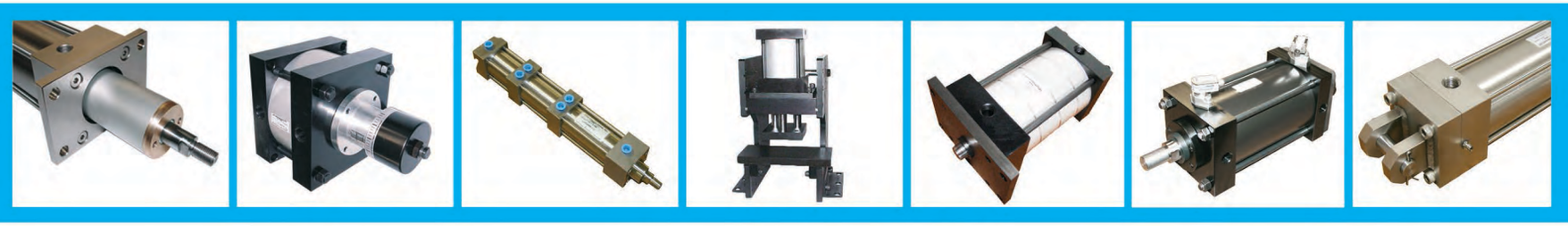
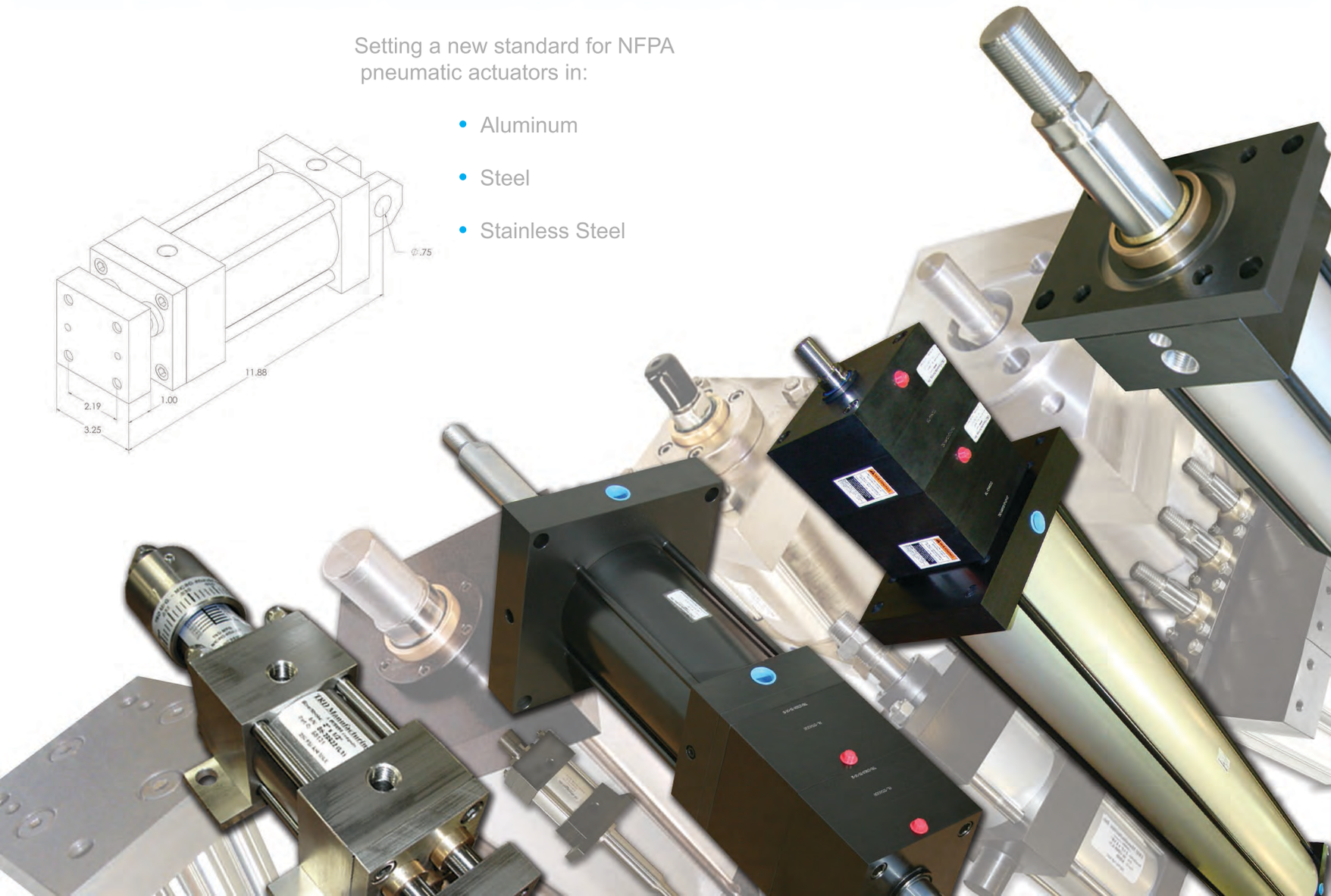
BIMBA | TRD

Full Line Catalog



Setting a new standard for NFPA pneumatic actuators in:

- Aluminum
- Steel
- Stainless Steel



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 that 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

THREE YEAR WARRANTY

TRD Manufacturing Incorporated, a Bimba Company, is an employee owned company. We take great pride in our products.
TRD Manufacturing, Inc. warranties its cylinders for a full three 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 a Returned Goods Authorization (RGA) 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 three 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

QUICK GUIDE – Design the Right Cylinder for Your Application

TRD offers a wide range of cylinder customizations and options to provide the best cylinders in the industry for any application. Here's a brief overview of common cylinder design and option considerations to assist in choosing the right cylinder for you. A cylinder that is tailored to a specific application will improve overall performance and lead to increased cylinder life. If you need help in sizing the cylinder bore or selecting a cylinder mount, refer to pages 260 and 261.

Cylinder Material – Which is best: Aluminum, Steel or Stainless Steel?

Aluminum – Used indoors and outdoors, aluminum is the go-to material since it provides the best overall value for the dollar. In moist or wet environments (and some food applications), the combination of aluminum heads/caps/tube with stainless steel hardware (tie rods, fasteners, piston rod, etc.) can provide excellent corrosion resistance and also meet some food processing safety concerns.

TRD uses 6061 T6 aluminum extrusions whenever possible for aluminum cylinder components, heads and caps. Our MP1 and MS2 extruded aluminum mounts are as strong as steel welded mounts without the added weight.

Steel – Typically, steel cylinders are used in the most heavy-duty, demanding applications due to stress levels within the mounts or the piston to tube surface. The steel tube also provides additional resistance to denting from flying debris. An aluminum cylinder with head and cap made from solid 6061 T6 aluminum tool plate will never fail due to load or abuse but the mount may be the weakest link. For example, MT1/MT2 trunnion mounts are a "bolt-on" design for aluminum cylinders and cannot take the same stress levels as 1-piece all steel trunnion mounts.

Steel cylinder tubes have hard chrome plated and honed I.D.s, which are also made to tighter diameter tolerances than aluminum tubes. In long stroke and unsupported piston rod applications, a steel tube will provide added protection from internal tube scoring due to the weight of the piston rod and light side loads. They can also outperform aluminum tubes in air/oil applications due to less piston seal bypass and smoother I.D. surface. This will provide the smoothest operation possible in ultra-low speed applications.

One drawback to steel tubes is that you cannot use low-cost, magnetic piston type position sensors since the steel tube itself is a magnetic material. A Balluff end of STROKEMASTER® type sensor or internal type transducers must be used for cylinder stroke position sensing.

Tip: You can use an aluminum series cylinder with the TMS (steel tube option) to reduce overall weight and cost to match an all-steel cylinder performance (as long as the cylinder mount isn't MT1 or MT2).

303/304 Stainless Steel – Is the preferred material for most food processing and corrosive applications due to its natural resistance to corrosion and sanitizing solutions. The more costly 316 SS is common in cheese processing, battery manufacturing, paper pulp processing and other very demanding/highly corrosive applications. Since stainless steel cylinder tubes do not have a hard chrome plated I.D., they do not have the same load carrying ability as a carbon steel tube cylinder.

SS cylinders are compatible with magnetic piston type sensors.

PISTON RODS: Rod Diameters, Rod Thread Size, Type of Thread, Rod Extensions and more...

Each piston rod is made-to-order and typically does not effect our two to three day delivery – so why not get exactly the rod thread, rod extension and rod end design that you NEED. In-stock rod diameters are listed in each cylinder model series. All rod diameters come in high alloy carbon steel and also 303/304 SS; with hard chrome plated O.D. Diameters are nominal with a tolerance of +.000" to –.001"

Piston Rod Diameter – Which is right for my application?

Standard Piston Rods – Used 90% of the time in low to medium stroke length applications with good results.

Oversized Piston Rods – These should always be considered on longer stroke, high load or side load applications. Each TRD series has a standard rod and OS (oversized) rod diameter listed and both ship within our published delivery schedule. Larger rod sizes are also available but will add additional cost and a few days to the delivery schedule.

Design Considerations – Keep in mind that the weight of the piston rod is a "mass" that is moved for each cylinder extend and retract stroke. Applications that require a "hammer" effect, such as driving fasteners into wood, benefit with the additional weight of an oversized rod. However, higher cylinder velocities may be more difficult to achieve due to the added weight of the rod and the reduced effective piston area on the rod side (retract stroke).

Undersized Piston Rods – Available but rarely used because of the added cost since all of the associated parts are non-standard. All undersized rod parts (rod bushings, pistons, etc.) are made-to-order, which require additional time for engineering and delivery.

QUICK GUIDE – Design the Right Cylinder for Your Application (Continued)

Piston Rod Thread – How to make the right selection.

All NFPA rod threads are UNF fine, class 2 threads (the catalog standard on all cylinders).
The default rod thread (if no other thread call-out is made) is the KK1, small male; to the catalog "A" dimension length. Typically, you do not want to use a smaller thread than the KK1 due to the tendency of threads breaking at the rod shoulder, but smaller threads are possible.

KK2 (Large Male Thread) - Used to match an existing mating size thread or if a side load is expected that may be too much load for the standard small male rod thread. This option should also be considered for higher speed applications and higher impact applications.

KK3 (Female Rod Thread) - Same size thread as a KK1, but a female thread. This thread diameter is the largest female thread that you can order for any given rod size.

KK3S (Female Rod Thread With Rod Stud Installed) - Same physical dimensions as a KK1 thread. But this is truly a go-to thread choice any time you are breaking rod threads. The hardened stud is permanently attached using anaerobic adhesives. This is one tough rod thread that rarely fails, even in the toughest applications.

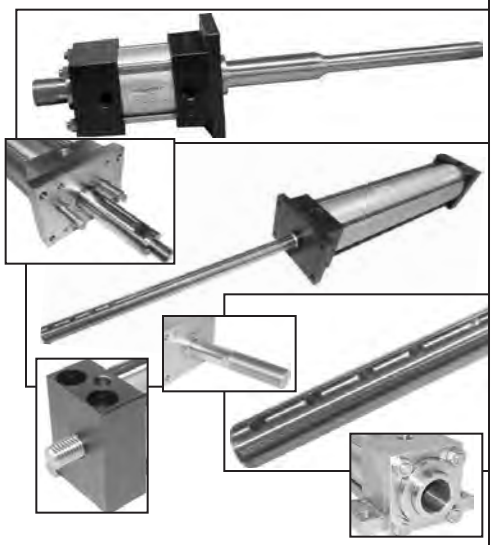
KK4 (Full Male Thread) - The strongest male rod thread possible since it's the same diameter as the rod. High Impact, high speed and higher suspected side load applications should use this option. The reason being it that there is no shoulder on the rod therefore no undercut area that would present itself as an area that could cause failure due to snapping off the rod threads.

Other Rod Ends - Course "UNC" threads, metric rod threads, plain rod ends (machined flat with no thread), cross drilled holes to attach tooling, custom rod ends used as shot pins, etc. can all be furnished.

Tip: It is good practice to bottom out the rod thread attachment to the rod shoulder, to minimize thread breakage. The use of jam nuts to position an attachment on the rod thread should be limited to low stress applications.

Rod "Extensions" also known as "C" Dimensions in the Catalog – What is possible?

Many times the "C=" dimension needs to be altered to provide a drop-in replacement to an existing cylinder model, or allow for additional cylinder clearance in an application. The cost adder is minimal because you are only paying for the additional rod material.



The design possibilities are unlimited. Many times a customer will add length to the rod to locate the cylinder away from a hostile environment or to provide easy access to the cylinder. One customer uses a 3.00" stroke cylinder with 36" of rod extension to make the cylinder easy to service and make adjustments.

In general, the basic "C" dimension also provides the room for the piston rod wrench flat, so accessories can be tightened to the rod.

Many features can be machined into the rod extension such as a turned down diameter, an additional shoulder or tapered surface. Sometimes a bullet nose is provided so the cylinder rod can act as a shot pin.

For close tolerance milled or drilled rod features, TRD has assembled the cylinders and milled/drilled the rods as a secondary operation.

Just send your local distributor a sketch!

Cylinder Strokes – The long and short on what is possible and what to expect…

Cylinder stroke components are also made to order, so you are not limited to specifying a stroke in full inch increments. It is also easy to make a cylinder in a metric equivalent stroke length; just specify the required stroke length in inches (Example: 80mm stroke = 3.15"). Strokes up to 120 inches will ship per our delivery schedule (usually in two to three days). Longer strokes are available but usually require engineering assistance and time to order the special length materials.

In general, NFPA cylinders on the market today are not considered to have close tolerance strokes. Due to the stack-up of cylinder parts and tolerances, it is common to see stroke lengths vary from –.000" to + .060." TRD typically holds each cylinder component to a close tolerance, minimizing the stack-up of tolerance that affect the cylinder stroke.

Many customers will rely on external stroke adjustments or options such as "MA" micro-adjust to provide a precise, adjustable stroke output. Cylinder strokes can be made to close tolerances down to +/- .005" for an additional charge.

For the above mentioned reasons, the shortest practical cylinder stroke length is about .125" (3 mm).

QUICK GUIDE – Design the Right Cylinder for Your Application (Continued)

Port size, Thread Type and Port Locations…

Any port size that can fit in a cylinder and any thread type can be provided. The most common are NPTF but BSPP, BSPT and SAE are also available (for additional cost). Delivery: two to three days standard!
Many times a smaller port size will be used to limit the air flow and cylinder speed. At the other end of the spectrum, customers may want the largest possible port size that can be machined into a head and cap for maximum cylinder speed.

Ports can be located on any cylinder side; cap ports can even be located in the end (at position nine). If a cushion is specified, the port and cushion adjustment can also be provided on the same side (for additional cost).

Cylinder Velocities – Cushions and other available options…

Cushions are the most common option to improve cylinder performance and minimize cylinder end of stroke noise. They work by trapping the last 1/2" (or so) of exhaust air in the cylinder and the air is then metered out over an adjustable cushion needle. For a cushion to perform properly, they do typically increase the stroke cycle time. When cycle rates permit, longer cushions can be used to trap and meter even higher amounts of air, increasing the overall effectiveness of an air cushion.

For rapid cycle rates, cushions are not always an option. Bumpers or BP bumper piston seals can be used to minimize cylinder noise and also provide some load deceleration, increasing a cylinder's life and performance.

For even higher impacts and loads, there are only a few internal cylinder solutions available to consider.
The DC dampening cushion option is very effective but available in only the 2.50, 3.25 and 4.00 bore sizes.

Refer to pages 171-190 for a listing of the most common cylinder performance options.

Temperatures – HIGH, LOW and everything in between…

Standard operating temperature range of products: -20°F to +200°F (-25°C to +90°C)

All cylinder components, seals and lubrication are designed to perform very well within the standard temperature range.

When the application is at either end of the temperature range for extended periods of time, performance seals and lubrication should be considered for maximum performance.

Low temperature range: -65°F (-65°C) rated seals and lubricant are available. Ideal for freezer applications.

High temperature range: +400°F (+200°C) rated seals and lubricant are available. Ideal for furnace applications.

Refer to page 178 for special temperature lubes and page 183 for special temperature seals.

Dust, dirt and other unfriendly environments…

Standard Rod Wiper: Urethane – Aggressive; heavy-duty; high abrasion resistance; ideal for 95% of all applications.

Since the standard rod wiper is separate from the rod seal, we can use a high performance material such as urethane.
For extreme environments, such as mud, weld splatter, paint, cement dust, concentrated fruit juice syrups, etc., the standard rod wiper may not provide optimum service. There isn't enough room to cover all the application possibilities and solutions; contact your local distributor for more information and for application assistance.

Side load – "The Good, The Bad and the Ugly"…

Everyone knows that an NFPA cylinder can take a certain amount of side load, even though the industry clearly states that "cylinders are not designed for side load applications." When you know you have a fair amount of side load, a better actuator solution in the long run might be a thruster or a slide type actuator.

In general, a long stroke cylinder with an unsupported rod may cause a high enough stress between the piston and tube to cause tube scoring, even with a piston wear band. There is no published data that can outline all of the safe operating ranges, side load capabilities of cylinders, etc. to eliminate tube scoring and catastrophic cylinder failure.

If you are experiencing tube scoring, there are some solutions available. Special length pistons can be provided to handle multiple wear bands or extra-long wear bands. We have also used solid Delrin® pistons to increase the contact surface between the piston and tube, with excellent results. Special length rod bushings may also be used to increase the bearing surface and reduce piston rod to bearing stresses to eliminate rod bearing or piston rod scoring.

Contact your local distributor for more details.

There are many more cylinder topics than can be covered in a brief cylinder design overview. If you want to improve the life of any cylinder in an application, contact your local distributor with the details. Let us show you how to maximize cylinder life and improve performance!

TA Series NFPA Aluminum Cylinders

1.50″ to 12.00″ Bore

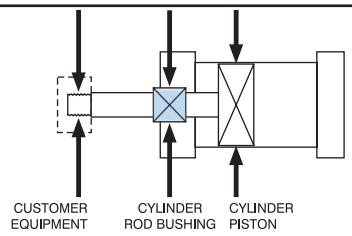
95% OF OUR CYLINDERS SHIP IN 2-3 DAYS!
ONE DAY RUSH SERVICE AVAILABLE ON ALL CATALOGED CYLINDER MODELS!

SERIES 'TA' (NFPA) CYLINDER

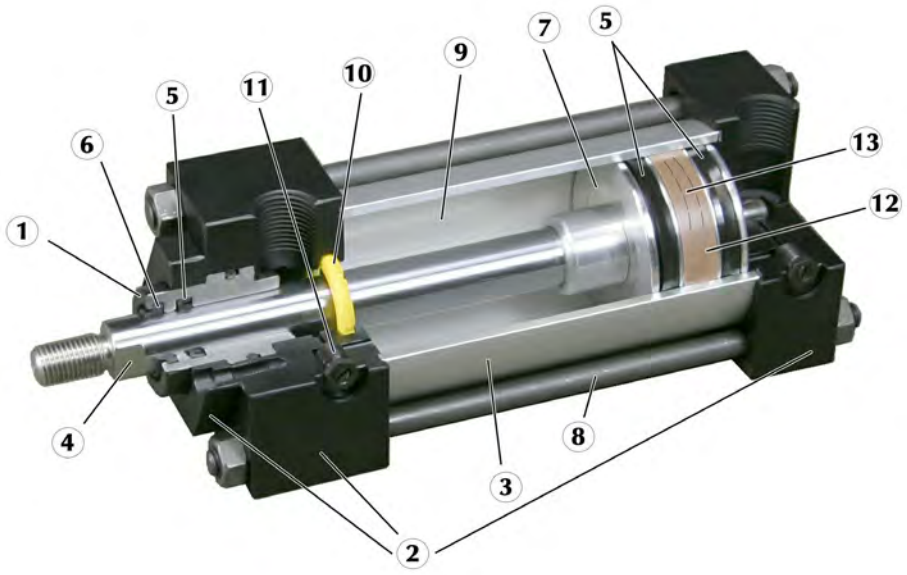
Floating Rod Bushing

SELF ALIGNMENT FEATURE

Rod Bushing is designed to float .002" to improve 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 Carboxilated 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*** – Pre-stressed 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 Magnalube-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*** – Floating cushion seal designed for maximum cushion performance, quick return stroke break-away and extended life (Options H & C).

⑪ ***CUSHION ADJUSTMENT NEEDLE*** – Adjustable steel needle design has fine thread metering and is positively captured to prevent needle ejection during adjustment.

⑫ ***PISTON WEAR BAND*** - 90% Virgin PTFE and 10% Polyphenylene Sulfide-filled wear band; extremely low wear rate.

⑬ ***PISTON MAGNET*** – For TRD magnetically operated reed and solid state switches (Option MPR; refer to page 178).

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)

Performance Options:

- ***ST*** – Stop tubes are used to reduce rod bearing and piston stress (refer to page 94 for cylinder design guidance).
- ***MA*** – Micro-Adjust provides a precision adjustment on the cylinder extend stroke, providing quick and accurate cylinder positioning to reduce 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.

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

TA - MF1 ___ - 2.50 x 10 - HC - MPR

SERIES	
TA	250 PSI AIR

NFPA MOUNTS	
MF1	FRONT FLANGE (1.50"- 6.00" Bore)
MF2	REAR FLANGE (1.50"- 6.00" Bore)
ME3	FRONT MOUNTING HOLES (8.00"- 12.00" Bore)
ME4	REAR MOUNTING HOLES (8.00"- 12.00" Bore)
MP1	REAR PIVOT CLEVIS (1.50"- 12.00" Bore)
MP2	REAR PIVOT CLEVIS (1.50"- 6.00" Bore)
MP4	REAR PIVOT EYE (1.50"- 6.00" Bore)
MS1	FRONT & REAR END ANGLE (1.50"- 8.00" Bore)
MS2	SIDE LUG (1.50"- 8.00" Bore)
MS4	BOTTOM TAPPED HOLES (1.50"- 12.00" Bore)
MT1	FRONT TRUNNION (1.50"- 8.00" Bore)
MT2	REAR TRUNNION (1.50"- 8.00" Bore)
MT4	INTERMEDIATE TRUNNION (1.50"- 8.00" Bore)
MXO	NO MOUNT (1.50"- 12.00" Bore)
MX1	EXTENDED TIE RODS - HEAD & CAP (1.50"-12.00" Bore)
MX2	EXTENDED TIE RODS (CAP) (1.50"- 12.00" Bore)
MX3	EXTENDED TIE RODS (HEAD) (1.50"- 12.00" Bore)

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

BORE	
1.50	2.00
2.50	3.25
4.00	5.00
6.00	8.00
10.00	12.00

STROKE
0" to 120" 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	X
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	X
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 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	.250" URETHANE BUMPER BOTH ENDS
X	BC	.250" URETHANE BUMPER CAP ONLY
X	BH	.250" URETHANE BUMPER HEAD ONLY
	BP	BUMPER PISTON SEALS (1.50" - 8" Bore)
	BSP	BSP PORTS (SPECIFY SIZE, Example: BSP = .250")
	C =	EXTENDED PISTON ROD (Example: IF C = 0.50", THEN 1" ROD EXTENSION IS C = 1.50")
	EN	**ELECTROLESS NICKEL PLATED** *(Refer to page 176 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 183 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 223-230 for selection)*
	MS	METALLIC ROD SCRAPER (BRASS CONSTRUCTION)
	NR	**NON-ROTATING** *(Refer to page 180 for specifications)*
	OP	OPTIONAL PORT LOCATION (Example: Ports @ 3 & 7)
	OS	OVERSIZE ROD DIAMETER (SPECIFY SIZE, Example: OS = 1.375")
	SAE	SAE PORTS (SPECIFY SIZE, Example: SAE #10)
X	SE	SPRING EXTEND (1.50, 2.00, 2.50 bore)
X	SR	SPRING RETURN (1.50, 2.00, 2.50 bore)
	SSA	STAINLESS STEEL PISTON ROD, TIE RODS & NUTS, AND FASTENERS
	SSF	STAINLESS STEEL FASTENERS
	SSN	STAINLESS STEEL TIE ROD NUTS
	SSR	STAINLESS STEEL PISTON ROD
	SST	STAINLESS STEEL TIE RODS
X	ST	**STOP TUBE** - SPECIFY STOP TUBE LENGTH (in inches) SPECIFY STROKE AS ES (effective stroke) (Example: TA MS4 2 X 24ES-ST=3)
	TMS	STEEL CYLINDER TUBE, BLACK EPOXY PAINT FINISH
	TH	**400 PSI HYDRAULIC NON-SHOCK** *(Refer to page 183 for specifications)*
	VS	FLUOROCARBON SEALS
	XX	SPECIAL VARIATION (SPECIFY)

About our Part Number System

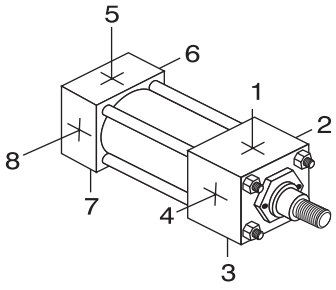
- Simple, easy to understand
- No excessive codes!
- Eliminates mistakes when ordering

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

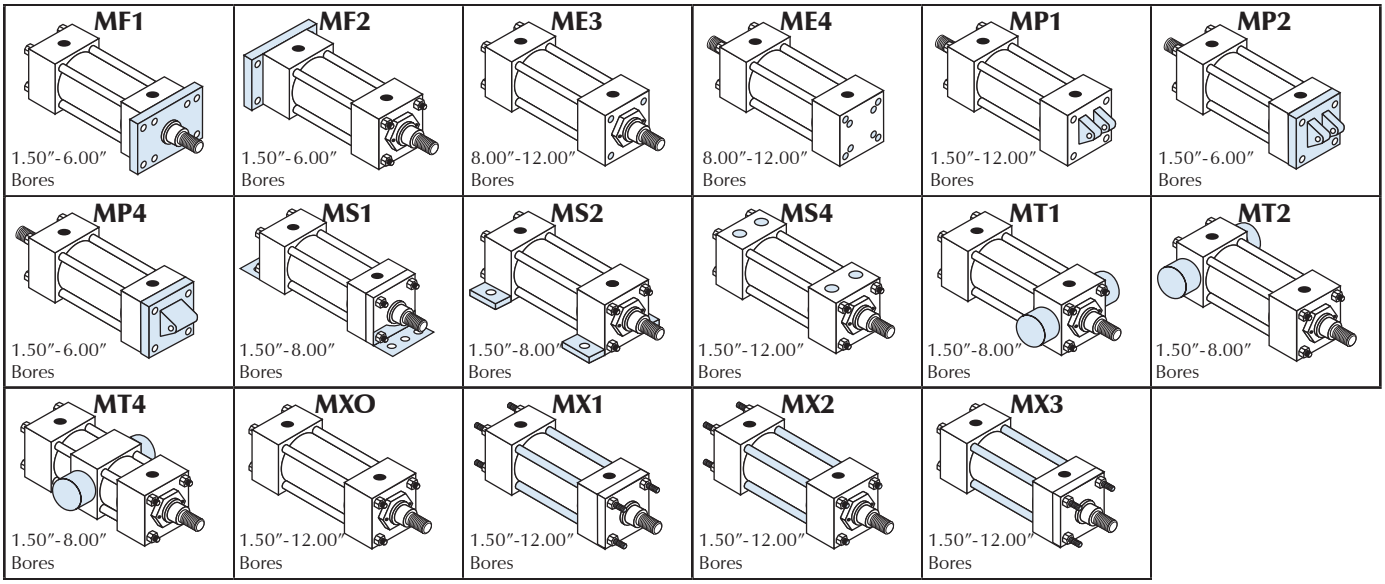


OPTION LENGTH ADDER
(ADD TO CATALOG BASIC OVERALL LENGTH DIMENSIONS)

BORE	OPTION							
	B	BC	BH	ELC	ELH	SE	SR	ST* (STOP TUBE) Example: ST=2
1.50	0.500	0.250	0.250	1.000	1.000	Refer to page 184 for length adders and available bore sizes and strokes		2
2.00	0.500	0.250	0.250	1.000	1.000			2
2.50	0.500	0.250	0.250	1.000	1.000			2
3.25	0.500	0.250	0.250	1.250	1.250			2
4.00	0.500	0.250	0.250	1.250	1.250			2
5.00	0.500	0.250	0.250	1.250	1.250			2
6.00	0.500	0.250	0.250	1.500	1.500			2
8.00	0.500	0.250	0.250	1.500	1.500			2
10.00	0.500	0.250	0.250	2.000	2.000			2
12.00	0.500	0.250	0.250	2.000	2.000			2

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

NFPA MOUNTS



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

EASY FLIP OUT PAGE FOR REFERENCE

About Rod End Styles

Style 1 Male Rod End is STANDARD

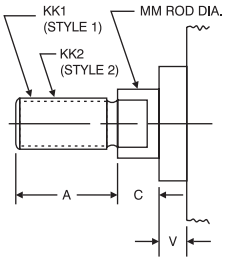
Other NFPA Styles can be specified (see chart).

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

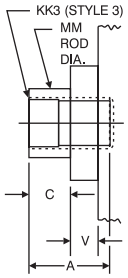
NEED SOMETHING NOT LISTED?
Just send us a sketch.
In most cases, quotes are turned around in one day!

PISTON ROD END STYLES

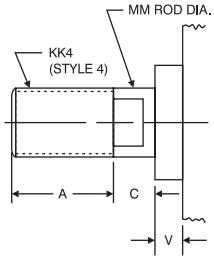
STYLE 1 & 2 — KK1 & KK2



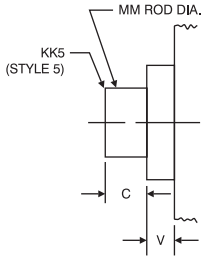
STYLE 3 — KK3



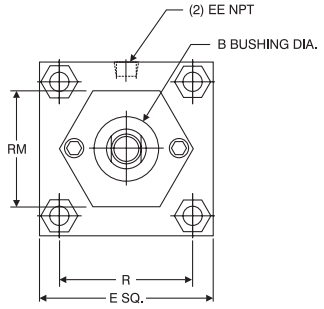
STYLE 4 — KK4

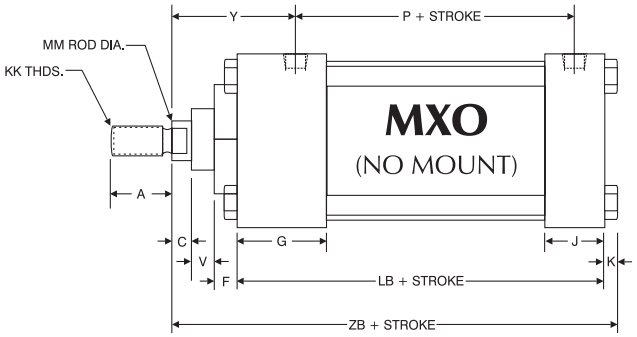


STYLE 5 — KK5



BORE	MM ROD DIAMETER	STANDARD Style 1 - Male KK1	A	OPTIONAL Style 2 - Male KK2	A	Style 3 - Female KK3	A	Style 4 - Male KK4	A	Style 5 - Blank KK5	C	V
1.50, 2.00, 2.50	0.625 Standard	7/16 -20	0.750	1/2 -20	0.750	7/16 -20	0.750	5/8 -18	0.750	No Threads	0.375	0.250
	1.000 Oversize	3/4 -16	1.125	7/8 -14	1.125	3/4 -16	1.125	1-14	1.125	No Threads	0.500	0.500
3.25, 4.00, 5.00	1.000 Standard	3/4 -16	1.125	7/8 -14	1.125	3/4 -16	1.125	1-14	1.125	No Threads	0.500	0.250
	1.375 Oversize	1-14	1.625	1 1/4 -12	1.625	1-14	1.625	1 3/8 -12	1.625	No Threads	0.625	0.375
6.00 & 8.00	1.375 Standard	1-14	1.625	1 1/4 -12	1.625	1-14	1.625	1 3/8 -12	1.625	No Threads	0.625	0.375
	1.750 Oversize	1 1/4 -12	2.000	1 1/2 -12	2.000	1 1/4 -12	2.000	1 3/4 -12	2.000	No Threads	0.750	0.500
10.00	1.750 Standard	1 1/4 -12	2.000	1 1/2 -12	2.000	1 1/4 -12	2.000	1 3/4 -12	2.000	No Threads	0.750	0.500
	2.000 Oversize	1 1/2 -12	2.250	1 3/4 -12	2.250	1 1/2 -12	2.250	2-12	2.250	No Threads	0.875	0.375
12.00	2.000 Standard	1 1/2 -12	2.250	1 3/4 -12	2.250	1 1/2 -12	2.250	2-12	2.250	No Threads	0.875	0.375
	2.500 Oversize	1 7/8 -12	3.000	2 1/4 -12	3.000	1 7/8 -12	3.000	2 1/2 -12	3.000	No Threads	1.000	0.500





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	0.625 Standard	0.750	1.125	0.375	2.000	0.375	0.375	1.500	1.000	0.250	7/16 -20	3.625	0.625	2.375	1.438	2.00 SQ.	0.250	1.875	4.875
	1.000 Oversize	1.125	1.500	0.500							3/4 -16		1.000				0.500	2.250	5.250
2.00	0.625 Standard	0.750	1.125	0.375	2.500	0.375	0.375	1.500	1.000	0.313	3/4 -20	3.625	0.625	2.375	1.844	1.75 HEX	0.250	1.875	4.938
	1.000 Oversize	1.125	1.500	0.500							3/4 -16		1.000			2.50 SQ.	0.500	2.250	5.313
2.50	0.625 Standard	0.750	1.125	0.375	3.000	0.375	0.375	1.500	1.000	0.313	7/16 -20	3.750	0.625	2.500	2.188	1.75 HEX	0.250	1.875	5.063
	1.000 Oversize	1.125	1.500	0.500							3/4 -16		1.000			3.00 SQ.	0.500	2.250	5.438
3.25	1.000 Standard	1.125	1.500	0.500	3.750	0.500	0.625	1.750	1.250	0.375	3/4 -16	4.250	1.000	2.750	2.766	2.75 DIA.	0.250	2.375	6.000
	1.375 Oversize	1.625	2.000	0.625							1-14		1.375			3.75 SQ.	0.375	2.625	6.250
4.00	1.000 Standard	1.125	1.500	0.500	4.500	0.500	0.625	1.750	1.250	0.375	3/4 -16	4.250	1.000	2.750	3.320	2.75 DIA.	0.250	2.375	6.000
	1.375 Oversize	1.625	2.000	0.625							1-14		1.375			3.50 DIA.	0.375	2.625	6.250
5.00	1.000 Standard	1.125	1.500	0.500	5.500	0.500	0.625	1.750	1.250	0.438	3/4 -16	4.500	1.000	3.000	4.100	2.75 DIA.	0.250	2.375	6.313
	1.375 Oversize	1.625	2.000	0.625							1-14		1.375			3.50 DIA.	0.375	2.625	6.563
6.00	1.375 Standard	1.625	2.000	0.625	6.500	0.750	0.625	2.000	1.500	0.438	1-14	5.000	1.375	3.250	4.875	3.50 DIA.	0.375	2.750	7.063
	1.750 Oversize	2.000	2.375	0.750							1 1/4 -12		1.750				0.500	3.000	7.313
8.00	1.375 Standard	1.625	2.000	0.625	8.500	0.750	0.625	2.000	1.500	0.563	1-14	5.125	1.375	3.375	6.438	3.50 DIA.	0.375	2.750	7.313
	1.750 Oversize	2.000	2.375	0.750							1 1/4 -12		1.750				0.500	3.000	7.563
10.00	1.750 Standard	2.000	2.375	0.750	10.625	1.000	0.625	2.250	2.000	0.688	1 1/4 -12	6.375	1.750	4.313	7.922	3.50 DIA.	0.500	3.063	8.938
	2.000 Oversize	2.250	2.625	0.875			0.750				1 1/2 -12		2.000			5.00 DIA.	0.375	3.188	9.063
12.00	2.000 Standard	2.250	2.625	0.875	12.750	1.000	0.750	2.250	2.000	0.688	1 1/2 -12	6.875	2.000	4.813	9.400	5.00 DIA.	0.375	3.188	9.563
	2.500 Oversize	3.000	3.125	1.000							1 7/8 -12		2.500				0.500	3.438	9.813

'TA' SERIES BASE DIMENSIONS FLIP-OUT (PAGE 10)

EASY FLIP OUT PAGE FOR REFERENCE

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

About Rod End Styles

Style 1 Male Rod End is STANDARD

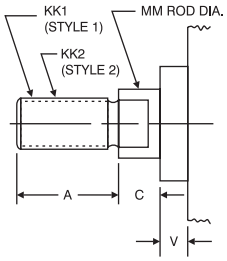
Other NFPA Styles can be specified (see chart).

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).

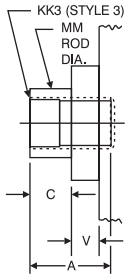
NEED SOMETHING NOT LISTED?
Just send us a sketch.
In most cases, quotes are turned around in one day!

PISTON ROD END STYLES

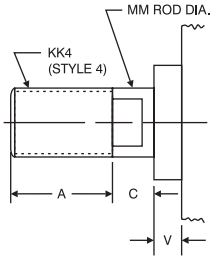
STYLE 1 & 2
KK1 & KK2



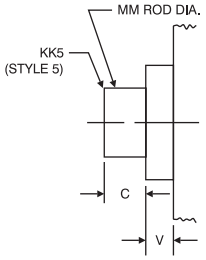
STYLE 3
KK3



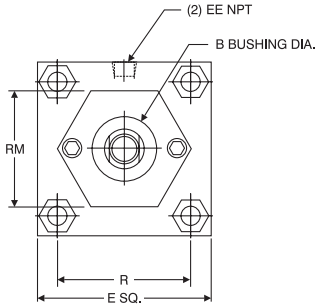
STYLE 4
KK4

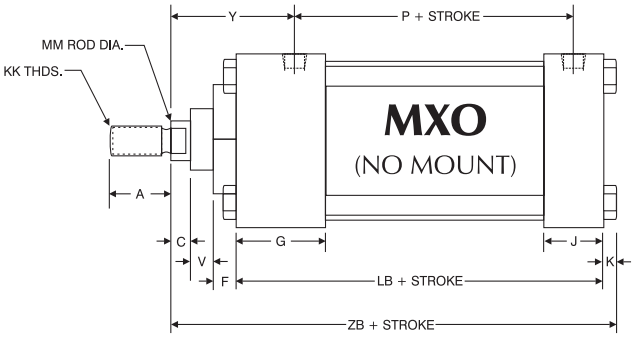


STYLE 5
KK5



BORE	MM ROD DIAMETER	STANDARD Style 1 - Male KK1	A	OPTIONAL Style 2 - Male KK2	A	Style 3 - Female KK3	A	Style 4 - Male KK4	A	Style 5 - Blank KK5	C	V
1.50, 2.00, 2.50	0.625 Standard	7/16 -20	0.750	1/2 -20	0.750	7/16 -20	0.750	5/8 -18	0.750	No Threads	0.375	0.250
	1.000 Oversize	3/4 -16	1.125	7/8 -14	1.125	3/4 -16	1.125	1-14	1.125	No Threads	0.500	0.500
3.25, 4.00, 5.00	1.000 Standard	3/4 -16	1.125	7/8 -14	1.125	3/4 -16	1.125	1-14	1.125	No Threads	0.500	0.250
	1.375 Oversize	1-14	1.625	1 1/4 -12	1.625	1-14	1.625	1 3/8 -12	1.625	No Threads	0.625	0.375
6.00 & 8.00	1.375 Standard	1-14	1.625	1 1/4 -12	1.625	1-14	1.625	1 3/8 -12	1.625	No Threads	0.625	0.375
	1.750 Oversize	1 1/4 -12	2.000	1 1/2 -12	2.000	1 1/4 -12	2.000	1 3/4 -12	2.000	No Threads	0.750	0.500
10.00	1.750 Standard	1 1/4 -12	2.000	1 1/2 -12	2.000	1 1/4 -12	2.000	1 3/4 -12	2.000	No Threads	0.750	0.500
	2.000 Oversize	1 1/2 -12	2.250	1 3/4 -12	2.250	1 1/2 -12	2.250	2-12	2.250	No Threads	0.875	0.375
12.00	2.000 Standard	1 1/2 -12	2.250	1 3/4 -12	2.250	1 1/2 -12	2.250	2-12	2.250	No Threads	0.875	0.375
	2.500 Oversize	1 7/8 -12	3.000	2 1/4 -12	3.000	1 7/8 -12	3.000	2 1/2 -12	3.000	No Threads	1.000	0.500

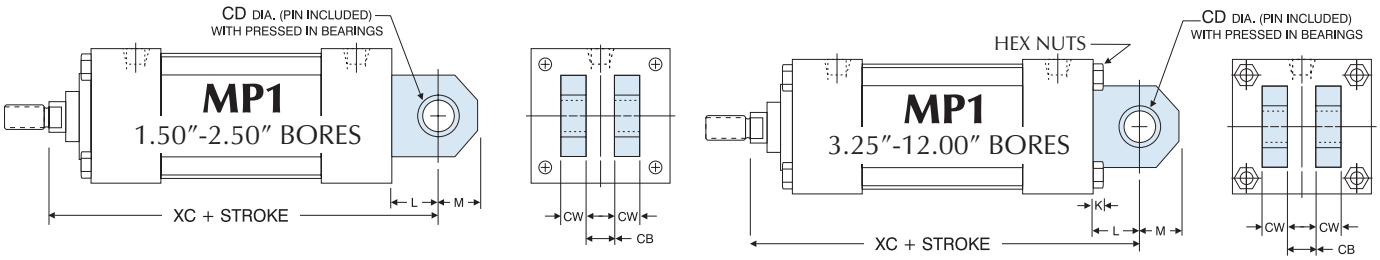




BASIC DIMENSIONS 'MXO' STANDARD & OVERSIZE RODS																			
BORE	ROD DIAMETER	A	B	C	E	EE	F	G	J	K	KK	LB	MM	P	R	RM	V	Y	ZB
1.50	0.625 Standard	0.750	1.125	0.375	2.000	0.375	0.375	1.500	1.000	0.250	7/16 -20	3.625	0.625	2.375	1.438	2.00 SQ.	0.250	1.875	4.875
	1.000 Oversize	1.125	1.500	0.500							3/4 -16		1.000				0.500	2.250	5.250
2.00	0.625 Standard	0.750	1.125	0.375	2.500	0.375	0.375	1.500	1.000	0.313	3/4 -20	3.625	0.625	2.375	1.844	1.75 HEX	0.250	1.875	4.938
	1.000 Oversize	1.125	1.500	0.500							3/4 -16		1.000			2.50 SQ.	0.500	2.250	5.313
2.50	0.625 Standard	0.750	1.125	0.375	3.000	0.375	0.375	1.500	1.000	0.313	7/16 -20	3.750	0.625	2.500	2.188	1.75 HEX	0.250	1.875	5.063
	1.000 Oversize	1.125	1.500	0.500							3/4 -16		1.000			3.00 SQ.	0.500	2.250	5.438
3.25	1.000 Standard	1.125	1.500	0.500	3.750	0.500	0.625	1.750	1.250	0.375	3/4 -16	4.250	1.000	2.750	2.766	2.75 DIA.	0.250	2.375	6.000
	1.375 Oversize	1.625	2.000	0.625							1-14		1.375			3.75 SQ.	0.375	2.625	6.250
4.00	1.000 Standard	1.125	1.500	0.500	4.500	0.500	0.625	1.750	1.250	0.375	3/4 -16	4.250	1.000	2.750	3.320	2.75 DIA.	0.250	2.375	6.000
	1.375 Oversize	1.625	2.000	0.625							1-14		1.375			3.50 DIA.	0.375	2.625	6.250
5.00	1.000 Standard	1.125	1.500	0.500	5.500	0.500	0.625	1.750	1.250	0.438	3/4 -16	4.500	1.000	3.000	4.100	2.75 DIA.	0.250	2.375	6.313
	1.375 Oversize	1.625	2.000	0.625							1-14		1.375			3.50 DIA.	0.375	2.625	6.563
6.00	1.375 Standard	1.625	2.000	0.625	6.500	0.750	0.625	2.000	1.500	0.438	1-14	5.000	1.375	3.250	4.875	3.50 DIA.	0.375	2.750	7.063
	1.750 Oversize	2.000	2.375	0.750							1 1/4 -12		1.750				0.500	3.000	7.313
8.00	1.375 Standard	1.625	2.000	0.625	8.500	0.750	0.625	2.000	1.500	0.563	1-14	5.125	1.375	3.375	6.438	3.50 DIA.	0.375	2.750	7.313
	1.750 Oversize	2.000	2.375	0.750							1 1/4 -12		1.750				0.500	3.000	7.563
10.00	1.750 Standard	2.000	2.375	0.750	10.625	1.000	0.625	2.250	2.000	0.688	1 1/4 -12	6.375	1.750	4.313	7.922	3.50 DIA.	0.500	3.063	8.938
	2.000 Oversize	2.250	2.625	0.875			0.750				1 1/2 -12		2.000			5.00 DIA.	0.375	3.188	9.063
12.00	2.000 Standard	2.250	2.625	0.875	12.750	1.000	0.750	2.250	2.000	0.688	1 1/2 -12	6.875	2.000	4.813	9.400	5.00 DIA.	0.375	3.188	9.563
	2.500 Oversize	3.000	3.125	1.000							1 7/8 -12		2.500				0.500	3.438	9.813

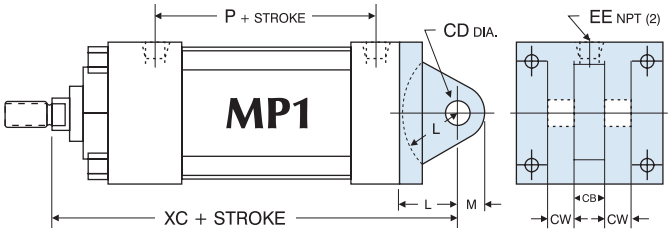
'TA' SERIES BASE DIMENSIONS FLIP-OUT (PAGE 10)

SERIES 'TA' DIMENSIONS: PIVOT MOUNTS



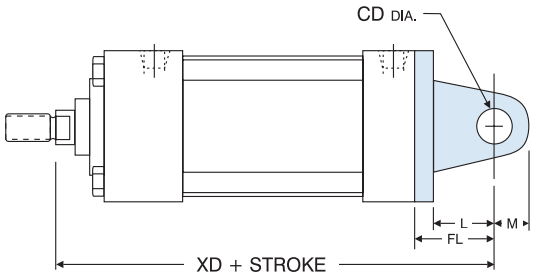
EXTRUDED MP1 MOUNT

(EXTRUDED: 1.50" - 8.00" BORES, WELDMENT: 10.00" & 12.00" BORES)

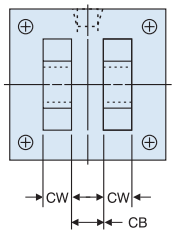


IRON CASTING MP1 MOUNT

*(OPTIONAL)***

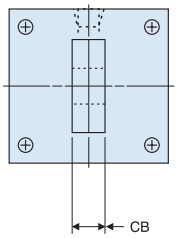


MP2/MP4



MP2 MOUNT

(IRON CASTING)



MP4 MOUNT

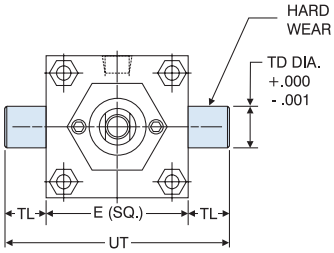
(IRON CASTING: 1.50" - 4.00" BORES, WELDMENT: 5.00" - 6.00" BORES)*

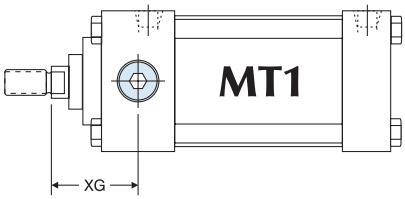
'MP1', 'MP2' CLEVIS AND 'MP4' EYE MOUNT DIMENSIONS											ACCESSORIES *(SEE PAGES 210-211 FOR DIMENSIONS)*				
BORE	ROD DIAMETER	CB	CD	CW	FL	K	L	M	XC	XD	ROD CLEVIS	ROD EYE	CLEVIS PIN	EYE BRACKET *(FOR MP1)*	CLEVIS BRKT *(FOR MP4)*
1.50	0.625 Standard	0.750	0.500	0.500	1.125	N/A	0.750	0.625	5.375	5.750	RC437	RE437	CP500	EB500	CB500
	1.000 Oversize								5.750	6.125	RC750	RE750	CP750		
2.00	0.625 Standard	0.750	0.500	0.500	1.125	N/A	0.750	0.625	5.375	5.750	RC437	RE437	CP500		
	1.000 Oversize								5.750	6.125	RC750	RE750	CP750		
2.50	0.625 Standard	0.750	0.500	0.500	1.125	N/A	0.750	0.625	5.500	5.875	RC437	RE437	CP500		
	1.000 Oversize								5.875	6.250	RC750	RE750	CP750		
3.25	1.000 Standard	1.250	0.750	0.625	1.875	0.375	1.250	0.875	6.875	7.500	RC750	RE750	CP750	EB750	CB750
	1.375 Oversize								7.125	7.750	RC1000	RE1000	CP1000		
4.00	1.000 Standard	1.250	0.750	0.625	1.875	0.375	1.250	0.875	6.875	7.500	RC750	RE750	CP750		
	1.375 Oversize								7.125	7.750	RC1000	RE1000	CP1000		
5.00*	1.000 Standard	1.250	0.750	0.625	1.875	0.438	1.250	0.875	7.125	7.750	RC750	RE750	CP750		
	1.375 Oversize								7.375	8.000	RC1000	RE1000	CP1000		
6.00*	1.375 Standard	1.500	1.000	0.750	2.250	0.438	1.500	1.000	8.125	8.875	RC1000	RE1000	CP1000	EB1000	CB1000
	1.750 Oversize								8.375	9.125	RC1250	RE1250	CP1375		
8.00	1.375 Standard	1.500	1.000	0.750	N/A	0.563	1.500	1.000	8.250	N/A	RC1000	RE1000	CP1000		
	1.750 Oversize								8.500		RC1250	RE1250	CP1375		
10.00	1.750 Standard	2.000	1.375	1.000	N/A	0.688	2.125	1.375	10.375	N/A	RC1250	RE1250	CP1375	EB1375	CB1375
	2.000 Oversize								10.500		RC1500	RE1500	CP1750	EB1750	CB1750
12.00	2.000 Standard	2.500	1.750	1.250	N/A	0.688	2.250	1.750	11.125	N/A	RC1500	RE1500	CP1750		
	2.500 Oversize								11.375		RC1875	N/A	CP2000		

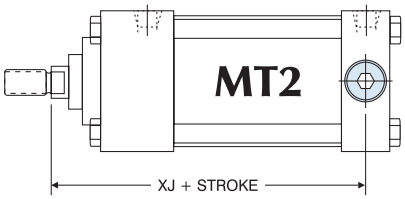
Clevis pins are provided with pivot mounts.
*MP4 5.00"-6.00" bores are 5-7 day delivery.
For dimensions not shown, see page 10.

**Extruded MP1 mounts are standard (1.50"-8.00" bores). Cast Iron removable mounts are optional, and must be requested when ordering (1.50"-6.00" bores). Specify "CAST MP1" when ordering.

SERIES 'TA' DIMENSIONS: PIVOT MOUNTS





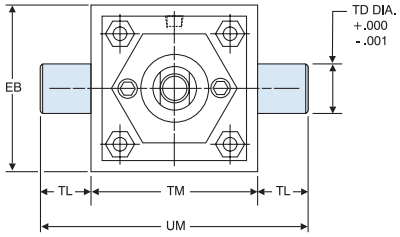


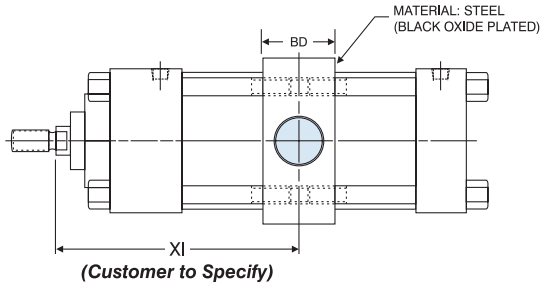
MT1 / MT2

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 210-211 FOR DIMENSIONS)*		
BORE	ROD DIAMETER	E	TD	TL	UT	XG	ADD STROKE XJ	ROD CLEVIS	ROD EYE	CLEVIS PIN
1.50	0.625 Standard	2.000	1.000	1.000	4.000	1.750	4.125	RC437	RE437	CP500
	1.000 Oversize					N/A*	4.500	RC750	RE750	CP750
2.00	0.625 Standard	2.500	1.000	1.000	4.500	1.750	4.125	RC437	RE437	CP500
	1.000 Oversize					2.125	4.500	RC750	RE750	CP750
2.50	0.625 Standard	3.000	1.000	1.000	5.000	1.750	4.250	RC437	RE437	CP500
	1.000 Oversize					2.125	4.625	RC750	RE750	CP750
3.25	1.000 Standard	3.750	1.000	1.000	5.750	2.250	5.000	RC750	RE750	CP750
	1.375 Oversize					2.500	5.250	RC1000	RE1000	CP1000
4.00	1.000 Standard	4.500	1.000	1.000	6.500	2.250	5.000	RC750	RE750	CP750
	1.375 Oversize					2.500	5.250	RC1000	RE1000	CP1000
5.00	1.000 Standard	5.500	1.000	1.000	7.500	2.250	5.250	RC750	RE750	CP750
	1.375 Oversize					2.500	5.500	RC1000	RE1000	CP1000
6.00	1.375 Standard	6.500	1.375	1.375	9.250	2.625	5.875	RC1000	RE1000	CP1000
	1.750 Oversize					2.875	6.125	RC1250	RE1250	CP1375
8.00	1.375 Standard	8.500	1.375	1.375	11.250	2.625	6.000	RC1000	RE1000	CP1000
	1.750 Oversize					2.875	6.250	RC1250	RE1250	CP1375

*No oversize rod available on 1.50" bore MT1.
For dimensions not shown, see page 10.





(Customer to Specify)

MT4

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

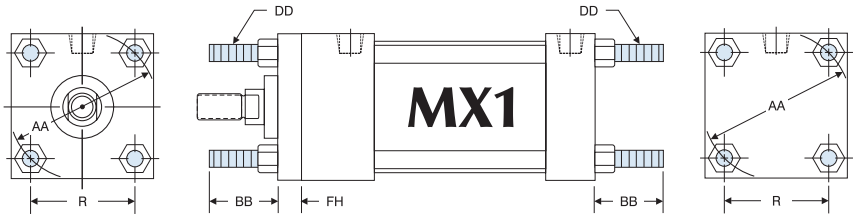
Note: MT4 Trunnions and Intermediate Section are one-piece steel construction.

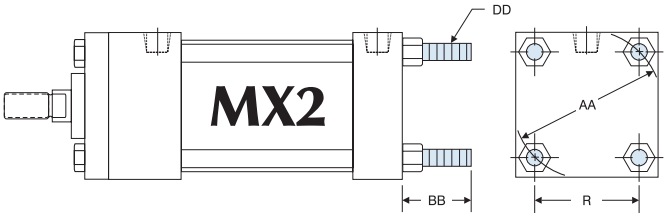
'MT4' INTERMEDIATE TRUNNION MOUNT DIMENSIONS							
BORE	BD	EB	TD	TL	TM	UM	XI
1.50	1.250	2.500	1.000	1.000	2.500	4.500	CUSTOMER TO SPECIFY
2.00	1.500	3.000	1.000	1.000	3.000	5.000	
2.50	1.500	3.500	1.000	1.000	3.500	5.500	
3.25	2.000	4.250	1.000	1.000	4.500	6.500	
4.00	2.000	5.000	1.000	1.000	5.250	7.250	
5.00	2.000	6.000	1.000	1.000	6.250	8.250	
6.00	2.000	7.000	1.375	1.375	7.625	10.375	
8.00	2.500	9.500	1.375	1.375	9.750	12.500	

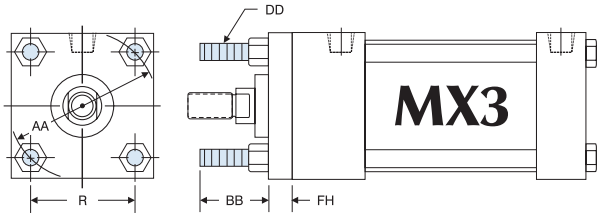
'MT1', 'MT2', 'MT4' STANDARD CUSHION LOCATIONS		
MOUNT	HEAD CUSHION	CAP CUSHION
MT1	3	6
MT2	2	7
MT4	2	6

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

SERIES 'TA' DIMENSIONS: TIE ROD & FLANGE MOUNTS



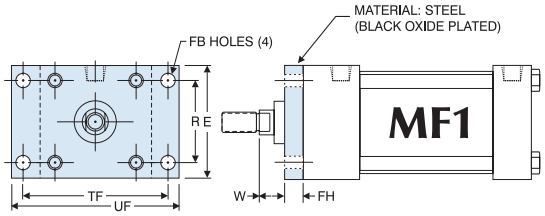




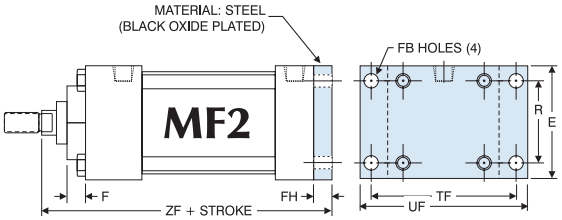
TIE ROD EXTENDED 'MX1', 'MX2' & 'MX3' MOUNT DIMENSIONS						
BORE	ROD DIAMETER	AA	BB	DD	FH	R
1.50	0.625 Standard 1.000 Oversize	2.020	1.000	1/4 -28	0.375	1.430
2.00	0.625 Standard 1.000 Oversize	2.600	1.125	5/16 -24	0.375	1.840
2.50	0.625 Standard 1.000 Oversize	3.100	1.125	5/16 -24	0.375	2.190
3.25	1.000 Standard 1.375 Oversize	3.900	1.375	3/8 -24	0.625	2.760
4.00	1.000 Standard 1.375 Oversize	4.700	1.375	3/8 -24	0.625	3.320

TIE ROD EXTENDED 'MX1', 'MX2' & 'MX3' MOUNT DIMENSIONS						
BORE	ROD DIAMETER	AA	BB	DD	FH	R
5.00	1.000 Standard 1.375 Oversize	5.800	1.813	1/2 -20	0.625	4.100
6.00	1.375 Standard 1.750 Oversize	6.900	1.813	1/2 -20	0.750	4.880
8.00	1.375 Standard 1.750 Oversize	9.100	**2.313	5/8 -18	*0.625	6.440
10.00	1.750 Oversize 2.000 Oversize	11.200	**2.688	3/4 -16	*0.625 *0.750	7.920
12.00	2.000 Standard 2.500 Oversize	13.300	**2.688	3/4 -16	*0.750	9.400

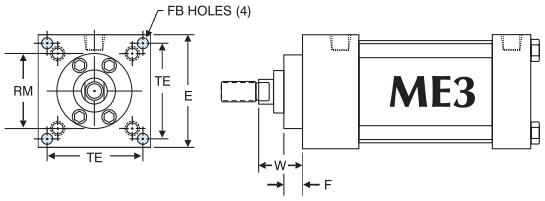
*MX1 & MX3 have full square bushing retainer on 1.50" - 6.00" bores, round retainers on 8.00" - 12.00" bores.
**BB dimension from face of head.
For dimensions not shown, see page 10.



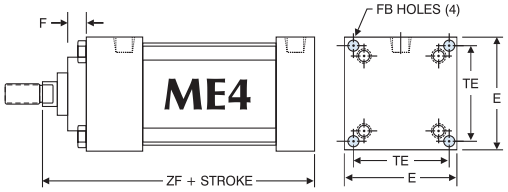
1.50" - 6.00" BORES



1.50" - 6.00" BORES



8.00" - 12.00" BORES



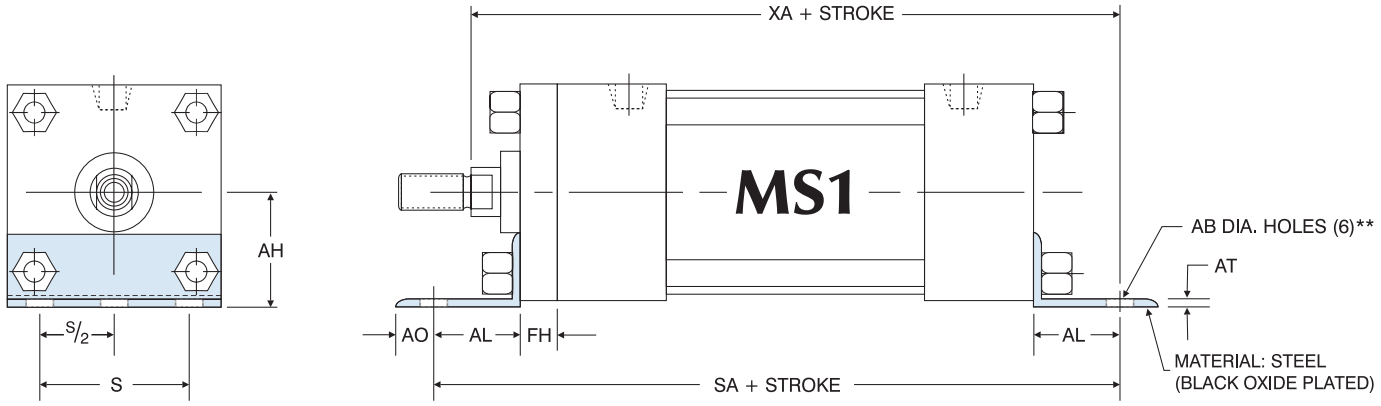
8.00" - 12.00" BORES

'MF1', 'MF2' FLANGE & 'ME3', 'ME4' CAP MOUNT DIMENSIONS												
BORE	ROD DIAMETER	E	F	FB	FH	R	RM	TE	TF	UF	W	ZF
1.50	0.625 Standard 1.000 Oversize	2.000	0.375	0.313	0.375	1.438	—	—	2.750	3.375	0.625 1.000	5.000 5.375
2.00	0.625 Standard 1.000 Oversize	2.500	0.375	0.375	0.375	1.848	—	—	3.375	4.125	0.625 1.000	5.000 5.375
2.50	0.625 Standard 1.000 Oversize	3.000	0.375	0.375	0.375	2.188	—	—	3.875	4.625	0.625 1.000	5.125 5.500
3.25	1.000 Standard 1.375 Oversize	3.750	0.625	0.438	0.625	2.766	—	—	4.688	5.500	0.750 1.000	6.250 6.500
4.00	1.000 Standard 1.375 Oversize	4.500	0.625	0.438	0.625	3.328	—	—	5.438	6.250	0.750 1.000	6.250 6.500

'MF1', 'MF2' FLANGE & 'ME3', 'ME4' CAP MOUNT DIMENSIONS												
BORE	ROD DIAMETER	E	F	FB	FH	R	RM	TE	TF	UF	W	ZF
5.00	1.000 Standard 1.375 Oversize	5.500	0.625	0.563	0.625	4.100	—	—	6.625	7.625	0.750 1.000	6.500 6.750
6.00	1.375 Standard 1.750 Oversize	6.500	0.625	0.563	0.750	4.875	—	—	7.625	8.625	0.875 1.125	7.375 7.625
8.00	1.375 Standard 1.750 Oversize	8.500	0.625	0.688	N/A	N/A	3.500	7.570	N/A	N/A	1.625 1.875	6.750 7.000
10.00	1.750 Standard 2.000 Oversize	10.625	0.625 0.750	0.813	N/A	N/A	3.500 5.000	9.400	N/A	N/A	1.875 2.000	8.250 8.375
12.00	2.000 Standard 2.500 Oversize	12.750	0.750	0.813	N/A	N/A	5.000	11.100	N/A	N/A	2.000 2.250	8.875 9.125

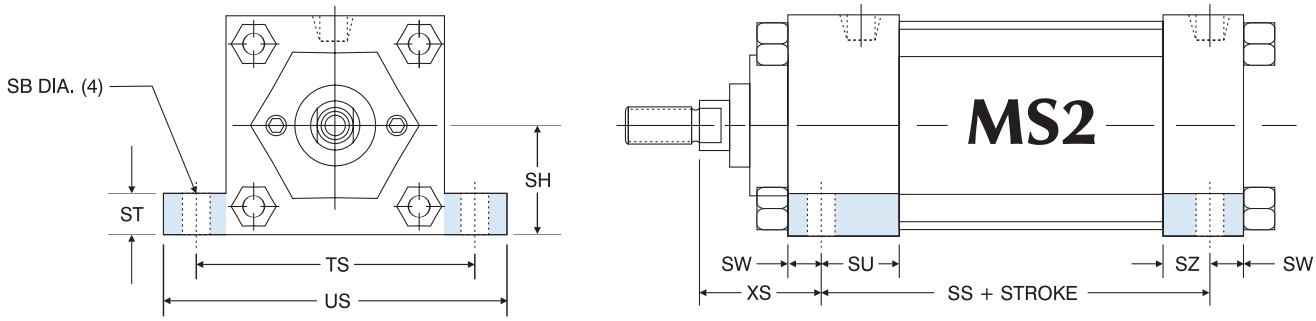
For dimensions not shown, see page 10.

SERIES 'TA' DIMENSIONS: BASE MOUNTS



'MS1' ANGLE MOUNT DIMENSIONS										
BORE	ROD DIAMETER	AB	AH	AL	AO	AT	FH	S	ADD STROKE SA	ADD STROKE XA
1.50	0.625 Standard	0.438	1.188	1.000	0.375	0.188	0.375	1.250	6.000	5.625
	1.000 Oversize									6.000
2.00	0.625 Standard	0.438	1.438	1.000	0.375	0.188	0.375	1.750	6.000	5.625
	1.000 Oversize									6.000
2.50	0.625 Standard	0.438	1.625	1.000	0.375	0.188	0.375	2.250	6.125	5.750
	1.000 Oversize									6.125
3.25	1.000 Standard	0.563	1.938	1.250	0.500	0.125	0.625	2.750	7.375	6.875
	1.375 Oversize									7.125
4.00	1.000 Standard	0.563	2.250	1.250	0.500	0.125	0.625	3.500	7.375	6.875
	1.375 Oversize									7.125
5.00	1.000 Standard	0.688	2.750	1.375	0.625	0.188	0.625	4.250	7.875	7.250
	1.375 Oversize									7.500
6.00	1.375 Standard	0.813	3.250	1.375	0.625	0.188	0.750	5.250	8.500	8.000
	1.750 Oversize									8.250
8.00	1.375 Standard	0.813	4.250	1.813	0.688	0.250	0.625*	7.125	8.750	8.563
	1.750 Oversize									8.813

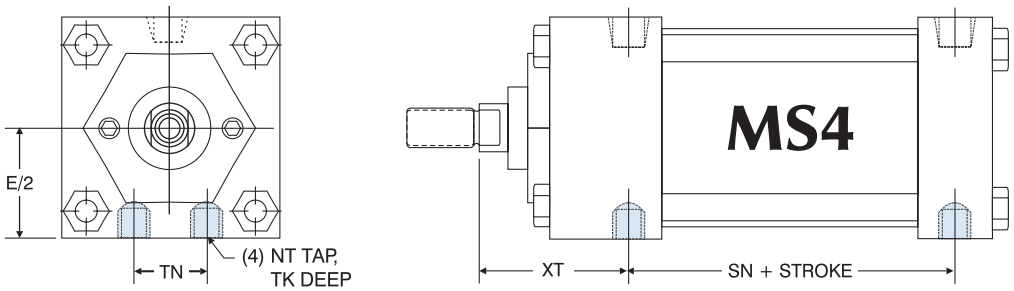
*3.50" diameter round retainer on 8.00" bore (MS1 BRACKET BOLTED DIRECTLY TO HEAD).
**1.50" bore has four (4) AB diameter holes.



'MS2' SIDE LUG MOUNT DIMENSIONS											
BORE	ROD DIAMETER	SB	SH	ST	SU	SW	SZ	TS	US	XS	ADD STROKE SS
1.50	0.625 Standard	0.438	1.000	0.500	1.125	0.375	0.625	2.750	3.500	1.375	2.875
	1.000 Oversize									1.750	
2.00	0.625 Standard	0.438	1.250	0.500	1.125	0.375	0.625	3.250	4.000	1.375	2.875
	1.000 Oversize									1.750	
2.50	0.625 Standard	0.438	1.500	0.500	1.125	0.375	0.625	3.750	4.500	1.375	3.000
	1.000 Oversize									1.750	
3.25	1.000 Standard	0.563	1.875	0.750	1.250	0.500	0.750	4.750	5.750	1.875	3.250
	1.375 Oversize									2.125	
4.00	1.000 Standard	0.563	2.250	0.750	1.250	0.500	0.750	5.500	6.500	1.875	3.250
	1.375 Oversize									2.125	
5.00	1.000 Standard	0.813	2.750	1.000	1.063	0.688	0.563	6.875	8.250	2.063	3.125
	1.375 Oversize									2.313	
6.00	1.375 Standard	0.813	3.250	1.000	1.313	0.688	0.813	7.875	9.250	2.313	3.625
	1.750 Oversize									2.563	
8.00	1.375 Standard	0.813	4.250	1.000	1.313	0.688	0.813	9.875	11.250	2.313	3.750
	1.750 Oversize									2.563	

For dimensions not shown, see page 10.

SERIES 'TA' DIMENSIONS: BASE MOUNTS



'MS4' BOTTOM TAPPED MOUNT DIMENSIONS							
BORE	ROD DIAMETER	E/2	NT	TK	TN	XT	ADD STROKE SN
1.50	0.625 Standard	1.000	1/4 -20	0.375	0.625	1.938	2.250
	1.000 Oversize					2.313	
2.00	0.625 Standard	1.250	5/16 -18	0.500	0.875	1.938	2.250
	1.000 Oversize					2.313	
2.50	0.625 Standard	1.500	3/8 -16	0.625	1.250	1.938	2.375
	1.000 Oversize					2.313	
3.25	1.000 Standard	1.875	1/2 -13	0.750	1.500	2.438	2.625
	1.375 Oversize					2.688	
4.00	1 .000 Standard	2.250	1/2 -13	0.750	2.063	2.438	2.625
	1.375 Oversize					2.688	
5.00	1.000 Standard	2.750	5/8 -11	1.000	2.688	2.438	2.875
	1.375 Oversize					2.688	
6.00	1.375 Standard	3.250	3/4 -10	1.125	3.250	2.813	3.125
	1.750 Oversize					3.063	
8.00	1.375 Standard	4.250	3/4 -10	1.125	4.500	2.813	3.250
	1.750 Oversize					3.063	
10.00	1.750 Standard	5.313	1 -8	1.500	5.500	3.125	4.125
	2.000 Oversize					3.250	
12.00	2.000 Standard	6.375	1 -8	1.500	7.250	3.250	4.625
	2.500 Oversize					3.500	

For dimensions not shown, see page 10.

COMBINATION MOUNTS

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

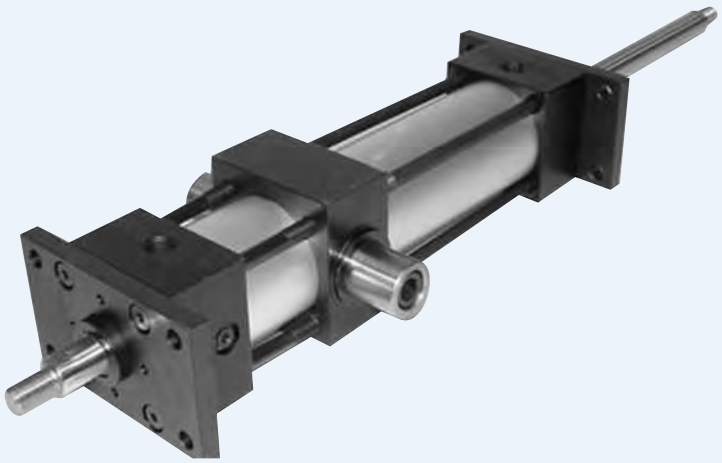
How to Order:

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

Example:
5.00" Bore 'TA' Series cylinder with 12.00" Stroke, Head and Cap Cushions, Magnetic Piston for Reed Switches and having a MS4 and MF1 Mount:

Part Number:
TA-MS4-MF1-5 x 12-HC-MPR

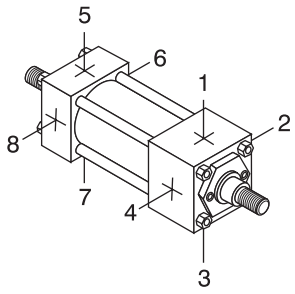
(FM-MF1-MF2-MT4D)



SERIES 'TA' DIMENSIONS: DOUBLE ROD END

Benefits

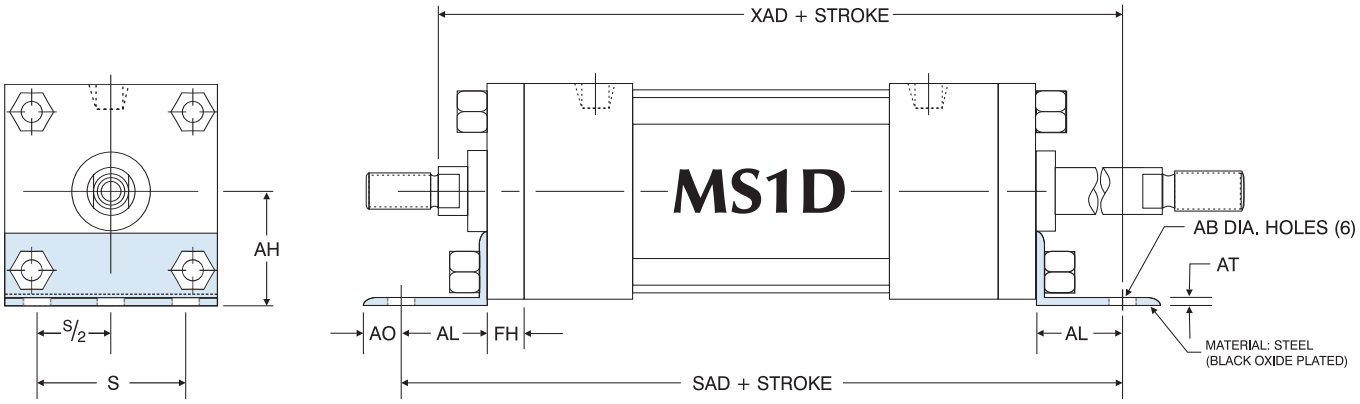
- Standard and Oversize Piston Rods available.
- Full range of Standard Options.
- Durable design. Full Rod Bearing at each end of cylinder.
- Can be provided with Hollow Piston Rods (gun-drilled through to your size requirements).
- Can be used in adjustable extend stroke applications by adding a stop collar on one rod end or option "MA" (*refer to page 179*).



STANDARD PORT AND CUSHION ADJUSTMENT POSITIONS

- Ports - Positions 1 and 5
- Cushion Adjustment - Positions 2 and 6
- 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	ADD STROKE XAD
1.50	0.625 Standard	0.438	1.188	1.000	0.375	0.188	0.375	1.250	6.875	6.500
	1.000 Oversize									6.875
2.00	0.625 Standard	0.438	1.438	1.000	0.375	0.188	0.375	1.750	6.875	6.500
	1.000 Oversize									6.875
2.50	0.625 Standard	0.438	1.625	1.000	0.375	0.188	0.375	2.250	7.000	6.625
	1.000 Oversize									7.000
3.25	1.000 Standard	0.563	1.938	1.250	0.500	0.125	0.625	2.750	8.500	8.000
	1.375 Oversize									8.250
4.00	1.000 Standard	0.563	2.250	1.250	0.500	0.125	0.625	3.500	8.500	8.000
	1.375 Oversize									8.250
5.00	1.000 Standard	0.688	2.750	1.375	0.625	0.188	0.625	4.250	9.000	8.375
	1.375 Oversize									8.625
6.00	1.375 Standard	0.813	3.250	1.375	0.625	0.188	0.750	5.250	9.750	9.250
	1.750 Oversize									9.500
8.00	1.375 Standard	0.813	4.250	1.813	0.688	0.250	0.625*	7.125	9.250	9.063
	1.750 Oversize									9.313

*3.50 diameter round retainer on 8.00" bore (MS1 BRACKETS BOLTED DIRECTLY TO HEAD).

SERIES 'TA' DIMENSIONS: DOUBLE ROD END

EASY FLIP OUT PAGE FOR REFERENCE

About Rod End Styles

Style 1 Male Rod End is STANDARD

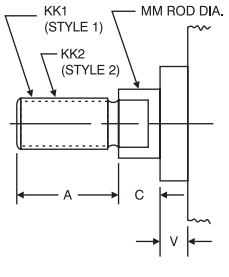
Other NFPA Styles can be specified (see chart).

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

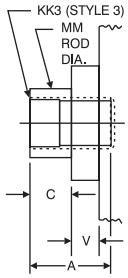
NEED SOMETHING NOT LISTED?
Just send us a sketch.
In most cases, quotes are turned around in one day!

PISTON ROD END STYLES

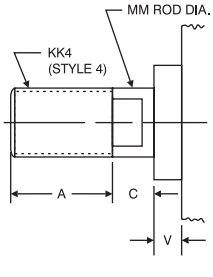
STYLE 1 & 2 — KK1 & KK2



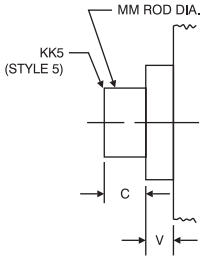
STYLE 3 — KK3



STYLE 4 — KK4

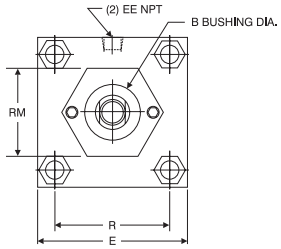


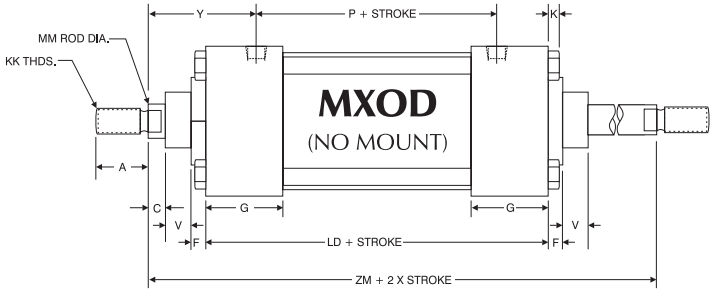
STYLE 5 — KK5



BORE	MM ROD DIAMETER	STANDARD Style 1 - Male KK1	A	OPTIONAL Style 2 - Male KK2	A	Style 3 - Female KK3	A	Style 4 - Male KK4	A	Style 5 - Blank KK5	C	V
1.50, 2.00, 2.50	0.625 Standard	7/16 -20	0.750	1/2 -20	0.750	7/16 -20	0.750	5/8 -18	0.750	No Threads	0.375	0.250
	1.000 Oversize	3/4 -16	1.125	7/8 -14	1.125	3/4 -16	1.125	1 -14	1.125	No Threads	0.500	0.500
3.25, 4.00, 5.00	1.000 Standard	3/4 -16	1.125	7/8 -14	1.125	3/4 -16	1.125	1 -14	1.125	No Threads	0.500	0.250
	1.375 Oversize	1 -14	1.625	1 1/4 -12	1.625	1 -14	1.625	1 3/8 -12	1.625	No Threads	0.625	0.375
6.00 & 8.00	1.375 Standard	1 -14	1.625	1 1/4 -12	1.625	1 -14	1.625	1 3/8 -12	1.625	No Threads	0.625	0.375
	1.750 Oversize	1 1/4 -12	2.000	1 1/2 -12	2.000	1 1/4 -12	2.000	1 3/4 -12	2.000	No Threads	0.750	0.500
10.00	1.750 Standard	1 1/4 -12	2.000	1 1/2 -12	2.000	1 1/4 -12	2.000	1 3/4 -12	2.000	No Threads	0.750	0.500
	2.000 Oversize	1 1/2 -12	2.250	1 3/4 -12	2.250	1 1/2 -12	2.250	2 -12	2.250	No Threads	0.875	0.375
12.00	2.000 Standard	1 1/2 -12	2.250	1 3/4 -12	2.250	1 1/2 -12	2.250	2 -12	2.250	No Threads	0.875	0.375
	2.500 Oversize	1 7/8-12	3.000	2 1/4 -12	3.000	1 7/8-12	3.000	2 1/2 -12	3.000	No Threads	1.000	0.500

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	0.625 Standard	0.750	1.125	0.375	2.000	0.375	0.375	1.500	0.250	7/16 -20	4.125	0.625	2.375	1.430	2.00 SQ.	0.250	1.875	6.125
	1.000 Oversize	1.125	1.500	0.500						3/4 -16		1.000				0.500	2.250	6.875
2.00	0.625 Standard	0.750	1.125	0.375	2.500	0.375	0.375	1.500	0.313	7/16 -20	4.125	0.625	2.375	1.844	1.75 HEX	0.250	1.875	6.125
	1.000 Oversize	1.125	1.500	0.500						3/4 -16		1.000			2.50 SQ.	0.500	2.250	6.875
2.50	0.625 Standard	0.750	1.125	0.375	3.000	0.375	0.375	1.500	0.313	7/16 -20	4.250	0.625	2.500	2.188	1.75 HEX	0.250	1.875	6.250
	1.000 Oversize	1.125	1.500	0.500						3/4 -16		1.000			3.00 SQ.	0.500	2.250	7.000
3.25	1.000 Standard	1.125	1.500	0.500	3.750	0.500	0.625	1.750	0.375	3/4 -16	4.750	1.000	2.750	2.760	2.75 DIA.	0.250	2.375	7.500
	1.375 Oversize	1.625	2.000	0.625						1 -14		1.375			3.75 SQ.	0.375	2.625	8.000
4.00	1.000 Standard	1.125	1.500	0.500	4.500	0.500	0.625	1.750	0.375	3/4 -16	4.750	1.000	2.750	3.320	2.75 DIA.	0.250	2.375	7.500
	1.375 Oversize	1.625	2.000	0.625						1 -14		1.375			3.50 DIA.	0.375	2.625	8.000
5.00	1.000 Standard	1.125	1.500	0.500	5.500	0.500	0.625	1.750	0.438	3/4 -16	5.000	1.000	3.000	4.100	2.75 DIA.	0.250	2.375	7.750
	1.375 Oversize	1.625	2.000	0.625						1 -14		1.375			3.50 DIA.	0.375	2.625	8.250
6.00	1.375 Standard	1.625	2.000	0.625	6.500	0.750	0.625	2.000	0.438	1 -14	5.500	1.375	3.250	4.875	3.50 DIA.	0.375	2.750	8.750
	1.750 Oversize	2.000	2.375	0.750						1 1/4 -12		1.750				0.500	3.000	9.250
8.00	1.375 Standard	1.625	2.000	0.625	8.500	0.750	0.625	2.000	0.563	1 -14	5.625	1.375	3.375	6.438	3.50 DIA.	0.375	2.750	8.875
	1.750 Oversize	2.000	2.375	0.750						1 1/4 -12		1.750				0.500	3.000	9.375
10.00	1.750 Standard	2.000	2.375	0.750	10.625	1.000	0.625	2.250	0.688	1 1/4 -12	6.625	1.750	4.313	7.922	3.50 DIA.	0.500	3.060	10.375
	2.000 Oversize	2.250	2.625	0.875			0.750			1 1/2 -12		2.000			5.00 DIA.	0.375	3.188	10.625
12.00	2.000 Standard	2.250	2.625	0.875	12.750	1.000	0.750	2.250	0.688	1 1/2 -12	7.125	2.000	4.813	9.400	5.00 DIA.	0.375	3.188	11.125
	2.500 Oversize	3.000	3.125	1.000						1 7/8-12		2.500				0.500	3.438	11.625

'TA' SERIES DOUBLE ROD END BASE DIMENSIONS FLIP-OUT (PAGE 17)

EASY FLIP OUT PAGE FOR REFERENCE

SERIES 'TA' DIMENSIONS: DOUBLE ROD END

About Rod End Styles

Style 1 Male Rod End is STANDARD

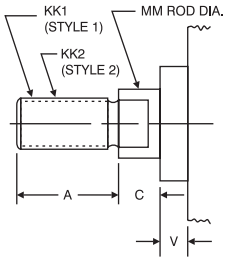
Other NFPA Styles can be specified (see chart).

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).

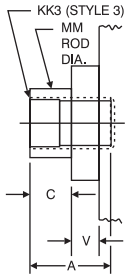
NEED SOMETHING NOT LISTED?
Just send us a sketch.
In most cases, quotes are turned around in one day!

PISTON ROD END STYLES

STYLE 1 & 2
KK1 & KK2



STYLE 3
KK3



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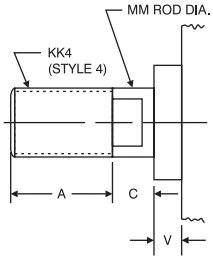
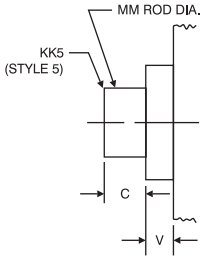
KK4

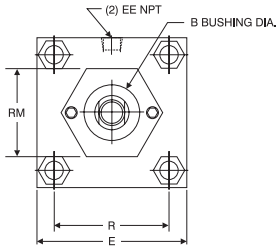


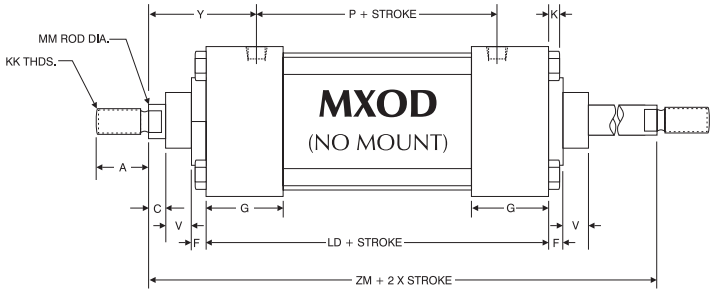
STYLE 5
KK5



BORE	MM ROD DIAMETER	STANDARD Style 1 - Male KK1	A	OPTIONAL Style 2 - Male KK2	A	Style 3 - Female KK3	A	Style 4 - Male KK4	A	Style 5 - Blank KK5	C	V
1.50, 2.00, 2.50	0.625 Standard	7/16 -20	0.750	1/2 -20	0.750	7/16 -20	0.750	5/8 -18	0.750	No Threads	0.375	0.250
	1.000 Oversize	3/4 -16	1.125	7/8 -14	1.125	3/4 -16	1.125	1 -14	1.125	No Threads	0.500	0.500
3.25, 4.00, 5.00	1.000 Standard	3/4 -16	1.125	7/8 -14	1.125	3/4 -16	1.125	1 -14	1.125	No Threads	0.500	0.250
	1.375 Oversize	1 -14	1.625	1 1/4 -12	1.625	1 -14	1.625	1 3/8 -12	1.625	No Threads	0.625	0.375
6.00 & 8.00	1.375 Standard	1 -14	1.625	1 1/4 -12	1.625	1 -14	1.625	1 3/8 -12	1.625	No Threads	0.625	0.375
	1.750 Oversize	1 1/4 -12	2.000	1 1/2 -12	2.000	1 1/4 -12	2.000	1 3/4 -12	2.000	No Threads	0.750	0.500
10.00	1.750 Standard	1 1/4 -12	2.000	1 1/2 -12	2.000	1 1/4 -12	2.000	1 3/4 -12	2.000	No Threads	0.750	0.500
	2.000 Oversize	1 1/2 -12	2.250	1 3/4 -12	2.250	1 1/2 -12	2.250	2 -12	2.250	No Threads	0.875	0.375
12.00	2.000 Standard	1 1/2 -12	2.250	1 3/4 -12	2.250	1 1/2 -12	2.250	2 -12	2.250	No Threads	0.875	0.375
	2.500 Oversize	1 7/8 -12	3.000	2 1/4 -12	3.000	1 7/8 -12	3.000	2 1/2 -12	3.000	No Threads	1.000	0.500

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

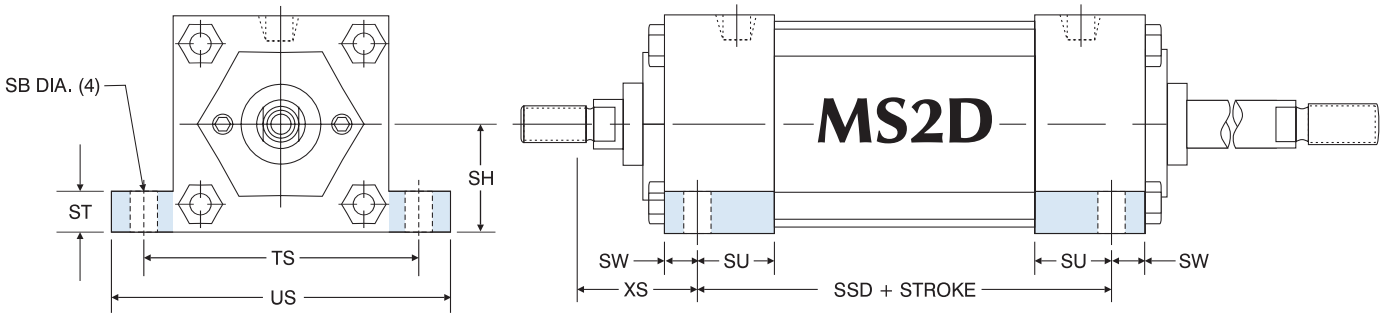




DOUBLE ROD END BASIC DIMENSIONS 'MXOD' STANDARD & OVERSIZE RODS																		
BORE	ROD DIAMETER	A	B	C	E	EE	F	G	K	KK	LD	MM	P	R	RM	V	Y	ZM
1.50	0.625 Standard	0.750	1.125	0.375	2.000	0.375	0.375	1.500	0.250	7/16 -20	4.125	0.625	2.375	1.430	2.00 SQ.	0.250	1.875	6.125
	1.000 Oversize	1.125	1.500	0.500						3/4 -16		1.000				0.500	2.250	6.875
2.00	0.625 Standard	0.750	1.125	0.375	2.500	0.375	0.375	1.500	0.313	7/16 -20	4.125	0.625	2.375	1.844	1.75 HEX	0.250	1.875	6.125
	1.000 Oversize	1.125	1.500	0.500						3/4 -16		1.000			2.50 SQ.	0.500	2.250	6.875
2.50	0.625 Standard	0.750	1.125	0.375	3.000	0.375	0.375	1.500	0.313	7/16 -20	4.250	0.625	2.500	2.188	1.75 HEX	0.250	1.875	6.250
	1.000 Oversize	1.125	1.500	0.500						3/4 -16		1.000			3.00 SQ.	0.500	2.250	7.000
3.25	1.000 Standard	1.125	1.500	0.500	3.750	0.500	0.625	1.750	0.375	3/4 -16	4.750	1.000	2.750	2.760	2.75 DIA.	0.250	2.375	7.500
	1.375 Oversize	1.625	2.000	0.625						1 -14		1.375			3.75 SQ.	0.375	2.625	8.000
4.00	1.000 Standard	1.125	1.500	0.500	4.500	0.500	0.625	1.750	0.375	3/4 -16	4.750	1.000	2.750	3.320	2.75 DIA.	0.250	2.375	7.500
	1.375 Oversize	1.625	2.000	0.625						1 -14		1.375			3.50 DIA.	0.375	2.625	8.000
5.00	1.000 Standard	1.125	1.500	0.500	5.500	0.500	0.625	1.750	0.438	3/4 -16	5.000	1.000	3.000	4.100	2.75 DIA.	0.250	2.375	7.750
	1.375 Oversize	1.625	2.000	0.625						1 -14		1.375			3.50 DIA.	0.375	2.625	8.250
6.00	1.375 Standard	1.625	2.000	0.625	6.500	0.750	0.625	2.000	0.438	1 -14	5.500	1.375	3.250	4.875	3.50 DIA.	0.375	2.750	8.750
	1.750 Oversize	2.000	2.375	0.750						1 1/4 -12		1.750				0.500	3.000	9.250
8.00	1.375 Standard	1.625	2.000	0.625	8.500	0.750	0.625	2.000	0.563	1 -14	5.625	1.375	3.375	6.438	3.50 DIA.	0.375	2.750	8.875
	1.750 Oversize	2.000	2.375	0.750						1 1/4 -12		1.750				0.500	3.000	9.375
10.00	1.750 Standard	2.000	2.375	0.750	10.625	1.000	0.625	2.250	0.688	1 1/4 -12	6.625	1.750	4.313	7.922	3.50 DIA.	0.500	3.060	10.375
	2.000 Oversize	2.250	2.625	0.875			0.750			1 1/2 -12		2.000			5.00 DIA.	0.375	3.188	10.625
12.00	2.000 Standard	2.250	2.625	0.875	12.750	1.000	0.750	2.250	0.688	1 1/2 -12	7.125	2.000	4.813	9.400	5.00 DIA.	0.375	3.188	11.125
	2.500 Oversize	3.000	3.125	1.000						1 7/8 -12		2.500				0.500	3.438	11.625

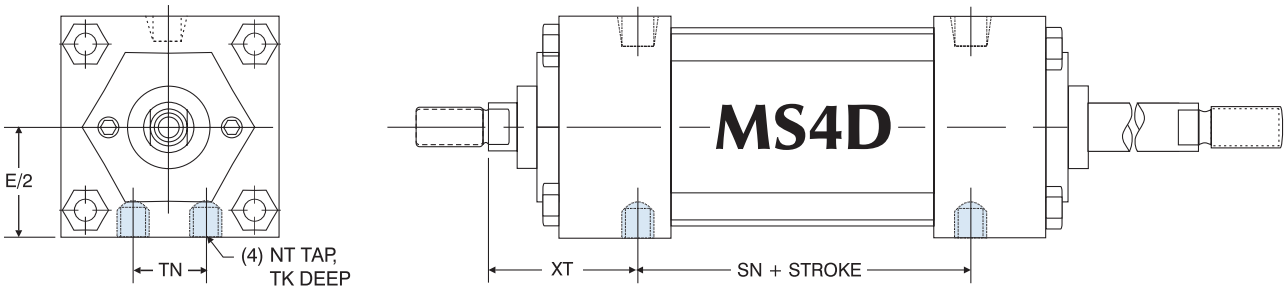
'TA' SERIES DOUBLE ROD END BASE DIMENSIONS FLIP-OUT (PAGE 17)

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	0.625 Standard 1.000 Oversize	0.438	1.000	0.500	1.125	0.375	2.750	3.500	1.375 1.750	3.375
2.00	0.625 Standard 1.000 Oversize	0.438	1.250	0.500	1.125	0.375	3.250	4.000	1.375 1.750	3.375
2.50	0.625 Standard 1.000 Oversize	0.438	1.500	0.500	1.125	0.375	3.750	4.500	1.375 1.750	3.500
3.25	1.000 Standard 1.375 Oversize	0.563	1.875	0.750	1.250	0.500	4.750	5.750	1.875 2.125	3.750
4.00	1.000 Standard 1.375 Oversize	0.563	2.250	0.750	1.250	0.500	5.500	6.500	1.875 2.125	3.750
5.00	1.000 Standard 1.375 Oversize	0.813	2.750	1.000	1.063	0.688	6.875	8.250	2.063 2.313	3.625
6.00	1.375 Standard 1.750 Oversize	0.813	3.250	1.000	1.313	0.688	7.875	9.250	2.313 2.563	4.125
8.00	1.375 Standard 1.750 Oversize	0.813	4.250	1.000	1.563	0.688	9.875	11.250	2.313 2.563	4.250

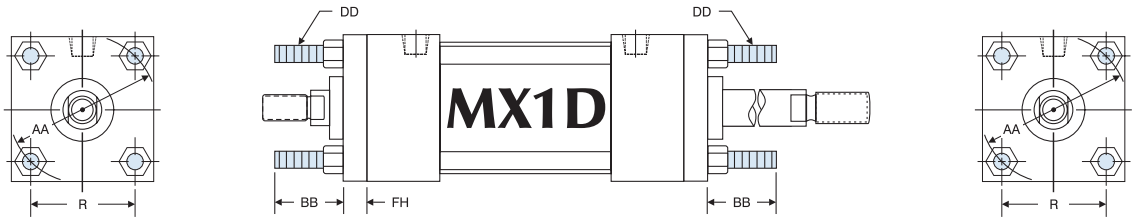
For dimensions not shown, see page 17.

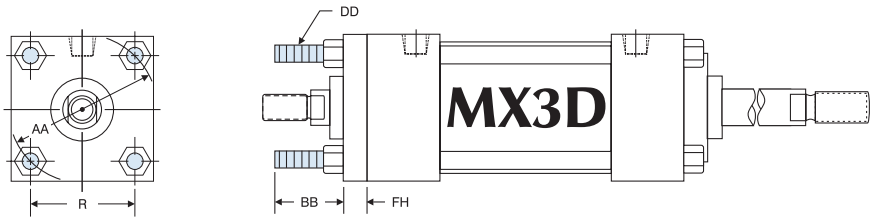


DOUBLE ROD END 'MS4D' BOTTOM TAPPED MOUNT DIMENSIONS							
BORE	ROD DIAMETER	E/2	NT	TK	TN	XT	ADD STROKE SN
1.50	0.625 Standard 1.000 Oversize	1.000	1/4-20	0.375	0.625	1.938 2.313	2.250
2.00	0.625 Standard 1.000 Oversize	1.250	5/16-18	0.500	0.875	1.938 2.313	2.250
2.50	0.625 Standard 1.000 Oversize	1.500	3/8-16	0.625	1.250	1.938 2.313	2.375
3.25	1.000 Standard 1.375 Oversize	1.875	1/2-13	0.750	1.500	2.438 2.688	2.625
4.00	1.000 Standard 1.375 Oversize	2.250	1/2-13	0.750	2.063	2.438 2.688	2.625
5.00	1.000 Standard 1.375 Oversize	2.750	5/8-11	1.000	2.688	2.438 2.688	2.875
6.00	1.375 Standard 1.750 Oversize	3.250	3/4-10	1.125	3.250	2.813 3.063	3.125
8.00	1.375 Standard 1.750 Oversize	4.250	3/4-10	1.125	4.500	2.813 3.063	3.250
10.00	1.750 Standard 2.000 Oversize	5.313	1-8	1.500	5.500	3.125 3.250	4.125
12.00	2.000 Standard 2.500 Oversize	6.375	1-8	1.500	7.250	3.250 3.500	4.625

For dimensions not shown, see page 17.

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

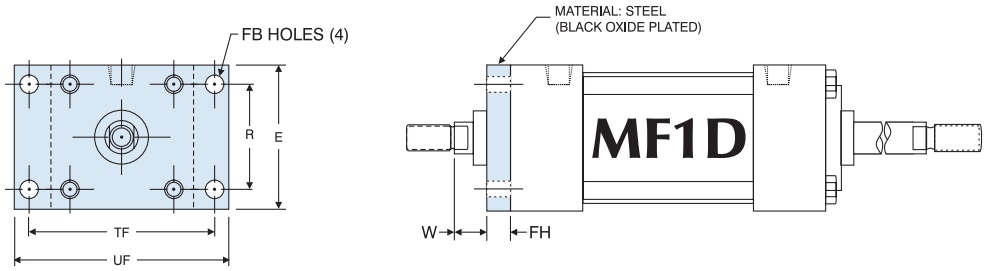




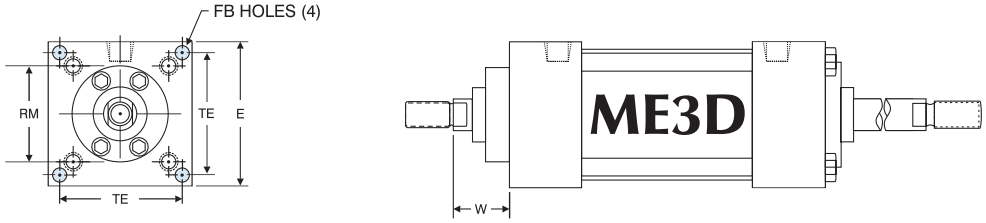
TIE ROD EXTENDED 'MX1D' & 'MX3D' MOUNT DIMENSIONS						
BORE	ROD DIAMETER	AA	BB	DD	FH	R
1.50	0.625 Standard 1.000 Oversize	2.020	1.000	1/4 -28	0.375	1.438
2.00	0.625 Standard 1.000 Oversize	2.600	1.125	5/16 -24	0.375	1.844
2.50	0.625 Standard 1.000 Oversize	3.100	1.125	5/16 -24	0.375	2.188
3.25	1.000 Standard 1.375 Oversize	3.900	1.375	3/8 -24	0.625	2.760
4.00	1.000 Standard 1.375 Oversize	4.700	1.375	3/8 -24	0.625	3.320

TIE ROD EXTENDED 'MX1D' & 'MX3D' MOUNT DIMENSIONS						
BORE	ROD DIAMETER	AA	BB	DD	FH	R
5.00	1.000 Standard 1.375 Oversize	5.800	1.813	1/2 -20	0.625	4.100
6.00	1.375 Standard 1.750 Oversize	6.900	1.813	1/2 -20	0.750	4.880
8.00	1.375 Standard 1.750 Oversize	9.100	**2.313	5/8 -18	*0.625	6.440
10.00	1.750 Oversize 2.000 Oversize	11.200	**2.688	3/4 -16	*0.625 *0.750	7.920
12.00	2.000 Standard 2.500 Oversize	13.300	**2.688	3/4 -16	*0.750	9.400

*Full square bushing retainer on 1.50" - 6.00" bores, round retainers on 8.00" - 12.00" bores.
**"BB" dimension from head on 8.00", 10.00" & 12.00" bores.



1.50" - 6.00" BORES



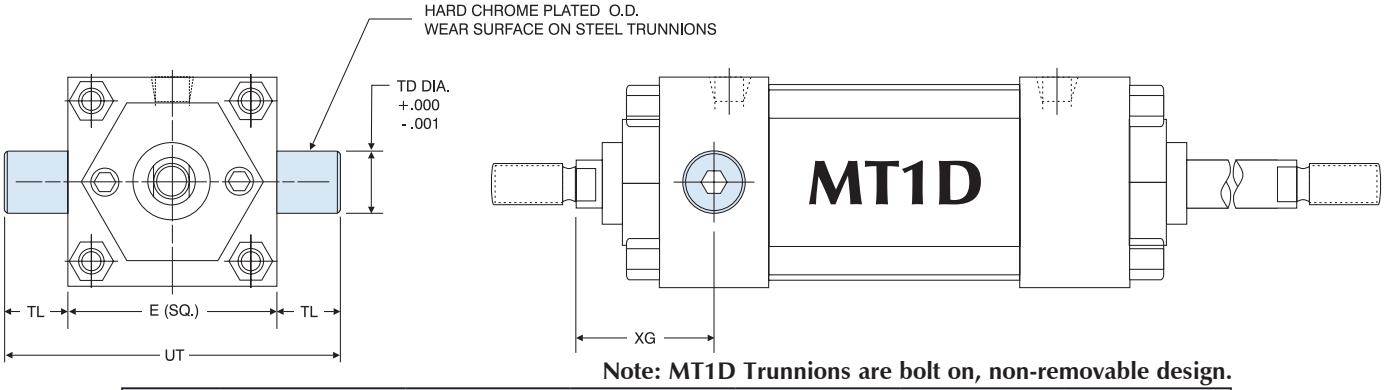
8.00" - 12.00" BORES ONLY

'MF1D' FLANGE & 'ME3D' CAP MOUNT DIMENSIONS										
BORE	ROD DIAMETER	E	FB	FH	R	RM	TE	TF	UF	W
1.50	0.625 Standard 1.000 Oversize	2.000	0.313	0.375	1.438	—	—	2.750	3.375	0.625 1.000
2.00	0.625 Standard 1.000 Oversize	2.500	0.375	0.375	1.844	—	—	3.375	4.125	0.625 1.000
2.50	0.625 Standard 1.000 Oversize	3.000	0.375	0.375	2.188	—	—	3.875	4.625	0.625 1.000
3.25	1.000 Standard 1.375 Oversize	3.750	0.438	0.625	2.760	—	—	4.688	5.500	0.750 1.000
4.00	1.000 Standard 1.375 Oversize	4.500	0.438	0.625	3.320	—	—	5.438	6.250	0.750 1.000

'MF1D' FLANGE & 'ME3D' CAP MOUNT DIMENSIONS										
BORE	ROD DIAMETER	E	FB	FH	R	RM	TE	TF	UF	W
5.00	1.000 Standard 1.375 Oversize	5.500	0.563	0.625	4.100	—	—	6.625	7.625	0.750 1.000
6.00	1.375 Standard 1.750 Oversize	6.500	0.563	0.750	4.875	—	—	7.625	8.625	0.875 1.125
8.00	1.375 Standard 1.750 Oversize	8.500	0.688	N/A	N/A	3.500	7.570	N/A	N/A	1.625 1.875
10.00	1.750 Standard 2.000 Oversize	10.625	0.813	N/A	N/A	3.500 5.000	9.400	N/A	N/A	1.875 2.000
12.00	2.000 Standard 2.500 Oversize	12.750	0.813	N/A	N/A	5	11.100	N/A	N/A	2.000 2.250

For dimensions not shown, see page 17.

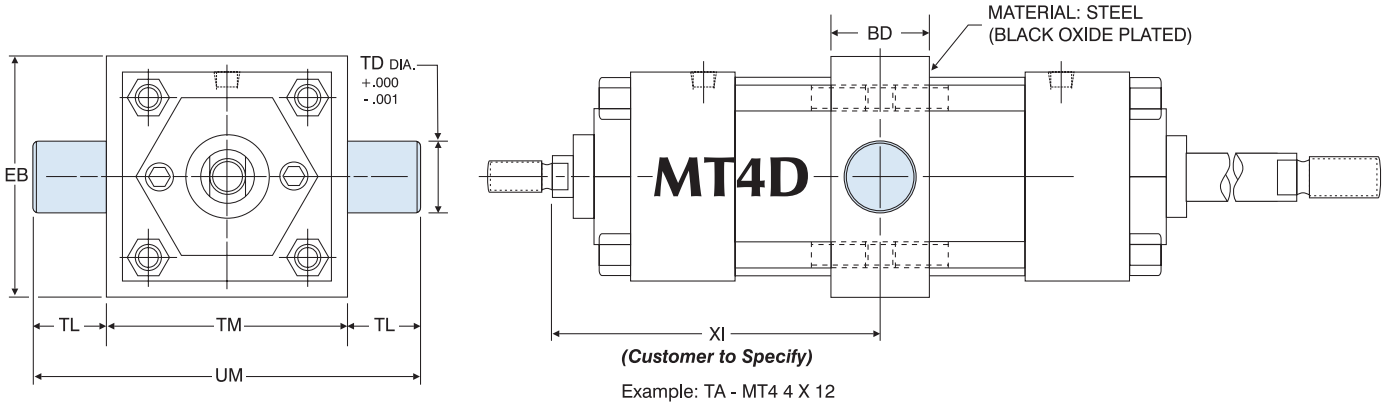
SERIES 'TA' DIMENSIONS: DOUBLE ROD END PIVOT MOUNTS



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	0.625 Standard	2.000	1.000	1.000	4.000	1.750
	N/A*					N/A
2.00	0.625 Standard	2.500	1.000	1.000	4.500	1.750
	1.000 Oversize					2.125
2.50	0.625 Standard	3.000	1.000	1.000	5.000	1.750
	1.000 Oversize					2.125
3.25	1.000 Standard	3.750	1.000	1.000	5.750	2.250
	1.375 Oversize					2.500
4.00	1.000 Standard	4.500	1.000	1.000	6.500	2.250
	1.375 Oversize					2.500
5.00	1.000 Standard	5.500	1.000	1.000	7.500	2.250
	1.375 Oversize					2.500
6.00	1.375 Standard	6.500	1.375	1.375	9.250	2.625
	1.750 Oversize					2.875
8.00	1.375 Standard	8.500	1.375	1.375	11.250	2.625
	1.750 Oversize					2.875

*No oversize rod available on 1.50" bore MT1D.
For dimensions not shown, see page 17.



(Customer to Specify)

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

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

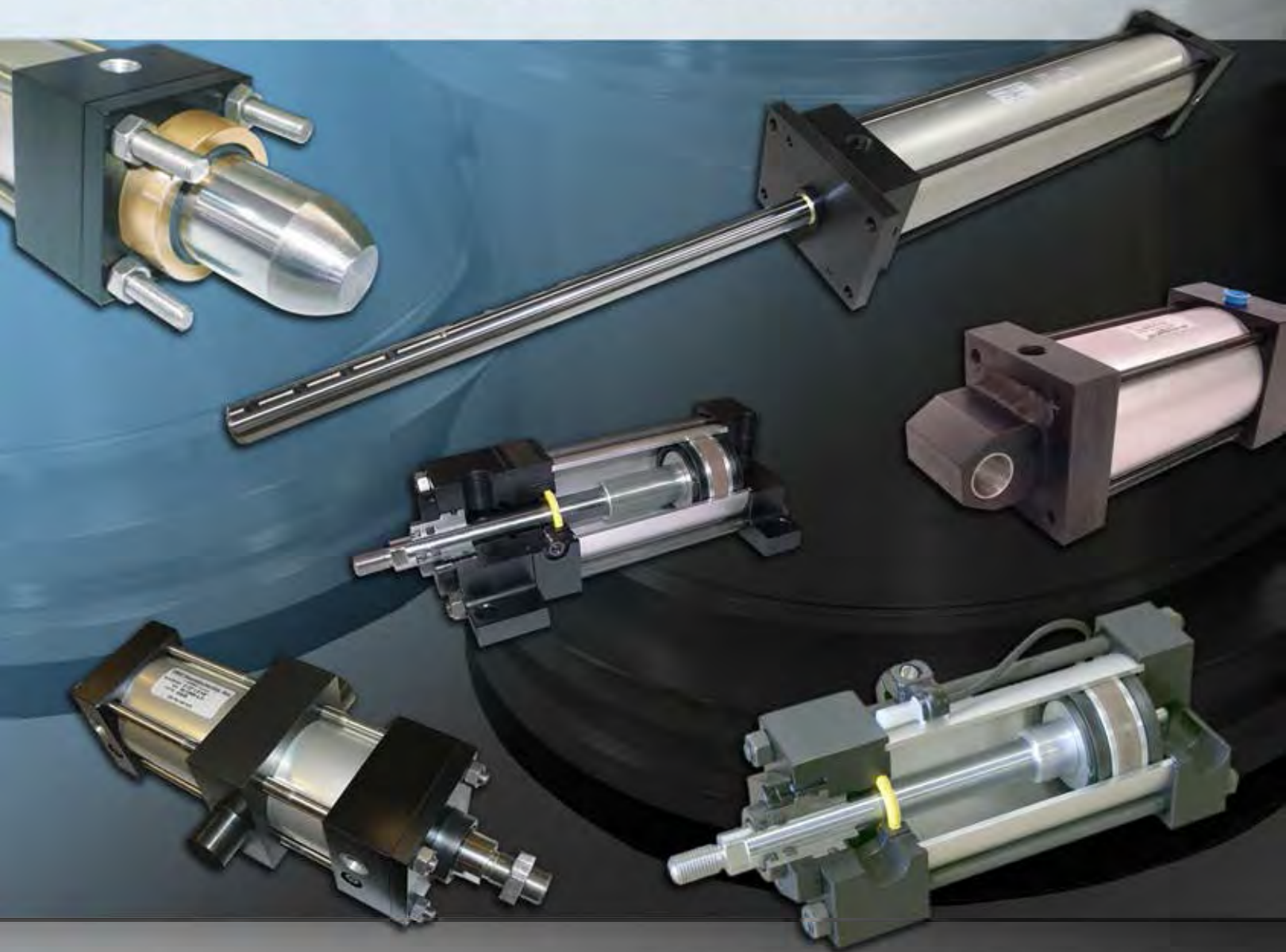
DOUBLE ROD END 'MT4D' INTERMEDIATE TRUNNION MOUNT DIMENSIONS							
BORE	BD	EB	TD	TL	TM	UM	XI
1.50	1.250	2.500	1.000	1.000	2.500	4.500	CUSTOMER TO SPECIFY
2.00	1.500	3.000	1.000	1.000	3.000	5.000	
2.50	1.500	3.500	1.000	1.000	3.500	5.500	
3.25	2.000	4.250	1.000	1.000	4.500	6.500	
4.00	2.000	5.000	1.000	1.000	5.250	7.250	
5.00	2.000	6.000	1.000	1.000	6.250	8.250	
6.00	2.000	7.000	1.375	1.375	7.625	10.375	
8.00	2.500	9.500	1.375	1.375	9.750	12.500	

'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.

TD Series NFPA
TOUGH-DUTY
Aluminum Cylinders
1.50″ to 8.00″ Bore

Refer to TA Series for dimensions



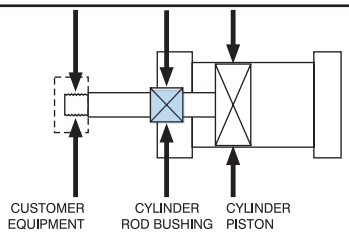
95% OF OUR CYLINDERS SHIP IN 2-3 DAYS!
ONE DAY RUSH SERVICE AVAILABLE ON ALL CATALOGED CYLINDER MODELS!

SERIES 'TD' TOUGH-DUTY

Floating Rod Bushing

SELF ALIGNMENT FEATURE

Rod Bushing is designed to float .002" to improve 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 173 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 172-186 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)

TD - MF1 ___ - 2.50 x 10 - ___ - MPR

SERIES	
TD	250 PSI AIR

NFPA MOUNTS	
MF1	FRONT FLANGE (1.50"- 6.00" Bore)
MF2	REAR FLANGE (1.50"- 6.00" Bore)
ME3	FRONT MOUNTING HOLES (8.00" Bore)
ME4	REAR MOUNTING HOLES (8.00" Bore)
MP1	REAR PIVOT CLEVIS (1.50"- 8.00" Bore)
MP2	REAR PIVOT CLEVIS (1.50"- 6.00" Bore)
MP4	REAR PIVOT EYE (1.50"- 4.00" Bore)
MS1	FRONT & REAR END ANGLE (1.50"- 8.00" Bore)
MS2	SIDE LUG (1.50"- 8.00" Bore)
MS4	BOTTOM TAPPED HOLES (1.50"- 8.00" Bore)
MT1	FRONT TRUNNION (1.50"- 8.00" Bore)
MT2	REAR TRUNNION (1.50"- 8.00" Bore)
MT4	INTERMEDIATE TRUNNION (1.50"- 8.00" Bore)
MX0	NO MOUNT (1.50"- 8.00" Bore)
MX1	EXTENDED TIE RODS - HEAD & CAP (1.50"- 8.00" Bore)
MX2	EXTENDED TIE RODS (CAP) (1.50"- 8.00" Bore)
MX3	EXTENDED TIE RODS (HEAD) (1.50"- 8.00" Bore)

BORE	
1.50	2.00
2.50	3.25
4.00	5.00
6.00	8.00

STROKE
0" to 120" Made to Order

STROKE
0" to 120" Made to Order

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

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	X
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	X

Notes: 1) Ordering example for adjustable cushions in non-standard locations: H3C7

2) Refer to page 171 for assistance in cushion length selection.

3) Cushions can be ordered on same side as ports. *Refer to page 181 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")
	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 176 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 223-230 for selection)
	MS	METALLIC ROD SCRAPER (BRASS CONSTRUCTION)
	OP	OPTIONAL PORT LOCATION (Example: Ports @ 3 & 7)
	OS	OVERSIZE ROD DIAMETER (SPECIFY SIZE, Example: OS = 1.375")
	SAE	SAE PORTS (SPECIFY SIZE, Example: SAE #10)
	SSA	STAINLESS STEEL PISTON ROD, TIE RODS & NUTS, AND FASTENERS
	SSF	STAINLESS STEEL FASTENERS
	SSN	STAINLESS STEEL TIE ROD NUTS
	SSR	STAINLESS STEEL PISTON ROD
	SST	STAINLESS STEEL TIE RODS
X	ST	**STOP TUBE** - SPECIFY STOP TUBE LENGTH (in inches) SPECIFY STROKE AS ES (effective stroke) (Example: TD MS4 2 X 24ES-ST=4)
	TMS	STEEL CYLINDER TUBE, BLACK EPOXY PAINT FINISH
	VS	FLUOROCARBON SEALS
	XX	SPECIAL VARIATION (SPECIFY)

*STEEL TUBES do not work with MPR magnetic pistons. Refer to pages 231-234 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, Front Flange Mount, (NON-ADJUSTABLE Head & Cap Cushions), and Magnetic Piston for Switches.

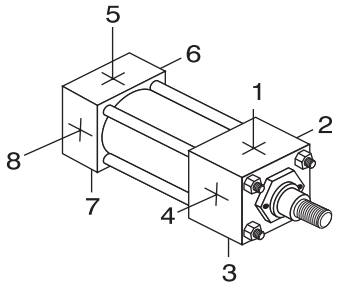
Part Number: TD-MF1-2.50 x 10-MPR

OPTION LENGTH ADDER (ADD TO CATALOG BASIC OVERALL LENGTH DIMENSIONS)			
BORE	**ELC**	**ELH**	**ST* (STOP TUBE) Example: ST=2**
1.50	1.000	1.000	2
2.00	1.000	1.000	2
2.50	1.000	1.000	2
3.25	1.250	1.250	2
4.00	1.250	1.250	2
5.00	1.250	1.250	2
6.00	1.500	1.500	2
8.00	1.500	1.500	2

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

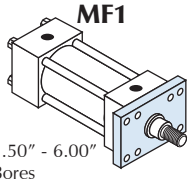
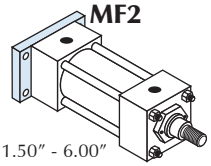
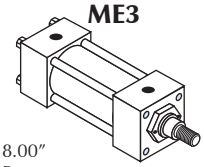
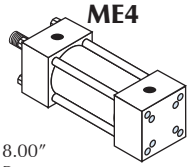
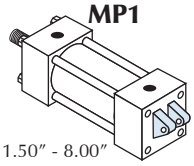
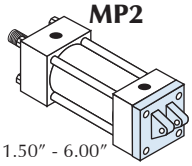
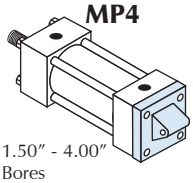
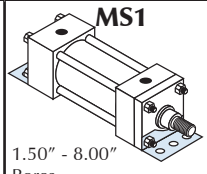
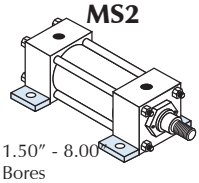
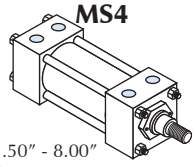
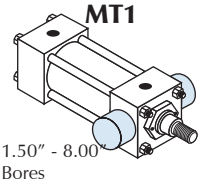
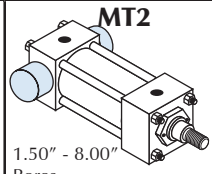
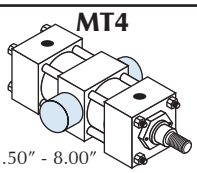
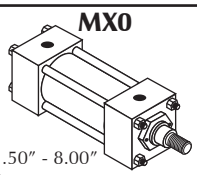
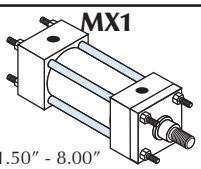
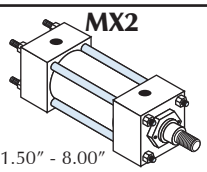
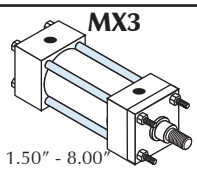
STANDARD PORT AND CUSHION ADJUSTMENT POSITIONS

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



NFPA MOUNTS

(Refer to pages 10-14 for mounting dimensions)

MF1  1.50" - 6.00" Bores	**MF2**  1.50" - 6.00" Bores	**ME3**  8.00" Bores	**ME4**  8.00" Bores	**MP1**  1.50" - 8.00" Bores	**MP2**  1.50" - 6.00" Bores
MP4  1.50" - 4.00" Bores	**MS1**  1.50" - 8.00" Bores	**MS2**  1.50" - 8.00" Bores	**MS4**  1.50" - 8.00" Bores	**MT1**  1.50" - 8.00" Bores	**MT2**  1.50" - 8.00" Bores
MT4  1.50" - 8.00" Bores	**MX0**  1.50" - 8.00" Bores	**MX1**  1.50" - 8.00" Bores	**MX2**  1.50" - 8.00" Bores	**MX3**  1.50" - 8.00" Bores	

NOTES

FM Series NFPA
FLUSH MOUNT
Aluminum Cylinders
1.50″ to 8.00″ Bore

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

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 four (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 37 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.
- ***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 two (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 27 for ordering instructions)

BORE	1.50	2.00	2.50	3.25	4.00	5.00	6.00
PORT SIZE	0.250 NPT	0.250 NPT	0.250 NPT	0.375 NPT	0.375 NPT	0.375 NPT	0.500 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)

FM - MS4 ___ - 2.50 x 10 - HC - MPR

SERIES	
FM	250 PSI AIR

NFPA MOUNTS	
MF1	FRONT FLANGE (1.50"- 6.00" Bore)
MF2	REAR FLANGE (1.50"- 6.00" Bore)
MP1	REAR PIVOT CLEVIS (1.50"- 6.00" Bore)
MP2	REAR PIVOT CLEVIS (1.50"- 6.00" Bore)
MP4	REAR PIVOT EYE (1.50"- 4.00" Bore)
MS1	FRONT & REAR END ANGLE (1.50"- 8.00" Bore)
MS2	SIDE LUG (1.50"- 8.00" Bore)
MS4	BOTTOM TAPPED HOLES (1.50"- 8.00" Bore)
MT1	FRONT TRUNNION (1.50"- 8.00" Bore)
MT2	REAR TRUNNION (1.50"- 8.00" Bore)
MXO	NO MOUNT (1.50"- 8.00" Bore)
BASE BAR	NON-NFPA (1.50"- 4.00" Bore)

BORE	
1.50	2.00
2.50	3.25
4.00	5.00
6.00	8.00

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	X
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	X
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: 1) Ordering example for non-standard cushion locations: H3C7

2) Refer to page 174 for assistance in cushion length selection.

3) Cushions can be ordered on same side as ports. *Refer to page 176 for dimensions.*

OPTIONS		
	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" - 6.00" 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 176 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 183 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 223-230 for selection)*
	MS	METALLIC ROD SCRAPER (BRASS CONSTRUCTION)
	NR	**NON-ROTATING** *(Refer to page 180 for specifications)*
	OP	OPTIONAL PORT LOCATION OR SIZE (Example: Ports @ 3 & 7)
	OS	OVERSIZE ROD DIAMETER (SPECIFY SIZE, Example: OS = 1.375")
	SAE	SAE PORTS (SPECIFY SIZE, Example: SAE #10)
X	SE	SPRING EXTEND (1.50", 2.00", 2.50" bore)
X	SR	SPRING RETURN (1.50", 2.00", 2.50" bore)
	SSA	STAINLESS STEEL PISTON ROD, TIE RODS & SLEEVE NUTS, AND FASTENERS
	SSF	STAINLESS STEEL FASTENERS
	SSN	STAINLESS STEEL TIE ROD NUTS
	SSR	STAINLESS STEEL PISTON ROD
	SST	STAINLESS STEEL TIE RODS
X	ST	**STOP TUBE** - SPECIFY STOP TUBE LENGTH (in inches) SPECIFY STROKE AS ES (effective stroke) (Example: FM MS4 2 X 24ES-ST=3)
	TMS	STEEL CYLINDER TUBE, BLACK EPOXY PAINT FINISH
	TH	400 PSI HYDRAULIC NON-SHOCK *(Refer to page 183 for specifications)*
	VS	FLUOROCARBON SEALS
	XX	SPECIAL VARIATION (SPECIFY)

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

*STEEL TUBES do not work with MPR magnetic pistons. Refer to pages 231-233 for Balluff end of stroke sensors.

About our Part Number System

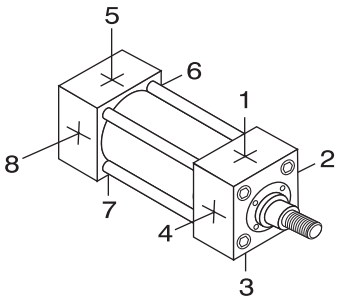
- Simple, easy to understand
- No excessive codes!
- Eliminates mistakes when ordering

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

Part Number: FM-MS4-2.5 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

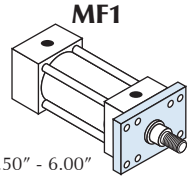


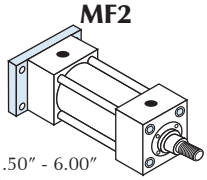
OPTION LENGTH ADDER
(ADD TO CATALOG BASIC OVERALL LENGTH DIMENSIONS)

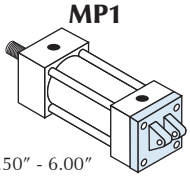
BORE	OPTION							
	B	BC	BH	ELC	ELH	SE	SR	ST* (STOP TUBE) Example: ST=2
1.50	0.500	0.250	0.250	1.000	1.000	Refer to page 92 for length adders and available bore sizes and strokes		2
2.00	0.500	0.250	0.250	1.000	1.000			2
2.50	0.500	0.250	0.250	1.000	1.000			2
3.25	0.500	0.250	0.250	1.250	1.250			2
4.00	0.500	0.250	0.250	1.250	1.250			2
5.00	0.500	0.250	0.250	1.250	1.250			2
6.00	0.500	0.250	0.250	1.500	1.500			2

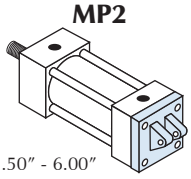
***Note:** The desired Stop Tube length adds directly to the overall cylinder length.

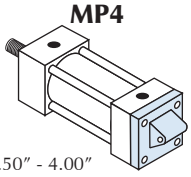
'FM' NFPA MOUNTS

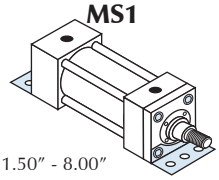
MF1

1.50" - 6.00" Bores

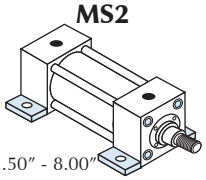
MF2

1.50" - 6.00" Bores

MP1

1.50" - 6.00" Bores

MP2

1.50" - 6.00" Bores

MP4

1.50" - 4.00" Bores

MS1

1.50" - 8.00" Bores

MS2

1.50" - 8.00" Bores

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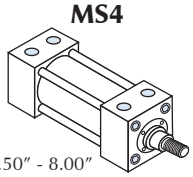
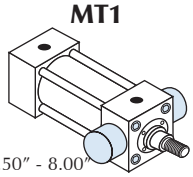
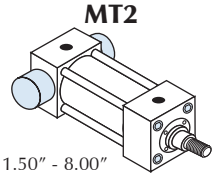
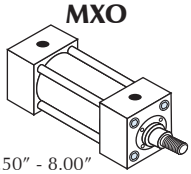
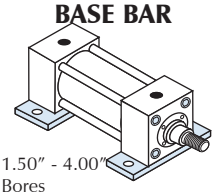

1.50" - 8.00" Bores

MT1

1.50" - 8.00" Bores

MT2

1.50" - 8.00" Bores

MXO

1.50" - 8.00" Bores

BASE BAR

1.50" - 4.00" Bores

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

EASY FLIP OUT PAGE FOR REFERENCE

About Rod End Styles

Style 1 Male Rod End is STANDARD

Other NFPA Styles can be specified (see chart).

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

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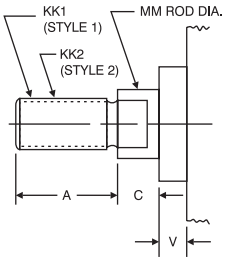
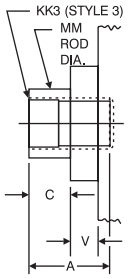
Just send us a sketch.
In most cases, quotes are turned around in one day!

PISTON ROD END STYLES

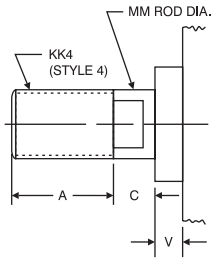
STYLE 1 & 2
KK1 & KK2



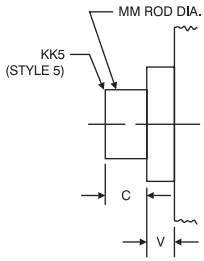
STYLE 3
KK3



STYLE 4
KK4

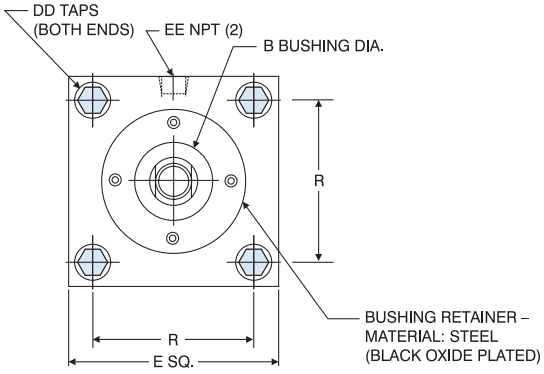


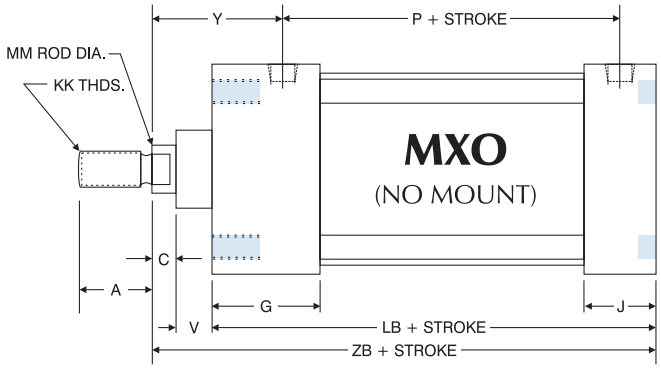
STYLE 5
KK5



BORE	MM ROD DIAMETER	STANDARD Style 1 - Male KK1	A	OPTIONAL Style 2 - Male KK2	A	Style 3 - Female KK3	A	Style 4 - Male KK4	A	Style 5 - Blank KK5	C	V
1.50, 2.00, 2.50	0.625 Standard	7/16 -20	0.750	1/2 -20	0.750	7/16 -20	0.750	5/8 -18	0.750	No Threads	0.375	0.625
	1.000 Oversize	3/4 -16	1.125	7/8 -14	1.125	3/4 -16	1.125	1 -14	1.125	No Threads	0.500	0.500
3.25, 4.00, 5.00	1.000 Standard	3/4 -16	1.125	7/8 -14	1.125	3/4 -16	1.125	1 -14	1.125	No Threads	0.500	0.875
	1.375 Oversize	1 -14	1.625	1 1/4 -12	1.625	1 -14	1.625	1 3/8 -12	1.625	No Threads	0.625	1.000
6.00 & 8.00	1.375 Standard	1 -14	1.625	1 1/4 -12	1.625	1 -14	1.625	1 3/8 -12	1.625	No Threads	0.625	1.000
	1.750 Oversize	1 1/4 -12	2.000	1 1/2 -12	2.000	1 1/4 -12	2.000	1 3/4 -12	2.000	No Threads	0.750	1.125

BASIC DIMENSIONS: *'MXO' (NO MOUNT) - STANDARD ROD*





'FM' SERIES BASIC DIMENSIONS 'MXO'																
BORE	A	B	C	DD	E	EE	G	J	KK	LB	MM	P	R	V	Y	ZB
1.50	0.750	1.125	0.375	1/4 -28	2.000	0.250	1.500	1.000	7/16 -20	3.625	0.625	2.375	1.438	0.625	1.875	4.625
2.00	0.750	1.125	0.375	5/16 -24	2.500	0.250	1.500	1.000	7/16 -20	3.625	0.625	2.375	1.843	0.625	1.875	4.625
2.50	0.750	1.125	0.375	5/16 -24	3.000	0.250	1.500	1.000	7/16 -20	3.750	0.625	2.500	2.188	0.625	1.875	4.750
3.25	1.125	1.500	0.500	3/8-24	3.750	0.375	1.750	1.250	3/4 -16	4.250	1.000	2.750	2.760	0.875	2.375	5.625
4.00	1.125	1.500	0.500	3/8-24	4.500	0.375	1.750	1.250	3/4 -16	4.250	1.000	2.750	3.320	0.875	2.375	5.625
5.00	1.125	1.500	0.500	1/2 -20	5.500	0.375	1.750	1.250	3/4 -16	4.500	1.000	3.000	4.100	0.875	2.375	5.875
6.00	1.625	2.000	0.625	1/2 -20	6.500	0.500	2.000	1.500	1 -14	5.000	1.375	3.250	4.875	1.000	2.750	6.625
8.00	1.625	2.000	0.625	5/8-18	8.500	0.750	2.000	1.500	1 -14	5.125	1.375	3.375	6.438	1.000	2.750	7.313

For oversize rod dimensions, see page 32.

EASY FLIP OUT PAGE FOR REFERENCE

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).

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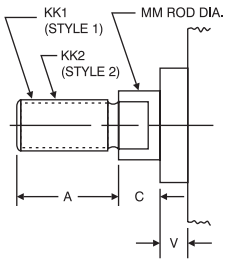
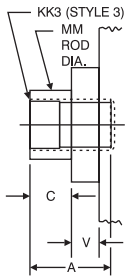
PISTON ROD END STYLES

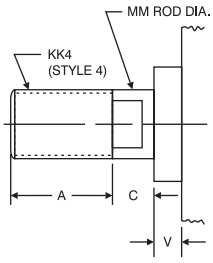
STYLE 1 & 2
KK1 & KK2



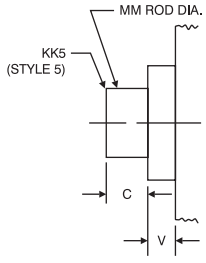
STYLE 3
KK3



STYLE 4
KK4

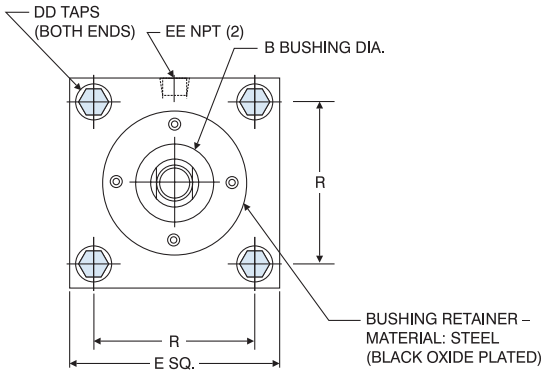


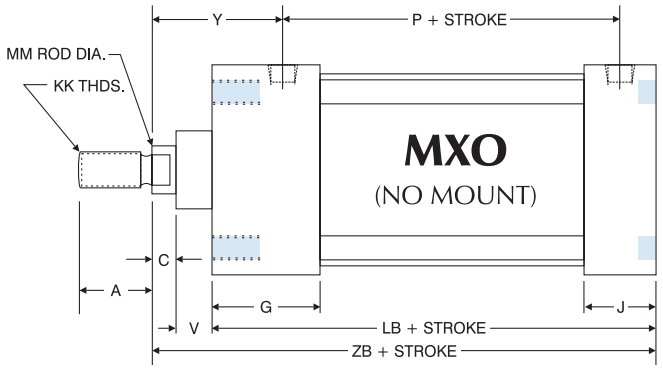
STYLE 5
KK5



BORE	MM ROD DIAMETER	STANDARD Style 1 - Male KK1	A	OPTIONAL Style 2 - Male KK2	A	Style 3 - Female KK3	A	Style 4 - Male KK4	A	Style 5 - Blank KK5	C	V
1.50, 2.00, 2.50	0.625 Standard	7/16 -20	0.750	1/2 -20	0.750	7/16 -20	0.750	5/8 -18	0.750	No Threads	0.375	0.625
	1.000 Oversize	3/4 -16	1.125	7/8 -14	1.125	3/4 -16	1.125	1 -14	1.125	No Threads	0.500	0.500
3.25, 4.00, 5.00	1.000 Standard	3/4 -16	1.125	7/8 -14	1.125	3/4 -16	1.125	1 -14	1.125	No Threads	0.500	0.875
	1.375 Oversize	1 -14	1.625	1 1/4 -12	1.625	1 -14	1.625	1 3/8 -12	1.625	No Threads	0.625	1.000
6.00 & 8.00	1.375 Standard	1 -14	1.625	1 1/4 -12	1.625	1 -14	1.625	1 3/8 -12	1.625	No Threads	0.625	1.000
	1.750 Oversize	1 1/4 -12	2.000	1 1/2 -12	2.000	1 1/4 -12	2.000	1 3/4 -12	2.000	No Threads	0.750	1.125

BASIC DIMENSIONS: *'MXO' (NO MOUNT) - STANDARD ROD*



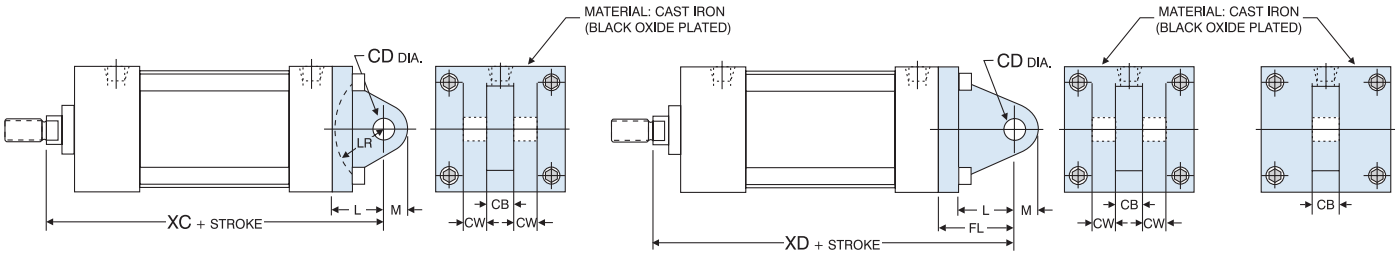


'FM' SERIES BASIC DIMENSIONS 'MXO'																
BORE	A	B	C	DD	E	EE	G	J	KK	LB	MM	P	R	V	Y	ZB
1.50	0.750	1.125	0.375	1/4-28	2.000	0.250	1.500	1.000	7/16 -20	3.625	0.625	2.375	1.438	0.625	1.875	4.625
2.00	0.750	1.125	0.375	5/16 -24	2.500	0.250	1.500	1.000	7/16 -20	3.625	0.625	2.375	1.843	0.625	1.875	4.625
2.50	0.750	1.125	0.375	5/16 -24	3.000	0.250	1.500	1.000	7/16 -20	3.750	0.625	2.500	2.188	0.625	1.875	4.750
3.25	1.125	1.500	0.500	3/8-24	3.750	0.375	1.750	1.250	3/4 -16	4.250	1.000	2.750	2.760	0.875	2.375	5.625
4.00	1.125	1.500	0.500	3/8-24	4.500	0.375	1.750	1.250	3/4 -16	4.250	1.000	2.750	3.320	0.875	2.375	5.625
5.00	1.125	1.500	0.500	1/2 -20	5.500	0.375	1.750	1.250	3/4 -16	4.500	1.000	3.000	4.100	0.875	2.375	5.875
6.00	1.625	2.000	0.625	1/2 -20	6.500	0.500	2.000	1.500	1 -14	5.000	1.375	3.250	4.875	1.000	2.750	6.625
8.00	1.625	2.000	0.625	5/8-18	8.500	0.750	2.000	1.500	1 -14	5.125	1.375	3.375	6.438	1.000	2.750	7.313

For oversize rod dimensions, see page 32.

'FM' SERIES BASE DIMENSIONS FLIP-OUT (PAGE 28)

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



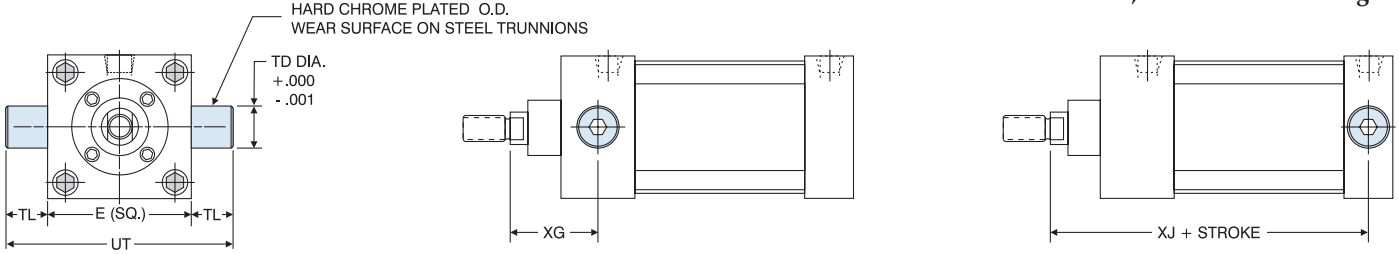
FM-MP1 **FM-MP2** **FM-MP4**

(1.50" - 4.00" 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	ADD STROKE XD
1.50	0.625 Standard	0.750	0.500	0.500	1.125	0.750	0.750	0.625	5.375	5.750
	1.000 Oversize								5.750	6.125
2.00	0.625 Standard	0.750	0.500	0.500	1.125	0.750	0.750	0.625	5.375	5.750
	1.000 Oversize								5.750	6.125
2.50	0.625 Standard	0.750	0.500	0.500	1.125	0.750	0.750	0.625	5.500	5.875
	1.000 Oversize								5.875	6.250
3.25	1.000 Standard	1.250	0.750	0.625	1.875	1.250	1.250	0.875	6.875	7.500
	1.375 Oversize								7.125	7.750
4.00	1.000 Standard	1.250	0.750	0.625	1.875	1.250	1.250	0.875	6.875	7.500
	1.375 Oversize								7.125	7.750
5.00	1.000 Standard	1.250	0.750	0.625	1.875	1.250	1.250	0.875	7.125	7.750
	1.375 Oversize								7.375	8.000
6.00	1.375 Standard	1.500	1.000	0.750	2.250	1.500	1.500	1.000	8.125	8.875
	1.750 Oversize								8.375	9.125

For dimensions not shown, see page 28.

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



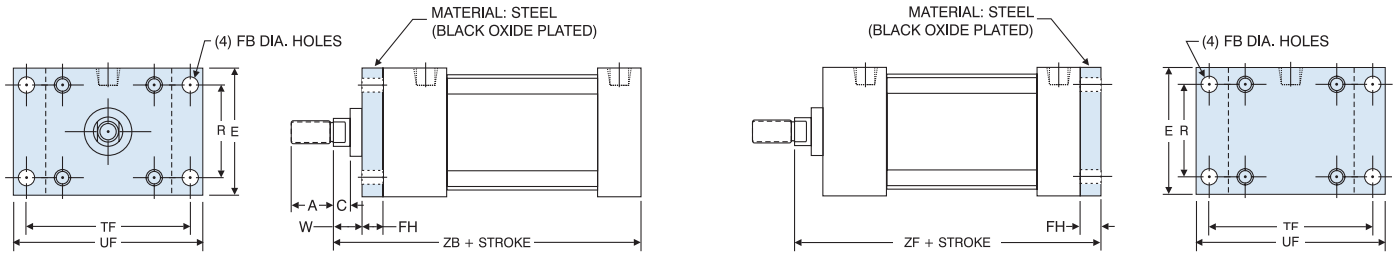
FM-MT1 / MT2 **FM-MT1** **FM-MT2**

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	0.625 Standard	2.000	1.000	1.000	4.000	1.750	4.125
	1.000 Oversize					N/A*	4.500
2.00	0.625 Standard	2.500	1.000	1.000	4.500	1.750	4.125
	1.000 Oversize					2.125	4.500
2.50	0.625 Standard	3.000	1.000	1.000	5.000	1.750	4.250
	1.000 Oversize					2.125	4.625
3.25	1.000 Standard	3.750	1.000	1.000	5.750	2.250	5.000
	1.375 Oversize					2.500	5.250
4.00	1.000 Standard	4.500	1.000	1.000	6.500	2.250	5.000
	1.375 Oversize					2.500	5.250
5.00	1.000 Standard	5.500	1.000	1.000	7.500	2.250	5.250
	1.375 Oversize					2.500	5.500
6.00	1.375 Standard	6.500	1.375	1.375	9.250	2.625	5.875
	1.750 Oversize					2.875	6.125
8.00	1.375 Standard	8.500	1.375	1.375	11.250	2.625	6.000
	1.750 Oversize					2.875	6.250

*No oversize rod available on 1.50" bore MT1.
For dimensions not shown, see page 28.

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

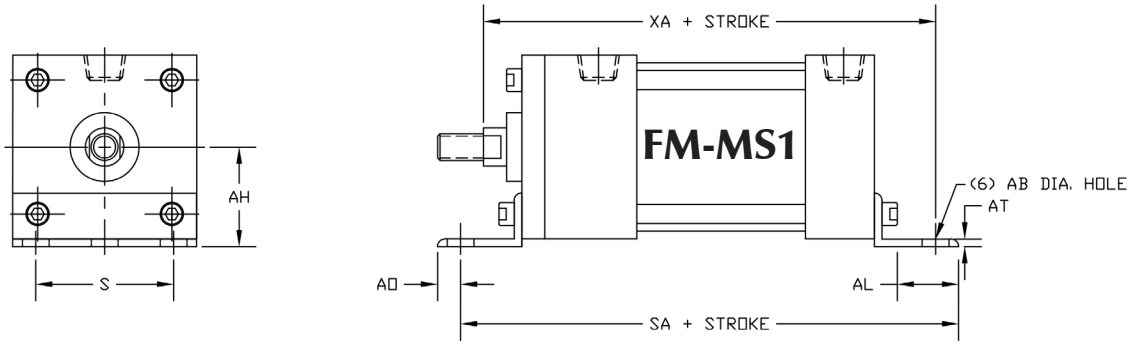


FM-MF1 **FM-MF2**

'FM' SERIES 'MF1' AND 'MF2' FLANGE MOUNT DIMENSIONS												
BORE	ROD DIAMETER	A	C	E	FB	FH	R	TF	UF	W	ZB	ZF
1.50	0.625 Standard	0.750	0.375	2.000	0.313	0.375	1.430	2.750	3.375	0.625	4.625	5.000
	1.000 Oversize	1.125	0.500							1.000	5.000	5.375
2.00	0.625 Standard	0.750	0.375	2.500	0.375	0.375	1.840	3.375	4.125	0.625	4.625	5.000
	1.000 Oversize	1.125	0.500							1.000	5.000	5.375
2.50	0.625 Standard	0.750	0.375	3.000	0.375	0.375	2.188	3.875	4.625	0.625	4.750	5.125
	1.000 Oversize	1.125	0.500							1.000	5.125	5.500
3.25	1.000 Standard	1.125	0.500	3.750	0.438	0.625	2.760	4.688	5.500	0.750	5.625	6.250
	1.375 Oversize	1.625	0.625							1.000	5.875	6.500
4.00	1.000 Standard	1.125	0.500	4.500	0.438	0.625	3.320	5.438	6.250	0.750	5.625	6.250
	1.375 Oversize	1.625	0.625							1.000	5.875	6.500
5.00	1.000 Standard	1.125	0.500	5.500	0.563	0.625	4.100	6.625	7.625	0.750	5.875	6.500
	1.375 Oversize	1.625	0.625							1.000	6.125	6.750
6.00	1.375 Standard	1.625	0.625	6.500	0.563	0.750	4.875	7.625	8.625	0.875	6.625	7.375
	1.750 Oversize	2.000	0.750							1.125	6.875	7.625

For dimensions not shown, see page 28.

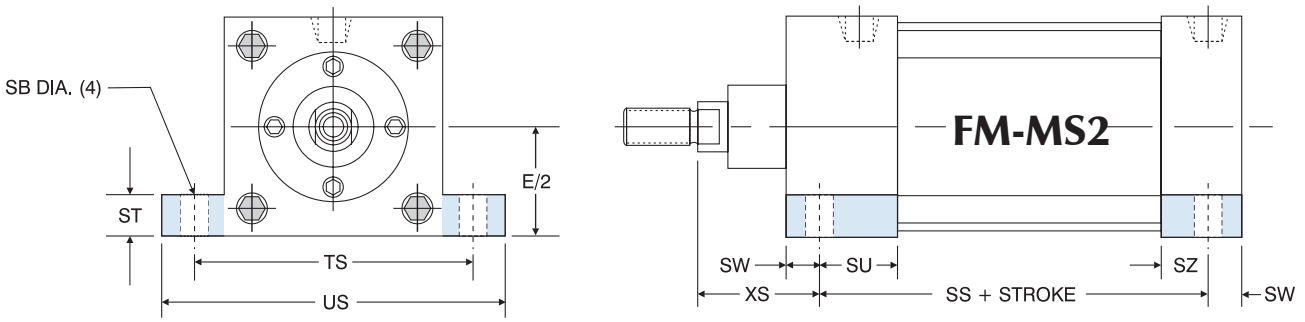
SERIES 'FM' DIMENSIONS: BASE MOUNTS
FLUSH MOUNT (WITH SLEEVE NUT CONSTRUCTION)



'FM' SERIES 'MS1' ANGLE MOUNT DIMENSIONS										
									ADD STROKE	
BORE	ROD DIAMETER	AB	AH	AL	AO	AT	FH	S	SA	XA
1.50	0.625 Standard	0.438	1.188	1.000	0.375	0.125	0.375	1.250	6.000	5.625
	1.000 Oversize									6.000
2.00	0.625 Standard	0.438	1.438	1.000	0.375	0.125	0.375	1.750	6.000	5.625
	1.000 Oversize									6.000
2.50	0.625 Standard	0.438	1.625	1.000	0.375	0.125	0.375	2.250	6.125	5.750
	1.000 Oversize									6.125
3.25	1.000 Standard	0.563	1.938	1.250	0.500	0.125	0.625	2.750	7.375	6.875
	1.375 Oversize									7.125
4.00	1.000 Standard	0.563	2.250	1.250	0.500	0.125	0.625	3.500	7.375	6.875
	1.375 Oversize									7.125
5.00	1.000 Standard	0.688	2.750	1.375	0.625	0.188	0.625	4.250	7.875	7.250
	1.375 Oversize									7.500
6.00	1.375 Standard	0.813	3.250	1.375	0.625	0.188	0.750	5.250	8.500	8.000
	1.750 Oversize									8.250
8.00	1.375 Standard	0.813	4.250	1.813	0.688	0.250	0.625*	7.125	8.750	8.563
	1.750 Oversize									8.813

*1.50" bore has four (4) "AB" holes on "S" dimension.
Note: Flush retainer on 4.00" to 8.00" bore (MS1 bracket bolted directly to head).
For dimensions not shown, see page 28.

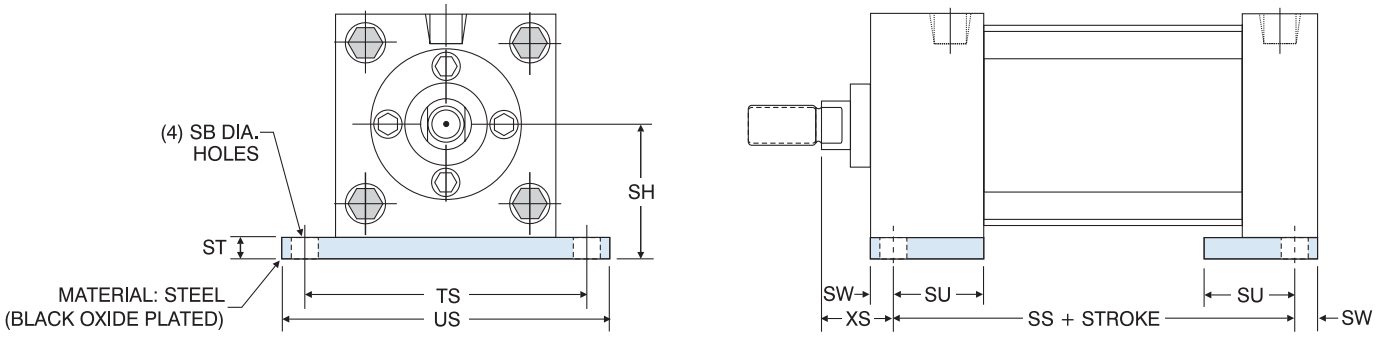
SERIES 'FM' DIMENSIONS: BASE MOUNTS
FLUSH MOUNT (WITH SLEEVE NUT CONSTRUCTION)



'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	0.625 Standard	0.438	1.000	0.500	1.125	0.375	0.625	2.750	3.500	1.375	2.875
	1.000 Oversize									1.750	
2.00	0.625 Standard	0.438	1.250	0.500	1.125	0.375	0.625	3.250	4.000	1.375	2.875
	1.000 Oversize									1.750	
2.50	0.625 Standard	0.438	1.500	0.500	1.125	0.375	0.625	3.750	4.500	1.375	3.000
	1.000 Oversize									1.750	
3.25	1.000 Standard	0.563	1.875	0.750	1.250	0.500	0.750	4.750	5.750	1.875	3.250
	1.375 Oversize									2.125	
4.00	1.000 Standard	0.563	2.250	0.750	1.250	0.500	0.750	5.500	6.500	1.875	3.250
	1.375 Oversize									2.125	
5.00	1.000 Standard	0.813	2.750	1.000	1.063	0.688	0.563	6.875	8.250	2.063	3.125
	1.375 Oversize									2.313	
6.00	1.375 Standard	0.813	3.250	1.000	1.313	0.688	0.813	7.875	9.250	2.313	3.625
	1.750 Oversize									2.563	
8.00	1.375 Standard	0.813	4.250	1.000	1.313	0.688	0.813	9.875	11.250	2.313	3.750
	1.750 Oversize									2.563	

Note: 1.50" to 3.25" oversized rods have full front retainer.
For dimensions not shown, see page 28.

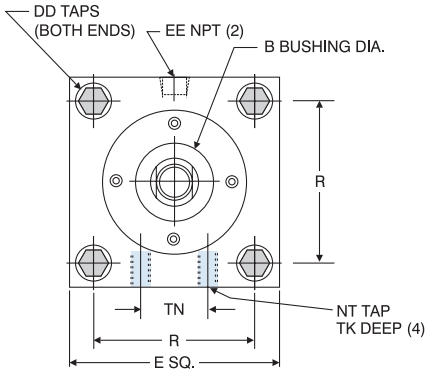
FM-BASE BAR (Non-NFPA)

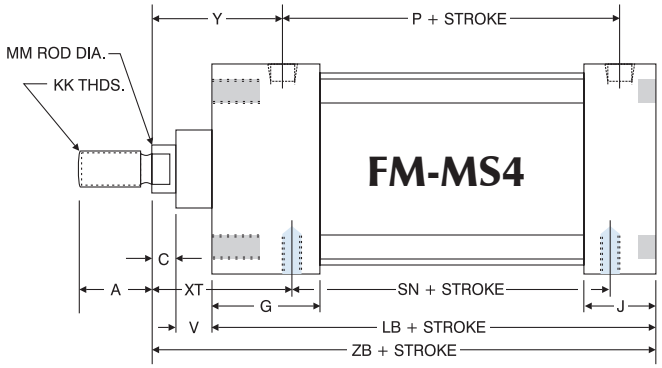


'FM' SERIES BASE BAR MOUNT (Non-NFPA) DIMENSIONS										
BORE	ROD DIAMETER	SB	SH	ST	SU	SW	TS	US	XS	ADD STROKE SS
1.50	0.625 Standard	0.438	1.250	0.250	1.125	0.375	2.750	3.500	1.375	2.875
	1.000 Oversize								1.750	
2.00	0.625 Standard	0.438	1.500	0.250	1.125	0.375	3.250	4.000	1.375	2.875
	1.000 Oversize								1.750	
2.50	0.625 Standard	0.438	1.875	0.375	1.125	0.375	3.750	4.500	1.375	3.000
	1.000 Oversize								1.750	
3.25	1.000 Standard	0.563	2.375	0.500	1.250	0.500	4.750	5.750	1.875	3.250
	1.375 Oversize								2.125	
4.00	1.000 Standard	0.563	2.750	0.500	1.250	0.500	5.500	6.500	1.875	3.250
	1.375 Oversize								2.125	

Note: 1.50" to 3.25" oversized rods have full front retainer.
For dimensions not shown, see page 28.

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

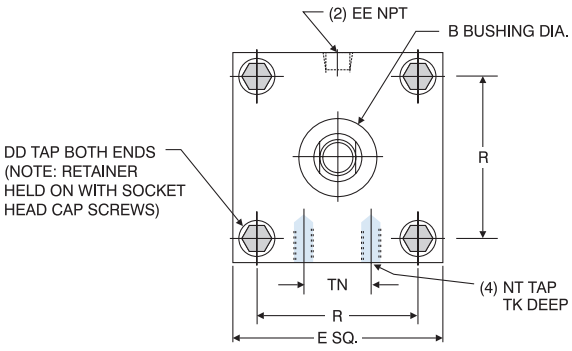


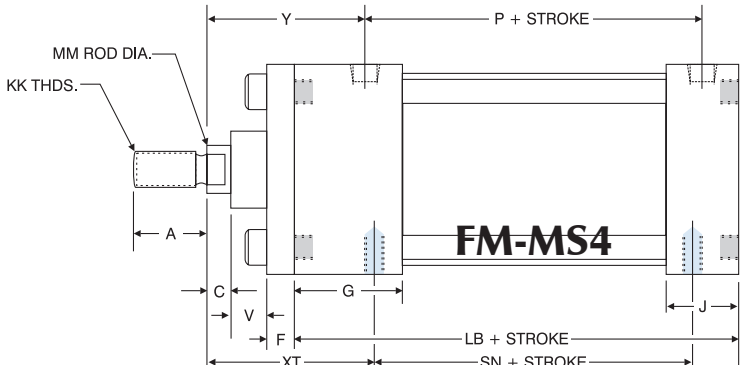


'FM' SERIES 'MS4' FLUSH MOUNT DIMENSIONS																					
BORE	MM	A	B	C	DD	E	EE	G	J	KK	LB	P	R	V	Y	NT	TK	TN	SN	XT	ZB
1.50	0.625	0.750	1.125	0.375	1/4 -28	2.000	0.250	1.500	1.000	7/16 -20	3.625	2.375	1.425	0.625	1.875	1/4 -20	0.375	0.625	2.250	1.938	4.625
2.00	0.625	0.750	1.125	0.375	5/16 -24	2.500	0.250	1.500	1.000	7/16 -20	3.625	2.375	1.844	0.625	1.875	5/16 -18	0.500	0.875	2.250	1.938	4.625
2.50	0.625	0.750	1.125	0.357	5/16 -24	3.000	0.250	1.500	1.000	7/16 -20	3.750	2.500	2.188	0.625	1.875	3/8 -16	0.625	1.250	2.375	1.938	4.750
3.25	1.000	1.125	1.500	0.500	3/8 -24	3.750	0.375	1.750	1.250	3/4 -16	4.250	2.750	2.760	0.875	2.375	1/2 -13	0.750	1.500	2.625	2.438	5.625
4.00	1.000	1.125	1.500	0.500	3/8 -24	4.500	0.375	1.750	1.250	3/4 -16	4.250	2.750	3.320	0.875	2.375	1/2 -13	0.750	2.063	2.625	2.438	5.625
	1.375	1.625	2.000	0.625						1-14				1.000	2.625					2.688	5.875
5.00	1.000	1.125	1.500	0.500	1/2 -20	5.500	0.375	1.750	1.250	3/4 -16	4.500	3.000	4.100	0.875	2.375	5/8 -11	1.000	2.688	2.875	2.438	5.875
	1.375	1.625	2.000	0.625						1-14				1.000	2.625					2.688	6.125
6.00	1.375	1.625	2.000	0.625	1/2 -20	6.500	0.500	2.000	1.500	1-14	5.000	3.250	4.875	1.000	2.750	3/4 -10	1.125	3.250	3.125	2.813	6.625
	1.750	2.000	2.375	0.750						1 1/4 -12				1.125	3.000					3.063	6.875
8.00	1.375	1.625	2.000	0.625	5/8-18	8.500	0.750	2.000	1.500	1-14	5.125	3.375	6.438	1.000	2.750	3/4 -10	1.125	4.500	3.250	2.813	7.313
	1.750	2.000	2.375	0.750						1 1/4 -12				1.125	3.000					3.063	7.563

For dimensions not shown, see page 28.

FM-MS4: *Oversize Rod Diameter (1.50" Bore to 3.25" Bore)*

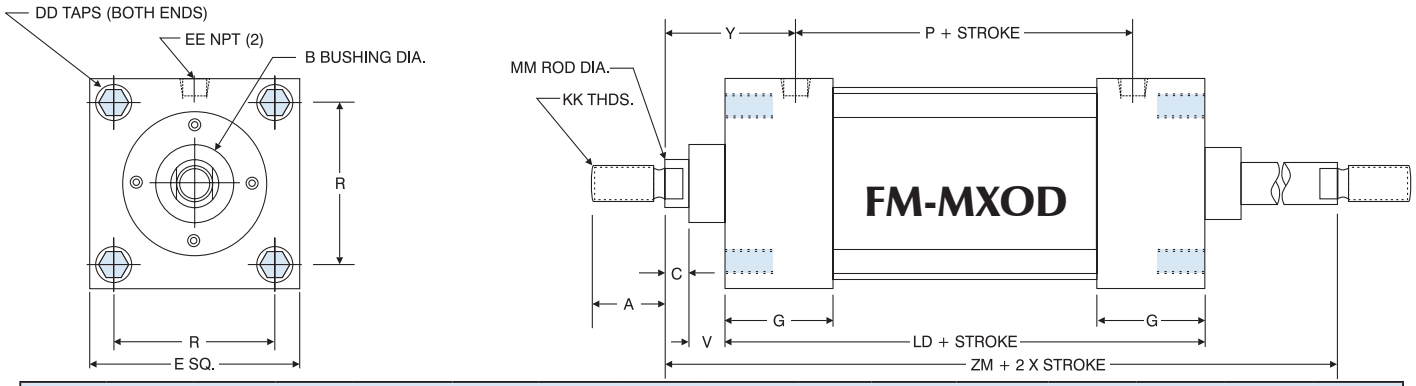




'FM' SERIES OVERSIZE ROD 'MS4' FLUSH MOUNT DIMENSIONS																						
BORE	MM	A	B	C	DD	E	EE	F	G	J	KK	LB	P	R	V	Y	NT	TK	TN	SN	XT	ZB
1.50	1.000	1.125	1.500	0.500	1/4 -28	2.000	0.250	0.375	1.500	1.000	3/4 -16	3.625	2.375	1.438	0.500	2.250	1/4 -20	0.375	0.625	2.250	2.313	5.000
2.00	1.000	1.125	1.500	0.500	5/16 -24	2.500	0.250	0.375	1.500	1.000	3/4 -16	3.625	2.375	1.844	0.500	2.250	5/16 -18	0.500	0.875	2.250	2.313	5.000
2.50	1.000	1.125	1.500	0.500	5/16 -24	3.000	0.250	0.375	1.500	1.000	3/4 -16	3.750	2.500	2.188	0.500	2.250	3/8 -16	0.625	1.250	2.375	2.313	5.125
3.25	1.375	1.625	2.000	0.625	3/8 -24	3.750	0.375	0.625	1.750	1.250	1-14	4.250	2.750	2.760	0.375	2.625	1/2 -13	0.750	1.500	2.625	2.688	5.875

For dimensions not shown, see page 28.

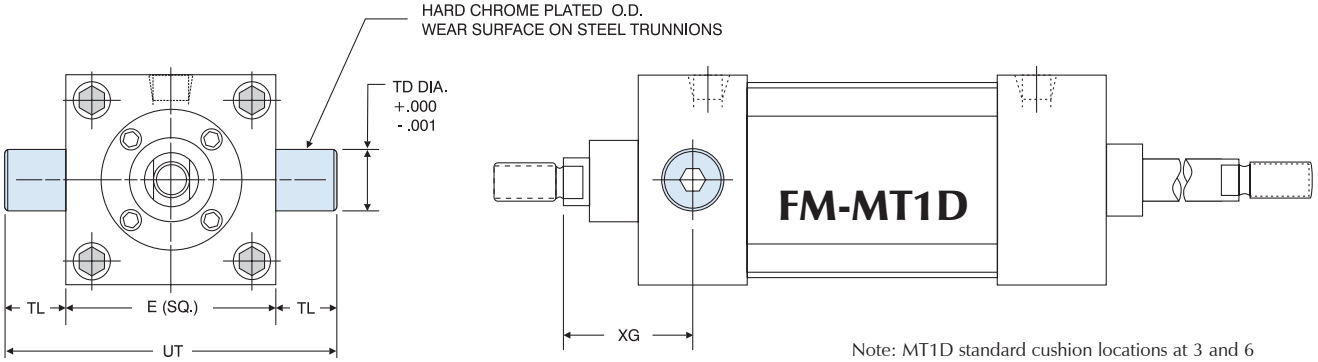
SERIES 'FM' DIMENSIONS: DOUBLE ROD END (NO MOUNT)
FLUSH MOUNT (WITH SLEEVE NUT CONSTRUCTION)
BASIC DIMENSIONS: *DOUBLE ROD END 'MXOD' (NO MOUNT)*



'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	0.750	1.125	0.375	1/4 -28	2.000	0.250	1.500	7/16 -20	4.125	0.625	2.375	1.438	0.625	1.875	6.125
2.00	0.750	1.125	0.375	5/16 -24	2.500	0.250	1.500	7/16 -20	4.125	0.625	2.375	1.844	0.625	1.875	6.125
2.50	0.750	1.125	0.375	5/16 -24	3.000	0.250	1.500	7/16 -20	4.250	0.625	2.500	2.188	0.625	1.875	6.250
3.25	1.125	1.500	0.500	3/8 -24	3.750	0.375	1.750	3/4 -16	4.750	1.000	2.750	2.760	0.875	2.375	7.500
4.00	1.125	1.500	0.500	3/8 -24	4.500	0.375	1.750	3/4 -16	4.750	1.000	2.750	3.320	0.875	2.375	7.500
5.00	1.125	1.500	0.500	1/2 -20	5.500	0.375	1.750	3/4 -16	5.000	1.000	3.000	4.100	0.875	2.375	7.750
6.00	1.625	2.000	0.625	1/2 -20	6.500	0.500	2.000	1 -14	5.500	1.375	3.250	4.875	1.000	2.750	8.750
8.00	1.625	2.000	0.625	5/8-18	8.500	0.750	2.000	1 -14	5.625	1.375	3.375	6.438	1.000	2.750	8.875

For oversize rod dimensions, refer to page 36.

SERIES 'FM' DIMENSIONS: *DOUBLE ROD END PIVOT MOUNT*

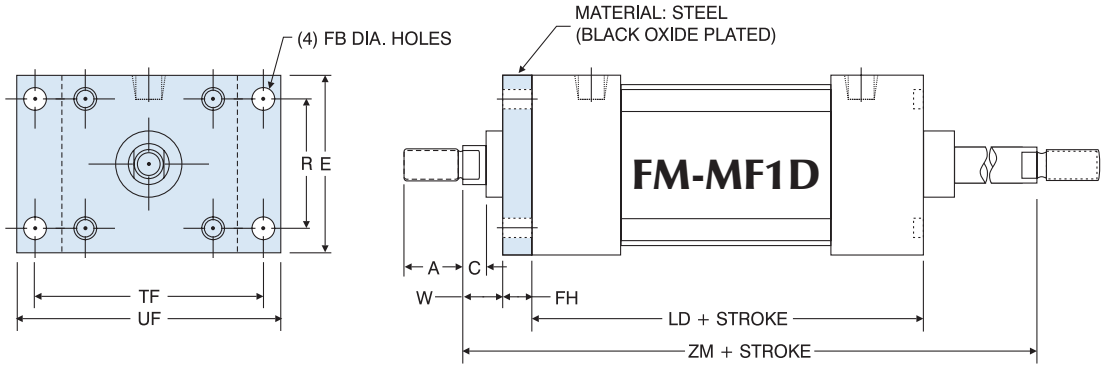


Note: MT1D standard cushion locations at 3 and 6

'FM' SERIES DOUBLE ROD END 'MT1D' HEAD TRUNNION MOUNT DIMENSIONS						
BORE	ROD DIAMETER	E	TD	TL	UT	XG
1.50*	0.625 Standard	2.000	1.000	1.000	4.000	1.750
2.00	0.625 Standard	2.500	1.000	1.000	4.500	1.750
	1.000 Oversize					2.125
2.50	0.625 Standard	3.000	1.000	1.000	5.000	1.750
	1.000 Oversize					2.125
3.25	1.000 Standard	3.750	1.000	1.000	5.750	2.250
	1.375 Oversize					2.500
4.00	1.000 Standard	4.500	1.000	1.000	6.500	2.250
	1.375 Oversize					2.500
5.00	1.000 Standard	5.500	1.000	1.000	7.500	2.250
	1.375 Oversize					2.500
6.00	1.375 Standard	6.500	1.375	1.375	9.250	2.625
	1.750 Oversize					2.875
8.00	1.375 Standard	8.500	1.375	1.375	11.250	2.625
	1.750 Oversize					2.875

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

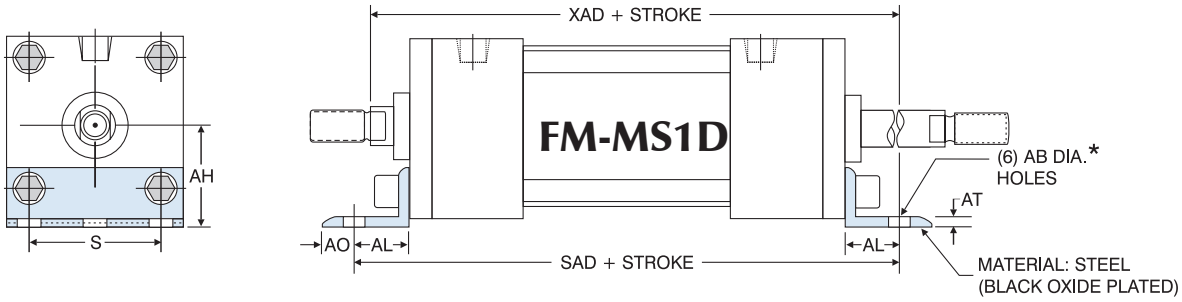
SERIES 'FM' DIMENSIONS: DOUBLE ROD END FLANGE MOUNT
FLUSH MOUNT (WITH SLEEVE NUT CONSTRUCTION)



'FM' SERIES DOUBLE ROD END 'MF1D' FLANGE MOUNT DIMENSIONS												
BORE	ROD DIAMETER	A	C	E	FB	FH	R	TF	UF	W	ADD STROKE LD	ADD STROKE ZM
1.50	0.625 Standard	0.750	0.375	2.000	0.313	0.375	1.438	2.750	3.375	0.625	4.125	6.125
	1.000 Oversize	1.125	0.500							1.000		6.875
2.00	0.625 Standard	0.750	0.375	2.500	0.375	0.375	1.844	3.375	4.125	0.625	4.125	6.125
	1.000 Oversize	1.125	0.500							1.000		6.875
2.50	0.625 Standard	0.750	0.375	3.000	0.375	0.375	2.188	3.875	4.625	0.625	4.250	6.250
	1.000 Oversize	1.125	0.500							1.000		7.000
3.25	1.000 Standard	1.125	0.500	3.750	0.438	0.625	2.760	4.688	5.500	0.750	4.750	7.500
	1.375 Oversize	1.625	0.625							1.000		8.000
4.00	1.000 Standard	1.125	0.500	4.500	0.438	0.625	3.320	5.438	6.250	0.750	4.750	7.500
	1.375 Oversize	1.625	0.625							1.000		8.000
5.00	1.000 Standard	1.125	0.500	5.500	0.563	0.625	4.100	6.625	7.625	0.750	5.000	7.750
	1.375 Oversize	1.625	0.625							1.000		8.250
6.00	1.375 Standard	1.625	0.625	6.500	0.563	0.750	4.875	7.625	8.625	0.875	5.500	8.750
	1.750 Oversize	2.000	0.750							1.125		9.250

Note: 1.50" to 3.25" oversized rods use full retainers.
For dimensions not shown, see page 33.

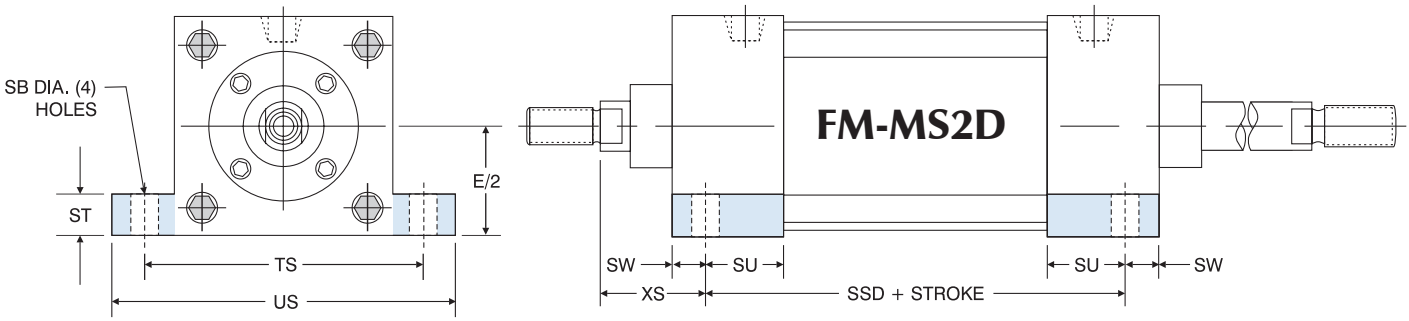
SERIES 'FM' DIMENSIONS: DOUBLE ROD END BASE MOUNTS
FLUSH MOUNT (WITH SLEEVE NUT CONSTRUCTION)



'FM' SERIES DOUBLE ROD END 'MS1D' ANGLE MOUNT DIMENSIONS									
BORE	ROD DIAMETER	AB	AH	AL	AO	AT	S	ADD STROKE SAD	ADD STROKE XAD
1.50	0.625 Standard	0.438	1.188	1.000	0.375	0.125	1.250	6.875	6.500
	1.000 Oversize								6.875
2.00	0.625 Standard	0.438	1.438	1.000	0.375	0.125	1.750	6.875	6.500
	1.000 Oversize								6.875
2.50	0.625 Standard	0.438	1.625	1.000	0.375	0.125	2.250	7.000	6.625
	1.000 Oversize								7.000
3.25	1.000 Standard	0.563	1.938	1.250	0.500	0.125	2.750	8.500	8.000
	1.375 Oversize								8.250
4.00	1.000 Standard	0.563	2.250	1.250	0.500	0.125	3.500	8.500	8.000
	1.375 Oversize								8.250
5.00	1.000 Standard	0.688	2.750	1.375	0.625	0.188	4.250	9.000	8.375
	1.375 Oversize								8.625
6.00	1.375 Standard	0.813	3.250	1.375	0.625	0.188	5.250	9.750	9.250
	1.750 Oversize								9.500
8.00	1.375 Standard	0.813	4.250	1.813	0.688	0.250	7.125	9.250	9.063
	1.750 Oversize								9.313

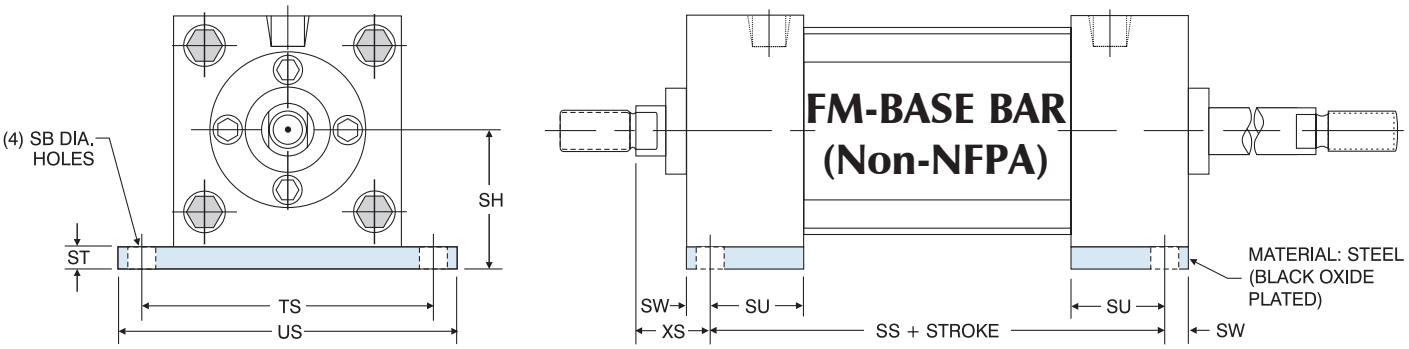
*1.50" bore has four (4) "AB" holes on "S" dimension.
Note: Flush retainer on 8.00" bore (MS1 bracket bolted directly to head).
For dimensions not shown, see page 33.

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



'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	0.625 Standard	0.438	1.000	0.500	1.125	0.375	2.750	3.500	1.375	3.375
	1.000 Oversize								1.750	
2.00	0.625 Standard	0.438	1.250	0.500	1.125	0.375	3.250	4.000	1.375	3.375
	1.000 Oversize								1.750	
2.50	0.625 Standard	0.438	1.500	0.500	1.125	0.375	3.750	4.500	1.375	3.500
	1.000 Oversize								1.750	
3.25	1.000 Standard	0.563	1.875	0.750	1.250	0.500	4.750	5.750	1.875	3.750
	1.375 Oversize								2.125	
4.00	1.000 Standard	0.563	2.250	0.750	1.250	0.500	5.500	6.500	1.875	3.750
	1.375 Oversize								2.125	
5.00	1.000 Standard	0.813	2.750	1.000	1.063	0.688	6.875	8.250	2.063	3.625
	1.375 Oversize								2.313	
6.00	1.375 Standard	0.813	3.250	1.000	1.313	0.688	7.875	9.250	2.313	4.125
	1.750 Oversize								2.563	
8.00	1.375 Standard	0.813	4.250	1.000	1.563	0.688	9.875	11.250	2.313	4.250
	1.750 Oversize								2.563	

Note: 1.50" to 3.25" oversized rods use full retainers.
For dimensions not shown, see page 33.

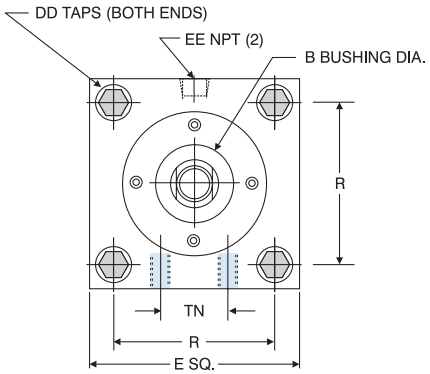


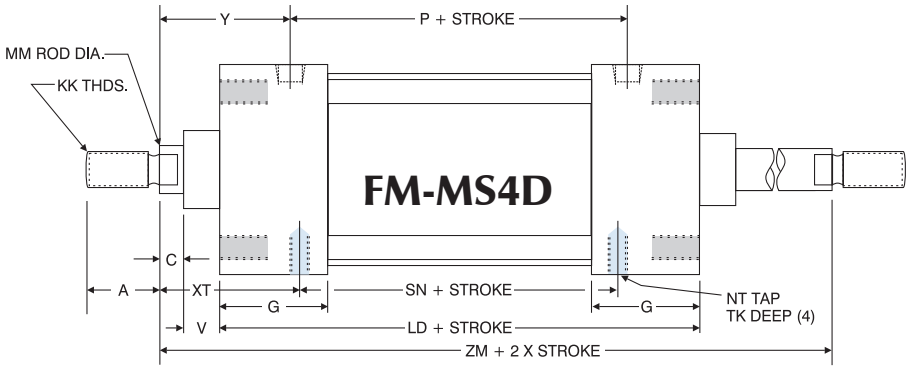
'FM' SERIES DOUBLE ROD END BASE BAR MOUNT (Non-NFPA) DIMENSIONS										
BORE	ROD DIAMETER	SB	SH	ADD STROKE SS	ST	SU	SW	TS	US	XS
1.50	0.625 Standard	0.438	1.250	3.375	0.250	1.125	0.375	2.750	3.500	1.375
	1.000 Oversize									1.750
2.00	0.625 Standard	0.438	1.500	3.375	0.250	1.125	0.375	3.250	4.000	1.375
	1.000 Oversize									1.750
2.50	0.625 Standard	0.438	1.875	3.500	0.375	1.125	0.357	3.750	4.500	1.375
	1.000 Oversize									1.750
3.25	1.000 Standard	0.563	2.375	3.750	0.500	1.250	0.500	4.750	5.750	1.875
	1.375 Oversize									2.125
4.00	1.000 Standard	0.563	2.750	3.750	0.500	1.250	0.500	5.500	6.500	1.875
	1.375 Oversize									2.125

For dimensions not shown, see page 33.

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

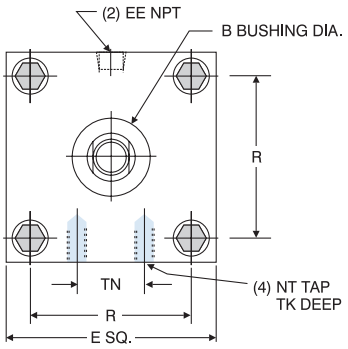
FM-MS4D: Standard Rod Diameter

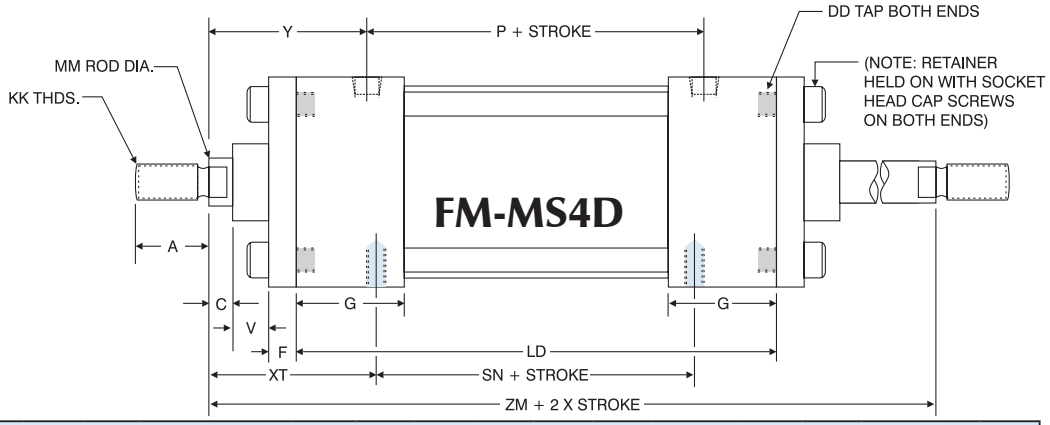




'FM' SERIES DOUBLE ROD END 'MS4D' FLUSH MOUNT DIMENSIONS																			
BORE	A	B	C	DD	E	EE	G	KK	LD	MM	P	R	V	Y	NT	TK	TN	SN	XT	ZM
1.50	0.750	1.125	0.375	1/4 -28	2.000	0.250	1.500	7/16 -20	4.125	0.625	2.375	1.438	0.625	1.875	1/4 -20	0.375	0.625	2.250	1.938	6.125
2.00	0.750	1.125	0.375	5/16 -24	2.500	0.250	1.500	7/16 -20	4.125	0.625	2.375	1.844	0.625	1.875	5/16 -18	0.500	0.875	2.250	1.938	6.125
2.50	0.750	1.125	0.375	5/16 -24	3.000	0.250	1.500	7/16 -20	4.250	0.625	2.500	2.188	0.625	1.875	3/8 -16	0.625	1.250	2.375	1.938	6.250
3.25	1.125	1.500	0.500	3/8 -24	3.750	0.375	1.750	3/4 -16	4.750	1.000	2.750	2.760	0.875	2.375	1/2 -13	0.750	1.500	2.625	2.438	7.500
4.00	1.125	1.500	0.500	3/8 -24	4.500	0.375	1.750	3/4 -16	4.750	1.000	2.750	3.320	0.875	2.375	1/2 -13	0.750	2.063	2.625	2.438	7.500
5.00	1.125	1.500	0.500	1/2 -20	5.500	0.375	1.750	3/4 -16	5.000	1.000	3.000	4.100	0.875	2.375	5/8 -11	1.000	2.688	2.875	2.438	7.750
6.00	1.625	2.000	0.625	1/2 -20	6.500	0.500	2.000	1-14	5.500	1.375	3.250	4.875	1.000	2.750	3/4 -10	1.125	3.250	3.125	2.813	8.750
8.00	1.625	2.000	0.625	5/8-18	8.500	0.750	2.000	1-14	5.625	1.375	3.375	6.438	1.000	2.750	3/4 -10	1.125	4.500	3.250	2.813	8.875

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	1.125	1.500	0.500	1/4 -28	2.000	0.250	0.375	1.500	3/4 -16	4.125	1.000	2.375	1.438	0.500	2.250	1/4 -20	0.375	0.625	2.250	2.313	6.875
2.00	1.125	1.500	0.500	5/16 -24	2.500	0.250	0.375	1.500	3/4 -16	4.125	1.000	2.375	1.845	0.500	2.250	5/16 -18	0.500	0.875	2.250	2.313	6.875
2.50	1.125	1.500	0.500	5/16 -24	3.000	0.250	0.375	1.500	3/4 -16	4.250	1.000	2.500	2.188	0.500	2.250	3/8 -16	0.625	1.250	2.375	2.313	7.000
3.25	1.625	2.000	0.625	3/8 -24	3.750	0.375	0.625	1.750	1-14	4.750	1.375	2.750	2.760	0.375	2.625	1/2 -13	0.750	1.500	2.625	2.688	8.000
4.00	1.625	2.000	0.625	3/8 -24	4.500	0.375	0.625	1.750	1-14	4.750	1.375	2.750	3.320	0.375	2.625	1/2 -13	0.750	2.063	2.625	2.688	8.000
5.00	1.625	2.000	0.625	1/2 -20	5.500	0.375	0.625	1.750	1-14	5.000	1.375	3.000	4.100	0.375	2.625	5/8 -11	1.000	2.688	2.875	2.688	8.250
6.00	2.000	2.375	0.750	1/2 -20	6.500	0.500	0.750	2.000	1 1/4 -12	5.500	1.750	3.250	4.875	0.500	3.125	3/4 -10	1.125	3.250	3.125	3.063	9.250
8.00	2.000	2.375	0.750	5/8-18	8.500	0.750	0.625	2.000	1 1/4 -12	5.625	1.750	3.375	6.438	1.125	3.000	3/4 -10	1.125	4.500	3.250	3.063	9.375

Note: Flush retainer on 4.00" to 8.00" bore.

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 four (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 six (6) mounting kits. Each kit comes complete with fasteners; pins are ordered separately.

SERIES 'FM' MOUNTING KITS

BORE	MP1 Part Number	MP2 Part Number	MP4 Part Number	MF1 Part Number	MF1 OS ROD Part Number	MF2 Part Number	MS1 Part Number	Base Bar Part Number
1.50	FM-MP1-15-KIT	FM-MP2-15-KIT	FM-MP4-15-KIT	FM-MF1-15-KIT	FM-MF1-15-OS-KIT	FM-MF2-15-KIT	FM-MS1-15-KIT	FM-BASEBAR-15-KIT
2.00	FM-MP1-20-KIT	FM-MP2-20-KIT	FM-MP4-20-KIT	FM-MF1-20-KIT	FM-MF1-20-OS-KIT	FM-MF2-20-KIT	FM-MS1-20-KIT	FM-BASEBAR-20-KIT
2.50	FM-MP1-25-KIT	FM-MP2-25-KIT	FM-MP4-25-KIT	FM-MF1-25-KIT	FM-MF1-25-OS-KIT	FM-MF2-25-KIT	FM-MS1-25-KIT	FM-BASEBAR-25-KIT
3.25	FM-MP1-32-KIT	FM-MP2-32-KIT	FM-MP4-32-KIT	FM-MF1-32-KIT	FM-MF1-32-OS-KIT	FM-MF2-32-KIT	FM-MS1-32-KIT	FM-BASEBAR-32-KIT
4.00	FM-MP1-40-KIT	FM-MP2-40-KIT	FM-MP4-40-KIT	FM-MF1-40-KIT	FM-MF1-40-OS-KIT	FM-MF2-40-KIT	FM-MS1-40-KIT	FM-BASEBAR-40-KIT
5.00	FM-MP1-50-KIT	FM-MP2-50-KIT	N/A	FM-MF1-50-KIT	FM-MF1-50-OS-KIT	FM-MF2-50-KIT	FM-MS1-50-KIT	N/A
6.00	FM-MP1-60-KIT	FM-MP2-60-KIT	N/A	FM-MF1-60-KIT	FM-MF1-60-OS-KIT	FM-MF2-60-KIT	FM-MS1-60-KIT	N/A

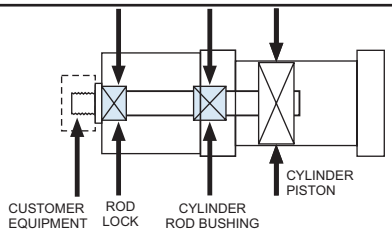
*Base Bar "SH" dimension is not NFPA. Refer to pages 31 & 35.
All other dimensions are NFPA.

SERIES 'FM' (NFPA) CYLINDER WITH ROD LOCK

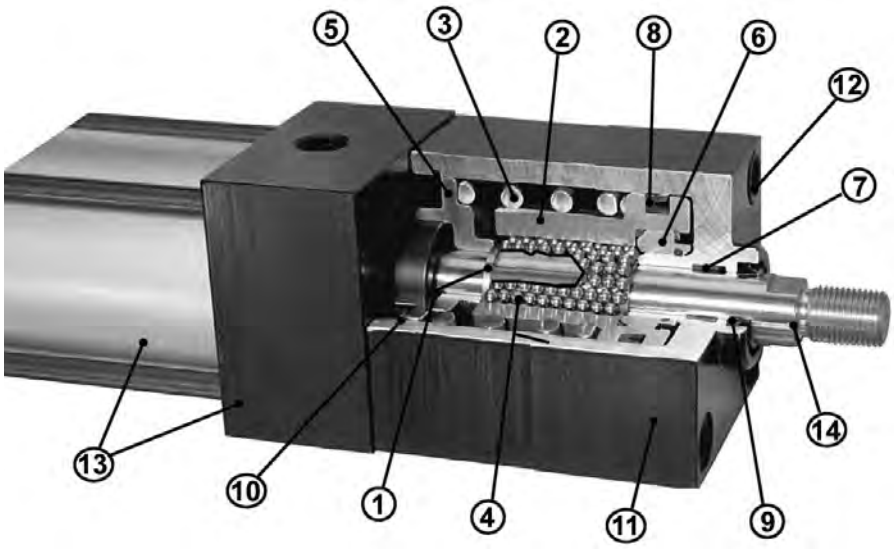
Floating Rod Bushing

SELF ALIGNMENT FEATURE

Rod Bushing is designed to float .002" to improve 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 ***LOCKING COLLAR*** – Hardened specialized tool steel, precision ground, multi-split collar design provides 4,000,000-5,000,000 cycles without fatigue or fracture.

② ***PISTON-OUTER LOCK HOUSING*** – Hardened tool steel, precision ground design also serves as a spring guide for uniform clamp force distribution with virtually no wear.

③ ***SPRING*** – Oversized for maximum power, heavy-duty coil spring (low fatigue) will provide millions of consistent rod lock actuations at full rated load.

④ ***BALL BEARINGS*** – Hardened, precision ground (high grade) steel ball bearings provide total transfer of spring force to locking collar.

⑤ ***ROD LOCK GUIDE*** (Steel) – Centers Rod Lock to cylinder rod bushing and maintains perfect alignment eliminating binding or rod scraping or reduced locking force due to misalignment.

⑥ ***PISTON GUIDE*** – Hardened and ground steel guide that centers the piston-outer lock housing and provides bearing surface for piston/spring assembly

⑦ ***ROD GUIDE BEARING*** – High-load wear strip (PTFE based), self lubricating.

⑧ ***PISTON SEAL*** – Heavy lip design Carboxylated Nitrile construction. Seal is pressure activated and wear compensating for extended life (self lubricating material).

⑨ ***ROD WIPER*** – Urethane

⑩ ***RETAINER RING*** (Steel) – Retains coil spring compression (under very high spring force) and internal lock components (NOTE: Do not remove).

⑪ ***HOUSING*** – Precision machined from 6061-T6 aluminum, black anodized for corrosion resistance.

⑫ ***SLEEVE NUT (Steel)*** – Provides four (4) tapped holes for mounting unit or MF1 flange.

⑬ ***FM SERIES CYLINDER*** – Refer to TRD catalog pages 28-36 for specifications and options.

⑭ ***CYLINDER PISTON ROD*** – Hard chrome plated steel.

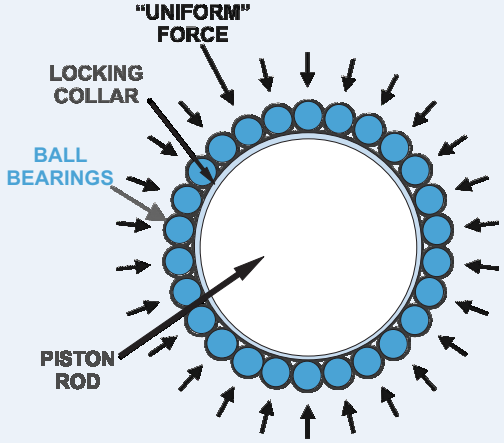
PERMANENT LUBRICATION – Permanently lubricated with Magnalube-G PTFE based grease on all internal components. No additional lubrication is required.

100% Fill Ball Bearing Design

The cavity between the Locking Collar and Outer Lock Housing is 100% filled with ball bearings, providing UNIFORM distribution of Locking (Clamp/Holding) Force.

DESIGN ADVANTAGES:

- ***LOW METAL FATIGUE*** – On all clamping components.
- ***SUPERIOR LOCKING FORCES*** – HIGHEST LOCKING FORCES IN THE INDUSTRY.
- ***NON WEARING*** – Low component fatigue eliminates wear and extends life to 4,000,000 - 5,000,000 cycles at full rated load.

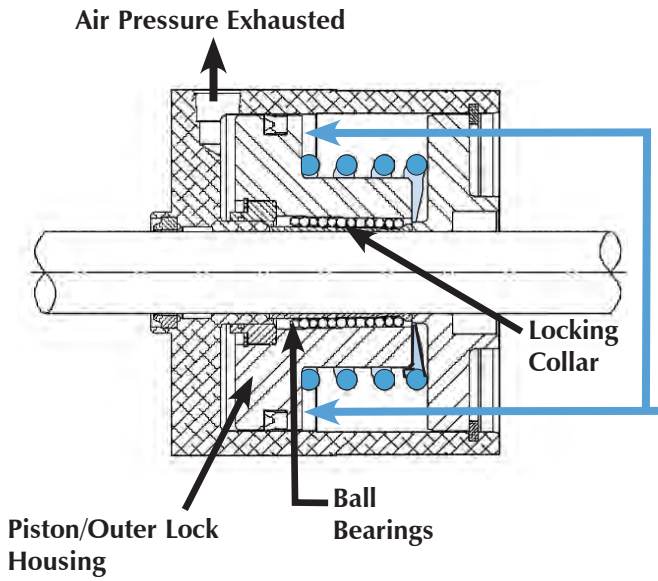


The TRD difference...

TRD's floating rod bushing design and 'RL' Series Rod Lock = OPTIMIZED RESULTS and SUPERIOR PERFORMANCE.

For rod locks to achieve the rated holding force and maximize cycle life, good alignment must be maintained between the locking mechanism and cylinder rod. With TRD's Floating Rod Bushing design and accurate rod lock alignment to assure superior performance and trouble-free operation.

OPERATING PRINCIPAL



CLAMPING (locked) CONDITION:

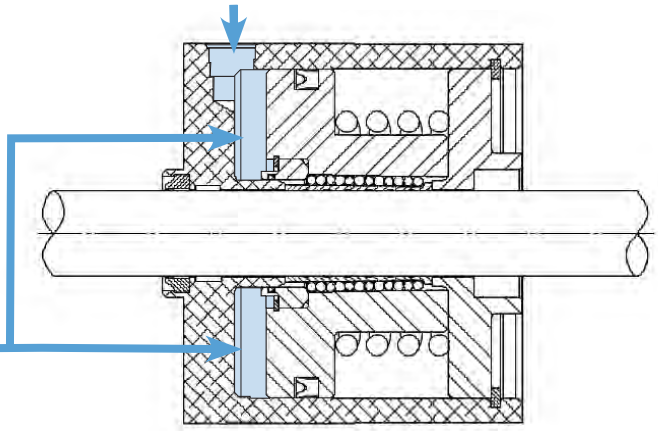
When air pressure is exhausted from rod lock, high spring force is applied to the piston/outer lock housing which utilizes an ultra-fine tapered wedge mechanism. Ball bearings transfer the spring force directly to the locking collar. The locking collar is designed to flex and securely grip the rod. Clamping action does not move or disturb the rod, maintaining rod position during actuation.

HIGH SPRING FORCE LOCKS PISTON ROD IN PLACE

UNCLAMPED CONDITION (Free Moving Piston Rod):

When air pressure is applied to rod lock, the air pressure overcomes the spring force, moving Piston/Outer Locking Housing. This movement provides clearance in the tapered mechanism allowing the Locking Collar to relax and provide free rod movement.

60-150 PSI Air Pressure



Air pressure moves piston, compressing spring, which eliminates locking force

OPERATING PRESSURE	
Cylinder	0 TO 250 PSI AIR
Rod Lock	60 TO 150 PSI AIR

OPERATING TEMPERATURE	
Standard Seals	10° F to 180° F (-12° C to 82° C)
Fluorocarbon Seals	0° F to 400° F (-18° C to 204° C)

AXIAL MOVEMENT (CLAMPED)*	
Standard	.000" to .008"
Close Tol. (Optional)	.000" to .002" - .003"

*Represents clearance within the rod lock unit, .000" movement due to actuation.

ROD MATERIAL REQUIREMENTS	
Diameter	+.000" to -.002" Nominal Diameter
Hardened Shaft	.0005" Minimum hard chrome
Unhardened Shaft	.001" Minimum hard chrome
Finish	6 to 10 micro-inch

APPLICATION & RATED HOLDING FORCE

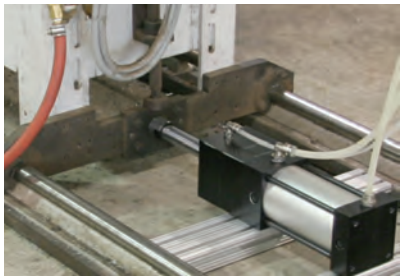
Rod Locks are used to hold linear cylinder loads stationary in any mounting orientation. Units will lock in both directions to rated holding force. They are not designed to withstand rotational loads or to "brake" the load in dynamic applications. Units are commonly used in work holding applications and for locking tools or fixtures in the event of air pressure loss. They are very common in positioning systems since they will hold the cylinder position very rigidly. Units are also common in emergency stop (E-Stop) applications.

Refer to safety information on page 59 for proper application.

COMMON APPLICATIONS








BASIC CYLINDER FORCE CHART

BORE	ROD DIA.	STROKE TYPE	EFFECTIVE PISTON AREA	POUNDS OF FORCE AT:		
				60 PSI	80 PSI	100 PSI
1.50	ALL	PUSH	1.767	106	142	177
	0.625	PULL	1.460	88	117	146
2.00	ALL	PUSH	3.142	188	251	314
	0.625	PULL	2.835	170	227	284
	1.000	PULL	2.357	141	189	236
2.50	ALL	PUSH	4.909	295	393	491
	0.625	PULL	4.602	276	368	460
	1.000	PULL	4.124	247	330	412
3.25	ALL	PUSH	8.296	498	664	830
	1.000	PULL	7.511	451	601	751
	1.375	PULL	6.811	409	545	681
4.00	ALL	PUSH	12.566	754	1005	1257
	1.000	PULL	11.781	707	942	1178
	1.375	PULL	11.081	665	886	1108
5.00	ALL	PUSH	19.635	1178	1571	1964
	1.000	PULL	18.850	1131	1508	1885
	1.375	PULL	18.150	1089	1452	1815
6.00	ALL	PUSH	28.274	1696	2262	2827
	1.375	PULL	26.789	1607	2144	2679
	1.750	PULL	25.869	1552	2070	2587

RATED HOLDING FORCE

BORE	ROD DIA.	ROD LOCK MODEL	HOLDING FORCE *
1.50	0.625	RL-063150	200
2.00	0.625	RL-063200	500
	1.000	RL-100200	350
2.50	0.625	RL-063250	650
	1.000	RL-100250	650
3.25	1.000	RL-100325	1000
	1.375	RL-138325	1000
4.00	1.000	RL-100400	1550
	1.375	RL-138400	1550
5.00	1.000	RL-100500	2150
	1.375	RL-138500	2150
6.00	1.375	RL-138600	2850
	1.750	RL-175600	2850

*Holding force is the minimum rating on clean and dry rods over the entire life of the unit. Add the load weight to the basic cylinder force when sizing rod lock.

ROD LOCKS ARE 100% TESTED to assure that each unit exceeds the published rated holding force. When properly applied, rod locks will maintain the published holding force over the life of the unit.

HOW TO ORDER: CYLINDER WITH ROD LOCK

FM - MS4 ___ - 2.50 x 10 - HC - RL - 063 250 - MPR

SERIES	
FM	250 PSI AIR

NFPA MOUNTS	
MF1	FRONT FLANGE (1.50"- 6.00" Bore)
MF2	REAR FLANGE (1.50"- 6.00" Bore)
MP1	REAR PIVOT CLEVIS (1.50"- 6.00" Bore)
MP2	REAR PIVOT CLEVIS (1.50"- 6.00" Bore)
MP4	REAR PIVOT EYE (1.50"- 4.00" Bore)
MS1	FRONT & REAR END ANGLE (1.50"- 6.00" Bore)
MS2	SIDE LUG (1.50"- 6.00" Bore)
MS4	BOTTOM TAPPED HOLES (1.50"- 6.00" Bore)
MT1	FRONT TRUNNION (1.50"- 6.00" Bore)
MT2	REAR TRUNNION (1.50"- 6.00" Bore)
MXO	NO MOUNT (1.50"- 6.00" Bore)
BASE BAR	NON-NFPA (1.50"- 4.00" Bore)

BORE	
1.50	2.00
2.50	3.25
4.00	5.00
6.00	

STROKE
0" to 120" MADE TO ORDER

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

ROD LOCK
RL

ROD SIZE	
063	0.625"
100	1.000"
138	1.375"
175	1.750"

BORE	
150	1.50"
200	2.00"
250	2.50"
325	3.25"
400	4.00"
500	5.00"
600	6.00"

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

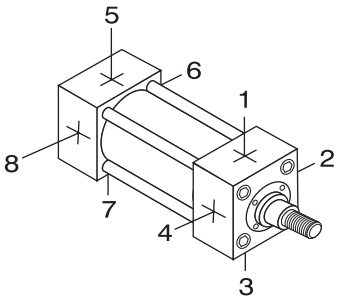
Notes: 1) Ordering example for non-standard cushion locations: H3C7
2) Refer to page 176 for assistance in cushion length selection.
3) Cushions can be ordered on same side as ports.

CYLINDER 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" - 6.00" Bore)
	BSP	BSP PORTS (SPECIFY SIZE, Example: BSP = 1/4")
	EN	ELECTROLESS NICKEL PLATED
	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
	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
	NR	NON-ROTATING
	OP	OPTIONAL PORT LOCATION OR SIZE (Example: Ports @ 3 & 7)
	OS	OVERSIZE ROD DIAMETER (SPECIFY SIZE, Example: OS = 1.38")
	RLC =	EXTENDED PISTON ROD (Example: IF RLC = 0.50", THEN 1" ROD EXTENSION IS RLC = 1.50")
	SAE	SAE PORTS (SPECIFY SIZE, Example: SAE #10)
	SSA	STAINLESS STEEL PISTON ROD, TIE RODS & SLEEVE NUTS, AND FASTENERS
	SSF	STAINLESS STEEL FASTENERS
	SSN	STAINLESS STEEL TIE ROD NUTS
	SSR	STAINLESS STEEL PISTON ROD
	SST	STAINLESS STEEL TIE RODS
X	ST	STOP TUBE - SPECIFY STOP TUBE LENGTH (in inches) SPECIFY STROKE AS ES (effective stroke) (Example: FM MS4 2 X 24ES-ST=3)
	TMS*	STEEL CYLINDER TUBE, BLACK EPOXY PAINT FINISH
	TH	400 PSI HYDRAULIC NON-SHOCK
	V	FLUOROCARBON ROD LOCK SEALS
	VS	FLUOROCARBON CYLINDER SEALS
	XX	SPECIAL VARIATION (SPECIFY)

*STEEL TUBES do not work with MPR magnetic pistons. Refer to pages 231-233 of TRD master catalog for Balluff end of stroke sensors.

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	ST* (STOP TUBE) Example: ST=2
1.50	0.500	0.250	0.250	1.000	1.000	2.000
2.00	0.500	0.250	0.250	1.000	1.000	2.000
2.50	0.500	0.250	0.250	1.000	1.000	2.000
3.25	0.500	0.250	0.250	1.250	1.250	2.000
4.00	0.500	0.250	0.250	1.250	1.250	2.000
5.00	0.500	0.250	0.250	1.250	1.250	2.000
6.00	0.500	0.250	0.250	1.500	1.500	2.000

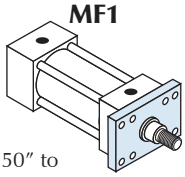
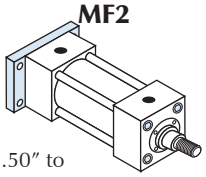
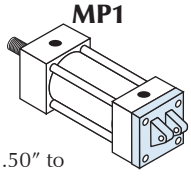
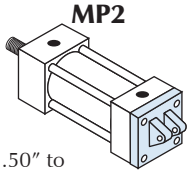
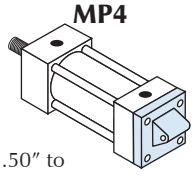
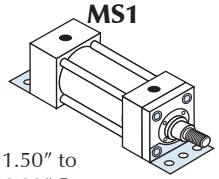
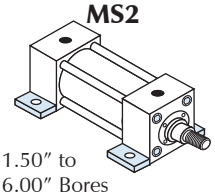
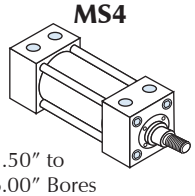
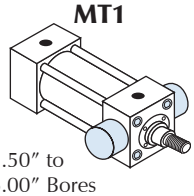
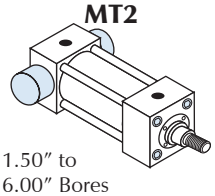
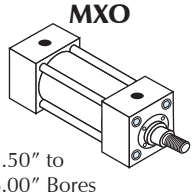
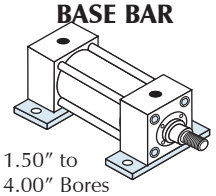
***Note:** The desired Stop Tube length adds directly to the overall cylinder length.

SPECIAL ROD LOCK MODIFICATIONS

Common rod lock modifications include metallic rod scraper, close tolerance axial movement, fluorocarbon seals, electroless nickel plating or stainless steel housing.

Consult your local distributor or TRD for more information and delivery.

'FM' NFPA MOUNTS

MF1  1.50" to 6.00" Bores	**MF2**  1.50" to 6.00" Bores	**MP1**  1.50" to 6.00" Bores	**MP2**  1.50" to 6.00" Bores	**MP4**  1.50" to 4.00" Bores	**MS1**  1.50" to 6.00" Bores
MS2  1.50" to 6.00" Bores	**MS4**  1.50" to 6.00" Bores	**MT1**  1.50" to 6.00" Bores	**MT2**  1.50" to 6.00" Bores	**MXO**  1.50" to 6.00" Bores	**BASE BAR**  1.50" to 4.00" Bores

HOW TO ORDER: CYLINDER & ROD LOCK REPLACEMENT PARTS

REPLACEMENT CYLINDERS

FM - MS4 ___ - 2.50 x 10 - HC - RL - MPR

- FM - SERIES
- MS4 - NFPA MOUNTS
- ___ - STYLE (DOUBLE ROD)
- 2.50 - BORE
- 10 - STROKE
- HC - CUSHIONS
- RL - CYLINDER "READY" FOR ROD LOCK
- MPR - OPTIONS

Note: Cylinders will ship with standard rod end (KK1) and standard rod extension (RLC dimension) unless otherwise noted by customer.

ROD LOCK PART LIST

BORE	ROD DIAMETER	ROD LOCK MODEL	RATED HOLDING FORCE (LBS)	ROD LOCK ONLY	MOUNTING KIT
1.50	0.625	RL-063150	200	RL-063150-1	MK-063150
2.00	0.625	RL-063200	500	RL-063200-1	MK-063200
	1.000	RL-100200	350	RL-100200-1	MK-100200
2.50	0.625	RL-063250	650	RL-063250-1	MK-063250
	1.000	RL-100250	650	RL-100250-1	MK-100250
3.25	1.000	RL-100325	1000	RL-100325-1	MK-100325
	1.375	RL-138325	1000	RL-138325-1	MK-138325
4.00	1.000	RL-100400	1550	RL-100400-1	MK-100400
	1.375	RL-138400	1550	RL-138400-1	MK-138400
5.00	1.000	RL-100500	2150	RL-100500-1	MK-100500
	1.375	RL-138500	2150	RL-138500-1	MK-138500
6.00	1.375	RL-138600	2850	RL-138600-1	MK-138600
	1.750	RL-175600	2850	RL-175600-1	MK-175600

Notes:

Holding Force - The minimum rating over the entire life of the rod lock.

Initial actual holding forces are higher.

DO NOT disassemble rod lock - UNIT CONTAINS HIGH SPRING FORCE. Return to TRD Mfg. for service.

Replacement Rod Locks are shipped with a steel shaft. DO NOT remove 60-150 PSI supply air to Rod Lock without steel shaft or cylinder rod in place - permanent damage to Rod Lock may occur.

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

About Rod End Styles

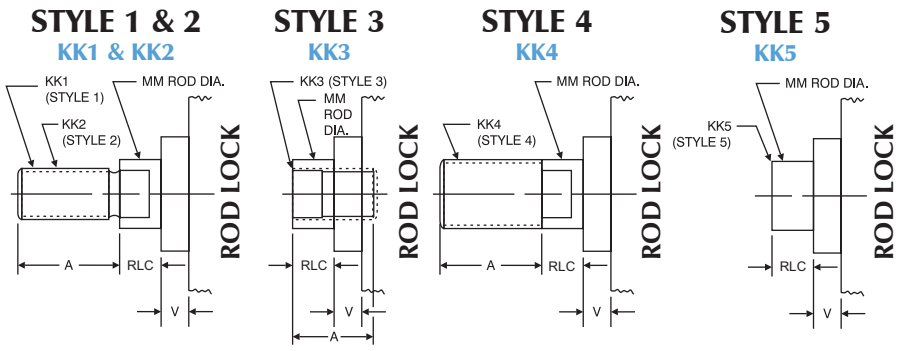
Style 1 Male Rod End is STANDARD

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).

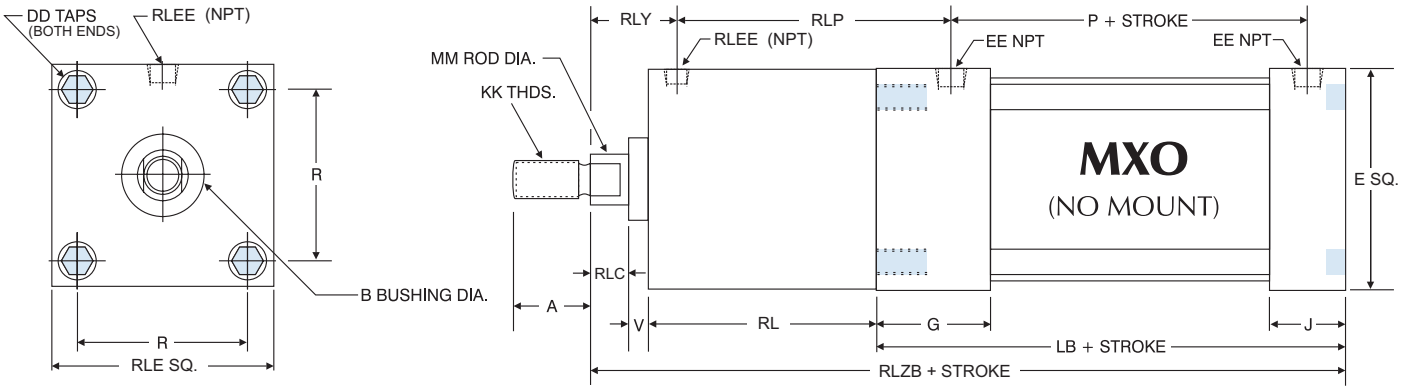
NEED SOMETHING NOT LISTED?
Just send us a sketch.
In most cases, quotes are turned around in one day!

PISTON ROD END STYLES



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

STANDARD ROD: 'MXO' (NO MOUNT)
WITH ROD LOCK MOUNTED



'FM' SERIES BASIC DIMENSIONS 'MXO' (STANDARD ROD)													ROD LOCK BASIC DIMENSIONS							
BORE	A	B	DD	E	EE	G	J	KK	LB	MM	P	R	RL	RLC	RLE	RLEE	RLP	RLY	V	RLZB
1.50	0.750	1.125	1/4 -28	2.000	1/4 NPT	1.500	1.000	7/16 -20	3.625	0.625	2.375	1.430	3.000	0.375	1.980	1/8 NPT	3.563	0.940	0.250	7.250
2.00	0.750	1.125	5/16 -24	2.500	1/4 NPT	1.500	1.000	7/16 -20	3.625	0.625	2.375	1.840	3.000	0.375	2.480	1/8 NPT	3.563	0.940	0.250	7.250
2.50	0.750	1.125	5/16 -24	3.000	1/4 NPT	1.500	1.000	7/16 -20	3.750	0.625	2.500	2.190	3.250	0.375	2.980	1/8 NPT	3.750	1.000	0.250	7.625
3.25	1.125	1.500	3/8 -24	3.750	3/8 NPT	1.750	1.250	3/4 -16	4.250	1.000	2.750	2.760	4.000	0.500	3.730	1/4 NPT	4.438	1.313	0.250	9.000
4.00	1.125	1.500	3/8 -24	4.500	3/8 NPT	1.750	1.250	3/4 -16	4.250	1.000	2.750	3.320	4.000	0.500	4.480	1/4 NPT	4.438	1.313	0.250	9.000
5.00	1.125	1.500	1/2 -20	5.500	3/8 NPT	1.750	1.250	3/4 -16	4.500	1.000	3.000	4.100	4.000	0.500	5.480	1/4 NPT	4.438	1.313	0.250	9.250
6.00	1.625	2.000	1/2 -20	6.500	1/2 NPT	2.000	1.500	1-14	5.000	1.375	3.250	4.880	4.500	0.625	6.480	1/4 NPT	5.060	1.440	0.250	10.375

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).

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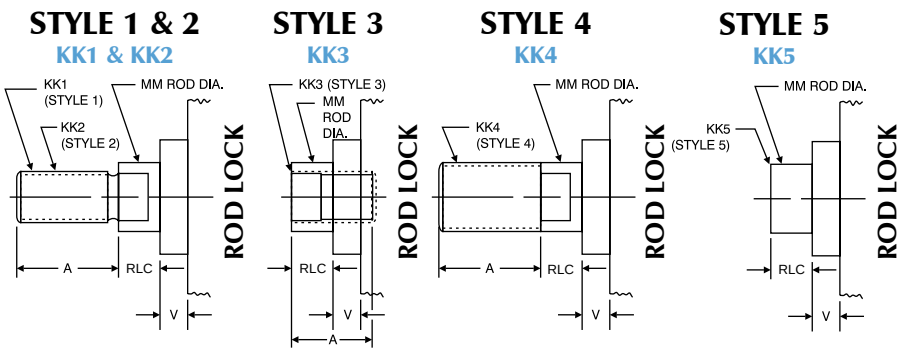
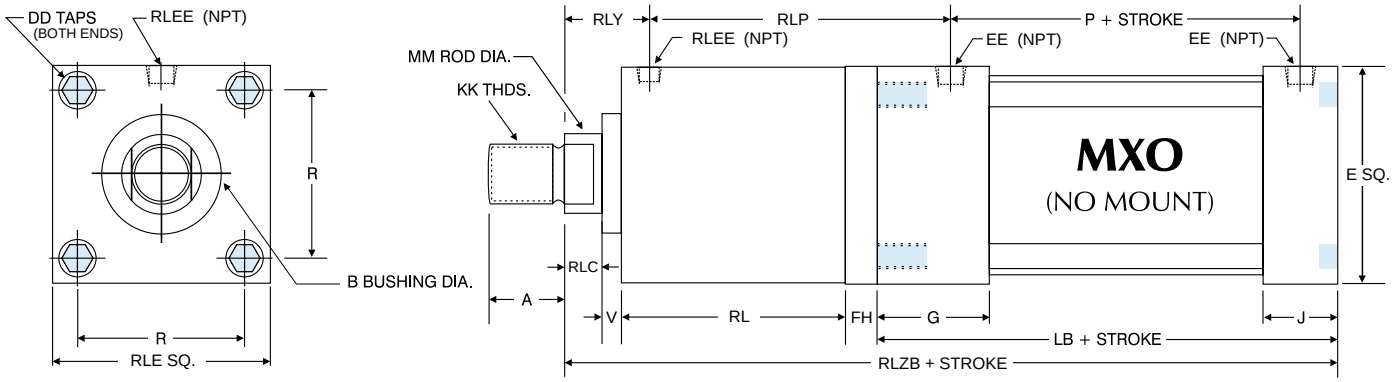
PISTON ROD END STYLES



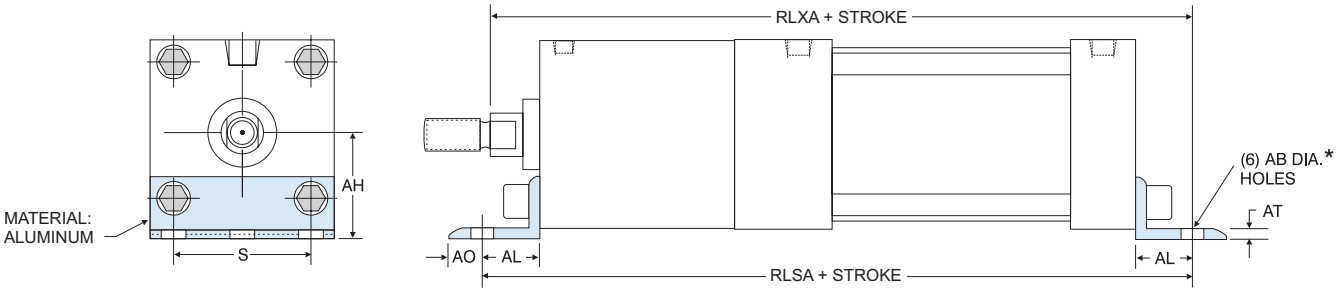
BORE	ROD DIAMETER (MM)	STANDARD Style 1 - Male KK1	A	OPTIONAL Style 2 - Male KK2	A	Style 3 - Female KK3	A	Style 4 - Male KK4	A	Style 5 - Blank KK5	RLC	V
2.00, 2.50	1.000	3/4 -16	1.125	7/8 -14	1.125	3/4 -16	1.125	1 -14	1.125	No Threads	0.500	0.250
3.25, 4.00, 5.00	1.375	1 -14	1.625	1 1/4 -12	1.625	1 -14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

'MXO' (NO MOUNT): OVERSIZED ROD
WITH ROD LOCK MOUNTED



'FM' SERIES BASIC DIMENSIONS 'MXO' (OVERSIZED ROD)														ROD LOCK BASIC DIMENSIONS							
BORE	A	B	DD	E	EE	FH	G	J	KK	LB	MM	P	R	RL	RLC	RLE	RLEE	RLP	RLY	V	RLZB
2.00	1.125	1.500	5/16 -24	2.500	1/4 NPT	0.375	1.500	1.000	3/4 -16	3.625	1.000	2.375	1.840	3.750	0.500	2.480	1/8 NPT	4.500	1.250	0.250	8.500
2.50	1.125	1.500	5/16 -24	3.000	1/4 NPT	0.375	1.500	1.000	3/4 -16	3.750	1.000	2.500	2.190	3.750	0.500	2.980	1/8 NPT	4.500	1.250	0.250	8.625
3.25	1.625	2.000	3/8 -24	3.750	3/8 NPT	0.625	1.750	1.250	1-14	4.250	1.375	2.750	2.760	4.000	0.625	3.730	1/4 NPT	5.063	1.438	0.250	9.750
4.00	1.625	2.000	3/8 -24	4.500	3/8 NPT	0.625	1.750	1.250	1-14	4.250	1.375	2.750	3.320	4.000	0.625	4.480	1/4 NPT	5.063	1.438	0.250	9.750
5.00	1.625	2.000	1/2 -20	5.500	3/8 NPT	0.625	1.750	1.250	1-14	4.500	1.375	3.000	4.100	4.125	0.625	5.480	1/4 NPT	5.188	1.438	0.250	10.125
6.00	2.000	2.375	1/2 -20	6.500	1/2 NPT	0.750	2.000	1.500	1 1/4 -12	5.000	1.750	3.250	4.875	4.500	0.750	6.480	1/4 NPT	5.820	1.563	0.250	11.250

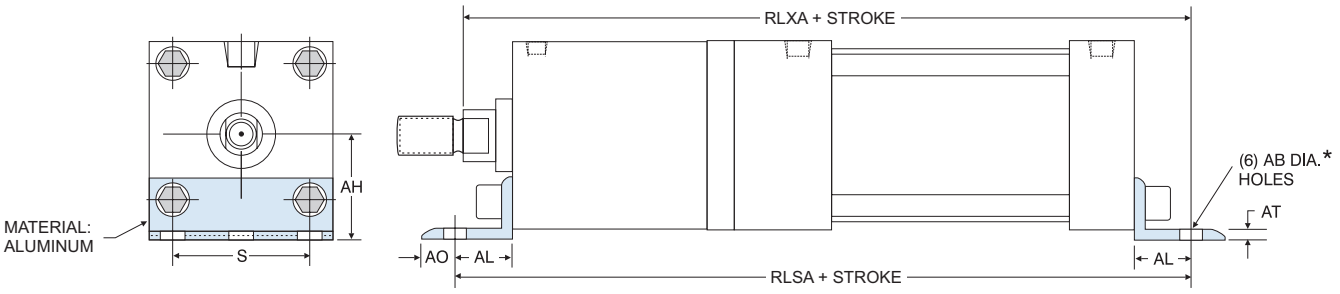
'MS1' (HEAD & CAP END ANGLE): STANDARD ROD WITH ROD LOCK MOUNTED



'FM' SERIES 'MS1' ANGLE MOUNT DIMENSIONS									
BORE	ROD DIAMETER	AB	AH	AL	AO	AT	S	ADD STROKE RLSA	ADD STROKE RLXA
1.50	0.625	0.438	1.188	1.000	0.375	0.125	1.250	8.625	8.250
2.00	0.625	0.438	1.438	1.000	0.375	0.125	1.750	8.625	8.250
2.50	0.625	0.438	1.625	1.000	0.375	0.125	2.250	9.000	8.625
3.25	1.000	0.563	1.938	1.250	0.500	0.125	2.750	10.750	10.250
4.00	1.000	0.563	2.250	1.250	0.500	0.125	3.500	10.750	10.250
5.00	1.000	0.688	2.750	1.375	0.625	0.188	4.250	11.250	10.625
6.00	1.375	0.813	3.250	1.375	0.625	0.188	5.250	12.250	11.750

*Note: 1.50" bore has four (4) "AB" holes on "S" dimension.
For dimensions not shown, see page 44.

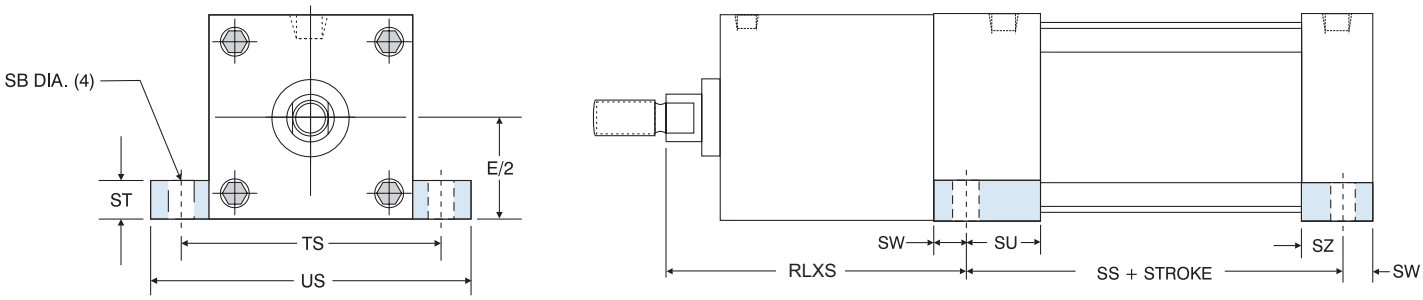
'MS1' (HEAD & CAP END ANGLE): OVERSIZED ROD WITH ROD LOCK MOUNTED



'FM' SERIES 'MS1' ANGLE MOUNT DIMENSIONS									
BORE	ROD DIAMETER	AB	AH	AL	AO	AT	S	ADD STROKE RLSA	ADD STROKE RLXA
2.00	1.000	0.438	1.438	1.000	0.375	0.125	1.750	9.750	9.500
2.50	1.000	0.438	1.625	1.000	0.375	0.125	2.250	9.875	9.625
3.25	1.375	0.563	1.938	1.250	0.500	0.125	2.750	11.375	11.000
4.00	1.375	0.563	2.250	1.250	0.500	0.125	3.500	11.375	11.000
5.00	1.375	0.688	2.750	1.375	0.625	0.188	4.250	12.000	11.500
6.00	1.750	0.813	3.250	1.375	0.625	0.188	5.250	13.000	12.625

*Note: 1.50" bore has four (4) "AB" holes on "S" dimension.
For dimensions not shown, see page 44.

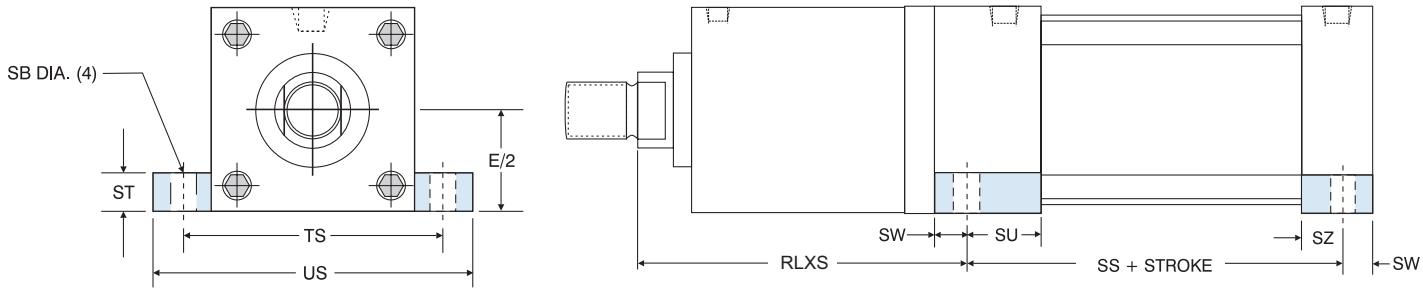
'MS2' (SIDE LUG): STANDARD ROD
WITH ROD LOCK MOUNTED



'FM' SERIES 'MS2' SIDE LUG MOUNT DIMENSIONS											
BORE	ROD DIAMETER	SB	E/2	ST	SU	SW	SZ	TS	US	RLXS	ADD STROKE SS
1.50	0.625	0.438	1.000	0.500	1.125	0.375	0.625	2.750	3.500	4.000	2.875
2.00	0.625	0.438	1.250	0.500	1.125	0.375	0.625	3.250	4.000	4.000	2.875
2.50	0.625	0.438	1.500	0.500	1.125	0.375	0.625	3.750	4.500	4.250	3.000
3.25	1.000	0.563	1.875	0.750	1.250	0.500	0.750	4.750	5.750	5.250	3.250
4.00	1.000	0.563	2.250	0.750	1.250	0.500	0.750	5.500	6.500	5.250	3.250
5.00	1.000	0.813	2.750	1.000	1.063	0.688	0.563	6.875	8.250	5.438	3.125
6.00	1.375	0.813	3.250	1.000	1.313	0.688	0.813	7.875	9.250	6.070	3.625

For dimensions not shown, see page 44.

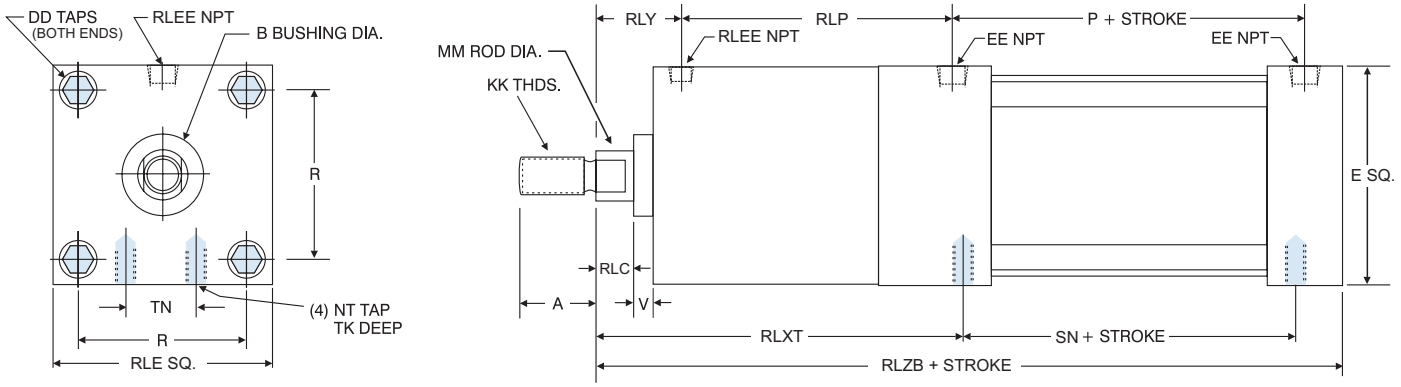
'MS2' (SIDE LUG): OVERSIZED ROD
WITH ROD LOCK MOUNTED



'FM' SERIES 'MS2' SIDE LUG MOUNT DIMENSIONS											
BORE	ROD DIAMETER	SB	E/2	ST	SU	SW	SZ	TS	US	RLXS	ADD STROKE SS
2.00	1.000	0.438	1.250	0.500	1.125	0.375	0.625	3.250	4.000	5.250	2.875
2.50	1.000	0.438	1.500	0.500	1.125	0.375	0.625	3.750	4.500	5.250	3.000
3.25	1.375	0.563	1.875	0.750	1.250	0.500	0.750	4.750	5.750	6.000	3.250
4.00	1.375	0.563	2.250	0.750	1.250	0.500	0.750	5.500	6.500	6.000	3.250
5.00	1.375	0.813	2.750	1.000	1.063	0.688	0.531	6.875	8.250	6.313	3.125
6.00	1.750	0.813	3.250	1.000	1.313	0.688	0.813	7.875	9.250	6.938	3.625

For dimensions not shown, see page 45.

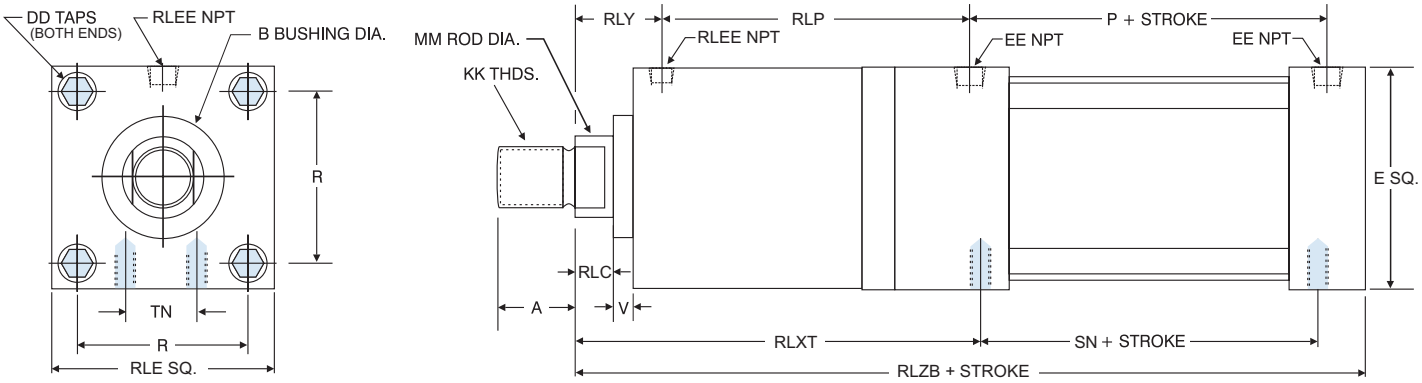
'MS4' (BOTTOM TAPPED HOLES): STANDARD ROD WITH ROD LOCK MOUNTED



'FM' SERIES 'MS4' FLUSH MOUNT DIMENSIONS														ROD LOCK BASIC DIMENSIONS							
BORE	A	B	DD	E	EE	KK	MM	NT	P	R	SN	TK	TN	RLC	RLE	RLEE	RLP	RLXT	RLY	RLZB	V
1.50	0.750	1.125	1/4-28	2.000	1/4 NPT	7/16-20	0.625	1/4-20	2.375	1.438	2.250	0.375	0.625	0.375	1.984	1/8 NPT	3.563	4.570	0.938	7.250	0.250
2.00	0.750	1.125	5/16-24	2.500	1/4 NPT	7/16-20	0.625	5/16-18	2.375	1.844	2.250	0.500	0.875	0.375	2.484	1/8 NPT	3.563	4.570	0.938	7.250	0.250
2.50	0.750	1.125	5/16-24	3.000	1/4 NPT	7/16-20	0.625	3/4-16	2.500	2.188	2.375	0.625	1.250	0.375	2.984	1/8 NPT	3.750	4.820	1.000	7.625	0.250
3.25	1.125	1.500	3/8-24	3.750	3/8 NPT	3/4-16	1.000	1/2-13	2.750	2.760	2.625	0.750	1.500	0.500	3.734	1/4 NPT	4.438	5.820	1.313	9.000	0.250
4.00	1.125	1.500	3/8-24	4.500	3/8 NPT	3/4-16	1.000	1/2-13	2.750	3.320	2.625	0.750	2.063	0.500	4.484	1/4 NPT	4.438	5.820	1.313	9.000	0.250
5.00	1.125	1.500	1/2-20	5.500	3/8 NPT	3/4-16	1.000	5/8-11	3.000	4.100	2.875	1.000	2.688	0.500	5.484	1/4 NPT	4.438	5.820	1.313	9.250	0.250
6.00	1.625	2.000	1/2-20	6.500	1/2 NPT	1-14	1.375	3/4-10	3.250	4.875	3.125	1.125	3.250	0.625	6.484	1/4 NPT	5.063	6.560	1.438	10.375	0.250

For dimensions not shown, see page 44.

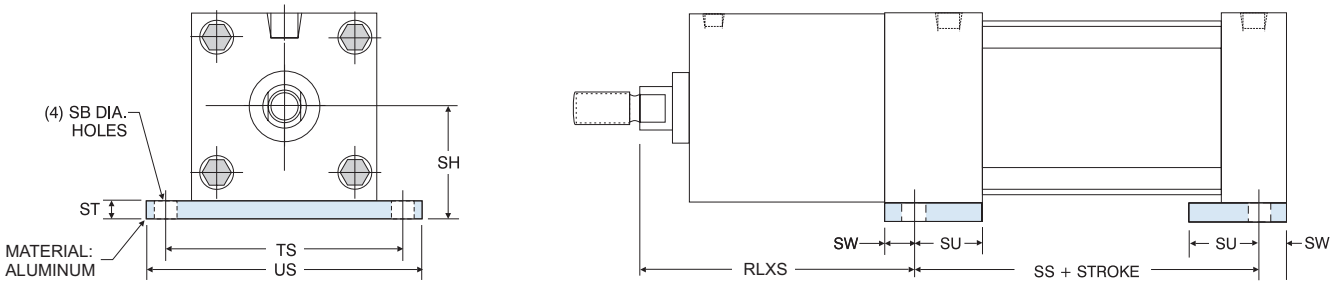
'MS4' (BOTTOM TAPPED HOLES): OVERSIZED ROD WITH ROD LOCK MOUNTED



'FM' SERIES OVERSIZE ROD 'MS4' FLUSH MOUNT DIMENSIONS														ROD LOCK BASIC DIMENSIONS							
BORE	A	B	DD	E	EE	KK	MM	NT	P	R	SN	TK	TN	RLC	RLE	RLEE	RLP	RLXT	RLY	RLZB	V
2.00	1.125	1.500	5/16-24	2.500	1/4 NPT	3/4-16	1.000	0.313-18	2.375	1.844	2.250	0.500	0.875	0.500	2.484	1/8 NPT	4.500	5.813	1.250	8.500	0.250
2.50	1.125	1.500	5/16-24	3.000	1/4 NPT	3/4-16	1.000	0.375-16	2.500	2.188	2.375	0.625	1.250	0.500	2.984	1/8 NPT	4.500	5.813	1.250	8.625	0.250
3.25	1.625	2.000	3/8-24	3.750	3/8 NPT	1-14	1.375	0.500-13	2.750	2.760	2.625	0.750	1.500	0.625	3.734	1/4 NPT	5.063	6.570	1.438	9.750	0.250
4.00	1.625	2.000	3/8-24	4.500	3/8 NPT	1-14	1.375	0.500-13	2.750	3.320	2.625	0.750	2.063	0.625	4.484	1/4 NPT	5.063	6.570	1.438	9.750	0.250
5.00	1.625	2.000	1/2-20	5.500	3/8 NPT	1-14	1.375	0.636-11	3.000	4.100	2.875	1.000	2.688	0.625	5.484	1/4 NPT	5.188	6.688	1.438	10.125	0.250
6.00	2.000	2.375	1/2-20	6.500	1/2 NPT	1 1/4-12	1.750	0.750-10	3.250	4.875	3.125	1.125	3.250	0.750	6.484	1/4 NPT	5.820	7.438	1.563	11.250	0.250

For dimensions not shown, see page 45.

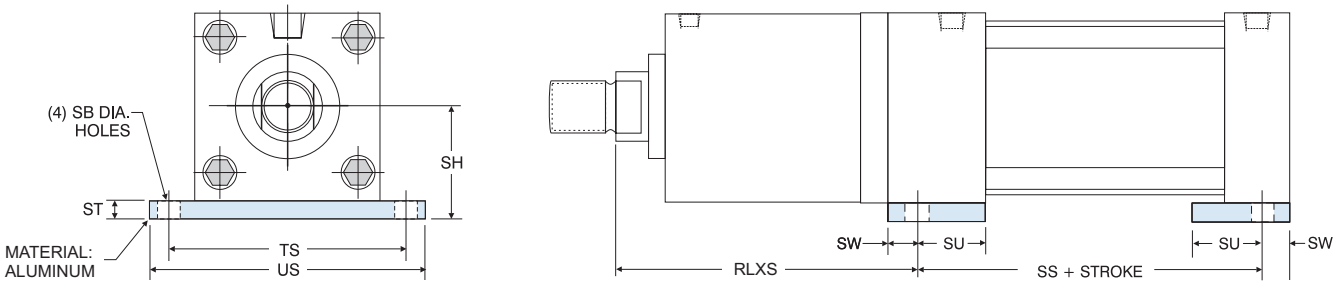
'BASEBAR' (NON-NFPA): STANDARD ROD
WITH ROD LOCK MOUNTED



'FM' SERIES BASE BAR MOUNT (Non-NFPA) DIMENSIONS										
BORE	ROD DIAMETER	SB	SH	ST	SU	SW	TS	US	RLXS	ADD STROKE SS
1.50	0.625	0.438	1.250	0.250	1.125	0.375	2.750	3.500	4.000	2.875
2.00	0.625	0.438	1.500	0.250	1.125	0.375	3.250	4.000	4.000	2.875
2.50	0.625	0.438	1.875	0.375	1.125	0.375	3.750	4.500	4.250	3.000
3.25	1.000	0.563	2.375	0.500	1.250	0.500	4.750	5.750	5.250	3.250
4.00	1.000	0.563	2.750	0.500	1.250	0.500	5.500	6.500	5.250	3.250

For dimensions not shown, see page 44.

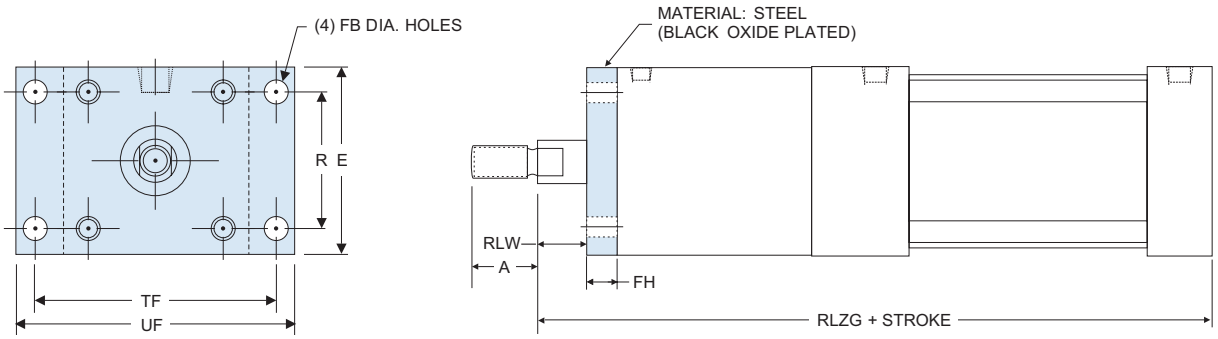
'BASEBAR' (NON-NFPA): OVERSIZED ROD
WITH ROD LOCK MOUNTED



'FM' SERIES BASE BAR MOUNT (Non-NFPA) DIMENSIONS										
BORE	ROD DIAMETER	SB	SH	ST	SU	SW	TS	US	RLXS	ADD STROKE SS
2.00	1.000	0.438	1.500	0.250	1.125	0.375	3.250	4.000	5.250	2.875
2.50	1.000	0.438	1.875	0.375	1.125	0.375	3.750	4.500	5.250	3.000
3.25	1.375	0.563	2.375	0.500	1.250	0.500	4.750	5.750	6.000	3.250
4.00	1.375	0.563	2.750	0.500	1.250	0.500	5.500	6.500	6.000	3.250

For dimensions not shown, see page 45.

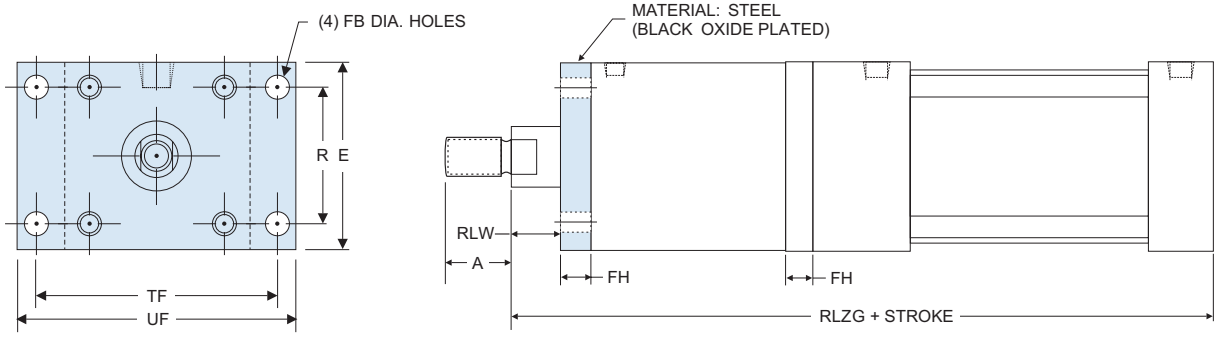
'MF1' (HEAD FLANGE): STANDARD ROD
WITH ROD LOCK MOUNTED



'FM' SERIES 'MF1' FLANGE MOUNT DIMENSIONS										
BORE	ROD DIAMETER	A	E	FB	FH	R	RLW	TF	UF	RLZG
1.50	0.625	0.750	2.000	0.313	0.375	1.438	0.625	2.750	3.375	7.625
2.00	0.625	0.750	2.500	0.375	0.375	1.844	0.625	3.375	4.125	7.625
2.50	0.625	0.750	3.000	0.375	0.375	2.188	0.625	3.875	4.625	8.000
3.25	1.000	1.125	3.750	0.438	0.625	2.760	0.750	4.688	5.500	9.625
4.00	1.000	1.125	4.500	0.438	0.625	3.320	0.750	5.438	6.250	9.625
5.00	1.000	1.125	5.500	0.563	0.625	4.100	0.750	6.625	7.625	9.875
6.00	1.375	1.625	6.500	0.563	0.750	4.875	0.875	7.625	8.625	11.125

For dimensions not shown, see page 44.

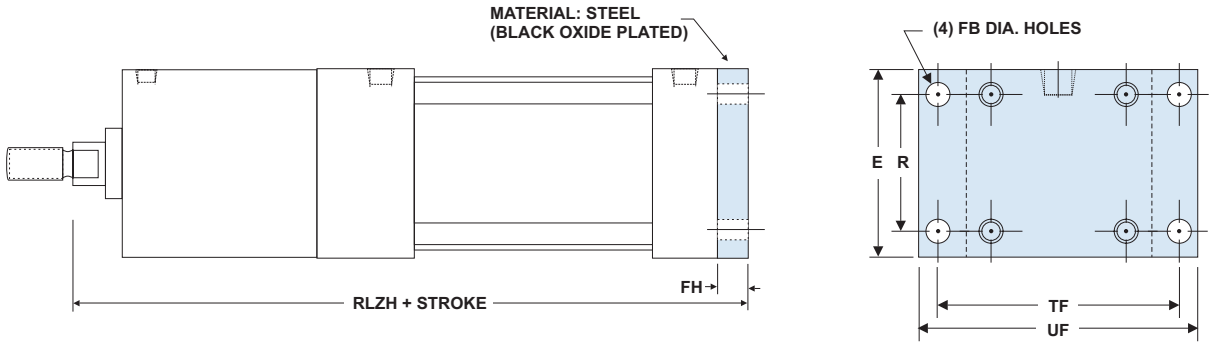
'MF1' (HEAD FLANGE): OVERSIZED ROD
WITH ROD LOCK MOUNTED



'FM' SERIES 'MF2' FLANGE MOUNT DIMENSIONS										
BORE	ROD DIAMETER	A	E	FB	FH	R	RLW	TF	UF	RLZG
2.00	1.000	1.125	2.500	0.375	0.375	1.844	1.000	3.375	4.125	9.125
2.50	1.000	1.125	3.000	0.375	0.375	2.188	1.000	3.875	4.625	9.250
3.25	1.375	1.625	3.750	0.438	0.625	2.760	1.000	4.688	5.500	10.500
4.00	1.375	1.625	4.500	0.438	0.625	3.320	1.000	5.438	6.250	10.500
5.00	1.375	1.625	5.500	0.563	0.625	4.100	1.000	6.625	7.625	10.875
6.00	1.750	2.000	6.500	0.563	0.750	4.875	1.125	7.625	8.625	12.125

For dimensions not shown, see page 45.

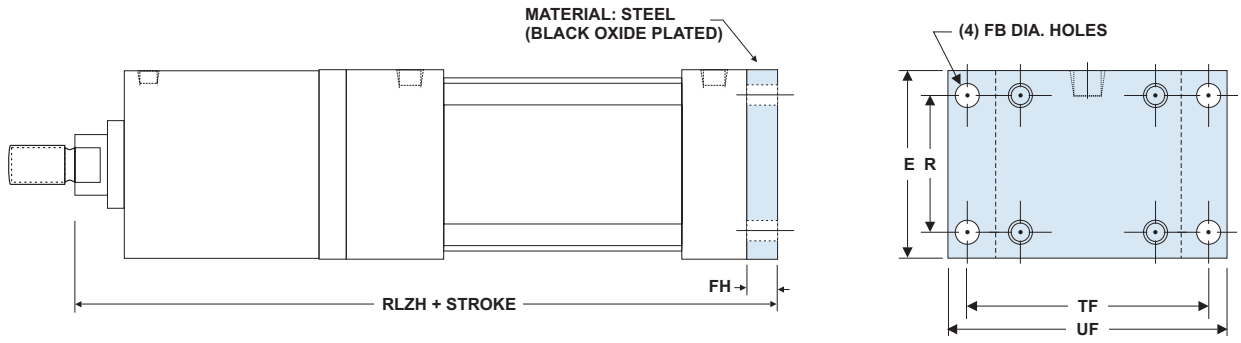
'MF2' (CAP FLANGE): STANDARD ROD
WITH ROD LOCK MOUNTED



'FM' SERIES 'MF2' FLANGE MOUNT DIMENSIONS								
BORE	ROD DIAMETER	E	FB	FH	R	TF	UF	RLZH
1.50	0.625	2.000	0.313	0.375	1.438	2.750	3.375	7.625
2.00	0.625	2.500	0.375	0.375	1.844	3.375	4.125	7.625
2.50	0.625	3.000	0.375	0.375	2.188	3.875	4.625	8.000
3.25	1.000	3.750	0.438	0.625	2.760	4.688	5.500	9.625
4.00	1.000	4.500	0.438	0.625	3.320	5.438	6.250	9.625
5.00	1.000	5.500	0.563	0.625	4.100	6.625	7.625	9.875
6.00	1.375	6.500	0.563	0.750	4.875	7.625	8.625	11.125

For dimensions not shown, see page 44.

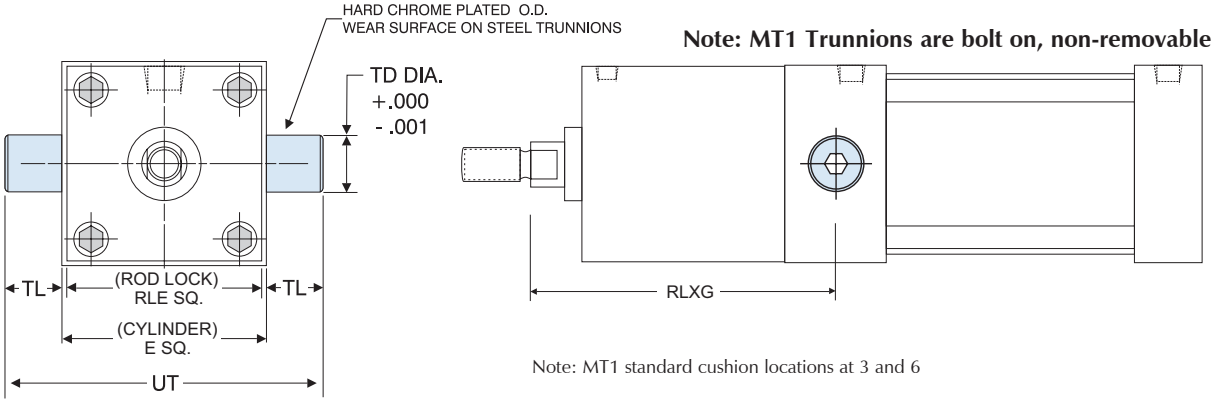
'MF2' (CAP FLANGE): OVERSIZED ROD
WITH ROD LOCK MOUNTED



'FM' SERIES 'MF2' FLANGE MOUNT DIMENSIONS								
BORE	ROD DIAMETER	E	FB	FH	R	TF	UF	RLZH
2.00	1.000	2.500	0.375	0.375	1.844	3.375	4.125	8.875
2.50	1.000	3.000	0.375	0.375	2.188	3.875	4.625	9.000
3.25	1.375	3.750	0.438	0.625	2.760	4.688	5.500	10.375
4.00	1.375	4.500	0.438	0.625	3.320	5.438	6.250	10.375
5.00	1.375	5.500	0.563	0.625	4.100	6.625	7.625	10.750
6.00	1.750	6.500	0.563	0.750	4.875	7.625	8.625	12.000

For dimensions not shown, see page 45.

'MT1' (HEAD TRUNNION): STANDARD ROD WITH ROD LOCK MOUNTED



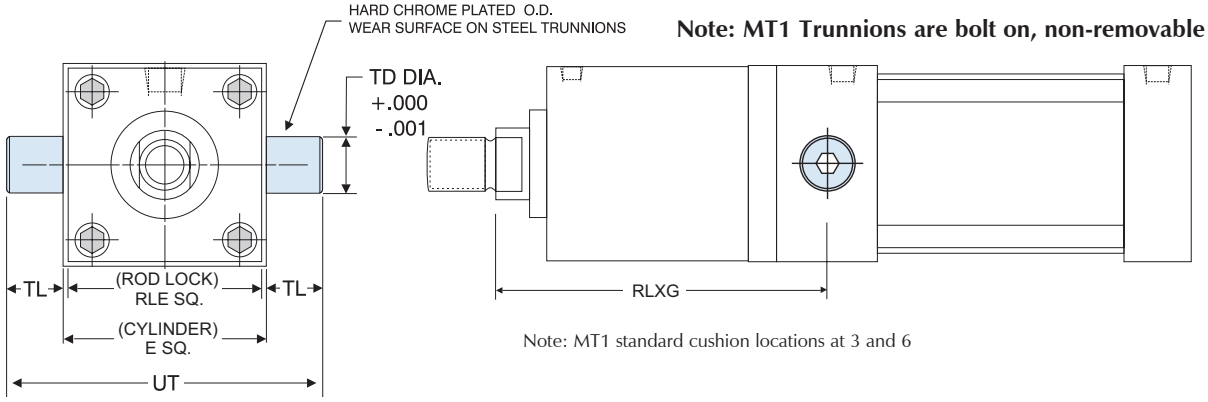
Note: MT1 Trunnions are bolt on, non-removable design.

Note: MT1 standard cushion locations at 3 and 6

'FM' SERIES 'MT1' HEAD TRUNNION AND 'MT2' CAP TRUNNION MOUNT DIMENSIONS							
BORE	ROD DIAMETER	E	RLE	TD	TL	UT	RLXG
1.50	0.625	2.000	1.984	1.000	1.000	4.000	4.375
2.00	0.625	2.500	2.484	1.000	1.000	4.500	4.375
2.50	0.625	3.000	2.984	1.000	1.000	5.000	4.625
3.25	1.000	3.750	3.734	1.000	1.000	5.750	5.625
4.00	1.000	4.500	4.484	1.000	1.000	6.500	5.625
5.00	1.000	5.500	5.484	1.000	1.000	7.500	5.625
6.00	1.375	6.500	6.484	1.375	1.375	9.250	6.375

For dimensions not shown, see page 44.

'MT1' (HEAD TRUNNION): OVERSIZED ROD WITH ROD LOCK MOUNTED



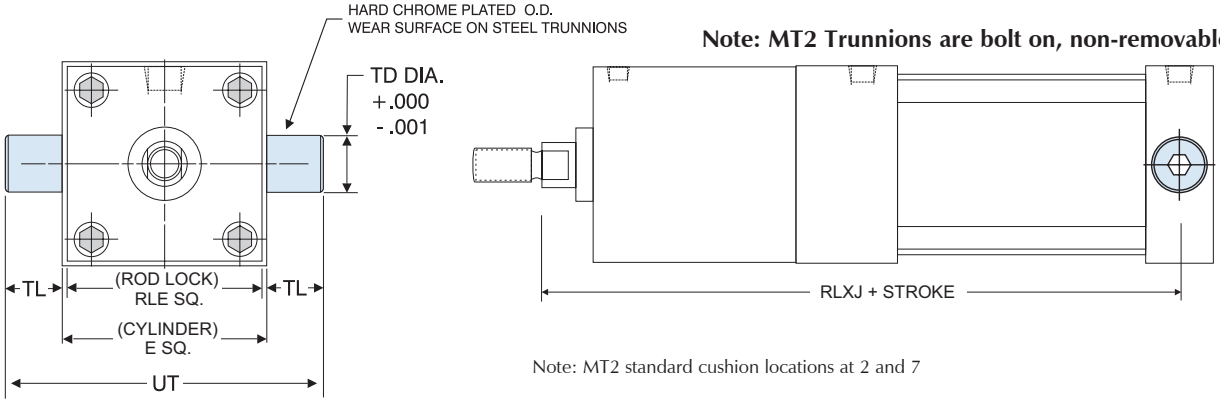
Note: MT1 Trunnions are bolt on, non-removable design.

Note: MT1 standard cushion locations at 3 and 6

'FM' SERIES 'MT1' HEAD TRUNNION AND 'MT2' CAP TRUNNION MOUNT DIMENSIONS							
BORE	ROD DIAMETER	E	RLE	TD	TL	UT	RLXG
2.00	1.000	2.500	2.484	1.000	1.000	4.500	5.625
2.50	1.000	3.000	2.984	1.000	1.000	5.000	5.625
3.25	1.375	3.750	3.734	1.000	1.000	5.750	6.375
4.00	1.375	4.500	4.484	1.000	1.000	6.500	6.375
5.00	1.375	5.500	5.484	1.000	1.000	7.500	6.500
6.00	1.750	6.500	6.484	1.375	1.375	9.250	7.250

For dimensions not shown, see page 45.

'MT2' (CAP TRUNNION): STANDARD ROD WITH ROD LOCK MOUNTED



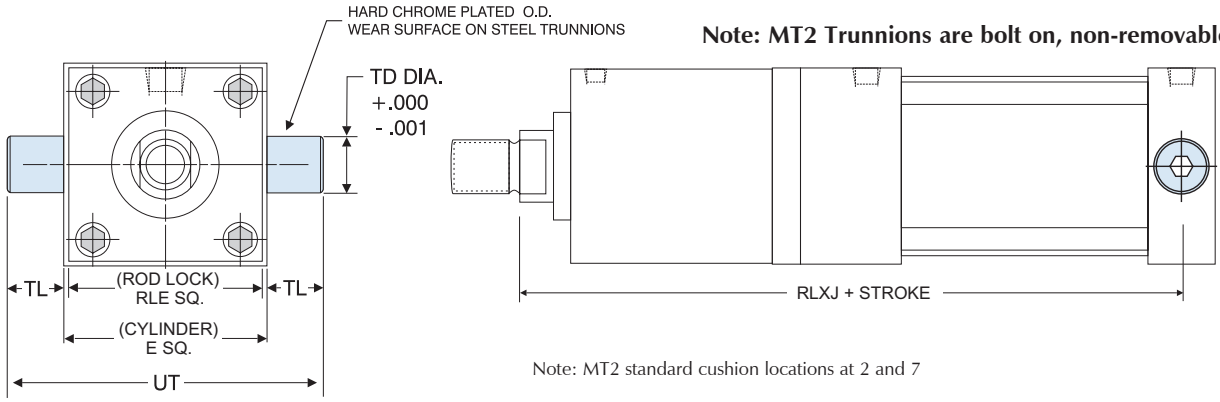
Note: MT2 Trunnions are bolt on, non-removable design.

Note: MT2 standard cushion locations at 2 and 7

'FM' SERIES 'MT1' HEAD TRUNNION AND 'MT2' CAP TRUNNION MOUNT DIMENSIONS							
BORE	ROD DIAMETER	E	RLE	TD	TL	UT	ADD STROKE RLXJ
1.50	0.625	2.000	1.984	1.000	1.000	4.000	6.750
2.00	0.625	2.500	2.484	1.000	1.000	4.500	6.750
2.50	0.625	3.000	2.984	1.000	1.000	5.000	7.125
3.25	1.000	3.750	3.734	1.000	1.000	5.750	8.375
4.00	1.000	4.500	4.484	1.000	1.000	6.500	8.375
5.00	1.000	5.500	5.484	1.000	1.000	7.500	8.625
6.00	1.375	6.500	6.484	1.375	1.375	9.250	9.625

For dimensions not shown, see page 44.

'MT2' (CAP TRUNNION): OVERSIZED ROD WITH ROD LOCK MOUNTED



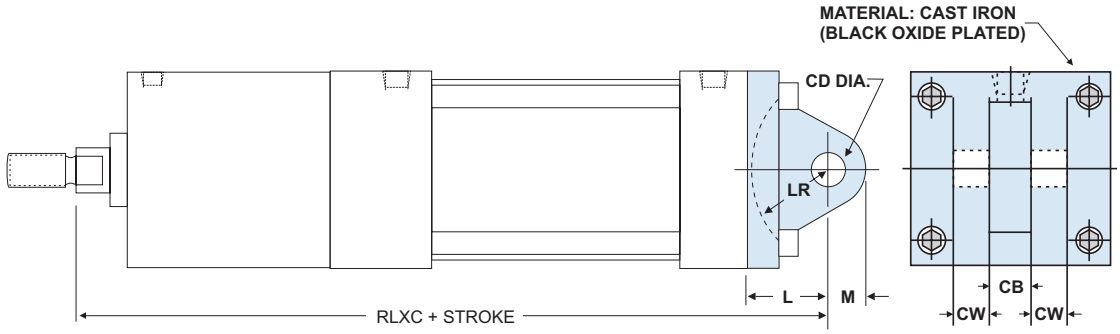
Note: MT2 Trunnions are bolt on, non-removable design.

Note: MT2 standard cushion locations at 2 and 7

'FM' SERIES 'MT1' HEAD TRUNNION AND 'MT2' CAP TRUNNION MOUNT DIMENSIONS							
BORE	ROD DIAMETER	E	RLE	TD	TL	UT	ADD STROKE RLXJ
2.00	1.000	2.500	2.484	1.000	1.000	4.500	8.000
2.50	1.000	3.000	2.984	1.000	1.000	5.000	8.125
3.25	1.375	3.750	3.734	1.000	1.000	5.750	9.125
4.00	1.375	4.500	4.484	1.000	1.000	6.500	9.125
5.00	1.375	5.500	5.484	1.000	1.000	7.500	9.375
6.00	1.750	6.500	6.484	1.375	1.375	9.250	10.500

For dimensions not shown, see page 45.

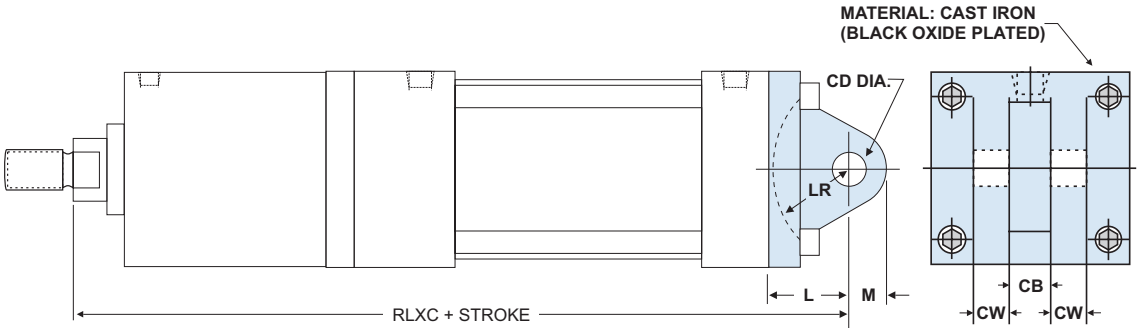
'MP1' (Detachable Cap Pivot Clevis): STANDARD ROD WITH ROD LOCK MOUNTED



'FM' SERIES 'MP1' CLEVIS MOUNT DIMENSIONS								
BORE	ROD DIAMETER	CB	CD	CW	L	LR	M	ADD STROKE RLXC
1.50	0.625	0.750	0.500	0.500	0.750	0.750	0.625	8.000
2.00	0.625	0.750	0.500	0.500	0.750	0.750	0.625	8.000
2.50	0.625	0.750	0.500	0.500	0.750	0.750	0.625	8.375
3.25	1.000	1.250	0.750	0.625	1.250	1.250	0.875	10.250
4.00	1.000	1.250	0.750	0.625	1.250	1.250	0.875	10.250
5.00	1.000	1.250	0.750	0.625	1.250	1.250	0.875	10.500
6.00	1.375	1.500	1.000	0.750	1.500	1.500	1.000	11.875

For dimensions not shown, see page 44.

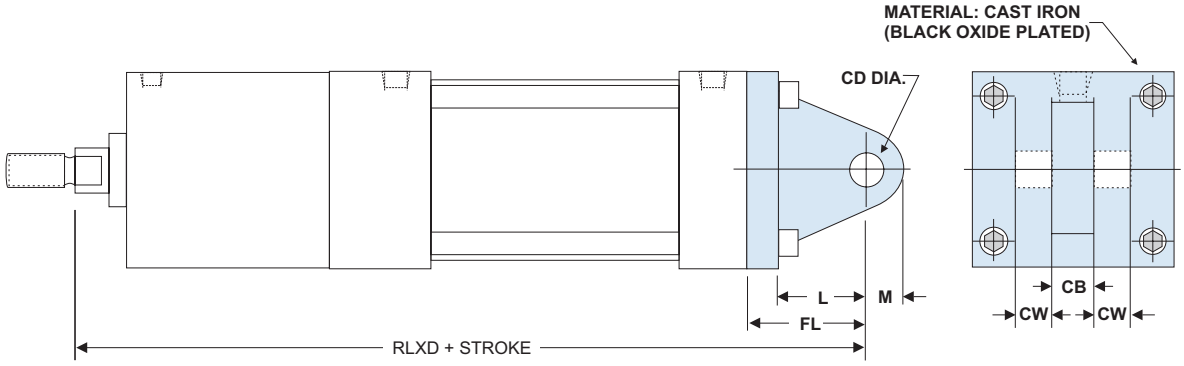
'MP1' (Detachable Cap Pivot Clevis): OVERSIZED ROD WITH ROD LOCK MOUNTED



'FM' SERIES 'MP1' CLEVIS MOUNT DIMENSIONS								
BORE	ROD DIAMETER	CB	CD	CW	L	LR	M	ADD STROKE RLXC
2.00	1.000	0.750	0.500	0.500	0.750	0.750	0.625	9.250
2.50	1.000	0.750	0.500	0.500	0.750	0.750	0.625	9.375
3.25	1.375	1.250	0.750	0.625	1.250	1.250	0.875	11.000
4.00	1.375	1.250	0.750	0.625	1.250	1.250	0.875	11.000
5.00	1.375	1.250	0.750	0.625	1.250	1.250	0.875	11.375
6.00	1.750	1.500	1.000	0.750	1.500	1.500	1.000	12.750

For dimensions not shown, see page 45.

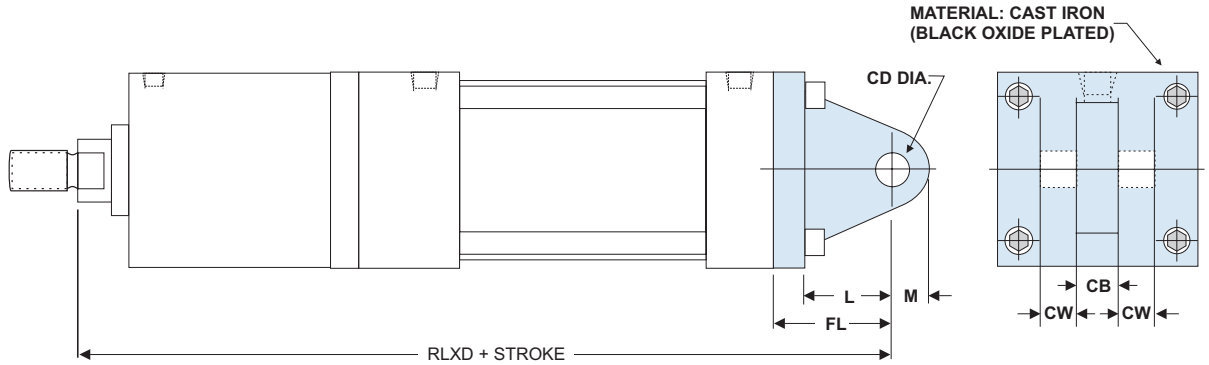
‘MP2’ (Detachable Cap Pivot Clevis): STANDARD ROD WITH ROD LOCK MOUNTED



‘FM’ SERIES ‘MP2’ CLEVIS MOUNT DIMENSIONS								
BORE	ROD DIAMETER	CB	CD	CW	FL	L	M	ADD STROKE RLXD
1.50	0.625	0.750	0.500	0.500	1.125	0.750	0.625	8.375
2.00	0.625	0.750	0.500	0.500	1.125	0.750	0.625	8.375
2.50	0.625	0.750	0.500	0.500	1.125	0.750	0.625	8.750
3.25	1.000	1.250	0.750	0.625	1.875	1.250	0.875	10.875
4.00	1.000	1.250	0.750	0.625	1.875	1.250	0.875	10.875
5.00	1.000	1.250	0.750	0.625	1.875	1.250	0.875	11.125
6.00	1.375	1.500	1.000	0.750	2.250	1.500	1.000	12.625

For dimensions not shown, see page 44.

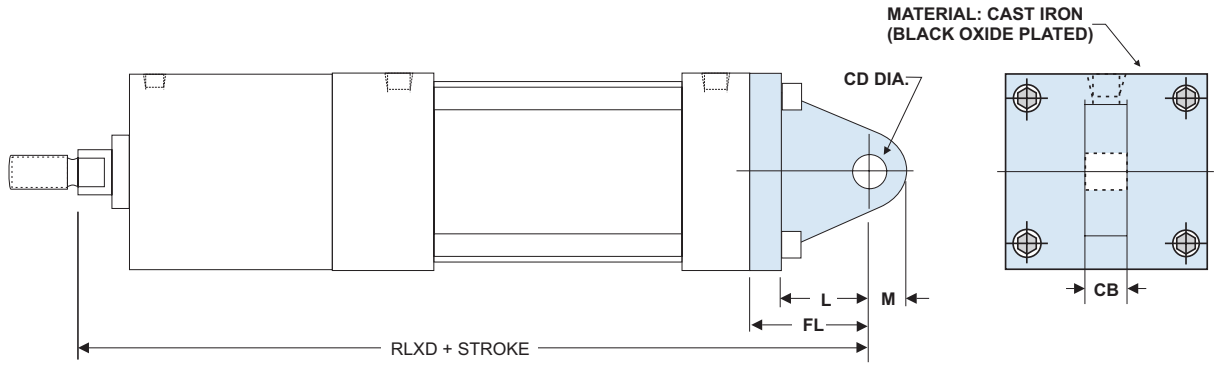
‘MP2’ (Detachable Cap Pivot Clevis): OVERSIZED ROD WITH ROD LOCK MOUNTED



‘FM’ SERIES ‘MP2’ CLEVIS MOUNT DIMENSIONS								
BORE	ROD DIAMETER	CB	CD	CW	FL	L	M	ADD STROKE RLXD
2.00	1.000	0.750	0.500	0.500	1.125	0.750	0.625	9.625
2.50	1.000	0.750	0.500	0.500	1.125	0.750	0.625	9.750
3.25	1.375	1.250	0.750	0.625	1.875	1.250	0.875	11.625
4.00	1.375	1.250	0.750	0.625	1.875	1.250	0.875	11.625
5.00	1.375	1.250	0.750	0.625	1.875	1.250	0.875	12.000
6.00	1.750	1.500	1.000	0.750	2.250	1.500	1.000	13.500

For dimensions not shown, see page 45.

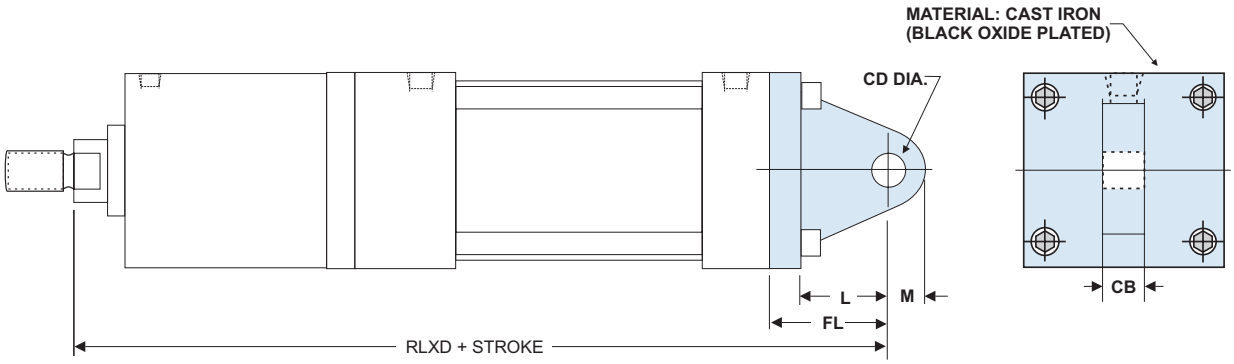
'MP4' (Detachable Cap Pivot Eye): STANDARD ROD
WITH ROD LOCK MOUNTED



'FM' SERIES 'MP4' ROD EYE MOUNT DIMENSIONS								
BORE	ROD DIAMETER	CB	CD	CW	FL	L	M	ADD STROKE RLXD
1.50	0.625	0.750	0.500	0.500	1.125	0.750	0.625	8.375
2.00	0.625	0.750	0.500	0.500	1.125	0.750	0.625	8.375
2.50	0.625	0.750	0.500	0.500	1.125	0.750	0.625	8.750
3.25	1.000	1.250	0.750	0.625	1.878	1.250	0.875	10.875
4.00	1.000	1.250	0.750	0.625	1.878	1.250	0.875	10.875

For dimensions not shown, see page 44.

'MP4' (Detachable Cap Pivot Eye): OVERSIZED ROD
WITH ROD LOCK MOUNTED



'FM' SERIES 'MP4' ROD EYE MOUNT DIMENSIONS								
BORE	ROD DIAMETER	CB	CD	CW	FL	L	M	ADD STROKE RLXD
2.00	1.000	0.750	0.500	0.500	1.125	0.750	0.625	9.625
2.50	1.000	0.750	0.500	0.500	1.125	0.750	0.625	9.750
3.25	1.375	1.250	0.750	0.625	1.875	1.250	0.875	11.625
4.00	1.375	1.250	0.750	0.625	1.875	1.250	0.875	11.625

For dimensions not shown, see page 45.

TECHNICAL DATA: ROD LOCK AIR CONTROLS

Rod Locks can be used in a wide range of general purpose applications. They are designed to mechanically lock the cylinder piston rod when the air supply (60 - 150 PSI) is removed. Rod Locks are designed for millions of trouble-free actuations if properly applied. Avoid designs or situations where the rod lock is frequently engaged while the piston rod is in motion. Since Rod Locks have a high degree of rigidity, they can be used in positioning systems. Total Rod Lock play (under loaded conditions) is very low (.000" to .008").

Cylinder Control - Use a 5/3 valve to extend and retract cylinder with rod lock. A four-way valve or closed center valve can cause the cylinder to lunge before the rod lock is fully released, causing damage to the rod lock or piston rod.

Rod Lock Control - Use a four-way NC valve to supply 60 - 150 PSI to engage and disengage the rod lock.

Check Valve - Can be used to isolate three-way valve from drop in supply air during cylinder operation.

Air Regulator - Can be used in vertical applications to offset the cylinder displacement differential between the rod end and cap end. They can also be used to help balance or counter the effects of gravity on the load.

Quick Exhaust Valve - Can be used to accelerate the rod lock response time for maximum performance. Typical rod lock response time is 200ms.

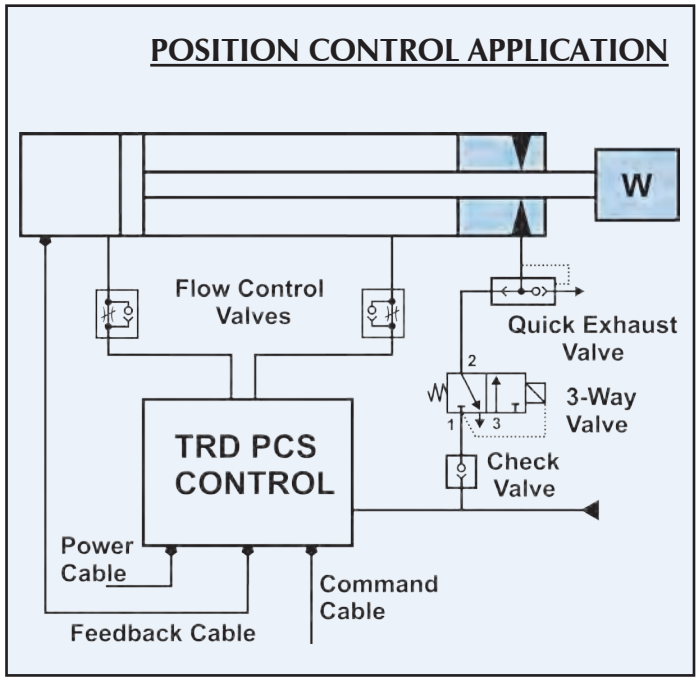
E-Stop - Rod locks can be used in E-Stop applications provided the design calls for infrequent actuation of rod lock while the cylinder rods are in motion.

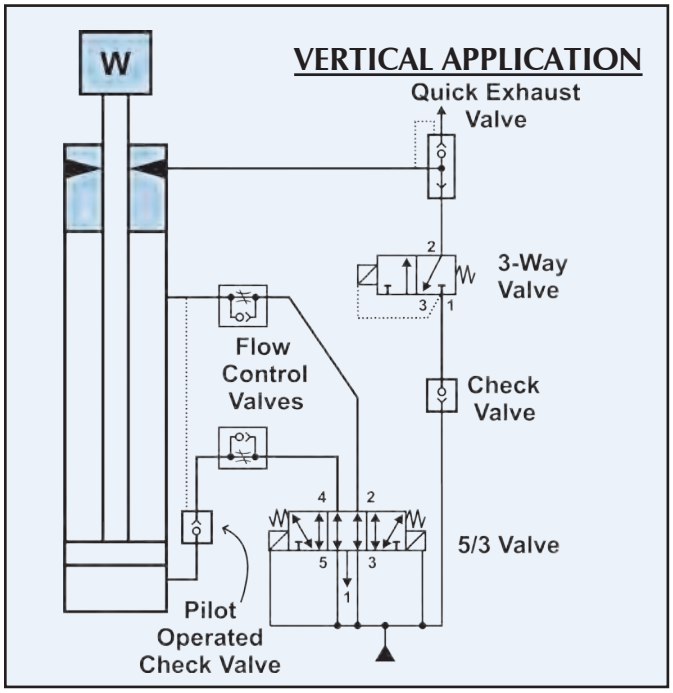
Manual Override - A three-way valve can be added to the control circuits below to act as a manual override for tooling set-up or adjustments.

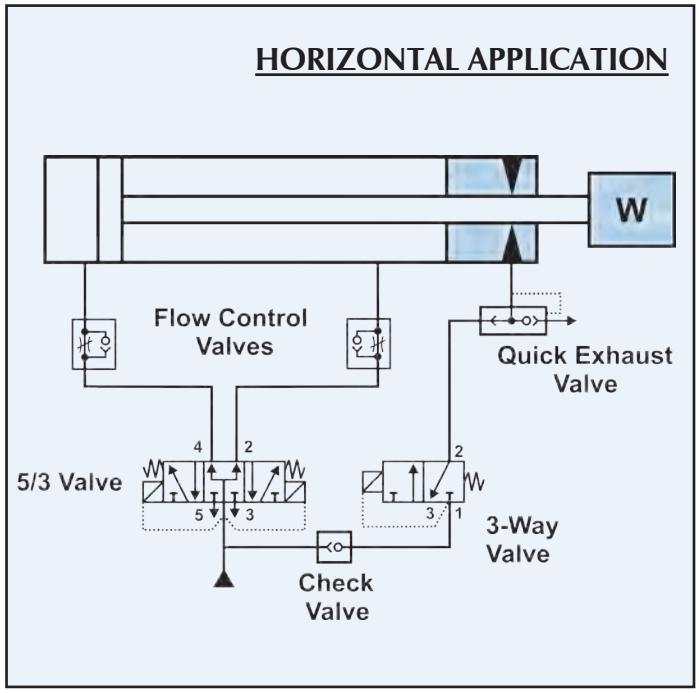
REFER TO PAGE 59 FOR SAFETY PRECAUTIONS BEFORE USING ROD LOCK.

Manual Override - A three-way valve can be added to the control circuits below to act as a manual override for tooling set-up or adjustments.

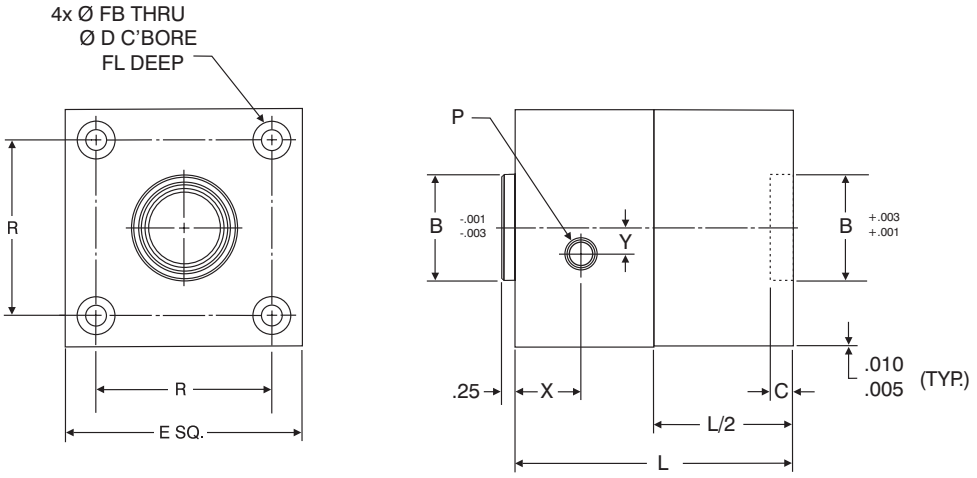
CONSULT YOUR LOCAL DISTRIBUTOR (OR FLUID POWER SPECIALIST) FOR PROPER AIR CIRCUIT DESIGN. AVOID SITUATIONS WHERE THE CYLINDER CAN LUNGE ON POWER UP OR CYCLING.







ROD LOCK DIMENSIONS



ROD LOCK DIMENSIONS															
BORE	ROD DIAMETER*	PART NO. ROD LOCK ONLY	AXIAL HOLDING FORCE	B	C	D	FL	E	FB	L	P	R	X	Y	WEIGHT (LBS.)
1.50	0.625 Standard	RL-063150-1	200	1.125	0.375	0.422	0.896	1.975	0.281	3.000	1/8 NPT	1.430	0.310	0.250	3.0
2.00	0.625 Standard	RL-063200-1	400	1.125	0.375	0.515	1.031	2.475	0.343	3.000	1/8 NPT	1.840	0.310	0.380	4.0
	1.000 Oversize	RL-100200-1	300	1.500	0.563					3.750			0.500		3.5
2.50	0.625 Standard	RL-063250-1	650	1.125	0.375	0.515	1.031	2.975	0.343	3.250	1/8 NPT	2.190	0.380	0.500	5.0
	1.000 Oversize	RL-100250-1	450	1.500	0.563					3.750			0.500		5.0
3.25	1.000 Standard	RL-100325-1	950	1.500	0.563	0.719	1.281	3.725	0.406	4.000	1/4 NPT	2.760	0.560	0.000	8.0
	1.375 Oversize	RL-138325-1	950	2.000	0.625					4.000			0.560		9.0
4.00	1.000 Standard	RL-100400-1	1550	1.500	0.563	0.719	1.281	4.475	0.406	4.000	1/4 NPT	3.320	0.560	0.000	14.0
	1.375 Oversize	RL-138400-1	1550	2.000	0.625					4.000			0.560		13.0
5.00	1.000 Standard	RL-100500-1	2150	1.500	0.563	0.844	1.500	5.475	0.531	4.000	1/4 NPT	4.100	0.560	0.000	18.0
	1.375 Oversize	RL-138500-1	1950	2.000	0.625					4.125			0.560		19.0
6.00	1.375 Standard	RL-138600-1	2650	2.000	0.625	0.844	1.500	6.475	0.531	4.500	1/4 NPT	4.880	0.560	0.000	16.0
	1.750 Oversize	RL-175600-1	2450	2.375	0.750					4.500			0.560		14.0

*Required Rod Diameter: Nominal size +000/-.002.

ROD LOCK INSTALLATION INSTRUCTIONS

1) Apply constant air supply to rod lock port (60 - 150 PSI)

2) Remove shipping arbor from inside rod lock. Save for future use.

3) Remove excess grease and dirt from cylinder piston rod. Slide rod lock onto piston rod, using care not to damage seals or bearings.

4) Align rod lock to cylinder so that unit is square and flush. Make sure that the cylinder is at least 1/2" extended.

5) Remove 60 - 150 PSI air supply to rod lock.

6) Fasten rod lock to cylinder using four (4) sleeve nuts & rods. Tighten sleeve nuts a little at a time, in a clockwise rotation, finishing with the proper torque specification.

7) Cycle Rod Lock by applying 60 - 150 PSI to rod lock port, then removing 60 - 150 PSI pressure; cycle several times in this manner.

8) Apply constant 60 - 150 PSI air supply to rod lock, then hand-cycle the cylinder piston rod to check for proper alignment.

9) If cylinder piston rod does not move freely, remove rod lock and repeat Installation Instructions. If the piston rod still "drags" or is difficult to move, check the squareness of the Rod Lock to the cylinder.

Note: Faulty alignment will cause rod damage and may drastically reduce holding force.

Sleeve Nut Torque Specs	
Bore	**Torque (FT/LBS)**
1.50	5 - 7
2.00	12 - 14
2.50	12 - 14
3.25	30
4.00	35
5.00	45
6.00	50

WARNING - DO NOT DISASSEMBLE ROD LOCK - UNIT CONTAINS HIGH SPRING FORCE.
Return to TRD Mfg. for service.

CAUTION - DO NOT REMOVE 60 - 150 PSI AIR SUPPLY TO ROD LOCK UNIT WITHOUT SHIPPING ARBOR OR CYLINDER PISTON ROD IN PLACE - PERMANENT DAMAGE MAY OCCUR

⚠ WARNING

UNIT CONTAINS HIGH SPRING FORCE
DO NOT DISASSEMBLE - INJURY MAY OCCUR
Return to TRD Mfg. for service

Refer to Rod Lock Catalog or visit www.trdmfg.com for complete instructions on proper use of rod lock

DO NOT REMOVE 60 - 150 PSI AIR SUPPLY TO ROD LOCK WHEN DIS-ASSEMBLED FROM CYLINDER. PERMANENT DAMAGE MAY OCCUR.

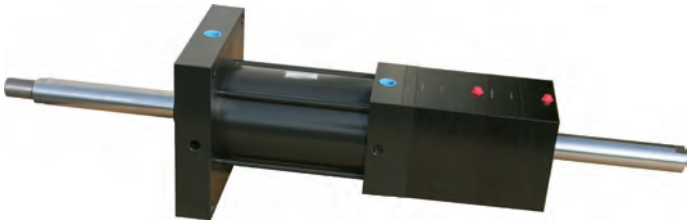
SAFETY INFORMATION

⚠ DANGER **IF PERSONAL SAFETY IS REQUIRED, AN UNRELATED, REDUNDANT SAFETY SYSTEM IS REQUIRED TO PREVENT BODILY INJURY**

⚠ WARNING **DO NOT DISASSEMBLE ROD LOCK - UNIT CONTAINS HIGH SPRING FORCE. Return to TRD Mfg. for service.**

⚠ WARNING Rod locks should be installed, operated and maintained by qualified personnel only. Units should be checked periodically for proper holding force.

GENERAL INFORMATION



One (or more rod locks) can be used on the same shaft or cylinder. Two units when combined will double the holding force. Steel cylinders should be considered in all high-load applications.

Rod locks are designed for static applications (rod not moving while engaging rod lock) and are suitable for infrequent dynamic braking (E-Stop) when used with proper shafting materials. Repeated dynamic stops may cause rod and seal damage and/or rod lock wear resulting in reduced life or holding force.

Filtered and dry air is important for proper rod lock functioning. Debris or moisture inside the rod lock may inhibit performance and/or shorten the life of the unit. Rod locks are pre-lubricated for life, no additional air lubrication is required.

The rod which the rod lock engages (clamps) must be kept clean and dry for optimum holding force.

The rod lock requires a minimum of 60 PSI to fully release. A low PSI condition (below 60 PSI) may cause the rod lock to drag on the rod, causing damage to the rod. Care should be taken to eliminate low PSI conditions.

Rod locks are intended for use with industrial compressed air systems within the operation specifications.

OPERATING PRESSURE	
Cylinder	0 TO 250 PSI AIR
Rod Lock	60 TO 150 PSI AIR

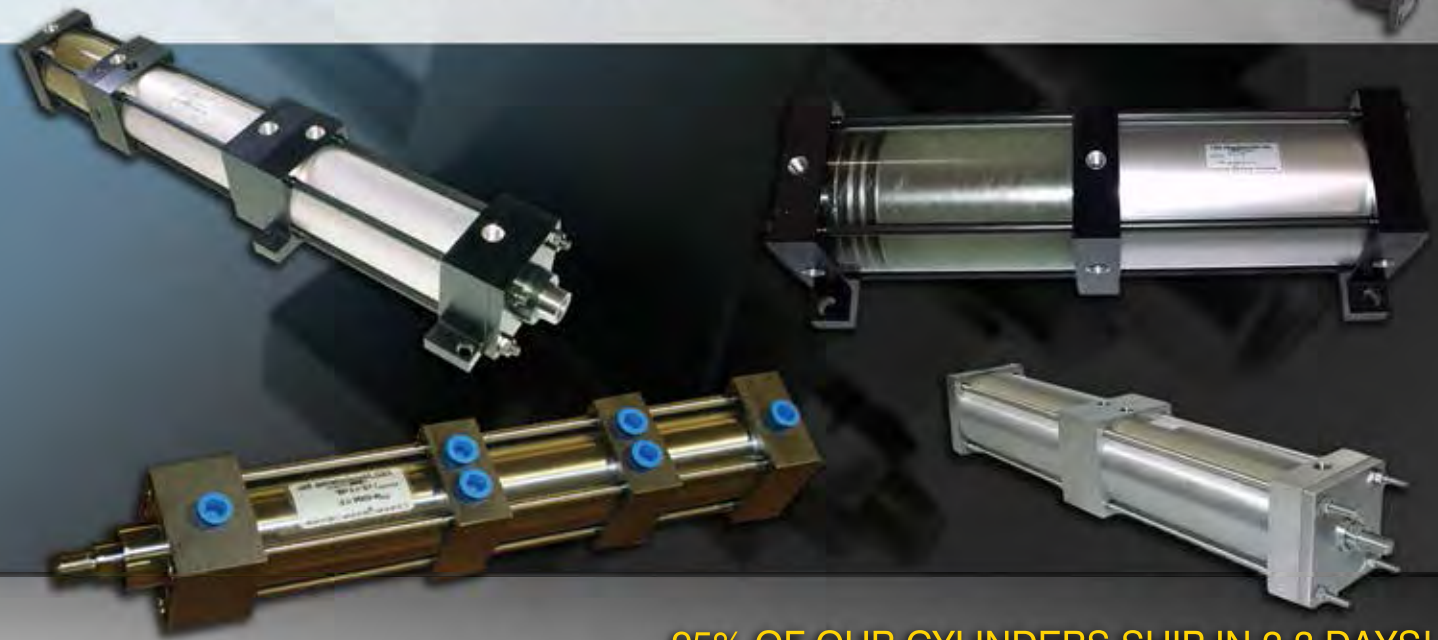
OPERATING TEMPERATURE	
Standard Seals	10°F to 180°F (-12°C to 82°C)
Fluorocarbon Seals	0°F to 400°F (-18°C to 204°C)

AXIAL MOVEMENT (CLAMPED)*	
Standard	.000″ to .008″
Close Tol. (Optional)	.000″ to .002″ - .003″

* Represents clearance within the rod lock unit, .000″ movement due to actuation.

ROD MATERIAL REQUIREMENTS	
Diameter	+.000″ to -.002″ Nominal Diameter
Hardened Shaft	.0005″ Minimum hard chrome
Unhardened Shaft	.001″ Minimum hard chrome
Finish	6 to 10 micro-inch

BTB Series NFPA - Back to Back
3P Series NFPA - 3 Position
TM Series NFPA - Tandem
Aluminum Cylinders
1.50″ to 8.00″ Bore



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

BACK-TO-BACK CYLINDERS:

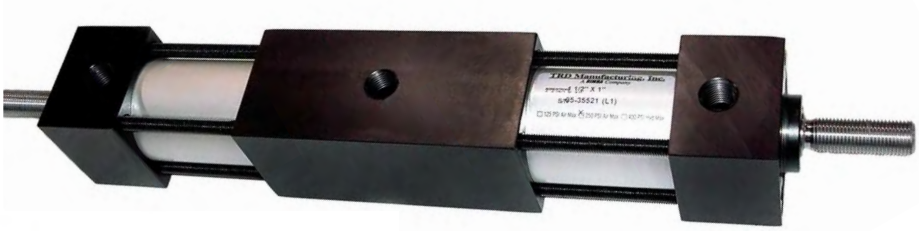
You can back-to-back ***any*** series of cylinder together - mixed or matched, to provide unlimited design possibilities.

Back-to-back cylinders consist of two (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.

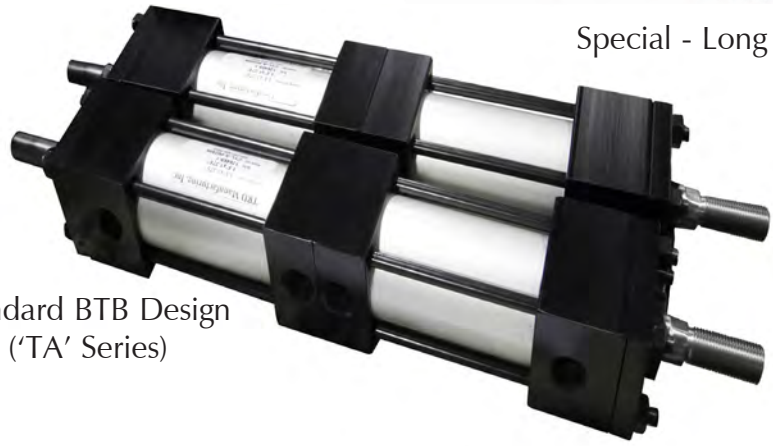
(Tip: You can use a rod clevis on each piston rod to create additional pivot mounting styles. Refer to page 185 for stop tube considerations in combined strokes over 40 inches.)

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: Three-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.



Special - Long Cap & Common Cap Port ('FM' Series)



Standard BTB Design
('TA' Series)

Special - One Cap &
Common Cap Port
('TRA' Series)

Standard BTB Design ('TA' Series)

HOW TO ORDER: BACK-TO-BACK CYLINDERS

CYL. #1 — CYL. #2

BTB - TA - MS4 - 2 x 10 - HC WITH TA - MXO - 2 X 5 - MPR - HC

BACK-TO-BACK

SERIES	
TA	250 PSI AIR
TD	250 PSI AIR, TOUGH-DUTY
SS	STAINLESS STEEL
FM	FLUSH MOUNT (Add-A-Mount)
TRA	TRIPLE ROD

BORE
1.50
2.00
2.50
3.25
4.00
5.00
6.00
8.00

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

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"-6.00" Bore)
ME3	FRONT MOUNTING HOLES (8.00" Bore)
MS1	FRONT & REAR END ANGLE
MS2	SIDE LUG (1.50"-4.00" Std., 5.00" and above consult factory)
MS4	BOTTOM TAPPED HOLES

CUSHIONS		
H	HEAD CUSHION POSITION 2 IS *STANDARD SPECIFY* FOR POSITIONS: 1, 3 & 4	
② LH	LONG HEAD CUSHION POSITION 2 IS *STANDARD SPECIFY* FOR POSITIONS: 1, 3 & 4	
② ELH	EXTRA LONG HEAD CUSHION POSITION 2 IS *STANDARD SPECIFY* FOR POSITIONS: 1, 3 & 4	X
C	CAP CUSHION POSITION 6 IS STANDARD SPECIFY FOR POSITIONS: 5, 7 & 8	
② LC	LONG CAP CUSHION POSITION 6 IS STANDARD SPECIFY FOR POSITIONS: 5, 7 & 8	
② ELC	EXTRA LONG CAP CUSHION POSITION 6 IS STANDARD SPECIFY FOR POSITIONS: 5, 7 & 8	X
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)	

② Not available on 'TRA' Series

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 9.
	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" - 8.00" 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 176 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 183 for specifications)*
	MPR	MAGNETIC PISTON FOR REED OR SOLID STATE SWITCHES - TRD MODELS: R10, R10P, RAC, RHT & MSS *(Refer to pages 223-230 for selection)*
	MS	METALLIC ROD SCRAPER (BRASS CONSTRUCTION)
	NR	**NON-ROTATING** *(Refer to page 180 for specifications)*
	OP	OPTIONAL PORT LOCATION (Example: Ports @ 3 & 7)
	OS	OVERSIZE ROD DIAMETER (SPECIFY SIZE, Example: OS = 1.375")
	SAE	SAE PORTS (SPECIFY SIZE, Example: SAE #10)
X	SE	SPRING EXTEND (CONSULT FACTORY)
X	SP	SPACER PLATE *(Refer to page 63)*
X	SR	SPRING RETURN (CONSULT FACTORY)
	SSA	STAINLESS STEEL PISTON ROD, TIE RODS & NUTS, AND FASTENERS
	SSF	STAINLESS STEEL FASTENERS
	SSN	STAINLESS STEEL TIE ROD NUTS
	SSR	STAINLESS STEEL PISTON ROD
	SST	STAINLESS STEEL TIE RODS
X	ST	**STOP TUBE** - SPECIFY STOP TUBE LENGTH (in inches) SPECIFY STROKE AS ES (effective stroke) (Example: TA MS4 2 X 24ES-ST=3)
	TMS	STEEL CYLINDER TUBE, BLACK EPOXY PAINT FINISH
	TH	400 PSI HYDRAULIC NON-SHOCK *(Refer to page 183 for specifications)*
	VS	FLUOROCARBON SEALS
	XX	SPECIAL VARIATION (SPECIFY)

STANDARD PORT AND CUSHION ADJUSTMENT POSITIONS

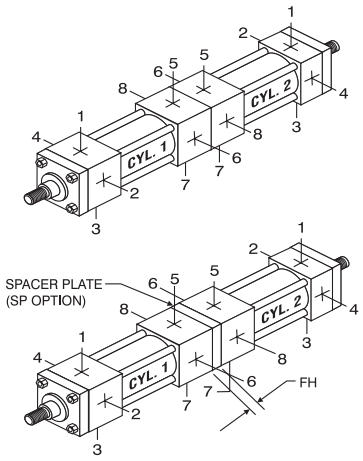
- Ports - Positions 1 and 5 ①
- Cushion Adjustment - Positions 2 and 6 on both cylinders (opposite sides from one another)
- Specify Non-Standard Positions When Ordering

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, 2.00" bore X 10" stroke.
Cyl. 2 is a 'TA' series, MXO (no mount), 2.00" 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



① 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 Back-to-Back Flip-Out 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)

EASY FLIP OUT PAGE FOR REFERENCE

About Rod End Styles

Style 1 Male Rod End is STANDARD

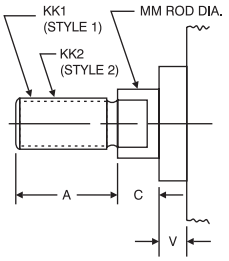
Other NFPA Styles can be specified (see chart).

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

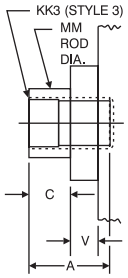
NEED SOMETHING NOT LISTED? Just send us a sketch. In most cases, quotes are turned around in one day!

PISTON ROD END STYLES

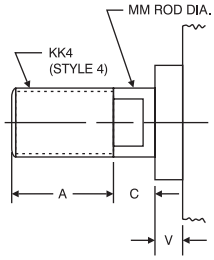
STYLE 1 & 2 KK1 & KK2



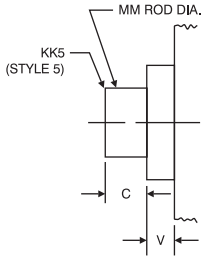
STYLE 3 KK3



STYLE 4 KK4



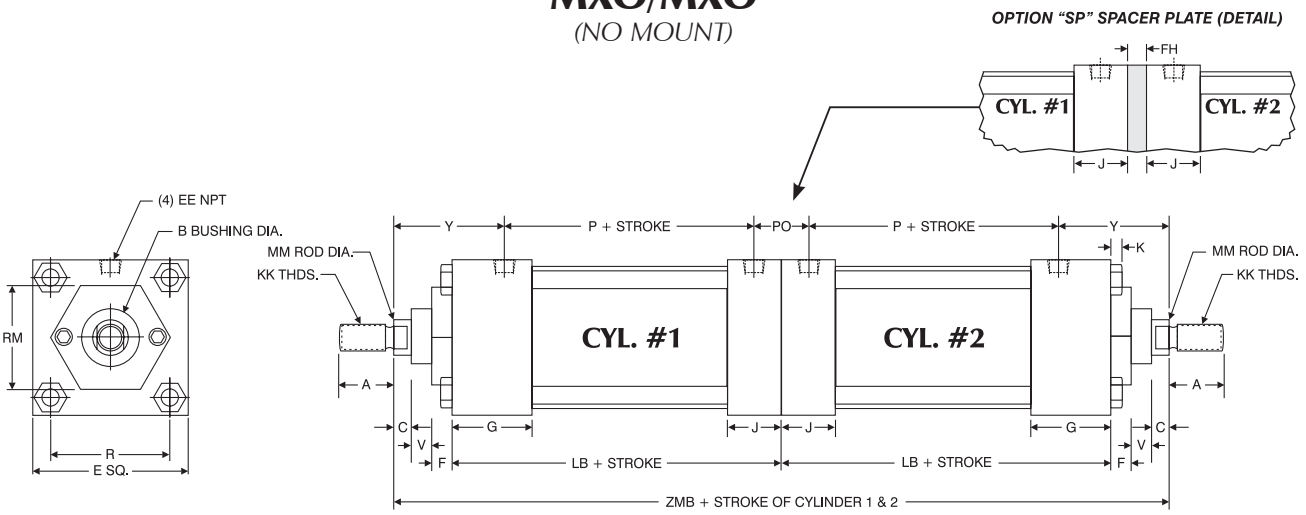
STYLE 5 KK5



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

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	0.625 Standard	0.750	1.125	0.375	2.000	0.375	0.375	0.375	1.500	1.000	0.250	7/16-20	3.625	0.625	2.375	0.750	1.438	2.00 SQ.	0.250	1.875	9.250
	1.000 Oversize	1.125	1.500	0.500								3/4-16		1.000					0.500	2.250	10.000
2.00	0.625 Standard	0.750	1.125	0.375	2.500	0.375	0.375	0.375	1.500	1.000	0.313	7/16-20	3.625	0.625	2.375	0.750	1.844	1.75 HEX	0.250	1.875	9.250
	1.000 Oversize	1.125	1.500	0.500								3/4-16		1.000				2.50 SQ.	0.500	2.250	10.000
2.50	0.625 Standard	0.750	1.125	0.375	3.000	0.375	0.375	0.375	1.500	1.000	0.313	7/16-20	3.750	0.625	2.500	0.750	2.188	1.75 HEX.	0.250	1.875	9.500
	1.000 Oversize	1.125	1.500	0.500								3/4-16		1.000				3.00 SQ.	0.500	2.250	10.250
3.25	1.000 Standard	1.125	1.500	0.500	3.750	0.500	0.625	0.625	1.750	1.250	0.375	3/4-16	4.250	1.000	2.750	1.000	2.760	2.75 DIA.	0.250	2.375	11.250
	1.375 Oversize	1.625	2.000	0.625								1-14		1.375				3.75 SQ.	0.375	2.625	11.750
4.00	1.000 Standard	1.125	1.500	0.500	4.500	0.500	0.625	0.625	1.750	1.250	0.375	3/4-16	4.250	1.000	2.750	1.000	3.320	2.75 DIA.	0.250	2.375	11.250
	1.375 Oversize	1.625	2.000	0.625								1-14		1.375				3.50 DIA.	0.375	2.625	11.750
5.00	1.000 Standard	1.125	1.500	0.500	5.500	0.500	0.625	0.625	1.750	1.250	0.438	3/4-16	4.500	1.000	3.000	1.000	4.100	2.75 DIA.	0.250	2.375	11.750
	1.375 Oversize	1.625	2.000	0.625								1-14		1.375				3.50 DIA.	0.375	2.625	12.250
6.00	1.375 Standard	1.625	2.000	0.625	6.500	0.750	0.625	0.750	2.000	1.500	0.438	1-14	5.000	1.375	3.250	1.250	4.875	3.50 DIA.	0.375	2.750	13.250
	1.750 Oversize	2.000	2.375	0.750								1 1/4-12		1.750					0.500	3.000	13.750
8.00	1.375 Standard	1.625	2.000	0.625	8.500	0.750	0.625	—	2.000	1.500	0.563	1-14	5.125	1.375	3.375	1.250	6.438	3.50 DIA.	0.375	2.750	13.500
	1.750 Oversize	2.000	2.375	0.750								1 1/4-12		1.750					0.500	3.000	14.000

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

EASY FLIP OUT PAGE FOR REFERENCE

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

About Rod End Styles

Style 1 Male Rod End is STANDARD

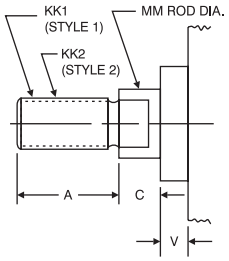
Other NFPA Styles can be specified (see chart).

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).

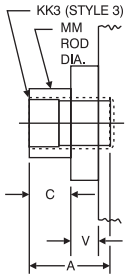
NEED SOMETHING NOT LISTED?
Just send us a sketch.
In most cases, quotes are turned around in one day!

PISTON ROD END STYLES

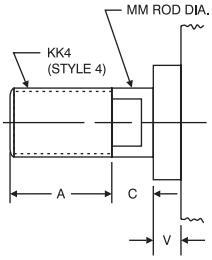
STYLE 1 & 2 — KK1 & KK2



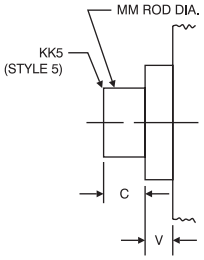
STYLE 3 — KK3



STYLE 4 — KK4



STYLE 5 — KK5

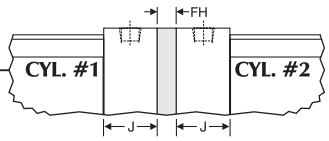


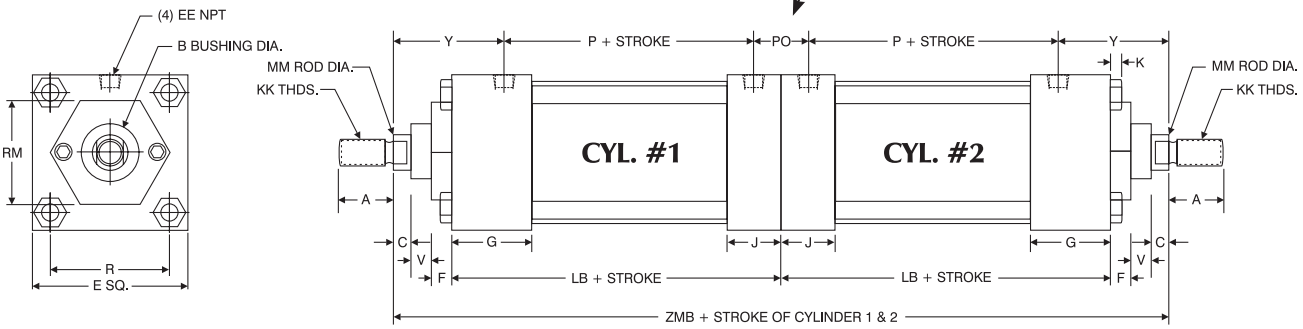
BORE	MM ROD DIAMETER	STANDARD Style 1 - Male KK1	A	OPTIONAL Style 2 - Male KK2	A	Style 3 - Female KK3	A	Style 4 - Male KK4	A	Style 5 - Blank KK5	C	V
1.50, 2.00, 2.50	0.625 Standard	7/16 -20	0.750	1/2 -20	0.750	7/16 -20	0.750	5/8 -18	0.750	No Threads	0.375	0.250
	1.000 Oversize	3/4 -16	1.125	7/8 -14	1.125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

MXO/MXO

(NO MOUNT)

OPTION "SP" SPACER PLATE (DETAIL)





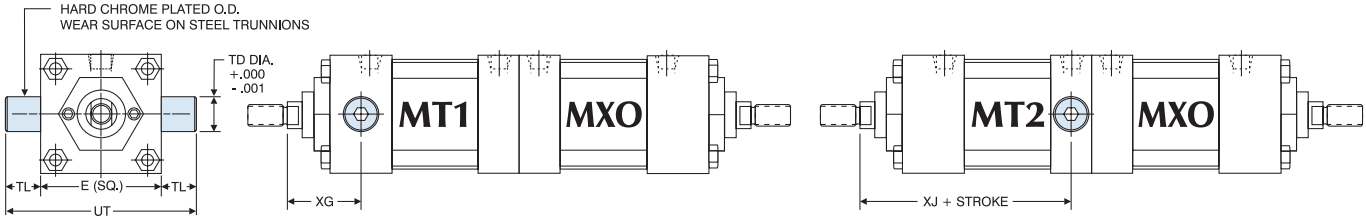
BACK-TO-BACK BASIC DIMENSIONS 'MXO' STANDARD & OVERSIZE RODS

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	0.625 Standard	0.750	1.125	0.375	2.000	0.375	0.375	0.375	1.500	1.000	0.250	7/16 -20	3.625	0.625	2.375	0.750	1.438	2.00 SQ.	0.250	1.875	9.250
	1.000 Oversize	1.125	1.500	0.500								3/4 -16		1.000					0.500	2.250	10.000
2.00	0.625 Standard	0.750	1.125	0.375	2.500	0.375	0.375	0.375	1.500	1.000	0.313	7/16 -20	3.625	0.625	2.375	0.750	1.844	1.75 HEX	0.250	1.875	9.250
	1.000 Oversize	1.125	1.500	0.500								3/4 -16		1.000				2.50 SQ.	0.500	2.250	10.000
2.50	0.625 Standard	0.750	1.125	0.375	3.000	0.375	0.375	0.375	1.500	1.000	0.313	7/16 -20	3.750	0.625	2.500	0.750	2.188	1.75 HEX.	0.250	1.875	9.500
	1.000 Oversize	1.125	1.500	0.500								3/4 -16		1.000				3.00 SQ.	0.500	2.250	10.250
3.25	1.000 Standard	1.125	1.500	0.500	3.750	0.500	0.625	0.625	1.750	1.250	0.375	3/4 -16	4.250	1.000	2.750	1.000	2.760	2.75 DIA.	0.250	2.375	11.250
	1.375 Oversize	1.625	2.000	0.625								1 -14		1.375				3.75 SQ.	0.375	2.625	11.750
4.00	1.000 Standard	1.125	1.500	0.500	4.500	0.500	0.625	0.625	1.750	1.250	0.375	3/4 -16	4.250	1.000	2.750	1.000	3.320	2.75 DIA.	0.250	2.375	11.250
	1.375 Oversize	1.625	2.000	0.625								1 -14		1.375				3.50 DIA.	0.375	2.625	11.750
5.00	1.000 Standard	1.125	1.500	0.500	5.500	0.500	0.625	0.625	1.750	1.250	0.438	3/4 -16	4.500	1.000	3.000	1.000	4.100	2.75 DIA.	0.250	2.375	11.750
	1.375 Oversize	1.625	2.000	0.625								1 -14		1.375				3.50 DIA.	0.375	2.625	12.250
6.00	1.375 Standard	1.625	2.000	0.625	6.500	0.750	0.625	0.750	2.000	1.500	0.438	1 -14	5.000	1.375	3.250	1.250	4.875	3.50 DIA.	0.375	2.750	13.250
	1.750 Oversize	2.000	2.375	0.750								1 1/4 -12		1.750					0.500	3.000	13.750
8.00	1.375 Standard	1.625	2.000	0.625	8.500	0.750	0.625	—	2.000	1.500	0.563	1 -14	5.125	1.375	3.375	1.250	6.438	3.50 DIA.	0.375	2.750	13.500
	1.750 Oversize	2.000	2.375	0.750								1 1/4 -12		1.750					0.500	3.000	14.000

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

BACK-TO-BACK SERIES BASE DIMENSIONS FLIP-OUT (PAGE 63)

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	0.625 Standard	2.000	1.000	1.000	4.000	1.750	4.125
	1.000 Oversize					N/A*	4.500
2.00	0.625 Standard	2.500	1.000	1.000	4.500	1.750	4.125
	1.000 Oversize					2.125	4.500
2.50	0.625 Standard	3.000	1.000	1.000	5.000	1.750	4.250
	1.000 Oversize					2.125	4.625
3.25	1.000 Standard	3.750	1.000	1.000	5.750	2.250	5.000
	1.375 Oversize					2.500	5.250
4.00	1.000 Standard	4.500	1.000	1.000	6.500	2.250	5.000
	1.375 Oversize					2.500	5.250
5.00	1.000 Standard	5.500	1.000	1.000	7.500	2.250	5.250
	1.375 Oversize					2.500	5.500
6.00	1.375 Standard	6.500	1.375	1.375	9.250	2.625	5.875
	1.750 Oversize					2.875	6.125
8.00	1.375 Standard	8.500	1.375	1.375	11.250	2.625	6.000
	1.750 Oversize					2.875	6.250

*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 two (2) separate piston rods. Cylinders operate independently of one another.

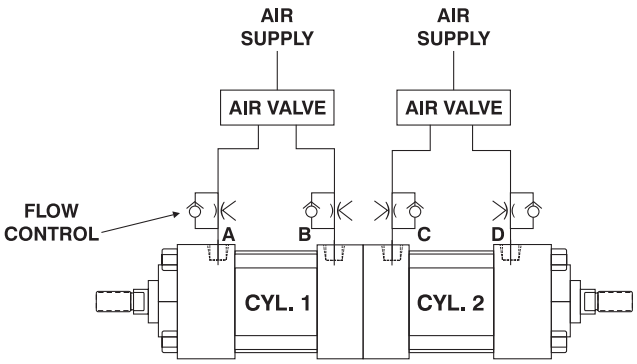
Tip: Before ordering, check the air fitting sizes to be sure you have adequate room at the ports "B" and "C" to install fittings. Ports can be rotated on one cylinder or a spacer plate can be added (between cylinder caps) to provide clearance for fittings.

EXAMPLE:

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

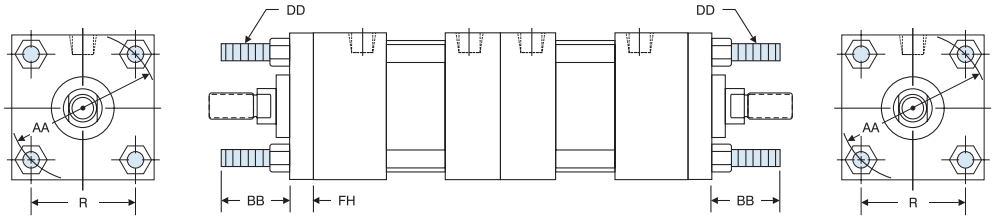
SCHEMATIC

ACTUATION SEQUENCE:
PRESSURE TO PORT 'B' EXTENDS CYLINDER #1,
PRESSURE TO PORT 'A' RETRACTS CYLINDER #1,
PRESSURE TO PORT 'C' EXTENDS CYLINDER #2,
PRESSURE TO PORT 'D' RETRACTS CYLINDER #2.

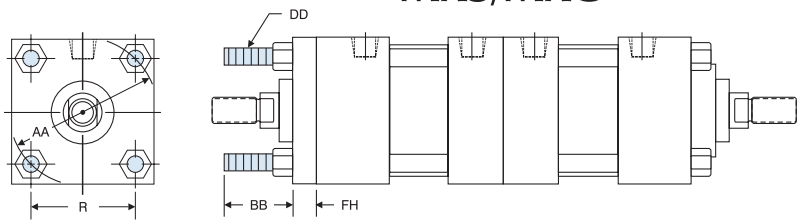


BACK-TO-BACK DIMENSIONS: TIE ROD & FLANGE MOUNTS

MX1



MX3/MXO



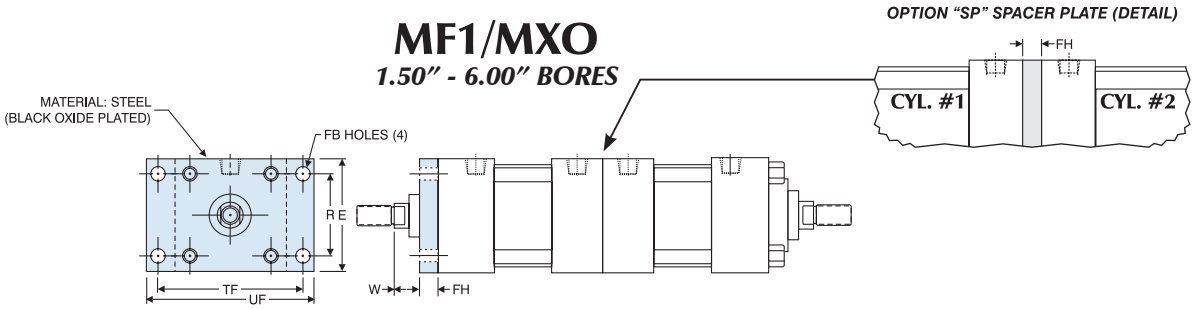
TIE ROD EXTENDED 'MX1' & 'MX3' MOUNT DIMENSIONS						
BORE	ROD DIAMETER	AA	BB	DD	FH	R
1.50	0.625 Standard	2.020	1.000	1/4 -28	0.375	1.438
	1.000 Oversize					
2.00	0.625 Standard	2.600	1.125	5/16 -24	0.375	1.844
	1.000 Oversize					
2.50	0.625 Standard	3.100	1.125	5/16 -24	0.375	2.188
	1.000 Oversize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

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

*Round retainer used to retain bushing, not a full front plate as other bores.
**"BB" dimension from head on 8" bore.

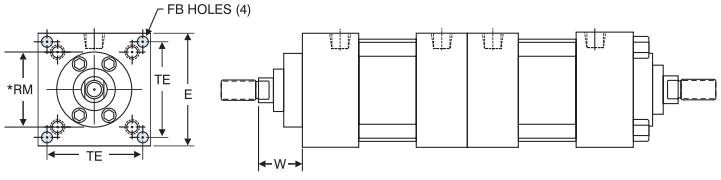
MF1/MXO

1.50" - 6.00" BORES



ME3/MXO

8.00" BORE ONLY



'MF1' FLANGE & 'ME3' CAP MOUNT DIMENSIONS										
BORE	ROD DIAMETER	E	FB	FH	R	RM	TE	TF	UF	W
1.50	0.625 Standard	2.000	0.313	0.357	1.438	—	—	2.750	3.375	0.625
	1.000 Oversize									1.000
2.00	0.625 Standard	2.500	0.375	0.375	1.844	—	—	3.375	4.125	0.625
	1.000 Oversize									1.000
2.50	0.625 Standard	3.000	0.375	0.375	2.188	—	—	3.875	4.625	0.625
	1.000 Oversize									1.000
3.25	1.000 Standard	3.750	0.438	0.625	2.760	—	—	4.688	5.500	0.750
	1.375 Oversize									1.000

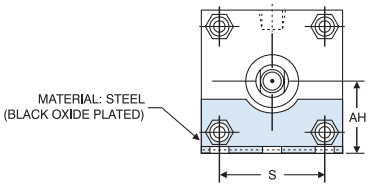
'MF1' FLANGE & 'ME3' CAP MOUNT DIMENSIONS										
BORE	ROD DIAMETER	E	FB	FH	R	RM	TE	TF	UF	W
4.00	1.000 Standard	4.500	0.438	0.625	3.320	—	—	5.438	6.250	0.750
	1.375 Oversize									1.000
5.00	1.000 Standard	5.500	0.563	0.625	4.100	—	—	6.625	7.625	0.750
	1.375 Oversize									1.000
6.00	1.375 Standard	6.500	0.563	0.750	4.875	—	—	7.625	8.625	0.875
	1.750 Oversize									1.125
8.00	1.375 Standard	8.500	0.688	N/A	N/A	*3.500	7.570	N/A	N/A	1.625
	1.750 Oversize									1.875

*Round retainer used to retain bushing.

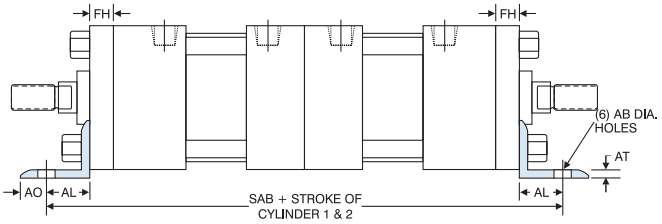
BACK-TO-BACK DIMENSIONS: BASE MOUNTS

'MS1' ANGLE MOUNT DIMENSIONS									
BORE	ROD DIAMETER	AB	AH	AL	AO	AT	FH	S	ADD STROKE SAB
1.50	0.625 Standard	0.438	1.188	1.000	0.375	0.125	0.375	1.250	10.000
	1.000 Oversize								
2.00	0.625 Standard	0.438	1.438	1.000	0.375	0.125	0.375	1.750	10.000
	1.000 Oversize								
2.50	0.625 Standard	0.438	1.625	1.000	0.375	0.125	0.375	2.250	10.250
	1.000 Oversize								
3.25	1.000 Standard	0.563	1.938	1.250	0.500	0.125	0.625	2.750	12.250
	1.375 Oversize								
4.00	1.000 Standard	0.563	2.250	1.250	0.500	0.125	0.625	3.500	12.250
	1.375 Oversize								
5.00	1.000 Standard	0.688	2.750	1.375	0.625	0.188	0.625	4.250	13.000
	1.375 Oversize								
6.00	1.375 Standard	0.813	3.250	1.375	0.625	0.188	0.750	5.250	14.250
	1.750 Oversize								
8.00	1.375 Standard	0.813	4.250	1.813	0.688	0.250	0.625*	7.125	13.875
	1.750 Oversize								

*3.50" diameter round retainer on 8.00" bore.



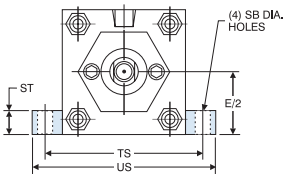
MS1



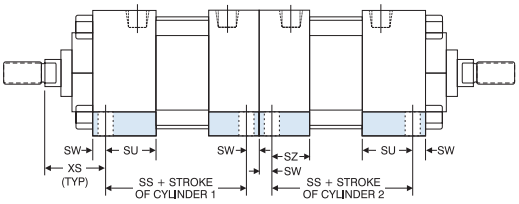
'MS2' SIDE LUG MOUNT DIMENSIONS											
BORE	ROD DIAMETER	SB	E/2	ST	SU	SW	SZ	TS	US	XS	ADD STROKE SS
1.50	0.625 Standard	0.438	1.000	0.500	1.125	0.375	0.625	2.750	3.500	1.375	2.875
	1.000 Oversize									1.750	
2.00	0.625 Standard	0.438	1.250	0.500	1.125	0.375	0.625	3.250	4.000	1.375	2.875
	1.000 Oversize									1.750	
2.50	0.625 Standard	0.438	1.500	0.500	1.125	0.375	0.625	3.750	4.500	1.375	3.000
	1.000 Oversize									1.750	
3.25	1.000 Standard	0.563	1.875	0.750	1.250	0.500	0.750	4.750	5.750	1.875	3.250
	1.375 Oversize									2.125	
4.00	1.000 Standard	0.563	2.250	0.750	1.250	0.500	0.750	5.500	6.500	1.875	3.250
	1.375 Oversize									2.125	
5.00	1.000 Standard	0.813	2.750	1.000	1.063	0.688	0.563	6.875	8.250	2.063	3.125
	1.375 Oversize									2.313	
6.00	1.375 Standard	0.813	3.250	1.000	1.313	0.688	0.813	7.875	9.250	2.313	3.625
	1.750 Oversize									2.563	
8.00	1.375 Standard	0.813	4.250	1.000	1.313	0.688	0.813	9.875	11.250	2.313	3.750
	1.750 Oversize									2.563	

Note: The option not to have side lugs on center two (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 two (2) caps



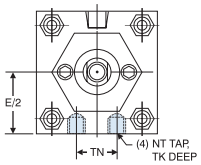
MS2



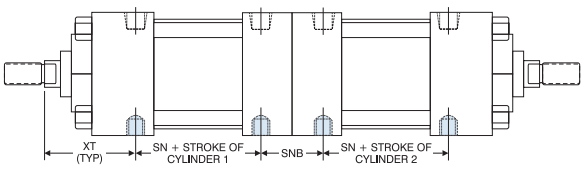
'MS4' BOTTOM TAPPED MOUNT DIMENSIONS								
BORE	ROD DIAMETER	E/2	NT	TK	TN	XT	SNB	ADD STROKE SN
1.50	0.625 Standard	1.000	1/4-20	0.375	0.625	1.938	0.875	2.250
	1.000 Oversize					2.313		
2.00	0.625 Standard	1.250	5/16-18	0.500	0.875	1.938	0.875	2.250
	1.000 Oversize					2.313		
2.50	0.625 Standard	1.500	3/8-16	0.625	1.250	1.938	0.875	2.375
	1.000 Oversize					2.313		
3.25	1.000 Standard	1.875	1/2-13	0.750	1.500	2.438	1.125	2.625
	1.375 Oversize					2.688		
4.00	1.000 Standard	2.250	1/2-13	0.750	2.063	2.438	1.125	2.625
	1.375 Oversize					2.688		
5.00	1.000 Standard	2.750	5/8-11	1.000	2.688	2.438	1.125	2.875
	1.375 Oversize					2.688		
6.00	1.375 Standard	3.250	3/4-10	1.125	3.250	2.813	1.375	3.125
	1.750 Oversize					3.063		
8.00	1.375 Standard	4.250	3/4-10	1.125	4.500	2.813	1.375	3.250
	1.750 Oversize					3.063		

Note: The option not to have 'MS4' taps on center two (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 two (2) caps



MS4



NOTES

3-POSITION CYLINDERS:

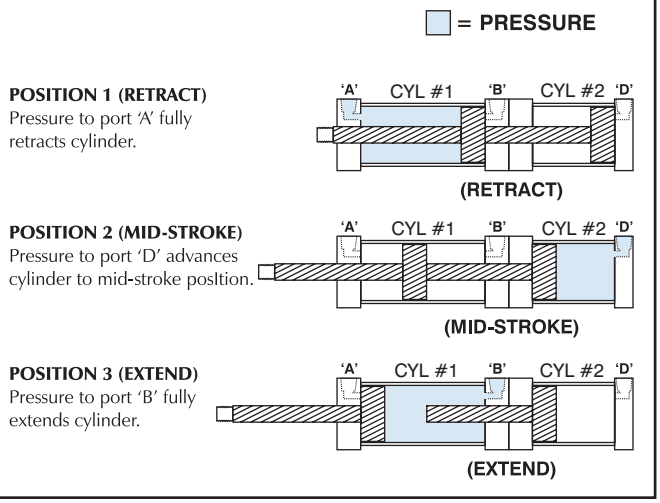
You can create a 3-Position cylinder from ***any*** single stage series of cylinder (Note: not available on multi-stage products).

3-Position cylinders consist of multiple cylinders built as one unit having ONE exposed working rod end, capable of delivering three 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. Three-Position cylinders reduce space and the cost to mount multiple cylinders.

3-POSITION CYLINDERS
HOW THEY WORK



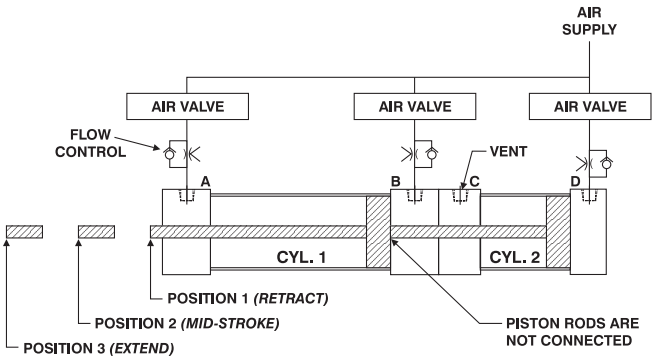
DESIGN TIPS & SCHEMATIC

Design Tips

- Order CYL 1 with "MPR" (magnetic piston option) and use three (3) switches to sense each stroke position. *See pages 223-230 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.

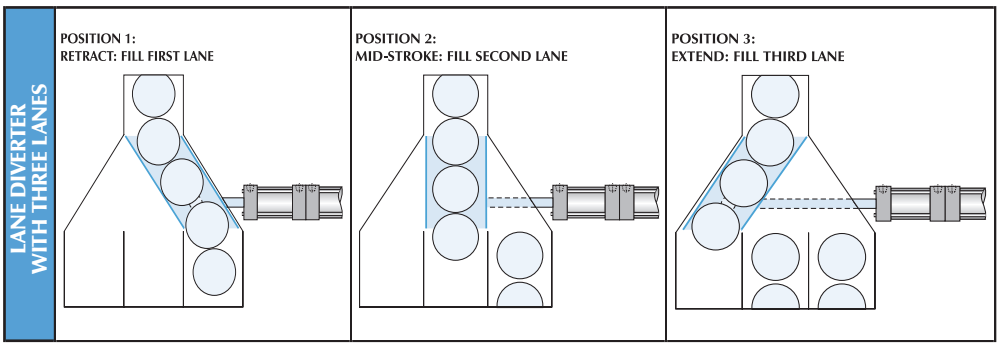
3-POSITION CYLINDER SCHEMATIC

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 three-way air solenoid valves and flow controls can operate a three-position cylinder. *See your local TRD distributor for help in designing an air circuit that's right for your application.*

Application Possibilities:



HOW TO ORDER: 3-POSITION CYLINDERS

CYL. #1 — CYL. #2

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

3P = 3-POSITION; MID-STROKE = 5

SERIES	
TA	250 PSI AIR
TD	250 PSI AIR, TOUGH-DUTY
SS	STAINLESS STEEL
FM	FLUSH MOUNT (Add-A-Mount)
TRA	TRIPLE ROD (CYL. #1 Only)

BORE
1.50
2.00
2.50
3.25
4.00
5.00
6.00
8.00

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

NFPA MOUNTS	
MXO	NO MOUNT
MP1	REAR PIVOT CLEVIS (CYL. 2 ONLY)
MP2	REAR PIVOT CLEVIS (1.50"-6.00" Bore) (CYL. 2 ONLY)
MP4	REAR PIVOT EYE (1.50" - 4.00" 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"-6.00") (CYL. 1 ONLY)
MF2	REAR FLANGE (1.50"-6.00") (CYL. 2 ONLY)
ME3	FRONT MOUNTING HOLES (8.00") (CYL. 1 ONLY)
ME4	REAR MOUNTING HOLES (8.00") (CYL. 2 ONLY)
MS1	FRONT & REAR END FOOT
MS2	SIDE LUG (1.50"-8.00")
MS4	BOTTOM TAPPED HOLES

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	X
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	X
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		
	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" - 8.00" 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 176 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 183 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 223-230 for selection)*
	MS	METALLIC ROD SCRAPER (BRASS CONSTRUCTION)
	NR	**NON-ROTATING** *(Refer to page 180 for specifications)*
	OP	OPTIONAL PORT LOCATION (Example: Ports @ 3 & 7)
	OS	OVERSIZE ROD DIAMETER (SPECIFY SIZE, Example: OS = 1.375")
	SAE	SAE PORTS (SPECIFY SIZE, Example: SAE #10)
X	SE	SPRING EXTEND (1.50", 2.00, 2.50" bore)
X	SR	SPRING RETURN (1.50", 2.00, 2.50" bore)
	SSA	STAINLESS STEEL PISTON ROD, TIE RODS & NUTS, AND FASTENERS
	SSF	STAINLESS STEEL FASTENERS
	SSN	STAINLESS STEEL TIE ROD NUTS
	SSR	STAINLESS STEEL PISTON ROD
	SST	STAINLESS STEEL TIE RODS
X	ST	**STOP TUBE** - SPECIFY STOP TUBE LENGTH (in inches) SPECIFY STROKE AS ES (effective stroke) (Example: TA MS4 2 X 24ES-ST=3)
	TMS	STEEL CYLINDER TUBE, BLACK EPOXY PAINT FINISH
	TH	**400 PSI HYDRAULIC NON-SHOCK** *(Refer to page 183 for specifications)*
	VS	FLUOROCARBON SEALS
	XX	SPECIAL VARIATION (SPECIFY)

ADDS LENGTH TO CYLINDER - SEE "OPTION LENGTH ADDER" CHART, PAGE 9.

About our Part Number System

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

Example: 3-Position

Application calls for a 2.00" 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"

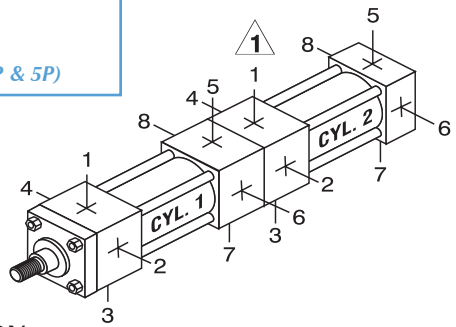
Position 2 (Mid-Stroke) - Total stroke of Cyl. #2

Position 3 (Full-Extend) - Total 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

⚠1 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)

EASY FLIP OUT PAGE FOR REFERENCE

About Rod End Styles

Style 1 Male Rod End is STANDARD

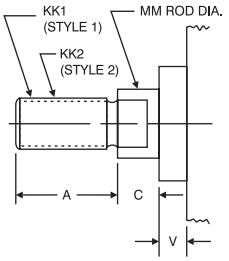
Other NFPA Styles can be specified (see chart).

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

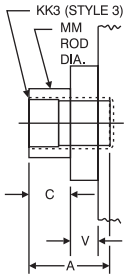
NEED SOMETHING NOT LISTED?
Just send us a sketch.
In most cases, quotes are turned around in one day!

PISTON ROD END STYLES

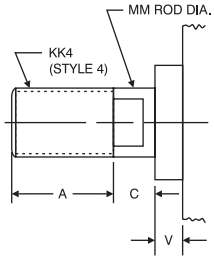
STYLE 1 & 2 KK1 & KK2



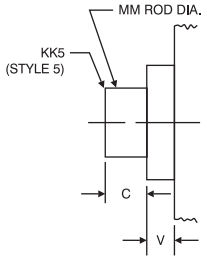
STYLE 3 KK3



STYLE 4 KK4



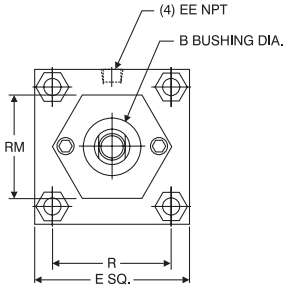
STYLE 5 KK5

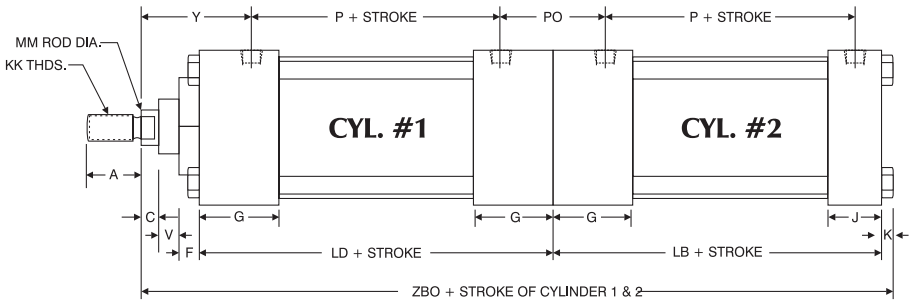


BORE	MM ROD DIAMETER	STANDARD Style 1 - Male KK1	A	OPTIONAL Style 2 - Male KK2	A	Style 3 - Female KK3	A	Style 4 - Male KK4	A	Style 5 - Blank KK5	C	V
1.50, 2.00, 2.50	0.625 Standard	7/16 -20	0.750	1/2 -20	0.750	7/16 -20	0.750	5/8 -18	0.750	No Threads	0.375	0.250
	1.000 Oversize	3/4 -16	1.125	7/8 -14	1.125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

MXO/MXO

(NO MOUNT)





3-POSITION BASIC DIMENSIONS 'MXO' STANDARD & OVERSIZE RODS																					
BORE	ROD DIA.	A	B	C	E	EE	F	G	J	K	KK	LB	LD	MM	P	PO	R	RM	V	Y	ZBO
1.50	0.625 Standard	0.750	1.125	0.375	2.000	0.375	0.375	1.500	1.000	0.250	7/16 -20	3.625	4.125	0.625	2.375	1.750	1.438	2.00 SQ.	0.250	1.875	9.000
	1.000 Oversize	1.125	1.500	0.500							3/4 -16			1.000					0.500	2.250	9.375
2.00	0.625 Standard	0.750	1.125	0.375	2.500	0.375	0.375	1.500	1.000	0.313	7/16 -20	3.625	4.125	0.625	2.375	1.750	1.844	1.75 HEX	0.250	1.875	9.063
	1.000 Oversize	1.125	1.500	0.500							3/4 -16			1.000				2.50 SQ.	0.500	2.250	9.438
2.50	0.625 Standard	0.750	1.125	0.375	3.000	0.375	0.375	1.500	1.000	0.313	7/16 -20	3.750	4.250	0.625	2.500	1.750	2.188	1.75 HEX	0.250	1.875	9.313
	1.000 Oversize	1.125	1.500	0.500							3/4 -16			1.000				3.00 SQ.	0.500	2.250	9.688
3.25	1.000 Standard	1.125	1.500	0.500	3.750	0.500	0.625	1.750	1.250	0.375	3/4 -16	4.250	4.750	1.000	2.750	2.000	2.760	2.75 DIA.	0.250	2.375	10.750
	1.375 Oversize	1.625	2.000	0.625							1 -14			1.375				3.75 SQ.	0.375	2.625	11.000
4.00	1.000 Standard	1.125	1.500	0.500	4.500	0.500	0.625	1.750	1.250	0.375	3/4 -16	4.250	4.750	1.000	2.750	2.000	3.320	2.75 DIA.	0.250	2.375	10.750
	1.375 Oversize	1.625	2.000	0.625							1 -14			1.375				3.50 DIA.	0.375	2.625	11.000
5.00	1.000 Standard	1.125	1.500	0.500	5.500	0.500	0.625	1.750	1.250	0.438	3/4 -16	4.500	5.000	1.000	3.000	2.000	4.100	2.75 DIA.	0.250	2.375	11.313
	1.375 Oversize	1.625	2.000	0.625							1 -14			1.375				3.50 DIA.	0.375	2.625	11.563
6.00	1.375 Standard	1.625	2.000	0.625	6.500	0.750	0.625	2.000	1.500	0.438	1 -14	5.000	5.500	1.375	3.250	2.250	4.875	3.50 DIA.	0.375	2.750	12.563
	1.750 Oversize	2.000	2.375	0.750							1 1/4 -12			1.750					0.500	3.000	12.813
8.00	1.375 Standard	1.625	2.000	0.625	8.500	0.750	0.625	2.000	1.500	0.563	1 -14	5.125	5.625	1.375	3.375	2.250	6.438	3.50 DIA.	0.375	2.750	12.813
	1.750 Oversize	2.000	2.375	0.750							1 1/4 -12			1.750					0.500	3.000	13.188

3-POSITION SERIES BASE DIMENSIONS FLIP-OUT (PAGE 70)

EASY FLIP OUT PAGE FOR REFERENCE

3-POSITION DIMENSIONS: BASIC CYLINDER (NO MOUNT)

About Rod End Styles

Style 1 Male Rod End is STANDARD

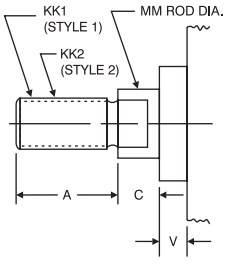
Other NFPA Styles can be specified (see chart).

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).

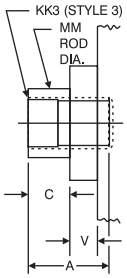
NEED SOMETHING NOT LISTED?
Just send us a sketch.
In most cases, quotes are turned around in one day!

PISTON ROD END STYLES

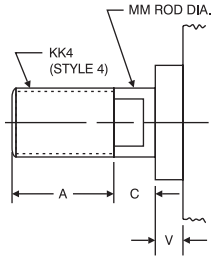
STYLE 1 & 2
KK1 & KK2



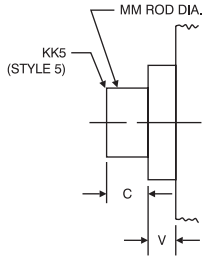
STYLE 3
KK3



STYLE 4
KK4



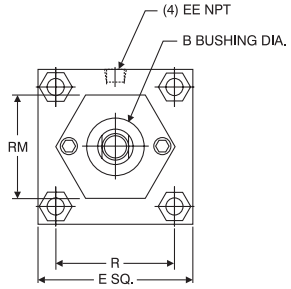
STYLE 5
KK5

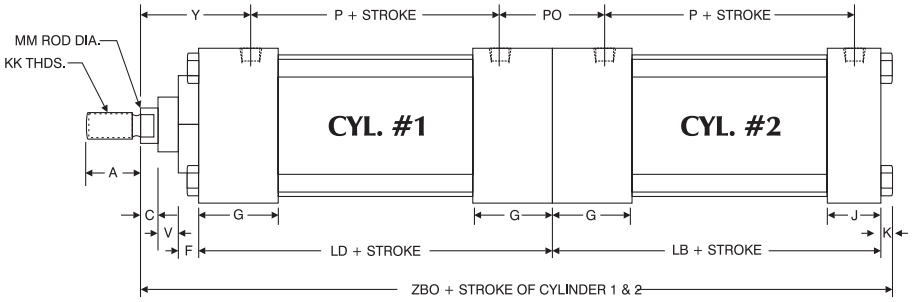


BORE	MM ROD DIAMETER	STANDARD Style 1 - Male KK1	STANDARD Style 1 - Male A	OPTIONAL Style 2 - Male KK2	OPTIONAL Style 2 - Male A	OPTIONAL Style 3 - Female KK3	OPTIONAL Style 3 - Female A	OPTIONAL Style 4 - Male KK4	OPTIONAL Style 4 - Male A	OPTIONAL Style 5 - Blank KK5	C	V
1.50, 2.00, 2.50	0.625 Standard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

MXO/MXO

(NO MOUNT)



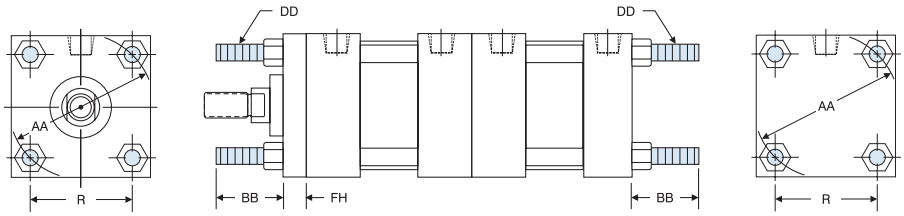


3-POSITION BASIC DIMENSIONS 'MXO' STANDARD & OVERSIZE RODS																					
BORE	ROD DIA.	A	B	C	E	EE	F	G	J	K	KK	LB	LD	MM	P	PO	R	RM	V	Y	ZBO
1.50	0.625 Standard	0.750	1.125	0.375	2.000	0.375	0.375	1.500	1.000	0.250	7/16 -20	3.625	4.125	0.625	2.375	1.750	1.438	2.00 SQ.	0.250	1.875	9.000
	1.000 Oversize	1.125	1.500	0.500							3/4 -16			1.000					0.500	2.250	9.375
2.00	0.625 Standard	0.750	1.125	0.375	2.500	0.375	0.375	1.500	1.000	0.313	7/16 -20	3.625	4.125	0.625	2.375	1.750	1.844	1.75 HEX	0.250	1.875	9.063
	1.000 Oversize	1.125	1.500	0.500							3/4 -16			1.000				2.50 SQ.	0.500	2.250	9.438
2.50	0.625 Standard	0.750	1.125	0.375	3.000	0.375	0.375	1.500	1.000	0.313	7/16 -20	3.750	4.250	0.625	2.500	1.750	2.188	1.75 HEX	0.250	1.875	9.313
	1.000 Oversize	1.125	1.500	0.500							3/4 -16			1.000				3.00 SQ.	0.500	2.250	9.688
3.25	1.000 Standard	1.125	1.500	0.500	3.750	0.500	0.625	1.750	1.250	0.375	3/4 -16	4.250	4.750	1.000	2.750	2.000	2.760	2.75 DIA.	0.250	2.375	10.750
	1.375 Oversize	1.625	2.000	0.625							1 -14			1.375				3.75 SQ.	0.375	2.625	11.000
4.00	1.000 Standard	1.125	1.500	0.500	4.500	0.500	0.625	1.750	1.250	0.375	3/4 -16	4.250	4.750	1.000	2.750	2.000	3.320	2.75 DIA.	0.250	2.375	10.750
	1.375 Oversize	1.625	2.000	0.625							1 -14			1.375				3.50 DIA.	0.375	2.625	11.000
5.00	1.000 Standard	1.125	1.500	0.500	5.500	0.500	0.625	1.750	1.250	0.438	3/4 -16	4.500	5.000	1.000	3.000	2.000	4.100	2.75 DIA.	0.250	2.375	11.313
	1.375 Oversize	1.625	2.000	0.625							1 -14			1.375				3.50 DIA.	0.375	2.625	11.563
6.00	1.375 Standard	1.625	2.000	0.625	6.500	0.750	0.625	2.000	1.500	0.438	1 -14	5.000	5.500	1.375	3.250	2.250	4.875	3.50 DIA.	0.375	2.750	12.563
	1.750 Oversize	2.000	2.375	0.750							1 1/4 -12			1.750					0.500	3.000	12.813
8.00	1.375 Standard	1.625	2.000	0.625	8.500	0.750	0.625	2.000	1.500	0.563	1 -14	5.125	5.625	1.375	3.375	2.250	6.438	3.50 DIA.	0.375	2.750	12.813
	1.750 Oversize	2.000	2.375	0.750							1 1/4 -12			1.750					0.500	3.000	13.188

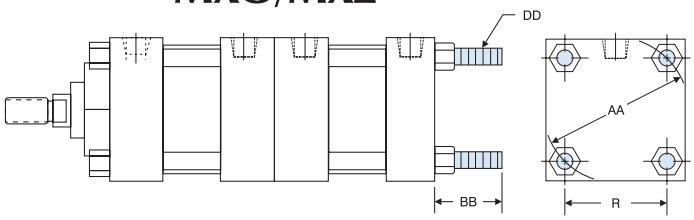
3-POSITION SERIES BASE DIMENSIONS FLIP-OUT (PAGE 70)

3-POSITION DIMENSIONS: TIE ROD & FLANGE MOUNTS

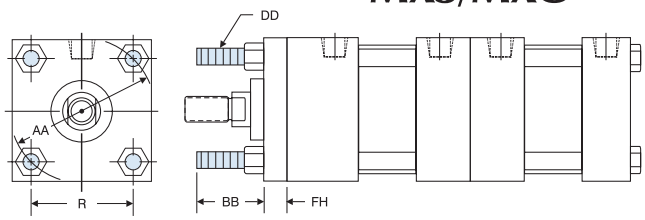
MX1



MXO/MX2



MX3/MXO

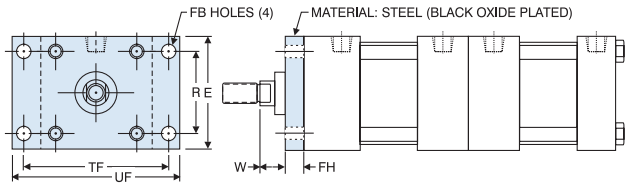


TIE ROD EXTENDED 'MX1', 'MX2' & 'MX3' MOUNT DIMENSIONS						
BORE	ROD DIAMETER	AA	BB	DD	FH	R
1.50	0.625 Standard 1.000 Oversize	2.020	1.000	1/4-28	0.375	1.438
2.00	0.625 Standard 1.000 Oversize	2.600	1.125	5/16-24	0.375	1.844
2.50	0.625 Standard 1.000 Oversize	3.100	1.125	5/16-24	0.375	2.188
3.25	1.000 Standard 1.375 Oversize	3.900	1.375	3/8-24	0.625	2.766

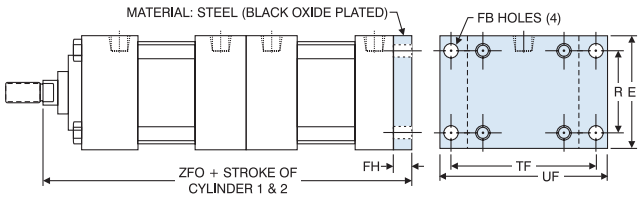
TIE ROD EXTENDED 'MX1', 'MX2' & 'MX3' MOUNT DIMENSIONS						
BORE	ROD DIAMETER	AA	BB	DD	FH	R
4.00	1.000 Standard 1.375 Oversize	4.700	1.375	3/8-24	0.625	3.320
5.00	1.000 Standard 1.375 Oversize	5.800	1.813	1/2-20	0.625	4.100
6.00	1.375 Standard 1.750 Oversize	6.900	1.813	1/2-20	0.750	4.875
8.00	1.375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

*MX1 & MX3 have full square bushing retainer on 1.50" - 6.00" bores, round retainers on 8.00" bores.
**BB dimension from head on 8.00" bore.

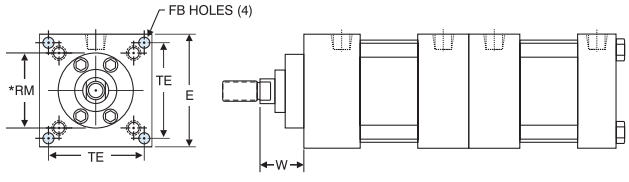
MF1/MXO
1.50" - 6.00" BORES



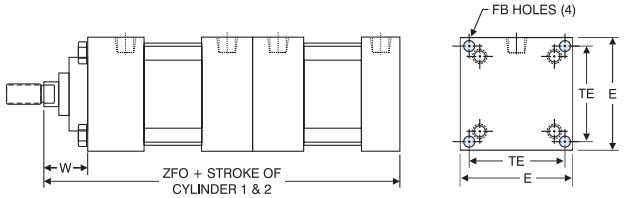
MXO/MF2
1.50" - 6.00" BORES



ME3/MXO
8.00" BORE ONLY



MXO/ME4
8.00" BORE ONLY



'MF1', 'MF2' FLANGE & 'ME3', 'ME4' CAP MOUNT DIMENSIONS											
BORE	ROD DIAMETER	E	FB	FH	R	RM	TE	TF	UF	W	ZFO
1.50	0.625 Standard 1.000 Oversize	2.000	0.313	0.375	1.438	—	—	2.750	3.375	0.625 1.000	9.125 9.500
2.00	0.625 Standard 1.000 Oversize	2.500	0.375	0.375	1.844	—	—	3.375	4.125	0.625 1.000	9.125 9.500
2.50	0.625 Standard 1.000 Oversize	3.000	0.375	0.375	2.188	—	—	3.875	4.625	0.625 1.000	9.375 9.750
3.25	1.000 Standard 1.375 Oversize	3.750	0.438	0.625	2.766	—	—	4.688	5.500	0.750 1.000	11.000 11.250

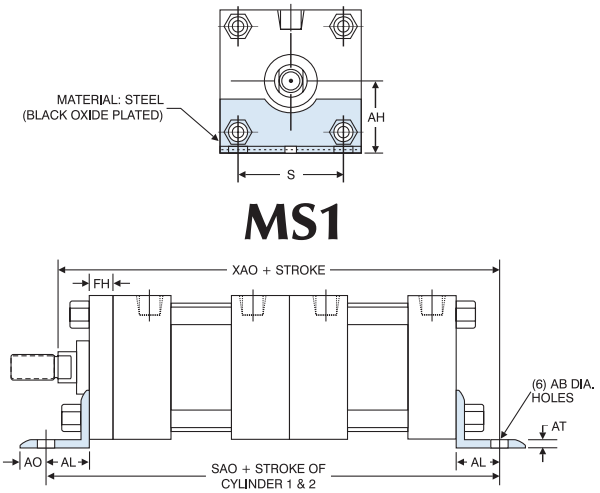
'MF1' FLANGE & 'ME3' CAP MOUNT DIMENSIONS											
BORE	ROD DIAMETER	E	FB	FH	R	RM	TE	TF	UF	W	ZFO
4.00	1.000 Standard 1.375 Oversize	4.500	0.438	0.625	3.320	—	—	5.438	6.250	0.750 1.000	11.000 11.250
5.00	1.000 Standard 1.375 Oversize	5.500	0.563	0.625	4.100	—	—	6.625	7.625	0.750 1.000	11.500 11.750
6.00	1.375 Standard 1.750 Oversize	6.500	0.563	0.750	4.875	—	—	7.625	8.625	0.875 1.125	12.875 13.125
8.00	1.375 Standard 1.750 Oversize	8.500	0.688	N/A	N/A	*3.500	7.570	N/A	N/A	1.625 1.875	12.375 12.625

*Round retainer used to retain bushing.
For dimensions not shown, see page 70.

3-POSITION DIMENSIONS: BASE MOUNTS

'MS1' ANGLE MOUNT DIMENSIONS										
BORE	ROD DIAMETER	AB	AH	AL	AO	AT	FH	S	ADD STROKE SAO	ADD STROKE XAO
1.50	0.625 Standard	0.438	1.188	1.000	0.375	0.125	0.375	1.250	10.125	9.750
	1.000 Oversize									10.125
2.00	0.625 Standard	0.438	1.438	1.000	0.375	0.125	0.375	1.750	10.125	9.750
	1.000 Oversize									10.125
2.50	0.625 Standard	0.438	1.625	1.000	0.375	0.125	0.375	2.250	10.375	10.000
	1.000 Oversize									10.375
3.25	1.000 Standard	0.563	1.938	1.250	0.500	0.125	0.625	2.750	12.125	11.625
	1.375 Oversize									11.875
4.00	1.000 Standard	0.563	2.250	1.250	0.500	0.125	0.625	3.500	12.125	11.625
	1.375 Oversize									11.875
5.00	1.000 Standard	0.688	2.750	1.375	0.625	0.188	0.625	4.250	12.875	12.250
	1.375 Oversize									12.500
6.00	1.375 Standard	0.813	3.250	1.375	0.625	0.188	0.750	5.250	14.000	13.500
	1.750 Oversize									13.750
8.00	1.375 Standard	0.813	4.250	1.813	0.688	0.250	0.625*	7.125	14.375	14.188
	1.750 Oversize									14.438

*Round retainer on 8.00" bore.
For dimensions not shown, see page 70.

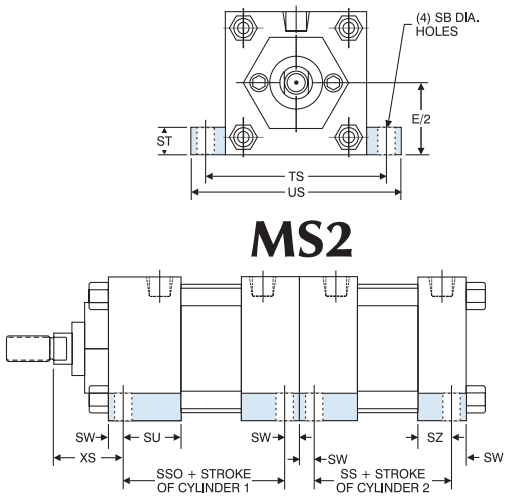


'MS2' SIDE LUG MOUNT DIMENSIONS												
BORE	ROD DIAMETER	SB	E/2	ST	SU	SW	SZ	TS	US	XS	ADD STROKE SSO	ADD STROKE SS
1.50	0.625 Standard	0.438	1.000	0.500	1.125	0.375	0.625	2.750	3.500	1.375	3.375	2.875
	1.000 Oversize									1.750		
2.00	0.625 Standard	0.438	1.250	0.500	1.125	0.375	0.625	3.250	4.000	1.375	3.375	2.875
	1.000 Oversize									1.750		
2.50	0.625 Standard	0.438	1.500	0.500	1.125	0.375	0.625	3.750	4.500	1.375	3.500	3.000
	1.000 Oversize									1.750		
3.25	1.000 Standard	0.563	1.875	0.750	1.250	0.500	0.750	4.750	5.750	1.875	3.750	3.250
	1.375 Oversize									2.125		
4.00	1.000 Standard	0.563	2.250	0.750	1.250	0.500	0.750	5.500	6.500	1.875	3.750	3.250
	1.375 Oversize									2.125		
5.00	1.000 Standard	0.813	2.750	1.000	1.063	0.688	0.563	6.875	8.250	2.063	3.625	3.125
	1.375 Oversize									2.313		
6.00	1.375 Standard	0.813	3.250	1.000	1.313	0.688	0.813	7.875	9.250	2.313	4.125	3.625
	1.750 Oversize									2.563		
8.00	1.375 Standard	0.813	4.250	1.000	1.313	0.688	0.813	9.875	11.250	2.313	4.250	3.750
	1.750 Oversize									2.563		

Note: The option not to have side lugs on center two (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 two (2) caps

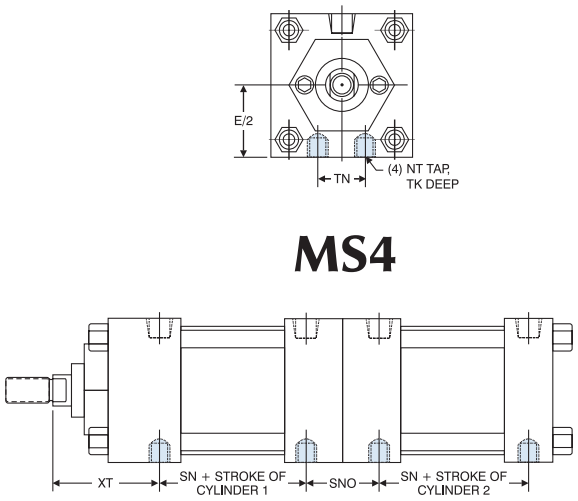
For dimensions not shown, see page 70.



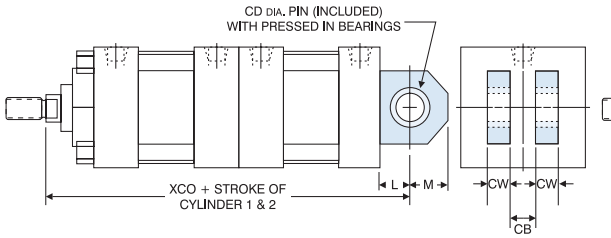
'MS4' BOTTOM TAPPED MOUNT DIMENSIONS								
BORE	ROD DIAMETER	E/2	NT	TK	TN	XT	SNO	ADD STROKE SN
1.50	0.625 Standard	1.000	1/4 -20	0.375	0.625	1.938	1.875	2.250
	1.000 Oversize					2.313		
2.00	0.625 Standard	1.250	5/16 -18	0.500	0.875	1.938	1.875	2.250
	1.000 Oversize					2.313		
2.50	0.625 Standard	1.500	3/8 -16	0.625	1.250	1.938	1.875	2.375
	1.000 Oversize					2.313		
3.25	1.000 Standard	1.875	1/2 -13	0.750	1.500	2.438	2.125	2.625
	1.375 Oversize					2.688		
4.00	1.000 Standard	2.250	1/2 -13	0.750	2.063	2.438	2.125	2.625
	1.375 Oversize					2.688		
5.00	1.000 Standard	2.750	5/8 -11	1.000	2.688	2.438	2.125	2.875
	1.375 Oversize					2.688		
6.00	1.375 Standard	3.250	3/4 -10	1.125	3.250	2.813	2.375	3.125
	1.750 Oversize					3.063		
8.00	1.375 Standard	4.250	3/4 -10	1.125	4.500	2.813	2.375	3.250
	1.750 Oversize					3.063		

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

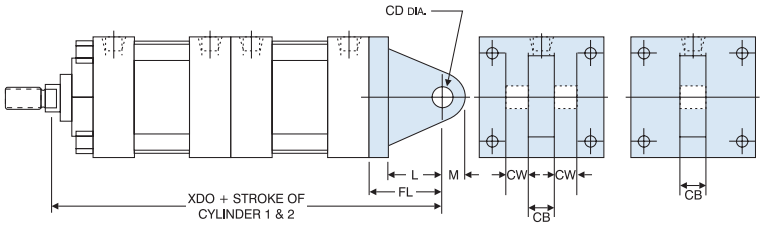
Example: 3P-TA-MS4-6 X 7-H with TA-MS4-6 X 4-C-"XX"
"XX" = No 'MS4' taps on center two (2) caps
For dimensions not shown, see page 70.



3-POSITION DIMENSIONS: PIVOT MOUNTS



MXO/MP1 MOUNT
(Extruded, 1.50″ - 8.00″ bores)

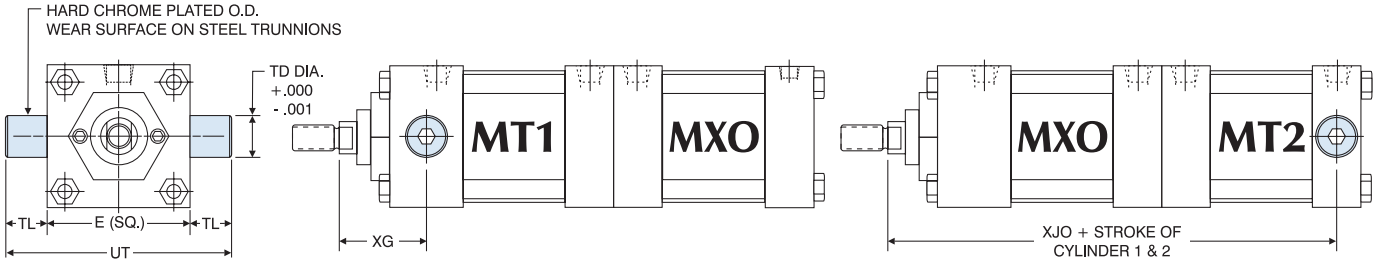


MXO/ MP2
(Casting, 1.50″ - 6.00″ bore)

MXO/ MP4
(Casting, 1.50″ - 4.00″ bore)

'MP1' & 'MP2' CLEVIS AND 'MP4' ROD EYE MOUNT DIMENSIONS									
BORE	ROD DIAMETER	CB	CD	CW	FL	L	M	ADD STROKE XCO	ADD STROKE XDO
1.50	0.625 Standard	0.750	0.500	0.500	1.125	0.750	0.625	9.500	9.875
	1.000 Oversize							9.875	10.250
2.00	0.625 Standard	0.750	0.500	0.500	1.125	0.750	0.625	9.500	9.875
	1.000 Oversize							9.875	10.250
2.50	0.625 Standard	0.750	0.500	0.500	1.125	0.750	0.625	9.750	10.125
	1.000 Oversize							10.125	10.500
3.25	1.000 Standard	1.250	0.750	0.625	1.875	1.250	0.875	11.625	12.250
	1.375 Oversize							11.875	12.500
4.00	1.000 Standard	1.250	0.750	0.625	1.875	1.250	0.875	11.625	12.250
	1.375 Oversize							11.875	12.500
5.00	1.000 Standard	1.250	0.750	0.625	1.875	1.250	0.875	12.125	12.750
	1.375 Oversize							12.375	13.000
6.00	1.375 Standard	1.500	1.000	0.750	2.250	1.500	1.000	13.625	14.500
	1.750 Oversize							13.875	14.750
8.00	1.375 Standard	1.500	1.000	0.750	N/A	1.500	1.000	13.875	N/A
	1.750 Oversize							14.125	

Clevis pins are provided with pivot mounts.
*MP4 mount not available as standard on 5.00″ bores and above.
Note: Extruded MP1 mounts are standard (1.50″ - 8.00″ bores).
Cast iron removable mounts are optional and must be requested when ordering (1.50″ - 6.00″ bores).
For dimensions not shown, see page 70.



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	0.625 Standard	2.000	1.000	1.000	4.000	1.750	8.250
	1.000 Oversize					N/A*	8.625
2.00	0.625 Standard	2.500	1.000	1.000	4.500	1.750	8.250
	1.000 Oversize					2.125	8.625
2.50	0.625 Standard	3.000	1.000	1.000	5.000	1.750	8.500
	1.000 Oversize					2.125	8.875
3.25	1.000 Standard	3.750	1.000	1.000	5.750	2.250	9.750
	1.375 Oversize					2.500	10.000
4.00	1.000 Standard	4.500	1.000	1.000	6.500	2.250	9.750
	1.375 Oversize					2.500	10.000
5.00	1.000 Standard	5.500	1.000	1.000	7.500	2.250	10.250
	1.375 Oversize					2.500	10.500
6.00	1.375 Standard	6.500	1.375	1.375	9.250	2.625	11.375
	1.750 Oversize					2.875	11.625
8.00	1.375 Standard	8.500	1.375	1.375	11.250	2.625	11.625
	1.750 Oversize					2.875	11.875

*No oversize rod available on 1.50″ bore MT1.
For dimensions not shown, see page 70.

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 — CYL. #2

TM - TA - MF1 - 2 x 10 - TH WITH TA - MXO - 2 x 10 - MPR - HC

TANDEM

SERIES	
TA	250 PSI AIR
SS	STAINLESS STEEL
FM	FLUSH MOUNT (Add-A-Mount)
TRA	TRIPLE ROD (CYL. #1 Only)

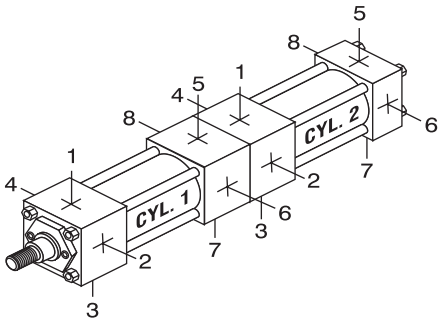
BORE
1.50
2.00
2.50
3.25
4.00
5.00
6.00
8.00

STROKE (CYL. #1)
0" to 50" Made to Order
NOTE: CYL. #1 and CYL. #2 strokes must be the same. **(PISTON RODS ARE CONNECTED)**

NFPA MOUNTS	
MXO	NO MOUNT
MP1	REAR PIVOT CLEVIS (CYL. 2 ONLY)
MP2	REAR PIVOT CLEVIS (1.50"-6.00" Bore) (CYL. 2 ONLY)
MP4	REAR PIVOT EYE (1.50" - 4.00" 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"-6.00" Bore) (CYL. 1 ONLY)
MF2	REAR FLANGE (1.50"-6.00" Bore) (CYL. 2 ONLY)
ME3	FRONT MOUNTING HOLES (8.00" Bore) (CYL. 1 ONLY)
ME4	REAR MOUNTING HOLES (8.00" Bore) (CYL. 2 ONLY)
MS1	FRONT & REAR END FOOT
MS2	SIDE LUG (1.50"- 8.00")
MS4	BOTTOM TAPPED HOLES

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 176 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 = 1.375")
TH	**400 PSI HYDRAULIC, NON-SHOCK** *(Refer to page 183 for specifications)*
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
SSN	STAINLESS STEEL TIE ROD NUTS
SSR	STAINLESS STEEL PISTON ROD
SST	STAINLESS STEEL TIE RODS

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



STANDARD PORT AND CUSHION ADJUSTMENT POSITIONS

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

OPTIONS*		
ADDS LENGTH TO CYLINDER - SEE "OPTION LENGTH ADDER" CHART, PAGE 9.		
	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 176 for specifications)*
	MPR	MAGNETIC PISTON FOR REED OR SOLID STATE SWITCHES - TRD MODELS: R10, R10P, RAC, RHT & MSS *(Refer to pages 223-230 for selection)*
	MA	MICRO-ADJUST (6" MAX. STROKE) *Available on Double Rod End Models*
	TH	400 PSI HYDRAULIC, NON-SHOCK *(Refer to page 183 for specifications)*
	OP	OPTIONAL PORT LOCATION (Example: Ports @ 3 & 7)
	OS	OVERSIZE ROD DIAMETER (SPECIFY SIZE, Example: OS = 1.375")
	VS	FLUOROCARBON SEALS
	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
	SSN	STAINLESS STEEL TIE ROD NUTS
	SSR	STAINLESS STEEL PISTON ROD
	SST	STAINLESS STEEL TIE RODS

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, 2.00" bore x 10" stroke, 400 PSI Hydraulic.
Cyl. 2 is a 'TA' series, MXO (no mount), 2.00" 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)

About Rod End Styles

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

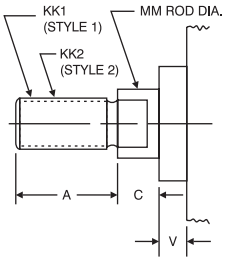
Other NFPA Styles can be specified (see chart).

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).

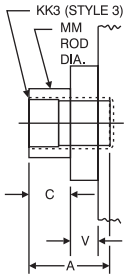
NEED SOMETHING NOT LISTED?
Just send us a sketch.
In most cases, quotes are turned around in one day!

PISTON ROD END STYLES

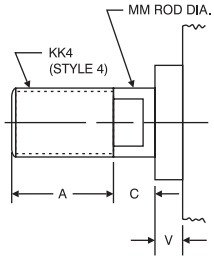
STYLE 1 & 2 KK1 & KK2



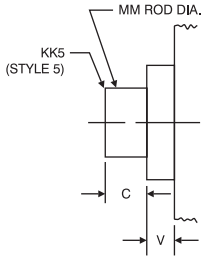
STYLE 3 KK3



STYLE 4 KK4

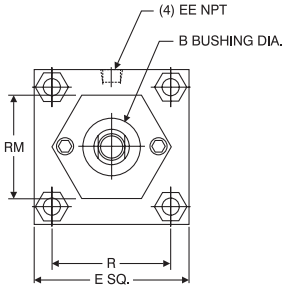


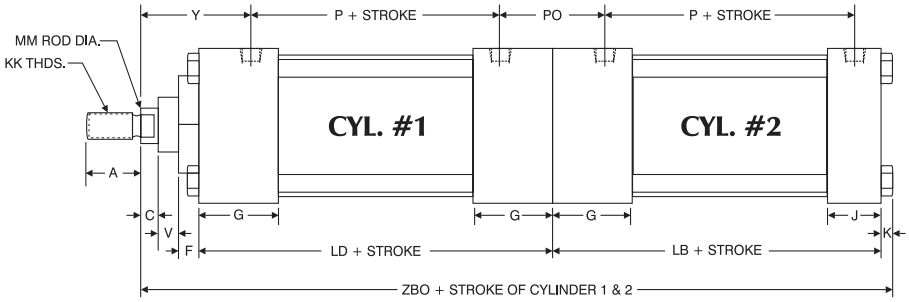
STYLE 5 KK5



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

MXO/MXO
(NO MOUNT)





BASIC DIMENSIONS 'MXO' STANDARD & OVERSIZE RODS																					
BORE	ROD DIA.	A	B	C	E	EE	F	G	J	K	KK	LB	LD	MM	P	PO	R	RM	V	Y	ZBO
1.50	0.625 Standard	0.750	1.125	0.375	2.000	0.375	0.375	1.500	1.000	0.250	7/16 -20	3.625	4.125	0.625	2.375	1.750	1.438	2.00 SQ.	0.250	1.875	9.000
	1.000 Oversize	1.125	1.500	0.500							3/4 -16			1.000					0.500	2.250	9.375
2.00	0.625 Standard	0.750	1.125	0.375	2.500	0.375	0.375	1.500	1.000	0.313	7/16 -20	3.625	4.125	0.625	2.375	1.750	1.844	1.75 HEX	0.250	1.875	9.063
	1.000 Oversize	1.125	1.500	0.500							3/4 -16			1.000				2.50 SQ.	0.500	2.250	9.438
2.50	0.625 Standard	0.750	1.125	0.375	3.000	0.375	0.375	1.500	1.000	0.313	7/16 -20	3.750	4.250	0.625	2.500	1.750	2.188	1.75 HEX	0.250	1.875	9.313
	1.000 Oversize	1.125	1.500	0.500							3/4 -16			1.000				3.00 SQ.	0.500	2.250	9.688
3.25	1.000 Standard	1.125	1.500	0.500	3.750	0.500	0.625	1.750	1.250	0.375	3/4 -16	4.250	4.750	1.000	2.750	2.000	2.766	2.75 DIA.	0.250	2.375	10.750
	1.375 Oversize	1.625	2.000	0.625							1-14			1.375				3.75 SQ.	0.375	2.625	11.000
4.00	1.000 Standard	1.125	1.500	0.500	4.500	0.500	0.625	1.750	1.250	0.375	3/4 -16	4.250	4.750	1.000	2.750	2.000	3.320	2.75 DIA.	0.250	2.375	10.750
	1.375 Oversize	1.625	2.000	0.625							1-14			1.375				3.50 DIA.	0.375	2.625	11.000
5.00	1.000 Standard	1.125	1.500	0.500	5.500	0.500	0.625	1.750	1.250	0.438	3/4 -16	4.500	5.000	1.000	3.000	2.000	4.100	2.75 DIA.	0.250	2.375	11.313
	1.375 Oversize	1.625	2.000	0.625							1-14			1.375				3.50 DIA.	0.375	2.625	11.563
6.00	1.375 Standard	1.625	2.000	0.625	6.500	0.750	0.625	2.000	1.500	0.438	1-14	5.000	5.500	1.375	3.250	2.250	4.875	3.50 DIA.	0.375	2.750	12.563
	1.750 Oversize	2.000	2.375	0.750							1 1/4 -12			1.750					0.500	3.000	12.813
8.00	1.375 Standard	1.625	2.000	0.625	8.500	0.750	0.625	2.000	1.500	0.563	1-14	5.125	5.625	1.375	3.375	2.250	6.438	3.50 DIA.	0.375	2.750	12.938
	1.750 Oversize	2.000	2.375	0.750							1 1/4 -12			1.750					0.500	3.000	13.188

TANDEM SERIES BASE DIMENSIONS FLIP-OUT (PAGE 75)

EASY FLIP OUT PAGE FOR REFERENCE

TANDEM DIMENSIONS: BASIC CYLINDER (NO MOUNT)

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).

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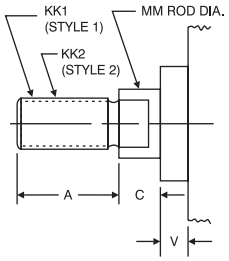
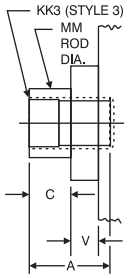
PISTON ROD END STYLES

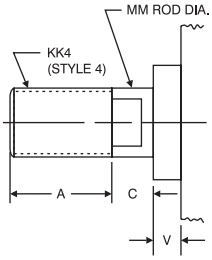
STYLE 1 & 2 KK1 & KK2



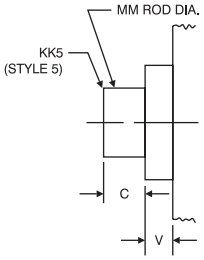
STYLE 3 KK3



STYLE 4 KK4



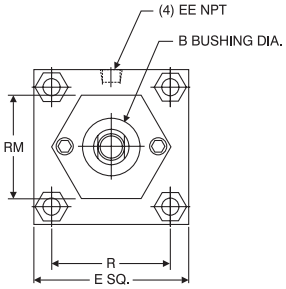
STYLE 5 KK5

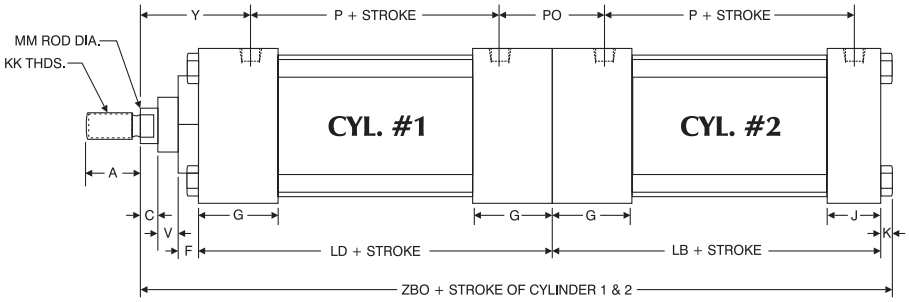


BORE	MM ROD DIAMETER	STANDARD Style 1 - Male KK1	A	OPTIONAL Style 2 - Male KK2	A	Style 3 - Female KK3	A	Style 4 - Male KK4	A	Style 5 - Blank KK5	C	V
1.50, 2.00, 2.50	0.625 Standard	7/16 -20	0.750	1/2 -20	0.750	7/16 -20	0.750	5/8 -18	0.750	No Threads	0.375	0.250
	1.000 Oversize	3/4 -16	1.125	7/8 -14	1.125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

MXO/MXO

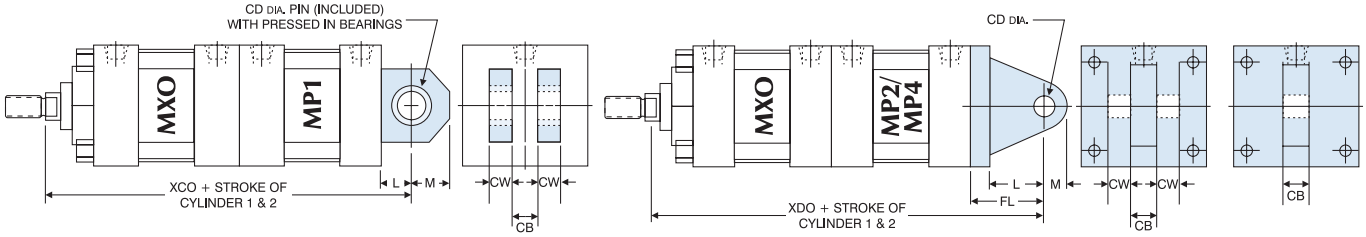
(NO MOUNT)





BASIC DIMENSIONS 'MXO' STANDARD & OVERSIZE RODS																					
BORE	ROD DIA.	A	B	C	E	EE	F	G	J	K	KK	LB	LD	MM	P	PO	R	RM	V	Y	ZBO
1.50	0.625 Standard	0.750	1.125	0.375	2.000	0.375	0.375	1.500	1.000	0.250	7/16 -20	3.625	4.125	0.625	2.375	1.750	1.438	2.00 SQ.	0.250	1.875	9.000
	1.000 Oversize	1.125	1.500	0.500							3/4 -16			1.000					0.500	2.250	9.375
2.00	0.625 Standard	0.750	1.125	0.375	2.500	0.375	0.375	1.500	1.000	0.313	7/16 -20	3.625	4.125	0.625	2.375	1.750	1.844	1.75 HEX	0.250	1.875	9.063
	1.000 Oversize	1.125	1.500	0.500							3/4 -16			1.000				2.50 SQ.	0.500	2.250	9.438
2.50	0.625 Standard	0.750	1.125	0.375	3.000	0.375	0.375	1.500	1.000	0.313	7/16 -20	3.750	4.250	0.625	2.500	1.750	2.188	1.75 HEX	0.250	1.875	9.313
	1.000 Oversize	1.125	1.500	0.500							3/4 -16			1.000				3.00 SQ.	0.500	2.250	9.688
3.25	1.000 Standard	1.125	1.500	0.500	3.750	0.500	0.625	1.750	1.250	0.375	3/4 -16	4.250	4.750	1.000	2.750	2.000	2.766	2.75 DIA.	0.250	2.375	10.750
	1.375 Oversize	1.625	2.000	0.625							1 -14			1.375				3.75 SQ.	0.375	2.625	11.000
4.00	1.000 Standard	1.125	1.500	0.500	4.500	0.500	0.625	1.750	1.250	0.375	3/4 -16	4.250	4.750	1.000	2.750	2.000	3.320	2.75 DIA.	0.250	2.375	10.750
	1.375 Oversize	1.625	2.000	0.625							1 -14			1.375				3.50 DIA.	0.375	2.625	11.000
5.00	1.000 Standard	1.125	1.500	0.500	5.500	0.500	0.625	1.750	1.250	0.438	3/4 -16	4.500	5.000	1.000	3.000	2.000	4.100	2.75 DIA.	0.250	2.375	11.313
	1.375 Oversize	1.625	2.000	0.625							1 -14			1.375				3.50 DIA.	0.375	2.625	11.563
6.00	1.375 Standard	1.625	2.000	0.625	6.500	0.750	0.625	2.000	1.500	0.438	1 -14	5.000	5.500	1.375	3.250	2.250	4.875	3.50 DIA.	0.375	2.750	12.563
	1.750 Oversize	2.000	2.375	0.750							1 1/4 -12			1.750					0.500	3.000	12.813
8.00	1.375 Standard	1.625	2.000	0.625	8.500	0.750	0.625	2.000	1.500	0.563	1 -14	5.125	5.625	1.375	3.375	2.250	6.438	3.50 DIA.	0.375	2.750	12.938
	1.750 Oversize	2.000	2.375	0.750							1 1/4 -12			1.750					0.500	3.000	13.188

TANDEM DIMENSIONS: PIVOT MOUNTS



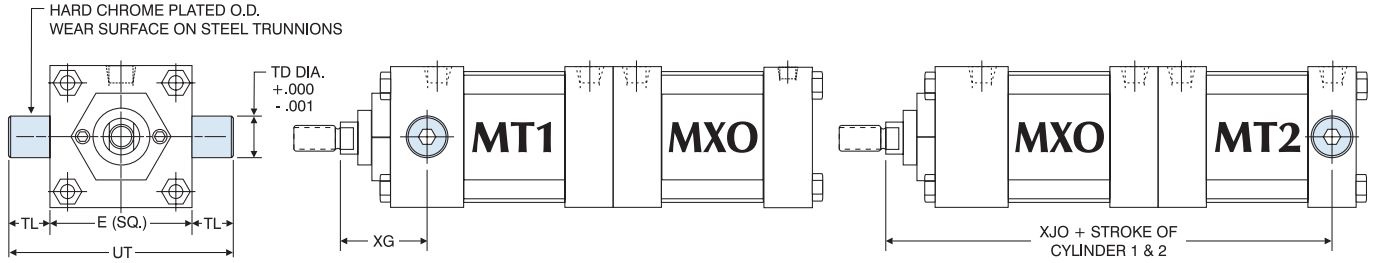
MXO/MP1 MOUNT
(Extruded, 1.50″ - 8.00″ bores)

MXO/ MP2
(Casting, 1.50″ - 6.00″ bore)

MXO/ MP4
(Casting, 1.50″ - 4.00″ bore)

'MP1' & 'MP2' CLEVIS AND 'MP4' ROD EYE MOUNT DIMENSIONS									
BORE	ROD DIAMETER	CB	CD	CW	FL	L	M	ADD STROKE XCO	ADD STROKE XDO
1.50	0.625 Standard	0.750	0.500	0.500	1.125	0.750	0.625	9.500	9.875
	1.000 Oversize							9.875	10.250
2.00	0.625 Standard	0.750	0.500	0.500	1.125	0.750	0.625	9.500	9.875
	1.000 Oversize							9.875	10.250
2.50	0.625 Standard	0.750	0.500	0.500	1.125	0.750	0.625	9.750	10.125
	1.000 Oversize							10.125	10.500
3.25	1.000 Standard	1.250	0.750	0.625	1.875	1.250	0.875	11.625	12.250
	1.375 Oversize							11.875	12.500
4.00	1.000 Standard	1.250	0.750	0.625	1.875	1.250	0.875	11.625	12.250
	1.375 Oversize							11.875	12.500
5.00	1.000 Standard	1.250	0.750	0.625	1.875	1.250	0.875	12.125	12.750
	1.375 Oversize							12.375	13.000
6.00	1.375 Standard	1.500	1.000	0.750	2.250	1.500	1.000	13.625	14.500
	1.750 Oversize							13.875	14.750
8.00	1.375 Standard	1.500	1.000	0.750	N/A	1.500	1.000	13.875	N/A
	1.750 Oversize							14.125	

Clevis pins are provided with pivot mounts.
* MP4 mount not available as standard on 5.00″ bores and above.
Note: Extruded MP1 mounts are standard (1.50″ - 8.00″ bores).
Cast iron removable mounts are optional and must be requested when ordering (1.50″ - 6.00″ bores).
For dimensions not shown, see page 75.



MT1 / MT2

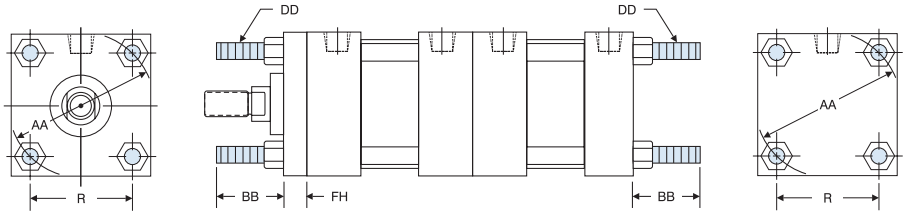
Note: MT1 and MT2 Trunnions are bolt on, non-removable design. Optional: One-piece solid steel trunnion available.

'MT1' HEAD TRUNNION AND 'MT2' CAP TRUNNION MOUNT DIMENSIONS							
BORE	ROD DIAMETER	E	TD	TL	UT	XG	ADD STROKE XJO
1.50	0.625 Standard	2.000	1.000	1.000	4.000	1.750	8.250
	1.000 Oversize					N/A*	8.625
2.00	0.625 Standard	2.500	1.000	1.000	4.500	1.750	8.250
	1.000 Oversize					2.125	8.625
2.50	0.625 Standard	3.000	1.000	1.000	5.000	1.750	8.500
	1.000 Oversize					2.125	8.875
3.25	1.000 Standard	3.750	1.000	1.000	5.750	2.250	9.750
	1.375 Oversize					2.500	10.000
4.00	1.000 Standard	4.500	1.000	1.000	6.500	2.250	9.750
	1.375 Oversize					2.500	10.000
5.00	1.000 Standard	5.500	1.000	1.000	7.500	2.250	10.250
	1.375 Oversize					2.500	10.500
6.00	1.375 Standard	6.500	1.375	1.375	9.250	2.625	11.375
	1.750 Oversize					2.875	11.625
8.00	1.375 Standard	8.500	1.375	1.375	11.250	2.625	11.625
	1.750 Oversize					2.875	11.875

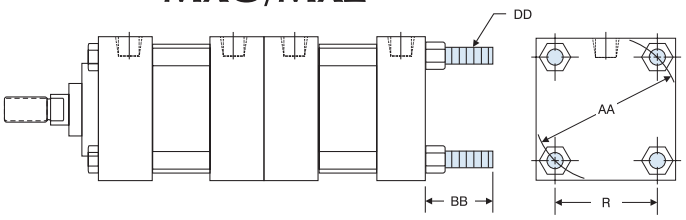
*No oversize rod available on 1.50″ bore MT1.
For dimensions not shown, see page 75.

TANDEM DIMENSIONS: TIE ROD & FLANGE MOUNTS

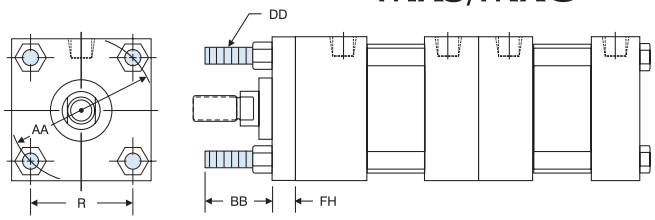
MX1



MXO/MX2



MX3/MXO



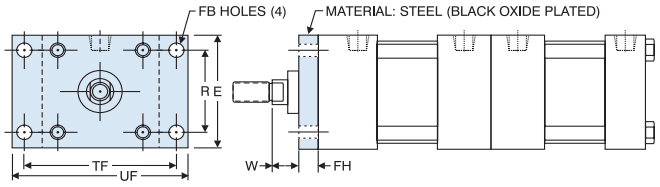
TIE ROD EXTENDED 'MX1', 'MX2' & 'MX3' MOUNT DIMENSIONS						
BORE	ROD DIAMETER	AA	BB	DD	FH	R
1.50	0.625 Standard 1.000 Oversize	2.020	1.000	1/4 -28	0.375	1.438
2.00	0.625 Standard 1.000 Oversize	2.600	1.125	5/16 -24	0.375	1.844
2.50	0.625 Standard 1.000 Oversize	3.100	1.125	5/16 -24	0.375	2.188
3.25	1.000 Standard 1.375 Oversize	3.900	1.375	3/8 -24	0.625	2.766

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

*MX1 & MX3 have full square bushing retainer on 1.50" - 6.00" bores, round retainers on 8.00" bores.
**"BB" dimension from head on 8.00" bore.
For dimensions not shown, see page 75.

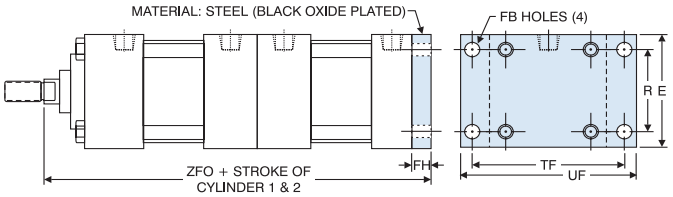
MF1/MXO

1.50" - 6.00" BORES



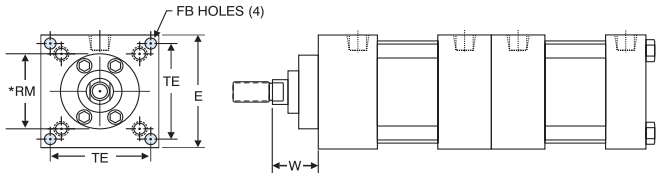
MXO/MF2

1.50" - 6.00" BORES



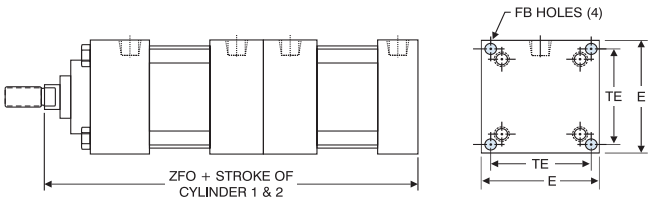
ME3/MXO

8.00" BORE ONLY



MXO/ME4

8.00" BORE ONLY



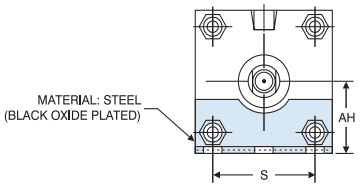
'MF1', 'MF2' FLANGE & 'ME3', 'ME4' CAP MOUNT DIMENSIONS											
BORE	ROD DIAMETER	E	FB	FH	R	RM	TE	TF	UF	W	ZFO
1.50	0.625 Standard	2.000	0.313	0.375	1.438	—	—	2.750	3.375	0.625	9.125
	1.000 Oversize									1.000	9.500
2.00	0.625 Standard	2.500	0.375	0.375	1.844	—	—	3.375	4.125	0.625	9.125
	1.000 Oversize									1.000	9.500
2.50	0.625 Standard	3.000	0.375	0.375	2.188	—	—	3.875	4.625	0.625	9.375
	1.000 Oversize									1.000	9.750
3.25	1.000 Standard	3.750	0.438	0.625	2.766	—	—	4.688	5.500	0.750	11.000
	1.375 Oversize									1.000	11.250

'MF1' FLANGE & 'ME3' CAP MOUNT DIMENSIONS											
BORE	ROD DIAMETER	E	FB	FH	R	RM	TE	TF	UF	W	ZFO
4.00	1.000 Standard	4.500	0.438	0.625	3.320	—	—	5.438	6.250	0.750	11.000
	1.375 Oversize									1.000	11.250
5.00	1.000 Standard	5.500	0.563	0.625	4.100	—	—	6.625	7.625	0.750	11.500
	1.375 Oversize									1.000	11.750
6.00	1.375 Standard	6.500	0.563	0.750	4.875	—	—	7.625	8.625	0.875	12.875
	1.750 Oversize									1.125	13.125
8.00	1.375 Standard	8.500	0.688	N/A	N/A	*3.500	7.570	N/A	N/A	1.625	12.375
	1.750 Oversize									1.875	12.625

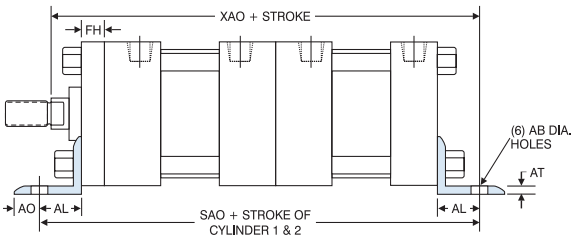
*Round retainer used to retain bushing.
For dimensions not shown, see page 75.

TANDEM DIMENSIONS: BASE MOUNTS

'MS1' ANGLE MOUNT DIMENSIONS										
BORE	ROD DIAMETER	AB	AH	AL	AO	AT	FH	S	ADD STROKE SAO	ADD STROKE XAO
1.50	0.625 Standard	0.438	1.188	1.000	0.375	0.125	0.375	1.250	10.125	9.750
	1.000 Oversize									10.125
2.00	0.625 Standard	0.438	1.438	1.000	0.375	0.125	0.375	1.750	10.125	9.750
	1.000 Oversize									10.125
2.50	0.625 Standard	0.438	1.625	1.000	0.375	0.125	0.375	2.250	10.375	10.000
	1.000 Oversize									10.375
3.25	1.000 Standard	0.563	1.938	1.250	0.500	0.125	0.625	2.705	12.125	11.625
	1.375 Oversize									11.875
4.00	1.000 Standard	0.563	2.250	1.250	0.500	0.125	0.625	3.500	12.125	11.625
	1.375 Oversize									11.875
5.00	1.000 Standard	0.688	2.750	1.375	0.625	0.188	0.625	4.250	12.875	12.250
	1.375 Oversize									12.500
6.00	1.375 Standard	0.813	3.250	1.375	0.625	0.188	0.750	5.250	14.000	13.500
	1.750 Oversize									13.750
8.00	1.375 Standard	0.813	4.250	1.813	0.688	0.250	0.625*	7.125	14.375	14.188
	1.750 Oversize									14.438

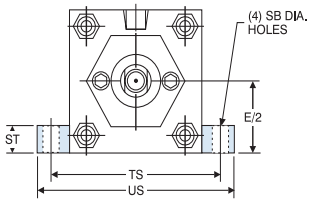


MS1

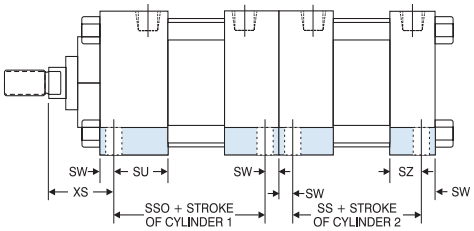


*Round retainer on 8.00" bore.
For dimensions not shown, see page 75.

'MS2' SIDE LUG MOUNT DIMENSIONS												
BORE	ROD DIAMETER	SB	E/2	ST	SU	SW	SZ	TS	US	XS	ADD STROKE SSO	ADD STROKE SS
1.50	0.625 Standard	0.438	1.000	0.500	1.125	0.375	0.625	2.750	3.500	1.375	3.375	2.875
	1.000 Oversize									1.750		
2.00	0.625 Standard	0.438	1.250	0.500	1.125	0.375	0.625	3.250	4.000	1.375	3.375	2.875
	1.000 Oversize									1.750		
2.50	0.625 Standard	0.438	1.500	0.500	1.125	0.375	0.625	3.750	4.500	1.375	3.500	3.000
	1.000 Oversize									1.750		
3.25	1.000 Standard	0.563	1.875	0.750	1.250	0.500	0.750	4.750	5.750	1.875	3.750	3.250
	1.375 Oversize									2.125		
4.00	1.000 Standard	0.563	2.250	0.750	1.250	0.500	0.750	5.500	6.500	1.875	3.750	3.250
	1.375 Oversize									2.125		
5.00	1.000 Standard	0.813	2.750	1.000	1.063	0.688	0.563	6.875	8.250	2.063	3.625	3.125
	1.375 Oversize									2.313		
6.00	1.375 Standard	0.813	3.250	1.000	1.313	0.688	0.813	7.875	9.250	2.313	4.125	3.625
	1.750 Oversize									2.563		
8.00	1.375 Standard	0.813	4.250	1.000	1.313	0.688	0.813	9.875	11.250	2.313	4.250	3.750
	1.750 Oversize									2.563		



MS2

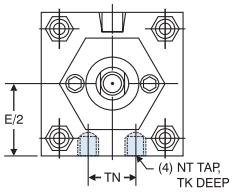


Note: The option not to have side lugs on center two (2) caps is available. Use the "XX" option in the "How To Order" section (specify).

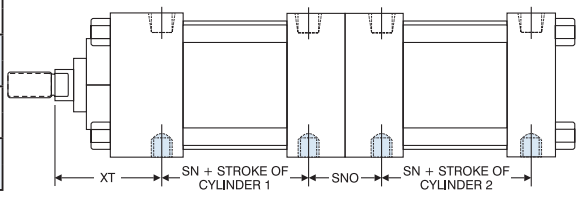
Example: TM-TA-MS2-4 X 5-TH with TA-MS2-4 X 5-BP-"XX"
"XX" = No side lugs on center two (2) caps

For dimensions not shown, see page 75.

'MS4' BOTTOM TAPPED MOUNT DIMENSIONS								
BORE	ROD DIAMETER	E/2	NT	TK	TN	XT	SNO	ADD STROKE SN
1.50	0.625 Standard	1.000	1/4-20	0.375	0.625	1.938	1.875	2.250
	1.000 Oversize					2.313		
2.00	0.625 Standard	1.250	5/16-18	0.500	0.875	1.938	1.875	2.250
	1.000 Oversize					2.313		
2.50	0.625 Standard	1.500	3/8-16	0.625	1.250	1.938	1.875	2.375
	1.000 Oversize					2.313		
3.25	1.000 Standard	1.875	1/2-13	0.750	1.500	2.438	2.125	2.625
	1.375 Oversize					2.688		
4.00	1.000 Standard	2.250	1/2-13	0.750	2.063	2.438	2.125	2.625
	1.375 Oversize					2.688		
5.00	1.000 Standard	2.750	5/8-11	1.000	2.688	2.438	2.125	2.875
	1.375 Oversize					2.688		
6.00	1.375 Standard	3.250	3/4-10	1.125	3.250	2.813	2.375	3.125
	1.750 Oversize					3.063		
8.00	1.375 Standard	4.250	3/4-10	1.125	4.500	2.813	2.375	3.250
	1.750 Oversize					3.063		



MS4



Note: The option not to have 'MS4' taps on center two (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 two (2) caps

For dimensions not shown, see page 75.

TANDEM CYLINDERS: SCHEMATICS

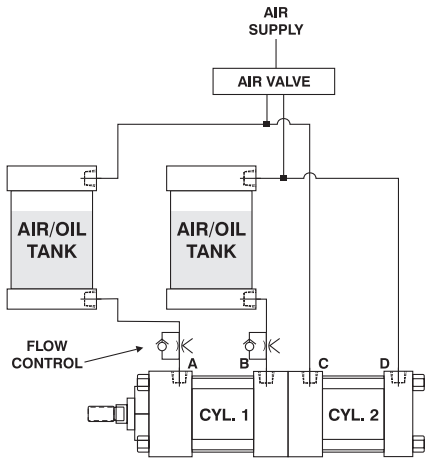
The following schematics are commonly used for air/oil applications.

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 80 for maximum air inlet pressures!

SCHEMATIC "A"

ACTUATION SEQUENCE:
PRESSURE TO PORTS 'B' & 'D' EXTENDS CYLINDER
PRESSURE TO PORTS 'A' & 'C' RETRACTS CYLINDER



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)

(Refer to charts on page 80 for more details)

CYCLE RATES

Extend: Moderate to high speed
Retract: Moderate to high speed

NUMBER OF AIR/OIL TANKS: 2

RECOMMENDED TANK SIZE:

130% - 150% of CYL. #1 total volume, filled approximately 80% full.

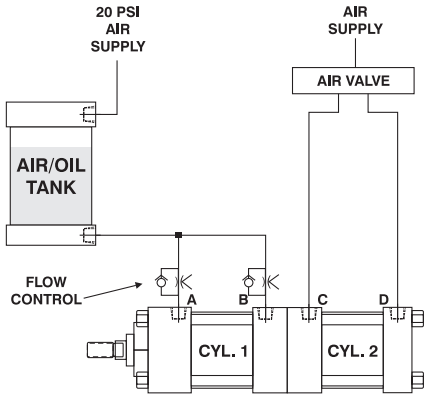
(Refer to page 74 for ordering information)

DESIGN BENEFITS

- 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.

SCHEMATIC "B"

ACTUATION SEQUENCE:
PRESSURE TO PORT 'D' EXTENDS CYLINDER
PRESSURE TO PORT 'C' RETRACTS CYLINDER



AIR TO OIL RATIO

Extend: 1:1 (for both standard and oversize rods)

Retract: 2:1 (for both standard and oversize rods)

(Refer to charts on page 80 for more details)

CYCLE RATES

Extend: Slow to moderate speed
Retract: Slow to moderate speed

NUMBER OF AIR/OIL TANKS: 1

RECOMMENDED TANK SIZE:

130% - 150% of CYL. #1 total volume, filled approximately 50% full.

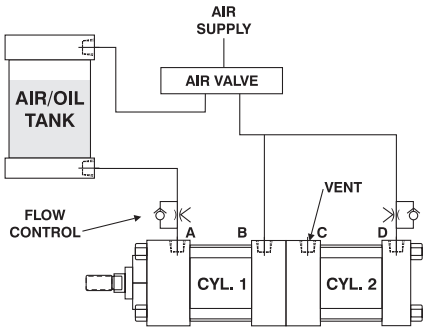
(Refer to page 74 for ordering information)

DESIGN BENEFITS

- 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.

SCHEMATIC "C"

ACTUATION SEQUENCE:
PRESSURE TO PORTS 'B' & 'D' EXTENDS CYLINDER
PRESSURE TO PORT 'A' RETRACTS CYLINDER



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)

(Refer to charts on page 80 for more details)

CYCLE RATES

Extend: Moderate to high speed
Retract: Slow to moderate speed

NUMBER OF AIR/OIL TANKS: 1

RECOMMENDED TANK SIZE:

130% - 150% of CYL. #1 total volume, filled approximately 80% full.

(Refer to page 74 for ordering information)

DESIGN BENEFITS

- 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 196 to order Air/Oil tanks (A/T).

TANDEM CYLINDERS: TECHNICAL DATA

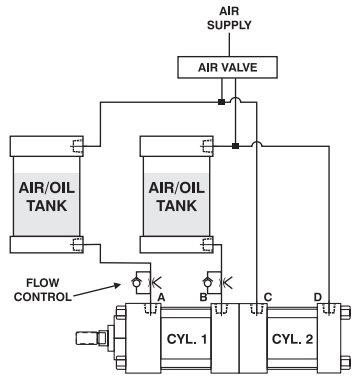
FORCE CHARTS

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	0.625	3.227	2.920	323	292	181	1.83	2.00
	1.000	2.749	1.964	275	196	143	1.56	2.00
2.00	0.625	5.977	5.670	598	567	190	1.90	2.00
	1.000	5.499	4.714	550	471	171	1.75	2.00
2.50	0.625	9.511	9.204	951	920	194	1.94	2.00
	1.000	9.033	8.248	903	825	183	1.84	2.00
3.25	1.000	15.807	15.022	1581	1502	190	1.91	2.00
	1.375	15.107	13.622	1511	1362	180	1.82	2.00
4.00	1.000	24.347	23.562	2435	2356	194	1.94	2.00
	1.375	23.647	22.162	2365	2216	187	1.88	2.00
5.00	1.000	38.485	37.700	3849	3770	196	1.96	2.00
	1.375	37.785	36.300	3779	3630	192	1.92	2.00
6.00	1.375	55.063	53.578	5506	5358	195	1.95	2.00
	1.750	54.143	51.738	5414	5174	191	1.91	2.00
8.00	1.375	99.045	97.560	9905	9756	197	1.97	2.00
	1.750	98.125	95.720	9813	9572	195	1.95	2.00

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

SCHEMATIC "A"

ACTUATION SEQUENCE:
PRESSURE TO PORTS 'B' & 'D' EXTENDS CYLINDER
PRESSURE TO PORTS 'A' & 'C' RETRACTS CYLINDER

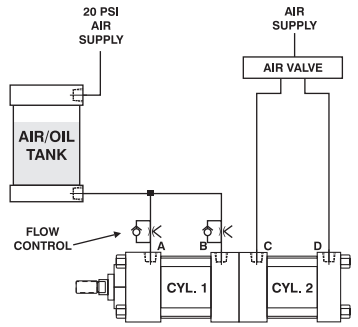


SCHEMATIC "B" - TANDEM CYLINDER THEORETICAL* FORCE CHART								
BORE	ROD	EXTEND EFFECTIVE PISTON AREA (IN/SQ.)	RETRACT EFFECTIVE PISTON AREA (IN/SQ.)	EXTEND FORCE AT 100 PSI (IN POUNDS)	RETRACT FORCE AT 100 PSI (IN POUNDS)	MAXIMUM AIR INLET PRESSURE	EXTEND OIL/AIR RATIO	RETRACT OIL/AIR RATIO
1.50	0.625	1.767	1.460	177	146	250	1.00	1.00
	1.000	1.767	0.982	177	98	222	1.00	1.00
2.00	0.625	3.142	2.835	314	284	250	1.00	1.00
	1.000	3.142	2.357	314	236	250	1.00	1.00
2.50	0.625	4.909	4.602	491	460	250	1.00	1.00
	1.000	4.909	4.124	491	412	250	1.00	1.00
3.25	1.000	8.296	7.511	830	751	250	1.00	1.00
	1.375	8.296	6.811	830	681	250	1.00	1.00
4.00	1.000	12.566	11.781	1257	1178	250	1.00	1.00
	1.375	12.566	11.081	1257	1108	250	1.00	1.00
5.00	1.000	19.635	18.850	1964	1885	250	1.00	1.00
	1.375	19.635	18.150	1964	1815	250	1.00	1.00
6.00	1.375	28.274	26.789	2827	2679	250	1.00	1.00
	1.750	28.274	25.869	2827	2587	250	1.00	1.00
8.00	1.375	50.265	48.780	5027	4878	250	1.00	1.00
	1.750	50.265	47.860	5027	4786	250	1.00	1.00

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

SCHEMATIC "B"

ACTUATION SEQUENCE:
PRESSURE TO PORT 'D' EXTENDS CYLINDER
PRESSURE TO PORT 'C' RETRACTS CYLINDER

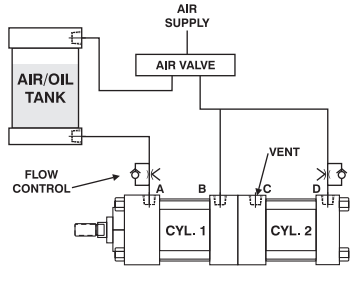


SCHEMATIC "C" - TANDEM CYLINDER THEORETICAL* FORCE CHART								
BORE	ROD	EXTEND EFFECTIVE PISTON AREA (IN/SQ.)	RETRACT EFFECTIVE PISTON AREA (IN/SQ.)	EXTEND FORCE AT 100 PSI (IN POUNDS)	RETRACT FORCE AT 100 PSI (IN POUNDS)	MAXIMUM AIR INLET PRESSURE	EXTEND OIL/AIR RATIO	RETRACT OIL/AIR RATIO
1.50	0.625	3.227	1.460	323	146	181	1.83	1.00
	1.000	2.749	0.982	275	98	143	1.56	1.00
2.00	0.625	5.977	2.835	598	284	190	1.90	1.00
	1.000	5.499	2.357	550	236	171	1.75	1.00
2.50	0.625	9.511	4.602	951	460	194	1.94	1.00
	1.000	9.033	4.124	903	412	183	1.84	1.00
3.25	1.000	15.807	7.511	1581	751	190	1.91	1.00
	1.375	15.107	6.811	1511	681	180	1.82	1.00
4.00	1.000	24.347	11.781	2435	1178	194	1.94	1.00
	1.375	23.647	11.081	2365	1108	187	1.88	1.00
5.00	1.000	38.485	18.850	3849	1885	196	1.96	1.00
	1.375	37.785	18.150	3779	1815	192	1.92	1.00
6.00	1.375	55.063	26.789	5506	2679	195	1.95	1.00
	1.750	54.143	25.869	5414	2587	191	1.91	1.00
8.00	1.375	99.045	48.780	9905	4878	197	1.97	1.00
	1.750	98.125	47.860	9813	4786	195	1.95	1.00

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

SCHEMATIC "C"

ACTUATION SEQUENCE:
PRESSURE TO PORTS 'B' & 'D' EXTENDS CYLINDER
PRESSURE TO PORT 'A' RETRACTS CYLINDER



TRA Series NFPA
TRIPLE PISTON ROD
Aluminum Cylinders
1.50″ to 8.00″ Bore

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

SERIES 'TRA' TRIPLE ROD

'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 94 for details)*.
- **Load and End Play Charts Available —** Refer to pages 95-99 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 103 for details)*.

'TR' Series — Design Upgrade

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

'TR-TH' Series (400 PSI Hyd.) is obsolete and super-ceded 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

NFPA MOUNTS	
MXO	NO MOUNT
MS4	BOTTOM TAPPED HOLES (1 .50"-8.00" Bore)
MS2	SIDE LUG (1.50"-8.00" Bore)
BASE BAR	SIDE LUG (1.50"-4.00" Bore)
MP1	REAR PIVOT CLEVIS (EXTRUDED)
MP2	REAR PIVOT CLEVIS (CASTING) (1.50"-6.00" Bore)
MP4	REAR PIVOT EYE (CASTING) (1.50"-4.00" Bore)
MF1	FRONT FLANGE (1.50"-6.00" Bore)
MF2	REAR FLANGE (1.50"-6.00" Bore)
ME4	REAR MOUNTING HOLES (8.00" Bore)
ME5	FRONT MOUNTING HOLES (8.00" Bore)

BORE	
1.50	2.00
2.50	3.25
4.00	5.00
6.00	8.00

STROKE
SEE STROKE OPTIONS ON PAGE 94 Made to Order

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)

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 176 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 223-230 for selection)*
X	MPR-WB	COMBINATION MAGNETIC PISTON & WEAR-BAND (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
	SSN	STAINLESS STEEL TIE ROD NUTS
	SSR	STAINLESS STEEL PISTON ROD
	SST	STAINLESS STEEL TIE RODS
X	ST	**STOP TUBE** - SPECIFY STOP TUBE LENGTH (in inches) SPECIFY STROKE AS ES (effective stroke) (Example: TA MS4 2 X 24ES-ST=3)
	TMS	STEEL CYLINDER TUBE, BLACK EPOXY PAINT FINISH
	TH	**400 PSI HYDRAULIC NON-SHOCK** *(Refer to page 183 for specifications)*
	VS	FLUOROCARBON SEALS
	AS	ADJUSTABLE STROKE (RETRACT) (SPECIFY LENGTH, Example: AS = 3")
	XX	SPECIAL VARIATION (SPECIFY)

*STEEL TUBES do not work with MPR magnetic pistons. Refer to pages 231-234 for Balluff end of stroke sensors.

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

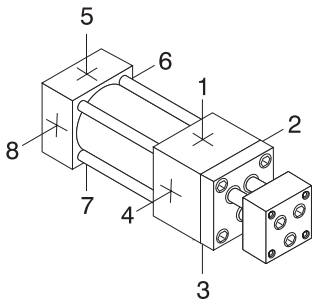
OPTIONS FOR "D1" DOUBLE ROD END MODEL - SINGLE ROD		
	KK2	LARGE MALE ROD THREAD
	KK3	FEMALE ROD THREAD
	KK3S	STUDDED PISTON ROD (KK3 with Stud, Loctite in place)
	KK4	FULL DIAMETER MALE ROD THREAD
	KK5	BLANK ROD END (NO THREADS, "A" = 0")

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

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

OPTION LENGTH ADDER (ADD TO CATALOG BASIC OVERALL LENGTH DIMENSIONS)						
	OPTION					
BORE	B	BC	BH	MPR (WITHOUT "WB" WEARBAND)	MPR-WB (MAGNET & WEARBAND)	ST* (STOP TUBE) Example: ST=2
1.50	0.500	0.250	0.250	0	0.500	2
2.00	0.500	0.250	0.250	0	0.500	2
2.50	0.500	0.250	0.250	0	0.500	2
3.25	0.500	0.250	0.250	NOTE: There is no length adder for MPR Option and Wear Band on 3 .25" - 8.00" Bore.		2
4.00	0.500	0.250	0.250			2
5.00	0.500	0.250	0.250			2
6.00	0.500	0.250	0.250			2
8.00	0.500	0.250	0.250			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.

STAINLESS STEEL 'TRA'

Consult factory for available models and delivery.

'TRA-MSE' & 'TRA-MSR'

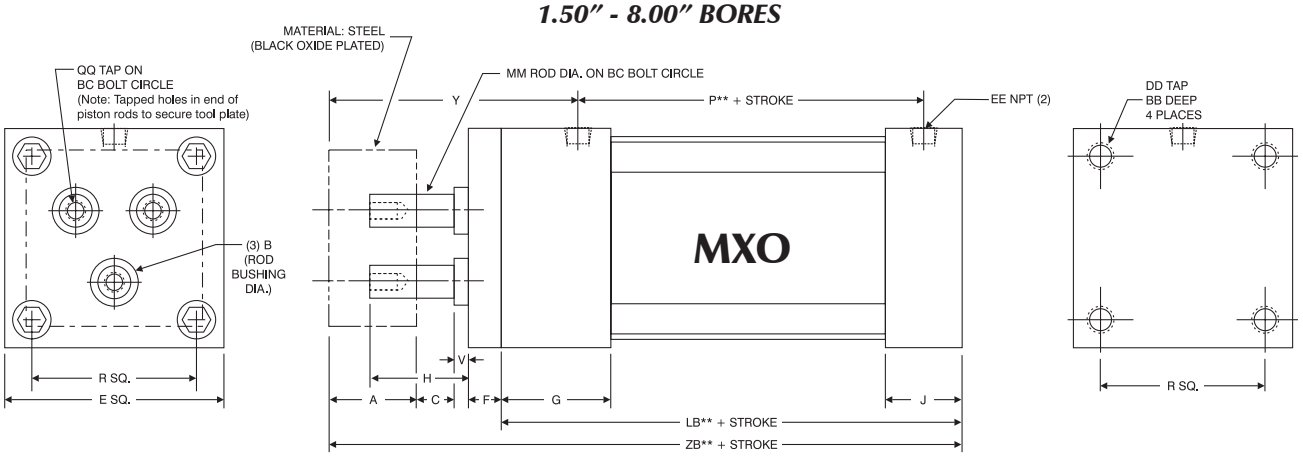
Triple Rod Cylinders can be furnished in multi-stage designs.
(Consult factory for available models and delivery)

SERIES 'TRA' HEAVY-DUTY: TRIPLE PISTON ROD

EASY FLIP OUT PAGE FOR REFERENCE

MXO (NO MOUNT)

1.50" - 8.00" BORES

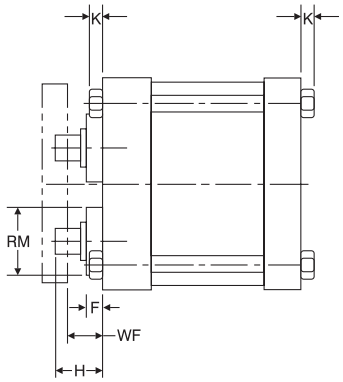


'TRA' SERIES BASIC DIMENSIONS 'MXO'																			
BORE	A	B	BB	BC	C	DD	E	EE	F	G	H	J	LB	MM	P	QQ	R	V	Y	ZB
1.50	0.750	0.563	0.500	0.891	0.500	1/4 -28	2.000	0.250	0.375	1.500	1.100	1.000	3.625**	0.313	2.375**	10-32	1.438	0.250	2.750	5.500**
2.00	0.750	0.813	0.500	1.195	0.500	5/16-24	2.500	0.250	0.375	1.500	1.100	1.000	3.625**	0.500	2.375**	1/4 -28	1.844	0.250	2.750	5.500**
2.50	1.000	1.016	0.500	1.500	0.500	5/16-24	3.000	0.250	0.375	1.500	1.350	1.000	3.750**	0.625	2.500**	5/16-24	2.188	0.250	3.000	5.875**
3.25	1.000	1.125	0.625	2.075	0.500	3/8-24	3.750	0.375	0.625	1.750	1.100	1.250	4.250	0.625	2.750	3/8 -24	2.766	0.250	3.375	6.625
4.00	1.000	1.125	0.625	2.825	0.500	3/8-24	4.500	0.375	0.625	1.750	1.100	1.250	4.250	0.625	2.750	3/8 -24	3.320	0.250	3.375	6.625
5.00	1.000	1.500	0.625	3.375	1.000	1/2-20	5.500	0.375	0.625	1.750	1.844	1.250	4.500	1.000	3.000	1/2 -20	4.100	0.250	3.875	7.375
6.00	1.000	1.500	0.750	3.938	1.000	1/2-20	6.500	0.500	0.750	2.000	1.844	1.500	5.000	1.000	3.250	1/2 -20	4.875	0.250	4.125	8.000
8.00	1.000	1.500	—	5.750	1.375	—	8.500	0.750	—	2.000	2.844	1.500	5.125	1.000	3.375	1/2 -20	6.438	0.250	4.375	8.375*

*"ZB" does not include "K" hex nut dimension (see below for dimensions).
**Option "MPR-WB" will add 0.500" to overall cylinder length - 1.50", 2.00" & 2.50" bores only.

MXO (NO MOUNT)

8.00" BORE



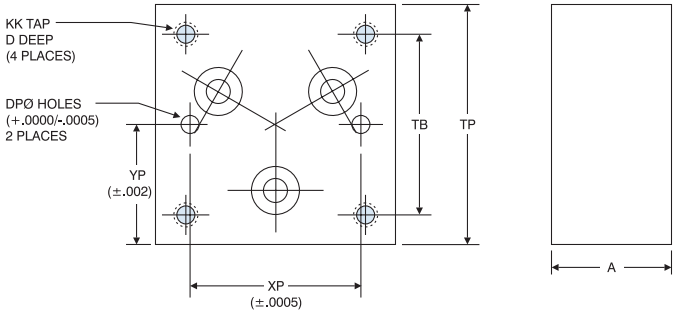
'TRA' SERIES BASIC DIMENSIONS 'MXO'					
BORE	F	H	K	RM	WF
8.00	0.625	2.844	0.563	2.750	2.250

*8.00" bore has three (3) round retainers, 0.625" 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	0.750	0.750	10-32	1.125	1.500	1.50	0.125	1.125	0.750
2.00	0.750	0.750	1/4 -28	1.438	2.000	2.00	0.125	1.375	1.000
2.50	1.000	1.000	5/16 -24	1.844	2.500	2.50	0.188	1.750	1.250
3.25	1.000	1.000	3/8 -24	2.188	3.250	3.25	0.250	2.250	1.625
4.00	1.000	1.000	3/8 -24	2.766	4.000	4.00	0.250	2.750	2.000
5.00	1.000	1.000	1/2 -20	3.313	5.000	5.00	0.313	3.250	2.500
6.00	1.000	1.000	1/2 -20	4.100	6.000	6.00	0.313	4.000	3.000
8.00	1.000	1.000	1/2 -20	4.875	8.000	8.00	0.375	4.875	4.000

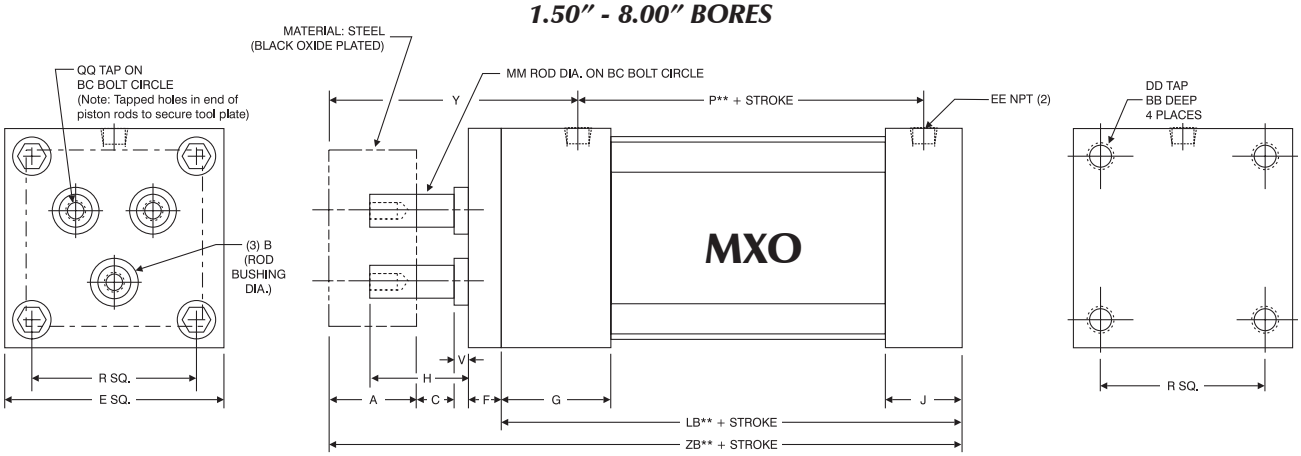
'TRA' SERIES HEAVY-DUTY BASE DIMENSIONS FLIP-OUT (PAGE 84)

EASY FLIP OUT PAGE FOR REFERENCE

SERIES 'TRA' HEAVY-DUTY: TRIPLE PISTON ROD

MXO (NO MOUNT)

1.50" - 8.00" BORES

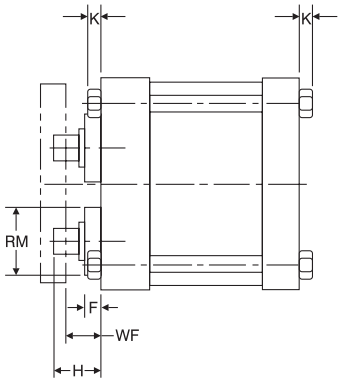


'TRA' SERIES BASIC DIMENSIONS 'MXO'																			
BORE	A	B	BB	BC	C	DD	E	EE	F	G	H	J	LB	MM	P	QQ	R	V	Y	ZB
1.50	0.750	0.563	0.500	0.891	0.500	1/4-28	2.000	0.250	0.375	1.500	1.100	1.000	3.625**	0.313	2.375**	10-32	1.438	0.250	2.750	5.500**
2.00	0.750	0.813	0.500	1.195	0.500	5/16-24	2.500	0.250	0.375	1.500	1.100	1.000	3.625**	0.500	2.375**	1/4-28	1.844	0.250	2.750	5.500**
2.50	1.000	1.016	0.500	1.500	0.500	5/16-24	3.000	0.250	0.375	1.500	1.350	1.000	3.750**	0.625	2.500**	5/16-24	2.188	0.250	3.000	5.875**
3.25	1.000	1.125	0.625	2.075	0.500	3/8-24	3.750	0.375	0.625	1.750	1.100	1.250	4.250	0.625	2.750	3/8-24	2.766	0.250	3.375	6.625
4.00	1.000	1.125	0.625	2.825	0.500	3/8-24	4.500	0.375	0.625	1.750	1.100	1.250	4.250	0.625	2.750	3/8-24	3.320	0.250	3.375	6.625
5.00	1.000	1.500	0.625	3.375	1.000	1/2-20	5.500	0.375	0.625	1.750	1.844	1.250	4.500	1.000	3.000	1/2-20	4.100	0.250	3.875	7.375
6.00	1.000	1.500	0.750	3.938	1.000	1/2-20	6.500	0.500	0.750	2.000	1.844	1.500	5.000	1.000	3.250	1/2-20	4.875	0.250	4.125	8.000
8.00	1.000	1.500	—	5.750	1.375	—	8.500	0.750	—	2.000	2.844	1.500	5.125	1.000	3.375	1/2-20	6.438	0.250	4.375	8.375*

*"ZB" does not include "K" hex nut dimension (see below for dimensions).
**Option "MPR-WB" will add .50" to overall cylinder length - 1.50", 2.00" & 2.50" bores only.

MXO (NO MOUNT)

8.00" BORE



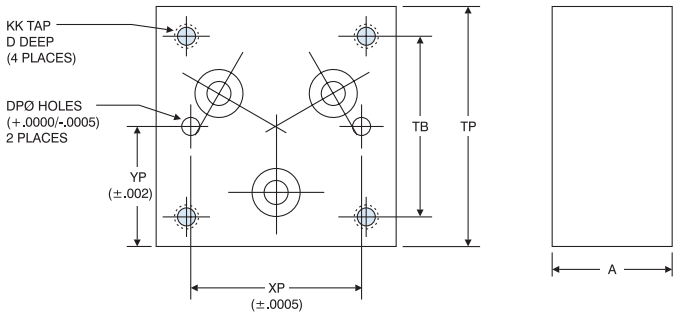
'TRA' SERIES BASIC DIMENSIONS 'MXO'					
BORE	F	H	K	RM	WF
8.00	0.625	2.844	0.563	2.750	2.250

*8.00" bore has three (3) round retainers, 0.625" thick, 2.750" 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)



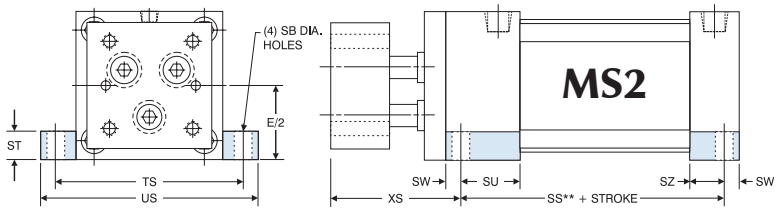
'TRA' SERIES TOOLING PLATE DIMENSIONS									
STANDARD						DOWEL PIN DIMENSIONS			
BORE	A	D	KK	TB	TP	BORE	DP Ø	XP	YP
1.50	0.750	0.750	10-32	1.125	1.500	1.50	0.125	1.125	0.750
2.00	0.750	0.750	1/4-28	1.438	2.000	2.00	0.125	1.375	1.000
2.50	1.000	1.000	5/16-24	1.844	2.500	2.50	0.188	1.750	1.250
3.25	1.000	1.000	3/8-24	2.188	3.250	3.25	0.250	2.250	1.625
4.00	1.000	1.000	3/8-24	2.766	4.000	4.00	0.250	2.750	2.000
5.00	1.000	1.000	1/2-20	3.313	5.000	5.00	0.313	3.250	2.500
6.00	1.000	1.000	1/2-20	4.100	6.000	6.00	0.313	4.000	3.000
8.00	1.000	1.000	1/2-20	4.875	8.000	8.00	0.375	4.875	4.000

'TRA' SERIES HEAVY-DUTY BASE DIMENSIONS FLIP-OUT (PAGE 84)

SERIES 'TRA' DIMENSIONS: BASE & PIVOT MOUNTS

BASE MOUNTS *(1.50" - 8.00" BORE)*

MS2

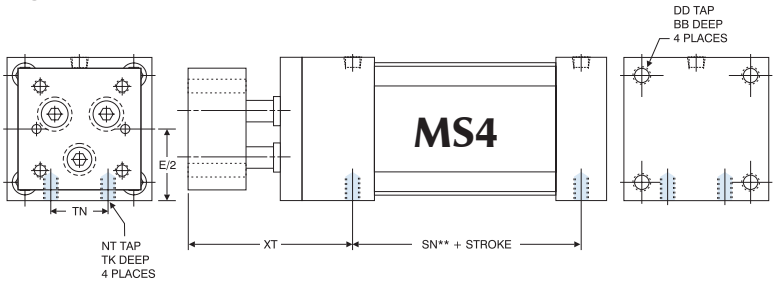


'TRA' SERIES 'MS2' DIMENSIONS										
BORE	SB	E/2	SS	ST	SU	SW	SZ	TS	US	XS
1.50	0.438	1.000	2.875**	0.500	1.125	0.375	0.625	2.750	3.500	2.250
2.00	0.438	1.250	2.875**	0.500	1.125	0.375	0.625	3.250	4.000	2.250
2.50	0.438	1.500	3.000**	0.500	1.125	0.375	0.625	3.750	4.500	2.500
3.25	0.563	1.875	3.250	0.750	1.250	0.500	0.750	4.750	5.750	2.875
4.00	0.563	2.250	3.250	0.750	1.250	0.500	0.750	5.500	6.500	2.875
5.00	0.813	2.750	3.125	1.000	1.063	0.688	0.563	6.875	8.250	3.563
6.00	0.813	3.250	3.625	1.000	1.313	0.688	0.813	7.875	9.250	3.688
8.00	0.813	4.250	3.750	1.000	1.313	0.688	0.813	9.875	11.250	3.938

**Option "MPR-WB" will add 0.500" to overall cylinder length - 1.50", 2.00" & 2.50" bores only.

For dimensions not shown, see page 84.

MS4

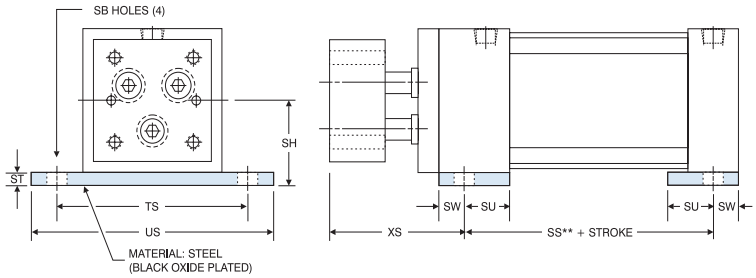


'TRA' SERIES 'MS4' DIMENSIONS						
BORE	E/2	NT	TK	TN	XT	SN
1.50	1.000	1/4 -20	0.375	0.625	2.813	2.250**
2.00	1.250	5/16 -18	0.500	0.875	2.813	2.250**
2.50	1.500	3/8 -16	0.625	1.250	3.063	2.375**
3.25	1.875	1/2 -13	0.750	1.500	3.438	2.625
4.00	2.250	1/2 -13	0.750	2.063	3.438	2.625
5.00	2.750	5/8 -11	1.000	2.688	3.938	2.875
6.00	3.250	3/4 -10	1.125	3.250	4.188	3.125
8.00	4.250	3/4 -10	1.125	4.500	4.438	3.250

**Option "MPR-WB" will add 0.500" to overall cylinder length - 1.50", 2.00" & 2.50" bores only.

For dimensions not shown, see page 84.

BASE BAR (Non-NFPA)



'TRA' SERIES BASE BAR (Non-NFPA) DIMENSIONS									
BORE	SB	SH	SS	ST	SU	SW	TS	US	XS
1.50	0.438	1.250	2.875 **	0.250	1.125	0.375	2.750	3.500	2.250
2.00	0.438	1.500	2.875 **	0.250	1.125	0.375	3.250	4.000	2.250
2.50	0.438	1.875	3.000**	0.375	1.125	0.375	3.750	4.500	2.500
3.25	0.563	2.375	3.250	0.500	1.250	0.500	4.750	5.750	2.875
4.00	0.563	2.750	3.250	0.500	1.250	0.500	5.500	6.500	2.875

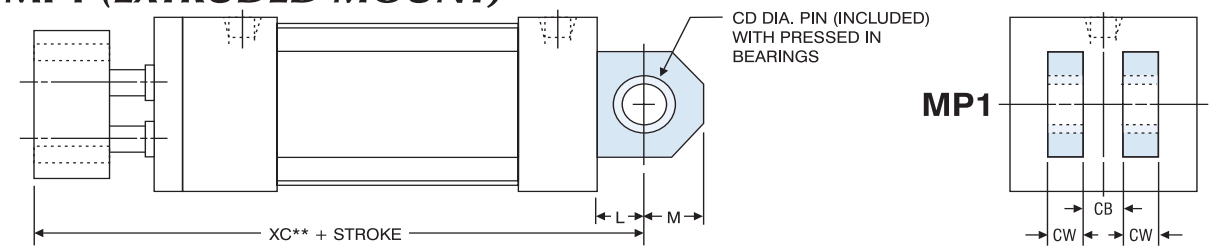
**Option "MPR-WB" will add 0.500" to overall cylinder length - 1.50", 2.00" & 2.50" bores only.

For dimensions not shown, see page 84.

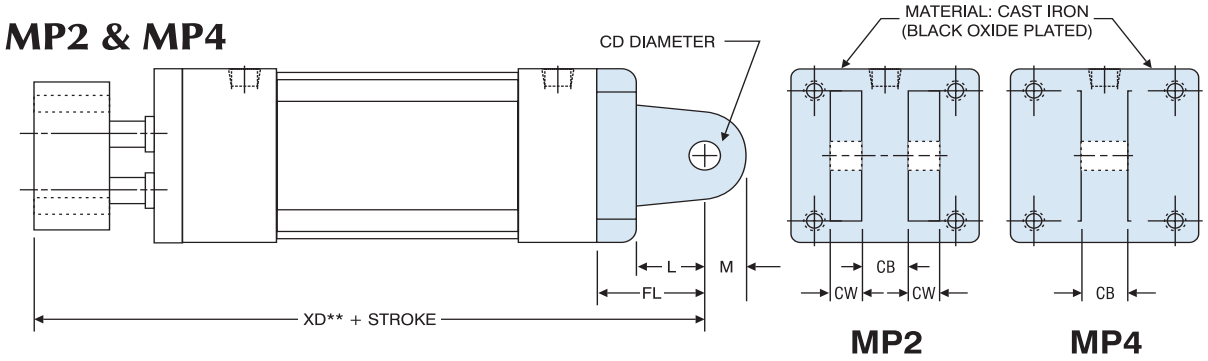
SERIES 'TRA' DIMENSIONS: BASE & PIVOT MOUNTS

PIVOT MOUNTS *(1.50" - 8.00" BORE)*

MP1 *(EXTRUDED MOUNT)*



MP2 & MP4



Clevis Pin included with MP1, MP2 & MP4 mounts

'TRA' SERIES 'MP1'-'MP2'-'MP4' DIMENSIONS ⚠								
BORE	CB	CD	CW	FL	L	M	XC	XD
1.50	0.750	0.500	0.500	1.125	0.750	0.625	6.250 **	6.625 **
2.00	0.750	0.500	0.500	1.125	0.750	0.625	6.250 **	6.625**
2.50	0.750	0.500	0.500	1.125	0.750	0.625	6.625**	7.000**
3.25	1.250	0.750	0.625	1.875	1.250	0.875	7.875	8.500
4.00	1.250	0.750	0.625	1.875	1.250	0.875	7.875	8.500
5.00	1.250	0.750	0.625	1.875	1.250	0.875	8.625	9.250
6.00	1.500	1.000	0.750	2.250	1.500	1.000	9.500	10.250
8.00	1.500	1.000	0.750	N/A	1.500	1.000	9.875	N/A

**Option "MPR-WB" will add 0.500" to overall cylinder length - 1.50", 2.00" & 2.50" bores only.

Note: 8.00" bore is a welded mount with through holes and tie rod nuts.

⚠ MP4 available as specials in 5.00", 6.00" & 8.00" bores.

Note: Extruded MP1 mounts are standard (1.50" - 8.00" bores) Cast Iron removable mounts are optional and must be requested when ordering (1.50" - 6.00" bores).

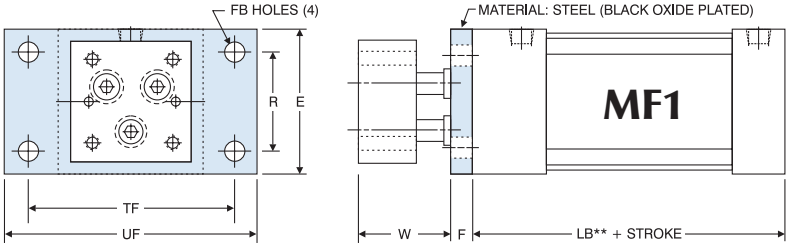
For dimensions not shown, see page 84.

SERIES 'TRA' DIMENSIONS: FLANGE MOUNTS

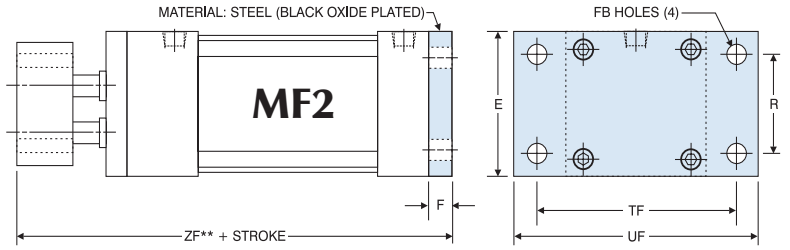
FLANGE MOUNTS

(1.50" - 6.00" BORE)

MF1



MF2



'TRA' SERIES 'MF1' & 'MF2' DIMENSIONS									
BORE	E	F	FB	LB	R	TF	UF	W	ZF
1.50	2.000	0.375	0.313	3.625**	1.430	2.750	3.375	1.500	5.875**
2.00	2.500	0.375	0.375	3.625**	1.844	3.375	4.125	1.500	5.875**
2.50	3.000	0.375	0.375	3.750**	2.188	3.875	4.625	1.750	6.250**
3.25	3.750	0.625	0.438	4.250	2.760	4.688	5.500	1.750	7.250
4.00	4.500	0.625	0.438	4.250	3.320	5.438	6.250	1.750	7.250
5.00	5.500	0.625	0.563	4.500	4.100	6.625	7.625	2.250	8.000
6.00	6.500	0.750	0.563	5.000	4.875	7.625	8.625	2.250	8.750

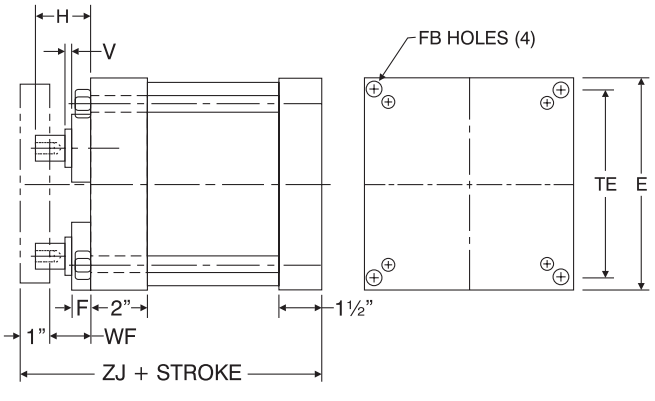
**Option "MPR-WB" will add 0.500" to overall cylinder length - 1.50", 2.00" & 2.50" bores only.

For dimensions not shown, see 'TRA' SERIES HEAVY-DUTY FLIP-OUT.

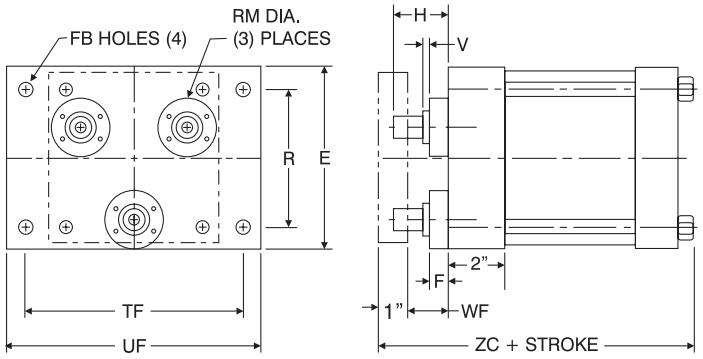
FLANGE MOUNTS

(8.00" BORE)

ME4



ME5 (Non-NFPA)



'TRA' SERIES 'ME4' & 'ME5' DIMENSIONS												
BORE	E	F	FB	H	R	RM	TE	TF	UF	V	WF	ZC	ZJ
8.00	8.500	0.625	0.688	2.844	6.438	2.750	7.570	10.250	12.000	0.250	2.250	8.938	8.375

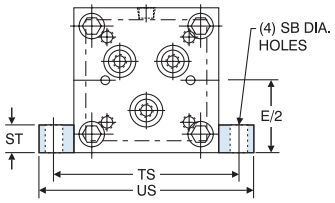
Note: Three (3) 1.00" diameter rods on 5.750 B.C.

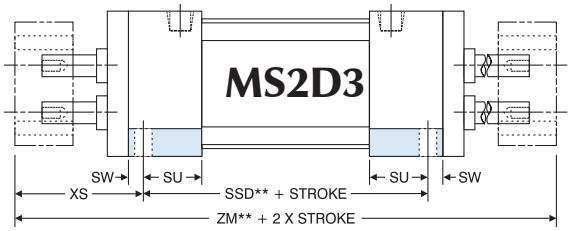
For dimensions not shown, see page 84.

SERIES 'TRA': DOUBLE ROD END

MODELS

SERIES 'TRA' DIMENSIONS: DOUBLE ROD END
BASE MOUNTS

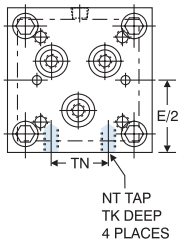


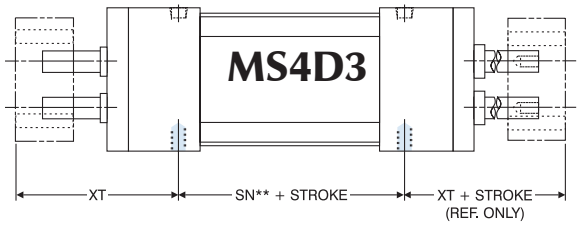


'TRA' SERIES 'MS2D' DIMENSIONS										
BORE	SB	E/2	SSD	ST	SU	SW	TS	US	XS	ZM
1.50	0.438	1.000	3.375**	0.500	1.125	0.375	2.750	3.500	2.250	7.875**
2.00	0.438	1.250	3.375**	0.500	1.125	0.375	3.250	4.000	2.250	7.875**
2.50	0.438	1.500	3.500**	0.500	1.125	0.375	3.750	4.500	2.500	8.500**
3.25	0.563	1.875	3.750	0.750	1.250	0.500	4.750	5.750	2.875	9.500
4.00	0.563	2.250	3.750	0.750	1.250	0.500	5.500	6.500	2.875	9.500
5.00	0.813	2.750	3.625	1.000	1.063	0.688	6.875	8.250	3.563	10.750
6.00	0.813	3.250	4.125	1.000	1.313	0.688	7.875	9.250	3.688	11.500
8.00	0.813	4.250	4.250	1.000	1.313	0.688	9.875	11.250	3.938	12.125

**Option "MPR-WB" will add 0.500" to overall cylinder length - 1.50", 2.00" & 2.50" bores only.

For dimensions not shown, see page 84.



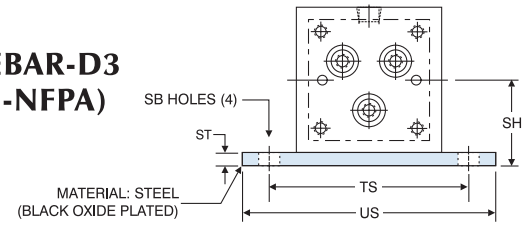


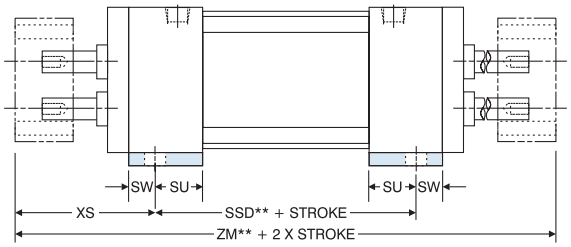
'TRA' SERIES 'MS4D1' DIMENSIONS						
BORE	E/2	NT	TK	TN	XT	SN
1.50	1.000	1/4 -20	0.375	0.625	2.813	2.250**
2.00	1.250	5/16 -18	0.500	0.875	2.813	2.250**
2.50	1.500	3/8 -16	0.625	1.250	3.063	2.375**
3.25	1.875	1/2 -13	0.750	1.500	3.438	2.625
4.00	2.250	1/2 -13	0.750	2.063	3.438	2.625
5.00	2.750	5/8 -11	1.000	2.688	3.938	2.875
6.00	3.250	3/4 -10	1.125	3.250	4.188	3.125
8.00	4.250	3/4 -10	1.125	4.500	4.438	3.250

**Option "MPR-WB" will add 0.500" to overall cylinder length - 1.50", 2.00" & 2.50" bores only.

For dimensions not shown, see page 84.

BASEBAR-D3 (Non-NFPA)





'TRA' SERIES BASEBAR-D3 (Non-NFPA) DIMENSIONS										
BORE	SB	SH	SSD	ST	SU	SW	TS	US	XS	ZM
1.50	0.438	1.250	3.375**	0.250	1.125	0.375	2.750	3.500	2.250	7.875**
2.00	0.438	1.500	3.375**	0.250	1.125	0.375	3.250	4.000	2.250	7.875**
2.50	0.438	1.875	3.500**	0.375	1.125	0.375	3.750	4.500	2.500	8.500**
3.25	0.563	2.375	3.750	0.500	1.250	0.500	4.750	5.750	2.875	9.500
4.00	0.563	2.750	3.750	0.500	1.250	0.500	5.500	6.500	2.875	9.500

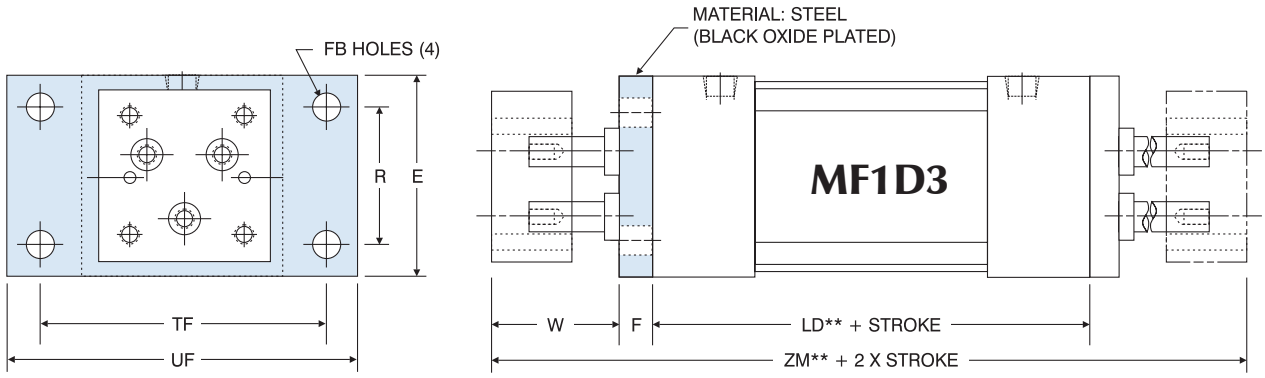
**Option "MPR-WB" will add 0.500" to overall cylinder length - 1.50", 2.00" & 2.50" bores only.

For dimensions not shown, see page 84.

SERIES 'TRA' DIMENSIONS: DOUBLE ROD END

FLANGE MOUNTS

(1.50" - 6.00" BORE)



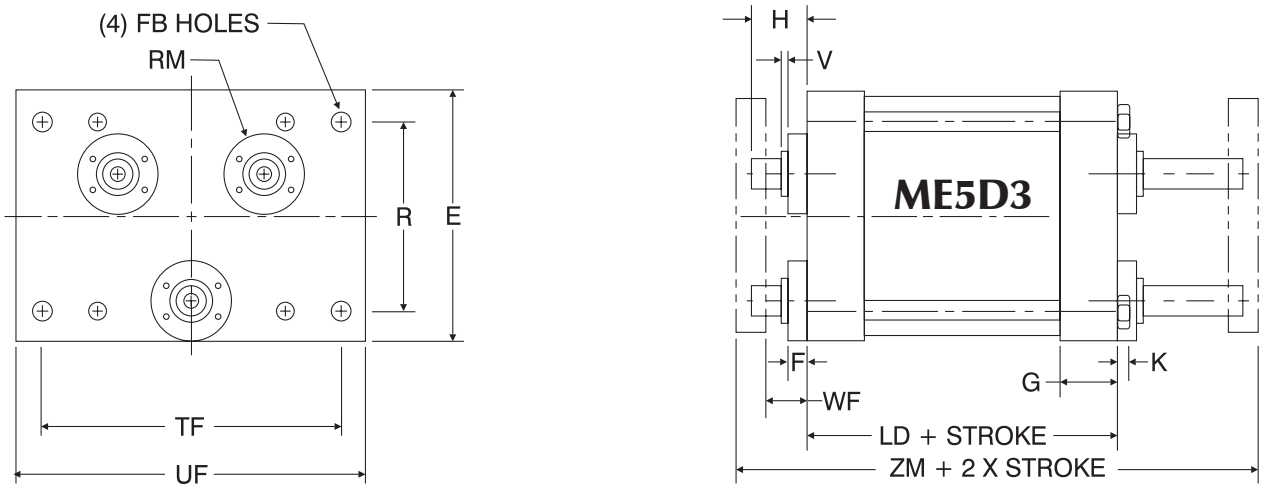
'TRA' SERIES 'MF1D3' DIMENSIONS									
BORE	E	F	FB	LD	R	TF	UF	W	ZM
1.50	2.000	0.375	0.313	4.125**	1.438	2.750	3.375	1.500	7.875**
2.00	2.500	0.375	0.375	4.125**	1.844	3.375	4.125	1.500	7.875**
2.50	3.000	0.375	0.375	4.250**	2.188	3.875	4.625	1.750	8.500**
3.25	3.750	0.625	0.438	4.750	2.760	4.688	5.500	1.750	9.500
4.00	4.500	0.625	0.438	4.750	3.320	5.438	6.250	1.750	9.500
5.00	5.500	0.625	0.563	5.000	4.100	6.625	7.625	2.250	10.750
6.00	6.500	0.750	0.563	5.500	4.875	7.625	8.625	2.250	11.500

**Option "MPR-WB" will add 0.500" to overall cylinder length - 1.50", 2.00" & 2.50" bores only.

For dimensions not shown, see page 84.

FLANGE MOUNTS

(8.00" BORE)



'TRA' SERIES 'ME5D3' DIMENSIONS															
BORE	E	F	FB	G	H	K	LD	R	RM	TE	TF	UF	V	WF	ZM
8.00	8.500	0.625	0.688	2.000	2.844	0.563	5.625	6.438	2.750	7.563	10.250	12.000	.250	2.250	12.125

Note: Three (3) 1.00" diameter rods on 5.750 B.C.

For dimensions not shown, see page 84.

SERIES 'TRA' DIMENSIONS: DOUBLE ROD END

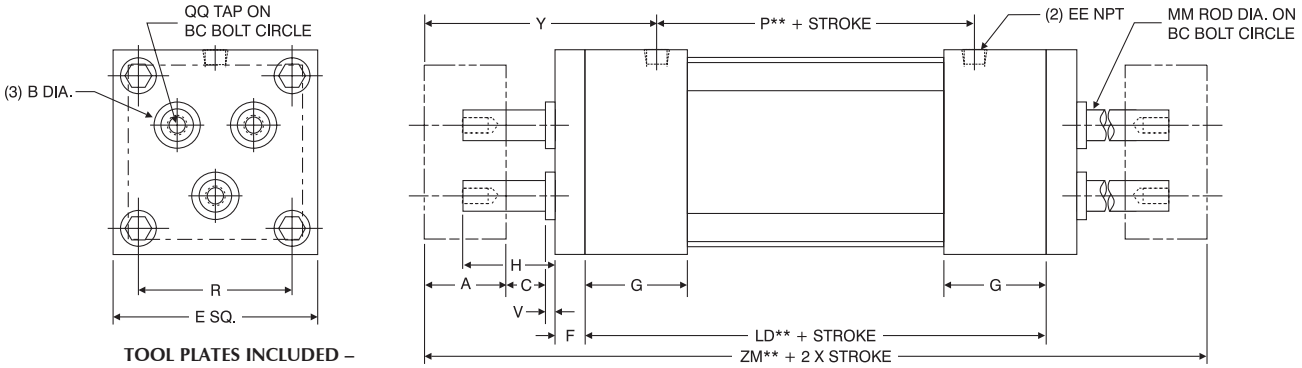
EASY FLIP OUT PAGE FOR REFERENCE

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)



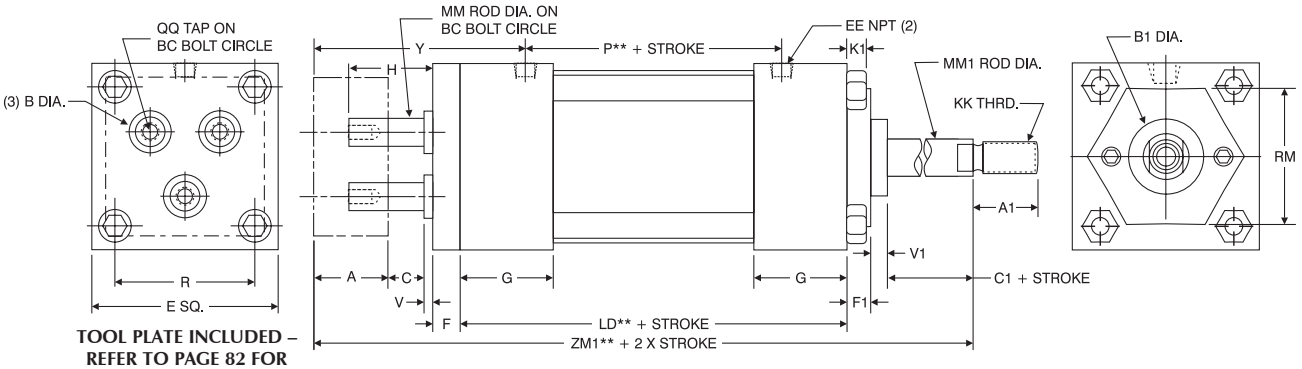
TOOL PLATES INCLUDED – REFER TO 'TRA' SERIES HEAVY DUTY FLIP-OUT FOR TOOL PLATE DETAIL

'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	0.750	0.563	0.891	0.500	2.000	0.250	0.375	1.500	1.100	4.125**	0.313	2.375**	10-32	1.430	0.250	2.750	7.875**
2.00	0.750	0.813	1.195	0.500	2.500	0.250	0.375	1.500	1.100	4.125**	0.500	2.375**	1/4-28	1.844	0.250	2.750	7.875**
2.50	1.000	1.016	1.500	0.500	3.000	0.250	0.375	1.500	1.350	4.250**	0.625	2.500**	5/16-24	2.188	0.250	3.000	8.500**
3.25	1.000	1.125	2.075	0.500	3.750	0.375	0.625	1.750	1.100	4.750	0.625	2.750	3/8-24	2.760	0.250	3.375	9.500
4.00	1.000	1.125	2.825	0.500	4.500	0.375	0.625	1.750	1.100	4.750	0.625	2.750	3/8-24	3.320	0.250	3.375	9.500
5.00	1.000	1.500	3.375	1.000	5.500	0.375	0.625	1.750	1.844	5.000	1.000	3.000	1/2-20	4.100	0.250	3.875	10.750
6.00	1.000	1.500	3.937	1.000	6.500	0.500	0.750	2.000	1.844	5.500	1.000	3.250	1/2-20	4.875	0.250	4.125	11.500
8.00	1.000	1.500	5.750	1.375	8.500	0.750	0.625*	2.000	2.844	5.625	1.000	3.375	1/2-20	6.438	0.250	4.375	12.125

*8.00" bore has three (3) round retainers, 0.625" thick, 2.750" dia. and uses hex nuts on ends (see 'TRA' SERIES HEAVY DUTY FLIP-OUT).
**Option "MPR-WB" will add 0.500" to overall cylinder length - 1.50", 2.00" & 2.50" bores only.

MXOD1 (TRIPLE ROD WITH SINGLE ROD) BASIC DIMENSIONS

(NO MOUNT)



TOOL PLATE INCLUDED – REFER TO PAGE 82 FOR TOOL PLATE DETAIL

'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	0.750	0.750	0.563	1.125	0.891	0.500	0.375	2.000	0.250	0.375	0.375	1.500	1.100	0.250	7/16-20	4.125**	0.313	0.625	2.375**	10	1.438	2.00 Sq.	0.250	0.250	2.750	7.000**
2.00	0.750	0.750	0.816	1.125	1.195	0.500	0.375	2.500	0.250	0.375	0.375	1.500	1.100	0.313	7/16-20	4.125**	0.500	0.625	2.375**	1/4-28	1.844	1.75 Hex.	0.250	0.250	2.750	7.000**
2.50	1.000	0.750	1.016	1.125	1.500	0.500	0.375	3.000	0.250	0.375	0.375	1.500	1.350	0.313	7/16-20	4.250**	0.625	0.625	2.500**	5/16-24	2.188	1.75 Hex.	0.250	0.250	3.000	7.375**
3.25	1.000	1.125	1.125	1.500	2.075	0.500	0.500	3.750	0.375	0.625	0.625	1.750	1.100	0.375	3/4-16	4.750	0.625	1.000	2.750	3/8-24	2.760	2.75 Dia.	0.250	0.250	3.375	8.500
4.00	1.000	1.125	1.125	1.500	2.825	0.500	0.500	4.500	0.375	0.625	0.625	1.750	1.100	0.375	3/4-16	4.750	0.625	1.000	2.750	3/8-24	3.320	2.75 Dia.	0.250	0.250	3.375	8.500
5.00	1.000	1.125	1.500	1.500	3.375	1.000	0.500	5.500	0.375	0.625	0.625	1.750	1.844	0.438	3/4-16	5.000	1.000	1.000	3.000	1/2-20	4.100	2.75 Dia.	0.250	0.250	3.875	9.250
6.00	1.000	1.625	1.500	2.000	3.937	1.000	0.625	6.500	0.500	0.750	0.625	2.000	1.844	0.438	1-14	5.500	1.000	1.375	3.250	1/2-20	4.875	3.50 Dia.	0.250	0.375	4.125	10.125
8.00	1.000	1.625	1.500	2.000	5.750	1.375	0.625	8.500	0.750	0.625*	0.625	2.000	2.844	0.563	1-14	5.625	1.000	1.375	3.375	1/2-20	6.438	3.50 Dia.	0.250	0.375	4.375	10.500

*8.00" bore has three (3) round retainers, 0.625" thick, 2.750" dia. and uses hex nuts on ends (see 'TRA' SERIES HEAVY DUTY FLIP-OUT).
**Option "MPR-WB" will add 0.500" to overall cylinder length - 1.50", 2.00" & 2.50" bores only.

'TRA' SERIES DOUBLE ROD END DIMENSIONS FLIP-OUT (PAGE 91)

EASY FLIP OUT PAGE FOR REFERENCE

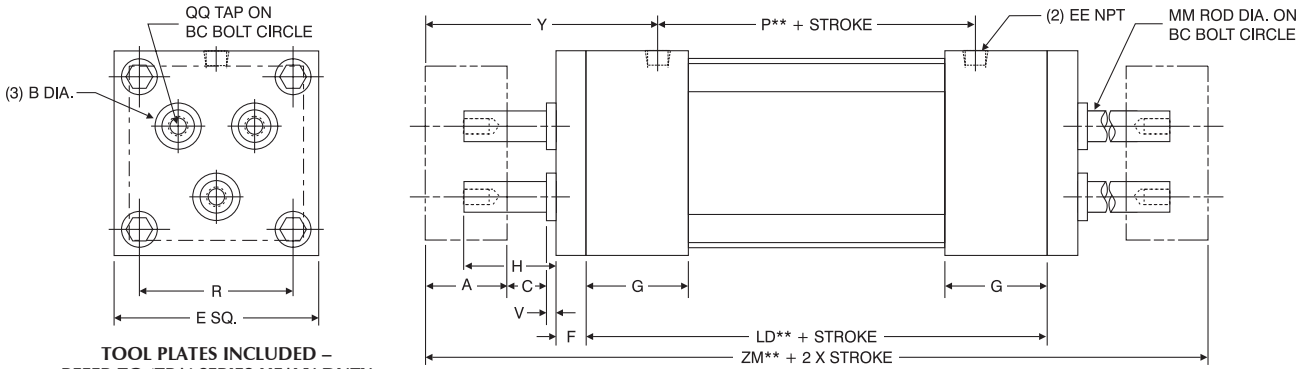
SERIES 'TRA' DIMENSIONS: DOUBLE ROD END

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)



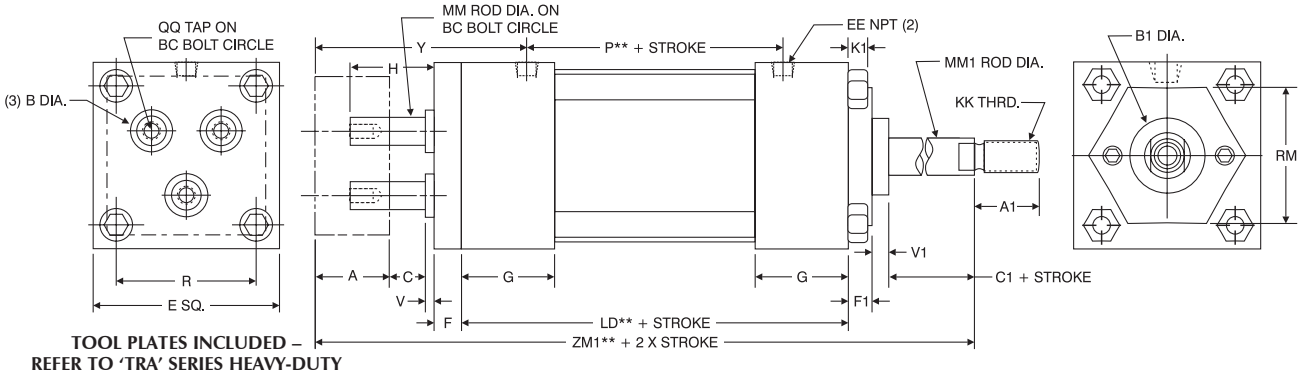
TOOL PLATES INCLUDED – REFER TO 'TRA' SERIES HEAVY-DUTY FLIP-OUT FOR TOOL PLATE DETAIL

'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	0.750	0.563	0.891	0.500	2.000	0.250	0.375	1.500	1.100	4.125**	0.313	2.375**	10-32	1.430	0.250	2.750	7.875**
2.00	0.750	0.813	1.195	0.500	2.500	0.250	0.375	1.500	1.100	4.125**	0.500	2.375**	1/4-28	1.844	0.250	2.750	7.875**
2.50	1.000	1.016	1.500	0.500	3.000	0.250	0.375	1.500	1.350	4.250**	0.625	2.500**	5/16-24	2.188	0.250	3.000	8.500**
3.25	1.000	1.125	2.075	0.500	3.750	0.375	0.625	1.750	1.100	4.750	0.625	2.750	3/8-24	2.760	0.250	3.375	9.500
4.00	1.000	1.125	2.825	0.500	4.500	0.375	0.625	1.750	1.100	4.750	0.625	2.750	3/8-24	3.320	0.250	3.375	9.500
5.00	1.000	1.500	3.375	1.000	5.500	0.375	0.625	1.750	1.844	5.000	1.000	3.000	1/2-20	4.100	0.250	3.875	10.750
6.00	1.000	1.500	3.937	1.000	6.500	0.500	0.750	2.000	1.844	5.500	1.000	3.250	1/2-20	4.875	0.250	4.125	11.500
8.00	1.000	1.500	5.750	1.375	8.500	0.750	0.625*	2.000	2.844	5.625	1.000	3.375	1/2-20	6.438	0.250	4.375	12.125

*8.00" bore has three (3) round retainers, .625" thick, 2.75" dia. and uses hex nuts on ends (see 'TRA' SERIES HEAVY-DUTY FLIP-OUT).
**Option "MPR-WB" will add .500" to overall cylinder length - 1.50", 2.00" & 2.50" bores only.

MXOD1 (TRIPLE ROD WITH SINGLE ROD) BASIC DIMENSIONS

(NO MOUNT)



TOOL PLATES INCLUDED – REFER TO 'TRA' SERIES HEAVY-DUTY FLIP-OUT FOR TOOL PLATE DETAIL

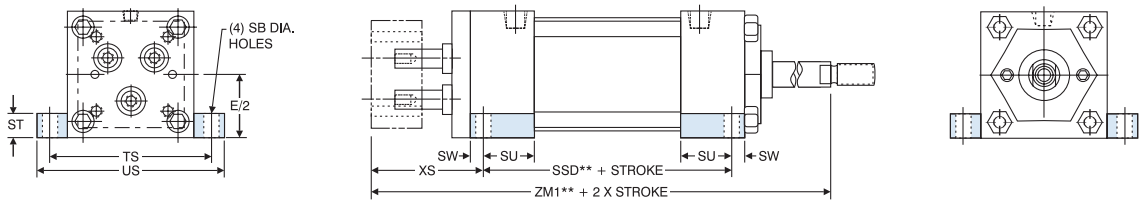
'TRA' SERIES TWIN TOOLING PLATE BASIC DIMENSIONS 'MXOD1'																									
BORE	A	A1	B	B1	BC	C	C1	E	EE	F	F1	G	H	K1	KK	LD	MM	MM1	P	QQ	R	RM	V	V1	Y	ZM1
1.50	0.750	0.750	0.563	1.125	0.891	0.500	0.375	2.000	0.250	0.375	0.375	1.500	1.100	0.250	7/16-20	4.125**	0.313	0.625	2.375**	10	1.438	2.00 Sq.	0.250	0.250	2.750	7.000**
2.00	0.750	0.750	0.816	1.125	1.195	0.500	0.375	2.500	0.250	0.375	0.375	1.500	1.100	0.313	7/16-20	4.125**	0.500	0.625	2.375**	1/4-28	1.844	1.75 Hex.	0.250	0.250	2.750	7.000**
2.50	1.000	0.750	1.016	1.125	1.500	0.500	0.375	3.000	0.250	0.375	0.375	1.500	1.350	0.313	7/16-20	4.250**	0.625	0.625	2.500**	5/16-24	2.188	1.75 Hex.	0.250	0.250	3.000	7.375**
3.25	1.000	1.125	1.125	1.500	2.075	0.500	0.500	3.750	0.375	0.625	0.625	1.750	1.100	0.375	3/4-16	4.750	0.625	1.000	2.750	3/8-24	2.760	2.75 Dia.	0.250	0.250	3.375	8.500
4.00	1.000	1.125	1.125	1.500	2.825	0.500	0.500	4.500	0.375	0.625	0.625	1.750	1.100	0.375	3/4-16	4.750	0.625	1.000	2.750	3/8-24	3.320	2.75 Dia.	0.250	0.250	3.375	8.500
5.00	1.000	1.125	1.500	1.500	3.375	1.000	0.500	5.500	0.375	0.625	0.625	1.750	1.844	0.438	3/4-16	5.000	1.000	1.000	3.000	1/2-20	4.100	2.75 Dia.	0.250	0.250	3.875	9.250
6.00	1.000	1.625	1.500	2.000	3.937	1.000	0.625	6.500	0.500	0.750	0.625	2.000	1.844	0.438	1-14	5.500	1.000	1.375	3.250	1/2-20	4.875	3.50 Dia.	0.250	0.375	4.125	10.125
8.00	1.000	1.625	1.500	2.000	5.750	1.375	0.625	8.500	0.750	0.625*	0.625	2.000	2.844	0.563	1-14	5.625	1.000	1.375	3.375	1/2-20	6.438	3.50 Dia.	0.250	0.375	4.375	10.500

*8.00" bore has three (3) round retainers, 0.625" thick, 2.750" dia. and uses hex nuts on ends (see 'TRA' SERIES HEAVY-DUTY FLIP-OUT).
**Option "MPR-WB" will add 0.500" to overall cylinder length - 1.50", 2.00" & 2.50" bores only.

'TRA' SERIES DOUBLE ROD END DIMENSIONS FLIP-OUT (PAGE 91)

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

MS2D1 (TRIPLE ROD WITH SINGLE ROD)

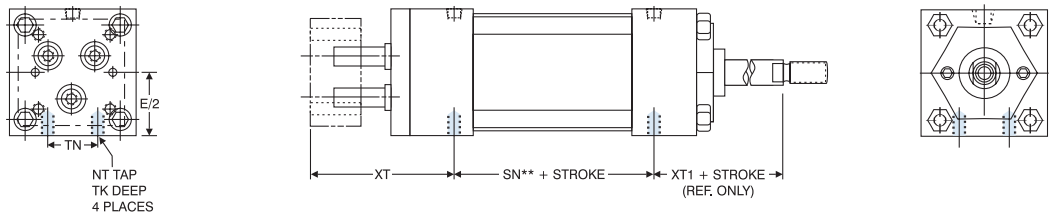


'TRA' SERIES 'MS2D1' DIMENSIONS										
BORE	SB	E/2	SSD	ST	SU	SW	TS	US	XS	ZM1
1.50	0.438	1.000	3.375**	0.500	1.125	0.375	2.750	3.500	2.250	7.000**
2.00	0.438	1.250	3.375**	0.500	1.125	0.375	3.250	4.000	2.250	7.000**
2.50	0.438	1.500	3.500**	0.500	1.125	0.375	3.750	4.500	2.500	7.375**
3.25	0.563	1.875	3.750	0.750	1.250	0.500	4.750	5.750	2.875	8.500
4.00	0.563	2.250	3.750	0.750	1.250	0.500	5.500	6.500	2.875	8.500
5.00	0.813	2.750	3.625	1.000	1.063	0.688	6.875	8.250	3.563	9.250
6.00	0.813	3.250	4.125	1.000	1.313	0.688	7.875	9.250	3.688	10.125
8.00	0.813	4.250	4.250	1.000	1.313	0.688	9.875	11.250	3.938	10.500

**Option "MPR-WB" will add 0.500" to overall cylinder length - 1.50", 2.00" & 2.50" bores only.

For single rod end dimensions not shown, see page 91 or page 94.

MS4D1 (TRIPLE ROD WITH SINGLE ROD)

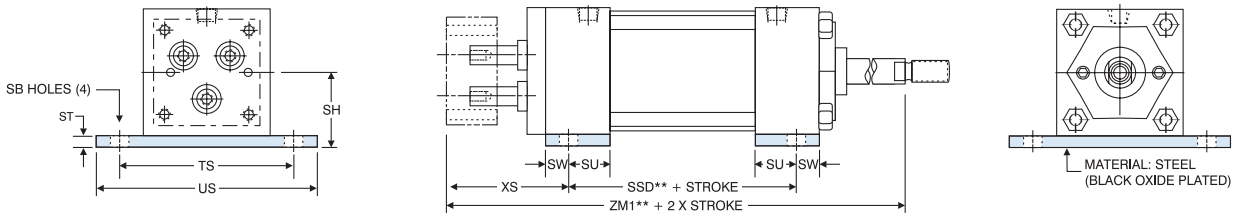


'TRA' SERIES 'MS4D1' DIMENSIONS							
BORE	E/2	NT	TK	TN	XT	SN	XT1
1.50	1.000	1/4 -20	0.375	0.625	2.813	2.250**	1.938
2.00	1.250	5/16 -18	0.500	0.875	2.813	2.250**	1.938
2.50	1.500	3/8 -16	0.625	1.250	3.063	2.375**	1.938
3.25	1.875	1/2 -13	0.750	1.500	3.438	2.625	2.438
4.00	2.250	1/2 -13	0.750	2.063	3.438	2.625	2.438
5.00	2.750	5/8 -11	1.000	2.688	3.938	2.875	2.438
6.00	3.250	3/4 -10	1.125	3.250	4.188	3.125	2.813
8.00	4.250	3/4 -10	1.125	4.500	4.438	3.250	2.813

**Option "MPR-WB" will add 0.500" to overall cylinder length - 1.50", 2.00" & 2.50" bores only.

For single rod end dimensions not shown, see page 91 or page 94.

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



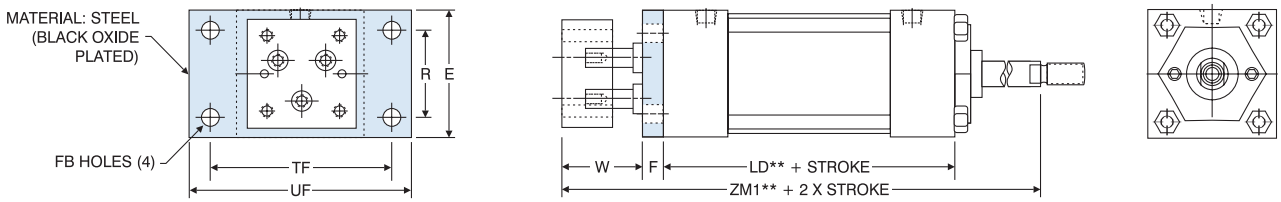
'TRA' SERIES BASEBAR-D1 (Non-NFPA) DIMENSIONS										
BORE	SB	SH	SSD	ST	SU	SW	TS	US	XS	ZM1
1.50	0.438	1.250	3.375**	0.250	1.125	0.375	2.750	3.500	2.250	7.000**
2.00	0.438	1.500	3.375**	0.250	1.125	0.375	3.250	4.000	2.250	7.000**
2.50	0.438	1.875	3.500**	0.375	1.125	0.375	3.750	4.500	2.500	7.375**
3.25	0.563	2.375	3.750	0.500	1.250	0.500	4.750	5.750	2.875	8.500
4.00	0.563	2.750	3.750	0.500	1.250	0.500	5.500	6.500	2.875	8.500

**Option "MPR-WB" will add 0.500" to overall cylinder length - 1.50", 2.00" & 2.50" bores only.

For single rod end dimensions not shown, see page 91 or page 94.

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

MF1D1 (TRIPLE ROD WITH SINGLE ROD)

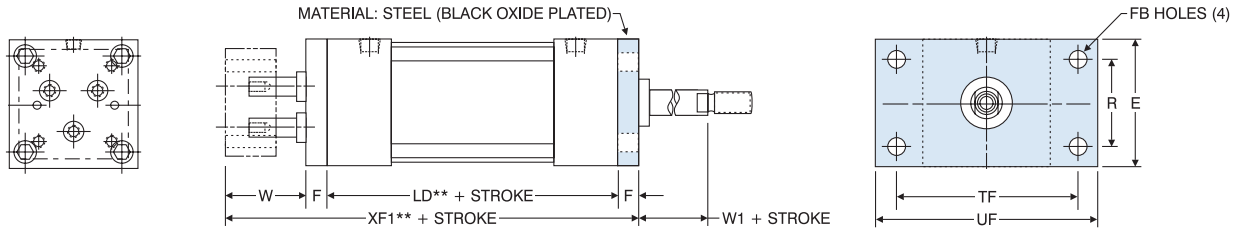


'TRA' SERIES 'MF1D1' DIMENSIONS									
BORE	E	F	FB	LD	R	TF	UF	W	ZM1
1.50	2.000	0.375	0.313	4.125**	1.438	2.750	3.375	1.500	7.000**
2.00	2.500	0.375	0.375	4.125**	1.844	3.375	4.125	1.500	7.000**
2.50	3.000	0.375	0.375	4.250**	2.188	3.875	4.625	1.750	7.375**
3.25	3.750	0.625	0.438	4.750	2.760	4.688	5.500	1.750	8.500
4.00	4.500	0.625	0.438	4.750	3.320	5.438	6.250	1.750	8.500
5.00	5.500	0.625	0.563	5.000	4.100	6.625	7.625	2.250	9.250
6.00	6.500	0.750	0.563	5.500	4.875	7.625	8.625	2.250	10.125

**Option "MPR-WB" will add 0.500" to overall cylinder length - 1.50", 2.00" & 2.50" bores only.

For single rod end dimensions not shown, see page 91 or page 94.

MF2D1 (TRIPLE ROD WITH SINGLE ROD)

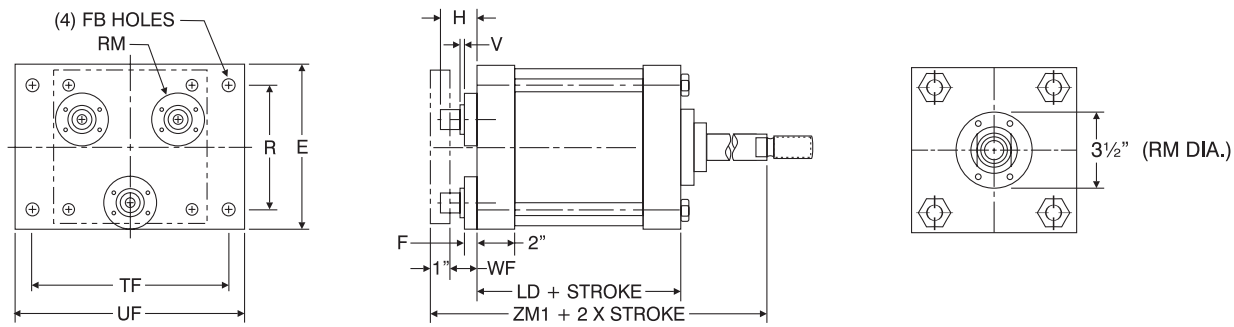


'TRA' SERIES 'MF2D1' DIMENSIONS										
BORE	E	F	FB	LD	R	TF	UF	W	XF1	W1
1.50	2.000	0.375	0.313	4.125**	1.438	2.750	3.375	1.500	6.375**	0.625
2.00	2.500	0.375	0.375	4.125**	1.844	3.375	4.125	1.500	6.375**	0.625
2.50	3.000	0.375	0.375	4.250**	2.188	3.875	4.625	1.750	6.750**	0.625
3.25	3.750	0.625	0.438	4.750	2.760	4.688	5.500	1.750	7.750	0.750
4.00	4.500	0.625	0.438	4.750	3.320	5.438	6.250	1.750	7.750	0.750
5.00	5.500	0.625	0.563	5.000	4.100	6.625	7.625	2.250	8.500	0.750
6.00	6.500	0.750	0.563	5.500	4.875	7.625	8.625	2.250	9.250	0.875

**Option "MPR-WB" will add 0.500" to overall cylinder length - 1.50", 2.00" & 2.50" bores only.

For single rod end dimensions not shown, see page 91 or page 94.

ME5D1 (TRIPLE ROD WITH SINGLE ROD)



'TRA' SERIES 'ME5D1' DIMENSIONS												
BORE	E	F	FB	H	R	RM	TF	UF	V	WF	LD	ZM1
8.00	8.500	0.625	0.688	2.844	6.438	2.750	10.250	12.000	0.250	2.250	5.625	10.500

Note: Three (3) 1.00" diameter rods on 5.750 B.C.

For single rod end dimensions not shown, see page 91 or page 94.

SERIES 'TRA': OPTIONS

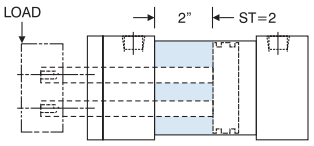
ST=2 ST=4 Stop Tubes

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.

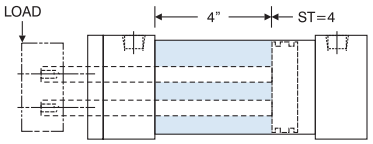
Ordering Example: TRA MS4 2.00 x 10ES-ST=2-

The effective stroke (ES) 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
2.00	14	18	24	18	24	30
2.50	20	24	30	30	38	40
3.25	24	28	36	34	42	46
4.00	24	30	38	36	44	48
5.00	26	34	42	40	52	56
6.00	28	36	44	42	54	58
8.00	30	38	46	42	54	60

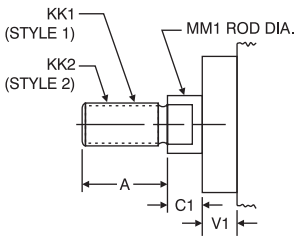
*MAXIMUM STROKE FOR HORIZONTAL APPLICATIONS.

"D1" ROD END OPTIONS

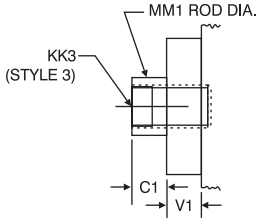
KK1 is standard (leave blank). Specify at end of part number for -KK2, -KK3, -KK4 or -KK5.

Piston rod end styles apply to single rod end of cylinder only.

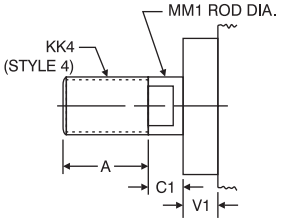
STYLE 1 & 2



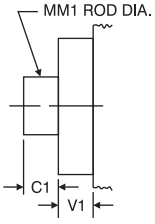
STYLE 3



STYLE 4



STYLE 5
(BLANK ROD END)



BORE	MM1 ROD DIAMETER	STANDARD Style 1 - Male		OPTIONAL Style 2 - Male		Style 3 - Female		Style 4 - Male		Style 5 - Blank	C1*	V1
		KK1	A	KK2	A	KK3	A	KK4	A	KK5		
1.50, 2.00, 2.50	0.625 Standard	7/16 -20	0.750	1/2 -20	0.750	7/16 -20	0.750	5/8 -18	0.750	No Threads	0.375	0.250
3.25, 4.00, 5.00	1.000 Standard	3/4 -16	1.125	7/8 -14	1.125	3/4 -16	1.125	1 -14	1.125	No Threads	0.500	0.250
6.00 & 8.00	1.375 Standard	1 -14	1.625	1 1/4 -12	1.625	1 -14	1.625	1 3/8 -12	1.625	No Threads	0.625	0.375

*Dimension is with single rod fully retracted.

CUSTOM SOLUTIONS

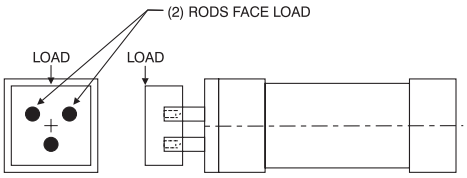
Still don't see what you need? No Problem! With our extensive machining abilities, our engineering staff can assist with the design of a cylinder for your application. Call, fax or e-mail your specifications for a quick response! When it comes to delivery, TRD has the reputation as being one of the fastest.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

SERIES 'TRA': TECHNICAL DATA
LOAD CHARTS: 1.50" - 4.00" BORE

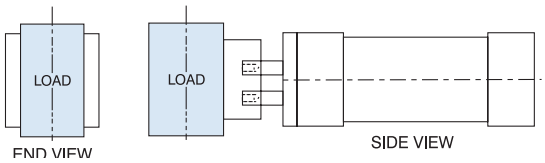
How to use LOAD CHARTS:

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

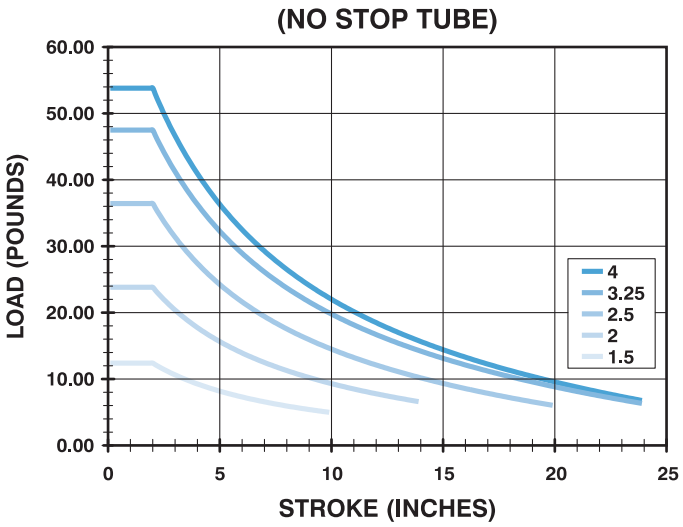
"Triple Rod" mounting to LOAD:

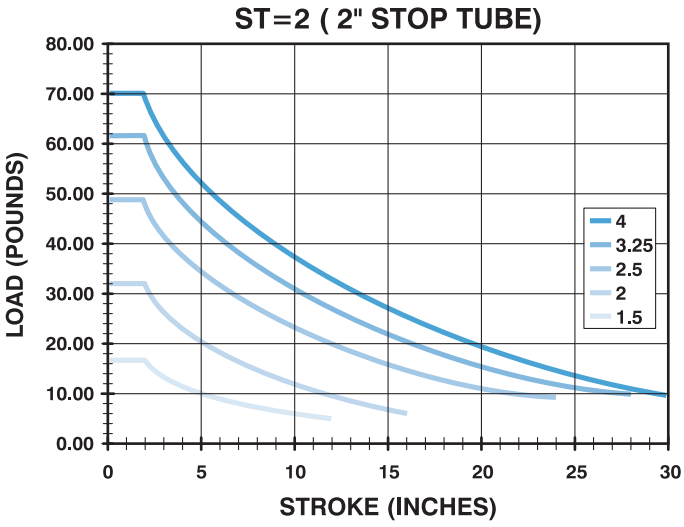


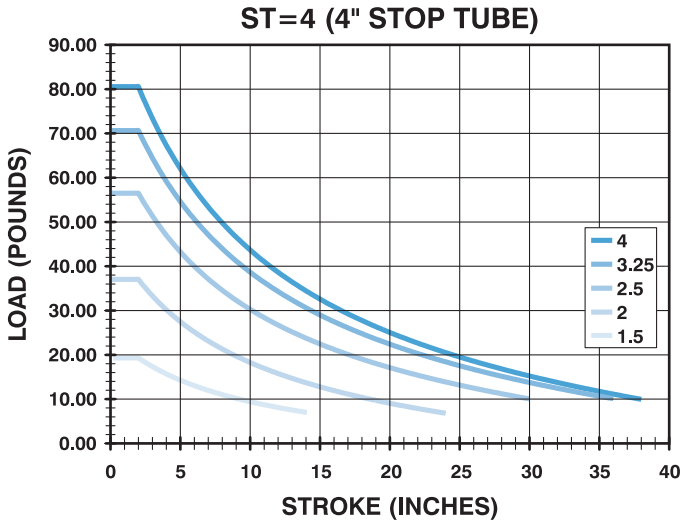
EXAMPLE 1



SINGLE ROD END: 1.50" - 4.00" Bore MAXIMUM RECOMMENDED LOAD





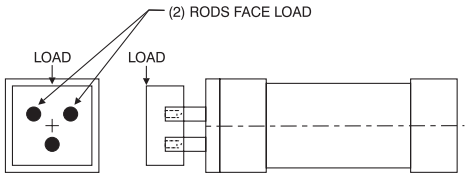


SERIES 'TRA': TECHNICAL DATA
LOAD CHARTS: 5.00" - 8.00" BORE

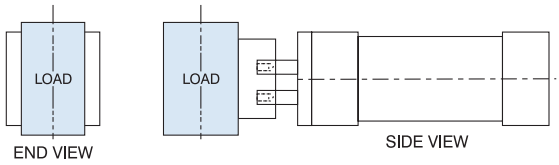
How to use LOAD CHARTS:

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

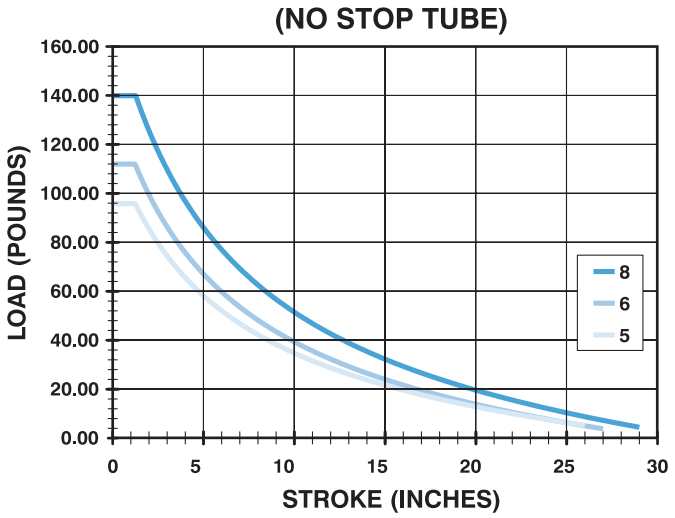
"Triple Rod" mounting to LOAD:

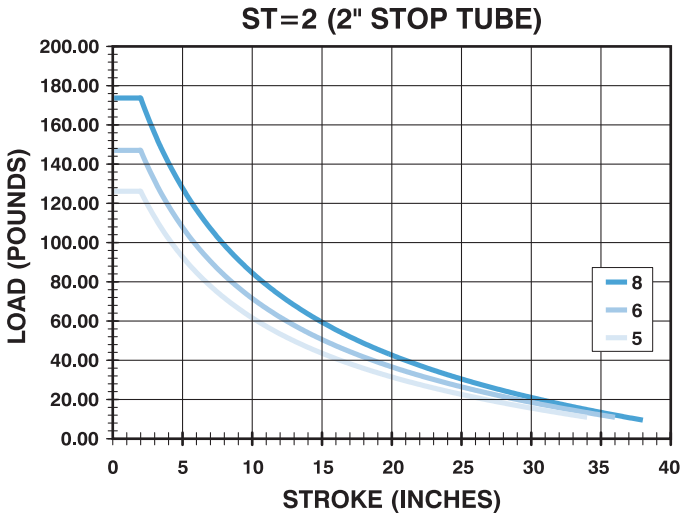


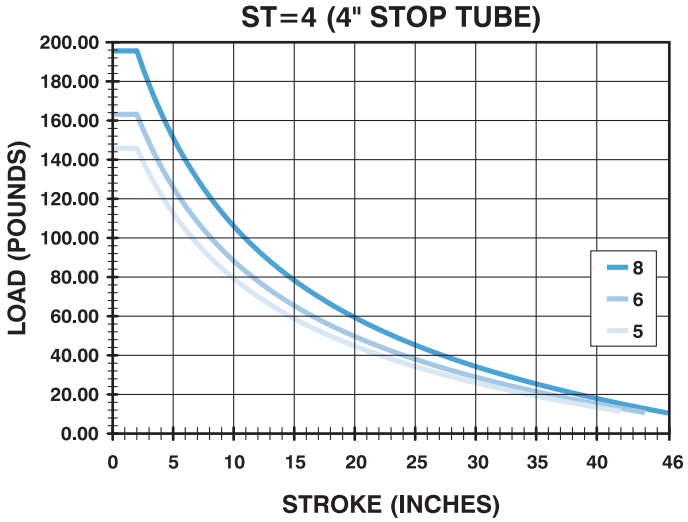
EXAMPLE 1



SINGLE ROD END: 5.00" - 8.00" Bore MAXIMUM RECOMMENDED LOAD





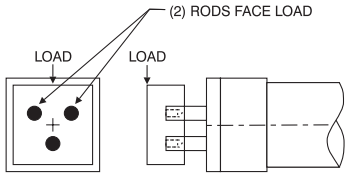


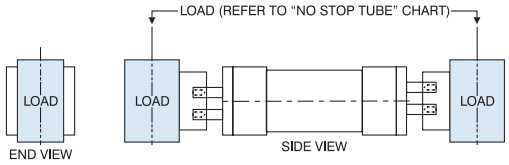
SERIES 'TRA': TECHNICAL DATA (D3 MODELS)
LOAD CHARTS: 1.50" - 4.00" BORE – DOUBLE ROD END

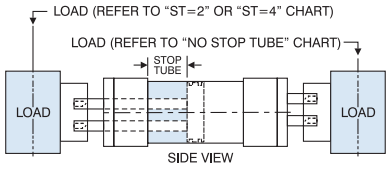
How to use LOAD CHARTS:

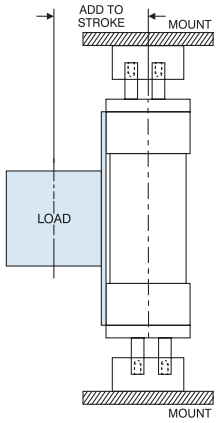
1.) Determine weight of LOAD (pounds)
2.) Refer to Load Charts for model selection

"Triple Rod" mounting to LOAD:

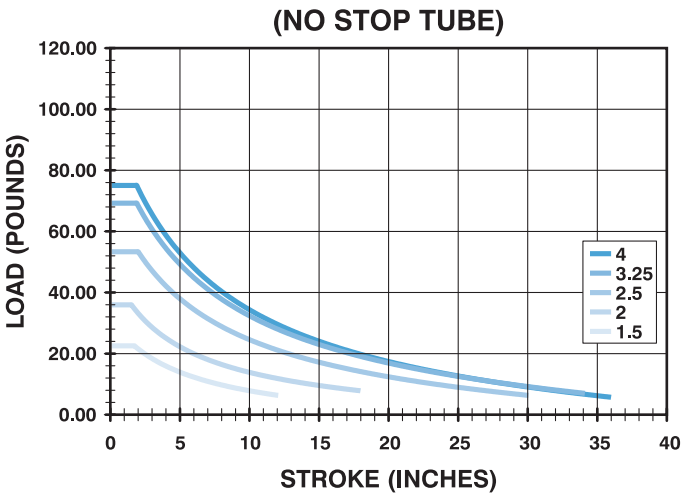


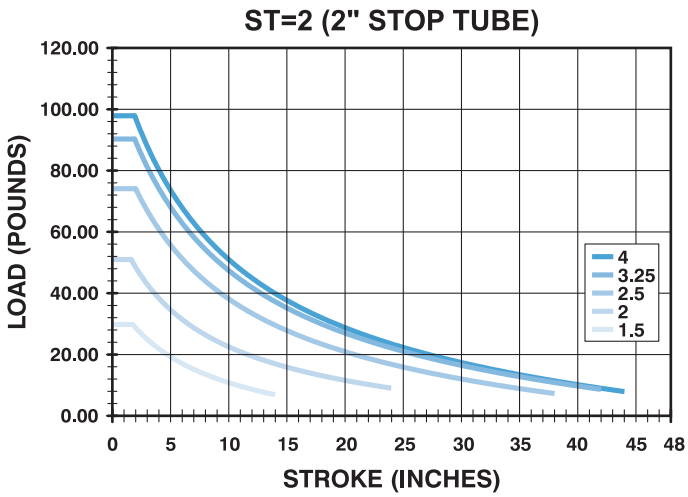


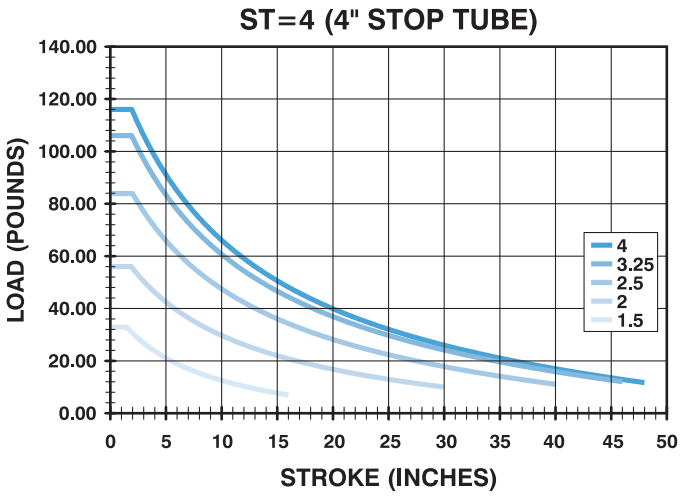




DOUBLE ROD END: 1.50" - 4.00" Bore MAXIMUM RECOMMENDED LOAD





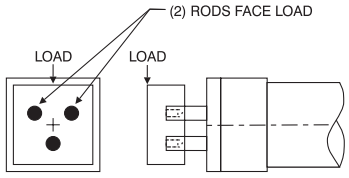


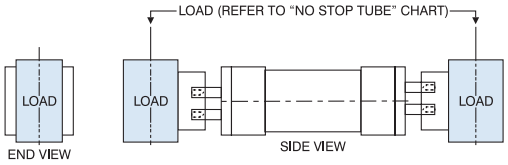
SERIES 'TRA': TECHNICAL DATA (D3 MODELS)
LOAD CHARTS: 5.00" - 8.00" BORE – DOUBLE ROD END

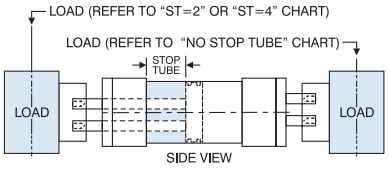
How to use LOAD CHARTS:

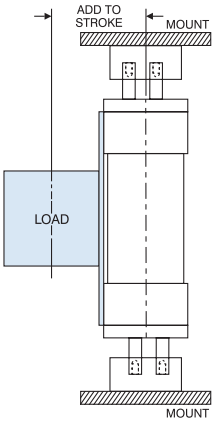
1.) Determine weight of LOAD (pounds)
2.) Refer to Load Charts for model selection

"Triple Rod" mounting to LOAD:

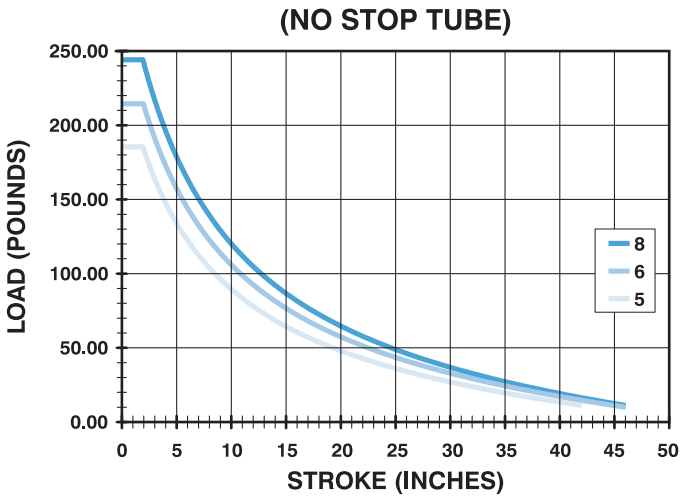


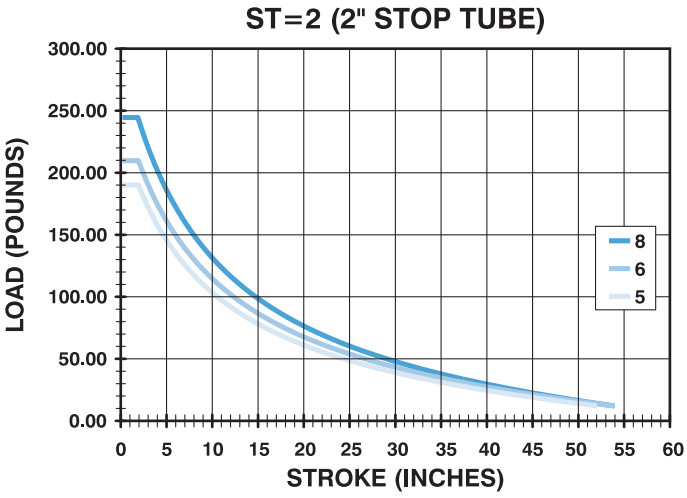


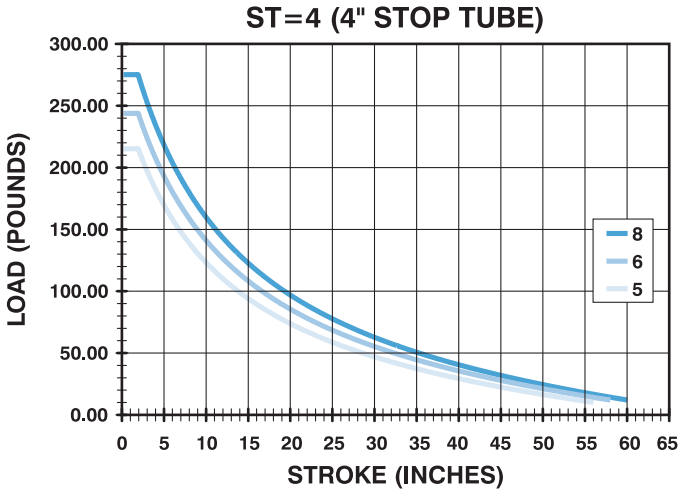




DOUBLE ROD END: 5.00" - 8.00" Bore MAXIMUM RECOMMENDED LOAD







SERIES 'TRA': TECHNICAL DATA
TORQUE CHARTS

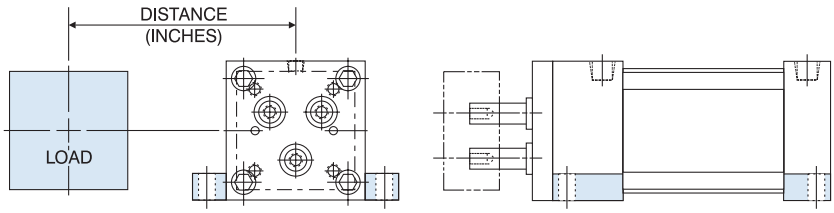
How to use TORQUE CHARTS:

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

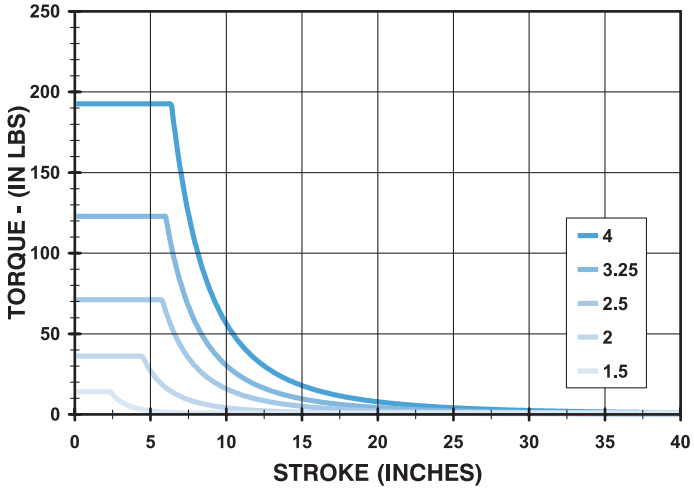
4.) Refer to Torque Charts for model selection



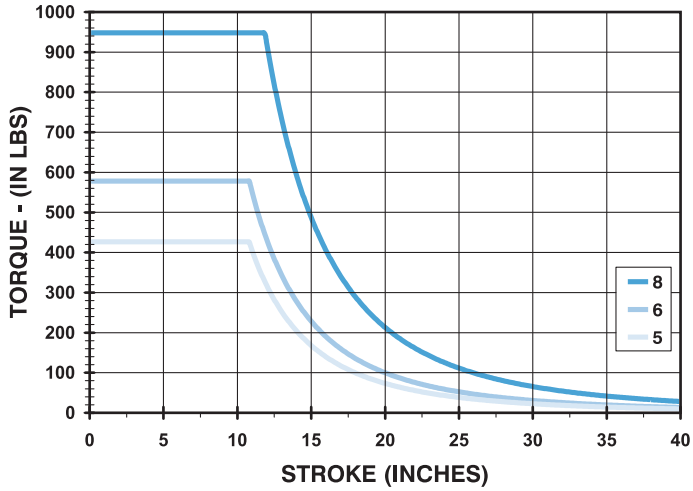
TORQUE (INCH-POUNDS)

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

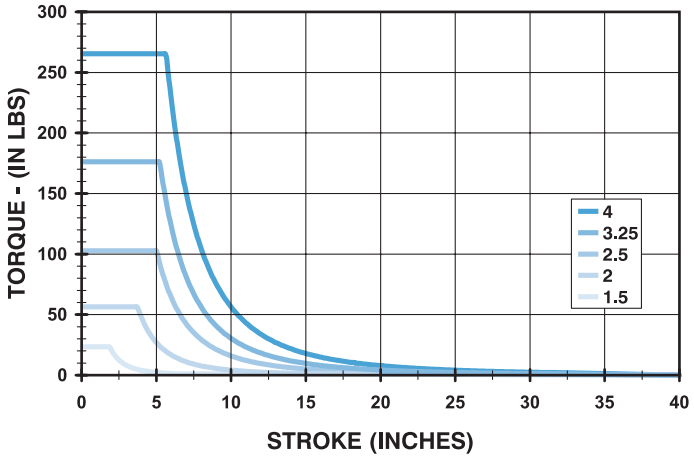
SINGLE ROD END TORQUE (1.50"- 4")



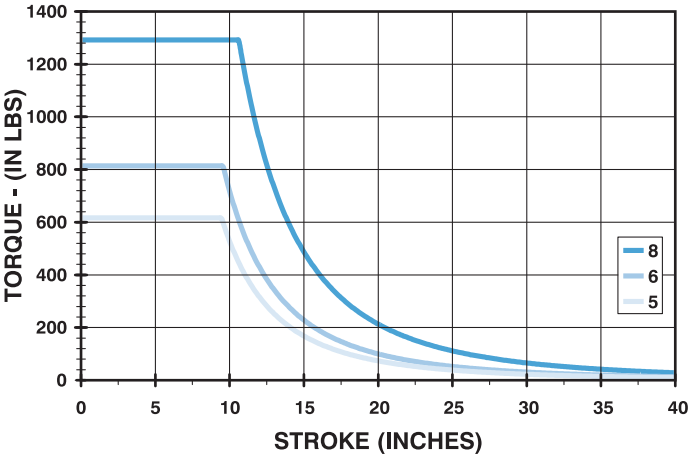
SINGLE ROD END TORQUE (5"-8")



DOUBLE ROD END TORQUE (1.50" - 4")



DOUBLE ROD END TORQUE (5"-8")

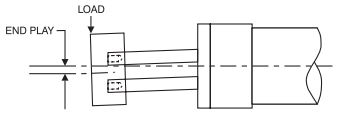


SERIES 'TRA': TECHNICAL DATA

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)

TOOLING PLATE END PLAY



SINGLE ROD END CYLINDERS - NO STOP TUBE

1.50" - 8.00" BORE SINGLE ROD END CYLINDERS - NO STOP TUBE								
STROKE	1.50	2.00	2.50	3.25	4.00	5.00	6.00	8.00
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" - 8.00" BORE SINGLE ROD END CYLINDERS - 2.00" STOP TUBE								
STROKE	1.50	2.00	2.50	3.25	4.00	5.00	6.00	8.00
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

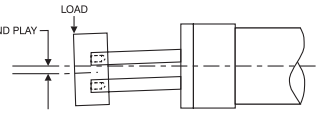
1.50" - 8.00" BORE SINGLE ROD END CYLINDERS - 4.00" STOP TUBE								
STROKE	1.50	2.00	2.50	3.25	4.00	5.00	6.00	8.00
0	0.002	0.003	0.003	0.003	0.005	0.006	0.008	0.005
2	0.006	0.007	0.006	0.007	0.012	0.015	0.015	0.014
4	0.009	0.012	0.010	0.011	0.019	0.023	0.025	0.022
6	0.013	0.016	0.014	0.015	0.026	0.032	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)

TOOLING PLATE END PLAY



DOUBLE ROD END CYLINDERS - NO STOP TUBE

1.50" - 8.00" BORE DOUBLE ROD END CYLINDERS - NO STOP TUBE								
STROKE	**1.50**	**2.00**	**2.50**	**3.25**	**4.00**	**5.00**	**6.00**	**8.00**
0	0.003	0.003	0.003	0.003	0.004	0.005	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" - 8.00" BORE DOUBLE ROD END CYLINDERS - 2.00" STOP TUBE								
STROKE	**1.50**	**2.00**	**2.50**	**3.25**	**4.00**	**5.00**	**6.00**	**8.00**
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" - 8.00" BORE DOUBLE ROD END CYLINDERS - 4.00" STOP TUBE								
STROKE	**1.50**	**2.00**	**2.50**	**3.25**	**4.00**	**5.00**	**6.00**	**8.00**
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
2.00	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
4.00	15.0	15.0	16.2	18.3	19.5	19.5	19.3	19.7	N/A	0.55
5.00	24.0	24.0	25.3	28.6	30.7	N/A	30.5	31.1	N/A	1.10
6.00	35.2	35.2	36.6	43.4	45.9	N/A	45.8	46.7	N/A	1.15
8.00	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 (D3 MODELS)

(WEIGHT IN POUNDS)

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
2.00	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
4.00	26.4	26.4	27.6	30.7	0.85
5.00	42.9	42.9	44.3	49.4	1.83
6.00	59.8	59.8	61.4	70.4	1.95
8.00	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	4.00	4.16	6.00	9.30
2.00	0.70	3.25	2.7	5.00	6.25	8.00	17.0

TORQUE CHART - CYLINDER TIE RODS

BORE	TIE ROD THREAD SIZE	TORQUE IN FT. - LBS.
1.50	1/4 -28	7
2.00	5/16 -24	12
2.50	5/16 -24	14
3.25	3/8 -24	30
4.00	3/8 -24	35
5.00	1/2 -20	45
6.00	1/2 -20	50
8.00	5/8 -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	1/4 -28	7
2.00	5/16 -24	12
2.50	5/16 -24	12
3.25	3/8 -24	22
4.00	3/8 -24	22
5.00	1/2 -20	35
6.00	1/2 -20	35
8.00	1/4 -28	7

1.50" - 6.00" bore have full square retainer plate, 8.00" bore has three (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
2.00	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
4.00	PUSH	12.566	754	1005	1257	2514	3141	5026	.00727
	PULL	11.646	699	932	1165	2330	2911	4658	.00674
5.00	PUSH	19.635	1178	1571	1964	3928	4908	7854	.01136
	PULL	17.279	1037	1382	1728	3456	4320	6911	.00999
6.00	PUSH	28.274	1696	2262	2827	5654	7068	11310	.01636
	PULL	25.918	1555	2073	2592	5184	6479	10367	.01499
8.00	PUSH	50.265	3016	4021	5026	10052	12566	20106	.02908
	PULL	47.909	2874	3832	4791	9582	11977	19163	.02773

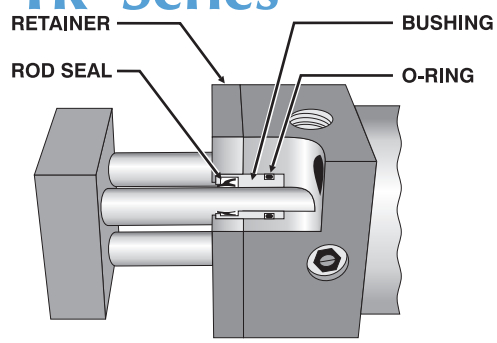
'TR' SERIES: DESIGN ENHANCEMENT

'TR' Series (250 PSI Air) is super-ceded by 'TRA' Series *(effective 5/01/03).*
'TR-TH' (400 PSI Hyd.) Series is super-ceded by 'TRA' Series with 'TH' option *(effective 5/01/03).*

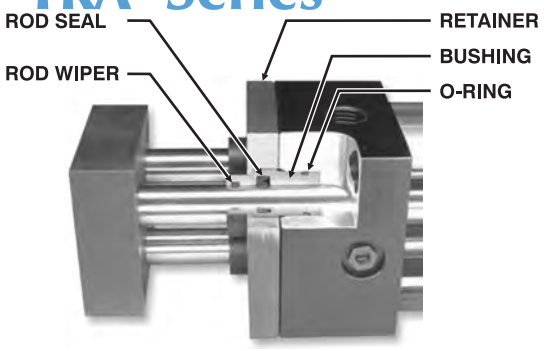
TRD's 'TR' Series has been redesigned. The new 'TRA' Series is a ***Heavy-Duty*** version of the obsoleted 'TR' Series. The new series is a drop-in replacement of the previous model. Overall dimensions are not affected*. The affected service parts are listed below for reference. Any existing 'TR' Series in service can be fitted with the new 'TRA' Series ***Heavy-Duty*** Bushing design. A new set of three (3) Bushings, three (3 sets) Seals and one (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 0.500" to overall cylinder length - 1.50", 2.00" & 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
2.00	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
4.00	TR-B-30-3	TR/BO-625	TR/RW-625	TR-36-40
5.00	TR-B-30-4	TR/BO-1000	TR/RW-1000	TR-36-50
6.00	TR-B-30-4	TR/BO-1000	TR/RW-1000	TR-36-60
8.00	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
2.00	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
4.00	TRHD-30-4	TR-BO-625	RS-625	RW-625	TRHD-36-40	TRA-40-RK
5.00	TRHD-30-5	TR-BO-1000	RS-1000	RW-1000	TRHD-36-50	TRA-50-RK
6.00	TRHD-30-6	TR-BO-1000	RS-1000	RW-1000	TRHD-36-60	TRA-60-RK
8.00	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
2.00	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
4.00	TH/TR-B-30-3	TR/BO-625	TR/TH-625	TR-36-40
5.00	TH/TR-B-30-4	TR/BO-1000	TR/TH-1000	TR-36-50
6.00	TH/TR-B-30-4	TR/BO-1000	TR/TH-1000	TR-36-60
8.00	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
2.00	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
4.00	TRHD-30-4	TR-BO-625	RS-625	RW-625	TRHD-36-40	TRH-40-RK
5.00	TRHD-30-5	TR-BO-1000	RS-1000	RW-1000	TRHD-36-50	TRH-50-RK
6.00	TRHD-30-6	TR-BO-1000	RS-1000	RW-1000	TRHD-36-60	TRH-60-RK
8.00	TH-30-2	BO-2	RS-1000	RW-1000	A-35-2 (3 Req'd)	N/A

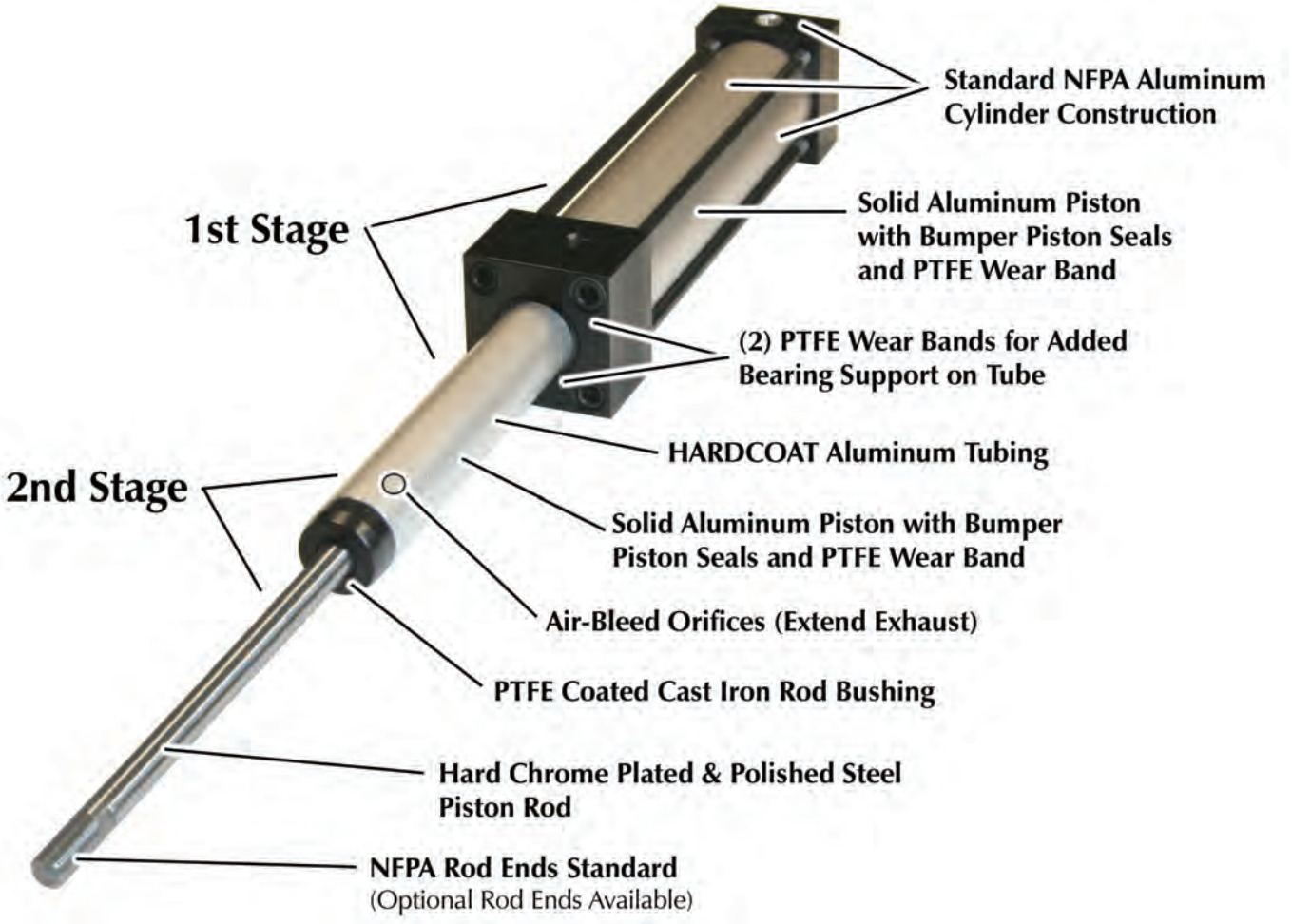
NOTES

TC Series NFPA
2-STAGE TELESCOPING
Aluminum Cylinders
1.50″ to 2.50″ Effective Bore

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

SERIES 'TC' 2-STAGE TELESCOPING CYLINDER

CONSTRUCTION



FEATURES

- 3 Bore Sizes: 0.75", 1.50" and 2.50"
- Strokes up to 60"
- 2-Stage Telescoping
- Space Saving Design
- 100% Double Action
- Heavy-Duty Construction
- Rated for Non-Lube Service
- Standard NFPA Mounting
- Internal Bumpers at Each Stage

SPACE SAVING DESIGN
STROKE EXAMPLES FOR 1.50" BORE
NOTE: CYLINDERS ARE MADE TO ANY STROKE

CYLINDER STROKE	STANDARD NFPA CYLINDER	TELESCOPING CYLINDER	SPACE SAVINGS
12"	16.625"	10.750"	35.34%
18"	22.625"	13.750"	39.23%
24"	28.625"	16.750"	41.48%
30"	34.625"	19.750"	42.96%
36"	40.625"	22.750"	44.00%
42"	46.625"	25.750"	44.77%
48"	52.625"	28.750"	45.37%
54"	58.625"	31.750"	45.84%
60"	64.625"	34.750"	46.23%

SERIES 'TC': HOW TO ORDER

TC - MS4 - 1.50 x 10 x 2S - KK2 - SSA

SERIES	
TC	125 PSI AIR

NFPA MOUNTS	
MF1	FRONT FLANGE
MF2	REAR FLANGE
MP1	REAR PIVOT CLEVIS
MP2	REAR PIVOT CLEVIS
MP4	REAR PIVOT EYE
MS1	FRONT & REAR ANGLES
MS4	BOTTOM TAPPED HOLES
MT2	REAR TRUNNION
Basebar	SIDE LUG MOUNT (Non-NFPA)
MX0	NO MOUNT

BORE
0.75"
1.50"
2.50"

STROKE
0" to 60" MADE TO ORDER

STAGES	
2S	TWO STAGE

OPTIONS	
A=	EXTENDED PISTON ROD THREAD (EXAMPLE: A=2)
C=	EXTENDED PISTON ROD (EXAMPLE C=3)
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
MPR	MAGNETIC PISTON FOR REED OR SOLID STATE SWITCHES TRD MODELS R10, RAC, AND MSS. NOTE: MAGNET IS ONLY ON 1ST STAGE AND WILL ONLY DETECT THE POSITION OF ONE STAGE.
OS	OS = 1" PISTON ROD (AVAILABLE ON 2.50" BORE ONLY
OP	OPTIONAL PORT LOCATION (EXAMPLE: OP=3 AND 7)
SSA	STAINLESS STEEL PISTON ROD, TIE RODS & NUTS, AND FASTENERS
SSF	STAINLESS STEEL FASTENERS
SSN	STAINLESS STEEL TIE ROD NUTS
SSR	STAINLESS STEEL PISTON ROD
SST	STAINLESS STEEL TIE RODS
XX	SPECIAL VARIATION (SPECIFY: XX=)

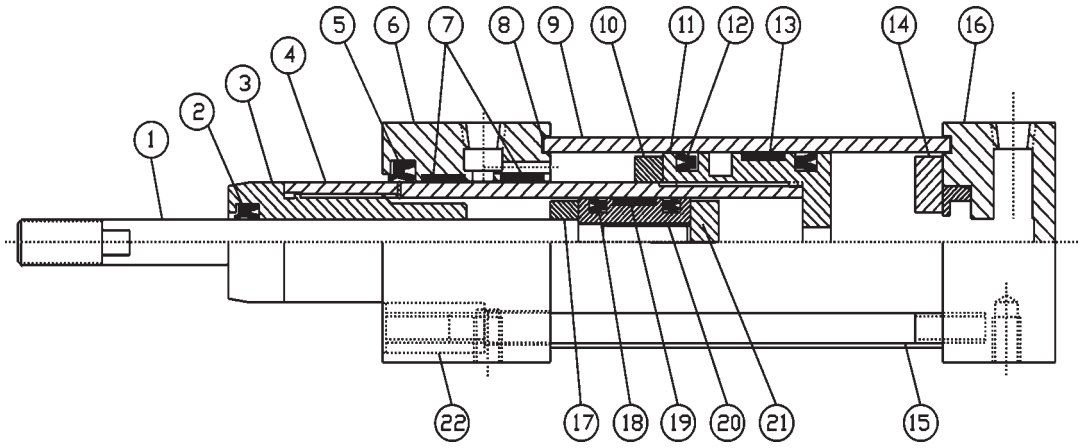
Design Tips:

- ***Cylinders are designed to support the unit's weight only, and not intended for side-load applications. All loads should be guided and supported.***
- ***For proper speed control, use "meter-in" type flow control devices.***
- ***In high cycle speed applications, external shock absorbers should be used at end of strokes.***

OPERATING PRESSURE	125 PSI AIR

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

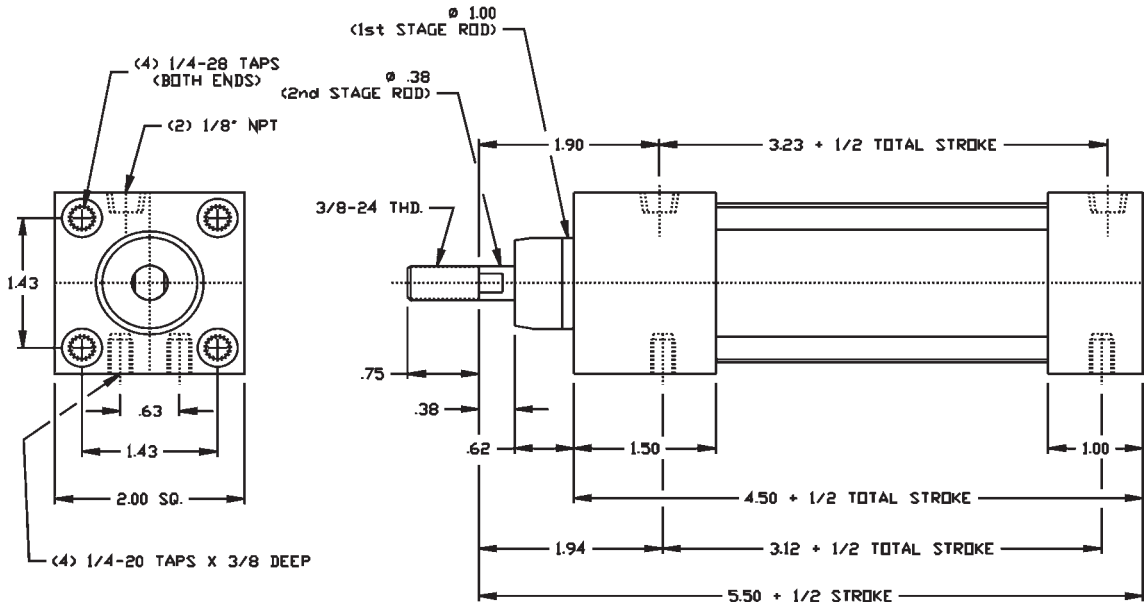
SERIES 'TC' 0.750" BORE: CONSTRUCTION



① *0.375" ROD PISTON*
② *ROD SEAL*
③ *ROD BUSHING*
④ *0.750" I.D. TUBE*
⑤ *ROD SEAL*
⑥ *ALUMINUM HEAD*
⑦ *PTFE WEAR BANDS (2)*
⑧ *1.500" TUBE SEALS (2)*
⑨ *1.500" TUBE*
⑩ *1.500" HEAD BUMPER*
⑪ *1.500" PISTON*
⑫ *1.500" PISTON SEAL (2)*
⑬ *PTFE WEAR BAND*
⑭ *1.500" CAP BUMPER*
⑮ *TIE ROD (4)*
⑯ *ALUMINUM CAP*
⑰ *0.750" HEAD BUMPER*
⑱ *0.750" PISTON SEAL (2)*
⑲ *PTFE WEAR BAND*
⑳ *0.750" PISTON*
㉑ *0.750" CAP BUMPER*
㉒ *SLEEVE NUT (4)*

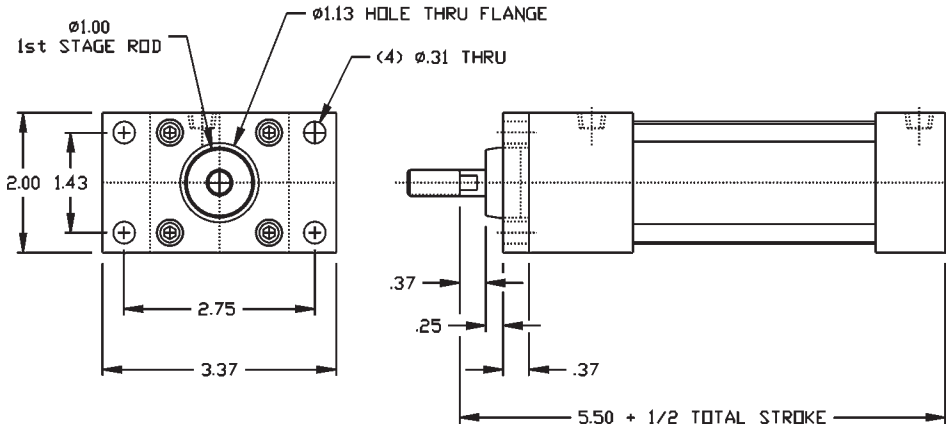
CYLINDER FORCE COMPARISON CHART (at 100 PSI)			
TYPE	**STROKE**	**1ST STAGE**	**2ND STAGE**
2-Stage Telescoping	Push	176 lbs	44 lbs
	Pull	98 lbs	33 lbs
Standard 0.75" Bore	Push	44 lbs	N/A
	Pull	33 lbs	N/A

MS4 MOUNT

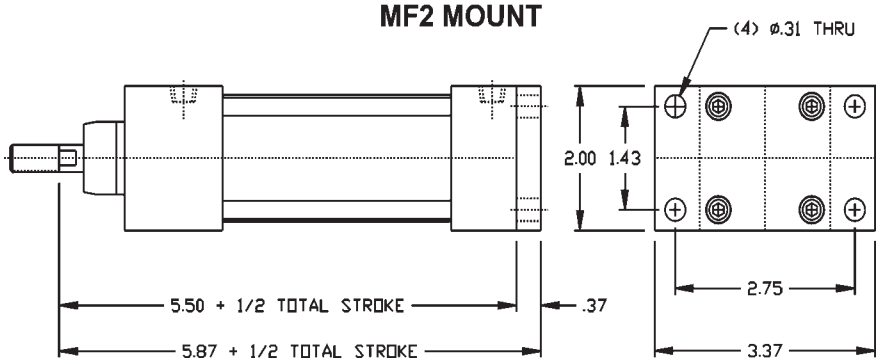


SERIES 'TC' DIMENSIONS: BASE MOUNTS (STROKES 0" to 36")

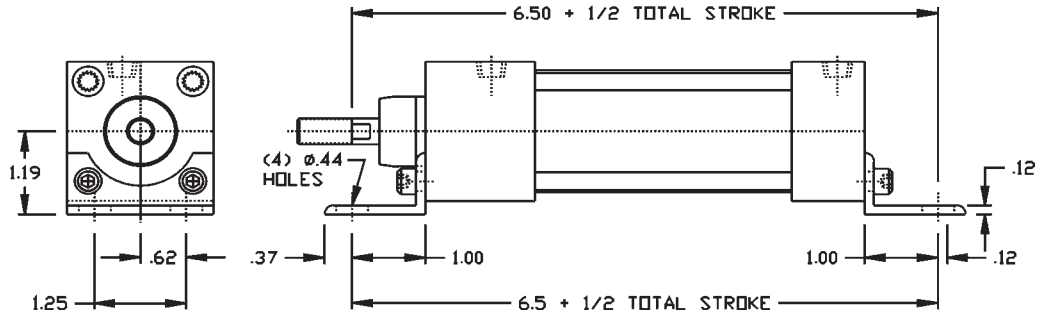
MF1 MOUNT



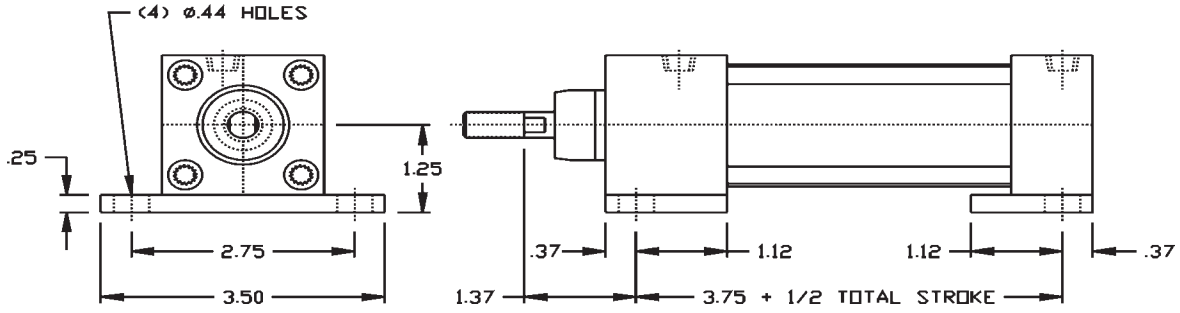
MF2 MOUNT



MS1 MOUNT

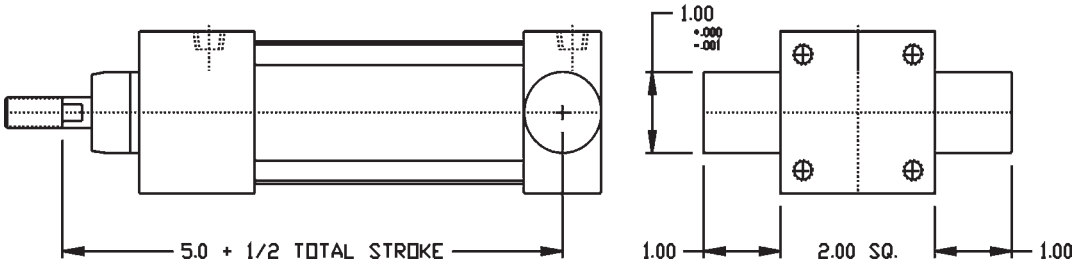


BASEBAR MOUNT

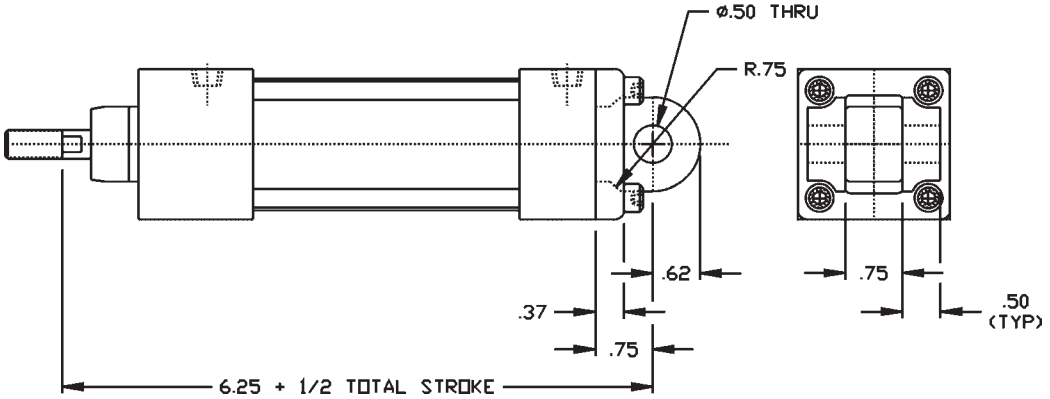


SERIES 'TC' DIMENSIONS: PIVOT MOUNTS (STROKES 0" to 24")

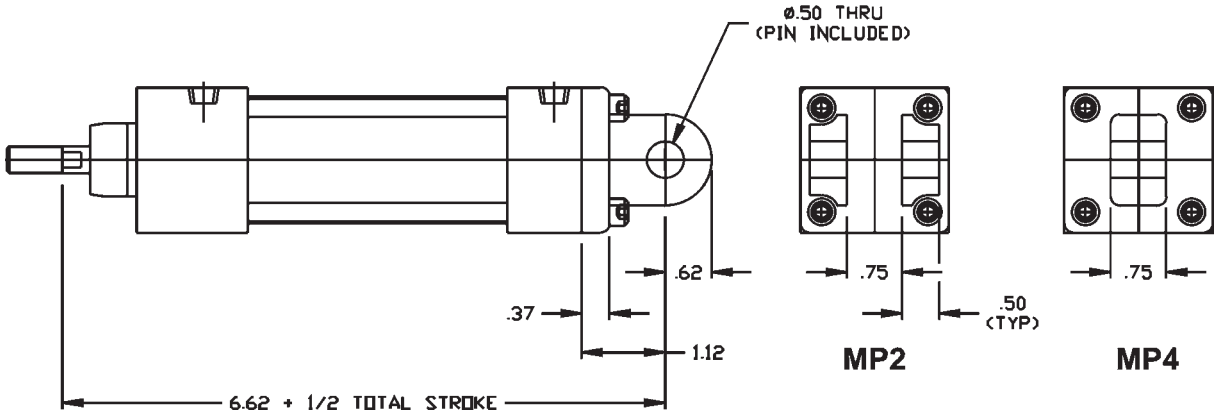
MT2 MOUNT



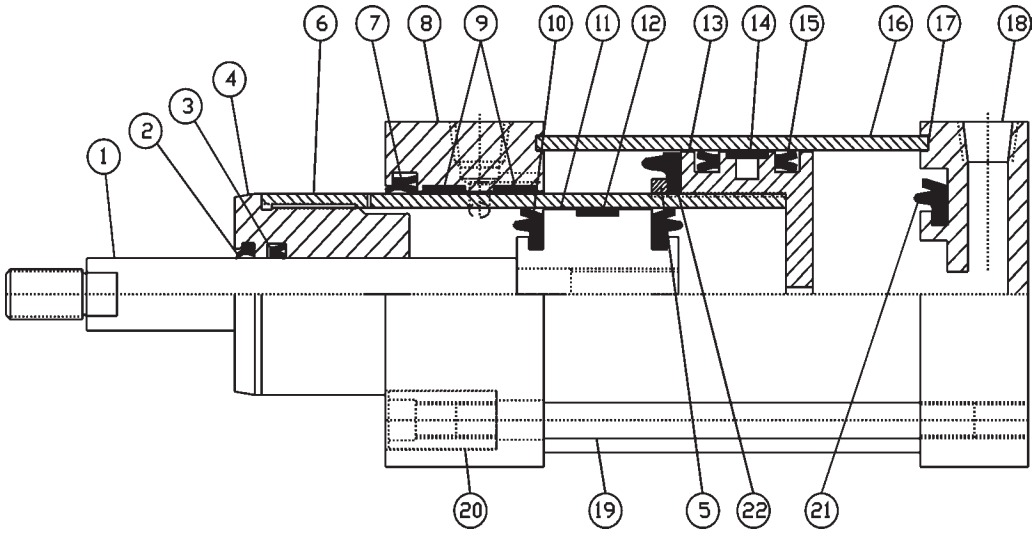
MP1 MOUNT



MP2 & MP4 (CAST BOLT ON) MOUNT



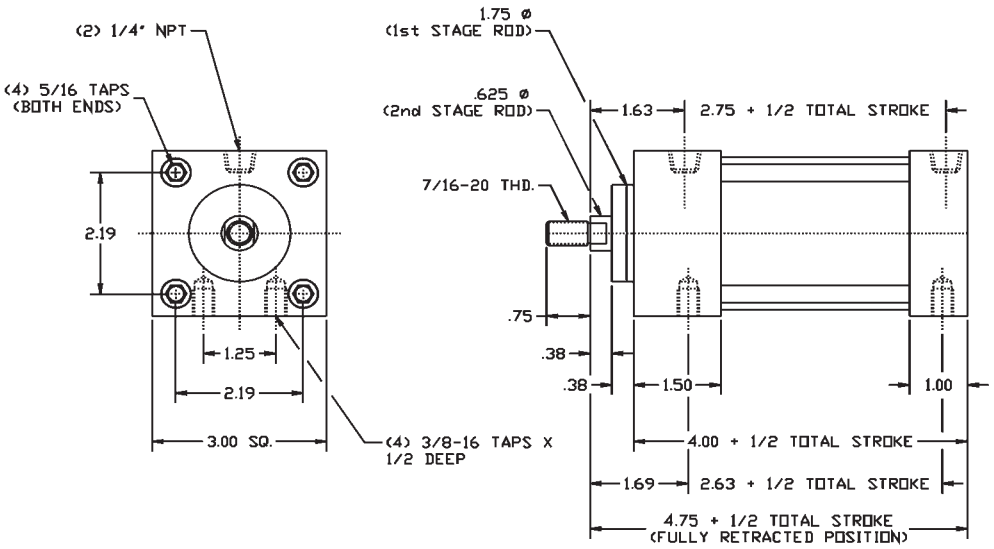
SERIES 'TC' 1.500" BORE: CONSTRUCTION



① *0.625" PISTON ROD*
② *ROD WIPER*
③ *ROD SEAL*
④ *ROD BUSHING*
⑤ *BUMPER RETAINER*
⑥ *1.750" O.D. TUBE*
⑦ *ROD WIPER/SEAL*
⑧ *ALUMINUM HEAD*
⑨ *PTFE WEAR BAND (2)*
⑩ *1.500" BUMPER PISTON SEALS (2)*
⑪ *1.500" O.D. PISTON*
⑫ *PTFE WEAR BAND*
⑬ *2.500" O.D. PISTON*
⑭ *PTFE WEAR BAND*
⑮ *2.500" PISTON SEAL (2)*
⑯ *2.500" TUBE*
⑰ *TUBE SEALS (2)*
⑱ *ALUMINUM CAP*
⑲ *TIE RODS (4)*
⑳ *SLEEVE NUT (4)*
㉑ *2.500" CAP BUMPER*
㉒ *2.500" HEAD BUMPER*

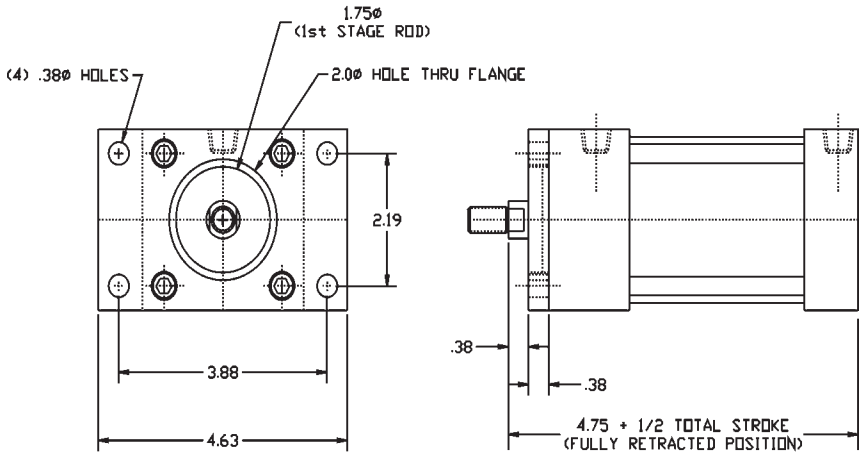
CYLINDER FORCE COMPARISON CHART (at 100 PSI)			
Type	**Stroke**	**1st Stage**	**2nd Stage**
2-Stage Telescoping	Push	490 lbs	176 lbs
	Pull	250 lbs	146 lbs
Standard 1.50" Bore	Push	176 lbs	N/A
	Pull	146 lbs	N/A

MS4 MOUNT

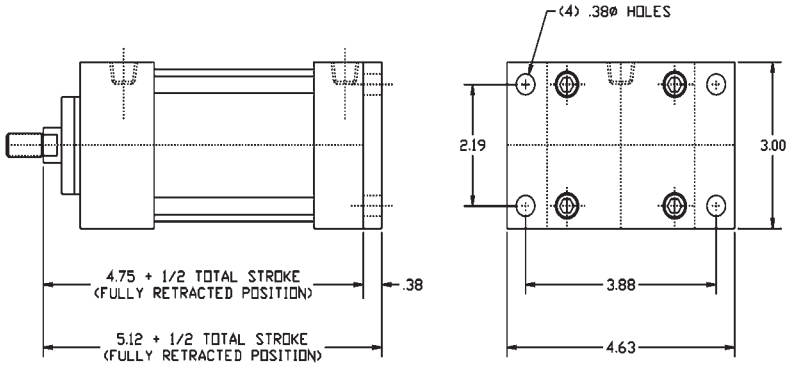


SERIES 'TC' DIMENSIONS: BASE MOUNTS (STROKES 0" to 36")

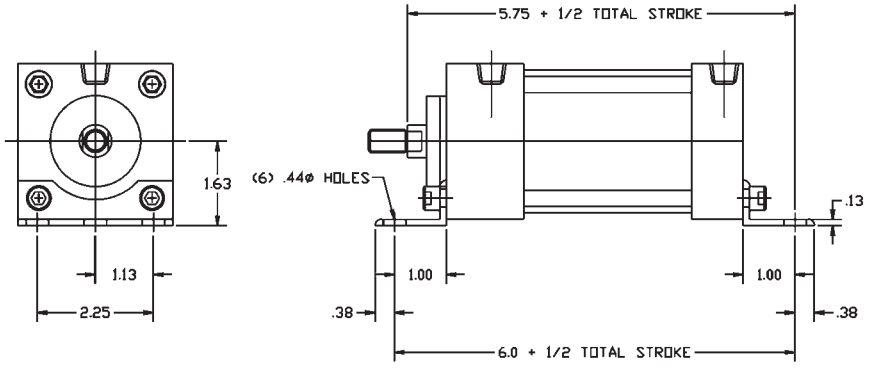
MF1 MOUNT



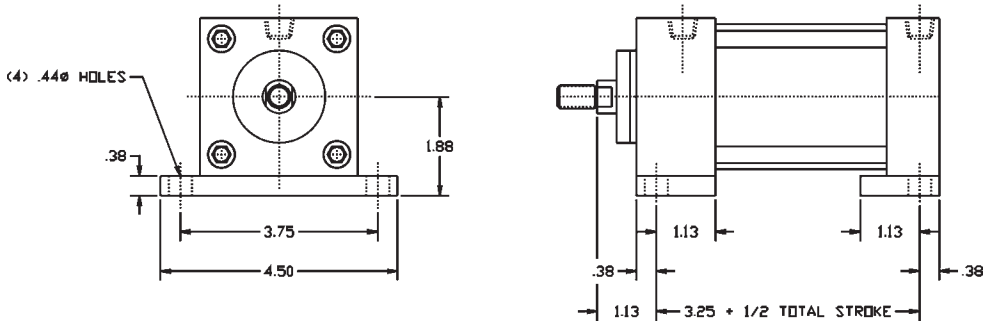
MF2 MOUNT



MS1 MOUNT

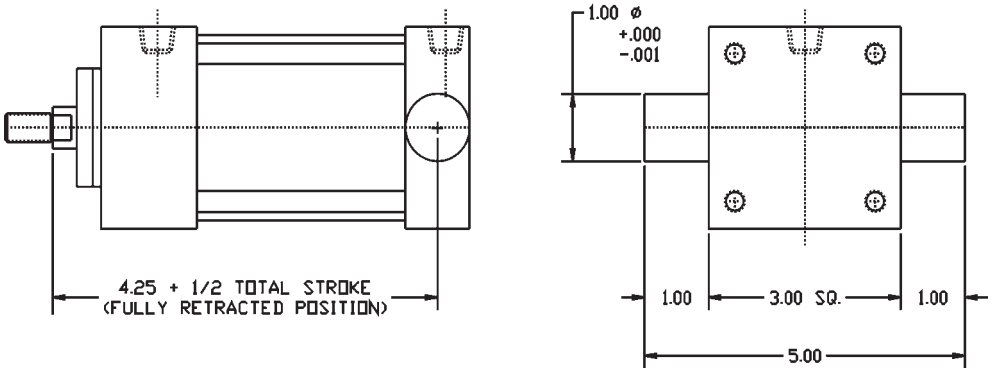


BASEBAR MOUNT

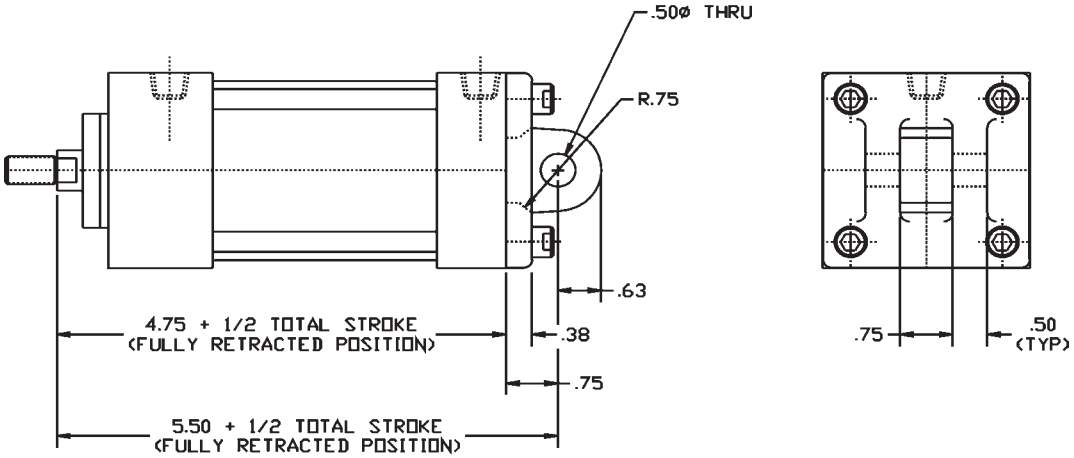


SERIES 'TC' DIMENSIONS: PIVOT MOUNTS (STROKES 0" to 36")

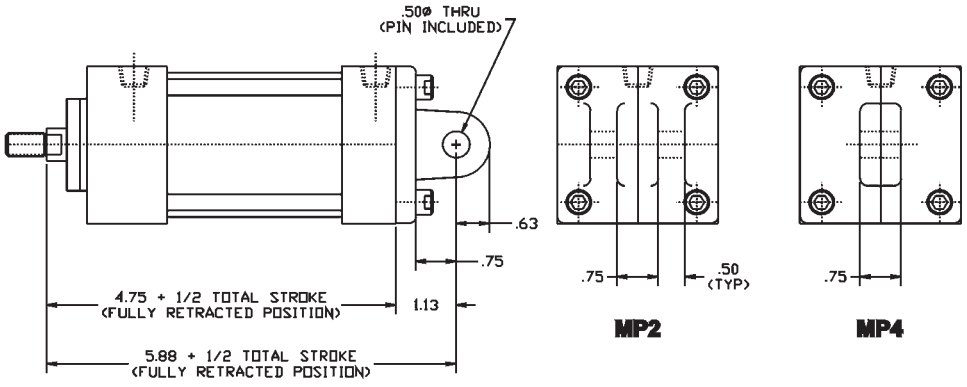
MT2 MOUNT



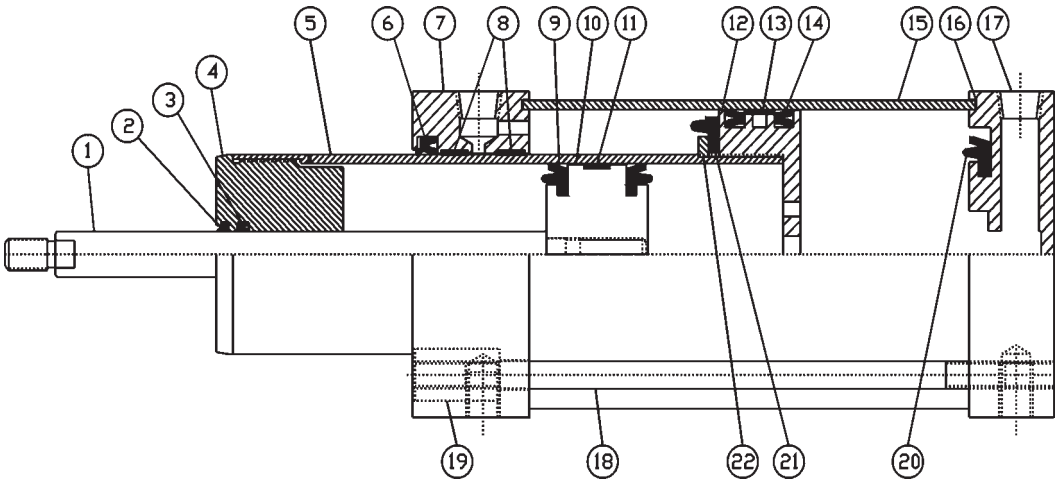
MP1 (CAST BOLT ON) MOUNT



MP2 & MP4 (CAST BOLT ON) MOUNT



SERIES 'TC' 2.500" BORE: CONSTRUCTION



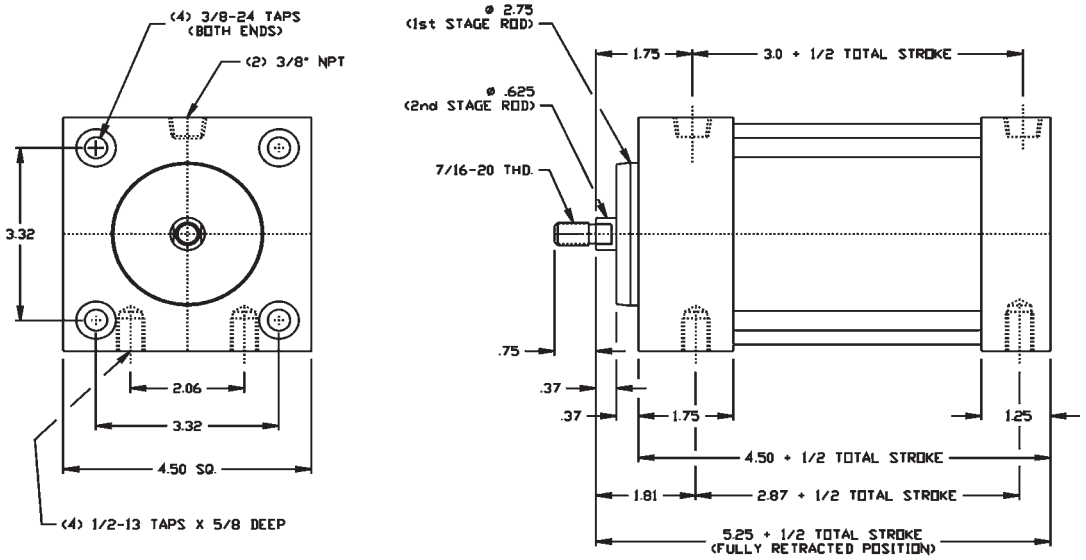
① *0.625" PISTON ROD*
② *ROD WIPER*
③ *ROD SEAL*
④ *ROD BUSHING*
⑤ *2.500" O.D. TUBE*
⑥ *ROD WIPER/SEAL*
⑦ *ALUMINUM HEAD*
⑧ *PTFE WEAR BAND (2)*
⑨ *2.500" BUMPER PISTON SEALS (2)*
⑩ *2.500" PISTON*
⑪ *PTFE WEAR BAND*
⑫ *4.00" PISTON*
⑬ *PTFE WEAR BAND*
⑭ *4.00" PISTON SEAL (2)*
⑮ *4.00" O.D. TUBE*
⑯ *4.00" TUBE SEALS (2)*
⑰ *ALUMINUM CAP*
⑱ *TIE RODS (4)*
⑲ *SLEEVE NUT (4)*
⑳ *BUMPER PISTON SEAL*
㉑ *BUMPER PISTON SEAL*
㉒ *BUMPER RETAINER*

CYLINDER FORCE COMPARISON CHART (at 100 PSI)			
Type	**Stroke**	**1st Stage**	**2nd Stage**
2-Stage Telescoping	Push	1256 lbs	490 lbs
	Pull (0.625" rod)	662 lbs	460 lbs
	Pull (1.000" rod)	662 lbs	412 lbs
Standard 2.50" Bore	Push	490 lbs	N/A
	Pull	460 lbs	N/A

Other Models in Development

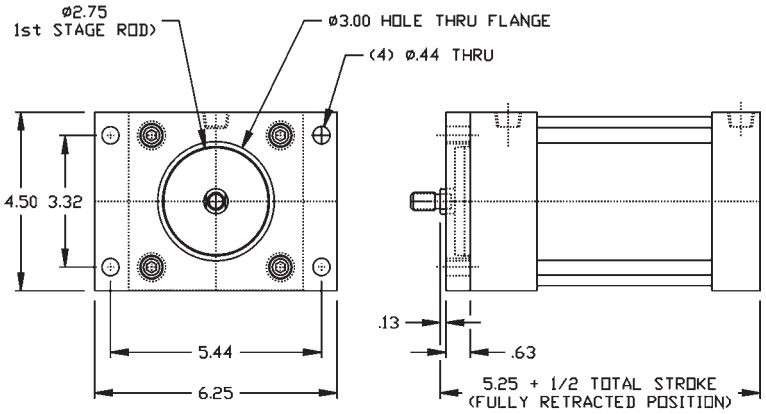
Stainless Steel for Food Applications
(Note: Rod Orifices are replaced with NPT Port for "sealed" System - Contact TRD with your application).

MS4 MOUNT

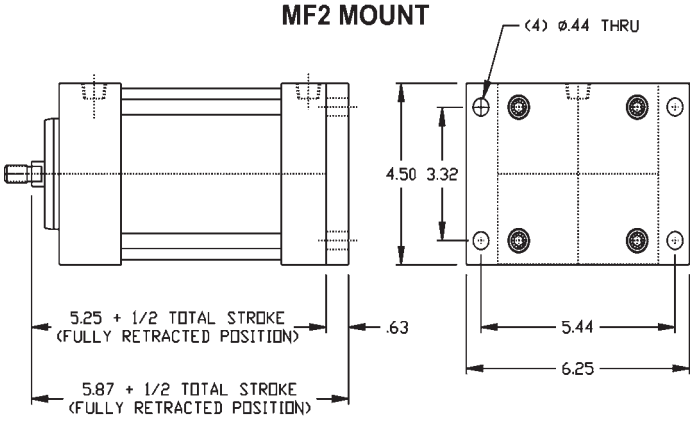


SERIES 'TC' DIMENSIONS: BASE MOUNTS (STROKES 0" to 36")

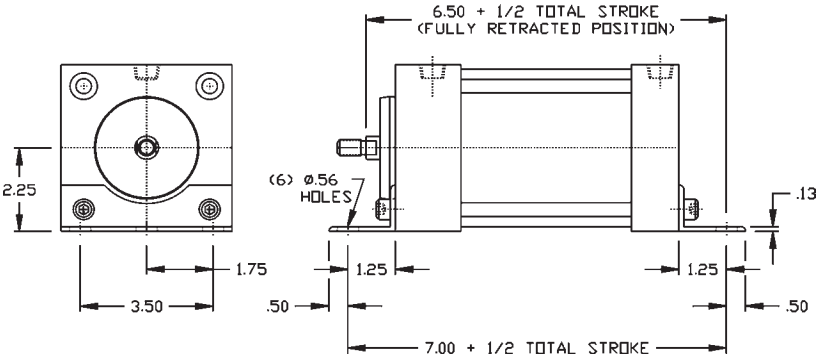
MF1 MOUNT



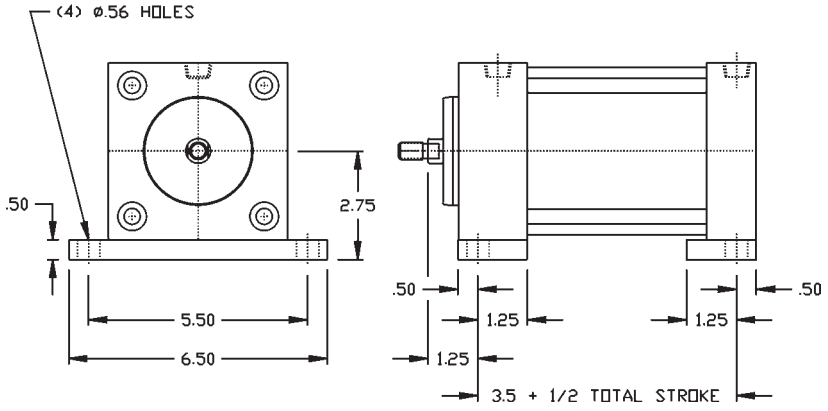
MF2 MOUNT



MS1 MOUNT

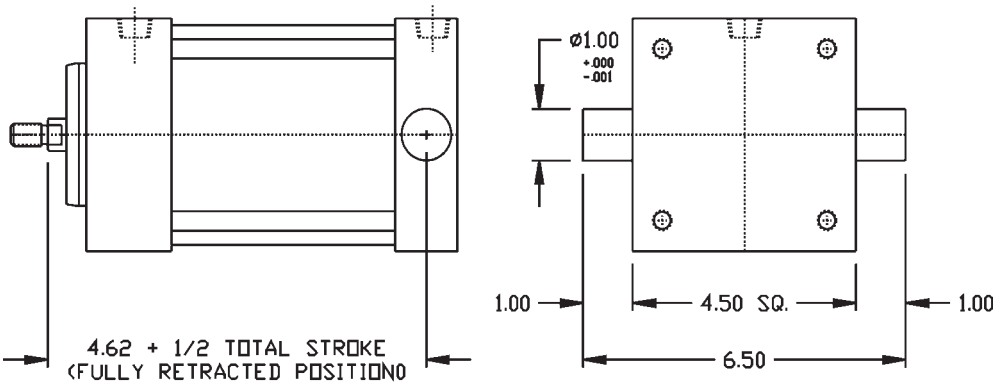


BASEBAR MOUNT

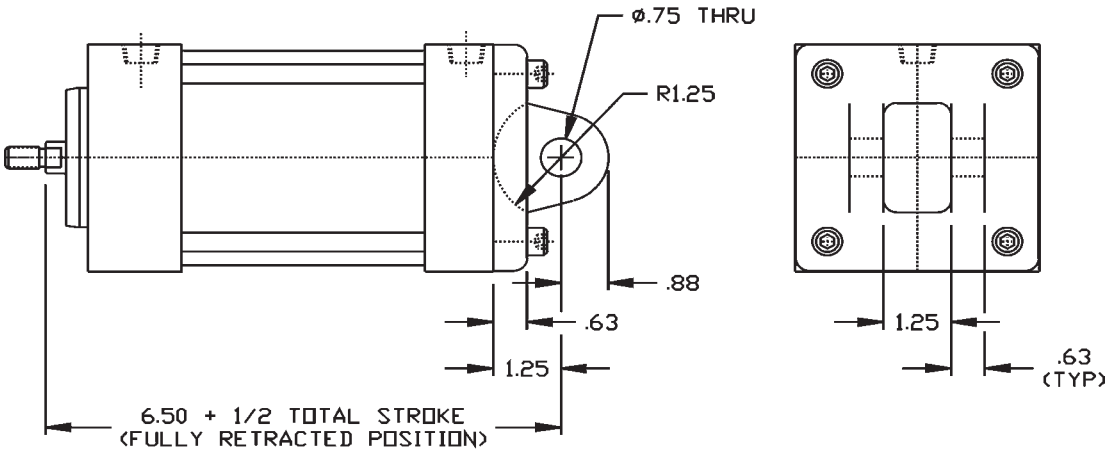


SERIES 'TC' DIMENSIONS: PIVOT MOUNTS (STROKES 0" to 36")

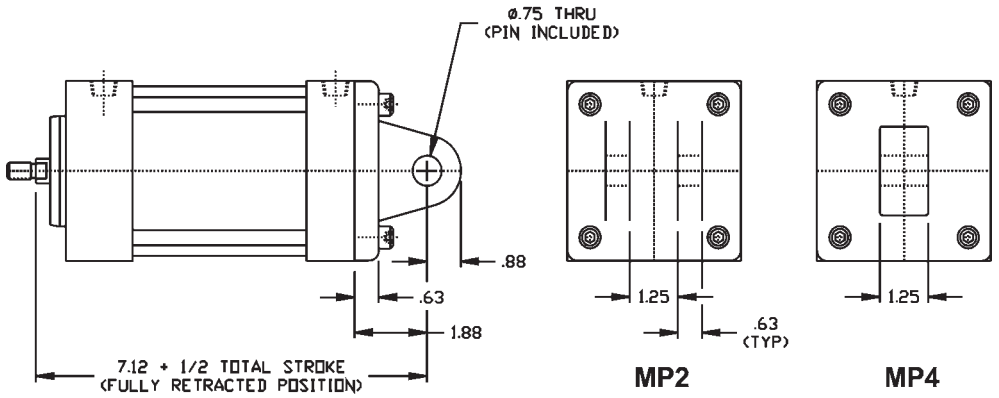
MT2 MOUNT



MP1 MOUNT



MP2 & MP4 (CAST BOLT ON) MOUNT



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

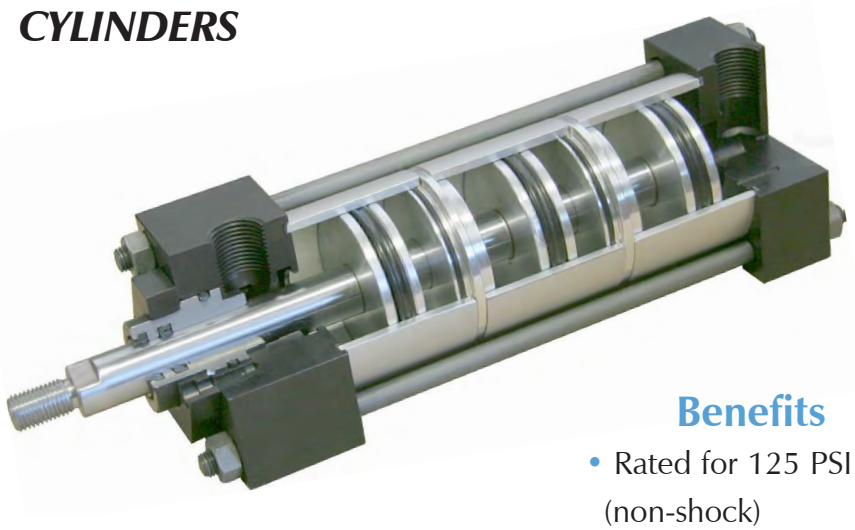
Single Rod End Page 118

Force Chart Page 127

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

SERIES 'MS': MULTI-STAGE

FORCE MULTIPLYING CYLINDERS



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

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

Benefits

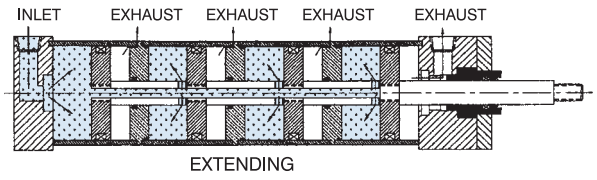
- Rated for 125 PSI Air, or Hydraulic (non-shock)
- Eliminates the need for high pressure systems
- Bore size vs. output force saves space
- Optional Double Rod End Models available
- Optional force multiplying in both extend and retract strokes available
- Heavy Duty construction
- 2 Stage, 3 Stage,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

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

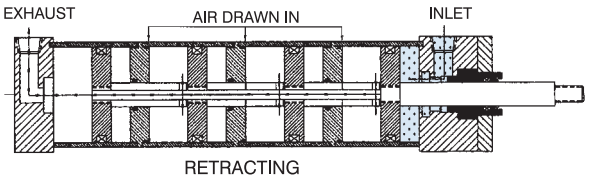
How They Work

Model MSE **4 Stage Shown**

Extension-air supplied to multiple pistons

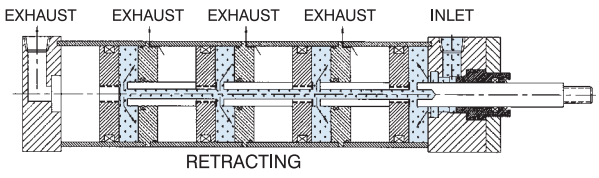


Retraction-air supplied to one piston

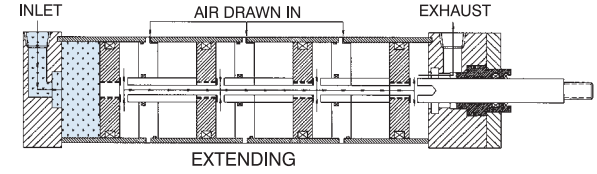


Model MSR **4 Stage Shown**

Retraction-air supplied to multiple pistons



Extension-air supplied to one piston

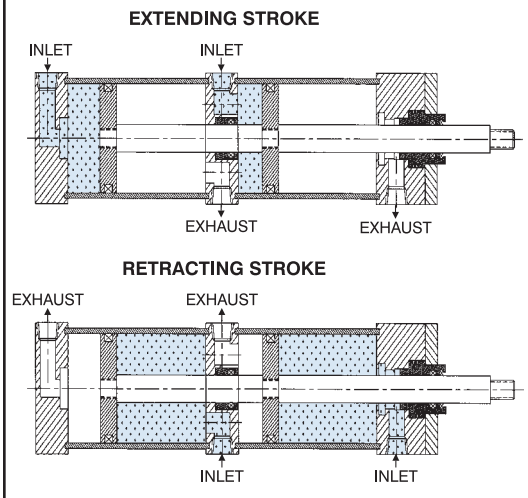


Force multiplying in both Extend and Retract strokes

(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



Model MSE–MSR
2 Stage Shown

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" - 8.00"*
- *Extend 2, 3, 4 or 5 Stages through 5.00" Bores*
- *Extend or Retract 2, 3 or 4 Stages through 8.00" Bores*
- *Exposed Tie Rod and Nut Construction (similar to 'TA')*
- *'FM' Flush Mount construction available as an option*

MSE - MF1 - ___ - 2 x 3 x 4S - MPR

BASIC MODEL	
MSE	MULTI-STAGE EXTEND
MSR	MULTI-STAGE RETRACT
MSE-MSR	MULTI-STAGE EXTEND AND RETRACT

NFPA MOUNTS	
MXO	MX1
MX2	MX3
MF1	MF2
ME3	ME4
MP1	MP2
MS2	MS4

MODEL VARIATIONS	
LEAVE BLANK IF NONE	
D	DOUBLE ROD END

BORE	
1.50	2.00
2.50	3.25
4.00	5.00
6.00	8.00

STROKE
1" to 12" CONSULT FACTORY FOR OTHER STROKES

STAGES	
2S	TWO
3S	THREE
4S	FOUR
5S	FIVE*

*1.50" - 5.00" BORES, MSE ONLY

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 176 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	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)
X	MPR	MAGNETIC PISTON FOR REED OR SOLID STATE SWITCHES - TRD MODELS: R10, R10P, RAC, RHT & MSS *(Refer to pages 223-230 for selection)*
	MS	METALLIC ROD SCRAPER (BRASS CONSTRUCTION)
X	NR	**NON-ROTATING** *(Refer to page 180 for specifications)*
	OP	OPTIONAL PORT LOCATION (Example: Ports @ 3 & 7)
	OS	OVERSIZE ROD DIAMETER (SPECIFY SIZE, Example: OS = 1.375")
	SAE	SAE PORTS (SPECIFY SIZE, Example: SAE #10)
	SSA	STAINLESS STEEL PISTON ROD, TIE RODS & NUTS, AND FASTENERS
	SSF	STAINLESS STEEL FASTENERS
	SSN	STAINLESS STEEL TIE ROD NUTS
	SSR	STAINLESS STEEL PISTON ROD
	SST	STAINLESS STEEL TIE RODS
X	ST	**STOP TUBE** - SPECIFY STOP TUBE LENGTH (in inches) SPECIFY STROKE AS ES (effective stroke) (Example: MSE-MS4 2 X 12ES - 2S - ST=3)
	TMS	STEEL CYLINDER TUBE, BLACK EPOXY PAINT FINISH*
	TH	**400 PSI HYDRAULIC NON-SHOCK** *(Refer to page 183 for specifications)*
	VS	FLUOROCARBON SEALS
	XX	SPECIAL VARIATION (SPECIFY)

*STEEL TUBES do not work with MPR pistons. Refer to page 231-234 for Balluff end of stroke sensors.

ORDERING EXAMPLES:

EXAMPLE 1: MF1 3.25" Bore, 2.00" 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, 6.00" Bore, 3.00" Stroke, Force Multiplied in RETRACT with Magnetic Piston for REED Switches is:
MSR MS4D 6 x 3 x 2S - MPR
(Note: MPR Option adds 0.750" to Cylinder Length)

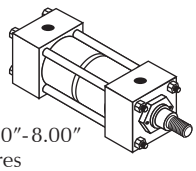
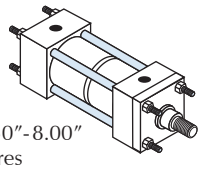
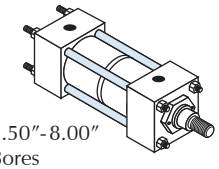
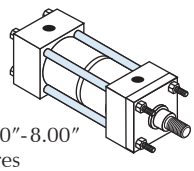
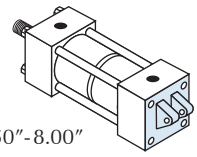
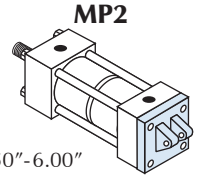
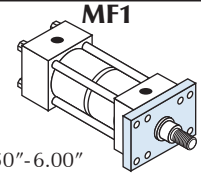
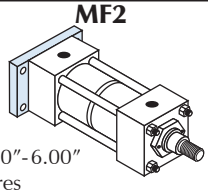
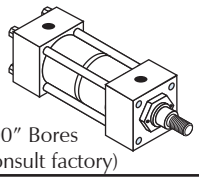
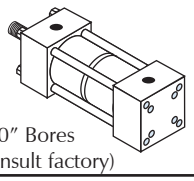
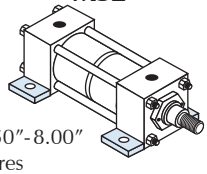
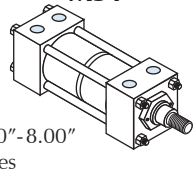
OPTION LENGTH ADDER
(ADD TO CATALOG BASIC OVERALL LENGTH DIMENSIONS)

BORE	OPTION B	BC	BH	MPR or MPH	NR	ST* (STOP TUBE) Example: ST=2
1.50	0.500	0.250	0.250	0.625	0.625	2
2.00	0.500	0.250	0.250	0.625	0.625	2
2.50	0.500	0.250	0.250	0.750	0.750	2
3.25	0.500	0.250	0.250	0.625	0.625	2
4.00	0.500	0.250	0.250	0.625	0.625	2
5.00	0.500	0.250	0.250	0.875	0.875	2
6.00	0.500	0.250	0.250	0.750	0.750	2
8.00	0.500	0.250	0.250	0.875	0.875	2

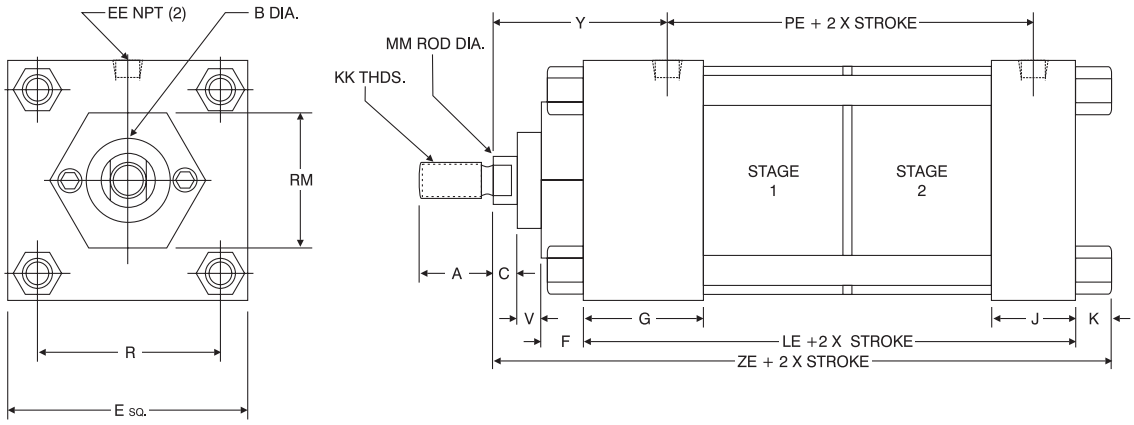
*Note: The desired stop tube length adds directly to the overall cylinder length. Specify stop tube location.

Example: Stop tube on rear stage only.

SERIES 'MS' CYLINDERS: NFPA MOUNTS

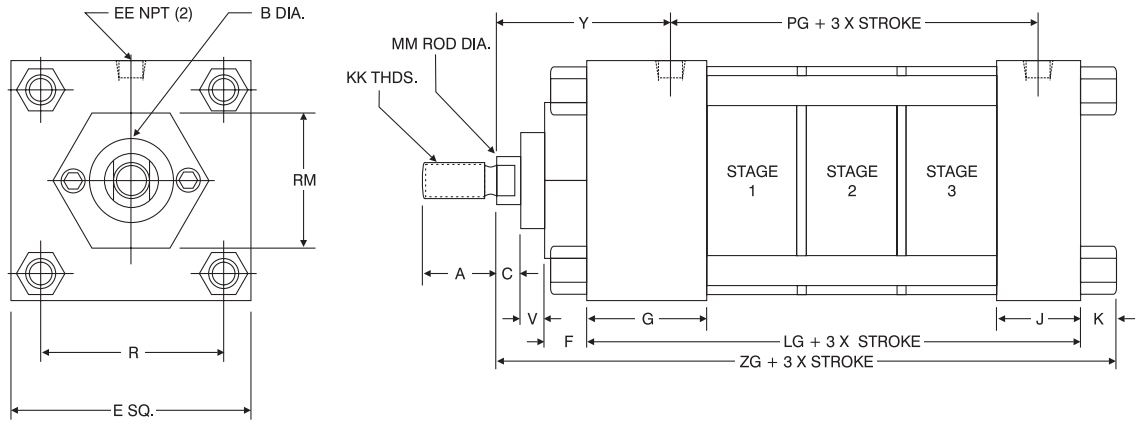
MXO  1.50"-8.00" Bores	**MX1**  1.50"-8.00" Bores	**MX2**  1.50"-8.00" Bores	**MX3**  1.50"-8.00" Bores
MP1  1.50"-8.00" Bores	**MP2**  1.50"-6.00" Bores	**MF1**  1.50"-6.00" Bores	**MF2**  1.50"-6.00" Bores
ME3  8.00" Bores (Consult factory)	**ME4**  8.00" Bores (Consult factory)	**MS2**  1.50"-8.00" Bores	**MS4**  1.50"-8.00" Bores

SERIES 'MS' DIMENSIONS: 2 STAGE EXTEND OR RETRACT
STANDARD ROD DIAMETER BASIC DIMENSIONS 'MXO' (NO MOUNT)



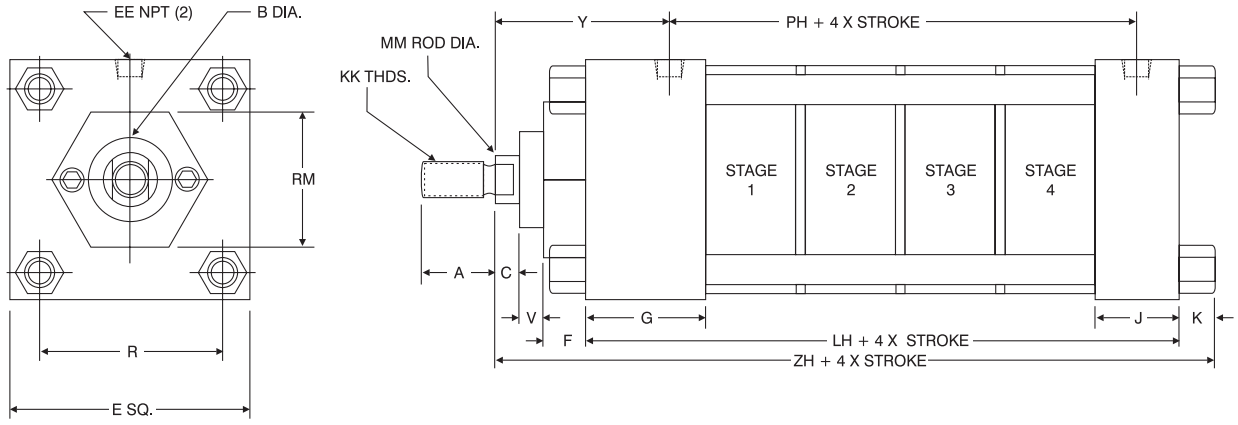
BORE	A	B	C	E	EE	F	G	J	K	KK	LE	MM	PE	R	RM	V	Y	ZE
1.50	0.750	1.125	0.375	2.000	0.375	0.375	1.500	1.000	0.250	7/16-20	4.000	0.625	2.750	1.438	2.00 SQ.	0.250	1.875	5.250
2.00	0.750	1.125	0.375	2.500	0.375	0.375	1.500	1.000	0.313	7/16-20	4.000	0.625	2.750	1.844	1.75 HEX	0.250	1.875	5.313
2.50	0.750	1.125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

3 STAGE EXTEND OR RETRACT
STANDARD ROD DIAMETER BASIC DIMENSIONS 'MXO' (NO MOUNT)



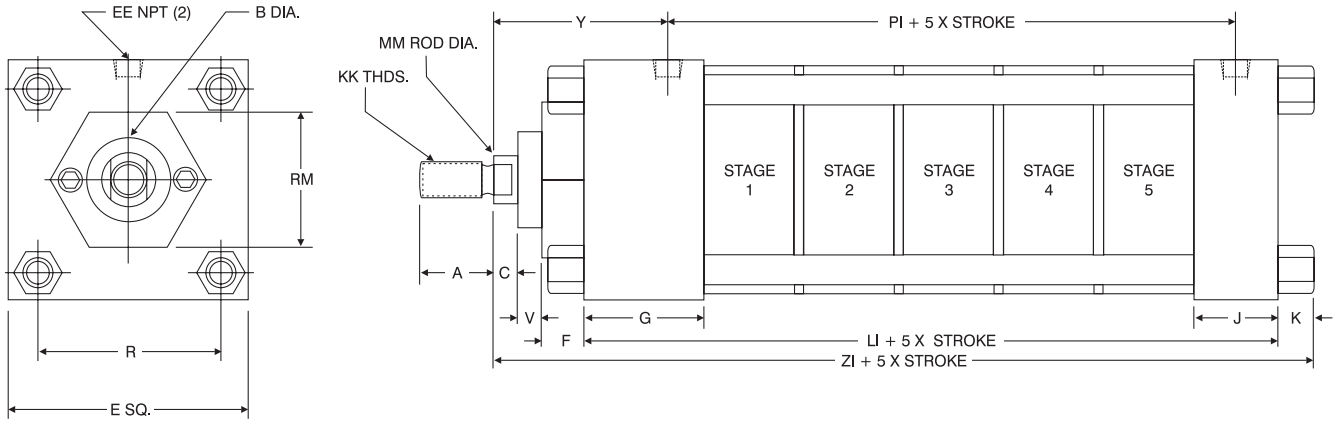
BORE	A	B	C	E	EE	F	G	J	K	KK	LG	MM	PG	R	RM	V	Y	ZG
1.50	0.750	1.125	0.375	2.000	0.375	0.375	1.500	1.000	0.250	7/16-20	5.000	0.625	3.750	1.438	2.00 SQ.	0.250	1.875	6.250
2.00	0.750	1.125	0.375	2.500	0.375	0.375	1.500	1.000	0.313	7/16-20	5.000	0.625	3.750	1.844	1.75 HEX	0.250	1.875	6.313
2.50	0.750	1.125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

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



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

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



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

SERIES 'MS' DIMENSIONS: MULTI-STAGE

EASY FLIP OUT PAGE FOR REFERENCE

About Rod End Styles

Style 1 Male Rod End is STANDARD

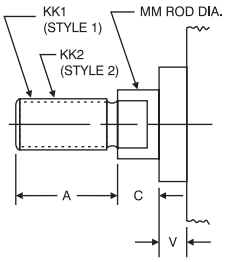
Other NFPA Styles can be specified (see chart).

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

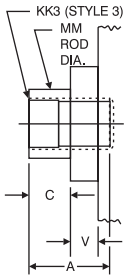
NEED SOMETHING NOT LISTED?
Just send us a sketch.
In most cases, quotes are turned around in one day!

PISTON ROD END STYLES

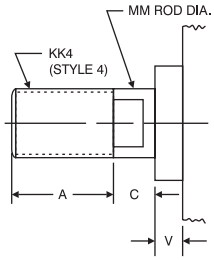
STYLE 1 & 2
KK1 & KK2



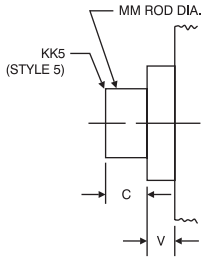
STYLE 3
KK3



STYLE 4
KK4



STYLE 5
KK5



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

EASY FLIP OUT PAGE FOR REFERENCE

SERIES 'MS' DIMENSIONS: MULTI-STAGE

About Rod End Styles

Style 1 Male Rod End is STANDARD

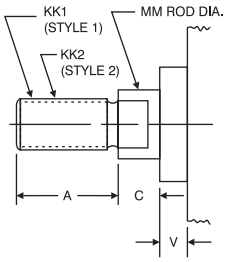
Other NFPA Styles can be specified (see chart).

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).

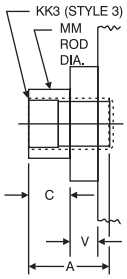
NEED SOMETHING NOT LISTED?
Just send us a sketch.
In most cases, quotes are turned around in one day!

PISTON ROD END STYLES

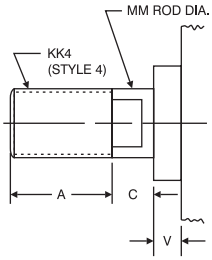
STYLE 1 & 2
KK1 & KK2



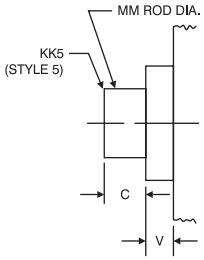
STYLE 3
KK3



STYLE 4
KK4



STYLE 5
KK5

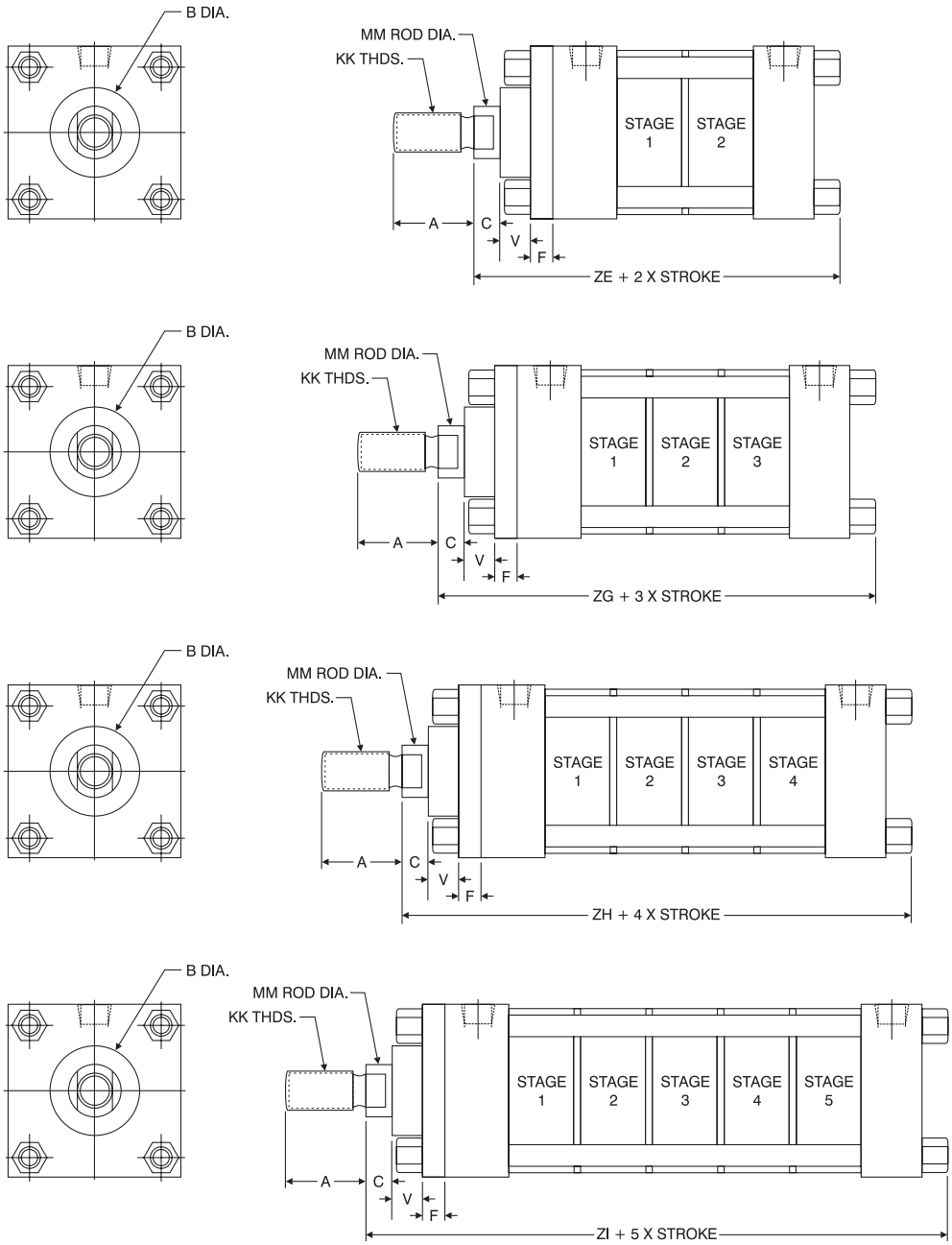


BORE	MM ROD DIAMETER	STANDARD		OPTIONAL							C	V
		Style 1 - Male		Style 2 - Male		Style 3 - Female		Style 4 - Male		Style 5 - Blank		
		KK1	A	KK2	A	KK3	A	KK4	A	KK5		
1.50, 2.00, 2.50	0.625 Standard	7/16 -20	0.750	1/2 -20	0.750	7/16 -20	0.750	5/8 -18	0.750	No Threads	0.375	0.250
	1.000 Oversize	3/4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

'MS' SERIES BASE DIMENSIONS FLIP-OUT (PAGE 122)

SERIES 'MS' CYLINDERS: EXTEND OR RETRACT

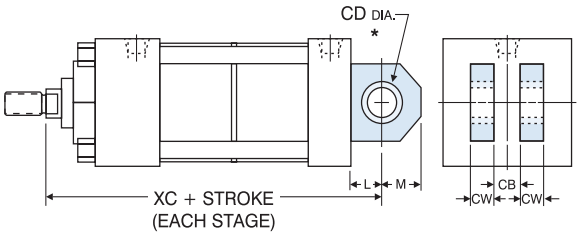
Oversize Rod Diameter Basic Dimension 'MXO' (NO MOUNT)



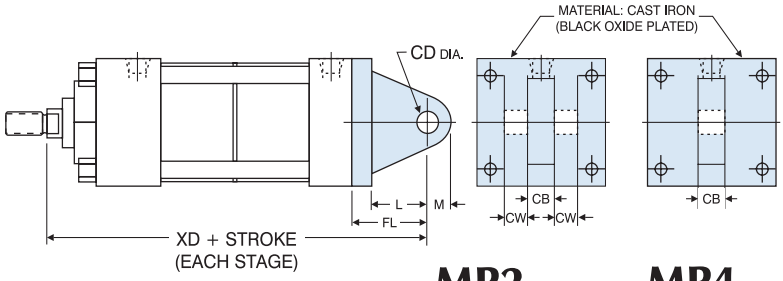
MULTI-STAGE OVERSIZE ROD DIAMETER								ADD STROKE PER STAGE			
BORE	A	B	C	F	V	KK	MM	ZE	ZG	ZH	ZI
1.50	1.125	1.500	0.500	0.375	0.500	3/4 -16	1.000	5.625	6.625	7.625	8.625
2.00	1.125	1.500	0.500	0.375	0.500	3/4 -16	1.000	5.688	6.688	7.688	8.688
2.50	1.125	1.500	0.500	0.375	0.500	3/4 -16	1.000	5.688	6.688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

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

'MS' SERIES CYLINDERS: *PIVOT MOUNTS*



MP1



MP2 **MP4**

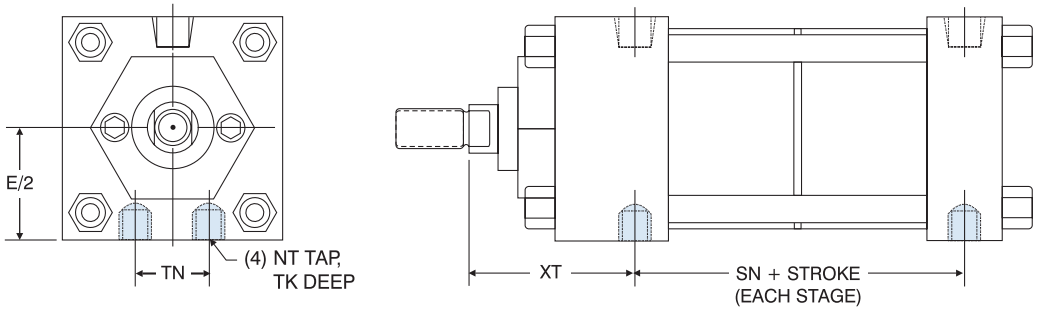
1.50" - 4.00" BORE

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

For dimensions not shown, see pages 120 & 121.
* Pin included, two (2) pressed in bearings.

Note: Extruded MP1 mounts are standard (1.50"-8.00" bores).
Cast Iron removable mounts are optional, and must be requested when ordering (1.50"-6.00" bores).

SERIES 'MS' DIMENSIONS: BASE MOUNTS



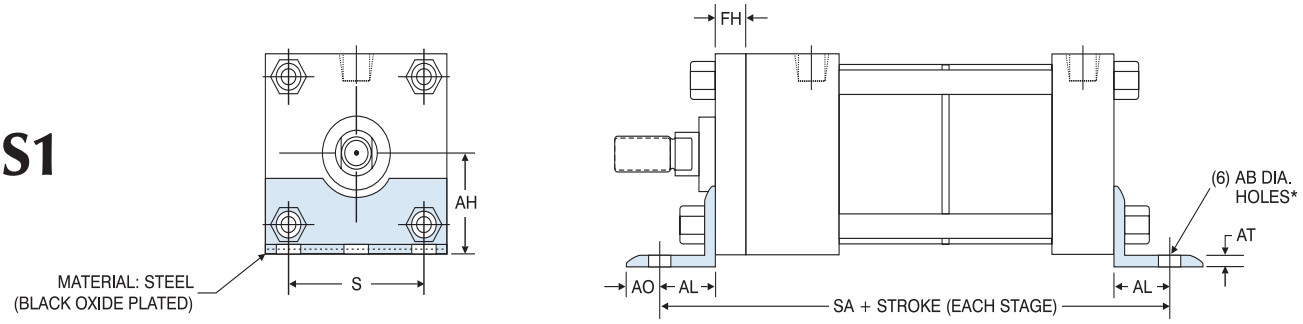
MS4

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

For dimensions not shown, see pages 120 & 121.

SERIES 'MS' DIMENSIONS: BASE MOUNTS

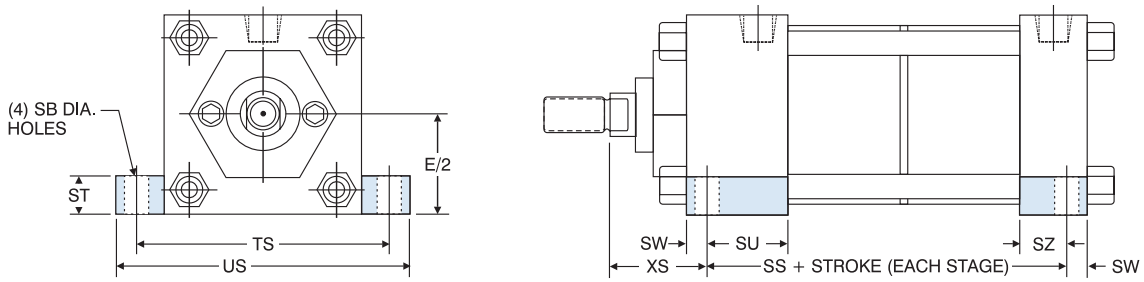
MS1



MULTI-STAGE 'MS1' ANGLE MOUNT DIMENSIONS												
BORE	ROD DIAMETER	AB	AH	AL	AO	AT	FH	S	**SA + STROKE PER STAGE 2-STAGE	3-STAGE	4-STAGE	5-STAGE
1.50	0.625 Standard 1.000 Oversize	0.438	1.188	1.000	0.375	0.188	0.375	1.250	6.375	7.375	8.375	9.375
2.00	0.625 Standard 1.000 Oversize	0.438	1.438	1.000	0.375	0.188	0.375	1.750	6.375	7.375	8.375	9.375
2.50	0.625 Standard 1.000 Oversize	0.438	1.625	1.000	0.375	0.188	0.375	2.250	6.375	7.375	8.375	9.375
3.25	1.000 Standard 1.375 Oversize	0.563	1.938	1.250	0.500	0.125	0.625	2.750	8.000	9.250	10.500	11.750
4.00	1.000 Standard 1.375 Oversize	0.563	2.250	1.250	0.500	0.125	0.625	3.500	8.000	9.250	10.500	11.750
5.00	1.000 Standard 1.375 Oversize	0.688	2.750	1.375	0.625	0.188	0.625	4.250	8.250	9.500	10.750	12.000
6.00	1.375 Standard 1.750 Oversize	0.813	3.250	1.375	0.625	0.188	0.750	5.250	9.250	10.750	12.250	N/A
8.00	1.375 Standard 1.750 Oversize	0.813	4.250	1.813	0.688	0.250	0.625***	7.125	9.375	10.875	12.375	N/A

*Note: 1.50" bore has four (4) "AB" holes on "S" dimension.
**SA dimensions increase 0.500" and one FH on double rod cylinders.
***3.50" diameter round retainer on 8.00" bore.
For dimensions not shown, see pages 120 & 121.

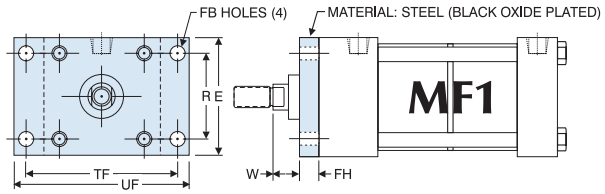
MS2



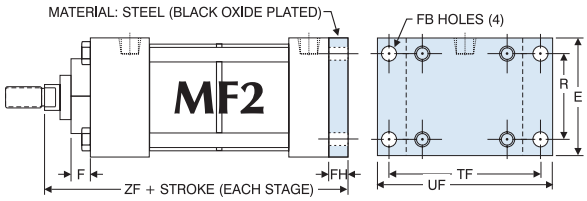
MULTI-STAGE 'MS2' SIDE LUG MOUNT DIMENSIONS														
BORE	ROD DIAMETER	SB	E/2	ST	SU	SW	SZ	TS	US	XS	SS + STROKE PER STAGE 2-STAGE	3-STAGE	4-STAGE	5-STAGE
1.50	0.625 Standard 1.000 Oversize	0.438	1.000	0.500	1.125	0.375	0.625	2.750	3.500	1.375 1.750	3.250	4.250	5.250	6.250
2.00	0.625 Standard 1.000 Oversize	0.438	1.250	0.500	1.125	0.375	0.625	3.250	4.000	1.375 1.750	3.250	4.250	5.250	6.250
2.50	0.625 Standard 1.000 Oversize	0.438	1.500	0.500	1.125	0.375	0.625	3.750	4.500	1.375 1.750	3.250	4.250	5.250	6.250
3.25	1.000 Standard 1.375 Oversize	0.563	1.875	0.750	1.250	0.500	0.750	4.750	5.750	1.875 2.125	3.875	5.125	6.375	7.625
4.00	1.000 Standard 1.375 Oversize	0.563	2.250	0.750	1.250	0.500	0.750	5.500	6.500	1.875 2.125	3.875	5.125	6.375	7.625
5.00	1.000 Standard 1.375 Oversize	0.813	2.750	1.000	1.063	0.688	0.563	6.875	8.250	2.063 2.313	3.500	4.750	6.000	7.250
6.00	1.375 Standard 1.750 Oversize	0.813	3.250	1.000	1.313	0.688	0.813	7.875	9.250	2.313 2.563	4.375	5.875	7.375	N/A
8.00	1.375 Standard 1.750 Oversize	0.813	4.250	1.000	1.313	0.688	0.813	9.875	11.250	2.313 2.563	4.375	5.875	7.375	N/A

*SS dimensions increase 0.500" on double rod cylinders.
For dimensions not shown, see pages 120 & 121.

SERIES 'MS' DIMENSIONS: FLANGE MOUNTS



1.50" - 6.00" BORES

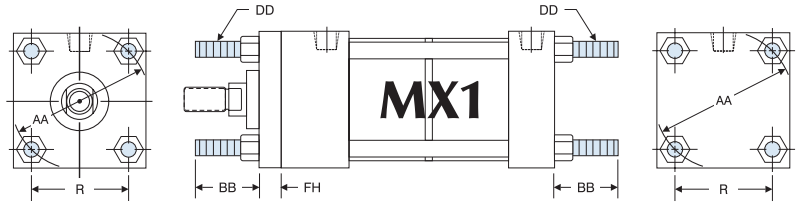


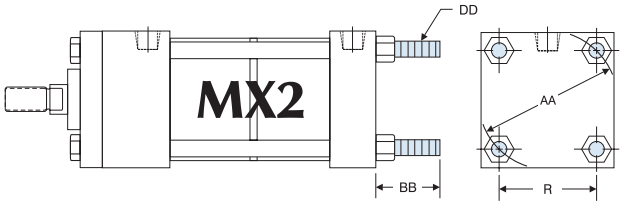
1.50" - 6.00" BORES

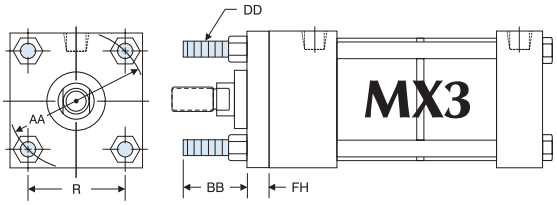
MULTI-STAGE 'MF1' AND 'MF2' FLANGE MOUNT DIMENSIONS													
BORE	ROD DIAMETER	E	F	FB	FH	R	TF	UF	W	ZF-STROKE PER STAGE			
										2-STAGE	3-STAGE	4-STAGE	5-STAGE
1.50	0.625 Standard	2.000	0.375	0.313	0.375	1.438	2.750	3.375	0.625	5.375	6.375	7.375	8.375
	1.000 Oversize								1.000	5.750	6.750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

For dimensions not shown, see pages 120 & 121.

SERIES 'MS' DIMENSIONS: TIE ROD MOUNTS







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

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

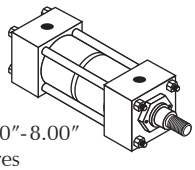
Full square bushing retainer on 1.50" - 6.00" bores.
*Round retainer on 8.00" bore. BB dimension from face of head.
For dimensions not shown, see pages 120 & 121.

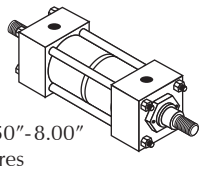
SERIES 'MS' EFFECTIVE PISTON AREA/FORCE CHART*

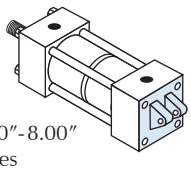
BORE	STAGES	EFF. PISTON AREA (SQ. IN.)				FORCE IN LBS. AT 60 PSI				FORCE IN LBS. AT 100 PSI			
		EXTEND (MSE)		RETRACT (MSR)		EXTEND (MSE)		RETRACT (MSR)		EXTEND (MSE)		RETRACT (MSR)	
		STD. ROD Ø	O' SIZE Ø	STD. ROD Ø	O' SIZE Ø	STD. ROD Ø	O' SIZE Ø	STD. ROD Ø	O' SIZE Ø	STD. ROD Ø	O' SIZE Ø	STD. ROD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

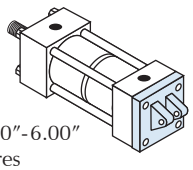
*Theoretical force - actual force will be reduced due to seal friction.

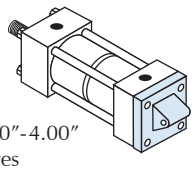
SERIES 'MS' CYLINDERS: NFPA MOUNTS

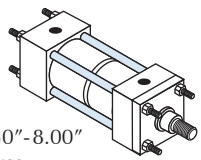
MXO

1.50"-8.00" Bores

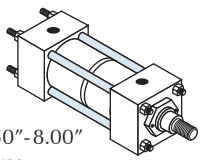
MXOD

1.50"-8.00" Bores

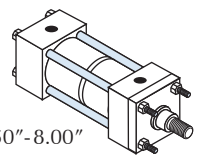
MP1

1.50"-8.00" Bores

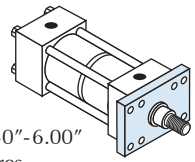
MP2

1.50"-6.00" Bores

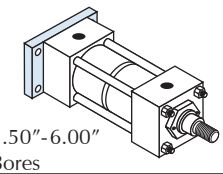
MP4

1.50"-4.00" Bores

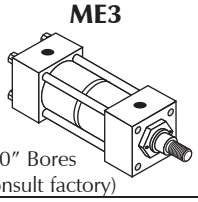
MX1

1.50"-8.00" Bores

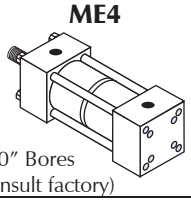
MX2

1.50"-8.00" Bores

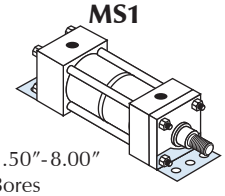
MX3

1.50"-8.00" Bores

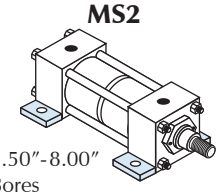
MF1

1.50"-6.00" Bores

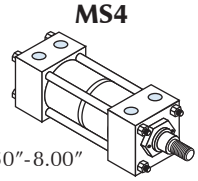
MF2

1.50"-6.00" Bores

ME3

8.00" Bores (Consult factory)

ME4

8.00" Bores (Consult factory)

MS1

1.50"-8.00" Bores

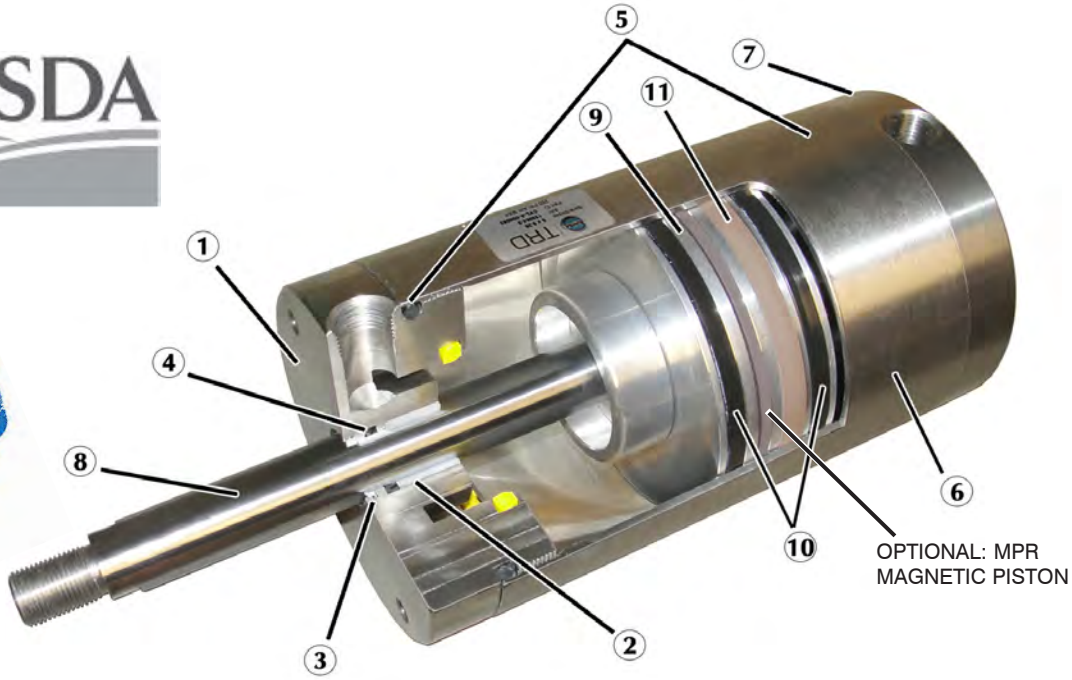
MS2

1.50"-8.00" Bores

MS4

1.50"-8.00" Bores

RS Series Round USDA/FDA
SS Series NFPA Tie Rod
SS-MS Series Multi-Stage
Stainless Steel Cylinders
1.50″ to 8.00″ Bore

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

REPAIRABLE STAINLESS STEEL 'RS': CONSTRUCTION



USDA APPROVAL OPTION U - EQUIPMENT ACCEPTANCE CERTIFICATE

UNITED STATES DEPARTMENT OF AGRICULTURE MARKETING AND REGULATORY PROGRAMS AGRICULTURAL MARKING SERVICE

The issuance of this form is based on U.S. Department of Agriculture, Dairy and Grading Branch, Equipment Design Review Section, evaluation of the equipment listed above for compliance with: 3-A Sanitary Standard

① ***ROD GUIDE/HEAD*** – Corrosion resistant 303 stainless steel is ideal for wash-down applications. Designed to reduce sharp edges and corners to provide a smooth transition to the cylinder body eliminating catch points for contamination and to allow ease in cleaning. Optional Tapped holes are provided to allow easy mounting of USDA approved secondary wiper retainer or foot bracket as an option.

② ***ROD BUSHING*** – Material is Acetal for extended life.

③ ***ROD WIPER*** – A PTFE rod wiper is standard (high temperature or urethane material is optional) and offers resistance to a wide variety of wash-down chemicals.

④ ***ROD SEAL*** – Nitrile rod seal (high temperature material is optional) is pressure activated and wear compensating for long life.

⑤ ***BODY SEALS*** – Nitrile material is standard (high temperature material is optional)

⑥ ***BODY*** – Thick walled 300 series stainless steel offers superior corrosion resistance and is designed to minimize gaps with the mating end caps where contamination can build up.

⑦ ***REAR CAP*** – Corrosion resistant 303 stainless steel is ideal for wash-down applications. Designed specifically to reduce sharp edges and corners and provide a smooth transition to the cylinder body eliminating catch points for contamination and to allow ease in cleaning. Optional tapped holes allow for easy mounting of NFPA rear pivot or rear clevis mounting brackets.

⑧ ***PISTON ROD*** – Hard Chrome Plated 303 stainless steel for maximum corrosion resistance.

⑨ ***PISTON*** – Precision machined from aluminum (optional stainless steel for internal corrosion resistance when required).

⑩ ***PISTON SEALS*** – Nitrile material is standard (high temperature material is optional). Seals are pressure activated and wear compensating.

⑪ ***PISTON WEAR BAND*** – 90% Virgin PTFE and 10% Polyphenylene Sulfide filled wear band; 65,000 PSI Compressive Modules; extremely low wear rate.

LUBRICANT – Food Grade (H1) Grease.

OPERATING PRESSURE	200 PSI Maximum

OPERATING TEMPERATURE	Standard: -20°F to 200°F (-25°C to 90°C) VS Option: 0°F to 400°F (-20°C to 200°C)

SERIES 'RS': HOW TO ORDER

RS - MP2 - 4.00 X 1.50 - U

SERIES	
RS	REPAIRABLE STAINLESS STEEL

NFPA MOUNTS	
MX0	TAPPED BOTH ENDS
MXF	TAPPED FRONT
MXR	TAPPED REAR
MP2	CLEVIS REAR
MP4	PIVOT REAR

BORE
1.50
2.00
2.50
3.25
4.00
5.00
6.00
8.00

STROKE
0" to 24" MADE TO ORDER

NOTE: Longer strokes are available, Contact TRD for Application Review

OPTIONS		
	A =	EXTENDED PISTON ROD THREAD (Example: A = 2")
X	B	URETHANE BUMPER BOTH ENDS
X	BC	URETHANE BUMPER CAP ONLY
X	BH	URETHANE BUMPER HEAD ONLY
	BP	BUMPER PISTON SEALS (1.50"-8.00" Bore)
	C=	EXTENDED PISTON ROD (SPECIFY) (EXAMPLE: C=2)
	FC	FIXED CUSHIONS
	KK2	INTERMEDIATE MALE ROD THREAD
	KK3	FEMALE ROD THREAD
	KK4	FULL DIAMETER MALE ROD THREAD
	KK5	BLANK ROD END (NO THREADS, "A" = 0")
	L001	MAGNALUBE G GREASE
	LF	LOW FRICTION SEALS
	MPR	MAGNETIC PISTON FOR REED SWITCHES
	OS	OVERSIZE ROD DIAMETER (5.00"-8.00" ONLY)
	P	PROXIMITY SWITCH BOTH ENDS (1.50"-4.00" ONLY)
	PXX	SINKING PROXIMITY SWITCH
	RWU	URETHANE ROD WIPER
	RWV	FLUOROCARBON ROD WIPER
	SSP	STAINLESS STEEL PISTON (WITH WEAR-BAND)
	U	USDA APPROVED OPTIONS *
	VS	FLUOROCARBON SEALS
	XX	SPECIAL VARIATION (SPECIFY) EXAMPLE - NO PISTON WEAR BAND, ETC.

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

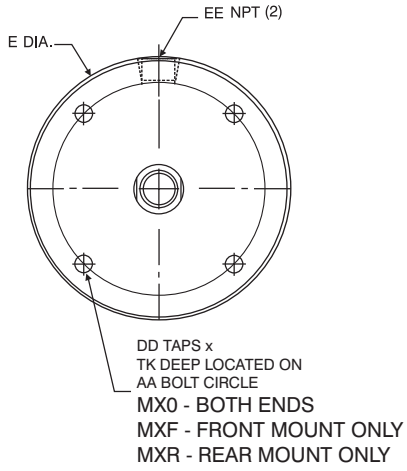
* USDA APPROVED OPTION- Includes an external wiper as required by the USDA. The cylinder rod length will automatically increase by the amount required to accommodate the seal retaining bracket.

OPTION NOTES:

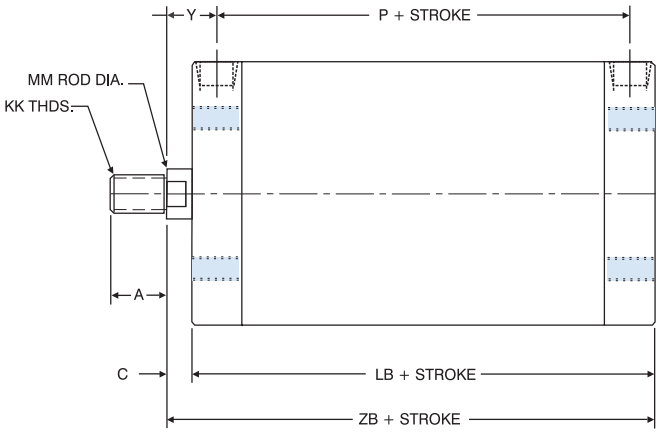
- Option (B) Bumpers cannot be combined with Option (FC) Cushions or Option (P) Prox. Switches
- If Option (P) (Proximity switch both ends) and Option (VS) are ordered in combination, the standard proximity switch thread seal material will be used
- Option (MPR) Magnetic Piston and Option (VS) High Temperature Seals should be specified for chemical compatibility requirements only. The piston magnet is nitrile based, hence the temperature rating remains at 200°F.

OPTION LENGTH ADDER (ADD TO CATALOG BASIC OVERALL LENGTH DIMENSIONS)			
	OPTION		
BORE	B	BC	BH
1.50	0.250"	0.125"	0.125"
2.00	0.250"	0.125"	0.125"
2.50	0.250"	0.125"	0.125"
3.25	0.250"	0.125"	0.125"
4.00	0.250"	0.125"	0.125"
5.00	0.500"	0.250"	0.250"
6.00	0.500"	0.250"	0.250"
8.00	0.500"	0.250"	0.250"

SERIES 'RS' DIMENSIONS: FRONT & REAR MOUNT

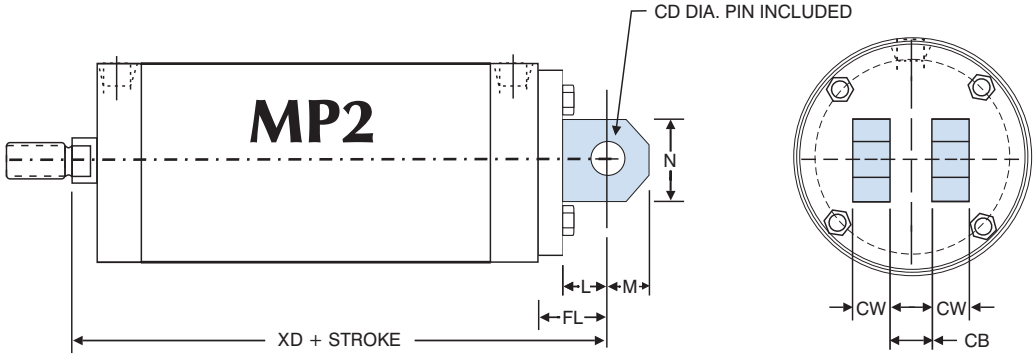


MX0 - BOTH ENDS
MXF - FRONT MOUNT ONLY
MXR - REAR MOUNT ONLY



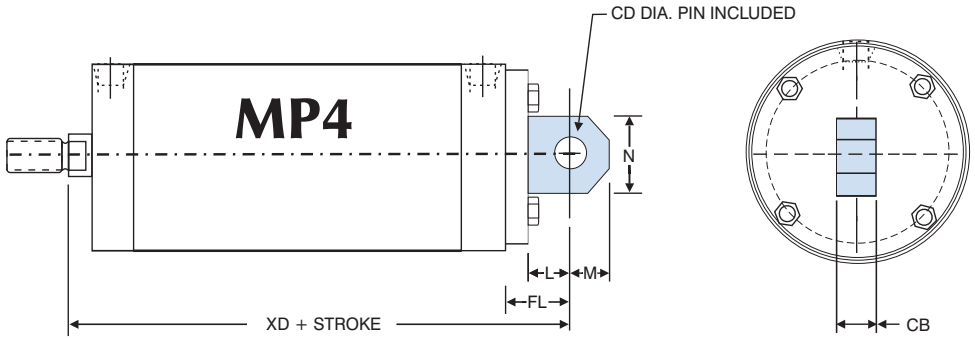
'MX0', 'MXR' & 'MXF' MOUNT DIMENSIONS														
BORE	ROD DIAMETER	A	AA	C	DD	E DIA.	EE NPT	KK	LB	MM	TK	Y	P	ZB
1.50	0.625 Standard	0.750	1.450	0.560	8-32	1.750	0.375	7/16-20	5.210	0.625	0.330	1.990	3.160	5.770
2.00	0.625 Standard	0.750	1.850	0.560	10-24	2.250	0.375	7/16-20	5.450	0.625	0.375	1.940	3.150	6.010
2.50	0.625 Standard	0.750	2.150	0.560	1/4-20	2.750	0.375	7/16-20	5.950	0.625	0.500	1.930	3.390	6.510
3.25	1.000 Standard	1.125	2.620	0.640	5/16-18	3.500	0.500	3/4-16	7.430	1.000	0.625	2.640	3.830	8.070
4.00	1.000 Standard	1.125	3.250	0.640	3/8-16	4.250	0.500	3/4-16	7.430	1.000	0.750	2.520	3.930	8.070
5.00	1.000 Standard	1.125	4.250	0.500	3/8-16	5.250	0.500	3/4-16	5.750	1.000	0.625	1.000	4.750	6.250
	1.375 Oversized	1.625	4.250	0.625	3/8-16	5.250	0.500	1-14	5.750	1.375	0.625	1.125	4.750	6.375
6.00	1.375 Standard	1.625	5.000	0.625	1/2-13	6.250	0.500	1-14	5.750	1.375	0.875	1.125	4.750	6.375
	1.750 Oversized	2.000	5.000	0.750	1/2-13	6.250	0.500	1-1/4-12	5.750	1.750	0.875	1.250	4.750	6.500
8.00	1.375 Standard	1.625	6.500	0.625	5/8-11	8.375	0.500	1-14	5.875	1.375	1.000	1.125	4.875	6.500
	1.750 Oversized	2.000	6.500	0.750	5/8-11	8.375	0.500	1-1/4-12	5.875	1.750	1.000	1.250	4.875	6.625

SERIES 'RS' DIMENSIONS: CLEVIS MOUNT



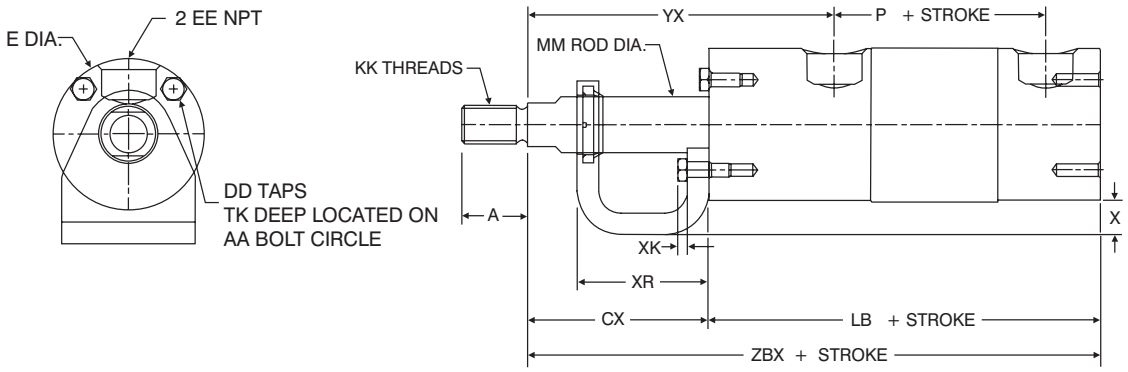
'MP2' CLEVIS MOUNT DIMENSIONS									
BORE	ROD DIAMETER	CB	CD	CW	FL	L	M	N	XD
1.50	0.625 Standard	0.750	0.500	0.490	1.125	0.750	0.350	0.700	6.900
2.00	0.625 Standard	0.750	0.500	0.500	1.125	0.750	0.400	0.800	7.140
2.50	0.625 Standard	0.750	0.500	0.500	1.125	0.750	0.400	0.800	7.640
3.25	1.000 Standard	1.250	0.750	0.625	1.875	1.250	0.600	1.000	9.940
4.00	1.000 Standard	1.250	0.750	0.625	1.875	1.250	0.750	1.400	9.940
5.00	1.000 Standard	1.250	0.750	0.625	1.875	1.250	0.875	1.750	8.125
	1.375 Oversized	1.250	0.750	0.625	1.875	1.250	0.875	1.750	8.250
6.00	1.375 Standard	1.500	1.000	0.750	2.250	1.500	1.000	2.000	8.625
	1.750 Oversized	1.500	1.000	0.750	2.250	1.500	1.000	2.000	8.750
8.00	1.375 Standard	1.500	1.000	0.750	2.250	1.500	1.000	3.500	8.750
	1.750 Oversized	1.500	1.000	0.750	2.250	1.500	1.000	3.500	8.875

SERIES 'RS' DIMENSIONS: PIVOT MOUNT

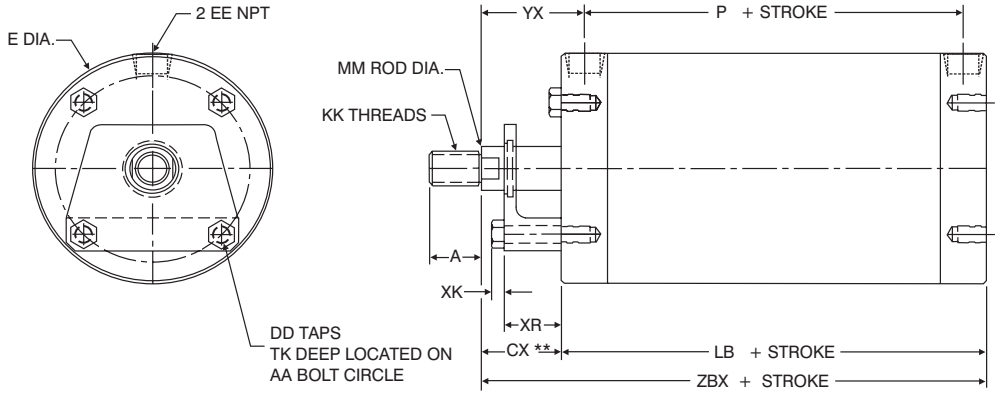


'MP4' PIVOT MOUNT DIMENSIONS								
BORE	ROD DIAMETER	CB	CD	FL	L	M	N	XD
1.50	0.625 Standard	0.750	0.500	1.125	0.750	0.350	0.700	6.900
2.00	0.625 Standard	0.750	0.500	1.125	0.750	0.400	0.800	7.140
2.50	0.625 Standard	0.750	0.500	1.125	0.750	0.400	0.800	7.640
3.25	1.000 Standard	1.250	0.750	1.875	1.250	0.600	1.000	9.940
4.00	1.000 Standard	1.250	0.750	1.875	1.250	0.750	1.400	9.940
5.00	1.000 Standard	1.250	0.750	1.875	1.250	0.875	1.750	8.125
	1.375 Oversized	1.250	0.750	1.875	1.250	0.875	1.750	8.250
6.00	1.375 Standard	1.500	1.000	2.250	1.500	1.000	2.000	8.625
	1.750 Oversized	1.500	1.000	2.250	1.500	1.000	2.000	8.750
8.00	1.375 Standard	1.500	1.000	2.250	1.500	1.000	3.500	8.750
	1.750 Oversized	1.500	1.000	2.250	1.500	1.000	3.500	8.875

SERIES 'RS' DIMENSIONS: USDA APPROVED OPTION "U"



1.50" - 4.00" Bores

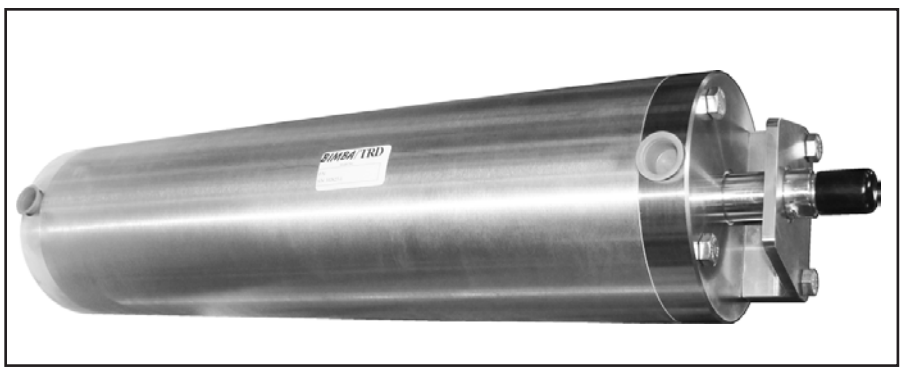


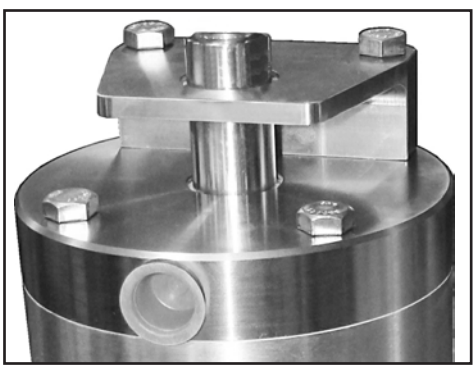
5.00", 6.00" & 8.00" Bores

EXTERNAL WIPER 'OPTION U' DIMENSIONS																	
BORE	ROD DIAMETER	A	AA	CX	DD	E DIA.	EE NPT	KK	LB	MM	TK	YX	P	XR	XK	ZBX	X
1.50	0.625 Standard	0.750	1.450	2.060	8-32	1.750	0.375	7/16-20	5.210	0.625	0.330	3.490	3.160	1.500	0.100	7.270	0.375
2.00	0.625 Standard	0.750	1.850	2.060	10-24	2.250	0.375	7/16-20	5.450	0.625	0.375	3.440	3.150	1.500	0.120	7.510	0.500
2.50	0.625 Standard	0.750	2.150	2.060	1/4-20	2.750	0.375	7/16-20	5.950	0.625	0.500	3.430	3.390	1.500	0.170	8.010	0.260
3.25	1.000 Standard	1.125	2.620	2.140	5/16-18	3.500	0.500	3/4-16	7.430	1.000	0.625	4.140	3.830	1.500	0.240	9.570	0.250
4.00	1.000 Standard	1.125	3.250	2.140	3/8-16	4.250	0.500	3/4-16	7.430	1.000	0.750	4.020	3.930	1.500	0.270	9.570	0.250
5.00	1.000 Standard	1.125	4.250	1.750	3/8-16	5.250	0.500	3/4-16	5.750	1.000	0.625	2.250	4.750	1.250	0.270	7.500	N/A
	1.375 Oversized	1.625	4.250	1.875	3/8-16	5.250	0.500	1-14	5.750	1.375	0.625	2.375	4.750	1.250	0.270	7.625	N/A
6.00	1.375 Standard	1.625	5.000	1.875	1/2-13	6.250	0.500	1-14	5.750	1.375	0.875	2.375	4.750	1.250	0.360	7.625	N/A
	1.750 Oversized	2.000	5.000	2.000	1/2-13	6.250	0.500	1 1/4-12	5.750	1.750	0.875	2.500	4.750	1.250	0.360	7.750	N/A
8.00	1.375 Standard	1.625	6.500	1.875	5/8-11	8.375	0.500	1-14	5.875	1.375	1.000	2.375	4.875	1.250	0.440	7.750	N/A
	1.750 Oversized	2.000	6.500	2.000	5/8-11	8.375	0.500	1 1/4-12	5.875	1.750	1.000	2.500	4.875	1.250	0.440	7.875	N/A

NOTE: The USDA-approved 'Option U' includes an external wiper as required by the USDA. Cylinder rod length is increased as shown.

EXAMPLES OF 'U OPTION' MOUNTING BRACKET





SERIES 'RS': OPTIONS

About Rod End Styles

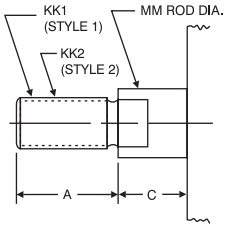
Style 1 Male Rod End is STANDARD

Other NFPA Styles can be specified (see chart).

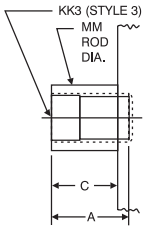
Need a rod end not listed?
NO PROBLEM! Each Piston Rod is made-to-order and does not delay shipment. Coarse (UNC) threads, Metric threads or just plain rod ends are common. Thread lengths are also made-to-order (Specify: "A"=Length).

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

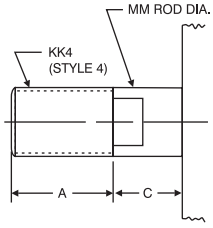
STYLE 1 & 2 KK1 & KK2



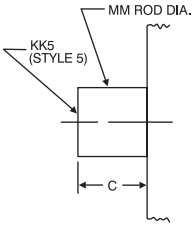
STYLE 3 KK3



STYLE 4 KK4

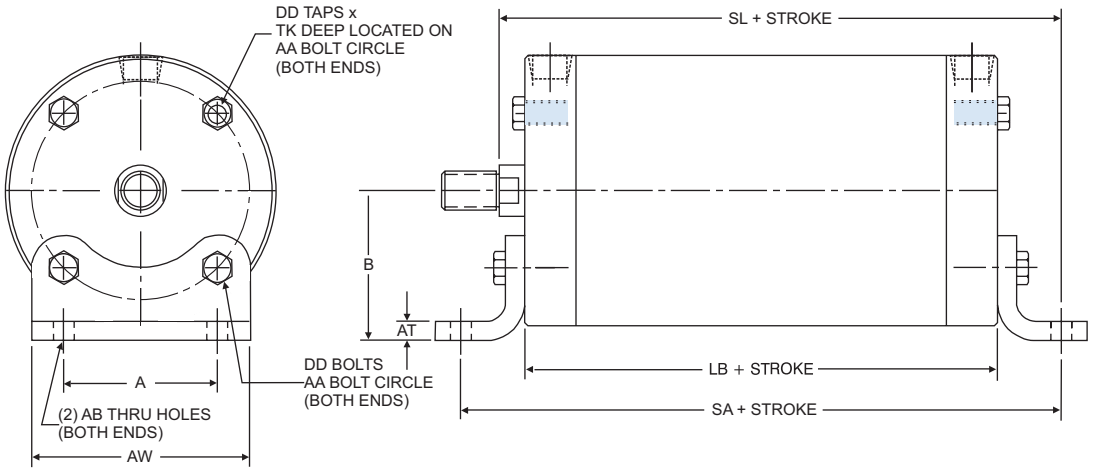


STYLE 5 KK5



BORE	MM ROD DIAMETER	STANDARD Style 1 - Male KK1	A	OPTIONAL Style 2 - Male KK2	A	Style 3 - Female KK3	A	Style 4 - Male KK4	A	Style 5 - Blank KK5	C
1.50, 2.00, 2.50	0.625 Standard	7/16-20	0.750	1/2-20	0.750	7/16-20	0.750	5/8-18	0.750	No Threads	0.560
3.25 & 4.00	1.000 Standard	3/4-16	1.125	7/8-14	1.125	3/4-16	1.125	1-14	1.125	No Threads	0.640
5.00	1.000 Standard	3/4-16	1.125	7/8-14	1.125	3/4-16	1.125	1-14	1.125	No Threads	0.500
	1.375 Oversize	1-14	1.625	1 1/4-12	1.625	1-14	1.625	1 3/8-12	1.625	No Threads	0.625
6.00 & 8.00	1.375 Standard	1-14	1.625	1 1/4-12	1.625	1-14	1.625	1 3/8-12	1.625	No Threads	0.625
	1.750 Oversize	1 1/4-12	2.000	1 1/2-12	2.000	1 1/4-12	2.000	1 3/4-12	2.000	No Threads	0.750

FOOT BRACKET ACCESSORY (INCHES)

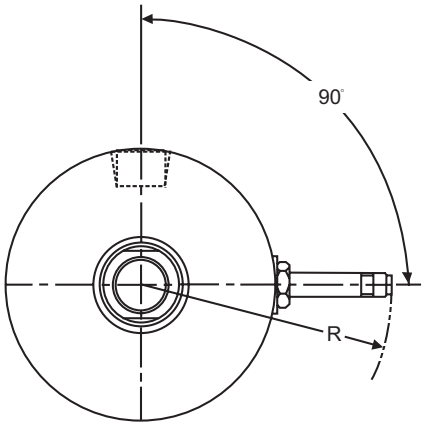


BORE	ROD DIAMETER	FOOT BRACKET KIT	A	AB	AW	B	AT	DD	AA	LB	TK	SA	SL
1.50	0.625 Standard	RS-FB150	1.030	0.188	1.520	1.250	0.250	8-32	1.450	5.210	0.330	6.620	6.460
2.00	0.625 Standard	RS-FB200	1.310	0.219	1.810	1.620	0.250	10-24	1.850	5.450	0.375	7.580	7.070
2.50	0.625 Standard	RS-FB250	1.550	0.281	2.300	1.640	0.250	1/4-20	2.150	5.950	0.500	7.900	7.480
3.25	1.000 Standard	RS-FB325	1.860	0.344	2.860	2.000	0.250	5/16-18	2.620	7.430	0.625	9.740	9.230
4.00	1.000 Standard	RS-FB400	2.300	0.406	3.500	2.375	0.250	3/8-16	3.250	7.430	0.750	10.050	9.390
5.00	1.000 Standard	RS-FB500	3.000	0.688	4.500	2.875	0.188	3/8-16	4.250	5.750	0.625	8.500	7.625
	1.375 Oversized												7.750
6.00	1.375 Standard	RS-FB600	4.000	0.813	5.500	3.375	0.188	1/2-13	5.000	5.750	0.875	8.500	7.750
	1.750 Oversized												7.875
8.00	1.375 Standard	RS-FB800	5.000	0.813	7.000	4.440	0.250	5/8-11	6.500	5.875	1.000	9.500	8.312
	1.750 Oversized												8.438

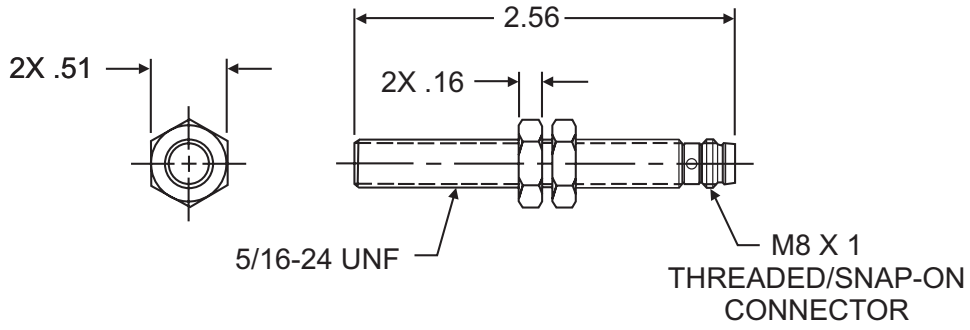
Note: Foot bracket mounting kits include two brackets and eight stainless steel screws.
Can only be applied to MX0 mounting styles

SERIES 'RS' OPTIONS: SWITCHES

PROXIMITY SWITCH OPTION DIMENSIONS (OPTIONS P & PXX)



BORE SIZE	DIMENSION R
1.50	3.04″
2.00	3.04″
2.50	3.04″
3.25	3.19″
4.00	3.19″
5.00	N/A
6.00	N/A
8.00	N/A



Specifications

Output: **Option P:** PNP Sourcing output, normally open
Option PXX: NPN Sinking output, normally open
Load Current: 100mA max.
Leakage Current: 10uA max.
Voltage Drop: 2VDC
Short Circuit and Overload Protection: yes
Reverse Polarity Protection: yes
Supply Voltage: 10-30 VDC
LED: yes
Current Consumption: 15mA
Repeatability: 0.010° (.25mm)
Hysteresis: 5%
Response Time: 330uS
Electromagnetic Compatibility Compliance: NEMA ICS5-1996
Protection Class: IP67
Ambient Temperature: -14°F to 158°F (-25°C to 70°C)
Housing Material: Stainless Steel
Sensing Face: Crastin
Approvals: UL-General Purpose
CSA-General Purpose
FM-Nonincendive

SWITCH OPTIONS: SWITCH ORDERING INSTRUCTIONS

TO ORDER, SPECIFY: Switch Model, Lead Type and Bracket Size

R10 X

Switch Model	
R10	= AC/DC Reed
RAC	= High Power AC Reed
RHT	= Extended Temperature Reed
MSS	= Solid State
R10P	= AC/DC Reed with Circuit Protection

Switch Lead Options	
(leave blank)	= 24″ Plain Cable
X	= 120″ Plain Cable
Q	= 8mm Quick Connect (not available on RAC or RHT)

Refer to catalog pages 223-230 in Full Line Pneumatic catalog for complete specifications.

Switch Mounting Bands	
USB25	Use with bores: 1.50″, 2.00″, 2.50″
USB50	Use with bores: 3.25″, 4.00″, 5.00″
USB80	Use with bores: 6.00″, 8.00″

Switch Accessories: Quick Connect Cord Sets	
MODEL	DESCRIPTION
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), 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!

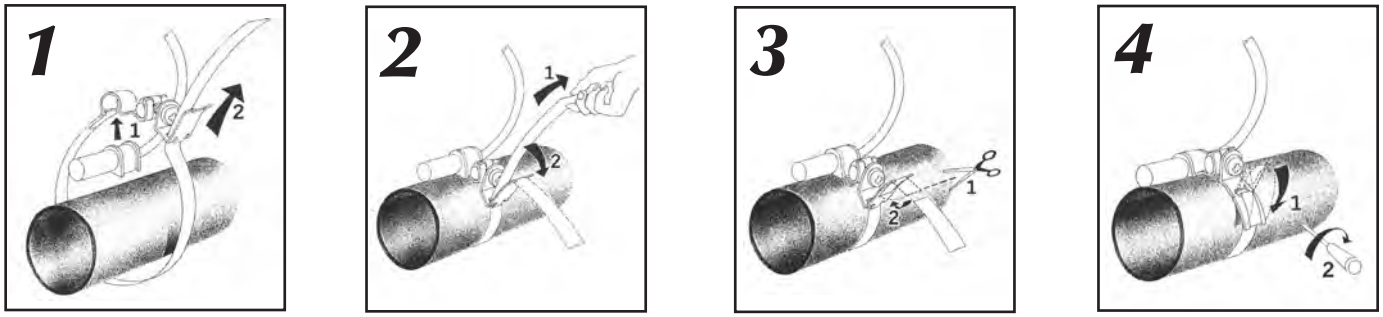
Other Switches Available:

- 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)

Specify 'M' Option for ALL switch models when ordering actuators.

SERIES 'RS': ACCESSORIES

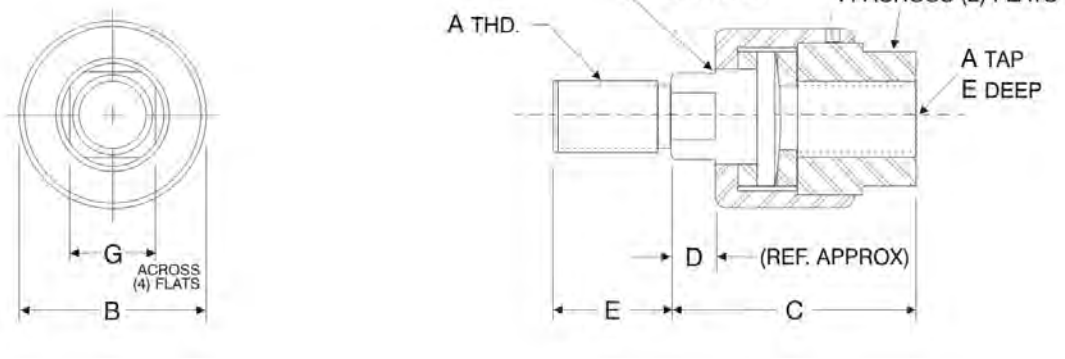
UNIVERSAL SWITCH BAND MOUNTING ILLUSTRATIONS



WARNING:

BE CAREFUL NOT TO SLIP WHEN PULLING BAND TIGHT. USE THUMB AND FINGER AND DO NOT PULL TOO HARD, THE BAND TIGHTENS WELL WITH THREAD TO SPARE.

STAINLESS STEEL ALIGNMENT COUPLERS (INCHES)



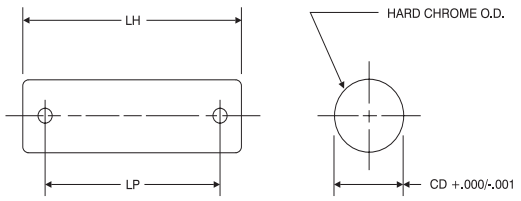
ALIGNMENT COUPLERS (INCHES)									
PART NUMBER	A	B	C	D	E	F	G	H	MAXIMUM PULL AT YIELD (LBS.)
SS-AC250	1/4-28	1.125	1.750	0.375	0.500	0.500	0.375	0.688	1,000
SS-AC312	5/16-24	1.125	1.750	0.375	0.500	0.500	0.375	0.688	1,800
SS-AC375	3/8-24	1.125	1.750	0.375	0.500	0.500	0.375	0.688	2,900
SS-AC437	7/16-20	1.250	2.000	0.438	0.750	0.625	0.500	0.813	4,000
SS-AC500	1/2-20	1.250	2.000	0.438	0.750	0.625	0.500	0.813	5,500
SS-AC625	5/8-18	1.250	2.000	0.438	0.750	0.625	0.500	0.813	7,000
SS-AC750	3/4-16	1.750	2.313	0.438	1.125	0.969	0.813	1.125	10,300
SS-AC875	7/8-14	1.750	2.313	0.438	1.125	0.969	0.813	1.125	12,000
SS-AC1000	1-14	2.500	2.938	0.438	1.625	1.344	1.156	1.625	15,000
SS-AC1250	1 1/4-12	2.500	2.938	0.438	1.625	1.344	1.156	1.625	17,000
SS-AC1500	1 1/2-12	3.250	4.375	0.875	2.250	1.969	1.750	2.375	20,000

SERIES 'RS': BASIC ACCESSORIES

Accessories (303 Stainless Steel)

CLEVIS PIN (WITH COTTER PINS)			
PART NO.	CD	LH	LP
SS-CP500	0.500	2.250	1.938
SS-CP750	0.750	3.000	2.719
SS-CP1000	1.000	3.500	3.219
SS-CP1375	1.375	5.000	4.250
SS-CP1750	1.750	6.000	5.500

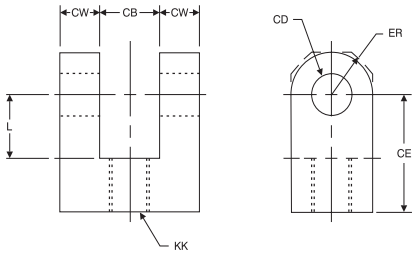
CLEVIS PIN (INCLUDES COTTER PINS)



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

ROD CLEVIS							
PART NO.	CB	CD	CE	CW	ER	KK	L
SS-RC437	0.750	0.500	1.500	0.500	0.500	7/16-20	0.750
SS-RC500						1/2-20	
SS-RC750	1.250	0.750	2.375	0.625	0.750	3/4-16	1.250
SS-RC1000	1.500	1.000	3.125	0.750	1.000	1-14	1.500
SS-RC1250	2.000	1.375	4.125	1.000	1.375	1 1/4-12	2.125
SS-RC1500	2.500	1.750	4.500	1.250	1.750	1 1/2-12	2.250

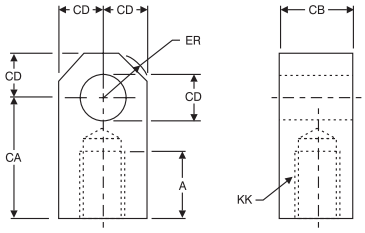
ROD CLEVIS



(Clevis Pins sold separately from Rod Clevis)

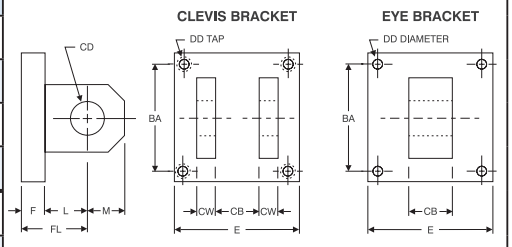
ROD EYE						
PART NO.	A	CA	CB	CD	ER	KK
SS-RE437	0.750	1.500	0.750	0.500	0.625	7/16-20
SS-RE500						1/2-20
SS-RE750	1.125	2.063	1.250	0.750	0.875	3/4-16
SS-RE1000	1.625	2.813	1.500	1.000	1.188	1-14
SS-RE1250	2.000	3.438	2.000	1.375	1.563	1 1/4-12
SS-RE1500	2.250	4.000	2.500	1.750	2.000	1 1/2-12

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
CLEVIS BRACKETS	SS-CB500	1.625	0.750	0.500	0.500	3/4-24	2.500	0.375	1.125	0.750	0.625
	SS-CB750	2.563	1.250	0.750	0.625	1/2-20	3.500	0.625	1.875	1.250	0.750
	SS-CB1000	3.250	1.500	1.000	0.750	5/8-18	4.500	0.750	2.250	1.500	1.000
	SS-CB1375	3.813	2.000	1.375	1.000	5/8-18	5.000	0.875	3.000	2.125	1.375
EYE BRACKETS	SS-EB500	1.625	0.750	0.500	N/A	0.406	2.500	0.375	1.125	0.750	0.500
	SS-EB750	2.563	1.250	0.750		0.532	3.500	0.625	1.875	1.250	0.750
	SS-EB1000	3.250	1.500	1.000		0.656	4.500	0.750	2.250	1.500	1.000
	SS-EB1375	3.813	2.000	1.375		0.656	5.000	0.875	3.000	2.125	1.375



(Clevis Pins sold separately from Clevis & Eye Brackets)

WEIGHTS OF CYLINDERS

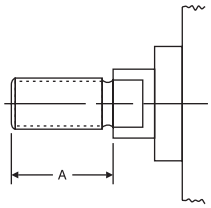
APPROXIMATE WEIGHT FOR STANDARD RODS (LBS.)					
CYLINDER BORE	BASE WEIGHT	ADD PER INCH OF STROKE	CYLINDER BORE	BASE WEIGHT	ADD PER INCH OF STROKE
1.50	2.82	0.27	4.00	30.20	0.70
2.00	5.25	0.33	5.00	24.10	0.84
2.50	8.92	0.39	6.00	36.45	1.12
3.25	20.63	0.61	8.00	69.80	1.80

SERIES 'RS': OPTIONS

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!*

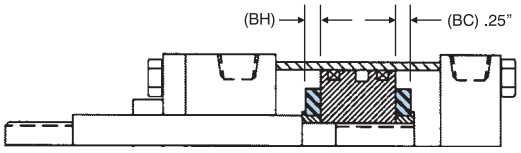


B BC BH Bumpers

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 for 1.50"-4.00" Bore adds .125" to cylinder length
Each bumper for 5.00"-8.00" Bore adds .250" to cylinder length



BP Bumper Piston Seals

1.50" Bore Shown

Available on 1.50" to 8.00" Bore

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"-8.00" Bores
Operating Temp: 0°F to 400°F (-18°C to 205°C)

Operating Pressure: 200 PSI Air (17 BAR)

For additional info, see page 173.

L001 Magnalube-G Grease

Magnalube-G Grease is our standard lubricant used for all products except for PFLF and RS Series.

MAGNALUBE®-G

Magnalube-G is a non-soap elastomer/PTFE grease designed for superior performance in a wide range of applications. Insoluble in water, Magnalube-G is a nonmigratory grease that tends to stay put in the cylinder if there is no other oil present.
Note: if an FRL is used in the pneumatic system, the FRL must be properly maintained to provide continued cylinder lubrication as any oil will negate the Magnalube-G.
See www.magnalube.com for more information.

Color: Green

Recommended temperature range: -20°F to 200°F (-25°C to 90°C)

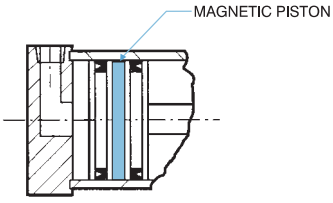
LF Low Friction

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

BORE SIZES:	1.50" to 8.00" Bore
MATERIAL:	Carboxilated Nitrile
OPERATING TEMPERATURE:	-20°F TO 200°F (-25°C TO 90°C)
OPERATING PRESSURE:	200 PSI AIR (17 BAR)

MPR Magnetic Piston

Magnetic Pistons (MPR) are used in conjunction with TRD R10, R10P, RHT, RAC Reed and MSS Solid State Switches.
(See pages 223-230 in Full Line Catalog for switches)



OS Oversize Rod

OVERSIZED PISTON ROD STANDARD PISTON 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 185 in Full Line Catalog **(available on 5.00"-8.00" Bore in RS Series Only).**

RWU Rod Wiper made of Urethane

Abrasion resistant urethane provides aggressive wiping action in most environments. External lip design prevents debris from entering cylinder.

VS RWV Fluorocarbon Seals

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

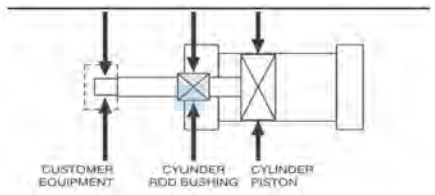
Note: Teflon wiper is used on "VS" Fluorocarbon seal option unless RWV is requested also.

HEAVY DUTY 'SS' STAINLESS STEEL: CONSTRUCTION

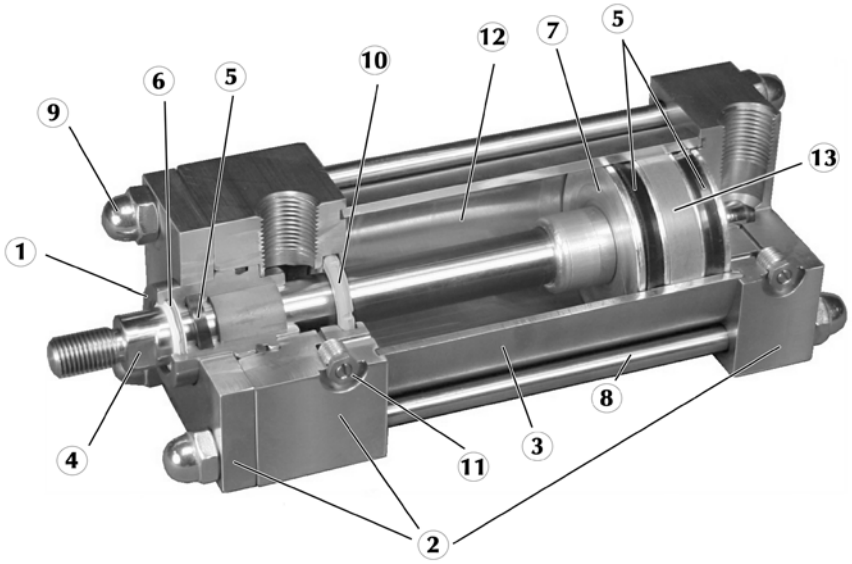
Ideal for:
- Food Processing Applications
- Chemical, Medical or Pharmaceutical
- Offshore or Marine Equipment
- Energy Production or Waste Treatment

Floating Rod Bushing

SELF ALIGNMENT FEATURE
Rod Bushing is designed to float .002" to improve bearing surface alignment.



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



① ***FLOATING ROD BUSHING*** – Precision machined from 303 stainless steel, extra-long PTFE composite wear band for extended service.

② ***HEAD, CAP & RETAINER*** – 100% Precision machined from highly corrosion resistant 303 stainless steel bar for tough and corrosive environments.

③ ***CYLINDER TUBE*** – Precision machined and honed from 304 stainless steel, providing smooth consistent operation.

④ ***PISTON ROD*** – Drawn, ground and polished high yield 303 stainless steel, hard chrome plated.

⑤ ***PISTON & ROD SEALS*** – Heavy lip design Carboxilated Nitrile construction. Seals are pressure activated and wear compensating for long life.

⑥ ***ROD WIPER*** – PTFE scraper design for maximum compatibility with wash-down and chemical solutions (FDA approved material).

⑦ ***PISTON*** – Precision machined from 6061-T651 alloy aluminum for excellent bearing surface to extend life (Optional: Stainless Steel with PTFE wear band).

⑧ ***TIE RODS*** – Drawn and ground 303 high strength stainless steel, rolled threads for maximum strength.

⑨ ***ACORN NUTS*** – 304 Stainless steel, eliminates exposed threads for food grade applications.

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*** - 303 stainless steel design has fine thread metering and is positively captured to prevent needle ejection during adjustment.

⑫ ***LUBRICATION*** - Permanently lubricated with Magnalube-G PTFE based grease on all internal components. This lubricant is a non-migratory type high performance grease, providing outstanding service for life (no additional lubrication is required).

⑬ ***PISTON WEAR BAND*** - 90% Virgin PTFE and 10% Polyphenylene Sulfide filled wear band; extremely low wear rate.

OPERATING PRESSURE	250 PSI AIR (17 BAR) 400 PSI Hydraulic (27 BAR) ("TH" Option)

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)

Performance options:

- ***FDAL*** – FDA approved lubricant, rated for 0°F to 300°F (-20°C to 150°C).
- ***DRB*** – Solid Delrin® Rod Bushing (FDA approved) for extra long life under "high pressure" wash-down applications. This bearing material requires ZERO lubrication due to self lubricating properties.
- ***VS*** – Fluorocarbon seals provide a higher chemical resistance to most wash-down solutions.
- ***SSP*** – Solid Stainless Steel Piston provides maximum corrosion resistance and FDA approval for food contact (PTFE wear band standard).

SERIES 'SS': HOW TO ORDER

SS - MX0 ___ - 1.50 X 1.00 - H1C5 - BP - KK3 - MPR - OP = PORTS AT 3 & 7

SERIES	
SS	250 PSI AIR

NFPA MOUNTS	
MXO	NO MOUNT (1.50" - 8".00 BORE)
MP1	REAR PIVOT CLEVIS (1.50" - .8.00" BORE)
MP4	REAR PIVOT EYE (1.50" - 6.00" BORE)
MT1	FRONT TRUNNION (1.50" - 8.00" BORE)
MT2	REAR TRUNNION (1.50" - 8.00" BORE)
MX1	EXTENDED TIE-RODS (HEAD & CAP) (1.50" - 8.00" BORE)
MX2	EXTENDED TIE-RODS (CAP) (1.50" - 8.00" BORE)
MX3	EXTENDED TIE-RODS (HEAD) (1.50" - 8.00" BORE)
MF1	FRONT FLANGE (1.50" - 6.00" BORE)
MF2	REAR FLANGE (1.50" - 6.00" BORE)
ME3	FRONT MOUNTING HOLES (8.0.0" BORE)
ME4	REAR MOUNTING HOLES (8.00" BORE)
MS2	SIDE LUG (1.50" - 8.00" BORE)
MS4	BOTTOM TAPPED HOLES (1.50" - 8.00" BORE)

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

BORE
1.50
2.00
2.50
3.25
4.00
5.00
6.00
8.00

STROKE
0" TO 120" CONSULT FACTORY FOR OTHER STROKES

CUSHIONS
H = HEAD CUSHION POSITION 2 STANDARD SPECIFY FOR POSITIONS 1, 3 OR 4
C = CAP CUSHION POSITION 6 STANDARD SPECIFY FOR POSITIONS 5, 7 OR 8

About Our Part Number System

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

Example: A 2.50" Bore by 10" Stroke, Front Flange Mount, Head & Cap Cushions

Part Number: SS-MF1-2.50 x 10-HC

OPTION LENGTH ADDER
(ADD TO CATALOG BASIC OVERALL LENGTH DIMENSIONS)

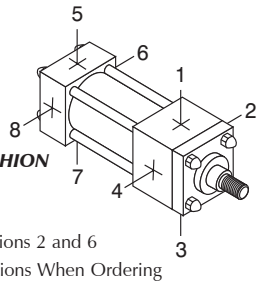
BORE	OPTION B	BC	BH	MPR or MPH	NR	ST* Example: ST=2
1.50	0.500	0.250	0.250	0.625	0.625	2
2.00	0.500	0.250	0.250	0.625	0.625	2
2.50	0.500	0.250	0.250	0.750	0.750	2
3.25	0.500	0.250	0.250	0.625	0.625	2
4.00	0.500	0.250	0.250	0.625	0.625	2
5.00	0.500	0.250	0.250	0.875	0.875	2
6.00	0.500	0.250	0.250	0.750	0.750	2
8.00	0.500	0.250	0.250	0.875	0.875	2

*Note: The desired stop tube length adds directly to the overall cylinder length. Specify stop tube location.

Example: Stop tube on rear stage only.

OPTIONS		
	ADDS LENGTH TO CYLINDER - SEE "OPTION LENGTH ADDER" CHART BELOW.	
	A / O	AIR / OIL PISTON
X	B**	.25" URETHANE BUMPER BOTH ENDS
X	BH**	.25" URETHANE BUMPER HEAD ONLY
X	BC**	.25" URETHANE BUMPER CAP ONLY
	BP	BUMPER PISTON SEAL (1.50" - 5.00" BORE)
	"A"-	EXTENDED PISTON ROD THREAD (SPECIFY)
	"C"-	EXTENDED PISTON ROD (SPECIFY)
	DRB	DELRIN® ROD BUSHING
	FDAL	FDA APPROVED LUBRICANT
	KK2	INTERMEDIATE MALE ROD THREAD
	KK3	FEMALE ROD THREAD
	KK3S	STUDDED PISTON ROD (WITH KK3)
	KK4	FULL DIAMETER MALE ROD THREAD
	LF	LOW FRICTION, 250 PSI AIR
X	MPR	MAGNETIC PISTON FOR REED SWITCHES
	MPH	MAGNETIC PISTON FOR HALL SWITCHES
	MS	METALLIC ROD SCRAPER (BRASS)
X	NR	NON-ROTATING
	OP	OPTIONAL PORT LOCATION
	OS	OVERSIZED ROD DIAMETER (SPECIFY SIZE)
	SE	SPRING EXTEND (CONSULT FACTORY)
	SR	SPRING RETURN (CONSULT FACTORY)
	SSP	STAINLESS STEEL PISTON (WITH WEAR-BAND)
X	ST	**STOP TUBE** - SPECIFY STOP TUBE LENGTH (in inches) SPECIFY STROKE AS ES (effective stroke) Example: SS MS4 2x24ES-ST=3
	TH	400 PSI HYDRAULIC, NON-SHOCK
	VS	FLUOROCARBON SEALS
	AS	ADJUSTABLE STROKE (RETRACT)
	XX	SPECIAL VARIATION (SPECIFY)
		BSP, SAE PORTS (SPECIFY SIZE)

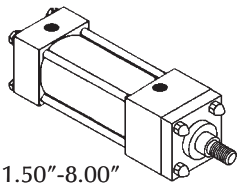
** BUMPERS ADD .25" PER END TO CYLINDER LENGTH

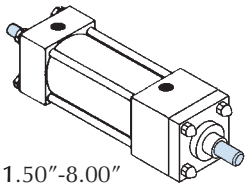


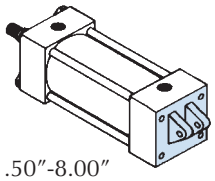
STANDARD PORT AND CUSHION ADJUSTMENT POSITIONS

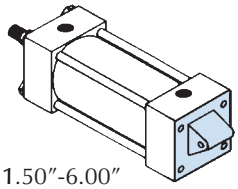
- Ports - Positions 1 and 5
- Cushion Adjustment - Positions 2 and 6
- Specify Non-Standard Positions When Ordering

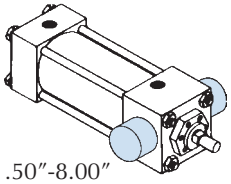
NFPA MOUNTS

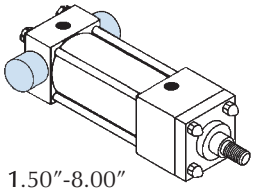
MXO

1.50"-8.00" Bores

MXOD

1.50"-8.00" Bores

MP1

1.50"-8.00" Bores

MP4

1.50"-6.00" Bores

MT1

1.50"-8.00" Bores

MT2

1.50"-8.00" Bores

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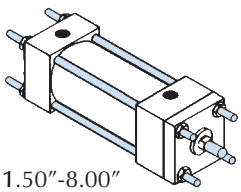
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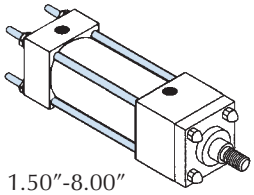
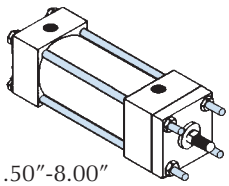
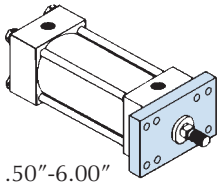
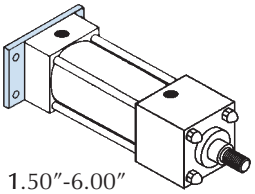
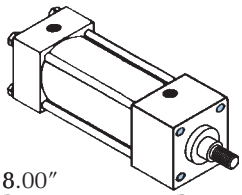
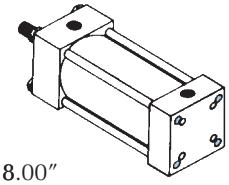

1.50"-8.00" Bores

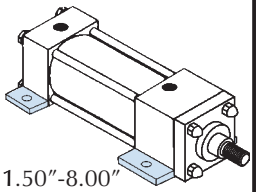
MX3

1.50"-8.00" Bores

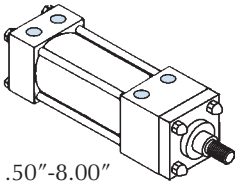
MF1

1.50"-6.00" Bores

MF2

1.50"-6.00" Bores

ME3

8.00" Bore

ME4

8.00" Bore

MS2

1.50"-8.00" Bores

MS4

1.50"-8.00" Bores

SERIES 'SS' 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).

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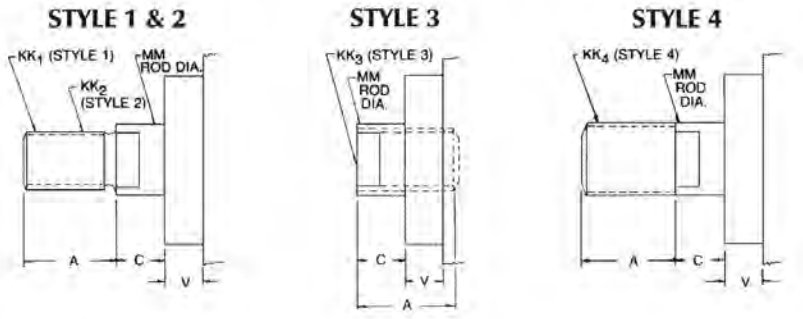
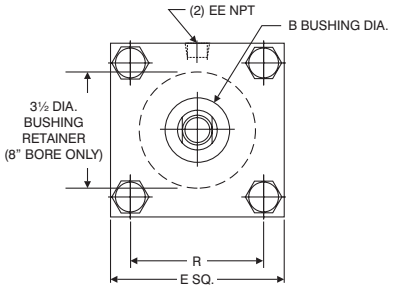
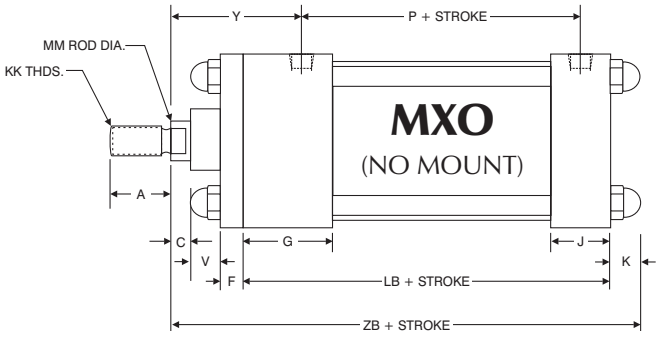
PISTON ROD END STYLES



BORE	MM ROD DIAMETER	STANDARD STYLE 1 - MALE KK1	STANDARD STYLE 1 - MALE A	OPTIONAL STYLE 2 - MALE KK2	OPTIONAL STYLE 2 - MALE A	OPTIONAL STYLE 3 - FEMALE KK3	OPTIONAL STYLE 3 - FEMALE A	OPTIONAL STYLE 4 - MALE KK4	OPTIONAL STYLE 4 - MALE A	C	V
1.50, 2.00, 2.50	0.625 Standard	7/16 -20	0.750	1/2-20	0.750	7/16 -20	0.750	5/8 -18	0.750	0.375	0.250
	1.000 Oversize	3/4 -16	1.125	7/8-14	1.125	3/4 -16	1.125	1 -14	1.125	0.500	0.500
3.25, 4.00, 5.00	1.000 Standard	3/4 -16	1.125	7/8-14	1.125	3/4 -16	1.125	1 -14	1.125	0.500	0.250
	1.375 Oversize	1 -14	1.625	1 1/4-12	1.625	1 -14	1.625	1 3/8 -12	1.625	0.625	0.375
6.00	1.375 Standard	1 -14	1.625	1 1/4-12	1.625	1 -14	1.625	1 3/8 -12	1.625	0.625	0.250
	1.750 Oversize	1 1/4 -12	2.000	1 1/2-12	2.000	1 1/4 -12	2.000	1 3/4 -12	2.000	0.750	0.375
8.00	1.375 Standard	1 -14	1.625	1 1/4-12	1.625	1 -14	1.625	1 3/8 -12	1.625	0.625	0.375
	1.750 Oversize	1 1/4 -12	2.000	1 1/2-12	2.000	1 1/4 -12	2.000	1 3/4 -12	2.000	0.750	0.500





BASIC DIMENSIONS 'MXO' STANDARD & OVERSIZED RODS

BORE	ROD DIAMETER	A	B	C	E	EE	F	G	J	K	KK	LB	MM	P	R	V	Y	ZB
1.50	0.625 Standard	0.750	1.125	0.375	2.000	0.375	0.375	1.500	1.000	0.438	7/16 -20	3.625	0.625	2.375	1.430	0.250	1.875	5.063
	1.000 Oversize	1.125	1.500	0.500							3/4 -16		1.000			0.500	2.250	5.438
2.00	0.625 Standard	0.750	1.125	0.375	2.500	0.375	0.375	1.500	1.000	0.563	7/16 -20	3.625	0.625	2.375	1.840	0.250	1.875	5.188
	1.000 Oversize	1.125	1.500	0.500							3/4 -16		1.000			0.500	2.250	5.563
2.50	0.625 Standard	0.750	1.125	0.375	3.000	0.375	0.375	1.500	1.000	0.563	7/16 -20	3.750	0.625	2.500	2.190	0.250	1.875	5.313
	1.000 Oversize	1.125	1.500	0.500							3/4 -16		1.000			0.500	2.250	5.688
3.25	1.000 Standard	1.125	1.500	0.500	3.750	0.500	0.625	1.750	1.250	0.625	3/4 -16	4.250	1.000	2.750	2.760	0.250	2.375	6.250
	1.375 Oversize	1.625	2.000	0.625							1 -14		1.375			0.375	2.625	6.500
4.00	1.000 Standard	1.125	1.500	0.500	4.500	0.500	0.625	1.750	1.250	0.625	3/4 -16	4.250	1.000	2.750	3.320	0.250	2.375	6.250
	1.375 Oversize	1.625	2.000	0.625							1 -14		1.375			0.375	2.625	6.500
5.00	1.000 Standard	1.125	1.500	0.500	5.500	0.500	0.625	1.750	1.250	0.813	3/4 -16	4.500	1.000	3.000	4.100	0.250	2.375	6.625
	1.375 Oversize	1.625	2.000	0.625							1 -14		1.375			0.375	2.625	6.875
6.00	1.375 Standard	1.625	2.000	0.625	6.500	0.750	0.750	2.000	1.500	0.813	1 -14	5.000	1.375	3.250	4.880	0.250	2.750	7.375
	1.750 Oversize	2.000	2.375	0.750							1 1/4 -12		1.750			0.375	3.000	7.625
8.00	1.375 Standard	1.625	2.000	0.625	8.500	0.750	0.625	2.000	1.500	1.000	1 -14	5.125	1.375	3.375	6.440	0.375	2.750	7.750
	1.750 Oversize	2.000	2.375	0.750							1 1/4 -12		1.750			0.500	3.000	8.000

EASY FLIP OUT PAGE FOR REFERENCE

SERIES 'SS' 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).

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Just send us a sketch.
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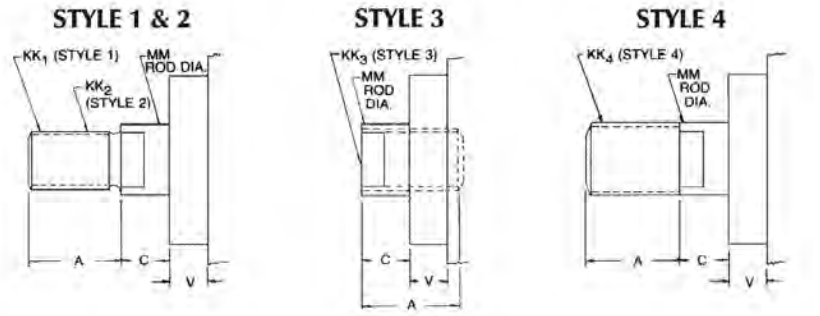
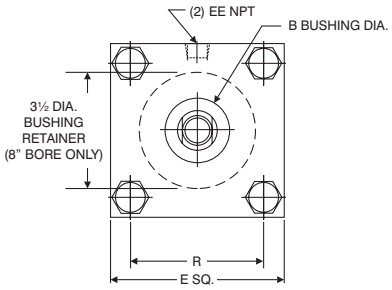
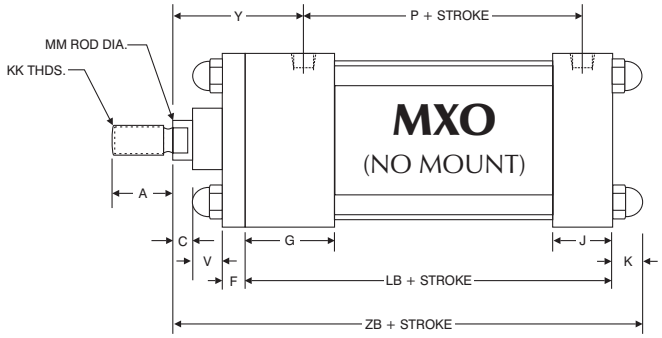
PISTON ROD END STYLES



BORE	MM ROD DIAMETER	STANDARD STYLE 1 - MALE KK1	STANDARD STYLE 1 - MALE A	OPTIONAL STYLE 2 - MALE KK2	OPTIONAL STYLE 2 - MALE A	OPTIONAL STYLE 3 - FEMALE KK3	OPTIONAL STYLE 3 - FEMALE A	OPTIONAL STYLE 4 - MALE KK4	OPTIONAL STYLE 4 - MALE A	C	V
1.50, 2.00, 2.50	0.625 Standard	7/16 -20	0.750	1/2-20	0.750	7/16 -20	0.750	5/8 -18	0.750	0.375	0.250
	1.000 Oversize	3/4 -16	1.125	7/8-14	1.125	3/4 -16	1.125	1 -14	1.125	0.500	0.500
3.25, 4.00, 5.00	1.000 Standard	3/4 -16	1.125	7/8-14	1.125	3/4 -16	1.125	1 -14	1.125	0.500	0.250
	1.375 Oversize	1 -14	1.625	1 1/4-12	1.625	1 -14	1.625	1 3/8 -12	1.625	0.625	0.375
6.00	1.375 Standard	1 -14	1.625	1 1/4-12	1.625	1 -14	1.625	1 3/8 -12	1.625	0.625	0.250
	1.750 Oversize	1 1/4 -12	2.000	1 1/2-12	2.000	1 1/4 -12	2.000	1 3/4 -12	2.000	0.750	0.375
8.00	1.375 Standard	1 -14	1.625	1 1/4-12	1.625	1 -14	1.625	1 3/8 -12	1.625	0.625	0.375
	1.750 Oversize	1 1/4 -12	2.000	1 1/2-12	2.000	1 1/4 -12	2.000	1 3/4 -12	2.000	0.750	0.500

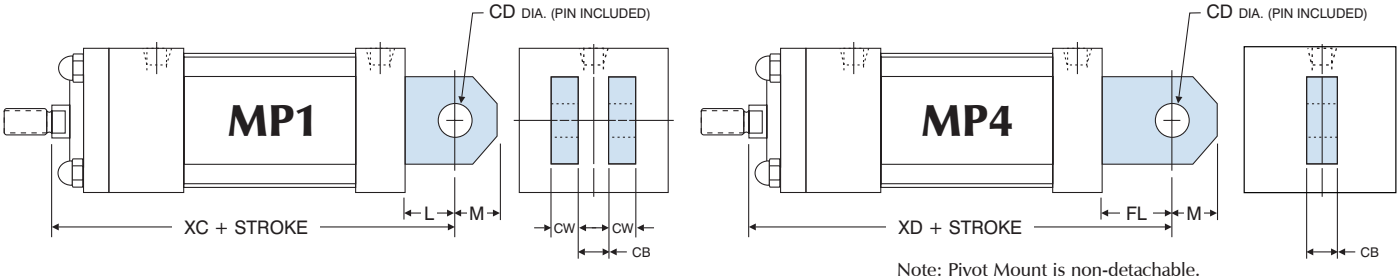




BASIC DIMENSIONS 'MXO' STANDARD & OVERSIZED RODS																		
BORE	ROD DIAMETER	A	B	C	E	EE	F	G	J	K	KK	LB	MM	P	R	V	Y	ZB
1.50	0.625 Standard	0.750	1.125	0.375	2.000	0.375	0.375	1.500	1.000	0.438	7/16 -20	3.625	0.625	2.375	1.430	0.250	1.875	5.063
	1.000 Oversize	1.125	1.500	0.500							3/4 -16		1.000			0.500	2.250	5.438
2.00	0.625 Standard	0.750	1.125	0.375	2.500	0.375	0.375	1.500	1.000	0.563	7/16 -20	3.625	0.625	2.375	1.840	0.250	1.875	5.188
	1.000 Oversize	1.125	1.500	0.500							3/4 -16		1.000			0.500	2.250	5.563
2.50	0.625 Standard	0.750	1.125	0.375	3.000	0.375	0.375	1.500	1.000	0.563	7/16 -20	3.750	0.625	2.500	2.190	0.250	1.875	5.313
	1.000 Oversize	1.125	1.500	0.500							3/4 -16		1.000			0.500	2.250	5.688
3.25	1.000 Standard	1.125	1.500	0.500	3.750	0.500	0.625	1.750	1.250	0.625	3/4 -16	4.250	1.000	2.750	2.760	0.250	2.375	6.250
	1.375 Oversize	1.625	2.000	0.625							1 -14		1.375			0.375	2.625	6.500
4.00	1.000 Standard	1.125	1.500	0.500	4.500	0.500	0.625	1.750	1.250	0.625	3/4 -16	4.250	1.000	2.750	3.320	0.250	2.375	6.250
	1.375 Oversize	1.625	2.000	0.625							1 -14		1.375			0.375	2.625	6.500
5.00	1.000 Standard	1.125	1.500	0.500	5.500	0.500	0.625	1.750	1.250	0.813	3/4 -16	4.500	1.000	3.000	4.100	0.250	2.375	6.625
	1.375 Oversize	1.625	2.000	0.625							1 -14		1.375			0.375	2.625	6.875
6.00	1.375 Standard	1.625	2.000	0.625	6.500	0.750	0.750	2.000	1.500	0.813	1 -14	5.000	1.375	3.250	4.880	0.250	2.750	7.375
	1.750 Oversize	2.000	2.375	0.750							1 1/4 -12		1.750			0.375	3.000	7.625
8.00	1.375 Standard	1.625	2.000	0.625	8.500	0.750	0.625	2.000	1.500	1.000	1 -14	5.125	1.375	3.375	6.440	0.375	2.750	7.750
	1.750 Oversize	2.000	2.375	0.750							1 1/4 -12		1.750			0.500	3.000	8.000

'SS' SERIES BASE DIMENSIONS FLIP-OUT (PAGE 141)

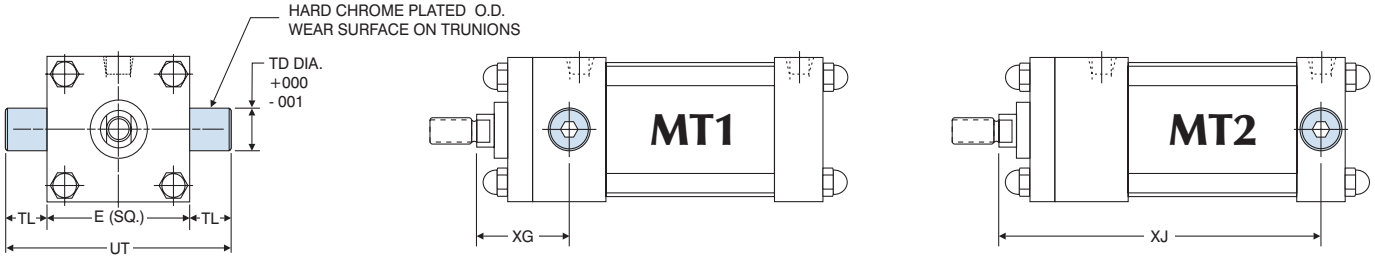
SERIES 'SS' DIMENSIONS: PIVOT MOUNTS



Note: Pivot Mount is non-detachable.
Contact factory for detachable mount options.

'MP1' CLEVIS AND 'MP4' EYE MOUNT DIMENSIONS										ACCESSORIES (SEE PAGE 210 FOR DIMENSIONS)			
BORE	ROD DIAMETER	CB	CD	CW	FL	L	M	XC	XD	ROD CLEVIS	ROD EYE	CLEVIS PIN	EYE BRACKET (FOR MP1)
1.50	0.625 Standard	0.750	0.500	0.500	1.125	0.750	0.625	5.375	5.750	SS-RC437	SS-RE437	SS-CP500	
	1.000 Oversize							5.750	6.125	SS-RC750	SS-RE750	SS-CP750	
2.00	0.625 Standard	0.750	0.500	0.500	1.125	0.750	0.625	5.375	5.750	SS-RC437	SS-RE437	SS-CP500	SS-EB500
	1.000 Oversize							5.750	6.125	SS-RC750	SS-RE750	SS-CP750	
2.50	0.625 Standard	0.750	0.500	0.500	1.125	0.750	0.625	5.500	5.875	SS-RC437	SS-RE437	SS-CP500	
	1.000 Oversize							5.875	6.250	SS-RC750	SS-RE750	SS-CP750	
3.25	1.000 Standard	1.250	0.750	0.625	1.875	1.250	0.875	6.875	7.500	SS-RC750	SS-RE750	SS-CP750	
	1.375 Oversize							7.125	7.750	SS-RC1000	SS-RE1000	SS-CP1000	
4.00	1.000 Standard	1.250	0.750	0.625	1.875	1.250	0.875	6.875	7.500	SS-RC750	SS-RE750	SS-CP750	SS-EB750
	1.375 Oversize							7.125	7.750	SS-RC1000	SS-RE1000	SS-CP1000	
5.00	1.000 Standard	1.250	0.750	0.625	1.875	1.250	0.875	7.125	7.750	SS-RC750	SS-RE750	SS-CP750	
	1.375 Oversize							7.375	8.000	SS-RC1000	SS-RE1000	SS-CP1000	
6.00	1.375 Standard	1.500	1.000	0.750	2.250	1.500	1.000	8.125	8.875	SS-RC1000	SS-RE1000	SS-CP1000	
	1.750 Oversize							8.375	9.125	SS-RC1250	SS-RE1250	SS-CP1375	SS-EB1000
8.00	1.375 Standard	1.500	1.000	0.750	N/A	1.500	1.000	8.250	N/A	SS-RC1000	SS-RE1000	SS-CP1000	
	1.750 Oversize							8.500	N/A	SS-RC1250	SS-RE1250	SS-CP1375	

Clevis pin provided with MP1 and MP4 mounts.
MP4 8.00" bore not available.
For dimensions not shown, see page 141.



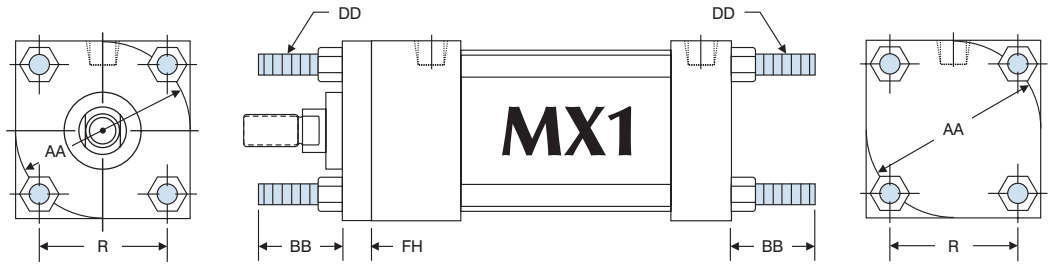
MT1 / MT2

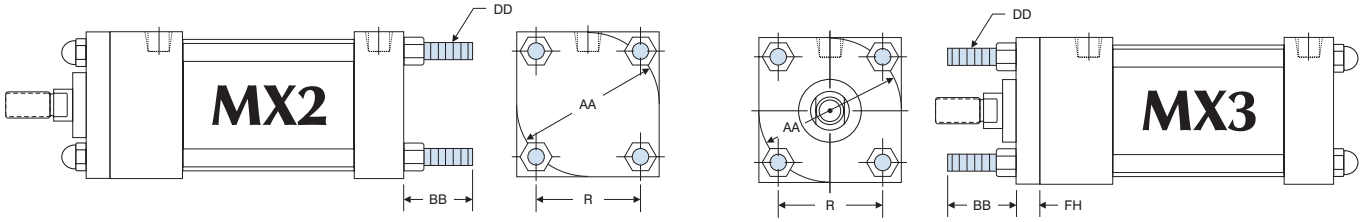
Note: Trunnions are bolt on, non-removable design.

'MT1' HEAD TRUNNION AND 'MT2' CAP TRUNNION MOUNT DIMENSIONS								ACCESSORIES (SEE PAGE 210 FOR DIMENSIONS)		
BORE	ROD DIAMETER	E	TD	TL	UT	XG	XJ	ROD CLEVIS	ROD EYE	CLEVIS PIN
1.50	0.625 Standard	2.000	1.000	1.000	4.000	1.750	4.125	SS-RC437	SS-RE437	SS-CP500
	1.000 Oversize*					N/A	4.500	SS-RC750	SS-RE750	SS-CP750
2.00	0.625 Standard	2.500	1.000	1.000	4.500	1.750	4.125	SS-RC437	SS-RE437	SS-CP500
	1.000 Oversize					2.125	4.500	SS-RC750	SS-RE750	SS-CP750
2.50	0.625 Standard	3.000	1.000	1.000	5.000	1.750	4.250	SS-RC437	SS-RE437	SS-CP500
	1.000 Oversize					2.125	4.625	SS-RC750	SS-RE750	SS-CP750
3.25	1.000 Standard	3.750	1.000	1.000	5.750	2.250	5.000	SS-RC750	SS-RE750	SS-CP750
	1.375 Oversize					2.500	5.250	SS-RC1000	SS-RE1000	SS-CP1000
4.00	1.000 Standard	4.500	1.000	1.000	6.500	2.250	5.000	SS-RC750	SS-RE750	SS-CP750
	1.375 Oversize					2.500	5.250	SS-RC1000	SS-RE1000	SS-CP1000
5.00	1.000 Standard	5.500	1.000	1.000	7.500	2.250	5.250	SS-RC750	SS-RE750	SS-CP750
	1.375 Oversize					2.500	5.500	SS-RC1000	SS-RE1000	SS-CP1000
6.00	1.375 Standard	6.500	1.375	1.375	9.250	2.625	5.875	SS-RC1000	SS-RE1000	SS-CP1000
	1.750 Oversize					2.875	6.125	SS-RC1250	SS-RE1250	SS-CP1375
8.00	1.375 Standard	8.500	1.375	1.375	11.250	2.625	6.000	SS-RC1000	SS-RE1000	SS-CP1000
	1.750 Oversize					2.875	6.250	SS-RC1250	SS-RE1250	SS-CP1375

* No Oversize rod on 1.50" bore on MT1 mount.
For dimensions not shown, see page 141.

SERIES 'SS' DIMENSIONS: TIE ROD & FLANGE MOUNTS

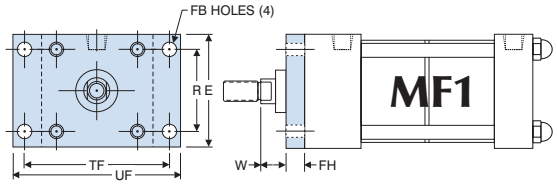




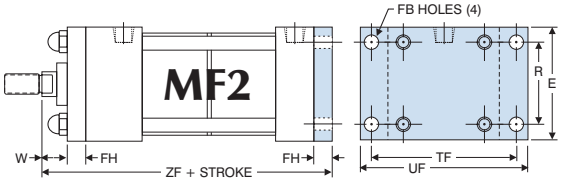
TIE ROD EXTENDED 'MX1', 'MX2' & 'MX3' MOUNT DIMENSIONS						
BORE	ROD DIAMETER	AA	BB	DD	FH	R
1.50	0.625 Standard	2.020	1.000	1/4 -28	0.375	1.430
	1.000 Oversize					
2.00	0.625 Standard	2.600	1.125	5/16 -24	0.375	1.840
	1.000 Oversize					
2.50	0.625 Standard	3.100	1.125	5/16 -24	0.375	2.190
	1.000 Oversize					
3.25	1.000 Standard	3.900	1.375	3/8 -24	0.625	2.760
	1.375 Oversize					

TIE ROD EXTENDED 'MX1', 'MX2' & 'MX3' MOUNT DIMENSIONS						
BORE	ROD DIAMETER	AA	BB	DD	FH	R
4.00	1.000 Standard	4.700	1.375	3/8 -24	0.625	3.320
	1.375 Oversize					
5.00	1.000 Standard	5.800	1.813	1/2 -20	0.625	4.100
	1.375 Oversize					
6.00	1.375 Standard	6.900	1.813	1/2 -20	0.750	4.880
	1.750 Oversize					
8.00	1.375 Standard	9.100	2.313	5/8 -18	0.625*	6.440
	1.750 Oversize					

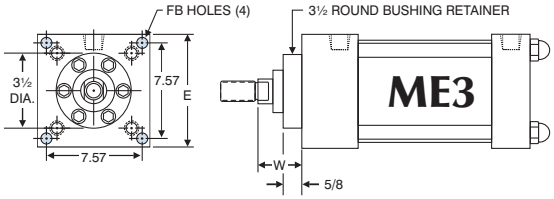
Full square bushing retainer on 1.50" through 6.00" bore.
*Round retainer on 8.00" bore. BB dimension from face of head.
For dimensions not shown, see page 141.



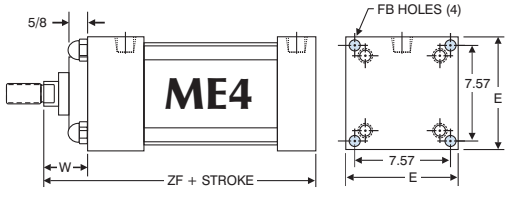
1.50" - 6.00" BORES



1.50" - 6.00" BORES



8.00" BORE ONLY



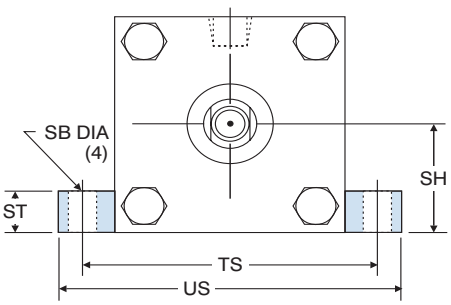
8.00" BORE ONLY

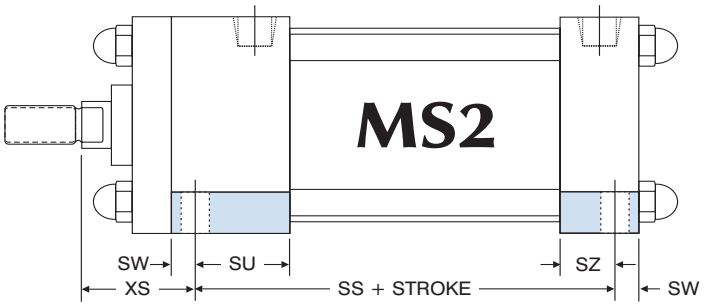
'MF1', 'MF2' FLANGE & 'ME3', 'ME4' CAP MOUNT DIMENSIONS									
BORE	ROD DIAMETER	E	FB	FH	R	TF	UF	W	ZF
1.50	0.625 Standard	2.000	0.313	0.375	1.430	2.750	3.375	0.625	5.000
	1.000 Oversize							1.000	5.375
2.00	0.625 Standard	2.500	0.375	0.375	1.840	3.375	4.125	0.625	5.000
	1.000 Oversize							1.000	5.375
2.50	0.625 Standard	3.000	0.375	0.375	2.190	3.875	4.625	0.625	5.125
	1.000 Oversize							1.000	5.500
3.25	1.000 Standard	3.750	0.438	0.625	2.760	4.688	5.500	0.750	6.250
	1.375 Oversize							1.000	6.500

'MF1', 'MF2' FLANGE & 'ME3', 'ME4' CAP MOUNT DIMENSIONS									
BORE	ROD DIAMETER	E	FB	FH	R	TF	UF	W	ZF
4.00	1.000 Standard	4.500	0.438	0.625	3.320	5.438	6.250	0.750	6.250
	1.375 Oversize							1.000	6.500
5.00	1.000 Standard	5.500	0.563	0.625	4.100	6.625	7.625	0.750	6.500
	1.375 Oversize							1.000	6.750
6.00	1.375 Standard	6.500	0.563	0.750	4.880	7.625	8.625	0.875	7.375
	1.750 Oversize							1.125	7.625
8.00	1.375 Standard	8.500	0.688	N/A	N/A	N/A	N/A	1.625	6.750
	1.750 Oversize							1.875	7.000

Full square bushing retainer on 1.50" through 6.00" bore.
*Round retainer on 8.00" bore.
For dimensions not shown, see page 141.

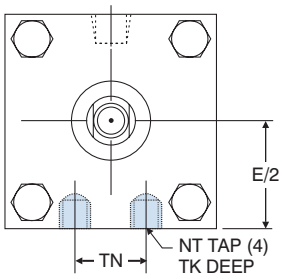
SERIES 'SS' DIMENSIONS: BASE MOUNTS

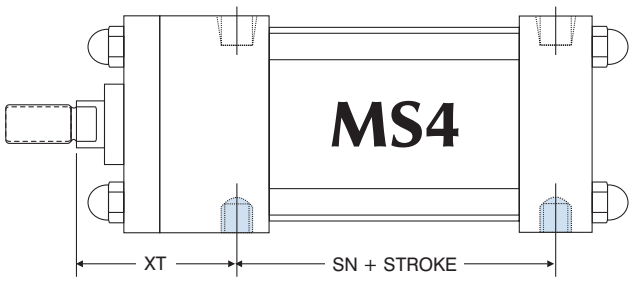




'MS2' SIDE LUG MOUNT DIMENSIONS											
BORE	ROD DIAMETER	SB	SH	ST	SU	SW	SZ	TS	US	XS	SS ADD STROKE
1.50	0.625 Standard 1.000 Oversize	0.438	1.000	0.500	1.125	0.375	0.625	2.750	3.500	1.375 1.750	2.875
2.00	0.625 Standard 1.000 Oversize	0.438	1.250	0.500	1.125	0.375	0.625	3.250	4.000	1.375 1.750	2.875
2.50	0.625 Standard 1.000 Oversize	0.438	1.500	0.500	1.125	0.375	0.625	3.750	4.500	1.375 1.750	3.000
3.25	1.000 Standard 1.375 Oversize	0.563	1.875	0.750	1.250	0.500	0.750	4.750	5.750	1.875 2.125	3.250
4.00	1.000 Standard 1.375 Oversize	0.563	2.250	0.750	1.250	0.500	0.750	5.500	6.500	1.875 2.125	3.250
5.00	1.000 Standard 1.375 Oversize	0.813	2.750	1.000	1.063	0.688	0.563	6.875	8.250	2.063 2.313	3.125
6.00	1.375 Standard 1.750 Oversize	0.813	3.250	1.000	1.313	0.688	0.813	7.875	9.250	2.313 2.563	3.625
8.00	1.375 Standard 1.750 Oversize	0.813	4.250	1.000	1.563	0.688	0.813	9.875	11.250	2.313 2.563	3.750

Full square bushing retainer on 1.50" through 6.00" bore.
Round retainer on 8.00" bore.
For dimensions not shown, see page 141.





'MS4' BOTTOM TAP MOUNT DIMENSIONS							
BORE	ROD DIAMETER	E/2	NT	TK	TN	XT	SN ADD STROKE
1.50	0.625 Standard 1.000 Oversize	1.000	1/4 -20	0.375	0.625	1.938 2.313	2.250
2.00	0.625 Standard 1.000 Oversize	1.250	5/16 -18	0.500	0.875	1.938 2.313	2.250
2.50	0.625 Standard 1.000 Oversize	1.500	3/8 -16	0.625	1.250	1.938 2.313	2.375
3.25	1.000 Standard 1.375 Oversize	1.875	1/2 -13	0.750	1.500	2.438 2.688	2.625
4.00	1.000 Standard 1.375 Oversize	2.250	1/2 -13	0.750	2.063	2.438 2.688	2.625
5.00	1.000 Standard 1.375 Oversize	2.750	5/8 -11	1.000	2.688	2.438 2.688	2.875
6.00	1.375 Standard 1.750 Oversize	3.250	3/4 -10	1.125	3.250	2.813 3.063	3.125
8.00	1.375 Standard 1.750 Oversize	4.250	3/4 -10	1.125	4.500	2.813 3.063	3.250

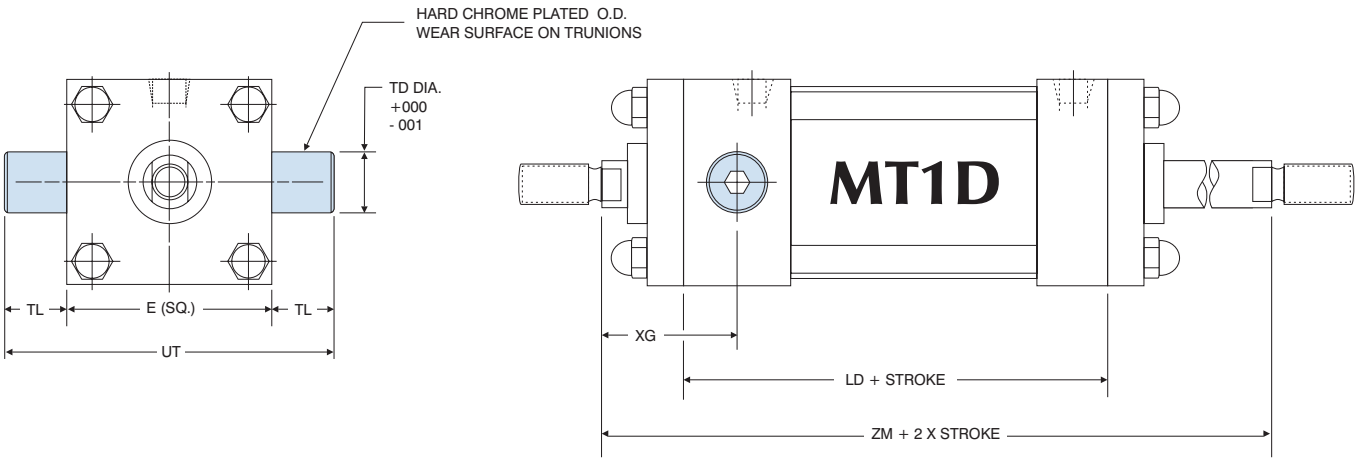
Full square bushing retainer on 1.50" through 6.00" bore
Round retainer on 8.00" bore.
For dimensions not shown, see page 141.

SERIES 'SS' DIMENSIONS: DOUBLE ROD END

Benefits

- Standard and Oversized 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).

(MT1D MOUNT SHOWN)



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

'SS-MT1D' HEAD TRUNNION MOUNT DIMENSIONS								
BORE	ROD DIAMETER	E	LD	TD	TL	UT	XG	ZM
1.50	0.625 Standard	2.000	4.125	1.000	1.000	4.000	1.750	6.125
	N/A*						N/A	N/A
2.00	0.625 Standard	2.500	4.125	1.000	1.000	4.500	1.750	6.125
	1.000 Oversize						2.125	6.875
2.50	0.625 Standard	3.000	4.250	1.000	1.000	5.000	1.750	6.250
	1.000 Oversize						2.125	7.000
3.25	1.000 Standard	3.750	4.750	1.000	1.000	5.750	2.250	7.500
	1.375 Oversize						2.500	8.000
4.00	1.000 Standard	4.500	4.750	1.000	1.000	6.500	2.250	7.500
	1.375 Oversize						2.500	8.000
5.00	1.000 Standard	5.500	5.000	1.000	1.000	7.500	2.250	7.750
	1.375 Oversize						2.500	8.250
6.00	1.375 Standard	6.500	5.500	1.375	1.375	9.250	2.625	8.750
	1.750 Oversize						2.875	9.250
8.00	1.375 Standard	8.500	5.625	1.375	1.375	11.250	2.625	8.875
	1.750 Oversize						2.875	9.375

* No oversized rod available on 1.50" bore.

SERIES 'SS' DIMENSIONS: DOUBLE ROD END

EASY FLIP OUT PAGE FOR REFERENCE

About Rod End Styles

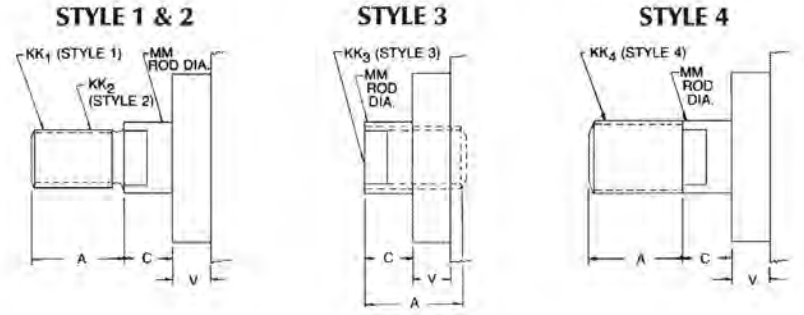
Style 1 Male Rod End is STANDARD

Other NFPA Styles can be specified (see chart).

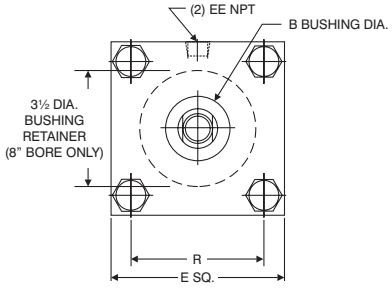
Need a rod end not listed?
NO PROBLEM! Each Piston Rod is made-to-order and does not delay shipment. Coarse (UNC) threads, Metric threads or just plain rod ends are common. Thread lengths are also made-to-order (Specify: "A"=Length).

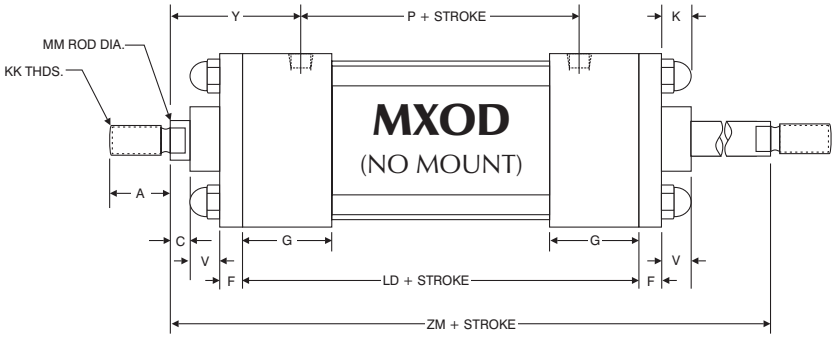
NEED SOMETHING NOT LISTED?
Just send us a sketch.
In most cases, quotes are turned around in one day!

PISTON ROD END STYLES



BORE	MM ROD DIAMETER	STANDARD STYLE 1 - MALE KK1	STANDARD STYLE 1 - MALE A	OPTIONAL STYLE 2 - MALE KK2	OPTIONAL STYLE 2 - MALE A	OPTIONAL STYLE 3 - FEMALE KK3	OPTIONAL STYLE 3 - FEMALE A	OPTIONAL STYLE 4 - MALE KK4	OPTIONAL STYLE 4 - MALE A	C	V
1.50, 2.00, 2.50	0.625 Standard	7/16 -20	0.750	1/2 -20	0.750	7/16 -20	0.750	5/8 -18	0.750	0.375	0.250
	1.000 Oversize	3/4 -16	1.125	7/8 -14	1.125	3/4 -16	1.125	1 -14	1.125	0.500	0.500
3.25, 4.00, 5.00	1.000 Standard	3/4 -16	1.125	7/8 -14	1.125	3/4 -16	1.125	1 -14	1.125	0.500	0.250
	1.375 Oversize	1 -14	1.625	1 1/4 -12	1.625	1 -14	1.625	1 3/8 -12	1.625	0.625	0.375
6.00	1.375 Standard	1 -14	1.625	1 1/4 -12	1.625	1 -14	1.625	1 3/8 -12	1.625	0.625	0.250
	1.750 Oversize	1 1/4 -12	2.000	1 1/2-12	2.000	1 1/4 -12	2.000	1 3/4 -12	2.000	0.750	0.375
8.00	1.375 Standard	1 -14	1.625	1 1/4-12	1.625	1 -14	1.625	1 3/8 -12	1.625	0.625	0.375
	1.750 Oversize	1 1/4 -12	2.000	1 1/2-12	2.000	1 1/4 -12	2.000	1 3/4 -12	2.000	0.750	0.500





DOUBLE ROD 'MXOD' DIMENSIONS STANDARD & OVERSIZED RODS																	
BORE	ROD DIAMETER	A	B	C	E	EE	F	G	K	KK	LD	MM	P	R	V	Y	ZM
1.50	0.625 Standard	0.750	1.125	0.375	2.000	0.375	0.375	1.500	0.438	7/16 -20	4.125	0.625	2.375	1.430	0.250	1.875	6.125
	1.000 Oversize	1.125	1.500	0.500						3/4 -16		1.000			0.500	2.250	6.875
2.00	0.625 Standard	0.750	1.125	0.375	2.500	0.375	0.375	1.500	0.563	7/16 -20	4.125	0.625	2.375	1.840	0.250	1.875	6.125
	1.000 Oversize	1.125	1.500	0.500						3/4 -16		1.000			0.500	2.250	6.875
2.50	0.625 Standard	0.750	1.125	0.375	3.000	0.375	0.375	1.500	0.563	7/16 -20	4.250	0.625	2.500	2.190	0.250	1.875	6.250
	1.000 Oversize	1.125	1.500	0.500						3/4 -16		1.000			0.500	2.250	7.000
3.25	1.000 Standard	1.125	1.500	0.500	3.750	0.500	0.625	1.750	0.625	3/4 -16	4.750	1.000	2.750	2.760	0.250	2.375	7.500
	1.375 Oversize	1.625	2.000	0.625						1 -14		1.375			0.375	2.625	8.000
4.00	1.000 Standard	1.125	1.500	0.500	4.500	0.500	0.625	1.750	0.625	3/4 -16	4.750	1.000	2.750	3.320	0.250	2.375	7.500
	1.375 Oversize	1.625	2.000	0.625						1 -14		1.375			0.375	2.625	8.000
5.00	1.000 Standard	1.125	1.500	0.500	5.500	0.500	0.625	1.750	0.813	3/4 -16	5.000	1.000	3.000	4.100	0.250	2.375	7.750
	1.375 Oversize	1.625	2.000	0.625						1 -14		1.375			0.375	2.625	8.250
6.00	1.375 Standard	1.625	2.000	0.625	6.500	0.750	0.750	2.000	0.813	1 -14	5.500	1.375	3.250	4.880	0.250	2.750	8.750
	1.750 Oversize	2.000	2.375	0.750						1 1/4 -12		1.750			0.375	3.000	9.250
8.00	1.375 Standard	1.625	2.000	0.625	8.500	0.750	0.625	2.000	1.000	1 -14	5.625	1.375	3.375	6.440	0.375	2.750	8.875
	1.750 Oversize	2.000	2.375	0.750						1 1/4 -12		1.750			0.500	3.000	9.375

'SS' SERIES DOUBLE ROD END BASE DIMENSIONS FLIP-OUT (PAGE 146)

EASY FLIP OUT PAGE FOR REFERENCE

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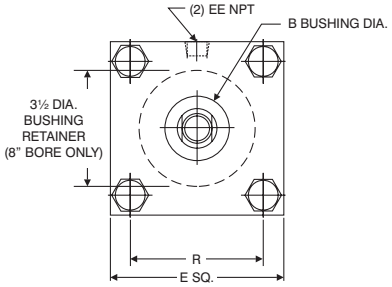
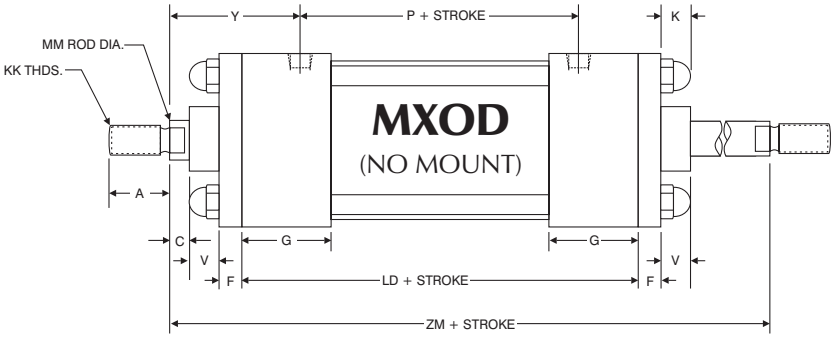
NEED SOMETHING NOT LISTED?
Just send us a sketch.
In most cases, quotes are turned around in one day!

PISTON ROD END STYLES

BORE	MM ROD DIAMETER	STANDARD STYLE 1 - MALE KK1	STANDARD STYLE 1 - MALE A	OPTIONAL STYLE 2 - MALE KK2	OPTIONAL STYLE 2 - MALE A	OPTIONAL STYLE 3 - FEMALE KK3	OPTIONAL STYLE 3 - FEMALE A	OPTIONAL STYLE 4 - MALE KK4	OPTIONAL STYLE 4 - MALE A	C	V
1.50, 2.00, 2.50	0.625 Standard	7/16 -20	0.750	1/2 -20	0.750	7/16 -20	0.750	5/8 -18	0.750	0.375	0.250
	1.000 Oversize	3/4 -16	1.125	7/8 -14	1.125	3/4 -16	1.125	1 -14	1.125	0.500	0.500
3.25, 4.00, 5.00	1.000 Standard	3/4 -16	1.125	7/8 -14	1.125	3/4 -16	1.125	1 -14	1.125	0.500	0.250
	1.375 Oversize	1 -14	1.625	1 1/4 -12	1.625	1 -14	1.625	1 3/8 -12	1.625	0.625	0.375
6.00	1.375 Standard	1 -14	1.625	1 1/4 -12	1.625	1 -14	1.625	1 3/8 -12	1.625	0.625	0.250
	1.750 Oversize	1 1/4 -12	2.000	1 1/2-12	2.000	1 1/4 -12	2.000	1 3/4 -12	2.000	0.750	0.375
8.00	1.375 Standard	1 -14	1.625	1 1/4-12	1.625	1 -14	1.625	1 3/8 -12	1.625	0.625	0.375
	1.750 Oversize	1 1/4 -12	2.000	1 1/2-12	2.000	1 1/4 -12	2.000	1 3/4 -12	2.000	0.750	0.500

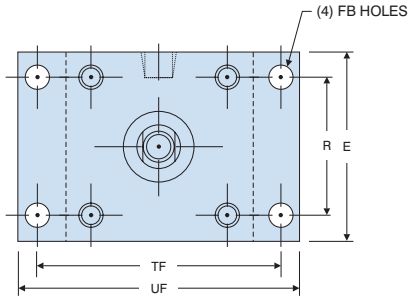


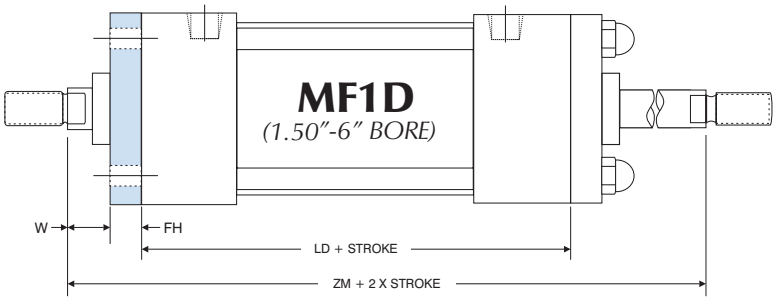


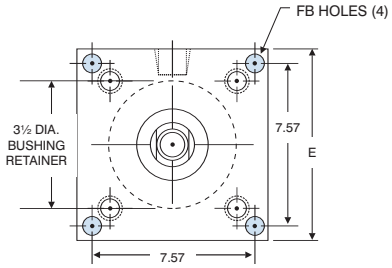
DOUBLE ROD 'MXOD' DIMENSIONS STANDARD & OVERSIZED RODS																	
BORE	ROD DIAMETER	A	B	C	E	EE	F	G	K	KK	LD	MM	P	R	V	Y	ZM
1.50	0.625 Standard	0.750	1.125	0.375	2.000	0.375	0.375	1.500	0.438	7/16 -20	4.125	0.625	2.375	1.430	0.250	1.875	6.125
	1.000 Oversize	1.125	1.500	0.500						3/4 -16		1.000			0.500	2.250	6.875
2.00	0.625 Standard	0.750	1.125	0.375	2.500	0.375	0.375	1.500	0.563	7/16 -20	4.125	0.625	2.375	1.840	0.250	1.875	6.125
	1.000 Oversize	1.125	1.500	0.500						3/4 -16		1.000			0.500	2.250	6.875
2.50	0.625 Standard	0.750	1.125	0.375	3.000	0.375	0.375	1.500	0.563	7/16 -20	4.250	0.625	2.500	2.190	0.250	1.875	6.250
	1.000 Oversize	1.125	1.500	0.500						3/4 -16		1.000			0.500	2.250	7.000
3.25	1.000 Standard	1.125	1.500	0.500	3.750	0.500	0.625	1.750	0.625	3/4 -16	4.750	1.000	2.750	2.760	0.250	2.375	7.500
	1.375 Oversize	1.625	2.000	0.625						1 -14		1.375			0.375	2.625	8.000
4.00	1.000 Standard	1.125	1.500	0.500	4.500	0.500	0.625	1.750	0.625	3/4 -16	4.750	1.000	2.750	3.320	0.250	2.375	7.500
	1.375 Oversize	1.625	2.000	0.625						1 -14		1.375			0.375	2.625	8.000
5.00	1.000 Standard	1.125	1.500	0.500	5.500	0.500	0.625	1.750	0.813	3/4 -16	5.000	1.000	3.000	4.100	0.250	2.375	7.750
	1.375 Oversize	1.625	2.000	0.625						1 -14		1.375			0.375	2.625	8.250
6.00	1.375 Standard	1.625	2.000	0.625	6.500	0.750	0.750	2.000	0.813	1 -14	5.500	1.375	3.250	4.880	0.250	2.750	8.750
	1.750 Oversize	2.000	2.375	0.750						1 1/4 -12		1.750			0.375	3.000	9.250
8.00	1.375 Standard	1.625	2.000	0.625	8.500	0.750	0.625	2.000	1.000	1 -14	5.625	1.375	3.375	6.440	0.375	2.750	8.875
	1.750 Oversize	2.000	2.375	0.750						1 1/4 -12		1.750			0.500	3.000	9.375

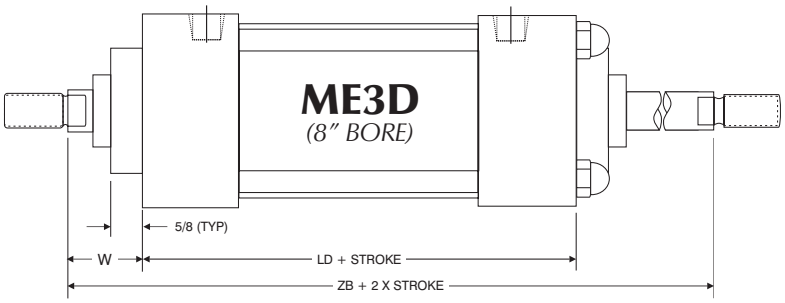
'SS' SERIES DOUBLE ROD END BASE DIMENSIONS FLIP-OUT (PAGE 146)

SERIES 'SS' DIMENSIONS: DOUBLE ROD END FLANGE MOUNTS



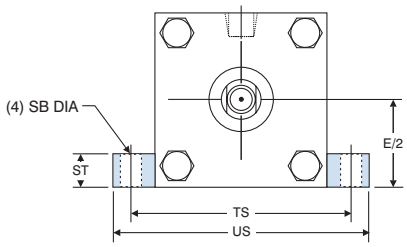


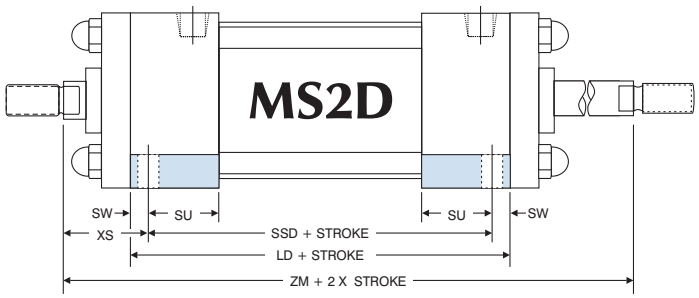




'SS-MF1D' FLANGE & 'SS-ME3D' HEAD MOUNT DIMENSIONS										
BORE	ROD DIAMETER	E	FB	FH	LD	R	TF	UF	W	ZM
1.50	0.625 Standard	2.000	0.313	0.375	4.125	1.430	2.750	3.375	0.625	6.125
	1.000 Oversize								1.000	6.875
2.00	0.625 Standard	2.500	0.375	0.375	4.125	1.840	3.375	4.125	0.625	6.125
	1.000 Oversize								1.000	6.875
2.50	0.625 Standard	3.000	0.375	0.375	4.250	2.190	3.875	4.625	0.625	6.250
	1.000 Oversize								1.000	7.000
3.25	1.000 Standard	3.750	0.438	0.625	4.750	2.760	4.688	5.500	0.750	7.500
	1.375 Oversize								1.000	8.000
4.00	1.000 Standard	4.500	0.438	0.625	4.750	3.320	5.438	6.250	0.750	7.500
	1.375 Oversize								1.000	8.000
5.00	1.000 Standard	5.500	0.563	0.625	5.000	4.100	6.625	7.625	0.750	7.750
	1.375 Oversize								1.000	8.250
6.00	1.375 Standard	6.500	0.563	0.750	5.500	4.880	7.625	8.625	0.875	8.750
	1.750 Oversize								1.125	9.250
8.00	1.375 Standard	8.500	0.688	N/A	5.625	N/A	N/A	N/A	1.625	8.875
	1.750 Oversize								1.875	9.375

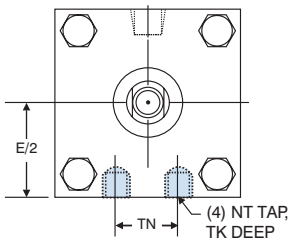
SERIES 'SS' DIMENSIONS: DOUBLE ROD END BASE MOUNTS

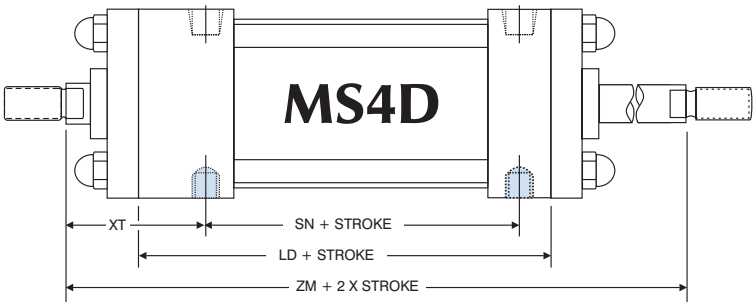




'SS-MS2D' SIDE LUG MOUNT DIMENSIONS												
BORE	ROD DIAMETER	E/2	LD	SB	ST	SU	SW	TS	US	XS	ZM	SSD
1.50	0.625 Standard	1.000	4.125	0.438	0.500	1.125	0.375	2.750	3.500	1.375	6.125	3.375
	1.000 Oversize									1.750	6.875	
2.00	0.625 Standard	1.250	4.125	0.438	0.500	1.125	0.375	3.250	4.000	1.375	6.125	3.375
	1.000 Oversize									1.750	6.875	
2.50	0.625 Standard	1.500	4.250	0.438	0.500	1.125	0.375	3.750	4.500	1.375	6.250	3.500
	1.000 Oversize									1.750	7.000	
3.25	1.000 Standard	1.875	4.750	0.563	0.750	1.250	0.500	4.750	5.750	1.875	7.500	3.750
	1.375 Oversize									2.125	8.000	
4.00	1.000 Standard	2.250	4.750	0.563	0.750	1.250	0.500	5.500	6.500	1.875	7.500	3.750
	1.375 Oversize									2.125	8.000	
5.00	1.000 Standard	2.750	5.000	0.813	1.000	1.063	0.688	6.875	8.250	2.063	7.750	3.625
	1.375 Oversize									2.313	8.250	
6.00	1.375 Standard	3.250	5.500	0.813	1.000	1.313	0.688	7.875	9.250	2.313	8.750	4.125
	1.750 Oversize									2.563	9.250	
8.00	1.375 Standard	4.250	5.625	0.813	1.000	1.313	0.688	9.875	11.250	2.313	8.875	4.250
	1.750 Oversize									2.563	9.375	

Note: Round retainer on 8.00" bore only.





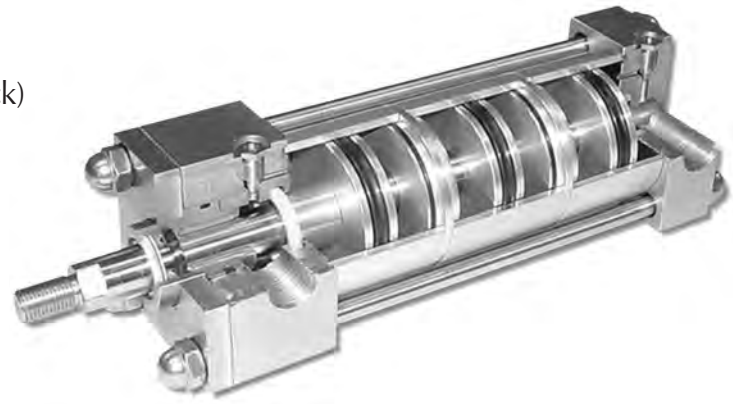
'SS-MS4D' BOTTOM TAPPED MOUNT DIMENSIONS									
BORE	ROD DIAMETER	E/2	LD	NT	TK	TN	XT	SN	ZM
1.50	0.625 Standard	1.000	4.125	1/4-20	0.375	0.625	1.938	2.250	6.125
	1.000 Oversize						2.313		6.875
2.00	0.625 Standard	1.250	4.125	5/16-18	0.500	0.875	1.938	2.250	6.125
	1.000 Oversize						2.313		6.875
2.50	0.625 Standard	1.500	4.250	3/8-16	0.625	1.250	1.938	2.375	6.250
	1.000 Oversize						2.313		7.000
3.25	1.000 Standard	1.875	4.750	1/2-13	0.750	1.500	2.438	2.625	7.500
	1.375 Oversize						2.688		8.000
4.00	1.000 Standard	2.250	4.750	1/2-13	0.750	2.063	2.438	2.625	7.500
	1.375 Oversize						2.688		8.000
5.00	1.000 Standard	2.750	5.000	5/8-11	1.000	2.688	2.438	2.875	7.750
	1.375 Oversize						2.688		8.125
6.00	1.375 Standard	3.250	5.500	3/4-10	1.125	3.250	2.813	3.125	8.750
	1.750 Oversize						3.063		9.250
8.00	1.375 Standard	4.250	5.625	3/4-10	1.125	4.500	2.813	3.250	8.875
	1.750 Oversize						3.063		9.375

Note: Round retainer on 8.00" bore only.

SERIES 'SS-MS': MULTI-STAGE

FORCE MULTIPLYING CYLINDERS

Benefits



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

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

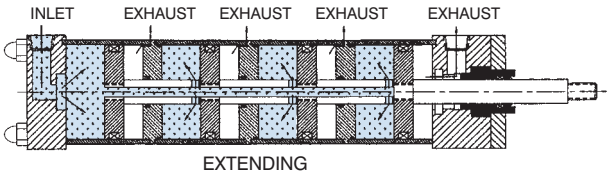
The SS-MSE multiplies the force on the extend stroke, the SS-MSR multiplies the force on the retract stroke. Both models use only one piston on the return stroke, saving air volume and operating costs.

How They Work

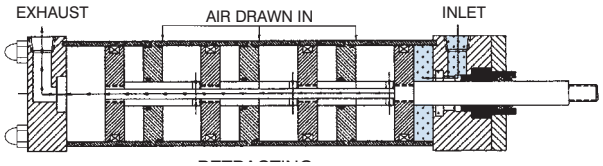
Model SS-MSE

4 Stage Shown

Extension-air supplied to multiple pistons



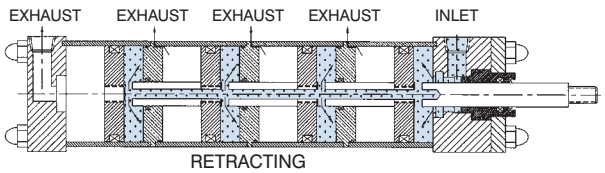
Retraction-air supplied to one piston



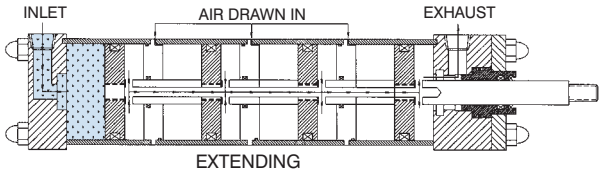
Model SS-MSR

4 Stage Shown

Retraction-air supplied to multiple pistons



Extension-air supplied to one piston



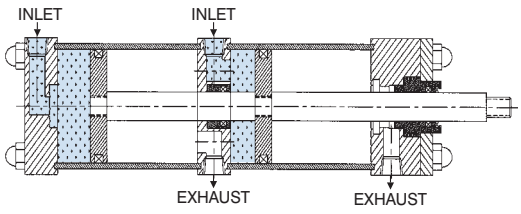
Force multiplying in both Extend and Retract strokes

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

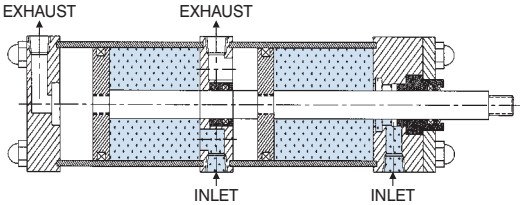
To Order, specify:
"SS-MSE/MSR" as model number.

Extension AND Retraction
Air supplied to multiple pistons

EXTENDING STROKE



RETRACTING STROKE



Model SS-MSE/MSR
2 Stage Shown

SERIES 'SS-MS': ORDERING INSTRUCTIONS

SS-MSE ___ - MS4 - 3.25 x 2 x 3S - MPR

SERIES	
SS-MSE	MULTI STAGE EXTEND
SS-MSR	MULTI STAGE RETRACT

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

NFPA MOUNTS	
MXO	NO MOUNT
MX1	EXTENDED TIE RODS - HEAD & CAP (1.50"-6.00" Bore)
MX2	EXTENDED TIE RODS (CAP) (1.50"-6.00" Bore)
MX3	EXTENDED TIE RODS (HEAD) (1.50"-6.00" Bore)
MF1	FRONT FLANGE (1.50"-6.00" Bore)
MF2	REAR PIVOT CLEVIS (1.50"-6.00" Bore)
MP1	REAR PIVOT CLEVIS (1.50"-6.00" Bore)
MP2	REAR PIVOT CLEVIS (1.50"-6.00" Bore)
MS2	SIDE LUG (1.50"-6.00" Bore)
MS4	BOTTOM TAPPED HOLES (1.50"-6.00" Bore)

BORE
1.50
2.00
2.50
3.25
4.00
5.00
6.00

STROKE
1.00" TO 12.00" CONSULT FACTORY FOR OTHER STROKES

STAGES	
2S	TWO STAGE
3S	THREE STAGE
4S	FOUR STAGE

OPTIONS		
		ADDS LENGTH TO CYLINDER - SEE "OPTION LENGTH ADDER" CHART BELOW.
X	B	.25" URETHANE BUMPER BOTH ENDS
X	BH	.25" URETHANE BUMPER HEAD ONLY
X	BC	.25" URETHANE BUMPER CAP ONLY
	"A"-	EXTEND PISTON ROD THREAD (SPECIFY)
	"C"-	EXTEND PISTON ROD (SPECIFY)
	H	HEAD CUSHION (AVAILABLE ON MSE ONLY)
	C	CAP CUSHION (AVAILABLE ON MSR ONLY)
	DRB	DELRIN® ROD BUSHING
	FDAL	FDA APPROVED LUBRICANT
	KK2	LARGE MALE ROD THREAD
	KK3	FEMALE ROD THREAD
	KK3S	STUDDED PISTON ROD (WITH KK3)
	KK4	FULL DIAMETER MALE ROD THREAD
X	MPR	MAGNETIC PISTON FOR REED SWITCHES
X	MPH	MAGNETIC PISTON FOR HALL SWITCHES
	MS	METALLIC ROD SCRAPER (BRASS)
X	NR	NON-ROTATING (INTERNALLY GUIDED) ADDITIONAL LENGTH - SEE CHART
	OP	OPTIONAL PORT LOCATION
	OS	OVERSIZED ROD DIAMETER (SPECIFY SIZE)
	ST	**STOP TUBE** - SPECIFY STOP TUBE LENGTH (in inches) SPECIFY STROKE AS ES (effective stroke) (Example: SS-MS MS4 2 X 24ES-ST=3)
	TH	HYDRAULIC (NON-SHOCK)
	VS	FLUOROCARBON SEALS
	AS	ADJUSTABLE STROKE (RETRACT)
	XX	SPECIAL VARIATION (SPECIFY)
		BSP, SAE PORTS (SPECIFY SIZE)

ORDERING EXAMPLES:

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

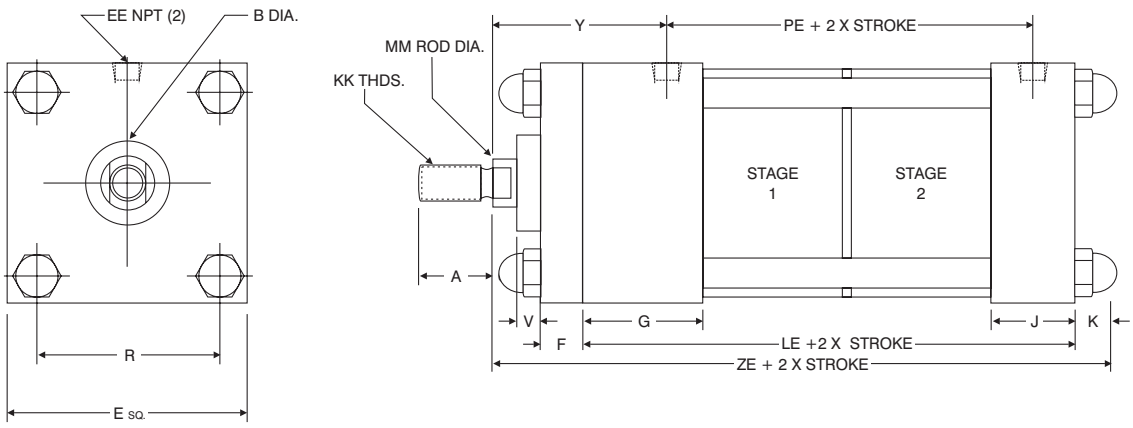
EXAMPLE 2: Double Rod End MS4 Mount, 2 Stage, 6.00" Bore, 3" Stroke, Force Multiplied in RETRACT with Magnetic Piston for REED Switches is:
SS-MSR MS4D 6 x 3 x 2S - MPR
(Note: MPR Option adds 0.750" to Cylinder length.)

OPTION LENGTH ADDER
(ADD TO CATALOG BASIC OVERALL LENGTH DIMENSIONS)

BORE	OPTION					
	B	BC	BH	MPR	MPH	NR
1.50	0.500	0.250	0.250	0.625	0.625	0.625
2.00	0.500	0.250	0.250	0.625	0.625	0.625
2.50	0.500	0.250	0.250	0.750	0.750	0.750
3.25	0.500	0.250	0.250	0.625	0.625	0.625
4.00	0.500	0.250	0.250	0.625	0.625	0.625
5.00	0.500	0.250	0.250	0.875	0.875	0.875
6.00	0.500	0.250	0.250	0.750	0.750	0.750

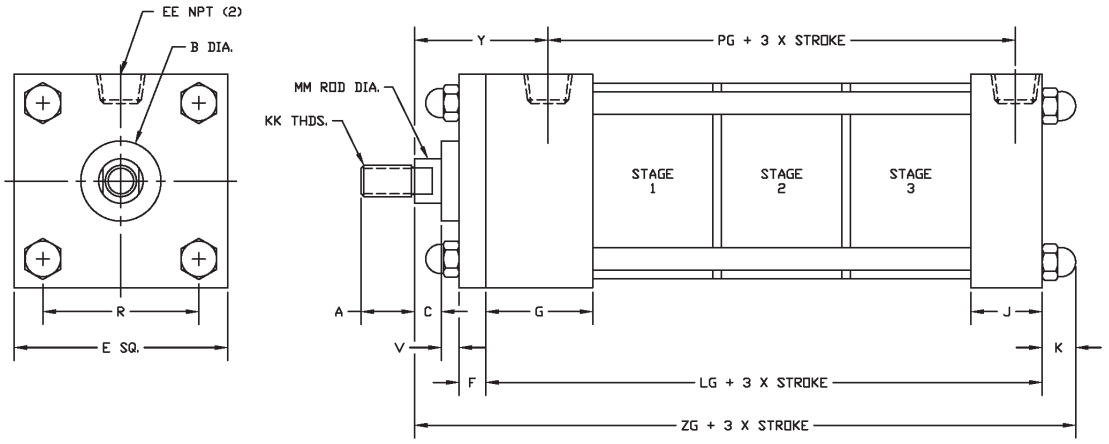
MPR/MPH OPTION: Magnet is located in stage at cap for standard units, in stage at head for 'NR' units

'SS-MS' SERIES CYLINDERS: 2 STAGE EXTEND OR RETRACT
STANDARD ROD DIAMETER BASIC DIMENSIONS MXO



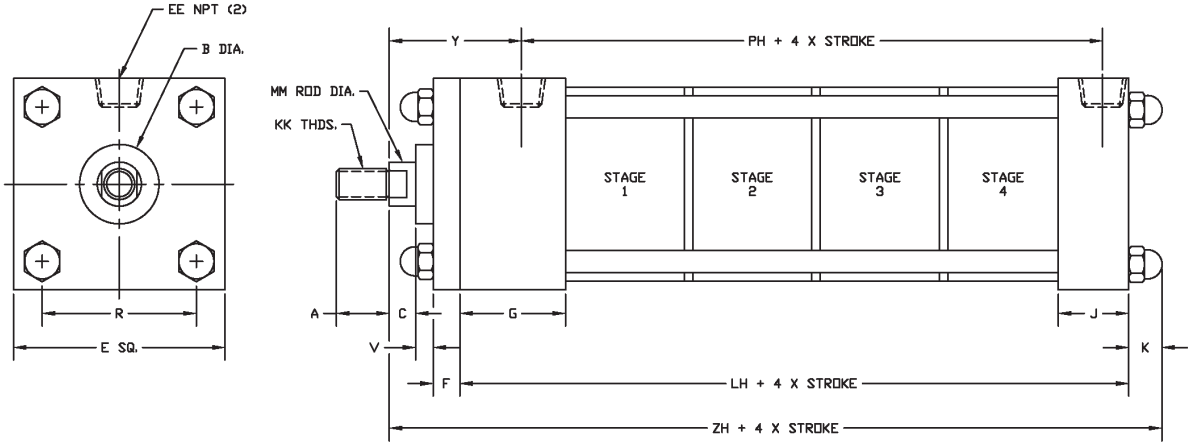
BORE	A	B	C	E	EE	F	G	J	K	KK	LE	MM	PE	R	V	Y	ZE
1.50	0.750	1.125	0.375	2.000	0.375	0.375	1.500	1.000	0.438	7/16-20	4.000	0.625	2.750	1.430	0.250	1.875	5.438
2.00	0.750	1.125	0.375	2.500	0.375	0.375	1.500	1.000	0.563	7/16-20	4.000	0.625	2.750	1.840	0.250	1.875	5.563
2.50	0.750	1.125	0.375	3.000	0.375	0.375	1.500	1.000	0.563	7/16-20	4.000	0.625	2.750	2.190	0.250	1.875	5.563
3.25	1.125	1.500	0.500	3.750	0.500	0.625	1.750	1.250	0.625	3/4-16	4.875	1.000	3.375	2.760	0.250	2.375	6.875
4.00	1.125	1.500	0.500	4.500	0.500	0.625	1.750	1.250	0.625	3/4-16	4.875	1.000	3.375	3.320	0.250	2.375	6.875
5.00	1.125	1.500	0.500	5.500	0.500	0.625	1.750	1.250	0.813	3/4-16	4.875	1.000	3.375	4.100	0.250	2.375	7.063
6.00	1.625	2.000	0.625	6.500	0.750	0.750	2.000	1.500	0.813	1-14	5.750	1.375	4.000	4.880	0.250	2.750	8.313

'SS-MS' SERIES CYLINDERS: 3 STAGE EXTEND OR RETRACT
STANDARD ROD DIAMETER BASIC DIMENSIONS MXO



BORE	A	B	C	E	EE	F	G	J	K	KK	LG	MM	PG	R	V	Y	ZG
1.50	0.750	1.125	0.375	2.000	0.375	0.375	1.500	1.000	0.438	7/16 -20	5.000	0.625	3.750	1.430	0.250	1.875	6.438
2.00	0.750	1.125	0.375	2.500	0.375	0.375	1.500	1.000	0.563	7/16 -20	5.000	0.625	3.750	1.840	0.250	1.875	6.563
2.50	0.750	1.125	0.375	3.000	0.375	0.375	1.500	1.000	0.563	7/16 -20	5.000	0.625	3.750	2.190	0.250	1.875	6.563
3.25	1.125	1.500	0.500	3.750	0.500	0.625	1.750	1.250	0.625	3/4 -16	6.125	1.000	4.625	2.760	0.250	2.375	8.125
4.00	1.125	1.500	0.500	4.500	0.500	0.625	1.750	1.250	0.625	3/4 -16	6.125	1.000	4.625	3.320	0.250	2.375	8.125
5.00	1.125	1.500	0.500	5.500	0.500	0.625	1.750	1.250	0.813	3/4 -16	6.125	1.000	4.625	4.100	0.250	2.375	8.313
6.00	1.625	2.000	0.625	6.500	0.750	0.750	2.000	1.500	0.813	1 -14	7.250	1.375	5.500	4.880	0.250	2.750	9.813

'SS-MS' SERIES CYLINDERS: 4 STAGE EXTEND OR RETRACT
STANDARD ROD DIAMETER BASIC DIMENSIONS MXO

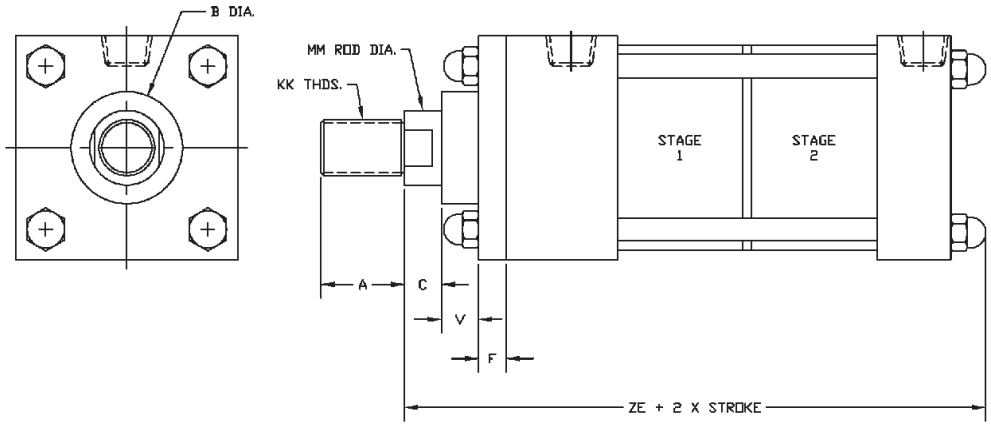


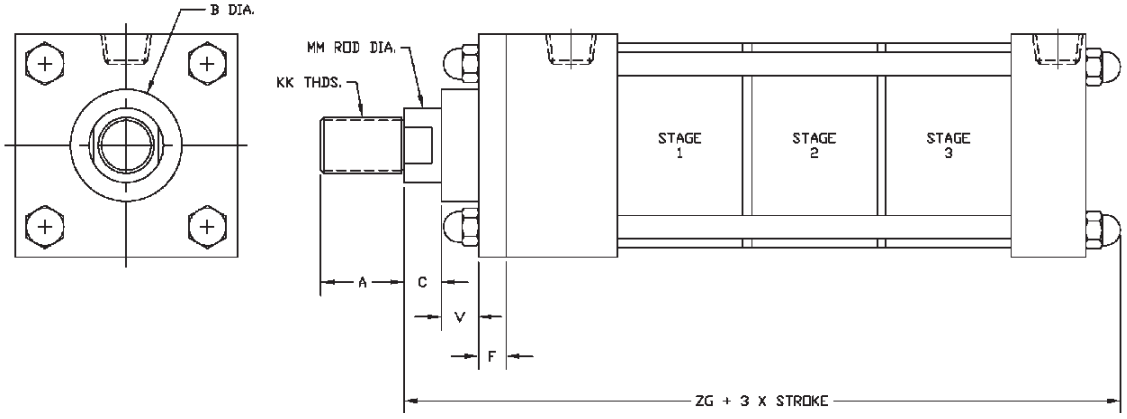
BORE	A	B	C	E	EE	F	G	J	K	KK	LH	MM	PH	R	V	Y	ZH
1.50	0.750	1.125	0.375	2.000	0.375	0.375	1.500	1.000	0.438	7/16 -20	6.000	0.625	4.750	1.430	0.250	1.875	7.438
2.00	0.750	1.125	0.375	2.500	0.375	0.375	1.500	1.000	0.563	7/16 -20	6.000	0.625	4.750	1.840	0.250	1.875	7.563
2.50	0.750	1.125	0.375	3.000	0.375	0.375	1.500	1.000	0.563	7/16 -20	6.000	0.625	4.750	2.190	0.250	1.875	7.563
3.25	1.125	1.500	0.500	3.750	0.500	0.625	1.750	1.250	0.625	3/4 -16	7.375	1.000	5.875	2.760	0.250	2.375	9.375
4.00	1.125	1.500	0.500	4.500	0.500	0.625	1.750	1.250	0.625	3/4 -16	7.375	1.000	5.875	3.320	0.250	2.375	9.375
5.00	1.125	1.500	0.500	5.500	0.500	0.625	1.750	1.250	0.813	3/4 -16	7.375	1.000	5.875	4.100	0.250	2.375	9.563
6.00	1.625	2.000	0.625	6.500	0.750	0.750	2.000	1.500	0.813	1 -14	8.750	1.375	7.000	4.880	0.250	2.750	11.313

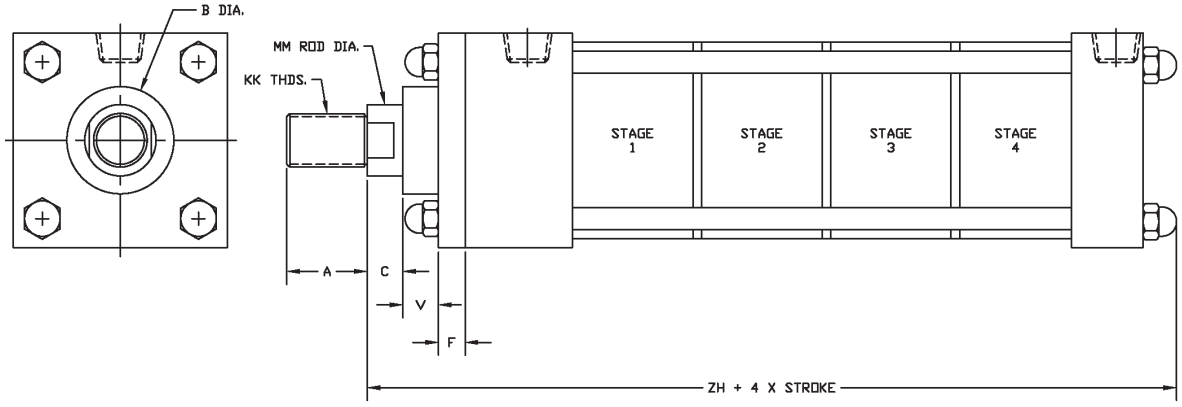
SERIES 'SS-MS' DIMENSIONS: OVERSIZED ROD

OVERSIZED ROD DIAMETER

BASIC DIMENSIONS MXO (NO MOUNT)







MULTI-STAGE OVERSIZE ROD DIAMETER								ADD STROKE PER STAGE		
BORE	A	B	C	F	V	KK	MM	ZE	ZG	ZH
1.50	1.125	1.500	0.500	0.375	0.500	3/4 -16	1.000	5.813	6.813	7.813
2.00	1.125	1.500	0.500	0.375	0.500	3/4 -16	1.000	5.938	6.938	7.938
2.50	1.125	1.500	0.500	0.375	0.500	3/4 -16	1.000	5.938	6.938	7.938
3.25	1.625	2.000	0.625	0.625	0.375	1 -14	1.375	7.125	8.375	9.625
4.00	1.625	2.000	0.625	0.625	0.375	1 -14	1.375	7.125	8.375	9.625
5.00	1.625	2.000	0.625	0.625	0.375	1 -14	1.375	7.313	8.563	9.813
6.00	2.000	2.375	0.750	0.750	0.375	1 1/4 -12	1.750	8.438	9.938	11.438

For dimensions not shown see pages 150-151.

SERIES 'SS' DIMENSIONS: 'SS-MS' DIMENSIONS

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).

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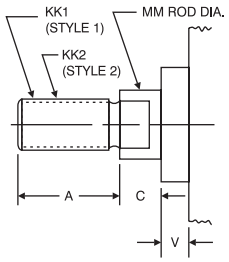
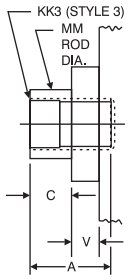
In most cases, quotes are turned around in one day!

PISTON ROD END STYLES

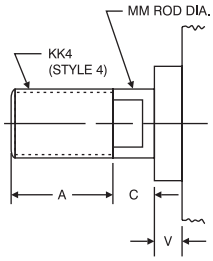
STYLE 1 & 2
KK1 & KK2



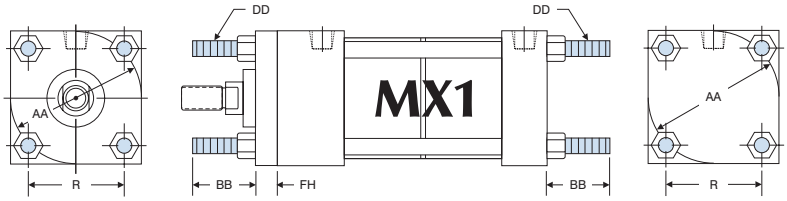
STYLE 3
KK3

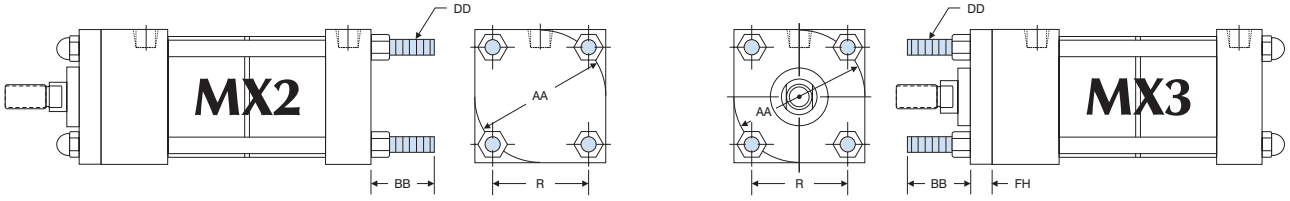


STYLE 4
KK4



BORE	MM ROD DIAMETER	STANDARD STYLE 1 - MALE KK1	A	OPTIONAL STYLE 2 - MALE KK2	A	STYLE 3 - FEMALE KK3	A	STYLE 4 - MALE KK4	A	C	V
1.50, 2.00, 2.50	0.625 Standard	7/16 -20	0.750	1/2 -20	0.750	7/16 -20	0.750	5/8 -18	0.750	0.375	0.250
	1.000 Oversize	3/4 -16	1.125	7/8 -14	1.125	3/4 -16	1.125	1 -14	1.125	0.500	0.500
3.25, 4.00, 5.00	1.000 Standard	3/4 -16	1.125	7/8 -14	1.125	3/4 -16	1.125	1 -14	1.125	0.500	0.250
	1.375 Oversize	1 -14	1.625	1 1/4 -12	1.625	1 -14	1.625	1 3/8 -12	1.625	0.625	0.375
6.00 & 8.00	1.375 Standard	1 -14	1.625	1 1/4 -12	1.625	1 -14	1.625	1 3/8 -12	1.625	0.625	0.375
	1.750 Oversize	1 1/4 -12	2.000	1 1/4 -12	2.000	1 1/4 -12	2.000	1 3/4 -12	2.000	0.750	0.500





TIE ROD EXTENDED 'MX1', 'MX2' & 'MX3' MOUNT DIMENSIONS						
BORE	ROD DIAMETER	AA	BB	DD	FH	R
1.50	0.625 Standard	2.020	1.000	1/4 -28	0.375	1.430
	1.000 Oversize					
2.00	0.625 Standard	2.600	1.125	5/16 -24	0.375	1.840
	1.000 Oversize					
2.50	0.625 Standard	3.100	1.125	5/16 -24	0.375	2.190
	1.000 Oversize					
3.25	1.000 Standard	3.900	1.375	3/8 -24	0.625	2.760
	1.375 Oversize					

TIE ROD EXTENDED 'MX1', 'MX2' & 'MX3' MOUNT DIMENSIONS						
BORE	ROD DIAMETER	AA	BB	DD	FH	R
4.00	1.000 Standard	4.700	1.375	3/8 -24	0.625	3.320
	1.375 Oversize					
5.00	1.000 Standard	5.800	1.813	1/2 -20	0.625	4.100
	1.375 Oversize					
6.00	1.375 Standard	6.900	1.813	1/2 -20	0.750	4.880
	1.750 Oversize					

'SS-MS' SERIES BASE DIMENSIONS FLIP-OUT (PAGE 153)

EASY FLIP OUT PAGE FOR REFERENCE

SERIES 'SS' DIMENSIONS: 'SS-MS' DIMENSIONS

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?
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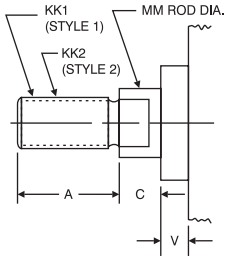
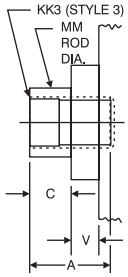
PISTON ROD END STYLES

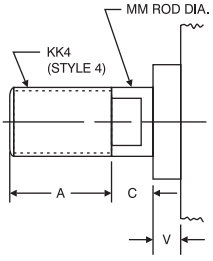
STYLE 1 & 2
KK1 & KK2



STYLE 3
KK3

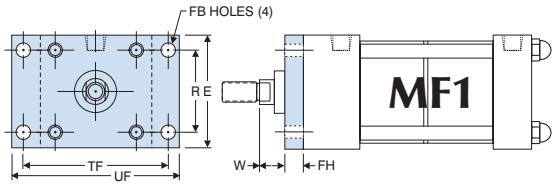


STYLE 4
KK4

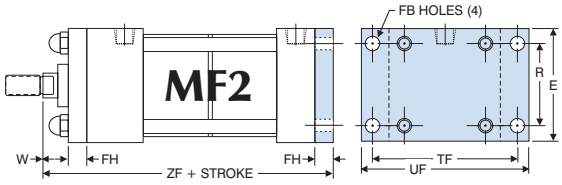


BORE	MM ROD DIAMETER	STANDARD STYLE 1 - MALE KK1	A	OPTIONAL STYLE 2 - MALE KK2	A	STYLE 3 - FEMALE KK3	A	STYLE 4 - MALE KK4	A	C	V
1.50, 2.00, 2.50	0.625 Standard	7/16 -20	0.750	1/2 -20	0.750	7/16 -20	0.750	5/8 -18	0.750	0.375	0.250
	1.000 Oversize	3/4 -16	1.125	7/8 -14	1.125	3/4 -16	1.125	1 -14	1.125	0.500	0.500
3.25, 4.00, 5.00	1.000 Standard	3/4 -16	1.125	7/8 -14	1.125	3/4 -16	1.125	1 -14	1.125	0.500	0.250
	1.375 Oversize	1 -14	1.625	1 1/4 -12	1.625	1 -14	1.625	1 3/8 -12	1.625	0.625	0.375
6.00 & 8.00	1.375 Standard	1 -14	1.625	1 1/4 -12	1.625	1 -14	1.625	1 3/8 -12	1.625	0.625	0.375
	1.750 Oversize	1 1/4 -12	2.000	1 1/4 -12	2.000	1 1/4 -12	2.000	1 3/4 -12	2.000	0.750	0.500

SERIES 'SS-MS' DIMENSIONS: FLANGE MOUNTS



1.50" - 6.00" BORES

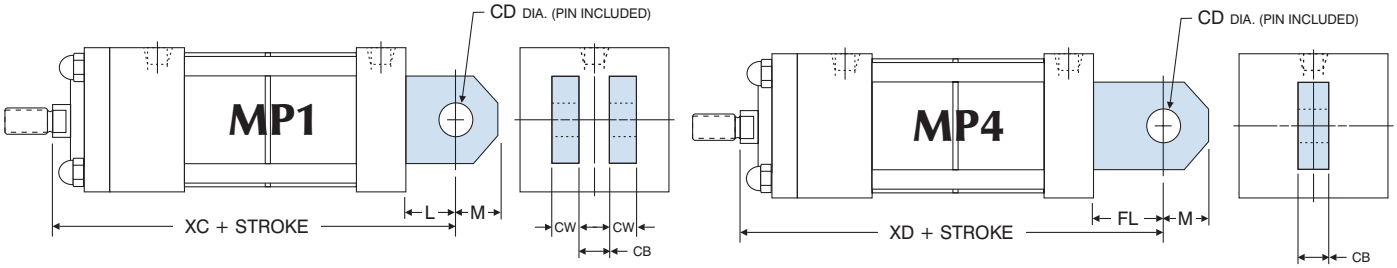


1.50" - 6.00" BORES

'MF1', 'MF2' FLANGE DIMENSIONS											
BORE	ROD DIAMETER	E	FB	FH	R	TF	UF	W	ZF + STROKE PER STAGE 2 STAGE	3 STAGE	4 STAGE
1.50	0.625 Standard	2.000	0.313	0.375	1.430	2.750	3.375	0.625	5.375	6.375	7.375
	1.000 Oversize							1.000	5.750	6.750	7.750
2.00	0.625 Standard	2.500	0.375	0.375	1.840	3.375	4.125	0.625	5.375	6.375	7.375
	1.000 Oversize							1.000	5.750	6.750	7.750
2.50	0.625 Standard	3.000	0.375	0.375	2.190	3.875	4.625	0.625	5.375	6.375	7.375
	1.000 Oversize							1.000	5.750	6.750	7.750
3.25	1.000 Standard	3.750	0.438	0.625	2.760	4.688	5.500	0.750	6.875	8.125	9.375
	1.375 Oversize							1.000	7.125	8.375	9.625
4.00	1.000 Standard	4.500	0.438	0.625	3.320	5.438	6.250	0.750	6.875	8.125	9.375
	1.375 Oversize							1.000	7.125	8.375	9.625
5.00	1.000 Standard	5.500	0.563	0.625	4.100	6.625	7.625	0.750	6.875	8.125	9.375
	1.375 Oversize							1.000	7.125	8.375	9.625
6.00	1.375 Standard	6.500	0.563	0.750	4.880	7.625	8.625	0.875	8.250	9.750	11.250
	1.750 Oversize							1.125	8.500	10.000	11.500

'SS-MS' SERIES BASE DIMENSIONS FLIP-OUT (PAGE 153)

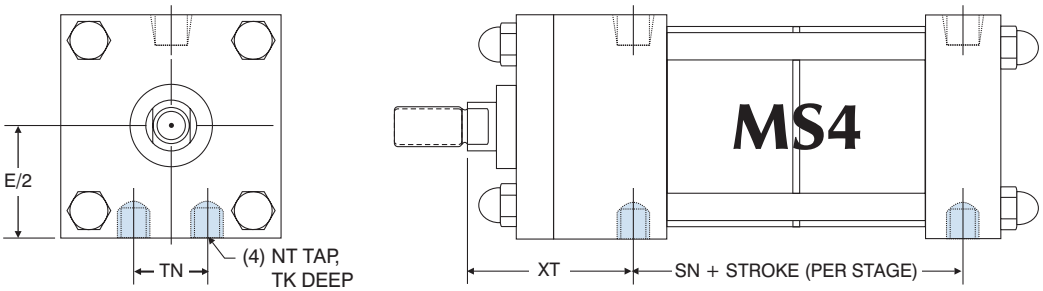
SERIES 'SS-MS' DIMENSIONS: PIVOT MOUNTS



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

For dimensions not shown see pages 150-151.
*Pivot pin included

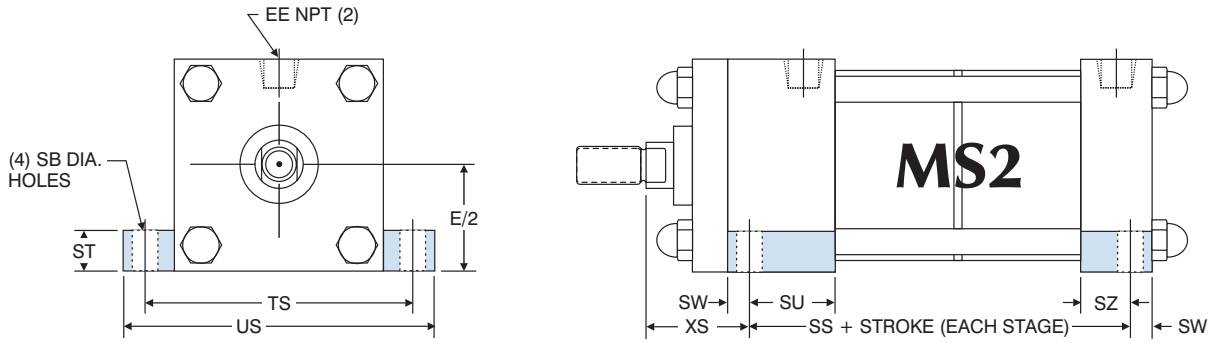
'SS-MS' SERIES: BASE MOUNTS



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

For dimensions not shown see pages 150-151.

SERIES 'SS-MS' DIMENSIONS: BASE MOUNTS



'MS2' SIDE LUG MOUNT DIMENSIONS													
BORE	ROD DIAMETER	E/2	SB	ST	SU	SW	SZ	TS	US	XS	SS + STROKE PER STAGE		
											2 STAGE	3 STAGE	4 STAGE
1.50	0.625 Standard	1.000	0.438	0.500	1.125	0.375	0.625	2.750	3.500	1.375	3.250	4.250	5.250
	1.000 Oversize									1.750			
2.00	0.625 Standard	1.250	0.438	0.500	1.125	0.375	0.625	3.250	4.000	1.375	3.250	4.250	5.250
	1.000 Oversize									1.750			
2.50	0.625 Standard	1.500	0.438	0.500	1.125	0.375	0.625	3.750	4.500	1.375	3.250	4.250	5.250
	1.000 Oversize									1.750			
3.25	1.000 Standard	1.875	0.563	0.750	1.250	0.500	0.750	4.750	5.750	1.875	3.875	5.125	6.375
	1.375 Oversize									2.125			
4.00	1.000 Standard	2.250	0.563	0.750	1.250	0.500	0.750	5.500	6.500	1.875	3.875	5.125	6.375
	1.375 Oversize									2.125			

* SS dimensions increase 0.500" on double rod cylinders

For dimensions not shown see pages 150-151.

Note: Overall lengths will change with the addition of non-rotating or magnetic pistons; consult factory.

'SS-MS' SERIES 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
2.00	2	5.974	5.499	5.668	4.714	358	329	340	282	597	549	566	471
	3	8.808	7.856	8.502	7.071	528	471	510	424	880	785	850	707
	4	11.642	10.213	11.336	9.428	698	612	680	565	1164	1021	1133	942
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
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
4.00	2	24.347	23.647	23.562	22.166	1460	1418	1413	1329	2434	2364	2356	2216
	3	36.127	34.728	35.342	33.243	2167	2083	2120	1994	3612	3472	3534	3324
	4	47.908	45.809	47.123	44.324	2874	2748	2827	2659	4790	4580	4712	4432
5.00	2	38.485	37.785	37.700	36.3	2309	2267	2262	2178	3848	3778	3770	3630
	3	57.334	55.935	56.549	54.45	3440	3356	3392	3267	5733	5593	5654	5445
	4	76.184	74.085	75.399	72.6	4571	4445	4523	4356	7618	7408	7539	7260
6.00	2	55.065	54.143	53.582	51.736	3303	3248	3214	3104	5506	5414	5358	5136
	3	81.854	80.012	80.370	77.607	4911	4800	4822	4656	8185	8001	8037	7760
	4	108.644	105.881	107.16	103.476	6518	6352	6429	6208	10864	10588	10716	10347

SERIES 'SS': 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 a 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 chart below 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 below shows that at 60 psi, the 2.00" bore with 0.625" rod extend force is 188 lbs. and retract force is 170 lbs.; the right cylinder for the application.

FORCE/VOLUME CHART

CYLINDER		STROKE TYPE	EFFECTIVE PISTON AREA	POUNDS OF FORCE AT PSI						CU. FT. DISPLACEMENT PER IN. OF STROKE
BORE	ROD			60	80	100	200	250	400	
1.50	ALL	PUSH	1.767	106	142	177	353	442	706	.00102
	0.625	PULL	1.460	88	117	146	292	365	584	.00084
	1.000	PULL	0.982	59	79	98	196	246	392	.00057
2.00	ALL	PUSH	3.142	188	251	314	628	785	1256	.00182
	0.625	PULL	2.835	170	227	284	567	708	1134	.00164
	1.000	PULL	2.357	141	189	236	471	589	942	.00136
2.50	ALL	PUSH	4.909	295	393	491	981	1227	1961	.00284
	0.625	PULL	4.602	267	368	460	920	1150	1840	.00266
	1.000	PULL	4.124	247	330	412	825	1031	1650	.00239
3.25	ALL	PUSH	8.296	498	664	830	1659	2074	3318	.00480
	1.000	PULL	7.511	451	601	751	1502	1877	3004	.00435
	1.375	PULL	6.811	409	545	681	1362	1702	2724	.00394
4.00	ALL	PUSH	12.566	754	1005	1257	2513	3141	5026	.00727
	1.000	PULL	11.781	707	942	1178	2356	2945	4712	.00682
	1.375	PULL	11.081	665	886	1108	2216	2770	4432	.00641
5.00	ALL	PUSH	19.635	1178	1571	1964	3927	4908	7854	.01136
	1.000	PULL	18.850	1131	1508	1885	3770	4712	7540	.01090
	1.375	PULL	18.150	1089	1452	1815	3630	4537	7260	.01050
6.00	ALL	PUSH	28.274	1696	2262	2827	5655	7068	11310	.01636
	1.375	PULL	26.789	1607	2144	2679	5358	6697	10716	.01550
	1.750	PULL	25.869	1552	2070	2587	5174	6467	10348	.01497
8.00	ALL	PUSH	50.265	3016	4021	5026	10053	12566	20106	.02908
	1.375	PULL	48.780	2927	3902	4878	9756	12195	19512	.02823
	1.750	PULL	47.860	2872	3829	4786	9572	11965	19144	.02770

TAS Series NFPA Steel Cylinders

1.50″ to 8.00″ Bore

Single Rod End Page 158

Double Rod End Page 166

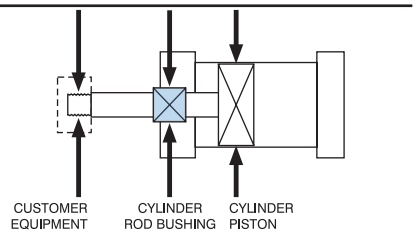
95% OF OUR CYLINDERS SHIP IN 2-3 DAYS!
ONE DAY RUSH SERVICE AVAILABLE ON ALL CATALOGED CYLINDER MODELS!

SERIES 'TAS' (NFPA) CYLINDER

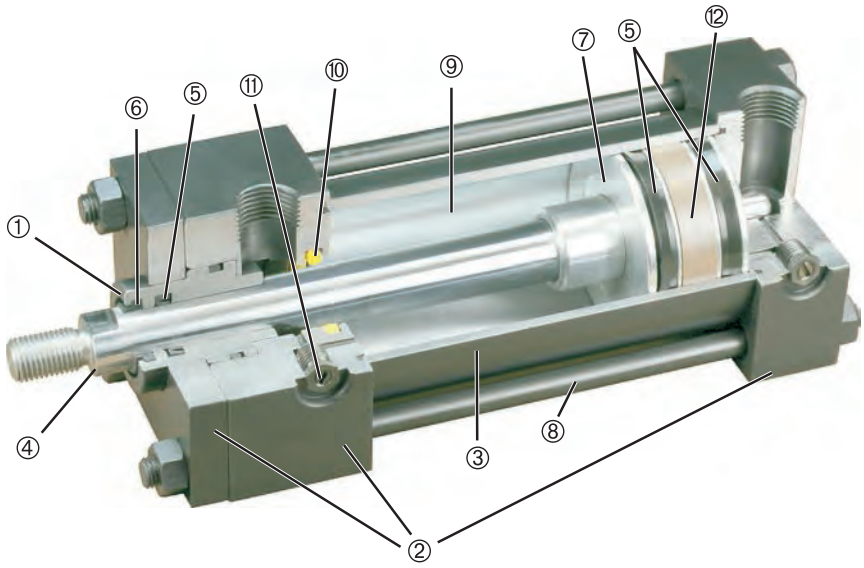
Floating Rod Bushing

SELF ALIGNMENT FEATURE

Rod Bushing is designed to float .002" to improve 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 steel head, cap and retainer are held to close tolerances and insure accurate alignment for a truly square cylinder.

③ ***CYLINDER TUBE*** – Precision machined steel tube with hard chrome I.D., is honed and micro finished for extended seal life and improved cycle rates.

④ ***PISTON ROD*** – Precision machined from high yield, polished and hard chrome plated steel.

⑤ ***PISTON & ROD SEALS*** – Heavy lip design Carboxilated 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*** – Pre-stressed 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 Magnalube-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 ***WEAR BAND*** – 90% Virgin PTFE and 10% Polyphenylene Sulfide material provides extended life due to extremely low wear factor.

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)

Performance options:

- ***BP*** – Bumper piston seals allow higher piston velocities due to rapid deceleration feature, increasing productivity.
- ***ST*** – Stop tubes are used to reduce rod bearing and piston stress (refer to page 185 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 two (2) internal guide rods preventing rod rotation (NFPA dimensions).

HOW TO ORDER: SERIES 'TAS' (HEAVY-DUTY STEEL CYLINDERS)

TAS - MF1 ___ - 2.50 x 10 - HC - KK3

SERIES	
TAS	250 PSI AIR

NFPA MOUNTS	
MF1	FRONT FLANGE (1.50"-6.00" Bore)
MF2	REAR FLANGE (1.50"-6.00" Bore)
ME3	FRONT MOUNTING HOLES (8.00" Bore)
ME4	REAR MOUNTING HOLES (8.00" Bore)
MP1	REAR PIVOT CLEVIS (1.50"-8.00" Bore)
MP2	REAR PIVOT CLEVIS (1.50"-6.00" Bore)
MP4	REAR PIVOT EYE (1.50"-6.00" Bore)
MS1	FRONT & REAR END ANGLE (1.50"-8.00" Bore)
MS2	SIDE LUG (1.50"-8.00" Bore)
MS4	BOTTOM TAPPED HOLES (1.50"-8.00" Bore)
MT1	FRONT TRUNNION (1.50"-8.00" Bore)
MT2	REAR TRUNNION (1.50"-8.00" Bore)
MT4	INTERMEDIATE TRUNNION (1.50"-8.00" Bore)
MX0	NO MOUNT (1.50"-8.00" Bore)
MX1	EXTENDED TIE RODS - HEAD & CAP (1.50"-8.00" Bore)
MX2	EXTENDED TIE RODS (CAP) (1.50"-8.00" Bore)
MX3	EXTENDED TIE RODS (HEAD) (1.50"-8.00" Bore)
SB	SPHERICAL BEARING CAP PIVOT (1.50"-8.00" Bore)

BORE	
1.50	2.00
2.50	3.25
4.00	5.00
6.00	8.00

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
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
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" CUSHION OPTION CAN BE ORDERED AS FIXED CUSHIONS.

Example: FCLH

	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" - 8.00" 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")
	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")
	KK10	ROD COUPLER END
	KKM	METRIC THREAD
	KKX	NON-STANDARD THREAD
	LF	**LOW FRICTION SEALS** *(Refer to page 183 for specifications)*
	MA	MICRO-ADJUST (6" MAX. STROKE) *Available on Double Rod End Models*
	MAB	MICRO-ADJUST WITH SOUND DAMPENING BUMPER (6" MAX. STROKE)
	MS	METALLIC ROD SCRAPER (BRASS CONSTRUCTION)
	NR	**NON-ROTATING** *(Refer to page 180 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
	SSC	STAINLESS STEEL CUSHION NEEDLES
	SSF	STAINLESS STEEL FASTENERS
	SSN	STAINLESS STEEL TIE ROD NUTS
	SSR	STAINLESS STEEL PISTON ROD
	SST	STAINLESS STEEL TIE RODS
X	ST	**STOP TUBE** - SPECIFY STOP TUBE LENGTH (in inches) SPECIFY STROKE AS ES (effective stroke) (Example: TAS MS4 2 X 24ES-ST=3)
	TH	**400 PSI HYDRAULIC NON-SHOCK** *(Refer to page 183 for specifications)*
	VS	FLUOROCARBON SEALS
	XX	SPECIAL VARIATION (SPECIFY)

About our Part Number System

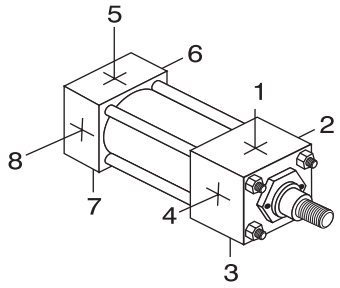
- Simple, easy to understand
- No excessive codes!
- Eliminates mistakes when ordering

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

Part Number: TAS-MF1-2.50 x 10-HC

STANDARD PORT AND CUSHION ADJUSTMENT POSITIONS

- Ports - Positions 1 and 5
- Cushion Adjustment - Positions 2 and 6
- Specify Non-Standard Positions When Ordering
- Port Location 9 is center of cap face.

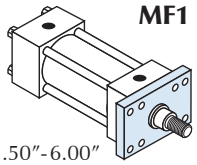
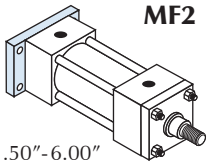
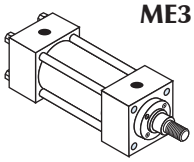
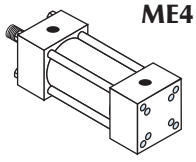
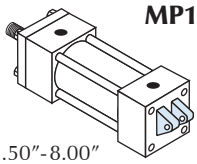
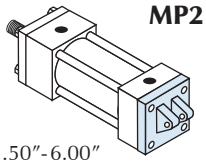
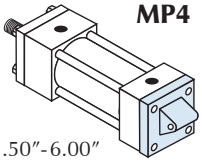
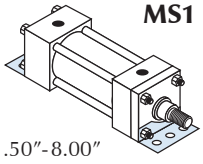
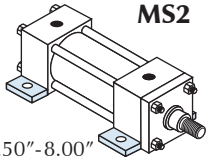
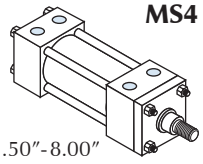
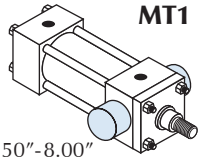
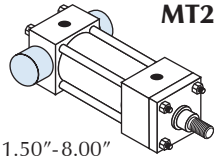
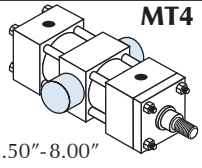
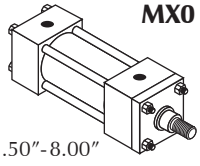
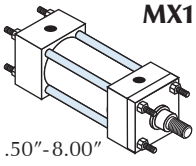
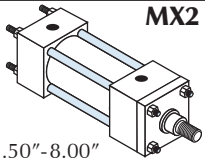
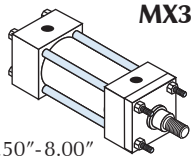
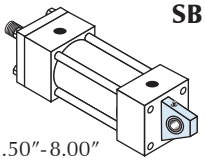


OPTION LENGTH ADDER
(ADD TO CATALOG BASIC OVERALL LENGTH DIMENSIONS)

BORE	OPTION B	OPTION BC	OPTION BH	OPTION ST* (STOP TUBE) Example: ST=2
1.50	0.500"	0.250"	0.250"	2
2.00	0.500"	0.250"	0.250"	2
2.50	0.500"	0.250"	0.250"	2
3.25	0.500"	0.250"	0.250"	2
4.00	0.500"	0.250"	0.250"	2
5.00	0.500"	0.250"	0.250"	2
6.00	0.500"	0.250"	0.250"	2
8.00	0.500"	0.250"	0.250"	2

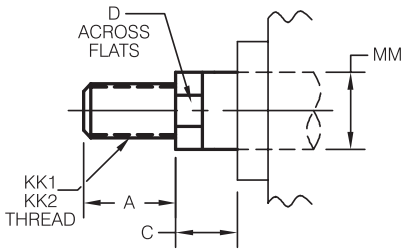
***Note:** The desired Stop Tube length adds directly to the overall cylinder length.

NFPA MOUNTS

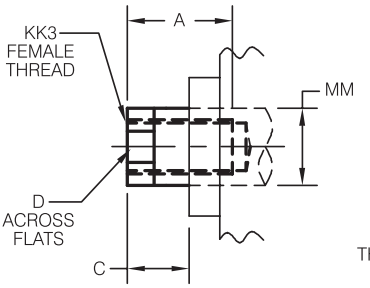
MF1  1.50"-6.00" Bores	**MF2**  1.50"-6.00" Bores	**ME3**  8.00" Bore	**ME4**  8.00"Bore	**MP1**  1.50"-8.00" Bores	**MP2**  1.50"-6.00" Bores
MP4  1.50"-6.00" Bores	**MS1**  1.50"-8.00" Bores	**MS2**  1.50"-8.00" Bores	**MS4**  1.50"-8.00" Bores	**MT1**  1.50"-8.00" Bores	**MT2**  1.50"-8.00" Bores
MT4  1.50"-8.00" Bores	**MX0**  1.50"-8.00" Bores	**MX1**  1.50"-8.00" Bores	**MX2**  1.50"-8.00" Bores	**MX3**  1.50"-8.00" Bores	**SB**  1.50"-8.00" Bores

SERIES 'TAS' DIMENSIONS: THREADS

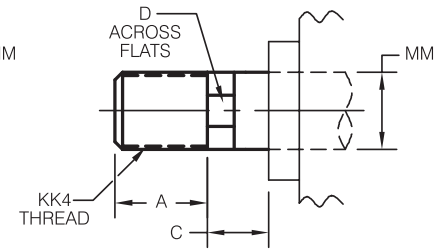
ROD END STYLE: KK1 KK2



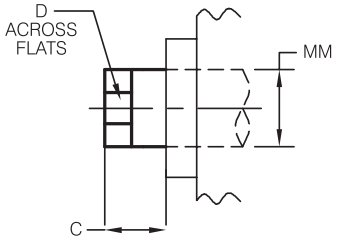
ROD END STYLE: KK3



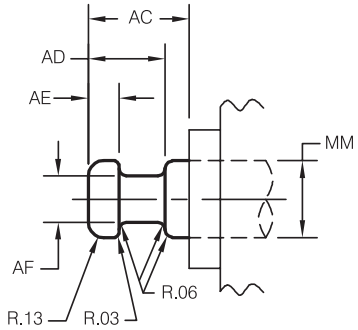
ROD END STYLE: KK4



ROD END STYLE: KK5



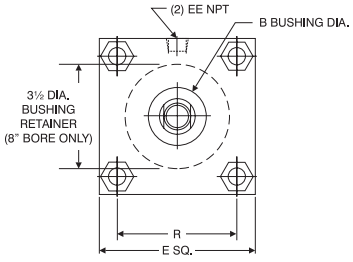
ROD END STYLE: KK10

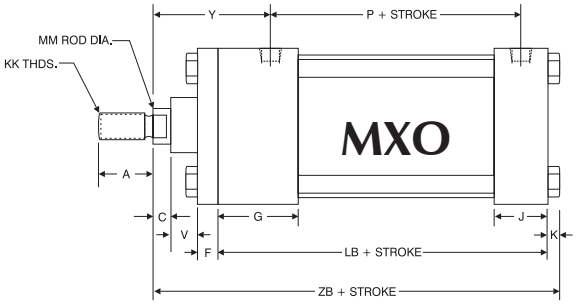


ROD DIA. (MM)	A	C	D	AC	AD	AE	AF	KK1	KK2	KK3	KK4
0.625	0.750	0.375	0.500	1.125	0.625	0.250	0.375	7/16 - 20	1/2 - 20	7/16 - 20	5/8 - 18
1.000	1.125	0.500	0.875	1.625	0.938	0.375	0.688	3/4 - 16	7/8 - 14	3/4 - 16	1 - 14
1.375	1.625	0.625	1.125	1.750	1.063	0.375	0.875	1 - 14	1 1/4 - 12	1 - 14	1 3/8 - 12
1.750	2.000	0.750	1.500	2.000	1.313	0.500	1.125	1 1/4 - 12	1 1/2 - 12	1 1/4 - 12	1 3/4 - 12

Four (4) wrench flats is an option.

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



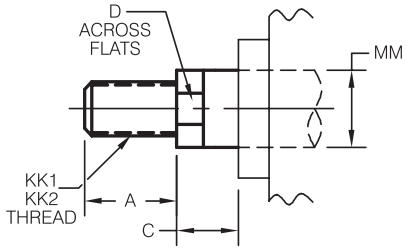


BORE	ROD DIA. (MM)	A	B	C	E	EE	F	G	J	K	KK	R	V	Y	ADD TO STROKE LB	P	ZB
1.50	0.625	0.750	1.125	0.375	2.000	0.375	0.375	1.500	1.000	0.250	7/16 -20	1.438	0.250	1.875	3.625	2.375	4.875
	1.000	1.125	1.500	0.500							3/4 -16		0.500	2.250			5.250
2.00	0.625	0.750	1.125	0.375	2.500	0.375	0.375	1.500	1.000	0.313	7/16 -20	1.844	0.250	1.875	3.625	2.375	4.938
	1.000	1.125	1.500	0.500							3/4 -16		0.500	2.250			5.313
2.50	0.625	0.750	1.125	0.375	3.000	0.375	0.375	1.500	1.000	0.313	7/16 -20	2.188	0.250	1.875	3.750	2.500	5.063
	1.000	1.125	1.500	0.500							3/4 -16		0.500	2.250			5.438
3.25	1.000	1.125	1.500	0.500	3.750	0.500	0.625	1.750	1.250	0.375	3/4 -16	2.766	0.250	2.375	4.250	2.750	6.000
	1.375	1.625	2.000	0.625							1 -14		0.375	2.625			6.250
4.00	1.000	1.125	1.500	0.500	4.500	0.500	0.625	1.750	1.250	0.375	3/4 -16	3.328	0.250	2.375	4.250	2.750	6.000
	1.375	1.625	2.000	0.625							1 -14		0.375	2.625			6.250
5.00	1.000	1.125	1.500	0.500	5.500	0.500	0.625	1.750	1.250	0.438	3/4 -16	4.109	0.250	2.375	4.500	3.000	6.313
	1.375	1.625	2.000	0.625							1 -14		0.375	2.625			6.563
6.00	1.375	1.625	2.000	0.625	6.500	0.750	0.750	2.000	1.500	0.438	1 -14	4.875	0.250	2.750	5.000	3.250	7.063
	1.750	2.000	2.375	0.750							1 1/4 -12		0.375	3.000			7.313
8.00	1.375	1.625	2.000	0.625	8.500	0.750	0.625	2.000	1.500	0.563	1 -14	6.438	0.375	2.750	5.125	3.375	7.313
	1.750	2.000	2.375	0.750							1 1/4 -12		0.500	3.000			7.563

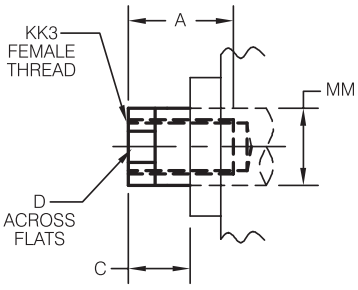
EASY FLIP OUT PAGE FOR REFERENCE

SERIES 'TAS' DIMENSIONS: THREADS

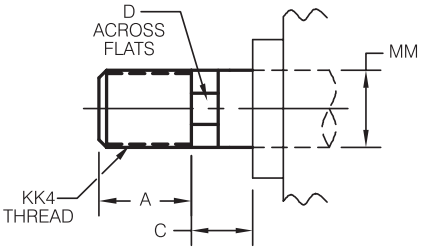
ROD END STYLE: KK1 KK2

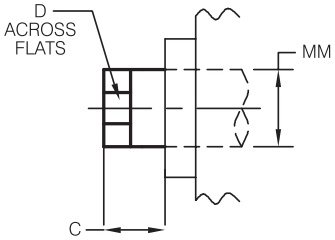


ROD END STYLE: KK3

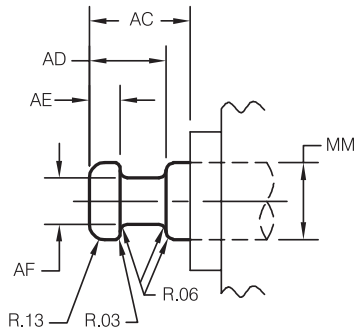


ROD END STYLE: KK4





ROD END STYLE: KK5

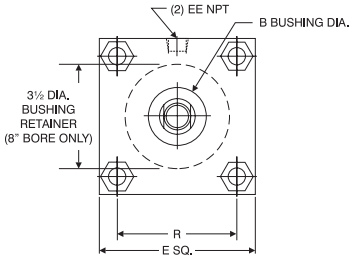


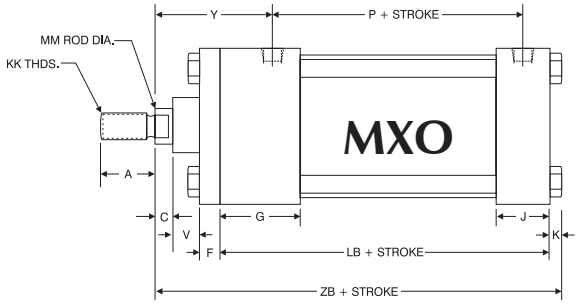
ROD END STYLE: KK10

ROD DIA. (MM)	A	C	D	AC	AD	AE	AF	KK1	KK2	KK3	KK4
0.625	0.750	0.375	0.500	1.125	0.625	0.250	0.375	7/16 - 20	1/2 - 20	7/16 - 20	5/8 - 18
1.000	1.125	0.500	0.875	1.625	0.938	0.375	0.688	3/4 - 16	7/8 - 14	3/4 - 16	1 - 14
1.375	1.625	0.625	1.125	1.750	1.063	0.375	0.875	1 - 14	1 1/4 - 12	1 - 14	1 3/8 - 12
1.750	2.000	0.750	1.500	2.000	1.313	0.500	1.125	1 1/4 - 12	1 1/2 - 12	1 1/4 - 12	1 3/4 - 12

Four (4) Wrench flats is an option.

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

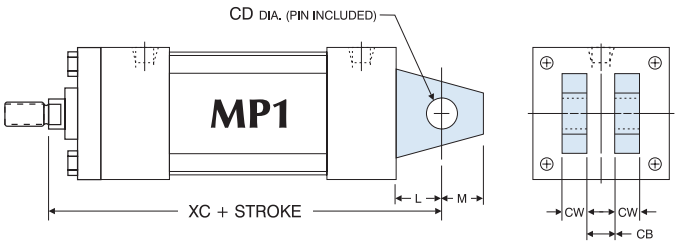




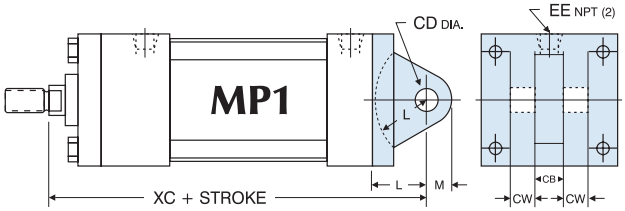
BORE	ROD DIA. (MM)	A	B	C	E	EE	F	G	J	K	KK	R	V	Y	ADD TO STROKE LB	P	ZB
1.50	0.625	0.750	1.125	0.375	2.000	0.375	0.375	1.500	1.000	0.250	7/16-20	1.438	0.250	1.875	3.625	2.375	4.875
	1.000	1.125	1.500	0.500							3/4-16		0.500	2.250			5.250
2.00	0.625	0.750	1.125	0.375	2.500	0.375	0.375	1.500	1.000	0.313	7/16-20	1.844	0.250	1.875	3.625	2.375	4.938
	1.000	1.125	1.500	0.500							3/4-16		0.500	2.250			5.313
2.50	0.625	0.750	1.125	0.375	3.000	0.375	0.375	1.500	1.000	0.313	7/16-20	2.188	0.250	1.875	3.750	2.500	5.063
	1.000	1.125	1.500	0.500							3/4-16		0.500	2.250			5.438
3.25	1.000	1.125	1.500	0.500	3.750	0.500	0.625	1.750	1.250	0.375	3/4-16	2.766	0.250	2.375	4.250	2.750	6.000
	1.375	1.625	2.000	0.625							1-14		0.375	2.625			6.250
4.00	1.000	1.125	1.500	0.500	4.500	0.500	0.625	1.750	1.250	0.375	3/4-16	3.328	0.250	2.375	4.250	2.750	6.000
	1.375	1.625	2.000	0.625							1-14		0.375	2.625			6.250
5.00	1.000	1.125	1.500	0.500	5.500	0.500	0.625	1.750	1.250	0.438	3/4-16	4.109	0.250	2.375	4.500	3.000	6.313
	1.375	1.625	2.000	0.625							1-14		0.375	2.625			6.563
6.00	1.375	1.625	2.000	0.625	6.500	0.750	0.750	2.000	1.500	0.438	1-14	4.875	0.250	2.750	5.000	3.250	7.063
	1.750	2.000	2.375	0.750							1 1/4-12		0.375	3.000			7.313
8.00	1.375	1.625	2.000	0.625	8.500	0.750	0.625	2.000	1.500	0.563	1-14	6.438	0.375	2.750	5.125	3.375	7.313
	1.750	2.000	2.375	0.750							1 1/4-12		0.500	3.000			7.563

'TAS' SERIES BASE DIMENSIONS FLIP-OUT (PAGE 160)

SERIES 'TAS' DIMENSIONS: PIVOT MOUNTS

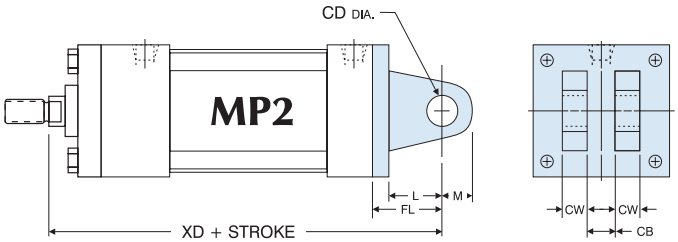


WELDED MP1 MOUNT



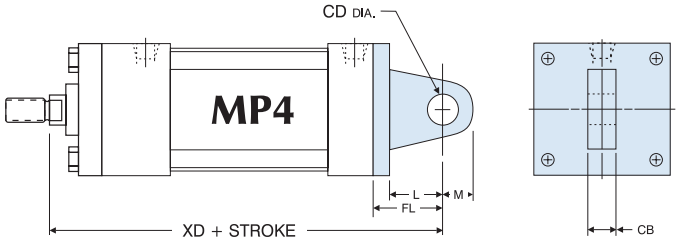
IRON CASTING MP1 MOUNT

*(OPTIONAL)***



MP2 MOUNT

(IRON CASTING)



MP4 MOUNT

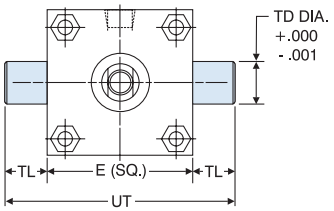
(IRON CASTING: 1.50" - 4.00" BORES, WELDMENT: 5.00" - 6.00" BORES)*

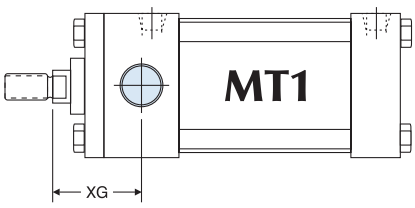
'MP1', 'MP2' CLEVIS AND 'MP4' EYE MOUNT DIMENSIONS										ACCESSORIES *(SEE PAGES 209-213 FOR DIMENSIONS)*				
BORE	ROD DIA. (MM)	CB	CD	CW	FL	L	M	XC	XD	ROD CLEVIS	ROD EYE	CLEVIS PIN	EYE BRACKET *(FOR MP1)*	CLEVIS BRKT *(FOR MP4)*
1.50	0.625	0.750	0.500	0.500	1.125	0.750	0.625	5.375	5.750	RC437	RE437	CP500	EB500	CB500
	1.000							5.750	6.125	RC750	RE750	CP750		
2.00	0.625	0.750	0.500	0.500	1.125	0.750	0.625	5.375	5.750	RC437	RE437	CP500		
	1.000							5.750	6.125	RC750	RE750	CP750		
2.50	0.625	0.750	0.500	0.500	1.125	0.750	0.625	5.500	5.875	RC437	RE437	CP500		
	1.000							5.875	6.250	RC750	RE750	CP750		
3.25	1.000	1.250	0.750	0.625	1.875	1.250	0.875	6.875	7.500	RC750	RE750	CP750	EB750	CB750
	1.375							7.125	7.750	RC1000	RE1000	CP1000		
4.00	1.000	1.250	0.750	0.625	1.875	1.250	0.875	6.875	7.500	RC750	RE750	CP750		
	1.375							7.125	7.750	RC1000	RE1000	CP1000		
5.00*	1.000	1.250	0.750	0.625	1.875	1.250	0.875	7.125	7.750	RC750	RE750	CP750		
	1.375							7.375	8.000	RC1000	RE1000	CP1000		
6.00*	1.375	1.500	1.000	0.750	2.250	1.500	1.000	8.125	8.875	RC1000	RE1000	CP1000	EB1000	CB1000
	1.750							8.375	9.125	RC1250	RE1250	CP1375		
8.00	1.375	1.500	1.000	0.750	N/A	1.500	1.000	8.250	N/A	RC1000	RE1000	CP1000		
	1.750							8.500		RC1250	RE1250	CP1375		

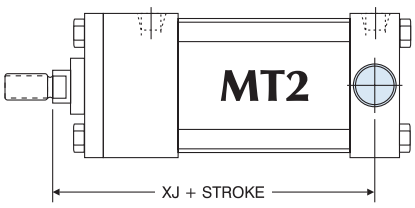
Clevis pins are provided with pivot mounts.
*MP4 5.00"-6.00" bores are 3-5 day delivery.
For dimensions not shown, see page 160.

**Cast Iron removable mounts are optional, and must be requested when ordering (1.50"-6.00" bores).
Specify "CAST MP1" when ordering.

SERIES 'TAS' DIMENSIONS: PIVOT MOUNTS





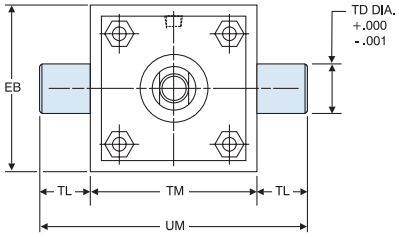


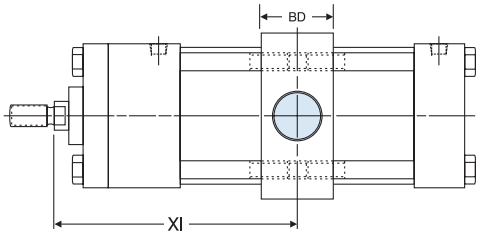
MT1 / MT2

Note: MT1 and MT2 Trunnions are one-piece solid steel construction.

'MT1' HEAD TRUNNION AND 'MT2' CAP TRUNNION MOUNT DIMENSIONS								ACCESSORIES *(SEE PAGES 209-213 FOR DIMENSIONS)*		
BORE	ROD DIA. (MM)	E	TD	TL	UT	XG	ADD STROKE XJ	ROD CLEVIS	ROD EYE	CLEVIS PIN
1.50	0.625	2.000	1.000	1.000	4.000	1.750	4.125	RC437	RE437	CP500
	1.000					N/A*	4.500	RC750	RE750	CP750
2.00	0.625	2.500	1.000	1.000	4.500	1.750	4.125	RC437	RE437	CP500
	1.000					2.125	4.500	RC750	RE750	CP750
2.50	0.625	3.000	1.000	1.000	5.000	1.750	4.250	RC437	RE437	CP500
	1.000					2.125	4.625	RC750	RE750	CP750
3.25	1.000	3.750	1.000	1.000	5.750	2.250	5.000	RC750	RE750	CP750
	1.375					2.500	5.250	RC1000	RE1000	CP1000
4.00	1.000	4.500	1.000	1.000	6.500	2.250	5.000	RC750	RE750	CP750
	1.375					2.500	5.250	RC1000	RE1000	CP1000
5.00	1.000	5.500	1.000	1.000	7.500	2.250	5.250	RC750	RE750	CP750
	1.375					2.500	5.500	RC1000	RE1000	CP1000
6.00	1.375	6.500	1.375	1.375	9.250	2.625	5.875	RC1000	RE1000	CP1000
	1.750					2.875	6.125	RC1250	RE1250	CP1375
8.00	1.375	8.500	1.375	1.375	11.250	2.625	6.000	RC1000	RE1000	CP1000
	1.750					2.875	6.250	RC1250	RE1250	CP1375

*No oversize rod available on 1.50" bore MT1.
For dimensions not shown, see page 160.





(Customer to Specify)

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

MT4

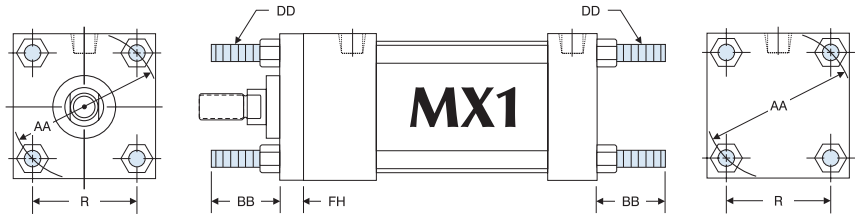
Note: MT4 Trunnions and Intermediate Section are one-piece solid steel construction.

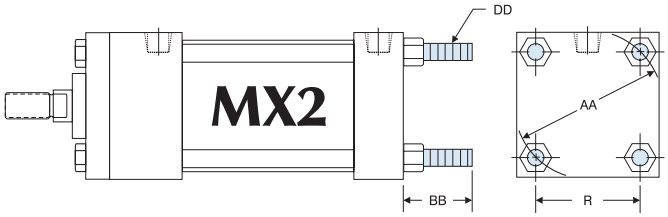
'MT4' INTERMEDIATE TRUNNION MOUNT DIMENSIONS							
BORE	BD	EB	TD	TL	TM	UM	XI
1.50	1.250	2.500	1.000	1.000	2.500	4.500	CUSTOMER TO SPECIFY
2.00	1.500	3.000	1.000	1.000	3.000	5.000	
2.50	1.500	3.500	1.000	1.000	3.500	5.500	
3.25	2.000	4.250	1.000	1.000	4.500	6.500	
4.00	2.000	5.000	1.000	1.000	5.250	7.250	
5.00	2.000	6.000	1.000	1.000	6.250	8.250	
6.00	2.000	7.000	1.375	1.375	7.625	10.375	
8.00	2.500	9.500	1.375	1.375	9.750	12.500	

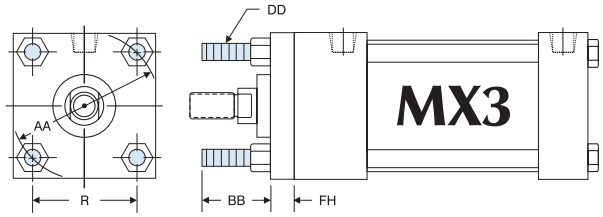
'MT1', 'MT2', 'MT4' STANDARD CUSHION LOCATIONS		
MOUNT	HEAD CUSHION	CAP CUSHION
MT1	3	6
MT2	2	7
MT4	2	6

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

SERIES 'TAS' DIMENSIONS: TIE ROD & FLANGE MOUNTS



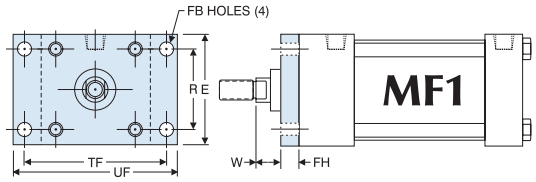




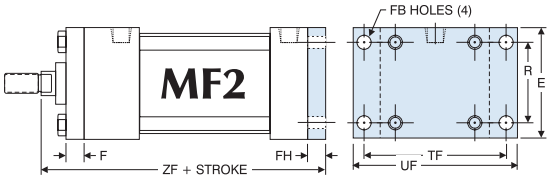
TIE ROD EXTENDED 'MX1', 'MX2' & 'MX3' MOUNT DIMENSIONS						
BORE	ROD DIA. (MM)	AA	BB	DD	FH	R
1.50	0.625	2.020	1.000	1/4 -28	0.375	1.438
	1.000					
2.00	0.625	2.600	1.125	5/16 -24	0.375	1.844
	1.000					
2.50	0.625	3.100	1.125	5/16 -24	0.375	2.188
	1.000					
3.25	1.000	3.900	1.375	3/8 -24	0.625	2.766
	1.375					

TIE ROD EXTENDED 'MX1', 'MX2' & 'MX3' MOUNT DIMENSIONS						
BORE	ROD DIA. (MM)	AA	BB	DD	FH	R
4.00	1.000	4.700	1.375	3/8 -24	0.625	3.328
	1.375					
5.00	1.000	5.800	1.813	1/2 -20	0.625	4.109
	1.375					
6.00	1.375	6.900	1.813	1/2 -20	0.750	4.875
	1.750					
8.00	1.375	9.100	**2.313	5/8 -18	*0.625	6.438
	1.750					

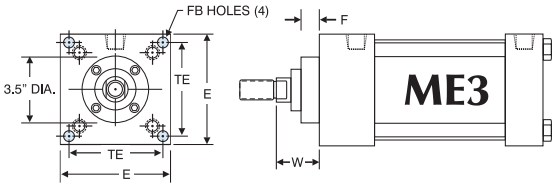
*8.00" bore utilizes a 3.50" diameter round retainer.
**BB dimension from face of head.
For dimensions not shown, see page 160.



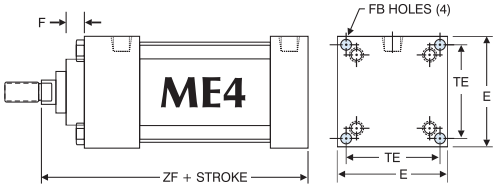
1.50" - 6.00" BORES



1.50" - 6.00" BORES



8.00" BORE



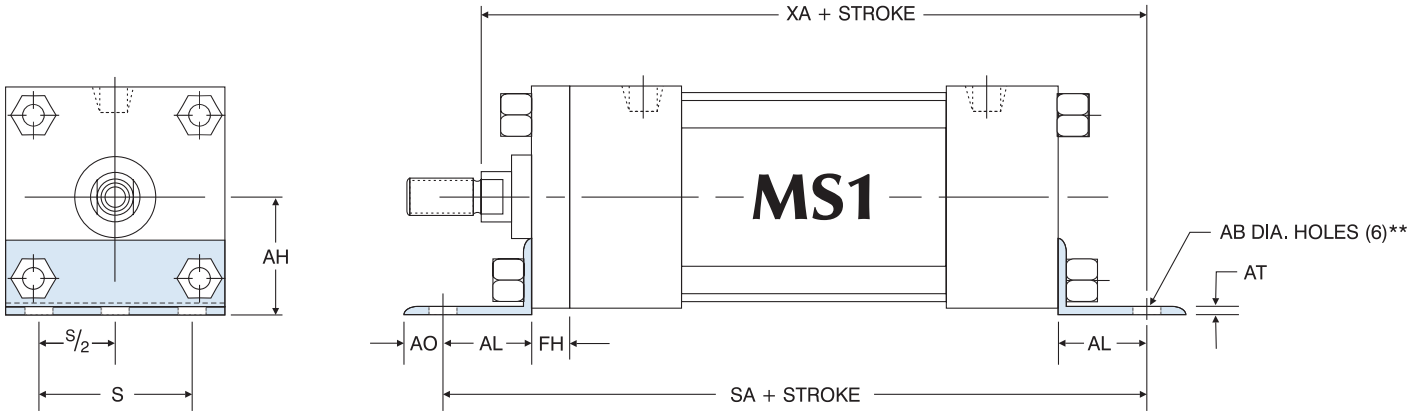
8.00" BORE

'MF1', 'MF2' FLANGE & 'ME3', 'ME4' CAP MOUNT DIMENSIONS											
											ADD TO STROKE
BORE	ROD DIA. (MM)	E	F	FB	FH	R	TE	TF	UF	W	ZF
1.50	0.625	2.000	0.375	0.313	0.375	1.438	—	2.750	3.375	0.625	5.000
	1.000									1.000	5.375
2.00	0.625	2.500	0.375	0.375	0.375	1.840	—	3.375	4.125	0.625	5.000
	1.000									1.00	5.375
2.50	0.625	3.000	0.375	0.375	0.375	2.188	—	3.875	4.625	0.625	5.125
	1.000									1.000	5.500
3.25	1.000	3.750	0.625	0.438	0.625	2.760	—	4.688	5.500	0.750	6.250
	1.375									1.000	6.500

'MF1', 'MF2' FLANGE & 'ME3', 'ME4' CAP MOUNT DIMENSIONS											
											ADD TO STROKE
BORE	ROD DIA. (MM)	E	F	FB	FH	R	TE	TF	UF	W	ZF
4.00	1.000	4.500	0.625	0.438	0.625	3.313	—	5.438	6.250	0.750	6.250
	1.375									1.000	6.500
5.00	1.000	5.500	0.625	0.563	0.625	4.125	—	6.625	7.625	0.750	6.500
	1.375									1.000	6.750
6.00	1.375	6.500	0.625	0.563	0.750	4.875	—	7.625	8.625	0.875	7.375
	1.750									1.125	7.625
8.00	1.375	8.500	0.625	0.688	N/A	N/A	7.570	N/A	N/A	1.625	6.750
	1.750									1.875	7.000

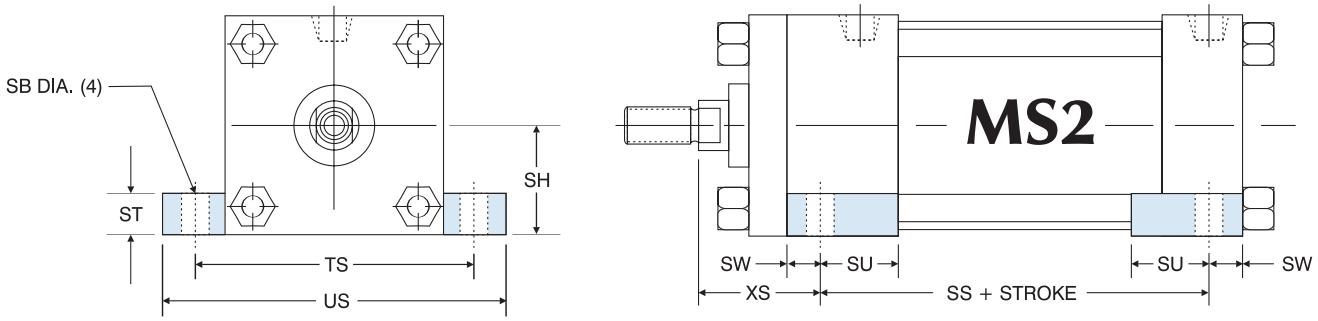
For dimensions not shown, see page 160.

SERIES 'TAS' DIMENSIONS: BASE MOUNTS



'MS1' ANGLE MOUNT DIMENSIONS										
BORE	ROD DIA. (MM)	AB	AH	AL	AO	AT	FH	S	ADD TO STROKE SA	ADD TO STROKE XA
1.50	0.625	0.438	1.188	1.000	0.375	0.188	0.375	1.250	6.000	5.625
	1.000									6.000
2.00	0.625	0.438	1.438	1.000	0.375	0.188	0.375	1.750	6.000	5.625
	1.000									6.000
2.50	0.625	0.438	1.625	1.000	0.375	0.188	0.375	2.250	6.125	5.750
	1.000									6.125
3.25	1.000	0.563	1.938	1.250	0.500	0.125	0.625	2.750	7.375	6.875
	1.375									7.125
4.00	1.000	0.563	2.250	1.250	0.500	0.125	0.625	3.500	7.375	6.875
	1.375									7.125
5.00	1.000	0.688	2.750	1.375	0.625	0.188	0.625	4.250	7.875	7.250
	1.375									7.500
6.00	1.375	0.813	3.250	1.375	0.625	0.188	0.750	5.250	8.500	8.000
	1.750									8.250
8.00	1.375	0.813	4.250	1.813	0.688	0.250	*0.625	7.125	8.750	8.563
	1.750									8.813

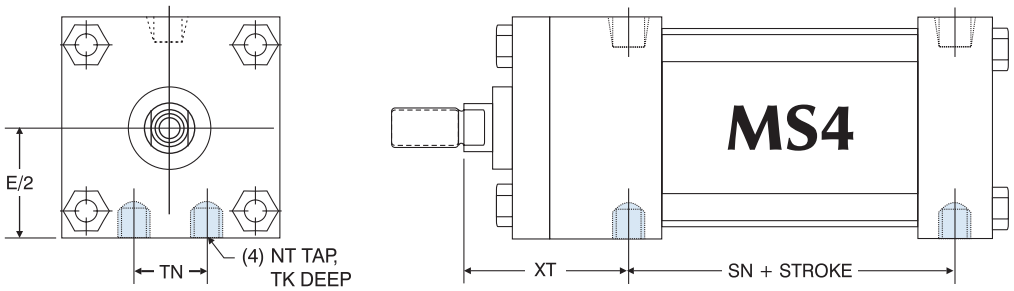
**1.50" bore has four (4) AB diameter holes.
*8.00" bore utilizes a round retainer.



'MS2' SIDE LUG MOUNT DIMENSIONS										
BORE	ROD DIA. (MM)	SB	SH	ST	SU	SW	TS	US	XS	ADD TO STROKE SS
1.50	0.625	0.438	1.000	0.500	1.125	0.375	2.750	3.500	1.375	2.875
	1.000								1.750	
2.00	0.625	0.438	1.250	0.500	1.125	0.375	3.250	4.000	1.375	2.875
	1.000								1.750	
2.50	0.625	0.438	1.500	0.500	1.125	0.375	3.750	4.500	1.375	3.000
	1.000								1.750	
3.25	1.000	0.563	1.875	0.750	1.250	0.500	4.750	5.750	1.875	3.250
	1.375								2.125	
4.00	1.000	0.563	2.250	0.750	1.250	0.500	5.500	6.500	1.875	3.250
	1.375								2.125	
5.00	1.000	0.813	2.750	1.000	1.063	0.688	6.875	8.250	2.063	3.125
	1.375								2.313	
6.00	1.375	0.813	3.250	1.000	1.313	0.688	7.875	9.250	2.313	3.625
	1.750								2.563	
8.00	1.375	0.813	4.250	1.000	1.313	0.688	9.875	11.250	2.313	3.750
	1.750								2.563	

*8.00" bore utilizes a round retainer.
For dimensions not shown, see page 160.

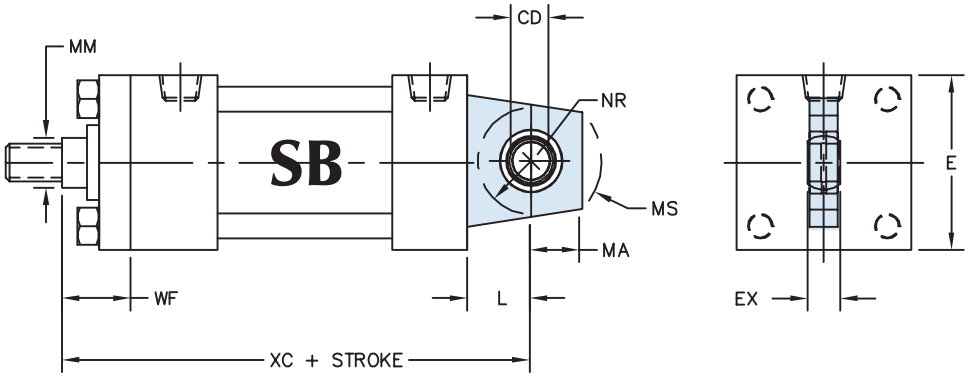
SERIES 'TAS' DIMENSIONS: BASE MOUNTS



'MS4' BOTTOM TAPPED MOUNT DIMENSIONS							
BORE	ROD DIA. (MM)	E/2	NT	TK	TN	XT	ADD TO STROKE SN
1.50	0.625	1.000	1/4 -20	0.375	0.625	1.938	2.250
	1.000					2.313	
2.00	0.625	1.250	5/16 -18	0.500	0.875	1.938	2.250
	1.000					2.313	
2.50	0.625	1.500	3/8 -16	0.625	1.250	1.938	2.375
	1.000					2.313	
3.25	1.000	1.875	1/2 -13	0.750	1.500	2.438	2.625
	1.375					2.688	
4.00	1.000	2.250	1/2 -13	0.750	2.063	2.438	2.625
	1.375					2.688	
5.00	1.000	2.750	5/8 -11	1.000	2.688	2.438	2.875
	1.375					2.688	
6.00	1.375	3.250	3/4 -10	1.125	3.250	2.813	3.125
	1.750					3.063	
8.00	1.375	4.250	3/4 -10	1.125	4.500	2.813	3.250
	1.750					3.063	

For dimensions not shown, see page 160.

SERIES 'TAS' DIMENSIONS: SPHERICAL BEARING MOUNT



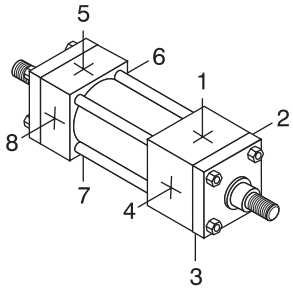
'SB' SPHERICAL BEARING MOUNT DIMENSIONS										
BORE	ROD DIA. (MM)	CD	E	EX	L	MA	MS	NR	WF	ADD TO STROKE XC
1.50	0.625	0.500	2.000	0.437	0.750	0.750	0.938	0.625	1.000	5.375
	1.000								1.375	5.750
2.00	0.625	0.500	2.500	0.437	0.750	0.750	0.938	0.625	1.000	5.375
	1.000								1.375	5.750
2.50	0.625	0.500	3.000	0.437	0.750	0.750	0.938	0.625	1.000	5.500
	1.000								1.375	5.875
3.25	1.000	0.750	3.750	0.656	1.250	1.000	1.375	1.000	1.375	6.875
	1.375								1.625	7.125
4.00	1.000	0.750	4.500	0.656	1.250	1.000	1.375	1.000	1.375	6.875
	1.375								1.625	7.125
5.00	1.000	0.750	5.500	0.656	1.250	1.000	1.375	1.000	1.375	7.125
	1.375								1.625	7.375
6.00	1.375	1.000	6.500	0.875	1.500	1.250	1.688	1.250	1.625	8.125
	1.750								1.875	8.375
8.00	1.375	1.000	8.500	0.875	1.500	1.250	1.688	1.250	1.625	8.250
	1.750								1.875	8.500

Note: Pivot pin included with cylinder cap end only. 3.25"- 8.00" bores have tie rod nuts exposed on cap end.
8.00" bore utilizes round retainer.
*Must specify KK3 rod end if to be used with "MSRE" rod eye.

SERIES 'TAS' DIMENSIONS: DOUBLE ROD END

Benefits

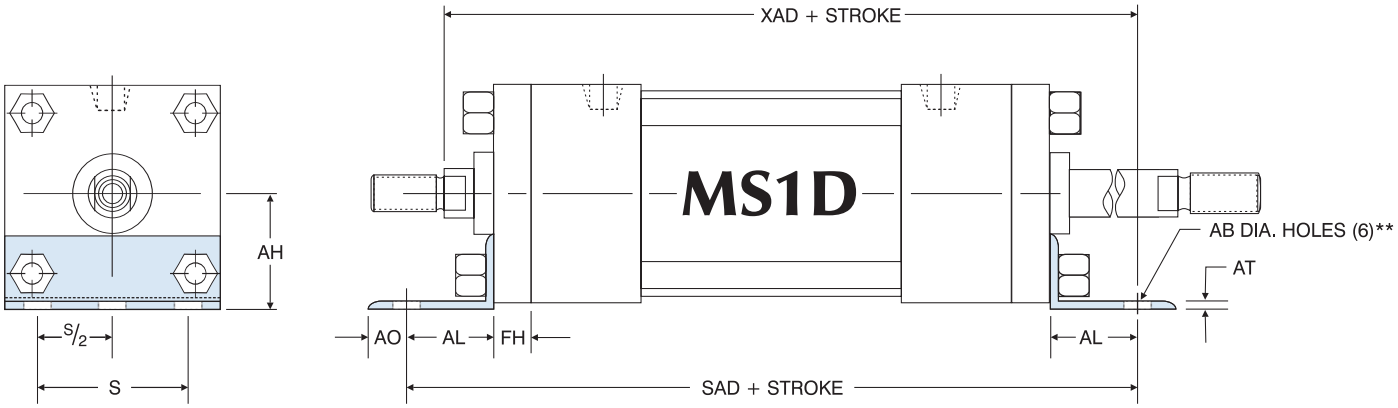
- Standard and Oversize Piston Rods available.
- Full range of Standard Options.
- Durable design. Full Rod Bearing at each end of cylinder.
- Can be provided with Hollow Piston Rods (gun-drilled through, to your size requirements).
- Can be used in adjustable extend stroke applications (by adding a stop collar on one rod end or option "MA" - *Refer to page 179*).



STANDARD PORT AND CUSHION ADJUSTMENT POSITIONS

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

SERIES 'TAS' DIMENSIONS: DOUBLE ROD END BASE MOUNTS



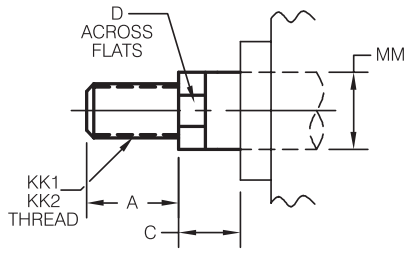
'MS1D' ANGLE MOUNT DIMENSIONS										
BORE	ROD DIA. (MM)	AB	AH	AL	AO	AT	FH	S	ADD TO STROKE SAD	ADD TO STROKE XAD
1.50	0.625	0.438	1.188	1.000	0.375	0.188	0.375	1.250	6.875	6.500
	1.000									6.875
2.00	0.625	0.438	1.438	1.000	0.375	0.188	0.375	1.750	6.875	6.500
	1.000									6.875
2.50	0.625	0.438	1.625	1.000	0.375	0.188	0.375	2.250	7.000	6.625
	1.000									7.000
3.25	1.000	0.563	1.980	1.250	0.500	0.125	0.625	2.750	8.500	8.000
	1.375									8.250
4.00	1.000	0.563	2.250	1.250	0.500	0.125	0.625	3.500	8.500	8.000
	1.375									8.250
5.00	1.000	0.688	2.750	1.375	0.625	0.188	0.625	4.250	9.000	8.375
	1.375									8.625
6.00	1.375	0.813	3.250	1.375	0.625	0.188	0.750	5.250	9.750	9.250
	1.750									9.500
8.00	1.375	0.813	4.250	1.813	0.688	0.250	*0.625	7.125	9.250	9.063
	1.750									9.313

*8.00" bore utilizes round retainer.
**1.50" bore uses four (4) "AB" holes.
For dimensions not shown, see page 160.

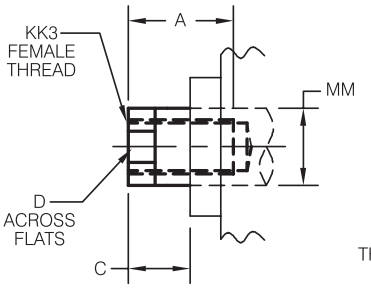
EASY FLIP OUT PAGE FOR REFERENCE

SERIES 'TAS' DIMENSIONS: THREADS

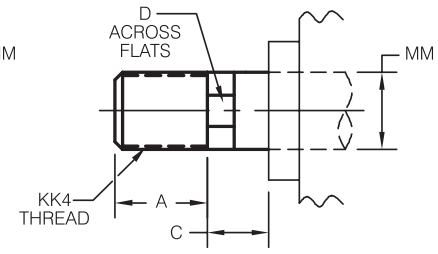
ROD END STYLE: KK1 KK2

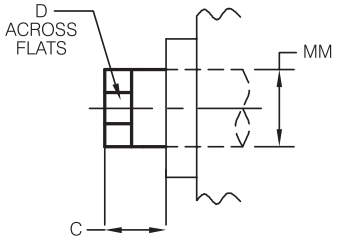


ROD END STYLE: KK3

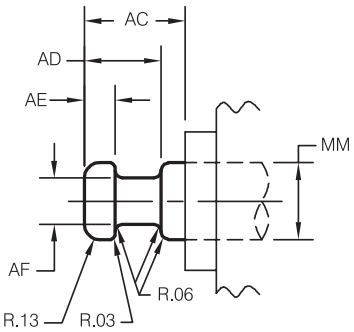


ROD END STYLE: KK4





ROD END STYLE: KK5

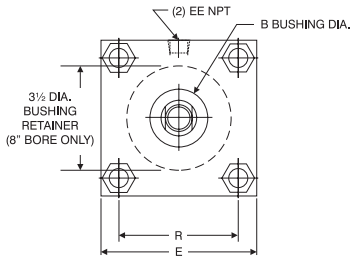


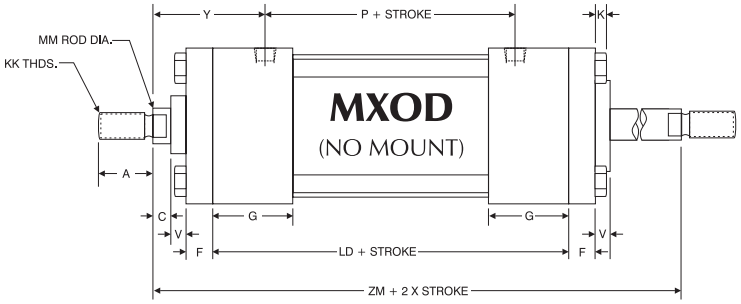
ROD END STYLE: KK10

ROD DIA. (MM)	A	C	D	AC	AD	AE	AF	KK1	KK2	KK3	KK4
0.625	0.750	0.375	0.500	1.125	0.625	0.250	0.375	7/16-20	1/2-20	7/16-20	5/8-18
1.000	1.125	0.500	0.875	1.625	0.938	0.375	0.688	3/4 -16	7/8-14	3/4 -16	1-14
1.375	1.625	0.625	1.125	1.750	1.063	0.375	0.875	1-14	1 1/4-12	1-14	1 3/8-12
1.750	2.000	0.750	1.500	2.000	1.313	0.500	1.125	1 1/4 -12	1 1/2-12	1 1/4 -12	1 3/4-12

Four (4) wrench flats is an option.

DOUBLE ROD END DIMENSIONS: BASIC CYLINDER (NO MOUNT)





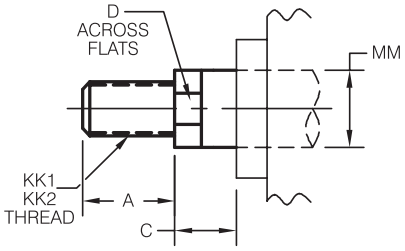
BORE	ROD DIA. (MM)	A	B	C	E	EE	F	G	K	KK	R	V	Y	ADD TO STROKE LD	ADD TO STROKE P	ADD 2x STROKE ZM
1.50	0.625	0.750	1.125	0.375	2.000	0.375	0.375	1.500	0.250	7/16-20	1.438	0.250	1.875	4.125	2.375	6.125
	1.000	1.125	1.500	0.500						3/4 -16		0.500	2.250			6.875
2.00	0.625	0.750	1.125	0.375	2.500	0.375	0.375	1.500	0.313	7/16-20	1.844	0.250	1.875	4.125	2.375	6.125
	1.000	1.125	1.500	0.500						3/4 -16		0.500	2.250			6.875
2.50	0.625	0.750	1.125	0.375	3.000	0.375	0.375	1.500	0.313	7/16-20	2.188	0.250	1.875	4.250	2.500	6.250
	1.000	1.125	1.500	0.500						3/4 -16		0.500	2.250			7.000
3.25	1.000	1.125	1.500	0.500	3.750	0.500	0.625	1.750	0.375	3/4 -16	2.766	0.250	2.375	4.750	2.750	7.500
	1.375	1.625	2.000	0.625						1-14		0.375	2.625			8.000
4.00	1.000	1.125	1.500	0.500	4.500	0.500	0.625	1.750	0.375	3/4 -16	3.328	0.250	2.375	4.750	2.750	7.500
	1.375	1.625	2.000	0.625						1-14		0.375	2.675			8.000
5.00	1.000	1.125	1.500	0.500	5.500	0.500	0.625	1.750	0.438	3/4 -16	4.109	0.250	2.375	5.000	3.000	7.750
	1.375	1.625	2.000	0.625						1-14		0.375	2.625			8.250
6.00	1.375	1.625	2.000	0.625	6.500	0.750	0.750	2.000	0.438	1-14	4.875	0.250	2.750	5.500	3.250	8.750
	1.750	2.000	2.375	0.750						1 1/4 -12		0.375	3.000			9.250
8.00	1.375	1.625	2.000	0.625	8.500	0.750	0.625	2.000	0.563	1-14	6.438	0.375	2.750	5.625	3.375	8.875
	1.750	2.000	2.375	0.750						1 1/4 -12		0.500	3.000			9.375

'TAS' SERIES DOUBLE ROD END BASE DIMENSIONS FLIP-OUT (PAGE 167)

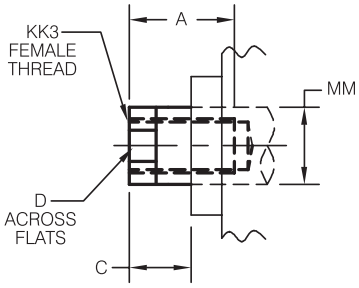
EASY FLIP OUT PAGE FOR REFERENCE

SERIES 'TAS' DIMENSIONS: THREADS

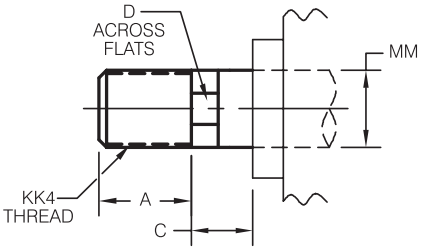
ROD END STYLE: KK1 KK2



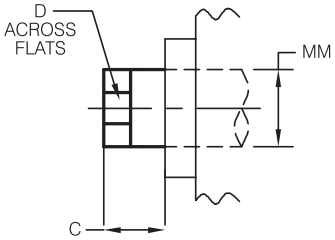
ROD END STYLE: KK3



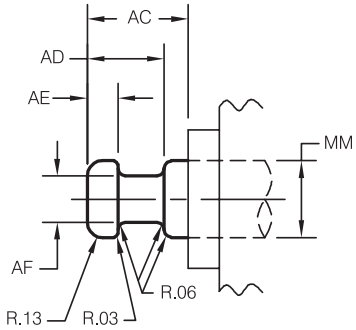
ROD END STYLE: KK4



ROD END STYLE: KK5



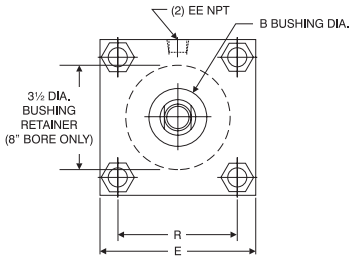
ROD END STYLE: KK10

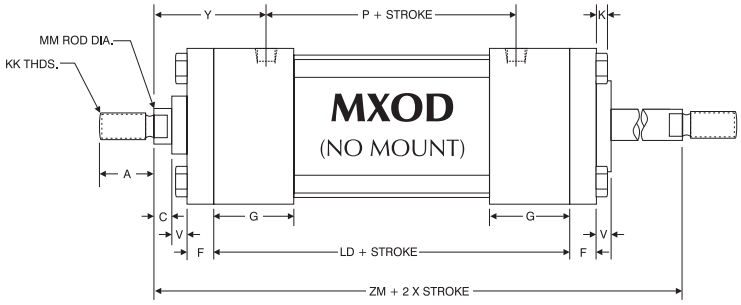


ROD DIA. (MM)	A	C	D	AC	AD	AE	AF	KK1	KK2	KK3	KK4
0.625	0.750	0.375	0.500	1.125	0.625	0.250	0.375	7/16-20	1/2-20	7/16-20	5/8-18
1.000	1.125	0.500	0.875	1.625	0.938	0.375	0.688	3/4 -16	7/8-14	3/4 -16	1-14
1.375	1.625	0.625	1.125	1.750	1.063	0.375	0.875	1-14	1 1/4-12	1-14	1 3/8-12
1.750	2.000	0.750	1.500	2.000	1.313	0.500	1.125	1 1/4 -12	1 1/2-12	1 1/4 -12	1 3/4-12

Four (4) wrench flats is an option.

DOUBLE ROD END DIMENSIONS: BASIC CYLINDER (NO MOUNT)

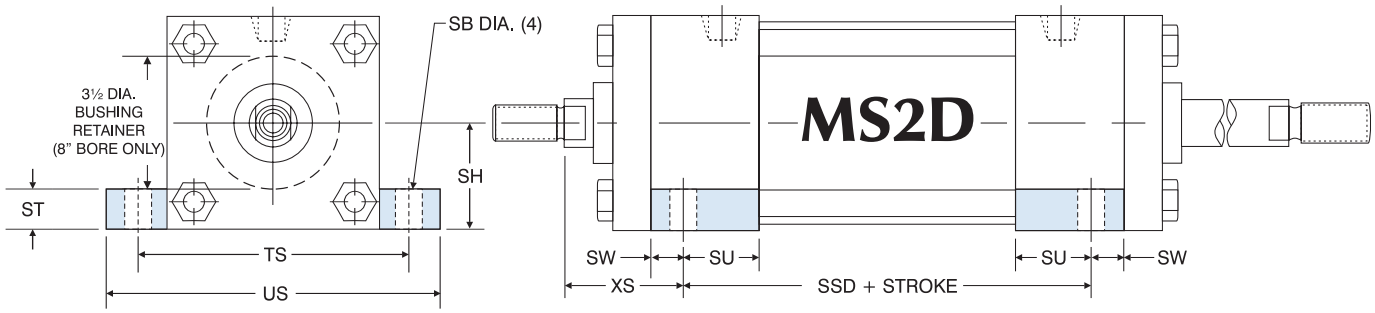




BORE	ROD DIA. (MM)	A	B	C	E	EE	F	G	K	KK	R	V	Y	ADD TO STROKE LD	ADD TO STROKE P	ADD 2x STROKE ZM
1.50	0.625	0.750	1.125	0.375	2.000	0.375	0.375	1.500	0.250	7/16-20	1.438	0.250	1.875	4.125	2.375	6.125
	1.000	1.125	1.500	0.500						3/4-16		0.500	2.250			6.875
2.00	0.625	0.750	1.125	0.375	2.500	0.375	0.375	1.500	0.313	7/16-20	1.844	0.250	1.875	4.125	2.375	6.125
	1.000	1.125	1.500	0.500						3/4-16		0.500	2.250			6.875
2.50	0.625	0.750	1.125	0.375	3.000	0.375	0.375	1.500	0.313	7/16-20	2.188	0.250	1.875	4.250	2.500	6.250
	1.000	1.125	1.500	0.500						3/4-16		0.500	2.250			7.000
3.25	1.000	1.125	1.500	0.500	3.750	0.500	0.625	1.750	0.375	3/4-16	2.766	0.250	2.375	4.750	2.750	7.500
	1.375	1.625	2.000	0.625						1-14		0.375	2.625			8.000
4.00	1.000	1.125	1.500	0.500	4.500	0.500	0.625	1.750	0.375	3/4-16	3.328	0.250	2.375	4.750	2.750	7.500
	1.375	1.625	2.000	0.625						1-14		0.375	2.675			8.000
5.00	1.000	1.125	1.500	0.500	5.500	0.500	0.625	1.750	0.438	3/4-16	4.109	0.250	2.375	5.000	3.000	7.750
	1.375	1.625	2.000	0.625						1-14		0.375	2.625			8.250
6.00	1.375	1.625	2.000	0.625	6.500	0.750	0.750	2.000	0.438	1-14	4.875	0.250	2.750	5.500	3.250	8.750
	1.750	2.000	2.375	0.750						1 1/4-12		0.375	3.000			9.250
8.00	1.375	1.625	2.000	0.625	8.500	0.750	0.625	2.000	0.563	1-14	6.438	0.375	2.750	5.625	3.375	8.875
	1.750	2.000	2.375	0.750						1 1/4-12		0.500	3.000			9.375

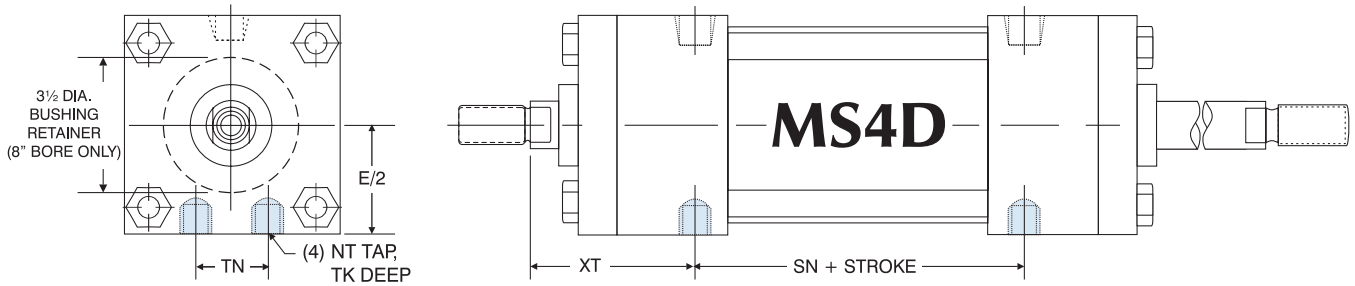
'TAS' SERIES DOUBLE ROD END BASE DIMENSIONS FLIP-OUT (PAGE 167)

SERIES 'TAS' DIMENSIONS: DOUBLE ROD END BASE MOUNTS



DOUBLE ROD END 'MS2D' SIDE LUG MOUNT DIMENSIONS										
BORE	ROD DIA. (MM)	SB	SH	ST	SU	SW	TS	US	XS	ADD TO STROKE SSD
1.50	0.625	0.438	1.000	0.500	1.125	0.375	2.750	3.500	1.375	3.375
	1.000								1.750	
2.00	0.625	0.438	1.250	0.500	1.125	0.375	3.250	4.000	1.375	3.375
	1.000								1.750	
2.50	0.625	0.438	1.500	0.500	1.125	0.375	3.750	4.500	1.375	3.500
	1.000								1.750	
3.25	1.000	0.563	1.875	0.750	1.250	0.500	4.750	5.750	1.875	3.750
	1.375								2.125	
4.00	1.000	0.563	2.250	0.750	1.250	0.500	5.500	6.500	1.875	3.750
	1.375								2.125	
5.00	1.000	0.813	2.750	1.000	1.063	0.688	6.875	8.250	2.063	3.625
	1.375								2.313	
6.00	1.375	0.813	3.250	1.000	1.313	0.688	7.875	9.250	2.313	4.125
	1.750								2.563	
8.00	1.375	0.813	4.250	1.000	1.563	0.688	9.875	11.250	2.313	4.250
	1.750								2.563	

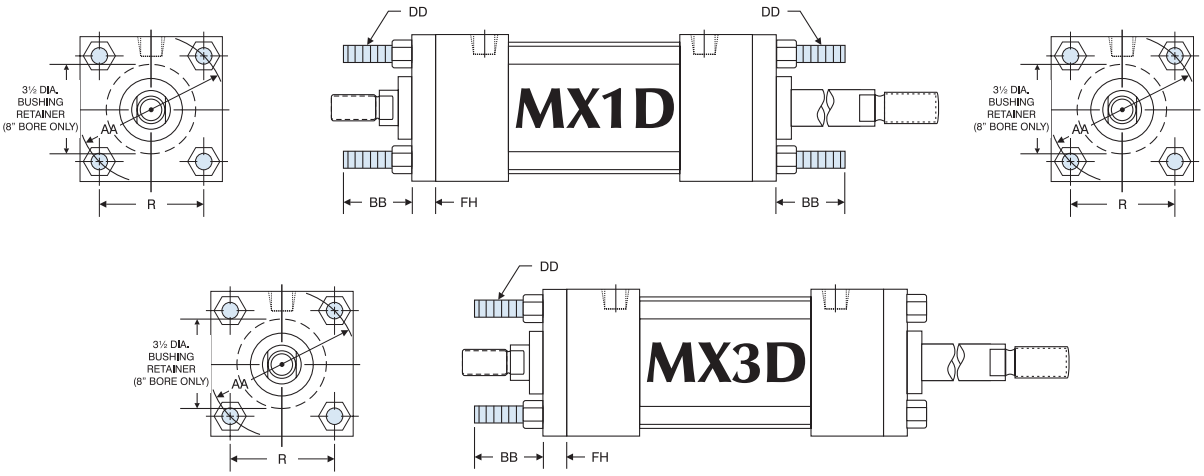
For dimensions not shown, see page 167.



DOUBLE ROD END 'MS4D' BOTTOM TAPPED MOUNT DIMENSIONS							
BORE	ROD DIA. (MM)	E/2	NT	TK	TN	XT	ADD TO STROKE SN
1.50	0.625	1.000	1/4-20	0.375	0.625	1.938	2.250
	1.000					2.313	
2.00	0.625	1.250	5/16-18	0.500	0.875	1.938	2.250
	1.000					2.313	
2.50	0.625	1.500	3/8-16	0.625	1.250	1.938	2.375
	1.000					2.313	
3.25	1.000	1.875	1/2-13	0.750	1.500	2.438	2.625
	1.375					2.688	
4.00	1.000	2.250	1/2-13	0.750	2.063	2.438	2.625
	1.375					2.688	
5.00	1.000	2.750	5/8-11	1.000	2.688	2.438	2.875
	1.375					2.688	
6.00	1.375	3.250	3/4-10	1.125	3.250	2.813	3.125
	1.750					3.063	
8.00	1.375	4.250	3/4-10	1.125	4.500	2.813	3.250
	1.750					3.063	

For dimensions not shown, see page 167.

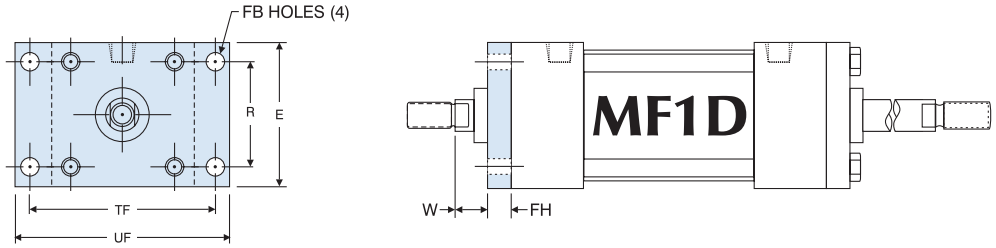
SERIES 'TAS' DIMENSIONS: DOUBLE ROD END TIE ROD & FLANGE MOUNTS



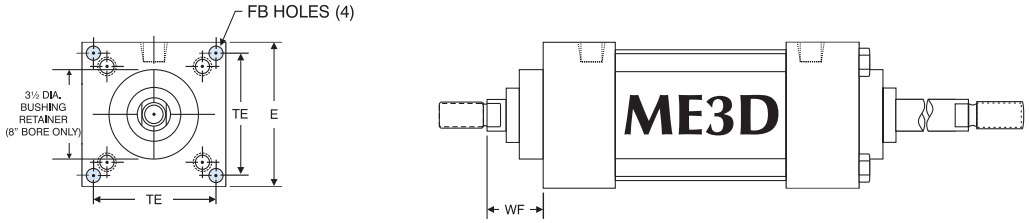
TIE ROD EXTENDED 'MX1D' & 'MX3D' MOUNT DIMENSIONS						
BORE	ROD DIA. (MM)	AA	BB	DD	FH	R
1.50	0.625	2.016	1.000	1/4 -28	0.375	1.438
	1.000					
2.00	0.625	2.594	1.125	5/16 -24	0.375	1.844
	1.000					
2.50	0.625	3.109	1.125	5/16 -24	0.375	2.188
	1.000					
3.25	1.000	3.906	1.375	3/8 -24	0.625	2.766
	1.375					

TIE ROD EXTENDED 'MX1D' & 'MX3D' MOUNT DIMENSIONS						
BORE	ROD DIA. (MM)	AA	BB	DD	FH	R
4.00	1.000	4.719	1.375	3/8 -24	0.625	3.328
	1.375					
5.00	1.000	5.813	1.813	1/2 -20	0.625	4.109
	1.375					
6.00	1.375	6.906	1.813	1/2 -20	0.750	4.875
	1.750					
8.00	1.375	9.125	**2.313	5/8 -18	*0.625	6.438
	1.750					

**"BB" dimension from head on 8.00" bore.
For dimensions not shown, see page 167.



1.50" - 6.00" BORES



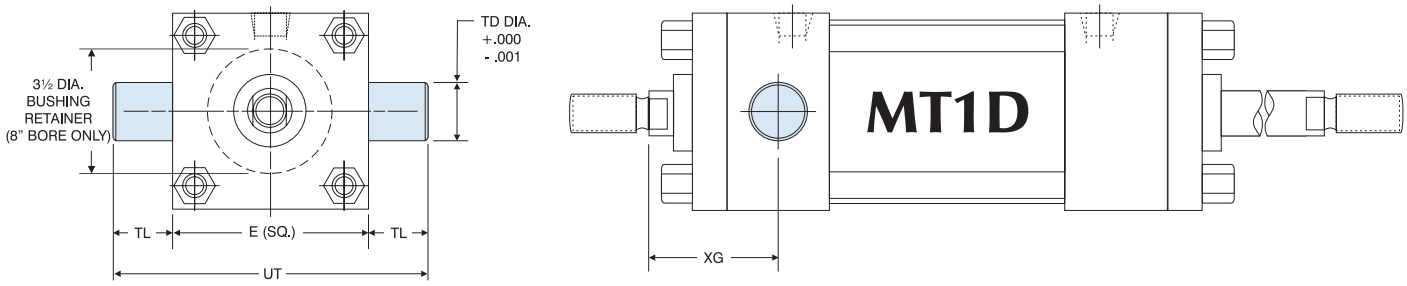
8.00" BORE ONLY

'MF1D' FLANGE & 'ME3D' CAP MOUNT DIMENSIONS										
BORE	ROD DIA. (MM)	E	FB	FH	R	TE	TF	UF	W	WF
1.50	0.625	2.000	0.313	0.375	1.438	—	2.750	3.375	0.625	N/A
	1.000								1.000	N/A
2.00	0.625	2.500	0.375	0.375	1.844	—	3.375	4.125	0.625	N/A
	1.000								1.000	N/A
2.50	0.625	3.000	0.375	0.375	2.188	—	3.875	4.625	0.625	N/A
	1.000								1.000	N/A
3.25	1.000	3.750	0.438	0.625	2.766	—	4.688	5.500	0.750	N/A
	1.375								1.000	N/A

'MF1D' FLANGE & 'ME3D' CAP MOUNT DIMENSIONS										
BORE	ROD DIA. (MM)	E	FB	FH	R	TE	TF	UF	W	WF
4.00	1.000	4.500	0.438	0.625	3.328	—	5.438	6.250	0.750	N/A
	1.375								1.000	N/A
5.00	1.000	5.500	0.563	0.625	4.109	—	6.625	7.625	0.750	N/A
	1.375								1.000	N/A
6.00	1.375	6.500	0.563	0.750	4.875	—	7.625	8.625	0.875	N/A
	1.750								1.125	N/A
8.00	1.375	8.500	0.688	N/A	N/A	7.563	N/A	N/A	1.625	1.625
	1.750								1.875	1.875

For dimensions not shown, see page 167.

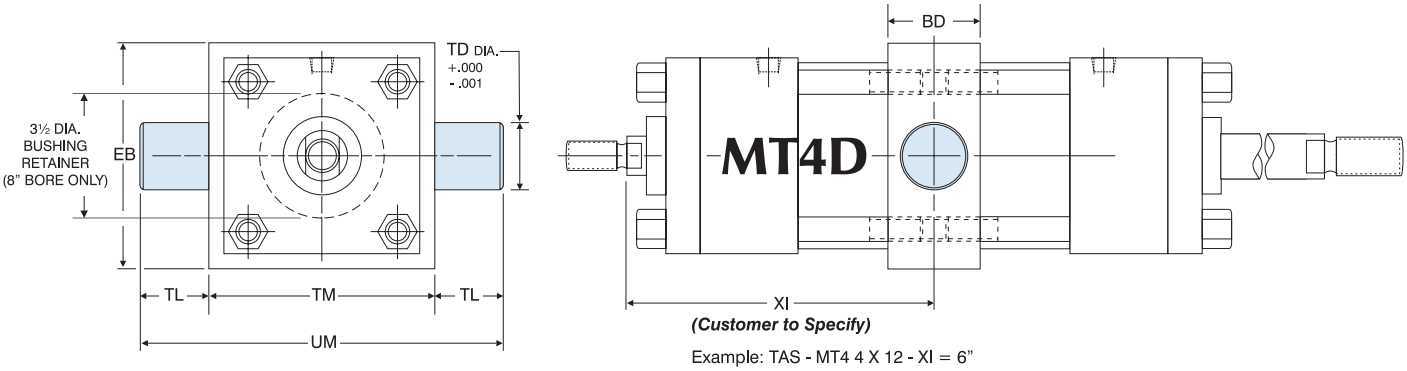
SERIES 'TAS' DIMENSIONS: DOUBLE ROD END PIVOT MOUNTS



Note: MT1D Trunnions are one-piece solid steel construction.

DOUBLE ROD END 'MT1D' HEAD TRUNNION MOUNT DIMENSIONS						
BORE	ROD DIA. (MM)	E	TD	TL	UT	XG
1.50	0.625	2.000	1.000	1.000	4.000	1.750
	N/A*					N/A
2.00	0.625	2.500	1.000	1.000	4.500	1.750
	1.000					2.125
2.50	0.625	3.000	1.000	1.000	5.000	1.750
	1.000					2.125
3.25	1.000	3.750	1.000	1.000	5.750	2.250
	1.375					2.500
4.00	1.000	4.500	1.000	1.000	6.500	2.250
	1.375					2.500
5.00	1.000	5.500	1.000	1.000	7.500	2.250
	1.375					2.500
6.00	1.375	6.500	1.375	1.375	9.250	2.625
	1.750					2.875
8.00	1.375	8.500	1.375	1.375	11.250	2.625
	1.750					2.875

*No oversize rod available on 1.50" bore MT1D.
For dimensions not shown, see page 167.



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

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

DOUBLE ROD END 'MT4D' INTERMEDIATE TRUNNION MOUNT DIMENSIONS							
BORE	BD	EB	TD	TL	TM	UM	XI
1.50	1.250	2.500	1.000	1.000	2.500	4.500	CUSTOMER TO SPECIFY
2.00	1.500	3.000	1.000	1.000	3.000	5.000	
2.50	1.500	3.500	1.000	1.000	3.500	5.500	
3.25	2.000	4.250	1.000	1.000	4.500	6.500	
4.00	2.000	5.000	1.000	1.000	5.250	7.250	
5.00	2.000	6.000	1.000	1.000	6.250	8.250	
6.00	2.000	7.000	1.375	1.375	7.625	10.375	
8.00	2.500	9.500	1.375	1.375	9.750	12.500	

8.00" bore utilizes round retainer.

'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.

Basic Cylinder Options

Uncommon Options & Specials

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

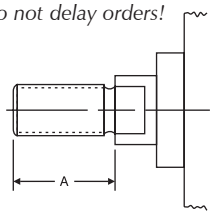
BASIC OPTIONS

Index To Options:

A= Extended Piston Rod Thread

"A=" refers to the length of piston rod thread.

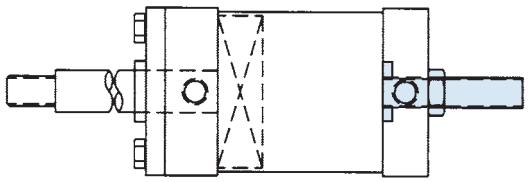
Shorter than standard lengths can be furnished at no charge. Longer than standard lengths can be furnished at a nominal price adder. *Special length threads do not delay orders!*



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.

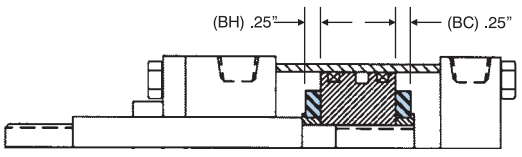
Note: Due to the nature of oil to remain in the tubing finish recesses, a condition called "collaring" will allow oil to seep past the A/O seal over time, escaping in the air valve exhaust.

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)*

1.50" Bore Shown

Available on 1.50" to 8.00" Bore

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"-8.00" 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 8.00" 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.

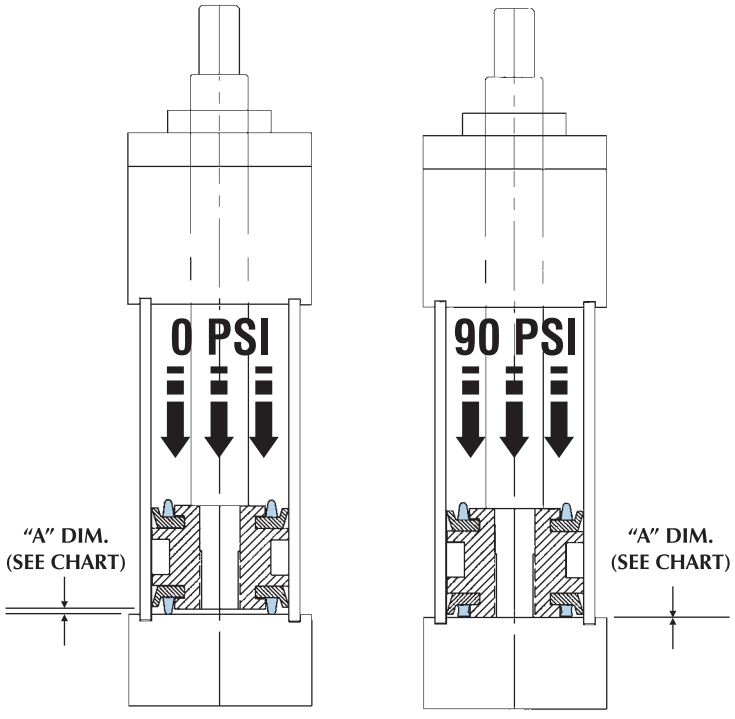
Bumper Piston Seals will shorten the cylinder stroke when operated at less than 90 PSI supply air. The charts below show the approximate (average) stroke reduction, at various pressure (for new cylinders). As the cylinders are cycled, the seals will take a slight set. Tests have shown that after 1,500,000 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
2.00	.14	.11	.07	.04	.01	.00
2.50	.18	.14	.08	.05	.02	.00
3.25	.14	.12	.08	.04	.01	.00
4.00	.17	.14	.09	.05	.02	.00
5.00	.18	.14	.07	.03	.01	.00
6.00	.23	.18	.10	.05	.01	.00
8.00	.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
2.00	.069	.056	.037	.020	.010	.00
2.50	.091	.070	.042	.024	.008	.00
3.25	.071	.059	.039	.020	.002	.00
4.00	.087	.069	.045	.026	.009	.00
5.00	.092	.072	.036	.013	.005	.00
6.00	.113	.091	.051	.023	.003	.00
8.00	.154	.132	.076	.037	.016	.00

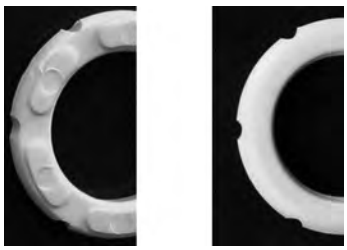


BASIC OPTIONS: ADJUSTABLE CUSHIONS

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



FRONT SIDE BACK SIDE

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 175 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 175 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:

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

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, 0.625" piston rod, moving a 25 lb. load at 6 feet per second with 80 PSI air.

P=80 PSI W=26.25 lbs. V=6 FPS. K=.17

Energy = (26.25/64) X (6^2) or (36) + (80 X .17)
Energy = 28.36 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 Standard Cushion Series Max Energy (ft-lbs)	LH or LC Long Cushion Series Max Energy (ft-lbs)	ELH or ELC Extra-Long Cushion Series Max Energy (ft-lbs.)
1.50	.06	8.2	12.8	26.9
2.00	.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
4.00	.38	57.3	137.1	282.6
5.00	.59	94.6	226.0	465.8
6.00	1.37	225.5	334.4	767.6
8.00	2.43	411.3	609.8	1399.8
10.00	3.79	379.4	621.4	1620.9
12.00	5.47	554.8	908.8	2370.6

PISTON ROD WEIGHT CHART

Rod Dia.	Piston Rod Weight*
0.625"	.35 lb. + .09 lb./in. of stroke
1.000"	1.1 lb. + .22 lb./in. of stroke
1.375"	2.3 lb. + .42 lb./in. of stroke
1.750"	5.0 lb. + .68 lb./in. of stroke
2.000"	6.1 lb. + .88 lb./in. of stroke
2.500"	10.4 lb. + 1.39 lb./in. of stroke

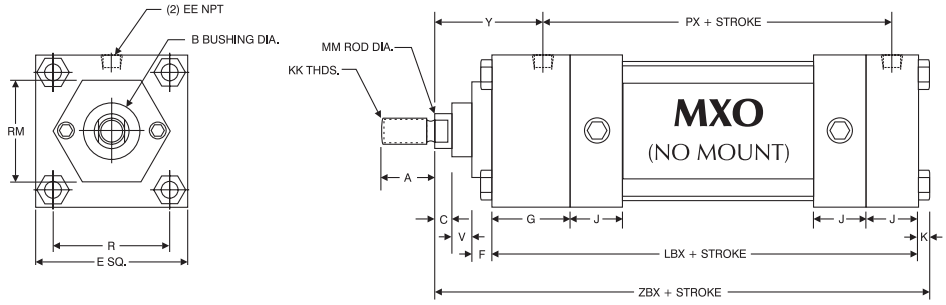
*Double Weight for double rod end cylinders.

Design Tips:

- **Cushions Adjustment screws can be ordered on same side as ports.** ***Refer to page 181 for details.***
- **BP** Seals provide additional impact dampening and noise reduction *(refer to page 173 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	0.625 Standard	0.750	1.125	0.375	2.000	0.375	0.375	1.500	1.000	0.250	7/16 -20	5.625	0.625	4.375	1.438	2.00 SQ.	0.250	1.875	6.875
	1.000 Oversize	N/A	N/A	N/A							N/A		N/A				N/A	N/A	N/A
2.00	0.625 Standard	0.750	1.125	0.375	2.500	0.375	0.375	1.500	1.000	0.313	7/16 -20	5.625	0.625	4.375	1.844	1.75 HEX	0.250	1.875	6.938
	1.000 Oversize	1.125	1.500	0.500							3/4 -16		1.000			2.50 SQ.	0.500	2.250	7.313
2.50	0.625 Standard	0.750	1.125	0.375	3.000	0.375	0.375	1.500	1.000	0.313	7/16 -20	5.750	0.625	4.500	2.188	1.75 HEX	0.250	1.875	7.063
	1.000 Oversize	1.125	1.500	0.500							3/4 -16		1.000			3.00 SQ.	0.500	2.250	7.438
3.25	1.000 Standard	1.125	1.500	0.500	3.750	0.500	0.625	1.750	1.250	0.375	3/4 -16	6.750	1.000	5.250	2.760	2.75 DIA.	0.250	2.375	8.500
	1.375 Oversize	1.625	2.000	0.625							1 -14		1.375			3.75 SQ.	0.375	2.625	8.750
4.00	1.000 Standard	1.125	1.500	0.500	4.500	0.500	0.625	1.750	1.250	0.375	3/4 -16	6.750	1.000	5.250	3.320	2.75 DIA.	0.250	2.375	8.500
	1.375 Oversize	1.625	2.000	0.625							1 -14		1.375			3.50 DIA.	0.375	2.625	8.750
5.00	1.000 Standard	1.125	1.500	0.500	5.500	0.500	0.625	1.750	1.250	0.438	3/4 -16	7.000	1.000	5.500	4.100	2.75 DIA.	0.250	2.375	8.813
	1.375 Oversize	1.625	2.000	0.625							1 -14		1.375			3.50 DIA.	0.375	2.625	9.063
6.00	1.375 Standard	1.625	2.000	0.625	6.500	0.750	0.625	2.000	1.500	0.438	1 -14	8.000	1.375	6.250	4.875	3.50 DIA.	0.375	2.750	10.063
	1.750 Oversize	2.000	2.375	0.750							1 1/4 -12		1.750				0.500	3.000	10.313
8.00	1.375 Standard	1.625	2.000	0.625	8.500	0.750	0.625	2.000	1.500	0.563	1 -14	8.125	1.375	6.375	6.438	3.50 DIA.	0.375	2.750	10.313
	1.750 Oversize	2.000	2.375	0.750							1 1/4 -12		1.750				0.500	3.000	10.563
10.00	1.750 Standard	2.000	2.375	0.750	10.625	1.000	0.625	2.250	2.000	0.688	1 1/4 -12	10.375	1.750	8.313	7.922	3.50 DIA.	0.500	3.063	12.938
	2.000 Oversize	2.250	2.625	0.875			0.750				1 1/2 -12		2.000			5.00 DIA.	0.375	3.188	13.063
12.00	2.000 Standard	2.250	2.625	0.875	12.750	1.000	0.750	2.250	2.000	0.688	1 1/2 -12	10.875	2.000	8.813	9.400	5.00 DIA.	0.375	3.188	13.563
	2.500 Oversize	3.000	3.125	1.000							1 7/8 -12		2.500				0.500	3.438	13.813

FC **FCH** **FCC** Fixed Head & Cap Cushions

NEW The fixed cushion option is comprised of a drilled orifice internally to provide a fixed flow rate for the cushion. The flow path is set at about 50% of the cushions capability. Since the orifice is internal to the cylinder, there is no external adjustable cushion hardware.

The advantage of a fixed cushion is there are no cushion adjustments to tamper with and get out of adjustment. Since the cushion flow path is a drilled hole, the flow path is less susceptible to blockage due to compressed air system contamination.

The disadvantage of the fixed cushion is the cylinder cannot be adjusted for optimum cushioning at end of stroke.

FIXED HEAD & CAP CUSHIONS

- **FC** Fixed Head & Cap Cushions
- **FCH** Fixed Standard Head Cushion
- **FCC** Fixed Standard Cap Cushion

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

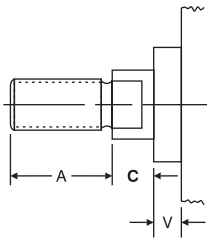
British Standard Pipe Taper **(BSPT)** threads have the same taper as American NPT tapered threads, but use a 55° Whitworth thread form and different diameters (not interchangeable with NPT).

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.



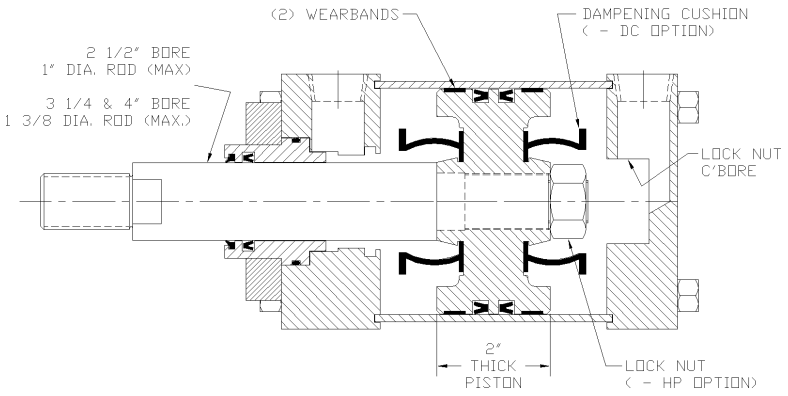
DC DCH DCC Dampening Cushions (ACE Controls NuCushions)

NEW The DC option, available on 2.50", 3.25" and 4.00" bore cylinders, greatly expand the range of available cylinder internal cushioning options. The DC option incorporates dual NuCushion bumpers, dual wear bands and an extended length piston to achieve outstanding performance.

Material: Urethane
Operating Temperature: -30°F to 150°F

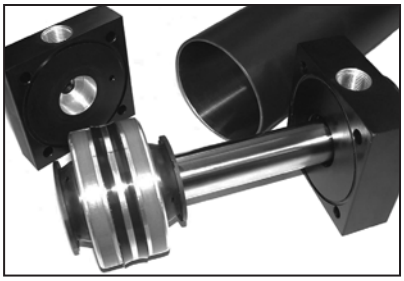
Application

The DC option has proven itself in the lumber industry. The "log kick out cylinder" application is one of the most demanding in a typical lumber mill. The industry has tried a variety of expensive custom cylinder designs to cope with the abuse the kick-out cylinders see. Recent test cylinders at mills running 24/7 average 3½ years of trouble-free service.



DAMPENING CUSHIONS

- **DC** Dampening Cushion at Head & Cap
- **DCH** Dampening Cushion at Head
- **DCC** Dampening Cushion at Cap



EN Electroless Nickel

Electroless Nickel (EN) 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 devises 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.

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

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:	Low
FINISH:	Bright and very smooth

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

BASIC OPTIONS

CS Center Supports

NEW Center supports are a design requirement for certain stroke lengths to help in the torque process. In some applications longer tie rods without the center support may droop or bow to a point where the tube won't remain properly aligned in the tube groove. Center supports will prevent this from occurring.

CENTER SUPPORT RECOMMENDATIONS	
1.50", 2.00" & 2.50" Bores	Strokes longer than 48"
3.25", 4.00" & 5.00" Bores	Strokes longer than 65"
6.00" & Larger Bores	Strokes longer than 72"

HP High Impact Piston

NEW TRD threads each piston to the piston rod, and uses a permanent type anaerobic sealant to provide a leak-free piston to piston rod connection. This design provides excellent service in 98% of applications. In high impact applications (lumber mills, vinyl shears, etc.) a more robust connection may be needed.

The high impact piston option consists of a steel hex locking nut in addition to the standard piston to rod connection. The hex locking nut is also staked to the piston rod for added durability.

Special Features
Counter bored Piston, Zinc Plated Steel Lock Nut

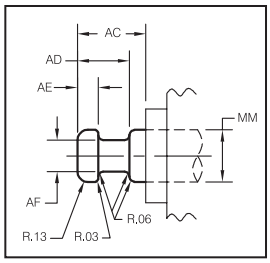
Standard Features
Staked Rod End, Permanent Loctite®, Threaded Piston to Rod Connection

KK10 Rod Coupler End

NEW The KK10 rod end was made popular in 3000 PSI hydraulic applications due to its versatility and high strength. Typically, a commercially available split flange end coupler and weld plate is used to connect the cylinder directly to the work that is being performed.

Example: TA-ME3-12x10-KK10

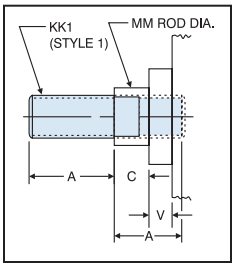
ROD DIAMETER (MM)	AC	AD	AE	AF
0.625	1.125	0.625	0.250	0.375
1.000	1.625	0.938	0.375	0.688
1.375	1.750	1.062	0.375	0.875
1.750	2.000	1.313	0.500	1.125
2.000	2.625	1.688	0.625	1.375
2.500	3.250	1.938	0.750	1.750



KK3S Studded 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.



KKX Special Rod Thread

NEW TRD can machine virtually any diameter and type of rod thread on the piston rod end. Standard NFPA rod threads are UNF (fine), class 2 threads. Common alternative choices are UNC (course) threads. Some uncommon thread choices are threads larger than the rod diameter. This is only possible by providing a KK3 (female) rod end and making a stud with the larger rod thread.

Note: Unless otherwise specified, the rod thread will be standard catalog "A" dimension lengths.

Example: TA-MX0-2x6-KKX=1/2-13 UNC

KKM Metric Rod Thread

NEW ISO 6431 is a very popular European tie rod cylinder design. Equipment that is imported from outside the United States typically will contain metric tie-rod cylinders. In general, ISO 6431 tie rod cylinders are not as robust as NFPA cylinder designs and some customers prefer to replace the metric cylinders with NFPA designs that will provide longer life.

TRD can provide cylinders with metric piston rod end threads to assist customers in mating replacement cylinders to existing equipment.

Example: TA-MX0-2.5x3.937-KKM=M10X1

BASIC OPTIONS: LUBE

L001 Magnalube-G Grease

Magnalube-G Grease is our standard lubricant used for all products except for PFLF and RS Series.

Magnalube-G is a non-soap elastomer/PTFE grease designed for superior performance in a wide range of applications. Insoluble in water, Magnalube-G is a nonmigratory grease that tends to stay put in the cylinder if there is no other oil present. Note: if an FRL is used in the pneumatic system, the FRL must be properly maintained to provide continued cylinder lubrication as any oil will negate the Magnalube-G.

See www.magnalube.com for more information.

Color: Green

Recommended temperature range: -20°F to 200°F (-25°C to 90°C)

L002 PFLF Series Standard Grease

A perfluoropolyether based grease that is relatively low friction and is matched to perform with PFLF cylinders in PCS controlled positioning systems.

Color: White Grease

Recommended temperature range: -55°F to 300°F (-48°C to 149°C)

L003 Low Temperature Grease

A silicone based high performance grease that is specifically designed for extremely low temperatures. The grease will cause slight swelling in seals, which improves the sealing abilities.

Color: Pink Grease

Recommended temperature range: -85°F to 200°F (-65°C to 90°C)

L004 Non-Conductive Grease

A petroleum-lithium based grease developed specifically for the electrical industry. Used primarily on ultrasonic welding equipment to eliminate internal arcing and rapid metal degradation in cylinders. NLGI #1

Color: White-Light Tan Grease

Recommended temperature range: -20°F to 200°F (-25°C to 90°C)

L005 USDA Food Grade Grease

Primarily white mineral oil based with zinc oxide and polytetrafluoroethylene. NLGI #2 grease; recommended for all food applications. USDA approved for incidental food contact.

Color: White Grease

Recommended temperature range: 15°F to 300°F (-9°C to 149°C)

L006 High Temperature Lube

A silicone oil (Phenylmethyl siloxane, trimethyl-terminated) with exceptional high temperature stability and lubricating properties. Relatively low friction; 500cs viscosity.

Color: Clear Liquid

Recommended temperature range: 32°F to 500°F (0°C to 260°C)

L007 High Vacuum Grease

A silicone compound (Polydimethylsiloxane, silica amorphous, dimethyl siloxane, hydroxyl-terminated) stiff grease used specifically in vacuum atmospheres on heat treat furnace and silicon wafer manufacturing processes. Non melting type. Note: Additional seals will be required for vacuum service; contact TRD for assistance.

Color: White-Gray

Recommended temperature range: -20°F to 375°F (-25°C to 190°C)

L008 RS Series Standard Grease

USDA Food Grade grease. Synthetic based fluid with aluminum complex soap thickener type grease that is ideal for freezer applications. USDA approved for incidental food contact.

Color: White

Recommended temperature range: -60°F to 300°F (-51°C to 149°C)

L011 EPDM Seal Lube

A silicone (Dimethyl Siloxane Polymer) based, tacky-stiff lubricant used specifically with EPDM type special seal materials. Note: this lube is not compatible with Nitrile seals.

Color: Clear

Recommended temperature range: -40°F to 300°F (-40°C to 149°C)

L012 Water Hydraulic Grease

A polymer-fortified petroleum grease, PTFE additives, and high molecular weight polymers formulated to resist water washout. Used specifically for water hydraulic cylinders. NLGI #2

Color: Green

Recommended temperature range: 0°F to 300°F (-18°C to 149°C)

L013 Low Friction Oil

A low friction, synthetic oil offering superior extreme pressure (EP), anti-wear properties and extremely low wear rates. Designed specifically for low friction applications such as counterbalance cylinders.

Color: White-Gray Liquid

Recommended temperature range: -30°F to 300°F (-34°C to 149°C)

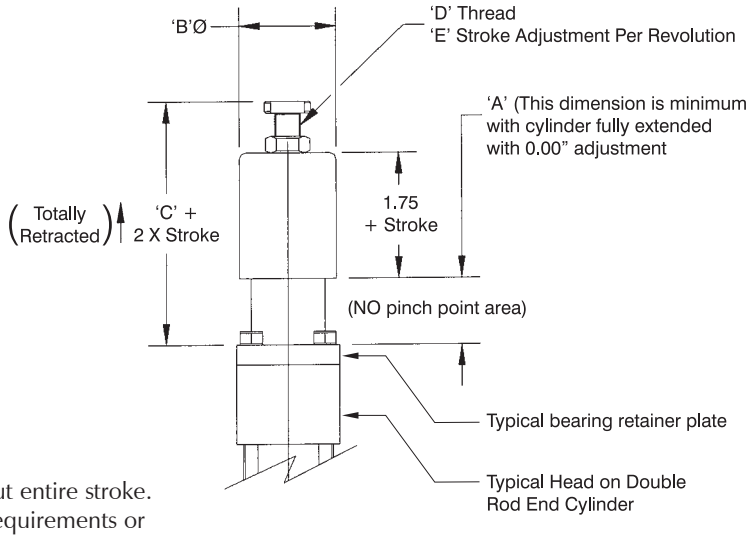
BASIC OPTIONS

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.

SKETCH A



TA-MF1D-MA (SHOWN)

MICRO-ADJUST DIMENSIONS					
BORE	A	B	C	D	E
1.50	1.000	1.875	3.710	1/2 -20	0.050
2.00	1.000	1.875	3.710	1/2 -20	0.050
2.50	1.000	1.875	3.710	1/2 -20	0.050
3.25	1.000	2.813	3.710	3/4 -16	0.063
4.00	0.750	2.813	3.469	3/4 -16	0.063
5.00	0.750	2.813	3.469	3/4 -16	0.063
6.00	0.750	3.750	3.469	3/4 -16	0.063
8.00	0.750	3.750	3.469	3/4 -16	0.063

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

MICRO-ADJUST SET-UP INSTRUCTIONS:

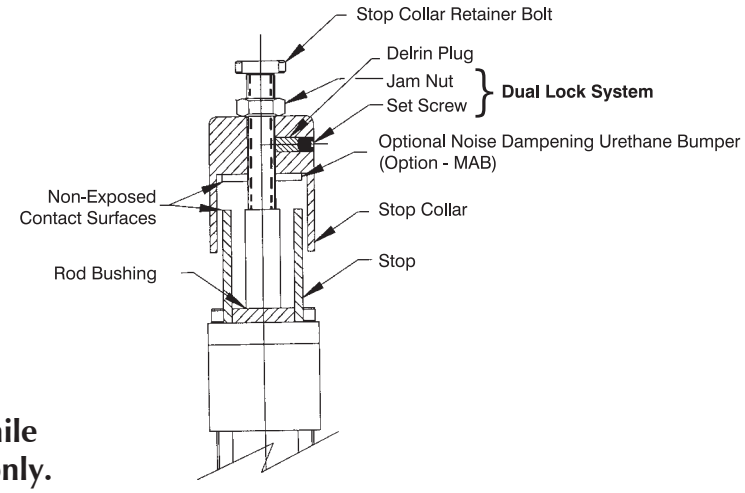
1) Set actuator to desired stroke
2) Turn stop collar until it makes contact with stop
3) Tighten set screw
4) Tighten jam nut for positive lock of stop collar

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.

SKETCH B



MAB *Micro-Adjust with Urethane Bumper*

A noise dampening urethane bumper is added between the metal contact points, minimizing noise (see Sketch B).

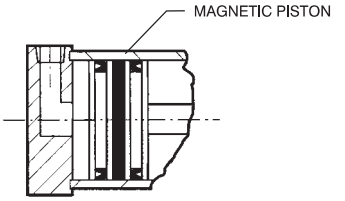
If the option you need isn't listed, just call TRD! We can accommodate most requests.

BASIC OPTIONS

MPR MPH Magnetic Piston

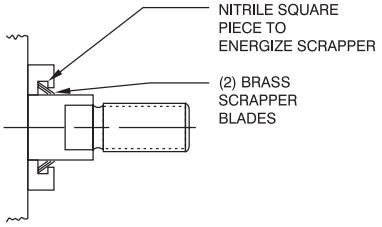
Magnetic Pistons (MPR) are used in conjunction with TRD R10, R10P, RHT, RAC Reed and MSS Solid State Switches.
(See pages 223-230 for switches)

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



MS Metallic Rod Scraper

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



NR Non-Rotating (NFPA) Cylinders

2.00" through 12.00" Bore
200 PSI Air, 400 PSI Hydraulic
(Non-Shock)

FORCE CHART **– Refer to page 262**

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

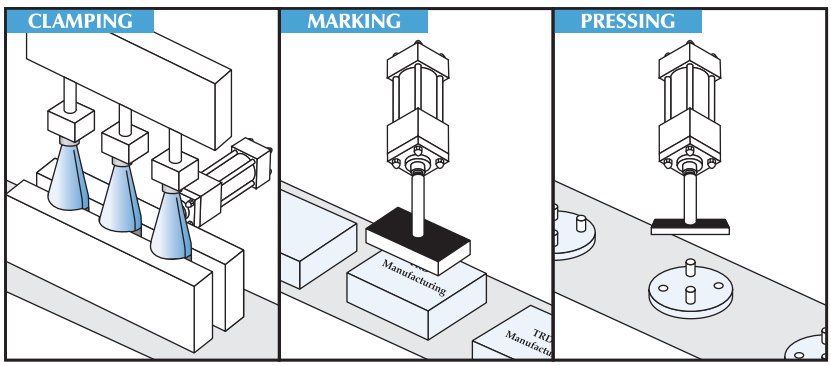
Advantages

- 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.

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 DIAMETER	CUSHIONS	GUIDE ROD DIAMETERS	MAXIMUM STROKE
2.00	0.625 Standard	Cap Only	0.250	10"
2.50	0.625 Standard	Cap Only	0.312	12"
	1.000 Oversize	N/A	0.312	12"
3.25	1.000 Standard	Available	0.375	18"
	1.375 Oversize	Cap Only	0.375	18"
4.00	1.000 Standard	Available	0.625	30"
	1.375 Oversize		0.625	30"
5.00	1.000 Standard	Available	0.625	30"
	1.375 Oversize		0.625	30"
6.00	1.375 Standard	Available	0.625	30"
	1.750 Oversize		0.625	30"
8.00	1.375 Standard	Available	1.000	40"
	1.750 Oversize		1.000	40"
10.00	1.750 Standard	Available	1.000	40"
	2.000 Oversize		1.000	40"
12.00	2.000 Standard	Available	1.000	40"
	2.500 Oversize		1.000	40"

BASIC OPTIONS

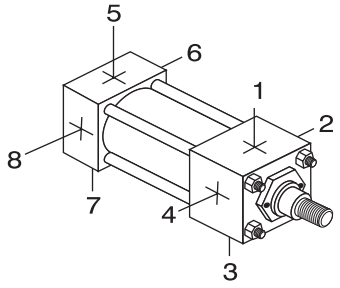
OP Optional Port Location

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 and 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

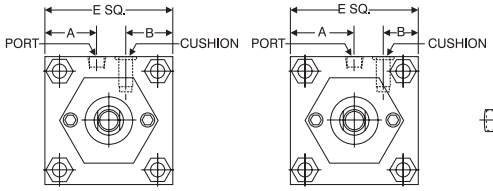
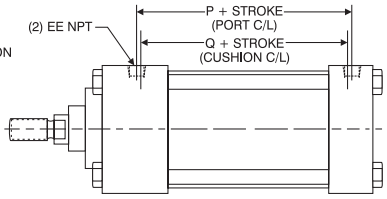


FIGURE #1 FIGURE #2



CAP VIEWS

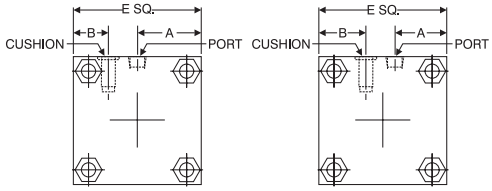


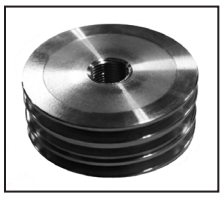
FIGURE #2 FIGURE #1

BORE	ROD DIAMETER	FIGURE	A	B	E	P	Q	EE
1.50	0.625 Standard	1	0.750	0.625	2.000	2.375	2.125	0.250
	1.000 Oversize	N/A	N/A	N/A	N/A			
2.00	0.625 Standard	1	0.875	0.938	2.500	2.375	2.125	0.375
	1.000 Oversize	1	1.000	0.750	2.500			
2.50	0.625 Standard	1	1.125	1.125	3.000	2.500	2.250	0.375
	1.000 Oversize	1	1.125	1.000	3.000			
3.25	1.000 Standard	1	1.500	1.375	3.750	2.750	2.500	0.500
	1.375 Oversize	2	1.875	1.000	3.750			
4.00	1.000 Standard	2	2.250	1.250	4.500	2.750	2.500	0.500
	1.375 Oversize	2	2.250	1.125	4.500			
5.00	1.000 Standard	2	2.750	1.750	5.500	3.000	3.000	0.500
	1.375 Oversize	2	2.750	1.625	5.500			
6.00	1.375 Standard	2	3.250	1.875	6.500	3.250	3.000	0.750
	1.750 Oversize	2	3.250	1.875	6.500			
8.00	1.375 Standard	2	4.250	2.750	8.500	3.375	3.125	0.750
	1.750 Oversize	2	4.250	2.750	8.500			
10.00	1.750 Standard	2	5.313	3.688	10.625	4.313	4.125	1.000
	2.000 Oversize	2	5.313	3.688	10.625			
12.00	2.000 Standard	2	6.375	4.750	12.750	4.813	4.625	1.000
	2.500 Oversize	2	6.375	4.750	12.750			

BASIC OPTIONS:

OPTIONAL PISTON & ROD BUSHING MATERIALS

PMB Solid Brass Pistons



The most common application for solid brass pistons is for water based hydraulic cylinder use.

Note: This option may require additional time for delivery depending on bore size and quantity.

PMC Solid Cast Iron Pistons

Solid cast iron pistons are standard in the 'HH' and 'MH' series. They can be ordered as an option for any other TRD series. Not suitable for use with an aluminum tube; we recommend that cast iron pistons are only used with a steel tube (Option TMS).

The most common use is to provide a more heavy-duty cylinder design in tough applications having higher side loads and/or higher impact loads.

PMD Solid Delrin® Pistons

The most common use for solid Delrin® pistons are in moderate side load, high frequency applications to reduce heat build-up and also provide higher piston to tube contact than a wear band can provide.

Note: Solid Delrin® pistons must be used in conjunction with HP option.

Available bore sizes: 1.50" to 6.00" This option may require additional time for delivery depending on bore size and quantity.

TEMP RATING: -20°F to 100°F (-25°C to 38°C)

SSP Solid Stainless Steel Pistons

Material: 303 Stainless Steel
Optional 316 SS (note: This option may require additional time for delivery depending on bore size and quantity).

Stainless steel pistons can be used in a multitude of applications ranging from water hydraulics to food processing, when the cylinders are used to dispense food products.

Standard features include a piston wear band.

RBB Solid Bronze Rod Bushing

Material: SAE 660 Bronze

Our standard floating rod bushing design is used in conjunction with solid SAE 660 bronze material. Material specifications: 20,000 PSI compressive strength.

Some customers prefer to use bronze rod bushings. Most common used are in water hydraulic applications.

Note: Since the mechanical properties of bronze is much lower than cast iron, bronze rod bushings typically do not provide the same long life that our standard PTFE coated cast iron rod bushings provide.

Specials: TRD can provide special length rod bushings; contact your local distributor for details

RBC Solid G2 Durabar Cast Iron Rod Bushing, PTFE baked finish

This is our standard rod bushing material, used in all series (except for 'SS' and 'RS' series).

Note: since this is our standard rod bushing, there is no need to specify the RBC option in the part number except in rare occurrences.

Material specifications: 150,000 PSI compressive strength. Graphite filled. PTFE baked finish that provides good exterior corrosion resistance.

Specials: TRD can provide special length rod bushings; contact your local distributor for details.

RBD Solid Delrin® Rod Bushing

Delrin® (Acetal Resin) rod bushings use our standard floating rod bushing design and are machined from solid bar stock material; color is white.

Delrin® has excellent overall properties: High mechanical strength and rigidity; long-term fatigue endurance against repeat impacts; resistant to moisture, solvents, and many other neutral chemicals; wide temperature range use; and excellent natural lubricity.

The most common use of Delrin® rod bushings are in the SS Series cylinders, in food processing applications. The Delrin® material has a natural lubricity that extends the rod bushing life in repeated was down applications and requires no further lubrication. This material has exceptionally long bearing life in food processing applications.

TEMP RATING: -20°F to 100°F (-25°C to 38°C)

RBS Solid Stainless Steel Rod Bushings (with PTFE wear band)

Material: 303 Stainless Steel
Optional 316 SS (Note: This option may require additional delivery time depending on bore size and quantity).

Stainless steel rod bushings can be used in a multitude of applications ranging from water hydraulics to wet environments. The RBS option incorporates our floating rod bushing design and an internal PTFE wear band as the rod bearing.

Anodized aluminum head, cap and tube type series cylinders with optional stainless steel tie rods, fasteners, piston rod and the RBS rod bushing option provide excellent corrosion resistance in many wet environments. This design combination is also a low cost alternative to solid stainless steel type cylinders such as the SS Series.

BASIC OPTIONS: SEALS

LF Low Friction

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

BORE SIZES: 1.50" to 8.00" Bore
MATERIAL: Carboxilated Nitrile
OPERATING TEMPERATURE: -20°F to 200°F (-25°C to 90°C)
OPERATING PRESSURE: 250 PSI AIR (17 BAR)

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

LT Low Temperature Seals

TEMP RATING: -30°F to 200°F (-34°C to 93°C)
PRESSURE RATING: 0 to 250 PSI Air (17 Bar); 0-400 PSI Hydraulic (27.6 Bar)

The LT option uses a special seal in the piston and rod areas to provide proper sealing and cylinder function at lower temperatures.
Note: These seals will fit in standard seal grooves.

Seal Type: U-Cup, urethane seals with O-ring energizer- which functions as a spring to maintain sealing contact under low temperature applications. Unidirectional seal.
Note: The piston will only contain one of these type seals since a "pressure trap" between two seals may occur.

MUST ALSO SPECIFY LTG (Low Temperature Grease) OPTION

How to order LT seal kit: SK100-325-LT (1" Rod, 3.25" Bore)

LTE Low Temperature Extreme Seals

TEMP RATING: -65°F to 200°F (-54°C to 93°C)
PRESSURE RATING: 0 to 250 PSI Air (17 Bar);
0-400 PSI Hydraulic (27.6 Bar)

The LTE option uses a special seal in the piston and rod areas to provide proper sealing and cylinder function at extremely lower temperatures.
Note: These seals will fit in standard seal grooves.

Seal Type: U-Cup, urethane seals with metal expander- which functions as a spring to maintain sealing contact under extremely low temperature applications. Unidirectional seal.
Note: The piston will only contain one of these type seals since a pressure trap between two seals may occur.

MUST ALSO SPECIFY LTG (Low Temperature Grease) OPTION

How to order LTE seal kit: SK137-500-LTE (1.375" Rod, 5" Bore)

OTS O-Ring Tube Seals

O-Ring tube seals can provide added sealing capabilities in high impact and/or hydraulic applications. The cylinders are machined with an O-Ring groove in the head and cap areas.

Note: Our standard tube end seals are a flat gasket type, rubber-like material. Static tests have shown that our standard flat gasket seals will withstand 1000 PSI static pressure. We recommend using the OTS option only if you are experiencing leakage in your specific application.

Flat gasket and O-Ring tube seals are **not** interchangeable. We recommend providing the cylinder serial number (for any seal kit requests) to verify the type of seals so the correct seal kit number can be provided.

TEMP RATING: -20°F to 200°F (-25°C to 90°C)
PRESSURE RATING: 0 to 250 PSI Air (17 Bar);
0-400 PSI Hydraulic (27.6 Bar)
MATERIAL: Nitrile

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 - one (1) POLY-PAK, one (1) Square-lip Rod Seal - POLY-PAK

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

RWV Rod Wiper made of Viton

RWV Option contains - Fluorocarbon rod wiper

VS Fluorocarbon Seals

VS Option contains two (2) Fluorocarbon U-Cup piston seals, Bushing O-Ring, rod seal and rod wiper.

Fluorocarbon seal material has an overall shorter seal life due to the higher wear rate inherent with the material. In general, Fluorocarbon seals should only be specified when temperatures exceed 200° F for prolonged periods of time or when there is a fluid compatibility issue with standard seals.

The RWV Option can provide a more cost effective solution than the "VS" Option when wash down fluid compatibility is the only issue.

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.

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 185.

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 (7/16-20)	5.00	#6 (9/16-18)
2.00	#4 (7/16-20)	6.00	#8 (3/4-16)
2.50	#4 (7/16-20)	8.00	#8 (3/4-16)
3.25	#6 (9/16-18)	10.00	#10 (7/8-14)
4.00	#6 (9/16-18)	12.00	#10 (7/8-14)

SE Spring Extend (1.50" - 2.50" Bore)

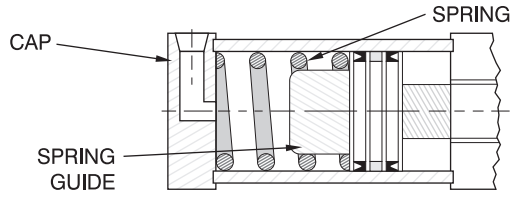
"SE" Option is designed to provide a spring bias to extend cylinder in the event of air pressure loss.

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", 2.00" 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.)
0.500	0.625	18	16
1.000	0.875	12	13
1.500	1.125	9	12
2.000	1.375	7	11
2.500	1.500	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)

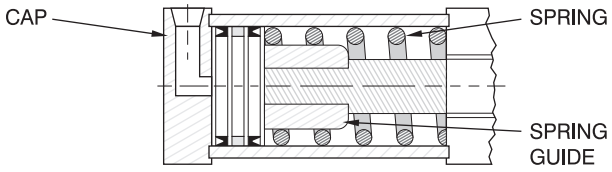
"SR" Option is designed to provide a spring bias to retract cylinder in the event of air pressure loss.

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", 2.00" 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.)
0.500	0.750	18	16
1.000	1.000	12	13
1.500	1.500	9	12
2.000	1.500	7	11
2.500	1.625	7	12
3.000	2.500	6	10
3.500	3.000	6	10
4.000	3.250	6	10
4.500	3.750	6	9
5.000	4.000	6	9
5.500	4.000	5	8
6.000	4.000	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

SSC Stainless Steel Cushion Needle (External Adjustment Components)

SSN Stainless Steel Sleeve Nuts ('FM' Series head end)

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:

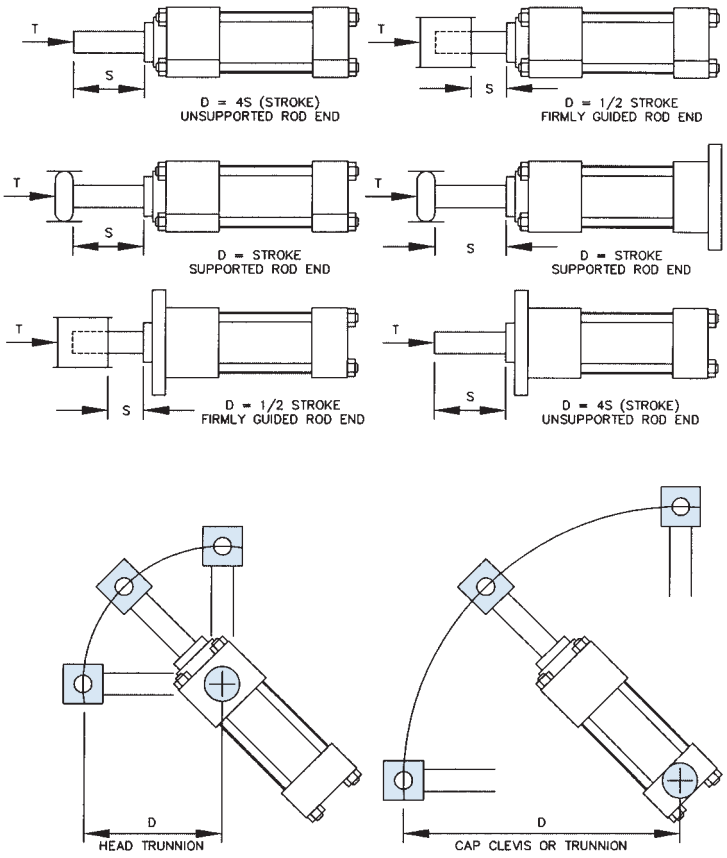
TA - MP1 - 3.25" x 40"ES - ST=2

As noted, the effective stroke (ES) 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

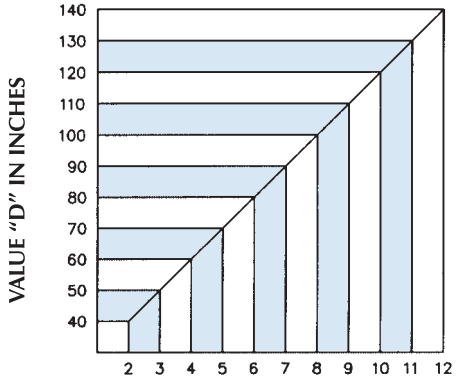
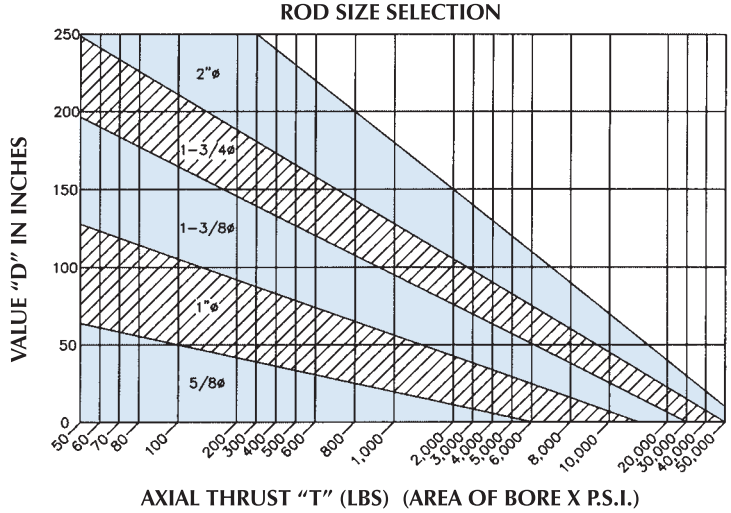


Chart 3



BASIC OPTIONS

TMS Tube Material - Steel

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.
- Since hard chrome plating is not a 100% homogeneous 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 231-234 for Balluff Proximity end of stroke sensors.

TMSS Tube Material - Stainless Steel

NEW

Since TRD uses the exact same design in our basic TA, FM, TD, SS and TAS series cylinder component materials can be easily substituted from series to series. The TMSS option can be ordered on any series for increased corrosion resistance.

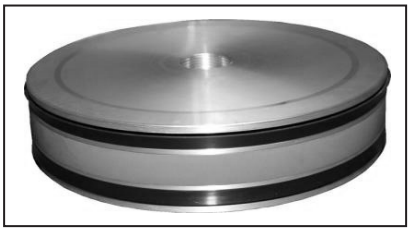
Stainless steel cylinder tubes basically the same wall thickness as the aluminum tubes in our standard product lines. The stainless steel tubing I.D. is "stainless steel" (not hard chrome plated) and is honed to close tolerances.

WB Piston Wear Band

Piston wear bands are standard on all TRD series (except for MSE, MSR and PFLF series) and cylinder model numbers do not need to include the "WB" option suffix for standard wear bands.

Material: 90% Virgin PTFE
10% Polyphenylene Sulfide
Tensile Strength: 2,700 - 3,300 PSI
Compressive Modulus: 65,000 PSI
Wear Factor: Extremely low

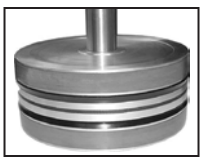
WEAR BAND WIDTHS	
BORE	WEAR BAND WIDTH
1.50 - 8.00	0.375
10.00	0.750
12.00	1.000



SPECIAL WEAR BANDS

TRD can provide special wear band designs for higher side load applications. Piston widths can be increased to accommodate wider wear bands or multiple wear bands for increased performance.

Note: Special wear band widths will increase the overall cylinder length.



Special 1" width dual wear band

ST option with dual wear bands

BASIC OPTIONS

PRIVATE LABELING

TRD is pleased to announce the availability of affordable, custom made private labels. Thanks to recent capital expenditures, TRD has new label printers which can produce full color labels at no additional cost over standard labels. Private labels can feature your customer's logo (instead of the TRD logo) and provide additional information such as a customer's part number or contact information. These labels will increase your customer's replacement cylinder business!

TRD has offered some means of private label for years, however cost has always been a limiting factor. Commercial printing setup costs would often run several hundred dollars, and all label orders were subject to minimum quantities at expensive per labels rates. Initial setup could sometimes take weeks, and all reorders were subject to printing delays.

TRD's new printing method makes it easy to do private labeling. All private labels will be printed on the same machines our standard labels use, so there is no additional per label cost. The labels are setup and maintained by TRD staff, so creation times is measured in hours, not days or weeks. Minor changes to a label design, like updating a customer's address or telephone number, can be made by quickly modifying the database. There are no old, outdated pre-printed labels being wasted. Private labeling is now easier, faster and better than ever before.

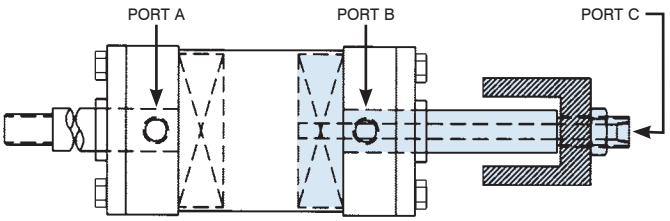
New private labels can be setup for a one-time charge of $75 NET per customer, per label size. Two sizes are available, 2″ x 1″ and 2″ x 2″ labels. Contact TRD for more information on setting up private labels for your customers.

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.

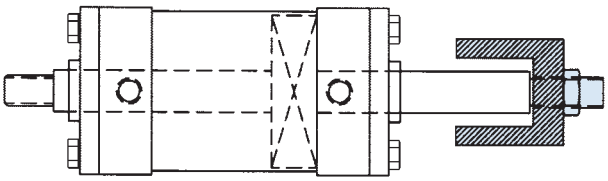
To order, specify "AS3POS" and length of adjustment. (Example: AS3POS = 4")



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")



PAINT & OTHER SPECIAL FINISHES

Standard Finish: Black Urethane Paint (indoor/outdoor use).

Optional Paint: Black Epoxy Paint (indoor use only).

Additional Paint Choices: TRD can provide paint in any color or type.
Contact TRD with your specifications.

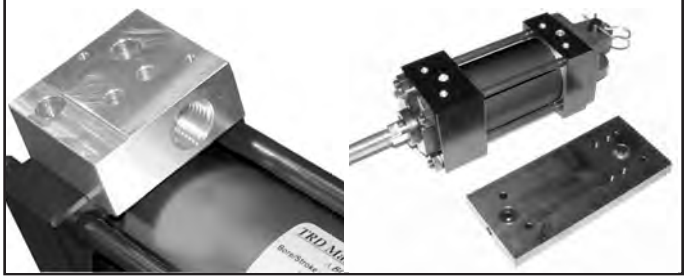
Additional Finishes: TRD can provide special finishes, i.e., Nutride Plate
Contact TRD with your specifications — we would be pleased to provide a quote!

Heavy Chrome Plated Piston Rods.
Contact TRD for more information.

MANIFOLD BLOCK or PLATE

For OEM's, TRD can design and provide custom made manifolds in high quantity.

Contact TRD with your specifications.



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 tape, and different size drilled orifices at each end of cylinder, for built-in speed control.

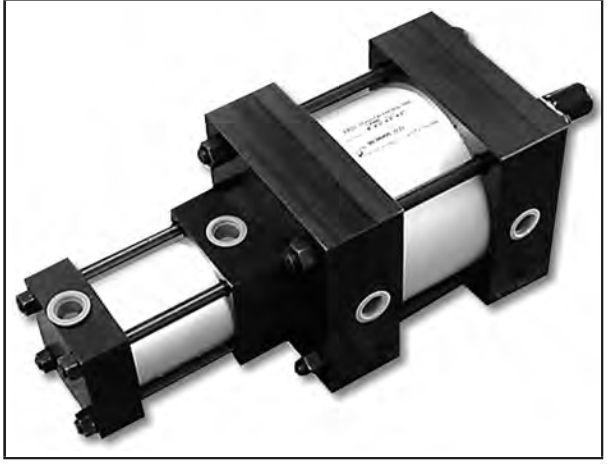
UNCOMMON OPTIONS AND SPECIALS

MT4X BOLT-ON SIDE PLATES

'FM' WITH FLUSH ROD BUSHING

SPECIAL STEEL MOUNTS

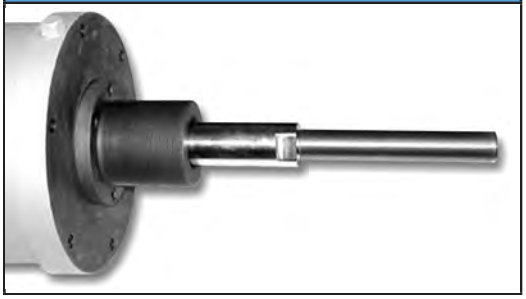
TANDEM WITH DIFFERENT SIZE BORES



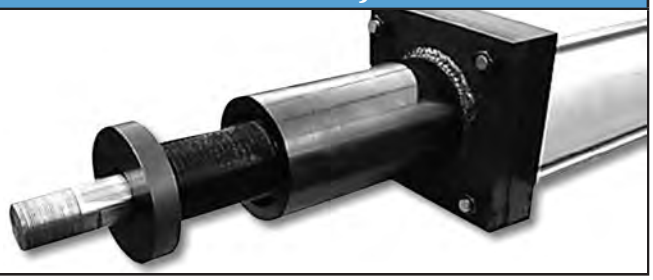
GREASE ZERKS (FOR HIGH CYCLE APPLICATIONS)

168" STROKE STAINLESS STEEL

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



8.00" BORE - FRONT EXTENSION ADJUSTABLE STROKE



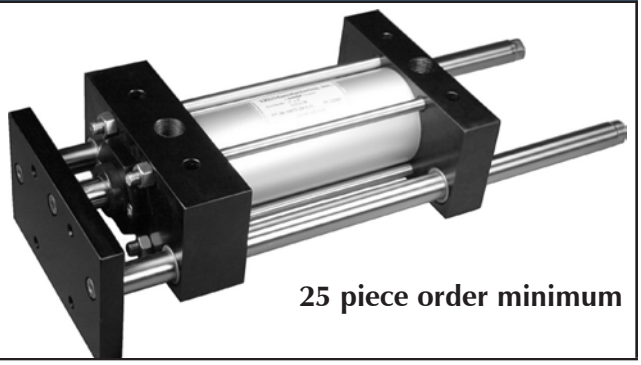
12.00" BORE STEEL, RATED FOR -40° F BELOW ZERO

EXTERNAL NON-ROTATING WITH SPECIAL TOOL PLATE

UNCOMMON OPTIONS AND SPECIALS

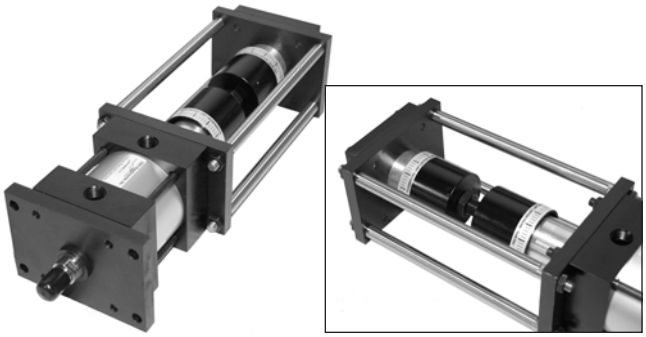
TWIN PISTON ROD 6.00" BORE, NON-ROTATING

2.00" BORE WITH EXTERNAL GUIDE RODS AND TOOL PLATE, SS HARDWARE FOR WASH-DOWN

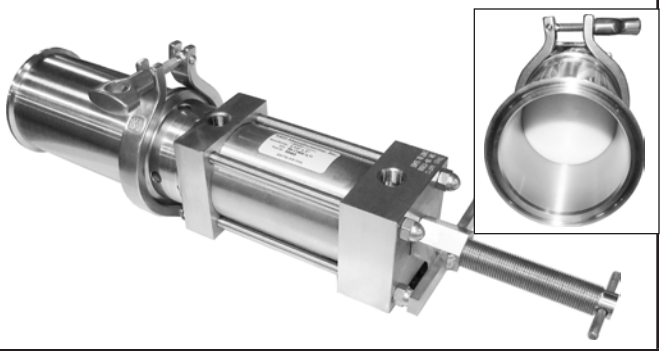


25 piece order minimum

'MA' MICRO ADJUST ON EXTEND AND RETRACT STROKE FOR PROCESS WEB CONTROL



3A SANITARY SS COUPLING WITH CYLINDER FOR MEASURING AND DISPENSING FOOD

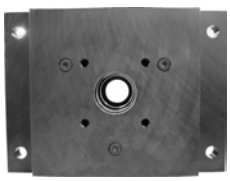


CLOSE TOLERANCE PISTON ROD MACHINING AFTER CYLINDER IS ASSEMBLED

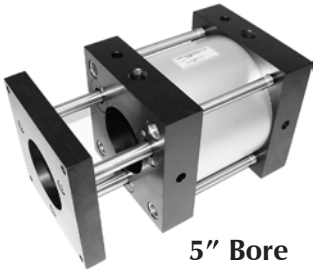
VACUUM SEAL FACE WITH BUSHING VENT (FOR FURNACE AND SILICON WAFER PROCESSES)

AIR/OIL BOOSTER PUMP

TRA SERIES WITH THROUGH HOLE



10" Bore Special



5" Bore

AB121 Booster
IT Series Intensifiers
Reservoirs and Tanks

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

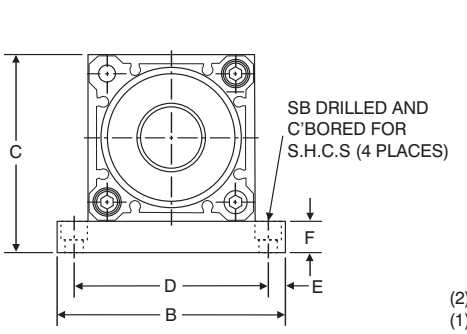
SERIES: AUTO RECIPROCATING AIR BOOSTER

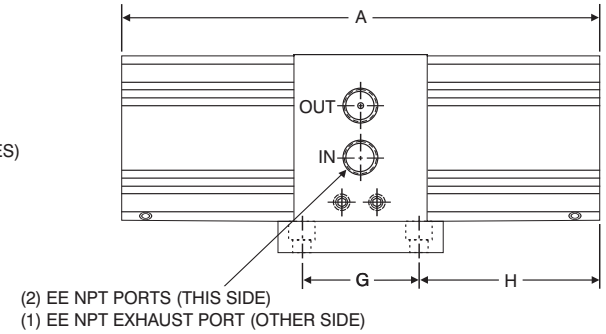
Model Numbers: AB121 & AB122

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.



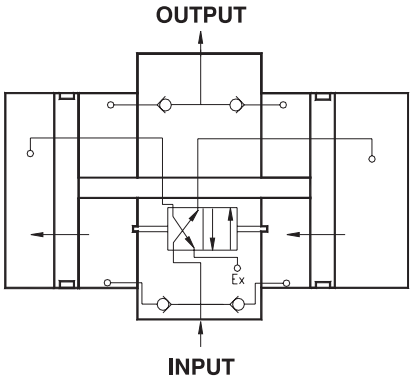


AUTO RECIPROCATING AIR BOOSTER DIMENSIONS										
PART NO.	A	B	C	D	E	F	G	H	EE NPT	SB DIA.
AB121	7.33	3.50	3.04	2.98	0.26	0.48	1.79	2.77	1/4 NPT	1/4
AB122	14.20	7.00	6.00	5.95	0.53	1.00	3.58	5.31	1/2 NPT	1/2

Engineering Specifications

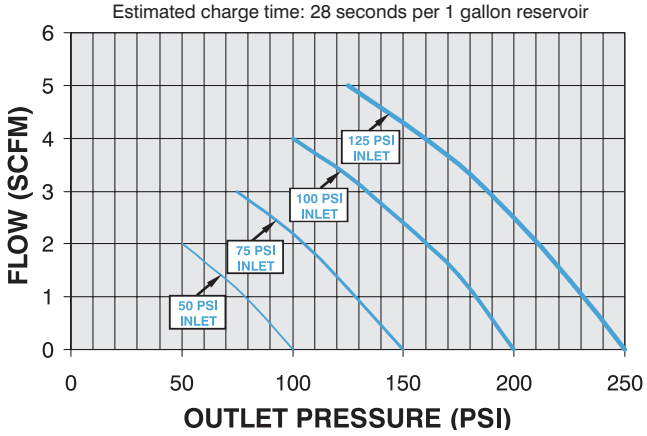
Maximum Input Pressure: 125 psi
Operating Temperature: 15° to 160°F
Lubrication: HT-99 oil; Pre-lubricated
Bodies and Center Section: Aluminum; Hard Coat with PTFE
Mounting Plate: Anodized Aluminum

NOTE: TRD Air Boosters are designed for intermittent duty usage such as maintaining pressure in an air reservoir. Continuous cycling decreases seal life.



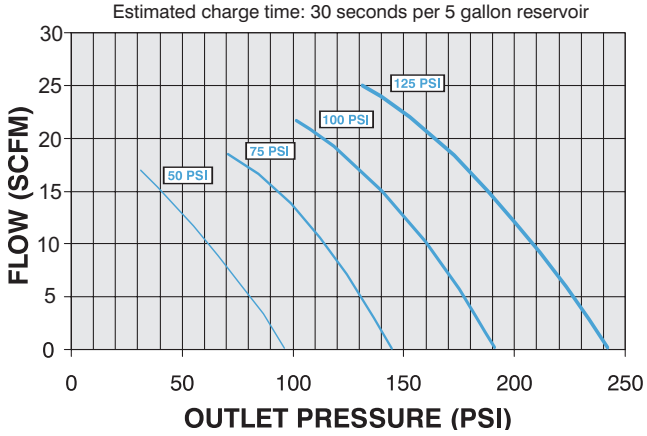
AB121 FLOW DATA

Estimated charge time: 28 seconds per 1 gallon reservoir



AB122 FLOW DATA

Estimated charge time: 30 seconds per 5 gallon reservoir



SERIES: AB121 WITH AIR RESERVOIR

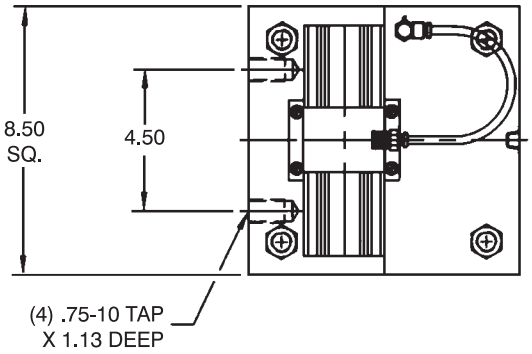
Model AB121 Air Booster furnished with Air Reservoir. Anodized Aluminum Tube and End Cap construction.

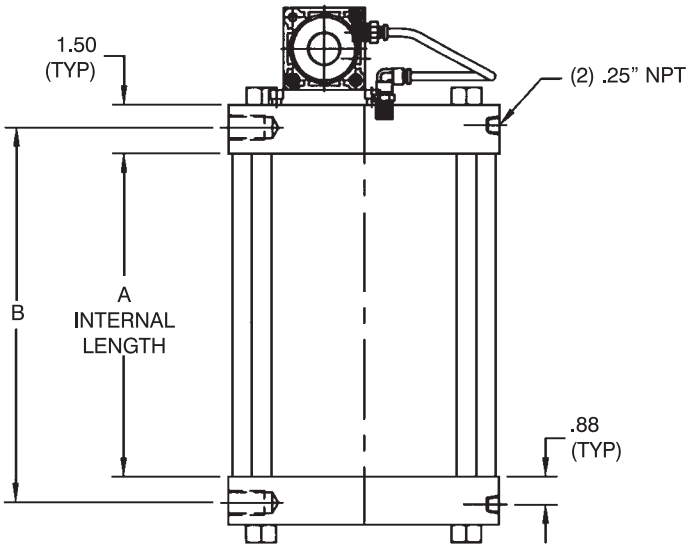
How to order:

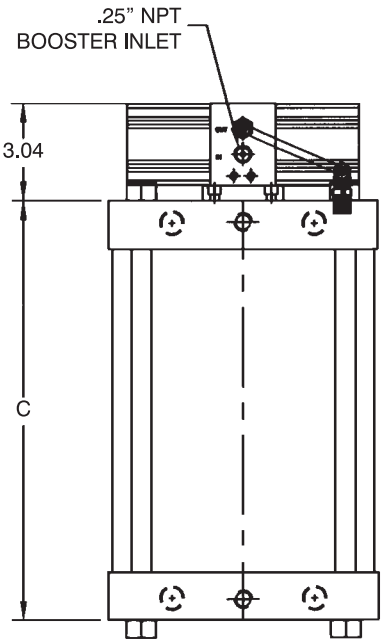
AB121 - ARB 800 X _____

- INTERNAL LENGTH: 12, 18, 24, or 36
- 8″ Bore Size
- Air Reservoir for Booster
- Auto Reciprocating Air Booster

PRESSURE RATING
250 PSI MAX.







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 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 — CYL. #2

AI - TA - MS4 - 5 x 10 - MPR WITH MXO - 2.50 X 10 - TH

AIR INTENSIFIERS

SERIES	
TA	250 PSI AIR
TD	250 PSI AIR
SS	STAINLESS STEEL (303, 304)

NFPA MOUNTS	
MXO	NO MOUNT (1.50" - 12.00" Bore)
MF1	FRONT FLANGE (1.50"- 6.00" Bore)
MS2	SIDE LUG (1.50"- 4.00" Bore STD., 5.00" & ABOVE CONSULT FACTORY)
MS4	BOTTOM TAPPED HOLES (1.50" - 12.00" Bore)

BORE	
CYL. 1	CYL. 2
3.25	1.50
4.00	2.00
5.00	2.50
6.00	3.25
8.00	4.00
10.00	5.00
12.00	6.00
—	8.00

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.		
	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
	BP	BUMPER PISTON SEALS (1.50" - 8.00" Bore)
	H	HEAD CUSHION
	C	CAP CUSHION
	EN	**ELECTROLESS NICKEL PLATED** *(Refer to page 176 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 223-230 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
	SSN	STAINLESS STEEL TIE ROD NUTS
	SSP	SOLID STAINLESS STEEL PISTON
	SSR	STAINLESS STEEL PISTON ROD
	SST	STAINLESS STEEL TIE RODS
	TH	**400 PSI HYDRAULIC NON-SHOCK** *(Refer to page 183 for specifications)*
	VS	FLUOROCARBON SEALS
	XX	SPECIAL VARIATION (SPECIFY)

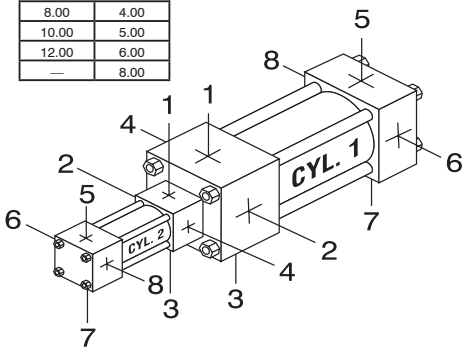
**BUMPERS ADD .25" PER END TO CYLINDER LENGTH.

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



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

AIR TO AIR/AIR TO HYDRAULIC INTENSIFIER CYLINDERS:

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

AIR TO AIR INTENSIFIERS
TRD STANDARD COMBINATIONS

CYL. #1		CYL. #2		INTENSIFIER RATIO	OUTPUT (PSI) OF CYL. #2 @ INPUT PRESSURE OF:			
BORE	AREA	BORE	AREA		50	80	100	120
3.25	8.296	1.50	1.767	4.69	235			
		2.00	3.142	2.64	132	211	264	
4.00	12.566	2.00	3.142	4	200			
		2.50	4.909	2.56	128	205	256	
5.00	19.635	2.50	4.909	4	200			
		3.25	8.296	2.37	119	190	237	
6.00	28.274	3.25	8.296	3.41	171			
		4.00	12.566	2.25	113	180	225	
8.00	50.265	4.00	12.566	4	200			
		5.00	19.635	2.56	128	205	256	
		6.00	28.274	1.78	89	143	178	214
10.00	78.54	5.00	19.635	4	200			
		6.00	28.274	2.78	139	223		
12.00	113.10	6.00	28.274	4	200			
		8.00	50.265	2.25	113	180	225	

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

Intensifier ratio = CYL. #1 AREA / CYL. #2 AREA

Output pressure = INPUT PRESSURE X INTENSIFIER RATIO

AIR TO HYDRAULIC INTENSIFIERS
TRD STANDARD COMBINATIONS

CYL. #1		CYL. #2		INTENSIFIER RATIO	OUTPUT (PSI) OF CYL. #2 @ INPUT PRESSURE OF:			
BORE	AREA	BORE	AREA		50	80	100	120
3.25	8.296	1.50	1.767	4.69	235	375		
		2.00	3.142	2.64	132	211	264	317
4.00	12.566	1.50	1.767	7.11	356			
		2.00	3.142	4	200	320	400	
		2.50	4.909	2.56	128	205	256	307
5.00	19.635	2.00	3.142	6.25	313			
		2.50	4.909	4	200	320	400	
		3.25	8.296	2.37	119	190	237	284
6.00	28.274	2.50	4.909	5.76	288			
		3.25	8.296	3.41	171	273	341	
		4.00	12.566	2.25	113	180	225	270
8.00	50.265	3.25	8.296	6.06	303			
		4.00	12.566	4	200	320	400	
		5.00	19.635	2.56	128	205	256	307
		6.00	28.274	1.78	89	143	178	214
10.00	78.54	4.00	12.566	6.25	313			
		5.00	19.635	4	200	320	400	
		6.00	28.274	2.78	139	223	278	334
12.00	113.10	5.00	19.635	5.76	288			
		6.00	28.274	4	200	320	400	
		8.00	50.265	2.25	113	180	225	270

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

Intensifier ratio = CYL. #1 AREA / CYL. #2 AREA

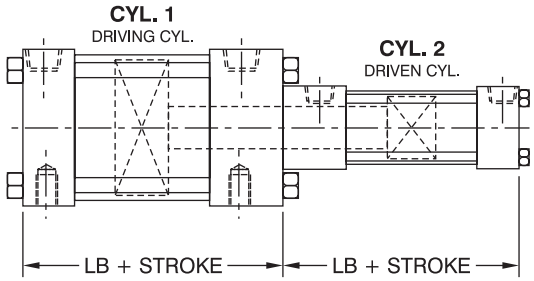
Output pressure = INPUT PRESSURE X INTENSIFIER RATIO

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
1.50	3.625
2.00	3.625
2.50	3.750
3.25	4.250

BORE	LB
4.00	4.250
5.00	4.500
6.00	5.000
8.00	5.125

BORE	LB
10.00	6.375
12.00	6.875

CYLINDER VOLUMES
(PER INCH OF CYLINDER STROKE)

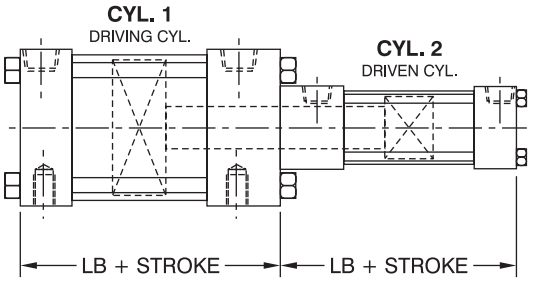
BORE	AREA	GAL. PER IN. OF STROKE
1.50	1.767	.0076
2.00	3.142	.0136
2.50	4.909	.0213
3.25	8.296	.0359

BORE	AREA	GAL. PER IN. OF STROKE
4.00	12.566	.0054
5.00	19.635	.085
6.00	28.274	.122
8.00	50.265	.2175

BORE	AREA	GAL. PER IN. OF STROKE
10.00	78.54	.340
12.00	113.10	.4896

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
1.50	3.625
2.00	3.625
2.50	3.750
3.25	4.250

BORE	LB
4.00	4.250
5.00	4.500
6.00	5.000
8.00	5.125

BORE	LB
10.00	6.375
12.00	6.875

CYLINDER VOLUMES
(PER INCH OF CYLINDER STROKE)

BORE	AREA	GAL. PER IN. OF STROKE
1.50	1.767	.0076
2.00	3.142	.0136
2.50	4.909	.0213
3.25	8.296	.0359

BORE	AREA	GAL. PER IN. OF STROKE
4.00	12.566	.0054
5.00	19.635	.085
6.00	28.274	.122
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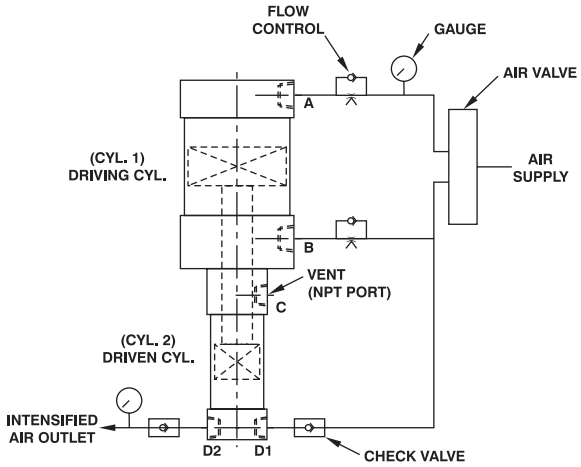
Example:
3.25" BORE X 16" STROKE CYLINDER = 8.296 X 16 = 132.736 CU. IN. OR .575 GALLONS

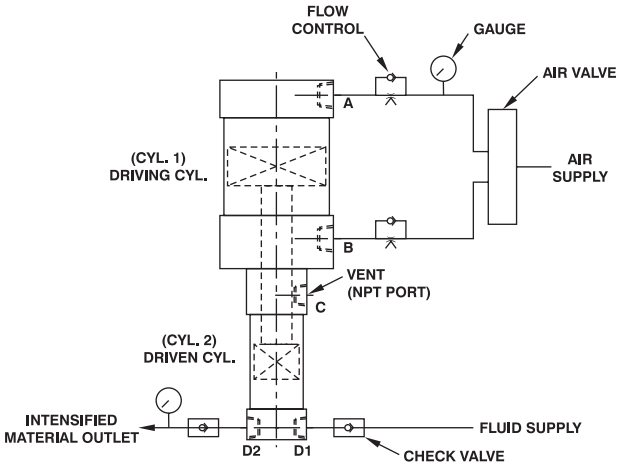
SCHEMATICS:

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' two (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' two (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, two (2) air/oil tanks, and a cylinder equipped with "TH" (hydraulic seals). Low initial investment and low maintenance to operate!

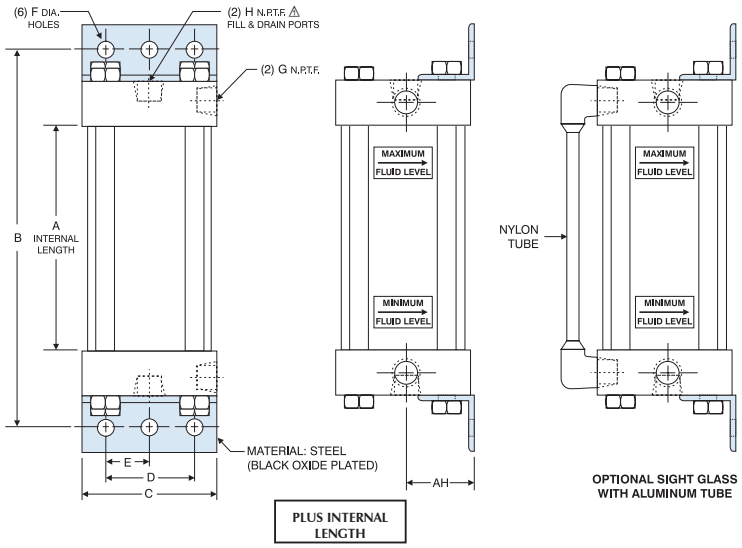
Tanks need to be mounted above the cylinder, but not necessarily by the cylinder. This will create a self-purging oil circuit. It is advisable to size tanks 30-50% larger than cylinder volume, to prevent the tanks from running dry and to allow for heat expansion.

Sizing your air/oil tank:

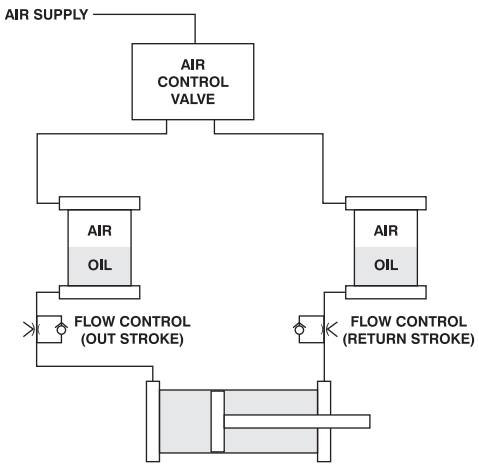
1. Determine the cylinder volume by multiplying the square inches of piston area by the inches of stroke (see Table B). Add 30-50% to determine actual tank size.
2. Find the volume closest to your tank volume requirement in Table C. Note: Tanks of smaller diameters with greater lengths are generally 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	4.000	1.625	3.000	2.250	1.125	0.438	0.375	0.375
AT325	3.25	8.29	.0359	0	5.000	1.938	3.750	2.750	1.375	0.563	0.500	0.375
AT400	4.00	12.56	.0544	0	5.000	2.250	4.500	3.500	1.750	0.563	0.500	0.375
AT500	5.00	19.64	.085	0	5.250	2.750	5.500	4.250	2.125	0.688	0.500	0.375
AT800	8.00	50.26	.2175	0	6.625	4.250	8.500	7.125	3.563	0.688	0.750	0.750

*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 263 for specifications.

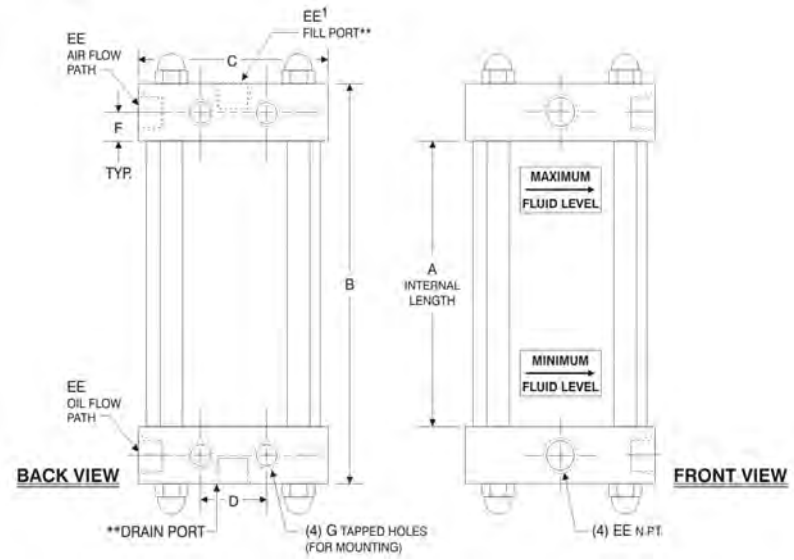
TABLE B - CYLINDER PISTON AREA	
CYLINDER BORE (In.)	PISTON AREA (Sq. In.)
1.50	1.77
2.00	3.14
2.50	4.91
3.25	8.30
4.00	12.57
5.00	19.64
6.00	28.27
8.00	50.27

TABLE C - RECOMMENDED USABLE TANK VOLUME (cubic inches) WITH 30% SAFETY FACTOR																	
		ACTUAL INTERNAL LENGTH OF TANK															
BORE	AREA	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
4.00	12.57	44	52	61	70	79	88	105	123	140	158	176	220	264	308	352	396
5.00	19.64	68	82	96	110	123	137	165	192	220	247	275	343	412	481	550	618
8.00	50.27	176	211	246	281	317	352	422	493	563	633	704	880	1056	1232	1408	1584

SERIES 'SS-AT': AIR/OIL TANKS

Series 'SS-AT' features:

- 303/304 Stainless Steel Hardware
- 200 PSI Operating Pressure
- Internal Steel baffles to reduce aeration and foaming
- Fiber wound translucent tube (non-FDA material)
- Optional stainless steel tube, fittings and sight glass (FDA approved materials)
- Standard mount (MS4; four-tapped mounting holes back side)
- Side lug mount (MS2) optional
- Fill port located in top, drain port in bottom cap
- Optional oversized ports for high flow applications (For oil velocity exceeding six feet per second)



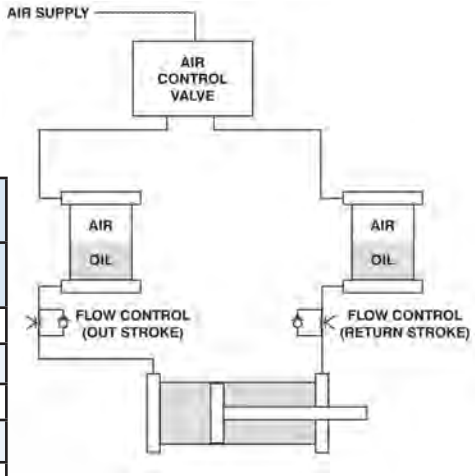
The TRD air/oil system gives you the smooth operation typically associated with hydraulic systems, without the expense! Uses shop air, two (2) air/oil tanks and a cylinder equipped with "TH" (hydraulic seals). Low initial investment and low maintenance to operate!

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. To order, specify Bore and internal length required. Example: SS-AT250 x 14 (2.50" Bore, 14" internal tank length, with a usable volume of 52 cubic inches).

TYPICAL AIR-OIL CIRCUIT



SS-AT MODEL			PLUS INTERNAL LENGTH		TANK DIMENSIONS					
PART NO.	BORE	*GALS PER INCH TANK	A	B	C	D	F	G	EE	EE[1]
SS-AT250	2.50	0.0213	0	2.000	3.000	1.250	0.438	3/8-16 x 0.625 DEEP	0.375	0.375
SS-AT325	3.25	0.0359	0	2.500	3.750	1.500	0.563	1/2-13 x 0.750 DEEP	0.500	0.375
SS-AT400	4.00	0.0544	0	2.500	4.500	2.063	0.563	1/2-13 x 0.750 DEEP	0.500	0.375
SS-AT500	5.00	0.0850	0	2.500	5.500	2.688	0.688	5/8-11 x 1.000 DEEP	0.500	0.375
SS-AT800	8.00	0.2175	0	3.000	8.500	4.500	0.688	3/4-10 x 1.125 DEEP	0.750	0.750

* This is total internal volume, not recommended usable oil capacity.
** Fill and drain ports located at top & bottom of air oil tank.

TABLE B - CYLINDER PISTON AREA	
CYLINDER BORE (In.)	PISTON AREA (Sq. In.)
1.50	1.77
2.00	3.14
2.50	4.91
3.25	8.30
4.00	12.57
5.00	19.64
6.00	28.27
8.00	50.27

TABLE C - RECOMMENDED USABLE TANK VOLUME (cubic inches) WITH 30% SAFETY FACTOR																	
		ACTUAL INTERNAL LENGTH OF TANK															
BORE	AREA	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
4.00	12.57	44	52	61	70	79	88	105	123	140	158	176	220	264	308	352	396
5.00	19.64	68	82	96	110	123	137	165	192	220	247	275	343	412	481	550	618
8.00	50.27	176	211	246	281	317	352	422	493	563	633	704	880	1056	1232	1408	1584

SERIES: AIR RESERVOIR

Stand-alone Air Reservoir from 2.50″ to 10.00″ bore size. Anodized Aluminum Tube and End Cap, Steel Mounting Bracket construction.

How to order:

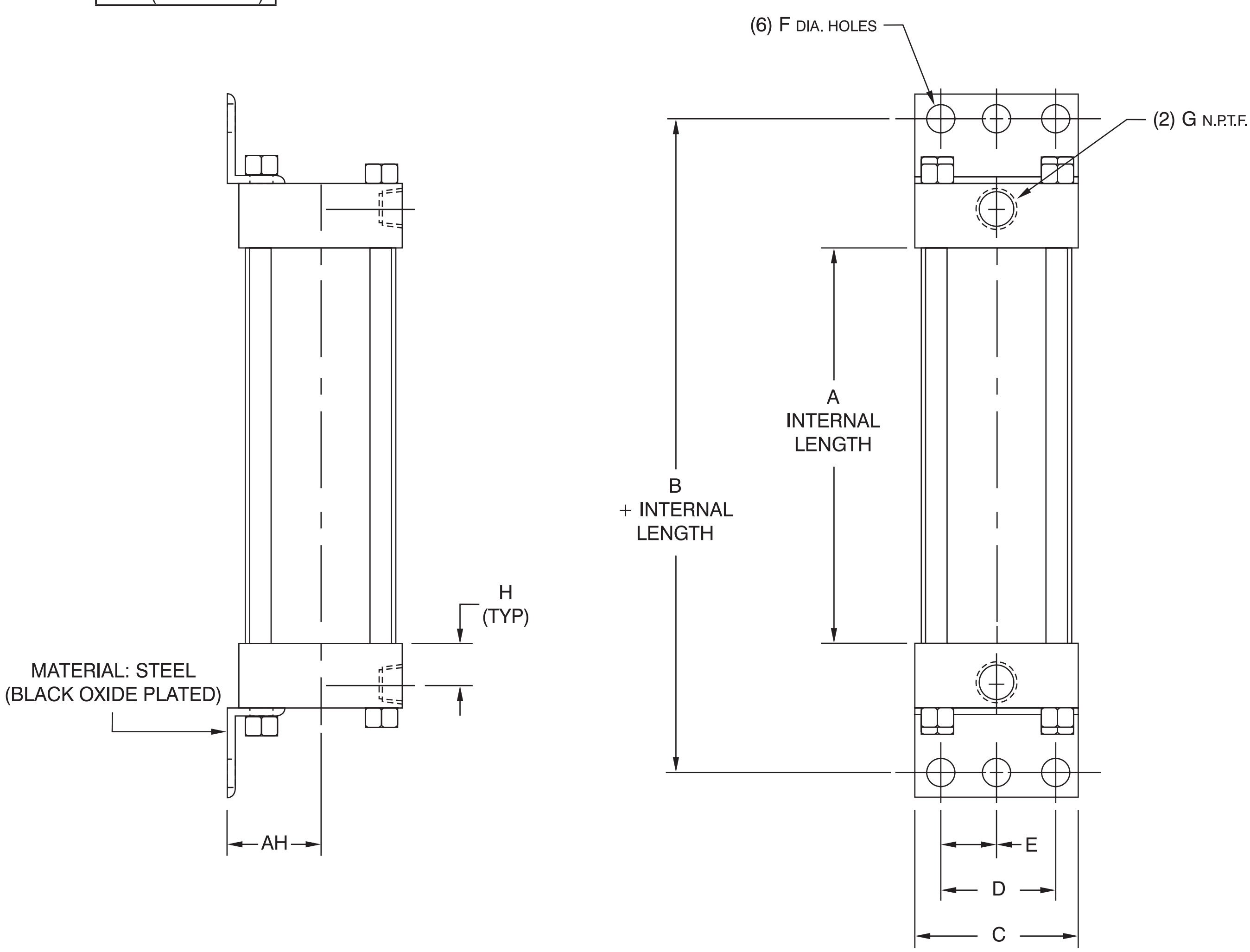
AR - _____ X _____

- AR: Air Reservoir
- First blank: Bore Size
- Second blank: Internal Length

INTERNAL LENGTH
1” to 100”

BORE SIZE
250 (2.50” BORE)
325 (3.25” BORE)
400 (4.00” BORE)
500 (5.00” BORE)
600 (6.00” BORE)
800 (8.00” BORE)
1000 (10.00” BORE)

PRESSURE RATING
250 PSI MAX.



AR SERIES (AIR RESERVOIR)

PART NUMBER & VOLUME				DIMENSIONS								
PART NUMBER	BORE	AREA	GAL. PER IN. OF RESERVOIR*	+ INTERNAL LENGTH A	+ INTERNAL LENGTH B	AH	C	D	E	F	G	H
AR-250	2.50	4.909	.0213	0	4.000	1.625	3.000	2.250	1.125	0.438	0.375	0.625
AR-325	3.25	8.29	.0359	0	5.000	1.938	3.750	2.750	1.375	0.563	0.500	0.625
AR-400	4.00	12.56	.0544	0	5.000	2.250	4.500	3.500	1.750	0.563	0.500	0.750
AR-500	5.00	19.64	.085	0	5.250	2.750	5.500	4.250	2.125	0.688	0.500	0.750
AR-600	6.00	28.27	.122	0	5.750	3.250	6.500	5.250	2.625	0.813	0.750	0.875
AR-800	8.00	50.26	.2175	0	6.625	4.250	8.500	7.125	3.563	0.813	0.750	0.875
AR-1000	10.00	78.54	.340	0	7.625	5.313	10.625	8.625	4.313	0.813	1.000	1.125

*Internal volume of reservoir.

BTP Series Bench Top Press & Cylinders

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

HEAVY DUTY BENCH TOP PRESS

MODEL: BTP-501

FOR SINGLE PISTON ROD, 5.00" BORE, MF1 MOUNT CYLINDERS

Heavy Duty Bench Top Press shown with 5.00" Bore three (3) Stage Multi-Stage Cylinder and Micro-Adjust precision stroke adjustment

MODEL: BTP-502

FOR 'TRA' TRIPLE PISTON ROD, 5.00" BORE, MF1 MOUNT CYLINDERS

Heavy Duty Bench Top Press shown with 5.00" Bore Single-Stage Triple Rod Cylinder and Tooling Plate

Heavy Duty Bench Top Press Features

- *Heavy duty STEEL keyed & bolted construction.*
- *Adjustable work heights - Choose from three different built-in height settings (2" increments).*
- *Open work area - Allows for through feed or side feed of large parts.*
- *Removable, oversized ground tool plate, dowel pinned to press frame - Provides precision location of tool plate to press frame.*
- *Press designed to accept 5.00" Bore NFPA standard cylinders, Multi-Stage cylinders, or optional Triple Rod Cylinders.*
- *Optional External Mounted Non-Rotating Feature.*
- *Strokes from 1.00" to 6.00"*
- *Easy to Assemble or can be ordered fully assembled.*
- *Finish - All steel parts are Black Oxide Plated, aluminum parts are Anodized.*

HOW TO ORDER: BENCH TOP PRESS

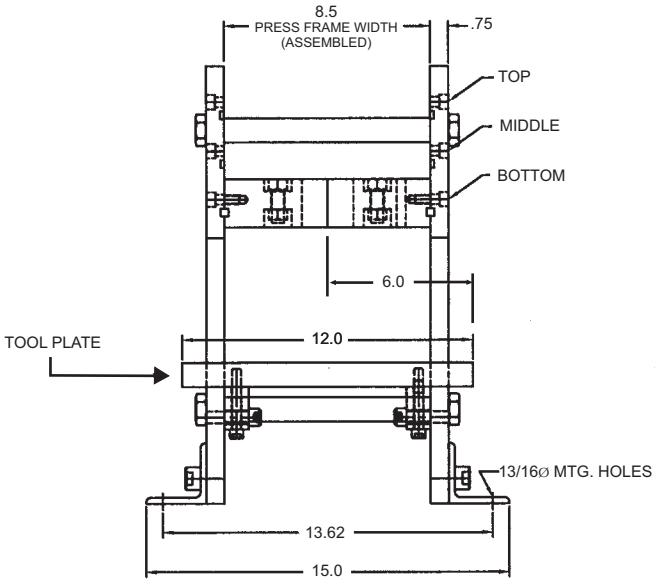
BTP - 501 - _____

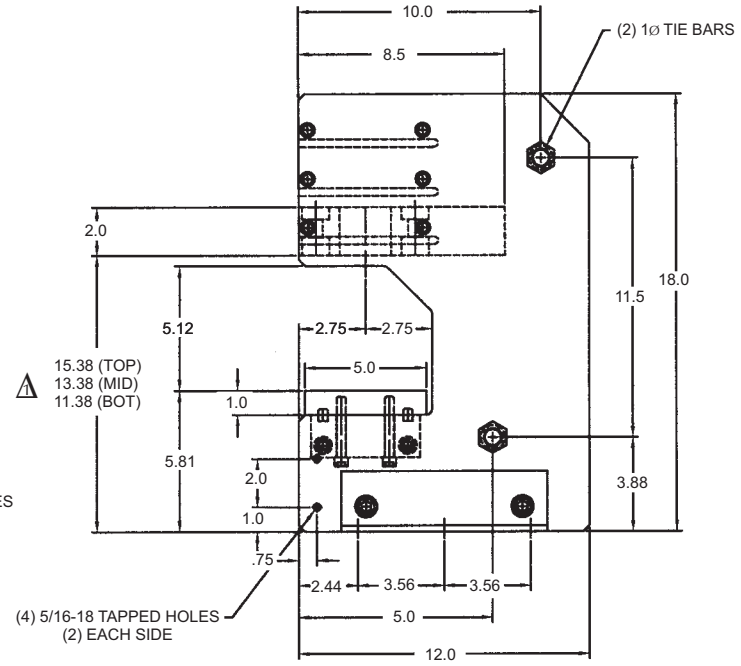
SERIES	
BTP	BENCH TOP PRESS FRAME

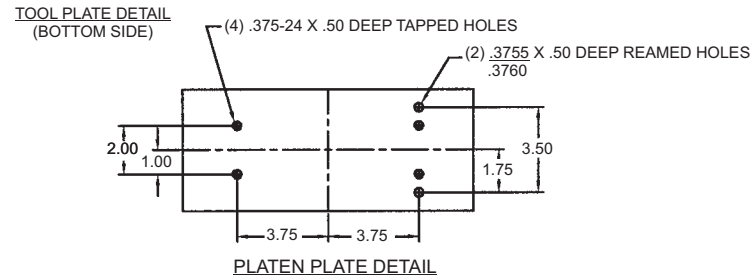
MODEL	
501	5.00" BORE CYLINDER MOUNTING (Single Stage or Multi-Stage)
502	5.00" BORE TRIPLE ROD CYLINDER MOUNTING
Order Cylinder Separately	

OPTIONS	
A	FULLY ASSEMBLED (Press & Cyl.)
NRE	NON-ROTATING EXTERNAL (Specify Cyl. Stroke & Rod Dia.)
U	UNASSEMBLED UNIT

BENCH TOP PRESS: DIMENSIONS







NOTES:

⚠ Dimension reflects the press top plate mounted in the bottom (lowest) position. Add 2" for mid position and 4" for top position

• Mounting brackets are reversible and can be assembled on inside of press frame to reduce overall width.

• Weight: 120 pounds (press frame only)

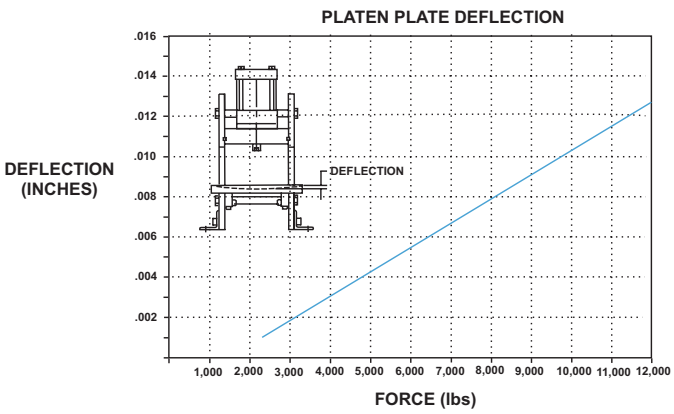
BENCH TOP PRESS: TECHNICAL DATA

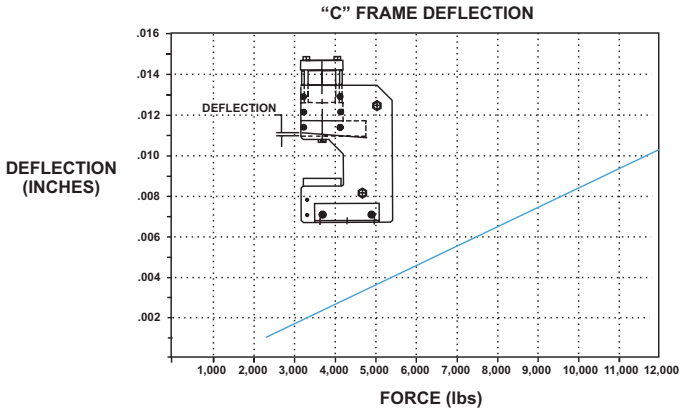
CYLINDER SELECTION FORCE CHART

EXTEND FORCE									
CYLINDER	ROD DIA.	EFFECTIVE AREA EXTENDING	60 PSI	70 PSI	80 PSI	90 PSI	100 PSI	110 PSI	125 PSI
SINGLE STAGE	1.000 ROD DIA.	19.635	1178	1374	1570	1767	1963	2160	2454
	1.375 ROD DIA.	19.635	1178	1374	1570	1767	1963	2160	2454
(2) STAGE	1.000 ROD DIA.	38.485	2309	2693	3078	3463	3848	4233	4810
	1.375 ROD DIA.	37.785	2267	2644	3022	3400	3778	4156	4723
(3) STAGE	1.000 ROD DIA.	57.334	3440	4013	4586	5160	5733	6306	7166
	1.375 ROD DIA.	55.935	3356	3915	4474	5034	5593	6153	6992
(4) STAGE	1.000 ROD DIA.	76.184	4571	5332	6094	6856	7618	8380	9523
	1.375 ROD DIA.	74.085	4445	5186	5927	6667	7408	8149	9260
(5) STAGE	1.000 ROD DIA.	95.034	5702	6652	7602	8553	9503	10453	11879
	1.375 ROD DIA.	92.235	5533	6456	7379	8301	9223	10145	11529

RETRACT FORCE									
CYLINDER	ROD DIA.	EFFECTIVE AREA EXTENDING	60 PSI	70 PSI	80 PSI	90 PSI	100 PSI	110 PSI	125 PSI
SINGLE STAGE (OR MULTI-STAGE)	1.000 ROD DIA.	18.85	1131	1319	1508	1696	1885	2073	2356
	1.375 ROD DIA.	18.15	1089	1270	1452	1633	1815	1996	2268
TRIPLE ROD	1.000 ROD DIA.	17.279	1036	1209	1382	1555	1728	1900	2160

PRESS FRAME DEFLECTION CHARTS





PRESS FRAME CYLINDER SPEED CHART

NOTES:

• Cylinder cycle rates can vary depending on air valve sizes, airline diameter and length, type of fitting, and if quick exhaust dump valves are used.

• The Speed Chart represents how fast cylinders can cycle and build pressure at each end of stroke (to simulate work being done.) To maximize cylinder performance, all cycle tests were performed using 5 Cv double solenoid valves, .750" air hose and quick-dump exhaust valves.

CYLINDER	CYCLES PER MINUTE
(1) STAGE-TA	263
(2) STAGE	141
(3) STAGE	125
(4) STAGE	91
(5) STAGE	77

PRESS FRAME CYLINDER

Choose from Single Stage, Multi-Stage, Triple-Rod (Non-Rotating with Tool Plate) or Triple-Rod Multi-Stage Press Cylinders. Double rod end styles are available on all models.

• **SINGLE STAGE:** Basic single bore, double acting cylinder.

• **MULTI-STAGE:** Multi-Stage cylinders are double acting and multiply the output force by supplying air to multiple pistons. The MSEP multiplies the force on the extend stroke and uses only one piston on the return stroke, saving air volume and operating costs. The MSEP/MSRP multiples the force in both directions. Choose from 2 stage (2S), 3 stage (3S), 4 stage (4S), or 5 stage (5S) models.

• **TRIPLE ROD:** A cylinder with three piston rods and a tooling plate as standard features. The 5.00" square tooling plate distributes the cylinder force over a large work area. Standard features also include four (4) .500-20 UNF tapped holes in the tooling plate that can be used to mount customer fixtures or tooling. Triple rod cylinders can be ordered as a single stage or multi-stage (2S, 3S, 4S or 5S) models.

About Rod End Styles

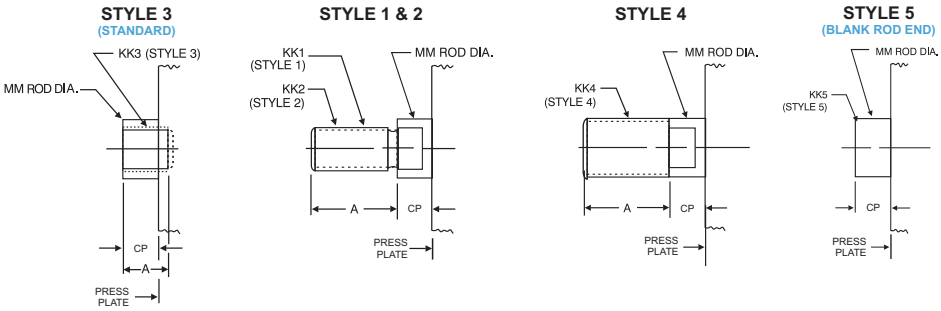
Style 3 (KK3) Female Rod End is STANDARD

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).

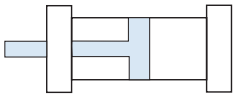
NEED SOMETHING NOT LISTED?
Just send us a sketch.
In most cases, quotes are turned around in one day!

PISTON ROD END STYLES



SINGLE STAGE OR MULTI-STAGE ROD END STYLES & OPTIONS										
MM ROD DIAMETER	CP	STANDARD		OPTIONAL						
		STYLE 3 - FEMALE		STYLE 1 - MALE		STYLE 2 - MALE		STYLE 4 - MALE		STYLE 5 - MALE
		KK3	A	KK1	A	KK2	A	KK4	A	KK3
1.000 Standard	0.875	3/4-16	1.125	3/4-16	1.125	7/8-14	1.125	1-14	1.125	NO THREAD
1.375 Oversize	0.875	1-14	1.625	1-14	1.625	1 1/4-12	1.625	1 3/8-12	1.625	

HOW TO ORDER: SINGLE STAGE



TAP - MX3 ___ - 5 x 1 - _____ - _____ - _____

SERIES	
TAP	250 PSI AIR

NFPA MOUNT

BORE

STROKE
0" to 6" MADE TO ORDER

STYLE
SINGLE ROD (LEAVE BLANK)
D = DOUBLE ROD END (REQUIRED FOR "MA" OPTION

CUSHIONS
NON-CUSHION (LEAVE BLANK)
H = HEAD CUSHION POSITION 1 STANDARD SPECIFY FOR POSITIONS 2, 3 OR 4 (Example = H2)
C = CAP CUSHION POSITION 5 STANDARD SPECIFY FOR POSITIONS 6, 7 OR 8 (Example = C6)

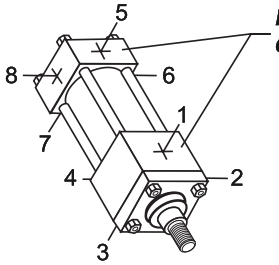
ROD STYLE END & MODIFICATIONS	
KK3	FEMALE ROD THREAD (LEAVE BLANK)
KK3S	STUDDED PISTON ROD (WITH KK3)
KK1	SMALL MALE ROD THREAD
KK2	LARGE MALE ROD THREAD
KK4	FULL DIAMETER MALE ROD THREAD
KK5	BLANK ROD END
"A" =	EXTENDED PISTON ROD THREAD (SPECIFY)
"C" =	EXTENDED PISTON ROD (SPECIFY)

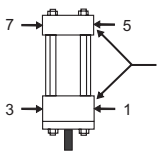
OPTIONS	
A / O	AIR / OIL PISTON
B**	.25" URETHANE BUMPER BOTH ENDS
BH**	.25" URETHANE BUMPER HEAD ONLY
BC**	.25" URETHANE BUMPER CAP ONLY
MPR	MAGNETIC PISTON FOR SWITCHES
MS	METALLIC ROD SCRAPER (BRASS)
OP	OPTIONAL PORT LOCATION
OS	OVERSIZED ROD DIAMETER (1.375")
TH	400 PSI HYDRAULIC, NON-SHOCK
VS	VITON® SEALS
XX	SPECIAL VARIATION (SPECIFY)
BSP, SAE PORTS (SPECIFY SIZE)	

MICRO-ADJUST	
MA	MICRO-ADJUST
MAB	WITH NOISE DAMPENING BUMPER INSTALLED

** BUMPERS ADD .25" PER END TO CYLINDER LENGTH

PORT & CUSHION POSITIONS



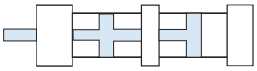


STANDARD PORT POSITIONS @ 3 AND 7 (BACK OF PRESS)

STANDARD CUSHION POSITIONS @ 1 AND 5 (FRONT OF PRESS)

SPECIFY NON-STANDARD LOCATIONS WHEN ORDERING

HOW TO ORDER: MULTI-STAGE



MSEP - MX3 ___ - 5 x 1 x 2S - _____ - _____ - _____

SERIES	
MSEP	125 PSI AIR or HYDRAULIC, NON-SHOCK (HIGH FORCE EXTEND)
MSEP/ MSRP	125 PSI AIR or HYDRAULIC, NON-SHOCK (HIGH FORCE EXTEND AND RETRACT)

STYLE
SINGLE ROD (LEAVE BLANK)
D = DOUBLE ROD END (REQUIRED FOR "MA" OPTION

NFPA MOUNT

BORE

STROKE
0" to 6" MADE TO ORDER

STAGES	
2S	TWO
3S	THREE
4S	FOUR
5S	FIVE

CUSHIONS
NON-CUSHION (LEAVE BLANK)
H = HEAD CUSHION POSITION 1 STANDARD SPECIFY FOR POSITIONS 2, 3 OR 4 (Example = H2)
C = CAP CUSHION (MSEP/MSRP ONLY) POSITION 5 STANDARD SPECIFY FOR POSITIONS 6, 7 OR 8 (Example = C6)

ROD STYLE END & MODIFICATIONS	
KK3	FEMALE ROD THREAD (LEAVE BLANK)
KK3S	STUDDED PISTON ROD (WITH KK3)
KK1	SMALL MALE ROD THREAD
KK2	LARGE MALE ROD THREAD
KK4	FULL DIAMETER MALE ROD THREAD
KK5	BLANK ROD END
"A" =	EXTENDED PISTON ROD THREAD (SPECIFY)
"C" =	EXTENDED PISTON ROD (SPECIFY)

OPTIONS	
B**	.25" URETHANE BUMPER BOTH ENDS
BH**	.25" URETHANE BUMPER HEAD ONLY
BC**	.25" URETHANE BUMPER CAP ONLY
MPR*	MAGNETIC PISTON FOR SWITCHES
MS	METALLIC ROD SCRAPER (BRASS)
OP	OPTIONAL PORT LOCATION
OS	OVERSIZED ROD DIAMETER (1.375")
VS	VITON® SEALS
XX	SPECIAL VARIATION (SPECIFY)
BSP, SAE PORTS (SPECIFY SIZE)	

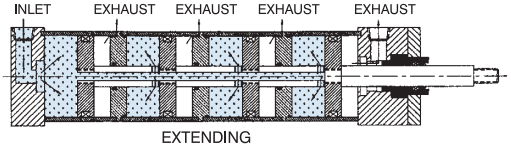
MICRO-ADJUST	
MA	MICRO-ADJUST
MAB	WITH NOISE DAMPENING BUMPER INSTALLED

** BUMPERS ADD .25" PER END TO CYLINDER LENGTH
*MPR ADD 0.875" TO CYLINDER LENGTH

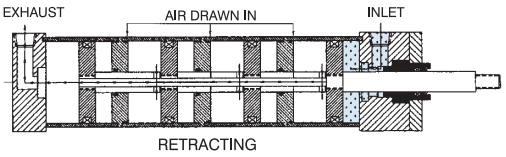
HOW THEY WORK

Model MSEP

4 Stage Shown



Extension-air supplied to multiple pistons



Retraction-air supplied to one piston

NOTE: Cap cushion not available on MSEP

Model MSEP/ MSRP

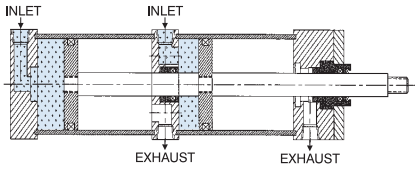
Extension AND Retraction-air supplied to multiple pistons

HEAD AND CAP CUSHION AVAILABLE

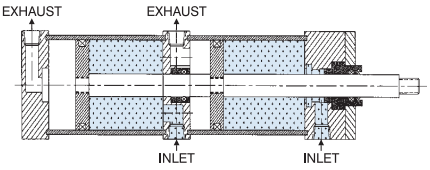
To Order, specify: "MSEP/MSRP" (as model number)

Note: Overall lengths are increased

EXTENDING STROKE

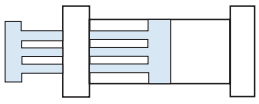


RETRACTING STROKE



Model MSE–MSR
2 Stage Shown

HOW TO ORDER: TRIPLE-ROD (WITH TOOL PLATE)



TRAP - MF1 ___ - 5 x 1 x 2S - _____ - _____

SERIES	
TRAP	SINGLE STAGE, 200 PSI AIR
TRAP-MSE	MULTI-STAGE EXTEND, 125 PSI AIR

STYLE
SINGLE ROD (LEAVE BLANK)
D = DOUBLE ROD END (SINGLE ROD AT CAP) (REQUIRED FOR "MA" OPTION)

NFPA MOUNT

BORE

STROKE
0" to 6" MADE TO ORDER

STAGES	
SINGLE STAGE (LEAVE BLANK)	
2S	TWO
3S	THREE
4S	FOUR
5S	FIVE

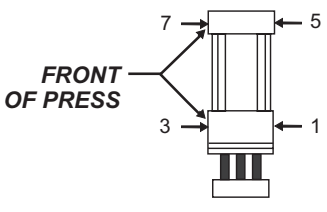
CUSHIONS
NON-CUSHION (LEAVE BLANK)
H = HEAD CUSHION POSITION 2 STANDARD SPECIFY FOR POSITIONS 1 OR 4 (Example = H2)
C = CAP CUSHION (TRP ONLY) POSITION 6 STANDARD SPECIFY FOR POSITIONS 5 OR 8 (Example = C6)

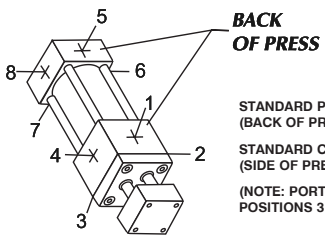
OPTIONS	
B**	.25" URETHANE BUMPER BOTH ENDS
BH**	.25" URETHANE BUMPER HEAD ONLY
BC**	.25" URETHANE BUMPER CAP ONLY
MPR	MAGNETIC PISTON FOR SWITCHES
OP	OPTIONAL PORT LOCATION
TH	400 PSI HYDRAULIC, NON-SHOCK
VS	VITON® SEALS
XX	SPECIAL VARIATION (SPECIFY)
BSP, SAE PORTS (SPECIFY SIZE)	

MICRO-ADJUST	
MA	MICRO-ADJUST
MAB	WITH NOISE DAMPENING BUMPER INSTALLED

** BUMPERS ADD .25" PER END TO CYLINDER LENGTH

PORT & CUSHION POSITIONS





STANDARD PORT POSITIONS @ 1 AND 5 (BACK OF PRESS)

STANDARD CUSHION POSITIONS @ 2 AND 6 (SIDE OF PRESS)

(NOTE: PORTS OR CUSHIONS NOT AVAILABLE AT POSITIONS 3 & 7, FRONT OF PRESS)

PRESS FRAME CYLINDER: OPTIONS

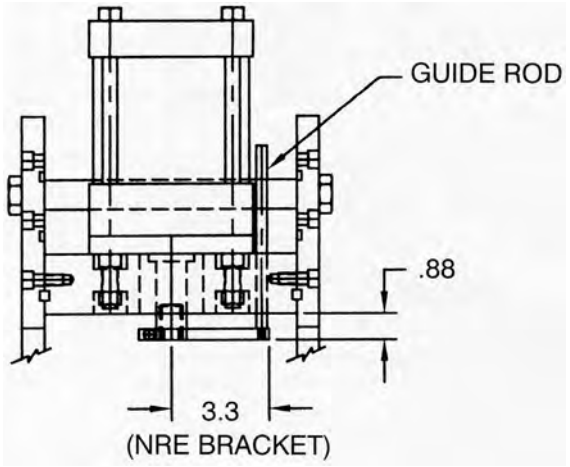
NRE External Non-Rotating

The External Non-Rotating option prevents the piston rod (and any attached tooling) from rotating as the cylinder cycles.

Since the "NRE" bracket and guide rod are externally mounted, they can be added or removed for different applications. All press frames are made to accept this add-on option.

For high torsional load applications, cylinder can be equipped with a twin guide rod internally ("NR" cylinder option).

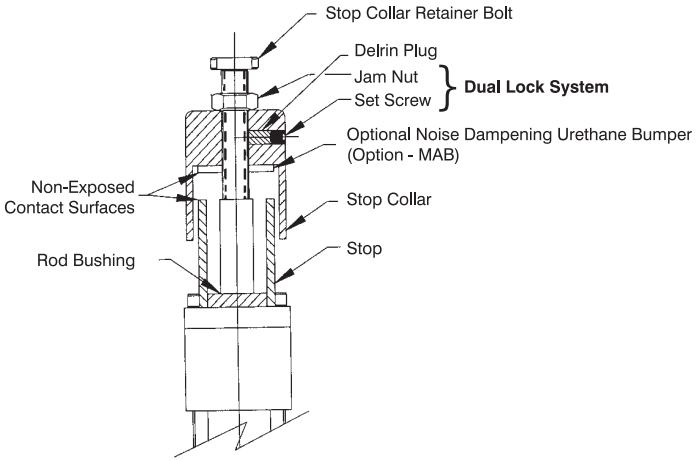
Consult factory for details.



MA Micro-Adjust

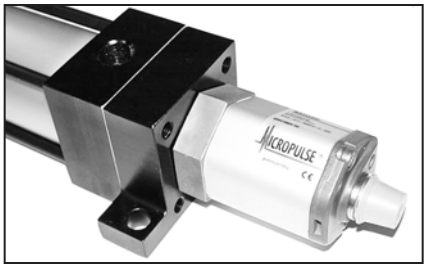
- Allows precision adjustment of cylinder extend stroke
- Easy to read precision scale (.001" calibration)
- Enclosed, no pinch point design
- Available on all cylinder models with "D" Double Rod End option
- Up to 6" stroke and adjustment over full range of stroke

Refer to page 179 for more details



BALLUFF TRANSDUCER

Balluff transducers can provide positive verification on the depth of each cylinder stroke cycle. This is very important for today's quality control system requirements.



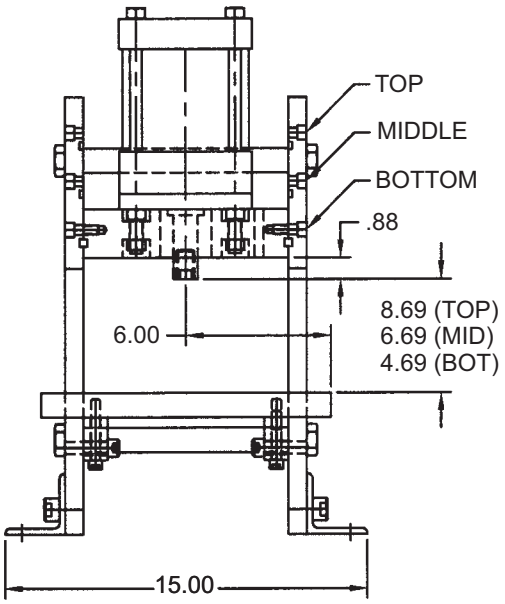
Ideal Applications:

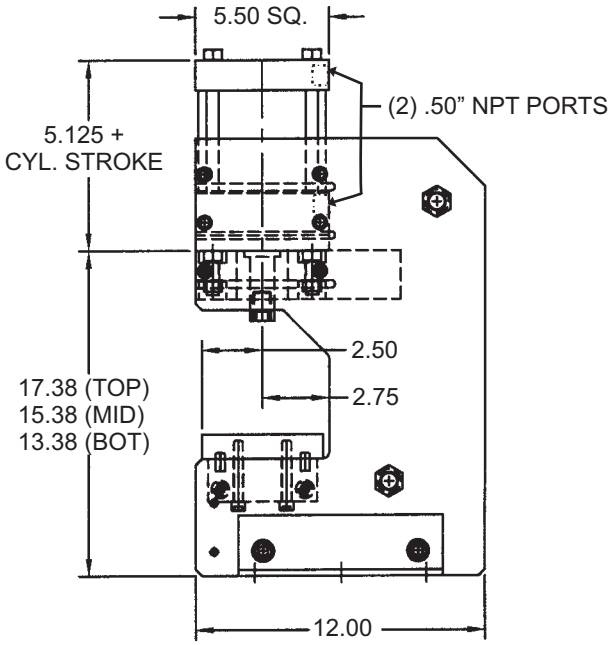
- Pressing bearings into housings and depth control is critical.
- Parts assembly
- Parts positioning for joining operations (i.e. riveting)

Refer to page 235 for more details

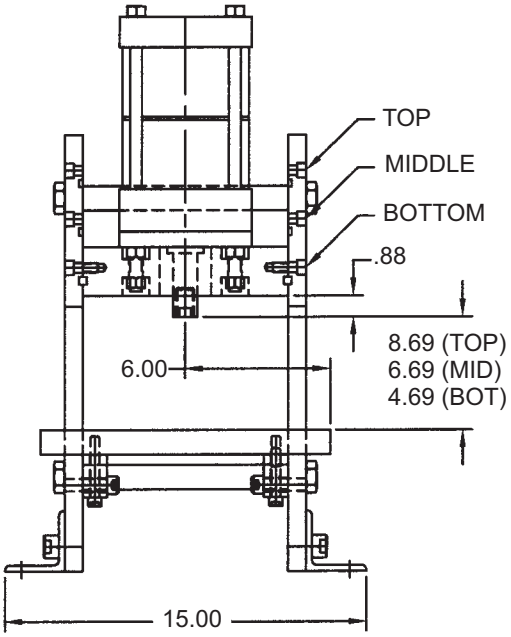
PRESS FRAME CYLINDER: DIMENSIONS

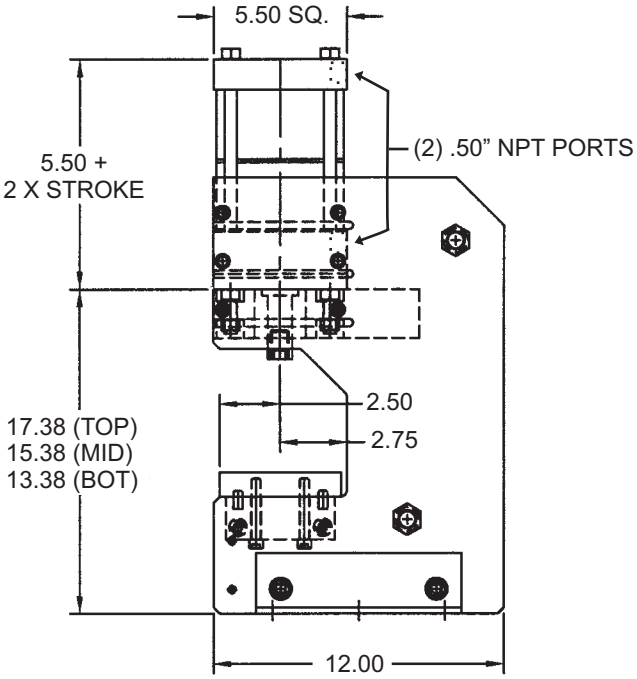
TAP (SINGLE STAGE): DIMENSIONS





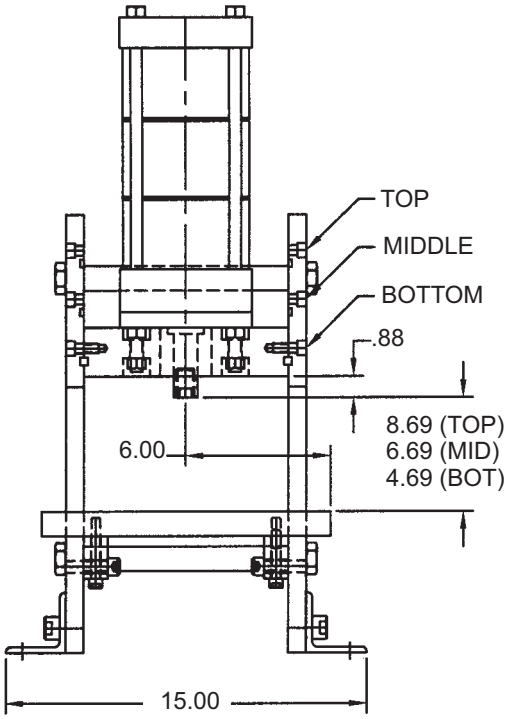
MSEP 2S (2 STAGE): DIMENSIONS

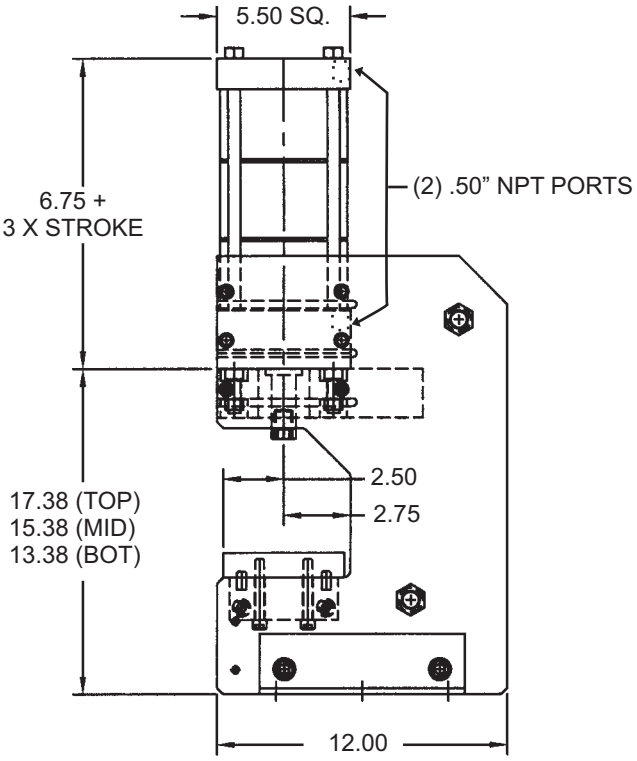




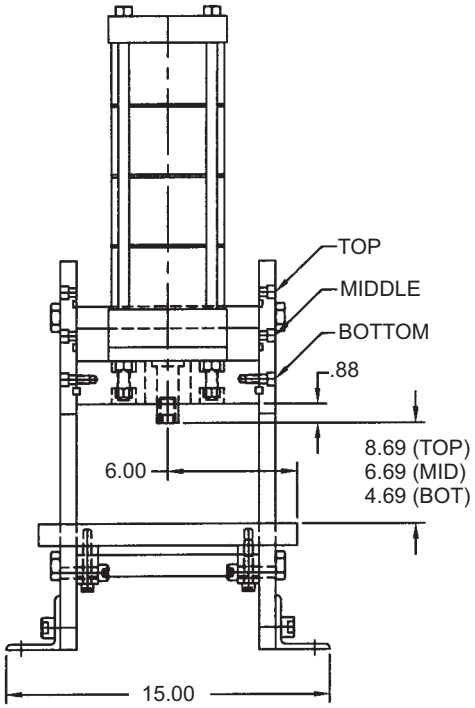
PRESS FRAME CYLINDER: DIMENSIONS

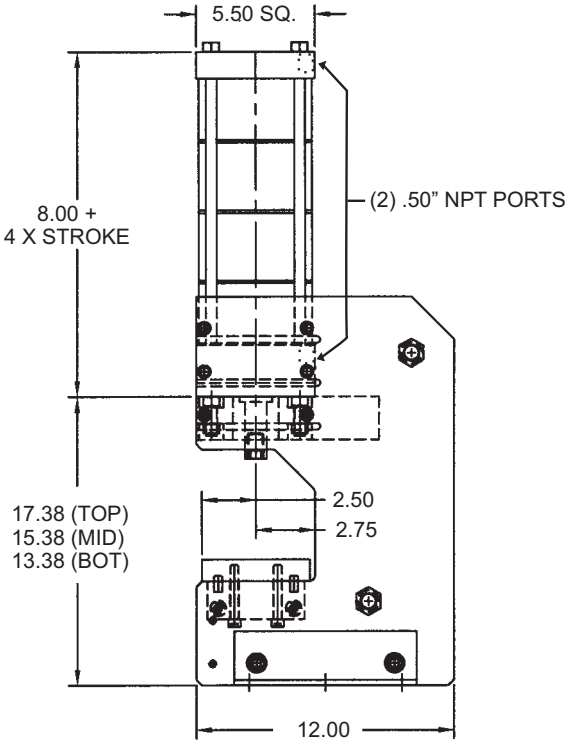
MSEP 3S (3 STAGE): DIMENSIONS





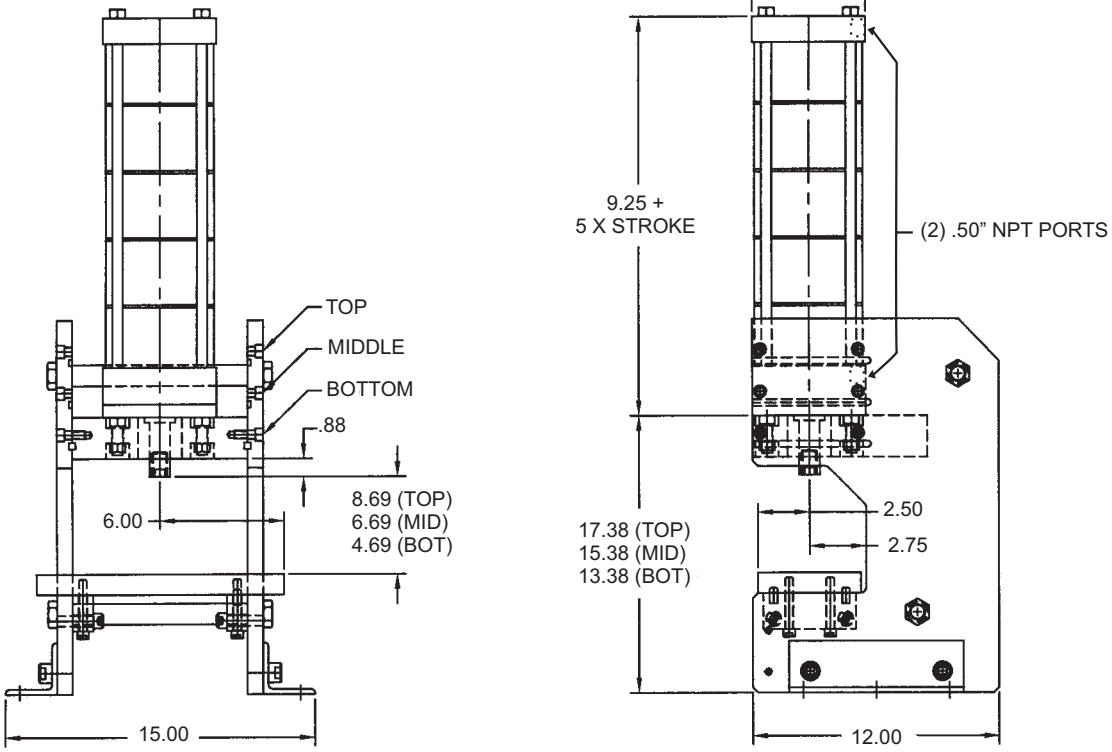
MSEP 4S (4 STAGE): DIMENSIONS



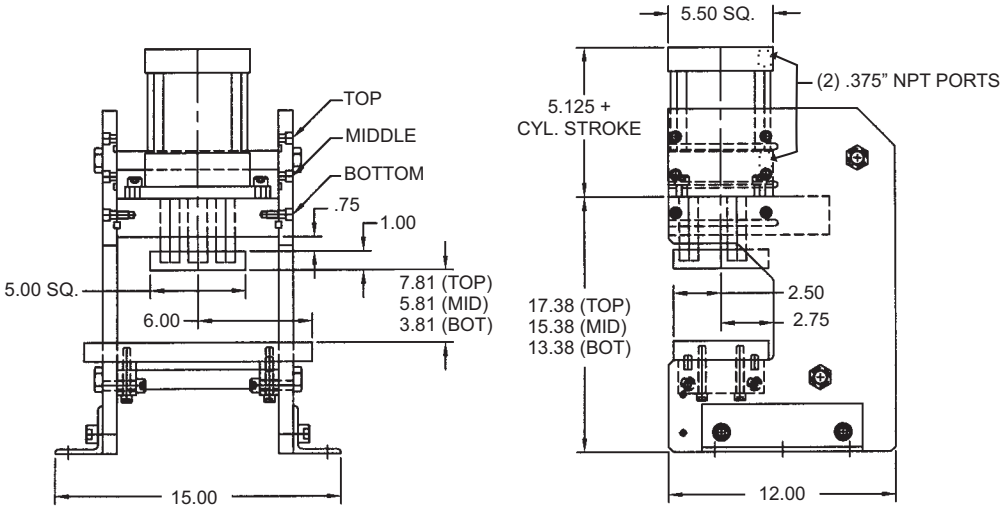


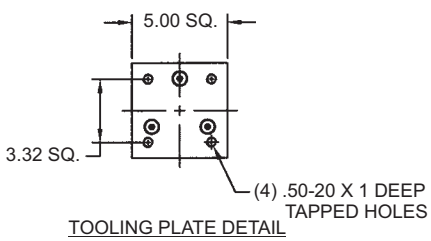
PRESS FRAME CYLINDER: DIMENSIONS

MSEP 5S (5 STAGE): DIMENSIONS



TRP (TRIPLE ROD): DIMENSIONS





TOOLING PLATE DETAIL

Accessories: Clevis Pins & Mounts
Spherical Rod Eye
Trunnion Blocks
Alignment Couplers
Flow Controls

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

ACCESSORIES: CLEVIS, PINS & MOUNTS

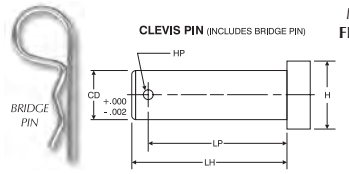
Accessories Cross Reference Chart

CYLINDER MODEL					ACCESSORIES				
BORE	ROD SIZE	ROD STYLE (KK)		ROD THREAD	ROD CLEVIS	ROD EYE	CLEVIS PIN	CLEVIS BRACKET	EYE BRACKET
1.50, 2.00, 2.50	0.625	#1 (STANDARD)	KK1	7/16-20	RC437	RE437	CP500	CB500	EB500
		#2	KK2	1/2-20	RC500	RE500	CP500		
	1.000	#1 (ST'D-OVERSIZE)	KK1	3/4-16	RC750	RE750	CP750		
		#4	KK4	1-14	RC1000	RE1000	CP1000		
3.25, 4.00, 5.00	1.000	#1 (STANDARD)	KK1	3/4-16	RC750	RE750	CP750	CB750	EB750
		#4	KK4	1-14	RC1000	RE1000	CP1000		
	1.375	#1 (ST'D-OVERSIZE)	KK1	1-14	RC1000	RE1000	CP1000		
		#2	KK2	1 1/4-12	RC1250	N/A	CP1375		
6.00 & 8.00	1.375	#1 (STANDARD)	KK1	1-14	RC1000	RE1000	CP1000	CB1000	EB1000
		#2	KK2	1 1/4-12	RC1250	N/A	CP1375		
	1.750	#1 (ST'D-OVERSIZE)	KK1	1 1/4-12	RC1250	N/A	CP1375		
		#2	KK2	1 1/2-12	RC1500	N/A	CP1750		
10.00	1.750	#1 (STANDARD)	KK1	1 1/4-12	RC1250	RE1250	CP1375	CB1375	EB1375
		#2	KK2	1 1/2-12	RC1500	RE1500	CP1750	CB1750	EB1750
	2.000	#1 (STANDARD)	KK1	1 1/2-12	RC1500	RE1500	CP1750	CB1750	EB1750
12.00	2.000	#1 (STANDARD)	KK1	1 1/2-12	RC1500	RE1500	CP1750	CB1750	EB1750

CLEVIS PIN (WITH BRIDGE PIN - STANDARD)

PART NUMBER	CD	H	HP	LH	LP
CP500	0.500	0.625	0.156	2.250	2.094
CP750	0.750	0.938	0.156	3.000	2.844
CP1000	1.000	1.188	0.203	3.500	3.313

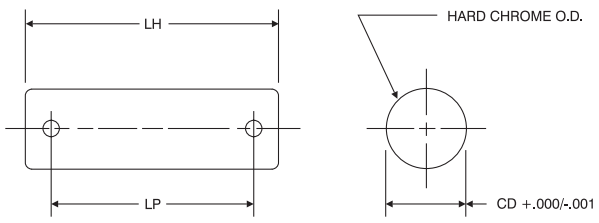
MATERIAL: 1018 CRS
FINISH: BLACK OXIDE



CLEVIS PIN (WITH COTTER PINS)

PART NUMBER	CD	LH	LP
CP500C	0.500	2.250	1.938
CP750C	0.750	3.000	2.719
CP1000C	1.000	3.500	3.219
CP1375C	1.375	5.000	4.250
CP1750C	1.750	6.000	5.500
CP2000C	2.000	6.000	5.500

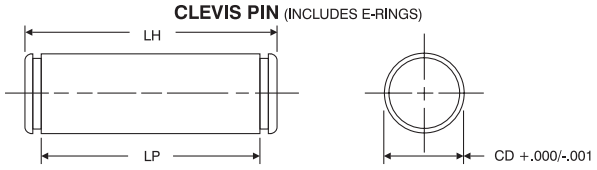
MATERIAL: 1045 CRS
FINISH: CHROME PLATED O.D.



CLEVIS PIN (WITH E-RINGS)

PART NUMBER	CD	LH	LP
CP500E	0.500	2.125	1.875
CP750E	0.750	2.938	2.625
CP1000E	1.000	3.438	3.125
CP1375E	1.375	4.188	4.484
CP1750E	1.750	5.188	5.547
CP2000E	2.000	5.188	5.547

MATERIAL: 1045 CRS
FINISH: NITROTECH PLATED*

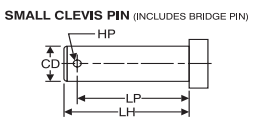


*HARD CHROME PLATED O.D. AVAILABLE

SMALL CLEVIS PIN (WITH BRIDGE PIN)

PART NUMBER	CD	HP	LH	LP
CP500CCS	0.500	0.156	1.375	1.250
CP750CCS	0.750	0.156	2.000	1.875

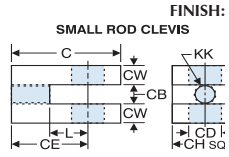
MATERIAL: 1018 CRS
FINISH: BLACK OXIDE



SMALL ROD CLEVIS

PART NUMBER	C	CB	CD	CE	CH	CW	KK1	KK2	L
RC437CCS	1.875	0.500	0.500	1.375	1.000	0.250	7/16-20	—	0.750
RC500CCS	1.875	0.500	0.500	1.375	1.000	0.250	—	1/2-20	0.750
RC750CCS	2.500	0.750	0.750	1.750	1.500	0.375	3/4-16	—	1.000

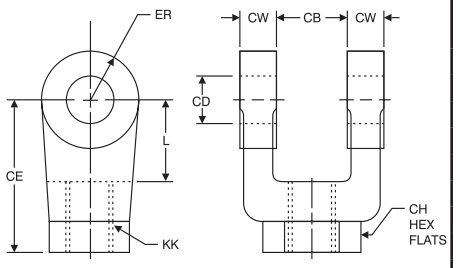
MATERIAL: 1018 CRS
FINISH: BLACK OXIDE



ACCESSORIES: CLEVIS, PINS & MOUNTS

ROD CLEVIS

MATERIAL: CAST STEEL
FINISH: BLACK OXIDE



(Clevis Pins sold separately from Rod Clevises)

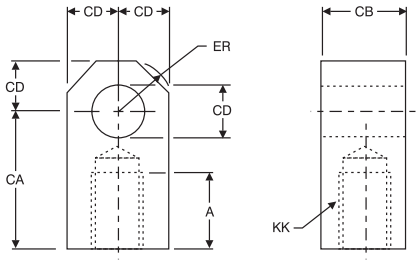
Note: When using a Rod Clevis in combination with an Eye Bracket, the operating angle is limited to +/-75° from the bracket center line.

ROD CLEVIS DIMENSIONS

PART NUMBER	MAX LOAD (TENSION) RATED IN LBS	CB	CD (DIA.)	CE	CH	CW	ER (RADIUS)	KK	L
RC437	2950	0.750	0.500	1.500	1.000	0.500	0.500	7/16-20	0.750
RC500	4000	0.750	0.500	1.500	1.000	0.500	0.500	1/2-20	0.750
RC750	11200	1.250	0.750	2.375	1.250	0.625	0.750	3/4-16	1.250
RC875	11200	1.250	0.750	2.375	1.250	0.625	0.750	7/8-14	1.250
RC1000	19500	1.500	1.000	3.125	1.500	0.750	1.000	1-14	1.500
RC1250	26800	2.000	1.375	4.125	2.000	1.000	1.375	1 1/4-12	2.125
RC1375	26800	2.000	1.375	4.125	2.000	1.000	1.375	1 3/8-12	2.125
RC1500	39500	2.500	1.750	4.500	2.375	1.250	1.750	1 1/2-12	2.250
RC1750	54700	2.500	1.750	4.500	2.375	1.250	1.750	1 3/4-12	2.250
RC1875	56000	2.500	2.000	5.500	3.000	1.250	2.000	1 7/8-12	2.500
RC2250	84000	3.031	2.500	6.500	3.500	1.500	2.500	2 1/4-12	3.000
RC2500	84000	3.031	3.000	6.750	3.875	1.500	2.750	2 1/2-12	3.250
RC3250	155000	4.031	3.500	8.500	5.000	2.000	3.500	3 1/4-12	4.000
RC4000	200000	4.531	4.000	10.000	6.125	2.250	4.000	4-12	4.500

ROD EYE

MATERIAL: 1018 CRS
FINISH: BLACK OXIDE



(Clevis Pins sold separately from Rod Eyes)

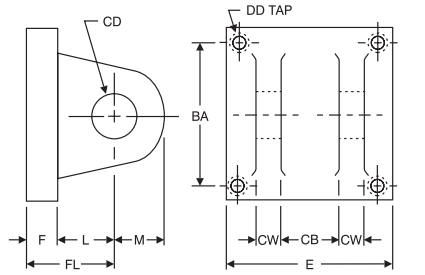
Note: When using a Rod Eye in combination with a Clevis Bracket, the operating angle is +/-90° from the bracket center line.

ROD EYE DIMENSIONS

PART NUMBER	MAX LOAD (TENSION) RATED IN LBS	A	CA	CB	CD (DIA.)	ER (RADIUS)	KK
RE437	2950	0.750	1.500	0.750	0.500	0.625	7/16-20
RE500	3350	0.750	1.500	0.750	0.500	0.625	1/2-20
RE750	8400	1.125	2.063	1.250	0.750	0.875	3/4-16
RE1000	13500	1.625	2.813	1.500	1.000	1.888	1-14
RE1250	24500	2.000	3.438	2.000	1.375	1.563	1 1/4-12
RE1500	39000	2.250	4.000	2.500	1.750	2.000	1 1/2-12
RE1875	45000	3.000	5.000	2.500	2.000	2.500	1 7/8-12
RE2250	67000	3.500	5.810	3.000	2.500	2.813	2 1/4-12
RE2500	81000	3.500	6.125	3.000	3.000	3.250	2 1/2-12
RE3250	125000	4.500	7.625	4.000	3.500	3.875	3 1/4-12
RE3500	125000	5.000	7.625	4.000	3.500	3.875	3 1/2-12
RE4000	162000	5.500	9.125	4.500	4.000	4.438	4-12

CLEVIS BRACKET

MATERIAL: CAST STEEL
FINISH: BLACK OXIDE



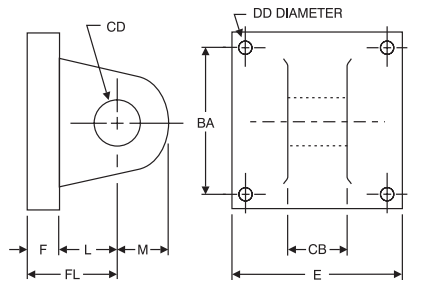
(Clevis Pins sold separately from Clevis Brackets)

CLEVIS BRACKET DIMENSIONS

PART NUMBER	MAX LOAD (TENSION) RATED IN LBS	BA	CB	CD (DIA.)	CW	DD	E	F	FL	L	M
CB500	4500	1.625	0.750	0.500	0.500	3/8-24	2.500	0.375	1.125	0.750	0.500
CB750	8400	2.563	1.250	0.750	0.625	1/2 -20	3.500	0.625	1.875	1.250	0.750
CB1000	13500	3.250	1.500	1.000	0.750	5/8-18	4.500	0.750	2.250	1.500	1.000
CB1375	34000	3.813	2.000	1.375	1.000	5/8-18	5.000	0.875	3.000	2.125	1.375
CB1750	54000	4.938	2.500	1.750	1.250	7/8-14	6.500	0.875	3.125	2.250	1.750
CB2000	89000	5.750	2.500	2.000	1.250	1-14	7.500	1.000	3.500	2.500	2.000
CB2500	124000	6.594	3.000	2.500	1.500	1 1/8-12	8.500	1.000	4.000	3.000	2.500
CB3000	126000	7.500	3.000	3.000	1.500	1 1/4-12	9.500	1.000	4.250	3.250	2.750
CB3500	126000	9.625	4.000	3.500	2.000	1 3/4-12	12.625	1.688	5.688	4.000	3.500

EYE BRACKET

MATERIAL: CAST STEEL
FINISH: BLACK OXIDE



(Clevis Pins sold separately from Eye Brackets)

EYE BRACKET DIMENSIONS

PART NUMBER	MAX LOAD (TENSION) RATED IN LBS	BA	CB	CD (DIA.)	DD	E	F	FL	L	M
EB500	3375	1.625	0.750	0.500	0.406	2.500	0.375	1.125	0.750	0.500
EB750	8400	2.563	1.250	0.750	0.531	3.500	0.625	1.875	1.250	0.750
EB1000	13500	3.250	1.500	1.000	0.656	4.500	0.750	2.250	1.500	1.000
EB1375	25000	3.813	2.000	1.375	0.656	5.000	0.875	3.000	2.125	1.375
EB1750	45000	4.938	2.500	1.750	0.906	6.500	0.875	3.125	2.250	1.750
EB2000	45000	5.750	2.500	2.000	1.063	7.500	1.000	3.500	2.500	2.000
EB2500	67000	6.594	3.000	2.500	1.188	8.500	1.000	4.000	3.000	2.500
EB3000	115000	7.500	3.000	3.000	1.313	9.500	1.000	4.250	3.250	2.750
EB3500	162000	9.625	4.000	3.500	1.813	12.625	1.688	5.688	4.000	3.500
EB4000	200000	11.500	4.500	4.000	2.063	14.875	1.938	6.480	4.500	4.000

ACCESSORIES: STAINLESS STEEL CLEVIS, PINS & MOUNTS

Stainless Steel Accessories Cross Reference Chart

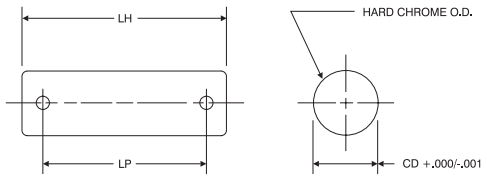
CYLINDER MODEL					ACCESSORIES				
BORE	ROD SIZE	ROD STYLE (KK)		ROD THREAD	ROD CLEVIS	ROD EYE	CLEVIS PIN	CLEVIS BRACKET	EYE BRACKET
1.50, 2.00, 2.50	0.625	#1 (STANDARD)	KK1	7/16-20	SS-RC437	SS-RE437	SS-CP500	SS-CB500	SS-EB500
		#2	KK2	1/2-20	SS-RC500	SS-RE500	SS-CP500		
	1.000	#1 (ST'D-OVERSIZE)	KK1	3/4-16	SS-RC750	SS-RE750	SS-CP750		
		#4	KK4	1-14	SS-RC1000	SS-RE1000	SS-CP1000		
3.25, 4.00, 5.00	1.000	#1 (STANDARD)	KK1	3/4-16	SS-RC750	SS-RE750	SS-CP750	SS-CB750	SS-EB750
		#4	KK4	1-14	SS-RC1000	SS-RE1000	SS-CP1000		
	1.375	#1 (ST'D-OVERSIZE)	KK1	1-14	SS-RC1000	SS-RE1000	SS-CP1000		
		#2	KK2	1 1/4-12	SS-RC1250	N/A	SS-CP1375		
6.00 & 8.00	1.375	#1 (STANDARD)	KK1	1-14	SS-RC1000	SS-RE1000	SS-CP1000	SS-CB1000	SS-EB1000
		#2	KK2	1 1/4-12	SS-RC1250	N/A	SS-CP1375		
	1.750	#1 (ST'D-OVERSIZE)	KK1	1 1/4-12	SS-RC1250	N/A	SS-CP1375		
		#2	KK2	1 1/2-12	SS-RC1500	N/A	SS-CP1750		

Accessories (303 Stainless Steel)

CLEVIS PIN (WITH COTTER PINS)

PART NUMBER	CD	LH	LP
SS-CP500	0.500	2.250	1.938
SS-CP750	0.750	3.000	2.719
SS-CP1000	1.000	3.500	3.219
SS-CP1375	1.375	5.000	4.250
SS-CP1750	1.750	6.000	5.500

CLEVIS PIN (INCLUDES COTTER PINS)

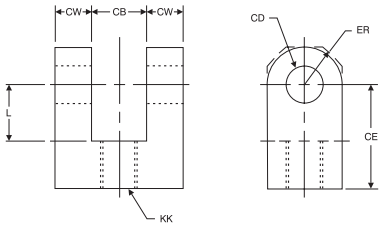


(Clevis Pins sold with (2) S.S. Cotter Pins)

ROD CLEVIS

PART NUMBER	CB	CD	CE	CW	ER	KK	L
SS-RC437	0.750	0.500	1.500	0.500	0.500	7/16-20	0.750
SS-RC500						1/2-20	
SS-RC750	1.250	0.750	2.375	0.625	0.750	3/4-16	1.250
SS-RC1000	1.500	1.000	3.125	0.750	1.000	1-14	1.500
SS-RC1250	2.000	1.375	4.125	1.000	1.375	1 1/4-12	2.125
SS-RC1500	2.500	1.750	4.500	1.250	1.750	1 1/2-12	2.250

ROD CLEVIS

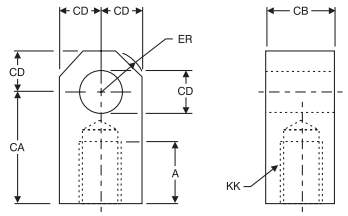


(Clevis Pins sold separately from Rod Clevis)

ROD EYE

PART NUMBER	A	CA	CB	CD	ER	KK
SS-RE437	0.750	1.500	0.750	0.500	0.625	7/16-20
SS-RE500						1/2-20
SS-RE750	1.125	2.063	1.250	0.750	0.875	3/4-16
SS-RE1000	1.625	2.813	1.500	1.000	1.188	1-14
SS-RE1250	2.000	3.438	2.000	1.375	1.563	1 1/4-12
SS-RE1500	2.250	4.000	2.500	1.750	2.000	1 1/2-12

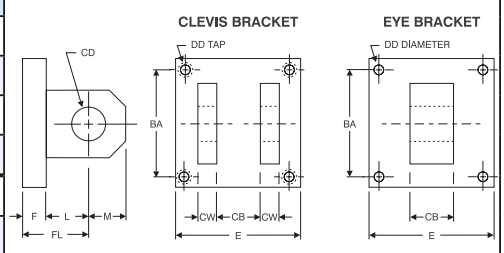
ROD EYE



(Clevis Pins sold separately from Rod Eyes)

CLEVIS BRACKETS AND EYE BRACKETS

	PART NUMBER	BA	CB	CD	CW	DD	E	F	FL	L	M
CLEVIS BRACKETS	SS-CB500	1.625	0.750	0.500	0.500	3/8-24	2.500	0.375	1.125	0.750	0.625
	SS-CB750	2.563	1.250	0.750	0.625	1/2-20	3.500	0.625	1.875	1.250	0.750
	SS-CB1000	3.250	1.500	1.000	0.750	5/8-18	4.500	0.750	2.250	1.500	1.000
	SS-CB1375	3.813	2.000	1.375	1.000	5/8-18	5.000	0.875	3.000	2.125	1.375
EYE BRACKETS	SS-EB500	1.625	0.750	0.500	N/A	0.406	2.500	0.375	1.125	0.750	0.500
	SS-EB750	2.563	1.250	0.750		0.532	3.500	0.625	1.875	1.250	0.750
	SS-EB1000	3.250	1.500	1.000		0.656	4.500	0.750	2.250	1.500	1.000
	SS-EB1375	3.813	2.000	1.375		5/8-18	5.000	0.875	3.000	2.125	1.375



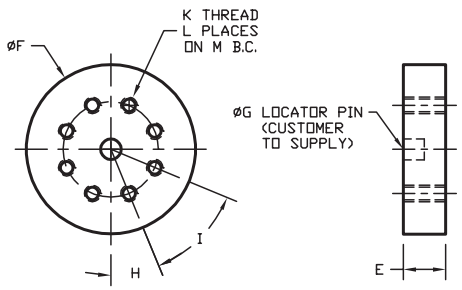
(Clevis Pins sold separately from Clevis & Eye Brackets)

ACCESSORIES: CLEVIS, PINS & MOUNTS

WELD PLATE DIMENSIONS

PART NUMBER	ROD DIA.	E	F	G (DIA.)	H	I	K	L	M
WP625	0.625	0.500	2.000	0.250	45.0°	90.0°	10 -20	4	1.125
WP1000	1.000	0.500	2.500	0.250	30.0°	60.0°	1/4 -20	6	1.500
WP1375	1.375	0.625	3.000	0.250	30.0°	60.0°	5/16 -18	6	2.000
WP1750	1.750	0.625	4.000	0.250	22.5°	45.0°	5/16 -18	8	2.375
WP2000	2.000	0.750	4.000	0.375	15.0°	30.0°	3/8 -16	12	2.688
WP2500	2.500	0.750	4.500	0.375	15.0°	30.0°	3/8 -16	12	3.188
WP3000	3.000	1.000	5.500	0.375	15.0°	30.0°	1/2 -13	12	4.000
WP3500	3.500	1.000	7.000	0.375	15.0°	30.0°	5/8 -11	12	4.688
WP4000	4.000	1.000	7.000	0.375	15.0°	30.0°	5/8 -11	12	5.188
WP4500	4.500	1.000	8.000	0.375	15.0°	30.0°	5/8 -11	12	5.688
WP5000	5.000	1.000	8.000	0.375	15.0°	30.0°	5/8 -11	12	6.188
WP5500	5.500	1.250	9.000	0.375	15.0°	30.0°	3/4 -10	12	6.875

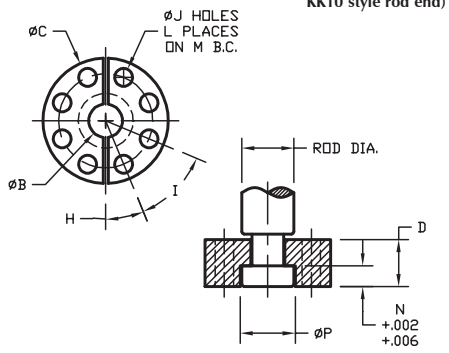
WELD PLATE



FLANGE END COUPLER DIMENSIONS

PART NUMBER	ROD DIA.	B	C	D	H	I	J	L	M	N	P
FEC625	0.625	0.406	1.500	0.563	45.0°	90.0°	0.219	4	1.125	0.250	0.656
FEC1000	1.000	0.750	2.000	0.875	30.0°	60.0°	0.281	6	1.500	0.375	1.063
FEC1375	1.375	0.938	2.500	1.000	30.0°	60.0°	0.344	6	2.000	0.375	1.438
FEC1750	1.750	1.188	3.000	1.250	22.5°	45.0°	0.344	8	2.375	0.500	1.813
FEC2000	2.000	1.438	3.500	1.625	15.0°	30.0°	0.406	12	2.688	0.625	2.063
FEC2500	2.500	1.875	4.000	1.875	15.0°	30.0°	0.406	12	3.188	0.750	2.625
FEC3000	3.000	2.375	5.000	2.375	15.0°	30.0°	0.531	12	4.000	0.875	3.125
FEC3500	3.500	2.625	5.875	2.625	15.0°	30.0°	0.656	12	4.688	1.000	3.625
FEC4000	4.000	3.125	6.375	2.625	15.0°	30.0°	0.656	12	5.188	1.000	4.125
FEC4500	4.500	3.625	6.875	3.125	15.0°	30.0°	0.656	12	5.688	1.500	4.625
FEC5000	5.000	4.000	7.375	3.125	15.0°	30.0°	0.656	12	6.188	1.500	5.125
FEC5500	5.500	4.500	8.250	3.875	15.0°	30.0°	0.781	12	6.875	1.875	5.625

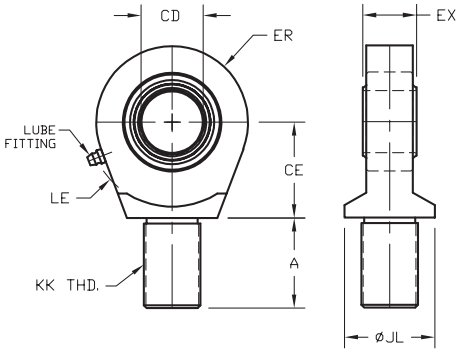
FLANGE END COUPLER (To be used with KK10 style rod end)



MALE SPHERICAL ROD EYE DIMENSIONS

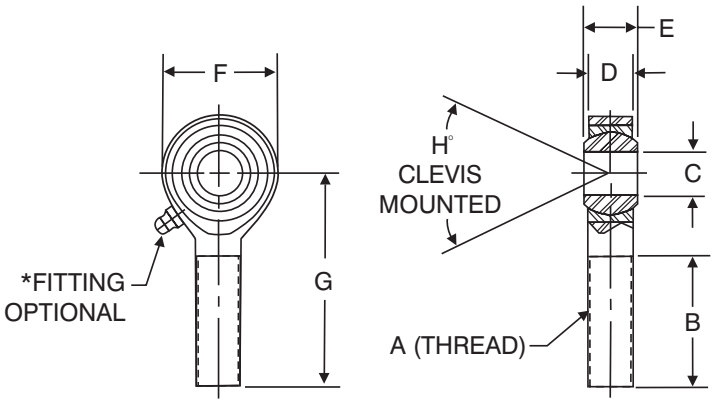
PART NUMBER	BORE (REF.)	ROD DIA.	A	CD	CE	ER	EX	JL	KK	LE	LOAD CAPACITY LBS
HH-MSRE-500	1.50	0.625 1.000	0.688	0.500	0.875	0.875	0.437	0.875	7/16 -20	0.750	2600
HH-MSRE-750	2.00	1.000 1.375	1.000	0.750	1.250	1.250	0.656	1.313	3/4 -16	1.063	9400
HH-MSRE-750	2.50	1.000 1.375 1.750	1.000	0.750	1.250	1.250	0.656	1.313	3/4 -16	1.063	9400
HH-MSRE-1000	3.25	1.375 1.750 2.000	1.500	1.000	1.875	1.375	0.875	1.500	1 -14	1.438	16800
HH-MSRE-1375	4.00	1.750 2.000 2.500	2.000	1.375	2.125	1.813	1.188	2.000	1 1/4 -12	1.875	28500
HH-MSRE-1750	5.00	2.000 2.500 3.000 3.500	2.125	1.750	2.500	2.188	1.531	2.250	1 1/2 -12	2.125	43000
HH-MSRE-2000	6.00	2.500 3.000 3.500 4.000	2.875	2.000	2.750	2.625	1.750	2.750	1 7/8 -12	2.500	70200

MALE SPHERICAL ROD EYE



ACCESSORIES: SPHERICAL ROD EYES

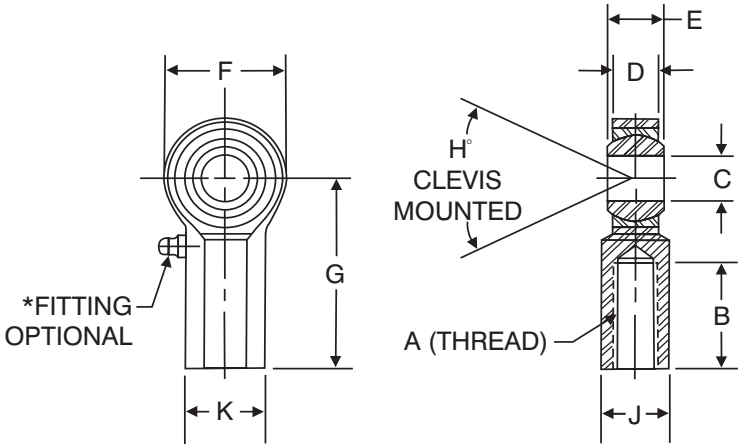
MALE SPHERICAL ROD EYE



Assortment of Male Spherical Rod Eyes.

MALE SPHERICAL ROD EYE DIMENSIONS										
PART NUMBER	A	B	C +.0015 -.0005	D	E	F	G	H*	STATIC LOAD CAPACITY LBS	APPROX. WEIGHT LBS
MSRE-437	7/16-20	1.500	0.5000	0.500	0.625	1.313	2.438	12	6,660	.25
MSRE-500	1/2-20	1.500	0.5000	0.500	0.625	1.313	2.438	12	6,660	.25
MSRE-750	3/4-16	1.750	0.7500	0.688	0.875	1.750	2.875	14	11,515	.60
MSRE-1000	1-14	2.125	1.0000	1.000	1.375	2.750	4.125	17	43,540	2.125
MSRE-1250	1 1/4-12	2.125	1.0000	1.000	1.375	2.750	4.125	17	43,540	2.413

FEMALE SPHERICAL ROD EYE



Assortment of Female Spherical Rod Eyes.

FEMALE SPHERICAL ROD EYE DIMENSIONS												
PART NUMBER	A	B	C +.0015 -.0005	D	E	F	G	H*	J	K	STATIC LOAD CAPACITY LBS	APPROX. WEIGHT LBS
*FSRE-312	5/16-24	0.750	0.3125	0.340	0.438	0.875	1.375	14	0.437	0.500	3,130	.09
FSRE-437	7/16-20	1.188	0.5000	0.500	0.625	1.313	2.125	12	0.750	0.875	6,660	.33
FSRE-500	1/2-20	1.188	0.5000	0.500	0.625	1.313	2.125	12	0.750	0.875	6,660	.33
FSRE-750	3/4-16	1.750	0.7500	0.688	0.875	1.750	2.875	14	1.000	1.125	11,515	.72
FSRE-1000	1-14	2.125	1.0000	1.000	1.375	2.750	4.125	17	1.500	1.625	43,540	2.413
*FSRE-1250	1 1/4-12	2.125	1.0000	1.000	1.375	2.750	4.125	17	1.500	1.625	43,540	2.413

* Consult factory for delivery.

ACCESSORIES: TRUNNION BLOCKS

TRD is making it easier to set up trunnion style actuation solutions. TRD now offers mountable trunnion supports for 1.50″ to 8.00″ bore trunnion mounts. The TB-1000 support will take all 1.50″ to 5.00″ bores and the TB-1375 support will fit 6.00″ and 8.00″ bores. Trunnion blocks are available in aluminum and stainless steel constructions.

All supports feature IGNUS® "High-Load" bearings as standard. These bearings are made of T-500 composite which provide over ten times the strength of bronze bushings for heavy-duty performance and long life. T-500 is rated for intermittent food and wash down applications.

Trunnion supports can be used with all NFPA mounts MT1, MT2 and MT4, as well as TRD solid one-piece steel trunnion styles SMT1 and SMT2.

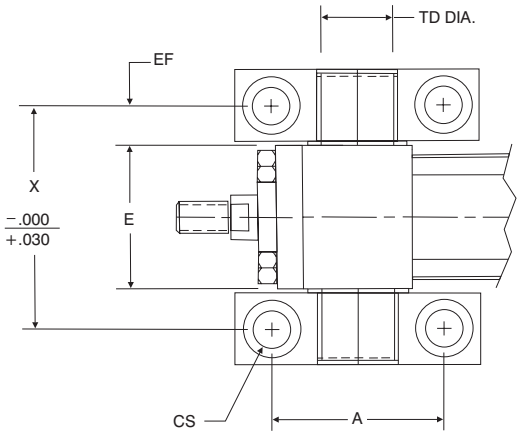
All trunnion blocks are in stock and available for immediate order.
Contact Factory for delivery for large orders or special requirements.

Aluminum trunnion blocks TB-1000 and TB-1375 with T-500 composite bearings.

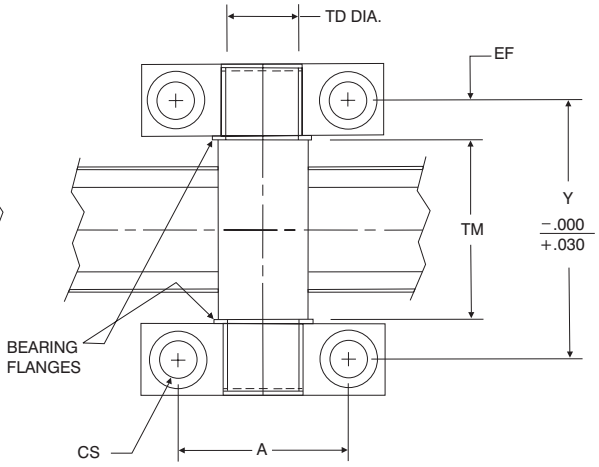
Stainless Steel trunnion block SS-TB-1000 with T-500 composite bearings.

TRUNNION BLOCK ORDERING INFORMATION			
PART NUMBER	**BORE SIZE**	**BLOCK MATERIAL**	**BEARING MATERIAL**
TB-1000	1.50 to 5.00	Aluminum w/ Black Anodize	T-500 Composite
TB-1375	6.00 to 8.00	Aluminum w/ Black Anodize	T-500 Composite
SS-TB-1000	1.50 to 5.00	303 Stainless Steel	T-500 Composite
SS-TB-1375	6.00 to 8.00	303 Stainless Steel	T-500 Composite
All above part numbers are for a pair of trunnion blocks. To order a single trunnion block, add -1 to the end of the part number (example: TB-1000-1). Note: fasteners not supplied.			
REPLACEMENT BEARING ORDERING INFORMATION			
PART NUMBER	**QTY REQUIRED PER TRUNNION**	**REPLACEMENT FOR TRUNNION BLOCK SERIES**	**BEARING MATERIAL**
TB-30-1	1	TB-1000 and SS-TB-1000	T-500 Composite
TB-30-2	2	TB-1375 and SS-TB-1375	T-500 Composite

ACCESSORIES: TRUNNION BLOCKS



MT1/MT2
HEAD & CAP TRUNNION
MOUNTING DIMENSIONS



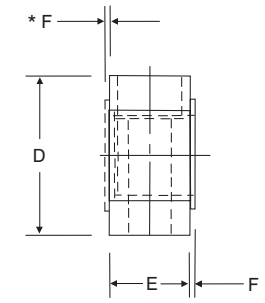
MT4
INTERMEDIATE TRUNNION
MOUNTING DIMENSIONS

NOTE: SHOWN WITH BEARING FLANGES ON INSIDE OF BLOCKS FACING CYLINDER.

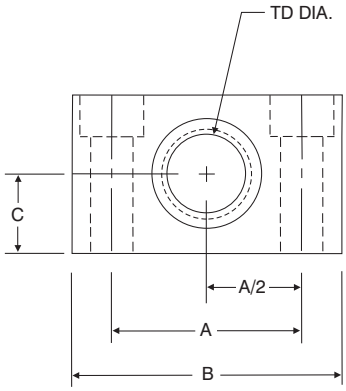
BORE	PART NUMBER	A	TD	E	EF	X	*CS	TM	Y
1.50	TB-1000	2.375	1.000	2.000	0.563	3.125	0.500	2.500	3.625
2.00	TB-1000	2.375	1.000	2.500	0.563	3.625	0.500	3.000	4.125
2.50	TB-1000	2.375	1.000	3.000	0.563	4.125	0.500	3.500	4.625
3.25	TB-1000	2.375	1.000	3.750	0.563	4.875	0.500	4.500	5.625
4.00	TB-1000	2.375	1.000	4.500	0.563	5.625	0.500	5.250	6.375
5.00	TB-1000	2.375	1.000	5.500	0.563	6.625	0.500	6.250	7.375
6.00	TB-1375	4.000	1.375	6.500	1.078	8.656	0.750	7.625	9.781
8.00	TB-1375	4.000	1.375	8.500	1.078	10.656	0.750	9.750	11.906

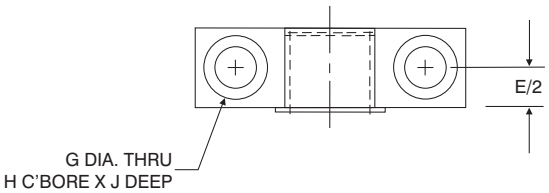
* Recommended cap screw size (cap screws not supplied).

STANDARD ALUMINUM TRUNNION BLOCKS WITH BEARING



* BEARING FLANGE ON BOTH SIDES ON TB-1375-1 ONLY

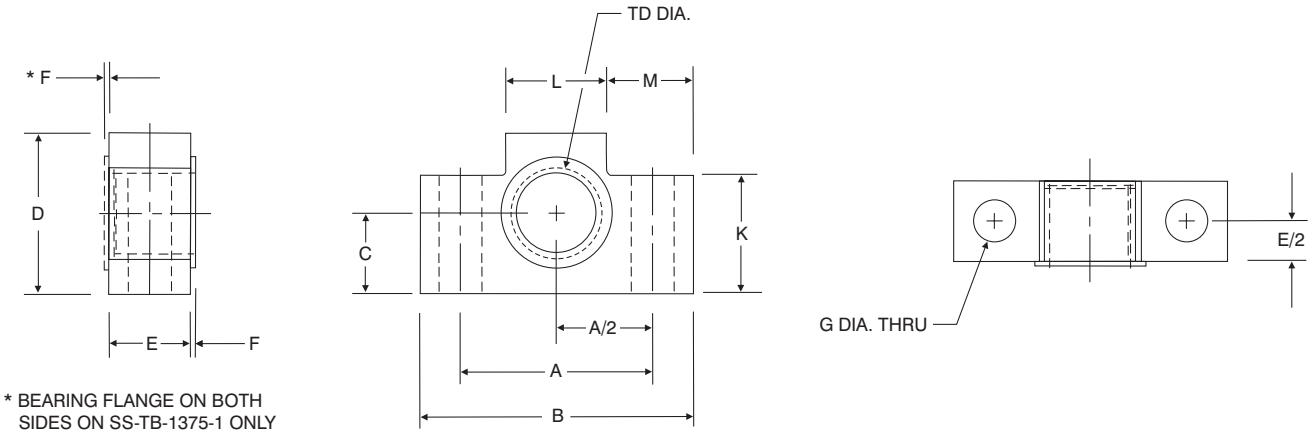




PART NUMBER	A	B	C	D	E	F	G	H	J	TB
TB-1000-1	2.375	3.375	1.000	2.000	1.000	0.062	0.531	0.797	0.531	1.000
TB-1375-1	4.000	5.500	1.500	3.000	2.000	0.078	0.781	1.187	0.781	1.375

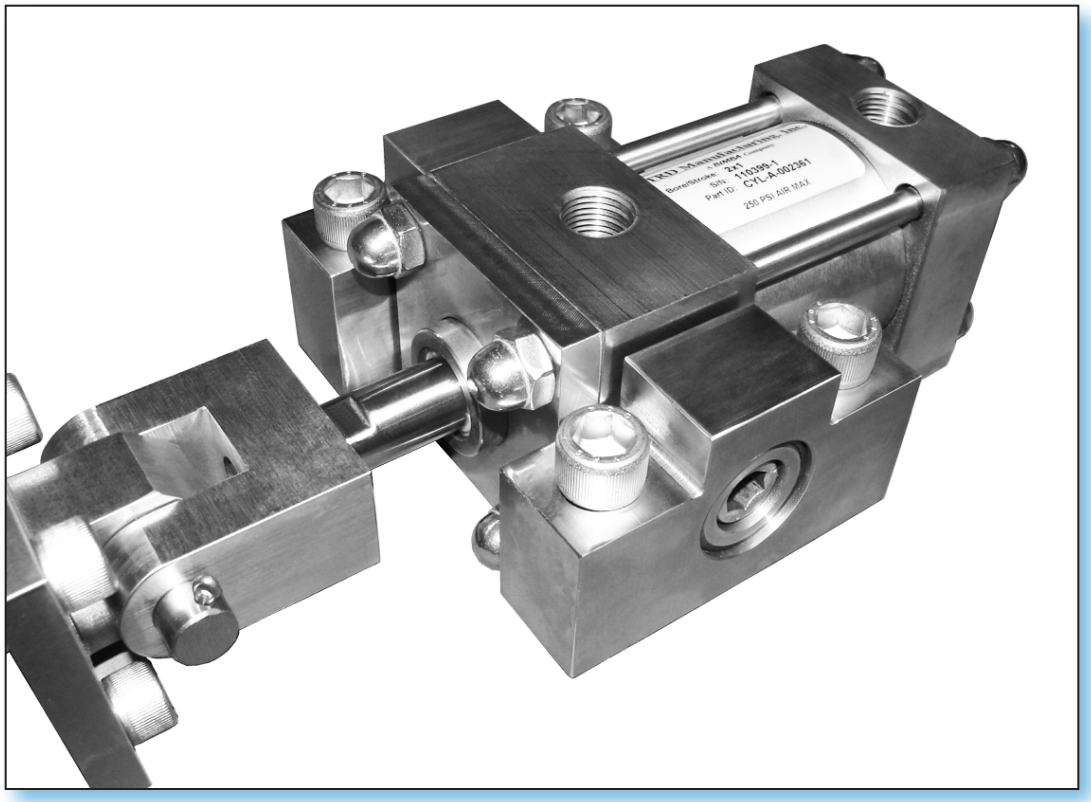
ACCESSORIES: TRUNNION BLOCKS

STAINLESS STEEL TRUNNION BLOCKS WITH BEARING



* BEARING FLANGE ON BOTH SIDES ON SS-TB-1375-1 ONLY

PART NUMBER	A	B	C	D	E	F	G	K	L	M	TD
SS-TB-1000-1	2.375	3.375	1.000	2.000	1.000	0.062	0.531	1.469	1.250	1.063	1.000
SS-TB-1375-1	4.000	5.500	1.500	3.000	2.000	0.078	0.781	2.219	2.125	1.688	1.375

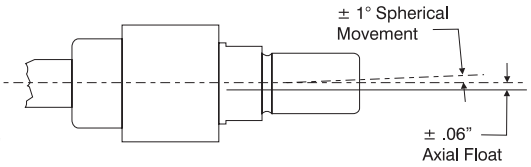


ACCESSORIES: ALIGNMENT COUPLERS

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.

MATERIAL: 100,000 MIN. YIELD *STRESS-PROOF™*



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: 0.625″ thread on 0.625″ 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 0.090″ diameter pin for 0.625″ rod threads and larger).

Standard AC Coupler
AC250 - AC5000

ACH Coupler
ACH250 - ACH1250

Stainless Steel Standard AC Coupler
SS-AC250 - SS-AC5000

How to Order:

AC — SERIES: AC, ACH

250 — SIZE: 250, 312, 375, 437, 500, 625, 750, 875, 1000, 1250, 1375, 1500, 1750

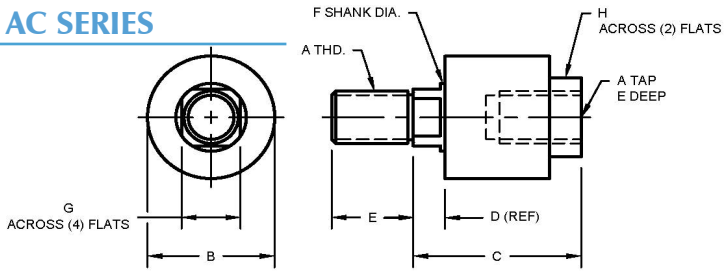
(Optional alternative size*) - 312 FEMALE — SIZE: 250, 312, 375, 437, 500, 625, 750, 875, 1000, 1250, 1375, 1500, 1750

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

Ordering Examples:
AC250 (AC with male & female 1/4-28 thread)
ACH500 (ACH with male & female 1/2-20 thread)
AC437-625 FEMALE (AC with 7/16-20 male and 5/8-18 female thread)

Recommended maximum stroke for cylinders with alignment couplers in horizontal applications	
BORE	**MAXIMUM STROKE**
1.50	**27**
2.00	**43**
2.50	**50**
3.25	**50**
4.00	**55**
5.00	**55**
6.00	**55**
8.00	**55**

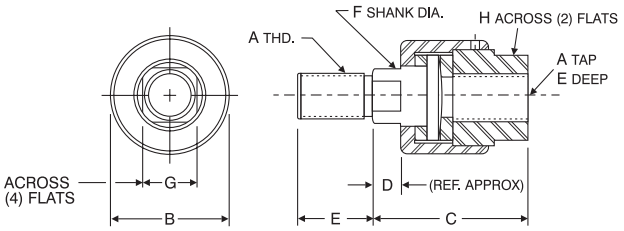
METRIC ROD AC SERIES



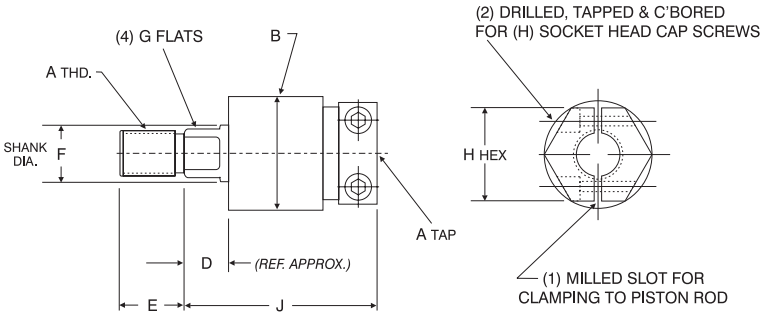
METRIC ROD ALIGNMENT COUPLERS									
PART NUMBER	A	B	C	D	E	F	G	H	MAX PULL POUNDS (3:1 SAFETY FACTOR)
MAC250-M4X0.7	M4X0.7	28.5	44.4	9.5	12.7	12.7	9.5	17.4	251
MAC250-M6X1.0	M6X1.0	28.5	44.4	9.5	12.7	12.7	9.5	17.4	687
MAC312-M8X1.25	M8X1.25	28.5	44.4	9.5	12.7	12.7	9.5	17.4	1,349
MAC437-M10X1.25	M10X1.25	31.7	50.8	11	19	15.8	12.7	20.6	2,435
MAC500-M12X1.25	M12X1.25	31.7	50.8	11	19	15.8	12.7	20.6	3,860
MAC625-M16X1.5	M16X1.5	31.7	50.8	11	19	15.8	12.7	20.6	7,299
MAC750-M20X1.5	M20X1.5	44.4	58.7	11	28.5	24.5	20.6	28.5	12,537

ACCESSORIES: ALIGNMENT COUPLERS

AC SERIES



ACH SERIES



ALIGNMENT COUPLER DIMENSIONS											
PART NUMBER	A	B	C	D	E	F	G	H	H HEX	J	MAX PULL POUNDS (3:1 SAFETY FACTOR)
AC250	1/4-28	1.125	1.750	0.375	0.500	0.500	0.375	0.688	1.250	2.000	886
AC312	5/16-24	1.125	1.750	0.375	0.500	0.500	0.375	0.688	1.250	2.000	1,623
AC375	3/8-24	1.125	1.750	0.375	0.500	0.500	0.375	0.688	1.250	2.000	2,532
AC437	7/16-20	1.250	2.000	0.438	0.750	0.625	0.500	0.813	1.250	2.156	3,526
AC500	1/2-20	1.250	2.000	0.438	0.750	0.625	0.500	0.813	1.125	2.156	4,841
AC625	5/8-18	1.250	2.000	0.438	0.750	0.625	0.500	0.813	1.250	2.156	7,862
AC750	3/4-16	1.750	2.313	0.438	1.125	0.969	0.813	1.125	1.750	2.500	11,543
AC875	7/8-14	1.750	2.313	0.438	1.125	0.969	0.813	1.125	1.750	2.500	15,846
AC1000	1-14	2.500	2.938	0.438	1.625	1.344	1.156	1.625	2.500	2.938	21,206
AC1250	1 1/4-12	2.500	2.938	0.438	1.625	1.344	1.156	1.625	2.500	2.938	34,024
AC1375	1 3/8-12	2.500	2.938	0.438	1.625	1.344	1.156	1.625	—	—	40,710
AC1500	1 1/2-12	3.250	4.375	0.875	2.250	1.969	1.750	2.375	—	—	49,857
AC1750	1 3/4-12	3.250	4.375	0.875	2.250	1.969	1.750	2.375	—	—	69,558
AC1875	1 7/8-12	3.750	5.625	1.000	3.000	2.469	2.125	2.750	—	—	79,354
AC2000	2-12	3.750	5.625	1.000	3.000	2.469	2.125	2.750	—	—	92,531
AC2250	2 1/4-12	4.500	6.375	1.000	3.500	2.969	2.625	3.375	—	—	118,776
AC2500	2 1/2-12	5.000	6.563	1.000	3.500	3.938	SPANNER HOLES**		—	—	149,543
AC2750	2 3/4-12	5.000	6.563	1.000	3.500	3.938			—	—	182,464
AC3000	3-12	5.000	6.563	1.000	3.500	3.938			—	—	218,658
AC3250	3 1/4-12	6.250	8.125	1.000	4.500	4.938			—	—	258,124
AC3500	3 1/2-12	6.250	8.125	1.000	4.500	4.938			—	—	300,863
AC3750	3 3/4-12	6.250	8.125	1.000	4.500	4.938			—	—	346,875
AC4000	4-12	7.500	9.500	1.000	5.500	5.938			—	—	396,158
AC4500	4 1/2-12	7.500	9.500	1.000	5.500	5.938			—	—	504,544
AC5000	5-12	7.500	9.500	1.000	5.500	5.938			—	—	626,019

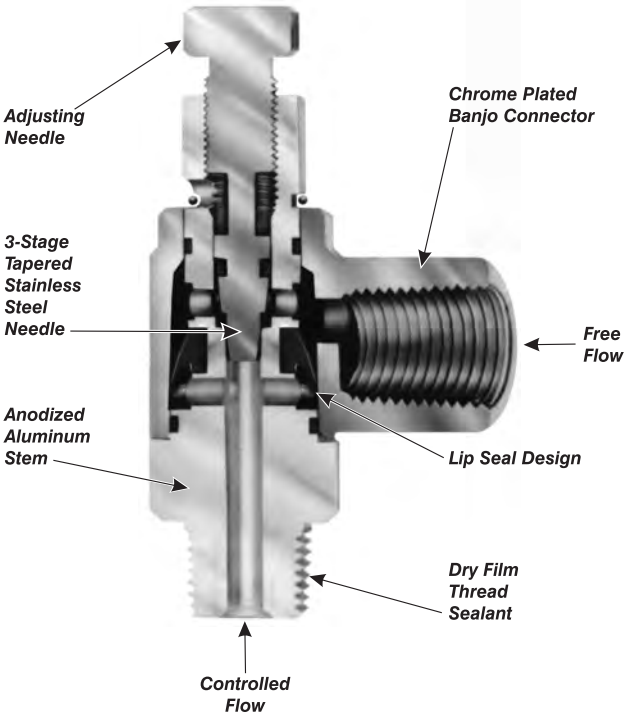
*Please specify AC or ACH coupler when ordering: i.e.: AC750 (Std. Coupler) or ACH750 (Hex Coupler).
**Spanner holes are used on AC2250 and larger,
Two (2) 0.500" diameter holes, 0.500" deep, 180° apart (each end).

STAINLESS STEEL ALIGNMENT COUPLERS

ALIGNMENT COUPLERS - STAINLESS STEEL									
PART NUMBER	A	B	C	D	E	F	G	H	MAX PULL POUNDS (3:1 SAFETY FACTOR)
SS-AC250	1/4-28	1.125	1.750	0.375	0.500	0.500	0.375	0.688	310
SS-AC312	5/16-24	1.125	1.750	0.375	0.500	0.500	0.375	0.688	568
SS-AC375	3/8-24	1.125	1.750	0.375	0.500	0.500	0.375	0.688	886
SS-AC437	7/16-20	1.250	2.000	0.438	0.750	0.625	0.500	0.813	1,234
SS-AC500	1/2-20	1.250	2.000	0.438	0.750	0.625	0.500	0.813	1,694
SS-AC625	5/8-18	1.250	2.000	0.438	0.750	0.625	0.500	0.813	2,752
SS-AC750	3/4-16	1.750	2.313	0.438	1.125	0.969	0.813	1.125	4,040
SS-AC875	7/8-14	1.750	2.313	0.438	1.125	0.969	0.813	1.125	5,546
SS-AC1000	1-14	2.500	2.938	0.438	1.625	1.344	1.156	1.625	7,422
SS-AC1250	1 1/4-12	2.500	2.938	0.438	1.625	1.344	1.156	1.625	11,908
SS-AC1500	1 1/2-12	3.250	4.375	0.875	2.250	1.969	1.750	2.375	17,450

ACCESSORIES: FLOW CONTROLS (FCP SERIES)

FCP



PORT SIZE
0.250", 0.375", 0.500"

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

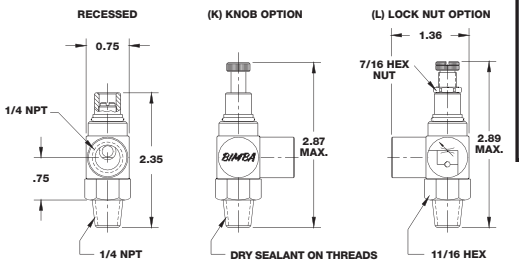
Maximum Operating Pressure:

150 PSI Air Only

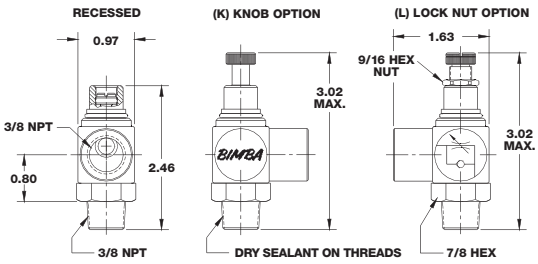
Operating Temperature Range:

-20°F to +200°F
(-25°C to +95°C)

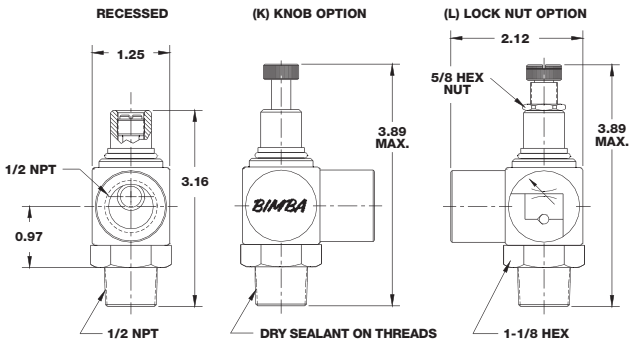
FCP4 **FCP4K** **FCP4L** — *For 1/4" port*



FCP6 **FCP6K** **FCP6L** — *For 3/8" port*

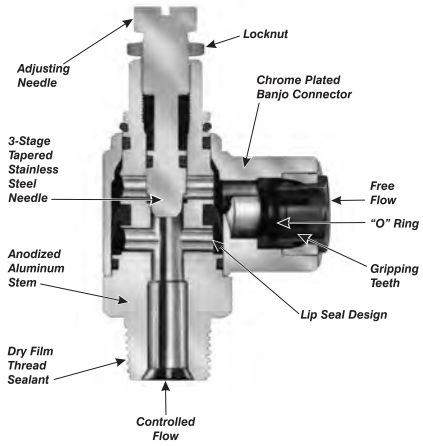


FCP8 **FCP8K** **FCP8L** — *For 1/2" port*

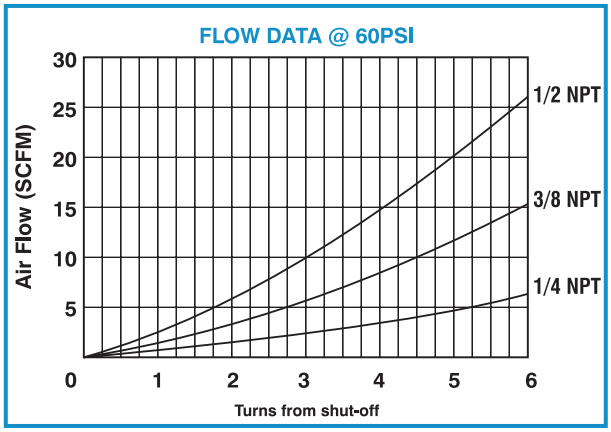


ACCESSORIES: QUICK-FLO® FLOW CONTROLS (FQP SERIES)

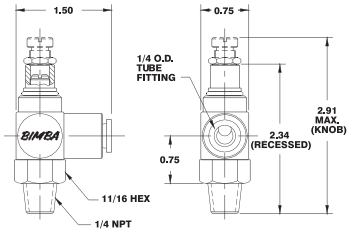
FQP



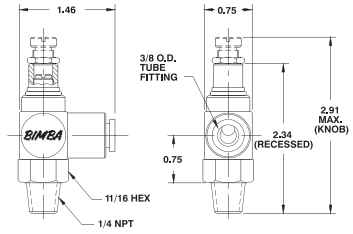
FQP & FCP Series



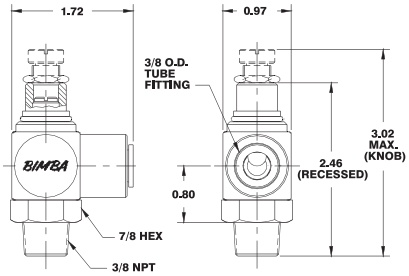
FQP44 FQP44K — For 1/4" port, 1/4" OD tubing



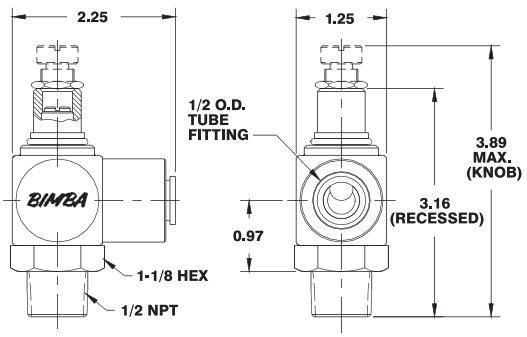
FQP4 FQP4K — For 1/4" port, 3/8" OD tubing



FQP6 FQP6K — For 3/8" port, 3/8" OD tubing



FQP8 FQP8K — For 1/2" port, 1/2" 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

Maximum Operating Pressure:

150 PSI Air Only

Operating Temperature Range:

-20°F to +200°F
(-25°C to +95°C)

NOTES

Switches
STROKEMASTER
Balluff Transducers

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

ACCESSORIES: SWITCHES

- Miniature AC/DC Reed
- High Power AC Reed
- Miniature DC Solid State
- RoHS
- 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) Screwdriver
- High visibility LED can be seen up to 20 feet
- Suitable for all bore sizes (1.50" to 12.00")
- Magnetically operated, can be located anywhere in the actuator stroke range
- **One magnet type (MPR) for both Reed AND Solid State TRD Switches.**
- Can be used with all TRD Aluminum Series Actuators (TA, TD, TRA, FM, MSE, MSR), Electroless Nickel (EN) Plated Series and Stainless Steel (SS) Series.

Benefits of REED Switch

- Internal Circuit Protection Option
- 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

R10 Miniature REED Switch

- 120 Volts Max. (AC or DC)
- 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)

Benefits of SOLID STATE Switch

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

- 120 Volts Max. (AC or 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 *(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	<300mA	<300mA	YES	<300mA	<300mA
R10P REED SWITCH	YES	<10VA	<10VA	<10VA	YES	<10VA	<10VA

*Use resistor-capacitor protection

**Minimum current = 80mA

Specify 'MPR' Option for ALL switch models when ordering actuators.

Electrical Specifications

Schematics

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

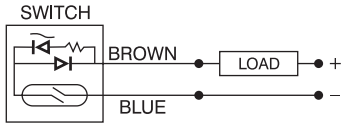
R10X **Miniature Reed Switch, 120" (24 AWG Wire, PVC Jacket) Plain Cable Lead, (2 wire Switch)**

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	120 Volts Max. (AC or DC)
Maximum Load Current	500 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

R10 / R10X

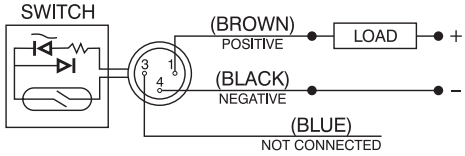
Miniature Reed Switch, Cable Type,
(2 Wire Switch)



Input Voltage 120 Volts Max. AC/DC
Maximum Load Current 500 mA Max. (Resistive)

R10Q

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



Input Voltage 120 Volts Max. AC/DC
Maximum Load Current 500 mA Max. (Resistive)

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

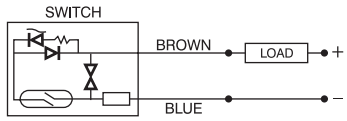
R10PX **Miniature Reed Switch, 120" (24 AWG Wire, PVC Jacket) Plain Cable Lead, Circuit Protection (2 wire Switch)**

R10PQ **Miniature Reed Switch, 8mm Male Quick Connect, (24 AWG Wire, PVC Jacket) Circuit Protection (2 wire Switch)**

Contacts	SPST Form A (Normally Open)
Contact Rating	10 Watts Max.
Input Voltage	120 Volts Max. (AC or DC)
Maximum Load Current	150 mA Max.
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

R10P / R10PX

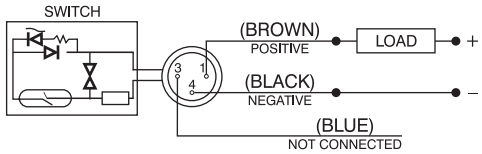
Miniature Reed Switch, Cable Type,
(2 Wire Switch)



Input Voltage 120 Volts Max. AC/DC
Maximum Load Current 150 mA Max.

R10PQ

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



Input Voltage 120 Volts Max. AC/DC
Maximum Load Current 150 mA Max.

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.

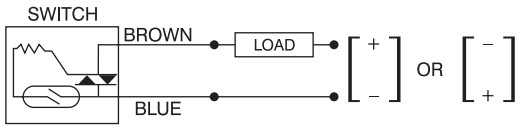
RAC **High Power AC Reed Switch, 24" (20 AWG Wire, PVC Jacket) Plain Cable Lead, (2 wire Switch)**

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

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

Specify 'MPR' Option for ALL switch models when ordering actuators.

ACCESSORIES: SWITCHES — REED

Electrical Specifications

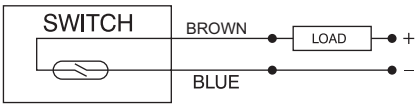
RHT **Extended Temperature Range Miniature Reed Switch, 24" (24 AWG Wire, Silicone rubber insulation with gray outer sheath, 4.5mm O.D.) Plain Cable Lead, (2 wire Switch)**

RHTX **Extended Temperature Range Miniature Reed Switch, 120" (24 AWG Wire, Silicone rubber insulation with gray outer sheath, 4.5mm O.D.) Plain Cable Lead, (2 wire Switch)**

Contacts	SPST Form A (Normally Open)
Contact Rating	10 Watts Max.
Input Voltage	120 Volts Max. (AC or DC)
Maximum Load Current	500 mA Max. (Resistive)
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

Schematics

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



Input Voltage	120 Volts Max. AC/DC
Maximum Load Current	500 mA Max. (Resistive)

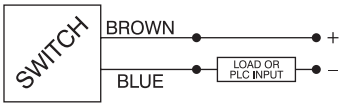
SWITCHES — SOLID STATE

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

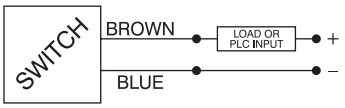
MSSX **Miniature Solid State Switch, 120" (24 AWG Wire, PVC Jacket) Plain Cable Lead, (2 wire Switch)**

*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



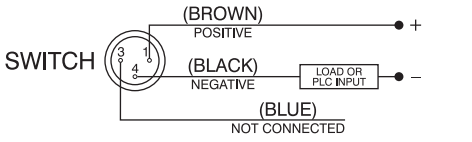
Typical Current Sinking (NPN) Configuration

*NOTE: This is a two (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.

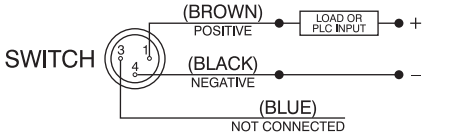
MSSQ **Miniature Solid State Switch, 8mm Male Quick Connect, 24 AWG Wire, PVC Jacket (2 wire Switch)**

*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	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

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



Typical Current Sourcing (PNP) Configuration



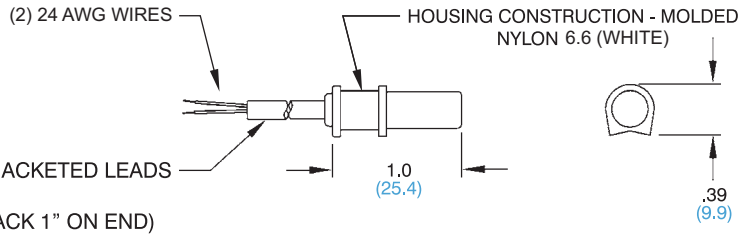
Typical Current Sinking (NPN) Configuration

*NOTE: This is a two (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.

Specify 'MPR' Option for ALL switch models when ordering actuators.

ACCESSORIES: SWITCHES AND BRACKET DIMENSIONS

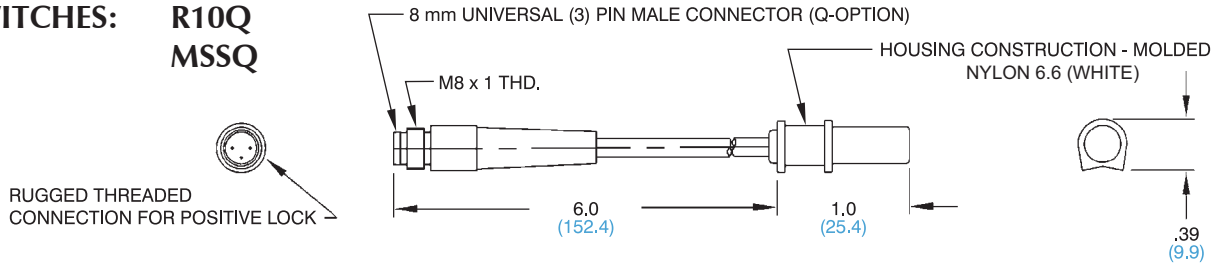
FOR SWITCHES: R10 / R10X RHT / RHTX MSS / MSSX



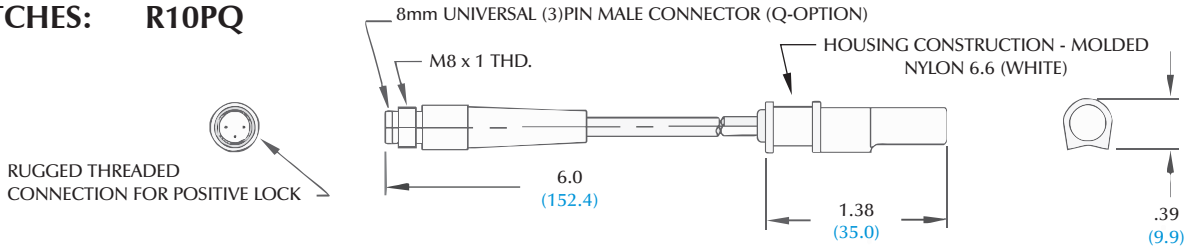
PLAIN CABLE LEADS

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

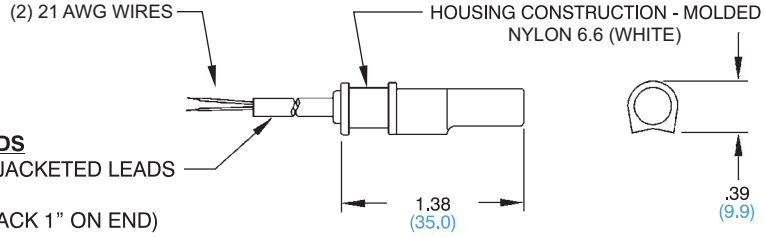
FOR SWITCHES: R10Q MSSQ



FOR SWITCHES: R10PQ



FOR SWITCHES: RAC / RACX R10P / R10PX

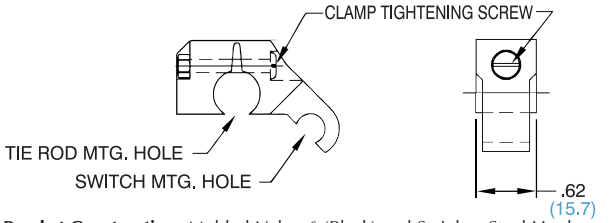


PLAIN CABLE LEADS

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

SWITCH BRACKET: SB15

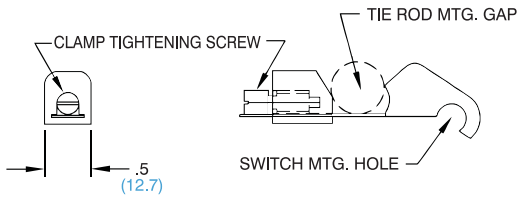
(For 1.50" Through 2.50" Bore Cylinders)



Bracket Construction: Molded Nylon 6 (Black) and Stainless Steel Hardware

SWITCH BRACKET: SB32

(For 3.25" Through 12.00" Bore Cylinders)



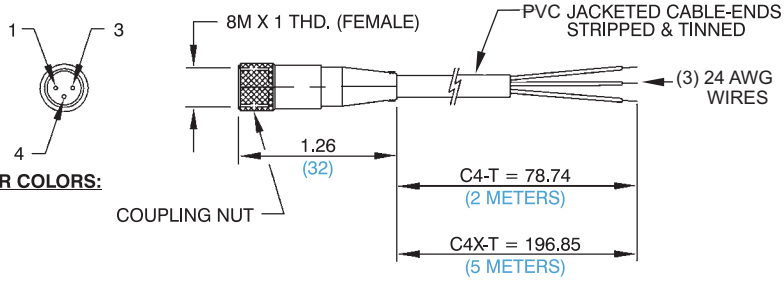
Bracket Construction: Molded Nylon 6 (Black) and Stainless Steel Hardware

QUICK CONNECT CORD SETS

(Used with "Q" Type Switch Leads)

FOR CABLES:
C4-T (2 METER CABLE LENGTH)
C4X-T (5 METER CABLE LENGTH)

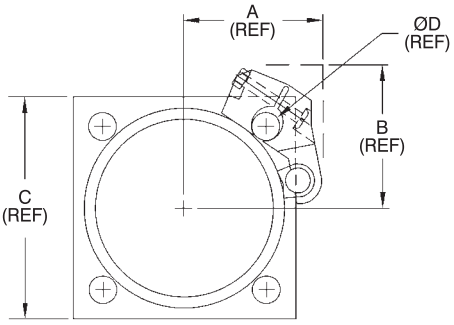
All Dimensions are in INCHES
(mm in parentheses)



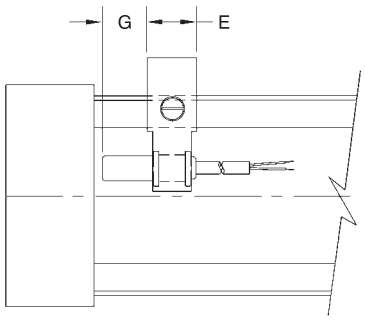
CONDUCTOR COLORS:
1. BROWN
3. BLUE
4. BLACK

Specify 'MPR' Option for ALL switch models when ordering actuators.

ACCESSORIES: *SWITCH MOUNTING DIMENSIONS*



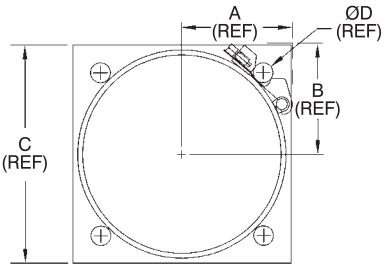
SB15



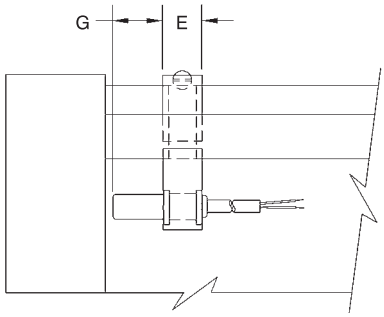
SB15

SWITCH BRACKET LETTER DIMENSIONS							
PART NO.	BORE	A	B	C	D	E	G
SB15	1.50	1.375	1.406	2.000	0.250	0.625	0.500
	2.00	1.625	1.656	2.500	0.313	0.625	0.500
	2.50	1.875	1.875	3.000	0.313	0.625	0.500
SB32	3.25	2.125	2.125	3.750	0.375	0.500	0.563
	4.00	2.438	2.375	4.500	0.375	0.500	0.563
	5.00	2.875	2.750*	5.500	0.500	0.500	0.563
	6.00	3.250*	3.250*	6.500	0.500	0.500	0.563
	8.00	4.250*	4.250*	8.500	0.625	0.500	0.563
	10.00	5.313*	5.313*	10.625	0.750	0.500	0.563
	12.00	6.375*	6.375*	12.750	0.750	0.500	0.563

*THESE DIMENSIONS ARE 0.500" OF THE 'C' DIMENSION. THE SWITCH BRACKET **DOES NOT** PROTRUDE BEYOND STANDARD HEAD/CAP.



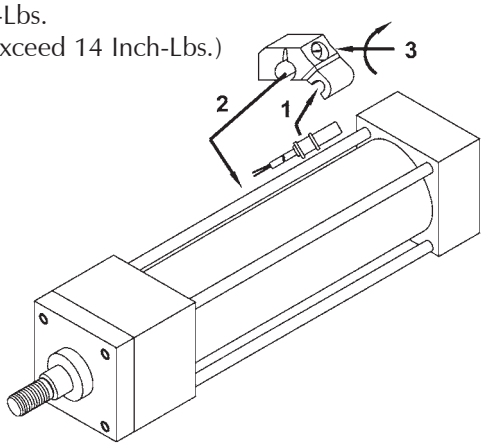
SB32



SB32

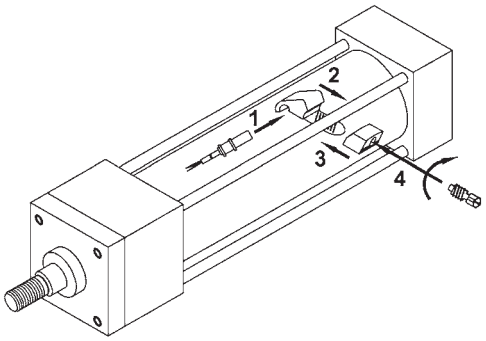
How To Assemble Switch and Brackets

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)

Specify 'MPR' Option for ALL switch models when ordering actuators.

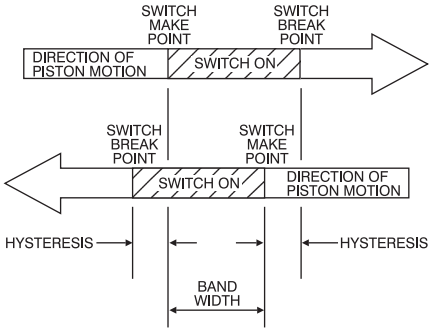
ACCESSORIES: SWITCHES HYSTERESIS & BAND WIDTH

HYSTERESIS:

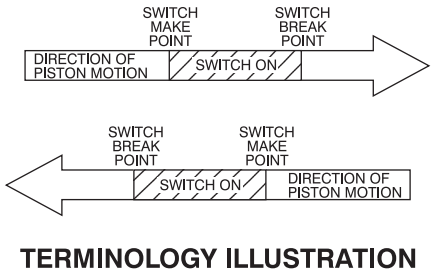
THE DISTANCE BETWEEN THE SWITCH BREAK POINT MOVING IN ONE DIRECTION AND THE SWITCH MAKE POINT MOVING IN THE OPPOSITE DIRECTION.

BAND WIDTH:

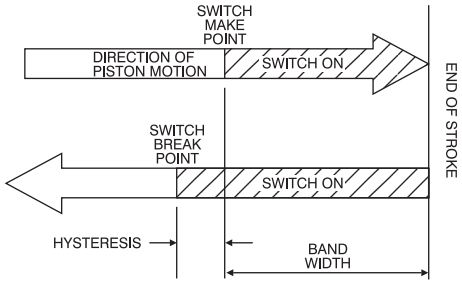
THE DISTANCE THE PISTON MOVES WHILE THE SWITCH IS MADE (IN EITHER DIRECTION), LESS THE HYSTERESIS.



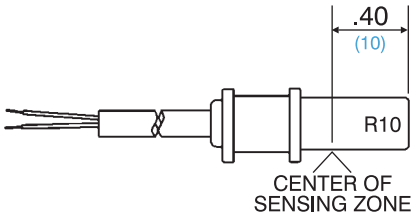
MID STROKE OPERATION



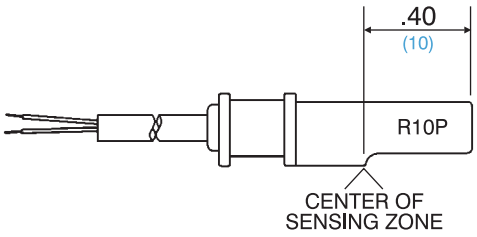
TERMINOLOGY ILLUSTRATION



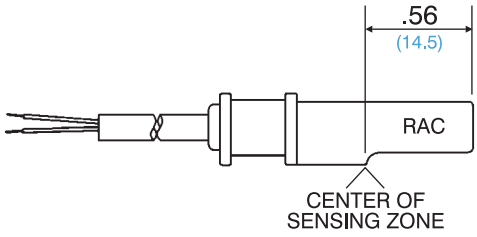
END OF STROKE OPERATION



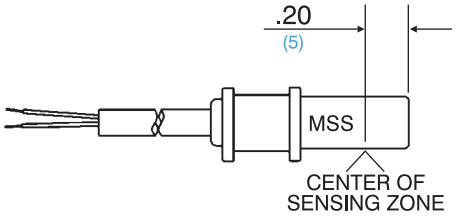
SWITCH	REPEATABILITY	HYSTERESIS (MAX)	BANDWITH (MAX)
R10 RHT R10X RHTX R10Q	±.010″ (±.25)	.040″ (1)	.200″ (5)



SWITCH	REPEATABILITY	HYSTERESIS (MAX)	BANDWITH (MAX)
R10P R10PQ R10PX	±.010″ (±.25)	.040″ (1)	.200″ (5)



SWITCH	REPEATABILITY	HYSTERESIS (MAX)	BANDWITH (MAX)
RAC RACX	±.010″ (±.25)	.085″ (2.1)	.345″ (8.8)



SWITCH	REPEATABILITY	HYSTERESIS (MAX)	BANDWITH (MAX)
MSS MSSX MSSQ	±.010″ (±.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.

Specify 'MPR' Option for ALL switch models when ordering actuators.

ACCESSORIES: SWITCH ORDERING INSTRUCTIONS

TO ORDER, SPECIFY: Switch Model, Lead Type and Bracket Size

R10 X - SB15

Switch Model	Switch Lead Options	Switch Bracket
R10 = AC/DC Reed RAC = High Power AC Reed RHT = Extended Temperature Reed MSS = Solid State R10P = AC/DC Reed with Circuit Protection	(leave blank) = 24″ Plain Cable X = 120″ Plain Cable Q = 8mm Quick Connect (not available on RAC, or RHT)	SB15 = 1.50″ to 2.50″ Bore SB32 = 3.25″ to 12.00″ Bore (leave blank for switch only)

Switch Accessories

Quick Connect Cord Sets

MODEL	DESCRIPTION
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)

Specify 'MPR' Option for ALL switch models when ordering actuators.

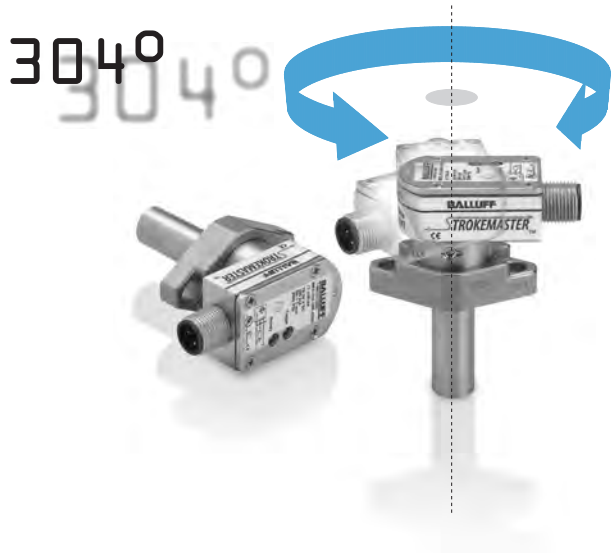
BALLUFF STROKEMASTER™ Inductive Sensors

Flexible Solutions for an Often Inflexible World

Balluff's Strokemaster® cylinder-piston sensors provide precision end-of-stroke sensing for hydraulic cylinders. The sensor body allows 304° of rotation to eliminate the hassle of post-installation cable management, which in some competitive designs requires unbolting the flange and breaking the hydraulic seal.

A high-pressure inductive proximity sensor, the Strokemaster® provides a 2mm (0.08") sensing range to detect the "spud" of hydraulic/pneumatic cylinders and indicate fully retracted or extended position. It mounts with two socket-head cap screws and seals with a Viton 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.

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 for the AC/DC versions. All units are weld-field immune, short-circuit, and reverse polarity protected. They fit all TRD series cylinder designs, with standard available probe lengths of 0.912" - 4.560" (23.165mm - 115.8mm). Custom probe lengths can be achieved by using TRD supplied spacer kits. Probes are made of stainless steel with a high-strength ceramic face. Both DC and AC/DC sensors have all-metal housings. The Strokemaster® sensor is UL-listed, CE-certified, and its housing is sealed to IP67 requirements.



CE cULus

SERIES: BALLUFF INDUCTION SENSORS

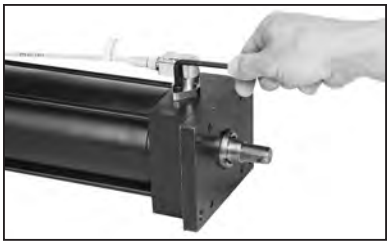
DC INDUCTIVE SENSORS

BALLUFF STROKEMASTER™

Features/Advantages

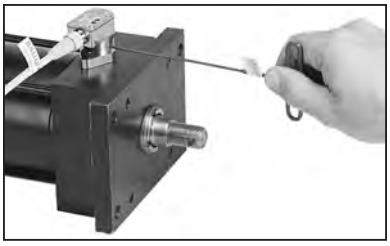
Inductive cylinder switch for piston position feedback in cylinders.

- Magnetic field immune, for use with welding equipment
- Available in DC or all current (AC/DC) versions
- Easy installation - sensor mounts to cylinder with two (2) fasteners
- Sealed directly at flange, connector can be oriented after installation
- Various lengths available for different cylinder sizes



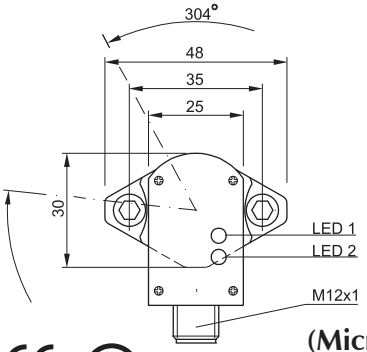
Bolt sensor to cylinder.

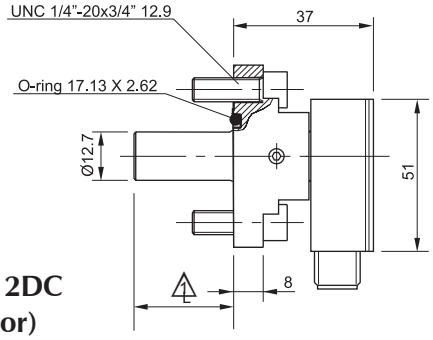
Position cable to desired orientation (even over mounting bolts).



Lock chosen position with one or both of the two integral set screws.

Refer to page 235 for available cable connector sets.

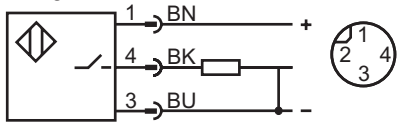




(Micro M12DC Connector)

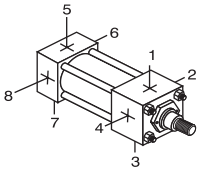
PNP Normally-open	BES 516-300-S 295-S 4
Rated operational voltage U_e	24 V DC
Supply voltage U_B	10...30 V DC
Voltage drop U_d at I	≤ 2.5 V
Rated insulation voltage U_i	75 V DC
Rated operational current I_e	200 mA
No-load supply current $I_{d./und.}$	≤ 18 mA/≤ 10 mA
Off-state current I_r	≤ 80 µA
Protected against polarity reversal	yes
Short circuit/overload protected	yes/yes
Load capacitance	≤ 1.0 µF
Repeat accuracy R	≤ 5 %
Ambient temperature range T	-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	Micro connector
Approvals	cULus
High pressure rated up to	207 bar (3000 PSI)
Recommended connector	**C04 AEL-00-VY-050M**

Wiring **PNP Normally Open** Pinout



⚠ TRD will supply the correct length probe and spacer combination (if required) for each cylinder. Using the combination of standard 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:

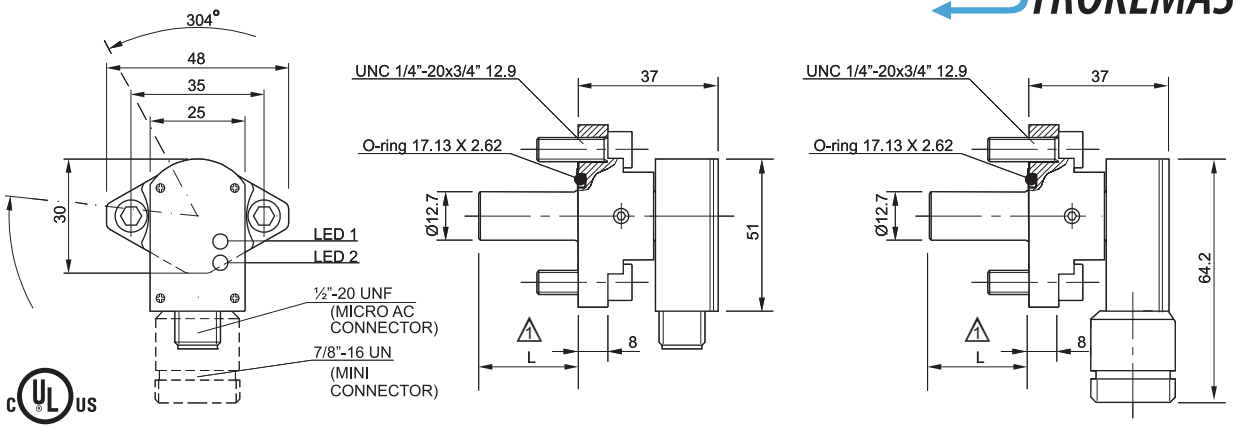
Cylinder Model Number ➡	**TA - MS2 3.25 X 6 - HC**
SENSOR MODEL (HEAD) ➡	**-BES 516-300-S 295-S4 (Head)**
SENSOR MODEL (CAP) ➡	**-BES 516-300-S 295-S4 (Cap)**
(Include ALL Sensor positions) ➡	**-Sensors at 4 & 8**

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.

SERIES: BALLUFF INDUCTION SENSORS

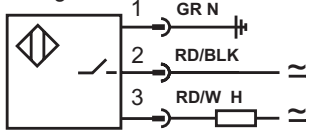
AC/DC INDUCTIVE SENSORS

BALLUFF STROKEMASTER™



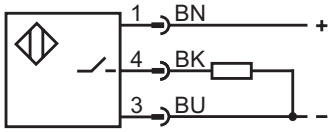
Normally-open	BES 516-200-S 2-S21	BES 516-200-S 2-S5
Rated operational voltage U_e	110 V AC	110 V AC
Supply voltage U_B	20...250 V AC/DC	20...250 V AC/DC
Voltage drop U_d at I	< 6 V	< 6 V
Rated insulation voltage U_i	250 V AC	250 V AC
Rated operational current I_e	500 mA	500 mA
Minimum operational current I_m	5 mA	5 mA
Off-state current I_r	< 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	-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/aluminum	stainless steel/aluminum
Material of sensing face	ceramic	ceramic
Connection	Micro connector	Mini connector
Approvals	cULus	cULus
High pressure rated up to	207 bar (3000 PSI)	207 bar (3000 PSI)
Recommended connector	**C21 AE3-00-VY-150F**	**C05 AE1-00-VY-150F**

Wiring



Pinout

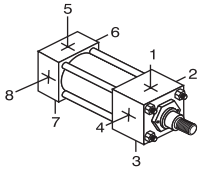
Wiring



Pinout

⚠ TRD will supply the correct length probe and spacer combination (if required) for each cylinder. Using the combination of standard 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 235 for available cable connector sets.

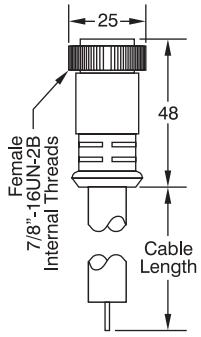
SERIES: BALLUFF INDUCTION SENSORS

CABLE CONNECTORS

BALLUFF STROKEMASTER™

S5 - Mini Connectors (7/8"-16 UNF Threads)

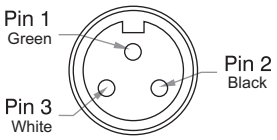
Connector	3-5 Pole Mini
Style	Mini Size A
Configuration	Straight Female
Recommended Connector	**C05 AE1-00-VY-150F**



	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

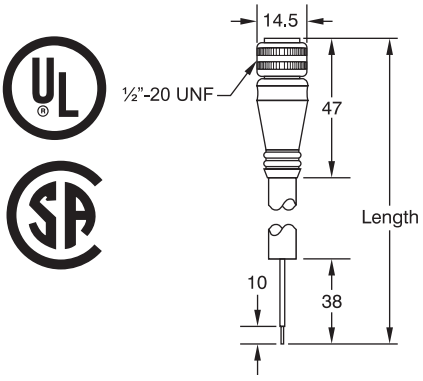
* Insert **V** = PVC Cable
T = TPE Cable
For 3 pole versions only

Female 3-pin - Face view



S21 - Micro Connectors (½"-20 UNF Threads)

Connector	Micro AC 1/2" x 20 UNF
Style	3 Pin Dual Keyway
Configuration	Straight Female
Recommended Connector	**C21 AE3-00-VY-150F**

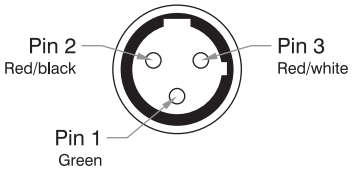


	ORDER NUMBER
Ordering Code	
3 Pin Dual Keyway	C21 AE3 00 * Y 150F
Voltage Rating	250 V AC/DC
Amperage	4A
Wire Gauge	22 AWG
Jacket	Yellow PVC or TPE
Coupling Nut	Black Epoxy Coated Zinc
O-Ring	Viton
Overmold Head	TPE
Protection	IP68 / NEMA 6P
Ambient Operating Temp.	-4 - 221°F (-21 to 105°C)
UL Listed	Yes
CSA Certified	Yes

Note: 15 ft cable is standard (other lengths available - contact factory)

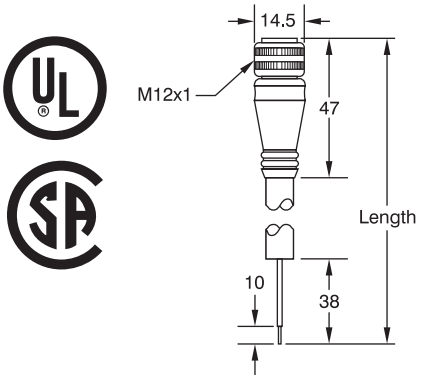
* Insert **V** = PVC Cable
T = TPE Cable
For 3 pole versions only

Female - Face view



S4 - Micro Connectors (M12x1 Metric Threads)

Connector	Micro
Style	M12 DC Single Keyway
Configuration	Straight Female
Recommended Connector	**C04 AEL-00-VY-050M**



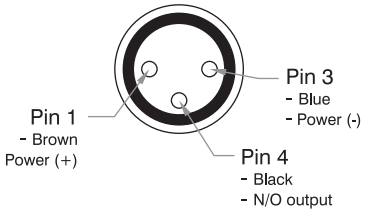
	Note	ORDER NUMBER
3 Wire DC		
3 Wire Normally Open, non-LED	**1,2,3**	C04 AEC 00 * Y 050M
3 Wire Normally Open PNP w/ LED		C04 AEH 00 * Y 050M
4 Wire DC (NO/NC)		
4 Wire (Universal), non-LED	**1,2,3**	C04 AEL 00 * Y 050M
4 Wire PNP w/LED	**1,3**	C04 AEM 00 * Y 050M
Voltage Rating		10 - 30 V DC
Amperage		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)

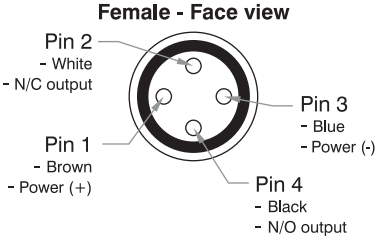
* Insert **V** = PVC Cable
T = TPE Cable
For 3 pole versions only

Note: **1** Add **B** = Braided 80% Metallic Braid, i.e. 050 M**B**
2 Add **S** = S-Shielded 360 Degree Shield through Coupling Nut, i.e. 050 M**S**
3 Stainless Steel Couple Nut: Change **E** to **S**, i.e. C04A**S**C00TY050M

Female - Face view



Female - Face view



Refer to Balluff Catalog for additional cable connectors.

BALLUFF

MICROPULSE Linear Position Transducers

Enhanced Magnetostrictive Technology

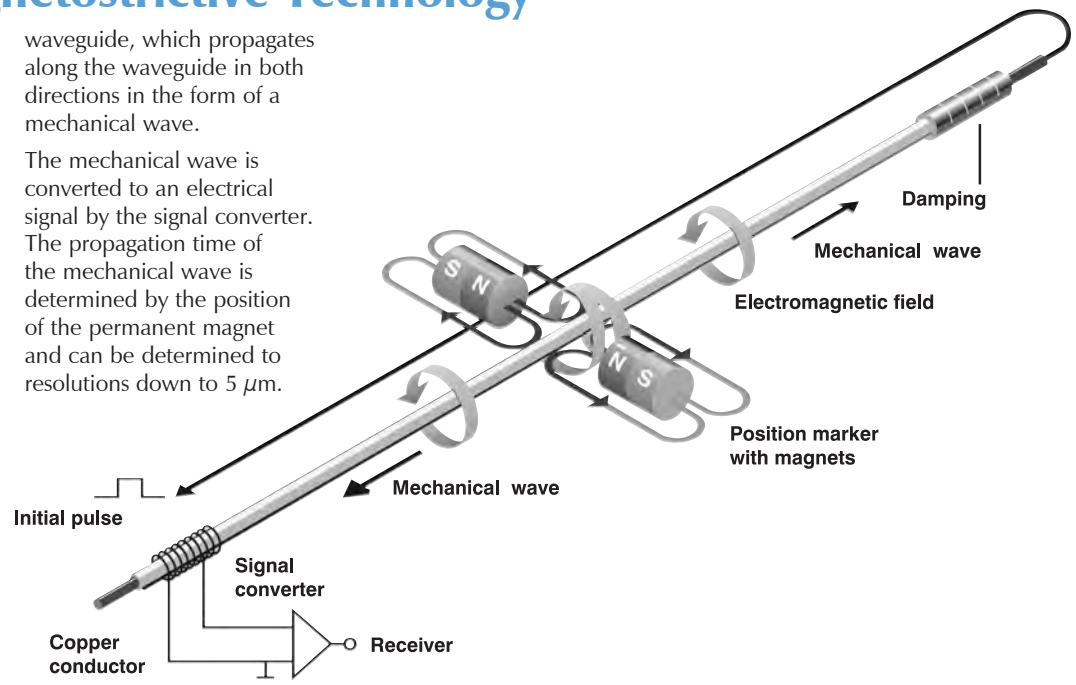
The waveguide consists of a special nickel-iron alloy with 0.7 mm O.D. and 0.5 mm I.D.

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.

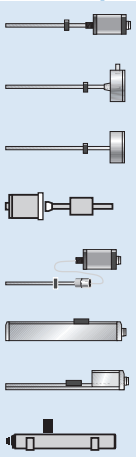
A permanent magnet at the point of measurement is used as the marker element, whose lines of field run at right angles to the electromagnetic field.

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.



MICROPULSE



Balluff has the right transducer for any application!

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

Rod Style

Z

- 3/4″-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
- 3/4″-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

	Z	W	K
Sensor Output Options			
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-**W**idth **M**odulated, RS422	•	•	•
PWM (w/ recirculation), RS422	•	•	•
Specialized			
Synchronous **S**erial **I**nterface*	•	•	•
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"
Wiring Options			
Quick disconnect	•	•	•
Cable-out	•	•	•
Operating Voltage			
24 V DC (±20%)	•	•	•
±15 V DC (±2%)	•	•	•

*(24 or 25 bit binary or gray code)

Switches
Switch & Bracket Dimensions
Switches - How to Order
STROKEMASTER
Balluff Transducers
Options Page 171
Accessories Page 208
Technical Data Page 259

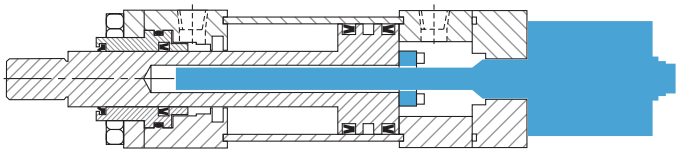
BALLUFF TRANSDUCERS

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)

- Not available on MP1 and MP2 Mounts
- 1.50″ to 8″ Bores
- Gun-drilled piston rod (Requires 1″ piston rod or larger)
- Balluff Magnet (Installed on piston)
- May require additional cap length

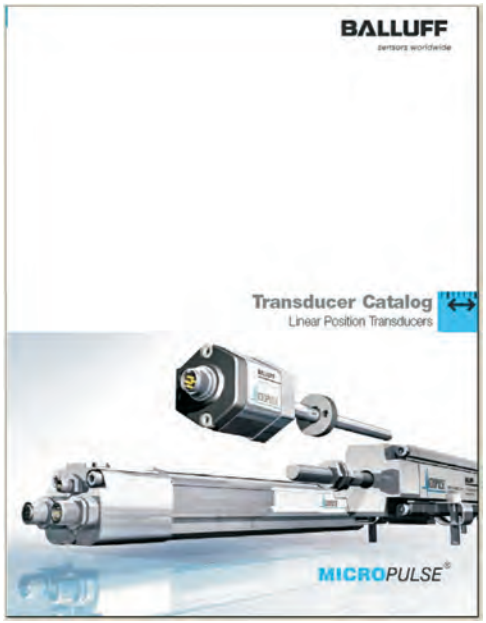
SERIES "Z" SHOWN

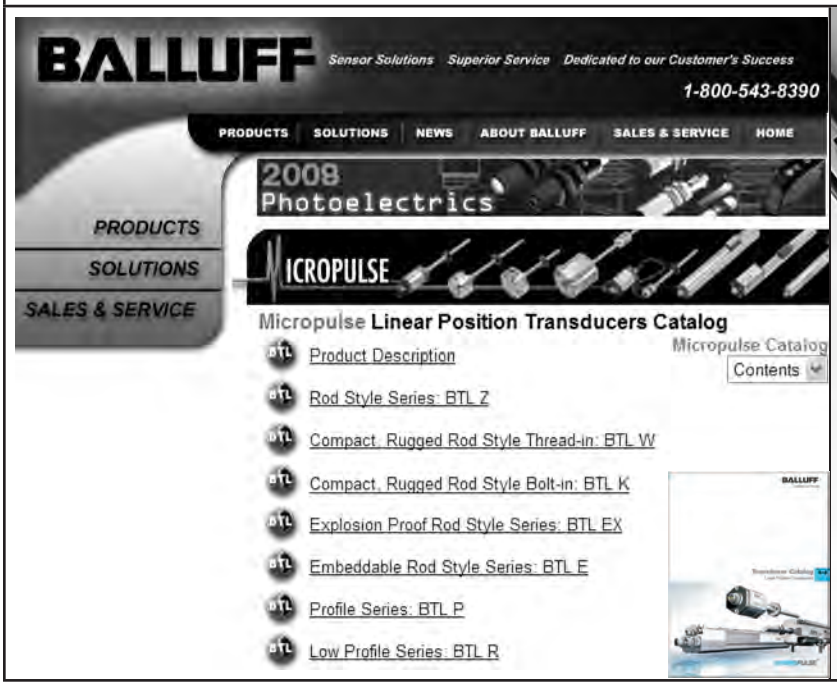


- Complete BALLUFF MICROPULSE™ Transducer information is available in catalog form or electronic PDF downloads.

  Visit www.balluff.com

- Other Balluff models are available. Call TRD Mfg. (800-654-2535) for information and cylinder design assistance.

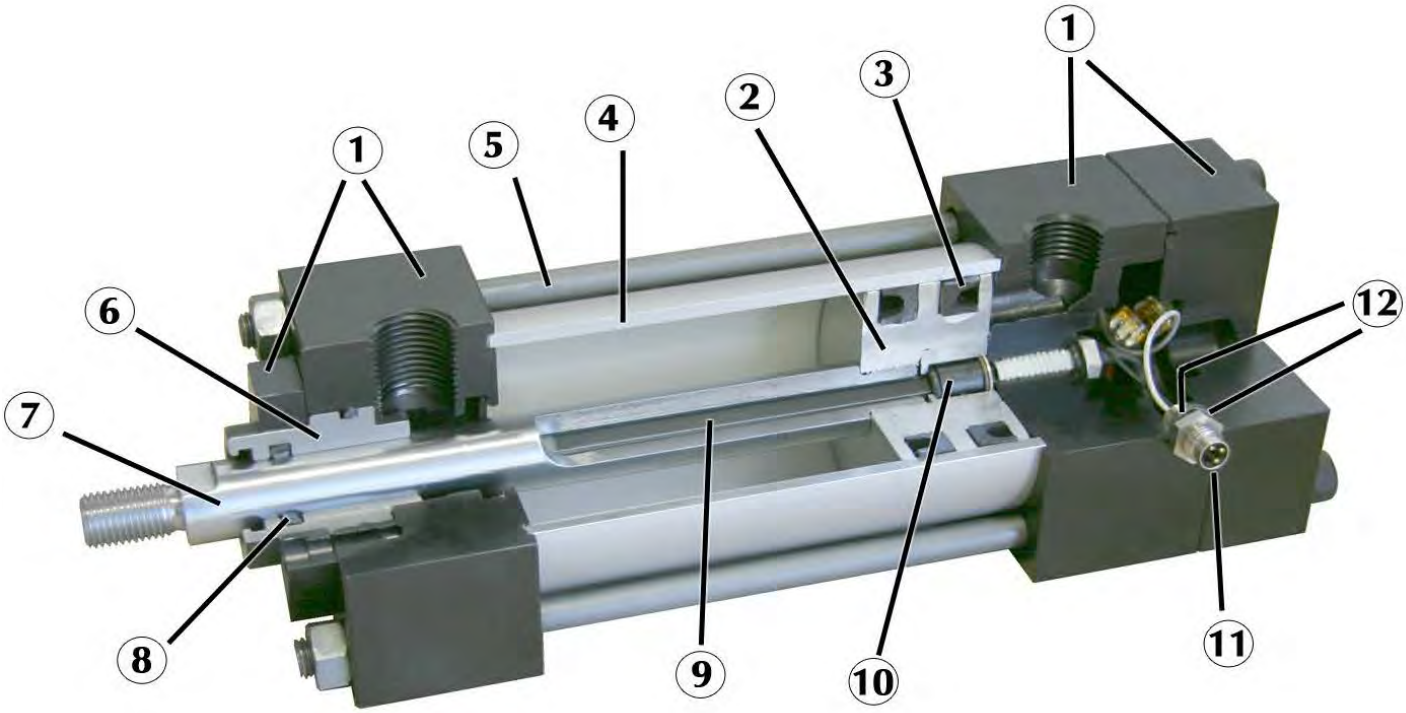




PFLF Series
POSITION FEEDBACK
Aluminum Cylinders
1.50″ to 8.00″ Bore

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

POSITION FEEDBACK LOW FRICTION (PFLF) CYLINDER



① ***HEAD, CAP & RETAINER*** – Precision machined from high strength 6061-T6 aluminum alloy. Black anodized for corrosion resistance.

② ***PISTON*** – Precision machined from high strength aluminum alloy for light weight and extended cycle life.

③ ***PISTON SEALS*** – Seals are low friction and packed with special low friction non-migrating Teflon® based grease for permanent lubrication. Lip seals are pressure activated and wear compensating.

④ ***CYLINDER TUBE*** – Precision machined from 6063-T832 high tensile aluminum alloy and hard coat to 60 Rc for wear resistance and extended cycle life.

⑤ ***TIE RODS*** – Pre-stressed tie rod construction eliminates axial loading of cylinder tube and maintains compression on tube end seals.

⑥ ***BEARING*** – Precision machined from graphite filled cast iron and Teflon® coated to reduce friction and extend cycle life. Design allows increased lubrication in effective bearing area.

⑦ ***PISTON ROD*** – Precision machined from high yield, polished and chrome plated steel.

⑧ ***ROD SEAL*** – Seals are low friction and packed with special low friction non-migrating Teflon® based grease for permanent lubrication. Lip seals are pressure activated and wear compensating (rod wiper is omitted unless requested–see options note on performance).

⑨ ***LINEAR RESISTIVE TRANSDUCER (LRT) PROBE*** – The LRT probe is an anodized aluminum probe with Delrin® threaded flange, o-ring and back-up washer. The probe has infinite resolution, nonlinearity of ± 1 percent of full stroke and a rated life of 10 million cycles. Typical probe input is 10 VDC, input impedance required is 1 Mohm with a temperature rating of 0 ° to +200 °F.

⑩ ***LINEAR RESISTIVE TRANSDUCER (LRT) WIPER*** – The LRT wiper is completely assembled precision molded assembly with a rated life of 1000 linear miles.

⑪ ***THREE PIN CONNECTOR*** - This connector is supplied on all PFLF cylinders. The connector has a universal 8mm (3) pin DIN male connection.

⑫ ***O-RINGS*** - To provide a positive seal to prevent any contaminates or liquids from entering cylinder cavity and affecting cylinder performance.

Features of the PFLF Cylinder

- Continuous Position Sensing
- Highly Accurate: Infinite resolution, linearity of ± 1 percent of full stroke, ± .001″ mechanical repeatability
- Strokes up to 24″
- Easily Repairable
- Electronic Controllers available for dual set point and scalable analog output applications.
- Closed Loop Pneumatic Control Systems (PCS) available for 1.50″ through 4.00″ bores.
- Permanently Lubricated Seals
- Quick Connect (IP67) Standard on all models.

HOW TO ORDER: POSITION FEEDBACK LOW FRICTION (PFLF)

PFLF - MS4 - 4.00 x 10 - KK3 - MPR

SERIES	
PFLF	ANODIZED ALUMINUM

NFPA MOUNTS	
MX0	NO MOUNT (1.50"- 8.00" Bore)
MP1	REAR PIVOT CLEVIS (1.50"- 8.00" Bore)
MP2	REAR PIVOT CLEVIS (1.50"- 6.00" Bore)
MP4	REAR PIVOT EYE (1.50"- 4.00" Bore)
MT1	FRONT TRUNNION (1.50"- 8.00" Bore)
MT2	REAR TRUNNION (1.50"- 8.00" Bore)
MT4	INTERMEDIATE TRUNNION (1.50"- 8.00" Bore)
MX3	EXTENDED TIE-RODS (HEAD) (1.50"- 8.00" Bore)
MF1	FRONT FLANGE (1.50"- 6.00" Bore)
MF2	REAR FLANGE (1.50"- 6.00" Bore)
ME3	FRONT MOUNTING HOLES (8.00" Bore)
MS1	FRONT & REAR END FOOT (1.50"- 8.00" Bore)
MS2	SIDE LUG (1.50"- 4.00" Bore Standard 5.00"- 8.00" Consult Factory)
MS4	BOTTOM TAPPED HOLES (1.50"- 8.00" Bore)

BORE	
1.50	2.00
2.50	3.25
4.00	5.00
6.00	8.00

STROKE
2"-24"(1.50" - 2.50")
3"-24" (3.25" - 8.00")

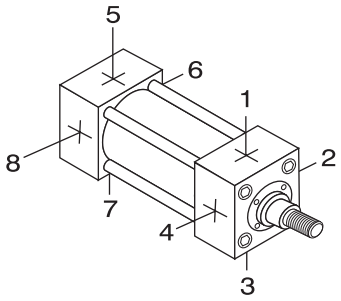
CYLINDER OPTIONS	
B*	.25" URETHANE BUMPER BOTH ENDS
BC*	.25" URETHANE BUMPER CAP ONLY
BH*	.25" URETHANE BUMPER HEAD ONLY
A =	EXTENDED PISTON ROD THREAD - SPECIFY (Example: A = 2")
C =	EXTENDED PISTON ROD - SPECIFY (Example: C = 1.5")
EN	ELECTROLESS NICKEL PLATED
KK2	LARGE MALE ROD THREAD
KK3	FEMALE ROD THREAD
KK4	FULL DIAMETER MALE ROD THREAD
MPR	MAGNETIC PISTON FOR REED SWITCHES
MPH	MAGNETIC PISTON FOR HALL SWITCHES
OP	OPTIONAL PORT LOCATION - SPECIFY (Example: Ports @ 3 & 7)
XX	SPECIAL VARIATIONS (SPECIFY)

*URETHANE BUMPERS ADD .25" PER END OF CYLINDER

OPTIONS AVAILABLE BUT NOT RECOMMENDED (WILL AFFECT CYLINDER PERFORMANCE)	
B*	.25" URETHANE BUMPER BOTH ENDS
H	HEAD CUSHION
MS	METALLIC ROD SCRAPER
RW	ROD WIPER

STANDARD PORT POSITIONS AND FEEDBACK CABLE CONNECTOR POSITIONS

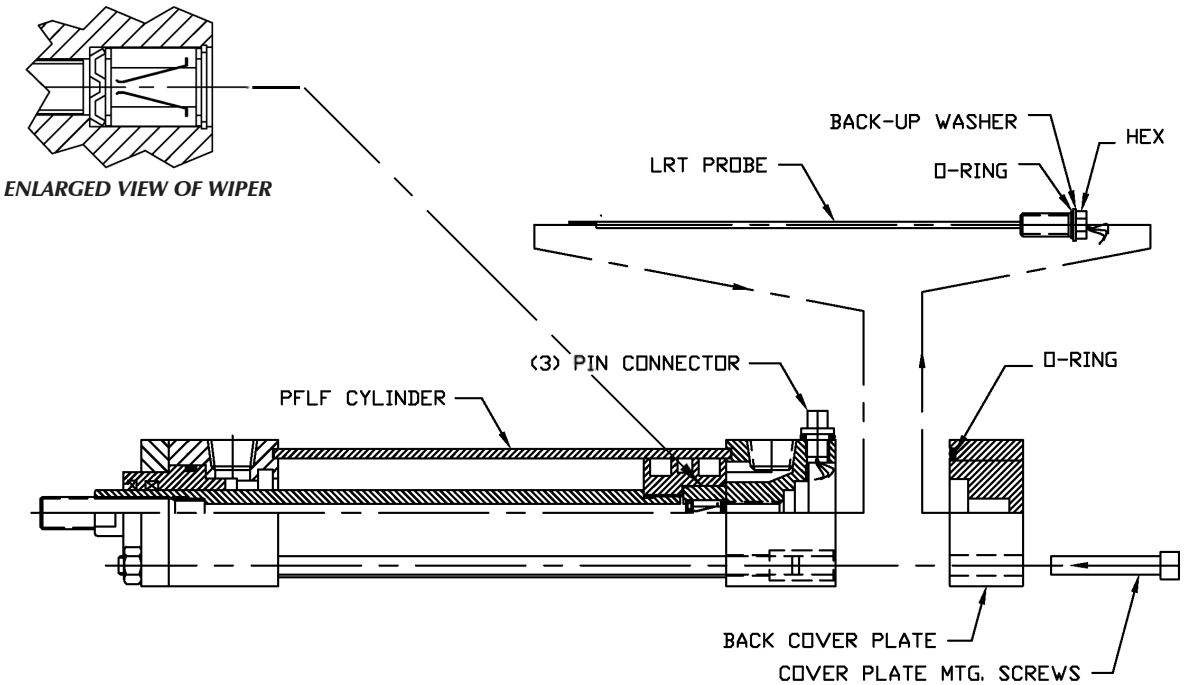
- Ports - Positions 1 and 5
- Cushion Adjustment - Positions 2 and 6
- Specify Non-Standard Positions When Ordering



PFLF MOUNTS

MX0 1.50"-8.00" Bores	**MS4** 1.50"-8.00" Bores	**MP1** 1.50"-8.00" Bores	**MP2** 1.50"-6.00" Bores	**MP4** 1.50"-4.00" Bores
MT1 1.50"-8.00" Bores	**MT2** 1.50"-8.00" Bores	**MT4** 1.50"-8.00" Bores	**MF1** 1.50"-6.00" Bores	**MF2** 1.50"- 6.00" Bores
MX3 1.50"-8.00" Bores	**MS1** 1.50"-8.00" Bores	**MS2** 1.50"-4.00" Bores *Consult factory for larger size.*	**ME3** 8.00" Bore	

POSITION FEEDBACK LOW FRICTION (PFLF) CYLINDER:
HOW IT WORKS



The Position Feedback Cylinder contains a Linear Resistive Transducer (LRT) or potentiometer mounted in the cylinder rear head. The LRT probe, which has a resistive element on one side and a collector strip on the other, is inside the cylinder rod. A wiper assembly is installed in the piston. As the piston moves, an electrical circuit is created between the resistive element and collector strip. The resulting voltage is directed externally via wiring. The output voltage is proportional to the wiper position on the resistive element, which allows the cylinder position to be determined.

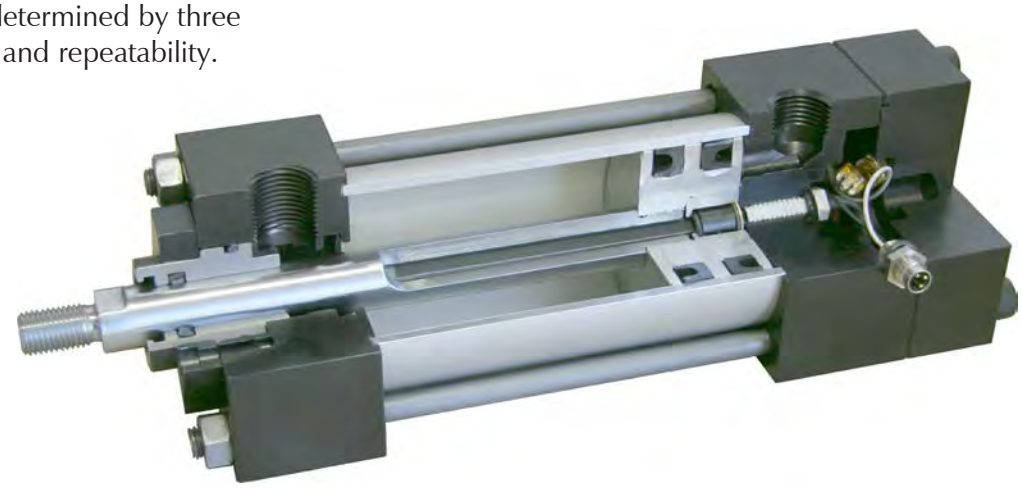
For example, in a 12-inch stroke cylinder, if the output voltage is 0 VDC when fully retracted and 10 VDC when fully extended, voltage readings of 2.5 and 5.833 VDC would indicate cylinder extensions of three inches and seven inches.

The accuracy of an LRT is determined by three factors: resolution, linearity and repeatability.

Resolution refers to the smallest change that can be detected on the LRT. The LRT has infinite resolution and can be divided into as many parts as the electronics allow. For example, with a 12-bit, 4096-part controller, the stroke could be divided into 4096 equal parts. When 10 VDC is placed on a 10″ cylinder, the smallest detectable increment would be 10 VDC ÷ 4096 = 2.4 millivolts or 0.0024″. Resolution is stroke sensitive (i.e. the longer the stroke, the less resolution).

Linearity refers to the maximum deviation of the output voltage to a straight line. The LRT's linearity is ± 1 percent of stroke.

Repeatability is the ability of the LRT to provide the same output voltage relative to a unique cylinder position each time the cylinder is cycled. Mechanical repeatability of the TRD Position Feedback Cylinder is ± 0.001″.



POSITION FEEDBACK LOW FRICTION CYLINDER: DIMENSIONS

About Rod End Styles

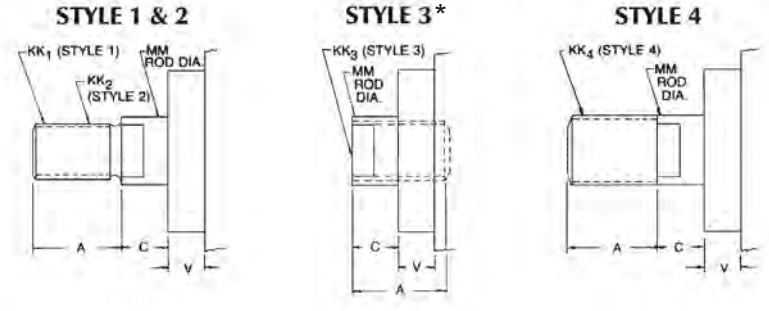
Style 1 Male Rod End is STANDARD

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).

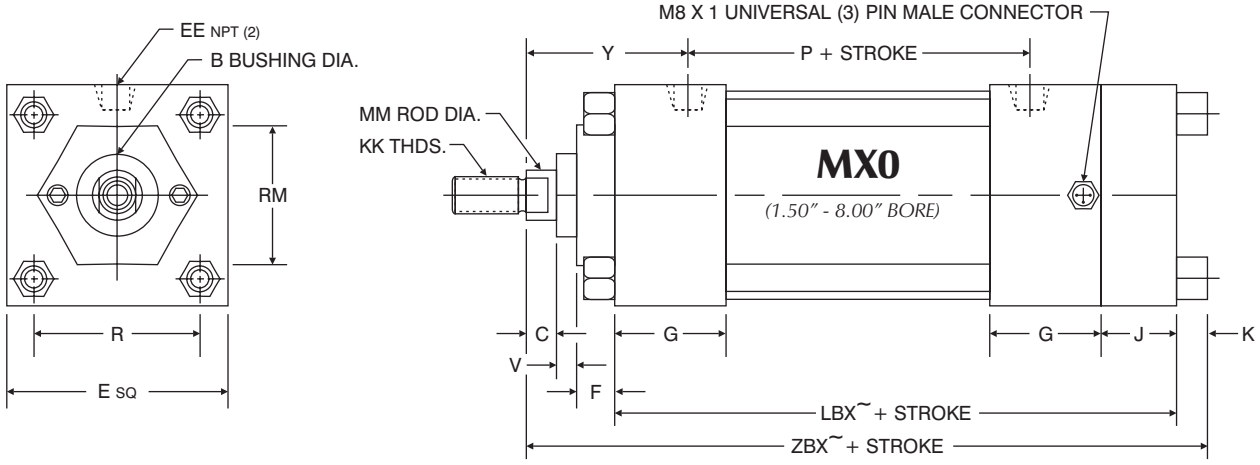
NEED SOMETHING NOT LISTED?
Just send us a sketch.
In most cases, quotes are turned around in one day!

PISTON ROD END STYLES



BORE	MM ROD DIAMETER	STANDARD Style 1 - Male KK1	STANDARD Style 1 - Male A	OPTIONAL Style 2 - Male KK2	OPTIONAL Style 2 - Male A	OPTIONAL Style 3 - Female KK3	OPTIONAL Style 3 - Female A	OPTIONAL Style 4 - Male KK4	OPTIONAL Style 4 - Male A	C	V
1.50, 2.00, 2.50	0.625	7/16-20	0.750	1/2-20	0.750	7/16-20	0.750	5/8-18	0.750	0.375	0.250
3.25, 4.00, 5.00	1.000	3/4-16	1.125	7/8-14	1.125	3/4-16	1.125	1-14	1.125	0.500	0.250
6.00 & 8.00	1.375	1-14	1.625	1 1/4-12	1.625	1-14	1.625	1 3/8-12	1.625	0.625	0.375

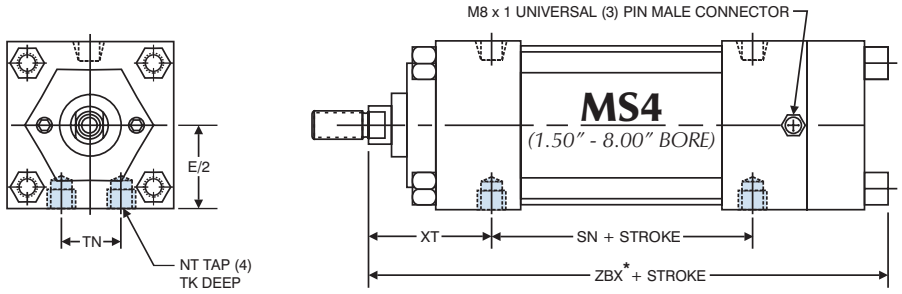
* KK (Style 3 - Female) will have a recessed plug due to through hole in rod.



'MX0' PFLF CYLINDER DIMENSIONS - STANDARD ROD ONLY																			
BORE	ROD DIAMETER	A	B	C	E	EE	F	G	J	K	KK	LBX~	MM	P	R	RM	V	Y	ZBX~
1.50	0.625	0.750	1.125	0.375	2.000	0.375	0.375	1.500	1.000	0.250	7/16-20	5.125	0.625	2.375	1.430	2.000 SQ.	0.250	1.875	6.375~
2.00	0.625	0.750	1.125	0.375	2.500	0.375	0.375	1.500	1.000	0.313	7/16-20	5.125	0.625	2.375	1.840	1.750 Hex	0.250	1.875	6.438~
2.50	0.625	0.750	1.125	0.375	3.000	0.375	0.375	1.500	1.000	0.313	7/16-20	5.250	0.625	2.500	2.190	1.750 Hex	0.250	1.875	6.563~
3.25	1.000	1.125	1.500	0.500	3.750	0.500	0.625	1.750	1.250	0.375	3/4-16	6.000	1.000	2.750	2.760	2.750*	0.250	2.375	7.750~
4.00	1.000	1.125	1.500	0.500	4.500	0.500	0.625	1.750	1.250	0.375	3/4-16	6.000	1.000	2.750	3.320	2.750*	0.250	2.375	7.750~
5.00	1.000	1.125	1.500	0.500	5.500	0.500	0.625	1.750	1.250	0.500	3/4-16	6.250	1.000	3.000	4.100	2.750*	0.250	2.375	8.125~
6.00	1.375	1.625	2.000	0.625	6.500	0.750	0.625	2.000	1.500	0.500	1-14	7.000	1.375	3.250	4.880	3.500*	0.375	2.750	9.125~
8.00	1.375	1.625	2.000	0.625	8.500	0.750	0.625	2.000	1.500	0.625	1-14	7.125	1.375	3.375	6.440	3.500*	0.375	2.750	9.375~

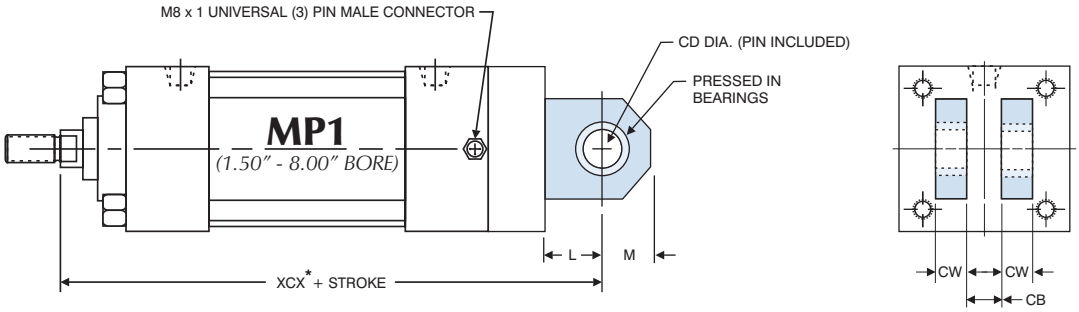
* RM dimension is round retainer diameter
~ NON-NFPA Dimensions

POSITION FEEDBACK LOW FRICTION CYLINDER: DIMENSIONS



'MS4' PFLF CYLINDER DIMENSIONS - STANDARD ROD ONLY								
							ADD STROKE	
BORE	ROD DIAMETER	E/2	NT	TK	TN	XT	SN	ZBX*
1.50	0.625 Standard	1.000	1/4-20	0.375	0.625	1.938	2.250	6.375
2.00	0.625 Standard	1.250	5/16-18	0.500	0.875	1.938	2.250	6.438
2.50	0.625 Standard	1.500	3/8-16	0.625	1.250	1.938	2.375	6.563
3.25	1.000 Standard	1.875	1/2-13	0.750	1.500	2.438	2.625	7.750
4.00	1.000 Standard	2.250	1/2-13	0.750	2.063	2.438	2.625	7.750
5.00	1.000 Standard	2.750	5/8-11	1.000	2.688	2.438	2.875	8.125
6.00	1.375 Standard	3.250	3/4-10	1.125	3.250	2.813	3.125	9.125
8.00	1.375 Standard	4.250	3/4-10	1.125	4.500	2.813	3.250	9.375

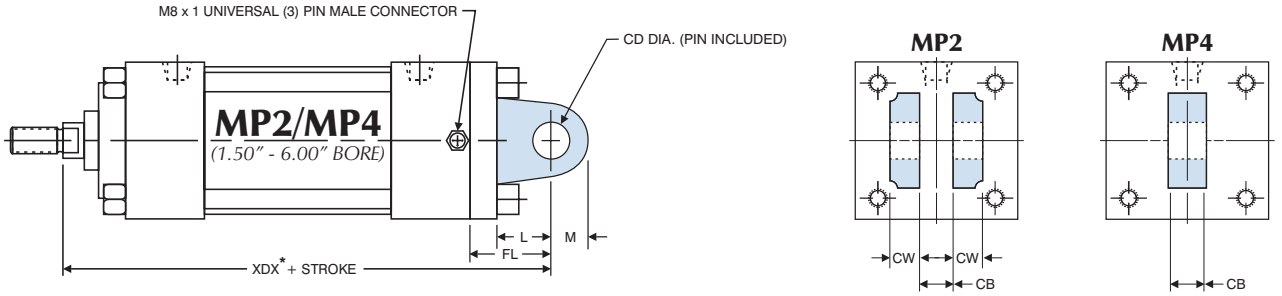
NOTE: All cylinder dimensions not shown are standard 'MX0' cylinder dimensions.
* NON-NFPA Dimensions



'MP1' PFLF CYLINDER DIMENSIONS - STANDARD ROD ONLY							
							ADD STROKE
BORE	ROD DIAMETER	CB	CD	CW	L	M	XCX*
1.50	0.625 Standard	0.750	0.500	0.500	0.750	0.625	6.875
2.00	0.625 Standard	0.750	0.500	0.500	0.750	0.625	6.875
2.50	0.625 Standard	0.750	0.500	0.500	0.750	0.625	7.000
3.25	1.000 Standard	1.250	0.750	0.625	1.250	0.875	8.625
4.00	1.000 Standard	1.250	0.750	0.625	1.250	0.875	8.625
5.00	1.000 Standard	1.250	0.750	0.625	1.250	0.875	8.875
6.00	1.375 Standard	1.500	1.000	0.750	1.500	1.000	10.125
8.00	1.375 Standard	1.500	1.000	0.750	1.500	1.000	10.250

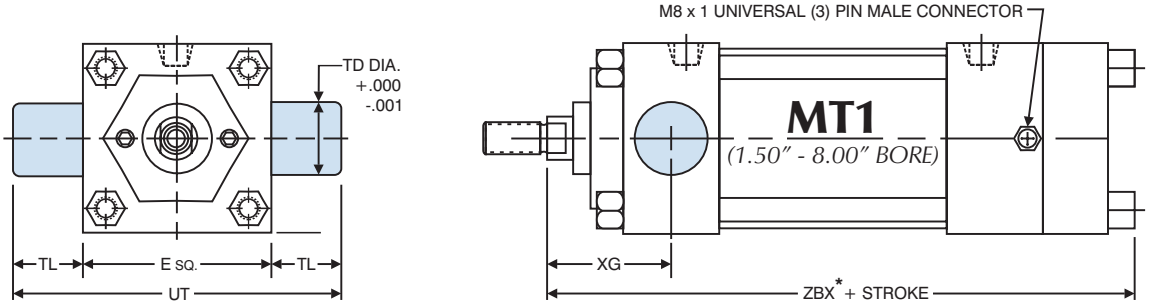
NOTE: All cylinder dimensions not shown are standard 'MX0' cylinder dimensions.
1.50" & 2.00" bore MP1 extruded mounts are through tie rod construction.
2.50" bore and larger the rear MP1 cap is bolted on.
* NON-NFPA Dimensions

POSITION FEEDBACK LOW FRICTION CYLINDER: DIMENSIONS



'MP2' & 'MP4' CAST PFLF CYLINDER DIMENSIONS - STANDARD ROD ONLY								
BORE	ROD DIAMETER	CB	CD	CW	L	M	FL	ADD STROKE XDX*
1.50	0.625 Standard	0.750	0.500	0.500	0.750	0.625	1.125	6.250
2.00	0.625 Standard	0.750	0.500	0.500	0.750	0.625	1.125	6.250
2.50	0.625 Standard	0.750	0.500	0.500	0.750	0.625	1.125	6.375
3.25	1.000 Standard	1.250	0.750	0.625	1.250	0.875	1.875	8.000
4.00	1.000 Standard	1.250	0.750	0.625	1.250	0.875	1.875	8.000
5.00	1.000 Standard	1.250	0.750	0.625	1.250	0.875	1.875	8.250
6.00	1.375 Standard	1.500	1.000	0.750	1.500	1.000	2.250	9.375

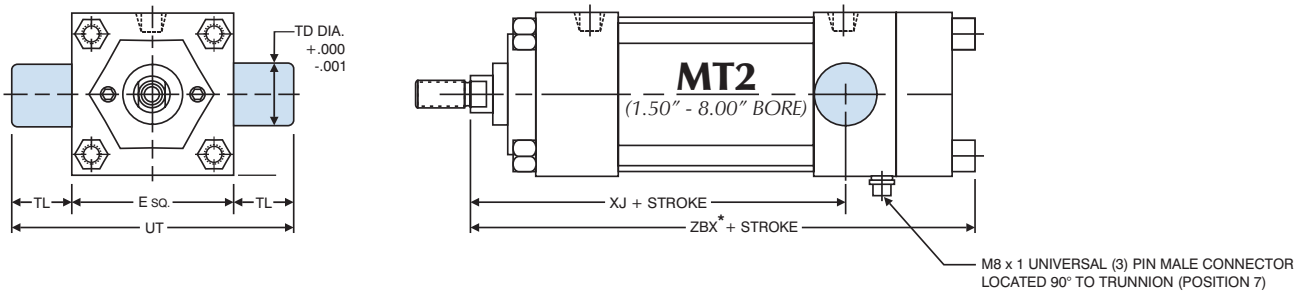
NOTE: All cylinder dimensions not shown are standard 'MX0' cylinder dimensions.
MP4 CAST MOUNT not available for 5.00" & 6.00" bores.
Special WELDED MOUNTS are available. Consult factory for more information.
* NON-NFPA Dimensions



'MT1' PFLF CYLINDER DIMENSIONS - STANDARD ROD ONLY							
BORE	ROD DIAMETER	E	TD	TL	UT	XG	ADD STROKE ZBX*
1.50	0.625 Standard	2.000	1.000	1.000	4.000	1.750	6.375
2.00	0.625 Standard	2.500	1.000	1.000	4.500	1.750	6.438
2.50	0.625 Standard	3.000	1.000	1.000	5.000	1.750	6.563
3.25	1.000 Standard	3.750	1.000	1.000	5.750	2.250	7.750
4.00	1.000 Standard	4.500	1.000	1.000	6.500	2.250	7.750
5.00	1.000 Standard	5.500	1.000	1.000	7.500	2.250	8.125
6.00	1.375 Standard	6.500	1.375	1.375	9.250	2.625	9.125
8.00	1.375 Standard	8.500	1.375	1.375	11.250	2.625	9.375

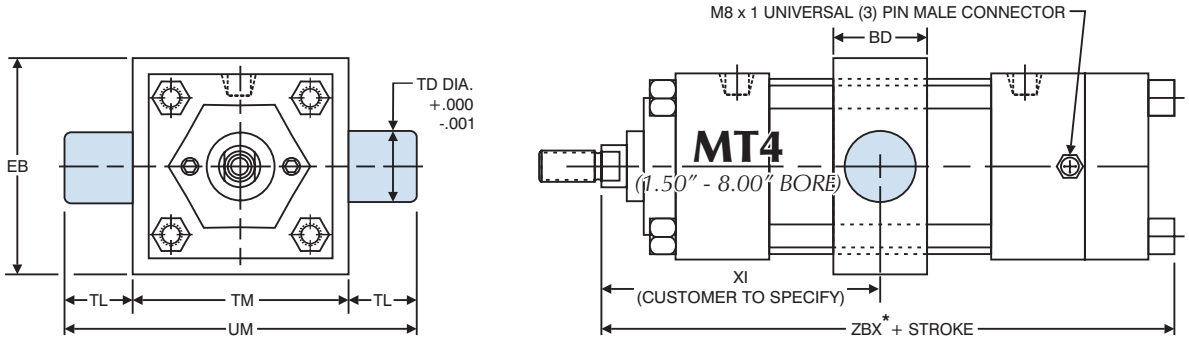
NOTE: All cylinder dimensions not shown are standard 'MX0' cylinder dimensions.
* NON-NFPA Dimensions

POSITION FEEDBACK LOW FRICTION CYLINDER: DIMENSIONS



'MT2' PFLF CYLINDER DIMENSIONS - STANDARD ROD ONLY							
BORE	ROD DIAMETER	E	TD	TL	UT	XJ	ADD STROKE ZBX*
1.50	0.625 Standard	2.000	1.000	1.000	4.000	4.125	6.375
2.00	0.625 Standard	2.500	1.000	1.000	4.500	4.125	6.438
2.50	0.625 Standard	3.000	1.000	1.000	5.000	4.250	6.563
3.25	1.000 Standard	3.750	1.000	1.000	5.750	5.000	7.750
4.00	1.000 Standard	4.500	1.000	1.000	6.500	5.000	7.750
5.00	1.000 Standard	5.500	1.000	1.000	7.500	5.250	8.125
6.00	1.375 Standard	6.500	1.375	1.375	9.250	5.875	9.125
8.00	1.375 Standard	8.500	1.375	1.375	11.250	6.000	9.375

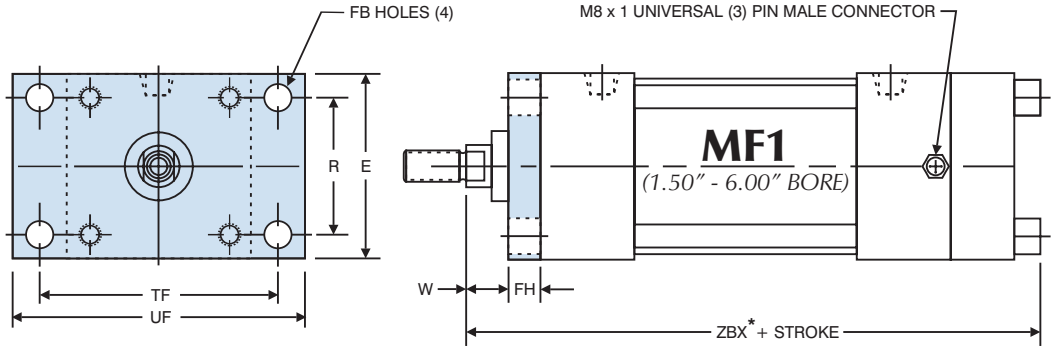
NOTE: All cylinder dimensions not shown are standard 'MX0' cylinder dimensions.
* NON-NFPA Dimensions



'MT4' PFLF CYLINDER DIMENSIONS - STANDARD ROD ONLY									
BORE	ROD DIAMETER	BD	EB	TD	TL	TM	UM	XI	ADD STROKE ZBX*
1.50	0.625 Standard	1.250	2.500	1.000	1.000	2.500	4.500	CUSTOMER TO SPECIFY	6.375
2.00	0.625 Standard	1.500	3.000	1.000	1.000	3.000	5.000		6.438
2.50	0.625 Standard	1.500	3.500	1.000	1.000	3.500	5.500		6.563
3.25	1.000 Standard	2.000	4.250	1.000	1.000	4.500	6.500		7.750
4.00	1.000 Standard	2.000	5.000	1.000	1.000	5.250	7.250		7.750
5.00	1.000 Standard	2.000	6.000	1.000	1.000	6.250	8.250		8.125
6.00	1.375 Standard	2.000	7.000	1.375	1.375	7.625	10.375		9.125
8.00	1.375 Standard	2.500	9.500	1.375	1.375	9.750	12.500		9.375

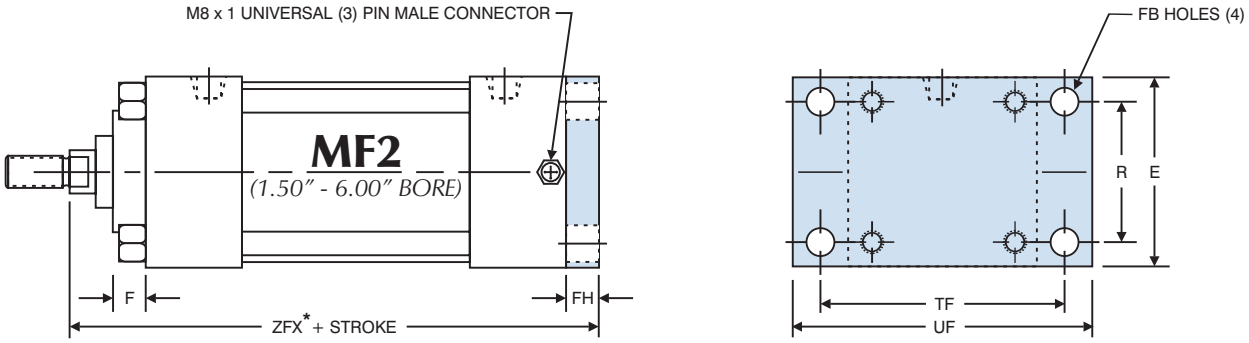
NOTE: All cylinder dimensions not shown are standard 'MX0' cylinder dimensions.
* NON-NFPA Dimensions

POSITION FEEDBACK LOW FRICTION CYLINDER: DIMENSIONS



'MF1' PFLF CYLINDER DIMENSIONS - STANDARD ROD ONLY									
BORE	ROD DIAMETER	E	FB	FH	R	TF	UF	W	ADD STROKE ZBX*
1.50	0.625 Standard	2.000	0.313	0.375	1.430	2.750	3.375	0.625	6.375
2.00	0.625 Standard	2.500	0.375	0.375	1.840	3.375	4.125	0.625	6.438
2.50	0.625 Standard	3.000	0.375	0.375	2.190	3.875	4.625	0.625	6.563
3.25	1.000 Standard	3.750	0.438	0.625	2.760	4.688	5.500	0.750	7.750
4.00	1.000 Standard	4.500	0.438	0.625	3.320	5.438	6.250	0.750	7.750
5.00	1.000 Standard	5.500	0.563	0.625	4.100	6.625	7.625	0.750	8.125
6.00	1.375 Standard	6.500	0.563	0.750	4.880	7.625	8.625	0.875	9.125

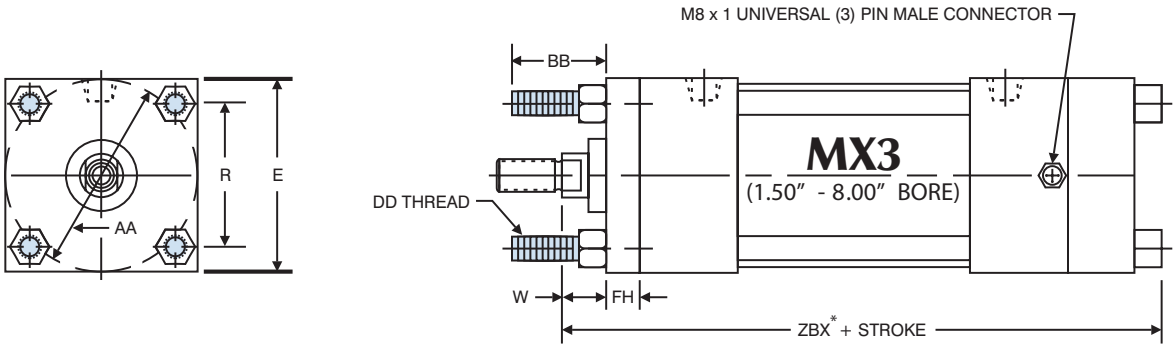
NOTE: All cylinder dimensions not shown are standard 'MX0' cylinder dimensions.
* NON-NFPA Dimensions



'MF2' PFLF CYLINDER DIMENSIONS - STANDARD ROD ONLY									
BORE	ROD DIAMETER	E	FB	FH	R	TF	UF	F	ADD STROKE ZFX*
1.50	0.625 Standard	2.000	0.313	0.375	1.430	2.750	3.375	0.375	5.500
2.00	0.625 Standard	2.500	0.375	0.375	1.840	3.375	4.125	0.375	5.500
2.50	0.625 Standard	3.000	0.375	0.375	2.190	3.875	4.625	0.375	5.625
3.25	1.000 Standard	3.750	0.438	0.625	2.760	4.688	5.500	0.625	6.750
4.00	1.000 Standard	4.500	0.438	0.625	3.320	5.438	6.250	0.625	6.750
5.00	1.000 Standard	5.500	0.563	0.625	4.100	6.625	7.625	0.625	7.000
6.00	1.375 Standard	6.500	0.563	0.750	4.880	7.625	8.625	0.625	7.875

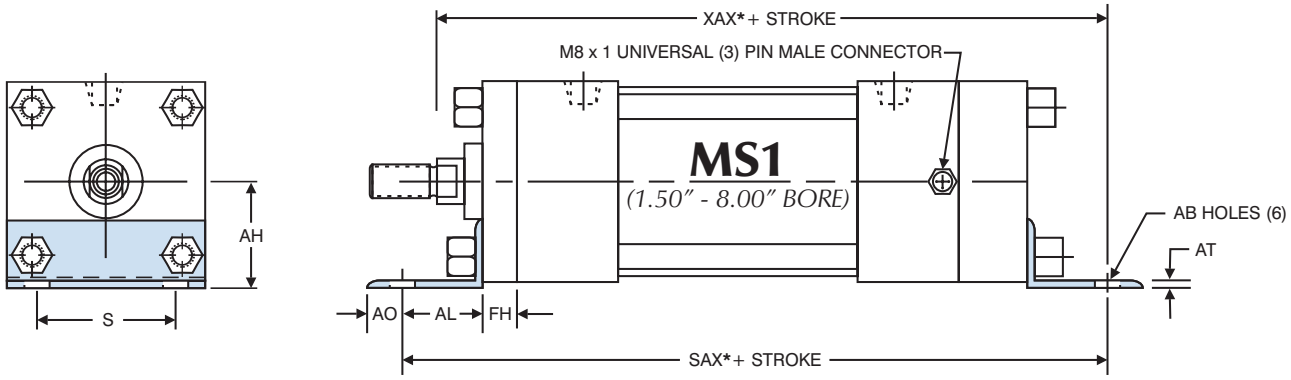
NOTE: All cylinder dimensions not shown are standard 'MX0' cylinder dimensions.
* NON-NFPA Dimensions

POSITION FEEDBACK LOW FRICTION CYLINDER: DIMENSIONS



'MX3' PFLF CYLINDER DIMENSIONS - STANDARD ROD ONLY									
									ADD STROKE
BORE	ROD DIAMETER	E	FH	R	AA	BB	DD	W	ZBX*
1.50	0.625 Standard	2.000	0.375	1.430	2.020	1.000	1/4-28	0.625	6.375
2.00	0.625 Standard	2.500	0.375	1.840	2.600	1.125	5/16-24	0.625	6.438
2.50	0.625 Standard	3.000	0.375	2.190	3.100	1.125	5/16-24	0.625	6.563
3.25	1.000 Standard	3.750	0.625	2.760	3.900	1.375	3/8-24	0.750	7.750
4.00	1.000 Standard	4.500	0.625	3.320	4.700	1.375	3/8-24	0.750	7.750
5.00	1.000 Standard	5.500	0.625	4.100	5.800	1.813	1/2-20	0.750	8.125
6.00	1.375 Standard	6.500	0.750	4.880	6.900	1.813	1/2-20	0.875	9.125
8.00	1.375 Standard	8.500	0.625**	6.440	9.100	2.313**	5/8-18	1.625	9.375

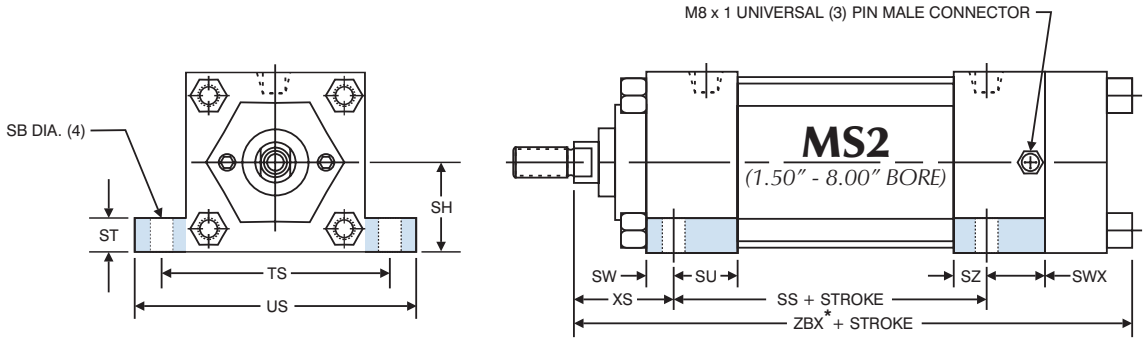
NOTE: All cylinder dimensions not shown are standard 'MX0' cylinder dimensions.
* NON-NFPA Dimensions
** 8.00" Bore has round retainer, not a full square retainer as smaller bores.
"BB" dimension is from head.



'MS1' PFLF CYLINDER DIMENSIONS - STANDARD ROD ONLY										
									ADD STROKE	
BORE	ROD DIAMETER	AB	AH	AL	AO	AT	FH	S	SAX*	XAX*
1.50	0.625 Standard	0.438	1.188	1.000	0.375	0.125	0.375	1.250	7.500	7.125
2.00	0.625 Standard	0.438	1.438	1.000	0.375	0.125	0.375	1.750	7.500	7.125
2.50	0.625 Standard	0.438	1.625	1.000	0.375	0.125	0.375	2.250	7.625	7.250
3.25	1.000 Standard	0.563	1.938	1.250	0.500	0.125	0.625	2.750	9.125	8.625
4.00	1.000 Standard	0.563	2.250	1.250	0.500	0.125	0.625	3.500	9.125	8.625
5.00	1.000 Standard	0.688	2.750	1.375	0.625	0.188	0.625	4.250	9.625	9.000
6.00	1.375 Standard	0.813	3.250	1.375	0.625	0.188	0.750	5.250	10.500	10.000
8.00	1.375 Standard	0.813	4.250	1.813	0.688	0.250	0.625**	7.125	10.750	10.563

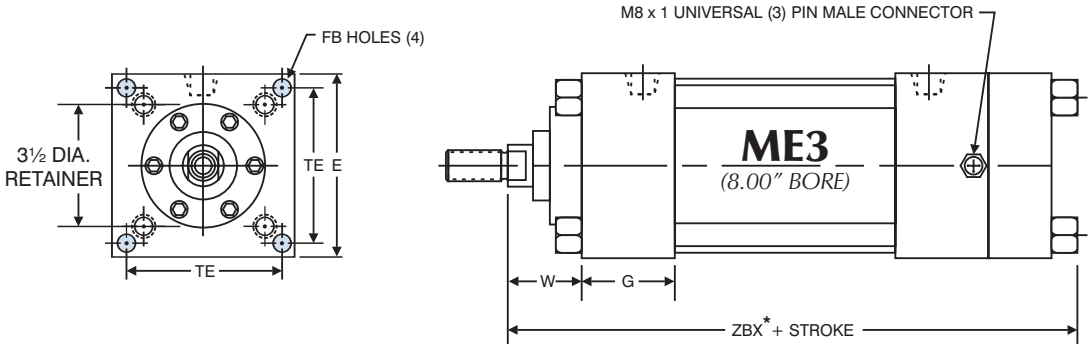
NOTE: All cylinder dimensions not shown are standard 'MX0' cylinder dimensions.
** 8.00" bore cylinders have round retainer, bracket bolted to head.
* NON-NFPA Dimensions

POSITION FEEDBACK LOW FRICTION CYLINDER: DIMENSIONS



'MS2' PFLF CYLINDER DIMENSIONS - STANDARD ROD ONLY													
												ADD STROKE	
BORE	ROD DIAMETER	SB	SH	ST	SU	SW	SZ	TS	US	XS	SWX*	SS	ZBX*
1.50	0.625 Standard	0.438	1.000	0.500	1.125	0.375	0.625	2.750	3.500	1.375	0.875	2.875	6.375
2.00	0.625 Standard	0.438	1.250	0.500	1.125	0.375	0.625	3.250	4.000	1.375	0.875	2.875	6.438
2.50	0.625 Standard	0.438	1.500	0.500	1.125	0.375	0.625	3.750	4.500	1.375	0.875	3.000	6.563
3.25	1.000 Standard	0.563	1.875	0.750	1.250	0.500	0.750	4.750	5.750	1.875	1.000	3.250	7.750
4.00	1.000 Standard	0.563	2.250	0.750	1.250	0.500	0.750	5.500	6.500	1.875	1.000	3.250	7.750
5.00	1.000 Standard	0.813	2.750	1.000	1.063	0.688	0.563	6.875	8.250	2.063	1.188	3.125	8.125
6.00	1.375 Standard	0.813	3.250	1.000	1.313	0.688	0.813	7.875	9.250	2.313	1.188	3.625	9.125
8.00	1.375 Standard	0.813	4.250	1.000	1.313	0.688	0.813	9.875	11.250	2.313	1.188	3.750	9.375

NOTE: All cylinder dimensions not shown are standard 'MX0' cylinder dimensions.
1.50″ - 4.00″ Standard, consult factory for 5.00″ - 8.00″
* NON-NFPA Dimensions



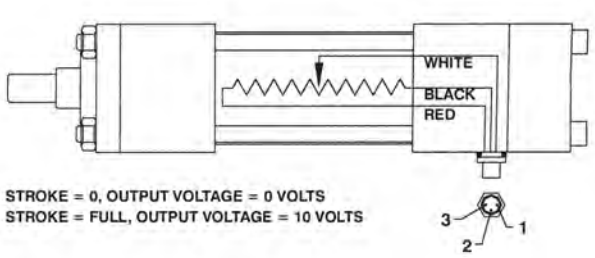
'ME3' PFLF CYLINDER DIMENSIONS - STANDARD ROD ONLY							
							ADD STROKE
BORE	ROD DIAMETER	E	TE	W	G	FB	ZBX*
8.00	1.375 Standard	8.500	7.570	1.625	2.000	0.688	9.375

NOTE: All cylinder dimensions not shown are standard 'MX0' cylinder dimensions.
* NON-NFPA Dimensions

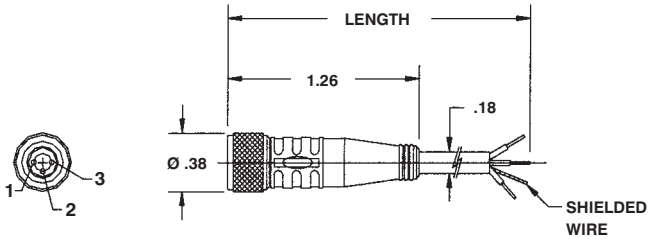
POSITION FEEDBACK LOW FRICTION CYLINDER: SPECIFICATIONS

Repeatability:	**±.001″ Cylinder Only** Refer to specifications in the following sections for positioning or measuring repeatability. Power supply ripple and A/D error will reduce repeatability when PFLF is utilized with industrial control systems.
Nonlinearity:	**± 1% of full stroke**
Resolution:	**Infinite**
Signal Input:	**10 VDC typical**
Input Impedance Required:	**1 MOhm**
Signal output:	**> 0 to slightly less than FS signal input** (The internal electrical stroke is slightly larger than the mechanical stroke of the cylinder)
Rated Life of Probe:	**10 million cycles**
Rated Life of Wiper:	**1000 linear miles**
Pressure Rating:	**150 psi**
Temperature Rating: *(Cylinder & Probe)*	**0° to 200°F**
Maximum Speed:	**25 in./sec.**
Interface:	**8mm DIN connector**
NEMA:	**6 (IP67)**

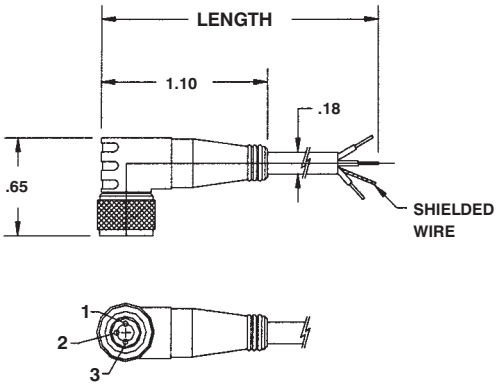
WIRE DESCRIPTION	PROBE/ PLUG WIRE COLORS	PLUG PIN NUMBERS	QUICK CONNECT CABLE/ WIRE COLORS
INPUT (+)	RED	3	BLUE
GROUND (-)	BLACK	2	BLACK
OUTPUT	WHITE	1	BROWN



Straight-Models
C4-S (2m), C4X-S (5m)



Right Angle-Models
C5-S (2m), C5X-S (5m)

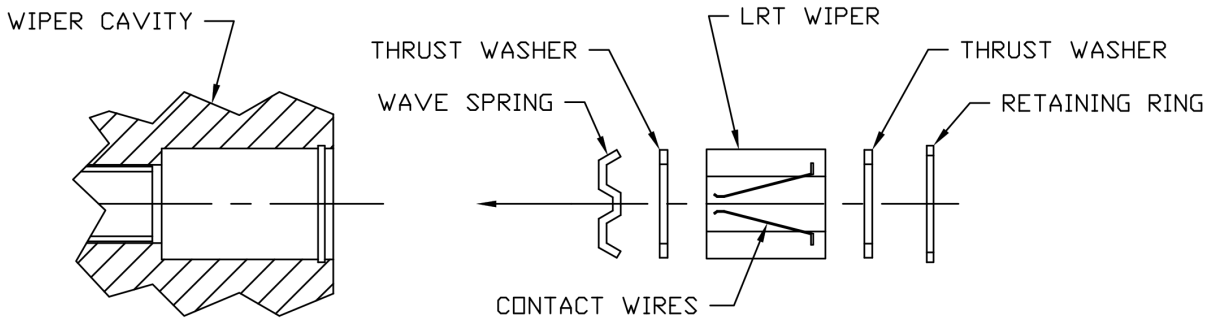


CONDUCTOR COLORS:
1 - BROWN
2 - BLACK
3 - BLUE

Note: All models have a M8 x 1 female thread.

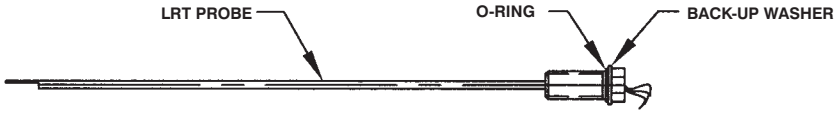
Cable: 24 A.W.G. PVC insulated, fine stranded copper conductors, with Gray PVC jacket with stripped and tinned ends.

POSITION FEEDBACK LOW FRICTION CYLINDER:
COMPONENTS/REPAIR KITS



LRT WIPER REPLACEMENT KIT

PART NUMBER	DESCRIPTION	REMARKS
PFLF-WK	POSITION FEEDBACK WIPER KIT	KIT TO CONSIST OF THE FOLLOWING: (1) WAVE SPRING, (1) LTR WIPER, (1) GUIDE WASHER, (1) RETAINING RING, (3) WIRE CONNECTORS & WIPER/PROBE INSTALLATION INSTRUCTION SHEET

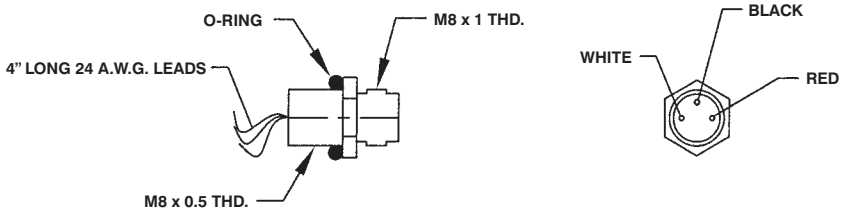


PROBE WIRE COLORS:
RED = SUPPLY (+)
BLACK = GROUND (-)
WHITE = OUTPUT

LRT PROBE REPLACEMENT KIT

PART NUMBER	DESCRIPTION	REMARKS
PFLF-PRK-STROKE	POSITION FEEDBACK PROBE REPLACEMENT KIT	KIT TO CONSIST OF THE FOLLOWING: One (1) LRT PROBE WITH O-RING & BACK-UP WASHER, Three (3) WIRE CONNECTORS & WIPER/PROBE INSTALLATION INSTRUCTION SHEET

Replacement LRT probe ordering example: 8.00" stroke PFLF cylinder, replacement probe would be PART NO. PFLF-PRK-8. Fractional stroke length cylinders use the next whole number. Example: 8.50" stroke replacement probe would be PFLF-PRK-9.



(3) PIN CONNECTOR REPLACEMENT KIT

PART NUMBER	DESCRIPTION	REMARKS
PFLF-CK	POSITION FEEDBACK CONNECTOR KIT	KIT TO CONSIST OF THE FOLLOWING: One (1) 3 PIN CONNECTOR WITH O-RING & Three (3) WIRE CONNECTORS

PFLF BASIC CYLINDER SEAL KITS

BORE	PART NUMBER
1.50	PFLF-SK-625-150
2.00	PFLF-SK-625-200

BORE	PART NUMBER
2.50	PFLF-SK-625-250
3.25	PFLF-SK-100-325

BORE	PART NUMBER
4.00	PFLF-SK-100-400
5.00	PFLF-SK-100-500

BORE	PART NUMBER
6.00	PFLF-SK-137-600
8.00	PFLF-SK-137-800

Replacement PFLF cylinder seal kit to consist of the following:
two (2) low friction piston seals, two (2) tube end seals, one (1) rod seal, one (1) bushing o-ring and one (1) container of low friction grease.
Note: basic seal kit **DOES NOT** include wiper, probe or connector kits

PNEUMATIC CONTROL SYSTEM (MODEL PCS): HOW IT WORKS

The TRD Pneumatic Control System (Model PCS) is designed to control any 1.50"-4.00" bore pneumatic TRD position feedback actuator. The system is a closed-loop electronic controller with pneumatic valves that can accurately position the actuator rod and hold it in position with a high degree of accuracy and force. The system accomplishes the long term goal of using pneumatic technology to accurately stop and hold the rod at any desired position.

The standard PCS accepts a 0 to 10 VDC analog command signal. The command signal is used as a reference to move to and hold a specific position. Order Option C if a 0 to 20 mA or a 4 to 20 mA analog command signal is required. For example, if the application has a stroke of 10 inches (i.e., the electrical zero and span is set for a 10 inch stroke), then a 1 volt change in the command voltage is equal to a 1 inch movement. Similarly, a change in command signal of 0.005 of a volt equals a position change of 0.005 of an inch for the same 10 inch stroke application. If the application has a stroke of 5 inches, a change of 1 volt in the command signal represents a 0.500" movement.

The system utilizes the feedback from the actuator to close the control loop. The control loop compares the system's command signal (the 0-10 VDC, 0-20 mA, or 4-20 mA input command signal) to the feedback signal from the actuator. The difference between the command and feedback is referred to as the error term. When the error term is zero, all valves close, trapping air on both sides of the actuator piston. The error term is considered to be zero when it is within the dead-band range. The dead-band range is an adjustable range that determines the final repeatability of the system. The Application Sizing chart located later in this section shows recommended dead-band ranges for given application parameters. This holds the rod at its commanded position. If some force or weight attempts to move the rod out of the commanded position, the system will react by increasing the restoring force eventually to full supply pressure, if necessary. Likewise, if the command signal changes, the system will respond to make the feedback equal the command signal.

There are four adjustments on the PCS system, adjustable via four trim pots. They include the Zero, Span, Decel and dead-band adjustment. The Zero and Span adjustments allow you to set the zero and full scale position of the actuator to match the input (command) signal. The Decel and dead-band adjustments are used to optimize the performance of the system based on application parameters. These adjustments are described in detail in the Operating Manual, which is included with each system.

The actual accuracy/repeatability of the movements will depend on many factors, including signal noise, load, velocity, supply pressure, supply voltage and application friction. Refer to the Application Sizing charts found later in this section for detailed information regarding sizing and suggestions for your application.

PNEUMATIC CONTROL SYSTEM (PCS): HOW TO ORDER

PCS - 5 - Q

PNEUMATIC CONTROL SYSTEM

FLOW/TYPE*	
1	Cv = .02
2	Cv = .04
3	Cv = .08
4	Cv = .09
5	Cv = .10
6	Cv = .105
7	Cv = .11
8	Cv = .25

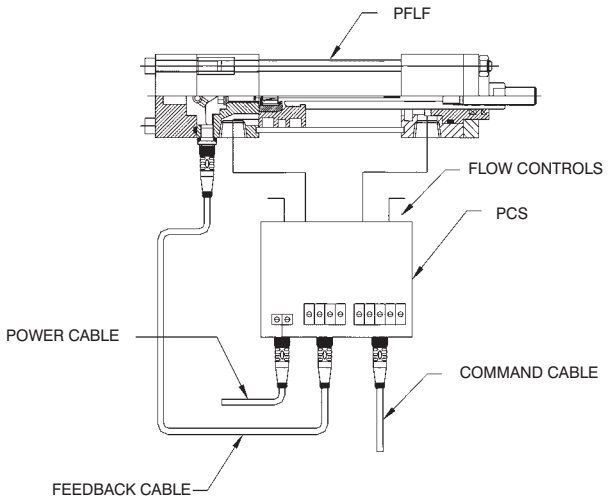
OPTIONS	
BLANK	NO CABLES OR CONNECTIONS (0-10 VDC COMMAND INPUT)
C	0-20 mA OR 4-20 mA COMMAND INPUT
I	METRIC DIMENSIONS
N	NO ENCLOSURE**
Q	QUICK CONNECT RECEPTACLES (CABLES SOLD SEPARATELY)

* The Cv values are approximated. The velocities for the different systems are shown in the sizing recommendations chart.
** Allows mounting of control valves close to the actuator and the electronics/PC board in a remote location. This would be beneficial in applications that would otherwise require long air lines which could reduce system accuracy or in applications that would place the electronics/PC board in an area that exceeds the **100°F** operational temperature range.

ACCESSORY CABLES*

PART NUMBER	DESCRIPTION
PCS-CBL-PWR	2 meter Power Cable for Quick Connect Option
PCS-CBL-PWR-X	5 meter Power Cable for Quick Connect Option
PCS-CBL-CMD	2 meter Command Signal Cable for Quick Connect Option
PCS-CBL-CMD-X	5 meter Command Signal Cable for Quick Connect Option
PCS-CBL-FBK	2 meter Feedback Cable for Quick Connect Option
PCS-CBL-FBK-X	5 meter Feedback Cable for Quick Connect Option

*** One Power, Command and Feedback cable required if Option Q is purchased (3 CABLES TOTAL REQUIRED).**



System Block Diagram, shown with Option Q

PNEUMATIC CONTROL SYSTEM (PCS): SPECIFICATIONS

DESCRIPTION	SPECIFICATION
Zero Adjustment	50% of Total Full Scale Output between both adjustments
Span Adjustment	
DECEL Adjustment	Approximately 0.5 to 13.5 volts
Dead-band Adjustment	Approximately 0.005 to 0.500 volts
@ Position	Discrete signal that Sinks to Ground when Within dead-band zone. 10mA Maximum
Current Position	0 to 10 VDC signal, 1M ohm input Impedance required for input device
Operation at Power Loss	All valves close at power loss
Input Supply Voltage	23.5 to 24.5 VDC, 1 amp
Operating Pressure	70 to 80 max. psig
Air Requirement	Regulated and Filtered to 5 microns
Operational Temperature Range	0 to **100°F** (Electronics/PC Board)
Reverse Polarity Protected	
Over-voltage Protected	

APPLICATION SIZING AND RULES OF THUMB

PFLF CYLINDER/PCS VALVE SYSTEM MATCHING AND SIZING RECOMMENDATIONS									
BORE SIZE	PCS MODEL	STROKE RANGE	MAXIMUM PAYLOAD	AVERAGE VELOCITY	MAXIMUM EXTERNAL FRICTION	ZERO FRICTION DEADBAND**	1/2 MAXIMUM FRICTION DEADBAND	MAXIMUM FRICTION DEADBAND	MINIMUM STEP***
PFLF-1.50″	PCS-1	2.00″ to 3.00″	2 lbs.	2.50 in/sec	Zero	±25mV	N/A	N/A	0.040″
PFLF-1.50″	PCS-2	4.00″ to 24.00″	50 lbs.	5.50 in/sec	10 lbs.	±20mV	±40mV	±80mV	2 X Deadband
PFLF-2.00″	PCS-2	2.00″ to 3.00″	4 lbs.	2.75 in/sec	Zero	±50mV	N/A	N/A	0.020″
PFLF-2.00″	PCS-3	4.00″ to 24.00″	90 lbs.	6.50 in/sec	20 lbs.	±15mV	±30mV	±60mV	2 X Deadband
PFLF-2.50″	PCS-4	3.00″ to 4.00″	120 lbs.	2.00 in/sec	35 lbs.	±90mV	N/A	N/A	2 X Deadband
PFLF-2.50″	PCS-5	5.00″ to 24.00″	150 lbs.	2.50 in/sec	35 lbs.	±40mV	±60mV	±60mV	2 X Deadband
PFLF-3.25″	PCS-6	3.00″ to 4.00″	235 lbs.	2.00 in/sec	60 lbs.	±80mV	N/A	N/A	2 X Deadband
PFLF-3.25″	PCS-7	5.00″ to 24.00″	235 lbs.	2.00 in/sec	60 lbs.	±40mV	±40mV	±60mV	2 X Deadband
PFLF-4.00″	PCS-7	3.00″ to 4.00″	360 lbs.	2.00 in/sec	90 lbs.	±80mV	N/A	N/A	2 X Deadband
PFLF-4.00″	PCS-8	5.00″ to 24.00″	360 lbs.	2.00 in/sec	90 lbs.	±40mV	±40mV	±60mV	2 X Deadband

If your application requires lower velocities or payloads, you may be able to reduce the minimum recommended dead-band setting, or if your dead-band requirements can accommodate a large range, you may be able to increase your payload higher than the recommended values.

**Note: the following formula can be used to convert the dead-band voltage to displacement: w=0.1(V) x t, where w is the dead-band width, V is dead-band voltage listed above and t is full scale travel of the actuator.

For example: if the dead-band is set for 20mv (0.02 of a volt) for a 6 inch stroke cylinder, w=0.1 (0.02) x 6=±0.012 of an inch.

***Minimum step is stroke dependent.

RECOMMENDED TUBING SIZES

BORE	I.D.	O.D.
1.50″ Bore	0.125	0.250″
2.00″ Bore	0.187	0.250″
2.50″ Bore	0.187	0.250″
3.25″ Bore	0.312	0.375″
4.00″ Bore	0.312	0.375″

PNEUMATIC CONTROL SYSTEM (PCS):
APPLICATION SIZING AND RULES OF THUMB (CONTINUED)

Assumptions used for Sizing Values recommendations:

- Values shown in sizing table are with no overshoot. If overshoot is acceptable for your application, the dead-band may be less than specified. However, be sure your system cannot go unstable.
- The PFLF cylinder is a very low friction cylinder with a standard rod diameter and NO rod wiper. The use of a rod wiper or oversized rod diameters will have adverse effects on positioning capabilities.
- 80 PSI air supply.
- Minimum of 23.5 VDC provided to the PCS.
- Clean Command Signal for Main Control (<5mV noise/ripple).
- Leak-free system. The system will actually perform well with some system leakage, however, the best performance is with no leakage.
- Short (<18 inches), hard air lines (nylon) between the valves and the actuator.
- No backlash in the system.
- Horizontally guided load. The system can handle vertical or inclined loads and still meet the minimum dead-band specified above, however, the velocity may be effected by up to 40%.

Typical Rules of Thumb:

- Deviation from the recommended parameters, such as air pressure, power supply voltage, external friction, etc., will negatively effect system performance. However, the system may still perform adequately for your application.
- Applications with loads less than 10% of actuator capacity and strokes greater than four inches will yield better repeatability than the minimum dead-band shown in the sizing table.
- Reducing actuator velocity by use of Flow Controls may enable the dead-band to be adjusted tighter for a given application. The Flow Controls must be inserted into the exhaust ports of the valve manifold, NOT in the actuator.
- Oversizing the actuator for a given application typically yields better repeatability.
- Generically, following are relative influences on velocity:
  – As Mass increases, Velocity decreases (up to 20%)
  – As Friction increases, Velocity decreases (up to 20%)
  – As Pressure decreases, Velocity decreases (up to 20%)
- Increased Friction decreases repeatability. Maximum external friction should not exceed 20% of the maximum rated payload. Any external friction in the application will degrade system performance. Ensure the system is aligned properly to any guiding systems. Misalignment will cause external application friction.
- A borderline solution can be effective through any/all of the following:
  – Sacrificing performance in one area for another
  – Limiting velocity with external flow controls
  – Employing a small central portion of a longer probe
  – Using a larger bore cylinder
- The PCS system is not suited for applications where accurate velocity control is needed by controlling the rate of command signal change. Flow controls can be used if lower velocities are required.

Do not allow the PCS valves to stay on for prolonged time periods unless the valves are well ventilated, as they may overheat potentially causing damage to the valves.

PNEUMATIC CONTROL SYSTEM (PCS): APPLICATION EXAMPLE

PFLF Example

Let's say we have just finished the installation procedure for a PFLF Cylinder with 10 inches of stroke and are using a 0-10 VDC input command signal. There is a retracted hard stop at 1.5 inches of cylinder stroke and an extended hard stop at the nine inches of cylinder stroke.

Therefore:

- After adjusting the Span setting, 10 volts is equivalent to nine inches of cylinder rod extension.
- After adjusting the Zero setting, 1.5 inches of cylinder rod extension will equal 0 volts.

Therefore, 0 to 10 volts covers the 7.5 inches (9.0″ - 1.5″) range of motion.

Using the following formula:
The command signal can be translated into actuator displacement with the following formula:

$$CS = d * R / t + Z$$

CS	=	the command signal required to achieve a desired position
d	=	the displacement the desired position is from the zero position
R	=	the full range of the command signal
t	=	full scale travel of the actuator
z	=	the command signal for the zero position

To command the PFLF to go to a position that is 2.0 inches extended from the retracted hard stop, the command signal would be calculated as follows:

CS = 2 x 10/7.5 + 0 = 2.667 VDC Command Input Signal

If a 4-20 mA signal is used, the command input signal would be calculated as follows:

CS = 2 x 16/7.5 + 4 = 8.267 mA Command Input Signal

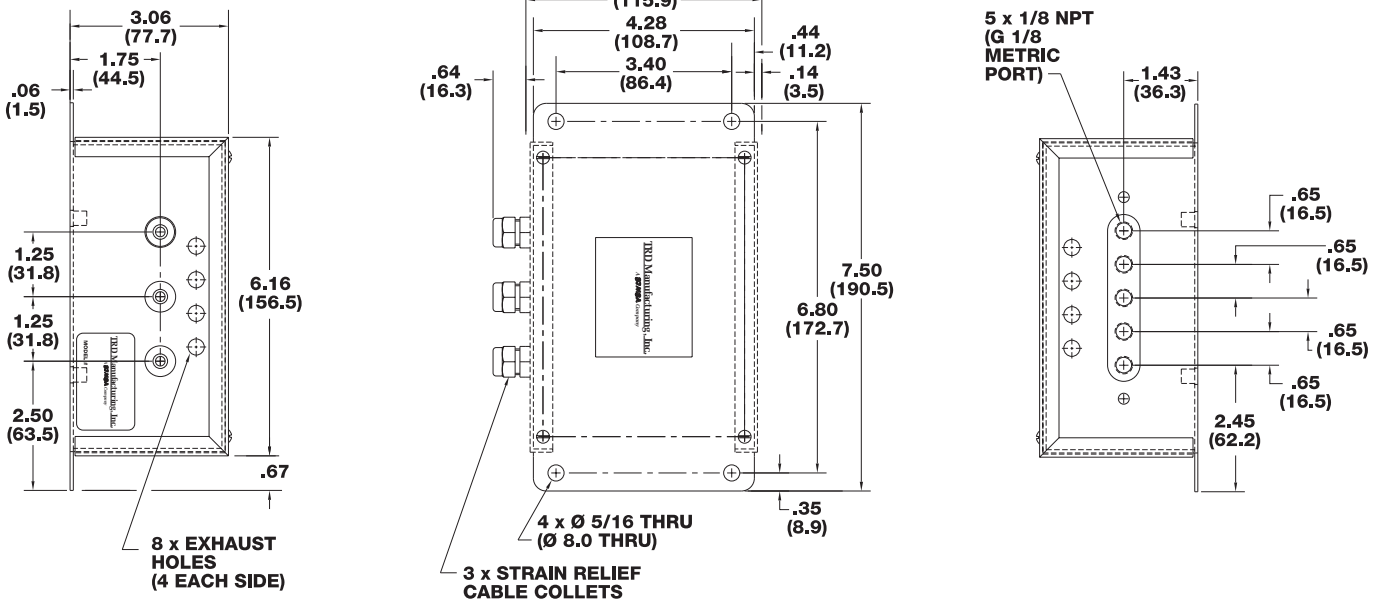
Note: The positional repeatability of the system will be determined by the Dead-band adjustment. If the dead-band was adjusted to ± 20mV in this example, the system would position to the 2 inch position within ± 0.015″ (w=0.1 (V) * t).

PNEUMATIC CONTROL SYSTEM (PCS): DIMENSIONS

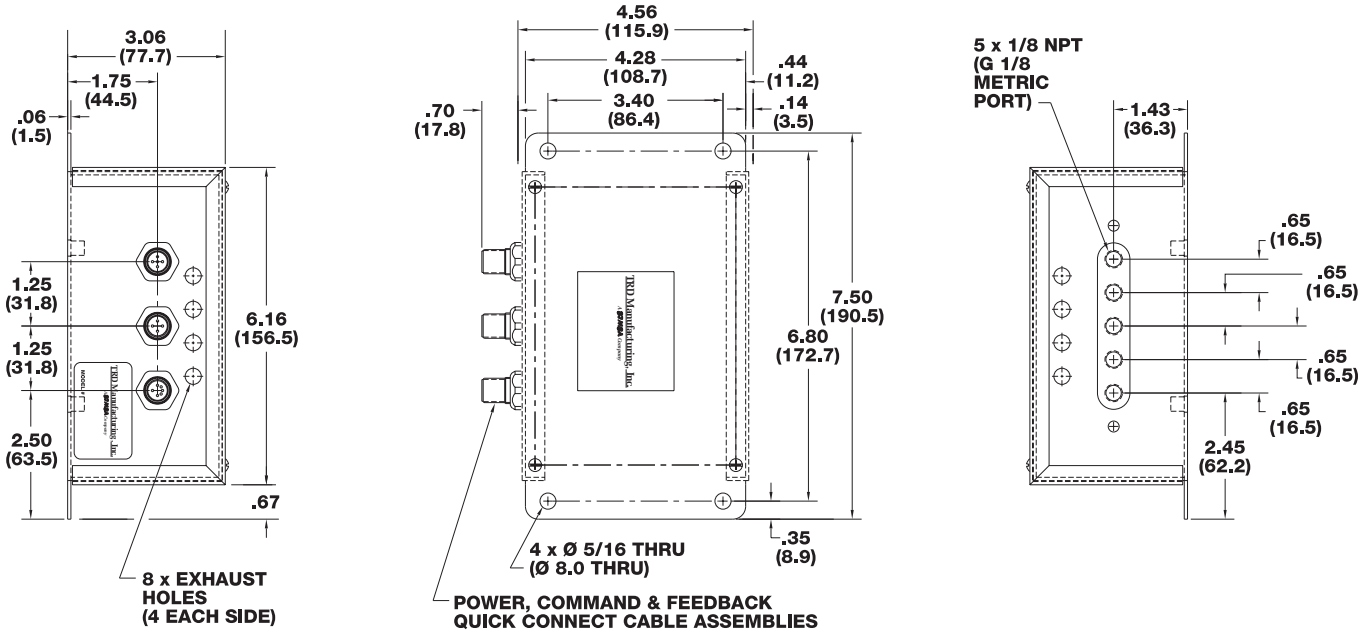
PCS1 THROUGH PCS3

Shown in inches (millimeters are in parenthesis)

ENCLOSURE



OPTION Q
(Quick Connect Receptacle)

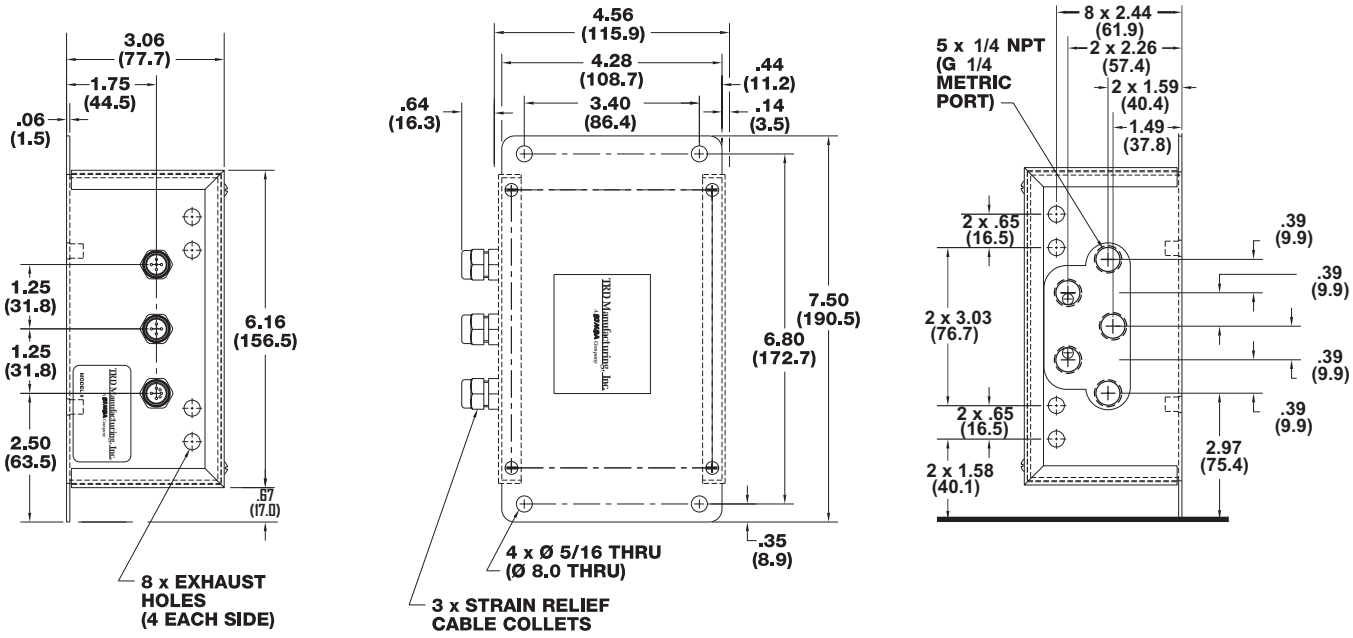


PNEUMATIC CONTROL SYSTEM (PCS): DIMENSIONS

PCS4 THROUGH PCS8

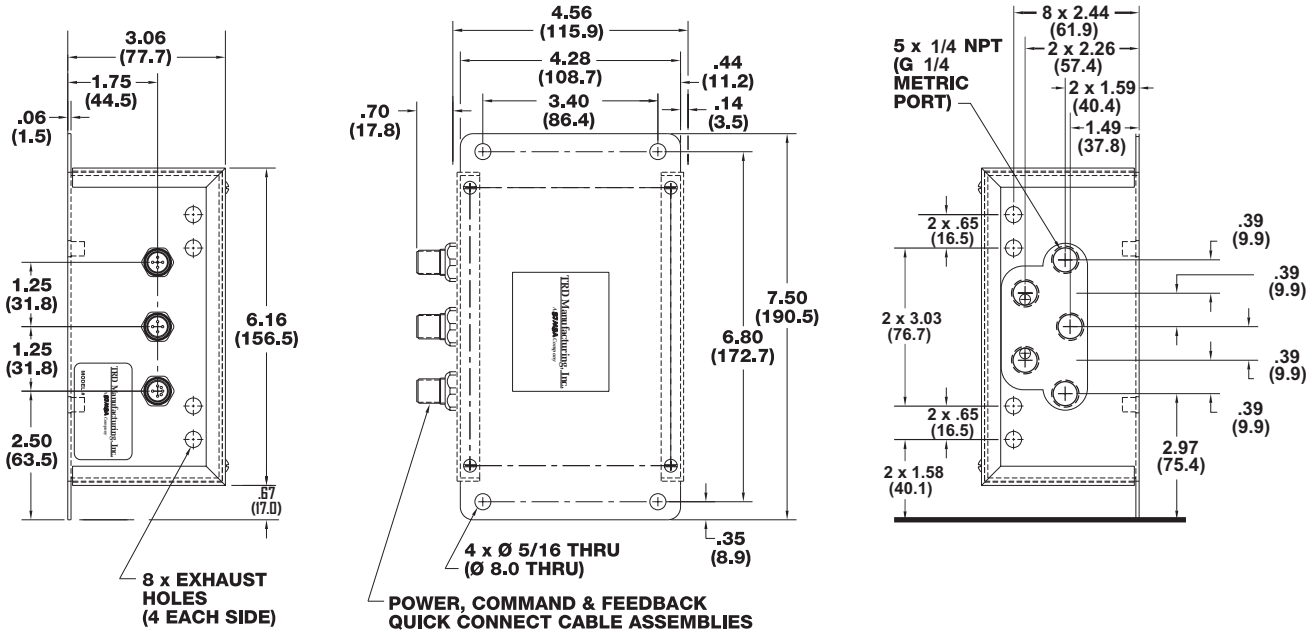
Shown in inches (millimeters are in parenthesis)

ENCLOSURE



OPTION Q

(Quick Connect Receptacle)

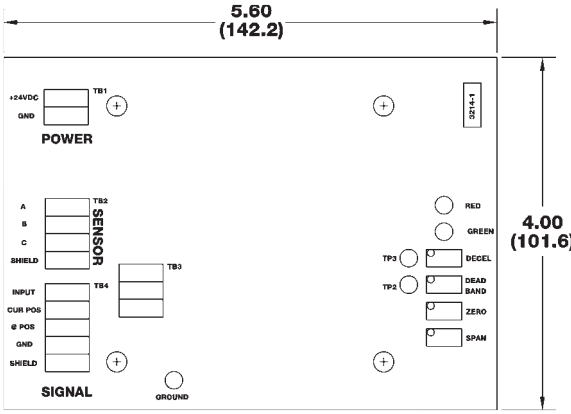


PNEUMATIC CONTROL SYSTEM (PCS): DIMENSIONS

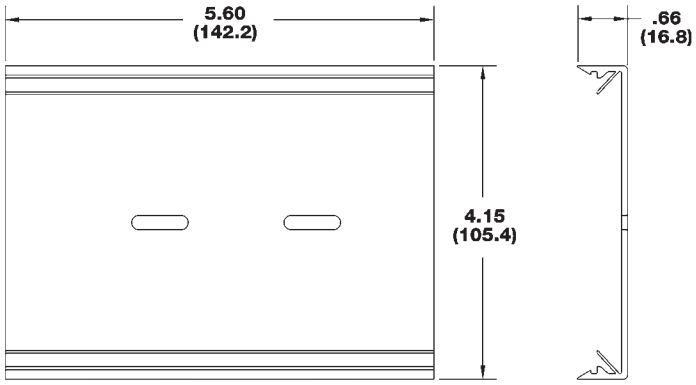
Shown in inches (millimeters are in parenthesis)

OPTION N (No Enclosure)

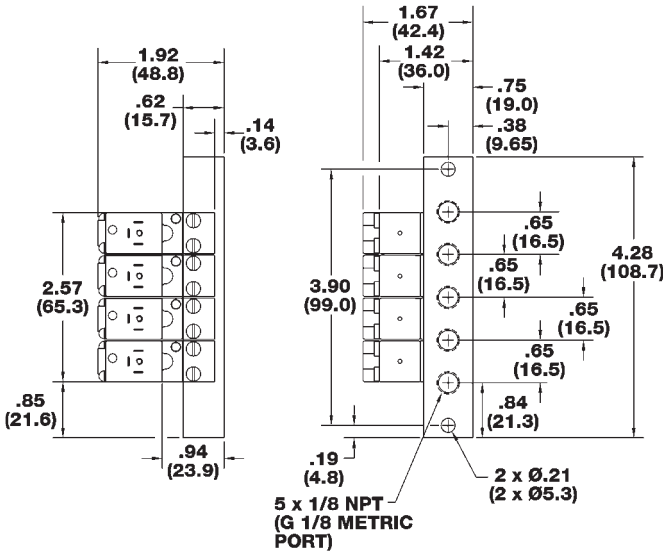
PC BOARD



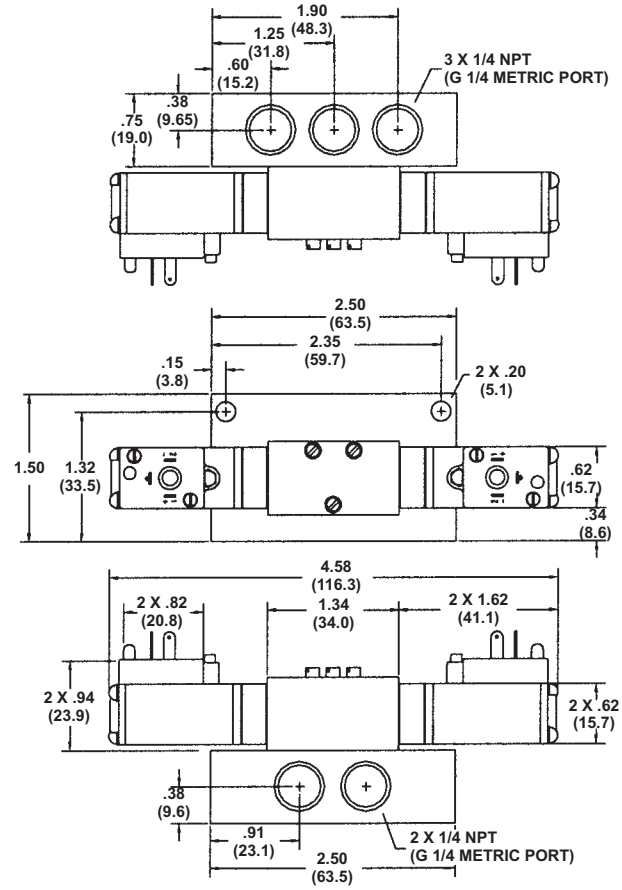
SNAP TRACK



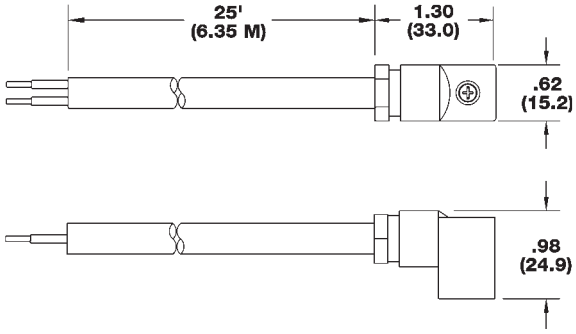
VALVE/MANIFOLD PCS1 THROUGH PCS3



VALVE/MANIFOLD PCS4 THROUGH PCS8



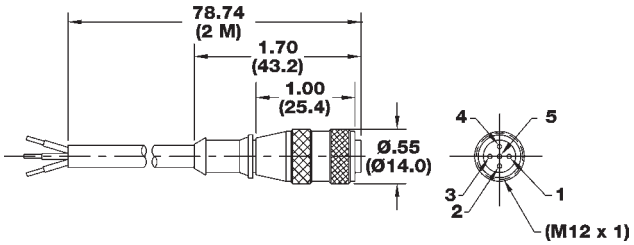
VALVE CABLE



PNEUMATIC CONTROL SYSTEM (PCS): ACCESSORIES

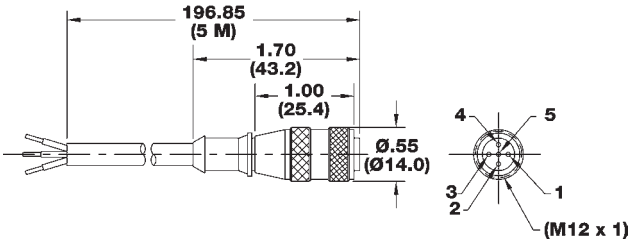
PCS-CBL-PWR

SPECIFICATIONS
5 CONDUCTORS OF 22 AWG LEADS RATED TO 250 V AT 4 AMPS
SHIELDED



PCS-CBL-PWR-X

SPECIFICATIONS
5 CONDUCTORS OF 22 AWG LEADS RATED TO 250 V AT 4 AMPS
SHIELDED



PCS-CBL-PWR WIRE COLOR CODES

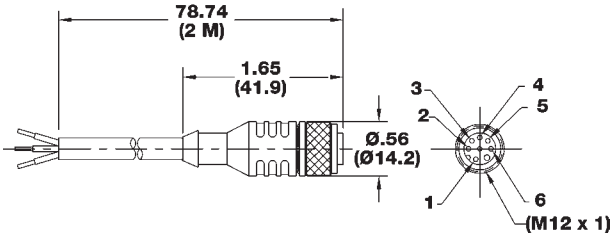
COLOR	PIN	DESCRIPTION
BROWN	1	POSITIVE
WHITE	2	N/C
BLUE	3	NEGATIVE
BLACK	4	N/C

PCS-CBL-CMD WIRE COLOR CODES

COLOR	PIN	DESCRIPTION
BROWN	1	INPUT
WHITE	2	@ POSITION
BLUE	3	GROUND
BLACK	4	CURRENT POSITION
GREEN/YELLOW	5	N/C
PINK	6	N/C

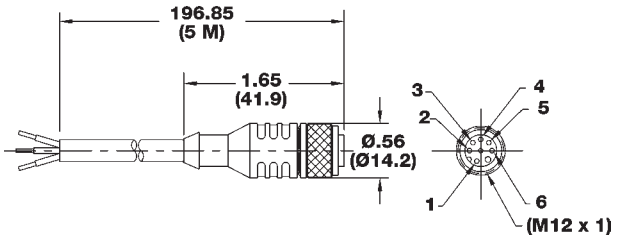
PCS-CBL-CMD

SPECIFICATIONS
6 CONDUCTORS OF 24 AWG LEADS RATED TO EITHER 30 VAC OR 36 VDC AT 4 AMPS
SHIELDED



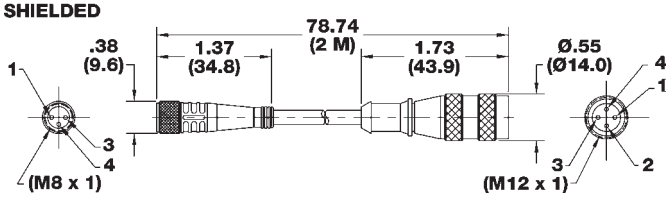
PCS-CBL-CMD-X

SPECIFICATIONS
6 CONDUCTORS OF 24 AWG LEADS RATED TO EITHER 30 VAC OR 36 VDC AT 4 AMPS
SHIELDED



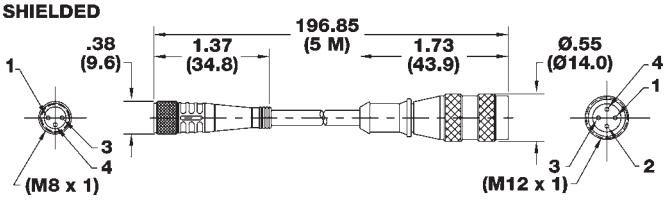
PCS-CBL-FBK

SPECIFICATIONS
3 CONDUCTORS OF 24 AWG LEADS RATED TO 120 V AT 4 AMPS
SHIELDED



PCS-CBL-FBK-X

SPECIFICATIONS
3 CONDUCTORS OF 24 AWG LEADS RATED TO 120 V AT 4 AMPS
SHIELDED



Technical Data

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

TECHNICAL DATA

How to determine the right cylinder size for the job.

To determine what cylinder size 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 four in/sec) require 25% more force than the load, moderate speeds (four 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. 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.

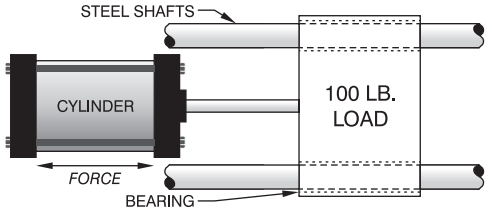
Once you've determined the force you need to move the load at the desired velocity and allow for friction, here's how to find the cylinder bore that meets your specifications.

The force generated by a cylinder is determined by the effective piston area times the air pressure. The force chart on page 280 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 four 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 263 shows that at 60 PSI, the 2" bore with .625" 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)*.

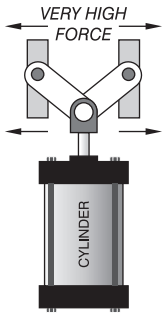
Plain Bearing Material	Cylinder Force	
	Dry Bearing	Oiled Bearing
PTFE	10 lbs.	10 lbs.
UHMW	20 lbs.	20 lbs.
Hardened Steel	25 lbs.	20 lbs.
Brass	40 lbs.	25 lbs.
Cast Iron	45 lbs.	25 lbs.
Steel (soft)	85 lbs.	25 lbs.
Ball Bearing	5-10 lb. Cylinder Force	



General Mechanics

TOGGLE

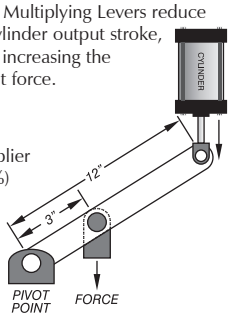
Toggles are complex mechanisms that can achieve very high force.



FORCE MULTIPLYING LEVER

Force Multiplying Levers reduce the cylinder output stroke, while increasing the output force.

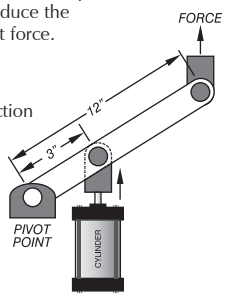
4:1 Force Multiplier (400%)



FORCE REDUCING LEVER

Force Reducing Levers increase the cylinder output stroke but reduce the output force.

1:4 Force Reduction (25%)

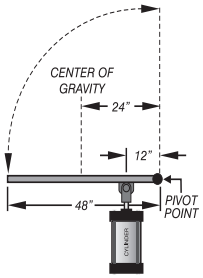


EXAMPLE

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.



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 FRICTION) = 4,000 X 1.25 = 5,000 LBS.

AT 100 PSI AIR PRESSURE, THE FORCE CHART (ON PAGE 119) SHOWS THAT AN 8" BORE HAS 5,026 LBS. FORCE.

How the right mounting and careful installation helps prevent premature cylinder wear.

Choosing the right style of mounting for your cylinder's size, force and function has a direct effect on it's 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.

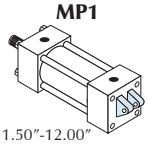
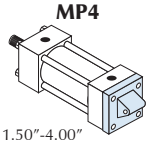
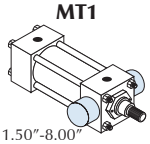
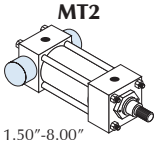
There are cylinder mounts and options to suit virtually every application.

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 185 to determine if a stop tube is needed).

Samples of Pivot Mounts:

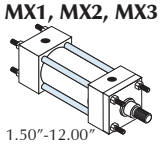
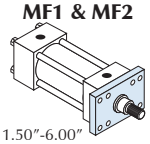
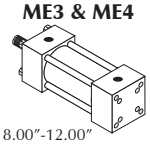
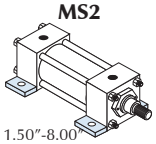
MP1	MP4	MT1	MT2
			
1.50″-12.00″ Bores	1.50″-4.00″ Bores	1.50″-8.00″ Bores	1.50″-8.00″ Bores

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 218). 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:

MX1, MX2, MX3	MF1 & MF2	ME3 & ME4	MS2
			
1.50″-12.00″ Bores	1.50″-6.00″ Bores	8.00″-12.00″ Bores	1.50″-8.00″ Bores

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 advise 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 .063″ thick x 0.375″ wide (for 1.50″ to 8.00″ 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 are 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 is 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-born 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 242-252 for more details.

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
	0.625	PULL	1.460	88	117	146	292	365	584	.00084
	1.000	PULL	0.982	59	79	98	196	246	392	.00057
2.00	ALL	PUSH	3.142	188	251	314	628	785	1256	.00182
	0.625	PULL	2.835	170	227	284	567	708	1134	.00164
	1.000	PULL	2.357	141	189	236	471	589	942	.00136
2.50	ALL	PUSH	4.909	295	393	491	981	1227	1962	.00284
	0.625	PULL	4.602	276	368	460	920	1150	1840	.00266
	1.000	PULL	4.124	247	330	412	825	1031	1650	00239
3.25	ALL	PUSH	8.296	498	664	830	1659	2074	3318	.00480
	1.000	PULL	7.511	451	601	751	1502	1877	3004	.00435
	1.375	PULL	6.811	409	545	681	1362	1702	2724	.00394
4.00	ALL	PUSH	12.566	754	1005	1257	2513	3141	5026	.00727
	1.000	PULL	11.781	707	942	1178	2356	2945	4712	.00682
	1.375	PULL	11.081	665	886	1108	2216	2770	4432	.00641
5.00	ALL	PUSH	19.635	1178	1571	1964	3927	4908	7854	.01136
	1.000	PULL	18.850	1131	1508	1885	3770	4712	7540	.01090
	1.375	PULL	18.150	1089	1452	1815	3630	4537	7260	.01050
6.00	ALL	PUSH	28.274	1696	2262	2827	5655	7068	11310	.01636
	1.375	PULL	26.789	1607	2144	2679	5358	6697	10716	.01550
	1.750	PULL	25.869	1552	2070	2587	5174	6467	10348	.01497
8.00	ALL	PUSH	50.265	3016	4021	5026	10053	12566	20106	.02908
	1.375	PULL	48.780	2927	3902	4878	9756	12195	19512	.02832
	1.750	PULL	47.860	2872	3829	4786	9572	11965	19144	.02770
10.00	ALL	PUSH	78.540	4712	6283	7854	15708	19635	31416	.04545
	1.750	PULL	76.130	4568	6090	7613	15226	19032	30452	.04406
	2.000	PULL	75.400	4524	6032	7540	15080	18850	30160	.04363
12.00	ALL	PUSH	113.098	6786	9048	11310	22620	28275	45239	.06545
	2.000	PULL	109.956	6597	8796	10996	21992	27489	43982	.06363
	2.500	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	
2.00	ALL	0.250	PUSH	3.044	182	243	304	609	761	1217	.00176
	0.625		PULL	2.737	164	218	273	547	684	1094	.00158
2.50	ALL	0.313	PUSH	4.755	285	380	475	951	1188	1902	.00275
	0.625		PULL	4.448	266	355	444	889	1112	1779	.00257
	1.000		PULL	3.970	238	317	397	794	992	1588	00229
3.25	ALL	0.375	PUSH	8.076	484	646	807	1613	2016	3226	.00466
	1.000		PULL	7.291	437	583	729	1458	1822	2916	.00422
	1.375		PULL	6.591	395	527	659	1318	1647	2636	.00381
4.00	ALL	0.625	PUSH	11.952	717	956	1195	2390	2988	4780	.00692
	1.000		PULL	11.167	670	893	1116	2233	2791	4466	.00646
	1.375		PULL	11.467	628	837	1046	2093	2616	4186	.00606
5.00	ALL	0.625	PUSH	19.021	1141	1521	1902	3804	4755	7608	.01100
	1.000		PULL	18.236	1094	1458	1823	3647	4559	7294	.01050
	1.375		PULL	17.536	1052	1402	1753	3507	4384	7014	.01010
6.00	ALL	0.625	PUSH	27.660	1659	2212	2766	5532	6915	11064	.01600
	1.375		PULL	26.175	1570	2094	2617	5235	6543	10470	.01510
	1.750		PULL	25.255	1515	2020	2525	5051	6313	10102	.01460
8.00	ALL	1.000	PUSH	48.694	2921	3895	4869	9738	12173	19477	.02810
	1.375		PULL	47.209	2832	3776	4720	9441	11802	18883	.02730
	1.750		PULL	46.289	2777	3703	4628	9257	11572	18515	.02670
10.00	ALL	1.000	PUSH	76.969	4618	6157	7696	15393	19242	30787	.04450
	1.750		PULL	74.564	4473	5965	7456	14912	18641	29825	.04310
	2.000		PULL	73.829	4429	5906	7382	14765	18457	29531	.04270
12.00	ALL	1.000	PUSH	111.527	6691	8922	11152	22305	27881	44610	.06450
	2.000		PULL	108.385	6503	8670	10838	21677	27096	43354	.06270
	2.500		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 102.

*Theoretical force. Actual force will be reduced by friction.

TECHNICAL DATA: FORCE & TORQUE CHART

SERIES 'MS' EFFECTIVE PISTON AREA/FORCE CHART*

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

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

TORQUE CHARTS: CYLINDER TIE RODS

(Aluminum, Stainless Steel & Steel Tubing)

CYLINDER BORE	TIE ROD THREAD SIZE	TORQUE IN FT.-LBS.
1.50	1/4-28	7
2.00	5/16-24	12
2.50	5/16-24	14
3.25	3/8-24	30
4.00	3/8-24	35
5.00	1/2-20	45
6.00	1/2-20	50
8.00	5/8-18	125
10.00	3/4-16	125
12.00	3/4-16	125

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

(Fiberglass AIR/OIL TANK Tubing Only)

CYLINDER BORE	TIE ROD THREAD SIZE	TORQUE IN FT.-LBS.
2.50	5/16-24	10-12
3.25	3/8-24	20
4.00	3/8-24	25
5.00	1/2-20	35
8.00	5/8-18	75

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

RETAINER SCREWS

CYLINDER BORE	SIZE	TORQUE IN FT.-LBS.
2.00 & 2.50	#10-32 S.H.C.S.	5
3.25 TO 12.00	1/4-28 S.H.C.S.	12

TECHNICAL DATA: WEIGHT CHARTS

TA, TD, FM BASIC CYLINDERS (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
2.00	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
4.00	8.8	10.5	8.8	12.1	13.3	13.2	13.2	11.1	.55
5.00	13.2	14.3	13.2	17.8	19.9	N/A	20.0	17.5	.59
6.00	21.5	25.2	21.5	29.7	32.2	N/A	32.2	27.2	.84
8.00	35.4	36.5	35.4	43.5	N/A	N/A	35.4	N/A	1.25
10.00	70.3	N/A	70.0	72.0	N/A	N/A	70.3	N/A	1.60
12.00	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.

FM CYLINDERS WITH ROD LOCK MOUNTED

WEIGHT IN POUNDS

BORE	ROD DIA.	CYLINDER WITH ROD LOCK									ROD LOCK UNIT ONLY
		MXO	MS1 MT1 MT2	MS4	MP1	MP2	MP4	MF1 MF2	MS2 BASEBAR	ADD PER IN. OF STROKE	
1.50	0.625	3.3	3.7	3.3	3.8	3.9	3.9	3.9	4.2	0.20	1.23
2.00	0.625	5.1	5.6	5.1	5.9	6.0	5.9	5.9	6.3	0.25	2.12
	1.000	6.3	6.8	6.8	7.5	7.6	7.5	7.5	7.9	0.28	2.40
2.50	0.625	7.0	7.6	7.0	8.0	8.2	8.2	8.2	8.4	0.27	3.04
	1.000	8.5	9.1	8.5	9.5	9.7	9.7	9.7	9.9	0.30	3.64
3.25	1.000	13.9	15.3	13.9	16.6	17.5	17.5	17.5	16.5	0.51	5.88
	1.375	15.4	16.8	15.4	18.1	19.0	19.0	19.0	18.0	0.56	5.81
4.00	1.000	19.6	21.3	19.6	22.9	24.1	24.0	24.0	21.9	0.55	9.28
	1.375	21.2	22.9	21.2	24.5	25.7	25.6	25.6	23.5	0.61	9.01
5.00	1.000	28.0	28.9	28.0	32.6	34.8	-	34.9	32.3	0.59	12.70
	1.375	31.2	32.1	31.2	35.8	38.0	-	38.1	35.5	0.65	13.86
6.00	1.375	45.6	49.3	45.6	53.8	56.3	-	56.3	51.3	0.84	20.83
	1.750	49.4	53.1	49.4	57.6	60.1	-	60.1	55.1	0.93	21.25

PFLF BASIC CYLINDERS

WEIGHT IN POUNDS

CYLINDER BORE	MODEL									ADD PER IN. OF STROKE
	MXO	MS1 MT1/MT2	MS4	MP1	MP2	MP4	MF1 ME3	MF2	MS2	
1.50	2.4	2.8	2.4	2.9	2.7	2.7	3.0	2.7	3.3	.19
2.00	3.6	4.1	3.6	4.4	3.9	3.9	4.4	3.8	4.8	.24
2.50	4.9	5.5	4.9	5.9	5.2	5.2	6.1	5.2	6.3	.26
3.25	9.0	10.4	9.0	11.7	11.1	11.1	12.5	11.0	11.5	.49
4.00	12.3	14.0	12.3	15.6	14.5	14.5	16.7	14.4	14.6	.53
5.00	18.6	19.7	18.6	23.2	21.8	N/A	25.4	21.9	22.9	.57
6.00	29.7	33.4	29.7	37.9	34.6	N/A	40.4	34.6	35.4	.81
8.00	49.6	50.7	49.6	57.7	N/A	N/A	49.6	N/A	N/A	1.22

All weights are in pounds. For oversize rod series add 10%.
*Weight includes clevis pins.

'SS' SERIES BASIC CYLINDERS

WEIGHT IN POUNDS

BORE	ROD DIAMETER	MODEL				ADD PER INCH OF STROKE
		MX0/MS4 ME3/ME4	MF1 MF2	MT1 MT2	MP1*	
1.50	0.625	3.3	4	3.8	3.8	0.3
	1.000	4.1	4.8	4.6	4.6	0.4
2.00	0.625	5.8	7	6.4	6.4	0.5
	1.000	6.2	7.4	6.8	6.8	0.6
2.50	0.625	8	9.5	8.5	8.7	0.6
	1.000	8.5	10	9	9.2	0.7
3.25	1.000	15	18.7	15.5	16	0.8
	1.375	15.4	19.2	16	16.5	1.0

BORE	ROD DIAMETER	MODEL				ADD PER INCH OF STROKE
		MX0/MS4 ME3/ME4	MF1 MF2	MT1 MT2	MP1*	
4.00	1.000	23	28	23.5	27	1.0
	1.375	23.4	28.5	24	27.5	1.2
5.00	1.000	34.4	42	35	41	1.1
	1.375	34.9	42.5	35.5	41.5	1.3
6.00	1.375	60	71.9	61.5	69	1.5
	1.750	62	73.9	63.2	71	1.7
8.00	1.375	79	N/A	80.2	88	2.0
	1.750	82	N/A	83.2	91	2.3

TECHNICAL DATA: WEIGHT CHARTS

'TAS' SERIES BASIC CYLINDERS

WEIGHT IN POUNDS

BORE	ROD DIA. (MM)	MOUNT												ADD PER INCH OF STROKE
		MS4 MXO	MX1 MX2 MX3	MF1	MF2	MF5	MF6	MP1	MP2	MS2 MS3 MS7	MT1 MT2	MT4	ME3 ME4	SB	
1.50	0.625	3.9		4.3	4.6	4.6	5.0	4.2	4.8	4.4	4.4	5.8	N/A	4.1	0.6
	1.000	4.7		5.0	5.4	5.4	5.8	5.0	5.6	5.2	5.2	6.6	N/A	4.9	0.8
2.00	0.625	6.4		6.9	7.3	7.4	8.0	6.7	7.3	6.9	7.0	8.7	N/A	6.6	1.0
	1.000	6.9		7.3	7.8	7.9	8.5	7.2	7.8	7.4	7.5	9.2	N/A	7.1	1.3
2.50	0.625	8.9		9.6	10.2	10.0	11.0	9.3	9.8	9.4	9.6	11.7	N/A	9.2	1.2
	1.000	9.4		10.0	10.7	10.5	11.5	9.8	10.3	9.9	10.1	12.2	N/A	9.7	1.4
3.25	1.000	16.4		18.4	19.9	19.1	21.6	17.8	19.5	17.7	17.8	20.0	N/A	17.2	1.6
	1.375	16.9		18.8	20.4	19.5	22.1	18.3	20.0	18.2	18.3	20.5	N/A	17.7	1.8
4.00	1.000	25.9		28.7	30.7	29.0	32.6	27.3	29.0	27.2	27.3	29.8	N/A	26.7	2.0
	1.375	26.3		28.9	31.1	29.1	33.0	27.7	29.4	27.6	27.7	30.2	N/A	27.1	2.2
5.00	1.000	38.8		42.8	45.8	43.4	48.7	40.5	41.9	41.9	40.2	44.5	N/A	39.7	2.2
	1.375	39.3		42.9	46.3	43.7	49.2	41.0	42.4	42.4	40.7	45.0	N/A	40.2	2.4
6.00	1.375	67.8		74.8	79.3	74.2	83.2	69.9	74.0	70.9	69.5	78.3	N/A	68.9	3.0
	1.750	72.0		78.6	83.5	78.2	87.4	74.1	78.2	75.1	73.7	82.5	N/A	73.1	3.3
8.00	1.375	96.0		N/A	N/A	N/A	N/A	99.0	N/A	99.5	98.0	113.0	95.0	97.7	4.0
	1.750	103.0		N/A	N/A	N/A	N/A	106.0	N/A	106.5	105.0	120.0	102.0	104.7	4.3

ACCESSORIES WEIGHT CHART

WEIGHT IN POUNDS

ROD CLEVIS		ROD EYES		EYE BRACKETS		CLEVIS BRACKETS		CLEVIS PINS				WELD PLATE		FLANGE END COUPLER	
PART NO.	WEIGHT	PART NO.	WEIGHT	PART NO.	WEIGHT	PART NO.	WEIGHT	PART NO.	WEIGHT	PART NO.	WEIGHT	PART NO.	WEIGHT	PART NO.	WEIGHT
RC437	.40	RE437	.30	EB500	.86	CB500	.90	CP500C	.12	CP500E	.12	WP625	.45	FEC625	.41
RC500	.40	RE500	.30	EB750	3.00	CB750	3.10	CP750C	.38	CP750E	.38	WP1000	.69	FEC1000	.65
RC750	1.22	RE625	.30	EB1000	6.36	CB1000	6.20	CP1000C	.80	CP1000E	.80	WP1375	1.26	FEC1375	1.22
RC1000	2.58	RE750	1.10	EB1375	11.22	CB1375	9.70	CP1375C	1.22	CP1375E	1.22	WP1750	2.25	FEC1750	2.25
RC1250	6.28	RE1000	2.40	EB1750	17.5	CB1750	17	CP1750C	4.1	CP1750E	3.78	WP2000	2.67	FEC2000	2.59
RC1375	6.28	RE1250	5.58	EB2000	25	CB2000	26	CP2000C	5.36	CP2000E	4.93	WP2500	3.38	FEC2500	3.30
RC1500	11.6	RE1375	5.58	EB2500	39	CB2500	37	CP2500C	9.42	CP2500E	9.22	—	—	—	—
RC1750	12.7	RE1500	10.52	—	—	—	—	—	—	—	—	—	—	—	—
RC1875	18	RE1875	11.5	—	—	—	—	—	—	—	—	—	—	—	—
RC2250	27	RE2250	23	—	—	—	—	—	—	—	—	—	—	—	—
RC2500	36	RE2500	32	—	—	—	—	—	—	—	—	—	—	—	—

ALIGNMENT COUPLERS WEIGHT CHART

WEIGHT IN POUNDS

PART NO.	WEIGHT	PART NO.	WEIGHT	PART NO.	WEIGHT	PART NO.	WEIGHT	PART NO.	WEIGHT
AC250	.30	AC625	.40	AC1375	7.50	AC2250	8.50	AC3500	39.5
AC312	.30	AC750	1.10	AC1500	7.60	AC2500	28	AC3750	40.2
AC375	.30	AC875	1.10	AC1750	7.60	AC2750	29.2	AC4000	55
AC437	.30	AC1000	2.90	AC1875	8.00	AC3000	30.4	AC4500	60
AC500	.30	AC1250	2.90	AC2000	8.30	AC3250	38	AC5000	66

STAINLESS STEEL			
PART NO.	WEIGHT	PART NO.	WEIGHT
SS-AC250	.30	SS-AC750	1.10
SS-AC312	.32	SS-AC875	1.30
SS-AC375	.34	SS-AC1000	2.90
SS-AC437	.36	SS-AC1250	3.10
SS-AC500	.38	SS-AC1500	8.00
SS-AC625	.40	-	-

STAINLESS STEEL ACCESSORIES WEIGHT CHART

WEIGHT IN POUNDS

ROD CLEVIS		ROD EYES		EYE BRACKETS & CLEVIS BRACKETS		CLEVIS PINS	
PART NUMBER	WEIGHT	PART NUMBER	WEIGHT	PART NUMBER	WEIGHT	PART NUMBER	WEIGHT
SS-RC437	.28	SS-RE750	.32	SS-EB500	1.2	SS-CP500-1	.12
SS-RC500	.28	SS-RE1000	.30	SS-EB750	3.8	SS-CP750-1	.38
SS-RC750	.78	SS-RE1375	1.10	SS-EB1000	6.9	SS-CP1000-1	.80
SS-RC1000	2.13	SS-RE1500	2.40	SS-CB500	1.5	SS-CP1375-1	1.22
SS-RC1250	5.8	-	-	SS-CB750	4.5	SS-CP1750-1	4.7
SS-RC1500	11.1	-	-	SS-CB1000	7.6	-	-

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 NUMBER	WITH CUSHIONS			PART NUMBER	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
2.00	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
4.00	SK 100-400	SK 100-400H	SK 100-400C	SK 100-400HC	SKD 100-400	SKD 100-400H	SKD 100-400HC
5.00	SK 100-500	SK 100-500H	SK 100-500C	SK 100-500HC	SKD 100-500	SKD 100-500H	SKD 100-500HC
6.00	SK 137-600	SK 137-600H	SK 137-600C	SK 137-600HC	SKD 137-600	SKD 137-600H	SKD 137-600HC
8.00	SK 137-800	SK 137-800H	SK 137-800C	SK 137-800HC	SKD 137-800	SKD 137-800H	SKD 137-800HC
10.00	SK 175-1000	SK 175-1000H	SK 175-1000C	SK 175-1000HC	SKD 175-1000	SKD 175-1000H	SKD 175-1000HC
12.00	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 NUMBER	WITH CUSHIONS			PART NUMBER	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
2.00	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
4.00	SK 137-400	SK 137-400H	SK 137-400C	SK 137-400HC	SKD 137-400	SKD 137-400H	SKD 137-400HC
5.00	SK 137-500	SK 137-500H	SK 137-500C	SK 137-500HC	SKD 137-500	SKD 137-500H	SKD 137-500HC
6.00	SK 175-600	SK 175-600H	SK 175-600C	SK 175-600HC	SKD 175-600	SKD 175-600H	SKD 175-600HC
8.00	SK 175-800	SK 175-800H	SK 175-800C	SK 175-800HC	SKD 175-800	SKD 175-800H	SKD 175-800HC
10.00	SK 200-1000	SK 200-1000H	SK 200-1000C	SK 200-1000HC	SKD 200-1000	SKD 200-1000H	SKD 200-1000HC
12.00	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 two (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 NUMBER	WITH CUSHIONS			PART NUMBER	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
2.00	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
4.00	THSK 100-400	THSK 100-400H	THSK 100-400C	THSK 100-400HC	THSKD 100-400	THSKD 100-400H	THSKD 100-400HC
5.00	THSK 100-500	THSK 100-500H	THSK 100-500C	THSK 100-500HC	THSKD 100-500	THSKD 100-500H	THSKD 100-500HC
6.00	THSK 137-600	THSK 137-600H	THSK 137-600C	THSK 137-600HC	THSKD 137-600	THSKD 137-600H	THSKD 137-600HC
8.00	THSK 137-800	THSK 137-800H	THSK 137-800C	THSK 137-800HC	THSKD 137-800	THSKD 137-800H	THSKD 137-800HC
10.00	THSK 175-1000	THSK 175-1000H	THSK 175-1000C	THSK 175-1000HC	THSKD 175-1000	THSKD 175-1000H	THSKD 175-1000HC
12.00	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 NUMBER	WITH CUSHIONS			PART NUMBER	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
2.00	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
4.00	THSK 137-400	THSK 137-400H	THSK 137-400C	THSK 137-400HC	THSKD 137-400	THSKD 137-400H	THSKD 137-400HC
5.00	THSK 137-500	THSK 137-500H	THSK 137-500C	THSK 137-500HC	THSKD 137-500	THSKD 137-500H	THSKD 137-500HC
6.00	THSK 175-600	THSK 175-600H	THSK 175-600C	THSK 175-600HC	THSKD 175-600	THSKD 175-600H	THSKD 175-600HC
8.00	THSK 175-800	THSK 175-800H	THSK 175-800C	THSK 175-800HC	THSKD 175-800	THSKD 175-800H	THSKD 175-800HC
10.00	THSK 200-1000	THSK 200-1000H	THSK 200-1000C	THSK 200-1000HC	THSKD 200-1000	THSKD 200-1000H	THSKD 200-1000HC
12.00	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 two (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 NUMBER	WITH CUSHIONS		
		H	C	HC
1.50	TSK 625-150	TSK 625-150H	TSK 625-150C	TSK 625-150HC
2.00	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
4.00	TSK 100-400	TSK 100-400H	TSK 100-400C	TSK 100-400HC
5.00	TSK 100-500	TSK 100-500H	TSK 100-500C	TSK 100-500HC
6.00	TSK 137-600	TSK 137-600H	TSK 137-600C	TSK 137-600HC
8.00	TSK 137-800	TSK 137-800H	TSK 137-800C	TSK 137-800HC

BORE	OVERSIZE SINGLE ROD END			
	PART NUMBER	WITH CUSHIONS		
		H	C	HC
1.50	TSK 100-150	N/A	TSK 100-150C	N/A
2.00	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
4.00	TSK 137-400	TSK 137-400H	TSK 137-400C	TSK 137-400HC
5.00	TSK 137-500	TSK 137-500H	TSK 137-500C	TSK 137-500HC
6.00	TSK 175-600	TSK 175-600H	TSK 175-600C	TSK 175-600HC
8.00	TSK 175-800	TSK 175-800H	TSK 175-800C	TSK 175-800HC

SERIES 'TD'

BORE	STANDARD SINGLE ROD END	
	PART NUMBER	
1.50	BPSK 625-150	KITS INCLUDE CUSHION SEALS AND WEAR BAND
2.00	BPSK 625-200	
2.50	BPSK 625-250	
3.25	BPSK 100-325	
4.00	BPSK 100-400	
5.00	BPSK 100-500	
6.00	BPSK 137-600	
8.00	BPSK 137-800	

BORE	OVERSIZE SINGLE ROD END	
	PART NUMBER	
1.50	BPSK 100-150	KITS INCLUDE CUSHION SEALS AND WEAR BAND
2.00	BPSK 100-200	
2.50	BPSK 100-250	
3.25	BPSK 137-325	
4.00	BPSK 137-400	
5.00	BPSK 137-500	
6.00	BPSK 175-600	
8.00	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
2.00	0.625	NRSK 625-200
2.50	0.625	NRSK 625-250
	1.000	NRSK 100-250
3.25	1.000	NRSK 100-325
	1.375	NRSK 137-325
4.00	1.000	NRSK 100-400
	1.375	NRSK 137-400
5.00	1.000	NRSK 100-500
	1.375	NRSK 137-500
6.00	1.375	NRSK 137-600
	1.750	NRSK 175-600
8.00	1.375	NRSK 137-800
	1.750	NRSK 175-800
10.00	1.750	NRSK 175-1000
	2.000	NRSK 200-1000
12.00	2.000	NRSK 200-1200
	2.500	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
2.00	SK-MSE-625-200-2S	2.00	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
4.00	SK-MSE-100-400-2S	4.00	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
5.00	SK-MSE-100-500-2S	5.00	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
6.00	SK-MSE-137-600-2S	6.00	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
8.00	SK-MSE-137-800-2S	8.00	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

TECHNICAL DATA: SEAL KITS

SERIES 'TAS'

NOTE: To insure proper seals are supplied for all models, ALWAYS supply TRD serial number.

	STANDARD SINGLE ROD END				STANDARD DOUBLE ROD END		
		WITH CUSHIONS				WITH CUSHIONS	
BORE	PART NO.	H	C	HC	PART NO.	H	HC
1.50	SK 625-150-OTS	SK 625-150-OTS-H	SK 625-150-OTS-C	SK 625-150-OTS-HC	SKD 625-150-OTS	SKD 625-150-OTS-H	SKD 625-150-OTS-HC
2.00	SK 625-200-OTS	SK 625-200-OTS-H	SK 625-200-OTS-C	SK 625-200-OTS-HC	SKD 625-200-OTS	SKD 625-200-OTS-H	SKD 625-200-OTS-HC
2.50	SK 625-250-OTS	SK 625-250-OTS-H	SK 625-250-OTS-C	SK 625-250-OTS-HC	SKD 625-250-OTS	SKD 625-250-OTS-H	SKD 625-250-OTS-HC
3.25	SK 100-325-OTS	SK 100-325-OTS-H	SK 100-325-OTS-C	SK 100-325-OTS-HC	SKD 100-325-OTS	SKD 100-325-OTS-H	SKD 100-325-OTS-HC
4.00	SK 100-400-OTS	SK 100-400-OTS-H	SK 100-400-OTS-C	SK 100-400-OTS-HC	SKD 100-400-OTS	SKD 100-400-OTS-H	SKD 100-400-OTS-HC
5.00	SK 100-500-OTS	SK 100-500-OTS-H	SK 100-500-OTS-C	SK 100-500-OTS-HC	SKD 100-500-OTS	SKD 100-500-OTS-H	SKD 100-500-OTS-HC
6.00	SK 137-600-OTS	SK 137-600-OTS-H	SK 137-600-OTS-C	SK 137-600-OTS-HC	SKD 137-600-OTS	SKD 137-600-OTS-H	SKD 137-600-OTS-HC
8.00	SK 137-800-OTS	SK 137-800-OTS-H	SK 137-800-OTS-C	SK 137-800-OTS-HC	SKD 137-800-OTS	SKD 137-800-OTS-H	SKD 137-800-OTS-HC

	OVERSIZE SINGLE ROD END				OVERSIZE DOUBLE ROD END		
		WITH CUSHIONS				WITH CUSHIONS	
BORE	PART NO.	H	C	HC	PART NO.	H	HC
1.50	SK 100-150-OTS	N/A	SK 100-150-OTS-C	N/A	SKD 100-150-OTS	N/A	N/A
2.00	SK 100-200-OTS	SK 100-200-OTS-H	SK 100-200-OTS-C	SK 100-200-OTS-HC	SKD 100-200-OTS	SKD 100-200-OTS-H	SKD 100-200-OTS-HC
2.50	SK 100-250-OTS	SK 100-250-OTS-H	SK 100-250-OTS-C	SK 100-250-OTS-HC	SKD 100-250-OTS	SKD 100-250-OTS-H	SKD 100-250-OTS-HC
3.25	SK 137-325-OTS	SK 137-325-OTS-H	SK 137-325-OTS-C	SK 137-325-OTS-HC	SKD 137-325-OTS	SKD 137-325-OTS-H	SKD 137-325-OTS-HC
4.00	SK 137-400-OTS	SK 137-400-OTS-H	SK 137-400-OTS-C	SK 137-400-OTS-HC	SKD 137-400-OTS	SKD 137-400-OTS-H	SKD 137-400-OTS-HC
5.00	SK 137-500-OTS	SK 137-500-OTS-H	SK 137-500-OTS-C	SK 137-500-OTS-HC	SKD 137-500-OTS	SKD 137-500-OTS-H	SKD 137-500-OTS-HC
6.00	SK 175-600-OTS	SK 175-600-OTS-H	SK 175-600-OTS-C	SK 175-600-OTS-HC	SKD 175-600-OTS	SKD 175-600-OTS-H	SKD 175-600-OTS-HC
8.00	SK 175-800-OTS	SK 175-800-OTS-H	SK 175-800-OTS-C	SK 175-800-OTS-HC	SKD 175-800-OTS	SKD 175-800-OTS-H	SKD 175-800-OTS-HC

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 two (2) of the above kits.

SERIES 'SS'

NOTE: To insure proper seals are supplied for all models, ALWAYS supply TRD serial number.

	STANDARD SINGLE ROD END				STANDARD DOUBLE ROD END		
		WITH CUSHIONS				WITH CUSHIONS	
BORE	PART NO.	H	C	HC	PART NO.	H	HC
1.50	SSSK 625-150	SSSK 625-150H	SSSK 625-150C	SSSK 625-150HC	SSSKD 625-150	SSSKD 625-150H	SSSKD 625-150HC
2.00	SSSK 625-200	SSSK 625-200H	SSSK 625-200C	SSSK 625-200HC	SSSKD 625-200	SSSKD 625-200H	SSSKD 625-200HC
2.50	SSSK 625-250	SSSK 625-250H	SSSK 625-250C	SSSK 625-250HC	SSSKD 625-250	SSSKD 625-250H	SSSKD 625-250HC
3.25	SSSK 100-325	SSSK 100-325H	SSSK 100-325C	SSSK 100-325HC	SSSKD 100-325	SSSKD 100-325H	SSSKD 100-325HC
4.00	SSSK 100-400	SSSK 100-400H	SSSK 100-400C	SSSK 100-400HC	SSSKD 100-400	SSSKD 100-400H	SSSKD 100-400HC
5.00	SSSK 100-500	SSSK 100-500H	SSSK 100-500C	SSSK 100-500HC	SSSKD 100-500	SSSKD 100-500H	SSSKD 100-500HC
6.00	SSSK 137-600	SSSK 137-600H	SSSK 137-600C	SSSK 137-600HC	SSSKD 137-600	SSSKD 137-600H	SSSKD 137-600HC
8.00	SSSK 137-800	SSSK 137-800H	SSSK 137-800C	SSSK 137-800HC	SSSKD 137-800	SSSKD 137-800H	SSSKD 137-800HC

	OVERSIZE SINGLE ROD END				OVERSIZE DOUBLE ROD END		
		WITH CUSHIONS				WITH CUSHIONS	
BORE	PART NO.	H	C	HC	PART NO.	H	HC
1.50	SSSK 100-150	N/A	SSSK 100-150C	N/A	SSSKD 100-150	N/A	N/A
2.00	SSSK 100-200	SSSK 100-200H	SSSK 100-200C	SSSK 100-200HC	SSSKD 100-200	SSSKD 100-200H	SSSKD 100-200HC
2.50	SSSK 100-250	SSSK 100-250H	SSSK 100-250C	SSSK 100-250HC	SSSKD 100-250	SSSKD 100-250H	SSSKD 100-250HC
3.25	SSSK 137-325	SSSK 137-325H	SSSK 137-325C	SSSK 137-325HC	SSSKD 137-325	SSSKD 137-325H	SSSKD 137-325HC
4.00	SSSK 137-400	SSSK 137-400H	SSSK 137-400C	SSSK 137-400HC	SSSKD 137-400	SSSKD 137-400H	SSSKD 137-400HC
5.00	SSSK 137-500	SSSK 137-500H	SSSK 137-500C	SSSK 137-500HC	SSSKD 137-500	SSSKD 137-500H	SSSKD 137-500HC
6.00	SSSK 175-600	SSSK 175-600H	SSSK 175-600C	SSSK 175-600HC	SSSKD 175-600	SSSKD 175-600H	SSSKD 175-600HC
8.00	SSSK 175-800	SSSK 175-800H	SSSK 175-800C	SSSK 175-800HC	SSSKD 175-800	SSSKD 175-800H	SSSKD 175-800HC

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 two (2) of the above kits.

CONVERSION CHARTS

FRACTION EQUIVALENTS

FRACTION (INCHES)	DECIMAL (INCHES)	METRIC (MM) (x 25.4)	FRACTION (INCHES)	DECIMAL (INCHES)	METRIC (MM) (x 25.4)	FRACTION (INCHES)	DECIMAL (INCHES)	METRIC (MM) (x 25.4)	FRACTION (INCHES)	DECIMAL (INCHES)	METRIC (MM) (x 25.4)
1/64	.016	.4	17/64	.266	6.8	33/64	.516	13.1	49/64	.766	19.5
1/32	.031	.8	9/32	.281	7.1	17/32	.531	13.5	25/32	.781	19.8
3/64	.047	1.2	19/64	.297	7.5	35/64	.547	13.9	51/64	.797	20.2
1/16	.062	1.6	5/16	.312	7.9	9/16	.562	14.3	13/16	.812	20.6
5/64	.078	2.0	21/64	.328	8.3	37/64	.578	14.7	53/64	.828	21.0
3/32	.094	2.4	11/32	.344	8.7	19/32	.594	15.1	27/32	.844	21.4
7/64	.109	2.8	23/64	.359	9.1	39/64	.609	15.5	55/64	.859	21.8
1/8	.125	3.2	3/8	.375	9.5	5/8	.625	15.9	7/8	.875	22.2
9/64	.141	3.6	25/64	.391	9.9	41/64	.641	16.3	57/64	.891	22.6
5/32	.156	4.0	13/32	.406	10.3	21/32	.656	16.7	29/32	.906	23.0
11/64	.172	4.4	27.64	.422	10.7	43/64	.672	17.1	59/64	.922	23.4
3/16	.187	4.7	7/16	.437	11.1	11/16	.687	17.4	15/16	.937	23.8
13/64	.203	5.2	29/64	.453	11.5	45/64	.703	17.9	61/64	.953	24.2
7/32	.219	5.6	15/32	.469	11.9	23/32	.719	18.3	31/32	.969	24.6
15/64	.234	5.9	31/64	.484	12.3	47/64	.734	18.6	63/64	.984	25.0
1/4	.250	6.3	1/2	.500	12.7	3/4	.750	19.0	1	1.000	25.4

TEMPERATURE EQUIVALENTS

FAHRENHEIT TO CELSIUS CONVERSION

F°	C°	F°	C°
-30	-34.4	130	54.4
-20	-28.9	140	60.0
-10	-23.3	150	65.6
0	-17.8	160	71.1
10	-12.2	170	76.7
20	-6.7	180	82.2
30	-1.1	190	87.8
40	4.4	200	93.3
50	10.0	210	98.9
60	15.6	220	104.4
70	21.1	230	110.0
80	26.7	240	115.6
90	32.2	250	121.1
100	37.8	300	148.9
110	43.3	350	176.7
120	48.9	400	204.4

C° = (F° - 32) ÷ 1.8

CELSIUS TO FAHRENHEIT CONVERSION

C°	F°	C°	F°
-30	-22	65	149
-20	-4	70	158
-10	14	75	167
0	32	80	176
5	41	85	185
10	50	90	194
15	59	95	203
20	68	100	212
25	77	105	221
30	86	110	230
35	95	115	239
40	104	120	248
45	113	125	257
50	122	130	266
55	131	150	302
60	140	200	392

F° = C° x 1.8 + 32

PRESSURE CONVERSIONS

PSI	KG/CM²	BARS	KG/CM²	PSI	BARS
60	4.2	4.1	4	56.9	3.9
70	4.9	4.8	5	71.1	4.9
80	5.6	5.5	6	85.3	5.9
90	6.3	6.2	7	99.5	6.9
100	7.0	6.9	8	113.8	7.8
150	10.5	10.3	9	128.0	8.8
200	14.0	13.8	10	142.2	9.8
250	17.6	17.2	20	284.4	19.6
300	21.1	20.7	30	426.6	29.4
350	24.6	24.1	40	568.8	39.2
400	28.1	27.6	50	711.0	49.0
450	31.6	31.0	60	853.2	58.8
500	35.1	34.4	70	995.4	68.6
550	38.7	37.9	80	1137.6	78.4
600	42.2	41.3	90	1279.8	88.2
650	45.7	44.8	100	1422.0	98.0
700	49.2	48.2	150	2133.0	147.0
750	52.7	51.7	200	2844.0	196.0
800	56.2	55.1	250	3555.0	245.0
850	59.8	58.6	300	4266.0	294.0
900	63.3	62.0	350	4977.0	343.0
950	66.8	65.5	—	—	—
1000	70.3	68.9	—	—	—
1500	105.5	103.4	—	—	—
2000	140.6	137.8	—	—	—
2500	175.8	172.3	—	—	—
3000	210.9	206.7	—	—	—
3500	246.1	241.2	—	—	—
4000	281.2	275.6	—	—	—
4500	316.4	310.1	—	—	—
5000	351.5	344.5	—	—	—

Kg/cm² = PSI x .0703
Bars = PSI x .0689

PSI = Kg/cm² x 14.22
Bars = Kg/cm² x .98

MEASUREMENT CONVERSIONS

INCHES	CM	MM	CM	INCHES
1	2.5	25.4	1	.4
2	5.1	50.8	2	.8
3	7.6	76.2	3	1.2
4	10.2	101.6	4	1.6
5	12.7	127.0	5	2.0
6	15.2	152.4	6	2.4
7	17.8	177.8	7	2.8
8	20.3	203.2	8	3.1
9	22.9	228.6	9	3.5
10	25.4	254.0	10	3.9
15	38.1	381.0	20	7.9
20	50.8	508.0	30	11.8
25	63.5	635.0	40	15.8
30	76.2	762.0	50	19.7
35	88.9	889.0	60	23.6
40	101.6	1016.0	70	27.6
45	114.3	1143.0	80	31.5
50	127.0	1270.0	90	35.5
55	139.7	1397.0	100	39.4
60	152.4	1524.0	110	43.3
65	165.1	1651.0	120	47.3
70	177.8	1778.00	130	51.2
75	190.5	1905.0	140	55.2
80	203.2	2032.0	150	59.1
85	215.9	2159.0	160	63.0
90	228.6	2286.0	170	67.0
95	241.3	2413.0	180	70.9
100	254.0	2540.0	190	74.9
—	—	—	200	78.8
—	—	—	210	82.7
—	—	—	220	86.7
—	—	—	230	90.6
—	—	—	240	94.6
—	—	—	250	98.5
—	—	—	260	102.4

cm = in. x 2.54 mm = in. x 25.4 in. = cm x .394

TECHNICAL DATA

COMMON FLUID POWER FORMULAS

PROPERTY	WORD FORMULA	MATHEMATIC EQUATION
FLUID PRESSURE psi (Pounds per Square Inch)	Pressure = $\frac{\text{Force (lbs)}}{\text{Area (in}^2\text{)}}$	$P = \frac{F}{A}$
CYLINDER AREA EXTEND in² (Square Inches)	Area = $\frac{\pi}{A4}$ x Diameter^2 (inches)	$A = .7854\ D^2$
CYLINDER AREA RETRACT in² (Square Inches)	Area = ($\frac{\pi}{A4}$ x Bore Diameter^2) – ($\frac{\pi}{A4}$ x Rod Diameter^2)	$A = (.7854\ D_b^2) - (.7854\ D_r^2)$
CYLINDER FORCE lbs. (Pounds of Force)	Force = Pressure (psi) x Net Area (in²)	$F = PA$
CYLINDER VELOCITY ft/s (Feet per Second)	Velocity = $\frac{231 \times \text{Flow Rate (GPM)}}{12 \times 60 \times \text{Net Area (in}^2\text{)}}$	$v = \frac{.3208\ Q}{A}$
CYLINDER VOLUME G (Gallons of Fluid)	Volume = $\frac{\text{Net Area (in}^2\text{)} \times \text{Stroke (in)}}{231}$	$V = \frac{A\ L}{231}$
CYLINDER FLOW RATE GPM (Gallons per Minute)	Flow Rate = $\frac{12 \times 60 \times \text{Velocity (ft/s)} \times \text{Net Area (in}^2\text{)}}{231}$	$Q = 3.117\ v\ A$
CYLINDER POWER hp (Horsepower)	Horsepower = $\frac{\text{Pressure (psi)} \times \text{Flow Rate (GPM)}}{1714}$	$hp = \frac{P\ Q}{1714}$
FLUID MOTOR TORQUE lb-in (Inch Pounds)	Torque = $\frac{\text{Pressure (psi)} \times \text{F.M. Displacement (in}^3\text{/rev.)}}{2\pi}$	$T = \frac{P\ d}{2\pi}$
	Torque = $\frac{\text{Horsepower} \times 63025}{\text{RPM}}$	$T = \frac{63025\ hp}{n}$
	Torque = $\frac{\text{Flow Rate (GPM)} \times \text{Pressure (psi)} \times 36.77}{\text{RPM}}$	$T = \frac{36.77\ Q\ P}{N}$
FLUID MOTOR SPEED RPM (Revolutions per Minute)	Speed = $\frac{231 \times \text{Flow Rate (GPM)}}{\text{F.M. Displacement (in}^3\text{/rev.)}}$	$n = \frac{231\ Q}{d}$
FLUID MOTOR POWER hp (Horsepower)	Horsepower = $\frac{\text{Torque (lbs-in)} \times \text{RPM}}{63025}$	$hp = \frac{T\ n}{63025}$
PUMP OUTLET FLOW GPM (Gallons per Minute)	Flow = $\frac{\text{RPM} \times \text{Pump Displacement (in}^3\text{/rev.)}}{231}$	$Q = \frac{n\ d}{231}$
FLOW RATE THROUGH PIPING ft/s Velocity (Feet per Second)	Velocity = $\frac{.3208 \times \text{Flow Rate Through I.D. (GPM)}}{\text{Internal Area (in}^2\text{)}}$	$v = \frac{.3208\ Q}{A}$
TORQUE REQUIREMENT lb-in (Inch Pounds)	Torque = Lever Length (in.) x Pull (lbs.)	$T = L \times F$

TECHNICAL DATA: TRD APPLICATION CHECK LIST

Date
/ /

Need help selecting the right cylinder for your application? Just fill out as much information about your application and contact your local distributor or TRD. (TRD Customer Service fax: 815-654-0690. E-mail: techsupport@trdmfg.com)

DISTRIBUTOR INFORMATION

Distributor: _____ Branch Office: _____ Contact: _____

How do you want to be contacted?

Phone: _____ Fax: _____ E-Mail: _____

CUSTOMER INFORMATION

Customer: _____ Contact: _____

_____

How do you want to be contacted?

Phone: _____ Fax: _____ E-Mail: _____

APPLICATION INFORMATION

Do you have a basic cylinder description?

Bore: _____ Stroke: _____ Mount: _____ Options: _____

Modification: _____

Cylinder Operating Pressure: ❑ Pneumatic _____ PSI ❑ Hydraulic _____ PSI (Non-Shock)

Ambient Temperature: ❑ Normal Indoor Industrial ❑ Cold: _____ °F ❑ Hot: _____ °F

Cylinder Velocity: _____ inches/second Cycles per Minute: _____

Cylinder Orientation: ❑ Horizontal ❑ Vertical: ❑ Rod Up ❑ Rod Down ❑ Angle: _____ (Degrees)

Describe the load (including weight). Is the load guided? How is the cylinder rod attached to the load? Any side load?

_____

_____

_____

_____

Application: _____

_____

_____

_____

_____

Sketch:
(include dimensions)

TECHNICAL DATA: TRD APPLICATION CHECK LIST

Date
/ /

Need help selecting the right cylinder for your application? Just fill out as much information about your application and contact your local distributor or TRD. (TRD Customer Service fax: 815-654-0690. E-mail: techsupport@trdmfg.com)

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_____

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Ambient Temperature: ❑ Normal Indoor Industrial ❑ Cold: _____ °F ❑ Hot: _____ °F

Cylinder Velocity: _____ inches/second Cycles per Minute: _____

Cylinder Orientation: ❑ Horizontal ❑ Vertical: ❑ Rod Up ❑ Rod Down ❑ Angle: _____ (Degrees)

Describe the load (including weight). Is the load guided? How is the cylinder rod attached to the load? Any side load?

_____

_____

_____

_____

Application: _____

_____

_____

_____

_____

Sketch:
(include dimensions)

Ask your local distributor about these other products:

BIMBA FULL LINE CATALOG

Setting a new standard for:

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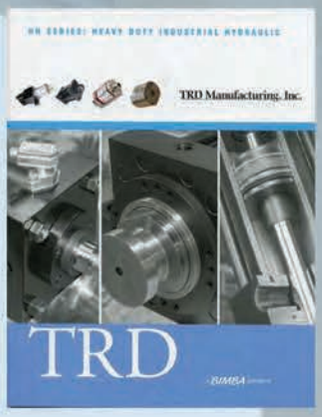

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1.50″ TO 8.00″ BORE

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15″ BORE MULTI-STAGE DEVELOPS OVER 100,000 POUNDS OF FORCE @ 100 PSI AIR

TRD DELIVERIES (F.O.B. Factory)

SERIES	DELIVERY SCHEDULE
TA, TD, FM, TRA, MSE, MSR	2-3 Days
BTB, TM, 3P	2-3 Days
Air Boosters, Air/Oil Tanks, BTP	2-3 Days
SS, TAS (excluding MP1, MP4, MS2 mounts)	2-3 Days
SS, TAS with MP1, MP4, MS2 mounts	3-5 Days
SS-MSE, SS-MSR	3-5 Days
RS	4-6 Days
TC	5-7 Days
PFLF	7-10 Days
TRD Switches	1 Day
Rod Clevis, Pins & Mounts, Alignment Couplers.	1 Day
Balluff Strokemaster	7-10 Days
Balluff Micropulse Transducers	10-12 Days

STANDARD OPTIONS INCLUDED IN ABOVE DELIVERIES

OPTIONS WITH EXTENDED DELIVERY

SE, SR (with catalog spring rates)	3-5 Days
SMT1, SMT2 (one-Piece steel mount)	3-5 Days
MP4SP Mounts	3-5 Days
Special Piston Materials (PMB, PMC, PMD options)	5-7 Days
EN plating option	5-7 Days
Non Catalog welded mounts (for bore sizes up to 12.00"	5-7 Days
LTE Seal Option	35-40 Days

RUSH SERVICE

RUSH SERVICES ARE AVAILABLE FOR ALL TRD PRODUCTS. CONTACT YOUR LOCAL TRD DISTRIBUTOR FOR DETAILS.

Your Local Distributor:

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Fax: 815-654-0690
Email: sales@trdmfg.com
www.trdmfg.com

National FLUID POWER Association MEMBER

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Phone: 708-534-8544
Toll Free: 800-44-BIMBA
Fax: 708-235-2014
Email: support@bimba.com
www.bimba.com

TRD DELIVERIES (F.O.B. Factory)

SERIES	DELIVERY SCHEDULE
TA, TD, FM, TRA, MSE, MSR	2-3 Days
BTB, TM, 3P	2-3 Days
Air Boosters, Air/Oil Tanks, BTP	2-3 Days
SS, TAS (excluding MP1, MP4, MS2 mounts)	2-3 Days
SS, TAS with MP1, MP4, MS2 mounts	3-5 Days
SS-MSE, SS-MSR	3-5 Days
RS (4.00" to 8.00" Bore)	4-6 Days
RS (1.50" to 3.25" Bore)	10-12 Days
TC	5-7 Days
PFLF	7-10 Days
TRD Switches	1 Day
Rod Clevis, Pins & Mounts, Alignment Couplers.	1 Day
Balluff Strokemaster	7-10 Days
Balluff Micropulse Transducers	10-12 Days

STANDARD OPTIONS INCLUDED IN ABOVE DELIVERIES

OPTIONS WITH EXTENDED DELIVERY

SE, SR (with catalog spring rates)	3-5 Days
SMT1, SMT2 (one-Piece steel mount)	3-5 Days
MP4SP Mounts	3-5 Days
Special Piston Materials (PMB, PMC, PMD options)	5-7 Days
EN plating option	5-7 Days
Non Catalog welded mounts (for bore sizes up to 12.00"	5-7 Days
LTE Seal Option	35-40 Days

RUSH SERVICE

RUSH SERVICES ARE AVAILABLE FOR ALL TRD PRODUCTS. CONTACT YOUR LOCAL TRD DISTRIBUTOR FOR DETAILS.

Your Local Distributor:

Worldwide distribution means there is a professional stocking Bimba distributor nearby ready to service your needs.

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