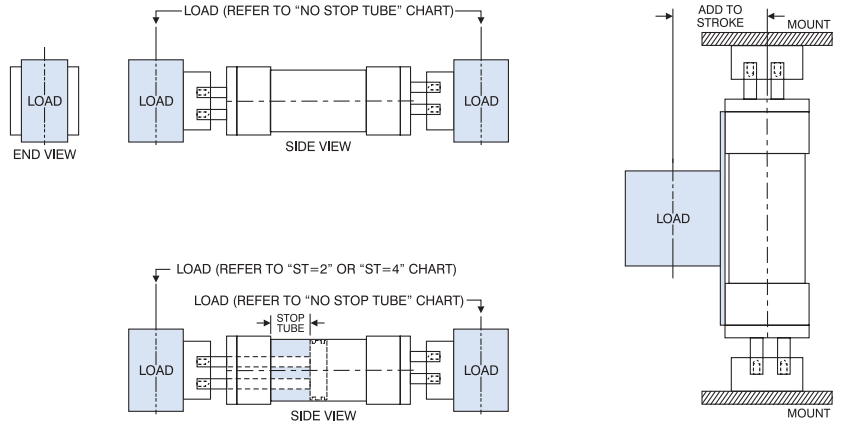
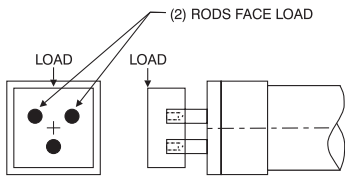
SERIES 'TRA': TECHNICAL DATA (D3 MODELS)

LOAD CHARTS: 1.50" - 4" BORE – *DOUBLE ROD END*

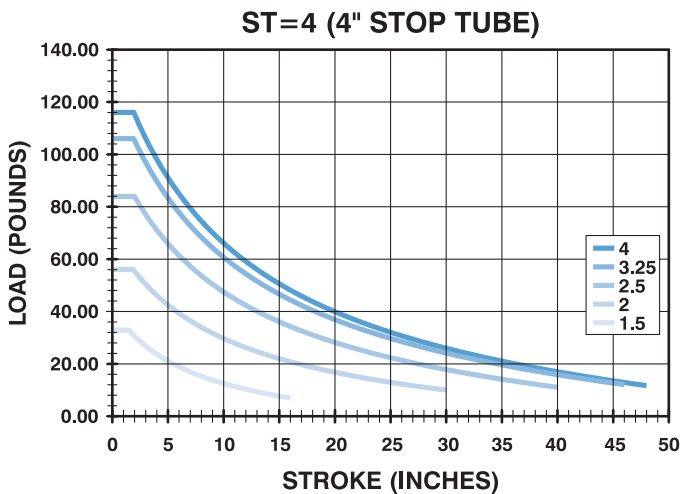
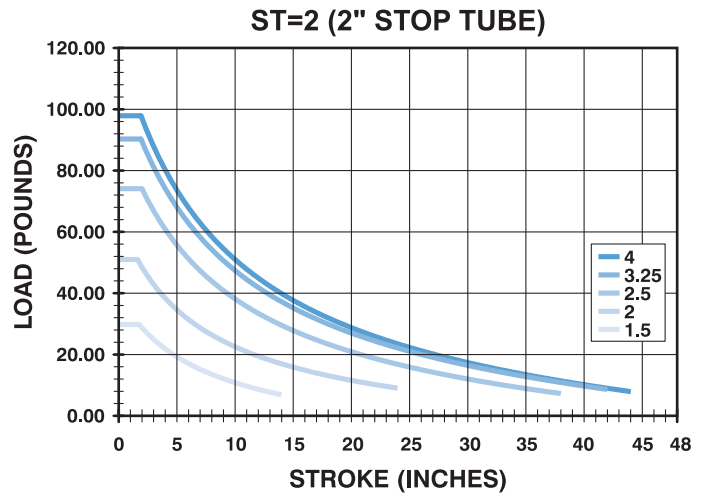
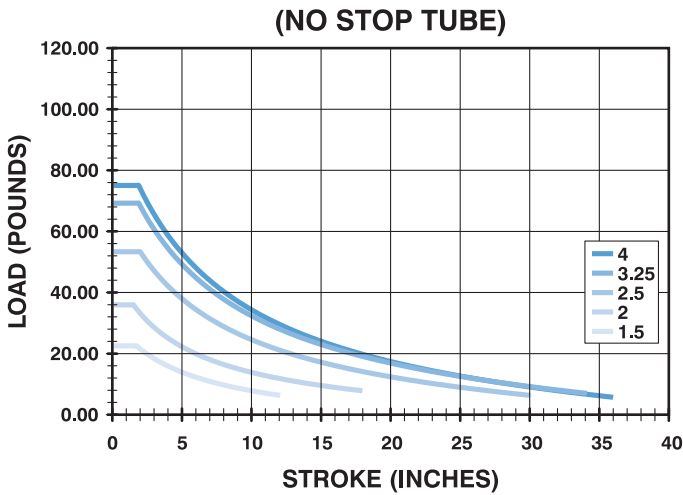
How to use LOAD CHARTS:

- 1.) Determine weight of LOAD (pounds)
- 2.) Refer to Load Charts for model selection

"Triple Rod" mounting to LOAD:



DOUBLE ROD END: 1.50" - 4" Bore MAXIMUM RECOMMENDED LOAD



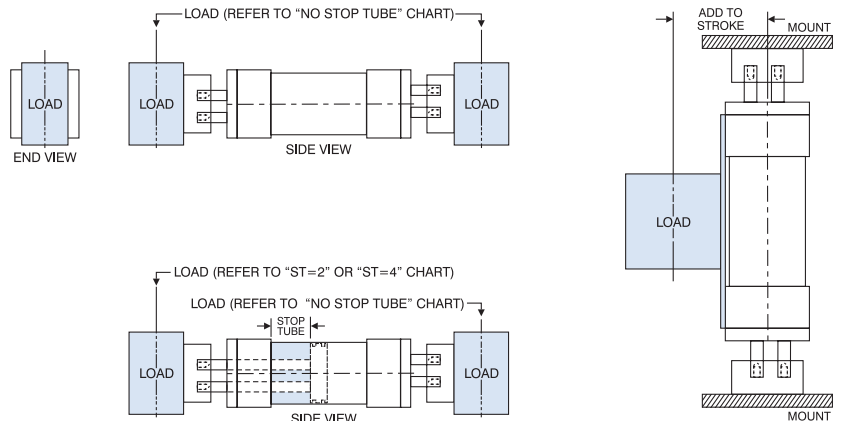
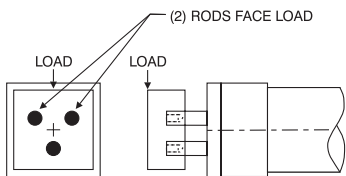
SERIES 'TRA': TECHNICAL DATA (D3 MODELS)

LOAD CHARTS: 5" - 8" BORE – DOUBLE ROD END

How to use LOAD CHARTS:

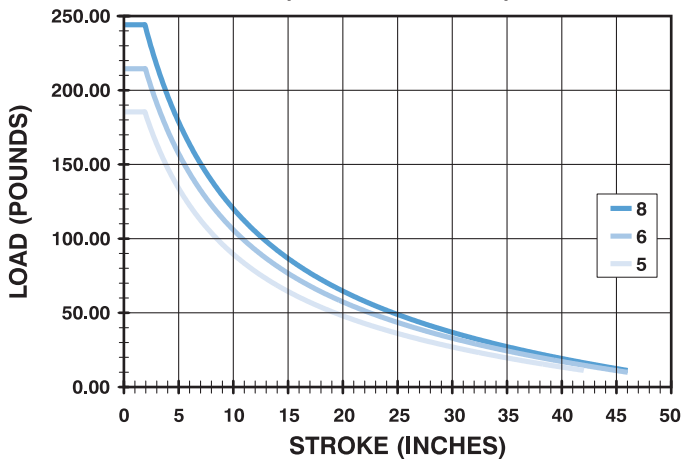
- 1.) Determine weight of LOAD (pounds)
- 2.) Refer to Load Charts for model selection

"Triple Rod" mounting to LOAD:

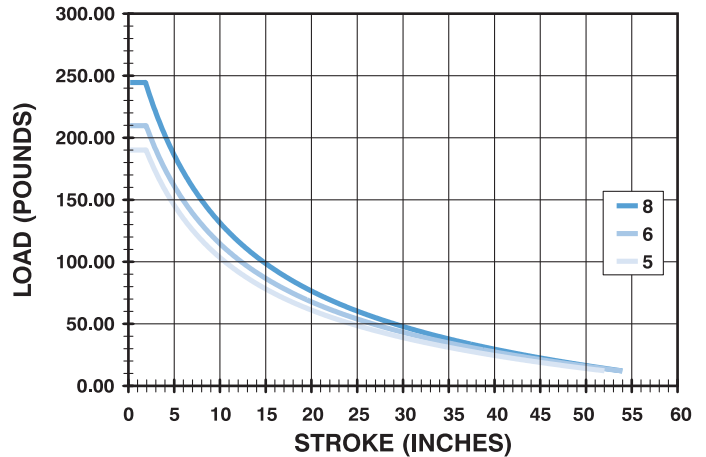


DOUBLE ROD END: 5" - 8" Bore MAXIMUM RECOMMENDED LOAD

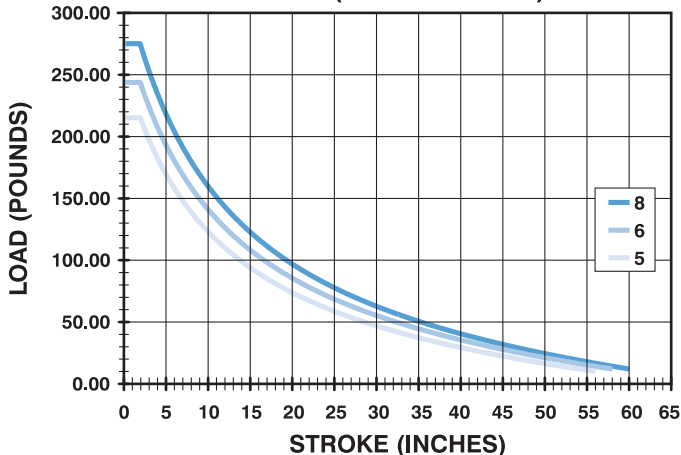
(NO STOP TUBE)



ST=2 (2" STOP TUBE)



ST=4 (4" STOP TUBE)

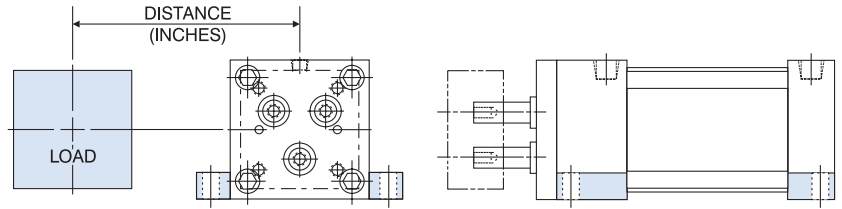


SERIES 'TRA': TECHNICAL DATA

TORQUE CHARTS

How to use TORQUE CHARTS:

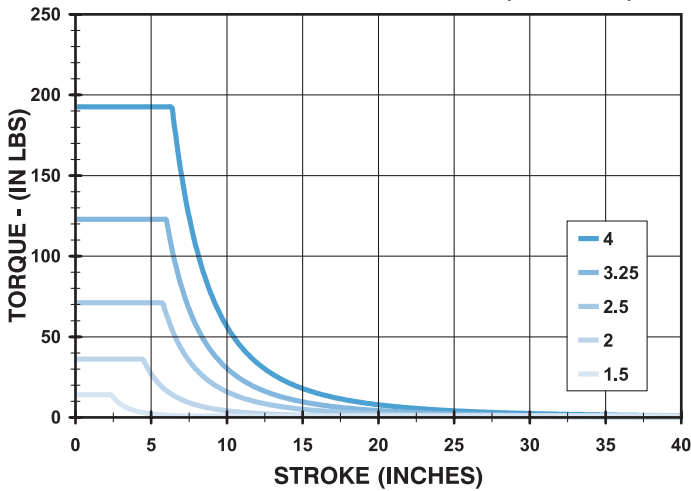
- 1.) Determine weight of LOAD (pounds)
- 2.) Determine DISTANCE (inches) of LOAD off center of Cylinder
- 3.) Multiply:
LOAD (in pounds) X DISTANCE (inches)
= Inch-Pounds of TORQUE
- 4.) Refer to Torque Charts for model selection



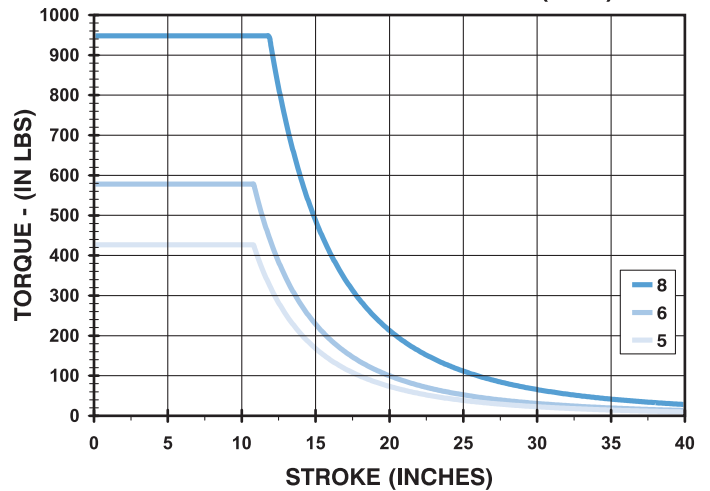
TORQUE (INCH-POUNDS)

(FOR NO STOP TUBE, ST=2" & ST=4" MODELS)

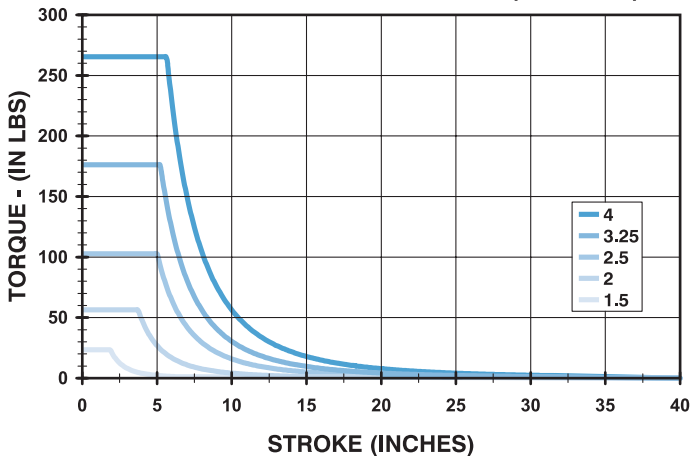
SINGLE ROD END TORQUE (1.50" - 4")



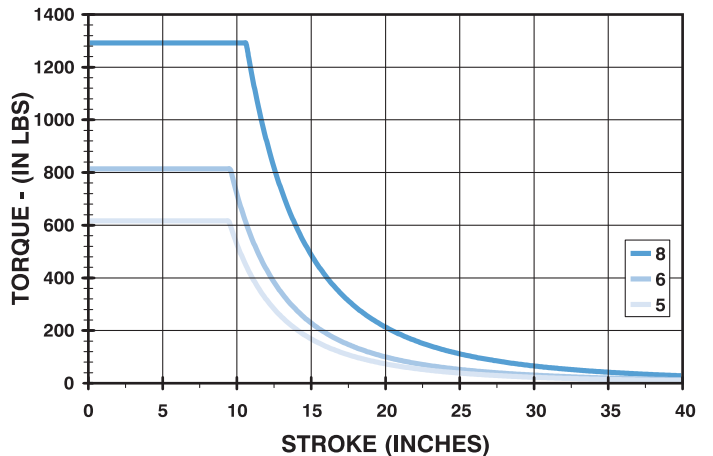
SINGLE ROD END TORQUE (5" - 8")



DOUBLE ROD END TORQUE (1.50" - 4")



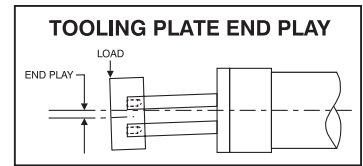
DOUBLE ROD END TORQUE (5" - 8")



SERIES 'TRA': TECHNICAL DATA

TOOLING PLATE "END PLAY" CHARTS

(Note: Tooling Plate "End Play" values include rod deflection due to weight of rods and tool plate, parts clearance, and maximum manufacturing tolerances.)



SINGLE ROD END CYLINDERS - NO STOP TUBE

1.50" - 8" BORE SINGLE ROD END CYLINDERS - NO STOP TUBE								
STROKE	1.50	2	2.50	3.25	4	5	6	8
0	0.006	0.006	0.006	0.006	0.009	0.010	0.010	0.007
2	0.015	0.017	0.013	0.013	0.022	0.024	0.023	0.018
4	0.024	0.027	0.021	0.021	0.034	0.038	0.037	0.030
6	0.033	0.037	0.029	0.028	0.047	0.051	0.051	0.042
8	0.042	0.047	0.037	0.036	0.059	0.065	0.065	0.053
10	0.051	0.058	0.044	0.044	0.071	0.079	0.079	0.065
12	—	0.068	0.052	0.051	0.084	0.092	0.093	0.077
14	—	0.078	0.060	0.059	0.096	0.106	0.106	0.088
16	—	—	0.067	0.066	0.109	0.120	0.120	0.100
18	—	—	0.075	0.074	0.121	0.133	0.134	0.112
20	—	—	0.083	0.081	0.134	0.147	0.148	0.123
22	—	—	—	0.089	0.146	0.161	0.162	0.135
24	—	—	—	0.097	0.158	0.174	0.176	0.147
26	—	—	—	—	—	0.188	0.190	0.158
28	—	—	—	—	—	—	0.203	0.170
30	—	—	—	—	—	—	—	0.182

SINGLE ROD END CYLINDERS - 2" STOP TUBE

1.50" - 8" BORE SINGLE ROD END CYLINDERS - 2" STOP TUBE								
STROKE	1.50	2	2.50	3.25	4	5	6	8
0	0.006	0.004	0.004	0.004	0.007	0.008	0.008	0.007
2	0.009	0.011	0.009	0.009	0.016	0.019	0.019	0.016
4	0.014	0.017	0.014	0.015	0.026	0.030	0.031	0.026
6	0.019	0.024	0.019	0.020	0.035	0.041	0.042	0.036
8	0.024	0.030	0.024	0.026	0.044	0.052	0.054	0.047
10	0.030	0.037	0.029	0.031	0.054	0.063	0.065	0.057
12	0.035	0.043	0.035	0.036	0.063	0.074	0.076	0.067
14	—	0.049	0.040	0.042	0.072	0.084	0.088	0.077
16	—	0.056	0.045	0.047	0.082	0.095	0.099	0.088
18	—	0.062	0.050	0.053	0.091	0.106	0.111	0.098
20	—	—	0.055	0.058	0.100	0.117	0.122	0.108
22	—	—	0.060	0.064	0.110	0.128	0.134	0.118
24	—	—	0.065	0.069	0.119	0.139	0.145	0.129
26	—	—	—	0.074	0.128	0.150	0.156	0.139
28	—	—	—	0.080	0.138	0.161	0.168	0.149
30	—	—	—	—	0.147	0.172	0.179	0.159
32	—	—	—	—	—	0.183	0.191	0.170
34	—	—	—	—	—	0.193	0.202	0.180
36	—	—	—	—	—	—	0.214	0.190
38	—	—	—	—	—	—	—	0.200

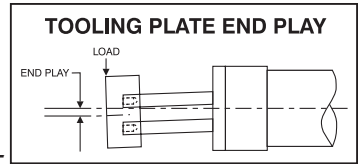
SINGLE ROD END CYLINDERS - 4" STOP TUBE

1.50" - 8" BORE SINGLE ROD END CYLINDERS - 4" STOP TUBE								
STROKE	1.50	2	2.50	3.25	4	5	6	8
0	0.002	0.003	0.003	0.003	0.005	0.006	0.008	0.005
2	0.006	0.007	0.006	0.007	0.012	0.015	0.015	0.014
4	0.009	0.012	0.010	0.011	0.019	0.023	0.025	0.022
6	0.013	0.016	0.014	0.015	0.026	0.032	0.034	0.031
8	0.016	0.021	0.017	0.019	0.033	0.040	0.043	0.039
10	0.020	0.025	0.021	0.023	0.040	0.049	0.052	0.048
12	0.024	0.030	0.024	0.027	0.047	0.057	0.061	0.057
14	0.027	0.035	0.028	0.031	0.054	0.066	0.070	0.065
16	—	0.039	0.032	0.035	0.061	0.074	0.080	0.074
18	—	0.044	0.035	0.039	0.068	0.083	0.089	0.083
20	—	0.048	0.039	0.043	0.075	0.091	0.098	0.091
22	—	0.053	0.043	0.047	0.082	0.100	0.107	0.100
24	—	0.057	0.046	0.050	0.089	0.108	0.116	0.109
26	—	—	0.050	0.054	0.096	0.117	0.125	0.117
28	—	—	0.053	0.058	0.103	0.125	0.135	0.126
30	—	—	0.057	0.062	0.110	0.134	0.144	0.135
32	—	—	—	0.066	0.117	0.142	0.153	0.143
34	—	—	—	0.070	0.124	0.151	0.162	0.152
36	—	—	—	0.074	0.131	0.159	0.171	0.161
38	—	—	—	—	0.138	0.168	0.180	0.169
40	—	—	—	—	—	0.176	0.190	0.178
42	—	—	—	—	—	0.185	0.199	0.187
44	—	—	—	—	—	—	0.208	0.195
46	—	—	—	—	—	—	—	0.204

SERIES 'TRA': TECHNICAL DATA

TOOLING PLATE "END PLAY" CHARTS (D3 MODELS)

(Note: Tooling Plate "End Play" values include rod deflection due to weight of rods and tool plate, parts clearance, and maximum manufacturing tolerances.)



DOUBLE ROD END CYLINDERS - NO STOP TUBE

1.50" - 8" BORE DOUBLE ROD END CYLINDERS - NO STOP TUBE								
STROKE	1.50	2	2.50	3.25	4	5	6	8
0	0.003	0.003	0.003	0.003	0.003	0.004	0.005	0.004
2	0.007	0.008	0.006	0.006	0.011	0.012	0.011	0.009
4	0.012	0.013	0.010	0.010	0.017	0.019	0.018	0.015
6	0.017	0.018	0.014	0.014	0.023	0.025	0.025	0.021
8	0.021	0.023	0.018	0.018	0.029	0.032	0.032	0.026
10	0.026	0.029	0.022	0.022	0.035	0.039	0.039	0.032
12	0.031	0.034	0.026	0.025	0.042	0.046	0.046	0.038
14	—	0.038	0.030	0.029	0.048	0.053	0.053	0.044
16	—	0.044	0.033	0.033	0.054	0.060	0.060	0.050
18	—	0.050	0.037	0.037	0.060	0.066	0.067	0.056
20	—	—	0.041	0.040	0.067	0.073	0.074	0.061
22	—	—	0.045	0.044	0.073	0.080	0.081	0.067
24	—	—	0.049	0.048	0.079	0.087	0.088	0.073
26	—	—	0.053	0.052	0.085	0.094	0.095	0.079
28	—	—	0.057	0.056	0.091	0.100	0.101	0.085
30	—	—	0.060	0.059	0.098	0.107	0.108	0.091
32	—	—	—	0.063	0.104	0.114	0.115	0.096
34	—	—	—	—	0.110	0.121	0.122	0.102
36	—	—	—	—	0.116	0.128	0.129	0.108
38	—	—	—	—	—	0.135	0.136	0.114
40	—	—	—	—	—	—	0.143	0.120
42	—	—	—	—	—	—	0.150	0.126

DOUBLE ROD END CYLINDERS - 2" STOP TUBE

1.50" - 8" BORE DOUBLE ROD END CYLINDERS - 2" STOP TUBE								
STROKE	1.50	2	2.50	3.25	4	5	6	8
0	0.003	0.003	0.003	0.003	0.004	0.004	0.004	0.003
2	0.005	0.005	0.005	0.005	0.008	0.009	0.009	0.008
4	0.007	0.009	0.007	0.008	0.013	0.015	0.015	0.013
6	0.009	0.012	0.009	0.010	0.017	0.020	0.021	0.018
8	0.012	0.015	0.012	0.013	0.022	0.026	0.027	0.023
10	0.015	0.018	0.014	0.015	0.027	0.031	0.032	0.028
12	0.018	0.021	0.017	0.018	0.031	0.037	0.038	0.033
14	0.020	0.025	0.020	0.021	0.036	0.042	0.044	0.038
16	—	0.028	0.022	0.023	0.041	0.047	0.049	0.044
18	—	0.031	0.025	0.026	0.045	0.053	0.055	0.049
20	—	0.034	0.027	0.029	0.050	0.058	0.061	0.054
22	—	0.037	0.030	0.032	0.055	0.064	0.067	0.059
24	—	0.041	0.032	0.034	0.059	0.069	0.072	0.064
26	—	—	0.035	0.037	0.064	0.075	0.078	0.069
28	—	—	0.037	0.040	0.069	0.080	0.084	0.074
30	—	—	0.040	0.042	0.073	0.086	0.089	0.079
32	—	—	0.043	0.045	0.078	0.091	0.095	0.085
34	—	—	0.045	0.048	0.083	0.096	0.101	0.090
36	—	—	0.048	0.050	0.088	0.102	0.107	0.095
38	—	—	0.051	0.053	0.092	0.107	0.112	0.100
40	—	—	—	0.056	0.097	0.113	0.118	0.105
42	—	—	—	0.059	0.101	0.118	0.124	0.110
44	—	—	—	—	0.106	0.124	0.129	0.115
46	—	—	—	—	—	0.129	0.135	0.120
48	—	—	—	—	—	0.135	0.141	0.126
50	—	—	—	—	—	0.140	0.147	0.131
52	—	—	—	—	—	0.145	0.152	0.136
54	—	—	—	—	—	—	0.158	0.141

DOUBLE ROD END CYLINDERS - 4" STOP TUBE

1.50" - 8" BORE DOUBLE ROD END CYLINDERS - 4" STOP TUBE								
STROKE	1.50	2	2.50	3.25	4	5	6	8
0	0.002	0.003	0.003	0.003	0.004	0.004	0.004	0.003
2	0.003	0.004	0.004	0.004	0.006	0.007	0.007	0.007
4	0.004	0.006	0.005	0.005	0.009	0.011	0.012	0.011
6	0.006	0.008	0.007	0.007	0.013	0.016	0.017	0.015
8	0.008	0.010	0.008	0.009	0.016	0.020	0.021	0.019
10	0.010	0.012	0.010	0.011	0.020	0.024	0.026	0.024
12	0.012	0.015	0.012	0.013	0.023	0.028	0.030	0.028
14	0.014	0.017	0.014	0.015	0.027	0.033	0.035	0.032
16	0.016	0.020	0.016	0.017	0.030	0.037	0.040	0.037
18	—	0.022	0.017	0.019	0.034	0.041	0.044	0.041
20	—	0.024	0.019	0.021	0.038	0.045	0.049	0.045
22	—	0.026	0.021	0.023	0.041	0.050	0.053	0.050
24	—	0.028	0.023	0.025	0.044	0.054	0.058	0.054
26	—	0.031	0.025	0.027	0.048	0.058	0.062	0.058
28	—	0.033	0.026	0.029	0.051	0.062	0.067	0.063
30	—	0.035	0.028	0.031	0.055	0.067	0.072	0.067
32	—	—	0.030	0.033	0.058	0.071	0.076	0.071
34	—	—	0.032	0.035	0.062	0.075	0.081	0.076
36	—	—	0.034	0.037	0.065	0.079	0.085	0.080
38	—	—	0.036	0.039	0.069	0.084	0.090	0.084
40	—	—	0.038	0.041	0.072	0.088	0.095	0.089
42	—	—	—	0.043	0.076	0.092	0.099	0.093
44	—	—	—	0.045	0.079	0.096	0.104	0.097
46	—	—	—	0.047	0.083	0.101	0.108	0.102
48	—	—	—	—	0.086	0.105	0.113	0.106
50	—	—	—	—	—	0.109	0.117	0.110
52	—	—	—	—	—	0.113	0.122	0.115
54	—	—	—	—	—	0.117	0.127	0.119
56	—	—	—	—	—	0.122	0.131	0.123
58	—	—	—	—	—	—	0.136	0.128
60	—	—	—	—	—	—	—	0.132

SERIES 'TRA': TECHNICAL DATA

WEIGHT CHART - TRIPLE ROD BASIC CYLINDERS

(WEIGHT IN POUNDS)

BORE	MXO	MS4	MS2 BASE BAR	* MP1	* MP2	* MP4	MF1 ME4	MF2	ME5	ADD PER INCH OF STROKE
1.50	2.2	2.2	2.5	2.7	2.8	2.8	2.8	2.9	N/A	0.19
2	3.7	3.7	4.0	4.5	4.6	4.6	4.5	4.7	N/A	0.34
2.50	6.0	6.0	6.5	7.0	7.2	7.2	7.1	7.4	N/A	0.45
3.25	10.1	10.1	11.0	12.8	13.7	13.7	13.1	13.5	N/A	0.52
4	15.0	15.0	16.2	18.3	19.5	19.5	19.3	19.7	N/A	0.55
5	24.0	24.0	25.3	28.6	30.7	N/A	30.5	31.1	N/A	1.10
6	35.2	35.2	36.6	43.4	45.9	N/A	45.8	46.7	N/A	1.15
8	50.8	50.8	N/A	58.9	N/A	N/A	50.8 (ME4)	N/A	56.7	1.50

All weights are in pounds & include tooling plate.

*Weight includes clevis pins.

WEIGHT CHART - TRIPLE ROD DOUBLE END

(WEIGHT IN POUNDS) (D3 MODELS)

BORE	MXOD	MS4D	MS2D BASE BAR	MF1D ME4D	ADD PER INCH OF STROKE
1.50	4.3	4.3	4.6	4.9	0.30
2	6.2	6.2	6.5	7	0.55
2.50	11.2	11.2	11.7	12.3	0.75
3.25	18.5	18.5	19.4	21.5	0.82
4	26.4	26.4	27.6	30.7	0.85
5	42.9	42.9	44.3	49.4	1.83
6	59.8	59.8	61.4	70.4	1.95
8	75.8	75.8	N/A	75.0 (ME4D)	2.45

All weights are in pounds & include tooling plate.

WEIGHT CHART - TOOLING PLATE

(WEIGHT IN POUNDS)

BORE	WEIGHT	BORE	WEIGHT	BORE	WEIGHT	BORE	WEIGHT
1.50	0.45	2.50	1.5	4	4.16	6	9.30
2	0.70	3.25	2.7	5	6.25	8	17.0

TORQUE CHART - CYLINDER TIE RODS

BORE	TIE ROD THREAD SIZE	TORQUE IN FT.-LBS.
1.50	.25-28	7
2	.31-24	12
2.50	.31-24	14
3.25	.38-24	30
4	.38-24	35
5	.50-20	45
6	.50-20	50
8	.63-18	125

Tighten cylinders using an "X" tightening pattern on tie rods.

TORQUE CHART - RETAINER SCREWS

BORE	RETAINER SCREW THREAD SIZE	TORQUE IN FT.-LBS.
1.50	.25-28	7
2	.31-24	12
2.50	.31-24	12
3.25	.38-24	22
4	.38-24	22
5	.50-20	35
6	.50-20	35
8	.25-28	7

1.50" - 6" bore have full square retainer plate, 8" bore has (3) separate round retainer plates.

TRIPLE ROD FORCE/VOLUME CHART

BORE	STROKE TYPE	EFFECTIVE PISTON AREA	POUNDS OF FORCE AT PSI						CU. FT. DISPLACEMENT PER IN. OF STROKE
			60	80	100	200	250	400	
1.50	PUSH	1.767	106	142	177	353	442	706	.00102
	PULL	1.536	92	123	154	308	384	614	.00089
2	PUSH	3.142	188	251	314	628	785	1256	.00182
	PULL	2.553	153	204	255	510	638	1021	.00147
2.50	PUSH	4.909	295	393	491	982	1227	1962	.00284
	PULL	3.989	239	319	399	798	997	1595	.00231
3.25	PUSH	8.296	498	664	830	1660	2074	3318	.00480
	PULL	7.376	442	590	738	1476	1844	2950	.00427
4	PUSH	12.566	754	1005	1257	2514	3141	5026	.00727
	PULL	11.646	699	932	1165	2330	2911	4658	.00674
5	PUSH	19.635	1178	1571	1964	3928	4908	7854	.01136
	PULL	17.279	1037	1382	1728	3456	4320	6911	.00999
6	PUSH	28.274	1696	2262	2827	5654	7068	11310	.01636
	PULL	25.918	1555	2073	2592	5184	6479	10367	.01499
8	PUSH	50.265	3016	4021	5026	10052	12566	20106	.02908
	PULL	47.909	2874	3832	4791	9582	11977	19163	.02773

'TR' SERIES: DESIGN REVISION ENHANCEMENT

'TR' Series (250 PSI Air) is superseded by 'TRA' Series (effective 5/01/03)

'TR-TH' (400 PSI Hyd.) Series is superseded by 'TRA' Series with 'TH' option (effective 5/01/03)

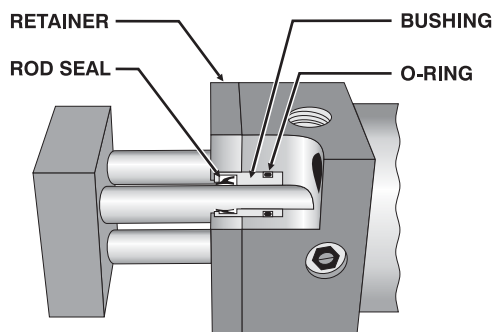
TRD's 'TR' Series has been redesigned. The new 'TRA' Series is a **Heavy-Duty** version of the obsolete 'TR' Series. The new series is a drop-in replacement of the previous model. Overall dimensions are not affected*. The affected service parts are listed below for reference. Any existing 'TR' Series in service can be fitted with the new 'TRA' Series **Heavy-Duty** Bushing design. A new set of (3) Bushings, (3 sets) Seals and (1) Retainer are required.

(Note: A 'TR' model fitted with the **heavy-duty** bushings will not be rated for the same load capacity as the 'TRA' Series.

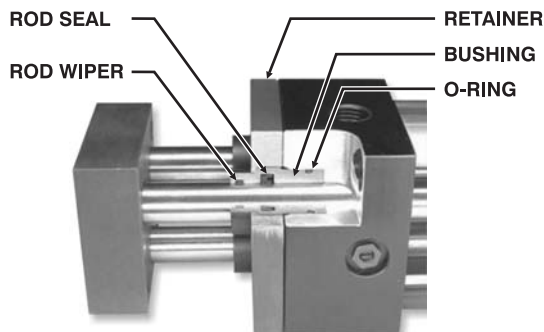
A new Piston & Rod assembly with wear band is required to receive the same load capacity rating as the 'TRA' Series.)

*Option "MPR-WB" will add .50" to overall cylinder length - 1.50", 2" & 2.50" bores only.

'TR' Series



'TRA' Series



'TR' SERIES PARTS				
BORE	BUSHING (3 Req'd)	O-RING (3 Req'd)	ROD SEAL (3 Req'd)	RETAINER (1 Req'd)
1.50	TR-B-30-1	TR/BO-312	TR/RW-312	TR-36-15
2	TR-B-30-2	TR/BO-500	TR/RW-500	TR-36-20
2.50	TR-B-30-3	TR/BO-625	TR/RW-625	TR-36-25
3.25	TR-B-30-3	TR/BO-625	TR/RW-625	TR-36-32
4	TR-B-30-3	TR/BO-625	TR/RW-625	TR-36-40
5	TR-B-30-4	TR/BO-1000	TR/RW-1000	TR-36-50
6	TR-B-30-4	TR/BO-1000	TR/RW-1000	TR-36-60
8	TR-B-30-BZ	BO-2	RW-1000 RS-1000	A-35-2 (3 Req'd)

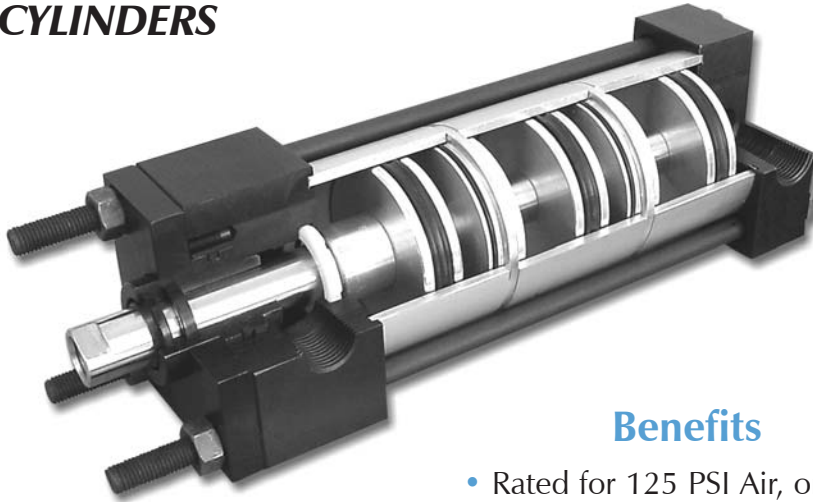
'TRA' SERIES PARTS						
BORE	BUSHING (3 Req'd)	O-RING (3 Req'd)	ROD SEAL (3 Req'd)	ROD WIPER (3 Req'd)	RETAINER (1 Req'd)	RETAINER KIT (RK) (3 Bushings w/ Seals & (1) Retainer Plate)
1.50	TRHD-30-1	TR-BO-312	RS-312	RW-312	TRHD-36-15	TRA-15-RK
2	TRHD-30-2	TR-BO-500	RS-500	RW-500	TRHD-36-20	TRA-20-RK
2.50	TRHD-30-3	TR-BO-625	RS-625	RW-625	TRHD-36-25	TRA-25-RK
3.25	TRHD-30-4	TR-BO-625	RS-625	RW-625	TRHD-36-32	TRA-32-RK
4	TRHD-30-4	TR-BO-625	RS-625	RW-625	TRHD-36-40	TRA-40-RK
5	TRHD-30-5	TR-BO-1000	RS-1000	RW-1000	TRHD-36-50	TRA-50-RK
6	TRHD-30-6	TR-BO-1000	RS-1000	RW-1000	TRHD-36-60	TRA-60-RK
8	A-30-2	BO-2	RS-1000	RW-1000	A-35-2 (3 Req'd)	N/A

'TR-TH' SERIES PARTS				
BORE	BUSHING (3 Req'd)	O-RING (3 Req'd)	ROD SEAL (3 Req'd)	RETAINER (1 Req'd)
1.50	TH/TR-B-30-1	TR/BO-312	TR/TH-312	TR-36-15
2	TH/TR-B-30-2	TR/BO-500	TR/TH-500	TR-36-20
2.50	TH/TR-B-30-3	TR/BO-625	TR/TH-625	TR-36-25
3.25	TH/TR-B-30-3	TR/BO-625	TR/TH-625	TR-36-32
4	TH/TR-B-30-3	TR/BO-625	TR/TH-625	TR-36-40
5	TH/TR-B-30-4	TR/BO-1000	TR/TH-1000	TR-36-50
6	TH/TR-B-30-4	TR/BO-1000	TR/TH-1000	TR-36-60
8	TH-30-2	BO-2	RS-1000 TH-1000	A-35-2 (3 Req'd)

'TRA' SERIES - WITH 'TH' OPTION - PARTS						
BORE	BUSHING (3 Req'd)	O-RING (3 Req'd)	ROD SEAL (3 Req'd)	ROD WIPER (3 Req'd)	RETAINER (1 Req'd)	RETAINER KIT (RK) (3 Bushings w/ Seals & (1) Retainer Plate)
1.50	TRHD-30-1	TR-BO-312	RS-312	RW-312	TRHD-36-15	TRH-15-RK
2	TRHD-30-2	TR-BO-500	RS-500	RW-500	TRHD-36-20	TRH-20-RK
2.50	TRHD-30-3	TR-BO-625	RS-625	RW-625	TRHD-36-25	TRH-25-RK
3.25	TRHD-30-4	TR-BO-625	RS-625	RW-625	TRHD-36-32	TRH-32-RK
4	TRHD-30-4	TR-BO-625	RS-625	RW-625	TRHD-36-40	TRH-40-RK
5	TRHD-30-5	TR-BO-1000	RS-1000	RW-1000	TRHD-36-50	TRH-50-RK
6	TRHD-30-6	TR-BO-1000	RS-1000	RW-1000	TRHD-36-60	TRH-60-RK
8	TH-30-2	BO-2	RS-1000	RW-1000	A-35-2 (3 Req'd)	N/A

SERIES 'MS': MULTI-STAGE

FORCE MULTIPLYING CYLINDERS



Benefits

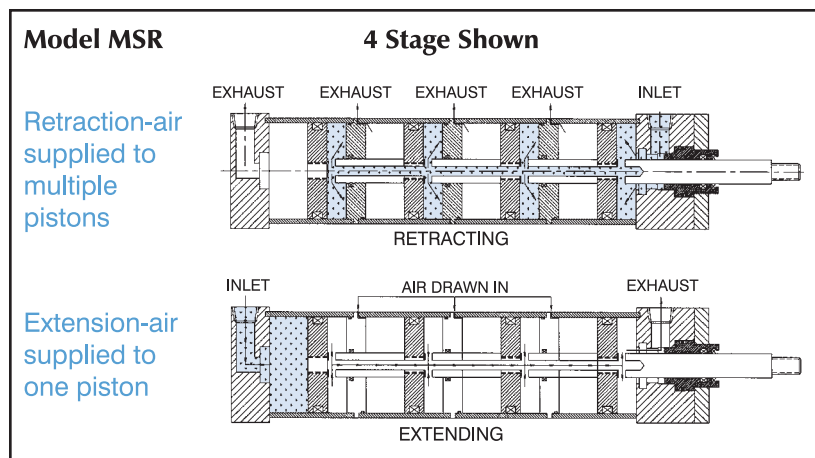
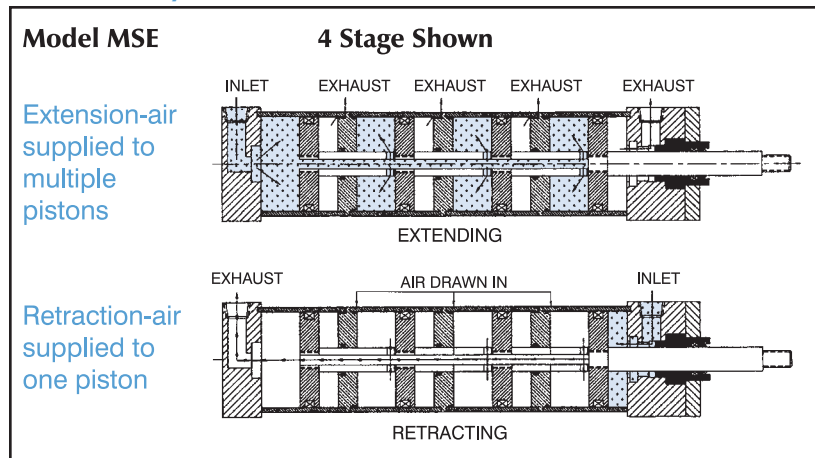
- Rated for 125 PSI Air, or Hydraulic (non-shock)
- Eliminates the need for high pressure systems
- Heavy Duty construction
- Bore size vs. output force saves space
- 2 Stage, 3 Stage, 4 Stage & 5 Stage models
- Optional Double Rod End Models available
- Optional force multiplying in both extend and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

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.

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

How they work



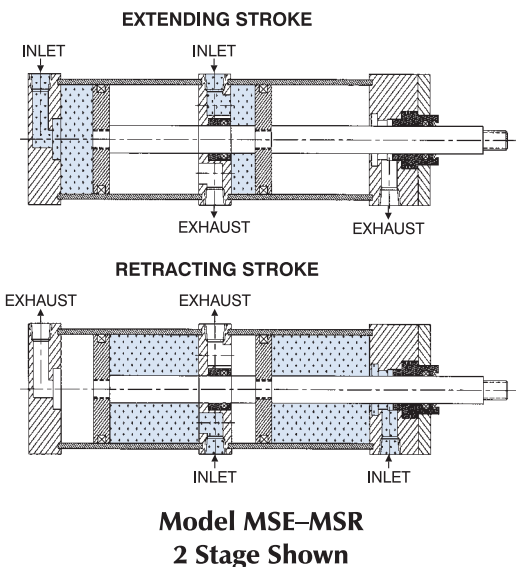
Force multiplying in both Extend and Retract strokes

(Note: Overall lengths are increased-consult factory for details)

To Order, specify:

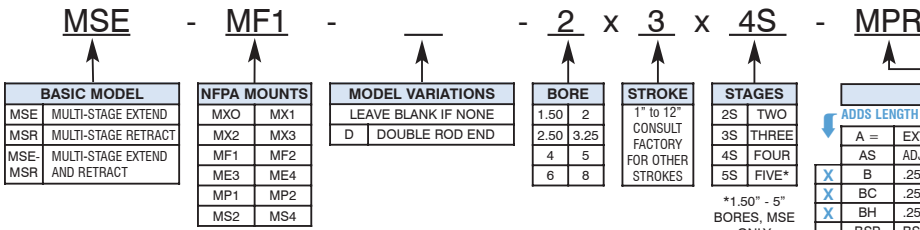
“MSE-MSR” as model number.

Extension AND Retraction-air supplied to multiple pistons



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

- Multi-Stage NFPA Mount Cylinders
- Force Multiplier Air and Non-Shock Hydraulic Cylinders 125 PSI
- Eight Bore Sizes 1.50" - 8" Bores
- Extend 2, 3, 4 or 5 Stages, thru 5" Bores
- Extend or Retract 2, 3 or 4 Stages, thru 8" Bores
- Exposed Tie Rod and Nut Construction (similar to 'TA')
- 'FM' Flush Mount Construction available as an option



ORDERING EXAMPLES:

EXAMPLE 1: MF1 3.25" Bore, 2" Stroke, 3 Stage Force Multiplied in EXTEND is:
MSE MF1 3.25" x 2 x 3S

EXAMPLE 2: Double Rod End MS4 Mount, 2 Stage, 6" Bore, 3" Stroke, Force Multiplied in RETRACT with Magnetic Piston for REED Switches is:
MSR MS4D 6 x 3 x 2S - MPR
(Note: MPR Option adds 7" 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	.50	.25	.25	.63	.63	2
2	.50	.25	.25	.63	.63	2
2.50	.50	.25	.25	.75	.75	2
3.25	.50	.25	.25	.63	.63	2
4	.50	.25	.25	.63	.63	2
5	.50	.25	.25	.88	.88	2
6	.50	.25	.25	.75	.75	2
8	.50	.25	.25	.88	.88	2

*Note: The desired Stop Tube length adds directly to the overall cylinder length.

OPTIONS	
ADDS LENGTH TO CYLINDER - SEE "OPTION LENGTH ADDER" CHART BELOW.	
A =	EXTENDED PISTON ROD THREAD (Example: A = 2")
AS	ADJUSTABLE STROKE - RETRACT (SPECIFY LENGTH, Example: AS = 4")
X B	.25" URETHANE BUMPER BOTH ENDS
X BC	.25" URETHANE BUMPER CAP ONLY
X BH	.25" URETHANE BUMPER HEAD ONLY
BSP	BSP PORTS (SPECIFY SIZE, Example: BSP = .25")
C =	EXTENDED PISTON ROD (Example: IF C = 0.50", THEN 1" ROD EXTENSION IS C = 1.50")
C	CAP CUSHION (Available on MSR only)
EN	ELECTROLESS NICKEL PLATED (Refer to page 84 for specifications)
FM	FLUSH MOUNT HEAD AND CAP (Refer to factory for dimensions)
H	HEAD CUSHION (Available on MSE only)
KK2	LARGE MALE ROD THREAD
KK3	FEMALE ROD THREAD
KK3S	STUDDER PISTON ROD (KK3 with Stud, Loctite in place)
KK4	FULL DIAMETER MALE ROD THREAD
KK5	BLANK ROD END (NO THREADS, "A" = 0")
MA	MICRO-ADJUST (6" MAX. STROKE) Available on Double Rod End Models
MAB	MICRO-ADJUST WITH SOUND DAMPENING BUMPER (6" MAX. STROKE)
X MPR	MAGNETIC PISTON FOR REED OR SOLID STATE SWITCHES - TRD MODELS: R10, R10P, RAC, RHT & MSS (Refer to pages 107-113 for selection)
MS	METALLIC ROD SCRAPER (BRASS CONSTRUCTION)
X NR	NON-ROTATING (Refer to page 86 for specifications)
OP	OPTIONAL PORT LOCATION (Example: Ports @ 3 & 7)
OS	OVERSIZE ROD DIAMETER (SPECIFY SIZE, Example: OS = 1.38")
SAE	SAE PORTS (SPECIFY SIZE, Example: SAE #10)
SSA	STAINLESS STEEL PISTON ROD, TIE RODS & NUTS, AND FASTENERS
SSF	STAINLESS STEEL FASTENERS
SSR	STAINLESS STEEL PISTON ROD
SST	STAINLESS STEEL TIE RODS & NUTS
X ST	STOP TUBE (SPECIFY STOP TUBE LENGTH AND EFFECTIVE STROKE) (Example: MSE-MS4 2 X 12" EFFECTIVE STROKE - 2S - ST=3)
STEEL TUBE	STEEL CYLINDER TUBE, BLACK EPOXY PAINT FINISH*
TH	400 PSI HYDRAULIC NON-SHOCK (Refer to page 90 for specifications)
VS	FLUOROCARBON SEALS
XX	SPECIAL VARIATION (SPECIFY)

*STEEL TUBES do not work with MPR pistons. Refer to page 114-117 for Balluff end of stroke sensors.

SERIES 'MS' DIMENSIONS: MULTI-STAGE

About Rod End Styles

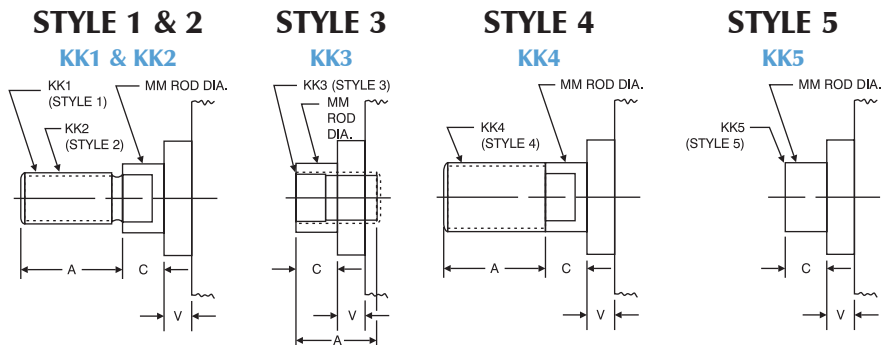
Style 1 Male Rod End is STANDARD

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!

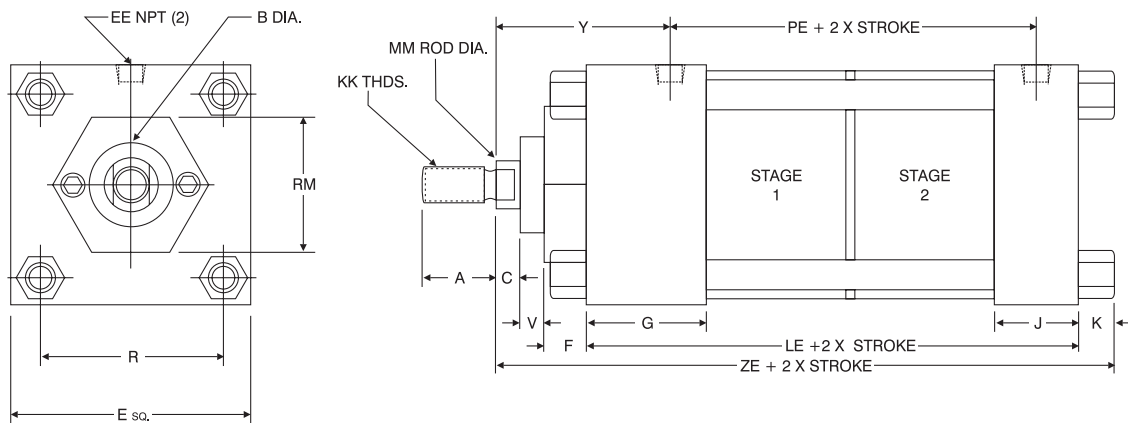
PISTON ROD END STYLES



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, 2.50	.63 Standard	.44-20	.75	.50-20	.75	.44-20	.75	.63-18	.75	No Threads	.38	.25	
	1 Oversize	.75-16	1.13	.88-14	1.13	.75-16	1.13	1-14	1.13	No Threads	.50	.50	
3.25, 4, 5	1 Standard	.75-16	1.13	.88-14	1.13	.75-16	1.13	1-14	1.13	No Threads	.50	.25	
	1.38 Oversize	1-14	1.63	1.25-12	1.63	1-14	1.63	1.38-12	1.63	No Threads	.63	.38	
6 & 8	1.38 Standard	1-14	1.63	1.25-12	1.63	1-14	1.63	1.38-12	1.63	No Threads	.63	.38	
	1.75 Oversize	1.25-12	2	1.50-12	2	1.25-12	2	1.75-12	2	No Threads	.75	.50	

SERIES 'MS' DIMENSIONS: 2 STAGE EXTEND OR RETRACT

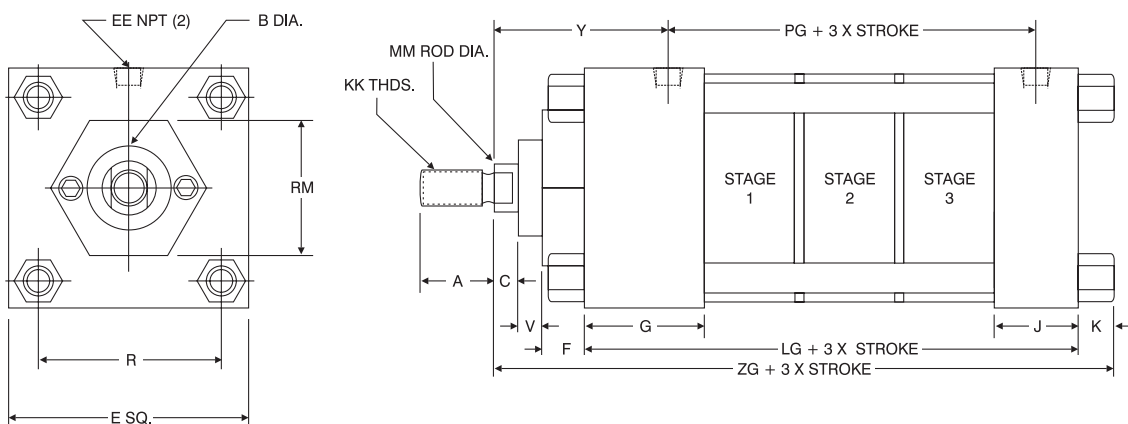
STANDARD ROD DIAMETER BASIC DIMENSIONS 'MXO' (NO MOUNT)



BORE	A	B	C	E	EE	F	G	J	K	KK	LE	MM	PE	R	RM	V	Y	ZE
1.50	.75	1.13	.38	2	.38	.38	1.50	1	.25	.44-20	4	.63	2.75	1.43	2 SQ.	.25	1.88	5.25
2	.75	1.13	.38	2.50	.38	.38	1.50	1	.31	.44-20	4	.63	2.75	1.84	1.75 HEX	.25	1.88	5.31
2.50	.75	1.13	.38	3	.38	.38	1.50	1	.31	.44-20	4	.63	2.75	2.19	1.75 HEX	.25	1.88	5.31
3.25	1.13	1.50	.50	3.75	.50	.63	1.75	1.25	.38	.75-16	4.88	1	3.38	2.76	2.75 DIA.	.25	2.38	6.63
4	1.13	1.50	.50	4.50	.50	.63	1.75	1.25	.38	.75-16	4.88	1	3.38	3.32	2.75 DIA.	.25	2.38	6.63
5	1.13	1.50	.50	5.50	.50	.63	1.75	1.25	.44	.75-16	4.88	1	3.38	4.10	2.75 DIA.	.25	2.38	6.69
6	1.63	2	.63	6.50	.75	.63	2	1.50	.44	1-14	5.75	1.38	4	4.88	3.50 DIA.	.38	2.75	7.81
8	1.63	2	.63	8.50	.75	.63	2	1.50	.56	1-14	5.75	1.38	4	6.44	3.50 DIA.	.38	2.75	7.94

3 STAGE EXTEND OR RETRACT

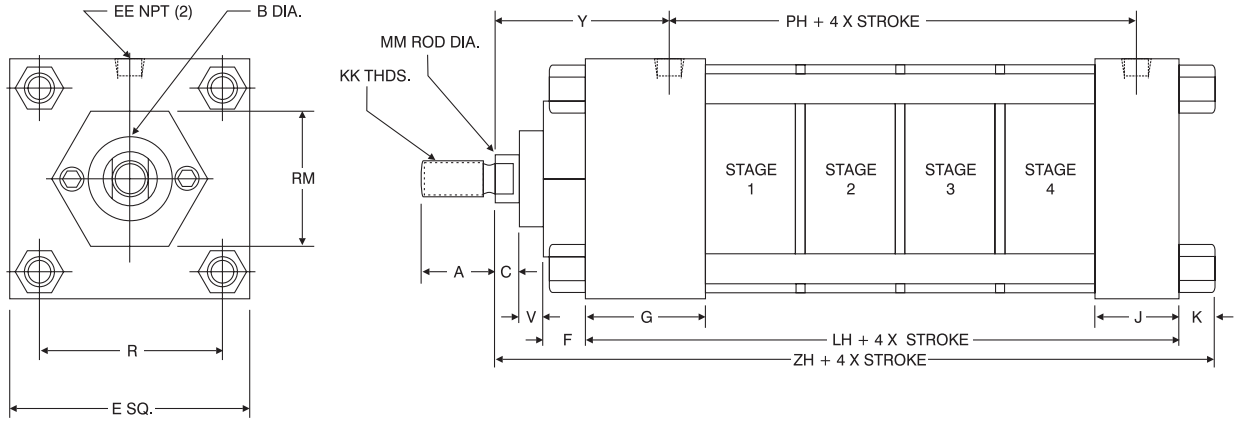
STANDARD ROD DIAMETER BASIC DIMENSIONS 'MXO' (NO MOUNT)



BORE	A	B	C	E	EE	F	G	J	K	KK	LG	MM	PG	R	RM	V	Y	ZG
1.50	.75	1.13	.38	2	.38	.38	1.50	1	.25	.44-20	5	.63	3.75	1.43	2 SQ.	.25	1.88	6.25
2	.75	1.13	.38	2.50	.38	.38	1.50	1	.31	.44-20	5	.63	3.75	1.84	1.75 HEX	.25	1.88	6.31
2.50	.75	1.13	.38	3	.38	.38	1.50	1	.31	.44-20	5	.63	3.75	2.19	1.75 HEX	.25	1.88	6.31
3.25	1.13	1.50	.50	3.75	.50	.63	1.75	1.25	.38	.75-16	6.13	1	4.63	2.76	2.75 DIA.	.25	2.38	7.88
4	1.13	1.50	.50	4.50	.50	.63	1.75	1.25	.38	.75-16	6.13	1	4.63	3.32	2.75 DIA.	.25	2.38	7.88
5	1.13	1.50	.50	5.50	.50	.63	1.75	1.25	.44	.75-16	6.13	1	4.63	4.10	2.75 DIA.	.25	2.38	7.94
6	1.63	2	.63	6.50	.75	.63	2	1.50	.44	1-14	7.25	1.38	5.50	4.88	3.50 DIA.	.38	2.75	9.31
8	1.63	2	.63	8.50	.75	.63	2	1.50	.56	1-14	7.25	1.38	5.50	6.44	3.50 DIA.	.38	2.75	9.44

'MS' SERIES CYLINDERS: 4 STAGE EXTEND OR RETRACT

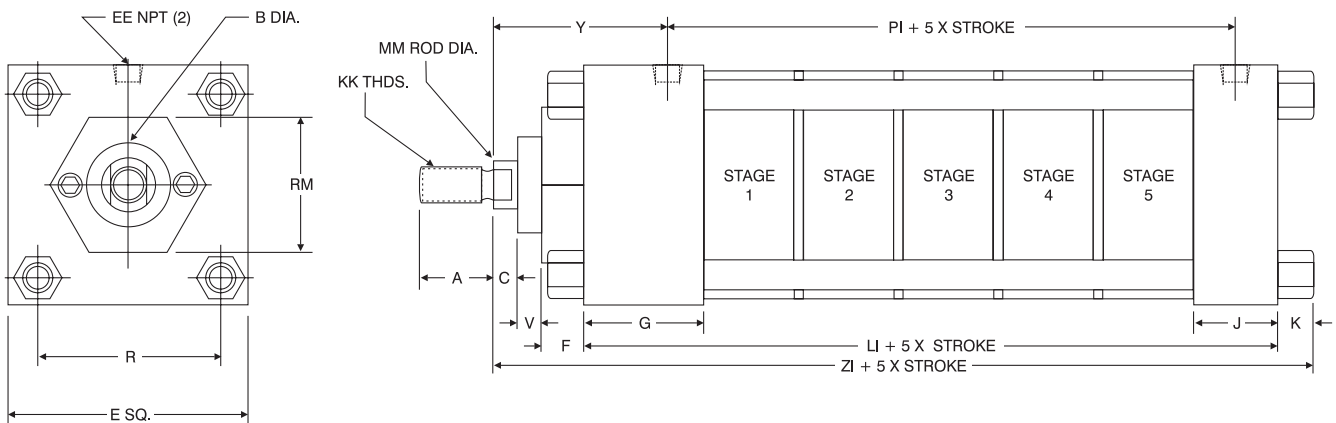
STANDARD ROD DIAMETER BASIC DIMENSIONS 'MXO' (NO MOUNT)



BORE	A	B	C	E	EE	F	G	J	K	KK	LH	MM	PH	R	RM	V	Y	ZH
1.50	.75	1.13	.38	2	.38	.38	1.50	1	.25	.44-20	6	.63	4.75	1.43	2 SQ.	.25	1.88	7.25
2	.75	1.13	.38	2.50	.38	.38	1.50	1	.31	.44-20	6	.63	4.75	1.84	1.75 HEX	.25	1.88	7.31
2.50	.75	1.13	.38	3	.38	.38	1.50	1	.31	.44-20	6	.63	4.75	2.19	1.75 HEX	.25	1.88	7.31
3.25	1.13	1.50	.50	3.75	.50	.63	1.75	1.25	.38	.75-16	7.38	1	5.88	2.76	2.75 DIA.	.25	2.38	9.13
4	1.13	1.50	.50	4.50	.50	.63	1.75	1.25	.38	.75-16	7.38	1	5.88	3.32	2.75 DIA.	.25	2.38	9.13
5	1.13	1.50	.50	5.50	.50	.63	1.75	1.25	.44	.75-16	7.38	1	5.88	4.10	2.75 DIA.	.25	2.38	9.19
6	1.63	2	.63	6.50	.75	.63	2	1.50	.44	1-14	8.75	1.38	7	4.88	3.50 DIA.	.38	2.75	10.81
8	1.63	2	.63	8.50	.75	.63	2	1.50	.56	1-14	8.75	1.38	7	6.44	3.50 DIA.	.38	2.75	10.94

5 STAGE EXTEND OR RETRACT (1.50" - 5" BORES ONLY)

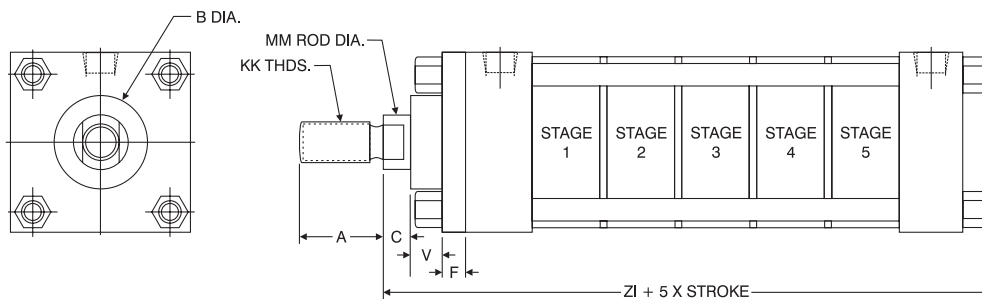
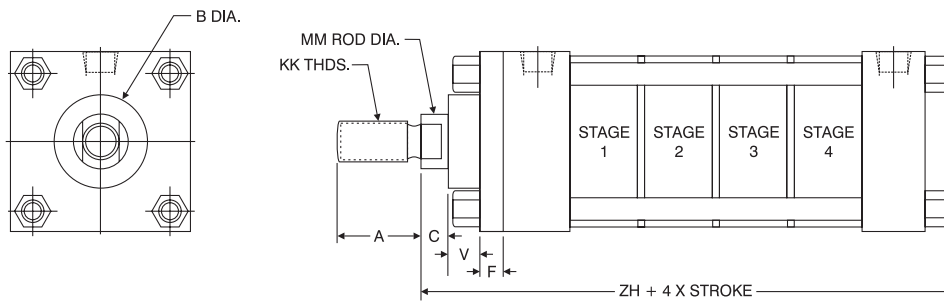
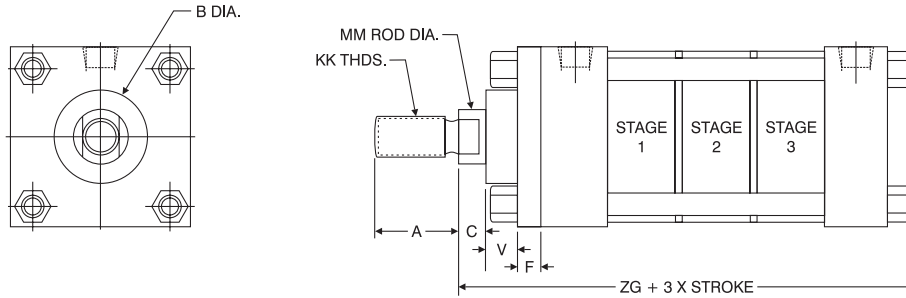
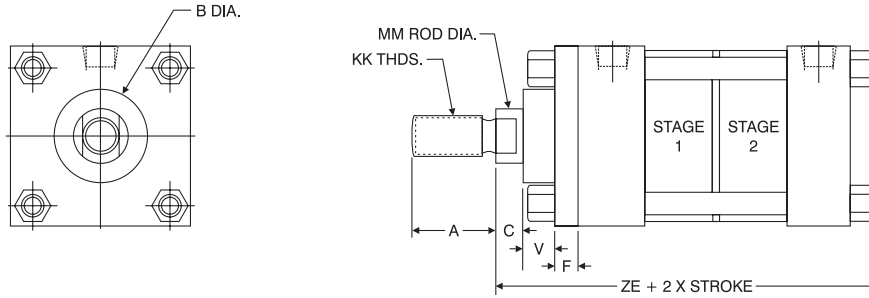
STANDARD ROD DIAMETER BASIC DIMENSIONS 'MXO' (NO MOUNT)



BORE	A	B	C	E	EE	F	G	J	K	KK	LI	MM	PI	R	RM	V	Y	ZI
1.50	.75	1.13	.38	2	.38	.38	1.50	1	.25	.44-20	7	.63	5.75	1.43	2 SQ.	.25	1.88	8.25
2	.75	1.13	.38	2.50	.38	.38	1.50	1	.31	.44-20	7	.63	5.75	1.84	1.75 HEX	.25	1.88	8.31
2.50	.75	1.13	.38	3	.38	.38	1.50	1	.31	.44-20	7	.63	5.75	2.19	1.75 HEX	.25	1.88	8.31
3.25	1.13	1.50	.50	3.75	.50	.63	1.75	1.25	.38	.75-16	8.63	1	7.13	2.76	2.75 DIA.	.25	2.38	10.38
4	1.13	1.50	.50	4.50	.50	.63	1.75	1.25	.38	.75-16	8.63	1	7.13	3.32	2.75 DIA.	.25	2.38	10.38
5	1.13	1.50	.50	5.50	.50	.63	1.75	1.25	.44	.75-16	8.63	1	7.13	4.10	2.75 DIA.	.25	2.38	10.44

SERIES 'MS' CYLINDERS: EXTEND OR RETRACT

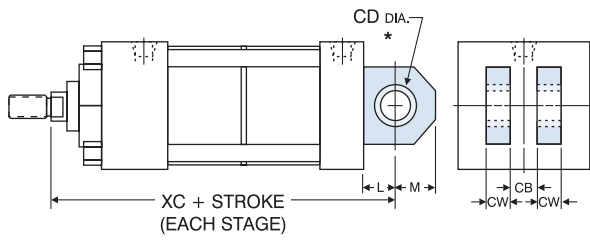
Oversize Rod Diameter Basic Dimension 'MXO' (NO MOUNT)



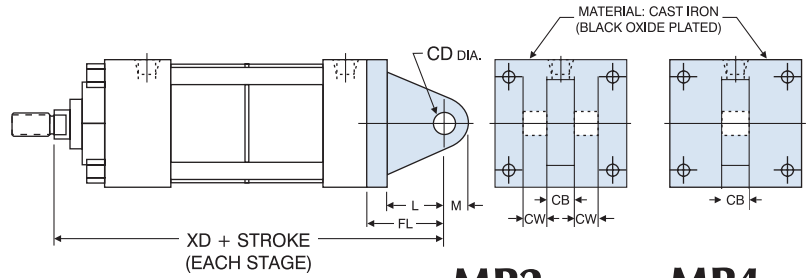
BORE	MULTI-STAGE OVERSIZE ROD DIAMETER							ADD STROKE PER STAGE			
	A	B	C	F	V	KK	MM	ZE	ZG	ZH	ZI
1.50	1.13	1.50	.50	.38	.50	.75-16	1	5.63	6.63	7.63	8.63
2	1.13	1.50	.50	.38	.50	.75-16	1	5.69	6.69	7.69	8.69
2.50	1.13	1.50	.50	.38	.50	.75-16	1	5.69	6.69	7.69	8.69
3.25	1.63	2	.63	.63	.38	1-14	1.38	6.88	8.13	9.38	10.63
4	1.63	2	.63	.63*	.38	1-14	1.38	6.88	8.13	9.38	10.63
5	1.63	2	.63	.63*	.38	1-14	1.38	6.94	8.19	9.44	10.69
6	2	2.38	.75	.63 *	.50	1.25-12	1.75	8.06	9.56	11.06	—
8	2	2.38	.75	.63*	.50	1.25-12	1.75	8.19	9.69	11.19	—

*Round retainer 4" thru 8" bore. (square retainer shown)
For dimensions not shown, see pages 73 & 74.

'MS' SERIES CYLINDERS: PIVOT MOUNTS



MP1



MP2

MP4

(1.50" - 4" bore)

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	.63 Standard	.75	.50	.50	1.13	.75	.63	5.75	6.13	6.75	7.13	7.75	8.13	8.75	9.13
	1 Oversize							6.13	6.50	7.13	7.50	8.13	8.50	9.13	9.50
2	.63 Standard	.75	.50	.50	1.13	.75	.63	5.75	6.13	6.75	7.13	7.75	8.13	8.75	9.13
	1 Oversize							6.13	6.50	7.13	7.50	8.13	8.50	9.13	9.50
2.50	.63 Standard	.75	.50	.50	1.13	.75	.63	5.75	6.13	6.75	7.13	7.75	8.13	8.75	9.13
	1 Oversize							6.13	6.50	7.13	7.50	8.13	8.50	9.13	9.50
3.25	1 Standard	1.25	.75	.63	1.88	1.25	.88	7.50	8.13	8.75	9.38	10	10.63	11.25	11.88
	1.38 Oversize							7.75	8.38	9	9.63	10.25	10.88	11.50	12.13
4	1 Standard	1.25	.75	.63	1.88	1.25	.88	7.50	8.13	8.75	9.38	10	10.63	11.25	11.88
	1.38 Oversize							7.75	8.38	9	9.63	10.25	10.88	11.50	12.13
5	1 Standard	1.25	.75	.63	1.88	1.25	.88	7.50	8.13	8.75	9.38	10	10.63	11.25	11.88
	1.38 Oversize							7.75	8.38	9	9.63	10.25	10.88	11.50	12.13
6	1.38 Standard	1.50	1	.75	2.25	1.50	1	8.88	9.63	10.38	11.13	11.88	12.63	N/A	N/A
	1.75 Oversize							9.13	9.88	10.63	11.38	12.13	12.88	N/A	N/A
8	1.38 Standard	1.50	1	.75	N/A	1.50	1	8.88	N/A	10.38	N/A	11.88	N/A	N/A	N/A
	1.75 Oversize							9.13	N/A	10.63	N/A	11.88	N/A	N/A	N/A

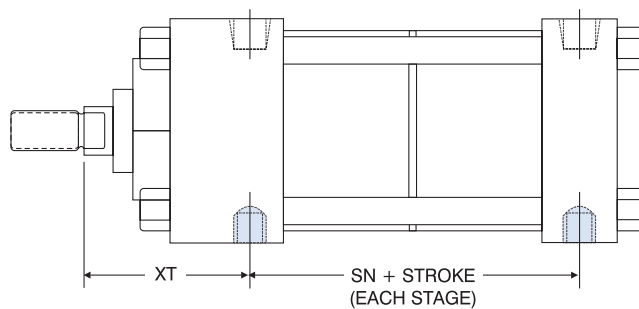
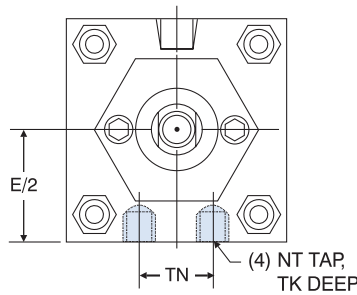
For dimensions not shown, see pages 73 & 74.

* Pin included, (2) pressed in bearings.

Note: Extruded MP1 mounts are standard (1.50"-8" bores).

Cast Iron removable mounts are optional, and must be requested when ordering (1.50"-6" bores).

SERIES 'MS' DIMENSIONS: BASE MOUNTS



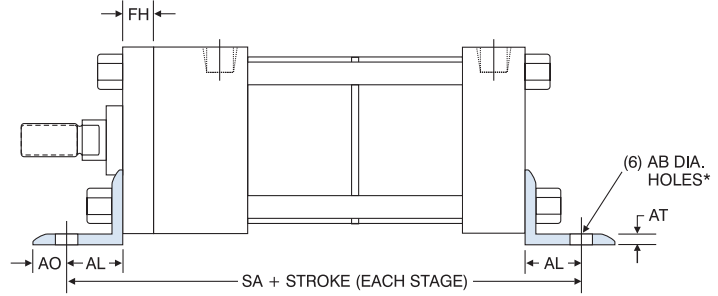
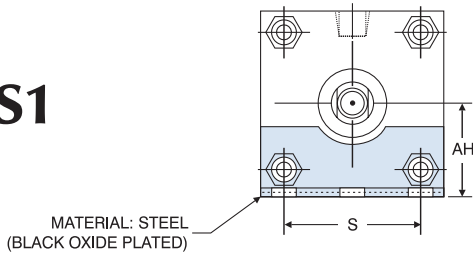
MS4

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	.63 Standard	1	.25-20	.38	.63	1.94	2.63	3.63	4.63	5.63	
	1 Oversize					2.31					
2	.63 Standard	1.25	.31-18	.50	.88	1.94	2.63	3.63	4.63	5.63	
	1 Oversize					2.31					
2.50	.63 Standard	1.50	.38-16	.63	1.25	1.94	2.63	3.63	4.63	5.63	
	1 Oversize					2.31					
3.25	1 Standard	1.88	.50-13	.75	1.50	2.44	3.25	4.50	5.75	7	
	1.38 Oversize					2.69					
4	1 Standard	2.25	.50-13	.75	2.06	2.44	3.25	4.50	5.75	7	
	1.38 Oversize					2.69					
5	1 Standard	2.75	.63-11	1	2.69	2.44	3.25	4.50	5.75	7	
	1.38 Oversize					2.69					
6	1.38 Standard	3.25	.75-10	1.13	3.25	2.81	3.88	5.38	6.88	N/A	
	1.75 Oversize					3.06					
8	1.38 Standard	4.25	.75-10	1.13	4.50	2.81	3.88	5.38	6.88	N/A	
	1.75 Oversize					3.06					

For dimensions not shown, see pages 73 & 74.

SERIES 'MS' DIMENSIONS: BASE MOUNTS

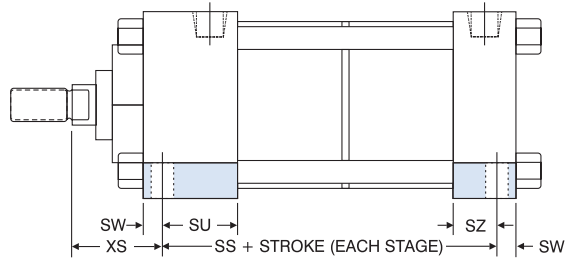
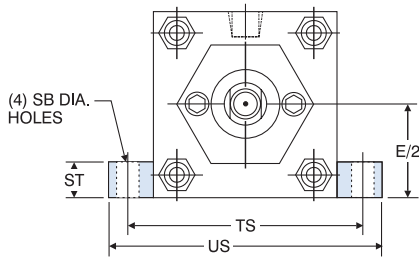
MS1



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	.63 Standard	.44	1.19	1	.38	.19	.38	1.25	6.38	7.38	8.38	9.38	
	1 Oversize												
2	.63 Standard	.44	1.44	1	.38	.19	.38	1.75	6.38	7.38	8.38	9.38	
	1 Oversize												
2.50	.63 Standard	.44	1.63	1	.38	.19	.38	2.25	6.38	7.38	8.38	9.38	
	1 Oversize												
3.25	1 Standard	.56	1.94	1.25	.50	.13	.63	2.75	8	9.25	10.50	11.75	
	1.38 Oversize												
4	1 Standard	.56	2.25	1.25	.50	.13	.63	3.50	8	9.25	10.50	11.75	
	1.38 Oversize												
5	1 Standard	.69	2.75	1.38	.63	.19	.63	4.25	8.25	9.50	10.75	12	
	1.38 Oversize												
6	1.38 Standard	.81	3.25	1.38	.63	.19	.75	5.25	9.25	10.75	12.25	N/A	
	1.75 Oversize												
8	1.38 Standard	.81	4.25	1.81	.69	.25	.63***	7.13	9.38	10.88	12.38	N/A	
	1.75 Oversize												

*Note: 1.50" bore has (4) "AB" holes on "S" dimension.
 **SA dimensions increase .50" and one FH on double rod cylinders.
 ***3.50" diameter round retainer on 8" bore.
 For dimensions not shown, see pages 73 & 74.

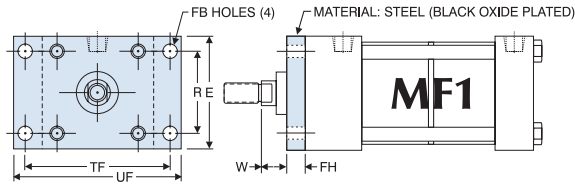
MS2



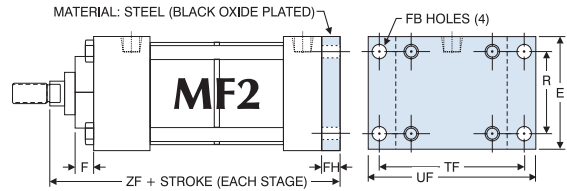
MULTI-STAGE 'MS2' SIDE LUG MOUNT DIMENSIONS														
BORE	ROD DIAMETER	SB	E/2	ST	SU	SW	SZ	TS	US	XS	SS + STROKE PER STAGE			
											2-STAGE	3-STAGE	4-STAGE	5-STAGE
1.50	.63 Standard	.44	1	.50	1.13	.38	.63	2.75	3.50	1.38	3.25	4.25	5.25	6.25
	1.75													
2	.63 Standard	.44	1.25	.50	1.13	.38	.63	3.25	4	1.38	3.25	4.25	5.25	6.25
	1.75													
2.50	.63 Standard	.44	1.50	.50	1.13	.38	.63	3.75	4.50	1.38	3.25	4.25	5.25	6.25
	1.75													
3.25	1 Standard	.56	1.88	.75	1.25	.50	.75	4.75	5.75	1.88	3.88	5.13	6.38	7.63
	1.38 Oversize													
4	1 Standard	.56	2.25	.75	1.25	.50	.75	5.50	6.50	1.88	3.88	5.13	6.38	7.63
	1.38 Oversize													
5	1 Standard	.81	2.75	1	1.06	.69	.56	6.88	8.25	2.06	3.50	4.75	6	7.25
	1.38 Oversize													
6	1.38 Standard	.81	3.25	1	1.31	.69	.81	7.88	9.25	2.31	4.38	5.88	7.38	N/A
	1.75 Oversize													
8	1.38 Standard	.81	4.25	1	1.31	.69	.81	9.88	11.25	2.31	4.38	5.88	7.38	N/A
	1.75 Oversize													

*SS dimensions increase .50" on double rod cylinders.
 For dimensions not shown, see pages 73 & 74.

SERIES 'MS' DIMENSIONS: FLANGE MOUNTS



1.50" - 6" BORES

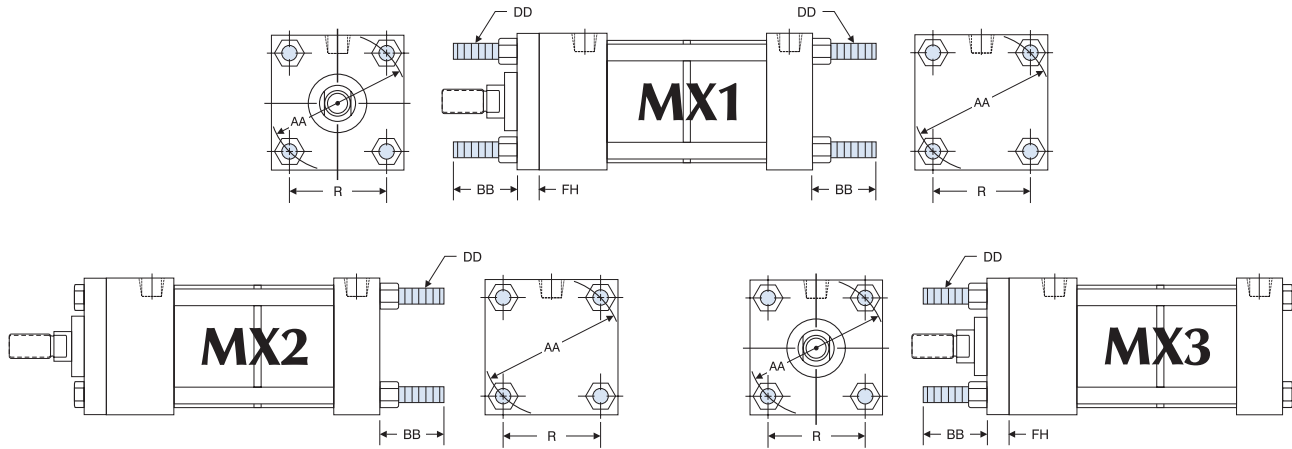


1.50" - 6" BORES

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	.63 Standard	2	.38	.31	.38	1.43	2.75	3.38	.63	5.38	6.38	7.38	8.38
	1 Oversize									1	5.75	6.75	7.75
2	.63 Standard	2.50	.38	.38	.38	1.84	3.38	4.13	.63	5.38	6.38	7.38	8.38
	1 Oversize									1	5.75	6.75	7.75
2.50	.63 Standard	3	.38	.38	.38	2.19	3.88	4.63	.63	5.38	6.38	7.38	8.38
	1 Oversize									1	5.75	6.75	7.75
3.25	1 Standard	3.75	.63	.44	.63	2.76	4.69	5.50	.75	6.88	8.13	9.38	10.63
	1.38 Oversize									1	7.13	8.38	9.63
4	1 Standard	4.50	.63	.44	.63	3.32	5.44	6.25	.75	6.88	8.13	9.38	10.63
	1.38 Oversize									1	7.13	8.38	9.63
5	1 Standard	5.50	.63	.56	.63	4.10	6.63	7.63	.75	6.88	8.13	9.38	10.63
	1.38 Oversize									1	7.13	8.38	9.63
6	1.38 Standard	6.50	.63	.56	.75	4.88	7.63	8.63	.88	8.13	9.63	11.13	N/A
	1.75 Oversize									1.13	8.38	9.88	11.38

For dimensions not shown, see pages 73 & 74.

SERIES 'MS' DIMENSIONS: TIE ROD MOUNTS



TIE ROD EXTENDED 'MX1', 'MX2' & 'MX3' MOUNT DIMENSIONS						
BORE	ROD DIAMETER	AA	BB	DD	FH	R
1.50	.63 Standard	2.02	1	.25-28	.38	1.43
	1 Oversize					
2	.63 Standard	2.6	1.13	.31-24	.38	1.84
	1 Oversize					
2.50	.63 Standard	3.1	1.13	.31-24	.38	2.19
	1 Oversize					
3.25	1 Standard	3.9	1.38	.38-24	.63	2.76
	1.38 Oversize					

TIE ROD EXTENDED 'MX1', 'MX2' & 'MX3' MOUNT DIMENSIONS						
BORE	ROD DIAMETER	AA	BB	DD	FH	R
4	1 Standard	4.7	1.38	.38-24	.63	3.32
	1.38 Oversize					
5	1 Standard	5.8	1.81	.50-20	.63	4.10
	1.38 Oversize					
6	1.38 Standard	6.9	1.81	.50-20	.75	4.88
	1.75 Oversize					
8	1.38 Standard	9.1	2.31	.63-18	*.63	6.44
	1.75 Oversize					

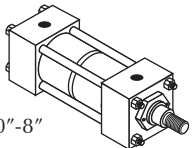
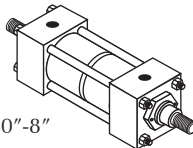
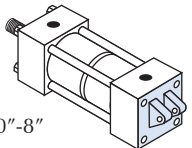
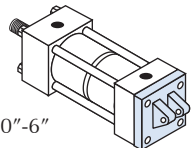
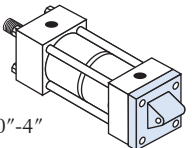
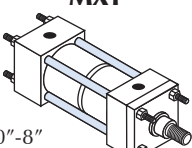
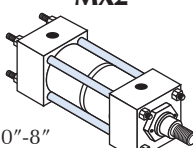
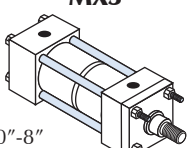
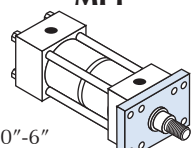
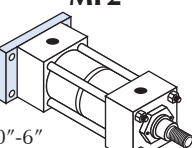
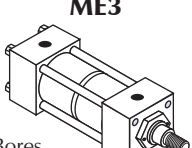
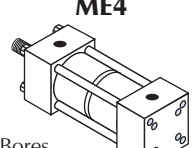
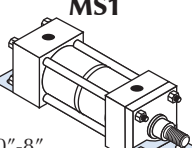
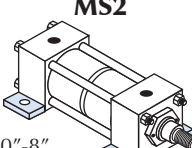
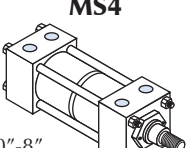
Full square bushing retainer on 1.50" - 6" bores.
 *Round retainer on 8" bore. BB dimension from face of head.
 For dimensions not shown, see pages 73 & 74.

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	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	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	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	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	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.

SERIES 'MS' CYLINDERS: NFPA MOUNTS

 1.50"-8" Bores	 1.50"-8" Bores	 1.50"-8" Bores	 1.50"-6" Bores	 1.50"-4" Bores
 1.50"-8" Bores	 1.50"-8" Bores	 1.50"-8" Bores	 1.50"-6" Bores	 1.50"-6" Bores
 8" Bores (Consult factory)	 8" Bores (Consult factory)	 1.50"-8" Bores	 1.50"-8" Bores	 1.50"-8" Bores

BASIC OPTIONS

Index To Standard Options:

	<u>PAGE</u>
• A= - Extended Piston Rod Thread	80
• AS - Adjustable Stroke (Retract)	80
• A/O - Air/Oil Piston	80
• B, BC, BH - Bumpers	80
• BP - Bumper Piston Seals	81
• H, C, LH, LC, ELH, ELC - Cushions	82
• ELH, ELC - Dimensions for Extra Long Cushions	83
• Custom Length Cushions	83
• BSPT/BSPP - British Standard Pipe Threads	84
• C= - Extended Piston Rod	84
• EN - Electroless Nickel	84
• KK3S - Studded Piston Rod	84
• LF - Low Friction	84
• MA - Micro-Adjust	85
• MAB - Micro-Adjust with Urethane Bumper	85
• MPR, MPH - Magnetic Piston	86
• MS - Metallic Rod Scraper	86

	<u>PAGE</u>
• MS - Metallic Rod Scraper	86
• NR - Non-Rotating (NFPA) Cylinders	86
• OP - Optional Port Location	87
• Optional Port & Cushion at Same Location	87
• OS - Oversize Rod	88
• SAE - SAE "O"-Ring Boss Ports	88
• SE - Spring Extend	88
• SR - Spring Retract	88
• SSA - Stainless Steel "All"	88
• SSF - Stainless Steel Fasteners	88
• SSR - Stainless Steel Piston Rod	88
• SST - Stainless Steel Tie Rods & Nuts	88
• ST - Stop Tube	89
• Steel Tube	90
• TH - 400 PSI Hydraulic (Non-Shock)	90
• VS - Fluorocarbon Seals	90
• WB - Piston Wear Band	90

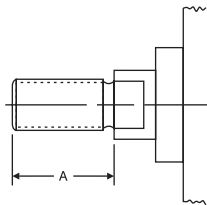
Uncommon Options:

	<u>PAGE</u>
• AS3POS - Adjustable Mid Stroke (3 Position Cyl.)	91
• DAS - Double Rod Adjustable Stroke (Extend)	91
• Spherical Bearing (cap pivot mount)	91
• Extra Wide Multiple Wear Bands	91
• Hollow Piston Rods	91
• Rod Boots	91
• Special MF1 Flange	91
• Special Short Tap with Orifice	91
• MT4X Bolt-On Side Plates	92

	<u>PAGE</u>
• FM with Flush Rod Bushing	92
• Tandem with Different Size Bores	92
• FM with No Rod Bushing	92
• 168" Stroke Stainless Steel	92
• Solid Brass Pistons	92
• 7" Bore Steel, Non-Tie Rod Design	92
• 8" Bore - Front Extension Adjustable Stroke	92
• External Non-Rotating with Special Tool Plate	92
• 12" Bore Steel, Rated 40°F Below Zero	92

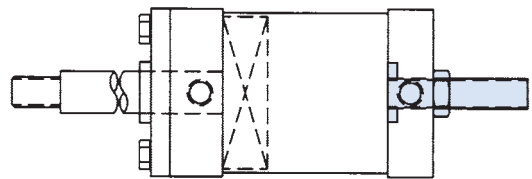
A= Extended Piston Rod Thread

"A=" refers to the length of piston rod thread.
Shorter than standard lengths can be furnished at no charge. Longer than standard lengths can be furnished at a nominal price adder.
Special length threads do not delay orders!



AS Adjustable Stroke (Retract)

Consists of a threaded rod in the cylinder cap, non-removable. Provides an adjustable positive stop on the cylinder retract.
To order, specify "AS" and length of adjustment (Example: AS=3")



A/O Air/Oil Piston

Air/Oil pistons allow for the combination of pneumatic supply air with the precise control of oil.

The basic A/O piston is designed for oil on the cylinder cap end, and a "meter out" flow control (not provided) for precise return stroke control.

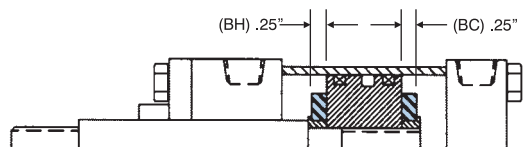
For applications that require the oil to be on the cylinder rod end, specify the TH option.

Note: Due to the nature of oil to remain in the tubing finish recesses, a condition called "collaring" will allow oil to seep past the A/O seal over time, escaping in the air valve exhaust.

B **BC** **BH** Bumpers

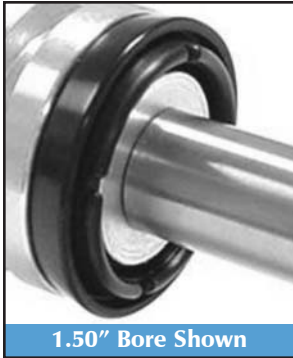
Urethane impact dampening bumpers, used when cylinder speeds do not allow for standard cushions.

BC=Cap Bumper **BH**=Head Bumper **B**=Head & Cap Bumper
(Note: Each bumper adds .25" to cylinder length)



BASIC OPTIONS

BP Bumper Piston Seals (Note: "BP" Seals are Standard on Series 'TD' Tough Duty)



TRD's Bumper Piston Seal, when used with our advanced cushion design, decelerates the cylinder at end of stroke - reducing noise and extending cylinder life.

Standard Material: Nitrile

Operating Temp: -20°F to 200°F (-25°C to 90°C)

Optional Material: Fluorocarbon

Available in 1.50"-8" Bores

Operating Temp: 0°F to 400°F (-18°C to 205°C)

Operating Pressure: 250 PSI Air (17 BAR)

Benefits

- **Reduces cycle rates** - Higher piston velocities can be achieved due to rapid deceleration feature, increasing productivity.
- **Provides maximum impact dampening** - Reduces machine vibration
- **Reduces cylinder end-of-stroke noise**
- **Available in Fluorocarbon Seals (1.50" to 8" Bore)**

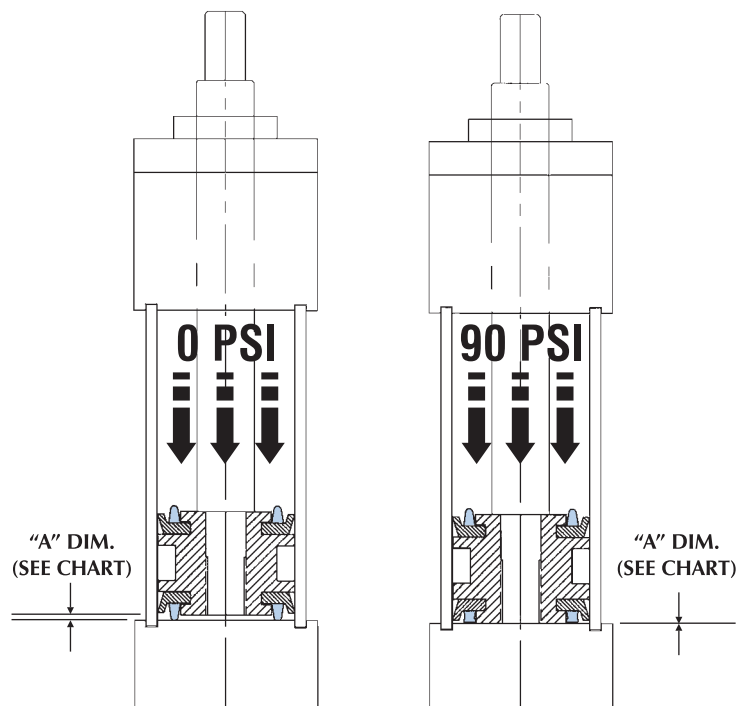
Design Tips

- Use cushions to achieve optimum performance on longer strokes (Options HC & BP).
- Use the BP Seals without cushions on short strokes requiring fast cycles.
- Due to compressibility, BP Seals are not recommended for applications that require 100% repeatable stroke increments.

Bumper Piston Seals will shorten the cylinder stroke when operated at less than 90 PSI supply air. The charts below show the approximate (average) stroke reduction, at various pressure (for new cylinders). As the cylinders are cycled, the seals will take a slight set. Tests have shown that after 1,500,000 cycles, the seals will have between .001" and .008" compression set per seal. After that, there is no noticeable compression set.

TOTAL STROKE REDUCTION ("A" DIMENSION X 2) (IN INCHES)							
BORE	0 PSI	10 PSI	30 PSI	50 PSI	70 PSI	90 PSI	
1.50	.10	.09	.07	.06	.04	.00	
2	.14	.11	.07	.04	.01	.00	
2.50	.18	.14	.08	.05	.02	.00	
3.25	.14	.12	.08	.04	.01	.00	
4	.17	.14	.09	.05	.02	.00	
5	.18	.14	.07	.03	.01	.00	
6	.23	.18	.10	.05	.01	.00	
8	.31	.26	.15	.07	.03	.00	

PER END STROKE REDUCTION ("A" DIMENSION) (IN INCHES)							
BORE	0 PSI	10 PSI	30 PSI	50 PSI	70 PSI	90 PSI	
1.50	.048	.043	.035	.028	.021	.00	
2	.069	.056	.037	.020	.010	.00	
2.50	.091	.070	.042	.024	.008	.00	
3.25	.071	.059	.039	.020	.002	.00	
4	.087	.069	.045	.026	.009	.00	
5	.092	.072	.036	.013	.005	.00	
6	.113	.091	.051	.023	.003	.00	
8	.154	.132	.076	.037	.016	.00	



BASIC OPTIONS

H

C

LH

LC

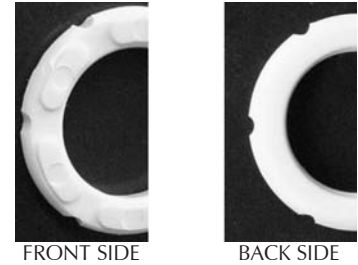
ELH

ELC

Cushions

TRD's advanced cushion design features a unique, one piece seal that is allowed to float in a precision machined groove. *This type of seal design provides consistent cushion performance and maximum seal life. Oversized flow paths molded in the periphery of the seal provide "full flow" on the return stroke without the use of ball checks.*

SEAL DESIGN



HEAD CUSHIONS

H Standard Length Head Cushion

LH Long Head Cushion

ELH Extra-Long Head Cushion*

*NOTE: Extra-Long Cushions add length to cylinder. Refer to page 83 for details.

CAP CUSHIONS

C Standard Length Cap Cushion

LC Long Cap Cushion

ELC Extra-Long Cap Cushion*

*NOTE: Extra-Long Cushions add length to cylinder. Refer to page 83 for details.

HOW TO SIZE CUSHIONS FOR YOUR APPLICATION

Cylinders with air cushions provide a possible solution to destructive energies. The air cushion traps a small amount of exhaust air at the end of stroke, providing an air pocket that decelerates the load. This reduces the potentially destructive energy being transmitted to the cylinder and other components. The following is a brief explanation on how to determine the energy level of your application and determine if an air cushion can provide adequate energy absorption. *Air cushions do not build heat since the heat generated is dissipated with the exhausted air flow.*

STEP 1: Determine the total load to be stopped by the cylinder. Include the piston rod weight (see piston rod weight chart below).

STEP 2: Determine the velocity (in feet per second) at which the load impacts the cylinder end caps.

STEP 3: Use the following formula to calculate the energy the cylinder generates.

STEP 4: Using the table below, select the proper cushion length. Note: You can choose a larger bore size to increase cushion capacities.

CUSHION SIZING FORMULA:

$$\text{energy} = \left(\frac{W}{64} \times v^2\right) + (p \times k)$$

W = Total weight of load in pounds (including piston rod)

V = Velocity (in feet per second)

P = Driving pressure in PSI (usually the air line pressure)

K = Bore constant value (see chart below for "K" values)

Sizing Example:

How to figure the energy for a 2.50" bore cylinder, 10" stroke, .63" piston rod, moving a 25 lb. load at 6 feet per second with 80 PSI air.

$$P=80 \text{ PSI} \quad W=26.25 \text{ lbs.} \quad V=6 \text{ FPS.} \quad K=.17$$

$$\text{Energy} = (26.25/64) \times (6^2) + (80 \times .17)$$

$$\text{Energy} = 28.36 \text{ ft/lbs.}$$

The Maximum Energy Data Chart indicates that the "Long" Cushion at 38.6 maximum energy value would be the right choice for this application.

MAXIMUM ENERGY DATA				
BORE	K	H or C	LH or LC	ELH or ELC
		Standard Cushion Series Max Energy (ft-lbs)	Long Cushion Series Max Energy (ft-lbs)	Extra-Long Cushion Series Max Energy (ft-lbs)
1.50	.06	8.2	12.8	26.9
2	.11	13.8	21.7	45.8
2.50	.17	24.6	38.6	81.5
3.25	.25	45.7	83.6	172.2
4	.38	57.3	137.1	282.6
5	.59	94.6	226.0	465.8
6	1.37	225.5	334.4	767.6
8	2.43	411.3	609.8	1399.8
10	3.79	379.4	621.4	1620.9
12	5.47	554.8	908.8	2370.6

PISTON ROD WEIGHT CHART	
Rod Dia.	Piston Rod Weight*
.63"	.35 lb. + .09 lb./in. of stroke
1"	1.1 lb. + .22 lb./in. of stroke
1.38"	2.3 lb. + .42 lb./in. of stroke
1.75"	5.0 lb. + .68 lb./in. of stroke
2"	6.1 lb. + .88 lb./in. of stroke
2.50"	10.4 lb. + 1.39 lb./in. of stroke

*Double Weight for double rod end cylinders.

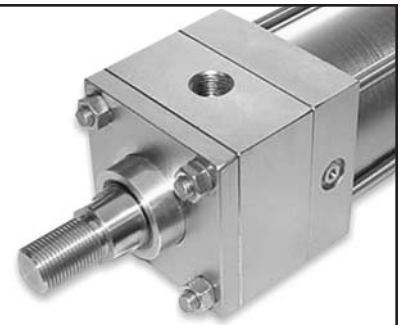
Design Tips:

- Cushions Adjustment screws can be ordered on same side as ports. Refer to page 87 for details.
- BP Seals provide additional impact dampening and noise reduction. (Refer to page 81 for details).

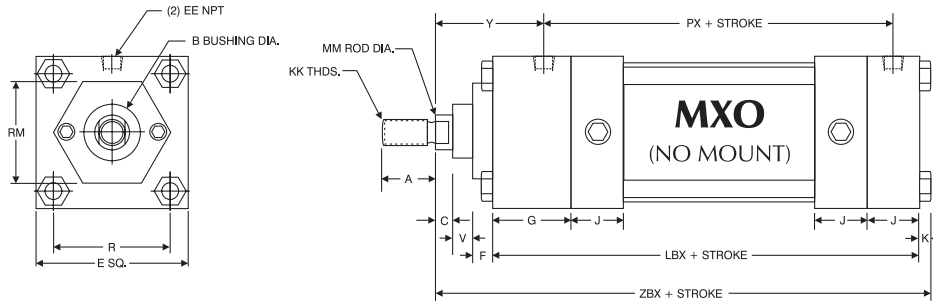
BASIC OPTIONS

ELH **ELC**

“ELH” Extra-Long Head Cushions and “ELC” Extra-Long Cap Cushions add length to the cylinder. Refer to the chart for dimensions.



(TA-MS4-1.50" X 6" ELH - EN) Shown



BASIC DIMENSIONS "MXO" STANDARD & OVERSIZE RODS

BORE	ROD DIAMETER	A	B	C	E	EE	F	G	J	K	KK	LBX	MM	PX	R	RM	V	Y	ZBX
1.50	.63 Standard	.75	1.13	.38	2	.38	.38	1.50	1	.25	.44 -20	5.63	.63	4.38	1.43	2 SQ.	.25	1.88	6.88
	1 Oversize	N/A	N/A	N/A							N/A		N/A						
2	.63 Standard	.75	1.13	.38	2.50	.38	.38	1.50	1	.31	.44 -20	5.63	.63	4.38	1.84	1.75 HEX	.25	1.88	6.94
	1 Oversize	1.13	1.50	.50							.75-16		1			2.50 SQ.			
2.50	.63 Standard	.75	1.13	.38	3	.38	.38	1.50	1	.31	.44 -20	5.75	.63	4.50	2.19	1.75 HEX	.25	1.88	7.06
	1 Oversize	1.13	1.50	.50							.75-16		1			3 SQ.			
3.25	1 Standard	1.13	1.50	.50	3.75	.50	.63	1.75	1.25	.38	.75-16	6.75	1	5.25	2.76	2.75 DIA.	.25	2.38	8.50
	1.38 Oversize	1.63	2	.63							1-14		1.38			3.75 SQ.			
4	1 Standard	1.13	1.50	.50	4.50	.50	.63	1.75	1.25	.38	.75-16	6.75	1	5.25	3.32	2.75 DIA.	.25	2.38	8.50
	1.38 Oversize	1.63	2	.63							1-14		1.38			3.50 DIA.			
5	1 Standard	1.13	1.50	.50	5.50	.50	.63	1.75	1.25	.44	.75-16	7	1	5.50	4.10	2.75 DIA.	.25	2.38	8.81
	1.38 Oversize	1.63	2	.63							1-14		1.38			3.50 DIA.			
6	1.38 Standard	1.63	2	.63	6.50	.75	.63	2	1.50	.44	1-14	8	1.38	6.25	4.88	3.50 DIA.	.38	2.75	10.06
	1.75 Oversize	2	2.38	.75							1.25-12		1.75			.50			
8	1.38 Standard	1.63	2	.63	8.50	.75	.63	2	1.50	.56	1-14	8.13	1.38	6.38	6.44	3.50 DIA.	.38	2.75	10.31
	1.75 Oversize	2	2.38	.75							1.25-12		1.75			.50			
10	1.75 Standard	2	2.38	.75	10.63	1	.63	2.25	2	.69	1.25-12	10.38	1.75	8.31	7.92	3.50 DIA.	.50	3.06	12.94
	2 Oversize	2.25	2.63	.88			.75				1.50-12		2			5 DIA.			
12	2 Standard	2.25	2.63	.88	12.75	1	.75	2.25	2	.69	1.50-12	10.88	2	8.81	9.40	5 DIA.	.38	3.19	13.56
	2.50 Oversize	3	3.13	1							1.88-12		2.50			.50			

CUSTOM LENGTH CUSHIONS

Custom length cushions can be designed for your application. [Contact TRD for details!](#)

Example: An OEM manufacturer of industrial equipment needed a cylinder to shuttle a 125 lb. rolling (and guided) fixture 36 inches of travel, at low airline pressure to avoid operator injury. TRD developed a 3.50" long head and cap cushion to meet the operating specifications.



BASIC OPTIONS

BSPT British Standard Pipe Taper

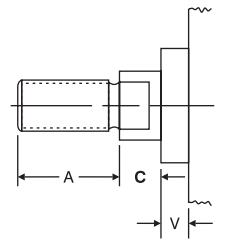
British Standard Pipe Taper (BSPT) threads have the same taper as American NPT tapered threads, but use a 55° Whitworth thread form and different diameters. (Not interchangeable with NPT)

BSPP British Standard Pipe Parallel

British Standard Pipe Parallel (BSPP), also referred to as BSP "Straight" Thread. (Not interchangeable with NPT)

C= Extended Piston Rod

"C=" is commonly referred to as Piston Rod Extension. Piston rods can be extended to any length up to 120" total piston rod length, including stroke portion. Cylinders with long "C" lengths can be mounted away from obstacles or outside hazardous environments.



EN Electroless Nickel

EN or Electroless Nickel plating was invented in 1946, and has gained worldwide commercial usage since 1964. Common usages include aircraft landing gear, automotive brake cylinder and components, fuel injector parts, gas turbine parts, spray nozzles for chemical applications and many electronic devices including hard drives.

The properties of Electroless Nickel contribute to the multitude of uses. The coating provides an attractive finish, while exhibiting high abrasion and corrosion resistance. It's ability to uniformly coat blind holes, threads, internal surfaces and sharp edges contributes to its effectiveness. It has a very high bonding strength to the base metal (100,000-200,000 PSI), so much so that gas turbines use electroless nickel plating as a base to braze broken blades to.

COMMON USAGES:

- **FOOD PROCESSING** — EN plating has been used to handle such diverse products as sodium hydroxide, food grade acids and fish oils. Excellent resistance to mild sanitizing caustics, chlorine, and chlorides in general. The natural smooth finish ensures cleanliness in food processing equipment.
- **PETROLEUM AND CHEMICAL** — The petroleum and chemical industry are large users of electroless nickel plating for corrosion protection. Design tip: Submit the list of chemicals and concentration levels to TRD for evaluation and recommendations. In some instances, Stainless Steel cylinders provide the best value and long cylinder life.
- **MEDICAL AND PHARMACEUTICAL** — The medical industry uses EN plated cylinders in clean-rooms, on equipment used to make plasma or IV bags, since it is critical that cylinder components need to be sterilized and particle "flake free". The pharmaceutical industry typically can be harsh on equipment, even abusive-but the equipment must remain completely reliable. EN cylinders provide the most reliable and cost effective choice.

EN CYLINDER SPECIFICATIONS

EN PLATED PARTS:

Tube, Head, Cap, Bushing Retainer, Mounts (excluding MT1/MT2 which is hard chrome plated stainless steel).

OTHER COMPONENTS:

303/304 Stainless Steel: Tie Rods & Nuts, Retainer Screws, Piston Rod (hard chrome plated), Rod Bushing with PTFE Wear Band and Rod Wiper. (Optional: SAE 660 Bronze Rod Bushing)

EN PLATING SPECIFICATIONS:

HIGH PHOSPHORUS (highest corrosion resistant Electroless Nickel plating available)

COMPOSITION: 87-90% Nickel, 10-13% Phosphorus

HARDNESS: Rc 46-48

THICKNESS: .0005"-.0007"

LUBRICITY: Excellent (Similar to chrome)

COEFFICIENT OF FRICTION:

FRICITION: Low

FINISH: Bright and very smooth

Other types of EN plating are available. Contact TRD with your specifications for a prompt quote.

NEW TRD PART NUMBER REVISION:

The "EN" Series used to be ordered as:

EN - MS4 - 2 X 10.

(Note: The "EN" Series was the "TA" Series with "EN" feature)

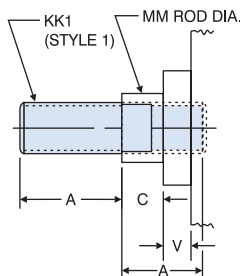
By offering "EN" as an option, you can now make any TRD Series an Electroless Nickel Plated cylinder!

New Part Number: TA - MS4 - 2 X 10 - EN

KK3S Studed Piston Rod

KK3S option combines the KK3 female threaded rod end design and a case-hardened stud, with permanent Loctite. When assembled, the KK3S has the same dimensions as a KK1 rod end.

This option is useful in applications that typically break standard KK1 rod ends due to high load impacting.



LF Low Friction

"LF" Low Friction option incorporates the use of round-lip, extremely low friction carboxylated nitrile seals. Round-lip seals "hydroplane" on opposed sealing surfaces, and have a lower running and break-away friction.

BORE SIZES: 1.50" to 8" Bore

MATERIAL: Carboxylated Nitrile

OPERATING TEMPERATURE: -20°F to 200°F (-25°C to 90°C)

OPERATING PRESSURE: 250 PSI AIR (17 BAR)

NEW TRD PART NUMBER REVISION:

The "LF" Series used to be ordered as: LF - MS4 - 2 X 10.

(Note: The "LF" Series was the "TA" Series with "LF" Low Friction feature.)

By offering "LF" as an option, you can now make the "TA" or "FM" Series a Low Friction Cylinder!

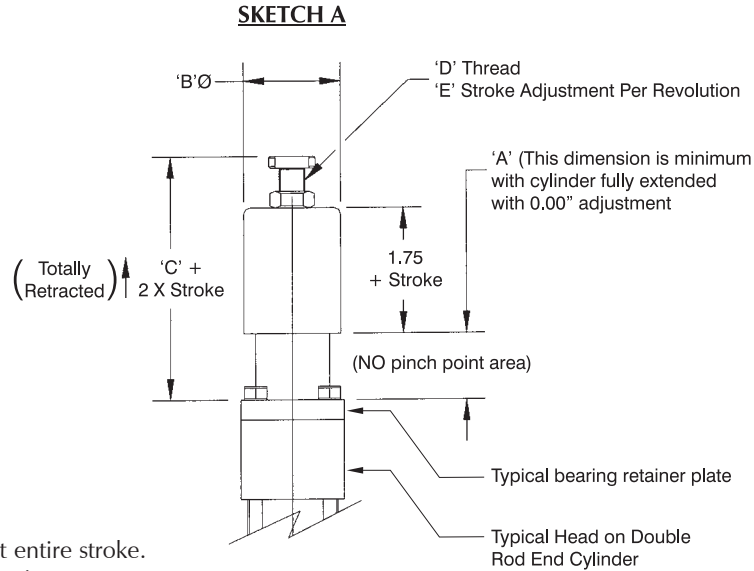
New Part Number: TA - MS4 - 2 X 10 - LF

BASIC OPTIONS

MA Micro-Adjust

- Allows precise adjustment of cylinder extend stroke
- Easy to read precision scale (.001" calibration)
- Enclosed, no "pinch point" design
- Available on all cylinder models with "D" Double Rod End option
- Up to 6" stroke and adjustment*

*Note: The adjustment range is throughout entire stroke. Consult factory for longer stroke requirements or modifications not listed.



TA-MF1D-MA (SHOWN)

MICRO-ADJUST DIMENSIONS					
BORE	A	B	C	D	E
1.50	1.00	1.88	3.71	.50-20	.050
2	1.00	1.88	3.71	.50-20	.050
2.50	1.00	1.88	3.71	.50-20	.050
3.25	1.00	2.81	3.71	.75-16	.063
4	.75	2.81	3.47	.75-16	.063
5	.75	2.81	3.47	.75-16	.063
6	.75	3.75	3.47	.75-16	.063
8	.75	3.75	3.47	.75-16	.063

Note: See double rod end cylinder drawings for dimensions not shown.

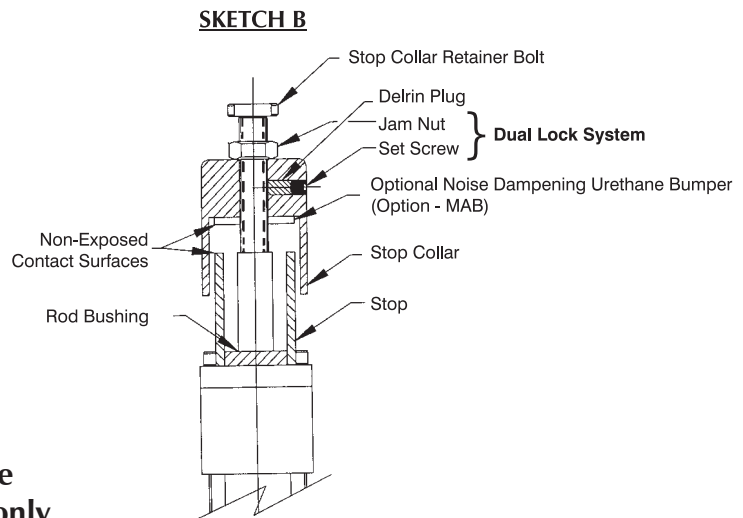
MICRO-ADJUST SET-UP INSTRUCTIONS:

- 1) Set actuator to desired stroke
- 2) Turn stop collar until it makes contact with stop
- 3) Tighten set screw
- 4) Tighten jam nut for positive lock of stop collar

NOTE: Do NOT apply torque to stop collar retainer bolt.

Hold stop collar by hand to tighten jam nut.

Stroke adjustments to be made while cylinder is in the "retract" position only.



MAB Micro-Adjust with Urethane Bumper

A Noise dampening urethane bumper is added between the metal contact points, minimizing noise. (See sketch B)

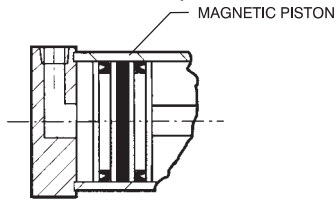
If the option you need isn't listed, just call TRD! We can accommodate most requests.

BASIC OPTIONS

MPR MPH Magnetic Piston

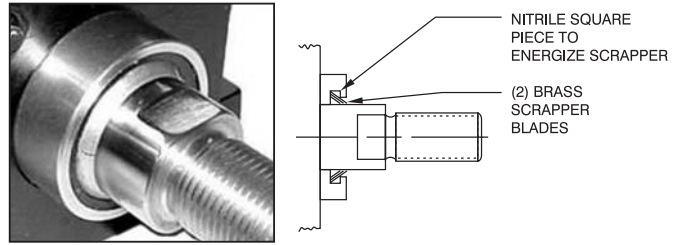
"MPR" Magnetic Pistons are used in conjunction with TRD R10, R10P, RHT, RAC Reed and MSS Solid State Switches. (See pages 107-113 for switches)

"MPH" Magnetic Pistons are used with TRD "Old Style" HE011, HE03SK and HE04SC Hall Effect Switches **Only**.



MS Metallic Rod Scrapper

Aggressively scrapes the piston rod, removing foreign material such as spatter, sprays and powders. (Brass construction)



NR Non-Rotating (NFPA) Cylinders

2" through 12" Bore
200 PSI Air, 400 PSI Hydraulic
(Non-Shock)

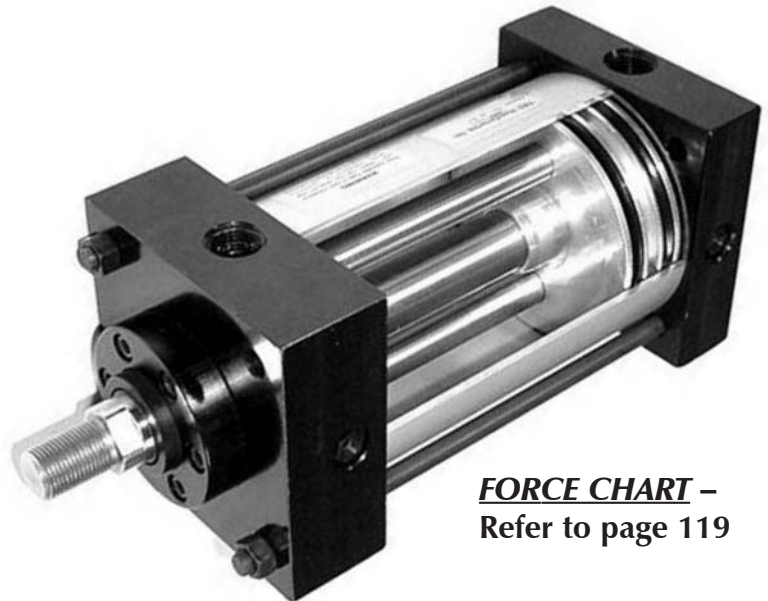
Benefits

- Two internal guide rods throughout stroke
- High repeatability at each end of stroke (+/- 1 degree)
- All external dimensions are the same as standard cylinder (no additional length or width required)
- Standard Diameter Guide Rod Seals & Bronze Bearings for long life and reliable operation
- Available in Double Rod End Models

Advantages

- Eliminates the need for external guide shafts in many positioning applications
- Guide rods are internal, self-cleaning, not subjected to harsh cleaners
- Compact design saves space, no larger than standard NFPA cylinders!
- Durable, self-contained construction

Note: "NR" option not available in combination with "BP" bumper piston seal option.



FORCE CHART –
Refer to page 119

NEW TRD PART NUMBER REVISION:

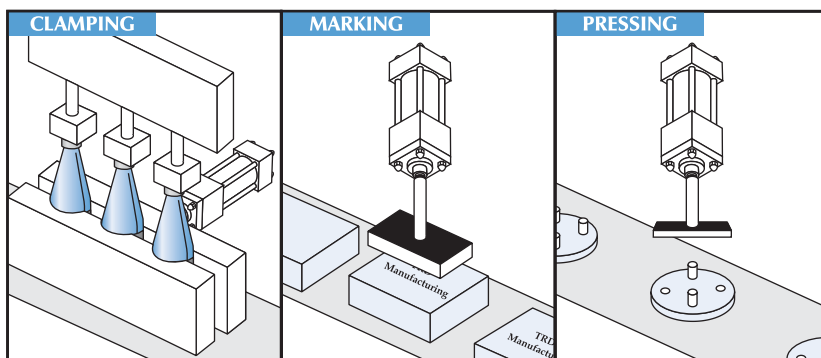
The "NR" Series used to be ordered as:
NR - MS4 - 2 X 10.

(Note: The "NR" Series was the "TA" Series with "NR" feature)

By offering "NR" as an option, you can now make any TRD Series a Non-Rotating cylinder!

New Part Number: TA - MS4 - 2 X 10 - NR

Application Possibilities:



'NR' GUIDE ROD SIZES AND MAX. STROKE				
BORE	ROD DIA.	CUSHIONS	GUIDE ROD DIAMETERS	MAXIMUM STROKE
2	.63 Standard	Cap Only	0.250	10"
2.50	.63 Standard	Cap Only	0.312	12"
	1 Oversize	N/A	0.312	12"
3.25	1 Standard	Available	0.375	18"
	1.38 Oversize	Cap Only	0.375	18"
4	1 Standard	Available	0.625	30"
	1.38 Oversize	Available	0.625	30"
5	1 Standard	Available	0.625	30"
	1.38 Oversize	Available	0.625	30"
6	1.38 Standard	Available	0.625	30"
	1.75 Oversize	Available	0.625	30"
8	1.38 Standard	Available	1.000	40"
	1.75 Oversize	Available	1.000	40"
10	1.75 Standard	Available	1.000	40"
	2 Oversize	Available	1.000	40"
12	2 Standard	Available	1.000	40"
	2.50 Oversize	Available	1.000	40"

BASIC OPTIONS

OP Optional Port Location

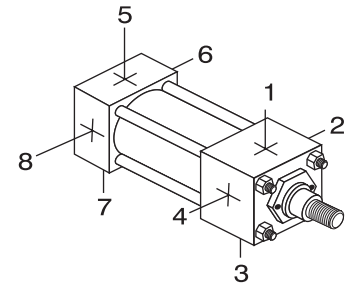
Optional port locations can be ordered simply by calling out the location numbers:

Example:

TA - MS4 - 2 X 10 - OP= 2 & 6

Note: When optional port locations are ordered, specify **both** port locations, even if one port is in the standard location.

- STANDARD PORT POSITIONS @ 1 & 5
- STANDARD CUSHION POSITIONS @ 2 & 6
- SPECIFY NON-STANDARD LOCATIONS WHEN ORDERING



NEW Optional Port and Cushion at Same Location ('TA' Series)*

Now available, the ability to specify Ports and Cushions on the same cylinder side!

Ordering Examples:

TA - MS4 - 2 X 10 - H1C5 - OP= 1 & 5
(Ports and Cushions @ 1 & 5)

TA - MS4 - 2 X 10 - H2C6 - OP= 2 & 6
(Ports and Cushions @ 2 & 6)

TA - MS4 - 2 X 10 - H1C6 - OP= 1 & 6
(Ports @ 1 & 6, Cushions @ 1 & 6)

Note: When optional port & cushion locations are ordered. Specify **both** port & cushion locations, even if a port or cushion is in the standard location.

*Check with factory for availability on other series.



BASIC DIMENSIONS:

HEAD VIEWS

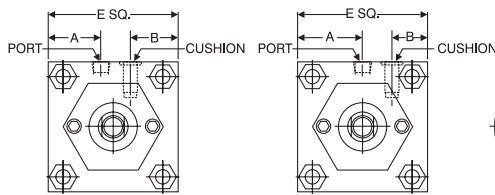
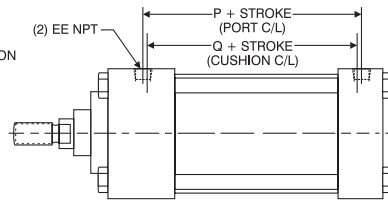


FIGURE #1

FIGURE #2



CAP VIEWS

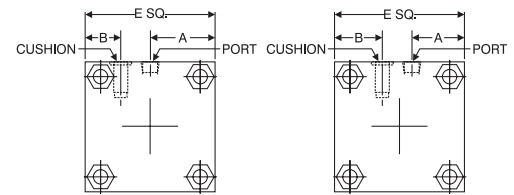


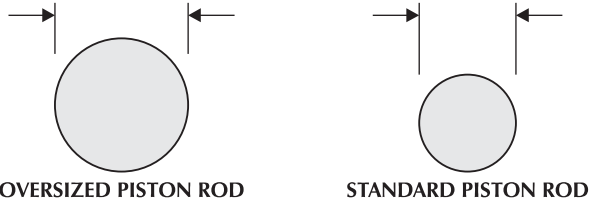
FIGURE #2

FIGURE #1

BORE	ROD DIAMETER	FIGURE	A	B	E	P	Q	EE
1.50	.63 Standard	1	.75	.63	2	2.38	2.13	.25
	1 Oversize	N/A	N/A	N/A	N/A			
2	.63 Standard	1	.88	.94	2.50	2.38	2.13	.38
	1 Oversize	1	1	.75	2.50			
2.50	.63 Standard	1	1.13	1.13	3	2.50	2.25	.38
	1 Oversize	1	1.13	1	3			
3.25	1 Standard	1	1.50	1.38	3.75	2.75	2.50	.50
	1.38 Oversize	2	1.88	1	3.75			
4	1 Standard	2	2.25	1.25	4.50	2.75	2.50	.50
	1.38 Oversize	2	2.25	1.13	4.50			
5	1 Standard	2	2.75	1.75	5.50	3	3	.50
	1.38 Oversize	2	2.75	1.63	5.50			
6	1.38 Standard	2	3.25	1.88	6.50	3.25	3	.75
	1.75 Oversize	2	3.25	1.88	6.50			
8	1.38 Standard	2	4.25	2.75	8.50	3.38	3.13	.75
	1.75 Oversize	2	4.25	2.75	8.50			
10	1.75 Standard	2	5.31	3.69	10.63	4.31	4.13	1
	2 Oversize	2	5.31	3.69	10.63			
12	2 Standard	2	6.38	4.75	12.75	4.81	4.63	1
	2.50 Oversize	2	6.38	4.75	12.75			

BASIC OPTIONS

OS Oversize Rod



Applications requiring long strokes may require oversize piston rod diameters to prevent sagging or buckling. To determine the recommended rod diameter, refer to Chart 3 on page 89.

SAE SAE "O"-Ring Boss Ports (SAE J514)

SAE ports can be ordered in place of NPT ports. Order by SAE number. (Example: SAE #10)

RECOMMENDED SAE PORT SIZE BY CYLINDER BORE			
BORE	SAE#	BORE	SAE#
1.50	#4 (.44-20)	5	#6 (.56-18)
2	#4 (.44-20)	6	#8 (.75-16)
2.50	#4 (.44-20)	8	#8 (.75-16)
3.25	#6 (.56-18)	10	#10 (.88-14)
4	#6 (.56-18)	12	#10 (.88-14)

SE Spring Extend (1.50" - 2.50" Bore)

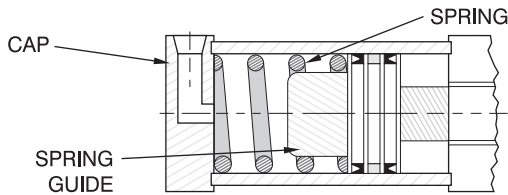
"SE" Option is designed to provide a spring bias to extend cylinder in the event of air pressure loss.

Springs add length to cylinder and provide a modest amount of extend spring force. See chart below for application design specs.

Note: Cylinders are furnished with standard head and cap.

1.50", 2" AND 2.50" BORE SPECS			
STROKE (inches)	OVERALL LENGTH ADDER FOR "SE" OPTION (inches)	SPRING RATE (lbs. per inch)	SPRING FORCE AT FULL EXTEND (lbs.)
.50	.63	18	16
1	.88	12	13
1.50	1.13	9	12
2	1.38	7	11
2.50	1.50	7	12

Note: Spring rates are for reference only - actual rates may vary from spring to spring.



SR Spring Retract (1.50" - 2.50" Bore)

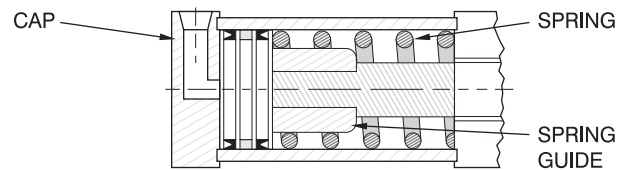
"SR" Option is designed to provide a spring bias to retract cylinder in the event of air pressure loss.

Springs add length to cylinder and provide a modest amount of retract spring force. See chart below for application design specs.

Note: Cylinders are furnished with standard head and cap.

1.50", 2" AND 2.50" BORE SPECS			
STROKE (inches)	OVERALL LENGTH ADDER FOR "SR" OPTION (inches)	SPRING RATE (lbs. per inch)	SPRING FORCE AT FULL RETRACT (lbs.)
.50	.75	18	16
1	1	12	13
1.50	1.50	9	12
2	1.50	7	11
2.50	1.63	7	12
3	2.50	6	10
3.50	3	6	10
4	3.25	6	10
4.50	3.75	6	9
5	4	6	9
5.50	4	5	8
6	4	5	8

Note: Spring rates are for reference only - actual rates may vary from spring to spring.



Stainless Steel, when used in conjunction with Anodized Aluminum Heads, Caps and Tube, provide corrosion resistance in outdoor applications and wet environments.

Customize your cylinder by choosing from Stainless Steel Fasteners, Piston Rod, or Tie Rods & Nuts.

SSA Stainless Steel Piston Rod (Hard-Chrome Plated), Stainless Steel Fasteners, Stainless Steel Tie Rods & Nuts

SSF Stainless Steel Fasteners (Bushing Retainer Screws)

SSR Stainless Steel Piston Rod (Hard-Chrome Plated)

SST Stainless Steel Tie Rods and Nuts

BASIC OPTIONS

ST Stop Tube

Stop Tubes are designed to reduce the piston rod bushing stress to within the designed range of the bearing material. This will insure proper cylinder performance, in any given application. Stop Tubes lower the cylinder bearing stress by adding length to the piston, which increases the overall length of the cylinder. (Note: TRD uses a double piston design for 2" and longer stop tubes.)

Stop Tube Selection

To determine the proper amount of stop tube for your application, you must first find the value of "D", which represents the "stroke, adjusted for mounting condition". Each mounting condition creates different levels of bushing stress, which have direct impact on the amount of stop tube required. (See Chart 1)

Once the value of "D" is known, refer to Chart 2 for the recommended amount of stop tube.

To order a Stop Tube, add the stop tube prefix "ST=" and the length, to the end of your cylinder model number.

Example:

TA - MP1 - 3.25" X 40" effective stroke - ST=2

As noted, the effective stroke must be included when ordering.

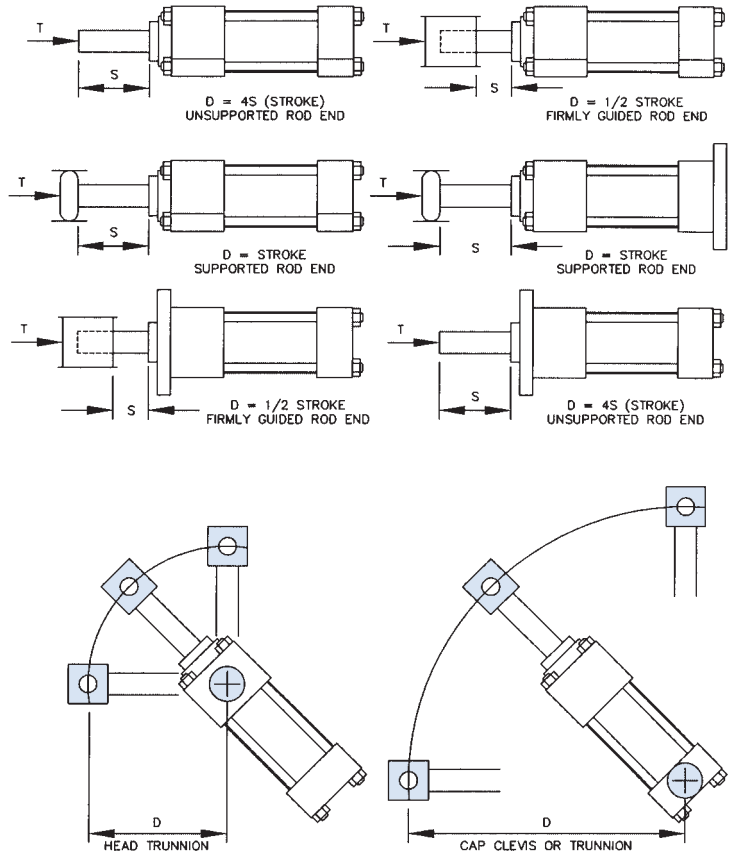
Chart 1

Find the value of "D" for your application

"D" = Stroke, adjusted for mounting condition

"S" = Actual cylinder stroke

"T" = Axial thrust (refer to Chart 3)



Note: Measure "D" when cylinder is fully extended.

Chart 2

Using the value of "D", find the recommended amount of stop tube

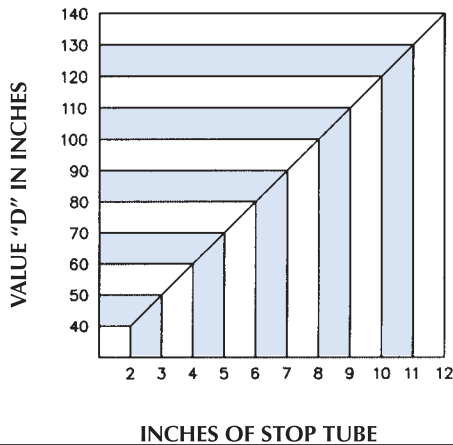
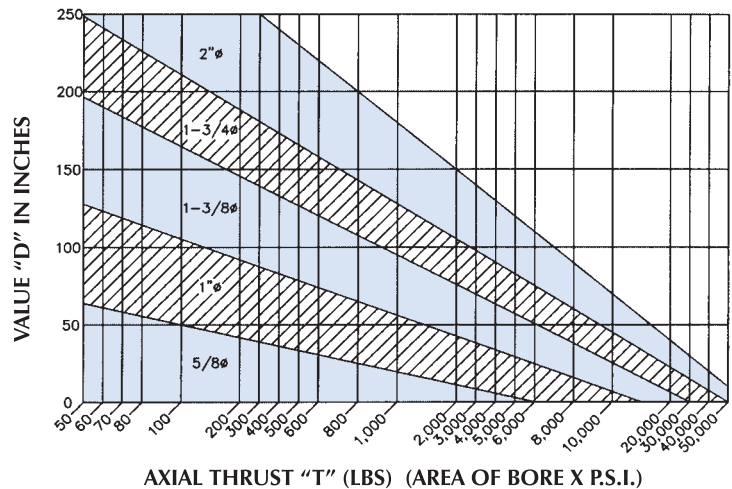


Chart 3

ROD SIZE SELECTION



BASIC OPTIONS

STEEL TUBE

Let's face it, some applications require a cylinder that can withstand higher side-loading, resistance to denting, and in general a more robust design than what hard-coated I.D. aluminum tube cylinders can offer. TRD has offered Steel Tubes for years as a special in the lumber, packaging machinery, and other industries that typically used 100% all steel cylinders. This *proven* option is now available as a standard option.

STEEL TUBE SPEC: Hydraulic grade chrome plated I.D. and honed steel tubing, black epoxy paint finished O.D.

BENEFITS:

- **HIGHER SIDE-LOAD CAPACITY** — Same size load capacity as 100% all steel cylinders.
- **HIGHER TENSILE AND YIELD STRENGTH** — Steel tubing offers double the mechanical properties of aluminum, drastically improving the resistance to internal scoring. In addition, the column strength of the cylinder tubing is twice that of aluminum tubing.
- **HIGHER DENT RESISTANCE** — Same resistance to dents as 100% all steel cylinders.
- **LOW WEIGHT** — The head and cap are machined from high grade aluminum alloy tool plate, reducing the overall cylinder weight by half when compared to typical 100% all steel cylinders.
- **IMPROVED HYDRAULIC PERFORMANCE** — Since the I.D. of the tubing is honed, the tubing roundness and diameter size limits are held to close tolerances, improving seal performance in hydraulic (TH Option) or air/oil applications.

DESIGN TIPS:

- The steel tube option was designed to replace many 100% all steel cylinders in use today, but it is not intended to replace "mill" type cylinder applications. Since "TA" Series mounts are standard, they may not offer adequate strength to replace 1-piece all steel pivot style mount applications. As an option, TRD can furnish 1-piece steel mounts on request.
- For applications where internal tube scoring is an issue, use "WB" wearband option.
- Since hard chrome plating is not a 100% homogenous coating, steel cylinders are prone to internal rusting of the cylinder bore when used in pneumatic applications. Care must be taken to remove excessive line moisture and properly lubricate the air with standard FRL units for maximum seal life.
- For end of stroke position sensing, see pages 114 - 117 for Balluff Proximity end of stroke Sensors.



TH 400 PSI Hydraulic (Non-Shock)

"TA", "TRA" and "FM" Series can be ordered with the "TH" option.

RATING: 400 PSI Hydraulic, Non-Shock

SEALS:

PISTON SEALS - (1) POLY-PAK, (1) Square-lip
Rod Seal - POLY-PAK

NEW TRD PART NUMBER REVISION:

The "TH" Series used to be ordered as:
TH - MS4 - 2 X 10.

(Note: The "TH" Series was the "TA" Series with "TH" 400 PSI feature)

By offering "TH" as an option, you can now make the "TA" or "FM" Series a 400 PSI Hydraulic cylinder!

New Part Number: TA - MS4 - 2 X 10 - TH

VS Fluorocarbon Seals

Benefits of Fluorocarbon Seals:

- Higher temperature performance
0°F to 400°F (-20°C to 200°C)
- Higher chemical resistance
Resists most wash down solutions

Many other seal materials are available. Contact TRD for proper seal material selection in tough applications or environments.

WB Piston Wear Band

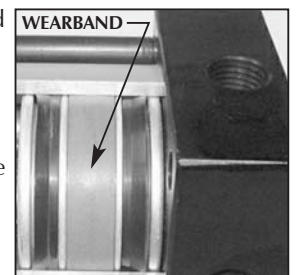
Piston wear bands are recommended for pivot mount cylinders, long strokes, or cylinders that may see side loads.

Material: 90% Virgin PTFE
10% Polyphenylene Sulfide

Tensile Strength: 2,700 - 3,300 PSI

Compressive Modulus: 65,000 PSI

Wear Factor: Extremely low



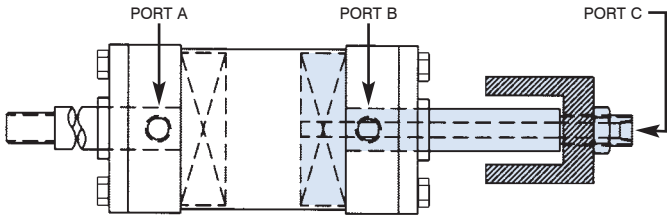
Special wear band widths are available. (Note: MPR magnetic piston options are available with Piston Wear Bands)

UNCOMMON OPTIONS

AS3POS Adjustable Mid Stroke (3 Position Cyl.)

Double piston design allows for adjustment of the mid stroke position. Three ported cylinder with adjustable stop collar.

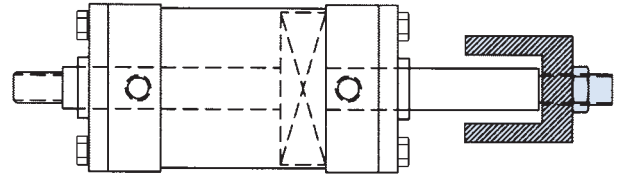
To order, specify "AS3POS" and length of adjustment.
(Example: AS3POS = 4")



DAS Double Rod Adjustable Stroke (Extend)

Consists of a double rod end cylinder and an adjustable stop collar. Used to adjust the extend cylinder stroke. Strokes up to 120" available. (Adjustments to 12" available)

To order, specify "DAS" and length of adjustment.
(Example: DAS = 4")



SPHERICAL PIVOT BEARINGS

Spherical pivot bearing mounts can be furnished as a weldment.

Contact TRD with your specifications.



EXTRA WIDE MULTIPLE WEAR BANDS

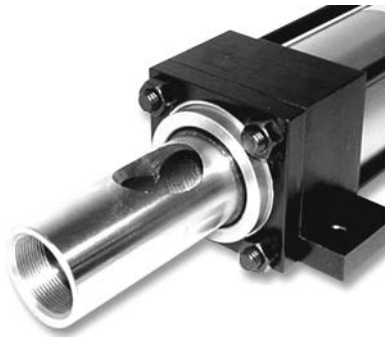
10" Piston with two 1" wide wear bands shown.



HOLLOW PISTON RODS

This cylinder shows a multitude of options:

Double Oversize Piston Rod, Gun-Drilled, Double Rod End with rod extension, special female rod thread, and special side drilled angle hole in piston rod.



ROD BOOTS

Rod Boots are common in dust filled environments — a standard spec for many robot welding applications.

(Note: Rod Boots add length to cylinder rod extension — contact TRD for specifications)



SPECIAL MF1 FLANGE

Customer needed front flange mounting, but didn't have the room for the standard flanges.

TRD provided flanges that were notched for a more compact design.



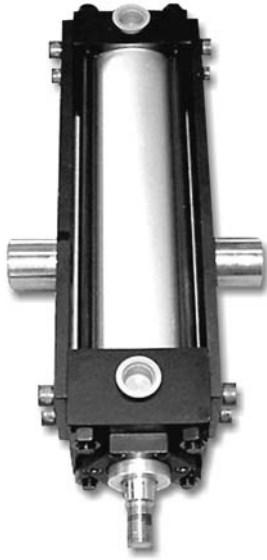
SPECIAL SHORT TAP WITH ORIFICE

Customer required a special short pipe tap, and different size drilled orifices at each end of cylinder, for built-in speed control.



UNCOMMON OPTIONS AND SPECIALS

MT4X BOLT-ON SIDE PLATES



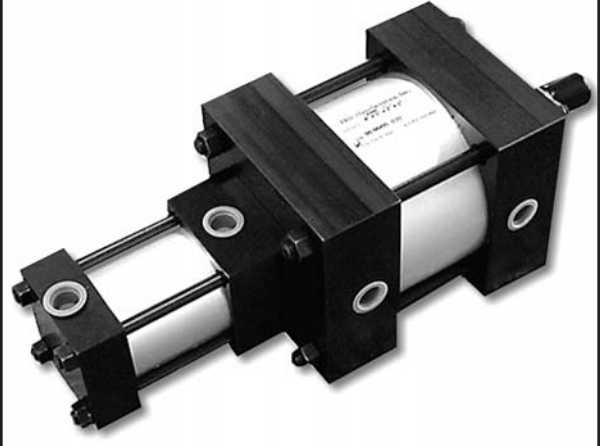
'FM' WITH FLUSH ROD BUSHING



'FM' WITH NO ROD BUSHING



TANDEM WITH DIFFERENT SIZE BORES



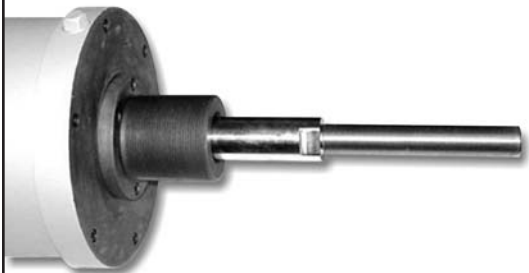
SOLID BRASS PISTONS



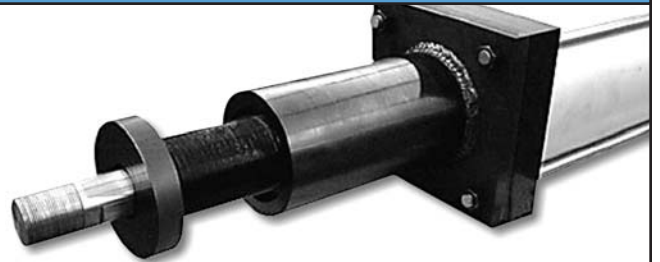
168" STROKE STAINLESS STEEL



7" BORE STEEL NON-TIE ROD DESIGN WITH "STEEL-IT" PAINT (FOOD GRADE DESIGN)



8" BORE - FRONT EXTENSION ADJUSTABLE STROKE



12" BORE STEEL, RATED FOR -40°F BELOW ZERO



EXTERNAL NON-ROTATING WITH SPECIAL TOOL PLATE



Basic Cylinders

Triple-Rod

Multi-Stage

Cylinder Options

Basic Options

Balluff Transducers

BALLUFF TRANSDUCERS



Enhanced Magnetostrictive Technology

The waveguide consists of a special nickel-iron alloy with 0.7 mm O.D. and 0.5 mm I.D.

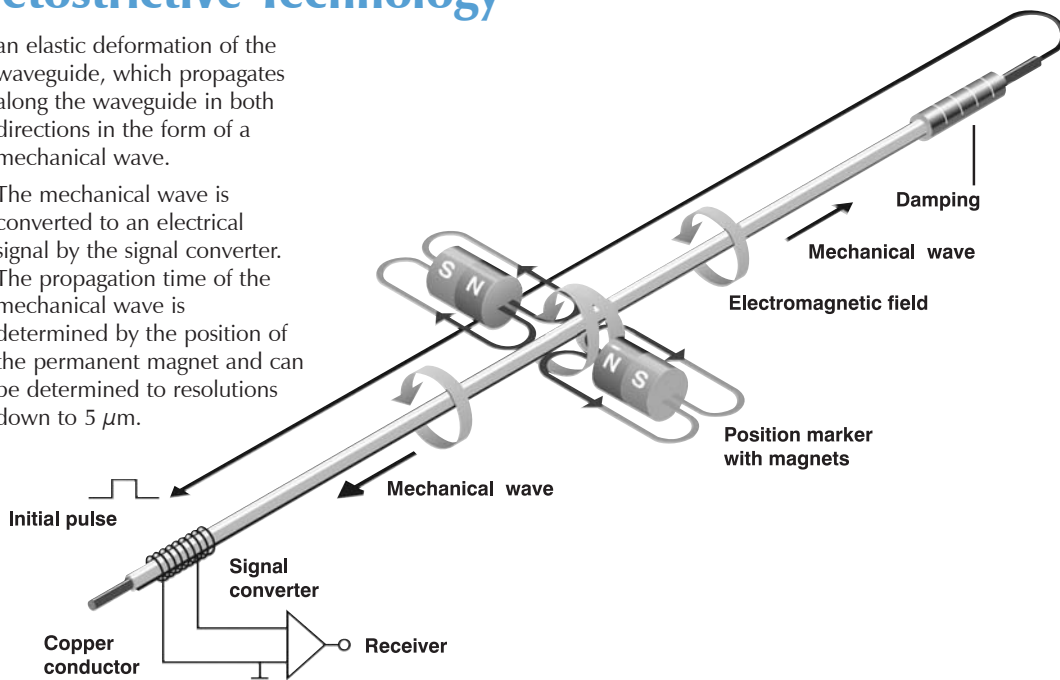
A copper conductor is introduced through the length of this tube. The start of measurement is initiated by a short current pulse. This current generates a circular magnetic field which rotates around the waveguide.

A permanent magnet at the point of measurement is used as the marker element, whose lines of field run at right angles to the electromagnetic field.

In the area on the waveguide where the two fields intersect, a magnetostrictive effect causes

an elastic deformation of the waveguide, which propagates along the waveguide in both directions in the form of a mechanical wave.

The mechanical wave is converted to an electrical signal by the signal converter. The propagation time of the mechanical wave is determined by the position of the permanent magnet and can be determined to resolutions down to 5 μm.



Balluff has the right transducer for any application!

- Rod styles
- Profile styles
- Tubular styles
- Embeddable style
- Explosion-proof style



Rod Style

Z

- .75" x 16 UNF threads
- Pressure rated to 8700 PSI for use in hydraulic cylinders
- Replaceable electronics head
- Analog signal adjustable in field



Rugged, Compact Rod Style

W

- Rugged all stainless steel housing
- Designed for demanding applications
- Eliminates the need for protective cover
- .75" - 16 UNF threads
- Pressure rated to 8700 PSI



Compact, Bolt-in Rod Style

K

- Rugged all stainless steel housing
- Bolt in design
- Pressure rated to 8700 PSI
- Eliminates the need for protective cover



Low-Profile Housing

R

- Lowest profile for space critical applications
- Compatible with "rod in cylinder" type linear potentiometers
- Unique design eliminates bearing wear problems associated with "rod in cylinder" designs

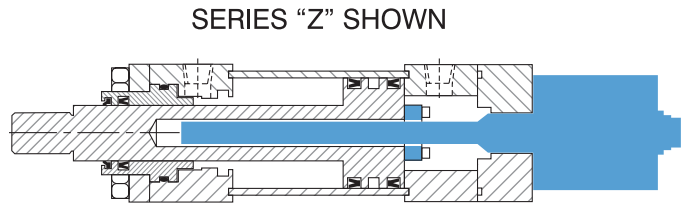
Sensor Output Options	Z	W	K	R
Analog				
0...10 V and 10...0 V	•	•	•	•
-5...+5 V and +5...-5 V	•	•	•	•
-10...+10 V and +10...-10 V	•	•	•	•
4...20 mA or 20...4 mA	•	•	•	•
0...20 mA or 20...0 mA	•	•	•	•
Digital				
Start/Stop, RS422	•	•	•	•
Pulse-Width Modulated, RS422	•	•	•	•
PWM (w/ recirculations), RS422	•	•	•	•
Specialized				
Synchronous Serial Interface*	•	•	•	•
CANopen	•	•	•	•
Profibus DP	•	•	•	•
Quadrature	•	•	•	•
Resolution				
0.1 mV (analog)	•	•	•	•
0.2 μA (analog)	•	•	•	•
16 bit (analog)	•	•	•	•
Controller-dependent (Start/Stop & PWM)	•	•	•	•
1, 2, 3, 5, 10 μm selectable (Quadrature output)	•	•	•	•
1, 5, 10, 20, 40 μm selectable (SSI output)	•	•	•	•
5 μm increments selectable (CANopen & Profibus)	•	•	•	•
10 μm	•	•	•	•
Stroke Length				
Active measurement area: 2" to 156" (Consult factory for longer lengths)	2" - 156"	2" - 156"	2" - 156"	2" - 156"
Wiring Options				
Quick disconnect	•	•	•	•
Cable-out	•	•	•	•
Operating Voltage				
24 V DC (±20%)	•	•	•	•
±15 V DC (±2%)	•	•	•	•
* (24 or 25 bit binary or gray code)				

BALLUFF TRANSDUCERS

TRD will build your cylinder with the proper magnet, spacer plates (if required), drilling and tapping, intermediate supports (if required) and furnish the transducer as a complete unit. *All cylinder/transducer assemblies are 100% tested at TRD before shipping.*

INTERNAL MODELS (BALLUFF Z, W, K SERIES)

- Available on TA, TD, FM, SS Series and STEEL TUBE Option
- Not available on MP1, MP2 and MP4 Mounts
- 1.50" to 12" Bores
- Gun-drilled piston rod (Requires 1" piston rod or larger)
- Balluff Magnet (Installed on piston)
- May require additional cap length



EXTERNAL MODEL (BALLUFF R SERIES)

- Available on TA, TD, TRA, FM, SS, MSE or MSR, Tandem, 3 Position Series and Double Rod end models
- Available on ALL mounts
- External mount to cylinder (Simple design, requires only 4 tapped holes)
- TRD "MPR" Magnet (Installed on piston)
- 1.50" to 10" Bores



- Complete BALLUFF MICROPULSE™ Transducer information is available in catalog form or electronic PDF downloads. Visit www.balluff.com/micropulsecatalog2002
- Other Balluff models are available. Call TRD Mfg. (800-654-2535, ext. 216) for information and cylinder design assistance.



BALLUFF Sensor Solutions Superior Service Dedicated to our Customer's Success
1-800-543-8390

PRODUCTS SOLUTIONS NEWS ABOUT BALLUFF SALES & SERVICE HOME

2003-2004 Photoelectrics

PRODUCTS SOLUTIONS SALES & SERVICE

ICROPULSE

Micropulse Linear Position Transducers Catalog

- Product Description
- Rod Style Series: BTL Z
- Compact, Rugged Rod Style Thread-in: BTL W
- Compact, Rugged Rod Style Bolt-in: BTL K
- Explosion Proof Rod Style Series: BTL EX
- Embeddable Rod Style Series: BTL E
- Profile Series: BTL P
- Low Profile Series: BTL R

Micropulse Catalog Contents

Order your copy today! 2002

SERIES: AUTO RECIPROCATING AIR BOOSTER

Model Number: AB121

This 2:1 ratio air-to-air booster is compact and self-contained. Unit incorporates integral valve components to perform auto-reciprocating function.

Can amplify inadequate air pressure in the following situations:

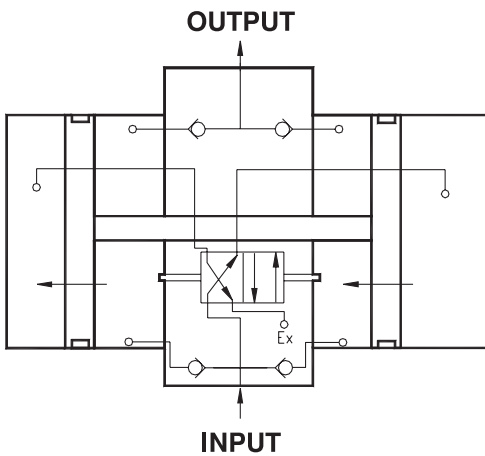
- Cylinders or Grippers: When space isn't available, a smaller bore or model size can be used with higher input PSI to achieve the desired output or grip force.
- Problem solver: Sometimes a cylinder or gripper was sized for an application, but in use, does not perform up to the production requirements. Increasing the input PSI can provide a quick and cost effective solution.



Model	Dimensions (inch)
<p>Model Number: AB121</p> <p>Availability: Stock Item</p> <p>Maximum Inlet Pressure: 125</p> <p>Prelubricated with HT-99</p>	

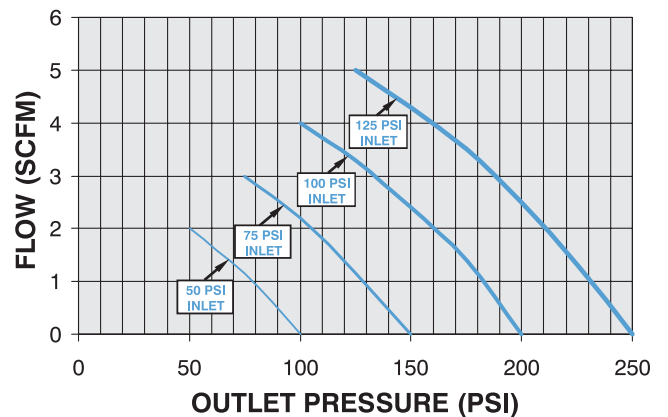
Engineering Specifications

- Maximum Input Pressure:** 125 psi
- Operating Temperature:** 15° to 160°F
- Lubrication:** HT-99 oil
- Bodies and Center Section:** Aluminum; Hard Coat with PTFE
- Mounting Plate:** Anodized Aluminum



SCHEMATIC

FLOW DATA

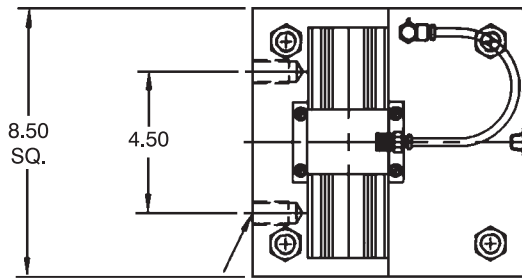
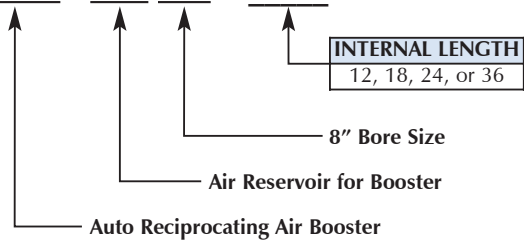


SERIES: AB121 WITH AIR RESERVOIR

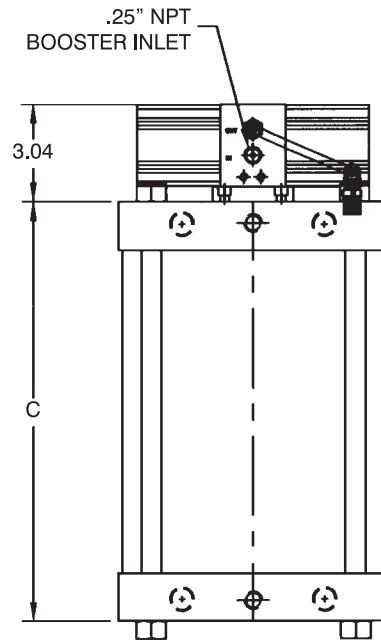
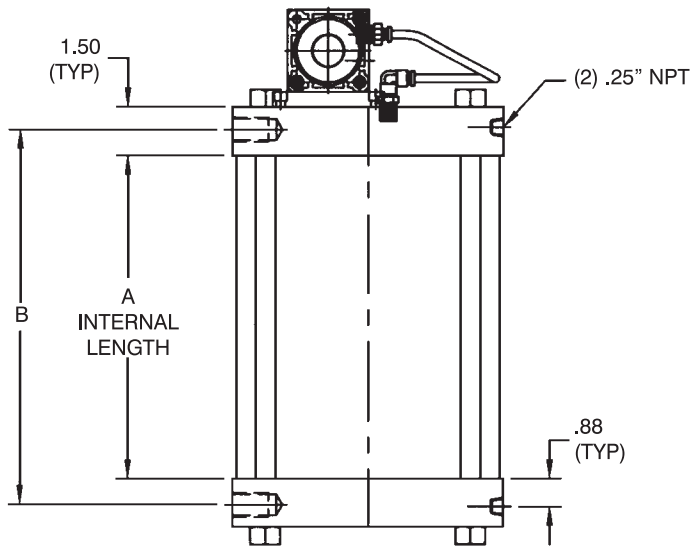
Model AB121 Air Booster furnished with Air Reservoir. Anodized Aluminum Tube and End Cap construction.

How to order:

AB121 - ARB 800 X



(4) .75-10 TAP
X 1.13 DEEP



SERIES AB121-ARB800 X _____ AIR BOOSTER MODEL AB121 MOUNTED AND PIPED TO ARB800 AIR RESERVOIR

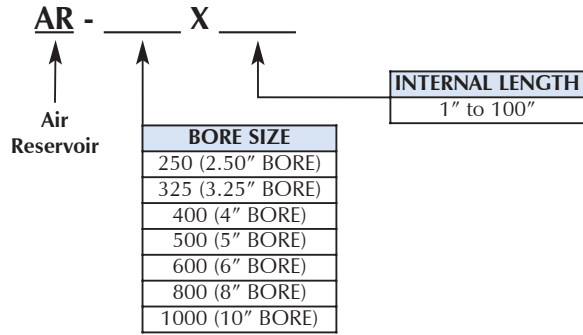
PART NUMBER & VOLUME					INTERNAL LENGTH (inches)	DIMENSIONS	
PART NO.	TANK BORE	AREA	GAL. PER IN. OF TANK	TOTAL CU. FT. PER TANK *	A	B	C
AB121-ARB800 X 12	8	50.26	.2175	.349	12	13.63	15
AB121-ARB800 X 18	8	50.26	.2175	.523	18	19.63	21
AB121-ARB800 X 24	8	50.26	.2175	.698	24	25.63	27
AB121-ARB800 X 36	8	50.26	.2175	1.047	36	37.63	39

*Internal Volume of reservoir.

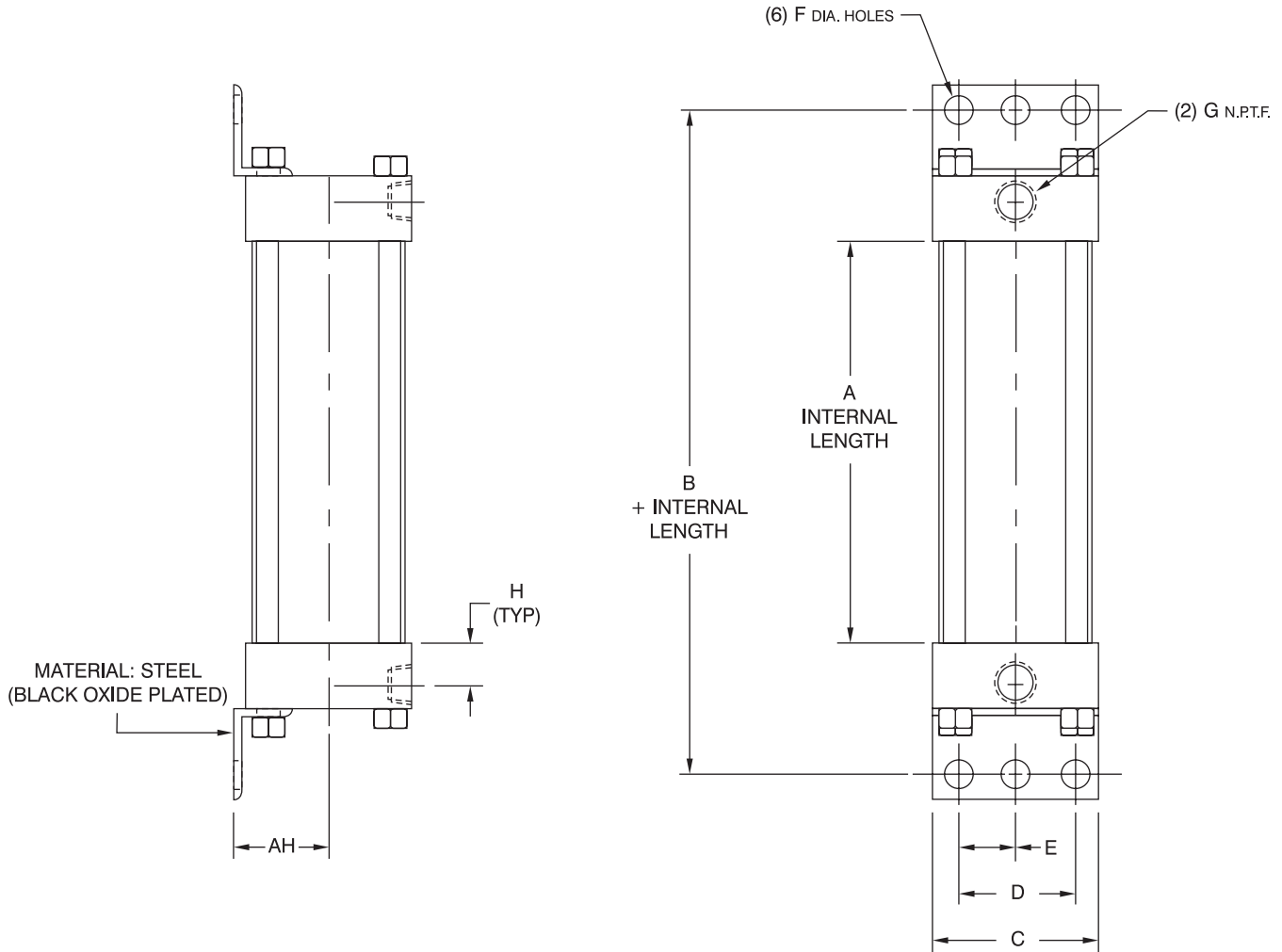
SERIES: AIR RESERVOIR

Stand-alone Air Reservoir from 2.50" to 10" bore size. Anodized Aluminum Tube and End Cap, Steel Mounting Bracket construction.

How to order:



PRESSURE RATING
250 PSI MAX.



AR SERIES (AIR RESERVOIR)

PART NUMBER & VOLUME				DIMENSIONS								
PART NO.	BORE	AREA	GAL. PER IN. OF RESERVOIR*	+ INTERNAL LENGTH		AH	C	D	E	F	G	H
				A	B							
AR-250	2.50	4.909	.0213	0	4	1.63	3	2.25	1.13	.44	.38	.63
AR-325	3.25	8.29	.0359	0	5	1.94	3.75	2.75	1.38	.56	.50	.63
AR-400	4	12.56	.0544	0	5	2.25	4.50	3.50	1.75	.56	.50	.75
AR-500	5	19.64	.085	0	5.25	2.75	5.50	4.25	2.13	.69	.50	.75
AR-600	6	28.27	.122	0	5.75	3.25	6.50	5.25	2.63	.81	.75	.88
AR-800	8	50.26	.2175	0	6.63	4.25	8.50	7.13	3.56	.81	.75	.88
AR-1000	10	78.54	.340	0	7.63	5.31	10.63	8.63	4.31	.81	1	1.13

*Internal Volume of reservoir.

SERIES: AIR TO AIR INTENSIFIER AIR TO HYDRAULIC INTENSIFIERS

“Air to Air” or “Air to Hydraulic” intensifiers are Single-Shot, one output per stroke design.

Benefits of Air to Air Intensifiers:

- Quick Response
- High Volume Outputs Available
- Simple Design
- Heavy-Duty Construction

Benefits of Air to Hydraulic Intensifiers:

- Quick Response
- High Volume Outputs Available
- Intensified Material Can Be Oil or Other Media
- Can Be Used For Measuring and Dispensing

HOW TO ORDER: INTENSIFIERS

CYL. #1

AI - TA - MS4 - 5 x 10 - MPR

WITH

CYL. #2

MXO - 2.50 X 10 - TH

SERIES

TA	250 PSI AIR
TD	250 PSI AIR
SS	STAINLESS STEEL (303, 304) (Refer to Cat. # CAT-TRDSS-704 for ordering information)

NFPA MOUNTS

MXO	NO MOUNT (1.50" - 12" Bore)
MF1	FRONT FLANGE (1.50"-6" Bore)
MS2	SIDE LUG (1.50"- 4" Bore STD., 5" & ABOVE CONSULT FACTORY)
MS4	BOTTOM TAPPED HOLES (1.50" - 12" Bore)

BORE

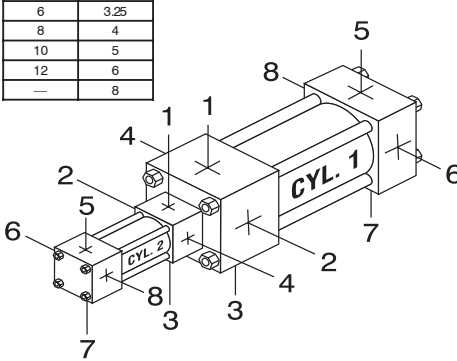
CYL. 1	CYL. 2
3.25	1.50
4	2
5	2.50
6	3.25
8	4
10	5
12	6
—	8

STROKE (CYL. #1)
0" to 50"
Made to Order

OPTIONS (CYL. #1 or CYL. #2)

ADDS LENGTH TO CYLINDER - SEE "OPTION LENGTH ADDER" CHART BELOW.

X	AS	ADJUSTABLE STROKE - RETRACT (SPECIFY LENGTH, Example: AS = 4")
X	BC	.25" URETHANE BUMPER BOTH ENDS
X	BH	.25" URETHANE BUMPER HEAD ONLY
	BP	BUMPER PISTON SEALS (1.50" - 8" Bore)
	H	HEAD CUSHION
	C	CAP CUSHION
	EN	ELECTROLESS NICKEL PLATED (Refer to page 84 for specifications)
	MA	MICRO-ADJUST (6" MAX. STROKE) Available on Double Rod End Models
	MAB	MICRO-ADJUST WITH SOUND DAMPENING BUMPER (6" MAX. STROKE)
	MPR	MAGNETIC PISTON FOR REED OR SOLID STATE SWITCHES - TRD MODELS: R10, RAC, AND MSS (Refer to pages 107-113 for selection)
	MPH	MAGNETIC PISTON FOR HALL SWITCHES
	OP	OPTIONAL PORT LOCATION (Example: Ports @ 3 & 7)
	SAE	SAE PORTS (SPECIFY SIZE, Example: SAE #10)
	SSA	STAINLESS STEEL PISTON ROD, TIE RODS & NUTS, AND FASTENERS
	SSF	STAINLESS STEEL FASTENERS
	SSP	SOLID STAINLESS STEEL PISTON
	SSR	STAINLESS STEEL PISTON ROD
	SST	STAINLESS STEEL TIE RODS & NUTS
	TH	400 PSI HYDRAULIC NON-SHOCK (Refer to page 90 for specifications)
	VS	FLUOROCARBON SEALS
	WB	PISTON WEAR BAND
	XX	SPECIAL VARIATION (SPECIFY)



STANDARD PORT AND CUSHION ADJUSTMENT POSITIONS

- Ports - Positions 1 and 5 (both cylinders)
- Cushion Adjustment - Positions 2 and 6 (CYL. #1), Positions 4 and 8 (CYL. #2)
- Specify Non-Standard Positions When Ordering

About our Part Number System

- Simple, easy to understand
- No excessive codes!
- Eliminates mistakes when ordering

Example:
Cyl. 1 is a standard 'TA' series, MS4 mount, 5" bore X 10" stroke, with a magnet (for Reed Switches), Air-to-Hydraulic Cylinder.
Cyl. 2 is a 'TA' series, MXO (no mount), 2.50" bore X 10" stroke with "TH" option.

Part Number:
AI - TA - MS4 - 5 x 10 - MPR with
TA - MXO - 2.50 x 10 - TH

AIR TO AIR / AIR TO HYDRAULIC INTENSIFIER CYLINDERS:

(2) STROKES MUST BE THE SAME, RODS ARE CONNECTED

AIR TO AIR INTENSIFIERS TRD STANDARD COMBINATIONS

CYL. #1 BORE	CYL. #1 AREA	CYL. #2 BORE	CYL. #2 AREA	INTENSIFIER RATIO	OUTPUT (PSI) OF CYL. #2 @ INPUT PRESSURE OF:			
					50	80	100	120
3.25	8.296	1.50	1.767	4.69	235			
		2	3.142	2.64	132	211	264	
4	12.566	2	3.142	4	200			
		2.50	4.909	2.56	128	205	256	
5	19.635	2.50	4.909	4	200			
		3.25	8.296	2.37	119	190	237	
6	28.274	3.25	8.296	3.41	171			
		4	12.566	2.25	113	180	225	
8	50.265	4	12.566	4	200			
		5	19.635	2.56	128	205	256	
		6	28.274	1.78	89	143	178	214
10	78.54	5	19.635	4	200			
		6	28.274	2.78	139	223		
12	113.10	6	28.274	4	200			
		8	50.265	2.25	113	180	225	

AIR TO HYDRAULIC INTENSIFIERS TRD STANDARD COMBINATIONS

CYL. #1 BORE	CYL. #1 AREA	CYL. #2 BORE	CYL. #2 AREA	INTENSIFIER RATIO	OUTPUT (PSI) OF CYL. #2 @ INPUT PRESSURE OF:			
					50	80	100	120
3.25	8.296	1.50	1.767	4.69	235	375		
		2	3.142	2.64	132	211	264	317
4	12.566	1.50	1.767	7.11	356			
		2	3.142	4	200	320	400	
		2.50	4.909	2.56	128	205	256	307
5	19.635	2	3.142	6.25	313			
		2.50	4.909	4	200	320	400	
		3.25	8.296	2.37	119	190	237	284
6	28.274	2.50	4.909	5.76	288			
		3.25	8.296	3.41	171	273	341	
		4	12.566	2.25	113	180	225	270
8	50.265	3.25	8.296	6.06	303			
		4	12.566	4	200	320	400	
		5	19.635	2.56	128	205	256	307
		6	28.274	1.78	89	143	178	214
10	78.54	4	12.566	6.25	313			
		5	19.635	4	200	320	400	
		6	28.274	2.78	139	223	278	334
12	113.10	5	19.635	5.76	288			
		6	28.274	4	200	320	400	
		8	50.265	2.25	113	180	225	270

Note: CYL. #2 output not to exceed 250 PSI.

Intensifier ratio = $\frac{\text{CYL. \#1 AREA}}{\text{CYL. \#2 AREA}}$

Output pressure = INPUT PRESSURE X INTENSIFIER RATIO

Note: CYL. #2 output not to exceed 400 PSI Non-Shock.

Intensifier ratio = $\frac{\text{CYL. \#1 AREA}}{\text{CYL. \#2 AREA}}$

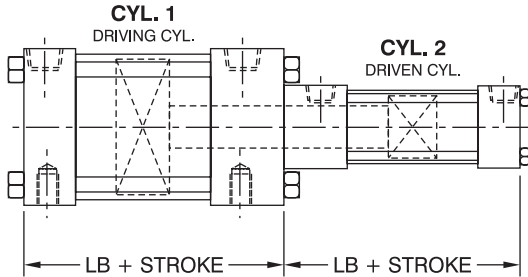
Output pressure = INPUT PRESSURE X INTENSIFIER RATIO

SERIES: AIR TO AIR INTENSIFIER AIR TO HYDRAULIC INTENSIFIERS

BASIC DIMENSIONS:

(For complete dimensions, refer to 'TA' section of catalog)

AIR TO AIR INTENSIFIERS BASIC DIMENSIONS



BORE	LB	BORE	LB	BORE	LB
1.50	3.63	4	4.25	10	6.38
2	3.63	5	4.50	12	6.88
2.50	3.75	6	5		
3.25	4.25	8	5.13		

CYLINDER VOLUMES (PER INCH OF CYLINDER STROKE)

BORE	AREA	GAL. PER IN. OF STROKE	BORE	AREA	GAL. PER IN. OF STROKE	BORE	AREA	GAL. PER IN. OF STROKE
1.50	1.767	.0076	4	12.566	.0054	10	78.54	.340
2	3.142	.0136	5	19.635	.085	12	113.10	.4896
2.50	4.909	.0213	6	28.274	.122			
3.25	8.296	.0359	8	50.265	.2175			

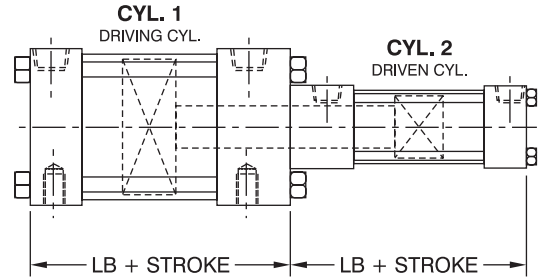
Notes: (To Figure Volumes)

Cubic Inches = **AREA X STROKE** Gallons = $\frac{\text{AREA X STROKE}}{231}$

Example:

3.25" BORE X 16" STROKE CYLINDER = 8.296 X 16 = 132.736 CU. IN. OR .575 GALLONS

AIR TO HYDRAULIC INTENSIFIERS BASIC DIMENSIONS



BORE	LB	BORE	LB	BORE	LB
1.50	3.63	4	4.25	10	6.38
2	3.63	5	4.50	12	6.88
2.50	3.75	6	5		
3.25	4.25	8	5.13		

CYLINDER VOLUMES (PER INCH OF CYLINDER STROKE)

BORE	AREA	GAL. PER IN. OF STROKE	BORE	AREA	GAL. PER IN. OF STROKE	BORE	AREA	GAL. PER IN. OF STROKE
1.50	1.767	.0076	4	12.566	.0054	10	78.54	.340
2	3.142	.0136	5	19.635	.085	12	113.10	.4896
2.50	4.909	.0213	6	28.274	.122			
3.25	8.296	.0359	8	50.265	.2175			

Notes: (To Figure Volumes)

Cubic Inches = **AREA X STROKE** Gallons = $\frac{\text{AREA X STROKE}}{231}$

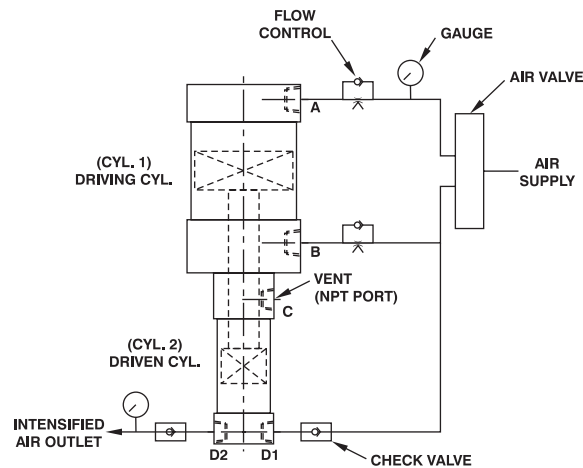
Example:

3.25" BORE X 16" STROKE CYLINDER = 8.296 X 16 = 132.736 CU. IN. OR .575 GALLONS

SCHEMATICS:

AIR TO AIR INTENSIFIER:

SAME STROKE IN EACH CYLINDER.
RODS ARE CONNECTED
ACTUATION SEQUENCE:
PRESSURE TO PORTS 'A' EXTENDS CYLINDER
PRESSURE TO PORTS 'B' RETRACTS CYLINDER

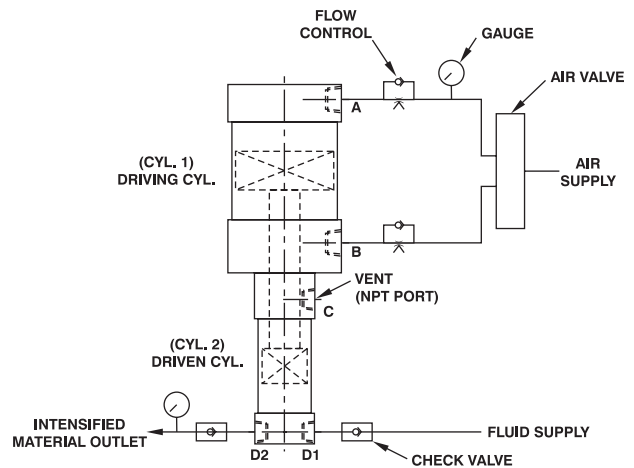


EXAMPLE:

SHOWN IS AN AIR TO AIR INTENSIFIER FOR APPLICATIONS REQUIRING SUPPLY TO BE INTENSIFIED. SUPPLY AIR TO PORT 'A' WILL STROKE CYLINDER AND INTENSIFIED AIR WILL EXIT PORT 'D2'. TO RETURN CYLINDER SUPPLY AIR TO PORT 'B' (2) FLOW CONTROLS USED TO REGULATE CYLINDER SPEED.

AIR TO HYDRAULIC INTENSIFIER:

SAME STROKE IN EACH CYLINDER.
RODS ARE CONNECTED
ACTUATION SEQUENCE:
PRESSURE TO PORTS 'A' EXTENDS CYLINDER
PRESSURE TO PORTS 'B' RETRACTS CYLINDER



EXAMPLE:

SHOWN IS AN AIR TO HYDRAULIC INTENSIFIER FOR APPLICATIONS REQUIRING FLUID SUPPLY TO BE INTENSIFIED. SUPPLY AIR TO PORT 'A' WILL STROKE CYLINDER AND INTENSIFIED MATERIAL WILL EXIT PORT 'D2'. TO RETURN CYLINDER SUPPLY AIR TO PORT 'B' (2) FLOW CONTROLS USED TO REGULATE CYLINDER SPEED.

SERIES 'AT': AIR/OIL TANKS

Series AT features:

- 200 PSI Operating Pressure
- Aluminum End Caps
- Internal baffles to reduce aeration and foaming
- Fiber wound translucent tube
- Optional aluminum tube, fittings and sight glass
- Side lug mount (MS2) optional
- Fill port located in top, drain port in bottom cap
- Optional oversized ports for high flow applications, or SAE and BSP ports



The TRD air/oil system gives you the smooth operation typically associated with hydraulic systems, without the expense! Uses shop air, (2) air/oil tanks, and a cylinder equipped with "TH" (hydraulic seals). Low initial investment and low maintenance to operate!

Tanks need to be mounted above the cylinder, but not necessarily by the cylinder. This will create a self-purging oil circuit. It is advisable to size tanks 30-50% larger than cylinder volume, to prevent the tanks from running dry and to allow for heat expansion.

Sizing your air/oil tank:

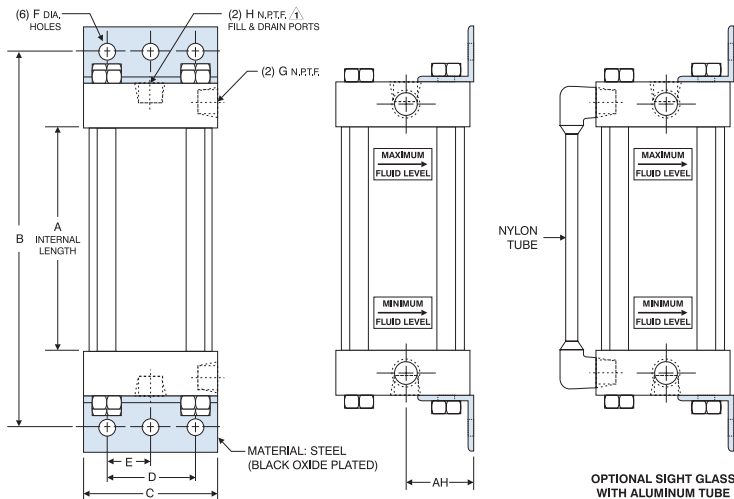
1. Determine the cylinder volume by multiplying the square inches of piston area by the inches of stroke. (See Table B) Add 30-50% to determine actual tank size.
2. Find the volume closest to your tank volume requirement in Table C. (Note: Tanks of smaller diameters with greater lengths are generally less expensive than larger diameter, short tanks of equal volume).
3. **HOW TO ORDER:**
Specify bore and internal length required.

Example 1: AT250 x 14

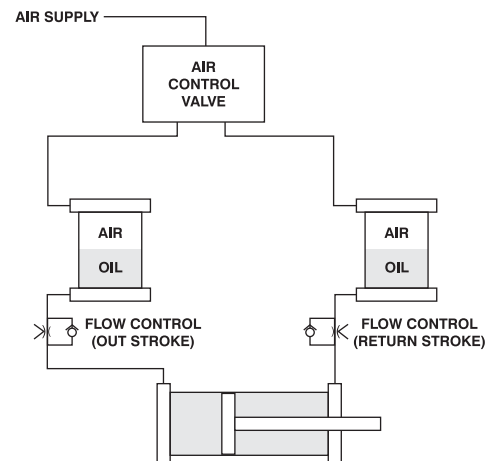
(2.50" Bore, 14" internal tank length, with a usable volume of 52 cubic inches).

Example 2: Same as above, with optional sight glass and aluminum tube —

AT250 x 14 - ALUMINUM TUBE AND SIGHT GLASS



TYPICAL AIR-OIL CIRCUIT



PART NUMBER & VOLUME				PLUS INTERNAL LENGTH		TANK DIMENSIONS						
PART NO.	BORE	AREA	*GALS PER INCH TANK	A	B	AH	C	D	E	F	G	H
AT250	2.50	4.91	.0213	0	4	1.63	3	2.25	1.13	.44	.38	.38
AT325	3.25	8.29	.0359	0	5	1.94	3.75	2.75	1.38	.56	.50	.38
AT400	4	12.56	.0544	0	5	2.25	4.50	3.50	1.75	.56	.50	.38
AT500	5	19.64	.085	0	5.25	2.75	5.50	4.25	2.13	.69	.50	.38
AT800	8	50.26	.2175	0	6.63	4.25	8.50	7.13	3.56	.69	.75	.75

* This is total internal volume, not recommended usable oil capacity.

△ On the AT-500 & AT-800 the fill & drain ports are not on centerline.

Note: When torquing Air/Oil Tank tie rods, refer to page 121 for specifications.

CYLINDER BORE (In.)	PISTON AREA (Sq. In.)
1.50	1.77
2	3.14
2.50	4.91
3.25	8.30
4	12.57
5	19.64
6	28.27
8	50.27

BORE	AREA	ACTUAL INTERNAL LENGTH OF TANK																
		5	6	7	8	9	10	12	14	16	18	20	25	30	35	40	45	
2.50	4.91	17	20	24	27	31	34	41	48	55	61	68	86	103	120	137	154	
3.25	8.30	29	34	40	46	52	58	69	81	93	104	116	145	174	203	232	261	
4	12.57	44	52	61	70	79	88	105	123	140	158	176	220	264	308	352	396	
5	19.64	68	82	96	110	123	137	165	192	220	247	275	343	412	481	550	618	
8	50.27	176	211	246	281	317	352	422	493	563	633	704	880	1056	1232	1408	1584	

ACCESSORIES: CLEVIS, PINS & MOUNTS

Accessories Cross Reference Chart

CYLINDER MODEL				ACCESSORIES				
BORE	ROD SIZE	ROD STYLE (KK)	ROD THREAD	ROD CLEVIS	ROD EYE	CLEVIS PIN	CLEVIS BRACKET	EYE BRACKET
1.50, 2, 2.50	.63	#1 (STANDARD) KK1	.44-20	RC437	RE437	CP500	CB500	EB500
		#2 KK2	.50-20	RC500	RE500	CP500		
	1	#1 (ST'D-OVERSIZE) KK1	.75-16	RC750	RE750	CP750		
		#4 KK4	1-14	RC1000	RE1000	CP1000		
3.25, 4, 5	1	#1 (STANDARD) KK1	.75-16	RC750	RE750	CP750	CB750	EB750
		#4 KK4	1-14	RC1000	RE1000	CP1000		
	1.38	#1 (ST'D-OVERSIZE) KK1	1-14	RC1000	RE1000	CP1000		
		#2 KK2	1.25-12	RC1250	N/A	CP1375		
6 & 8	1.38	#1 (STANDARD) KK1	1-14	RC1000	RE1000	CP1000	CB1000	EB1000
		#2 KK2	1.25-12	RC1250	N/A	CP1375		
	1.75	#1 (ST'D-OVERSIZE) KK1	1.25-12	RC1250	N/A	CP1375		
		#2 KK2	1.50-12	RC1500	N/A	CP1750		
10	1.75	#1 (STANDARD) KK1	1.25-12	RC1250	RE1250	CP1375	CB1375	EB1375
	2	#2 KK2	1.50-12	RC1500	RE1500	CP1750	CB1750	EB1750
12	2	#1 (STANDARD) KK1	1.50-12	RC1500	RE1500	CP1750	CB1750	EB1750
		#1 (STANDARD) KK1	1.50-12	RC1500	RE1500	CP1750	CB1750	EB1750

CLEVIS PIN (WITH BRIDGE PIN - STANDARD)					
PART NO.	CD	H	HP	LH	LP
CP500	.50	.63	.16	2.25	2.09
CP750	.75	.94	.16	3	2.84
CP1000	1	1.19	.20	3.50	3.31

MATERIAL: 1018 CRS
FINISH: BLACK OXIDE

CLEVIS PIN (WITH COTTER PINS)			
PART NO.	CD	LH	LP
CP500C	.50	2.25	1.94
CP750C	.75	3	2.72
CP1000C	1	3.50	3.22
CP1375C	1.38	5	4.25
CP1750C	1.75	6	5.50
CP2000C	2	6	5.50

MATERIAL: 1045 CRS
FINISH: CHROME PLATED O.D.

CLEVIS PIN (WITH E-RINGS)			
PART NO.	CD	LH	LP
CP500E	.50	2.13	1.88
CP750E	.75	2.94	2.63
CP1000E	1	3.44	3.13

MATERIAL: 1045 CRS
FINISH: NITROTECH PLATED*

*HARD CHROME PLATED O.D. AVAILABLE

SMALL CLEVIS PIN (WITH BRIDGE PIN)				
PART NO.	CD	HP	LH	LP
CP500CCS	.50	.16	1.38	1.25
CP750CCS	.75	.16	2	1.88

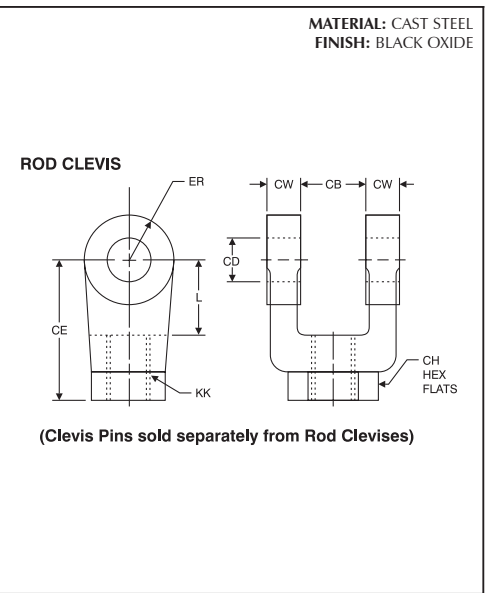
MATERIAL: 1018 CRS
FINISH: BLACK OXIDE

SMALL ROD CLEVIS									
PART NO.	C	CB	CD	CE	CH	CW	KK1	KK2	L
RC437CCS	1.875	.50	.50	1.38	1	.25	.44-20	—	.75
RC500CCS	1.875	.50	.50	1.38	1	.25	—	.50-20	.75
RC750CCS	2.500	.75	.75	1.75	1.50	.38	.75-16	—	1

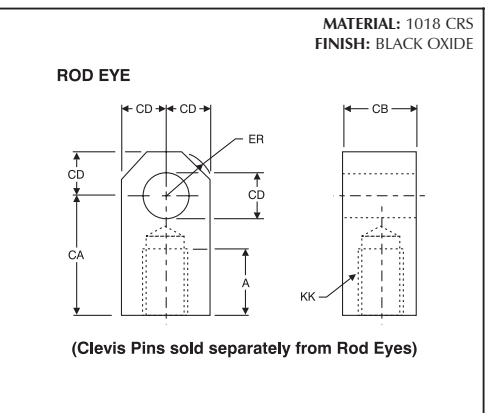
MATERIAL: 1018 CRS
FINISH: BLACK OXIDE

Accessories: Clevis, Pins & Mounts

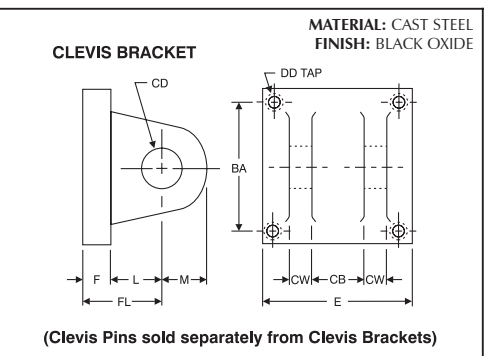
ROD CLEVIS								
PART NO.	CB	CD	CE	CH	CW	ER	KK	L
RC437	.75	.50	1.50	1	.50	.50	.44-20	.75
RC500							.50-20	
RC750	1.25	.75	2.38	1.25	.63	.75	.75-16	1.25
RC1000	1.50	1	3.13	1.50	.75	1	1-14	1.50
RC1250	2	1.38	4.13	2	1	1.38	1.25-12	2.13
RC1375	2	1.38	4.13	2	1	1.38	1.38-12	2.13
RC1500	2.50	1.75	4.50	2.38	1.25	1.75	1.50-12	2.25
RC1750	2.50	1.75	4.50	2.38	1.25	1.75	1.75-12	2.25
RC1875	2.50	2	5.50	3	1.25	2	1.88-12	2.50



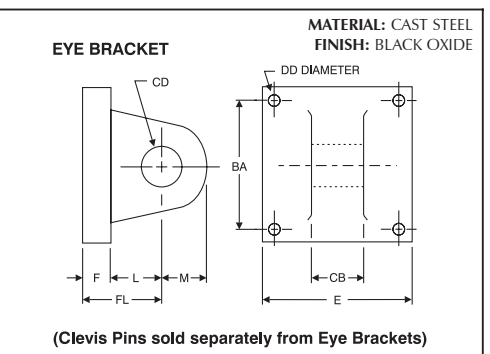
ROD EYE						
PART NO.	A	CA	CB	CD	ER	KK
RE437	.75	1.50	.75	.50	.63	.44-20
RE500						.50-20
RE750	1.13	2.06	1.25	.75	.88	.75-16
RE1000	1.63	2.81	1.50	1	1.19	1-14
RE1250	2	3.44	2	1.38	1.56	1.25-12
RE1500	2.25	4	2.50	1.75	2	1.50-12



CLEVIS BRACKET										
PART NO.	BA	CB	CD	CW	DD	E	F	FL	L	M
CB500	1.63	.75	.50	.50	.38-24	2.50	.38	1.13	.75	.50
CB750	2.56	1.25	.75	.63	.50-20	3.50	.63	1.88	1.25	.75
CB1000	3.25	1.50	1	.75	.63-18	4.50	.75	2.25	1.50	1
CB1375	3.81	2	1.38	1	.63-18	5	.88	3	2.13	1.38
CB1750	4.94	2.50	1.75	1.25	.88-14	6.50	.88	3.13	2.25	1.75



EYE BRACKET										
PART NO.	BA	CB	CD	DD	E	F	FL	L	M	
EB500	1.63	.75	.50	.41	2.50	.38	1.13	.75	.50	
EB750	2.56	1.25	.75	.53	3.50	.63	1.88	1.25	.75	
EB1000	3.25	1.50	1	.66	4.50	.75	2.25	1.50	1	
EB1375	3.81	2	1.38	.66	5	.88	3	2.13	1.38	
EB1750	4.95	2.50	1.75	.91	6.50	.88	3.13	2.25	1.75	



ACCESSORIES: STAINLESS STEEL CLEVIS, PINS & MOUNTS

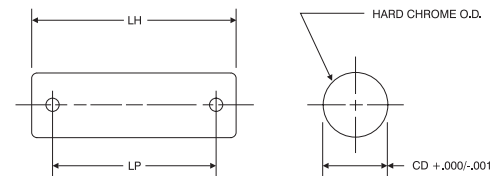
Stainless Steel Accessories Cross Reference Chart

CYLINDER MODEL				ACCESSORIES				
BORE	ROD SIZE	ROD STYLE (KK)	ROD THREAD	ROD CLEVIS	ROD EYE	CLEVIS PIN	CLEVIS BRACKET	EYE BRACKET
1.50, 2, 2.50	.63	#1 (STANDARD) KK1	.44-20	SS-RC437	SS-RE437	SS-CP500	SS-CB500	SS-EB500
		#2 KK2	.50-20	SS-RC500	SS-RE500	SS-CP500		
	1	#1 (ST'D-OVERSIZE) KK1	.75-16	SS-RC750	SS-RE750	SS-CP750		
		#4 KK4	1-14	SS-RC1000	SS-RE1000	SS-CP1000		
3.25, 4, 5	1	#1 (STANDARD) KK1	.75-16	SS-RC750	SS-RE750	SS-CP750	SS-CB750	SS-EB750
		#4 KK4	1-14	SS-RC1000	SS-RE1000	SS-CP1000		
	1.38	#1 (ST'D-OVERSIZE) KK1	1-14	SS-RC1000	SS-RE1000	SS-CP1000		
		#2 KK2	1.25-12	SS-RC1250	N/A	SS-CP1375		
6 & 8	1.38	#1 (STANDARD) KK1	1-14	SS-RC1000	SS-RE1000	SS-CP1000	SS-CB1000	SS-EB1000
		#2 KK2	1.25-12	SS-RC1250	N/A	SS-CP1375		
	1.75	#1 (ST'D-OVERSIZE) KK1	1.25-12	SS-RC1250	N/A	SS-CP1375		
		#2 KK2	1.50-12	SS-RC1500	N/A	SS-CP1750		

Accessories (303 Stainless Steel)

CLEVIS PIN (WITH COTTER PINS)			
PART NO.	CD	LH	LP
SS-CP500	.50	2.25	1.94
SS-CP750	.75	3	2.72
SS-CP1000	1	3.50	3.22
SS-CP1375	1.38	5	4.25
SS-CP1750	1.75	6	5.50

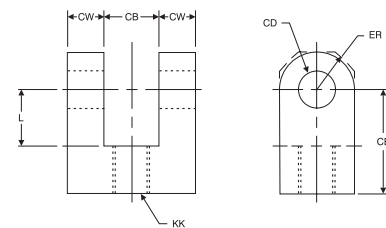
CLEVIS PIN (INCLUDES COTTER PINS)



(Clevis Pins sold with (2) S.S. Cotter Pins)

ROD CLEVIS							
PART NO.	CB	CD	CE	CW	ER	KK	L
SS-RC437	.75	.50	1.50	.50	.50	.44-20	.75
SS-RC500						.50-20	
SS-RC750	1.25	.75	2.38	.63	.75	.75-16	1.25
SS-RC1000	1.50	1	3.13	.75	1	1-14	1.50
SS-RC1250	2	1.38	4.13	1	1.38	1.25-12	2.13
SS-RC1500	2.50	1.75	4.50	1.25	1.75	1.50-12	2.25

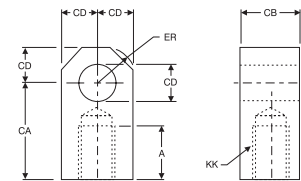
ROD CLEVIS



(Clevis Pins sold separately from Rod Clevis)

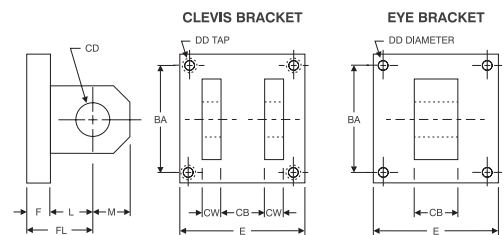
ROD EYE						
PART NO.	A	CA	CB	CD	ER	KK
SS-RE437	.75	1.50	.75	.50	.63	.44-20
SS-RE500						.50-20
SS-RE750	1.13	2.06	1.25	.75	.88	.75-16
SS-RE1000	1.63	2.81	1.50	1	1.19	1-14
SS-RE1250	2	3.44	2	1.38	1.56	1.25-12
SS-RE1500	2.25	4	2.50	1.75	2	1.50-12

ROD EYE



(Clevis Pins sold separately from Rod Eyes)

CLEVIS BRACKETS AND EYE BRACKETS										
PART NO.	BA	CB	CD	CW	DD	E	F	FL	L	M
SS-CB500	1.63	.75	.50	.50	.38-24	2.50	.38	1.13	.75	.63
SS-CB750	2.56	1.25	.75	.63	.50-20	3.50	.63	1.88	1.25	.75
SS-CB1000	3.25	1.50	1	.75	.63-18	4.50	.75	2.25	1.50	1
SS-CB1375	3.81	2	1.38	1	.63-18	5	.88	3	2.13	1.38
SS-EB500	1.63	.75	.50	N/A	.41	2.50	.38	1.13	.75	.50
SS-EB750	2.56	1.25	.75		.53	3.50	.63	1.88	1.25	.75
SS-EB1000	3.25	1.50	1		.66	4.50	.75	2.25	1.50	1
SS-EB1375	3.81	2	1.38		.63-18	5	.88	3	2.13	1.38



(Clevis Pins sold separately from Clevis & Eye Brackets)

ACCESSORIES: ALIGNMENT COUPLERS

Solid Steel self-aligning piston rod couplers

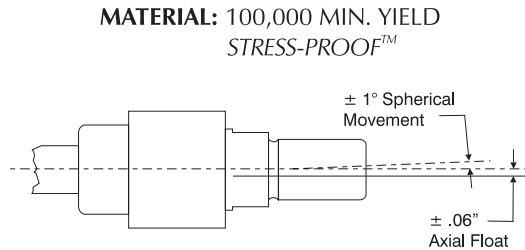
TRD's alignment couplers can virtually pay for themselves by eliminating the need to precisely mount cylinders in your applications. Our couplers prevent binding and erratic movement that misalignment causes, extending the bearing and seal life of your cylinders. Proper use of alignment couplers will allow cylinders to stroke in the shortest time possible, increasing production!

Benefits

- Rod alignment couplers eliminate expensive machining for mounting fixed or rigid cylinders on guided or slide applications.
- Cylinder efficiency is increased by eliminating friction caused by misalignment. Couplers compensate for 1° angular error and .06" lateral misalignment on push or pull strokes.
- Couplers provide greater reliability, performance, and reduce cylinder component wear.
- Simplifies alignment problems in the field.

Design Tips

- Alignment couplers can be exposed to high stresses that are not apparent in an application. Always use the largest thread size practical in your application. (see chart for maximum pull yields)
- Use jam nut to lock coupler to rod when used with full diameter threads (example: .63" thread on .63" rod).
- Large thread sizes can be "pinned" in high impact applications, eliminating unwanted loosening of coupler from rod. Always use the smallest pin possible to avoid weakening the piston rod thread. (example: Use a .09" diameter pin for .63" rod threads and larger)



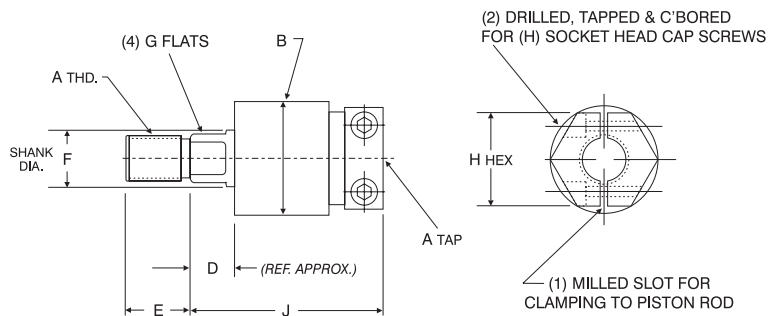
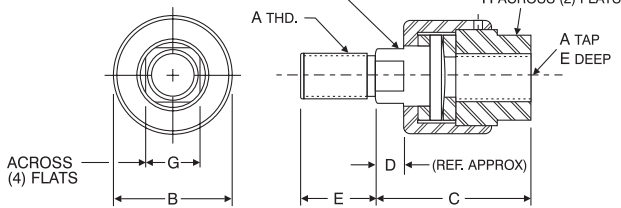
Standard AC Coupler
AC250 - AC2000



ACH Coupler
ACH250 - ACH1250

ACH SERIES

AC SERIES



ALIGNMENT COUPLER DIMENSIONS											
PART NO.	A	B	C	D	E	F	G	H	H HEX	J	MAX PULL AT YIELD
AC250	.25-28	1.13	1.75	.38	.50	.50	.38	.69	1.25	2	6,000
AC312	.31-24	1.13	1.75	.38	.50	.50	.38	.69	1.25	2	8,300
AC375	.38-24	1.13	1.75	.38	.50	.50	.38	.69	1.25	2	8,300
AC437	.44-20	1.25	2	.44	.75	.63	.50	.81	1.25	2.16	10,000
AC500	.50-20	1.25	2	.44	.75	.63	.50	.81	1.13	2.16	14,000
AC625	.63-18	1.25	2	.44	.75	.63	.50	.81	1.25	2.16	19,000
AC750	.75-16	1.75	2.31	.44	1.13	.97	.81	1.13	1.75	2.50	34,000
AC875	.88-14	1.75	2.31	.44	1.13	.97	.81	1.13	1.75	2.50	39,000
AC1000	1-14	2.50	2.94	.44	1.63	1.34	1.16	1.63	2.50	2.94	64,000
AC1250	1.25-12	2.50	2.94	.44	1.63	1.34	1.16	1.63	2.50	2.94	78,000
AC1375	1.38-12	2.50	2.94	.44	1.63	1.34	1.16	1.63	—	—	78,000
AC1500	1.50-12	3.25	4.38	.88	2.25	1.97	1.75	2.38	—	—	134,000
AC1750	1.75-12	3.25	4.38	.88	2.25	1.97	1.75	2.38	—	—	134,000
AC1875	1.88-12	3.75	5.63	1	3	2.47	2.13	2.75	—	—	134,000
AC2000	2-12	3.75	5.63	1	3	2.47	2.13	2.75	—	—	195,000

*Please specify AC or ACH coupler when ordering:
i.e.: AC750 (Std. Coupler) or ACH750 (Hex Coupler)

How to Order:

AC 250 - 312 FEMALE

(Optional alternative size*)

SERIES	SIZE	SIZE
AC	250	250
AC	312	312
ACH	375	375
	437	437
	500	500
	625	625
	750	750
	875	875
	1000	1000
	1250	1250
	1375	1375
	1500	1500
	1750	1750

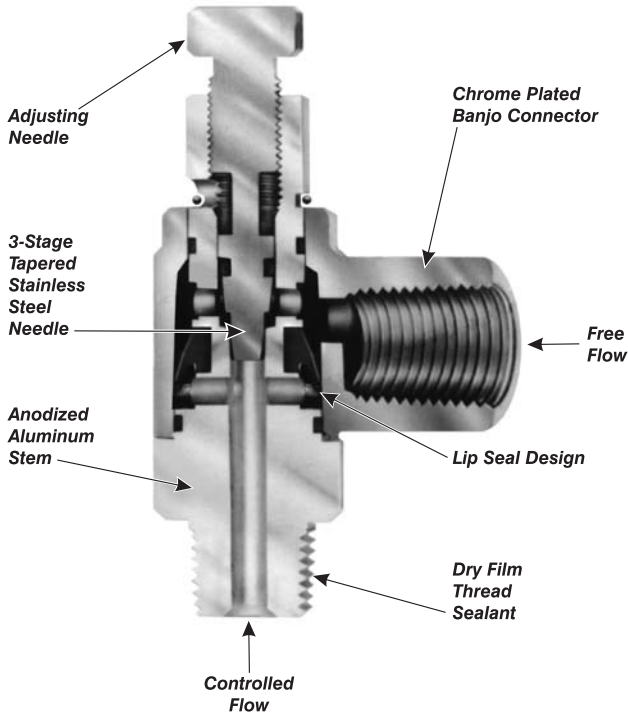
*You can order different thread sizes within the same size of coupler DIA. (Refer to "B" Diameter in dimension chart)

Ordering Examples:

- AC250 (AC with male & female .25-28 thread)
- ACH500 (ACH with male & female .50-20 thread)
- AC437-625 FEMALE (AC with .44-20 male and .63-18 female thread)

ACCESSORIES: FLOW CONTROLS (FCP SERIES)

FCP



PORT SIZE
.25", .38", .50"



Materials:

Banjo Connector: Chrome plated, zinc die cast

Banjo Retaining Ring: Zinc plated steel

Stem: High strength anodized aluminum alloy

Adjusting Needle: Stainless steel

"O" Rings and Lip Seal: Buna N

Maximum Operating Pressure:

150 PSI Air Only

Operating Temperature Range:

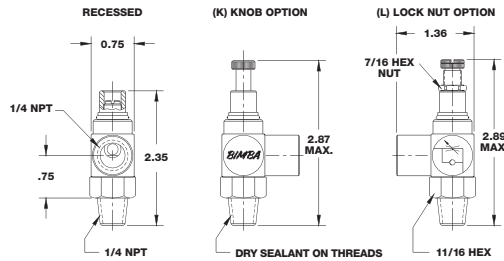
-20° to +200° F
(-25°C to +95°C)

FCP4

FCP4K

FCP4L

For .25" port

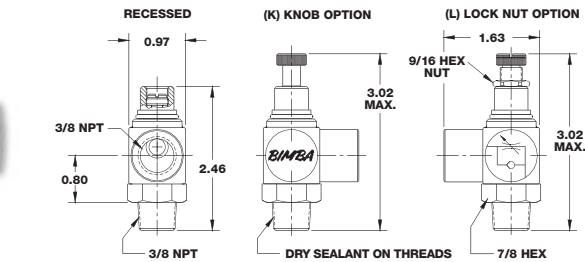


FCP6

FCP6K

FCP6L

For .38" port

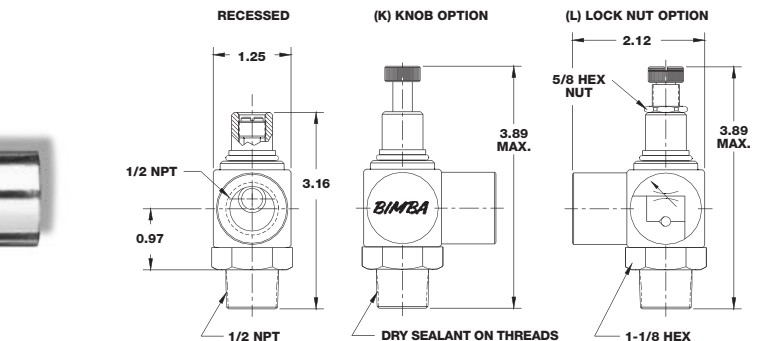


FCP8

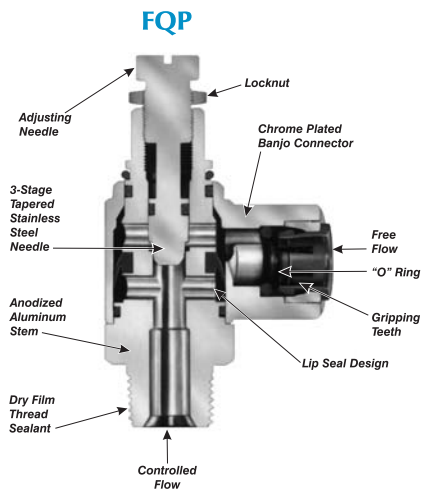
FCP8K

FCP8L

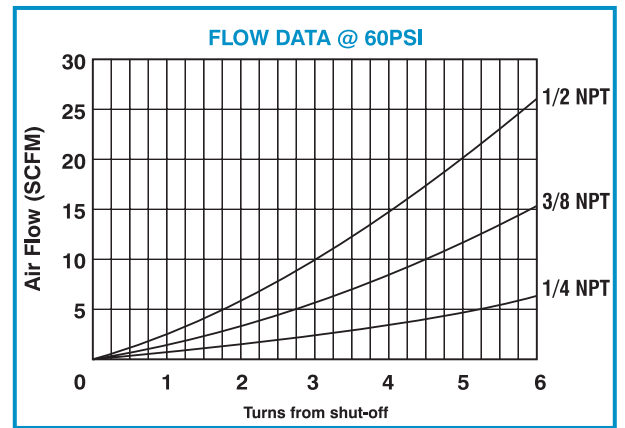
For .50" port



ACCESSORIES: QUICK-FLO® FLOW CONTROLS (FQP SERIES)



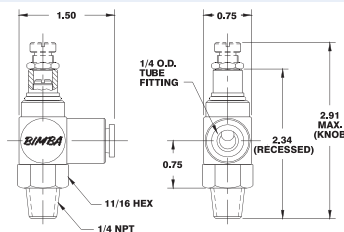
FQP & FCP Series



FQP44

FQP44K

For .25" port, .25" OD tubing



Materials:

Banjo Connector:
Chrome plated, zinc die cast

Banjo Retaining Ring:
Zinc plated steel

Stem:
High strength anodized aluminum alloy

Adjusting Needle:
Stainless steel

"O" Rings and Lip Seal:
Buna N

Collet:
Acetal copolymer

Gripping teeth:
Stainless steel

Collet Retainer (if applicable):
Brass

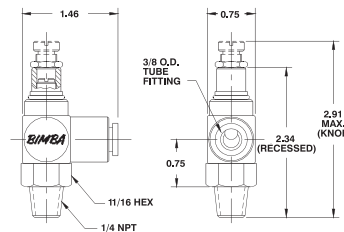
Locknut:
Chrome plated brass

Tube Types:
All plastic tubing, including nylon and polyethylene

FQP4

FQP4K

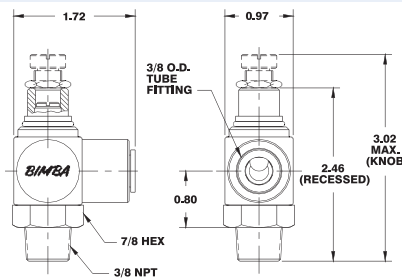
For .25" port, .38" OD tubing



FQP6

FQP6K

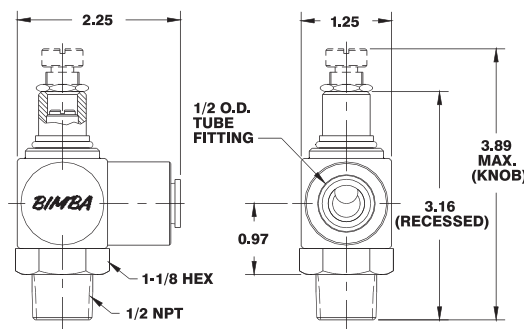
For .38" port, .38" OD tubing



FQP8

FQP8K

For .50" port, .50" OD tubing



Maximum Operating Pressure:

150 PSI Air Only

Operating Temperature Range:

-20° to +200° F
(-25°C to +95°C)

ACCESSORIES: SWITCHES



- Miniature AC/DC Reed
- High Power AC Reed
- Miniature DC Solid State
- Miniature AC/DC Reed with built-in Circuit Protection
- Extended Temperature Range Reed

TRD offers Reed, High Power AC Reed, DC Solid State and Reed Switches with built-in Circuit Protection to meet a wide variety of customer needs.

Advantages:

- Compact low profile Switch/Bracket Assembly
- Switches and Brackets are Nylon and Stainless Steel Hardware construction – suitable for wash down or corrosive environments (IP67)
- Quick, Simple Set-up: Requires Standard (slotted) Screw Driver only
- High visibility LED can be seen up to 20 feet
- Magnetically operated, can be located anywhere in the actuator stroke range
- Can be used with all TRD Aluminum Series Actuators (TA, TD, TRA, FM, MSE, MSR), Electroless Nickel Plated Series (EN), and Stainless Steel Series (SS) (Note: Specify “MPR” option when ordering actuator)
- Suitable for all bore sizes (1.50” to 12”)
- One magnet (MPR) for all switch models

Benefits of REED Switch

- Internal Circuit Protection
- Lower Cost
- Low or High Current Models available, AC or DC, and TRIAC type switch for inductive loads
- High Visibility Red LED (on Low Current Models)
- Choice of lead lengths available on all models
- Optional 8mm Quick Connect on Low Current Model

Benefits of SOLID STATE Switch

- Shock Proof
- GMR Technology - Giant Magneto Restrictive Design
- Reverse Polarity and Over Voltage Protection
- High Visibility Red LED (All Models)
- Choice of lead lengths available or 8mm Quick Connect

R10 Miniature REED Switch

- 5-120 Volts AC, 5-110 Volts DC, 400 mA current rating (MAX.)
- Cable options include 24 inch or 120 inch plain cable leads, and 8mm Threaded Quick Connect
- High visibility LED

RAC High Power AC REED Switch

- 12-240 Volts AC, 800 mA current rating, TRIAC output
- Cable options include 24 inch or 120 inch plain cable leads

MSS Miniature Solid State Switch

- 10-30 Volts DC, 4-300 mA current rating
- Can be wired Current Sinking (NPN) or Current Sourcing (PNP)

- Cable options include 24 inch or 120 inch plain cable leads, and 8mm Threaded Quick Connect
- High Visibility LED

R10P Miniature AC/DC REED Switch with built-in Circuit Protection

- 5-120 Volts AC, 5-110 Volts DC, 150 mA current rating (MAX.)
- Cable options include 24 inch or 120 inch plain cable leads
- High visibility LED

RHT Miniature Extended Temperature Range Reed Switch

- -40°F to 260°F (-40°C to 125°C)
- Cable options include 24 inch or 120 inch plain cable leads

Switch Application Selection Guide

For selecting the right switch for your application

SWITCH MODEL	PROGRAMMABLE CONTROLLERS	RELAYS	SOLENOIDS	INDICATOR LIGHTS		MOTORS	TIME COUNTERS
				BULBS	SOLID STATE		
R10 or RHT REED SWITCH	YES	<10VA*	<10VA*	<10VA*	YES	<10VA*	<10VA*
RAC HIGH POWERED REED SWITCHES**	NO	YES	YES	YES	NO	YES	YES
MSS SOLID STATE SWITCH	YES	<300mA	NO	<300mA	YES	NO	<300mA
R10P REED SWITCH	YES	<10VA	<10VA	<10VA	YES	<10VA	<10VA

*Use resistor-capacitor protection

**Minimum current = 80mA

ACCESSORIES: SWITCHES — REED

Electrical Specifications

R10 Miniature Reed Switch, 24" (24 AWG Wire, PVC Jacket) Plain Cable Lead, (2 wire Switch)

R10X Miniature Reed Switch, 120" (24 AWG Wire, PVC Jacket) Plain Cable Lead, (2 wire Switch)

Contacts	SPST Form A (Normally Open)
Contact Rating	10 Watts Max.
Input Voltage	5-120 Volts Max. AC, 5-110 Volts Max. DC
Maximum Load Current	400 mA Max. (Resistive) @ 25° C (77° F) 150 mA Max. (Resistive) @ 70° C (158° F)
Actuating Time Average	1.0 millisecond
LED Indicator	High Luminescence Housing
Temperature Range	-20° C to 70° C (-4° F to 158° F)
Protection Rating	IP67

R10Q Miniature Reed Switch, 8mm Male Quick Connect, 24 AWG Wire, PVC Jacket (2 wire Switch)

Contacts	SPST Form A (Normally Open)
Contact Rating	10 Watts Max.
Input Voltage	60 Volts Max. AC or DC
Maximum Load Current	400 mA Max. (Resistive) @ 25° C (77° F) 150 mA Max. (Resistive) @ 70° C (158° F)
Actuating Time Average	1.0 millisecond
LED Indicator	High Luminescence Housing
Temperature Range	-20° C to 70° C (-4° F to 158° F)
Protection Rating	IP67

R10P Miniature Reed Switch, 24" (24 AWG Wire, PVC Jacket) Plain Cable Lead, Circuit Protection (2 wire Switch)

R10PX Miniature Reed Switch, 120" (24 AWG Wire, PVC Jacket) Plain Cable Lead, Circuit Protection (2 wire Switch)

Contacts	SPST Form A (Normally Open)
Contact Rating	10 Watts Max.
Input Voltage	5-120 Volts Max. AC, 110 Volts Max. DC
Maximum Load Current	150 mA Max. (Resistive)
Actuating Time Average	1.0 millisecond
LED Indicator	High Luminescence Housing
Temperature Range	-20° C to 70° C (-4° F to 158° F)
Protection Rating	IP67

Circuit Protection

Varistor	138 Volts
Choke	680 μH

Note: The circuit protection consists of a Varistor and Choke arrangement. The Varistor will take transient & voltage spikes out of the line and is mounted in parallel with the switch. The Choke will disperse inrush currents (normally caused by long cable runs) and is mounted in series with the switch.

RAC High Power AC Reed Switch, 24" (20 AWG Wire, PVC Jacket) Plain Cable Lead, (2 wire Switch)

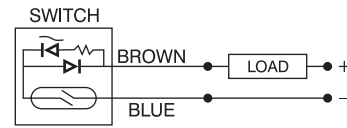
RACX High Power AC Reed Switch, 120" (20 AWG Wire, PVC Jacket) Plain Cable Lead, (2 wire Switch)

Contacts	TRIAC Output
Contact Rating	200 Watts Max.
Input Voltage	12 to 240 Volts (AC only)
Minimum Load Current	80 mA
Maximum Load Current	800 mA
Actuating Time Average	2.0 milliseconds
LED Indicator	Not Available
Temperature Range	-20° C to 70° C (-4° F to 158° F)
Protection Rating	IP67

Schematics

R10 / R10X

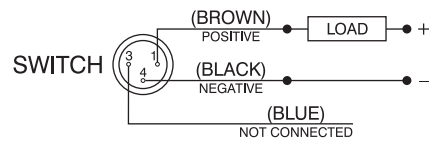
Miniature Reed Switch, Cable Type, (2 Wire Switch)



Input Voltage	110 Volts Max. DC, 120 Volts Max. AC
Maximum Load Current	400 mA Max. (Resistive) @ 25° C (77° F) 150 mA Max. (Resistive) @ 70° C (158° F)

R10Q

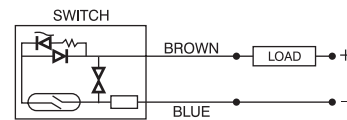
Miniature Reed Switch, 8mm Male Quick Connect, (2 Wire Switch)



Input Voltage	60 Volts Max. AC or DC
Maximum Load Current	400 mA Max. (Resistive) @ 25° C (77° F) 150 mA Max. (Resistive) @ 70° C (158° F)

R10P / R10PX

Miniature Reed Switch, Cable Type, Circuit Protected (2 Wire Switch)



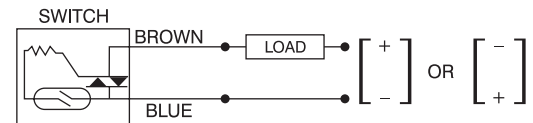
Input Voltage	120 Volts Max. AC, 110 Volts Max. DC
Maximum Load Current	150 mA Max. (Resistive)

Circuit Protection

Varistor	138 Volts
Choke	680 μH

RAC / RACX

High Power AC Reed Switch, Cable Type, (2 Wire Switch)

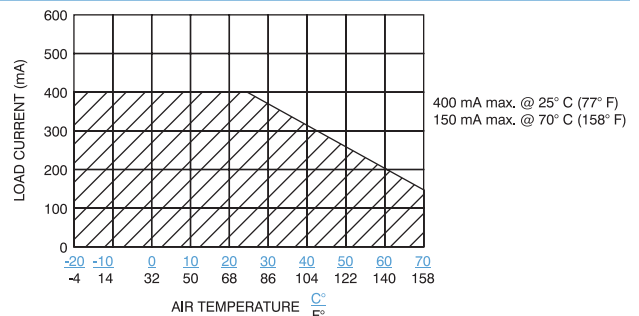


Contact Rating	200 Watts Max.
Input Voltage	12 to 240 Volts (AC only)
Minimum Load Current	80 mA
Maximum Load Current	800 mA

Load Current De-Rating Graph

R10 / R10X / R10Q

(R10PX: 150 mA MAX., -20°C to 70°C)



ACCESSORIES: SWITCHES — REED

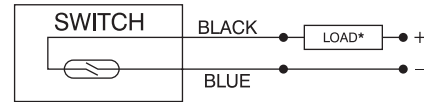
Electrical Specifications

RHT / RHTX	Miniature Reed Switch, Cable Type, Extended Temperature Range (2 Wire Switch)
Contacts	SPST Form A (Normally Open)
Contact Rating	10 Watts Max.
Input Voltage	120 Volts AC / 110 Volts DC Max.
Maximum Current	500 mA Max.
Actuating Time Average	1.0 millisecond
LED Indicator	Not Available
Temperature Range	-40° C to 125° C (-40° F to 260° F)
Protection Rating	IP67
Cable	Silicone rubber insulation with white outer sheath (3.5mm O.D.)
Wires (2)	24 AWG

Note: The RHT has a 24" cable length & the RHTX has a 120" cable length.

Schematics

RHT / RHTX
Miniature Reed Switch, Cable Type, Extended Temperature Range (2 Wire Switch)



*The Load may be on the + or - wire

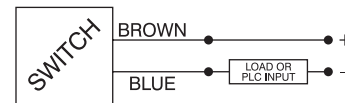
SWITCHES — SOLID STATE

MSS Miniature Solid State Switch, 24" (24 AWG Wire, PVC Jacket) Plain Cable Lead, (2 wire Switch)

MSSX Miniature Solid State Switch, 120" (24 AWG Wire, PVC Jacket) Plain Cable Lead, (2 wire Switch)

*Output Type	Current Sinking or Current Sourcing
Input Voltage	10 to 30 Volts DC
Current Consumption (not sensing)	1mA
Minimum Load Current	4 mA
Maximum Load Current	300 mA
"ON" Voltage Drop	2.5 Volts @ 4 mA 3.5 Volts @ 300 mA
LED Indicator	High Luminescence Housing
Temperature Range	-20° C to 70° C (-4° F to 158° F)
Actuating Time Average	2.0 microseconds
Protection Rating	IP67
Reverse Polarity Protected	yes
Transient (over voltage) Protected	yes

MSS / MSSX
Miniature Solid State Switch, Cable Type, (2 Wire Switch)



Typical Current Sourcing (PNP) Configuration



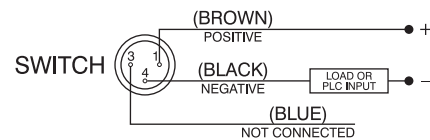
Typical Current Sinking (NPN) Configuration

***NOTE:** This is a (2) wire switch used in series with the load. Therefore, this switch can be used with devices requiring either a current sinking (NPN) output or a current sourcing (PNP) output from the solid state switch.

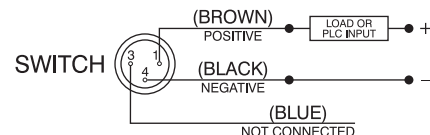
MSSQ Miniature Solid State Switch, 8mm Male Quick Connect, 24 AWG Wire, PVC Jacket (2 wire Switch)

*Output Type	Current Sinking or Current Sourcing
Input Voltage	10 to 30 Volts DC
Current Consumption (not sensing)	1mA
Minimum Load Current	4 mA
Maximum Load Current	300 mA
"ON" Voltage Drop	3 Volts @ 4 mA 4 Volts @ 300 mA
LED Indicator	High Luminescence Housing
Temperature Range	-20° C to 70° C (-4° F to 158° F)
Actuating Time Average	2.0 microseconds
Protection Rating	IP67
Reverse Polarity Protected	yes
Transient (over voltage) Protected	yes

MSSQ
Miniature Solid State Switch, 8mm Male Quick Connect, (2 Wire Switch)



Typical Current Sourcing (PNP) Configuration



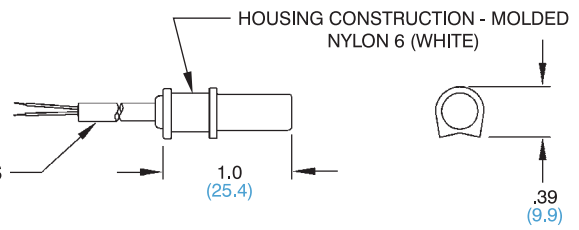
Typical Current Sinking (NPN) Configuration

***NOTE:** This is a (2) wire switch used in series with the load. Therefore, this switch can be used with devices requiring either a current sinking (NPN) output or a current sourcing (PNP) output from the solid state switch.

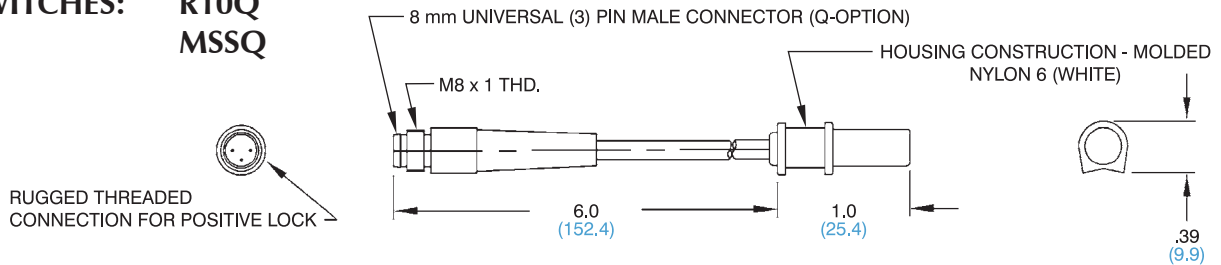
ACCESSORIES: SWITCHES AND BRACKET DIMENSIONS

FOR SWITCHES: R10 / R10X
RHT / RHTX
MSS / MSSX

PLAIN CABLE LEADS
R10 / RHT / MSS = 24" (0.6m) PVC JACKETED LEADS
R10X / RHTX / MSSX = 120" (3.0m)
(JACKET CUT BACK 1" ON END)
(25.4)

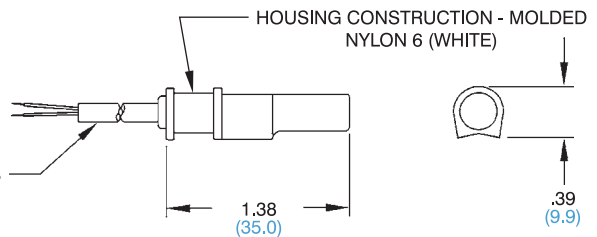


FOR SWITCHES: R10Q
MSSQ



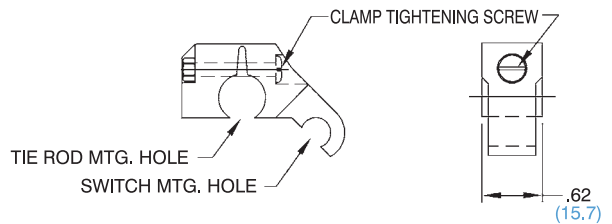
FOR SWITCHES: RAC / RACX
R10P / R10PX

PLAIN CABLE LEADS
R10P / RAC = 24" (0.6m) PVC JACKETED LEADS
R10PX / RACX = 120" (3.0m)
(JACKET CUT BACK 1" ON END)
(25.4)



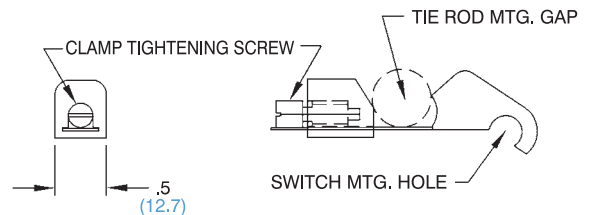
SWITCH BRACKET: SB15 (For 1.50" Through 2.50" Bore Cylinders)

Bracket Construction:
Molded Nylon 6 (Black) and
Stainless Steel Hardware



SWITCH BRACKET: SB32 (For 3.25" Through 12" Bore Cylinders)

Bracket Construction:
Molded Nylon 6 (Black) and
Stainless Steel Hardware

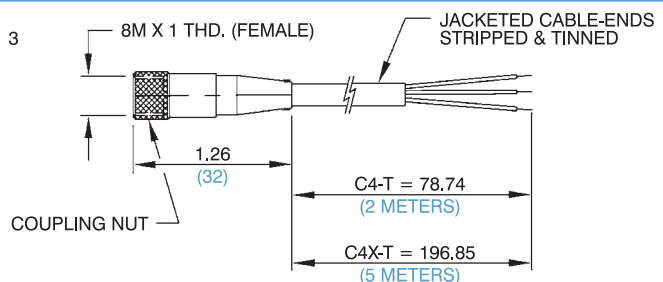


QUICK CONNECT CORD SETS

(Used with "Q" Type Switch Leads)

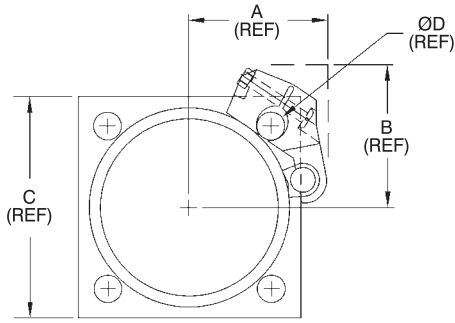
FOR CABLES:
C4-T (2 METER CABLE LENGTH)
C4X-T (5 METER CABLE LENGTH)

CONDUCTOR COLORS:
1. BROWN
3. BLUE
4. BLACK

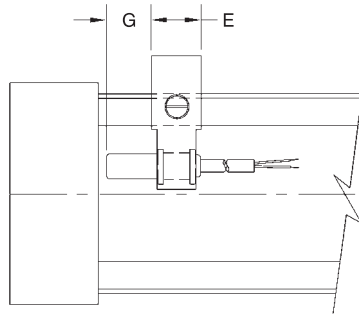


All Dimensions are in INCHES
(mm in parentheses)

ACCESSORIES: SWITCH MOUNTING DIMENSIONS



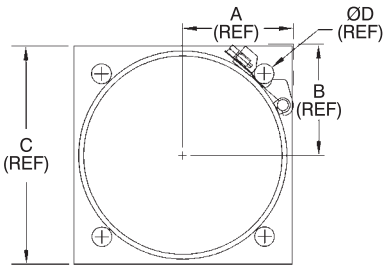
SB15



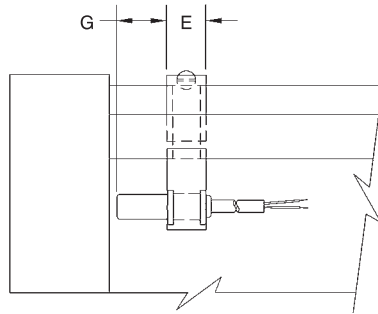
SB15

SWITCH BRACKET LETTER DIMENSIONS							
PART NO.	BORE	A	B	C	D	E	G
SB15	1.50	1.38	1.41	2	.25	.63	.50
	2	1.63	1.66	2.50	.31	.63	.50
	2.50	1.88	1.88	3	.31	.63	.50
SB32	3.25	2.13	2.13	3.75	.38	.50	.56
	4	2.44	2.38	4.50	.38	.50	.56
	5	2.88	2.75*	5.50	.50	.50	.56
	6	3.25*	3.25*	6.50	.50	.50	.56
	8	4.25*	4.25*	8.50	.63	.50	.56
	10	5.31*	5.31*	10.63	.75	.50	.56
	12	6.38*	6.38*	12.75	.75	.50	.56

*THESE DIMENSIONS ARE .50" OF THE 'C' DIMENSION. THE SWITCH BRACKET **DOES NOT** PROTRUDE BEYOND STANDARD HEAD/CAP.



SB32

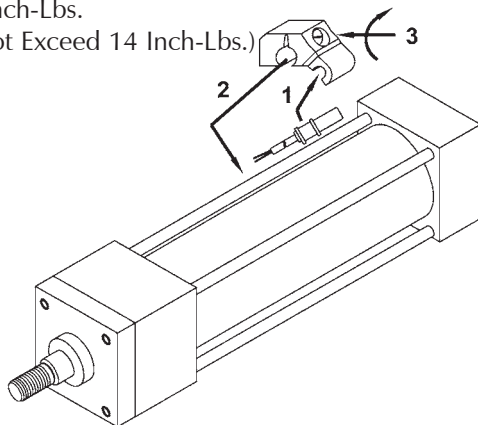


SB32

How To Assemble Switch and Brackets

Recommended Torque:

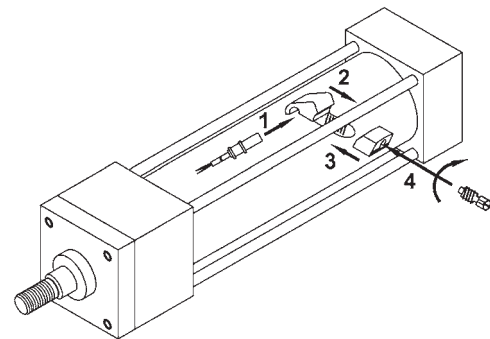
6-10 Inch-Lbs.
(Do Not Exceed 14 Inch-Lbs.)



SB15 SWITCH BRACKET
(MOUNTING ILLUSTRATION)

Recommended Torque:

8-12 Inch-Lbs.
(Do Not Exceed 14 Inch-Lbs.)



SB32 SWITCH BRACKET
(MOUNTING ILLUSTRATION)

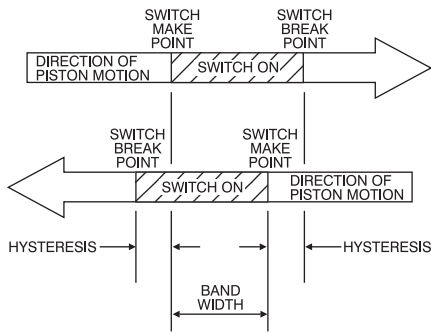
ACCESSORIES: SWITCHES HYSTERESIS & BAND WIDTH

HYSTERESIS:

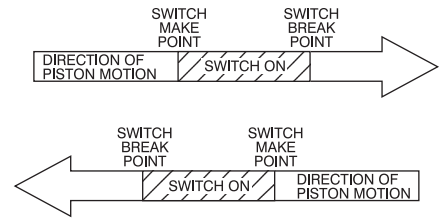
THE DISTANCE BETWEEN THE SWITCH BREAK POINT MOVING IN ONE DIRECTION, AND THE SWITCH MAKE POINT MOVING IN THE OPPOSITE DIRECTION.

BAND WIDTH:

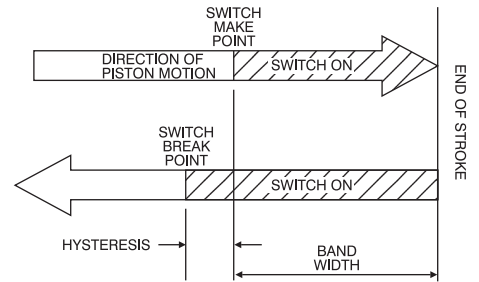
THE DISTANCE THE PISTON MOVES WHILE THE SWITCH IS MADE (IN EITHER DIRECTION), LESS THE HYSTERESIS.



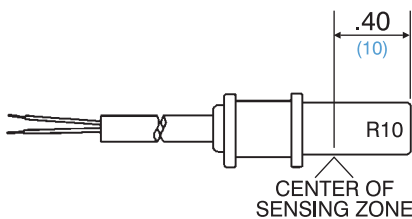
MID STROKE OPERATION



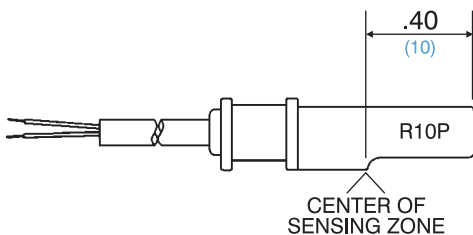
TERMINOLOGY ILLUSTRATION



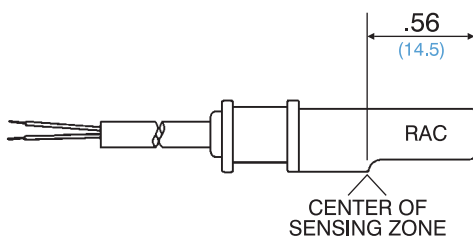
END OF STROKE OPERATION



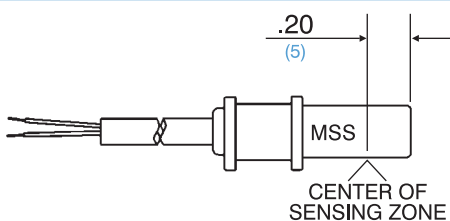
Switch	Repeatability	Hysteresis (Maximum)	Band Width (Minimum)
R10 RHT R10X RHTX R10Q	$\pm .010''$ ($\pm .25$)	.040'' (1)	.200'' (5)



Switch	Repeatability	Hysteresis (Maximum)	Band Width (Minimum)
R10P R10PX	$\pm .010''$ ($\pm .25$)	.040'' (1)	.200'' (5)



Switch	Repeatability	Hysteresis (Maximum)	Band Width (Minimum)
RAC RACX	$\pm .010''$ ($\pm .25$)	.085'' (2.1)	.345'' (8.8)



Switch	Repeatability	Hysteresis (Maximum)	Band Width (Minimum)
MSS MSSX MSSQ	$\pm .010''$ ($\pm .25$)	.075'' (1.9)	.315'' (8)

Note:

Dimensions are in inches, (mm in parentheses).

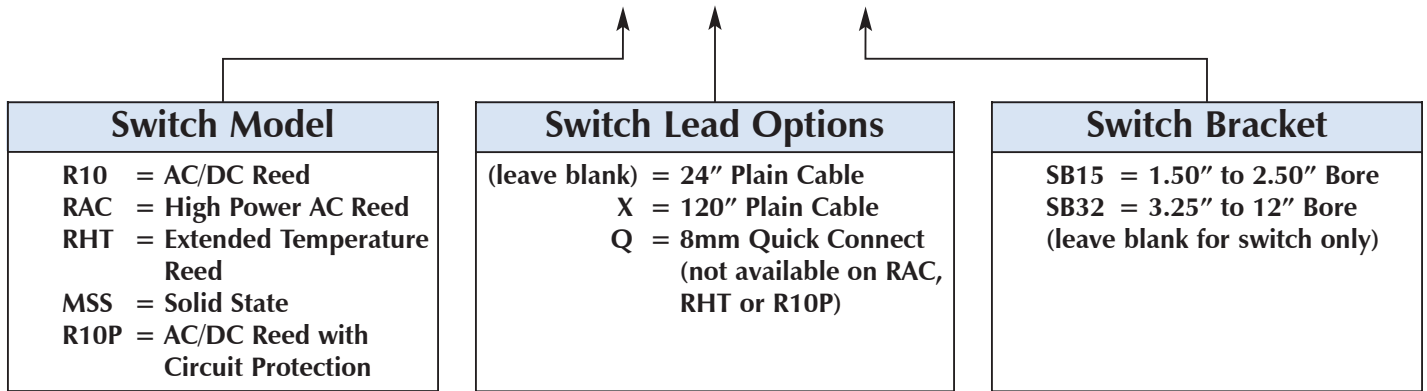
Results are based upon TRD piston and magnet assemblies. Results may vary if used with other manufacturers cylinder products.

ACCESSORIES: SWITCH ORDERING INSTRUCTIONS

TO ORDER, SPECIFY:

Switch Model, Lead Type, and Bracket Size

R10 X - SB15



Switch Accessories	
Quick Connect Cord Sets	
<u>MODEL</u>	<u>DESCRIPTION</u>
C4-T	8mm Straight Quick Connect Cord X 2 Meter (78")
C4X-T	8mm Straight Quick Connect Cord X 5 Meter (196")

About our switches

Our switches are different! The most common complaint in the market is the unreliability of magnetically operated switches. Most cylinder piston magnets have about 10-30% more power than required to operate the switch. This results in erratic operation, a nuisance for maintenance and lowering overall plant productivity.

TRD designed our magnet to have 50-100% more power than required to operate our switch! The combination of TRD R10, R10P, RAC, RHT and MSS Switches and our Cylinders, raises the reliability of switch operation comparable to that of many mechanically operated limit switches.

Application recommendations and precautions

- Noise suppression - Motors and valve solenoids will produce high pulses throughout an electrical system. Therefore, primary and control circuit wiring should not be mixed in the same conduit. Separate power supplies for both logic level signals (Microprocessor, P.C., CPU, Input Devices) and Output Field Devices (Motors, Valve Solenoids) is recommended.
- Never connect R10, R10P, RHT or MSS type switches without a load present. The switch will be destroyed.
- Some electrical loads may be capacitive. Capacitive loading may occur due to distributed capacity in cable runs over 25 feet. Use switch model RAC whenever capacitive loading may occur.
- To obtain optimum performance and long life, switches should not be subjected to strong magnetic fields, extreme temperatures (outside of specifications), or excessive ferrous filings or chip buildup.
- Improper wiring may damage or destroy the switch. Therefore, the wiring diagrams along with the listed power ratings, should be carefully observed before connecting power to the switch.

Following these tips can save time and provide trouble free installations!

Other switches available:

- 12mm Quick Connect
- Special Length Cable
- Weld Immune Switch
- Pulse Extension Switch (For Sensing Mid-Stroke Positions)
- Change Over Switch (SPDT)

(Consult factory for details.)

SERIES: BALLUFF INDUCTIVE SENSORS

BALLUFF **STROKEMASTER**™ Inductive Sensors

Flexible Solutions for an Often Inflexible World

Balluff's new Strokemaster® cylinder-piston sensors provide precision end-of-stroke sensing for hydraulic/pneumatic cylinders. It also eliminates post-installation cable management problems with 304° of rotational freedom on the connector.

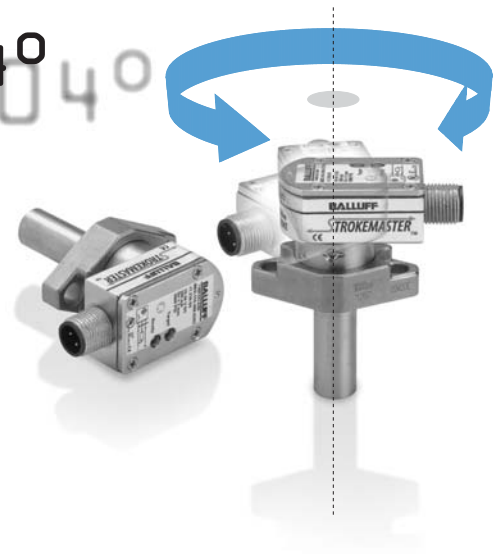
Strokemaster® sensors allow infinitely adjustable and lockable cable positioning anytime after mounting to the cylinder. Without breaking the seal, Strokemaster® enables quicker installation of the sensor *and* neat cable runs.

A high-pressure, inductive proximity switch, the Strokemaster® sensor provides a 2mm (0.8") sensing range to pick up the "spud" of hydraulic/pneumatic cylinders and indicate fully retracted or extended position. It mounts with just two screws, and seals with an O-ring. Withstanding cylinder pressures to 3000 psi (207 BAR), the embeddable design keeps most of the switch protected within the cylinder, with only a 0.62" (16mm) high housing exposed outside. The rotating housing can be locked in the desired position with either one of two set screws.

Strokemaster® sensors are available in 3-wire DC and 2-wire AC/DC versions, both with mini or micro connectors. Switching frequency is 50 Hz in the AC/DC versions. All units are weld-field immune and short-circuit and reverse polarity protected. They fit all popular cylinder designs, with standard probe lengths of 1.025" - 4.560" (26mm - 115.8mm), along with available custom probe lengths and spacers. Probes are made of stainless steel with a ceramic face. Both DC and AC/DC sensors have all metal housings.

Strokemaster® is CE-certified, and its housing is sealed to IP67 requirements.

304°



SERIES: BALLUFF INDUCTION SENSORS

DC INDUCTIVE SENSORS



Features/Advantages

Inductive cylinder switch for piston position feedback in cylinders.

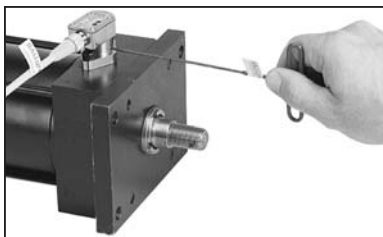
- Magnetic field immune, for use with welding equipment
- Available in DC or all current (AC/DC) versions
- Easy installation - sensor mounts to cylinder with (2) fasteners
- Sealed directly at flange, connector can be oriented after installation
- Various lengths available for different cylinder sizes



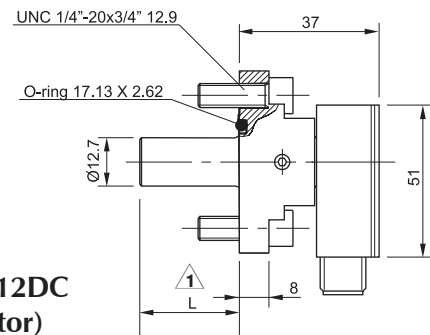
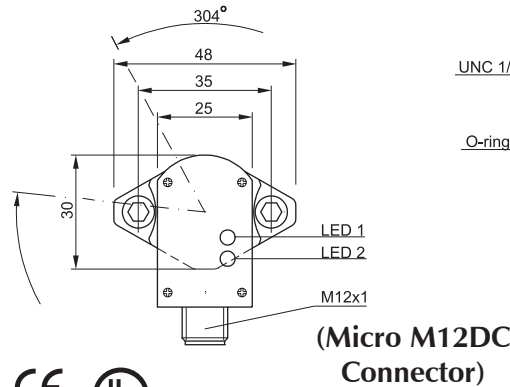
Bolt sensor to cylinder.



Position cable to desired orientation (even over mounting bolts).



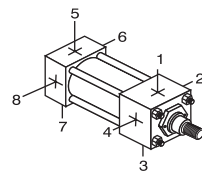
Lock chosen position with one or both of the two integral set screws.



PNP	Normally-open	BES 516-300-S 295-S 4
Rated operational voltage U_o		24 V DC
Supply voltage U_s		10...30 V DC
Voltage drop U_d at I_o		≤ 2.5 V
Rated insulation voltage U_i		75 V DC
Rated operational current I_o		200 mA
No-load supply current I_o d./und.		≤ 18 mA / ≤ 10 mA
Off-state current I_o		≤ 80 μ A
Protected against polarity reversal		yes
Short circuit/overload protected		yes/yes
Load capacitance		≤ 1.0 μ F
Repeat accuracy R		≤ 5 %
Ambient temperature range T_a		-25... +70°C
Frequency of operating cycles f		10 Hz
Utilization categories		DC 13
Function/Operating voltage indication		yes/yes
Degree of protection per IEC 529		IP 67/connector IP 65
Housing material		stainless steel/aluminum
Material of sensing face		ceramic
Connection		connector
Recommended connector		Micro M12DC
Approvals		UL, cUL

△ TRD will supply the correct length probe and spacer combination (if req'd.) for each cylinder. Using the combination of std. probe lengths & spacers will give the appropriate .030" gap between sensor and cylinder spud. The spacers supplied have the same base profile as the sensor. (Material: Stainless Steel)

HOW TO ORDER CYLINDERS WITH BALLUFF SENSORS:



STANDARD LOCATIONS:

- Ports at 1 and 5
 - Cushions at 2 and 6
 - Sensors at 4 and 8
- (Specify non-standard locations)

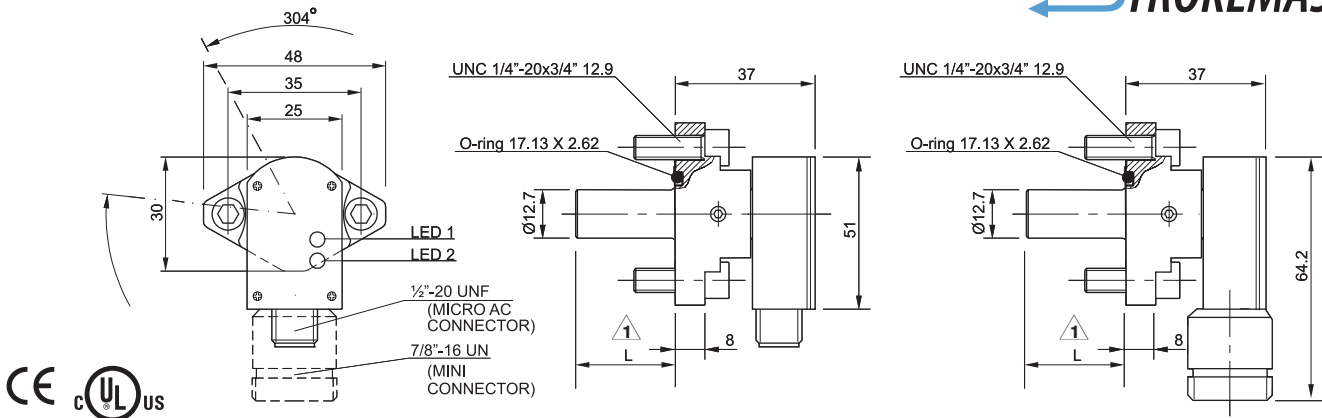
- How To Order:
- Cylinder Model Number ➔ TA - MS2 3.25 X 6 - HC
 - SENSOR MODEL (HEAD) ➔ -BES 516-300-S 295-S4 (Head)
 - SENSOR MODEL (CAP) ➔ -BES 516-300-S 295-S4 (Cap)
 - (Include ALL Sensor positions) ➔ -Sensors at 4 & 8

Note: TRD will include the STROKEMASTER probe length on your order, and any sensor spacers required. (Example: TA-MS2 4 X 6-HC- BES 516-300-S4 /1.025-S21 (Head) -BES 516-300-S4 /1.75-S21 (Cap)-Sensors at 4 & 8.

Refer to page 115 for available cable connector sets.

SERIES: BALLUFF INDUCTION SENSORS

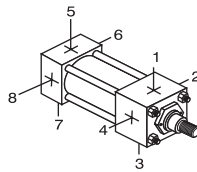
AC/DC INDUCTIVE SENSORS



	BES 516-200-S 2-S21	BES 516-200-S 2-S5
Normally-open		
Rated operational voltage U_e	110 V DC	110 V DC
Supply voltage U_b	20...250 V AC/DC	20...250 V AC/DC
Voltage drop U_d at I_e	≤ 6 V	≤ 6 V
Rated insulation voltage U_i	250 V AC	250 V AC
Rated operational current I_e	500 mA	500 mA
Minimum operational current I_m	5 mA	5 mA
Off-state current I_o	≤ 1.7 mA @ 110 V AC	≤ 1.7 mA @ 110 V AC
Inrush current I_k (t = 20 ms)	3 A max./1 Hz	3 A max./1 Hz
Protected against polarity reversal	yes	yes
Short circuit protected	yes	yes
Repeat accuracy R	≤ 5 %	≤ 5 %
Ambient temperature range T_a	-25...+70°C	-25...+70°C
Frequency of operating cycles f	≤ 50 Hz	≤ 50 Hz
Utilization categories	AC 140/DC 13	AC 140/DC 13
Function/Operating voltage indication	yes/yes	yes/yes
Degree of protection per IEC 529	IP 67	IP 67
Insulation class	1	1
Housing material	stainless steel/nickel plated brass	stainless steel/nickel plated brass
Material of sensing face	ceramic	ceramic
Connection	connector	connector
Recommended connector	Micro AC	Mini
Approvals	UL, cUL	UL, cUL

⚠ TRD will supply the correct length probe and spacer combination (if req'd.) for each cylinder. Using the combination of std. probe lengths & spacers will give the appropriate .030" gap between sensor and cylinder spud. The spacers supplied have the same base profile as the sensor. (Material: Stainless Steel)

HOW TO ORDER CYLINDERS WITH BALLUFF SENSORS:



STANDARD LOCATIONS:

- Ports at 1 and 5
- Cushions at 2 and 6
- Sensors at 4 and 8

(Specify non-standard locations)

How To Order:

- Cylinder Model Number ➔ TA - MS2 3.25 X 6 - HC
- SENSOR MODEL (HEAD) ➔ -BES 516-200-S 2-S21 (Head)
- SENSOR MODEL (CAP) ➔ -BES 516-200-S 2-S21 (Cap)
- (Include ALL Sensor positions) ➔ -Sensors at 4 & 8

Note: TRD will include the STROKEMASTER probe length on your order, and any sensor spacers required. (Example: TA-MS2 4 X 6-HC- BES 516-200-S 2 /1.025-S21 (Head) -BES 516-200-S 2 /1.75-S21 (Cap)- Sensors at 4 & 8.

Refer to page 115 for available cable connector sets.

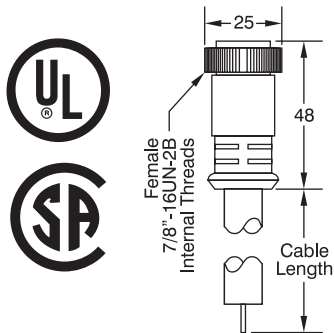
SERIES: BALLUFF INDUCTION SENSORS

CABLE CONNECTORS



Mini Connectors

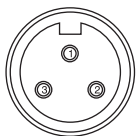
Connector	3-5 Pole Mini
Style	Mini Size A
Configuration	Straight Female



	ORDER NUMBER
3 Pole	C05 AE1 00 * Y 150
Voltage Rating	300 V AC/DC
Amperage	10A
Wire Gauge	16 AWG
Jacket	PVC
Coupling Nut	Black Epoxy Coated Zinc
Protection	IP68 / NEMA 6P
Ambient Operating Temp.	-4 - 221°F (-21 to 105°C)
UL Listed	Yes
CSA Certified	Yes

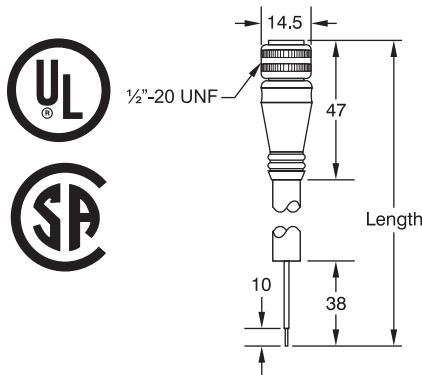
* Insert **V** = PVC Cable
T = TPE Cable
 For 3 pole versions only

Female 3-pin - Face view



Micro AC .50" x 20 UNF Connectors

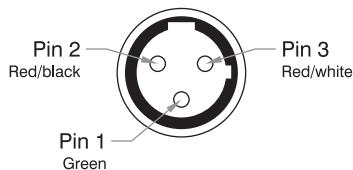
Connector	Micro AC ^{300V} x 20 UNF
Style	3 Pin Dual Keyway
Configuration	Straight Female



	ORDER NUMBER
Ordering Code	
3 Pin Dual Keyway	C21 AE3 00 * Y 150F
4 Pin Dual Keyway	
Voltage Rating	250 V AC/DC
Amperage	4A
Wire Gauge	22 AWG
Jacket	Yellow PVC or TPE
Coupling Nut	Black Epoxy Coated Zinc
O-Ring	Viton
Overmold Head	TPE
Protection	IP68 / NEMA 6P
Ambient Operating Temp.	-4 - 221°F (-21 to 105°C)
UL Listed	Yes
CSA Certified	Yes

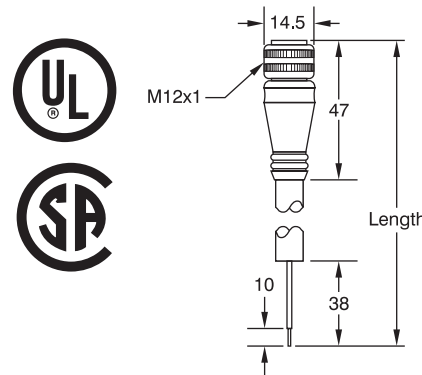
Note: 15 ft cable is standard (other lengths available - contact factory) For 3 pole versions only

Female - Face view



Micro M12 DC Connectors

Connector	Micro
Style	M12 DC Single Keyway
Configuration	Straight Female



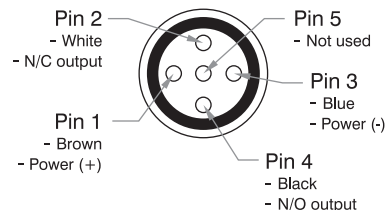
	Note	ORDER NUMBER
2 Wire DC		
2 Wire Normally Open		C04 AEA 00 * Y 050M
Normally Closed		C04 AEB 00 * Y 050M
3 Wire DC		
3 Wire Normally Open	1,2,3	C04 AEC 00 * Y 050M
3 Wire Normally Open PNP w/LED		C04 AEH 00 * Y 050M
3 Wire Normally Open NPN w/LED		C04 AEK 00 * Y 050M
3 Wire Normally Closed	1,2,3	C04 AED 00 * Y 050M
3 Wire Normally Closed PNP w/LED		C04 AEI 00 * Y 050M
3 Wire Normally Closed NPN w/LED		C04 AEJ 00 * Y 050M
4 Wire DC (NO/NC)		
4 Wire	1,2,3	C04 AEL 00 * Y 050M
4 Wire PNP w/LED	1,3	C04 AEM 00 * Y 050M
4 Wire NPN w/LED	1,3	C04 AEN 00 * Y 050M
5 Wire DC (NO/NC with Ground)		
5 Wire		C04 AEQ 00 * Y 050M
Voltage Rating		10 - 30 V DC
Amperage		4 Amps
Wire Gauge		22 AWG
Jacket		Yellow PVC or TPE
Coupling Nut		Black Epoxy Coated Zinc
*Optional Stainless Steel		*Stainless Type 303
Protection		IP68 / NEMA 6P
Ambient Operating Temp.		-4 - 221°F (-21 to 105°C)
UL Listed		Yes
CSA Certified		Yes

Note: 5 meter cable is standard (other lengths available - contact factory)

* Insert **V** = PVC Cable
T = TPE Cable
 For 3 pole versions only

Note: **1** Add **B** = Braided 80% Metallic Braid, i.e. 050 MB
2 Add **S** = S-Shielded 360 Degree Shield through Coupling Nut, i.e. 050 MS
3 Stainless Steel Couple Nut: Change **E** to **S**, i.e. C04ASC00TY050M

Female - Face view



Refer to Balluff Catalog for additional cable connectors.

Rod Clevis, Pins, & Mounts
Alignment Couplers
Flow Controls
TRD Magnetic Switches
Balluff Induction Switches
Accessories
Technical Data

TECHNICAL DATA

How to determine the right size Cylinder for the job

To determine what size cylinder the task requires, you need to answer a few questions about three main points: load, velocity and air pressure.

How heavy (in pounds) is the load to be moved? The answer to this is usually given, set by the machine design. However, unless you are lifting a load vertically-with no external friction, it can be difficult to determine the true load. If the load cannot be calculated, try to physically measure the load. The closer the true load is known, the better the results. In order to move the load, you need to choose a cylinder that provides force greater than the load. So, if the load is 100 lbs., it will take of force greater than 100 lbs. to move it. In fact, it's a good idea to allow an additional factor of 25% force to allow for friction.

What's the required velocity? Although velocity may also be set by machine design, often you have some latitude within a range. Whenever possible, for best results, we recommend using moderate speed because the greater the velocity required, the greater the *additional* force needed to achieve it. Slow speeds (up to 4 in/sec) require 25% more force than the load, moderate speeds (4 to 16 in/sec) about 50% more, and high speeds (greater than 16 in/sec) about 100% more force. So, for that 100 lb. load, you need 125 lbs. of force to move it slowly, 150 lbs. of force to move it at moderate speeds, and 200 lbs. of force to move it quickly. *Don't forget to add 25 lbs. (25% of 100 lbs.) for friction!*

What's the minimum effective air pressure you can use - and is your pressure source constant?

This is important because high pressures can accelerate seal wear and create stress on the cylinder, and inconsistent pressures can cause system malfunctions or failures. So, to maximize cylinder life and performance, you need to provide consistent airflow at the minimum effective pressure to maintain the desired velocity. The idea then, is for the cylinder to be able to move the maximum load, at the minimum acceptable velocity, and at the minimum available pressure.

About bore sizes

Once you've determined the force you need to move the load at the desired velocity and allow for friction, here's how to find the cylinder bore that meets your specifications.

The force generated by a cylinder is determined by the effective piston area times the air pressure. The force chart on page 119 lists the effective piston area for each bore size, the "Push" (extend) and "Pull" (retract) stroke, at various air pressures. If you assume a maximum load of 100 lbs., a minimum velocity of 4 in/sec, and a minimum pressure of 60 psi, here's how to select the right cylinder bore. Since the velocity is slow, the force should be 25% greater than the load, or 125 lbs. After adding 25 lbs. for friction (25% of 100 lbs.), the total force needed is 150 lbs. The chart on page 119 shows that at 60 psi, the 2" bore with .63" rod extend force is 188 lbs., and retract force is 170 lbs. - the right cylinder for the application.

Horizontal Applications

Cylinder force is reduced by the coefficient of friction between the bearing surface and guide shafts. Bearing materials, and bearing types (plain or ball) all perform differently. With hardened steel shafts, the following information lists how much cylinder force is required to move a 100 lb. load, on various bearing materials. *(For reference purposes only)*

Plain Bearing Material	Cylinder Force	
	Dry Bearing	Oiled Bearing
PTFE	10 lbs.	10 lbs.
UHMW	20 lbs.	20 lbs.
Hardened Steel	25 lbs.	20 lbs.
Brass	40 lbs.	25 lbs.
Cast Iron	45 lbs.	25 lbs.
Steel (soft)	85 lbs.	25 lbs.
Ball Bearing	5-10 lb. Cylinder Force	

General Mechanics

TOGGLE

Toggles are complex mechanisms that can achieve very high force.

FORCE MULTIPLYING LEVER

Force Multiplying Levers reduce the cylinder output stroke, while increasing the output force.

4:1 Force Multiplier (400%)

FORCE REDUCING LEVER

Force Reducing Levers increase the cylinder output stroke, but reduce the output force.

1:4 Force Reduction (25%)

EXAMPLE

A 2000 lb. steel plate needs to be raised from horizontal, 90° vertical. The highest force required will be at the horizontal position. As the plate nears the vertical position, less force will be required.

The example assumes that the weight (load) is evenly distributed over the plate length. For uneven loads, estimate the center of gravity of the load.

Additional force must be added for friction (assume 25%).

LOAD CENTER OF GRAVITY = $\frac{48"}{2} = 24"$

LEVER = $\frac{24"}{12"} = 2:1$

FORCE = 2 X 2,000 LBS. = 4,000 LBS.

FORCE (INCLUDING = 4,000 X 1.25 = 5,000 LBS. FRICTION)

AT 100 PSI AIR PRESSURE, THE FORCE CHART (ON PAGE 119) SHOWS THAT AN 8" BORE HAS 5,026 LBS. FORCE.

TECHNICAL DATA: FORCE CHART

BASIC CYLINDER FORCE CHART* (TA, TD, FM)

BORE	ROD DIA.	STROKE TYPE	EFFECTIVE PISTON AREA	POUNDS OF FORCE AT PSI						CU. FT. DISPLACEMENT PER IN. OF STROKE
				60	80	100	200	250	400	
1.50	ALL	PUSH	1.767	106	142	177	353	442	706	.00102
	.63	PULL	1.460	88	117	146	292	365	584	.00084
	1	PULL	.982	59	79	98	196	246	392	.00057
2	ALL	PUSH	3.142	188	251	314	628	785	1256	.00182
	.63	PULL	2.835	170	227	284	567	708	1134	.00164
	1	PULL	2.357	141	189	236	471	589	942	.00136
2.50	ALL	PUSH	4.909	295	393	491	981	1227	1962	.00284
	.63	PULL	4.602	276	368	460	920	1150	1840	.00266
	1	PULL	4.124	247	330	412	825	1031	1650	.00239
3.25	ALL	PUSH	8.296	498	664	830	1659	2074	3318	.00480
	1	PULL	7.511	451	601	751	1502	1877	3004	.00435
	1.38	PULL	6.811	409	545	681	1362	1702	2724	.00394
4	ALL	PUSH	12.566	754	1005	1257	2513	3141	5026	.00727
	1	PULL	11.781	707	942	1178	2356	2945	4712	.00682
	1.38	PULL	11.081	665	886	1108	2216	2770	4432	.00641
5	ALL	PUSH	19.635	1178	1571	1964	3927	4908	7854	.01136
	1	PULL	18.850	1131	1508	1885	3770	4712	7540	.01090
	1.38	PULL	18.150	1089	1452	1815	3630	4537	7260	.01050
6	ALL	PUSH	28.274	1696	2262	2827	5655	7068	11310	.01636
	1.38	PULL	26.789	1607	2144	2679	5358	6697	10716	.01550
	1.75	PULL	25.869	1552	2070	2587	5174	6467	10348	.01497
8	ALL	PUSH	50.265	3016	4021	5026	10053	12566	20106	.02908
	1.38	PULL	48.780	2927	3902	4878	9756	12195	19512	.02832
	1.75	PULL	47.860	2872	3829	4786	9572	11965	19144	.02770
10	ALL	PUSH	78.540	4712	6283	7854	15708	19635	31416	.04545
	1.75	PULL	76.130	4568	6090	7613	15226	19032	30452	.04406
	2	PULL	75.400	4524	6032	7540	15080	18850	30160	.04363
12	ALL	PUSH	113.098	6786	9048	11310	22620	28275	45239	.06545
	2	PULL	109.956	6597	8796	10996	21992	27489	43982	.06363
	2.50	PULL	108.189	6491	8655	10819	21638	27047	43276	.06261

*Theoretical force. Actual force will be reduced by friction.

'NR' NON-ROTATING CYLINDER FORCE CHART*

BORE	ROD DIA.	GUIDE RODS DIA.	STROKE TYPE	EFFECTIVE PISTON AREA	POUNDS OF FORCE AT PSI						CU. FT. DISPLACEMENT PER IN. OF STROKE
					60	80	100	200	250	400	
2	ALL	.25	PUSH	3.044	182	243	304	609	761	1217	.00176
	.63		PULL	2.737	164	218	273	547	684	1094	.00158
2.50	ALL	.31	PUSH	4.755	285	380	475	951	1188	1902	.00275
	.63		PULL	4.448	266	355	444	889	1112	1779	.00257
	1		PULL	3.970	238	317	397	794	992	1588	.00229
3.25	ALL	.38	PUSH	8.076	484	646	807	1613	2016	3226	.00466
	1		PULL	7.291	437	583	729	1458	1822	2916	.00422
	1.38		PULL	6.591	395	527	659	1318	1647	2636	.00381
4	ALL	.63	PUSH	11.952	717	956	1195	2390	2988	4780	.00692
	1		PULL	11.167	670	893	1116	2233	2791	4466	.00646
	1.38		PULL	11.467	628	837	1046	2093	2616	4186	.00606
5	ALL	.63	PUSH	19.021	1141	1521	1902	3804	4755	7608	.01100
	1		PULL	18.236	1094	1458	1823	3647	4559	7294	.01050
	1.38		PULL	17.536	1052	1402	1753	3507	4384	7014	.01010
6	ALL	.63	PUSH	27.660	1659	2212	2766	5532	6915	11064	.01600
	1.38		PULL	26.175	1570	2094	2617	5235	6543	10470	.01510
	1.75		PULL	25.255	1515	2020	2525	5051	6313	10102	.01460
8	ALL	1	PUSH	48.694	2921	3895	4869	9738	12173	19477	.02810
	1.38		PULL	47.209	2832	3776	4720	9441	11802	18883	.02730
	1.75		PULL	46.289	2777	3703	4628	9257	11572	18515	.02670
10	ALL	1	PUSH	76.969	4618	6157	7696	15393	19242	30787	.04450
	1.75		PULL	74.564	4473	5965	7456	14912	18641	29825	.04310
	2		PULL	73.829	4429	5906	7382	14765	18457	29531	.04270
12	ALL	1	PUSH	111.527	6691	8922	11152	22305	27881	44610	.06450
	2		PULL	108.385	6503	8670	10838	21677	27096	43354	.06270
	2.50		PULL	106.618	6397	8529	10661	21323	26654	42647	.06170

Note: Use the pull force/volume numbers for both ends of a double end cylinder.
 For TRA triple rod force chart, see page 69.
 For MSE multi-stage force chart, see page 79.

*Theoretical force. Actual force will be reduced by friction.

TECHNICAL DATA

How the right mounting and careful installation help prevent premature cylinder wear

Choosing the right style of mounting for your cylinder's size, force and function has a direct effect on its service life. The wrong mounting, or incorrect installation, can result in side load, which creates excessive wear on the piston, piston rod, rod bearing and seals. When wear occurs, leakage usually follows and that's how cylinders fail.

Side load occurs when a load is placed on the piston rod without guidance or support, or when the mounting and piston rod connection are misaligned. It can also occur in pivot type mounts when the weight of the cylinder places load on the piston and rod bearing points.

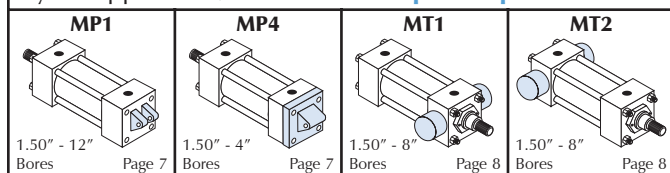
There are cylinder mounts and options to suit virtually every application.

Pivot Type Mountings: Clevis & Trunnion

Pivot type of mounts can eliminate side load in one plane, but careful alignment in the other plane is crucial. Since TRD uses a "floating" Rod Bushing design, side loading caused by misalignment is minimized, but not totally eliminated.

Long stroke pivot mount cylinders will have high side loads just because of the weight of the cylinder components. In these applications, a stop tube is usually essential for proper cylinder operation (see page 89 to determine if a stop tube is needed for your application).

Samples of pivot mounts.

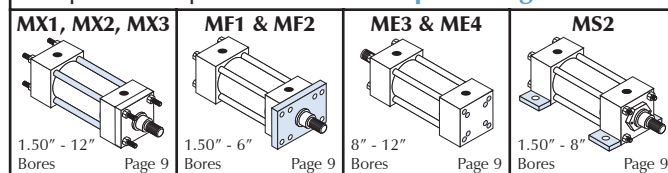


Rigid Mount Cylinders

Base mounted, flange mounted, and tie-rod mounted cylinders must be carefully aligned with the direction of load travel to avoid side loads.

If for some reason, proper alignment cannot be maintained throughout the entire cylinder stroke, a rod end connection that allows for some lateral misalignment should be used. TRD offers a full line of Rod Alignment Couplers to solve misalignment issues (refer to page 104 for details). Keep in mind, the rod alignment couplers do not provide any rod end support. Always check to see if your application requires a stop tube.

Samples of rigid mounts.



Choose options that enhance and extend the working life of your cylinders

Cushions. Can be designed into either one or both ends of the cylinder to provide controlled deceleration. This option prevents excessive end-of-stroke impact, reducing vibration and noise. Cushions are designed to stop light loads at moderate speeds. Heavy loads or higher speed applications may require shock absorbers. Your local distributor representative is qualified to provide expert advice on what options are best suited for your application.

Bumper Piston Seals. Whether used by themselves or with cushions, bumper piston seals provide additional controlled deceleration at end of stroke.

Wear band. A .06" thick X .38" wide (for 1.50" to 8" bore, larger strips for bigger bores) PTFE composite material strip is added to the piston diameter to eliminate metal to metal contact between the piston and the tube. Since wear band materials are compressive in nature, they can provide some cylinder side load protection. As side load pressure is applied, the wear band contact area with the tube increases, enabling a higher transfer of load due to the high amount of contact area.

Even though wear bands contain a high percentage of PTFE, they do add additional internal "drag" in the cylinder. Additional drag can effect cycle rates, and at times, lower overall production in high speed applications.

Fluorocarbon Seals. Usually associated with higher temperature applications, fluorocarbon can provide additional chemical resistance. Consult factory for additional information.

"SSP" Solid Stainless Steel Piston (with wear band). When cylinder bores are used to measure or dispense food products, it is essential to eliminate non-FDA approved materials from the cylinder internal construction. Specify "FDA approved materials only", at time of order.

FDA Lubricant. Typically used with stainless steel cylinders for food dispensing applications. Can also be specified when there is concern for possible contamination from petroleum based, air-borne particles associated with the normal cylinder operation.

Switches. Position sensing switches give you the potential for expanding the capabilities of your cylinder functions to include accurate piston sensing, event timing, sequencing and more. Magnetically operated, the switches are mounted to the exterior of the cylinder where they are actuated by a magnet contained on the piston. Refer to pages 107-117 for more details.

TECHNICAL DATA

WEIGHT CHARTS

BASIC CYLINDERS (TA, TD, FM with standard rod size)

WEIGHT IN POUNDS

CYLINDER BORE	MODEL								ADD PER IN. OF STROKE
	MXO	MS1 MT1/MT2	MS4	MP1	MP2	MP4	MF1/MF2 ME3/ME4	MS2	
1.50	1.6	2.0	1.6	2.1	2.2	2.2	2.2	2.5	.20
2	2.4	2.9	2.4	3.2	3.3	3.2	3.2	3.6	.25
2.50	3.3	3.9	3.3	4.3	4.5	4.5	4.5	4.7	.27
3.25	6.5	7.9	6.5	9.2	10.1	10.0	10.0	9.0	.51
4	8.8	10.5	8.8	12.1	13.3	13.2	13.2	11.1	.55
5	13.2	14.3	13.2	17.8	19.9	N/A	20.0	17.5	.59
6	21.5	25.2	21.5	29.7	32.2	N/A	32.2	27.2	.84
8	35.4	36.5	35.4	43.5	N/A	N/A	35.4	N/A	1.25
10	70.3	N/A	70.0	72.0	N/A	N/A	70.3	N/A	1.60
12	107.9	N/A	N/A	109.9	N/A	N/A	107.5	N/A	2.30

All weights are in pounds. For oversize rod series add 10%.

*Weight includes clevis pins.

ACCESSORIES

WEIGHT IN POUNDS

ROD CLEVIS		ROD EYES		EYE BRACKETS		CLEVIS BRACKETS		CLEVIS PINS	
PART NO.	WEIGHT	PART NO.	WEIGHT	PART NO.	WEIGHT	PART NO.	WEIGHT	PART NO.	WEIGHT
RC437	.40	RE750	1.10	EB500	.86	CB500	.90	CP500C	.12
RC500	.40	RE1000	2.40	EB750	3.00	CB750	3.10	CP750C	.38
RC750	1.22	RE1375	5.58	EB1000	6.36	CB1000	6.20	CP1000C	.80
RC1000	2.58	RE1500	10.52	EB1375	11.22	CB1375	9.70	CP1375C	1.22
RC1250	6.28	—	—	—	—	—	—	—	—
RC1500	11.60	—	—	—	—	—	—	—	—

ALIGNMENT COUPLERS

WEIGHT IN POUNDS

PART NO.	WEIGHT	PART NO.	WEIGHT	PART NO.	WEIGHT
AC250	.30	AC625	.40	AC1375	7.50
AC312	.30	AC750	1.10	AC1500	7.60
AC375	.30	AC875	1.10	AC1750	7.60
AC437	.30	AC1000	2.90	—	—
AC500	.30	AC1250	2.90	—	—

TORQUE CHARTS

CYLINDER TIE RODS

(Aluminum, Stainless Steel & Steel Tubing)

(Fiberglass AIR/OIL TANK Tubing Only)

CYLINDER BORE	TIE ROD THREAD SIZE	TORQUE IN FT.-LBS.
1.50	.25-28	7
2	.31-24	12
2.50	.31-24	14
3.25	.38-24	30
4	.38-24	35
5	.50-20	45
6	.50-20	50
8	.63-18	125
10	.75-16	125
12	.75-16	125

CYLINDER BORE	TIE ROD THREAD SIZE	TORQUE IN FT.-LBS.
2.50	.31-24	10-12
3.25	.38-24	20
4	.38-24	25
5	.50-20	35
8	.63-18	75

Tighten cylinders using an "X" tightening pattern on tie rods.

Tighten cylinders using an "X" tightening pattern on tie rods.

RETAINER SCREWS

CYLINDER BORE	SIZE	TORQUE IN FT.-LBS.
2 & 2.50	#10-32 S.H.C.S.	5
3.25 TO 12	.25-28 S.H.C.S.	12

TECHNICAL DATA: SEAL KITS

SERIES 'TA', 'EN' & 'FM'

NOTE: To insure proper seals are supplied for all models, **ALWAYS** supply TRD serial number.

BORE	STANDARD SINGLE ROD END				STANDARD DOUBLE ROD END		
	PART NO.	WITH CUSHIONS			PART NO.	WITH CUSHIONS	
		H	C	HC		H	HC
1.50	SK 625-150	SK 625-150H	SK 625-150C	SK 625-150HC	SKD 625-150	SKD 625-150H	SKD 625-150HC
2	SK 625-200	SK 625-200H	SK 625-200C	SK 625-200HC	SKD 625-200	SKD 625-200H	SKD 625-200HC
2.50	SK 625-250	SK 625-250H	SK 625-250C	SK 625-250HC	SKD 625-250	SKD 625-250H	SKD 625-250HC
3.25	SK 100-325	SK 100-325H	SK 100-325C	SK 100-325HC	SKD 100-325	SKD 100-325H	SKD 100-325HC
4	SK 100-400	SK 100-400H	SK 100-400C	SK 100-400HC	SKD 100-400	SKD 100-400H	SKD 100-400HC
5	SK 100-500	SK 100-500H	SK 100-500C	SK 100-500HC	SKD 100-500	SKD 100-500H	SKD 100-500HC
6	SK 137-600	SK 137-600H	SK 137-600C	SK 137-600HC	SKD 137-600	SKD 137-600H	SKD 137-600HC
8	SK 137-800	SK 137-800H	SK 137-800C	SK 137-800HC	SKD 137-800	SKD 137-800H	SKD 137-800HC
10	SK 175-1000	SK 175-1000H	SK 175-1000C	SK 175-1000HC	SKD 175-1000	SKD 175-1000H	SKD 175-1000HC
12	SK 200-1200	SK 200-1200H	SK 200-1200C	SK 200-1200HC	SKD 200-1200	SKD 200-1200H	SKD 200-1200HC

BORE	OVERSIZE SINGLE ROD END				OVERSIZE DOUBLE ROD END		
	PART NO.	WITH CUSHIONS			PART NO.	WITH CUSHIONS	
		H	C	HC		H	HC
1.50	SK 100-150	N/A	SK 100-150C	N/A	SKD 100-150	N/A	N/A
2	SK 100-200	SK 100-200H	SK 100-200C	SK 100-200HC	SKD 100-200	SKD 100-200H	SKD 100-200HC
2.50	SK 100-250	SK 100-250H	SK 100-250C	SK 100-250HC	SKD 100-250	SKD 100-250H	SKD 100-250HC
3.25	SK 137-325	SK 137-325H	SK 137-325C	SK 137-325HC	SKD 137-325	SKD 137-325H	SKD 137-325HC
4	SK 137-400	SK 137-400H	SK 137-400C	SK 137-400HC	SKD 137-400	SKD 137-400H	SKD 137-400HC
5	SK 137-500	SK 137-500H	SK 137-500C	SK 137-500HC	SKD 137-500	SKD 137-500H	SKD 137-500HC
6	SK 175-600	SK 175-600H	SK 175-600C	SK 175-600HC	SKD 175-600	SKD 175-600H	SKD 175-600HC
8	SK 175-800	SK 175-800H	SK 175-800C	SK 175-800HC	SKD 175-800	SKD 175-800H	SKD 175-800HC
10	SK 200-1000	SK 200-1000H	SK 200-1000C	SK 200-1000HC	SKD 200-1000	SKD 200-1000H	SKD 200-1000HC
12	SK 250-1200	SK 250-1200H	SK 250-1200C	SK 250-1200HC	SKD 250-1200	SKD 250-1200H	SKD 250-1200HC

Single rod end Seal Kit includes: 2 Piston Seals, 2 Tube End Seals, Rod Wiper, Rod Seal & Bushing "O" Ring.
Note: Back-to-Back cylinders would require (2) of the above kits.

SERIES 'TA', 'EN' & 'FM' (WITH 'TH' OPTION)

NOTE: To insure proper seals are supplied for all models, **ALWAYS** supply TRD serial number.

BORE	STANDARD SINGLE ROD END				STANDARD DOUBLE ROD END		
	PART NO.	WITH CUSHIONS			PART NO.	WITH CUSHIONS	
		H	C	HC		H	HC
1.50	THSK 625-150	THSK 625-150H	THSK 625-150C	THSK 625-150HC	THSKD 625-150	THSKD 625-150H	THSKD 625-150HC
2	THSK 625-200	THSK 625-200H	THSK 625-200C	THSK 625-200HC	THSKD 625-200	THSKD 625-200H	THSKD 625-200HC
2.50	THSK 625-250	THSK 625-250H	THSK 625-250C	THSK 625-250HC	THSKD 625-250	THSKD 625-250H	THSKD 625-250HC
3.25	THSK 100-325	THSK 100-325H	THSK 100-325C	THSK 100-325HC	THSKD 100-325	THSKD 100-325H	THSKD 100-325HC
4	THSK 100-400	THSK 100-400H	THSK 100-400C	THSK 100-400HC	THSKD 100-400	THSKD 100-400H	THSKD 100-400HC
5	THSK 100-500	THSK 100-500H	THSK 100-500C	THSK 100-500HC	THSKD 100-500	THSKD 100-500H	THSKD 100-500HC
6	THSK 137-600	THSK 137-600H	THSK 137-600C	THSK 137-600HC	THSKD 137-600	THSKD 137-600H	THSKD 137-600HC
8	THSK 137-800	THSK 137-800H	THSK 137-800C	THSK 137-800HC	THSKD 137-800	THSKD 137-800H	THSKD 137-800HC
10	THSK 175-1000	THSK 175-1000H	THSK 175-1000C	THSK 175-1000HC	THSKD 175-1000	THSKD 175-1000H	THSKD 175-1000HC
12	THSK 200-1200	THSK 200-1200H	THSK 200-1200C	THSK 200-1200HC	THSKD 200-1200	THSKD 200-1200H	THSKD 200-1200HC

BORE	OVERSIZE SINGLE ROD END				OVERSIZE DOUBLE ROD END		
	PART NO.	WITH CUSHIONS			PART NO.	WITH CUSHIONS	
		H	C	HC		H	HC
1.50	THSK 100-150	N/A	THSK 100-150C	N/A	THSKD 100-150	N/A	N/A
2	THSK 100-200	THSK 100-200H	THSK 100-200C	THSK 100-200HC	THSKD 100-200	THSKD 100-200H	THSKD 100-200HC
2.50	THSK 100-250	THSK 100-250H	THSK 100-250C	THSK 100-250HC	THSKD 100-250	THSKD 100-250H	THSKD 100-250HC
3.25	THSK 137-325	THSK 137-325H	THSK 137-325C	THSK 137-325HC	THSKD 137-325	THSKD 137-325H	THSKD 137-325HC
4	THSK 137-400	THSK 137-400H	THSK 137-400C	THSK 137-400HC	THSKD 137-400	THSKD 137-400H	THSKD 137-400HC
5	THSK 137-500	THSK 137-500H	THSK 137-500C	THSK 137-500HC	THSKD 137-500	THSKD 137-500H	THSKD 137-500HC
6	THSK 175-600	THSK 175-600H	THSK 175-600C	THSK 175-600HC	THSKD 175-600	THSKD 175-600H	THSKD 175-600HC
8	THSK 175-800	THSK 175-800H	THSK 175-800C	THSK 175-800HC	THSKD 175-800	THSKD 175-800H	THSKD 175-800HC
10	THSK 200-1000	THSK 200-1000H	THSK 200-1000C	THSK 200-1000HC	THSKD 200-1000	THSKD 200-1000H	THSKD 200-1000HC
12	THSK 250-1200	THSK 250-1200H	THSK 250-1200C	THSK 250-1200HC	THSKD 250-1200	THSKD 250-1200H	THSKD 250-1200HC

Single rod end Seal Kit includes: 2 Piston Seals, 2 Tube End Seals, Rod Wiper, Rod Seal & Bushing "O" Ring.
Note: Back-to-Back cylinders would require (2) of the above kits.

TECHNICAL DATA: SEAL KITS

NOTE: To insure proper seals are supplied for all models, **ALWAYS** supply TRD serial number.

3-POSITION & TANDEM

BORE	STANDARD SINGLE ROD END			
	PART NO.	WITH CUSHIONS		
		H	C	HC
1.50	TSK 625-150	TSK 625-150H	TSK 625-150C	TSK 625-150HC
2	TSK 625-200	TSK 625-200H	TSK 625-200C	TSK 625-200HC
2.50	TSK 625-250	TSK 625-250H	TSK 625-250C	TSK 625-250HC
3.25	TSK 100-325	TSK 100-325H	TSK 100-325C	TSK 100-325HC
4	TSK 100-400	TSK 100-400H	TSK 100-400C	TSK 100-400HC
5	TSK 100-500	TSK 100-500H	TSK 100-500C	TSK 100-500HC
6	TSK 137-600	TSK 137-600H	TSK 137-600C	TSK 137-600HC
8	TSK 137-800	TSK 137-800H	TSK 137-800C	TSK 137-800HC

SERIES 'TD'

BORE	STANDARD SINGLE ROD END		KITS INCLUDE CUSHION SEALS AND WEAR BAND
	PART NO.		
1.50	BPSK 625-150		
2	BPSK 625-200		
2.50	BPSK 625-250		
3.25	BPSK 100-325		
4	BPSK 100-400		
5	BPSK 100-500		
6	BPSK 137-600		
8	BPSK 137-800		

BORE	OVERSIZE SINGLE ROD END			
	PART NO.	WITH CUSHIONS		
		H	C	HC
1.50	TSK 100-150	N/A	TSK 100-150C	N/A
2	TSK 100-200	TSK 100-200H	TSK 100-200C	TSK 100-200HC
2.50	TSK 100-250	TSK 100-250H	TSK 100-250C	TSK 100-250HC
3.25	TSK 137-325	TSK 137-325H	TSK 137-325C	TSK 137-325HC
4	TSK 137-400	TSK 137-400H	TSK 137-400C	TSK 137-400HC
5	TSK 137-500	TSK 137-500H	TSK 137-500C	TSK 137-500HC
6	TSK 175-600	TSK 175-600H	TSK 175-600C	TSK 175-600HC
8	TSK 175-800	TSK 175-800H	TSK 175-800C	TSK 175-800HC

BORE	OVERSIZE SINGLE ROD END		KITS INCLUDE CUSHION SEALS AND WEAR BAND
	PART NO.		
1.50	BPSK 100-150		
2	BPSK 100-200		
2.50	BPSK 100-250		
3.25	BPSK 137-325		
4	BPSK 137-400		
5	BPSK 137-500		
6	BPSK 175-600		
8	BPSK 175-800		

NOTE: To insure proper seals are supplied for all models, **ALWAYS** supply TRD serial number.

SERIES 'NR'

(Internally Guided Non-Rotating)

BORE	PISTON ROD DIA.	PART NUMBER
2	.63	NRSK 625-200
2.50	.63	NRSK 625-250
	1	NRSK 100-250
3.25	1	NRSK 100-325
	1.38	NRSK 137-325
4	1	NRSK 100-400
	1.38	NRSK 137-400
5	1	NRSK 100-500
	1.38	NRSK 137-500
6	1.38	NRSK 137-600
	1.75	NRSK 175-600
8	1.38	NRSK 137-800
	1.75	NRSK 175-800
10	1.75	NRSK 175-1000
	2	NRSK 200-1000
12	2	NRSK 200-1200
	2.50	NRSK 250-1200

NOTE: Add suffix H and/or C to indicate if cushion seals are required on Head and/or Cap.

Example: NRSK 625-200HC

SERIES 'MS'

(Multi-Stage)

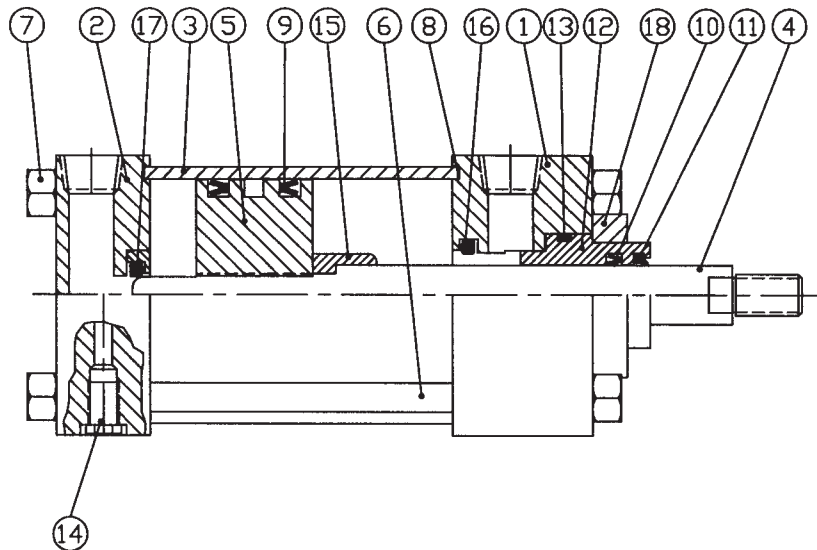
Seal Kits same for 'MSE' or 'MSR'

STANDARD ROD DIAMETER		OVERSIZE ROD DIAMETER	
BORE	PART NUMBER	BORE	PART NUMBER
1.50	SK-MSE-625-150-2S	1.50	SK-MSE-100-150-2S
	SK-MSE-625-150-3S		SK-MSE-100-150-3S
	SK-MSE-625-150-4S		SK-MSE-100-150-4S
2	SK-MSE-625-200-2S	2	SK-MSE-100-200-2S
	SK-MSE-625-200-3S		SK-MSE-100-200-3S
	SK-MSE-625-200-4S		SK-MSE-100-200-4S
2.50	SK-MSE-625-250-2S	2.50	SK-MSE-100-250-2S
	SK-MSE-625-250-3S		SK-MSE-100-250-3S
	SK-MSE-625-250-4S		SK-MSE-100-250-4S
3.25	SK-MSE-100-325-2S	3.25	SK-MSE-137-325-2S
	SK-MSE-100-325-3S		SK-MSE-137-325-3S
	SK-MSE-100-325-4S		SK-MSE-137-325-4S
4	SK-MSE-100-400-2S	4	SK-MSE-137-400-2S
	SK-MSE-100-400-3S		SK-MSE-137-400-3S
	SK-MSE-100-400-4S		SK-MSE-137-400-4S
5	SK-MSE-100-500-2S	5	SK-MSE-137-500-2S
	SK-MSE-100-500-3S		SK-MSE-137-500-3S
	SK-MSE-100-500-4S		SK-MSE-137-500-4S
6	SK-MSE-137-600-2S	6	SK-MSE-175-600-2S
	SK-MSE-137-600-3S		SK-MSE-175-600-3S
	SK-MSE-137-600-4S		SK-MSE-175-600-4S
8	SK-MSE-137-800-2S	8	SK-MSE-175-800-2S
	SK-MSE-137-800-3S		SK-MSE-175-800-3S
	SK-MSE-137-800-4S		SK-MSE-175-800-4S

SERIES 'TA' CYLINDER PARTS LIST: STANDARD ROD DIAMETER

(Below listed parts can also be used for Back To Back Cylinders)

NOTE:
When ordering any part, please supply TRD Serial Number to insure proper parts are supplied.



ITEM	QTY.	PART NAME	BORE SIZE									
			1.50	2	2.50	3.25	4	5	6	8	10	12
1	1	HEAD	A-10-15	A-10-20	A-10-25	A-10-32	A-10-40	A-10-50	A-10-60	A-10-80	A-10-100	A-10-120
2	1	CAP	A-25-15	A-25-20	A-25-25	A-25-32	A-25-40	A-25-50	A-25-60	A-25-80	A-25-100	A-25-120
3	1	TUBE	A-40-15 1.25 + STK	A-40-20 1.25 + STK	A-40-25 1.38 + STK	A-40-32 1.44 + STK	A-40-40 1.44 + STK	A-40-50 1.69 + STK	A-40-60 1.69 + STK	A-40-80 1.81 + STK	A-40-100 2.31 + STK	A-40-120 2.88 + STK
4	1	PISTON ROD 	Consult Factory with Serial Number									
5	1	*PISTON	A-15-15	A-15-20	A-15-25	A-15-32	A-15-40	A-15-50	A-15-60	A-15-80	A-15-100	A-15-120
6	4	†TIE ROD	A-50-15	A-50-20	A-50-25	A-50-32	A-50-32	A-50-50	A-50-60	A-50-80	A-50-100	A-50-120
7	8	TIE ROD NUTS	.25-28	.31-24	.31-24	.38-24	.38-24	.50-20	.50-20	.63-18	.75-16	.75-16
8	2	TUBE SEAL	TS-15	TS-20	TS-25	TS-32	TS-40	TS-50	TS-60	TS-80	TS-100	TS-120
9	2	PISTON SEAL	PS-15	PS-20	PS-25	PS-32	PS-40	PS-50	PS-60	PS-80	PS-100	PS-120
10	1	ROD SEAL	RS-625	RS-625	RS-625	RS-1000	RS-1000	RS-1000	RS-1375	RS-1375	RS-1750	RS-2000
11	1	ROD WIPER	RW-625	RW-625	RW-625	RW-1000	RW-1000	RW-1000	RW-1375	RW-1375	RW-1750	RW-2000
12	1	ROD BUSHING	A-30-1	A-30-1	A-30-1	A-30-2	A-30-2	A-30-2	A-30-3	A-30-3	A-30-4	A-30-5
13	1	BUSHING "O" RING	BO-1	BO-1	BO-1	BO-2	BO-2	BO-2	BO-3	BO-3	BO-4	BO-5
14	1 or 2	ADJ. NEEDLE (incl) SEAL	A-66-1	A-66-1	A-66-1	A-66-2	A-66-2	A-66-2	A-66-2	A-66-2	A-66-2	A-66-2
15	1	CUSHION SPUD	A-65-1	A-65-1	A-65-1	A-65-2	A-65-2	A-65-2	A-65-3	A-65-3	A-65-4	A-65-5
16	1	CUSHION SEAL-H	CS-3	CS-3	CS-3	CS-4	CS-4	CS-4	CS-5	CS-5	CS-6	CS-6
17	1	CUSHION SEAL-C	CS-1	CS-1	CS-1	CS-2	CS-2	CS-2	CS-3	CS-3	CS-3	CS-3
18	1	RETAINER PLATE	A-36-15	A-35-1	A-35-1	A-35-2	A-35-2	A-35-2	A-35-3	A-35-3	A-35-4	A-35-5
	1	ROD BUSH SEALS INSTALLED	A-30-1A	A-30-1A	A-30-1A	A-30-2A	A-30-2A	A-30-2A	A-30-3A	A-30-3A	A-30-4A	A-30-5A

When ordering piston rod it is recommended to order both piston rod & piston (parts 4 & 5). Please specify TRD serial number.

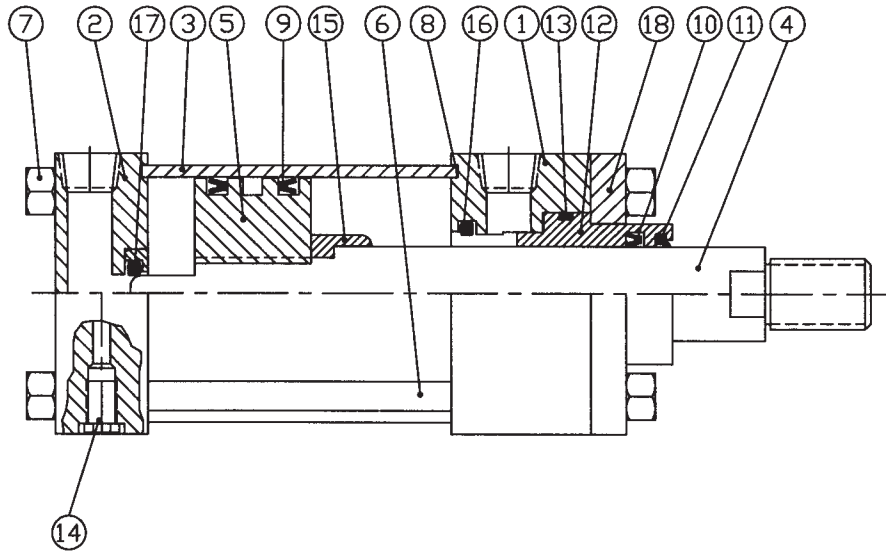
* Specify if air/oil seal is required - standard piston will accept magnetic strip only for center groove.

† Must supply serial number to insure proper tie rods are supplied.

SERIES 'TA' CYLINDER PARTS LIST: OVERSIZE ROD DIAMETER

(Below listed parts can also be used for Back To Back Cylinders)

NOTE:
When ordering any part, please supply TRD Serial Number to insure proper parts are supplied.



ITEM	QTY.	PART NAME	BORE SIZE									
			1.50	2	2.50	3.25	4	5	6	8	10	12
1	1	HEAD	A-110-15	A-110-20	A-110-25	A-110-32	A-110-40	A-110-50	A-110-60	A-110-80	A-110-100	A-110-120
2	1	CAP	A-25-15	A-25-20	A-25-25	A-25-32	A-25-40	A-25-50	A-25-60	A-25-80	A-25-100	A-25-120
3	1	TUBE	A-40-15 1.25 + STK	A-40-20 1.25 + STK	A-40-25 1.38 + STK	A-40-32 1.44 + STK	A-40-40 1.44 + STK	A-40-50 1.69 + STK	A-40-60 1.69 + STK	A-40-80 1.81 + STK	A-40-100 2.31 + STK	A-40-120 2.88 + STK
4	1	PISTON ROD 	Consult Factory with Serial Number									
5	1	*PISTON	A-15-15-1	A-15-20-1	A-15-25-1	A-15-32-1	A-15-40-1	A-15-50-1	A-15-60-1	A-15-80-1	A-15-100-1	A-15-120-1
6	4	†TIE ROD	A-50-15	A-50-20	A-50-25	A-50-32	A-50-32	A-50-50	A-50-60	A-50-80	A-50-100	A-50-120
7	8	TIE ROD NUTS	.25-28	.31-24	.31-24	.38-24	.38-24	.50-20	.50-20	.63-18	.75-16	.75-16
8	2	TUBE SEAL	TS-15	TS-20	TS-25	TS-32	TS-40	TS-50	TS-60	TS-80	TS-100	TS-120
9	2	PISTON SEAL	PS-15	PS-20	PS-25	PS-32	PS-40	PS-50	PS-60	PS-80	PS-100	PS-120
10	1	ROD SEAL	RS-1000	RS-1000	RS-1000	RS-1375	RS-1375	RS-1375	RS-1750	RS-1750	RS-2000	RS-2500
11	1	ROD WIPER	RW-1000	RW-1000	RW-1000	RW-1375	RW-1375	RW-1375	RW-1750	RW-1750	RW-2000	RW-2500
12	1	ROD BUSHING	A-30-2-OS	A-30-2	A-30-2	A-30-3	A-30-3	A-30-3	A-30-4	A-30-4	A-30-5	A-30-6
13	1	BUSHING "O" RING	BO-2-OS	BO-2	BO-2	BO-3	BO-3	BO-3	BO-4	BO-4	BO-5	BO-6
14	1 or 2	ADJ. NEEDLE (incl) SEAL	A-66-1	A-66-1	A-66-1	A-66-2	A-66-2	A-66-2	A-66-2	A-66-2	A-66-2	A-66-2
15	1	CUSHION SPUD	N/A	A-65-2	A-65-2	A-65-3	A-65-3	A-65-3	A-65-4	A-65-4	A-65-5	A-65-6
16	1	CUSHION SEAL-H	N/A	CS-4	CS-4	CS-5	CS-5	CS-5	CS-6	CS-6	CS-6	CS-10
17	1	CUSHION SEAL-C	CS-1	CS-1	CS-1	CS-2	CS-2	CS-2	CS-3	CS-3	CS-3	CS-3
18	1	RETAINER PLATE	A-36-15-OS	A-36-20-OS	A-36-25-OS	A-36-32-OS	A-35-3	A-35-3	A-35-4	A-35-4	A-35-5	A-35-6
	1	ROD BUSH SEALS INSTALLED	A-30-2A-OS	A-30-2A	A-30-2A	A-30-3A	A-30-3A	A-30-3A	A-30-4A	A-30-4A	A-30-5A	A-30-6A

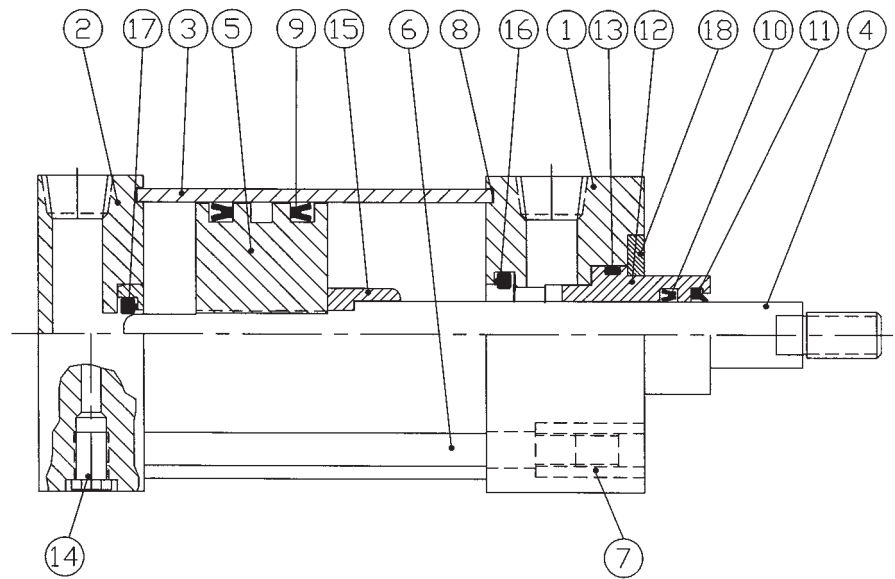
When ordering piston rod it is recommended to order both piston rod & piston (parts 4 & 5). Please specify TRD serial number.

* Specify if air/oil seal is required - standard piston will accept magnetic strip only for center groove.

† Must supply serial number to insure proper tie rods are supplied.

SERIES 'FM' CYLINDER PARTS LIST: STANDARD ROD DIAMETER

NOTE:
When ordering any part,
please supply TRD Serial
Number to insure proper
parts are supplied.



ITEM	QTY.	PART NAME	BORE SIZE						
			1.50	2	2.50	3.25	4	5	6
1	1	HEAD	FM-10-15	FM-10-20	FM-10-25	FM-10-32	FM-10-40	FM-10-50	FM-10-60
2	1	CAP	FM-25-15	FM-25-20	FM-25-25	FM-25-32	FM-25-40	FM-25-50	FM-25-60
3	1	TUBE	A-40-15 1.25 + STK	A-40-20 1.25 + STK	A-40-25 1.38 + STK	A-40-32 1.44 + STK	A-40-40 1.44 + STK	A-40-50 1.69 + STK	A-40-60 1.69 + STK
4	1	PISTON ROD 	Consult Factory with Serial Number						
5	1	*PISTON	A-15-15	A-15-20	A-15-25	A-15-32	A-15-40	A-15-50	A-15-60
6	4	†TIE ROD	A-50-15	A-50-20	A-50-25	A-50-32	A-50-32	A-50-50	A-50-60
7	4	SLEEVE NUTS	SN-100-250	SN-100-312	SN-100-312	SN-100-375	SN-100-375	SN-100-500	SN-100-500
8	2	TUBE SEAL	TS-15	TS-20	TS-25	TS-32	TS-40	TS-50	TS-60
9	2	PISTON SEAL	PS-15	PS-20	PS-25	PS-32	PS-40	PS-50	PS-60
10	1	ROD SEAL	RS-625	RS-625	RS-625	RS-1000	RS-1000	RS-1000	RS-1375
11	1	ROD WIPER	RW-625	RW-625	RW-625	RW-1000	RW-1000	RW-1000	RW-1375
12	1	ROD BUSHING	FM-30-1	FM-30-1	FM-30-1	FM-30-2	FM-30-2	FM-30-2	FM-30-3
13	1	BUSHING "O" RING	BO-1	BO-1	BO-1	BO-2	BO-2	BO-2	BO-3
14	1 or 2	ADJ. NEEDLE (incl) SEAL	A-66-1	A-66-1	A-66-1	A-66-2	A-66-2	A-66-2	A-66-2
15	1	CUSHION SPUD	A-65-1	A-65-1	A-65-1	A-65-2	A-65-2	A-65-2	A-65-3
16	1	CUSHION SEAL-H	CS-3	CS-3	CS-3	CS-4	CS-4	CS-4	CS-5
17	1	CUSHION SEAL-C	CS-1	CS-1	CS-1	CS-2	CS-2	CS-2	CS-3
18	1	RETAINER PLATE	FM-35-1	FM-35-1A	FM-35-1A	FM-35-2	FM-35-2	FM-35-2	FM-35-3
	1	ROD BUSH SEALS INSTALLED	A-30-1A	A-30-1A	A-30-1A	A-30-2A	A-30-2A	A-30-2A	A-30-3A

When ordering piston rod it is recommended to order both piston rod & piston (parts 4 & 5). Please specify TRD serial number.

* Specify if air/oil seal is required - standard piston will accept magnetic strip only for center groove.

† Must supply serial number to insure proper tie rods are supplied.

SERIES 'FM' CYLINDER PARTS LIST: OVERSIZE ROD DIAMETER

Basic Cylinders

Triple-Rod

Multi-Stage

Cylinder Options

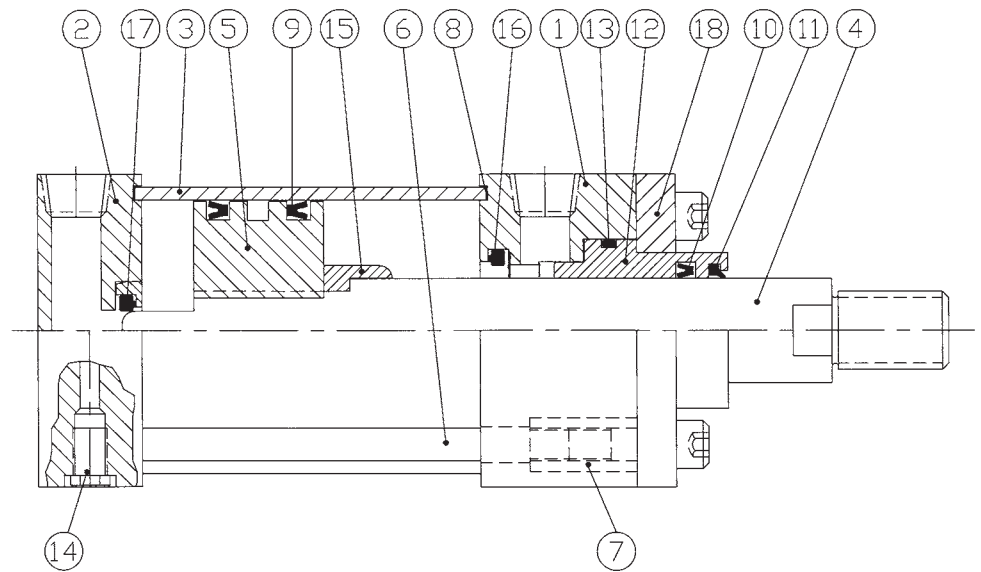
Air Boosters

Air/Oil Tanks

Accessories

Technical Data

NOTE:
When ordering any part, please supply TRD Serial Number to insure proper parts are supplied.



ITEM	QTY.	PART NAME	BORE SIZE						
			1.50	2	2.50	3.25	4	5	6
1	1	HEAD	FM-110-15	FM-110-20	FM-110-25	FM-110-32	FM-110-40	FM-110-50	FM-110-60
2	1	CAP	FM-25-15	FM-25-20	FM-25-25	FM-25-32	FM-25-40	FM-25-50	FM-25-60
3	1	TUBE	A-40-15 1.25 + STK	A-40-20 1.25 + STK	A-40-25 1.38 + STK	A-40-32 1.44 + STK	A-40-40 1.44 + STK	A-40-50 1.69 + STK	A-40-60 1.69 + STK
4	1	PISTON ROD 	Consult Factory with Serial Number						
5	1	*PISTON	A-15-15-OS-1	A-15-20-OS-1	A-15-25-OS-1	A-15-32-OS-1	A-15-40-OS-1	A-15-50-OS-1	A-15-60-OS-1
6	4	†TIE ROD	A-50-15	A-50-20	A-50-25	A-50-32	A-50-32	A-50-50	A-50-60
7	4	SLEEVE NUTS	SN-100-250	SN-100-312	SN-100-312	SN-100-375	SN-100-375	SN-100-500	SN-100-500
8	2	TUBE SEAL	TS-15	TS-20	TS-25	TS-32	TS-40	TS-50	TS-60
9	2	PISTON SEAL	PS-15	PS-20	PS-25	PS-32	PS-40	PS-50	PS-60
10	1	ROD SEAL	RS-1000	RS-1000	RS-1000	RS-1375	RS-1375	RS-1375	RS-1750
11	1	ROD WIPER	RW-1000	RW-1000	RW-1000	RW-1375	RW-1375	RW-1375	RW-1750
12	1	ROD BUSHING	FM-30-2-OS	FM-30-2	FM-30-2	FM-30-3	FM-30-3	FM-30-3	FM-30-4
13	1	BUSHING "O" RING	BO-2-OS	BO-2	BO-2	BO-3	BO-3	BO-3	BO-4
14	1 or 2	ADJ. NEEDLE (incl) SEAL	A-66-1	A-66-1	A-66-1	A-66-2	A-66-2	A-66-2	A-66-2
15	1	CUSHION SPUD	N/A	A-65-2	A-65-2	A-65-3	A-65-3	A-65-3	A-65-4
16	1	CUSHION SEAL-H	N/A	CS-4	CS-4	CS-5	CS-5	CS-5	CS-6
17	1	CUSHION SEAL-C	CS-1	CS-1	CS-1	CS-2	CS-2	CS-2	CS-3
18	1	RETAINER PLATE	FM-35-15-OS	FM-36-20-OS	FM-36-25-OS	FM-36-32-OS	FM-36-40-OS	FM-36-50-OS	FM-36-60-OS
	1	ROD BUSH SEALS INSTALLED	FM-30-2A-OS	FM-30-2A	FM-30-2A	FM-30-3A	FM-30-3A	FM-30-3A	FM-30-4A

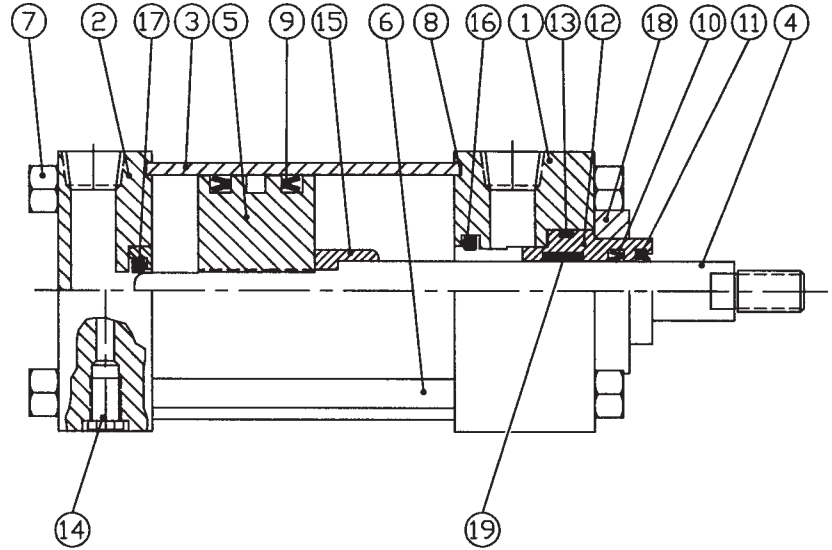
When ordering piston rod it is recommended to order both piston rod & piston (parts 4 & 5). Please specify TRD serial number.

* Specify if air/oil seal is required - standard piston will accept magnetic strip only for center groove.

† Must supply serial number to insure proper tie rods are supplied.

SERIES 'TA' CYLINDER WITH 'EN' OPTION PARTS LIST: STANDARD ROD DIAMETER

NOTE:
When ordering any part,
please supply TRD Serial
Number to insure proper
parts are supplied.



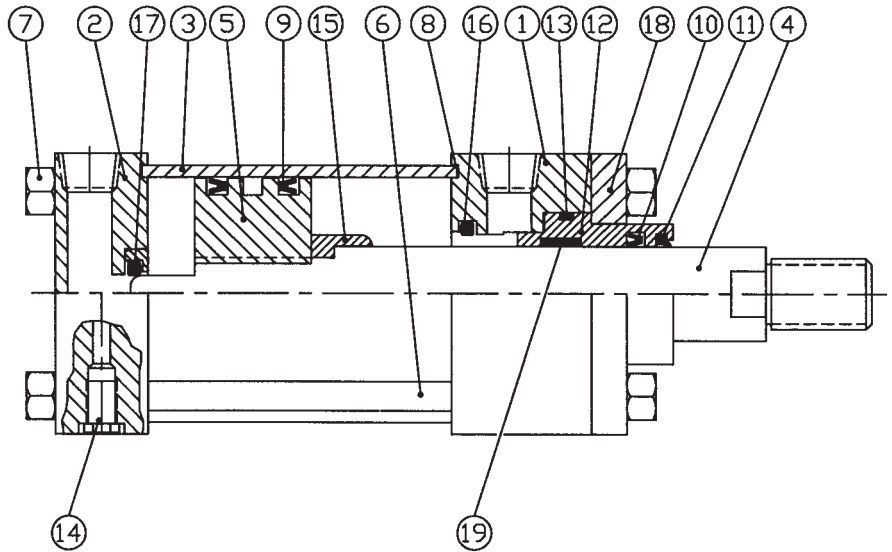
ITEM	QTY.	PART NAME	BORE SIZE									
			1.50	2	2.50	3.25	4	5	6	8	10	12
1	1	HEAD	EN-10-15	EN-10-20	EN-10-25	EN-10-32	EN-10-40	EN-10-50	EN-10-60	EN-10-80	EN-10-100	EN-10-120
2	1	CAP	EN-25-15	EN-25-20	EN-25-25	EN-25-32	EN-25-40	EN-25-50	EN-25-60	EN-25-80	EN-25-100	EN-25-120
3	1	TUBE	EN-40-15 1.25 + STK	EN-40-20 1.25 + STK	EN-40-25 1.38 + STK	EN-40-32 1.44 + STK	EN-40-40 1.44 + STK	EN-40-50 1.69 + STK	EN-40-60 1.69 + STK	EN-40-80 1.81 + STK	EN-40-100 2.31 + STK	EN-40-120 2.88 + STK
4	1	PISTON ROD 	Consult Factory with Serial Number									
5	1	*PISTON	A-15-15	A-15-20	A-15-25	A-15-32	A-15-40	A-15-50	A-15-60	A-15-80	A-15-100	A-15-120
6	4	†TIE ROD	SS-50-15	SS-50-20	SS-50-25	SS-50-32	SS-50-32	SS-50-50	SS-50-60	SS-50-80	SS-50-100	SS-50-120
7	8	TIE ROD NUTS (SS)	.25-28	.31-24	.31-24	.38-24	.38-24	.50-20	.50-20	.63-18	.75-16	.75-16
8	2	TUBE SEAL	TS-15	TS-20	TS-25	TS-32	TS-40	TS-50	TS-60	TS-80	TS-100	TS-120
9	2	PISTON SEAL	PS-15	PS-20	PS-25	PS-32	PS-40	PS-50	PS-60	PS-80	PS-100	PS-120
10	1	ROD SEAL	RS-625	RS-625	RS-625	RS-1000	RS-1000	RS-1000	RS-1375	RS-1375	RS-1750	RS-2000
11	1	PTFE ROD WIPER	TRW-625	TRW-625	TRW-625	TRW-1000	TRW-1000	TRW-1000	TRW-1375	TRW-1375	TRW-1750	TRW-2000
12	1	ROD BUSHING	SS-30-1	SS-30-1	SS-30-1	SS-30-2	SS-30-2	SS-30-2	SS-30-3	SS-30-3	SS-30-4	SS-30-5
13	1	BUSHING "O" RING	BO-1	BO-1	BO-1	BO-2	BO-2	BO-2	BO-3	BO-3	BO-4	BO-5
14	1 or 2	ADJ. NEEDLE (incl) SEAL	SS-66-1	SS-66-1	SS-66-1	SS-66-2	SS-66-2	SS-66-2	SS-66-2	SS-66-2	SS-66-2	SS-66-2
15	1	CUSHION SPUD	A-65-1	A-65-1	A-65-1	A-65-2	A-65-2	A-65-2	A-65-3	A-65-3	A-65-4	A-65-5
16	1	CUSHION SEAL-H	CS-3	CS-3	CS-3	CS-4	CS-4	CS-4	CS-5	CS-5	CS-6	CS-6
17	1	CUSHION SEAL-C	CS-1	CS-1	CS-1	CS-2	CS-2	CS-2	CS-3	CS-3	CS-3	CS-3
18	1	RETAINER PLATE	EN-36-15	EN-35-1	EN-35-1	EN-35-2	EN-35-2	EN-35-2	EN-35-3	EN-35-3	EN-35-4	EN-35-5
19	1	PTFE ROD WEARBAND	TWB-625	TWB-625	TWB-625	TWB-1000	TWB-1000	TWB-1000	TWB-1375	TWB-1375	TWB-1750	TWB-2000
	1	ROD BUSH SEALS INSTALLED	SS-30-1A	SS-30-1A	SS-30-1A	SS-30-2A	SS-30-2A	SS-30-2A	SS-30-3A	SS-30-3A	SS-30-4A	SS-30-5A

When ordering piston rod it is recommended to order both piston rod & piston (parts 4 & 5). Please specify TRD serial number.

* Specify if air/oil seal is required - standard piston will accept magnetic strip only for center groove.

† Must supply serial number to insure proper tie rods are supplied.

SERIES 'TA' CYLINDER WITH 'EN' OPTION PARTS LIST: OVERSIZE ROD DIAMETER



NOTE:
When ordering any part,
please supply TRD Serial
Number to insure proper
parts are supplied.

ITEM	QTY.	PART NAME	BORE SIZE									
			1.50	2	2.50	3.25	4	5	6	8	10	12
1	1	HEAD	EN-110-15	EN-110-20	EN-110-25	EN-110-32	EN-110-40	EN-110-50	EN-110-60	EN-110-80	EN-110-100	EN-110-120
2	1	CAP	EN-25-15	EN-25-20	EN-25-25	EN-25-32	EN-25-40	EN-25-50	EN-25-60	EN-25-80	EN-25-100	EN-25-120
3	1	TUBE	EN-40-15 1.25 + STK	EN-40-20 1.25 + STK	EN-40-25 1.38 + STK	EN-40-32 1.44 + STK	EN-40-40 1.44 + STK	EN-40-50 1.69 + STK	EN-40-60 1.69 + STK	EN-40-80 1.81 + STK	EN-40-100 2.31 + STK	EN-40-120 2.88 + STK
4	1	PISTON ROD ▲	Consult Factory with Serial Number									
5	1	*PISTON	A-15-15-OS-1	A-15-20-OS-1	A-15-25-OS-1	A-15-32-OS-1	A-15-40-OS-1	A-15-50-OS-1	A-15-60-OS-1	A-15-80-OS-1	A-15-100-OS-1	A-15-120-OS-1
6	4	†TIE ROD	SS-50-15	SS-50-20	SS-50-25	SS-50-32	SS-50-32	SS-50-50	SS-50-60	SS-50-80	SS-50-100	SS-50-120
7	8	TIE ROD NUTS (SS)	.25-28	.31-24	.31-24	.38-24	.38-24	.50-20	.50-20	.63-18	.75-16	.75-16
8	2	TUBE SEAL	TS-15	TS-20	TS-25	TS-32	TS-40	TS-50	TS-60	TS-80	TS-100	TS-120
9	2	PISTON SEAL	PS-15	PS-20	PS-25	PS-32	PS-40	PS-50	PS-60	PS-80	PS-100	PS-120
10	1	ROD SEAL	RS-1000	RS-1000	RS-1000	RS-1375	RS-1375	RS-1375	RS-1750	RS-1750	RS-2000	RS-2500
11	1	PTFE ROD WIPER	TRW-1000	TRW-1000	TRW-1000	TRW-1375	TRW-1375	TRW-1375	TRW-1750	TRW-1750	TRW-2000	TRW-2500
12	1	ROD BUSHING	SS-30-2-OS	SS-30-2	SS-30-2	SS-30-3	SS-30-3	SS-30-3	SS-30-4	SS-30-4	SS-30-5	SS-30-6
13	1	BUSHING "O" RING	BO-2-OS	BO-2	BO-2	BO-3	BO-3	BO-3	BO-4	BO-4	BO-5	BO-6
14	1 or 2	ADJ. NEEDLE (incl) SEAL	SS-66-1	SS-66-1	SS-66-1	SS-66-2	SS-66-2	SS-66-2	SS-66-2	SS-66-2	SS-66-2	SS-66-2
15	1	CUSHION SPUD	N/A	A-65-2	A-65-2	A-65-3	A-65-3	A-65-3	A-65-4	A-65-4	A-65-5	A-65-6
16	1	CUSHION SEAL-H	N/A	CS-4	CS-4	CS-5	CS-5	CS-5	CS-6	CS-6	CS-6	CS-10
17	1	CUSHION SEAL-C	CS-1	CS-1	CS-1	CS-2	CS-2	CS-2	CS-3	CS-3	CS-3	CS-3
18	1	RETAINER PLATE	EN-36-15-OS	EN-36-20-OS	EN-36-25-OS	EN-36-32-OS	EN-35-3	EN-35-3	EN-35-4	EN-35-4	EN-35-5	EN-35-6
19	1	PTFE ROD WEARBAND	TWB-1000	TWB-1000	TWB-1000	TWB-1375	TWB-1375	TWB-1375	TWB-1750	TWB-1750	TWB-2000	TWB-2500
	1	ROD BUSH SEALS INSTALLED	SS-30-2A-OS	SS-30-2A	SS-30-2A	SS-30-3A	SS-30-3A	SS-30-3A	SS-30-4A	SS-30-4A	SS-30-5A	SS-30-6A

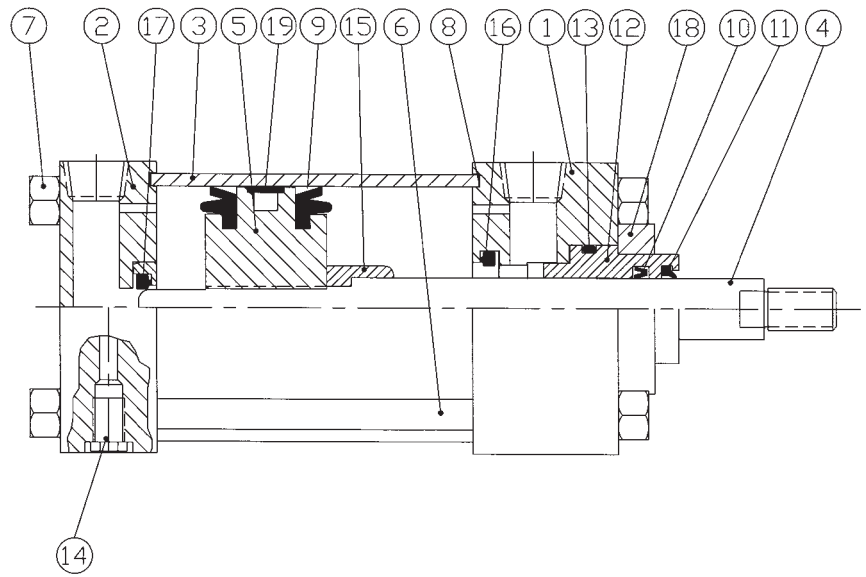
▲ When ordering piston rod it is recommended to order both piston rod & piston (parts 4 & 5). Please specify TRD serial number.

* Specify if air/oil seal is required - standard piston will accept magnetic strip only for center groove.

† Must supply serial number to insure proper tie rods are supplied.

SERIES 'TD' CYLINDER PARTS LIST: STANDARD ROD DIAMETER

NOTE:
When ordering any part,
please supply TRD Serial
Number to insure proper
parts are supplied.



ITEM	QTY.	PART NAME	BORE SIZE							
			1.50	2	2.50	3.25	4	5	6	8
1	1	HEAD	A-10-15-FC	A-10-20-FC	A-10-25-FC	A-10-32-FC	A-10-40-FC	A-10-50-FC	A-10-60-FC	A-10-80-FC
2	1	CAP	A-25-15-FC	A-25-20-FC	A-25-25-FC	A-25-32-FC	A-25-40-FC	A-25-50-FC	A-25-60-FC	A-25-80-FC
3	1	TUBE	A-40-15 1.25 + STK	A-40-20 1.25 + STK	A-40-25 1.38 + STK	A-40-32 1.44 + STK	A-40-40 1.44 + STK	A-40-50 1.69 + STK	A-40-60 1.69 + STK	A-40-80 1.81 + STK
4	1	PISTON ROD ▲	Consult Factory with Serial Number							
5	1	*PISTON	BP-15-15	BP-15-20	BP-15-25	BP-15-32	BP-15-40	BP-15-50	BP-15-60	BP-15-80
6	4	†TIE ROD	A-50-15	A-50-20	A-50-25	A-50-32	A-50-32	A-50-50	A-50-60	A-50-80
7	8	TIE ROD NUTS	.25-28	.31-24	.31-24	.38-24	.38-24	.50-20	.50-20	.63-18
8	2	TUBE SEAL	TS-15	TS-20	TS-25	TS-32	TS-40	TS-50	TS-60	TS-80
9	2	PISTON SEAL	BPS-15	BPS-20	BPS-25	BPS-32	BPS-40	BPS-50	BPS-60	BPS-80
10	1	ROD SEAL	RS-625	RS-625	RS-625	RS-1000	RS-1000	RS-1000	RS-1375	RS-1375
11	1	ROD WIPER	RW-625	RW-625	RW-625	RW-1000	RW-1000	RW-1000	RW-1375	RW-1375
12	1	ROD BUSHING	A-30-1	A-30-1	A-30-1	A-30-2	A-30-2	A-30-2	A-30-3	A-30-3
13	1	BUSHING "O" RING	BO-1	BO-1	BO-1	BO-2	BO-2	BO-2	BO-3	BO-3
14	1 or 2	ADJ. NEEDLE OPTIONAL	A-66-1	A-66-1	A-66-1	A-66-2	A-66-2	A-66-2	A-66-2	A-66-2
15	1	CUSHION SPUD	A-65-1	A-65-1	A-65-1	A-65-2	A-65-2	A-65-2	A-65-3	A-65-3
16	1	CUSHION SEAL-H	CS-3	CS-3	CS-3	CS-4	CS-4	CS-4	CS-5	CS-5
17	1	CUSHION SEAL-C	CS-1	CS-1	CS-1	CS-2	CS-2	CS-2	CS-3	CS-3
18	1	RETAINER PLATE	A-36-15	A-35-1	A-35-1	A-35-2	A-35-2	A-35-2	A-35-3	A-35-3
19	1	PISTON WEARBAND	PWB-15	PWB-20	PWB-25	PWB-32	PWB-40	PWB-50	PWB-60	PWB-80
	1	ROD BUSH SEALS INSTALLED	A-30-1A	A-30-1A	A-30-1A	A-30-2A	A-30-2A	A-30-2A	A-30-3A	A-30-3A

▲ When ordering piston rod it is recommended to order both piston rod & piston (parts 4 & 5). Please specify TRD serial number.

* Specify if air/oil seal is required - standard piston will accept magnetic strip only for center groove.

† Must supply serial number to insure proper tie rods are supplied.

SERIES 'TD' CYLINDER PARTS LIST: OVERSIZE ROD DIAMETER

Basic Cylinders

Triple-Rod

Multi-Stage

Cylinder Options

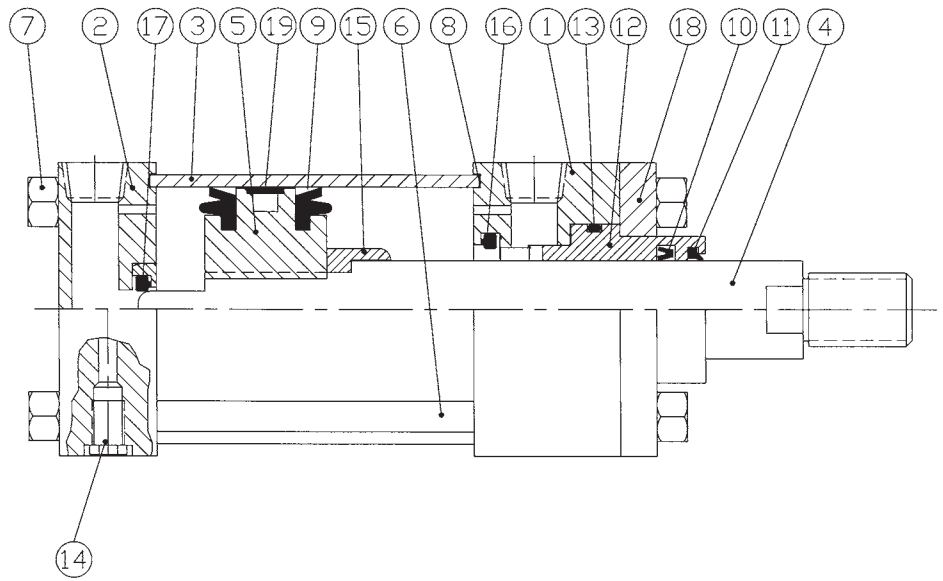
Air Boosters

Air/Oil Tanks

Accessories

Technical Data

NOTE:
When ordering any part, please supply TRD Serial Number to insure proper parts are supplied.



ITEM	QTY.	PART NAME	BORE SIZE							
			1.50	2	2.50	3.25	4	5	6	8
1	1	HEAD	A-110-15-FC	A-110-20-FC	A-110-25-FC	A-110-32-FC	A-110-40-FC	A-110-50-FC	A-110-60-FC	A-110-80-FC
2	1	CAP	A-25-15-FC	A-25-20-FC	A-25-25-FC	A-25-32-FC	A-25-40-FC	A-25-50-FC	A-25-60-FC	A-25-80-FC
3	1	TUBE	A-40-15 1.25 + STK	A-40-20 1.25 + STK	A-40-25 1.38 + STK	A-40-32 1.44 + STK	A-40-40 1.44 + STK	A-40-50 1.69 + STK	A-40-60 1.69 + STK	A-40-80 1.81 + STK
4	1	PISTON ROD ▲	Consult Factory with Serial Number							
5	1	*PISTON	BP-15-15-OS	BP-15-20-OS	BP-15-25-OS	BP-15-32-OS	BP-15-40-OS	BP-15-50-OS	BP-15-60-OS	BP-15-80-OS
6	4	†TIE ROD	A-50-15	A-50-20	A-50-25	A-50-32	A-50-32	A-50-50	A-50-60	A-50-80
7	8	TIE ROD NUTS	.25-28	.31-24	.31-24	.38-24	.38-24	.50-20	.50-20	.63-18
8	2	TUBE SEAL	TS-15	TS-20	TS-25	TS-32	TS-40	TS-50	TS-60	TS-80
9	2	PISTON SEAL	BPS-15	BPS-20	BPS-25	BPS-32	BPS-40	BPS-50	BPS-60	BPS-80
10	1	ROD SEAL	RS-1000	RS-1000	RS-1000	RS-1375	RS-1375	RS-1375	RS-1750	RS-1750
11	1	ROD WIPER	RW-1000	RW-1000	RW-1000	RW-1375	RW-1375	RW-1375	RW-1750	RW-1750
12	1	ROD BUSHING	A-30-2-OS	A-30-2	A-30-2	A-30-3	A-30-3	A-30-3	A-30-4	A-30-4
13	1	BUSHING "O" RING	BO-2-OS	BO-2	BO-2	BO-3	BO-3	BO-3	BO-4	BO-4
14	1 or 2	ADJ. NEEDLE OPTIONAL	A-66-1	A-66-1	A-66-1	A-66-2	A-66-2	A-66-2	A-66-2	A-66-2
15	1	CUSHION SPUD	N/A	A-65-2	A-65-2	A-65-3	A-65-3	A-65-3	A-65-4	A-65-4
16	1	CUSHION SEAL-H	N/A	CS-4	CS-4	CS-5	CS-5	CS-5	CS-6	CS-6
17	1	CUSHION SEAL-C	CS-1	CS-1	CS-1	CS-2	CS-2	CS-2	CS-3	CS-3
18	1	RETAINER PLATE	A-36-15-OS	A-36-20-OS	A-36-25-OS	A-36-32-OS	A-36-40-OS	A-36-50-OS	A-36-60-OS	A-35-4
19	1	PISTON WEAR BAND	PWB-15	PWB-20	PWB-25	PWB-32	PWB-40	PWB-50	PWB-60	PWB-80
	1	ROD BUSH SEALS INSTALLED	A-30-2A-OS	A-30-2A	A-30-2A	A-30-3A	A-30-3A	A-30-3A	A-30-4A	A-30-4A

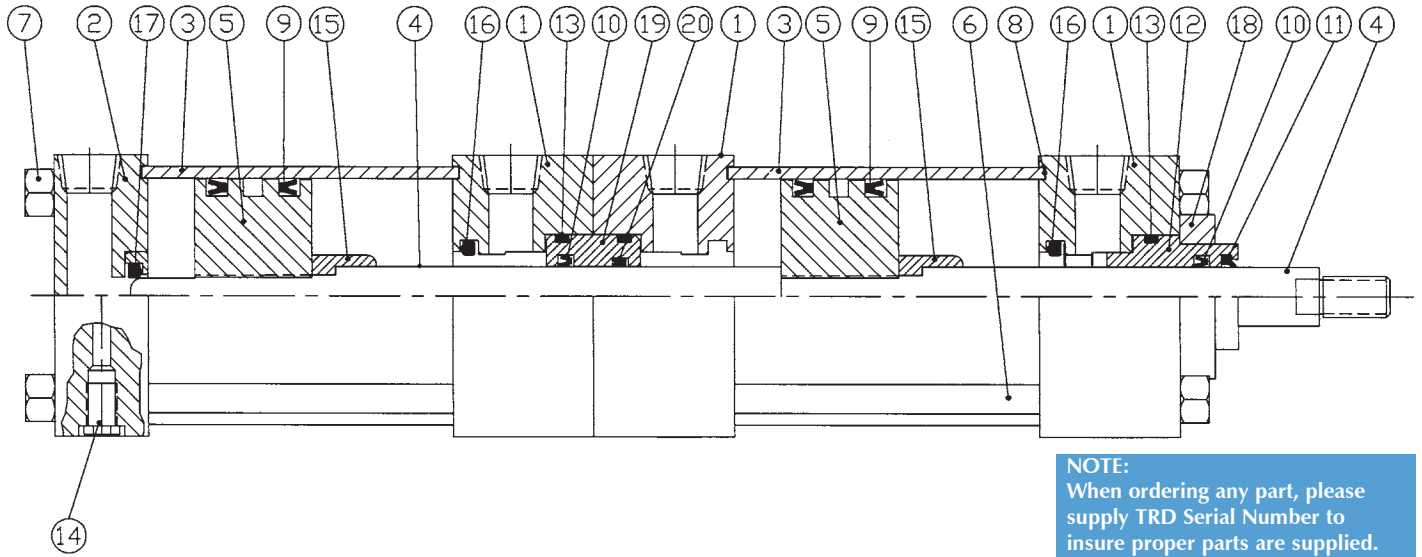
▲ When ordering piston rod it is recommended to order both piston rod & piston (parts 4 & 5). Please specify TRD serial number.

* Specify if air/oil seal is required - standard piston will accept magnetic strip only for center groove.

† Must supply serial number to insure proper tie rods are supplied.

No cushion available on 1.50" bore with oversize rod.

TANDEM AND 3 POSITION CYLINDER PARTS LIST: STANDARD ROD DIAMETER



NOTE:
When ordering any part, please supply TRD Serial Number to insure proper parts are supplied.

ITEM	QTY.	PART NAME	BORE SIZE									
			1.50	2	2.50	3.25	4	5	6	8	10	12
1	3	HEAD	A-10-15	A-10-20	A-10-25	A-10-32	A-10-40	A-10-50	A-10-60	A-10-80	A-10-100	A-10-120
2	1	CAP	A-25-15	A-25-20	A-25-25	A-25-32	A-25-40	A-25-50	A-25-60	A-25-80	A-25-100	A-25-120
3	2	TUBE	A-40-15 1.25 + STK	A-40-20 1.25 + STK	A-40-25 1.38 + STK	A-40-32 1.44 + STK	A-40-40 1.44 + STK	A-40-50 1.69 + STK	A-40-60 1.69 + STK	A-40-80 1.81 + STK	A-40-100 2.31 + STK	A-40-120 2.88 + STK
4	1	PISTON ROD	Consult Factory with Serial Number									
5	2	*PISTON	A-15-15	A-15-20	A-15-25	A-15-32	A-15-40	A-15-50	A-15-60	A-15-80	A-15-100	A-15-120
6	4	†TIE ROD	A-50-15	A-50-20	A-50-25	A-50-32	A-50-32	A-50-50	A-50-60	A-50-80	A-50-100	A-50-120
7	8	TIE ROD NUTS	.25-28	.31-24	.31-24	.38-24	.38-24	.50-20	.50-20	.63-18	.75-16	.75-16
8	4	TUBE SEAL	TS-15	TS-20	TS-25	TS-32	TS-40	TS-50	TS-60	TS-80	TS-100	TS-120
9	4	PISTON SEAL	PS-15	PS-20	PS-25	PS-32	PS-40	PS-50	PS-60	PS-80	PS-100	PS-120
10	2	ROD SEAL	RS-625	RS-625	RS-625	RS-1000	RS-1000	RS-1000	RS-1375	RS-1375	RS-1750	RS-2000
11	1	ROD WIPER	RW-625	RW-625	RW-625	RW-1000	RW-1000	RW-1000	RW-1375	RW-1375	RW-1750	RW-2000
12	1	ROD BUSHING	A-30-1	A-30-1	A-30-1	A-30-2	A-30-2	A-30-2	A-30-3	A-30-3	A-30-4	A-30-5
13	3	BUSHING "O" RING	BO-1	BO-1	BO-1	BO-2	BO-2	BO-2	BO-3	BO-3	BO-4	BO-5
14	1 to 3	ADJ. NEEDLE (incl) SEAL	A-66-1	A-66-1	A-66-1	A-66-2	A-66-2	A-66-2	A-66-2	A-66-2	A-66-2	A-66-2
15	1	CUSHION SPUD	A-65-1	A-65-1	A-65-1	A-65-2	A-65-2	A-65-2	A-65-3	A-65-3	A-65-4	A-65-5
16	1	CUSHION SEAL-H	CS-3	CS-3	CS-3	CS-4	CS-4	CS-4	CS-5	CS-5	CS-6	CS-6
17	1	CUSHION SEAL-C	CS-1	CS-1	CS-1	CS-2	CS-2	CS-2	CS-3	CS-3	CS-3	CS-3
18	1	RETAINER PLATE	A-36-15	A-35-1	A-35-1	A-35-2	A-35-2	A-35-2	A-35-3	A-35-3	A-35-4	A-35-5
19	1	△ TANDEM ROD BUSH	A-30-1-T	A-30-1-T	A-30-1-T	A-30-2-T	A-30-2-T	A-30-2-T	A-30-3-T	A-30-3-T	A-30-4-T	A-30-5-T
20	1	QUAD ROD SEAL	TH-625	TH-625	TH-625	TH-1000	TH-1000	TH-1000	TH-1375	TH-1375	TH-1750	TH-2000

△ Bushing replaceable on 3-Position cylinder only.

Note: The above can be used when ordering parts for a 3-Position cylinder if ordering tubes (Item 3) or rods (Item 4). You must supply the TRD serial number.

* Specify if air/oil seal is required - standard piston will accept magnetic strip only for center groove.

† Must supply serial number to insure proper tie rods are supplied.

SERIES 'TRA' CYLINDER PARTS LIST

Basic Cylinders

Triple-Rod

Multi-Stage

Cylinder Options

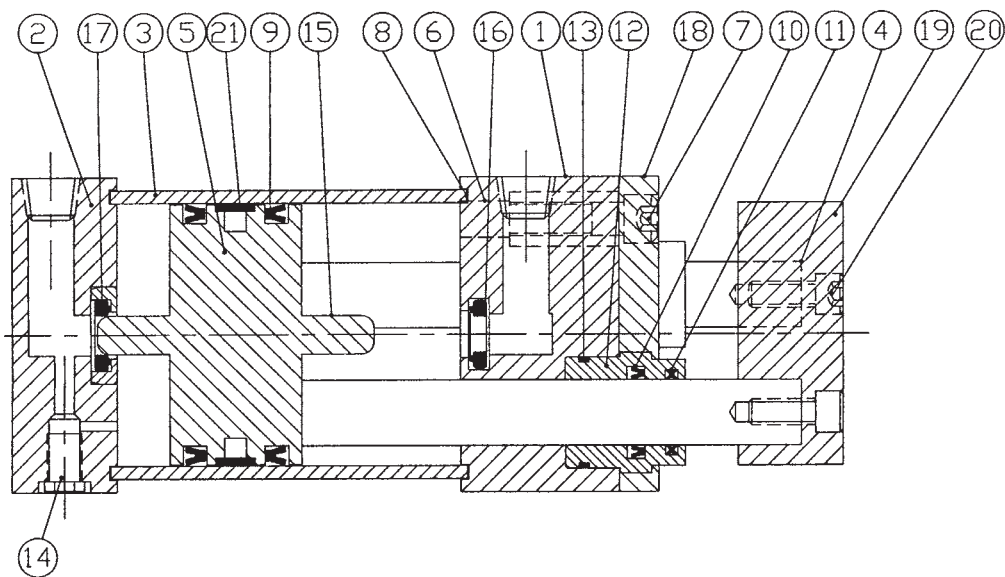
Air Boosters

Air/Oil Tanks

Accessories

Technical Data

NOTE:
When ordering any part,
please supply TRD Serial
Number to insure proper
parts are supplied.



ITEM	QTY.	PART NAME	BORE SIZE							
			1.50	2	2.50	3.25	4	5	6	8
1	1	HEAD	TR-10-15	TR-10-20	TR-10-25	TR-10-32	TR-10-40	TR-10-50	TR-10-60	TR-10-80
2	1	CAP	FM-25-15	FM-25-20	FM-25-25	FM-25-32	FM-25-40	FM-25-50	FM-25-60	FM-25-80
3	1	TUBE	A-40-15 1.25 + STK	A-40-20 1.25 + STK	A-40-25 1.38 + STK	A-40-32 1.44 + STK	A-40-40 1.44 + STK	A-40-50 1.69 + STK	A-40-60 1.69 + STK	A-40-80 1.81 + STK
4	1	PISTON ROD	Consult Factory with Serial Number							
5	1	*PISTON	TR2-15-15	TR2-15-20	TR2-15-25	TR2-15-32	TR2-15-40	TR2-15-50	TR2-15-60	TR2-15-80
6	4	†TIE ROD	TR-50-15	TR-50-20	TR-50-25	TR-50-32	TR-50-32	TR-50-50	TR-50-60	TR-50-80
7	4	SLEEVE NUTS	SN-100-250	SN-100-312	SN-100-312	SN-100-375	SN-100-375	SN-100-500	SN-100-500	⁶³ -18 Hex Nuts
8	2	TUBE SEAL	TS-15	TS-20	TS-25	TS-32	TS-40	TS-50	TS-60	TS-80
9	2	PISTON SEAL	PS-15	PS-20	PS-25	PS-32	PS-40	PS-50	PS-60	PS-80
10	3	ROD SEAL	RS-312	RS-500	RS-625	RS-625	RS-625	RS-1000	RS-1000	RS-1000
11	3	ROD WIPER	RW-312	RW-500	RW-625	RW-625	RW-625	RW-1000	RW-1000	RW-1000
12	3	ROD BUSHING	TRHD-30-1	TRHD-30-2	TRHD-30-3	TRHD-30-4	TRHD-30-4	TRHD-30-5	TRHD-30-6	A-30-2
13	3	BUSHING "O" RING	TR-BO-1	TR-BO-2	TR-BO-3	TR-BO-3	TR-BO-3	TR-BO-4	TR-BO-4	BO-2
14	1 or 2	ADJ. NEEDLE OPTIONAL	A-66-1	A-66-1	A-66-1	A-66-2	A-66-2	A-66-2	A-66-2	A-66-2
15	2	CUSHION SPUD	PART OF PISTON			TR-CS-32-5-H	TR-CS-32-5-H	TR-CS-32-5-H	TR-CS-6-8-H	TR-CS-6-8-H
16	1	CUSHION SEAL-H	CS-8	CS-9	CS-1	CS-2	CS-2	CS-2	CS-3	CS-3
17	1	CUSHION SEAL-C	CS-1	CS-1	CS-1	CS-2	CS-2	CS-2	CS-3	CS-3
18	1	RETAINER PLATE	TRHD-36-15	TRHD-36-20	TRHD-36-25	TRHD-36-32	TRHD-36-40	TRHD-36-50	TRHD-36-60	(3) A-35-3
19	1	TOOLING PLATE	TR-39-15	TR-39-20	TR-39-25	TR-39-32	TR-39-40	TR-39-50	TR-39-60	TR-39-80
20	3	TOOLING PLATE SCREWS ^Δ	#10-32X.50	.25-28X.50	.31-24X.81	.38-24X1	.38-24X1	.50-20X1	.50-20X1	.50-20X1
21	1	PISTON WEARBAND	PWB-15	PWB-20	PWB-25	PWB-32	PWB-40	PWB-50	PWB-60	PWB-80

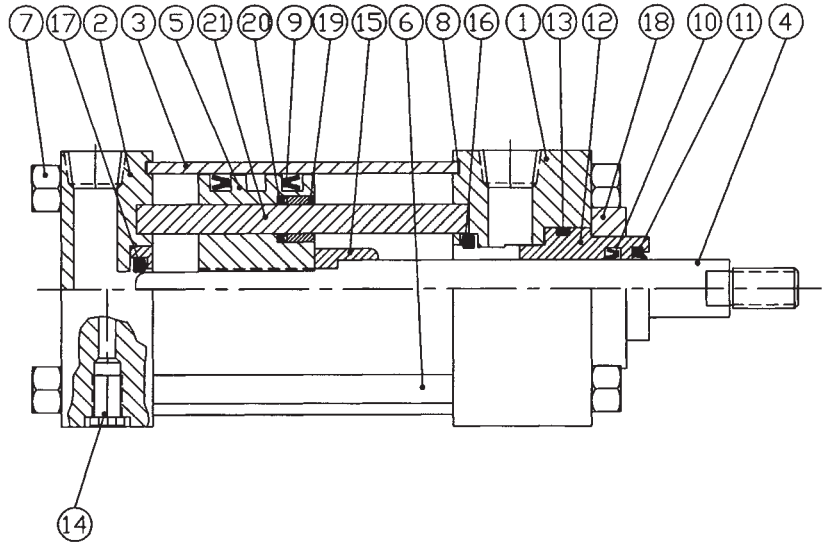
^Δ 2.50", 5", 6" & 8" bores use low head socket cap screws.
(Other sizes use socket head cap screws.)

* Specify if air/oil seal is required - standard piston will accept magnetic strip only for center groove.

133 † Must supply serial number to insure proper tie rods are supplied.

SERIES 'TA' CYLINDER WITH 'NR' OPTION PARTS LIST: STANDARD ROD DIAMETER

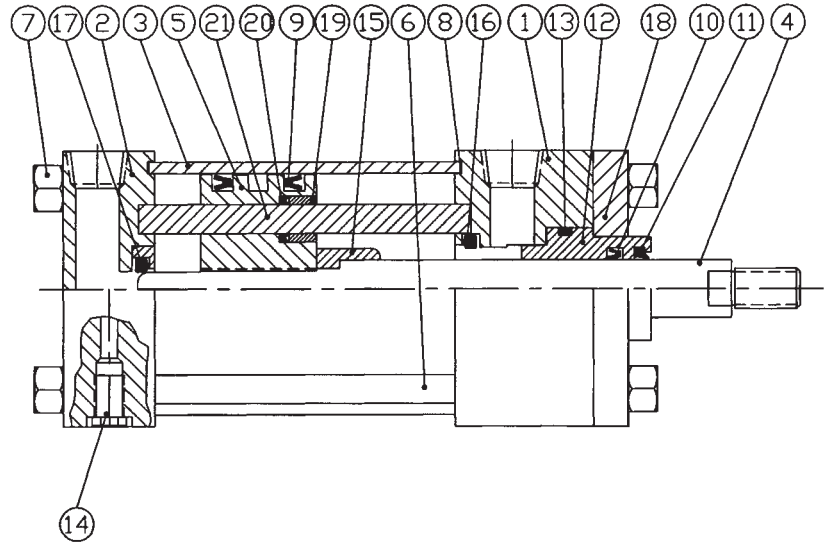
NOTE:
When ordering any part,
please supply TRD Serial
Number to insure proper
parts are supplied.



ITEM	QTY.	PART NAME	BORE SIZE									
			2	2.50	3.25	4	5	6	8	10	12	
1	1	HEAD	NR-A-10-20	NR-A-10-25	NR-A-10-32	NR-A-10-40	NR-A-10-50	NR-A-10-60	NR-A-10-80	NR-A-10-100	NR-A-10-120	
2	1	CAP	NR-A-25-20	NR-A-25-25	NR-A-25-32	NR-A-25-40	NR-A-25-50	NR-A-25-60	NR-A-25-80	NR-A-25-100	NR-A-25-120	
3	1	TUBE	A-40-20 1.25 + STK	A-40-25 1.38 + STK	A-40-32 1.44 + STK	A-40-40 1.44 + STK	A-40-50 1.69 + STK	A-40-60 1.69 + STK	A-40-80 1.81 + STK	A-40-100 2.31 + STK	A-40-120 2.88 + STK	
4	1	PISTON ROD ▲	Consult Factory with Serial Number									
5	1	*PISTON	NR-A-15-20	NR-A-15-25	NR-A-15-32	NR-A-15-40	NR-A-15-50	NR-A-15-60	NR-A-15-80	NR-A-15-100	NR-A-15-120	
6	4	†TIE ROD	A-50-20	A-50-25	A-50-32	A-50-32	A-50-50	A-50-60	A-50-80	A-50-100	A-50-120	
7	8	TIE ROD NUTS	.31-24	.31-24	.38-24	.38-24	.50-20	.50-20	.63-18	.75-16	.75-16	
8	2	TUBE SEAL	TS-20	TS-25	TS-32	TS-40	TS-50	TS-60	TS-80	TS-100	TS-120	
9	2	PISTON SEAL	PS-20	PS-25	PS-32	PS-40	PS-50	PS-60	PS-80	PS-100	PS-120	
10	1	ROD SEAL	RS-625	RS-625	RS-1000	RS-1000	RS-1000	RS-1375	RS-1375	RS-1750	RS-2000	
11	1	ROD WIPER	RW-625	RW-625	RW-1000	RW-1000	RW-1000	RW-1375	RW-1375	RW-1750	RW-2000	
12	1	ROD BUSHING	A-30-1	A-30-1	A-30-2	A-30-2	A-30-2	A-30-3	A-30-3	A-30-4	A-30-5	
13	1	BUSHING "O" RING	BO-1	BO-1	BO-2	BO-2	BO-2	BO-3	BO-3	BO-4	BO-5	
14	1 or 2	ADJ. NEEDLE (incl) SEAL	A-66-1	A-66-1	A-66-2	A-66-2	A-66-2	A-66-2	A-66-2	A-66-2	A-66-2	
15	1	CUSHION SPUD	N/A	N/A	A-65-2	A-65-2	A-65-2	A-65-3	A-65-3	A-65-4	A-65-5	
16	1	CUSHION SEAL-H	N/A	N/A	CS-4	CS-4	CS-4	CS-5	CS-5	CS-6	CS-6	
17	1	CUSHION SEAL-C	CS-1	CS-1	CS-2	CS-2	CS-2	CS-3	CS-3	CS-3	CS-3	
18	1	RETAINER PLATE	A-35-1	A-35-1	A-35-2	A-35-2	A-35-2	A-35-3	A-35-3	A-35-4	A-35-5	
19	2	GUIDE ROD BEARING	GRB-1	GRB-2	GRB-3	GRB-4	GRB-4	GRB-4	GRB-5	GRB-5	GRB-5	
20	2	GUIDE ROD SEAL	2-010	2-109	Q4012	Q4114	Q4114	Q4114	TH-1000	TH-1000	TH-1000	
21	2	GUIDE RODS ▲	GR-72-20	GR-72-25	GR-72-32	GR-72-40	GR-72-50	GR-72-60	GR-72-80	GR-72-100	GR-72-120	

▲ Serial number required to insure proper parts supplied.
* Order as piston & piston rod assembly - serial number required.
† Must supply serial number to insure proper tie rods are supplied.

SERIES 'TA' CYLINDER WITH 'NR' OPTION PARTS LIST: OVERSIZE ROD DIAMETER



NOTE:
When ordering any part,
please supply TRD Serial
Number to insure proper
parts are supplied.

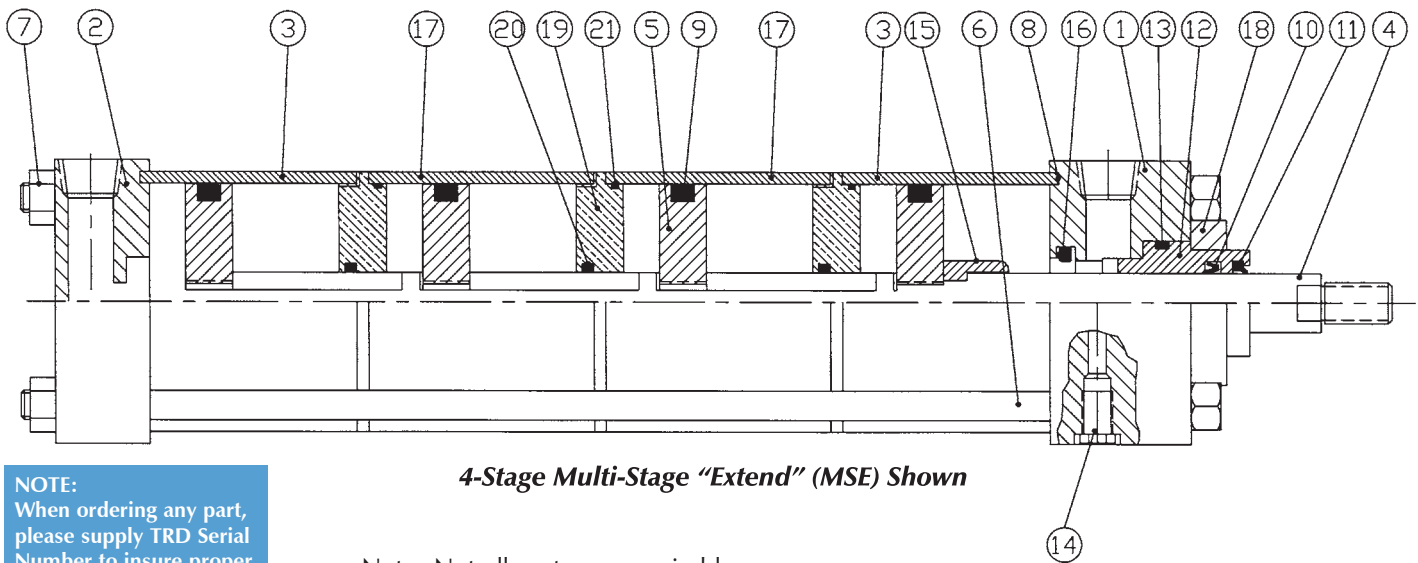
ITEM	QTY.	PART NAME	BORE SIZE							
			2.50	3.25	4	5	6	8	10	12
1	1	HEAD	NR-110-25	NR-110-32	NR-110-40	NR-110-50	NR-110-60	NR-110-80	NR-110-100	NR-110-120
2	1	CAP	NR-25-25	NR-25-32	NR-25-40	NR-25-50	NR-25-60	NR-25-80	NR-25-100	NR-25-120
3	1	TUBE	A-40-25 1.38 + STK	A-40-32 1.44 + STK	A-40-40 1.44 + STK	A-40-50 1.69 + STK	A-40-60 1.69 + STK	A-40-80 1.81 + STK	A-40-100 2.31 + STK	A-40-120 2.88 + STK
4	1	PISTON ROD ▲	Consult Factory with Serial Number							
5	1	*PISTON	NR-15-25-OS-1	NR-15-32-OS-1	NR-15-40-OS-1	NR-15-50-OS-1	NR-15-60-OS-1	NR-15-80-OS-1	NR-15-100-OS-1	NR-15-120-OS-1
6	4	†TIE ROD	A-50-25	A-50-32	A-50-32	A-50-50	A-50-60	A-50-80	A-50-100	A-50-120
7	8	TIE ROD NUTS	.31-24	.38-24	.38-24	.50-20	.50-20	.63-18	.75-16	.75-16
8	2	TUBE SEAL	TS-25	TS-32	TS-40	TS-50	TS-60	TS-80	TS-100	TS-120
9	2	PISTON SEAL	PS-25	PS-32	PS-40	PS-50	PS-60	PS-80	PS-100	PS-120
10	1	ROD SEAL	RS-1000	RS-1375	RS-1375	RS-1375	RS-1750	RS-1750	RS-2000	RS-2500
11	1	ROD WIPER	RW-1000	RW-1375	RW-1375	RW-1375	RW-1750	RW-1750	RW-2000	RW-2500
12	1	ROD BUSHING	A-30-2	A-30-3	A-30-3	A-30-3	A-30-4	A-30-4	A-30-5	A-30-6
13	1	BUSHING "O" RING	BO-2	BO-3	BO-3	BO-3	BO-4	BO-4	BO-5	BO-6
14	1 or 2	ADJ. NEEDLE (incl) SEAL	A-66-1	A-66-2	A-66-2	A-66-2	A-66-2	A-66-2	A-66-2	A-66-2
15	1	CUSHION SPUD	N/A	A-65-3	A-65-3	A-65-3	A-65-4	A-65-4	A-65-5	A-65-6
16	1	CUSHION SEAL-H	N/A	CS-5	CS-5	CS-5	CS-6	CS-6	CS-6	CS-10
17	1	CUSHION SEAL-C	CS-1	CS-2	CS-2	CS-2	CS-3	CS-3	CS-3	CS-3
18	1	RETAINER PLATE	A-36-25-OS	A-36-32-OS	A-36-40-OS	A-36-50-OS	A-36-60-OS	A-35-4	A-35-5	A-35-6
19	2	GUIDE ROD BEARING	GRB-2	GRB-3	GRB-4	GRB-4	GRB-4	GRB-5	GRB-5	GRB-5
20	2	GUIDE ROD SEAL	2-109	Q4012	Q4114	Q4114	Q4114	TH-1000	TH-1000	TH-1000
21	2	GUIDE RODS ▲	GR-72-25	GR-72-32	GR-72-40	GR-72-50	GR-72-60	GR-72-80	GR-72-100	GR-72-120

▲ Serial number required to insure proper parts supplied.

* Order as piston & piston rod assembly - serial number required.

† Must supply serial number to insure proper tie rods are supplied.

SERIES 'MSE' CYLINDER PARTS LIST: STANDARD ROD DIAMETER



NOTE:
When ordering any part, please supply TRD Serial Number to insure proper parts are supplied.

Note: Not all parts are repairable.
(MSR - consult factory)

ITEM	QTY.	PART NAME	BORE SIZE							
			1.50	2	2.50	3.25	4	5	6	8
1	1	HEAD	A-10-15	A-10-20	A-10-25	A-10-32	A-10-40	A-10-50	A-10-60	A-10-80
2	1	CAP	A-25-15	A-25-20	A-25-25	A-25-32	A-25-40	A-25-50	A-25-60	A-25-80
3	1	FRONT/REAR TUBE	A-40-15	A-40-20	A-40-25	A-40-32	A-40-40	A-40-50	A-40-60	A-40-80
4	1, 2 3 or 4	PISTON ROD ▲	Consult Factory with Serial Number							
5	1	*PISTON	MS-15-15	MS-15-20	MS-15-25	MS-15-32	MS-15-40	MS-15-50	MS-15-60	MS-15-80
6	4	†TIE ROD	A-50-15	A-50-20	A-50-25	A-50-32	A-50-32	A-50-50	A-50-60	A-50-80
7	4	TIE ROD NUTS	.25-28	.31-24	.31-24	.38-24	.38-24	.50-20	.50-20	.63-18
8	2	TUBE SEAL	TS-15	TS-20	TS-25	TS-32	TS-40	TS-50	TS-60	TS-80
9	2 3 or 4	PISTON SEAL	QPS-15	QPS-20	QPS-25	QPS-32	QPS-40	QPS-50	QPS-60	QPS-80
10	1	ROD SEAL	RS-625	RS-625	RS-625	RS-1000	RS-1000	RS-1000	RS-1375	RS-1375
11	1	ROD WIPER	RW-625	RW-625	RW-625	RW-1000	RW-1000	RW-1000	RW-1375	RW-1375
12	3	ROD BUSHING	A-30-1	A-30-1	A-30-1	A-30-2	A-30-2	A-30-2	A-30-3	A-30-3
13	3	BUSHING "O" RING	BO-1	BO-1	BO-1	BO-2	BO-2	BO-2	BO-3	BO-3
14	1	ADJ. NEEDLE OPTIONAL	A-66-1	A-66-1	A-66-1	A-66-2	A-66-2	A-66-2	A-66-2	A-66-2
15	1	CUSHION SPUD	A-65-1	A-65-1	A-65-2	A-65-2	A-65-2	A-65-3	A-65-3	A-65-3
16	1	CUSHION SEAL-H	CS-3	CS-3	CS-3	CS-4	CS-4	CS-4	CS-5	CS-5
17	1 or 2	CENTER TUBE ▲	A-40-15	A-40-20	A-40-25	A-40-32	A-40-40	A-40-50	A-40-60	A-40-80
18	1	RETAINER PLATE	A-36-15	A-35-1	A-35-1	A-35-2	A-35-2	A-35-2	A-35-3	A-35-3
19	1, 2 or 3	INTENSIFIER HEAD	MS-10-15	MS-10-20	MS-10-25	MS-10-32	MS-10-40	MS-10-50	MS-10-60	MS-10-80
20	1, 2 or 3	INTENSIFIER ROD SEAL	TH-625	TH-625	TH-625	TH-1000	TH-1000	TH-1000	TH-1375	TH-1375
21	1, 2 or 3	INTENSIFIER TUBE SEAL	MS-15	MS-20	MS-25	MS-32	MS-40	MS-50	MS-60	MS-80

▲ Serial number required to insure proper parts supplied.
* Order as piston & piston rod assembly - serial number required.
† Must supply serial number to insure proper tie rods are supplied.

Worldwide Distribution means there is a Professional Distributor Representative nearby – wherever you are – ready to service your needs.

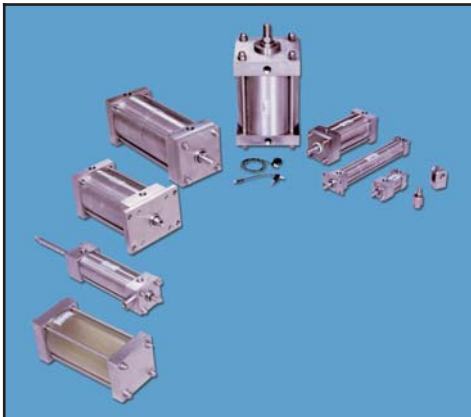
Ask Your Local Distributor About These Other Products:



NFPA cylinders with continuous piston rod position sensing.
Can be used for measuring and gauging applications.
Available from 1.50" to 8" Bore

NFPA cylinders with Pneumatic Position Control System.
For applications requiring accurate control of piston rod positioning in bore sizes from 1.50" to 4".

Request Catalog TRD #PFLF-1005



NFPA Stainless Steel cylinders
Available from 1.50" to 8" Bore

NFPA Stainless Steel Non-Rotating cylinders
Available from 2" to 8" Bore

NFPA Stainless Steel Multi-Stage force multiplying cylinders
Available from 1.50" to 8" Bore

NFPA Stainless Steel Air/Oil Tanks
Available from 2.50" to 8" Bore

Complete Line of Stainless Steel Accessories

Request Catalog TRD #CAT-TRDSS-704

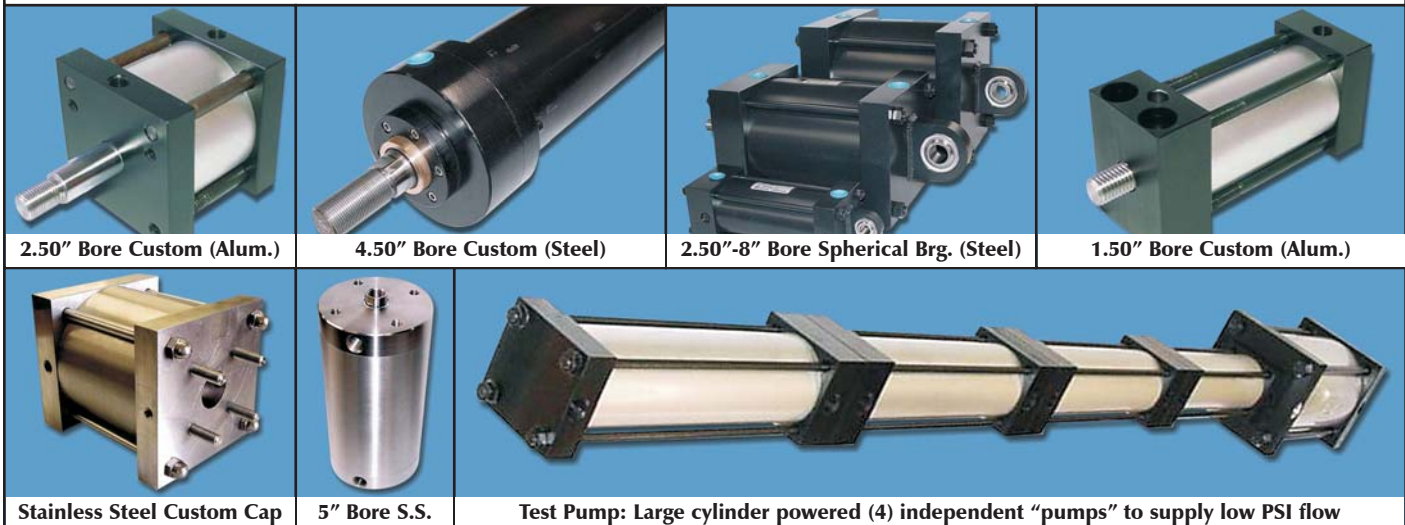


Bench Top Press Frame
Heavy duty STEEL keyed & bolted construction.
Adjustable work heights – Choose from three different built-in height settings.
Press designed to accept 5" Bore NFPA standard cylinders, Multi-Stage cylinders, or optional Triple Rod Cylinders.
Strokes from 1" to 6"

Request Catalog TRD #TRD-BTP-0905

TRD offers a complete range of custom solutions for your actuator needs.

Here are a few examples of actuators developed for OEM applications:



TRD DELIVERIES (F.O.B. Factory)

SERIES

DELIVERY SCHEDULE

TA (ALUMINUM - 250 PSI AIR)	2-3 DAYS
TD (ALUMINUM - 250 PSI AIR)	2-3 DAYS
TRA (ALUMINUM - TRIPLE ROD)	2-3 DAYS
FM (ALUMINUM - FLUSH MOUNT)	2-3 DAYS
BACK-TO-BACK (ALUMINUM - 250 PSI AIR)	2-3 DAYS
3-POSITION (ALUMINUM - 250 PSI AIR)	2-3 DAYS
TANDEM (ALUMINUM - 250 PSI AIR OR 400 PSI HYD.)	2-3 DAYS
MSE/MSR (ALUMINUM - MULTI-STAGE)	2-3 DAYS
AIR BOOSTERS	2-3 DAYS
AIR/OIL TANKS	2-3 DAYS
TRD SWITCHES (R10, R10P, RAC, RHT, MSS)	1 DAY
BALLUFF STROKEMASTER / MICROPULSE	5-7 DAYS
ROD CLEVIS, PINS & MOUNTS	1 DAY
ALIGNMENT COUPLERS	1 DAY
SS (STAINLESS STEEL - ALL STANDARD MODELS)	5-7 DAYS
SS-MS (STAINLESS STEEL - MULTI-STAGE)	7-10 DAYS

STANDARD OPTIONS INCLUDED IN ABOVE DELIVERIES

OPTIONS WITH EXTENDED DELIVERY

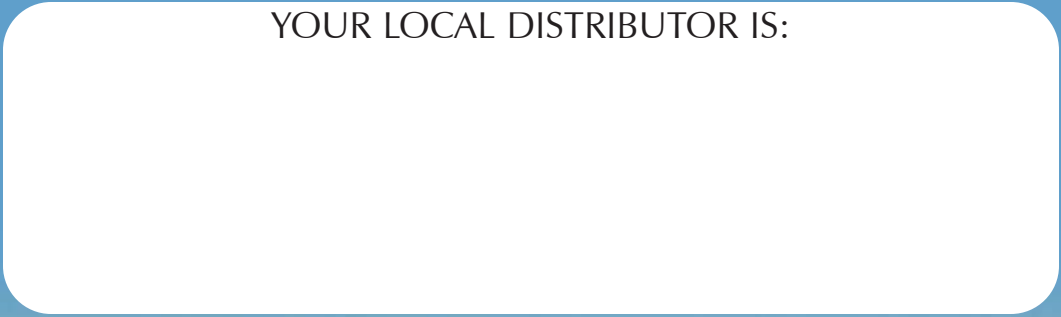
EN (ELECTROLESS NICKEL)	7-10 DAYS
STEEL TUBE (OPTION)	5-7 DAYS

RUSH SERVICE

RUSH SERVICES ARE AVAILABLE FOR ALL TRD PRODUCTS.
CONTACT YOUR LOCAL TRD DISTRIBUTOR FOR DETAILS.

TRD STAINLESS STEEL PRODUCTS - REFER TO TRD CATALOG # CAT-TRDSS-704
FOR ALL TRD STAINLESS STEEL PRODUCTS.

YOUR LOCAL DISTRIBUTOR IS:



TRD Manufacturing, Inc.

A **BIMBA** Company

10914 N. 2ND STREET • MACHESNEY PARK, ILLINOIS 61115-1400
PHONE: (815) 654-7775 • FAX: (815) 654-0690
WEBSITE: WWW.TRDMFG.COM • E-MAIL: SALES@TRDMFG.COM