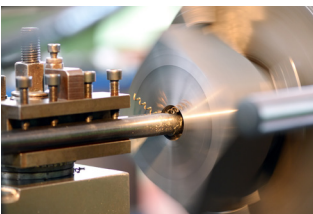




HYDRAULIC CYLINDERS INC.®

# PNEUMATIC CATALOG



## **WARRANTY**

HYDRAULIC CYLINDERS INC.® warrants its cylinders for a full three years to be free from defects in material and workmanship. HYDRAULIC CYLINDERS INC.® must be notified prior to returning product for warranty evaluation. A Returned Goods Authorization (RGA) number will be issued for proper tracking and expedite service on all warranty evaluations. HYDRAULIC CYLINDERS INC.® 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 HYDRAULIC CYLINDERS INC.® 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 HYDRAULIC CYLINDERS INC.® be liable for any consequential damages or installation costs resulting from delay or failure of delivery, defective material/workmanship or out of breach by HYDRAULIC CYLINDERS INC.® of any contract.

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## QUICK GUIDE – Design the Right Cylinder for Your Application

HYDRAULIC CYLINDERS INC.® 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.

### 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.

HYDRAULIC CYLINDERS INC.® 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 one-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** – It 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 HCS 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. HCS 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 affect 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 HCS; 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 HYDRAULIC CYLINDERS INC.® Manufacturing series has a standard rod and oversized (OS) 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?

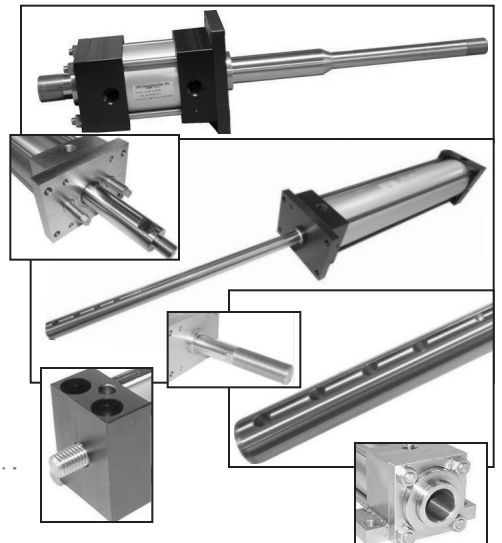
Many times the “C=” dimension needs to be altered to provide a drop-in replacement to an existing cylinder model or allow for additional cylinder clearance in an application. The cost adder is minimal because you are only paying for the additional rod material.

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, HYDRAULIC CYLINDERS INC.® has assembled the cylinders and milled/drilled the rods as a secondary operation.



### 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” 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  $+.060$ ”. HYDRAULIC CYLINDERS INC.® 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 Micro-Adjust (MA) to provide a precise, adjustable stroke output. Cylinder strokes can be made to close tolerances down to  $\pm .005$ ” 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 bumper piston (BP) 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.

### Temperatures – High, Low and Everything in Between...

**Standard operating temperature range of products: -20° F to +200° F (-29° C to +93° 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 (-54° C) rated seals and lubricant are available. Ideal for freezer applications.

High temperature range: +400° F (+204° C) rated seals and lubricant are available. Ideal for furnace applications.

### 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 is not enough room to cover all the application possibilities and solutions; contact your local distributor for more information and for application assistance.

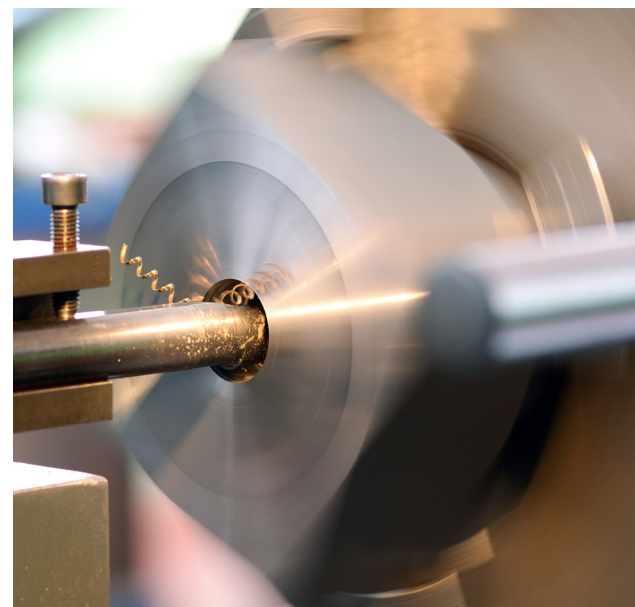
### Side Load – The Good, the Bad and the Ugly...

Everyone knows that a 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.

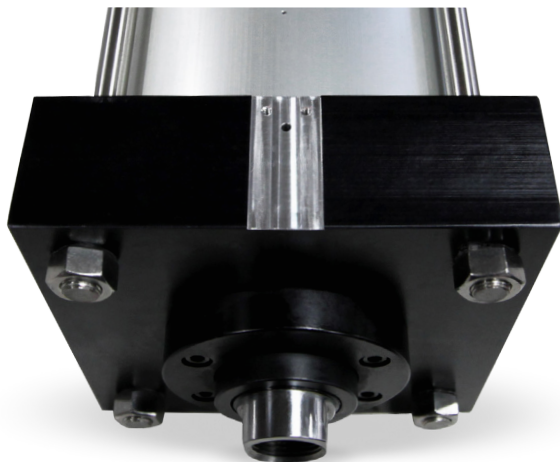
If you are experiencing tube scoring, there are some solutions available. Special length pistons can be provided to handle multiple wear bands or extra-long wear bands. We have also used solid Delrin® pistons to increase the contact surface between the piston and tube, with excellent results. Special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

**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!**

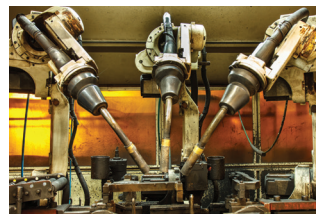
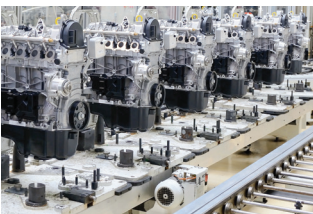
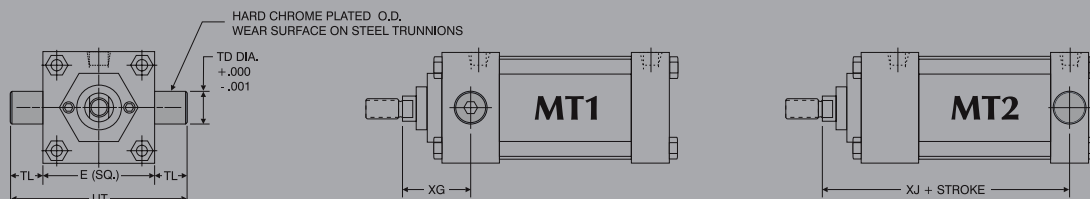


## HCA Series NFPA Aluminum Cylinders | 1.50" to 12.00" Bore

PNEUMATIC



- Single Rod End ..... 8
- Double Rod End ..... 16

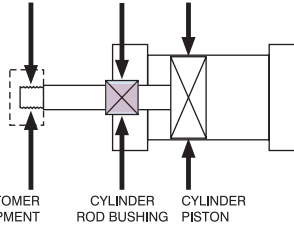


# SERIES 'HCA' (NFPA) CYLINDER

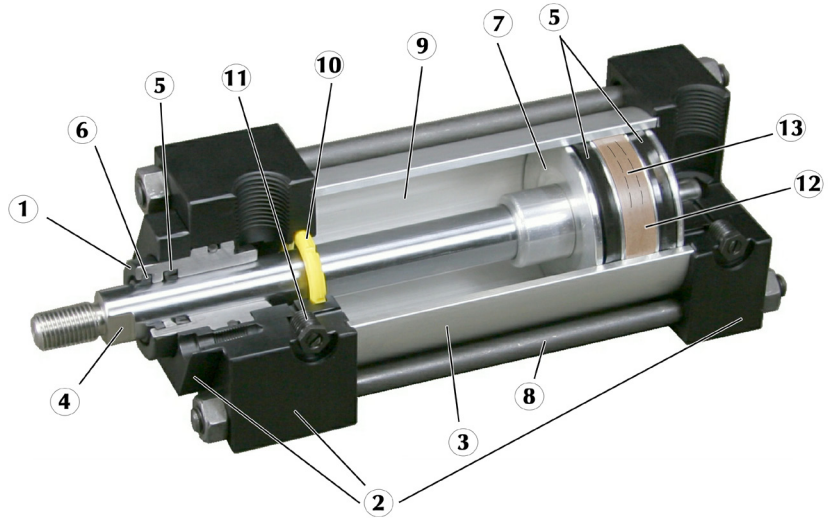
## Floating Rod Bushing

### 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 Carboxylated Nitrile construction. Seals are pressure activated and wear-compensating for long life (self-lubricating material).

**6: ROD WIPER** – Abrasion resistant urethane provides aggressive wiping action in all environments. External lip design prevents debris from entering cylinder.

**7: PISTON** – Precision machined from 6061-T651 alloy aluminum, provides an excellent bearing surface for extended cylinder life.

**8: TIE RODS** – 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 HYDRAULIC CYLINDERS INC.® magnetically operated reed and solid state switches

### OPERATING PRESSURE

250 PSI AIR (17 BAR)

### OPERATING TEMPERATURE

Carboxylated Nitrile: -20° F to 200° F (-29° C to 93° C) Fluorocarbon: 0° F to 400° F (-18° C to 204° C)

### PERFORMANCE OPTIONS:

- **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 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 'HCA' (STANDARD CYLINDER)

HCA - MF1 - 2.50 x 10 - HC - MPR

SERIES
HCA 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"- 8.00" 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)
MX0	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)

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

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

Example: FCLH, FCELH

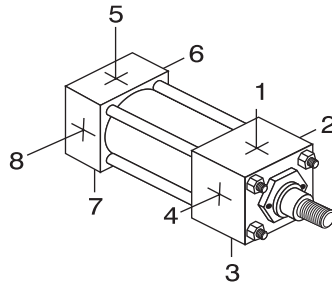
OPTIONS	
A =	EXTENDED PISTON ROD THREAD (EXAMPLE: A = 2")
AS	ADJUSTABLE STROKE - RETRACT (SPECIFY LENGTH, EXAMPLE: AS = 4")
A / O	AIR / OIL PISTON
X B	.250" URETHANE BUMPER BOTH ENDS
X BC	.250" URETHANE BUMPER CAP ONLY
X BH	.250" URETHANE BUMPER HEAD ONLY
BP	BUMPER PISTON SEALS (1.50" - 8" BORE)
BSP	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	STUDED 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 (12" MAX STROKE) AVAILABLE ON DOUBLE ROD END MODELS
MAB	MICRO-ADJUST W/ SOUND DAMPENING BUMPER (12" MAX STROKE)
MPR	MAGNETIC PISTON FOR REED OR SOLID STATE SWITCHES - MODELS: R10, R10P, RAC, RHT & MSS (Refer to pages 223-230)
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 & 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: HCA 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.

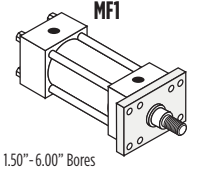
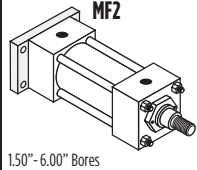
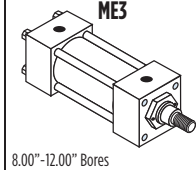
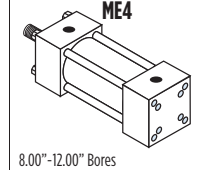
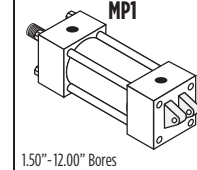
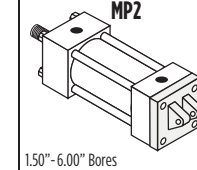
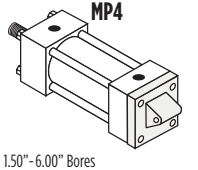
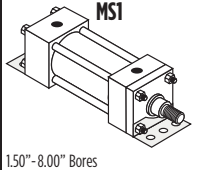
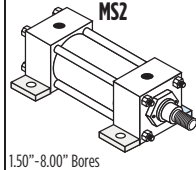
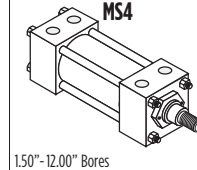
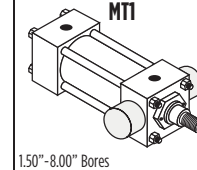
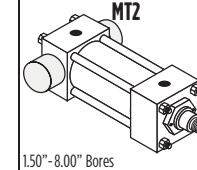
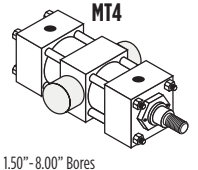
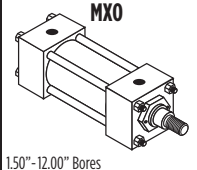
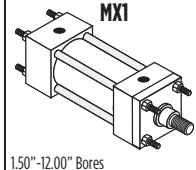
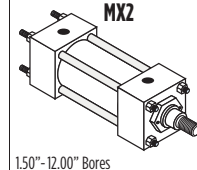
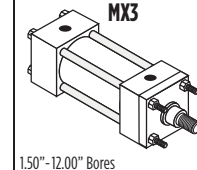
**Part Number:** HCA-MF1-2.50 x 10-HC-MPR



## STANDARD PORT AND CUSHION ADJUSTMENT POSITIONS

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

## NFPA MOUNTS

 1.50"-6.00" Bores	 1.50"-6.00" Bores	 8.00"-12.00" Bores	 8.00"-12.00" Bores	 1.50"-12.00" Bores	 1.50"-6.00" Bores
 1.50"-6.00" Bores	 1.50"-8.00" Bores	 1.50"-8.00" Bores	 1.50"-12.00" Bores	 1.50"-8.00" Bores	 1.50"-8.00" Bores
 1.50"-8.00" Bores	 1.50"-12.00" Bores	 1.50"-12.00" Bores	 1.50"-12.00" Bores	 1.50"-12.00" Bores	

OPTION LENGTH ADDER		OPTION				ST* (STOP TUBE) EXAMPLE: ST=2
BORE	B	BC	BH	ELC	ELH	
1.50	0.500	0.250	0.250	1.000	1.000	2
2.00	0.500	0.250	0.250	1.000	1.000	REFER TO PAGE 184
2.50	0.500	0.250	0.250	1.000	1.000	FOR LENGTH ADDERS AND AVAILABLE BORE SIZES AND STROKES
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.

# SERIES 'HCA' DIMENSIONS: BASIC CYLINDER (NO MOUNT)

## ABOUT ROD END STYLES

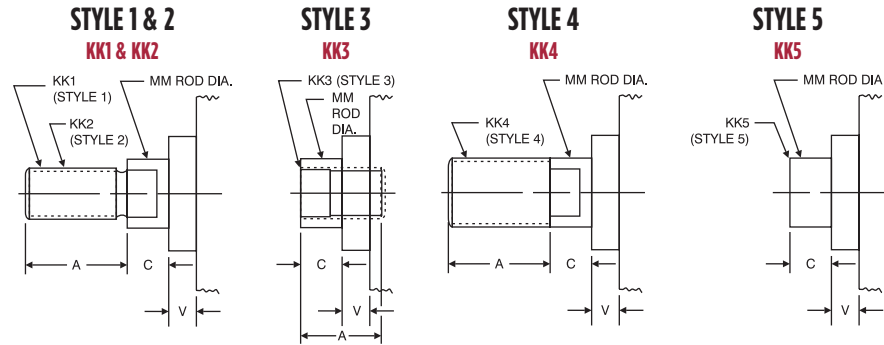
Style 1 Male Rod End is STANDARD

Other NFPA styles can be specified (see chart).

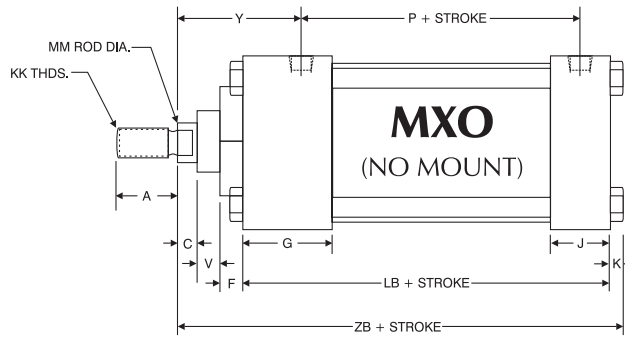
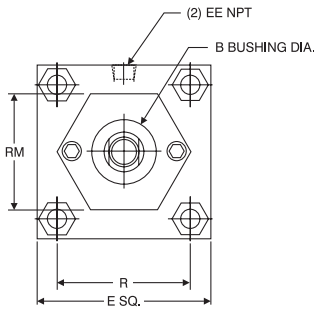
Need a rod end not listed?  
NO PROBLEM! Each Piston Rod is made-to-order and does not delay shipment. Coarse UNC threads, Metric threads or just plain rod ends are common. Thread lengths are also made-to-order (Specify: "A"=Length).

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

## PISTON ROD END STYLES



BORE	MM ROD DIAMETER	STANDARD		OPTIONAL							C	V
		Style 1 - Male	Style 2 - Male	Style 3 - Female	Style 4 - Male	Style 5 - Blank						
		KK1	A	KK2	A	KK3	A	KK4	A	KK5		
1.50,	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
2.00, 2.50	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,	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
4.00, 5.00	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	7/16 -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

EASY FLIP OUT PAGE FOR REFERENCE

HCA SERIES / DIMENSIONS

# SERIES 'HCA' DIMENSIONS: BASIC CYLINDER (NO MOUNT)

## ABOUT ROD END STYLES

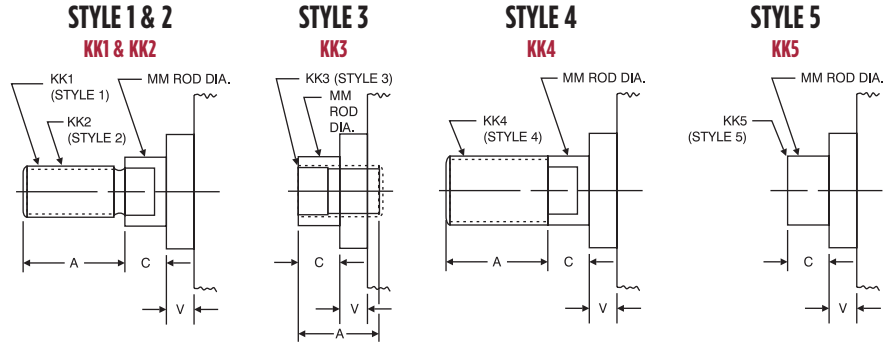
### Style 1 Male Rod End is STANDARD

Other NFPA Styles can be specified (see chart).

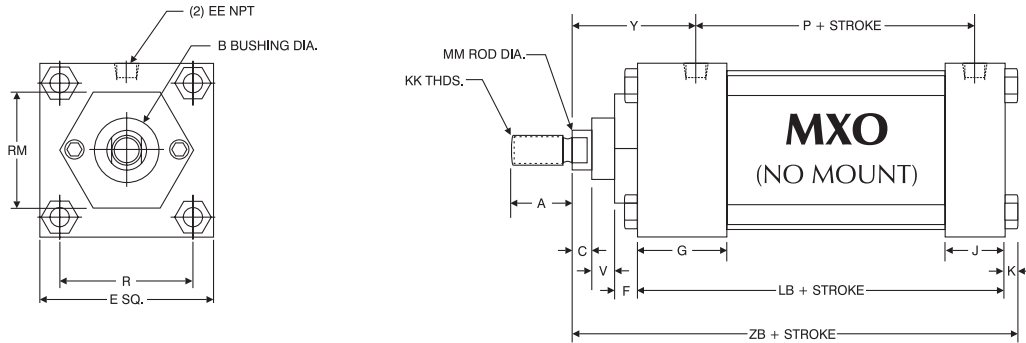
Need a rod end not listed?  
NO PROBLEM! Each Piston Rod is made-to-order and does not delay shipment. Coarse UNC threads, Metric threads or just plain rod ends are common. Thread lengths are also made-to-order (Specify: "A"=Length).

NEED SOMETHING NOT LISTED?  
Just send us a sketch.  
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## PISTON ROD END STYLES

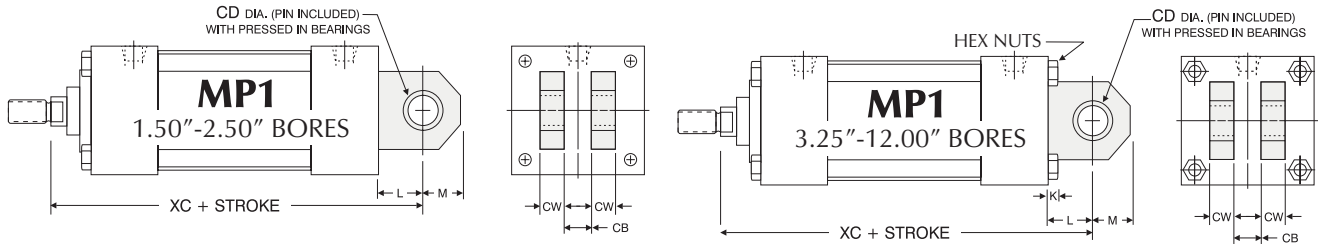


BORE	MM ROD DIAMETER	STANDARD					OPTIONAL					C	V
		Style 1 - Male		Style 2 - Male		Style 3 - Female		Style 4 - Male		Style 5 - Blank			
		KK1	A	KK2	A	KK3	A	KK4	A	KK5			
1.50, 2.00, 2.50	0.625 Standard	7/16 -20	0.750	1/2 -20	0.750	7/16 -20	0.750	5/8 -18	0.750	No Threads	0.375	0.250	
	1.000 Oversize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



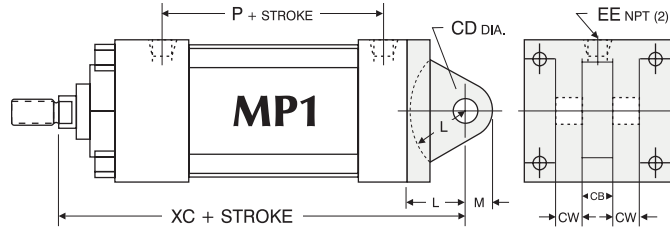
BASIC DIMENSIONS 'MXO' STANDARD & OVERSIZE RODS																			
BORE	ROD DIAMETER	A	B	C	E	EE	F	G	J	K	KK	LB	MM	P	R	RM	V	Y	ZB
1.50	0.625 Standard	0.750	1.125	0.375	2.000	0.375	0.375	1.500	1.000	0.250	7/16 -20	3.625	0.625	2.375	1.438	2.00 SQ.	0.250	1.875	4.875
	1.000 Oversize	1.125	1.500	0.500							1.000		0.500				2.250		
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	0.625	2.375	1.844	1.75 HEX	0.250	1.875	4.938
	1.000 Oversize	1.125	1.500	0.500							1.000		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							1.000		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							1.375		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							1.375		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							1.375		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							1.750		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							1.750		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			1.750				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							1.750		0.500			3.438	9.813		

# SERIES 'HCA' DIMENSIONS: PIVOT MOUNTS



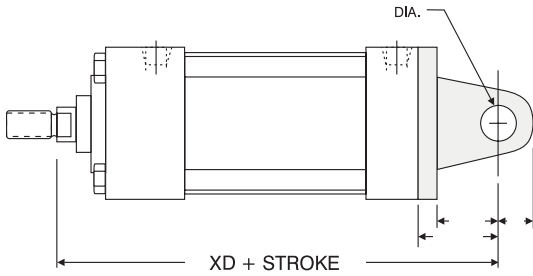
## EXTRUDED MP1 MOUNT

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

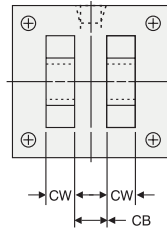


## IRON CASTING MP1 MOUNT

(OPTIONAL)\*\*

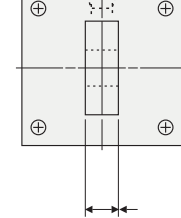


## MP2/MP4



## MP2 MOUNT

(IRON CASTING)



## MP4 MOUNT

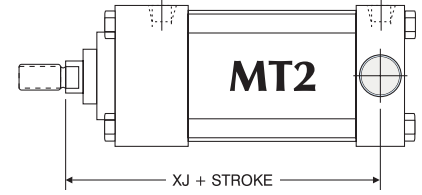
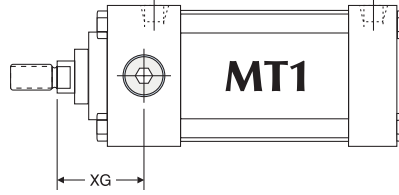
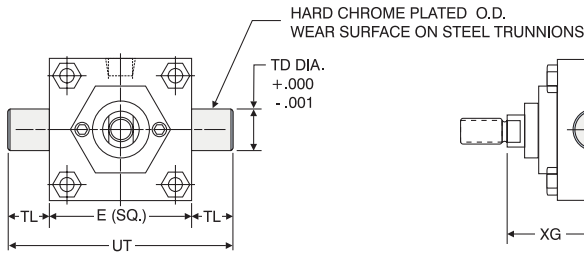
(IRON CASTING: 1.50" - 4.00" BORES, WELDMENT: 5.00" - 6.00" BORES\*)

'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	EB500	CB500
	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	EB500	CB500
	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	EB750	CB750
	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	EB750	CB750
	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	EB1000	CB1000
	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	EB1750	CB1750
	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.

\*\*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 'HCA' DIMENSIONS: PIVOT MOUNTS

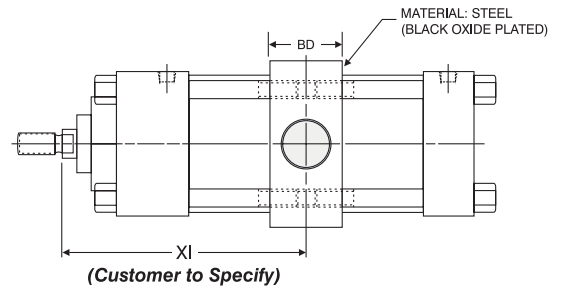
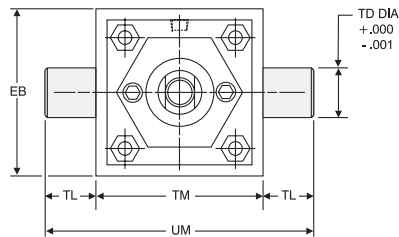


**Note: MT1 and MT2 Trunnions are bolt on, non-removable design.**  
**Optional: One-piece solid steel trunnion available.**

## MT1 / MT2

'MT1' HEAD TRUNNION AND 'MT2' CAP TRUNNION MOUNT DIMENSIONS							ACCESSORIES (SEE PAGES 210-211 FOR DIMENSIONS)			
BORE	ROD DIAMETER	E	HCD	TL	UT	XG	ADD STROKE	ROD CLEVIS	ROD EYE	CLEVIS PIN
							XJ			
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.



## MT4

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

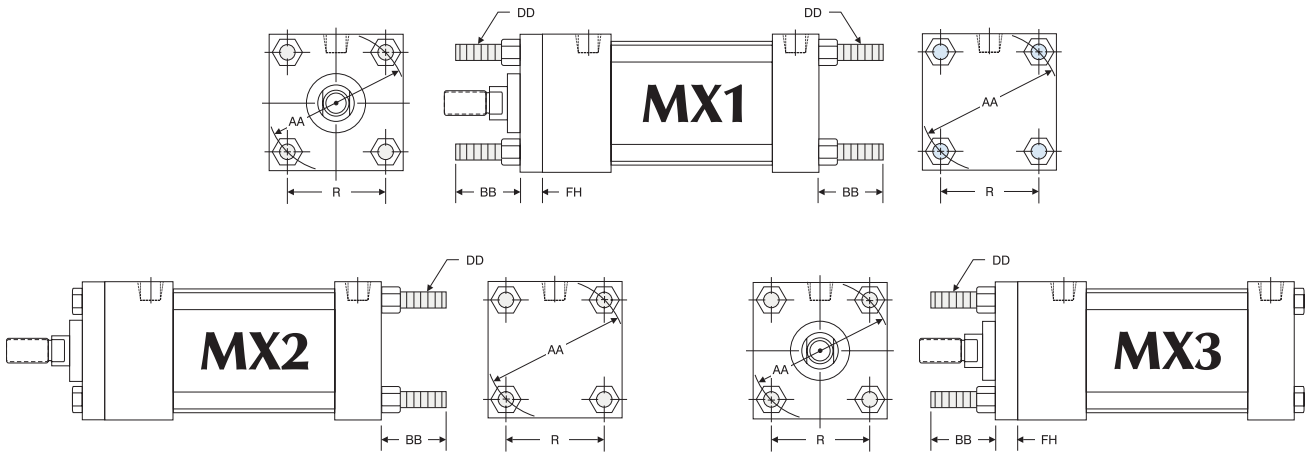
**Note: MT4 Trunnions and Intermediate Section are one-piece steel construction.**

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

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

'MT4' INTERMEDIATE TRUNNION MOUNT DIMENSIONS							
BORE	BD	EB	HCD	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	

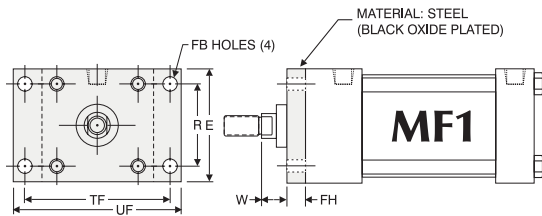
# SERIES 'HCA' DIMENSIONS: TIE ROD & FLANGE MOUNTS



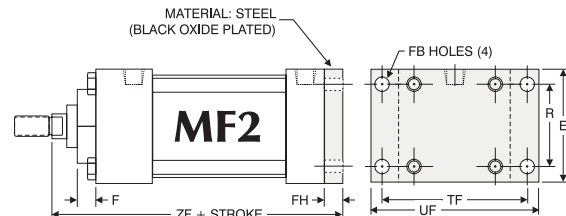
TIE ROD EXTENDED 'MX1', 'MX2' & 'MX3' MOUNT DIMENSIONS						
BORE	ROD DIAMETER	AA	BB	DD	FH	R
1.50	0.625 Standard	2.020	1.000	1/4 -28	0.375	1.430
	1.000 Oversize					
2.00	0.625 Standard	2.600	1.125	5/16 -24	0.375	1.840
	1.000 Oversize					
2.50	0.625 Standard	3.100	1.125	5/16 -24	0.375	2.190
	1.000 Oversize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

TIE ROD EXTENDED 'MX1', 'MX2' & 'MX3' MOUNT DIMENSIONS						
BORE	ROD DIAMETER	AA	BB	DD	FH	R
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					
10.00	1.750 Oversize	11.200	2.688**	3/4 -16	0.625*	7.920
	2.000 Oversize				0.750*	
12.00	2.000 Standard	13.300	2.688**	3/4 -16	0.750*	9.400
	2.500 Oversize					

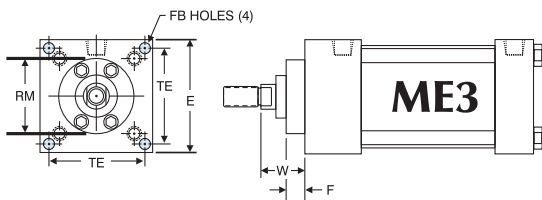
\*MX1 & MX3 have full square bushing retainer on 1.50" - 6.00" bores, round retainers on 8.00" - 12.00" bores.  
 \*\*BB dimension from face of head.



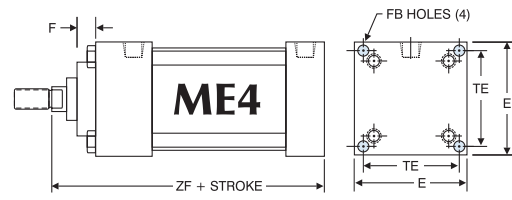
1.50" - 6.00" BORES



1.50" - 6.00" BORES



8.00" - 12.00" BORES



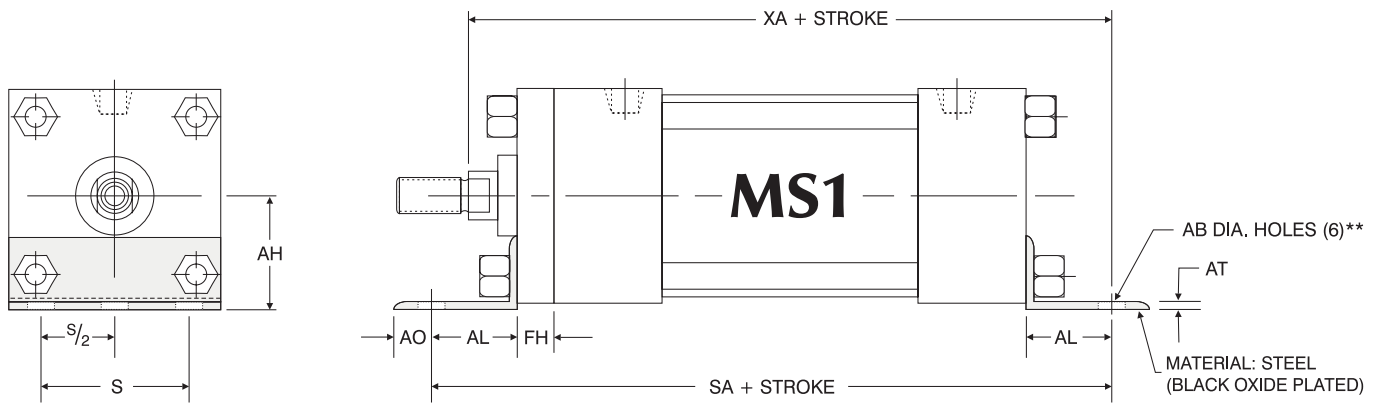
8.00" - 12.00" BORES

'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	2.000	0.375	0.313	0.375	1.438	-	-	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	0.375	1.848	-	-	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	0.375	2.188	-	-	3.875	4.625	0.625	5.125
	1.000 Oversize										1.000	5.500
3.25	1.000 Standard	3.750	0.625	0.438	0.625	2.766	-	-	4.688	5.500	0.750	6.250
	1.375 Oversize										1.000	6.500
4.00	1.000 Standard	4.500	0.625	0.438	0.625	3.328	-	-	5.438	6.250	0.750	6.250
	1.375 Oversize										1.000	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	5.500	0.625	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	0.625	0.563	0.750	4.875	-	-	7.625	8.625	0.875	7.375
	1.750 Oversize										1.125	7.625
8.00	1.375 Standard	8.500	0.625	0.688	N/A	N/A	3.500	7.570	N/A	N/A	1.625	6.750
	1.750 Oversize										1.875	7.000
10.00	1.750 Standard	10.625	0.625	0.813	N/A	N/A	3.500	9.400	N/A	N/A	1.875	8.250
	2.000 Oversize										2.000	8.375
12.00	2.000 Standard	12.750	0.750	0.813	N/A	N/A	5.000	11.100	N/A	N/A	2.000	8.875
	2.500 Oversize										2.250	9.125

# SERIES 'HCA' DIMENSIONS: BASE MOUNTS

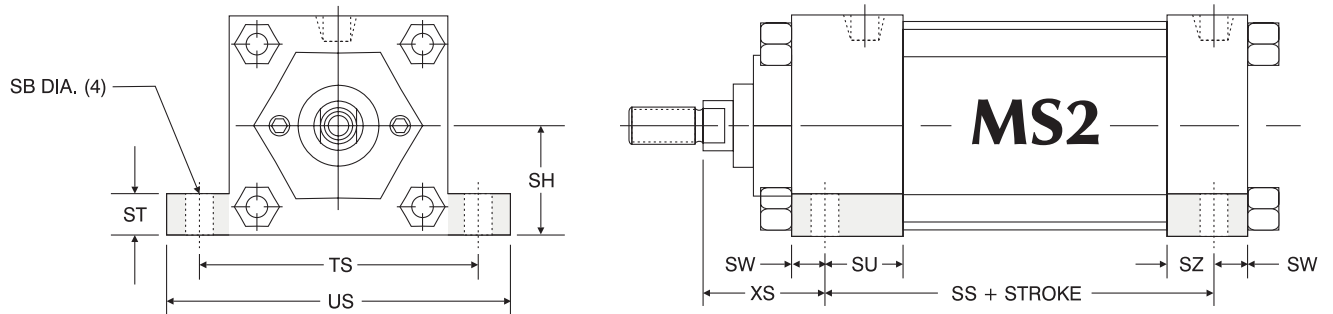
HCA / SINGLE ROD MOUNTS



'MS1' ANGLE MOUNT DIMENSIONS										
BORE	ROD DIAMETER	AB	AH	AL	AO	AT	FH	S	ADD STROKE	
									SA	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

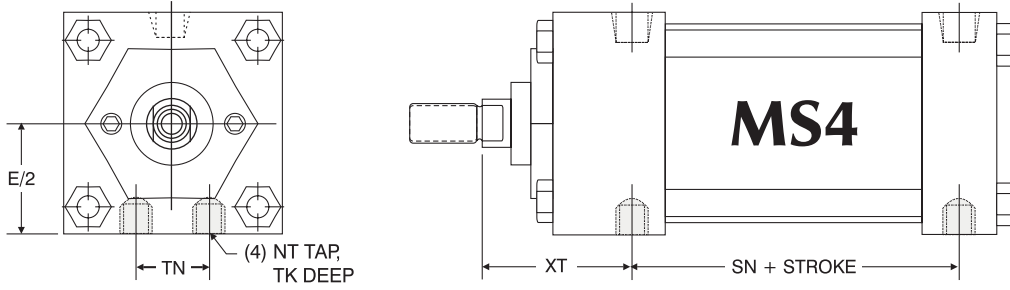
\*3.50" diameter round retainer on 8.00" bore (MS1 BRACKET BOLTED DIRECTLY TO HEAD).

\*\*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
											HCS
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										
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										
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										
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										
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										
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										
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										
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										

# SERIES 'HCA' 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						
2.00	0.625 Standard	1.250	5/16 -18	0.500	0.875	1.938	2.250
	1.000 Oversize						
2.50	0.625 Standard	1.500	3/8 -16	0.625	1.250	1.938	2.375
	1.000 Oversize						
3.25	1.000 Standard	1.875	1/2 -13	0.750	1.500	2.438	2.625
	1.375 Oversize						
4.00	1.000 Standard	2.250	1/2 -13	0.750	2.063	2.438	2.625
	1.375 Oversize						
5.00	1.000 Standard	2.750	5/8 -11	1.000	2.688	2.438	2.875
	1.375 Oversize						
6.00	1.375 Standard	3.250	3/4 -10	1.125	3.250	2.813	3.125
	1.750 Oversize						
8.00	1.375 Standard	4.250	3/4 -10	1.125	4.500	2.813	3.250
	1.750 Oversize						
10.00	1.750 Standard	5.313	1 -8	1.500	5.500	3.125	4.125
	2.000 Oversize						
12.00	2.000 Standard	6.375	1 -8	1.500	7.250	3.250	4.625
	2.500 Oversize						

## 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.

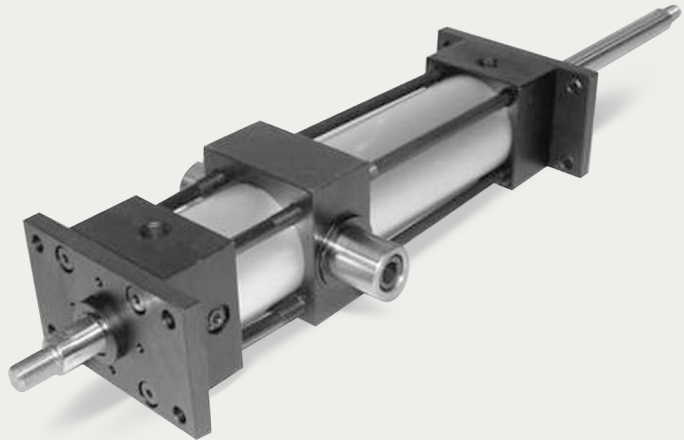
### Example:

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

### Part Number:

HCA-MS4-MF1-5 x 12-HC-MPR

(HCF-MF1-MF2-MT4D)

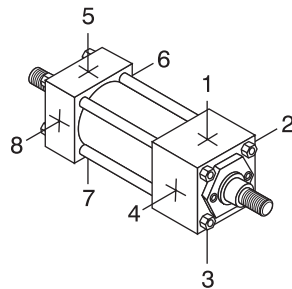
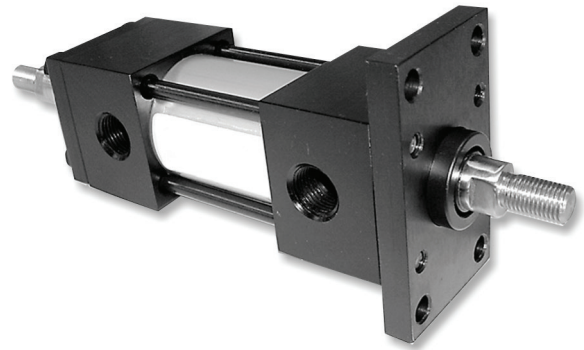




# SERIES 'HCA' DIMENSIONS: DOUBLE ROD END

## Benefits

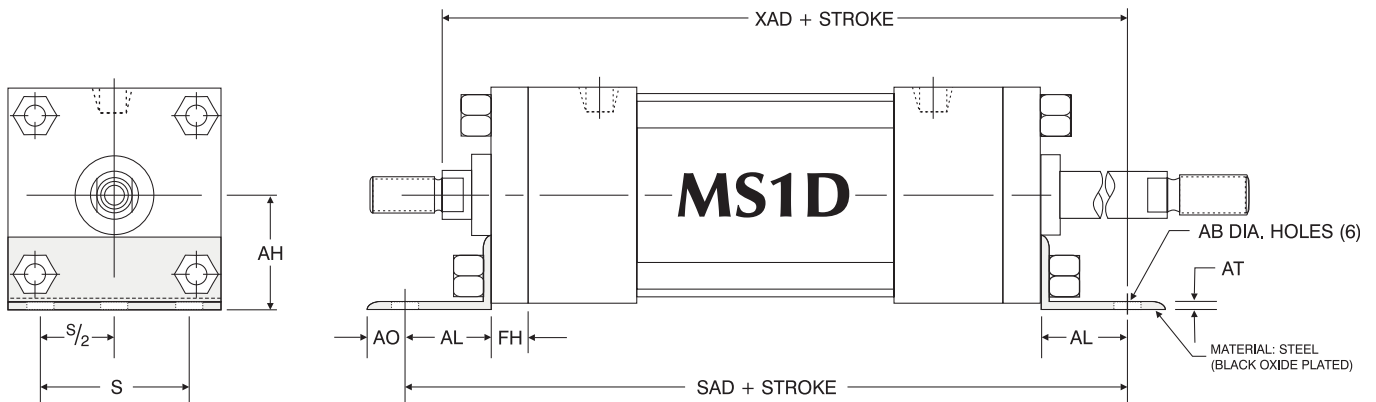
- Standard and Oversize Piston Rods available.
- Full range of Standard Options.
- Durable design. Full Rod Bearing at each end of cylinder.
- Can be provided with Hollow Piston Rods (gun-drilled through to your size requirements).
- Can be used in adjustable extend stroke applications by adding a stop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



### STANDARD PORT AND CUSHION ADJUSTMENT POSITIONS

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

# SERIES 'HCA' DIMENSIONS: DOUBLE ROD END BASE MOUNTS



'MS1D' ANGLE MOUNT DIMENSIONS										
BORE	ROD DIAMETER	AB	AH	AL	AO	AT	FH	S	ADD STROKE	
									SAD	XAD
1.50	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 'HCA' DIMENSIONS: DOUBLE ROD END

## ABOUT ROD END STYLES

### Style 1 Male Rod End is STANDARD

Other NFPA Styles can be specified (see chart).

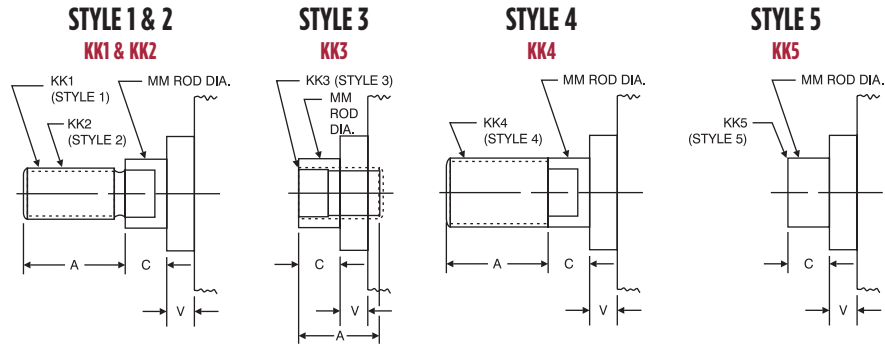
Need a rod end not listed? NO PROBLEM! Each Piston Rod is made-to-order and does not delay shipment. Coarse UNC threads, Metric threads or just plain rod ends are common. Thread lengths are also made-to-order (Specify: "A"=Length).

### NEED SOMETHING NOT LISTED?

Just send us a sketch.

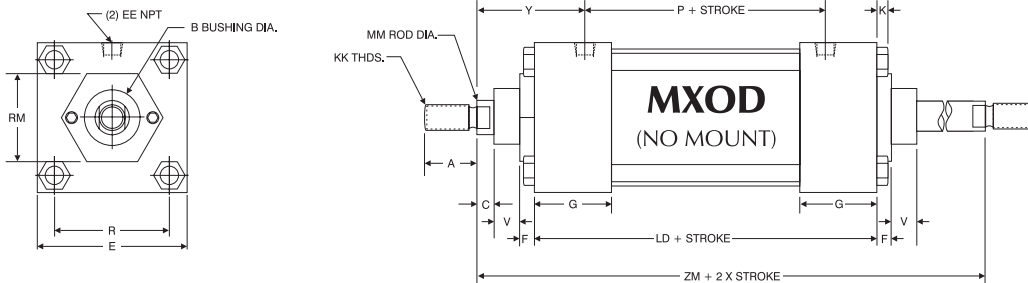
In most cases, quotes are turned around in one day!

## PISTON ROD END STYLES



BORE	MM ROD DIAMETER	STANDARD				OPTIONAL						C	V
		Style 1 - Male		Style 2 - Male		Style 3 - Female		Style 4 - Male		Style 5 - Blank			
		KK1	A	KK2	A	KK3	A	KK4	A	KK5			
1.50,	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	
2.00, 2.50	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,	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	
4.00, 5.00	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						
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			2.500			
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			3.000			
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			3.750			
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.			
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.			
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			5.000			
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			5.000			
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			1 1/2 -12			2.000		5.000			3.188			
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			5.000			

# SERIES 'HCA' DIMENSIONS: DOUBLE ROD END

## ABOUT ROD END STYLES

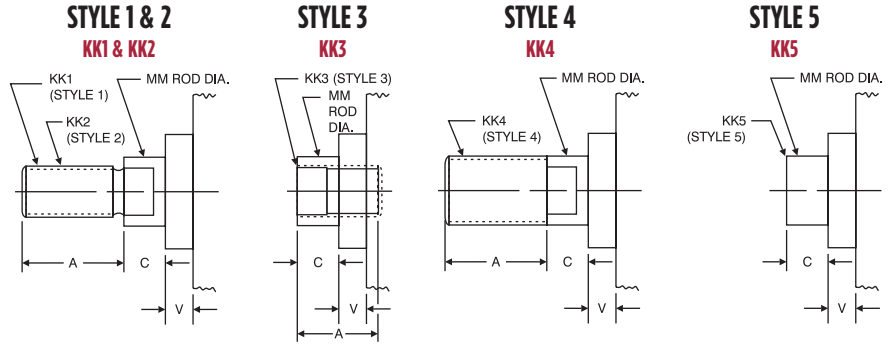
### Style 1 Male Rod End is STANDARD

Other NFPA Styles can be specified (see chart).

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

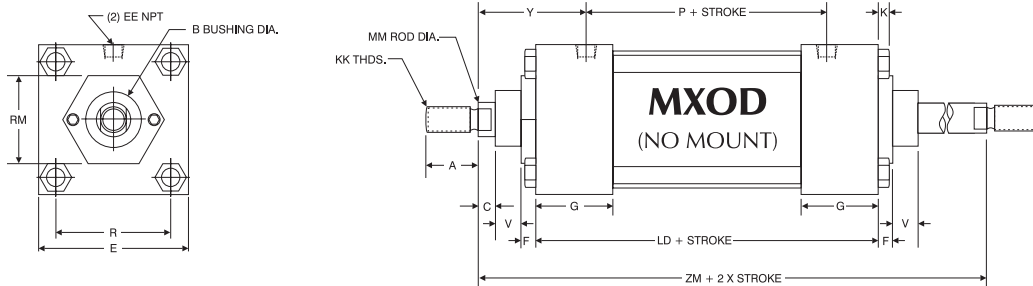
NEED SOMETHING NOT LISTED?  
 Just send us a sketch.  
 In most cases, quotes are turned around in one day!

## PISTON ROD END STYLES



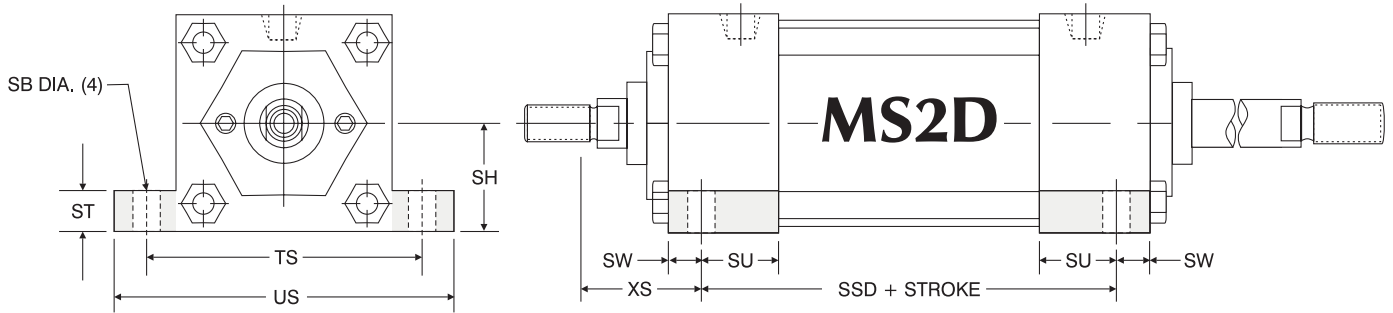
BORE	MM ROD DIAMETER	STANDARD				OPTIONAL						C	V
		Style 1 - Male		Style 2 - Male		Style 3 - Female		Style 4 - Male		Style 5 - Blank			
		KK1	A	KK2	A	KK3	A	KK4	A	KK5			
1.50,	0.625 Standard	7/16 -20	0.750	1/2 -20	0.750	7/16 -20	0.750	5/8 -18	0.750	No Threads	0.375	0.250	
	1.000 Oversize	3/4 -16	1.125	7/8 -14	1.125	3/4 -16	1.125	1-14	1.125	No Threads	0.500	0.500	
3.25,	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)

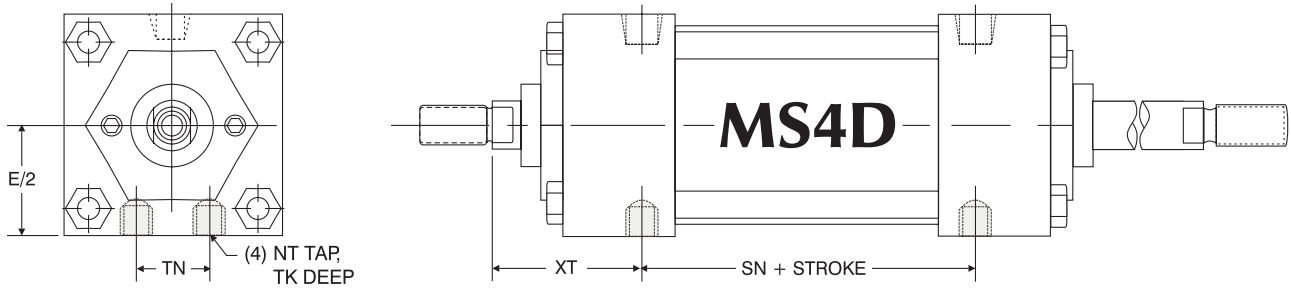


DOUBLE ROD END BASIC DIMENSIONS 'MXOD' STANDARD & OVERSIZE RODS																		
BORE	ROD DIAMETER	A	B	C	E	EE	F	G	K	KK	LD	MM	P	R	RM	V	Y	ZM
1.50	0.625 Standard	0.750	1.125	0.375	2.000	0.375	0.375	1.500	0.250	7/16 -20	4.125	0.625	2.375	1.430	2.00 SQ.	0.250	1.875	6.125
	1.000 Oversize	1.125	1.500	0.500						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			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			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			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			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			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			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	

# SERIES 'HCA' DIMENSIONS: DOUBLE ROD END BASE MOUNTS

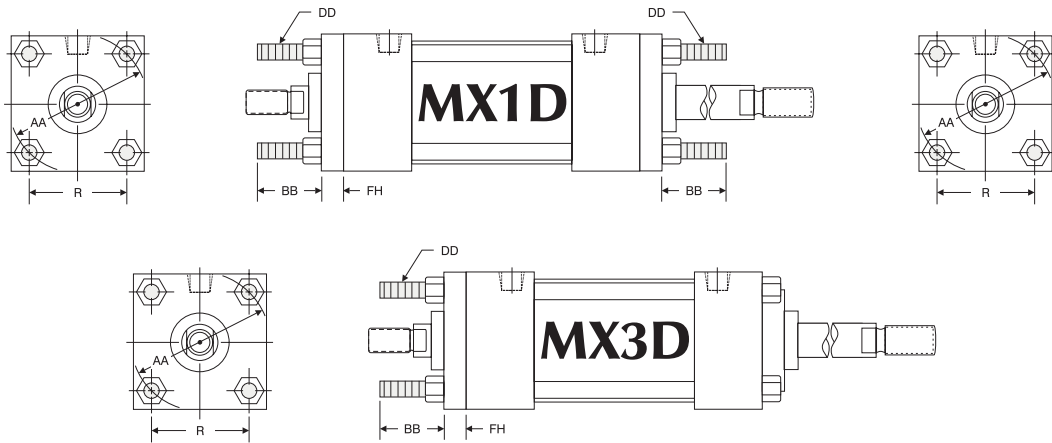


DOUBLE ROD END 'MS2D' SIDE LUG MOUNT DIMENSIONS										
BORE	ROD DIAMETER	SB	SH	ST	SU	SW	TS	US	XS	ADD STROKE
										SSD
1.50	0.625 Standard	0.438	1.000	0.500	1.125	0.375	2.750	3.500	1.375	3.375
	1.000 Oversize									
2.00	0.625 Standard	0.438	1.250	0.500	1.125	0.375	3.250	4.000	1.375	3.375
	1.000 Oversize									
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									
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									
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									
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									
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									
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									



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	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	

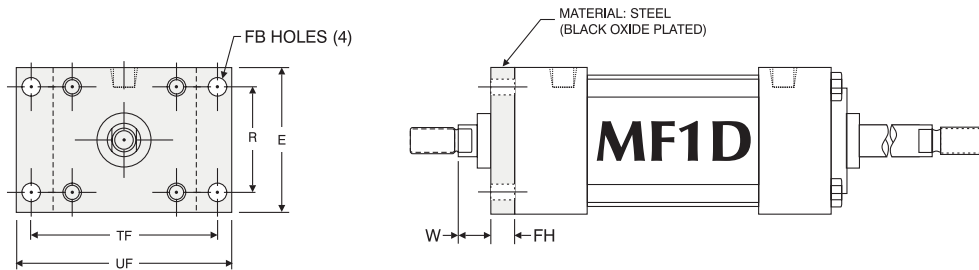
# SERIES 'HCA' DIMENSIONS: DOUBLE ROD END TIE ROD & FLANGE MOUNTS



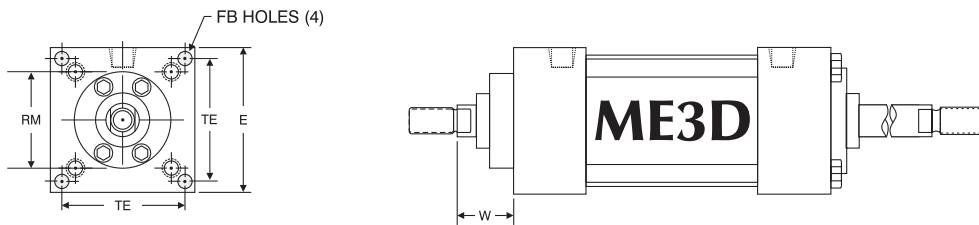
TIE ROD EXTENDED 'MX1D' & 'MX3D' MOUNT DIMENSIONS						
BORE	ROD DIAMETER	AA	BB	DD	FH	R
1.50	0.625 Standard	2.020	1.000	1/4 -28	0.375	1.438
	1.000 Oversize					
2.00	0.625 Standard	2.600	1.125	5/16 -24	0.375	1.844
	1.000 Oversize					
2.50	0.625 Standard	3.100	1.125	5/16 -24	0.375	2.188
	1.000 Oversize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

TIE ROD EXTENDED 'MX1D' & 'MX3D' MOUNT DIMENSIONS						
BORE	ROD DIAMETER	AA	BB	DD	FH	R
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					
10.00	1.750 Oversize	11.200	2.688**	3/4 -16	0.625*	7.920
	2.000 Oversize				0.750*	
12.00	2.000 Standard	13.300	2.688**	3/4 -16	0.750*	9.400
	2.500 Oversize					

\*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



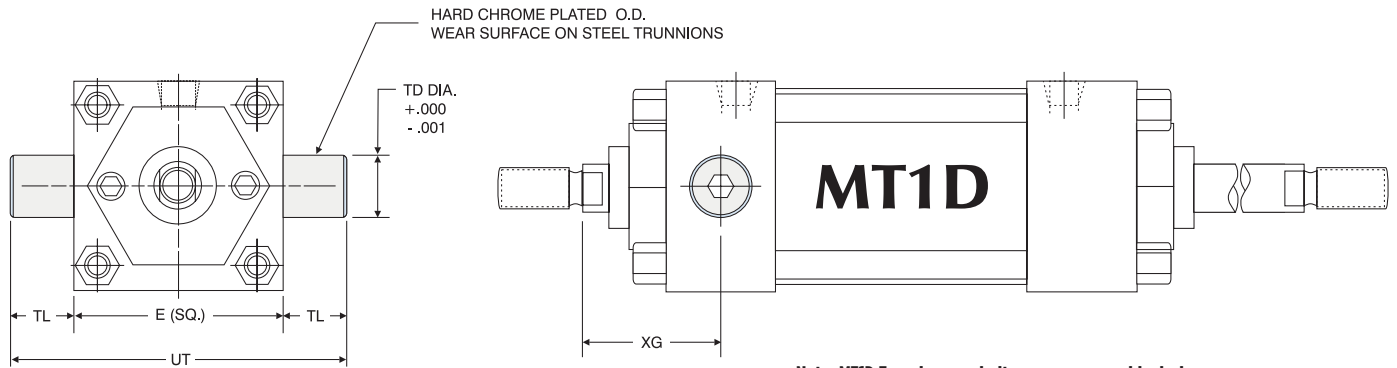
8.00" - 12.00" BORES ONLY

'MF1D' FLANGE & 'ME3D' CAP MOUNT DIMENSIONS										
BORE	ROD DIAMETER	E	FB	FH	R	RM	TE	TF	UF	W
1.50	0.625 Standard	2.000	0.313	0.375	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
4.00	1.000 Standard	4.500	0.438	0.625	3.320	-	-	5.438	6.250	0.750
	1.375 Oversize									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	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
10.00	1.750 Standard	10.625	0.813	N/A	N/A	3.500	9.400	N/A	N/A	1.875
	2.000 Oversize					5.000				2.000
12.00	2.000 Standard	12.750	0.813	N/A	N/A	5	11.100	N/A	N/A	2.000
	2.500 Oversize									2.250

# SERIES 'HCA' DIMENSIONS: DOUBLE ROD END PIVOT MOUNTS

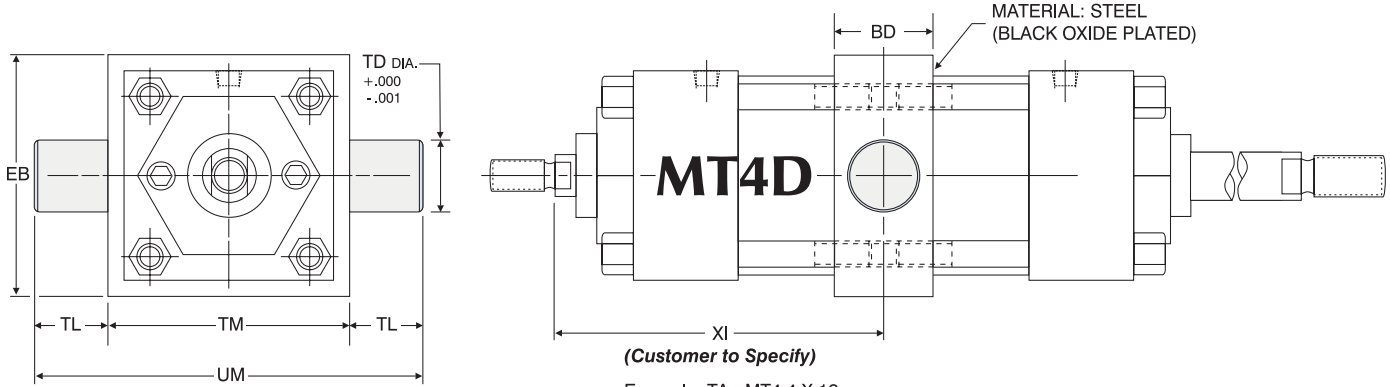
HCA / DOUBLE ROD MOUNTS



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

DOUBLE ROD END 'MT1D' HEAD TRUNNION MOUNT DIMENSIONS						
BORE	ROD DIAMETER	E	HCD	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.



(Customer to Specify)

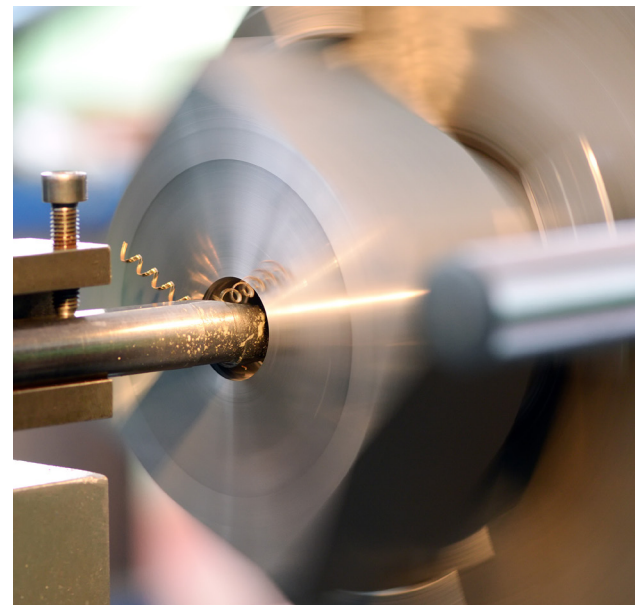
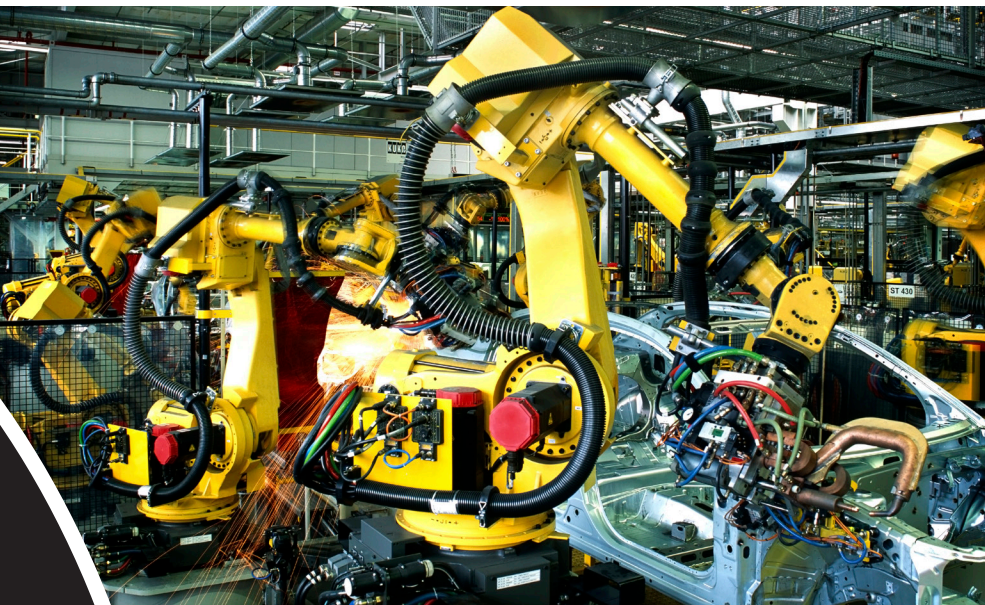
Example: TA - MT4 4 X 12  
XI = 6"

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

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

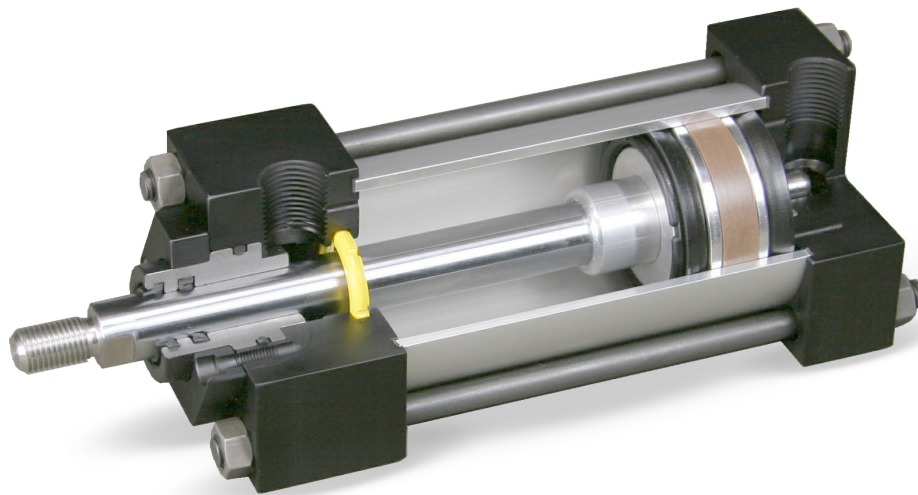
Note: Ports or cushions cannot be on same side as MT1D Trunnions.

DOUBLE ROD END 'MT4D' INTERMEDIATE TRUNNION MOUNT DIMENSIONS							
BORE	BD	EB	HCD	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	

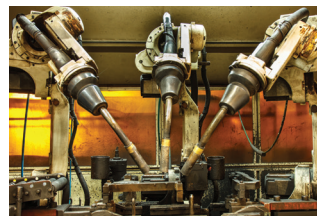
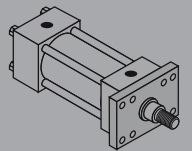
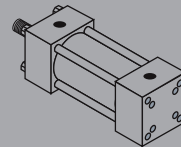
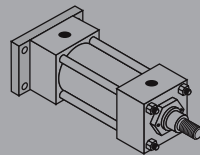
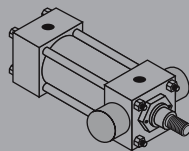
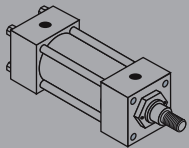


# HCD Series NFPA TOUGH-DUTY Aluminum Cylinders | 1.50" to 8.00" Bore

PNEUMATIC



• HCD Series – NFPA Tough Duty ..... 24

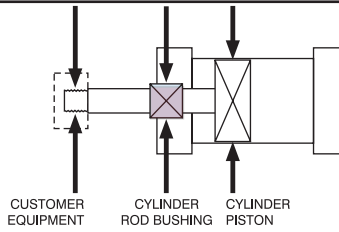


# SERIES 'HCD' TOUGH-DUTY

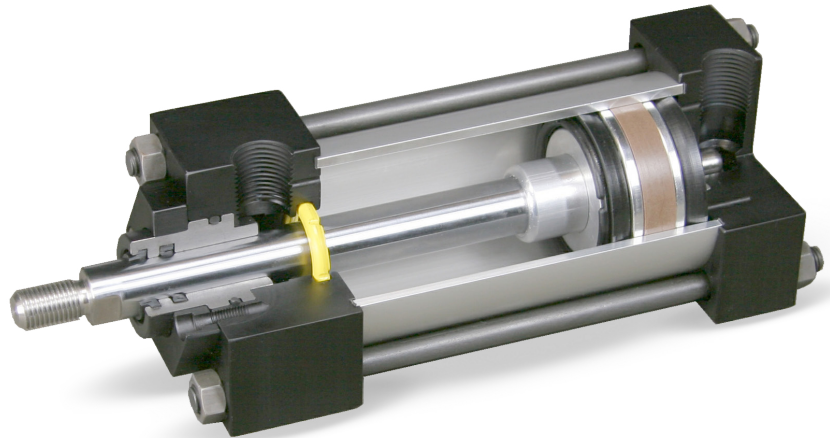
## Floating Rod Bushing

### 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 'HCA' 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

- **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 (-29° C to 93° C)  
Fluorocarbon: 0° F to 400° F (-18° C to 204° C)



# HOW TO ORDER: SERIES 'HCD' (TOUGH-DUTY)

**HCD** - **MF1** - **2.50** x **10** - **MPR**

SERIES	BORE	STROKE	CUSHIONS	OPTIONS
HCD 250 PSI AIR	1.50 2.00 2.50 3.25 4.00 5.00 6.00 8.00	0" to 120" MADE-TO-ORDER	NON-ADJUSTABLE (FIXED) HEAD & CAP CUSHIONS ARE STANDARD (LEAVE BLANK) <b>OPTIONAL ADJUSTABLE CUSHIONS</b>	<b>ADDS LENGTH TO CYLINDER - SEE "OPTION LENGTH ADDER" CHART BELOW.</b>
<b>NFPA MOUNTS</b>			<b>OPTIONAL ADJUSTABLE CUSHIONS</b>	<b>ADDS LENGTH TO CYLINDER - SEE "OPTION LENGTH ADDER" CHART BELOW.</b>
MF1 FRONT FLANGE (1.50" - 6.00" BORE)			H ADJUSTABLE HEAD CUSHION POSITION 2 IS STANDARD SPECIFY FOR POSITIONS: 1, 3 & 4	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 (12" MAX STROKE) AVAILABLE ON DOUBLE ROD END MODELS MAB MICRO-ADJUST W/ SOUND DAMPENING BUMPER (12" MAX STROKE) MPR MAGNETIC PISTON FOR REED OR SOLID STATE SWITCHES - MODELS: R10, R10P, RAC, RHT & MSS (Refer to pages 223-230) 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 & 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: HCD MS4 2 X 24ES-ST=4) TMS STEEL CYLINDER TUBE, BLACK EPOXY PAINT FINISH VS FLUOROCARBON SEALS XX SPECIAL VARIATION (SPECIFY)
MF2 REAR FLANGE (1.50" - 6.00" BORE)			LH ADJUSTABLE LONG HEAD CUSHION POSITION 2 IS STANDARD SPECIFY FOR POSITIONS: 1, 3 & 4	
ME3 FRONT MOUNTING HOLES (8.00" BORE)			ELH ADJUSTABLE EXTRA LONG HEAD CUSHION POSITION 2 IS STANDARD SPECIFY FOR POSITIONS: 1, 3 & 4	
ME4 REAR MOUNTING HOLES (8.00" BORE)			C ADJUSTABLE CAP CUSHION POSITION 6 IS STANDARD SPECIFY FOR POSITIONS: 5, 7 & 8	
MP1 REAR PIVOT CLEVIS (1.50" - 8.00" BORE)			LC ADJUSTABLE LONG CAP CUSHION POSITION 6 IS STANDARD SPECIFY FOR POSITIONS: 5, 7 & 8	
MP2 REAR PIVOT CLEVIS (1.50" - 6.00" BORE)			ELC ADJUSTABLE EXTRA LONG CAP CUSHION POSITION 6 IS STANDARD SPECIFY FOR POSITIONS: 5, 7 & 8	
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)				
	<b>STYLE</b>			
	SINGLE ROD (LEAVE BLANK) D = DOUBLE ROD END			

## 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:** HCD-MF1-2.50 x 10-MPR

- 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).

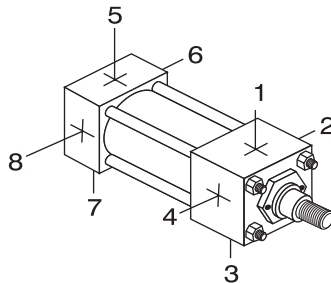
\*STEEL TUBES do not work with MPR magnetic pistons. Refer to pages 231-234 for Balluff end of stroke sensors.

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

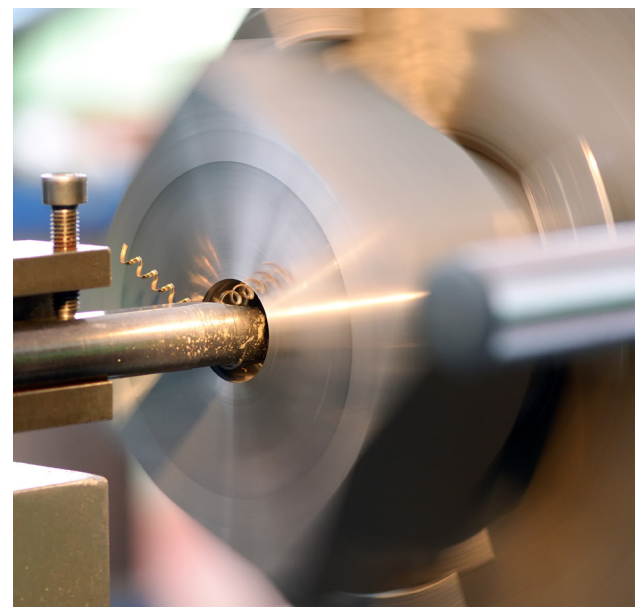
- Ports - Positions 1 and 5
- Fixed Cushions - No Adjustment Needle Required
- Cushion Adjustment - Positions 2 and 6
- Specify Non-Standard Positions When Ordering



## NFPA MOUNTS

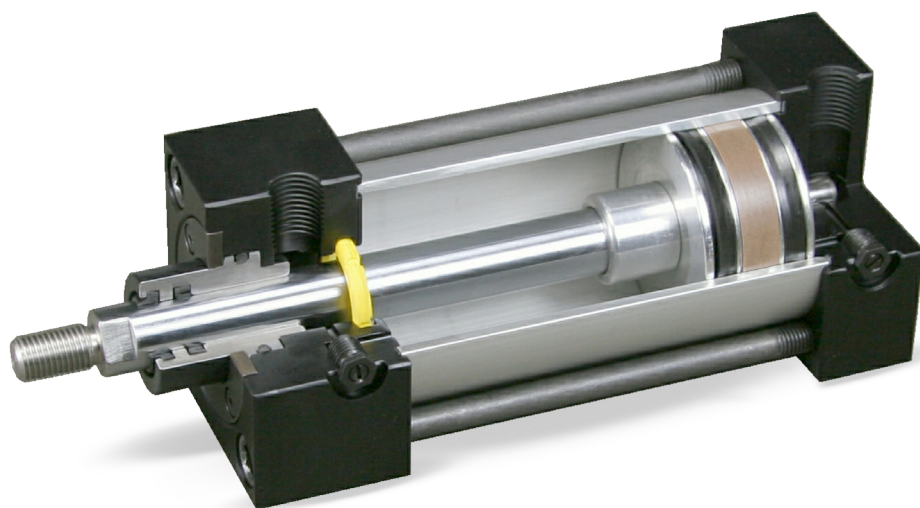
<b>MF1</b>  1.50" - 6.00" Bores	<b>MF2</b>  1.50" - 6.00" Bores	<b>ME3</b>  8.00" Bores	<b>ME4</b>  8.00" Bores	<b>MP1</b>  1.50" - 8.00" Bores	<b>MP2</b>  1.50" - 6.00" Bores
<b>MP4</b>  1.50" - 4.00" Bores	<b>MS1</b>  1.50" - 8.00" Bores	<b>MS2</b>  1.50" - 8.00" Bores	<b>MS4</b>  1.50" - 8.00" Bores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

# NOTES

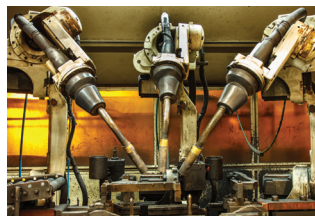
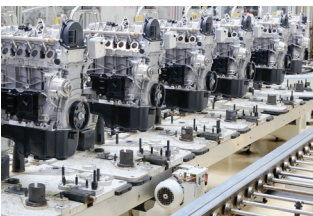
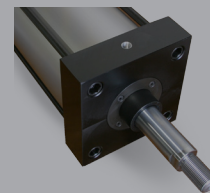
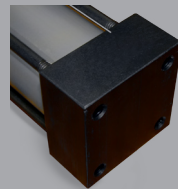
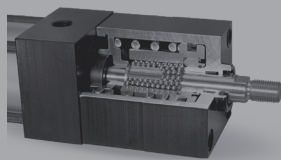


## HCF Series Flush Mount & Flush Mount with Rod Lock

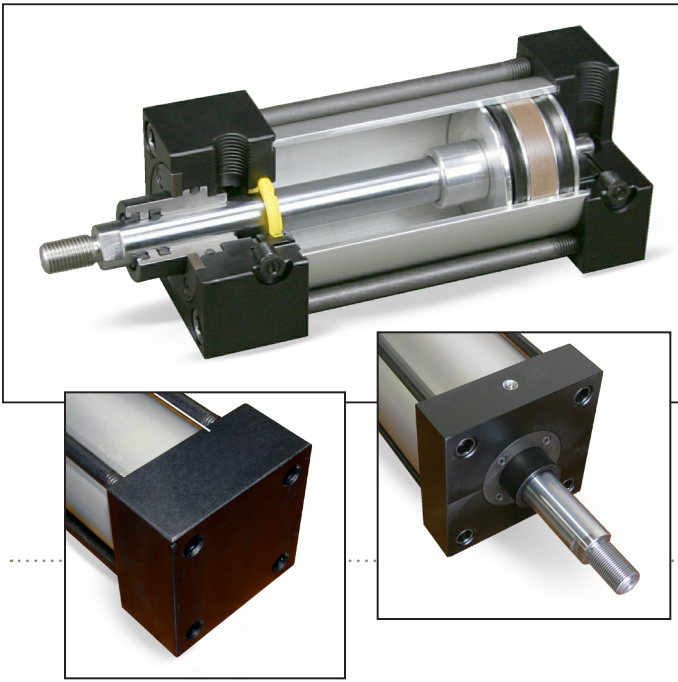
PNEUMATIC



- HCF Series – Flush Mount ..... 28
- HCF Series – Flush Mount with Rod Lock ..... 42



## SERIES 'HCF': FLUSH MOUNT (WITH SLEEVE NUT CONSTRUCTION)



### Benefits

- Same construction as 'HCA' 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 manufacturer' cylinder out in the field.
- 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 'HCA' 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 (-29°C to 93°C)  
 Fluorocarbon: 0°F to 400°F (-18°C to 204°C)

# HOW TO ORDER: SERIES 'HCF' (FLUSH MOUNT)

**HCF** - **MS4** - **2.50** x **10** - **HC** - **MPR**

SERIES	
HCF	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

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

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

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 = .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	STUDDER PISTON ROD (KK3 WITH STUD, LOCTITE IN PLACE)
KK4	FULL DIAMETER MALE ROD THREAD
KK5	BLANK ROD END (NO THREADS, "A" = 0")
LF	LOW FRICTION SEALS (Refer to page 183 for specifications)
MA	MICRO-ADJUST (12" MAX STROKE)
AVAILABLE ON DOUBLE ROD END MODELS	
MAB	MICRO-ADJUST W/ SOUND DAMPENING BUMPER (12" MAX STROKE)
MPR	MAGNETIC PISTON FOR REED OR SOLID STATE SWITCHES - MODELS: R10, R10P, RAC, RHT & MSS (Refer to pages 223-230)
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 & NUTS & 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: HCF MS4 2 X 24ES-ST=3)
TMS	STEEL CYLINDER TUBE, BLACK EPOXY PAINT FINISH
TH	400 PSI HYDRAULIC NON-SHOCK (Refer to page 183)
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, Bottom tap Mount, Head & Cap Cushions, and Magnetic Piston for Switches.

**Part Number:** HCF-MS4-2.5 x 10-HC-MPR

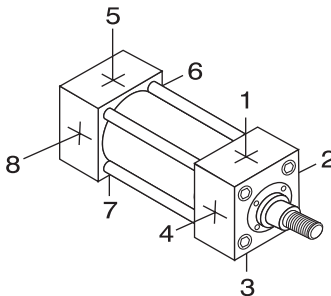
**Note:** "L" and "EL" CUSHION OPTIONS CAN BE ORDERED AS FIXED CUSHIONS.

**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).

## STANDARD PORT AND CUSHION ADJUSTMENT POSITIONS

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

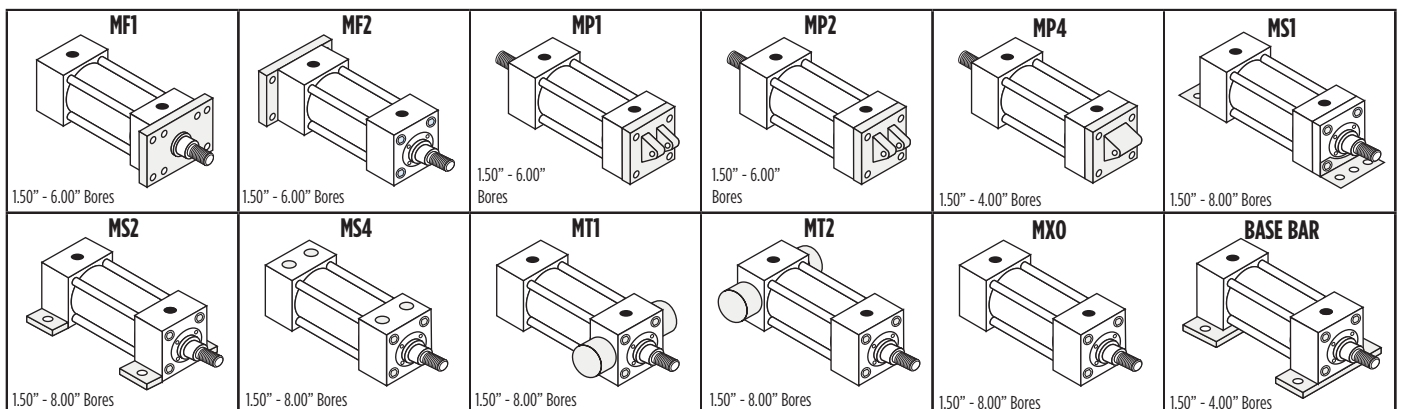


\*STEEL TUBES do not work with MPR magnetic pistons. Refer to pages 231-233 for Balluff end of stroke sensors.

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.

## 'HCF' NFPA MOUNTS



# SERIES 'HCF' DIMENSIONS: BASIC CYLINDER (MXO MOUNT)

## FLUSH MOUNT (WITH SLEEVE NUT CONSTRUCTION)

### ABOUT ROD END STYLES

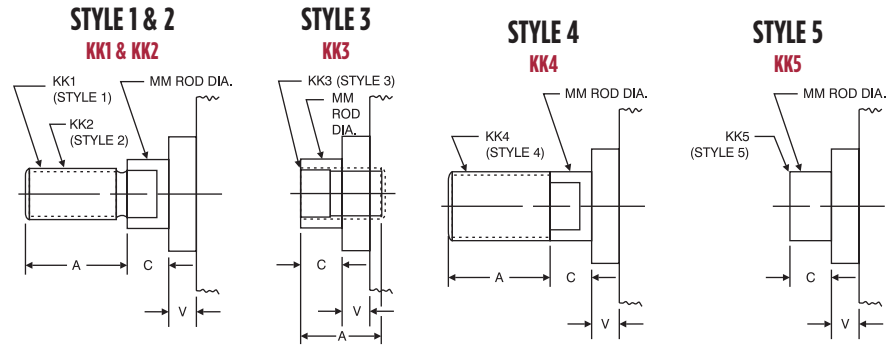
Style 1 Male Rod End is STANDARD

Other NFPA Styles can be specified (see chart).

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

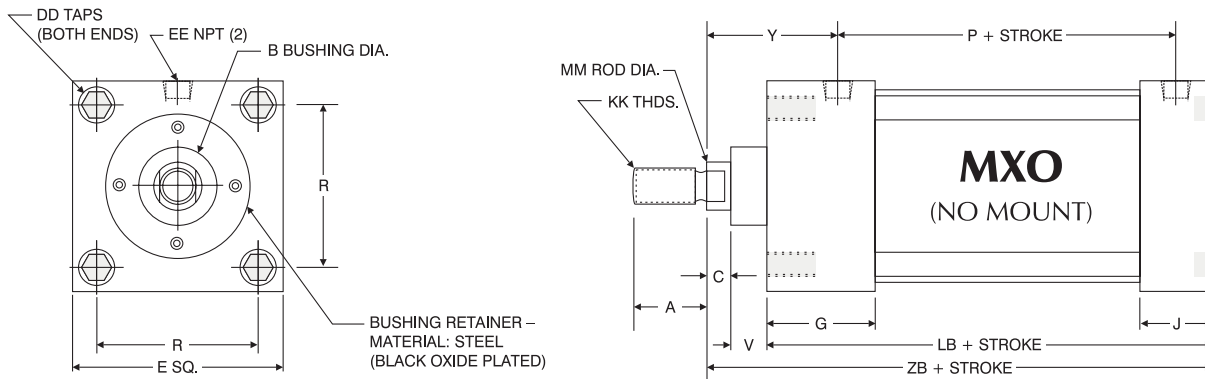
NEED SOMETHING NOT LISTED?  
Just send us a sketch. In most cases, quotes are turned around in one day!

### PISTON ROD END STYLES



BORE	MM ROD DIAMETER	STANDARD		OPTIONAL							C	V
		Style 1 - Male		Style 2 - Male		Style 3 - Female		Style 4 - Male		Style 5 - Blank		
		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	0.625
	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



'HCF' 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

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

## ABOUT ROD END STYLES

### Style 1 Male Rod End is STANDARD

Other NFPA Styles can be specified (see chart).

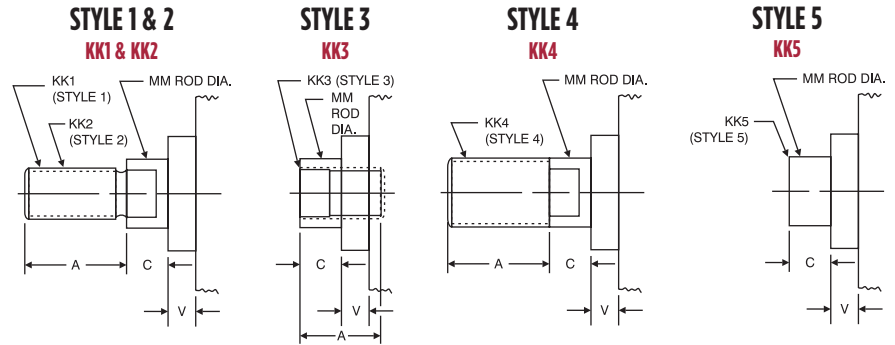
Need a rod end not listed?

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

NEED SOMETHING NOT LISTED?

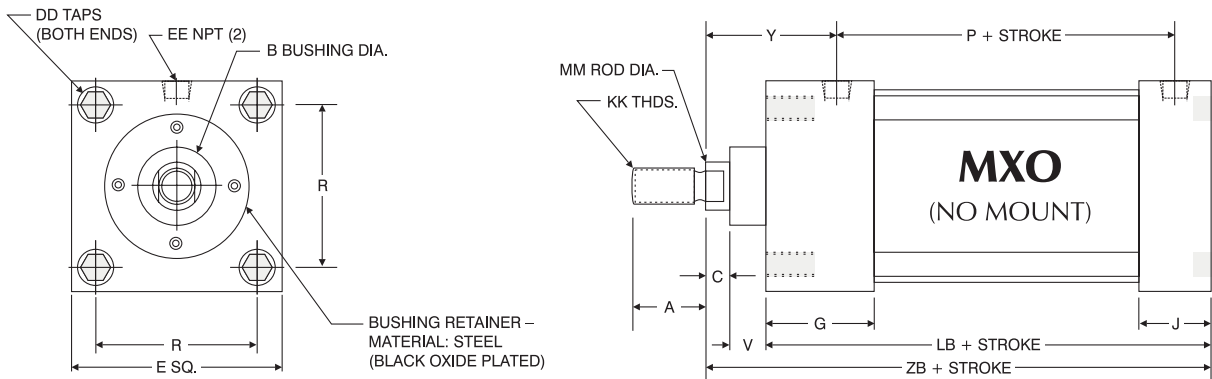
Just send us a sketch. In most cases, quotes are turned around in one day!

## PISTON ROD END STYLES



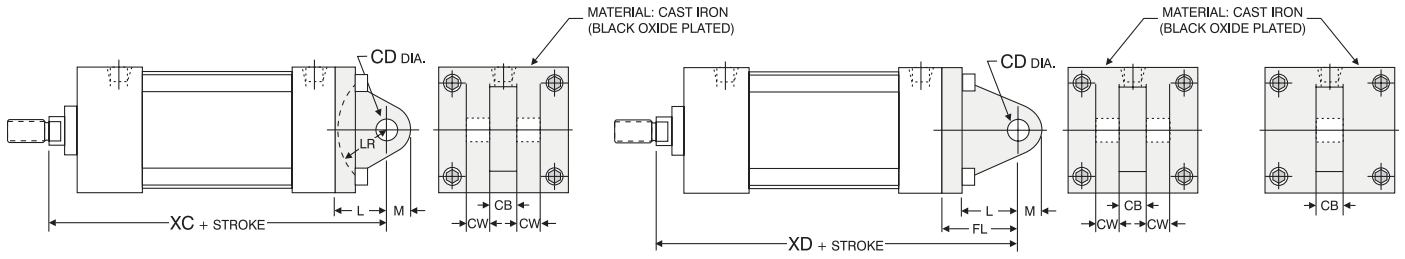
BORE	MM ROD DIAMETER	STANDARD		OPTIONAL					C	V		
		Style 1 - Male		Style 2 - Male	Style 3 - Female		Style 4 - Male				Style 5 - Blank	
		KK1	A	KK2	A	KK3	A	KK4			A	KK5
1.50, 2.00, 2.50	0.625 Standard	7/16 -20	0.750	1/2 -20	0.750	7/16 -20	0.750	5/8 -18	0.750	No Threads	0.375	0.625
	1.000 Oversize	3/4 -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



'HCF' 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

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

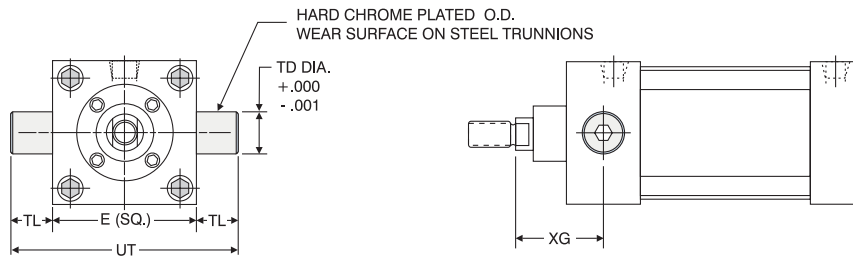


**HCF-MP1**

**HCF-MP2**

**HCF-MP4**  
(1.50" - 4.00" bore)

'HCF' SERIES 'MP1' & 'MP2' CLEVIS AND 'MP4' ROD EYE MOUNT DIMENSIONS										
BORE	ROD DIAMETER	CB	CD	CW	FL	L	LR	M	ADD STROKE	
									XC	XD
1.50	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



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

**HCF-MT1 / MT2**

**HCF-MT1**

**HCF-MT2**

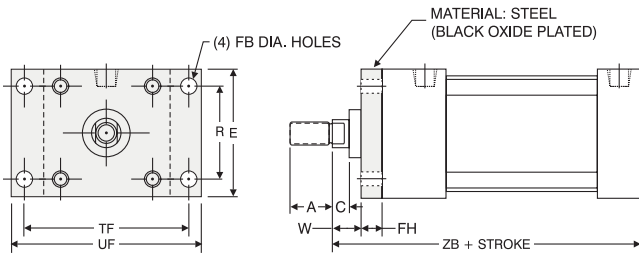
Note: MT1 standard cushion locations at 3 and 6  
MT2 standard cushion locations at 2 and 7

'HCF' SERIES 'MT1' HEAD TRUNNION AND 'MT2' CAP TRUNNION MOUNT DIMENSIONS								
BORE	ROD DIAMETER	E	HCD	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

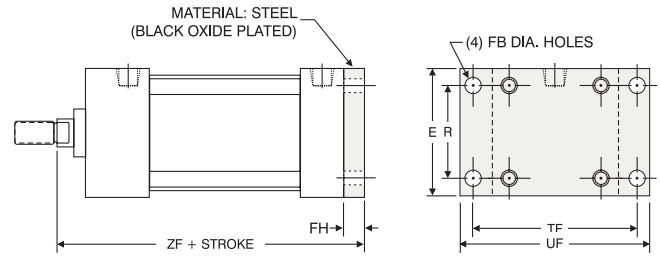
\*No oversize rod available on 1.50" bore MT1.



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



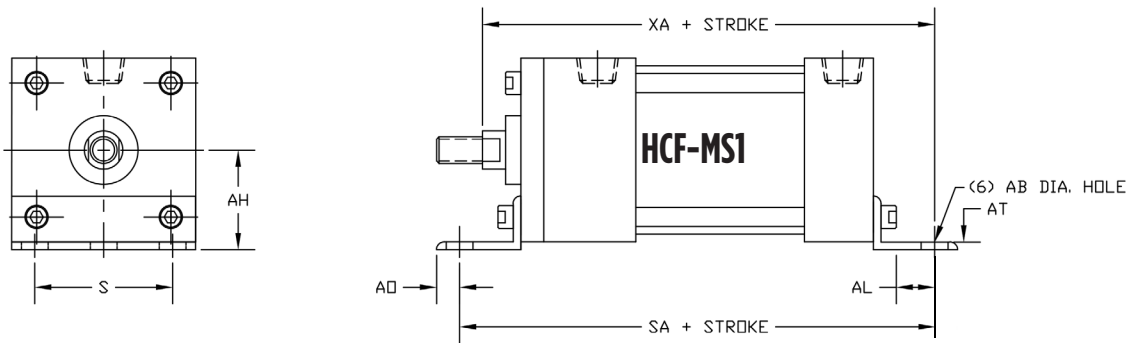
**HCF-MF1**



**HCF-MF2**

'HCF' 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

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

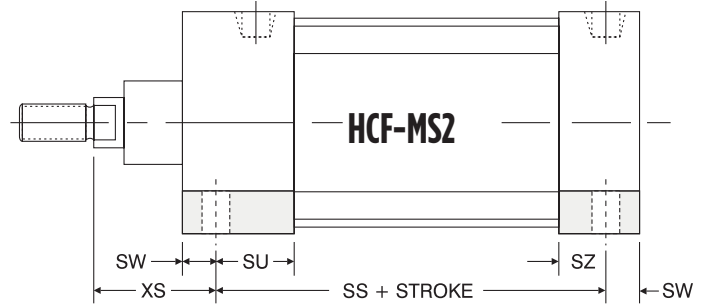
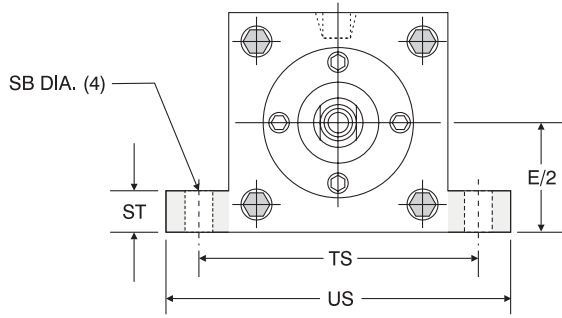


'HCF' SERIES 'MS1' ANGLE MOUNT DIMENSIONS										
BORE	ROD DIAMETER	AB	AH	AL	AO	AT	FH	S	ADD STROKE	
									SA	XA
1.50	0.625 Standard	0.438	1.188	1.000	0.375	0.125	0.375	1.250	6.000	5.625
	1.000 Oversize									6.000
2.00	0.625 Standard	0.438	1.438	1.000	0.375	0.125	0.375	1.750	6.000	5.625
	1.000 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).

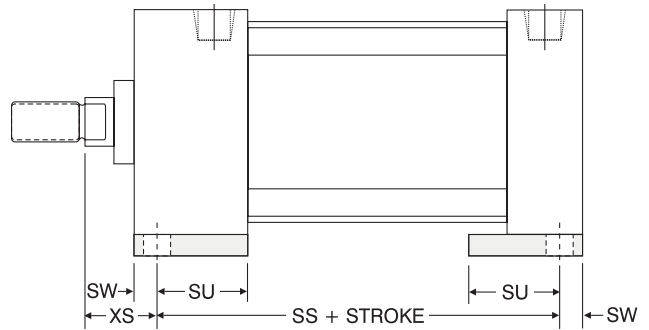
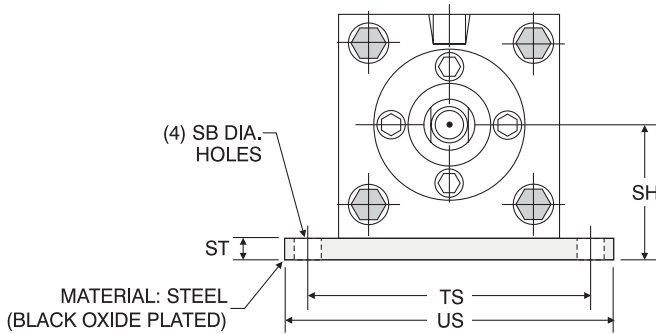
# SERIES 'HCF' DIMENSIONS: BASE MOUNTS FLUSH MOUNT (WITH SLEEVE NUT CONSTRUCTION)



'HCF' SERIES 'MS2' SIDE LUG MOUNT DIMENSIONS											
BORE	ROD DIAMETER	SB	E/2	ST	SU	SW	SZ	TS	US	XS	ADD STROKE
											HCS
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										
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										
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										
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										
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										
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										
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										
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										

Note: 1.50" to 3.25" oversized rods have full front retainer.

## HCF-BASE BAR (Non-NFPA)

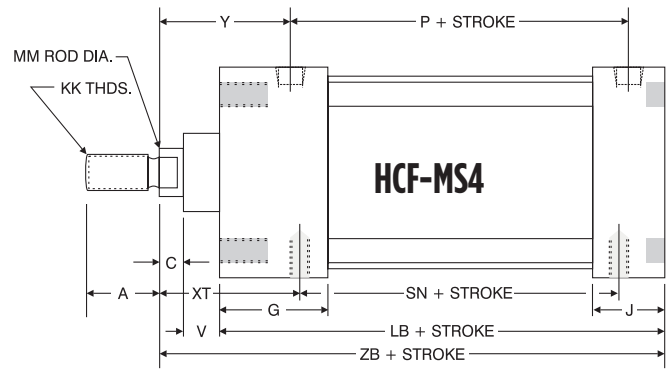
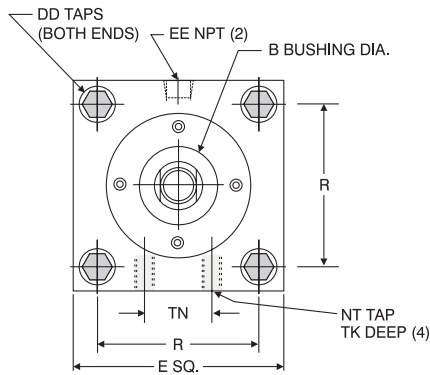


'HCF' SERIES BASE BAR MOUNT (Non-NFPA) DIMENSIONS											
BORE	ROD DIAMETER	SB	SH	ST	SU	SW	TS	US	XS	ADD STROKE	
										HCS	
1.50	0.625 Standard	0.438	1.250	0.250	1.125	0.375	2.750	3.500	1.375	2.875	
	1.000 Oversize										1.750
2.00	0.625 Standard	0.438	1.500	0.250	1.125	0.375	3.250	4.000	1.375	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.

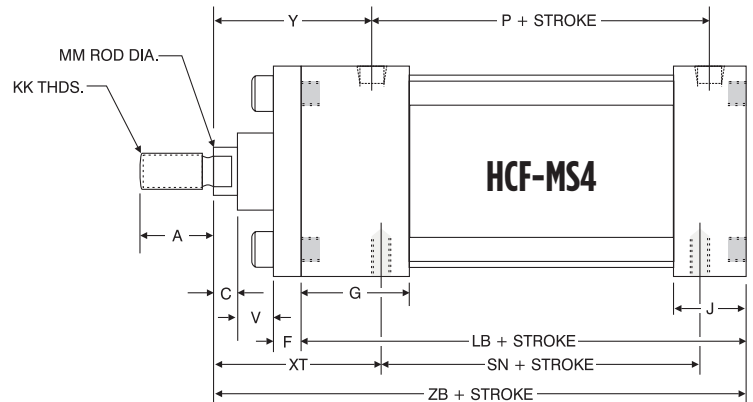
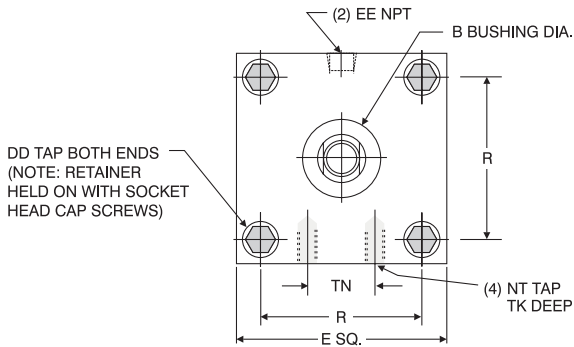
# SERIES 'HCF' DIMENSIONS: BASE MOUNTS

## FLUSH MOUNT (WITH SLEEVE NUT CONSTRUCTION)



'HCF' 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						11/4-12				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						11/4-12				1.125	3.000					3.063	7.563

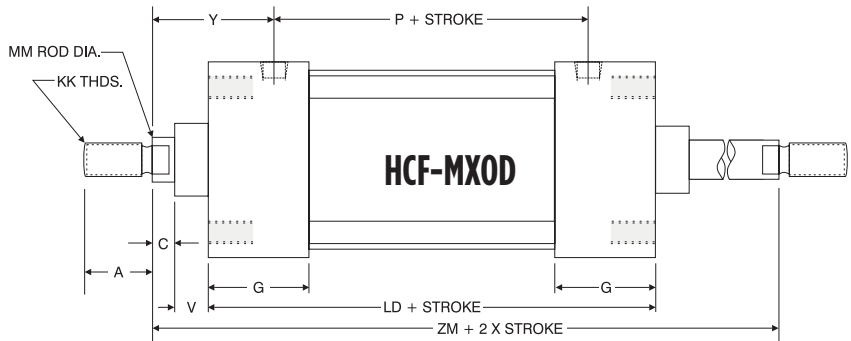
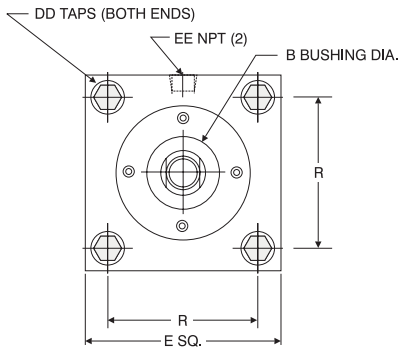
## HCF-MS4: Oversize Rod Diameter (1.50" Bore to 3.25" Bore)



'HCF' 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

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

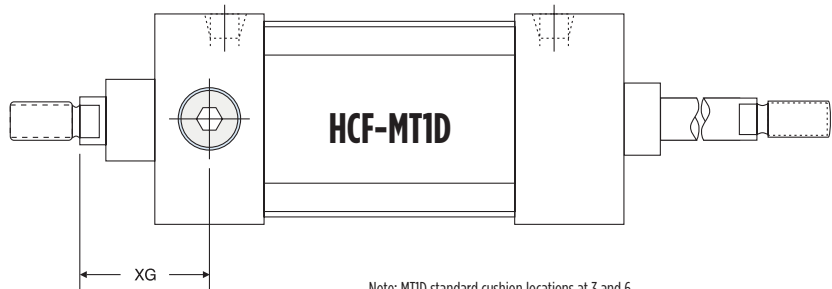
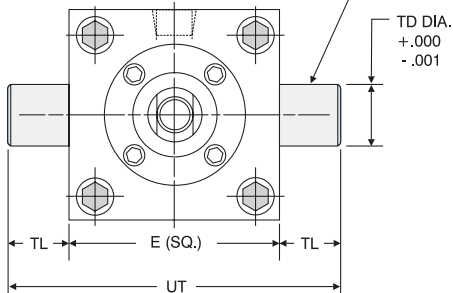
## BASIC DIMENSIONS: DOUBLE ROD END 'MXOD' (NO MOUNT)



'HCF' 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	

## SERIES 'HCF' DIMENSIONS: DOUBLE ROD END PIVOT MOUNT

HARD CHROME PLATED O.D.  
WEAR SURFACE ON STEEL TRUNNIONS

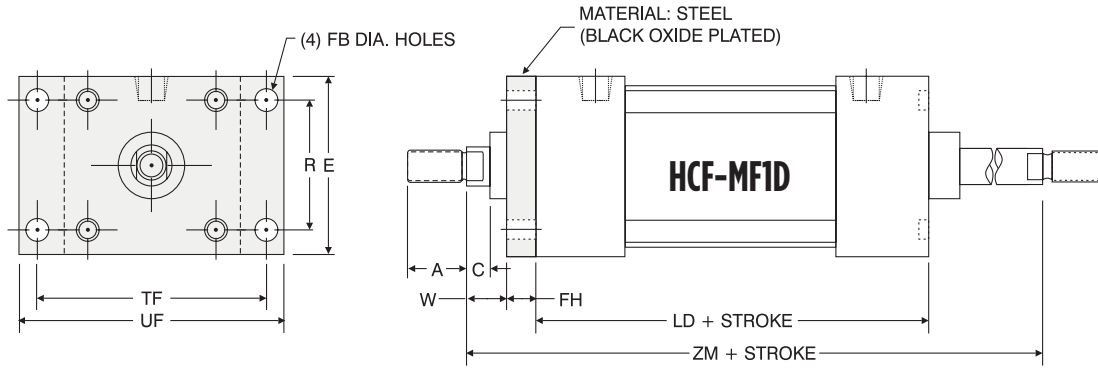


Note: MT1D standard cushion locations at 3 and 6

'HCF' SERIES DOUBLE ROD END 'MT1D' HEAD TRUNNION MOUNT DIMENSIONS						
BORE	ROD DIAMETER	E	HCD	TL	UT	XG
1.50*	0.625 Standard	2.000	1.000	1.000	4.000	1.750
	0.625 Standard					1.750
2.00	1.000 Oversize	2.500	1.000	1.000	4.500	2.125
	0.625 Standard					1.750
2.50	1.000 Oversize	3.000	1.000	1.000	5.000	2.125
	0.625 Standard					1.750
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.

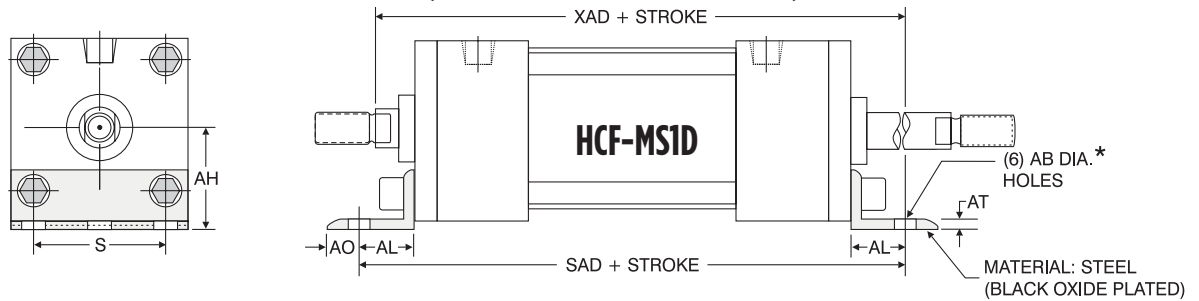
# SERIES 'HCF' DIMENSIONS: DOUBLE ROD END FLANGE MOUNT FLUSH MOUNT (WITH SLEEVE NUT CONSTRUCTION)



‘HCF’ SERIES DOUBLE ROD END ‘MF1D’ FLANGE MOUNT DIMENSIONS												
BORE	ROD DIAMETER	A	C	E	FB	FH	R	TF	UF	W	ADD STROKE	
											LD	ZM
1.50	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.

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

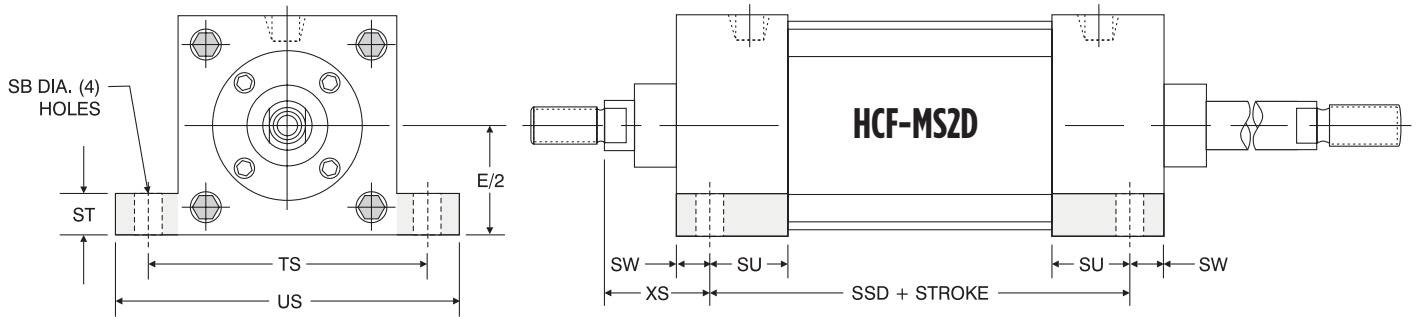


‘HCF’ SERIES DOUBLE ROD END ‘MS1D’ ANGLE MOUNT DIMENSIONS									
BORE	ROD DIAMETER	AB	AH	AL	AO	AT	S	ADD STROKE	
								SAD	XAD
1.50	0.625 Standard	0.438	1.188	1.000	0.375	0.125	1.250	6.875	6.500
	1.000 Oversize								6.875
2.00	0.625 Standard	0.438	1.438	1.000	0.375	0.125	1.750	6.875	6.500
	1.000 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.

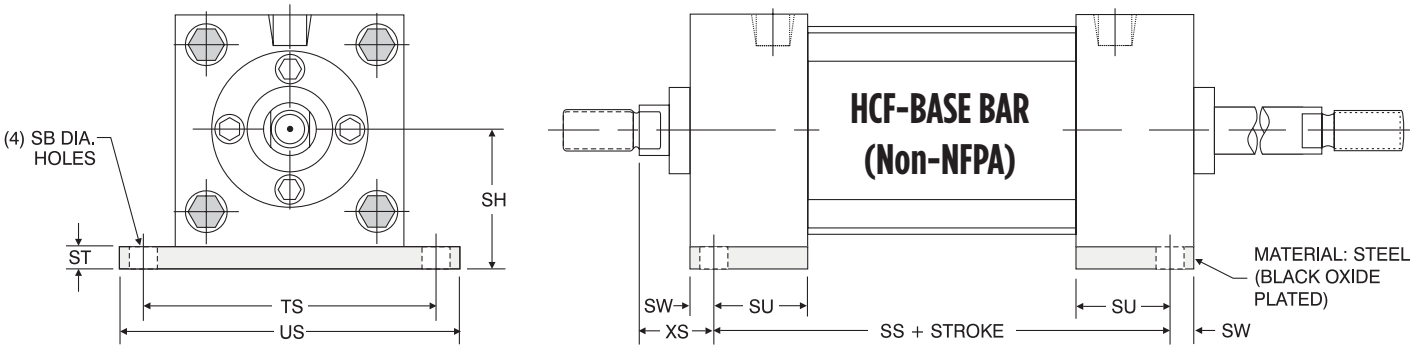
Note: Flush retainer on 8.00" bore (MS1 bracket bolted directly to head).

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



'HCF' 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									
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									
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									
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	

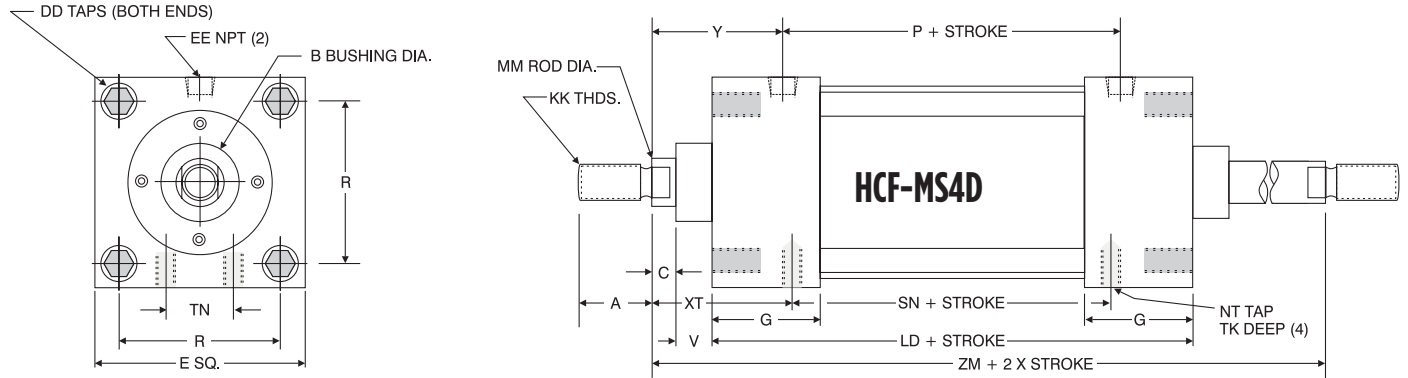
Note: 1.50" to 3.25" oversized rods use full retainers.



'HCF' SERIES DOUBLE ROD END BASE BAR MOUNT (Non-NFPA) DIMENSIONS										
BORE	ROD DIAMETER	SB	SH	ADD STROKE	ST	SU	SW	TS	US	XS
				HCS						
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									
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									
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									
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

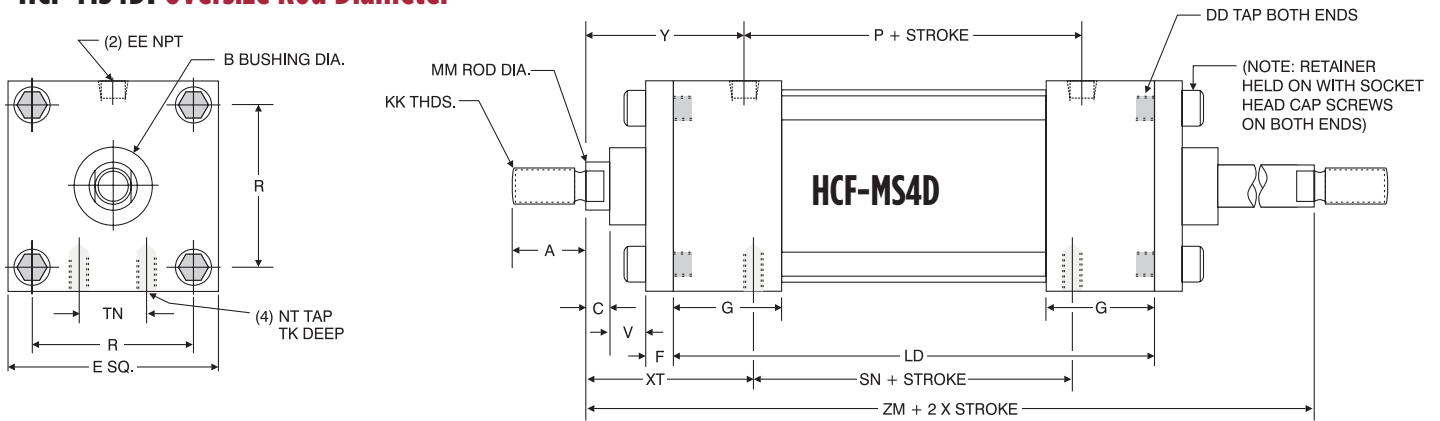
# SERIES 'HCF' DIMENSIONS: DOUBLE ROD END BASE MOUNT FLUSH MOUNT (WITH SLEEVE NUT CONSTRUCTION)

## HCF-MS4D: Standard Rod Diameter



'HCF' 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

## HCF-MS4D: Oversize Rod Diameter



'HCF' 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 'HCF' FLUSH MOUNT: MOUNTING KITS

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



## SERIES 'HCF' MOUNTING KITS

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

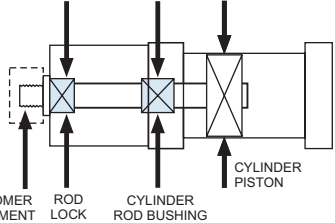
\*Base Bar "SH" dimension is not NFPA. Refer to pages 31 & 35.  
All other dimensions are NFPA.



# SERIES 'HCF' (NFPA) CYLINDER WITH ROD LOCK

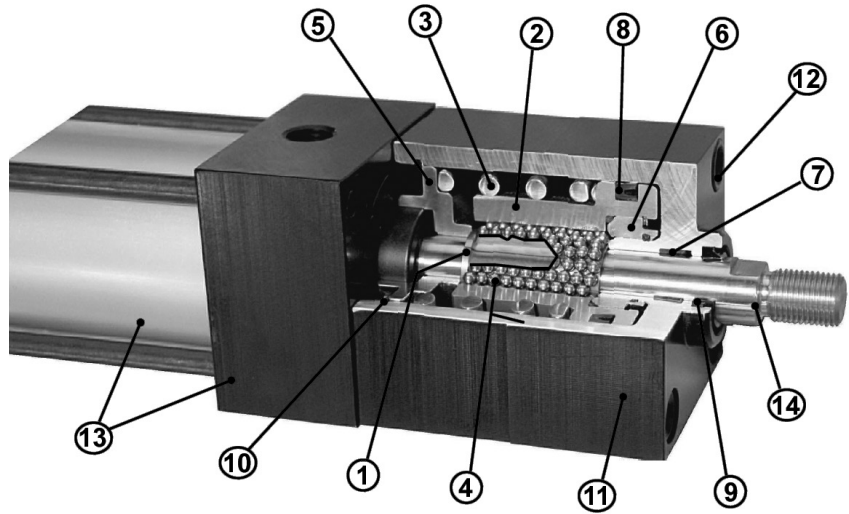
### Floating Rod Bushing

**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.

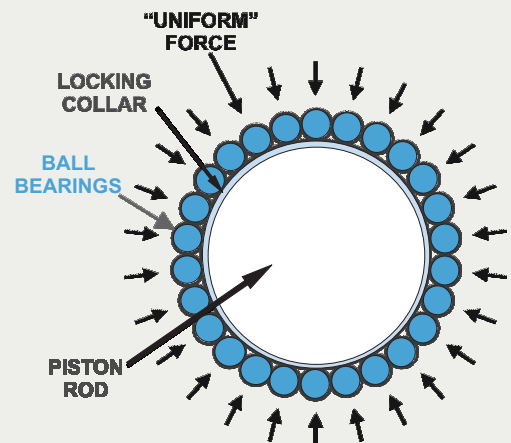
- 8: PISTON SEAL** – Heavy lip design Carboxylated Nitrile construction. Seal is pressure activated and wear compensating for extended life (self lubricating material).
- 9: ROD WIPER** – Urethane
- 10: RETAINER RING** (Steel) – Refrains coil spring compression (under very high spring force) and internal 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 MFI flange.
- 13: HCF SERIES CYLINDER** – Hydraulic Cylinders Inc' specifications
- 14: CYLINDER PISTON ROD** – Hard chrome plated steel.
- 15: 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:

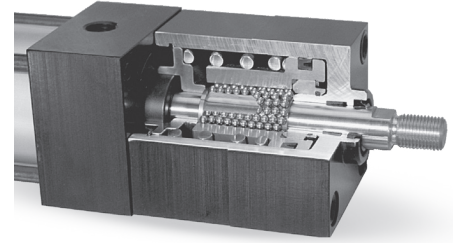
- **LOW METAL FATIGUE** – On all clamping components.
- **SUPERIOR LOCKING FORCES** – HIGHEST LOCKING FORCES IN THE INDUSTRY.
- **NON WEARING** – Low component fatigue eliminates wear and extends life to 4,000,000-5,000,000 cycles at full rated load.



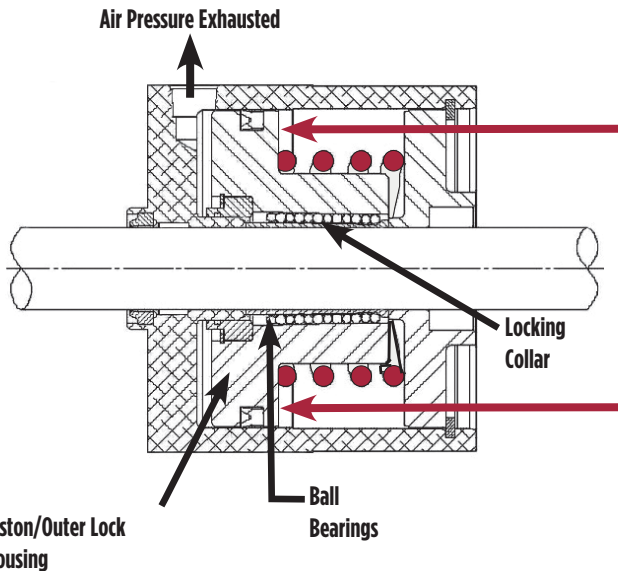
## The HYDRAULIC CYLINDERS INC.® difference...

HYDRAULIC CYLINDERS INC.®'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. HYDRAULIC CYLINDERS INC.®'s Floating Rod Bushing design and accurate rod lock alignment ensure superior performance and trouble-free operation.

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.



## 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

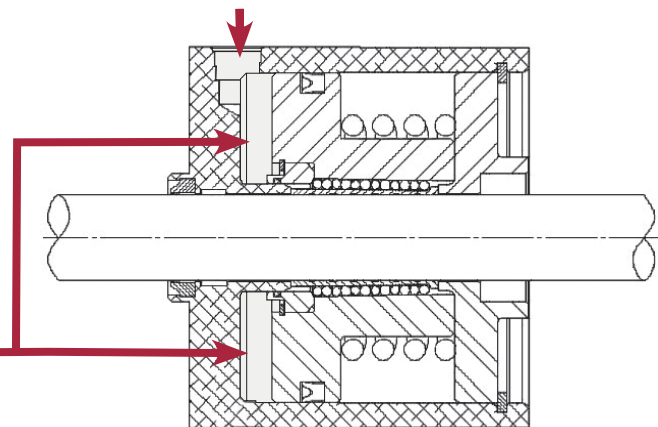
### UNCLAMPED CONDITION

#### (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.

AIR PRESSURE MOVES PISTON, COMPRESSING SPRING, WHICH ELIMINATES LOCKING FORCE

60-150 PSI Air Pressure



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

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

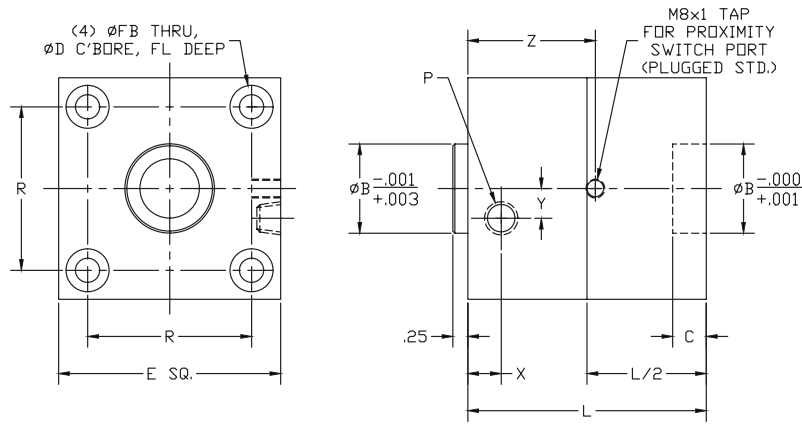
\*Represents clearance within the rod lock unit, .000" movement due to actuation.

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 )

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

# ROD LOCK DIMENSIONS & RATED HOLDING FORCE



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	Z	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	1.529	3.0
2.00	0.625 Standard	RL-063200-1	500	1.125	0.375	0.515	1.031	2.475	0.343	3.000	1/8 NPT	1.840	0.310	0.380	1.196	4.0
	1.000 Oversize	RL-100200-1	350	1.500	0.563					3.750						
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	1.490	5.0
	1.000 Oversize	RL-100250-1	650	1.500	0.563					3.750						
3.25	1.000 Standard	RL-100325-1	1000	1.500	0.563	0.719	1.281	3.725	0.406	4.000	1/4 NPT	2.760	0.560	0.000	2.140	8.0
	1.375 Oversize	RL-138325-1	1000	2.000	0.625					4.000						
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	1.782	14.0
	1.375 Oversize	RL-138400-1	1550	2.000	0.625					4.000						
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	1.810	18.0
	1.375 Oversize	RL-138500-1	2150	2.000	0.625					4.125						
6.00	1.375 Standard	RL-138600-1	2850	2.000	0.625	0.844	1.500	6.475	0.531	4.500	1/4 NPT	4.880	0.560	0.000	2.055	16.0
	1.750 Oversize	RL-175600-1	2850	2.375	0.750					4.500						

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

## 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
2.50	ALL	PUSH	4.909	295	393	491
	0.625	PULL	4.602	276	368	460
3.25	ALL	PUSH	8.296	498	664	830
	1.000	PULL	7.511	451	601	751
4.00	ALL	PUSH	12.566	754	1005	1257
	1.000	PULL	11.781	707	942	1178
5.00	ALL	PUSH	19.635	1178	1571	1964
	1.000	PULL	18.850	1131	1508	1885
6.00	ALL	PUSH	28.274	1696	2262	2827
	1.375	PULL	26.789	1607	2144	2679
6.00	ALL	PUSH	25.869	1552	2070	2587
	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.

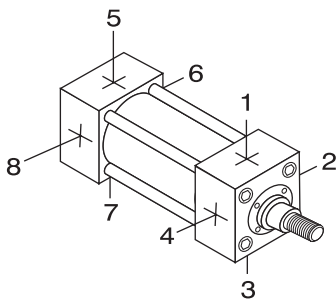
# HOW TO ORDER: CYLINDER WITH ROD LOCK

**HCF** - **MS4** - **2.50 x 10** - **HC** - **RL** - **063 250** - **MPR**

SERIES		BORE		STROKE		ROD LOCK		ROD SIZE		BORE		CYLINDER OPTIONS	
HCF	250 PSI AIR	1.50	2.00	0"	120"	RL	063	0.625"	150	1.50"	ADDS LENGTH TO CYLINDER - SEE "OPTION LENGTH ADDER" CHART BELOW.		
<b>NFPA MOUNTS</b>		2.50	3.25	MADE-TO-ORDER			100	1.000"	200	2.00"	A = EXTENDED PISTON ROD THREAD (EXAMPLE: A = 2")		
MF1	FRONT FLANGE (1.50" - 6.00" BORE)	4.00	5.00				138	1.375"	250	2.50"	AS ADJUSTABLE STROKE - RETRACT (SPECIFY LENGTH, EXAMPLE: AS = 4")		
MF2	REAR FLANGE (1.50" - 6.00" BORE)	6.00					175	1.750"	325	3.25"	A / O AIR / OIL PISTON		
MP1	REAR PIVOT CLEVIS (1.50" - 6.00" BORE)								400	4.00"	X B .25" URETHANE BUMPER BOTH ENDS		
MP2	REAR PIVOT CLEVIS (1.50" - 6.00" BORE)								500	5.00"	X BC .25" URETHANE BUMPER CAP ONLY		
MP4	REAR PIVOT EYE (1.50" - 4.00" BORE)								600	6.00"	X BH .25" URETHANE BUMPER HEAD ONLY		
MS1	FRONT & REAR END ANGLE (1.50" - 6.00" BORE)										BP BUMPER PISTON SEALS (1.50" - 6.00" BORE)		
MS2	SIDE LUG (1.50" - 6.00" BORE)										BSP BSP PORTS (SPECIFY SIZE, EXAMPLE: BSP = 1/4")		
MS4	BOTTOM TAPPED HOLES (1.50" - 6.00" BORE)										EN ELECTROLESS NICKEL PLATED		
MT1	FRONT TRUNNION (1.50" - 6.00" BORE)										KK2 LARGE MALE ROD THREAD		
MT2	REAR TRUNNION (1.50" - 6.00" BORE)										KK3 FEMALE ROD THREAD		
MX0	NO MOUNT (1.50" - 6.00" BORE)										KK3S STUDDED PISTON ROD (KK3 WITH STUD, LOCTITE IN PLACE)		
BASE BAR	NON-NFPA (1.50" - 4.00" BORE)										KK4 FULL DIAMETER MALE ROD THREAD		
											KK5 BLANK ROD END (NO THREADS, "A" = 0")		
											LF LOW FRICTION SEALS		
											MA MICRO-ADJUST (12" MAX STROKE) AVAILABLE ON DOUBLE ROD END MODELS		
											MAB MICRO-ADJUST WITH SOUND DAMPENING BUMPER (12" MAX STROKE)		
											MPR MAGNETIC PISTON FOR REED OR SOLID STATE SWITCHES - HYDRAULIC CYLINDERS INC.® MODELS: R10, R10P RAC, RHT & MSS		
											NR NON-ROTATING		
											OP OPTIONAL PORT LOCATION OR SIZE (EXAMPLE: PORTS @ 3 & 7)		
											OS OVERSIZE ROD DIA. (SPECIFY SIZE, EXAMPLE: OS = 1.38")		
											P PROXIMITY SWITCH (1.50" - 6.00" BORE)		
											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: HCF 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)		

## STANDARD PORT AND CUSHION ADJUSTMENT POSITIONS

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



STYLE		CUSHIONS	
SINGLE ROD (LEAVE BLANK)		H	HEAD CUSHION POSITION 2 IS STANDARD SPECIFY FOR POSITIONS: 1, 3 & 4
D = DOUBLE ROD END		LH	LONG HEAD CUSHION POSITION 2 IS STANDARD SPECIFY FOR POSITIONS: 1, 3 & 4
		ELH	EXTRA LONG HEAD CUSHION POSITION 2 IS STANDARD SPECIFY FOR POSITIONS: 1, 3 & 4
		C	CAP CUSHION POSITION 6 IS STANDARD SPECIFY FOR POSITIONS: 5, 7 & 8
		LC	LONG CAP CUSHION POSITION 6 IS STANDARD SPECIFY FOR POSITIONS: 5, 7 & 8
		ELC	EXTRA LONG CAP CUSHION POSITION 6 IS STANDARD SPECIFY FOR POSITIONS: 5, 7 & 8
<b>FIXED CUSHIONS</b>			
		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: FCHL, 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.

## 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.

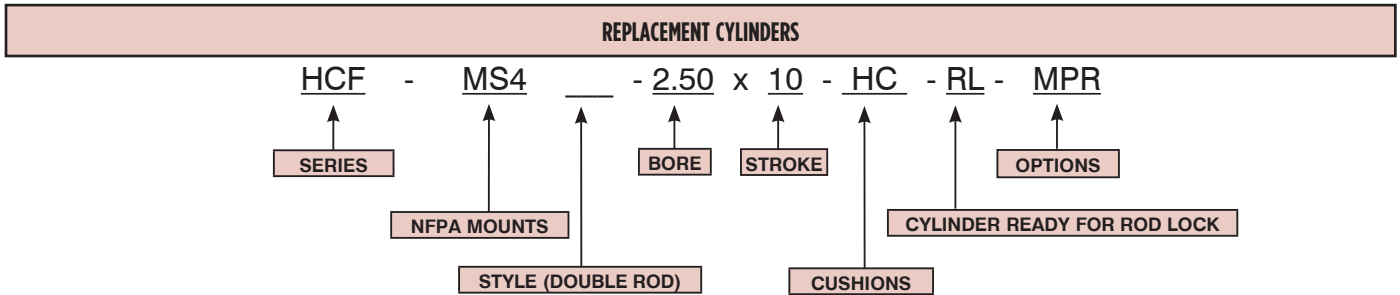
OPTION LENGTH ADDER						
(ADD TO CATALOG BASIC OVERALL LENGTH DIMENSIONS)						
BORE	OPTION					
	B	BC	BH	ELC	ELH	ST* (STOP TUBE) EXAMPLE: ST=2
1.50	0.500	0.250	0.250	1.000	1.000	2.000
2.00	0.500	0.250	0.250	1.000	1.000	2.000
2.50	0.500	0.250	0.250	1.000	1.000	2.000
3.25	0.500	0.250	0.250	1.250	1.250	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.

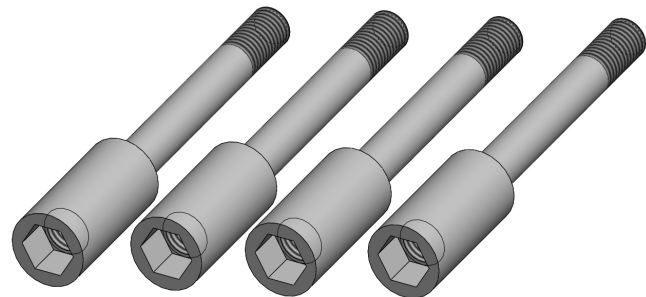
## 'HCF' NFPA MOUNTS

 1.50"-6.00" Bores	 1.50"-6.00" Bores	 1.50"-6.00" Bores	 1.50"-6.00" Bores	 1.50"-4.00" Bores	 1.50"-6.00" Bores
 1.50"-6.00" Bores	 1.50"-6.00" Bores	 1.50"-6.00" Bores	 1.50"-6.00" Bores	 1.50"-6.00" Bores	 1.50"-4.00" Bores

# HOW TO ORDER: CYLINDER & ROD LOCK REPLACEMENT PARTS



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



ROD LOCK PART LIST					
BORE	ROD DIAMETER	ROD LOCK MODEL (ROD LOCK & MOUNTING KIT)	RATED HOLDING FORCE (LBS)	ROD LOCK ONLY	MOUNTING KIT ONLY
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 HYDRAULIC CYLINDERS INC.® 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 'HCF' DIMENSIONS: BASIC CYLINDER (MXO MOUNT) FLUSH MOUNT (WITH SLEEVE NUT CONSTRUCTION)

## ABOUT ROD END STYLES

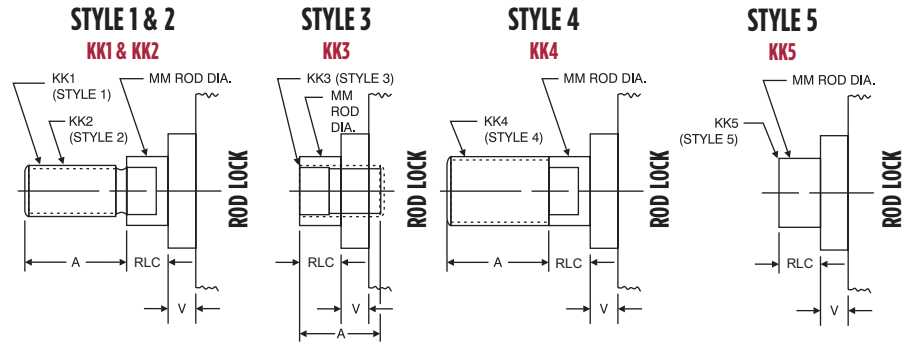
### Style 1 Male Rod End is STANDARD

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).

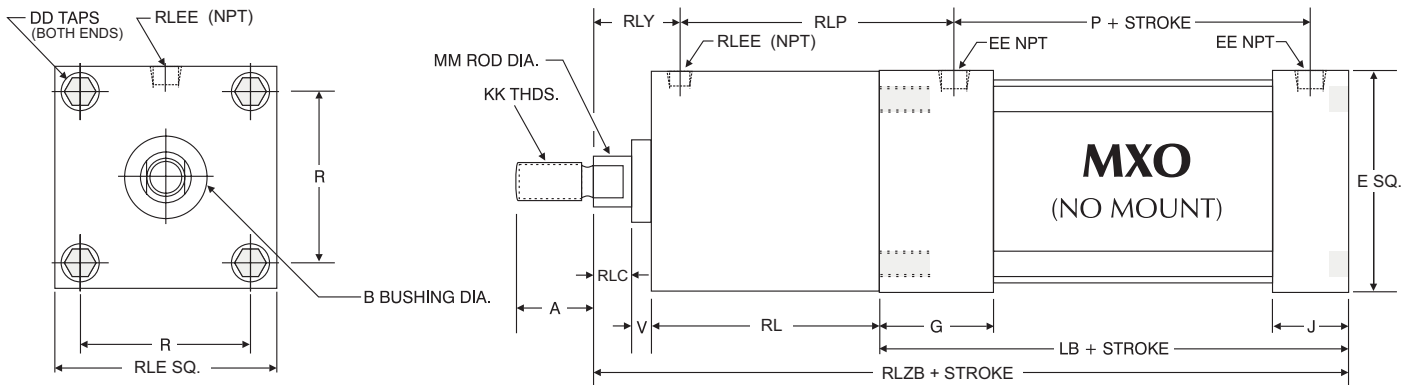
NEED SOMETHING NOT LISTED?  
Just send us a sketch.  
In most cases, quotes are turned around in one day!

## PISTON ROD END STYLES



BORE	ROD DIAMETER (MM)	STANDARD		OPTIONAL							RLC	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	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



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

## ABOUT ROD END STYLES

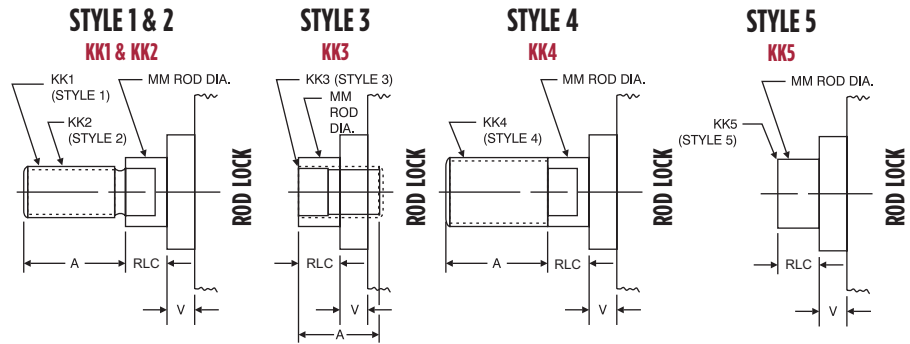
Style 1 Male Rod End is STANDARD

Other NFPA Styles can be specified (see chart).

Need a rod end not listed?  
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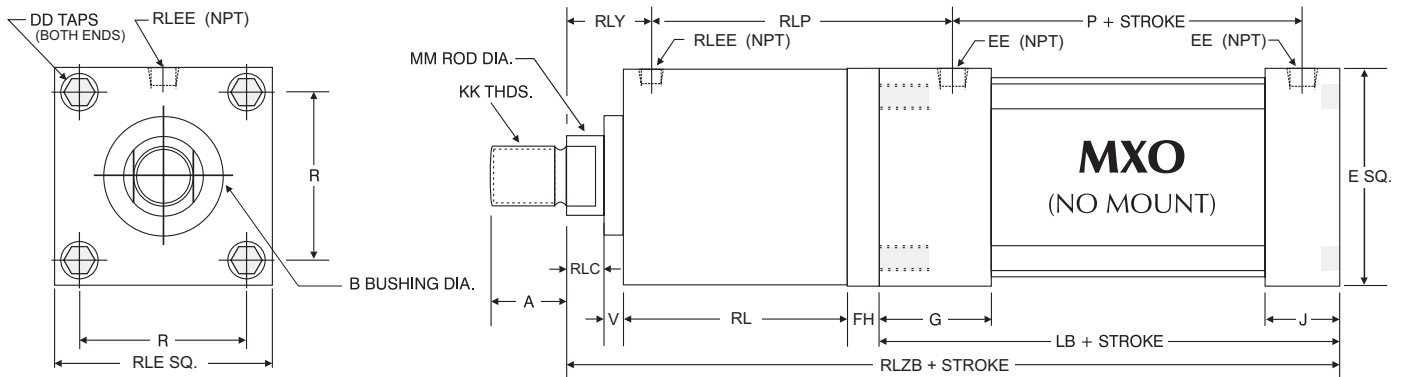
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## PISTON ROD END STYLES



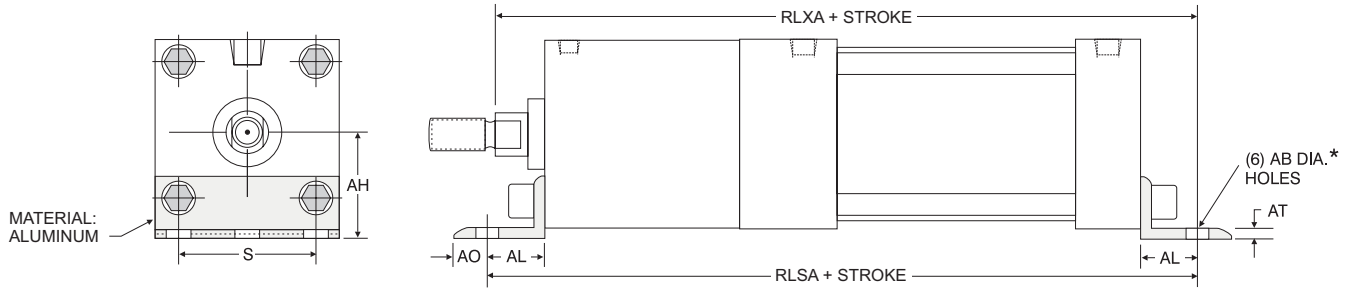
BORE	ROD DIAMETER (MM)	STANDARD		OPTIONAL							RLC	V
		Style 1 - Male	Style 2 - Male	Style 2 - Male	Style 3 - Female	Style 4 - Male	Style 4 - Male	Style 5 - Blank				
		KK1	A	KK2	A	KK3	A	KK4	A	KK5		
2.00, 2.50	1.000	3/4 -16	1.125	7/8 -14	1.125	3/4 -16	1.125	1 -14	1.125	No Threads	0.500	0.250
3.25, 4.00,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



'HCF' 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

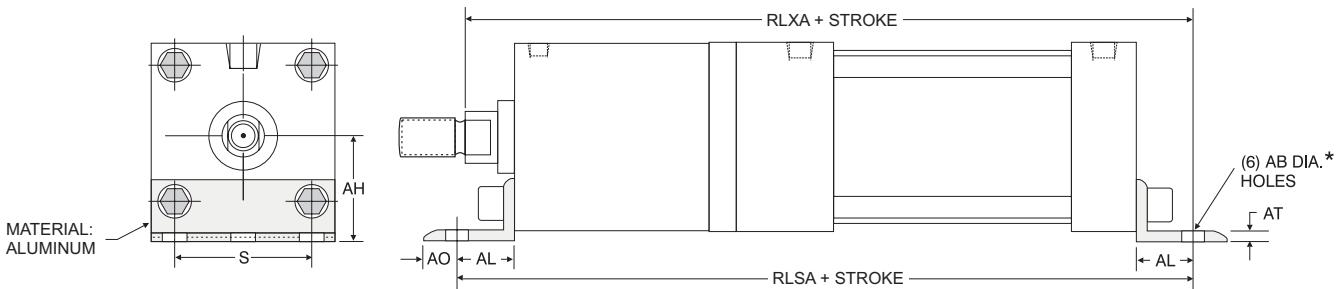
## 'MS1' (HEAD & CAP END ANGLE): STANDARD ROD WITH ROD LOCK MOUNTED



'HCF' SERIES 'MS1' ANGLE MOUNT DIMENSIONS									
BORE	ROD DIAMETER	AB	AH	AL	AO	AT	S	ADD STROKE	
								RLSA	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.

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

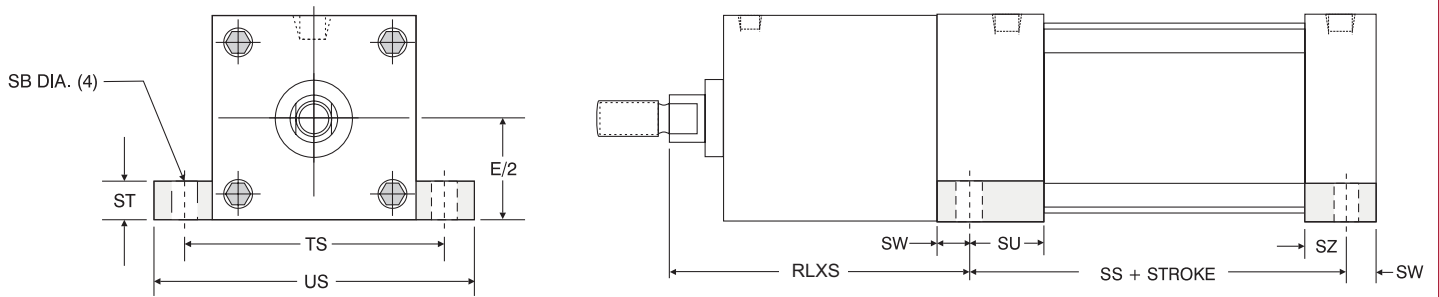


'HCF' SERIES 'MS1' ANGLE MOUNT DIMENSIONS									
BORE	ROD DIAMETER	AB	AH	AL	AO	AT	S	ADD STROKE	
								RLSA	RLXA
2.00	1.000	0.438	1.438	1.000	0.375	0.125	1.750	9.750	9.500
2.50	1.000	0.438	1.625	1.000	0.375	0.125	2.250	9.875	9.625
3.25	1.375	0.563	1.938	1.250	0.500	0.125	2.750	11.375	11.000
4.00	1.375	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.

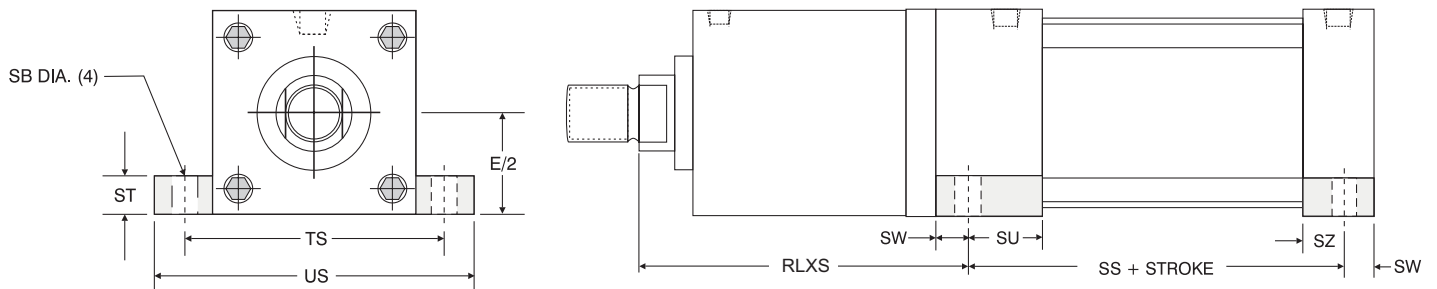


## 'MS2' (SIDE LUG): STANDARD ROD WITH ROD LOCK MOUNTED



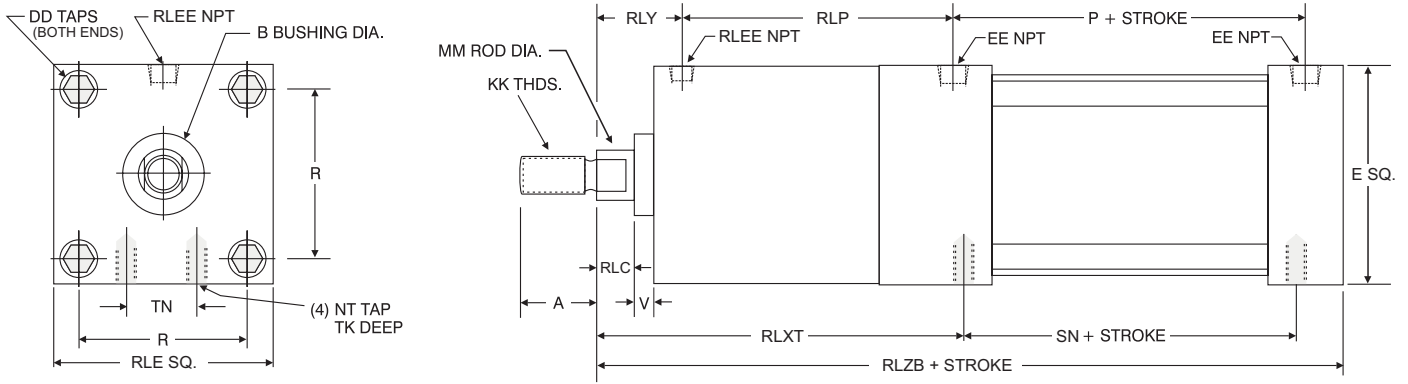
'HCF' SERIES 'MS2' SIDE LUG MOUNT DIMENSIONS											
BORE	ROD DIAMETER	SB	E/2	ST	SU	SW	SZ	TS	US	RLXS	ADD STROKE
											HCS
1.50	0.625	0.438	1.000	0.500	1.125	0.375	0.625	2.750	3.500	4.000	2.875
2.00	0.625	0.438	1.250	0.500	1.125	0.375	0.625	3.250	4.000	4.000	2.875
2.50	0.625	0.438	1.500	0.500	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

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



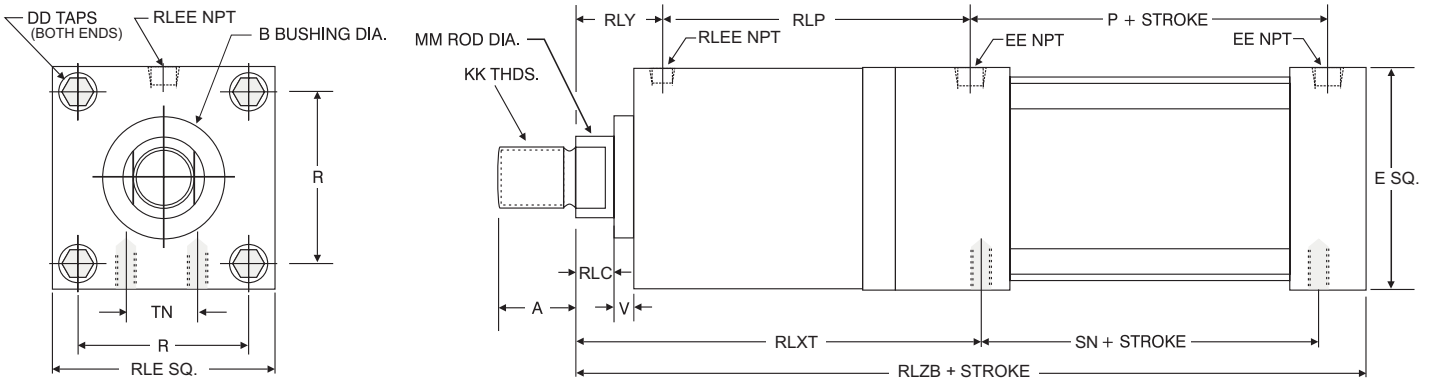
'HCF' SERIES 'MS2' SIDE LUG MOUNT DIMENSIONS											
BORE	ROD DIAMETER	SB	E/2	ST	SU	SW	SZ	TS	US	RLXS	ADD STROKE
											HCS
2.00	1.000	0.438	1.250	0.500	1.125	0.375	0.625	3.250	4.000	5.250	2.875
2.50	1.000	0.438	1.500	0.500	1.125	0.375	0.625	3.750	4.500	5.250	3.000
3.25	1.375	0.563	1.875	0.750	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

## ‘MS4’ (BOTTOM TAPPED HOLES): STANDARD ROD WITH ROD LOCK MOUNTED



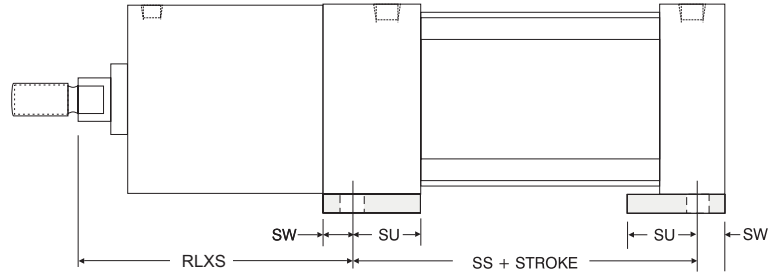
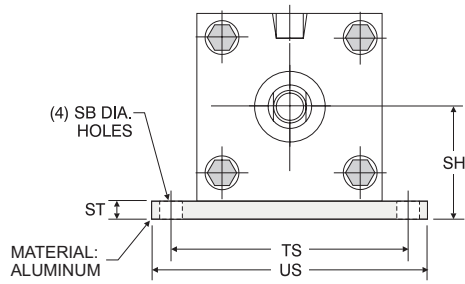
‘HCF’ SERIES ‘MS4’ FLUSH MOUNT DIMENSIONS													ROD LOCK BASIC DIMENSIONS								
BORE	A	B	DD	E	EE	KK	MM	NT	P	R	SN	TK	TN	RLC	RLE	RLEE	RLP	RLXT	RLY	RLZB	V
1.50	0.750	1.125	1/4-28	2.000	1/4 NPT	7/16-20	0.625	1/4-20	2.375	1.438	2.250	0.375	0.625	0.375	1.984	1/8 NPT	3.563	4.570	0.938	7.250	0.250
2.00	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

## ‘MS4’ (BOTTOM TAPPED HOLES): OVERSIZED ROD WITH ROD LOCK MOUNTED



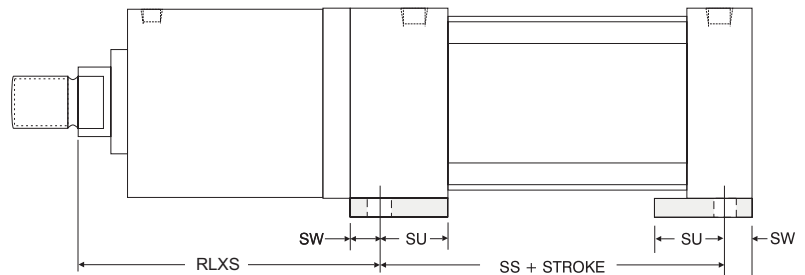
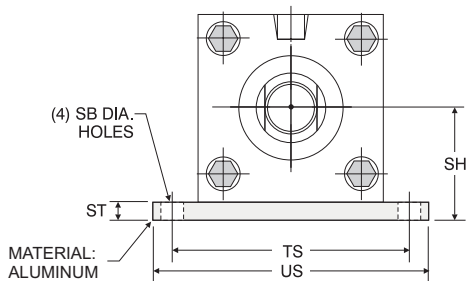
‘HCF’ SERIES OVERSIZE ROD ‘MS4’ FLUSH MOUNT DIMENSIONS													ROD LOCK BASIC DIMENSIONS								
BORE	A	B	DD	E	EE	KK	MM	NT	P	R	SN	TK	TN	RLC	RLE	RLEE	RLP	RLXT	RLY	RLZB	V
2.00	1.125	1.500	5/16-24	2.500	1/4 NPT	3/4-16	1.000	0.313-18	2.375	1.844	2.250	0.500	0.875	0.500	2.484	1/8 NPT	4.500	5.813	1.250	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

## ‘BASEBAR’ (NON-NFPA): STANDARD ROD WITH ROD LOCK MOUNTED



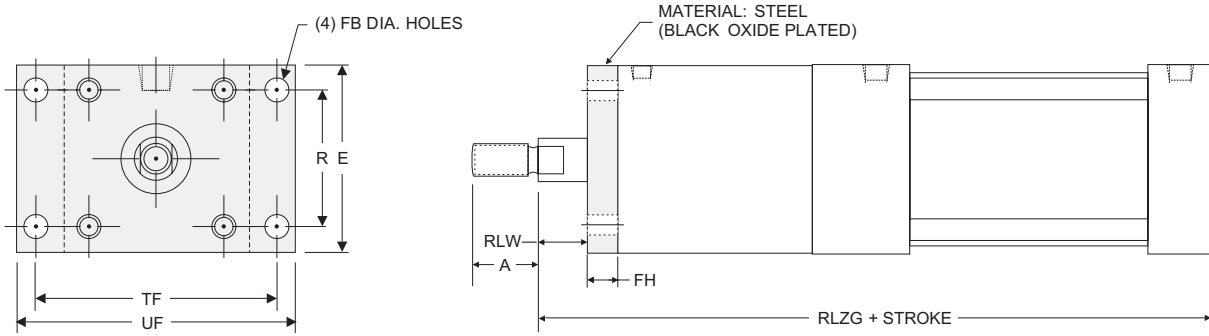
‘HCF’ SERIES BASE BAR MOUNT (NON-NFPA) DIMENSIONS										
BORE	ROD DIAMETER	SB	SH	ST	SU	SW	TS	US	RLXS	ADD STROKE
										HCS
1.50	0.625	0.438	1.250	0.250	1.125	0.375	2.750	3.500	4.000	2.875
2.00	0.625	0.438	1.500	0.250	1.125	0.375	3.250	4.000	4.000	2.875
2.50	0.625	0.438	1.875	0.375	1.125	0.375	3.750	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

## ‘BASEBAR’ (NON-NFPA): OVERSIZED ROD WITH ROD LOCK MOUNTED



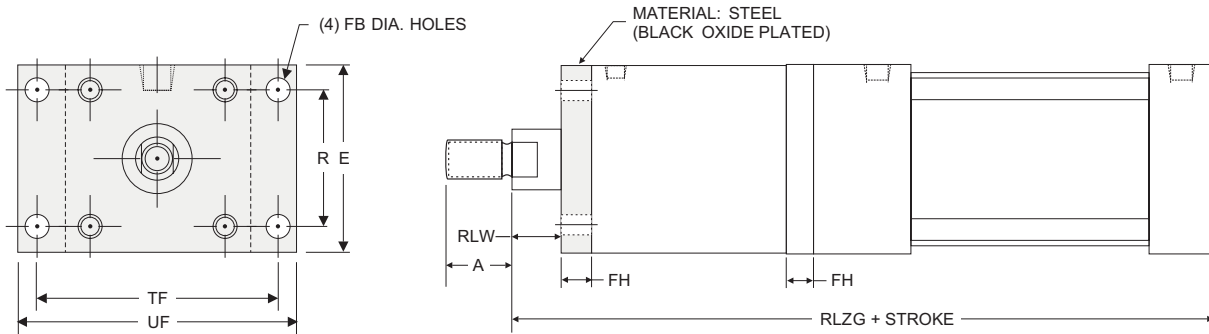
‘HCF’ SERIES BASE BAR MOUNT (NON-NFPA) DIMENSIONS										
BORE	ROD DIAMETER	SB	SH	ST	SU	SW	TS	US	RLXS	ADD STROKE
										HCS
2.00	1.000	0.438	1.500	0.250	1.125	0.375	3.250	4.000	5.250	2.875
2.50	1.000	0.438	1.875	0.375	1.125	0.375	3.750	4.500	5.250	3.000
3.25	1.375	0.563	2.375	0.500	1.250	0.500	4.750	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

## ‘MF1’ (HEAD FLANGE): STANDARD ROD WITH ROD LOCK MOUNTED



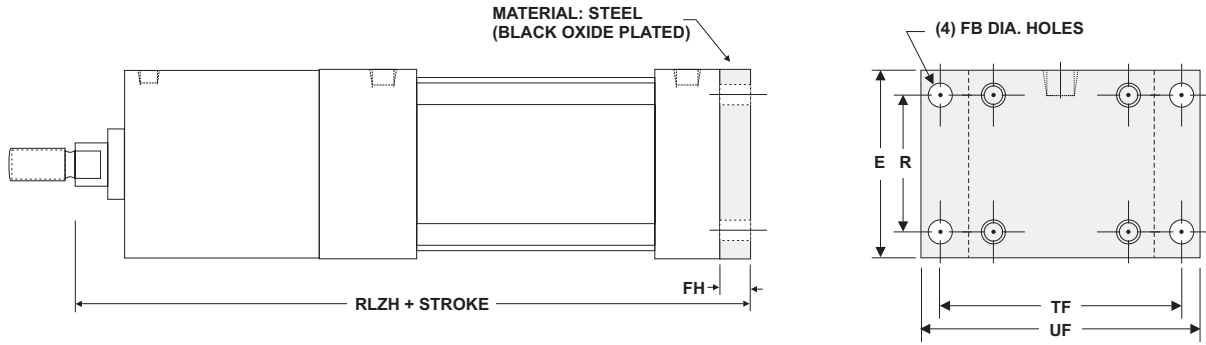
‘HCF’ SERIES ‘MF1’ FLANGE MOUNT DIMENSIONS										
BORE	ROD DIAMETER	A	E	FB	FH	R	RLW	TF	UF	RLZG
1.50	0.625	0.750	2.000	0.313	0.375	1.438	0.625	2.750	3.375	7.625
2.00	0.625	0.750	2.500	0.375	0.375	1.844	0.625	3.375	4.125	7.625
2.50	0.625	0.750	3.000	0.375	0.375	2.188	0.625	3.875	4.625	8.000
3.25	1.000	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

## ‘MF1’ (HEAD FLANGE): OVERSIZED ROD WITH ROD LOCK MOUNTED



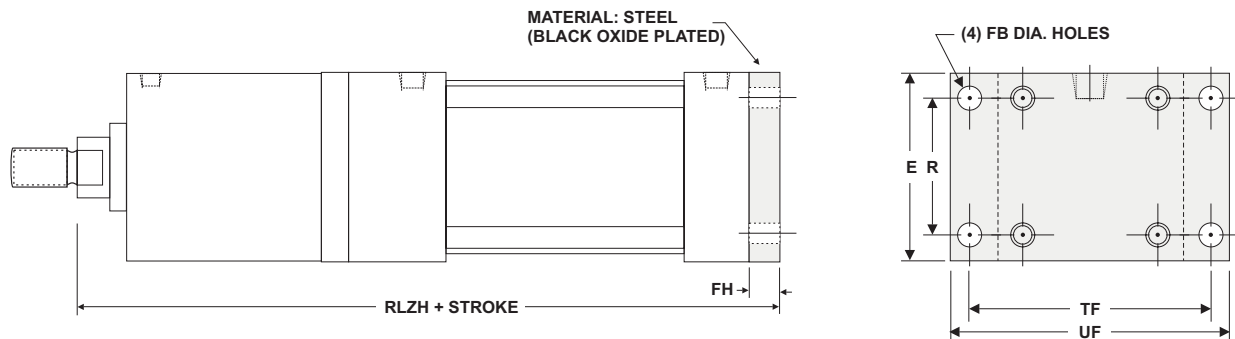
‘HCF’ SERIES ‘MF2’ FLANGE MOUNT DIMENSIONS										
BORE	ROD DIAMETER	A	E	FB	FH	R	RLW	TF	UF	RLZG
2.00	1.000	1.125	2.500	0.375	0.375	1.844	1.000	3.375	4.125	9.125
2.50	1.000	1.125	3.000	0.375	0.375	2.188	1.000	3.875	4.625	9.250
3.25	1.375	1.625	3.750	0.438	0.625	2.760	1.000	4.688	5.500	10.500
4.00	1.375	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

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



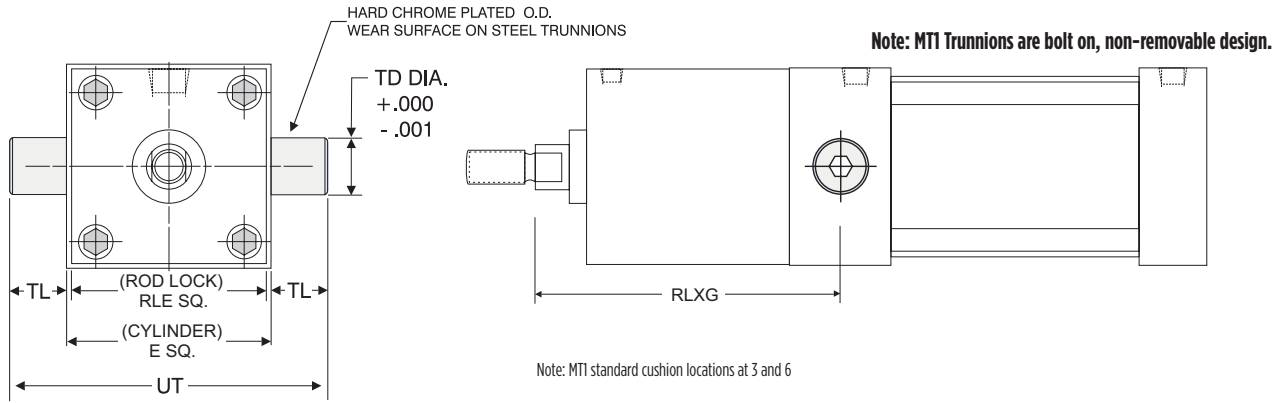
'HCF' SERIES 'MF2' FLANGE MOUNT DIMENSIONS								
BORE	ROD DIAMETER	E	FB	FH	R	TF	UF	RLZH
1.50	0.625	2.000	0.313	0.375	1.438	2.750	3.375	7.625
2.00	0.625	2.500	0.375	0.375	1.844	3.375	4.125	7.625
2.50	0.625	3.000	0.375	0.375	2.188	3.875	4.625	8.000
3.25	1.000	3.750	0.438	0.625	2.760	4.688	5.500	9.625
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

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



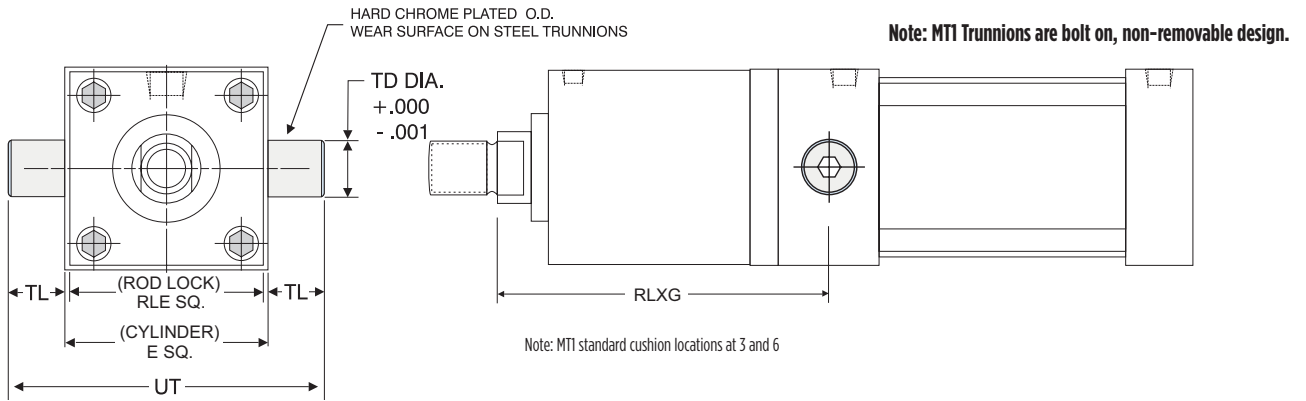
'HCF' SERIES 'MF2' FLANGE MOUNT DIMENSIONS								
BORE	ROD DIAMETER	E	FB	FH	R	TF	UF	RLZH
2.00	1.000	2.500	0.375	0.375	1.844	3.375	4.125	8.875
2.50	1.000	3.000	0.375	0.375	2.188	3.875	4.625	9.000
3.25	1.375	3.750	0.438	0.625	2.760	4.688	5.500	10.375
4.00	1.375	4.500	0.438	0.625	3.320	5.438	6.250	10.375
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

## ‘MT1’ (HEAD TRUNNION): STANDARD ROD WITH ROD LOCK MOUNTED



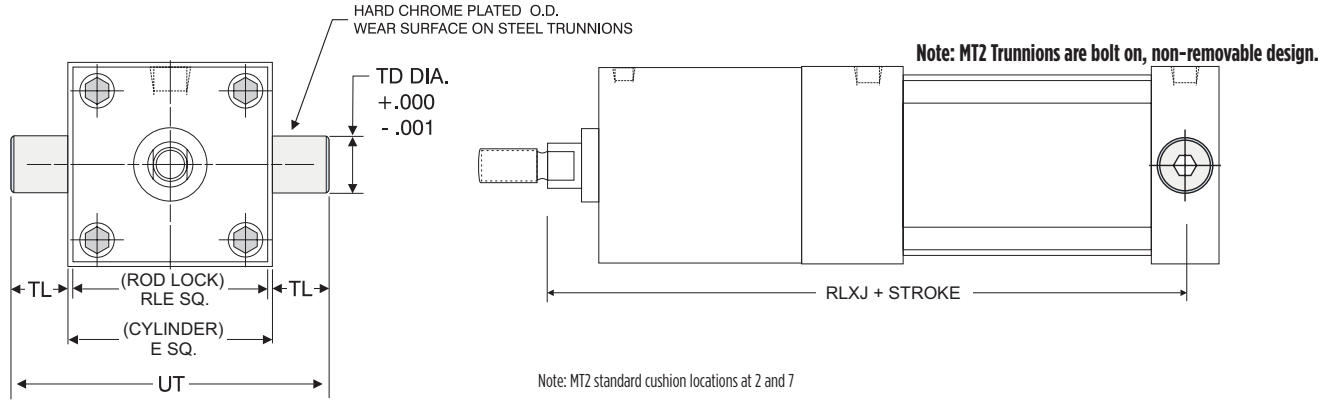
‘HCF’ SERIES ‘MT1’ HEAD TRUNNION AND ‘MT2’ CAP TRUNNION MOUNT DIMENSIONS							
BORE	ROD DIAMETER	E	RLE	HCD	TL	UT	RLXG
1.50	0.625	2.000	1.984	1.000	1.000	4.000	4.375
2.00	0.625	2.500	2.484	1.000	1.000	4.500	4.375
2.50	0.625	3.000	2.984	1.000	1.000	5.000	4.625
3.25	1.000	3.750	3.734	1.000	1.000	5.750	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

## ‘MT1’ (HEAD TRUNNION): OVERSIZED ROD WITH ROD LOCK MOUNTED



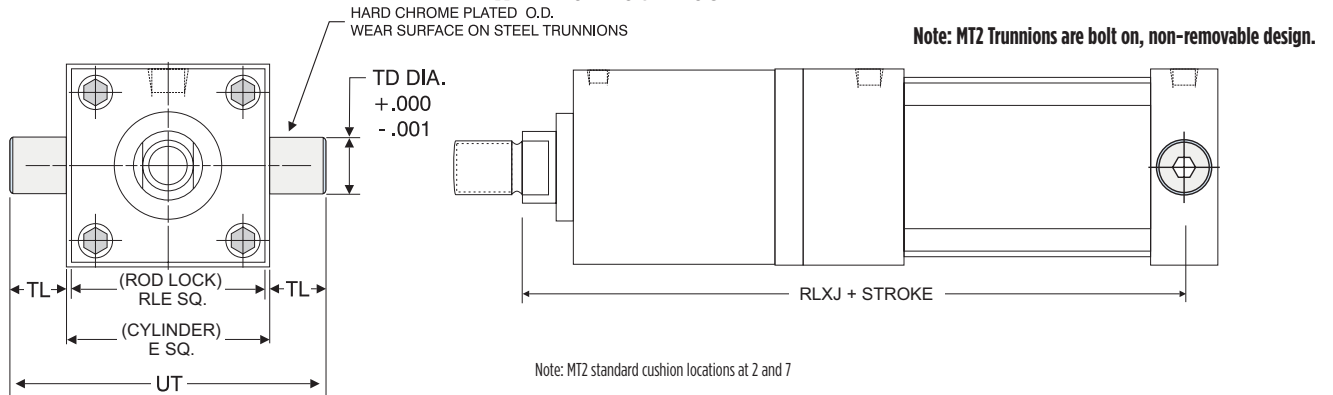
‘HCF’ SERIES ‘MT1’ HEAD TRUNNION AND ‘MT2’ CAP TRUNNION MOUNT DIMENSIONS							
BORE	ROD DIAMETER	E	RLE	HCD	TL	UT	RLXG
2.00	1.000	2.500	2.484	1.000	1.000	4.500	5.625
2.50	1.000	3.000	2.984	1.000	1.000	5.000	5.625
3.25	1.375	3.750	3.734	1.000	1.000	5.750	6.375
4.00	1.375	4.500	4.484	1.000	1.000	6.500	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

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



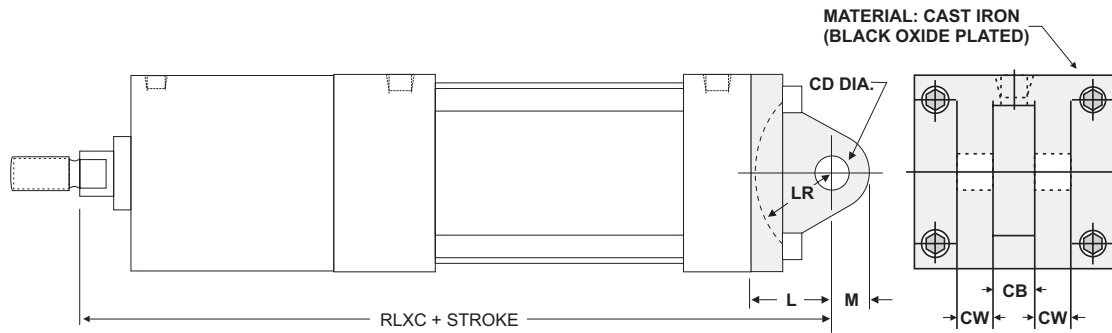
'HCF' SERIES 'MT1' HEAD TRUNNION AND 'MT2' CAP TRUNNION MOUNT DIMENSIONS							
BORE	ROD DIAMETER	E	RLE	HCD	TL	UT	ADD STROKE
							RLXJ
1.50	0.625	2.000	1.984	1.000	1.000	4.000	6.750
2.00	0.625	2.500	2.484	1.000	1.000	4.500	6.750
2.50	0.625	3.000	2.984	1.000	1.000	5.000	7.125
3.25	1.000	3.750	3.734	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

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



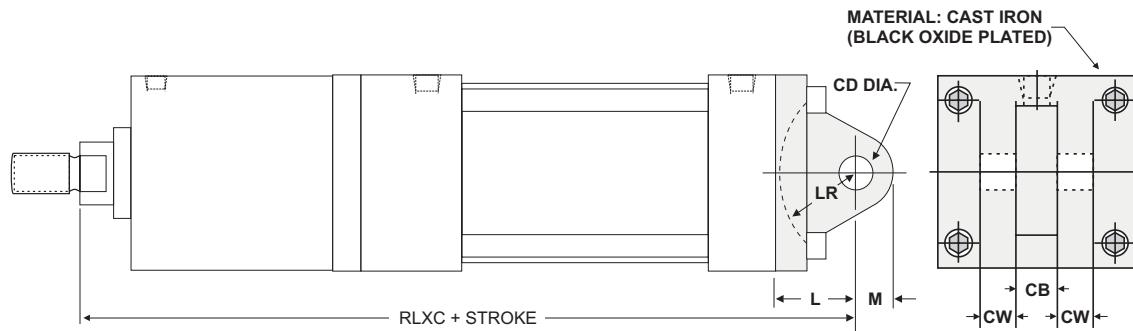
'HCF' SERIES 'MT1' HEAD TRUNNION AND 'MT2' CAP TRUNNION MOUNT DIMENSIONS							
BORE	ROD DIAMETER	E	RLE	HCD	TL	UT	ADD STROKE
							RLXJ
2.00	1.000	2.500	2.484	1.000	1.000	4.500	8.000
2.50	1.000	3.000	2.984	1.000	1.000	5.000	8.125
3.25	1.375	3.750	3.734	1.000	1.000	5.750	9.125
4.00	1.375	4.500	4.484	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

## ‘MP1’ (Detachable Cap Pivot Clevis): STANDARD ROD WITH ROD LOCK MOUNTED



‘HCF’ 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

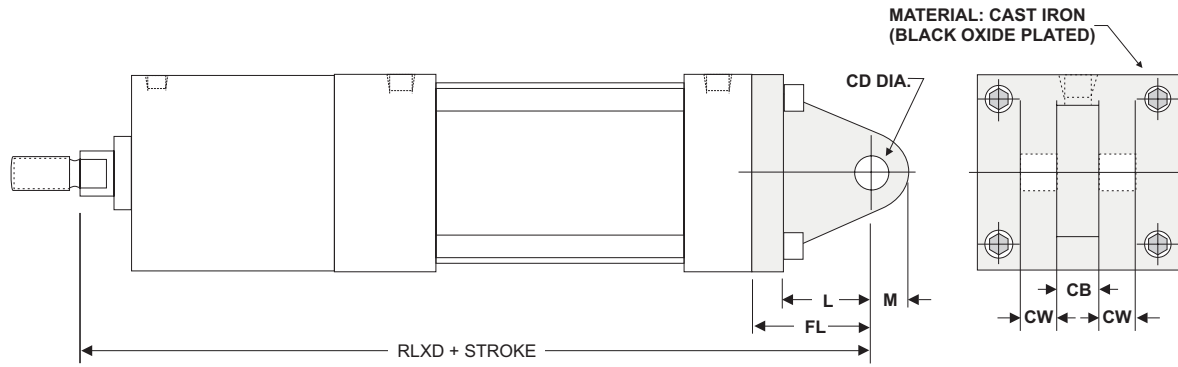
## ‘MP1’ (Detachable Cap Pivot Clevis): OVERSIZED ROD WITH ROD LOCK MOUNTED



‘HCF’ 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

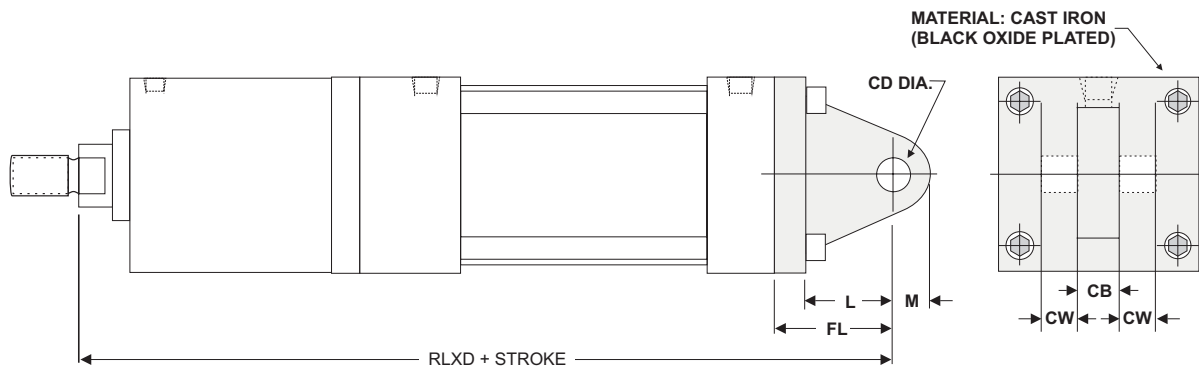


## ‘MP2’ (Detachable Cap Pivot Clevis): STANDARD ROD WITH ROD LOCK MOUNTED



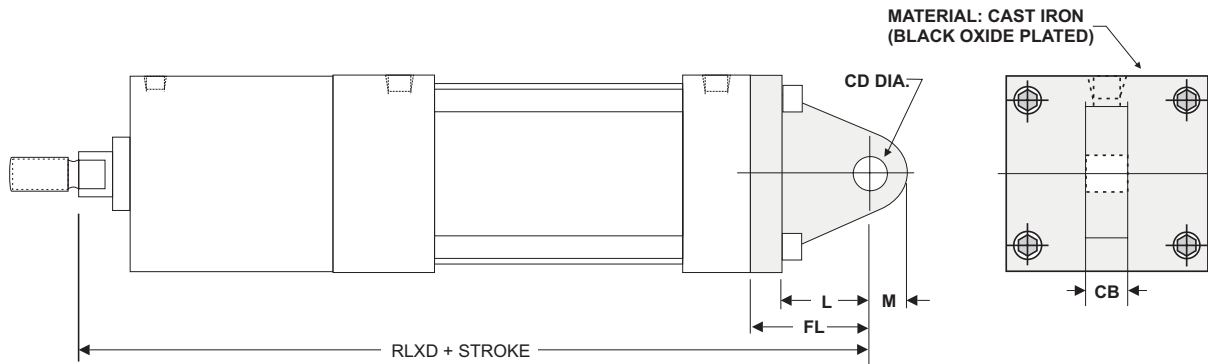
‘HCF’ SERIES ‘MP2’ CLEVIS MOUNT DIMENSIONS								
BORE	ROD DIAMETER	CB	CD	CW	FL	L	M	ADD STROKE
								RLXD
1.50	0.625	0.750	0.500	0.500	1.125	0.750	0.625	8.375
2.00	0.625	0.750	0.500	0.500	1.125	0.750	0.625	8.375
2.50	0.625	0.750	0.500	0.500	1.125	0.750	0.625	8.750
3.25	1.000	1.250	0.750	0.625	1.875	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

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



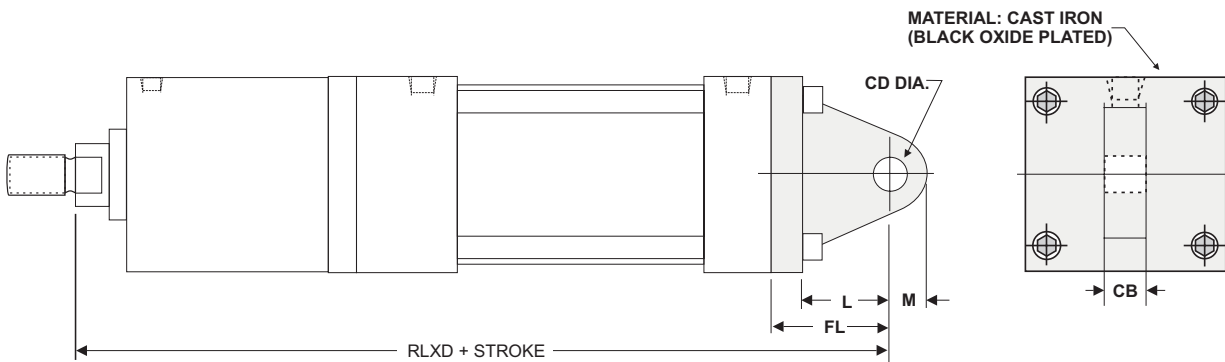
‘HCF’ SERIES ‘MP2’ CLEVIS MOUNT DIMENSIONS								
BORE	ROD DIAMETER	CB	CD	CW	FL	L	M	ADD STROKE
								RLXD
2.00	1.000	0.750	0.500	0.500	1.125	0.750	0.625	9.625
2.50	1.000	0.750	0.500	0.500	1.125	0.750	0.625	9.750
3.25	1.375	1.250	0.750	0.625	1.875	1.250	0.875	11.625
4.00	1.375	1.250	0.750	0.625	1.875	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

## ‘MP4’ (Detachable Cap Pivot Eye): STANDARD ROD WITH ROD LOCK MOUNTED



‘HCF’ 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

## ‘MP4’ (Detachable Cap Pivot Eye): OVERSIZED ROD WITH ROD LOCK MOUNTED



‘HCF’ 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

# 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.

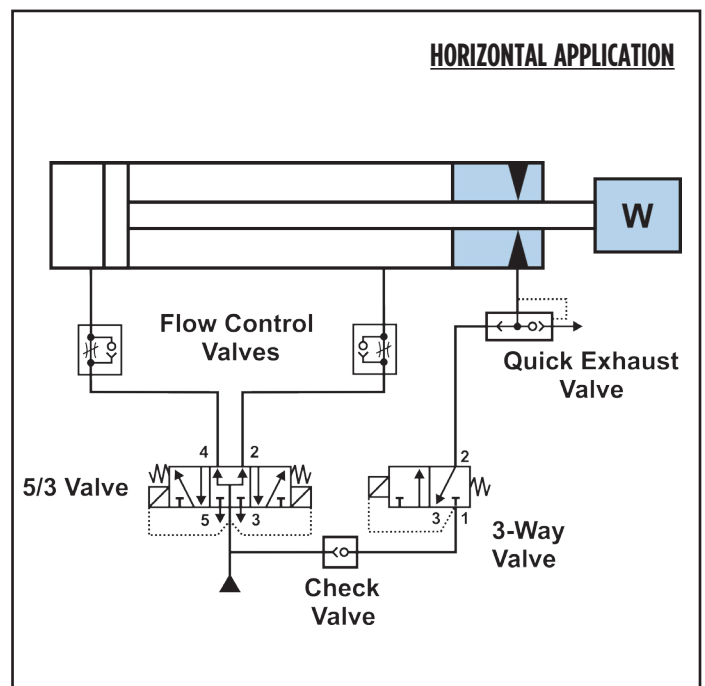
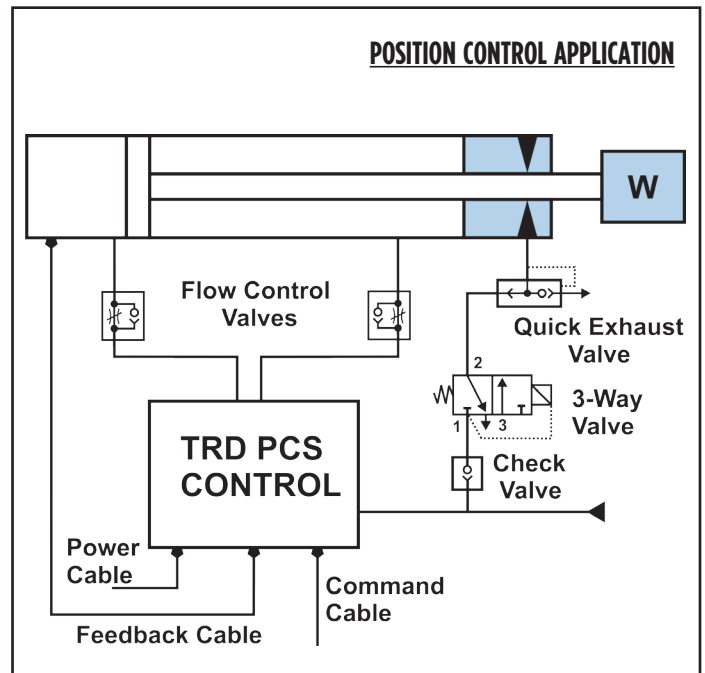
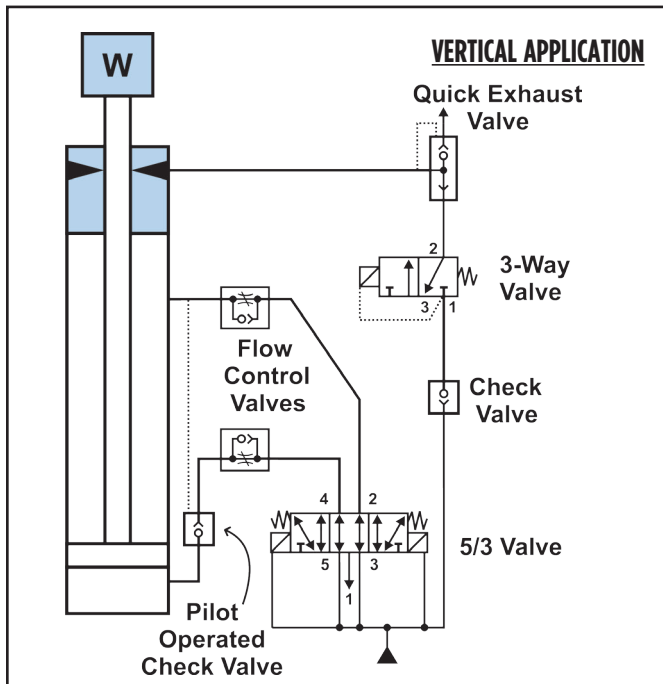
**Quick Exhaust Valve** – Can be used to accelerate the rod lock response time for maximum performance. Typical rod lock response time is 200ms.

**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.

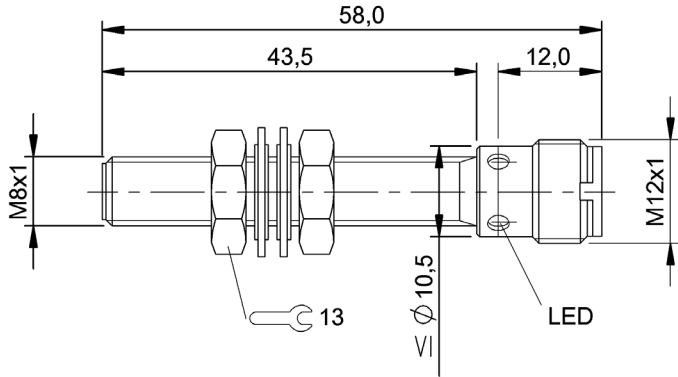
**Manual Override** – A three-way valve can be added to the control circuits below to act as a manual override for tooling set-up or adjustments.

**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.

## AVOID SITUATIONS WHERE THE CYLINDER CAN LUNGE ON POWER UP OR CYCLING.



# ROD LOCK PROXIMITY SWITCH: OPTION P



An inductive proximity switch (with M12x1 thread) can be used to sense the rod lock unclamped condition.

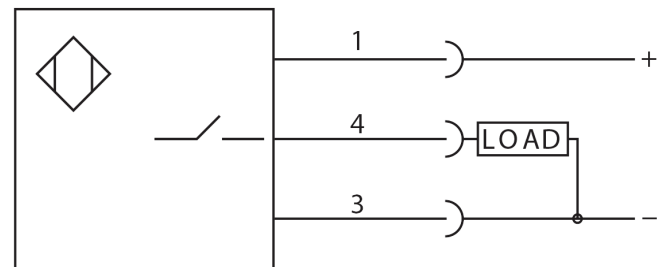
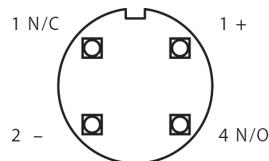
**BALLUFF Model: BES M08EH-PSC15B-S04G**

ELECTRICAL DATA	
Connection type	Connector
Eff. operating current I <sub>e</sub>	200 mA
Eff. operating voltage U <sub>e</sub> DC	24.0 V
Electrical version	DC, direct current
Load capacitance max. (at U <sub>e</sub> )	0.500 µF
Max. no-load cur. I <sub>o</sub> undamped	3.0 mA
Minimum operating current I <sub>m</sub>	0 mA
No-load current I <sub>o</sub> damped max.	9.0 mA
Operating voltage U <sub>B</sub> max. DC [V]	30.0 V
Operating voltage U <sub>B</sub> min. DC [V]	10.0 V
Rated insulation voltage U <sub>i</sub>	250 VAC
Rated short circuit current	100 A
Ripple max. (% of U <sub>e</sub> )	15%
Switching freq. f max. (at U <sub>e</sub> )	3000 Hz
Switching function	Normally open (NO)
Switching output	PNP
Voltage drop static max.	2.5 V

MECHANICAL DATA	
Ambient temperature HCA max.	70°C
Ambient temperature HCA min.	-25°C
Assured operating distance S <sub>a</sub>	1.20 mm
Connector type	M12x1-S04
Depth	58.0 mm
Diameter d1	M08x1
Eff. operating distance S <sub>r</sub>	1.50 mm
Housing material	Stainless steel
Mech. installation condition	Flush (shielded)
Mounting length	43.0 mm
Rated operating distance S <sub>n</sub> [mm]	1.50 mm
Sensing face material	PBT
Tightening torque	8 Nm (6 FT-LBS)
Function indicator	Yes
Function display	LED
Polarity reversal protected	Yes
Short circuit protected	Yes

## WIRING CONNECTIONS:

PNP Normally Open



## PROXIMITY SWITCH SETTING INSTRUCTIONS

- Set the rod lock to the unclamped "pressure applied" position.
- Screw the proximity switch (with jam nuts) into the designated M8x1 proximity switch hole until it contacts the position flange.
- Unscrew (back off) the proximity switch approximately 3/4 turn. While holding the proximity switch in the set position, tighten the locking nut using 6 ft/lbs of torque. Final adjustment may be necessary to achieve desired results.
- With the electrical power in the "off" position, connect the electrical wiring per the wiring diagram supplied with the switch. After the electrical power has been turned on, the proximity switch should indicate that the rod lock is in the unclamped position.

Notes: Ensure that the electrical power has been turned off before making adjustments. The locking nut should be tightened to a maximum of 15 ft/lbs of torque to prevent damage to the internal components of the switch. If sealing the unit for food or chemical service, make sure to include optional sealing ring.

# ROD LOCK INSTALLATION INSTRUCTIONS

- 1: Apply consonant 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 consonant 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.

## WARNING

**DO NOT DISASSEMBLE ROD LOCK!**  
**UNIT CONTAINS HIGH SPRING FORCE.**  
**RETURN TO HYDRAULIC CYLINDERS INC.® 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.**



HCF / WITH ROD LOCK

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**  
**UNIT CONTAINS HIGH SPRING FORCE**

**DO NOT DISASSEMBLE -**  
**INJURY MAY OCCUR**  
Return to HYDRAULIC CYLINDERS INC.® for service

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

# SAFETY INFORMATION

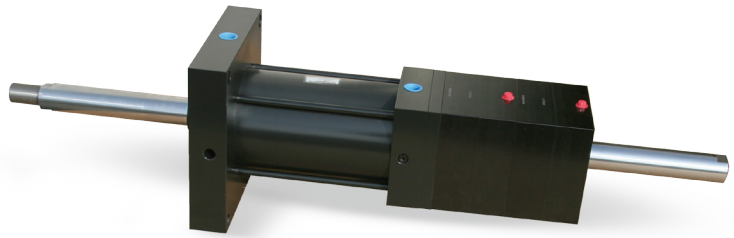
**! DANGER** IF PERSONAL SAFETY IS REQUIRED, AN UNRELATED, REDUNDANT SAFETY SYSTEM IS REQUIRED TO PREVENT BODILY INJURY

**! WARNING** DO NOT DISASSEMBLE ROD LOCK - UNIT CONTAINS HIGH SPRING FORCE. Return to HYDRAULIC CYLINDERS INC.® 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 cylinder 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.**

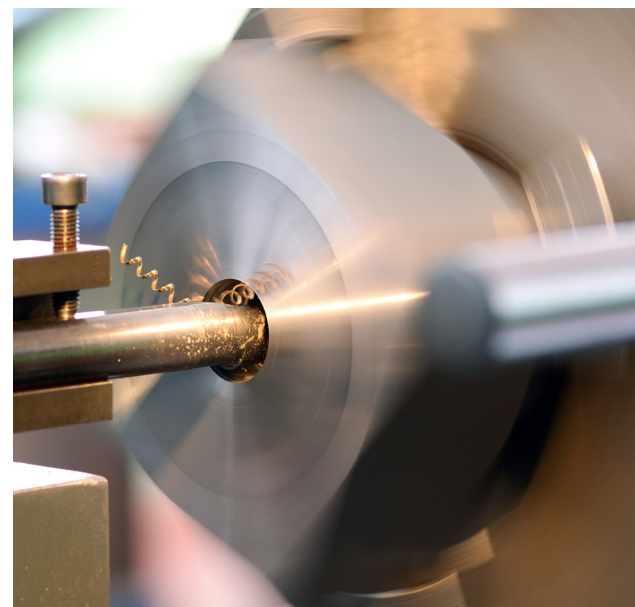
OPERATING PRESSURE	
Cylinder	0 TO 250 PSI AIR
Rod Lock	60 TO 150 PSI AIR

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"

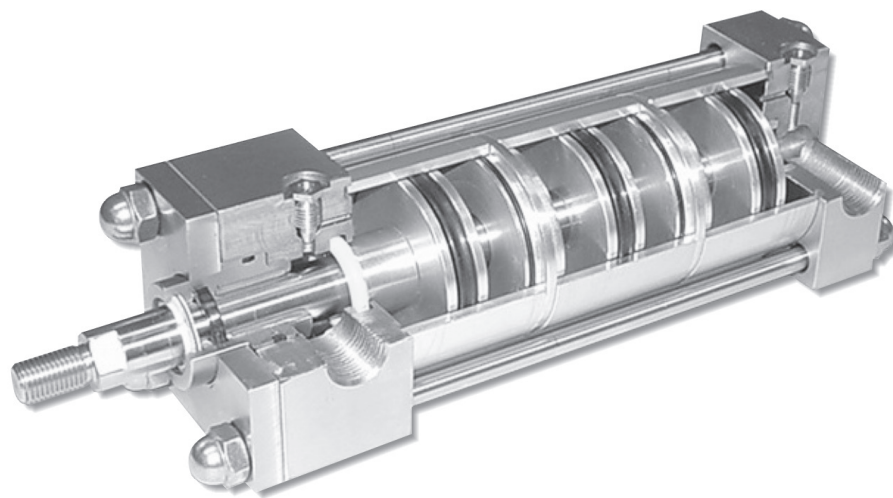
ROD MATERIAL REQUIREMENTS	
Diameter	+.000" to -.002" Nominal Diameter
Hardened Shaft	.0005" Minimum hard chrome
Unhardened Shaft	.001" Minimum hard chrome
Finish	6 to 10 micro-inch

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

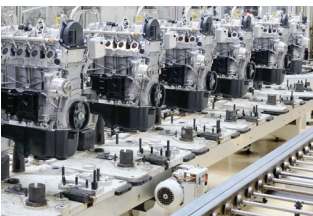
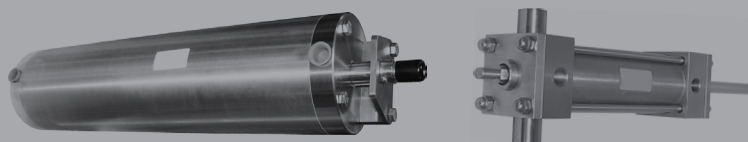


HCR Series | HCS Series | HCS-MS Series

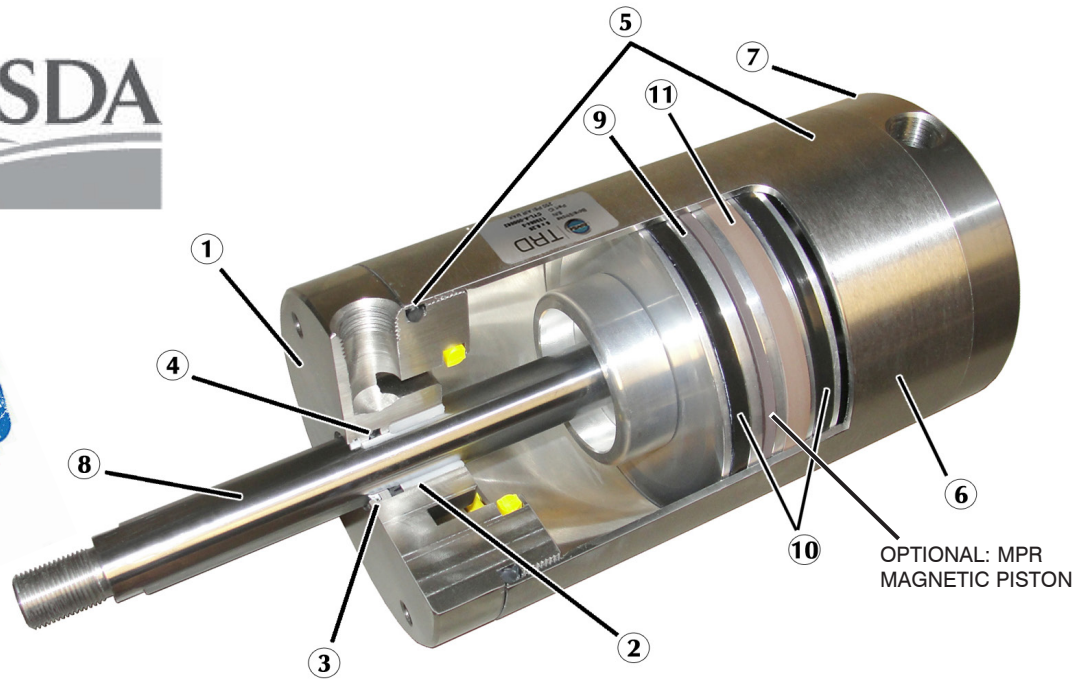
PNEUMATIC



- HCR Series – Repairable Stainless Steel ..... 64
- HCS Series – Stainless Steel ..... 74
- HCS-MS Series – Multi-Stage ..... 86



# REPAIRABLE STAINLESS STEEL 'HCR': CONSTRUCTION



## 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.

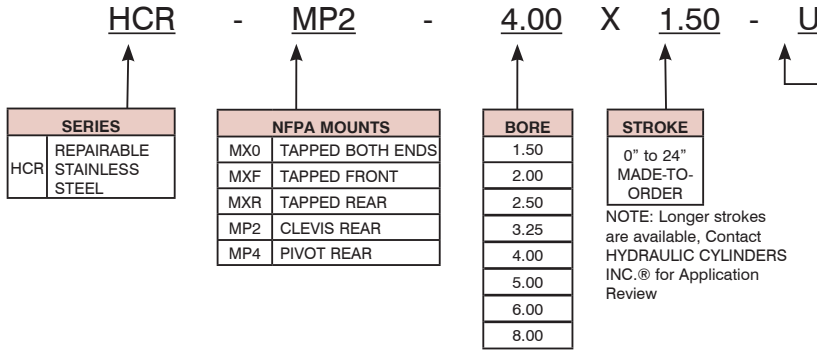
**OPERATING PRESSURE** 200 PSI Maximum

**OPERATING TEMPERATURE**

Standard: -20°F to 200°F (-29°C to 93°C)  
VS Option: 0°F to 400°F (-18°C to 204°C)



# SERIES 'HCR': HOW TO ORDER



SERIES	
HCR	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 HYDRAULIC CYLINDERS INC.® 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
MPP	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.

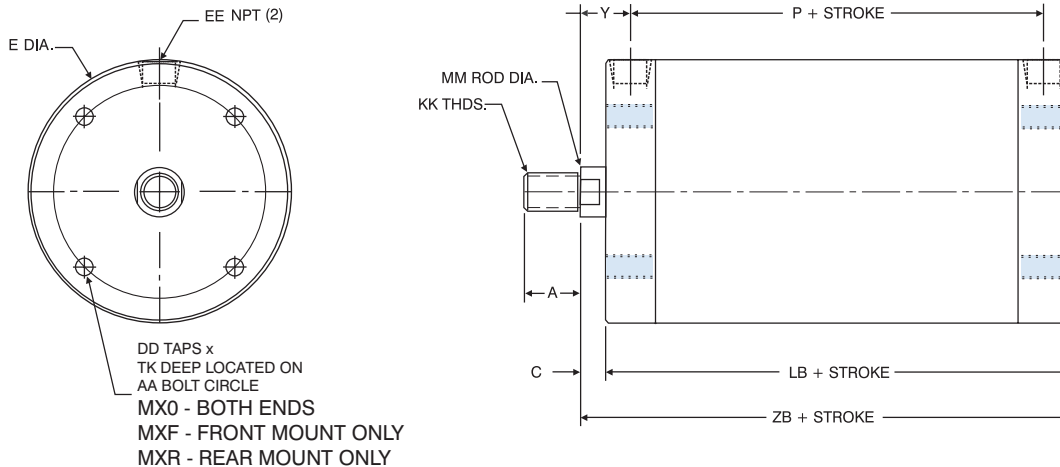
\* USDA APPROVED OPTION- Includes an external wiper as required by the USDA. The cylinder rod length will automatically increase by the amount required to accommodate the seal retaining bracket.

### 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 (MPP) 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.

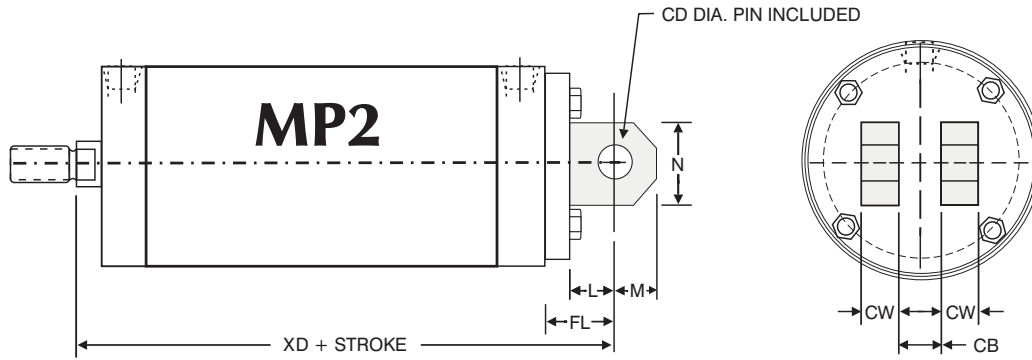
OPTION LENGTH ADDER (ADD TO CATALOG BASIC OVERALL LENGTH DIMENSIONS)			
BORE	OPTION		
	B	BC	BH
1.50	0.250"	0.125"	0.125"
2.00	0.250"	0.125"	0.125"
2.50	0.250"	0.125"	0.125"
3.25	0.250"	0.125"	0.125"
4.00	0.250"	0.125"	0.125"
5.00	0.500"	0.250"	0.250"
6.00	0.500"	0.250"	0.250"
8.00	0.500"	0.250"	0.250"

## SERIES 'HCR' DIMENSIONS: FRONT & REAR MOUNT



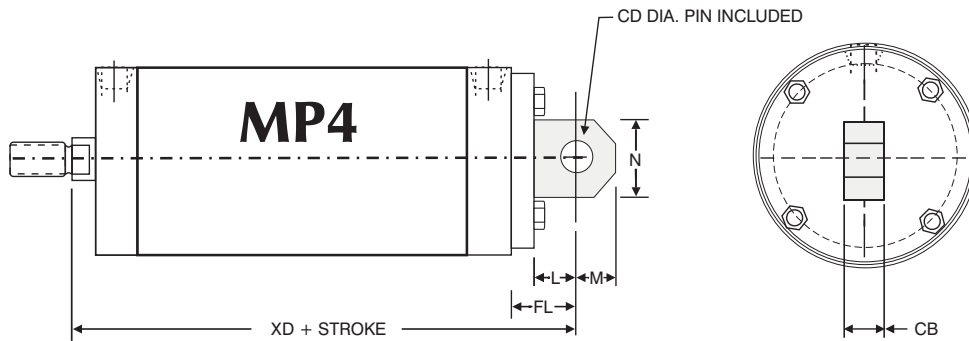
'MX0', 'MXR' & 'MXF' MOUNT DIMENSIONS														
BORE	ROD DIAMETER	A	AA	C	DD	E DIA.	EE NPT	KK	LB	MM	TK	Y	P	ZB
1.50	0.625 Standard	0.750	1.450	0.560	8-32	1.750	0.375	7/16-20	5.210	0.625	0.330	2.050	3.260	5.770
2.00	0.625 Standard	0.750	1.850	0.560	10-24	2.250	0.375	7/16-20	5.450	0.625	0.375	2.050	3.500	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	2.050	4.000	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	2.420	5.120	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	2.420	5.120	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 'HCR' DIMENSIONS: CLEVIS MOUNT



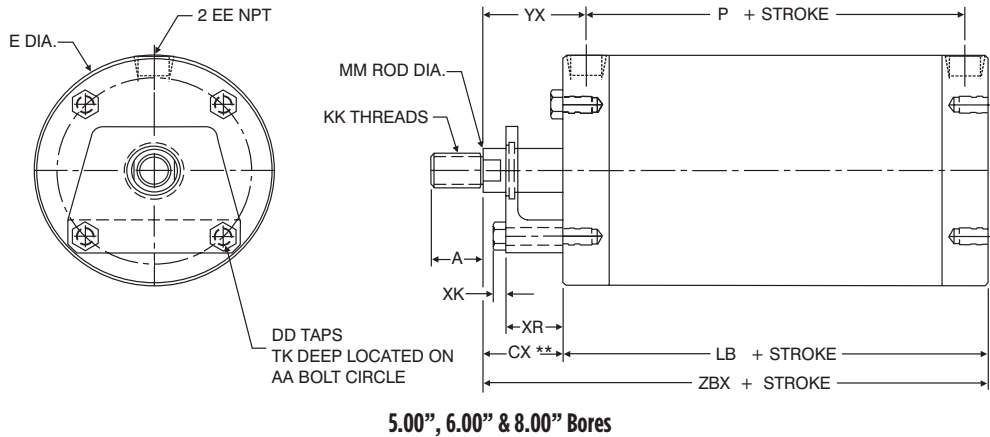
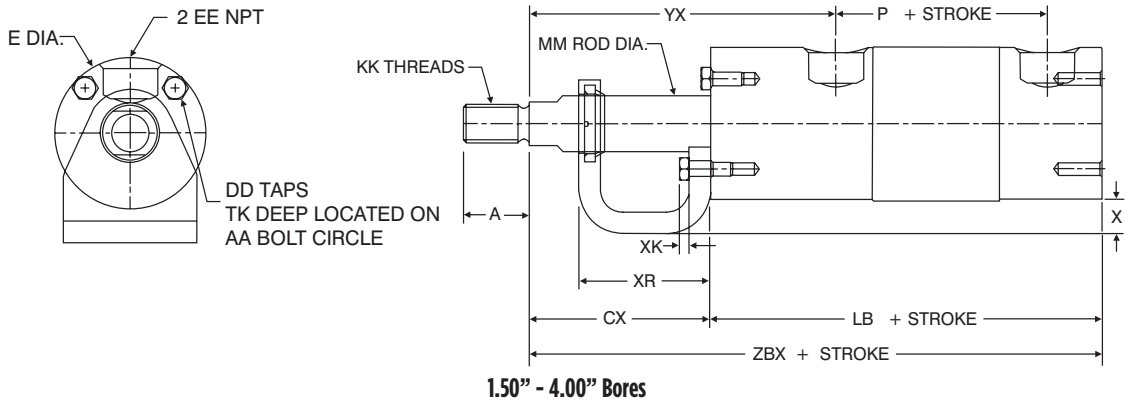
'MP2' CLEVIS MOUNT DIMENSIONS									
BORE	ROD DIAMETER	CB	CD	CW	FL	L	M	N	XD
1.50	0.625 Standard	0.750	0.500	0.490	1.125	0.750	0.350	0.700	6.900
2.00	0.625 Standard	0.750	0.500	0.500	1.125	0.750	0.400	0.800	7.140
2.50	0.625 Standard	0.750	0.500	0.500	1.125	0.750	0.400	0.800	7.640
3.25	1.000 Standard	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 'HCR' 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 'HCR' DIMENSIONS: USDA APPROVED OPTION "U"

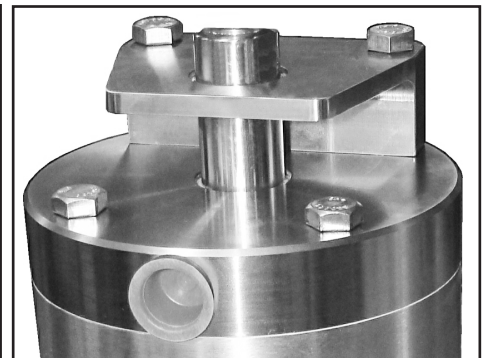
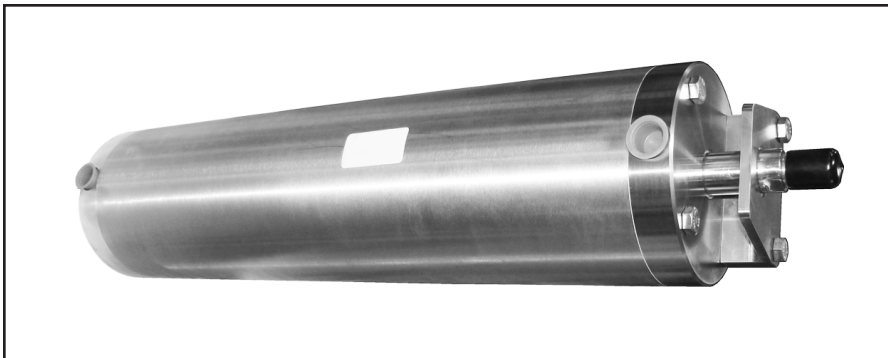


EXTERNAL WIPER 'OPTION U' DIMENSIONS

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	3.550	3.260	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	3.550	3.500	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	3.550	4.000	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	3.920	5.120	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	3.920	5.120	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 'HCR': OPTIONS

## ABOUT ROD END STYLES

### Style 1 Male Rod End is STANDARD

Other NFPA Styles can be specified (see chart).

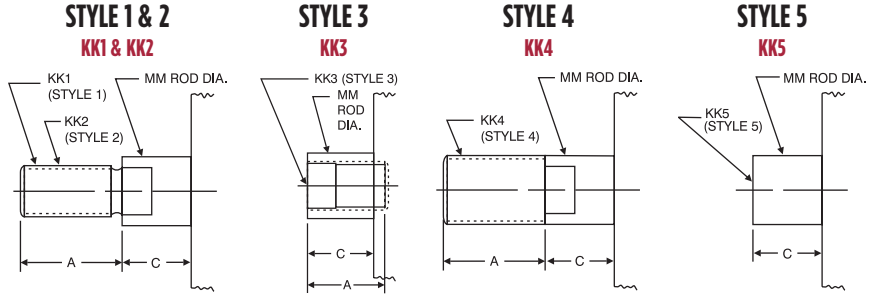
Need a rod end not listed?

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?

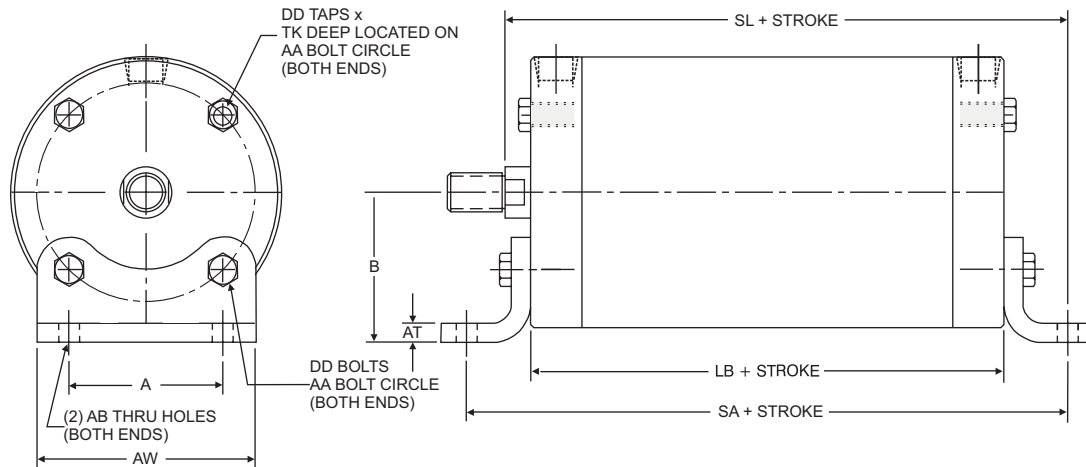
Just send us a sketch.

In most cases, quotes are turned around in one day!



BORE	MM ROD DIAMETER	STANDARD				OPTIONAL					C
		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	0.560
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)



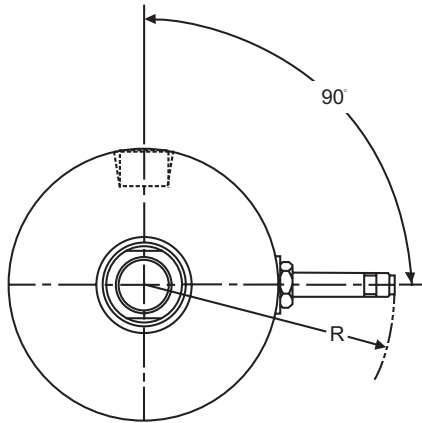
BORE	ROD DIAMETER	FOOT BRACKET KIT	A	AB	AW	B	AT	DD	AA	LB	TK	SA	SL
1.50	0.625 Standard	HCR-FB150	1.030	0.188	1.520	1.250	0.250	8 -32	1.450	5.210	0.330	6.620	6.460
2.00	0.625 Standard	HCR-FB200	1.310	0.219	1.810	1.620	0.250	10 -24	1.850	5.450	0.375	7.580	7.070
2.50	0.625 Standard	HCR-FB250	1.550	0.281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

Note: Foot bracket mounting kits include two brackets and eight stainless steel screws.

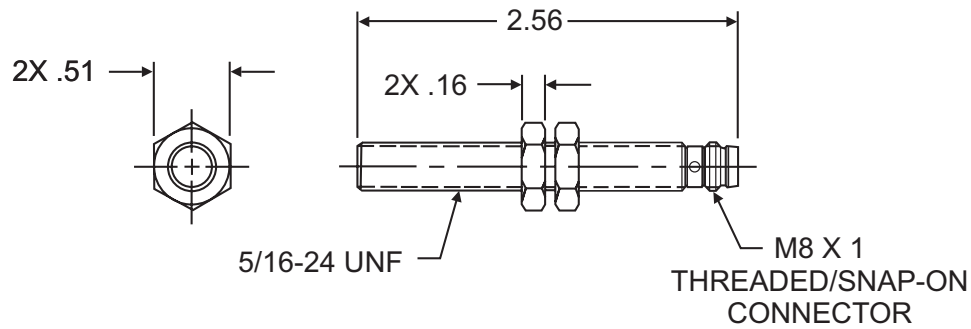
Can only be applied to MXO mounting styles

# SERIES 'HCR' 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

HCF-Nonincendive

# SWITCH OPTIONS: SWITCH ORDERING INSTRUCTIONS

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

**R10 X**

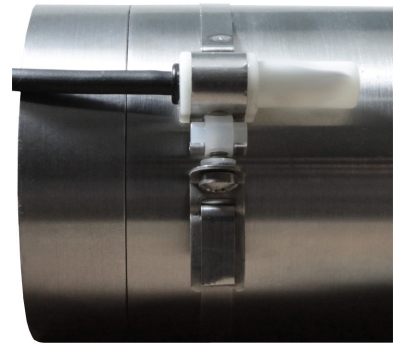
Switch Model	
<b>R10</b>	= AC/DC Reed
<b>RAC</b>	= High Power AC Reed
<b>RHT</b>	= Extended Temperature Reed
<b>MSS</b>	= Solid State
<b>R10P</b>	= AC/DC Reed with Circuit Protection

Switch Lead Options	
(leave blank)	= 24" Plain Cable
<b>X</b>	= 120" Plain Cable
<b>Q</b>	= 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	
<b>USB25</b>	Use with bores: 1.50", 2.00", 2.50"
<b>USB50</b>	Use with bores: 3.25", 4.00", 5.00"
<b>USB80</b>	Use with bores: 6.00", 8.00"

Switch Accessories: Quick Connect Cord Sets	
MODEL	DESCRIPTION
<b>C4-T</b>	8mm Straight Quick Connect Cord x 2 Meter (78")
<b>C4X-T</b>	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.

HYDRAULIC CYLINDERS INC.® designed our magnet to have 50-100% more power than required to operate our switch! The combination of HYDRAULIC CYLINDERS INC.® 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!

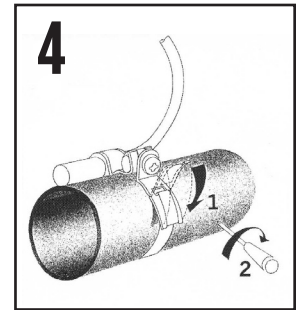
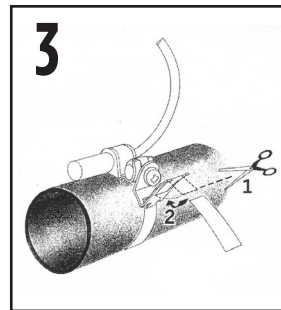
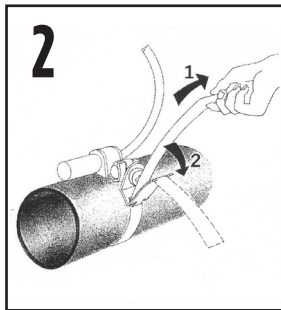
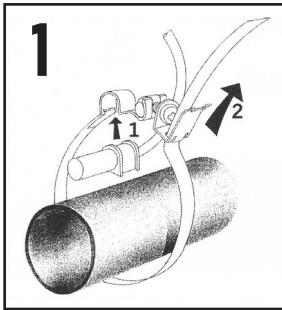
## Other Switches Available:

- 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 'HCR': ACCESSORIES

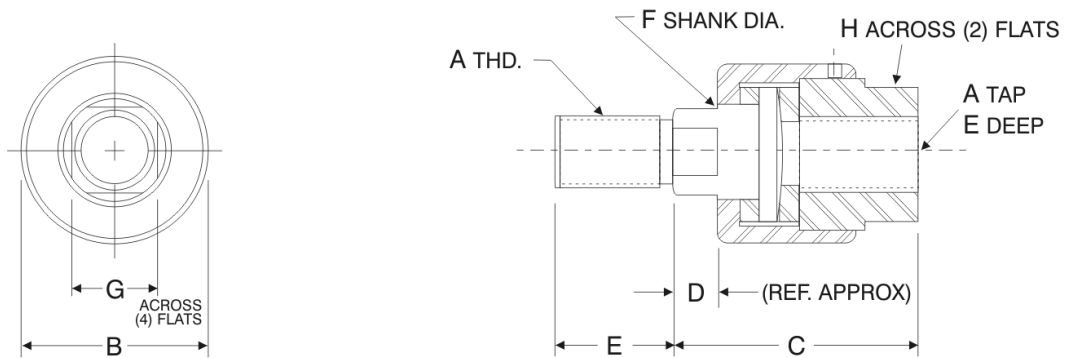
## UNIVERSAL SWITCH BAND MOUNTING ILLUSTRATIONS



**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)



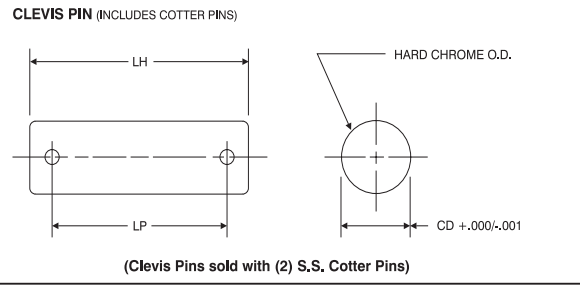
ALIGNMENT COUPLERS (INCHES)									
PART NUMBER	A	B	C	D	E	F	G	H	MAXIMUM PULL AT YIELD (LBS.)
HCS-AC250	1/4-28	1.125	1.750	0.375	0.500	0.500	0.375	0.688	1,000
HCS-AC312	5/16-24	1.125	1.750	0.375	0.500	0.500	0.375	0.688	1,800
HCS-AC375	3/8-24	1.125	1.750	0.375	0.500	0.500	0.375	0.688	2,900
HCS-AC437	7/16-20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

HCR / OPTIONS

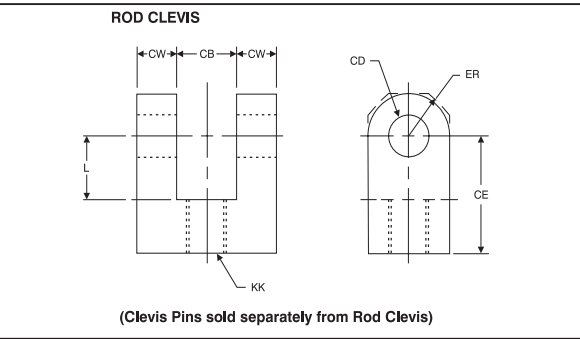
# SERIES 'HCR': BASIC ACCESSORIES

## Accessories (303 Stainless Steel)

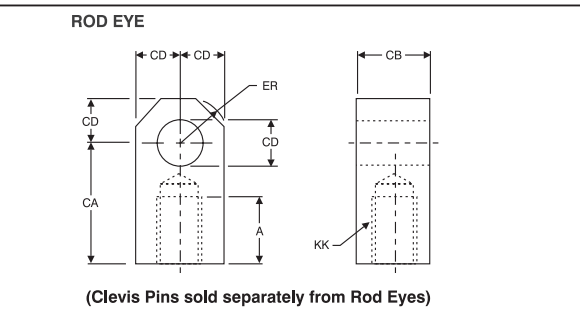
CLEVIS PIN (WITH COTTER PINS)			
PART NO.	CD	LH	LP
HCS-CP500	0.500	2.250	1.938
HCS-CP750	0.750	3.000	2.719
HCS-CP1000	1.000	3.500	3.219
HCS-CP1375	1.375	5.000	4.250
HCS-CP1750	1.750	6.000	5.500



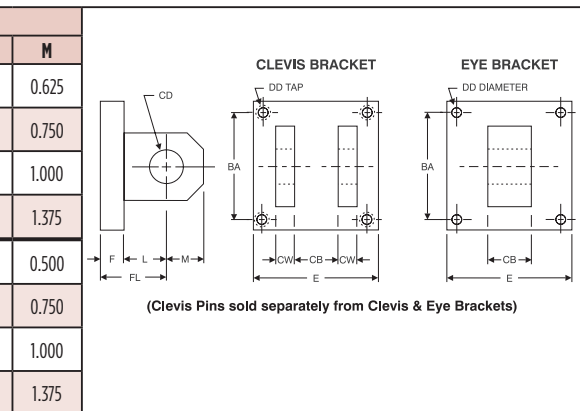
ROD CLEVIS							
PART NO.	CB	CD	CE	CW	ER	KK	L
HCS-RC437	0.750	0.500	1.500	0.500	0.500	7/16 -20	0.750
HCS-RC500	0.750	0.500	1.500	0.500	0.500	1/2 -20	0.750
HCS-RC750	1.250	0.750	2.375	0.625	0.750	3/4 -16	1.250
HCS-RC1000	1.500	1.000	3.125	0.750	1.000	1-14	1.500
HCS-RC1250	2.000	1.375	4.125	1.000	1.375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



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



CLEVIS BRACKETS AND EYE BRACKETS											
PART NO.	BA	CB	CD	CW	DD	E	F	FL	L	M	
CLEVIS BRACKETS	HCS-CB500	1.625	0.750	0.500	0.500	3/4 -24	2.500	0.375	1.125	0.750	0.625
	HCS-CB750	2.563	1.250	0.750	0.625	1/2 -20	3.500	0.625	1.875	1.250	0.750
	HCS-CB1000	3.250	1.500	1.000	0.750	5/8 -18	4.500	0.750	2.250	1.500	1.000
	HCS-CB1375	3.813	2.000	1.375	1.000	5/8 -18	5.000	0.875	3.000	2.125	1.375
EYE BRACKETS	HCS-EB500	1.625	0.750	0.500	N/A	0.406	2.500	0.375	1.125	0.750	0.500
	HCS-EB750	2.563	1.250	0.750		0.532	3.500	0.625	1.875	1.250	0.750
	HCS-EB1000	3.250	1.500	1.000		0.656	4.500	0.750	2.250	1.500	1.000
	HCS-EB1375	3.813	2.000	1.375		0.656	5.000	0.875	3.000	2.125	1.375



## 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

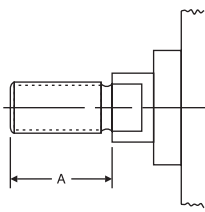


# SERIES 'HCR': OPTIONS

**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!

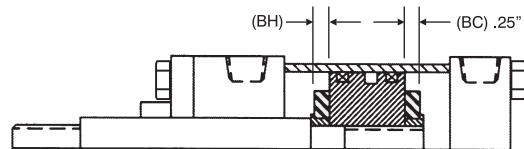


**B Bumpers**

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

HYDRAULIC CYLINDERS INC.'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 (-29° C to 93° C)

**Optional Material: Fluorocarbon**  
Available in 1.50" - 8.00" Bores  
Operating Temp: 0° F to 400° F (-18° C to 204° C)

**Operating Pressure: 200 PSI Air (17 BAR)**

**L001 Magnalube-G Grease**

Magnalube-G Grease is our standard lubricant used for all products except for PFLF and HCR 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](http://www.magnalube.com) for more information.

**Color: Green**  
**Recommended temperature range: -20° F to 200° F (-29° C to 93° C)**

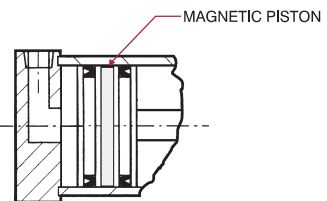
**LF Low Friction**

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


**BORE SIZES:** 1.50" to 8.00" Bore  
**MATERIAL:** Carboxylated Nitrile  
**OPERATING TEMPERATURE:** -20° F to 200° F (-29° C to 93° C)  
**OPERATING PRESSURE:** 200 PSI AIR (17 BAR)

**MPR Magnetic Piston**

Magnetic Pistons (MPR) are used in conjunction with HYDRAULIC CYLINDERS INC.® RIO, RIOP, 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 HCR 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 (-18° C to 204° C)  
Higher Chemical resistance: Resists most wash down solutions.

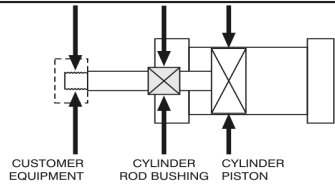
Note: Teflon wiper is used on "VS" Fluorocarbon seal option unless RWV is requested also.

# HEAVY DUTY 'HCS' STAINLESS STEEL: CONSTRUCTION

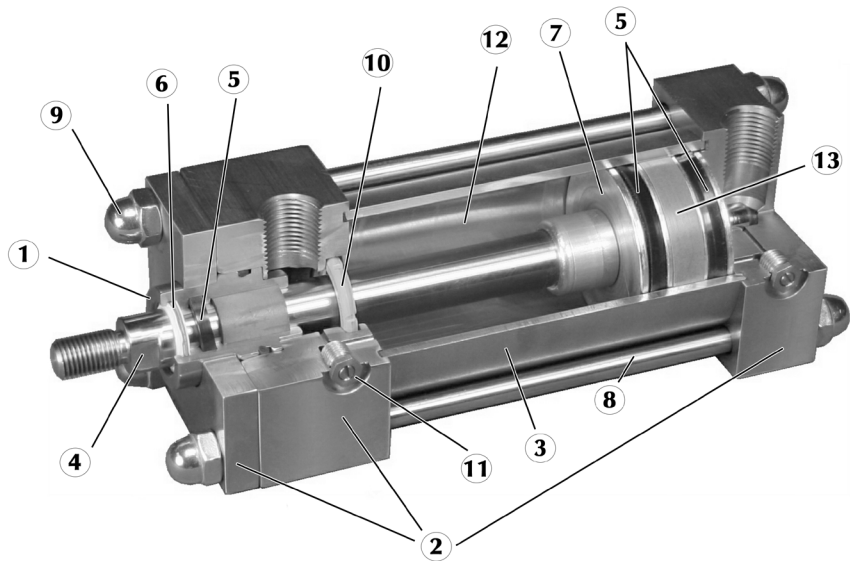
## Floating Rod Bushing

### 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



### IDEAL FOR:

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

**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 Carboxylated 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

Carboxylated Nitrile: -20°F to 200°F (-29°C to 93°C)  
Fluorocarbon: 0°F to 400°F (-18°C to 204°C)

### PERFORMANCE OPTIONS:

- **FDAL** – FDA approved lubricant, rated for 0°F to 300°F (-18°C to 149°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 'HCS': HOW TO ORDER

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

SERIES
HCS 250 PSI AIR

NFPA MOUNTS	
MX0	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 (8.00" 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

OPTIONS	
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 STUDDER 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 (INCHES) SPECIFY STROKE AS ES (EFFECTIVE STROKE) EXAMPLE: HCS 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)	

**About Our Part Number System**

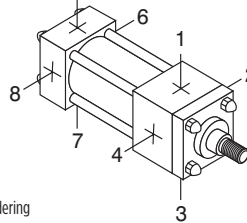
- Simple, easy to understand
- No excessive codes!
- Eliminates mistakes when ordering

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

**Part Number:** HCS-MF1-2.50 x 10-HC

OPTION LENGTH ADDER						
(ADD TO CATALOG BASIC OVERALL LENGTH DIMENSIONS)						
BORE	OPTION					ST* EXAMPLE: ST=2
	B	BC	BH	MPR or MPH	NR	
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.



- 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

<p><b>MX0</b></p> <p>1.50"-8.00" Bores</p>	<p><b>MX0D</b></p> <p>1.50"-8.00" Bores</p>	<p><b>MP1</b></p> <p>1.50"-8.00" Bores</p>	<p><b>MP4</b></p> <p>1.50"-6.00" Bores</p>	<p><b>MT1</b></p> <p>1.50"-8.00" Bores</p>
<p><b>MT2</b></p> <p>1.50"-8.00" Bores</p>	<p><b>MX1</b></p> <p>1.50"-8.00" Bores</p>	<p><b>MX2</b></p> <p>1.50"-8.00" Bores</p>	<p><b>MX3</b></p> <p>1.50"-8.00" Bores</p>	<p><b>MF1</b></p> <p>1.50"-6.00" Bores</p>
<p><b>MF2</b></p> <p>1.50"-6.00" Bores</p>	<p><b>ME3</b></p> <p>8.00" Bore</p>	<p><b>ME4</b></p> <p>8.00" Bore</p>	<p><b>MS2</b></p> <p>1.50"-8.00" Bores</p>	<p><b>MS4</b></p> <p>1.50"-8.00" Bores</p>

HCS / HOW TO ORDER

# SERIES 'HCS' DIMENSIONS: BASIC CYLINDER (NO MOUNT)

## PISTON ROD END STYLES

### ABOUT ROD END STYLES

#### Style 1 Male Rod End is STANDARD

Other NFPA Styles can be specified (see chart).

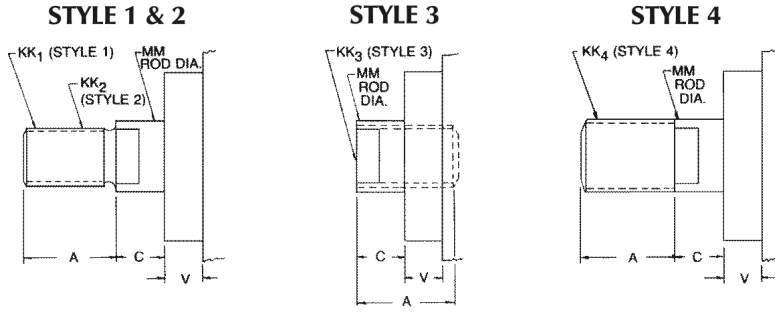
Need a rod end not listed?

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).

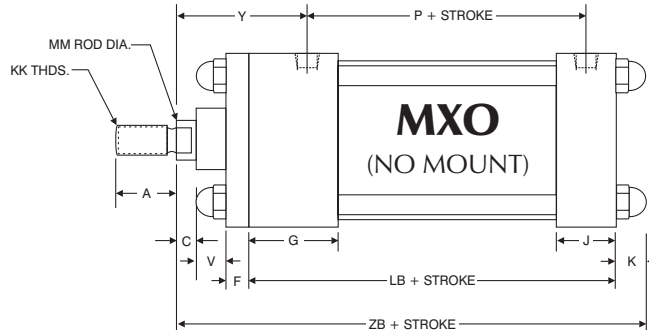
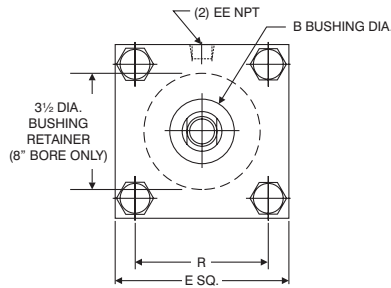
NEED SOMETHING NOT LISTED?

Just send us a sketch.

In most cases, quotes are turned around in one day!



BORE	MM ROD DIAMETER	STANDARD		OPTIONAL				C	V		
		STYLE 1 - MALE		STYLE 2 - MALE		STYLE 3 - FEMALE				STYLE 4 - MALE	
		KK1	A	KK2	A	KK3	A			KK4	A
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							1.000		3/4 -16			1.000	0.500	2.250
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							1.000		3/4 -16			1.000	0.500	2.250
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							1.000		3/4 -16			1.000	0.500	2.250
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

# SERIES 'HCS' DIMENSIONS: BASIC CYLINDER (NO MOUNT)

## PISTON ROD END STYLES

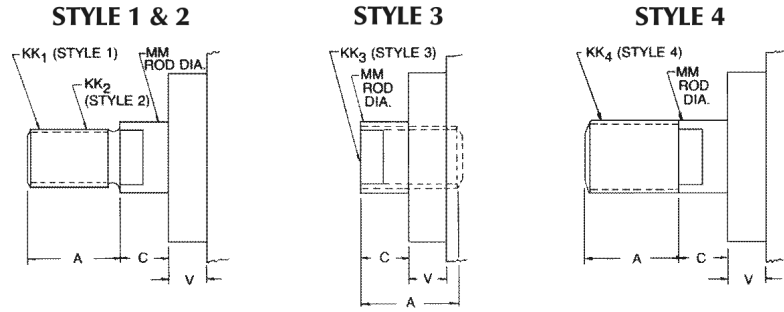
### ABOUT ROD END STYLES

Style 1 Male Rod End is STANDARD

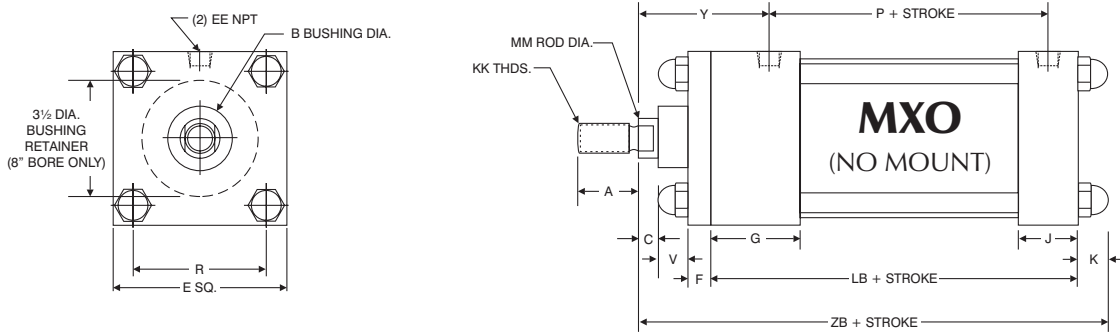
Other NFPA Styles can be specified (see chart).

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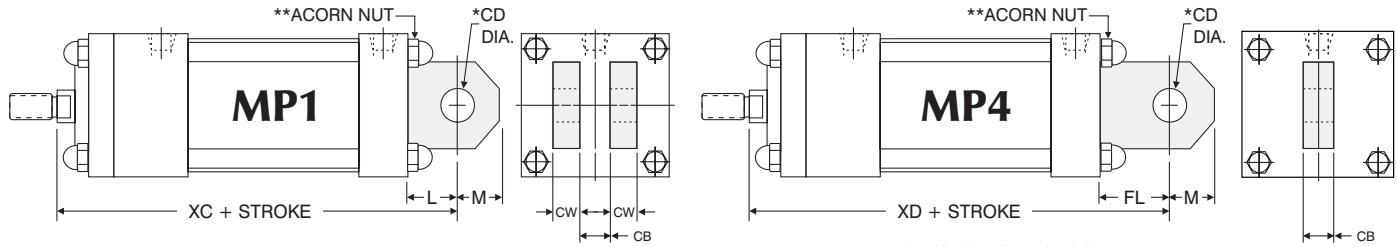


BORE	MM ROD DIAMETER	STANDARD		OPTIONAL				C	V		
		STYLE 1 - MALE		STYLE 2 - MALE		STYLE 3 - FEMALE				STYLE 4 - MALE	
		KK1	A	KK2	A	KK3	A			KK4	A
1.50, 2.00, 2.50	0.625 Standard	7/16 -20	0.750	1/2-20	0.750	7/16 -20	0.750	5/8 -18	0.750	0.375	0.250
	1.000 Oversize	3/4 -16	1.125	7/8-14	1.125	3/4 -16	1.125	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					
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					
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					
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					
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					
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					
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					
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					

# SERIES 'HCS' DIMENSIONS: PIVOT MOUNTS



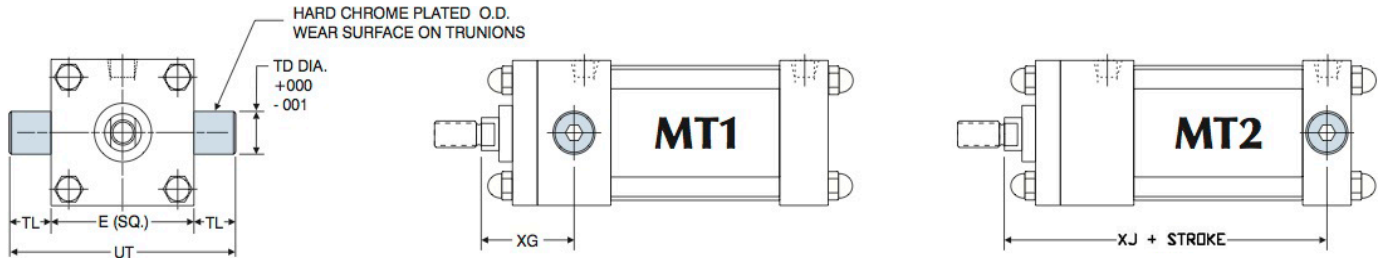
Note: Pivot Mount is non-detachable.  
Contact factory for detachable mount options.

'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	HCS-RC437	HCS-RE437	HCS-CP500	HCS-EB500
	1.000 Oversize							5.750	6.125	HCS-RC750	HCS-RE750	HCS-CP750	
2.00	0.625 Standard	0.750	0.500	0.500	1.125	0.750	0.625	5.375	5.750	HCS-RC437	HCS-RE437	HCS-CP500	HCS-EB500
	1.000 Oversize							5.750	6.125	HCS-RC750	HCS-RE750	HCS-CP750	
2.50	0.625 Standard	0.750	0.500	0.500	1.125	0.750	0.625	5.500	5.875	HCS-RC437	HCS-RE437	HCS-CP500	HCS-EB500
	1.000 Oversize							5.875	6.250	HCS-RC750	HCS-RE750	HCS-CP750	
3.25	1.000 Standard	1.250	0.750	0.625	1.875	1.250	0.875	6.875	7.500	HCS-RC750	HCS-RE750	HCS-CP750	HCS-EB750
	1.375 Oversize							7.125	7.750	HCS-RC1000	HCS-RE1000	HCS-CP1000	
4.00	1.000 Standard	1.250	0.750	0.625	1.875	1.250	0.875	6.875	7.500	HCS-RC750	HCS-RE750	HCS-CP750	HCS-EB750
	1.375 Oversize							7.125	7.750	HCS-RC1000	HCS-RE1000	HCS-CP1000	
5.00	1.000 Standard	1.250	0.750	0.625	1.875	1.250	0.875	7.125	7.750	HCS-RC750	HCS-RE750	HCS-CP750	HCS-EB750
	1.375 Oversize							7.375	8.000	HCS-RC1000	HCS-RE1000	HCS-CP1000	
6.00	1.375 Standard	1.500	1.000	0.750	2.250	1.500	1.000	8.125	8.875	HCS-RC1000	HCS-RE1000	HCS-CP1000	HCS-EB1000
	1.750 Oversize							8.375	9.125	HCS-RC1250	HCS-RE1250	HCS-CP1375	
8.00	1.375 Standard	1.500	1.000	0.750	N/A	1.500	1.000	8.250	N/A	HCS-RC1000	HCS-RE1000	HCS-CP1000	HCS-EB1000
	1.750 Oversize							8.500	N/A	HCS-RC1250	HCS-RE1250	HCS-CP1375	

\*Clevis pin provided with MP1 and MP4 mounts.

Note: MP4 8.00" bore not available.

\*\*Acorn nuts are located on cap end (4.00"-8.00" bores).



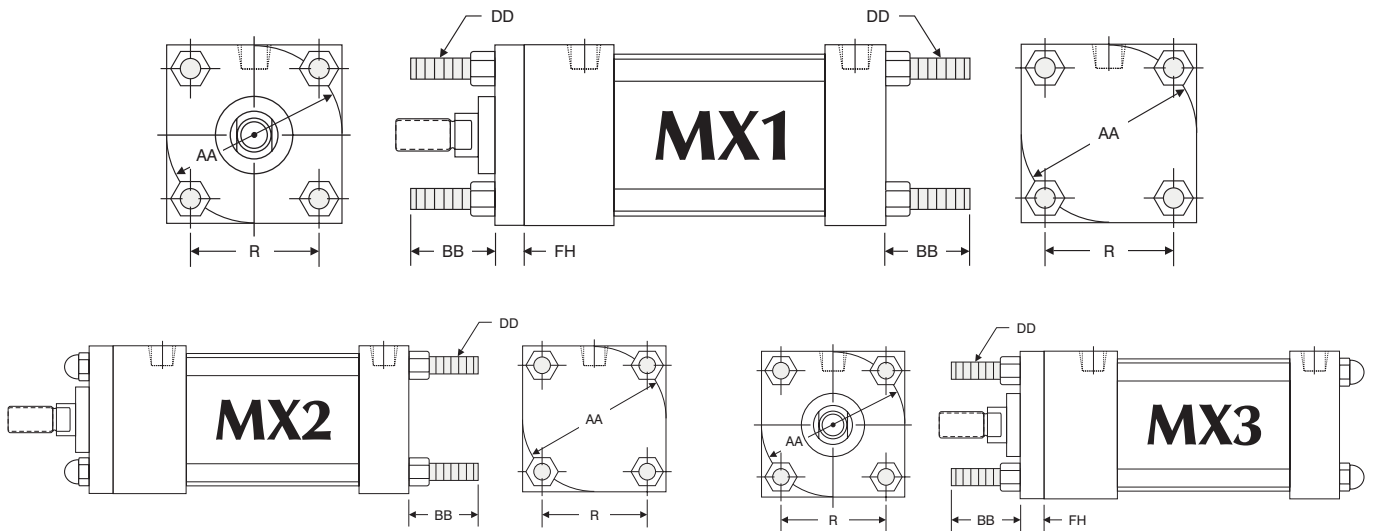
## MT1 / MT2

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	HCD	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	HCS-RC437	HCS-RE437	HCS-CP500		
	1.000 Oversize*					N/A	4.500	HCS-RC750	HCS-RE750	HCS-CP750		
2.00	0.625 Standard	2.500	1.000	1.000	4.500	1.750	4.125	HCS-RC437	HCS-RE437	HCS-CP500		
	1.000 Oversize					2.125	4.500	HCS-RC750	HCS-RE750	HCS-CP750		
2.50	0.625 Standard	3.000	1.000	1.000	5.000	1.750	4.250	HCS-RC437	HCS-RE437	HCS-CP500		
	1.000 Oversize					2.125	4.625	HCS-RC750	HCS-RE750	HCS-CP750		
3.25	1.000 Standard	3.750	1.000	1.000	5.750	2.250	5.000	HCS-RC750	HCS-RE750	HCS-CP750		
	1.375 Oversize					2.500	5.250	HCS-RC1000	HCS-RE1000	HCS-CP1000		
4.00	1.000 Standard	4.500	1.000	1.000	6.500	2.250	5.000	HCS-RC750	HCS-RE750	HCS-CP750		
	1.375 Oversize					2.500	5.250	HCS-RC1000	HCS-RE1000	HCS-CP1000		
5.00	1.000 Standard	5.500	1.000	1.000	7.500	2.250	5.250	HCS-RC750	HCS-RE750	HCS-CP750		
	1.375 Oversize					2.500	5.500	HCS-RC1000	HCS-RE1000	HCS-CP1000		
6.00	1.375 Standard	6.500	1.375	1.375	9.250	2.625	5.875	HCS-RC1000	HCS-RE1000	HCS-CP1000		
	1.750 Oversize					2.875	6.125	HCS-RC1250	HCS-RE1250	HCS-CP1375		
8.00	1.375 Standard	8.500	1.375	1.375	11.250	2.625	6.000	HCS-RC1000	HCS-RE1000	HCS-CP1000		
	1.750 Oversize					2.875	6.250	HCS-RC1250	HCS-RE1250	HCS-CP1375		

\*No Oversize rod on 1.50" bore on MT1 mount.

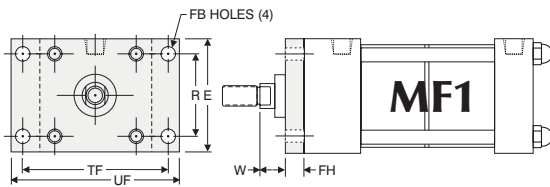
# SERIES 'HCS' DIMENSIONS: TIE ROD & FLANGE MOUNTS



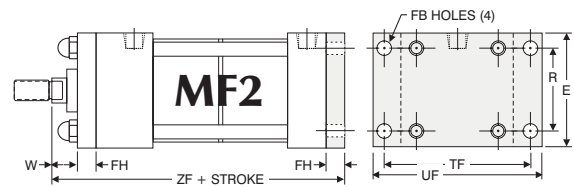
TIE ROD EXTENDED 'MX1', 'MX2' & 'MX3' MOUNT DIMENSIONS						
BORE	ROD DIAMETER	AA	BB	DD	FH	R
1.50	0.625 Standard	2.020	1.000	1/4 -28	0.375	1.430
	1.000 Oversize					
2.00	0.625 Standard	2.600	1.125	5/16 -24	0.375	1.840
	1.000 Oversize					
2.50	0.625 Standard	3.100	1.125	5/16 -24	0.375	2.190
	1.000 Oversize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

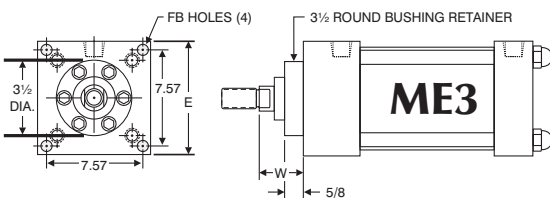
Full square bushing retainer on 1.50" through 6.00" bore.  
 \*Round retainer on 8.00" bore. BB dimension from face of head.



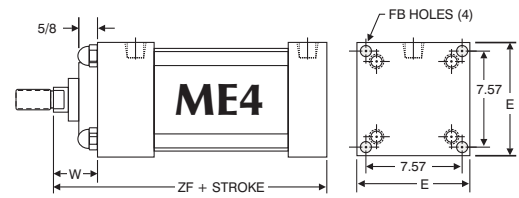
1.50" - 6.00" BORES



1.50" - 6.00" BORES



8.00" BORE ONLY



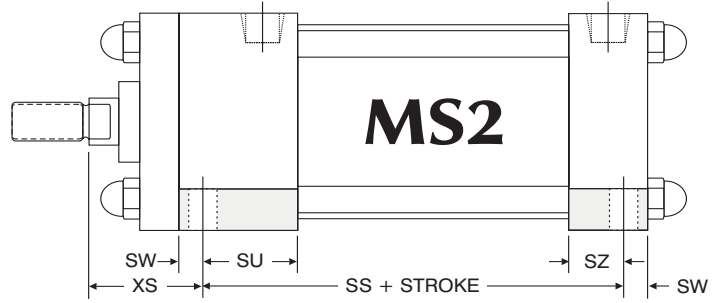
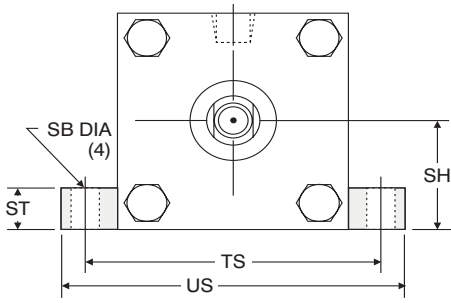
8.00" BORE ONLY

'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

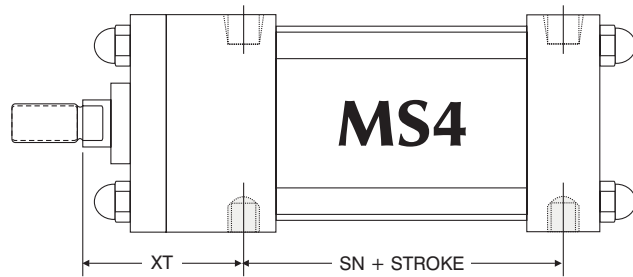
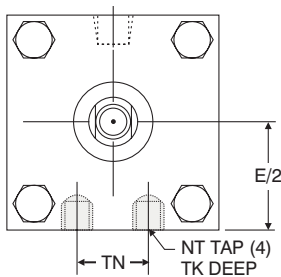
Full square bushing retainer on 1.50" through 6.00" bore.  
 \*Round retainer on 8.00" bore.

# SERIES 'HCS' DIMENSIONS: BASE MOUNTS



'MS2' SIDE LUG MOUNT DIMENSIONS											
BORE	ROD DIAMETER	SB	SH	ST	SU	SW	SZ	TS	US	XS	HCS ADD STROKE
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	1.563	0.688	0.813	9.875	11.250	2.313	3.750
	1.750 Oversize									2.563	

Full square bushing retainer on 1.50" through 6.00" bore.  
Round retainer on 8.00" bore.



'MS4' BOTTOM TAP MOUNT DIMENSIONS							
BORE	ROD DIAMETER	E/2	NT	TK	TN	XT	SN ADD STROKE
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	

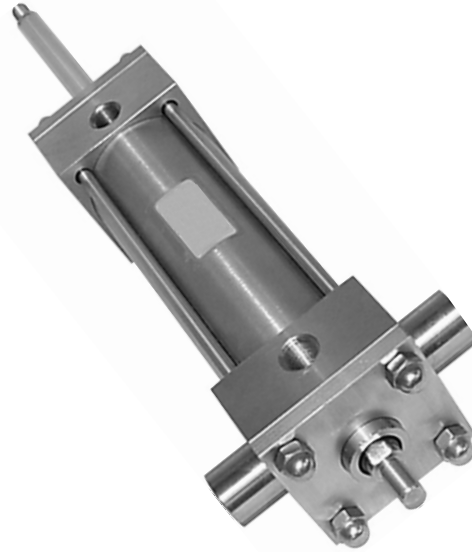
Full square bushing retainer on 1.50" through 6.00" bore.  
Round retainer on 8.00" bore.



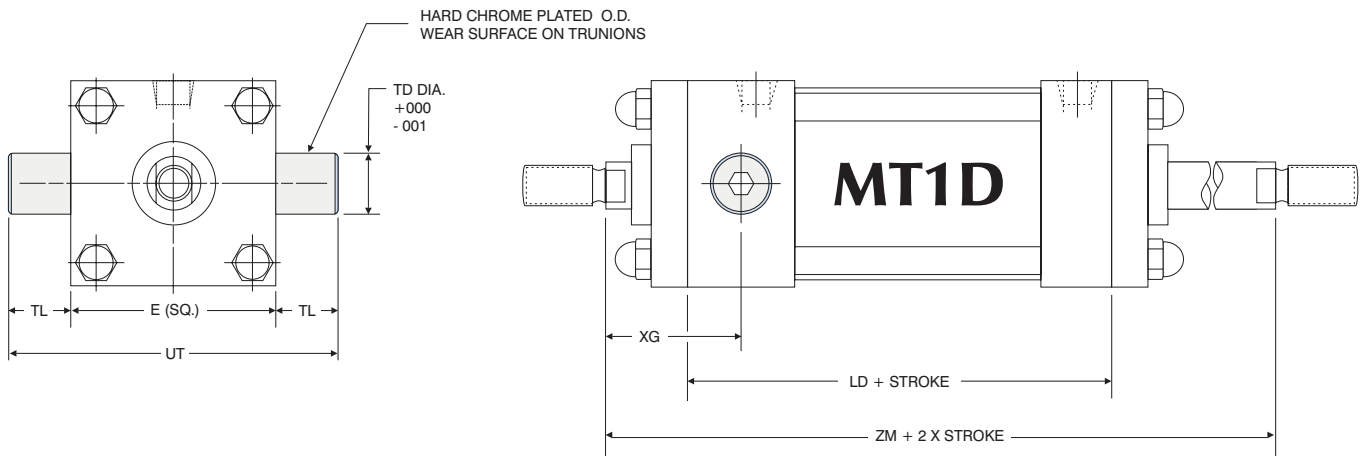
# SERIES 'HCS' DIMENSIONS: DOUBLE ROD END

## 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.

'HCS-MT1D' HEAD TRUNNION MOUNT DIMENSIONS								
BORE	ROD DIAMETER	E	LD	HCD	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	
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 'HCS' DIMENSIONS: DOUBLE ROD END

## ABOUT ROD END STYLES

Style 1 Male Rod End is STANDARD

Other NFPA Styles can be specified (see chart).

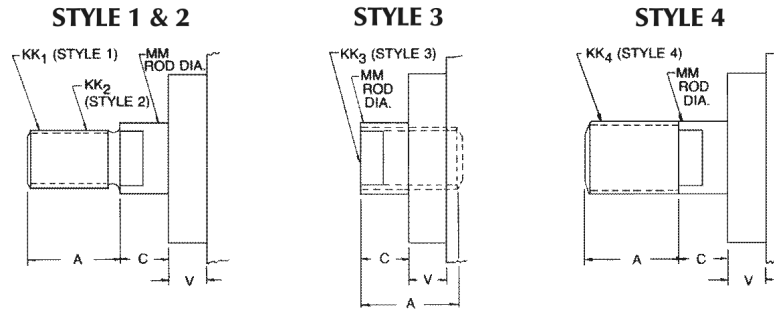
Need a rod end not listed? NO PROBLEM! Each Piston Rod is made-to-order and does not delay shipment. Coarse UNC threads, Metric threads or just plain rod ends are common. Thread lengths are also made-to-order (Specify: "A"=Length).

NEED SOMETHING NOT LISTED?

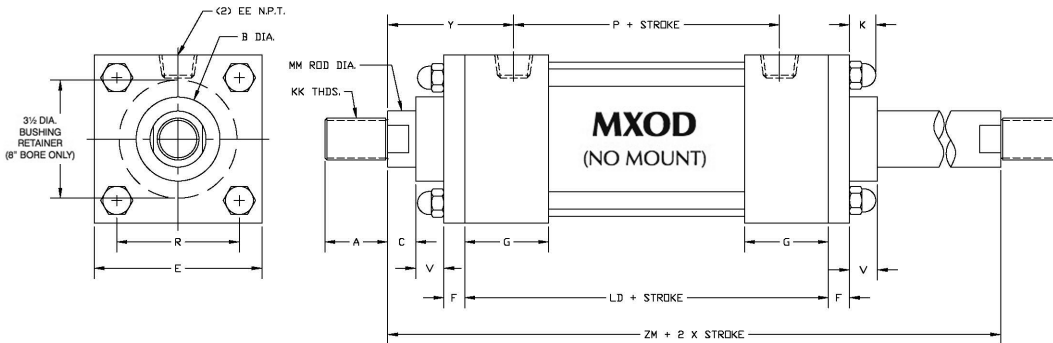
Just send us a sketch.

In most cases, quotes are turned around in one day!

## PISTON ROD END STYLES



BORE	MM ROD DIAMETER	STANDARD		OPTIONAL						C	V
		STYLE 1 - MALE		STYLE 2 - MALE		STYLE 3 - FEMALE		STYLE 4 - MALE			
		KK1	A	KK2	A	KK3	A	KK4	A		
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

HCS / DOUBLE ROD MOUNTS

EASY FLIP OUT PAGE FOR REFERENCE

# SERIES 'HCS' DIMENSIONS: DOUBLE ROD END

## PISTON ROD END STYLES

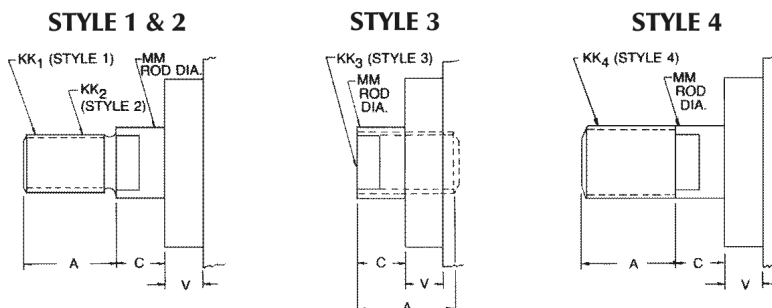
### ABOUT ROD END STYLES

#### Style 1 Male Rod End is STANDARD

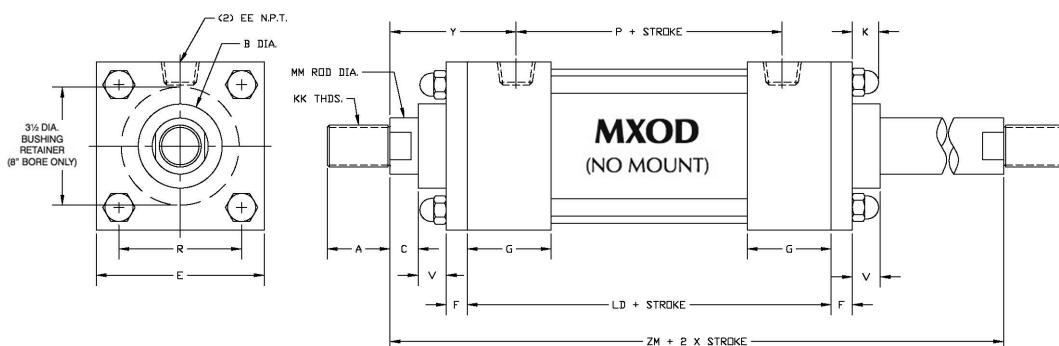
Other NFPA Styles can be specified (see chart).

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!

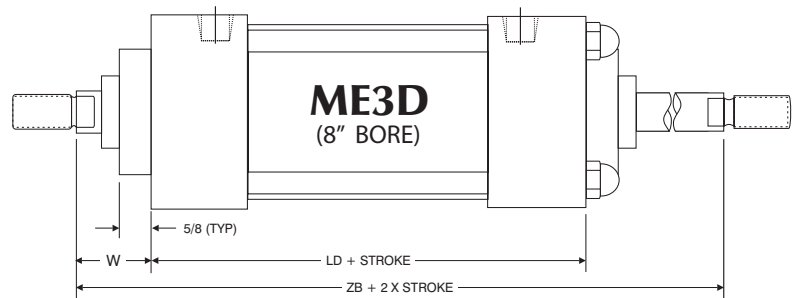
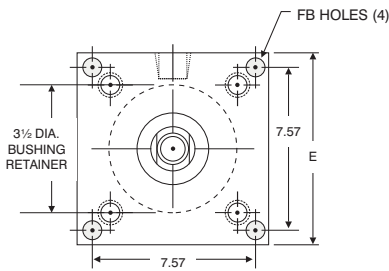
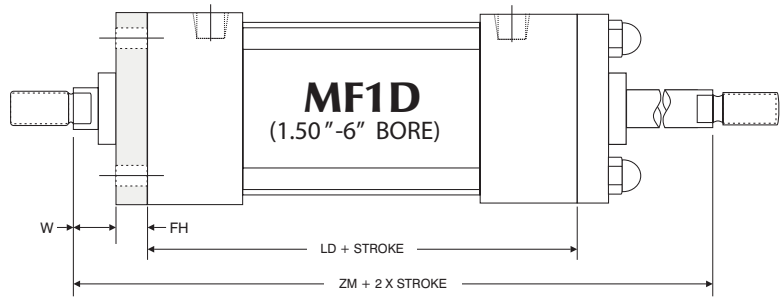
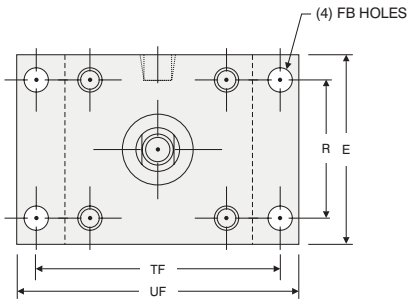


BORE	MM ROD DIAMETER	STANDARD		OPTIONAL				C	V		
		STYLE 1 - MALE		STYLE 2 - MALE		STYLE 3 - FEMALE				STYLE 4 - MALE	
		KK1	A	KK2	A	KK3	A			KK4	A
1.50, 2.00, 2.50	0.625 Standard	7/16 -20	0.750	1/2 -20	0.750	7/16 -20	0.750	5/8 -18	0.750	0.375	0.250
	1.000 Oversize	3/4 -16	1.125	7/8 -14	1.125	3/4 -16	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



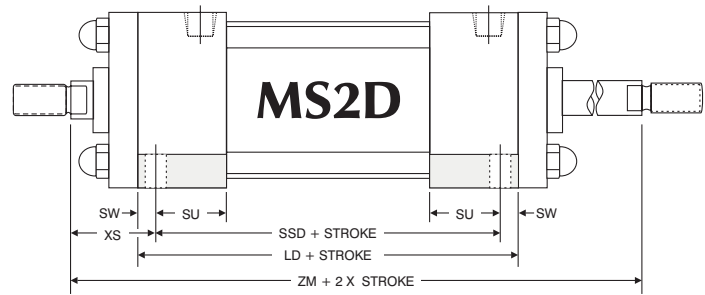
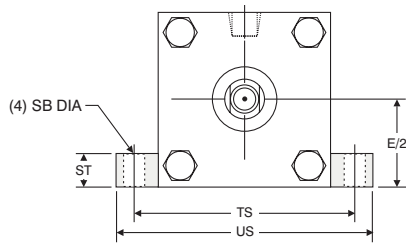
DOUBLE ROD 'MXOD' DIMENSIONS STANDARD & OVERSIZED RODS																	
BORE	ROD DIAMETER	A	B	C	E	EE	F	G	K	KK	LD	MM	P	R	V	Y	ZM
1.50	0.625 Standard	0.750	1.125	0.375	2.000	0.375	0.375	1.500	0.438	7/16 -20	4.125	0.625	2.375	1.430	0.250	1.875	6.125
	1.000 Oversize	1.125	1.500	0.500						3/4 -16		1.000			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

# SERIES 'HCS' DIMENSIONS: DOUBLE ROD END FLANGE MOUNTS



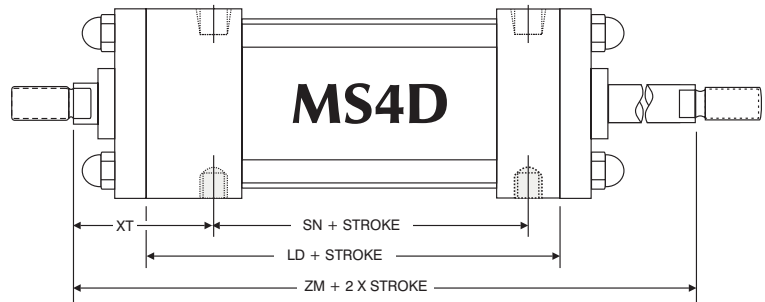
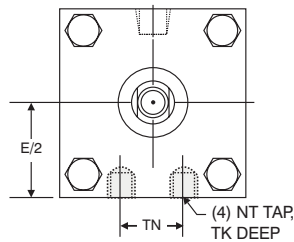
'HCS-MF1D' FLANGE & 'HCS-ME3D' HEAD MOUNT DIMENSIONS										
BORE	ROD DIAMETER	E	FB	FH	LD	R	TF	UF	W	ZM
1.50	0.625 Standard	2.000	0.313	0.375	4.125	1.430	2.750	3.375	0.625	6.125
	1.000 Oversize								1.000	6.875
2.00	0.625 Standard	2.500	0.375	0.375	4.125	1.840	3.375	4.125	0.625	6.125
	1.000 Oversize								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 'HCS' DIMENSIONS: DOUBLE ROD END BASE MOUNTS



'HCS-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.



'HCS-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

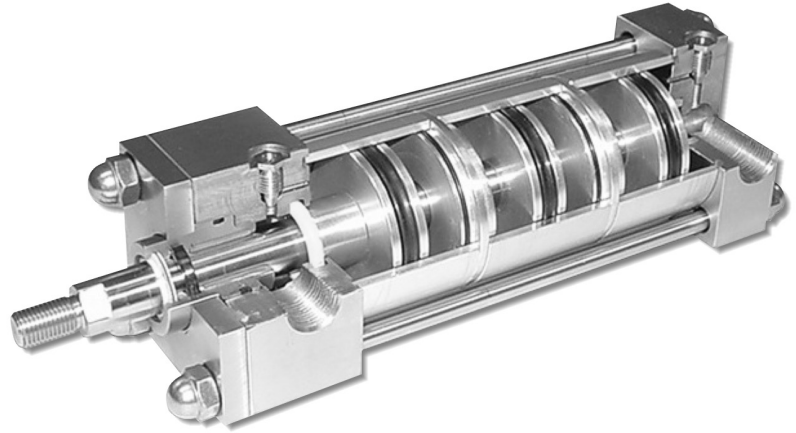
Note: Round retainer on 8.00" bore only.

# SERIES 'HCS-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 'HCS' construction
- 2 Stage, 3 Stage and 4 Stage models



The HYDRAULIC CYLINDERS INC.® HCS-MSE and HCS-MSR Series are double acting, single rod end cylinders that multiply the force output by supplying air to multiple pistons.

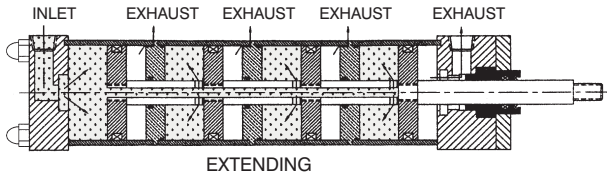
The HCS-MSE multiplies the force on the extend stroke, the HCS-MSR multiplies the force on the retract stroke. Both models use only one piston on the return stroke, saving air volume and operating costs.

### HOW THEY WORK

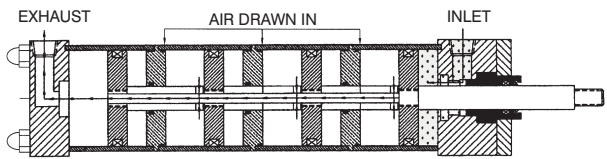
#### Model HCS-MSE

##### 4 Stage Shown

Extension-air supplied to multiple pistons



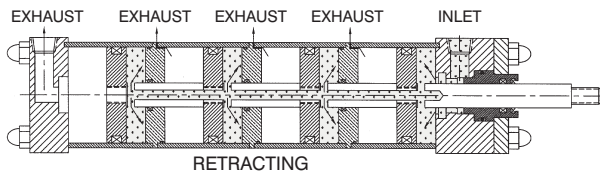
Retraction-air supplied to one piston



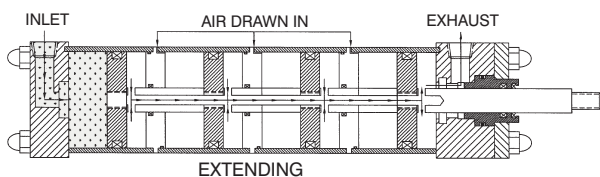
#### Model HCS-MSR

##### 4 Stage Shown

Retraction-air supplied to multiple pistons



Extension-air supplied to one piston



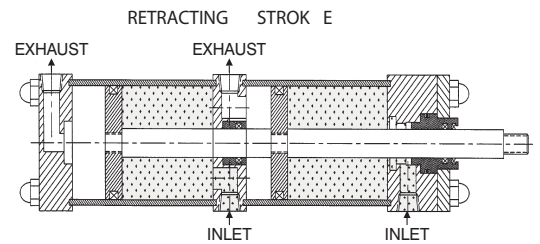
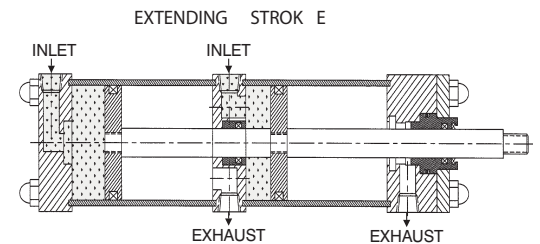
#### Force multiplying in both Extend and Retract strokes

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

#### To Order, specify:

"HCS-MSE/MSR" as model number.

Extension AND Retraction  
Air supplied to multiple pistons



Model HCS-MSE/MSR  
2 Stage Shown

# SERIES 'HCS-MS': ORDERING INSTRUCTIONS

**HCS-MSE** - **MS4** - **3.25** x **2** x **3S** - **MPR**

SERIES		NFA MOUNTS		BORE	STROKE	STAGES	OPTIONS
HCS-MSE	MULTI STAGE EXTEND	MX0	NO MOUNT	1.50	0.5" TO 12" CONSULT FACTORY FOR OTHER STROKES  *0.125" FOR SS-MSE	2S	TWO STAGE
HCS-MSE	MULTI STAGE EXTEND	MX1	EXTENDED TIE RODS - HEAD & CAP (1.50"-6.00" Bore)	2.00		3S	THREE STAGE
HCS-MSR	MULTI STAGE RETRACT	MX2	EXTENDED TIE RODS (CAP) (1.50"-6.00" Bore)	2.50		4S	FOUR STAGE
HCS-MSR	MULTI STAGE RETRACT	MX3	EXTENDED TIE RODS (HEAD) (1.50"-6.00" Bore)	3.25			
		MF1	FRONT FLANGE (1.50"-6.00" Bore)	4.00			
		MF2	REAR PIVOT CLEVIS (1.50"-6.00" Bore)	5.00			
		MP1	REAR PIVOT CLEVIS (1.50"-6.00" Bore)	6.00			
		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)				

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

OPTION LENGTH ADDER	
(ADD TO CATALOG BASIC OVERALL LENGTH DIMENSIONS)	
BORE	OPTION
	B
	BC
	BH
	MPR
	MPH
	NR

OPTION	DESCRIPTION
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	STUDDER 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:

**HCS-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:

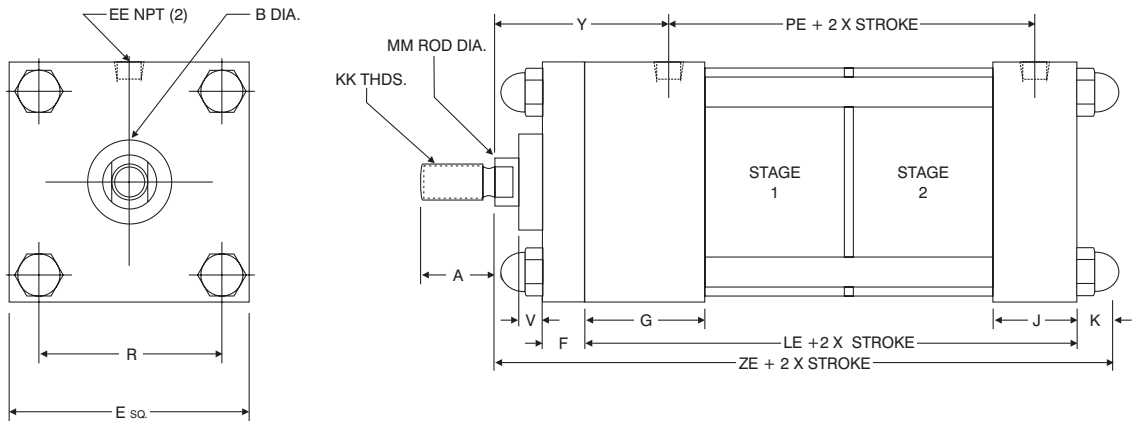
**HCS-MSR MS4D 6 x 3 x 2S - MPR**

(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

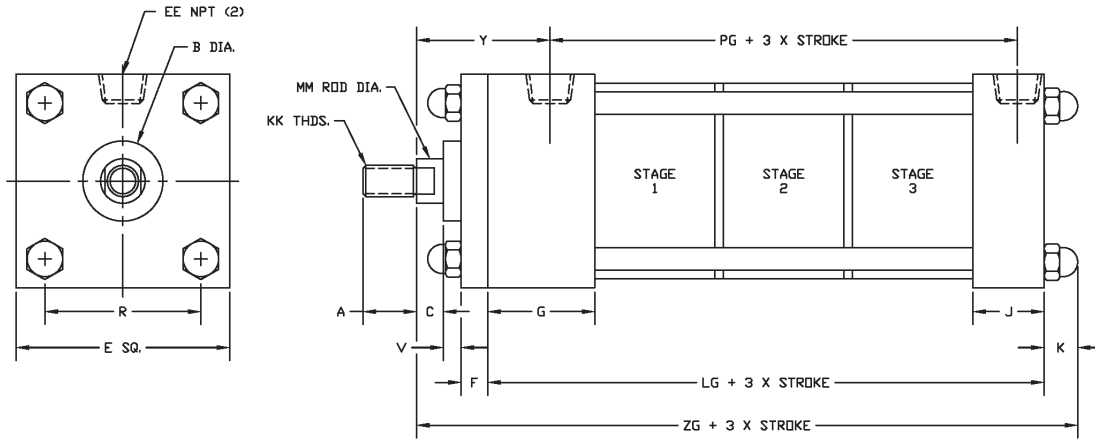
MPR/MPH OPTION: Magnet is located in stage at cap for standard units, in stage at head for 'NR' units

## 'HCS-MS' SERIES CYLINDERS: 2 STAGE EXTEND OR RETRACT STANDARD ROD DIAMETER BASIC DIMENSIONS MX0



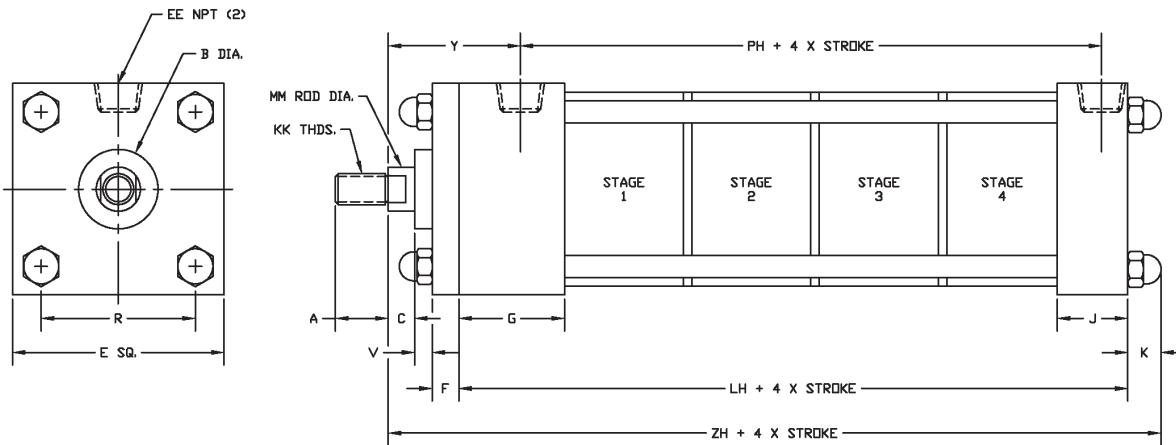
BORE	A	B	C	E	EE	F	G	J	K	KK	LE	MM	PE	R	V	Y	ZE
1.50	0.750	1.125	0.375	2.000	0.375	0.375	1.500	1.000	0.438	7/16-20	4.000	0.625	2.750	1.430	0.250	1.875	5.438
2.00	0.750	1.125	0.375	2.500	0.375	0.375	1.500	1.000	0.563	7/16-20	4.000	0.625	2.750	1.840	0.250	1.875	5.563
2.50	0.750	1.125	0.375	3.000	0.375	0.375	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

## ‘HCS-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

## ‘HCS-MS’ SERIES CYLINDERS: 4 STAGE EXTEND OR RETRACT STANDARD ROD DIAMETER BASIC DIMENSIONS MXO

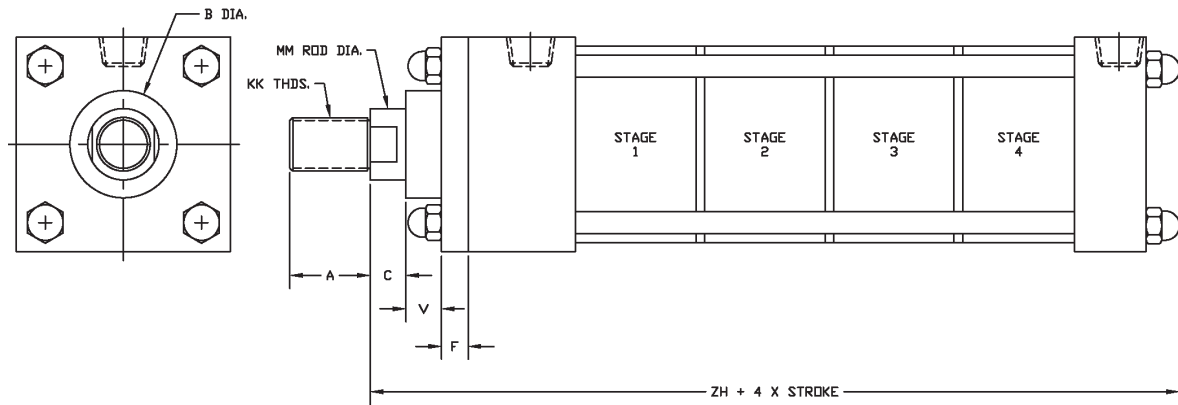
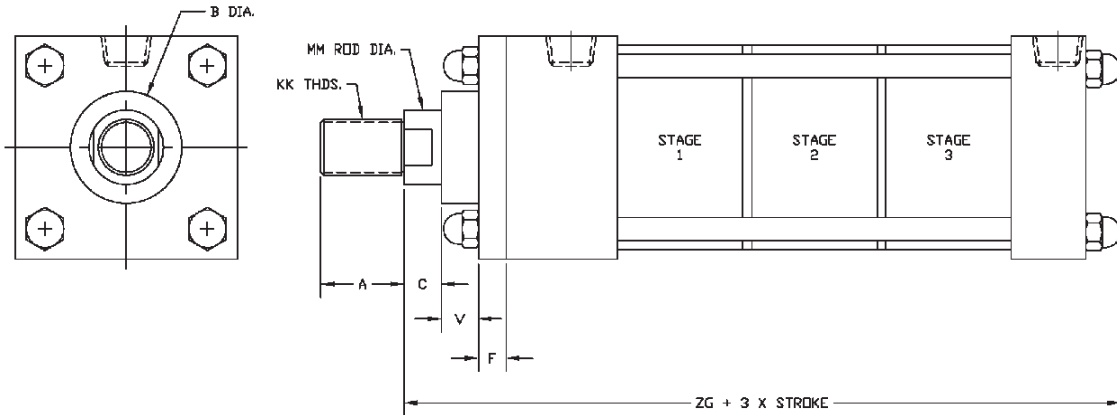
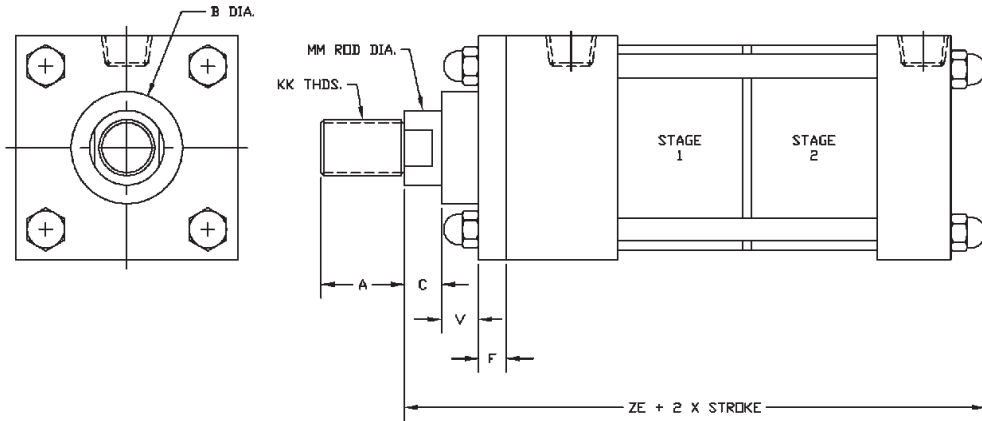


BORE	A	B	C	E	EE	F	G	J	K	KK	LH	MM	PH	R	V	Y	ZH
1.50	0.750	1.125	0.375	2.000	0.375	0.375	1.500	1.000	0.438	7/16 -20	6.000	0.625	4.750	1.430	0.250	1.875	7.438
2.00	0.750	1.125	0.375	2.500	0.375	0.375	1.500	1.000	0.563	7/16 -20	6.000	0.625	4.750	1.840	0.250	1.875	7.563
2.50	0.750	1.125	0.375	3.000	0.375	0.375	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 'HCS-MS' DIMENSIONS: OVERSIZED ROD

## OVERSIZED ROD DIAMETER BASIC DIMENSIONS MXO (NO MOUNT)



BORE	MULTI-STAGE OVERSIZE ROD DIAMETER							ADD STROKE PER STAGE		
	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.

HCS-MS / BASE DIMENSIONS

# SERIES 'HCS' DIMENSIONS: 'HCS-MS' DIMENSIONS

## ABOUT ROD END STYLES

### Style 1 Male Rod End is STANDARD

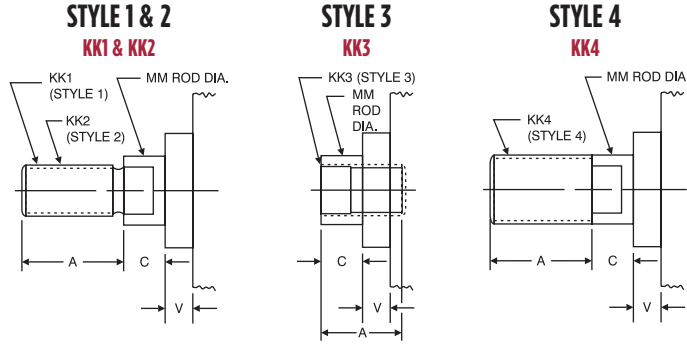
Other NFPA Styles can be specified (see chart).

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).

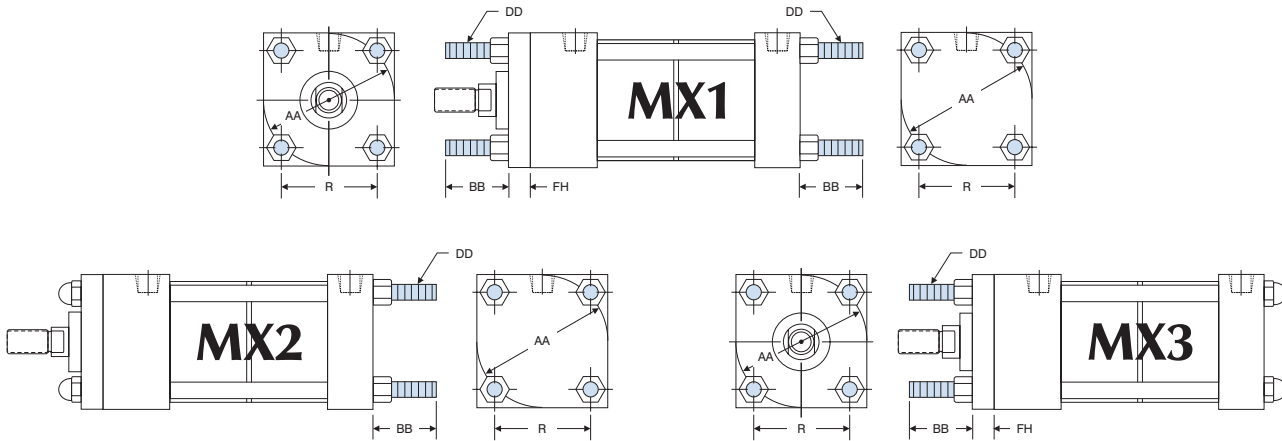
NEED SOMETHING NOT LISTED?  
 Just send us a sketch.

In most cases, quotes are turned around in one day!

## PISTON ROD END STYLES



BORE	MM ROD DIAMETER	STANDARD		OPTIONAL				C	V		
		STYLE 1 - MALE		STYLE 2 - MALE		STYLE 3 - FEMALE				STYLE 4 - MALE	
		KK1	A	KK2	A	KK3	A			KK4	A
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					

# SERIES 'HCS' DIMENSIONS: 'HCS-MS' DIMENSIONS

## ABOUT ROD END STYLES

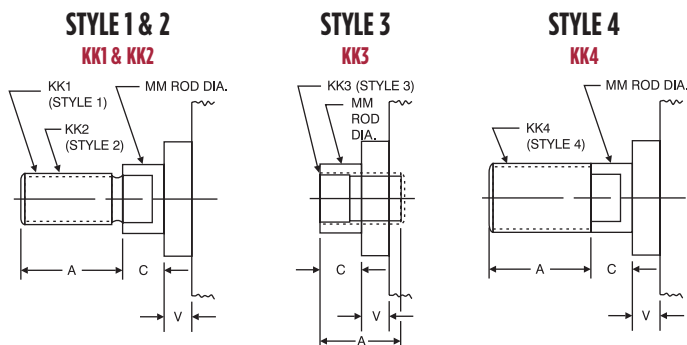
### Style 1 Male Rod End is STANDARD

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).

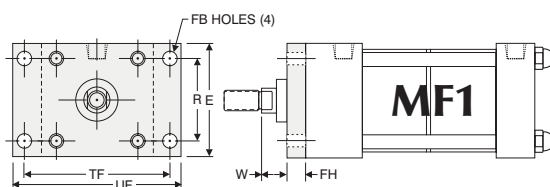
NEED SOMETHING NOT LISTED?  
 Just send us a sketch.  
 In most cases, quotes are turned around in one day!

## PISTON ROD END STYLES

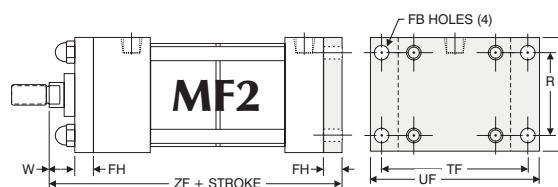


BORE	MM ROD DIAMETER	STANDARD		OPTIONAL						C	V
		STYLE 1 - MALE		STYLE 2 - MALE		STYLE 3 - FEMALE		STYLE 4 - MALE			
		KK1	A	KK2	A	KK3	A	KK4	A		
1.50, 2.00, 2.50	0.625 Standard	7/16 -20	0.750	1/2 -20	0.750	7/16 -20	0.750	5/8 -18	0.750	0.375	0.250
	1.000 Oversize	3/4 -16	1.125	7/8 -14	1.125	3/4 -16	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 'HCS-MS' DIMENSIONS: FLANGE MOUNTS



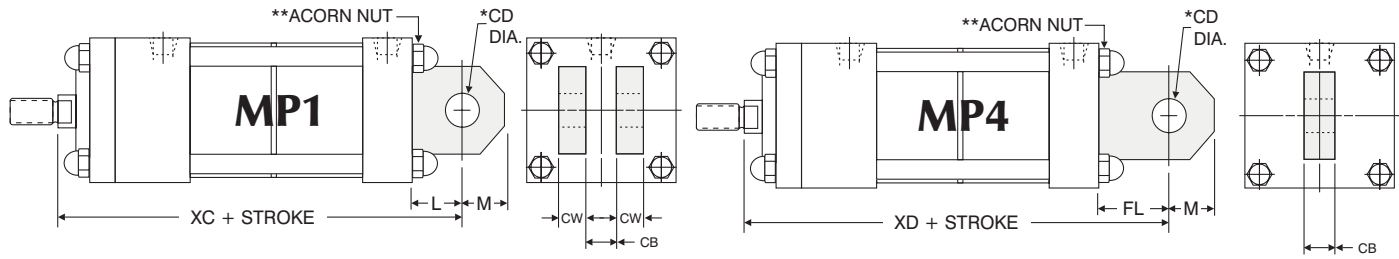
1.50" - 6.00" BORES



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								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								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								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								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								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								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

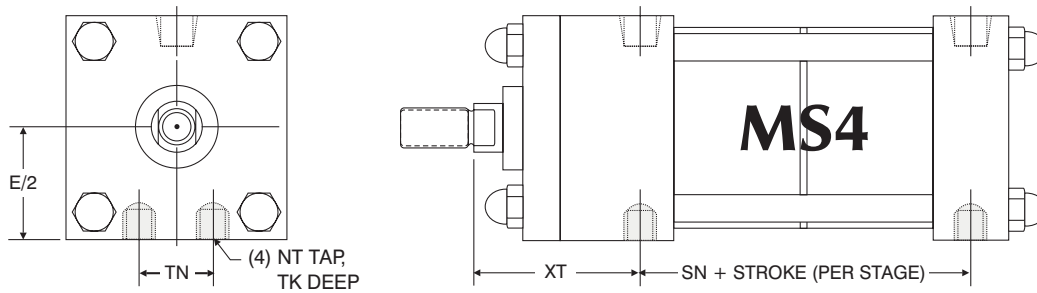
## SERIES 'HCS-MS' DIMENSIONS: PIVOT MOUNTS



MULTI-STAGE 'MP1' & 'MP2' CLEVIS AND 'MP4' EYE MOUNT DIMENSIONS								ADD STROKE PER STAGE					
BORE	ROD DIAMETER	CB	CD	CW	FL	L	M	2 STAGE		3 STAGE		4 STAGE	
								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
	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
	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
	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
	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
	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
	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
	9.125							9.875	10.625	11.375	12.125	12.875	

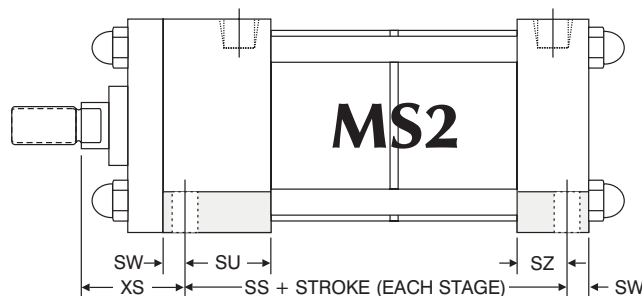
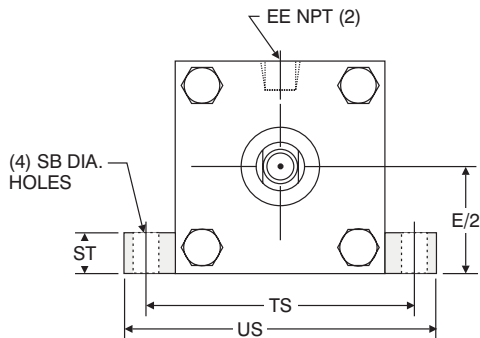
\*Clevis pin provided with MP1 and MP4 mounts.  
 \*\*Acorn nuts are located on cap end (4.00"-6.00" bores).

## 'HCS-MS' SERIES: BASE MOUNTS



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

# SERIES 'HCS-MS' DIMENSIONS: BASE MOUNTS



HCS-MS / MOUNT DIMENSIONS

'MS2' SIDE LUG MOUNT DIMENSIONS													
BORE	ROD DIAMETER	E/2	SB	ST	SU	SW	SZ	TS	US	XS	HCS + 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												
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												
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												
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												
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												

\* HCS dimensions increase 0.500" on double rod cylinders

Note: Overall lengths will change with the addition of non-rotating or magnetic pistons; consult factory.

## 'HCS-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 'HCS': TECHNICAL DATA

## How to Determine the Right Size Cylinder for the Job.

To determine what size cylinder the TSk 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?**

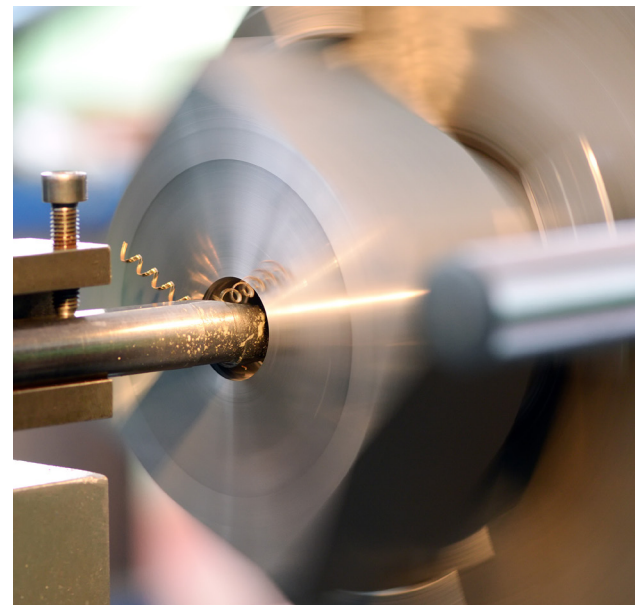
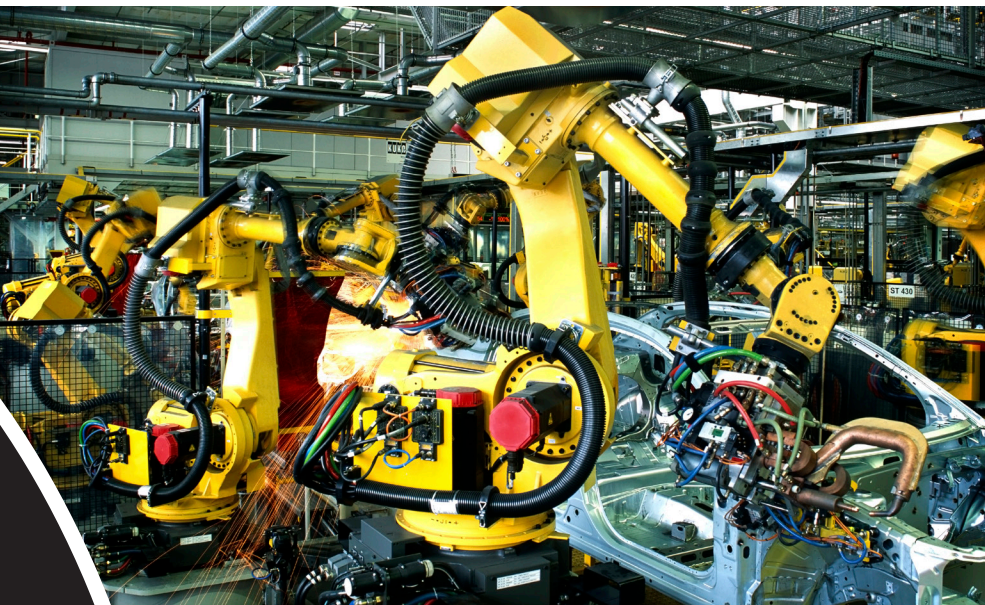
This is important because high pressures can accelerate seal wear and create stress on the cylinder, and inconsistent pressures can cause system malfunctions or failures. So, to maximize cylinder life and performance, you need to provide consistent airflow at the minimum effective pressure to maintain 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.

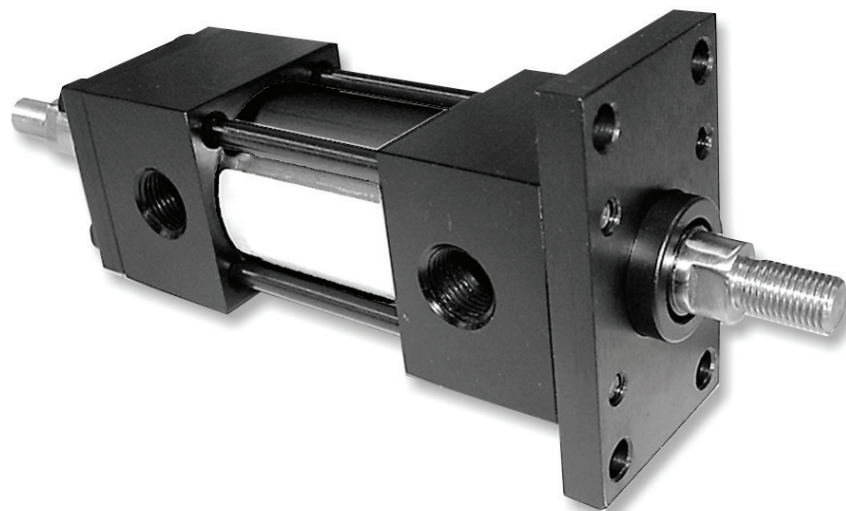
## FORCE/VOLUME CHART

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

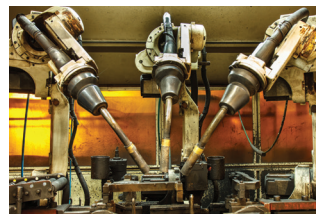
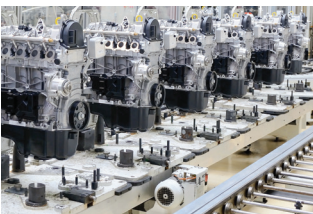
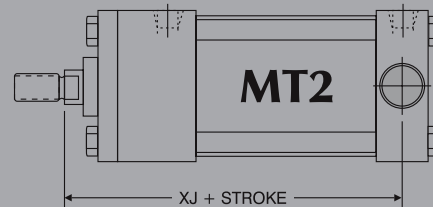
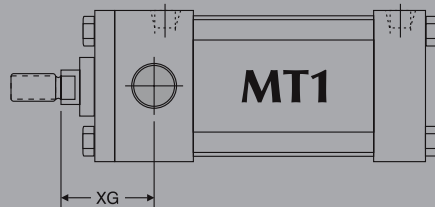


## TS Series NFPA Steel Cylinders | 1.50" to 8.00" Bore

PNEUMATIC



• TS Series – NFPA ..... 96

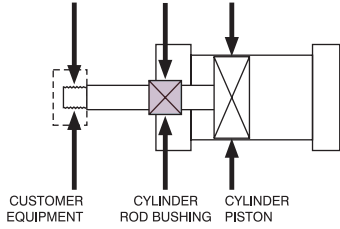


# SERIES 'TS' (NFPA) CYLINDER

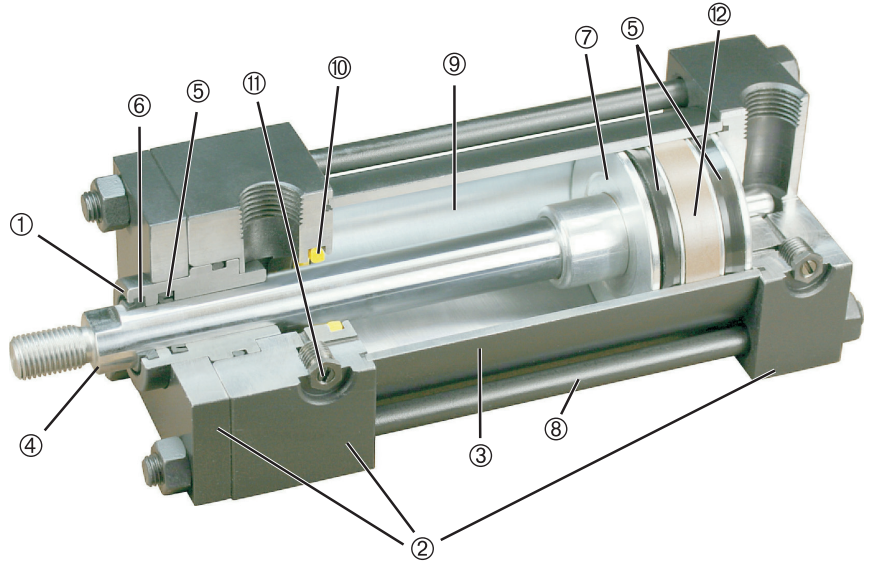
## Floating Rod Bushing

### 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 Carboxylated Nitrile construction. Seals are pressure activated and wear compensating for long life (self-lubricating material).
- 6: ROD WIPER** – Abrasion resistant urethane provides aggressive wiping action in all environments. External lip design prevents debris from entering cylinder.
- 7: PISTON** – Precision machined from 6061-T651 alloy aluminum, provides an excellent bearing surface for extended cylinder life.
- 8: TIE RODS** – 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

Carboxylated Nitrile: -20°F to 200°F (-29°C to 93°C)  
Fluorocarbon: 0°F to 400°F (-18°C to 204°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 'TS' (HEAVY-DUTY STEEL CYLINDERS)

TS - MF1 - 2.50 x 10 - HC - KK3

SERIES	
TS	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	

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 NEEDED)
FCC	FIXED CAP CUSHION (NON-ADJUSTABLE, NO ADJUSTMENT NEEDED)
FC	FIXED HEAD AND CAP CUSHION (NON-ADJUSTABLE, NO ADJUSTMENT NEEDED)

OPTIONS	
ADD 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 (12" MAX STROKE) AVAILABLE ON DOUBLE ROD END MODELS
MAB	MICRO-ADJUST WITH SOUND DAMPENING BUMPER (12" 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 & 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: TS MS4 2 X 24ES-ST=3)
TH	400 PSI HYDRAULIC NON-SHOCK (Refer to page 183)
VS	FLUOROCARBON SEALS
XX	SPECIAL VARIATION (SPECIFY)

Note: "L" CUSHION OPTION CAN BE ORDERED AS FIXED CUSHIONS.

Example: FCHL

## ABOUT OUR PART NUMBER SYSTEM

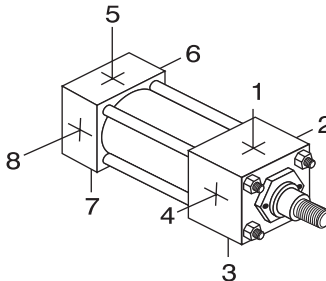
- Simple, easy to understand
- No excessive codes!
- Eliminates mistakes when ordering

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

Part Number: TS-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.



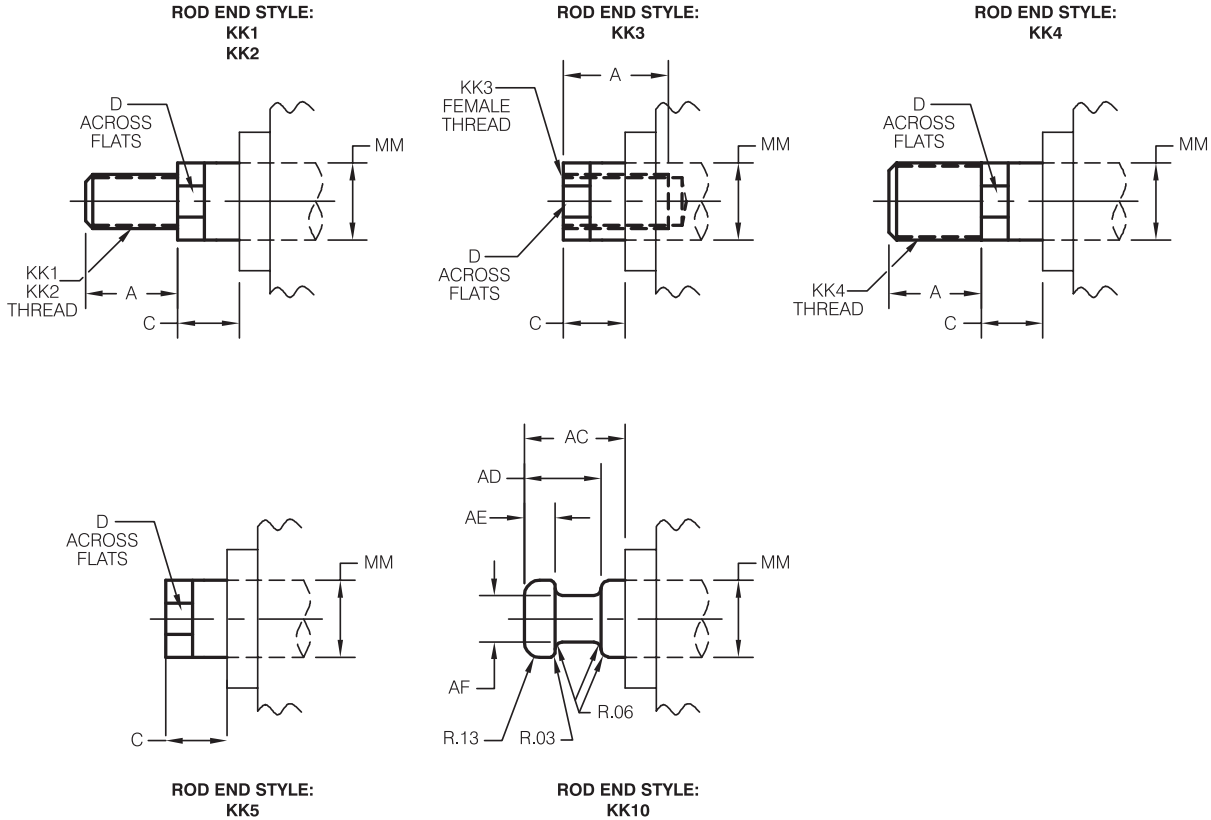
OPTION LENGTH ADDER (ADD TO CATALOG BASIC OVERALL LENGTH DIMENSIONS)				
BORE	OPTION			
	B	BC	BH	ST* (STOP TUBE) EXAMPLE: ST=2
1.50	0.500"	0.250"	0.250"	2
2.00	0.500"	0.250"	0.250"	2
2.50	0.500"	0.250"	0.250"	2
3.25	0.500"	0.250"	0.250"	2
4.00	0.500"	0.250"	0.250"	2
5.00	0.500"	0.250"	0.250"	2
6.00	0.500"	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

 1.50"-6.00" Bores	 1.50"-6.00" Bores	 8.00" Bore	 8.00" Bore	 1.50"-8.00" Bores	 1.50"-6.00" Bores
 1.50"-6.00" Bores	 1.50"-8.00" Bores	 1.50"-8.00" Bores	 1.50"-8.00" Bores	 1.50"-8.00" Bores	
 1.50"-8.00" Bores	 1.50"-8.00" Bores	 1.50"-8.00" Bores	 1.50"-8.00" Bores	 1.50"-8.00" Bores	

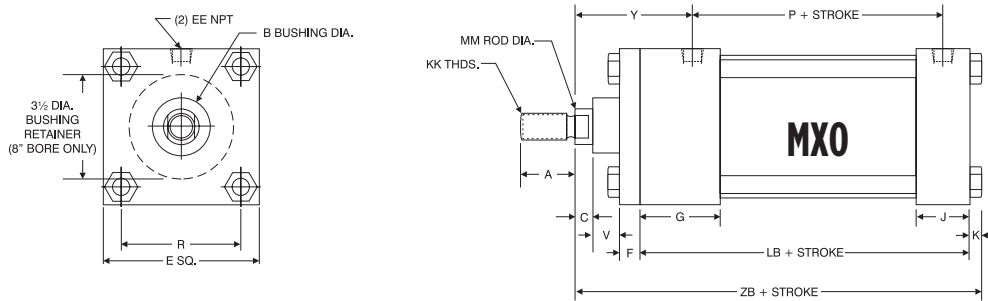
# SERIES 'TS' DIMENSIONS: THREADS



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

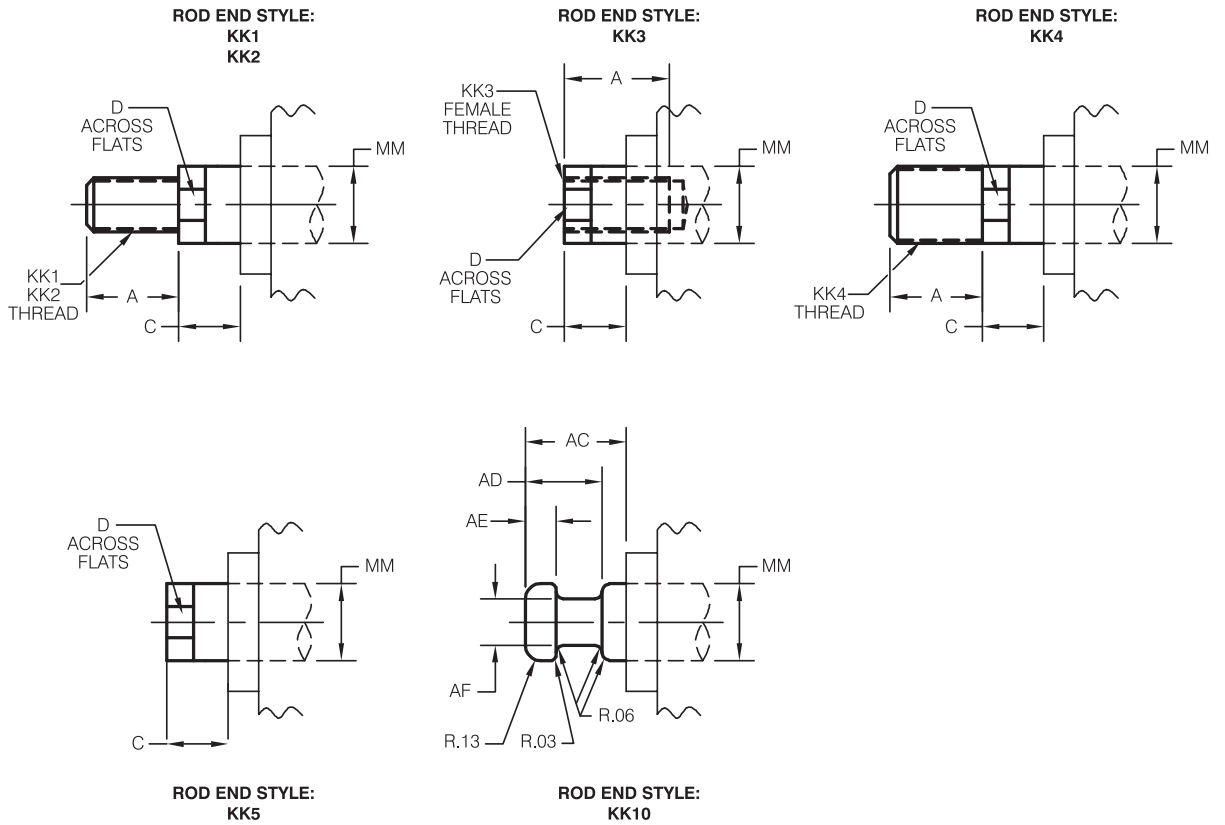
Four (4) wrench flats is an option.

# SERIES 'TS' 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									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									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									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									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									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									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									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									0.500	3.000			7.563

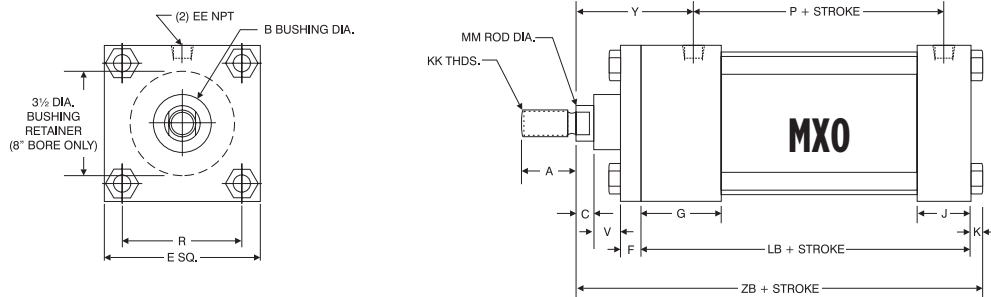
# SERIES 'TS' DIMENSIONS: THREADS



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

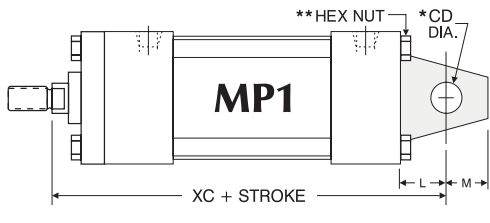
Four (4) Wrench flats is an option.

# SERIES 'TS' DIMENSIONS: BASIC CYLINDER (NO MOUNT)

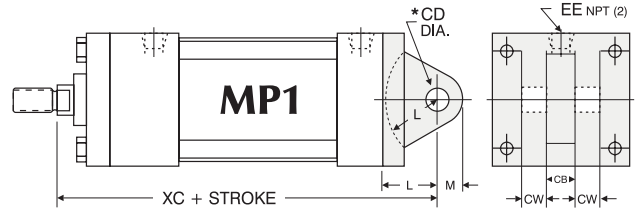


BORE	ROD DIA. (MM)	A	B	C	E	EE	F	G	J	K	KK	R	V	Y	ADD TO STROKE		
															LB	P	ZB
1.50	0.625	0.750	1.125	0.375	2.000	0.375	0.375	1.500	1.000	0.250	7/16 - 20	1.438	0.250	1.875	3.625	2.375	4.875
	1.000	1.125	1.500	0.500									2.250	5.250			
2.00	0.625	0.750	1.125	0.375	2.500	0.375	0.375	1.500	1.000	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									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									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									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									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									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									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									3.000	7.563			

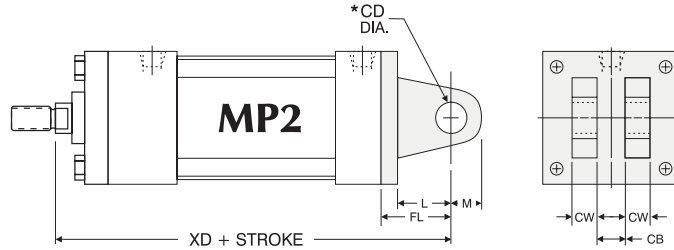
## SERIES 'TS' DIMENSIONS: PIVOT MOUNTS



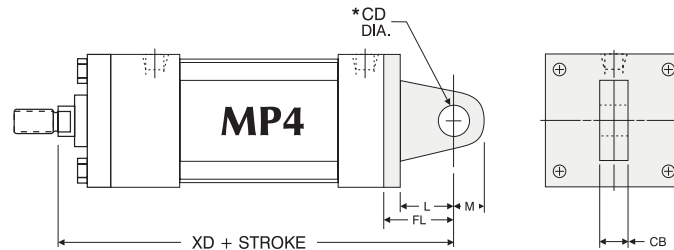
**WELDED MP1 MOUNT**



**IRON CASTING MP1 MOUNT  
(OPTIONAL)**



**MP2 MOUNT  
(IRON CASTING)**



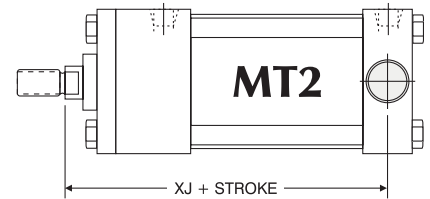
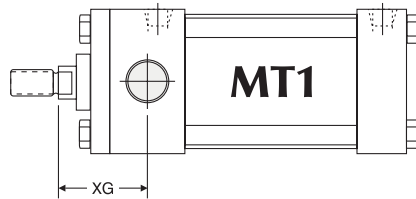
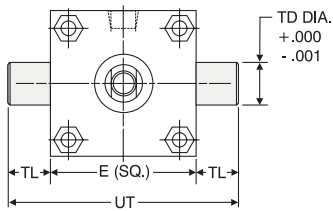
**MP4 MOUNT  
(IRON CASTING: 1.50" - 4.00" BORES, WELDMENT: 5.00" - 6.00" BORES\*)**

'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	EB500	CB500
	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	EB500	CB500
	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	EB750	CB750
	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	EB750	CB750
	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	EB1000	CB1000
	1.750							8.500		RC1250	RE1250	CP1375		

\*Clevis pins are provided with pivot mounts.  
 \*\*Hex nuts are located on cap end (4.00"-8.00" bores).

Note: MP4 5.00"-6.00" bores are 3-5 day delivery.  
 Cast iron removable mounts are optional and must be requested when ordering (1.50"-6.00" bores).  
 Specify "CAST MP1" when ordering.

# SERIES 'TS' DIMENSIONS: PIVOT MOUNTS

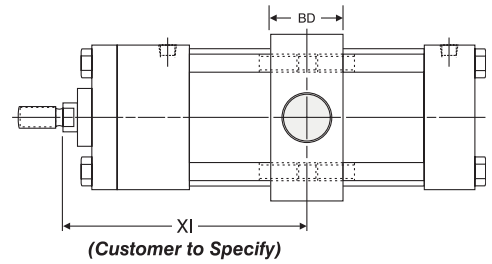
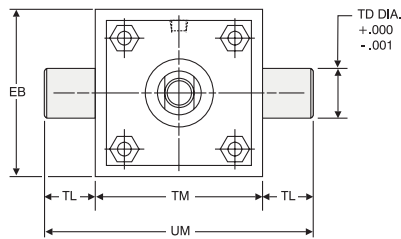


## MT1 / MT2

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	ROD CLEVIS	ROD EYE	CLEVIS PIN
							XJ			
1.50	0.625	2.000	1.000	1.000	4.000	1.750	4.125	RC437	RE437	CP500
	1.000					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					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					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					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					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					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					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					6.250	RC1250	RE1250	CP1375	

TS / SINGLE STAGE MOUNTS



## MT4

(Customer to Specify)  
Example: TAS - MT4 4 X 12 - XI = 6"

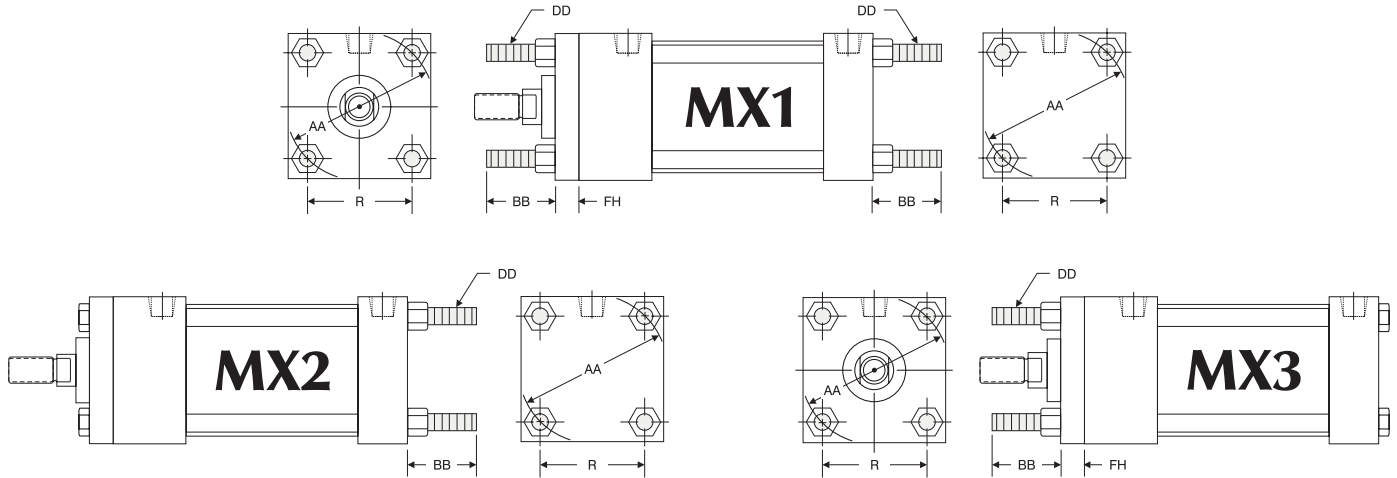
Note: MT4 Trunnions and Intermediate Section are one-piece solid steel construction.

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

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

'MT4' INTERMEDIATE TRUNNION MOUNT DIMENSIONS							
BORE	BD	EB	HCD	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	

# SERIES 'TS' DIMENSIONS: TIE ROD & FLANGE MOUNTS

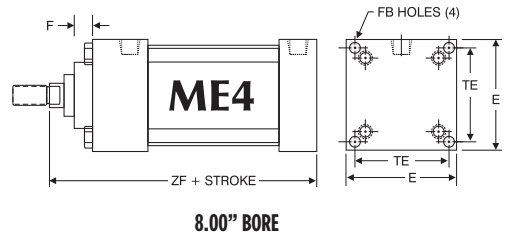
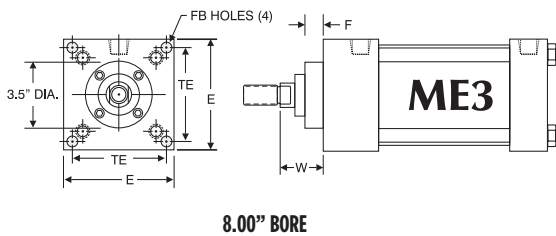
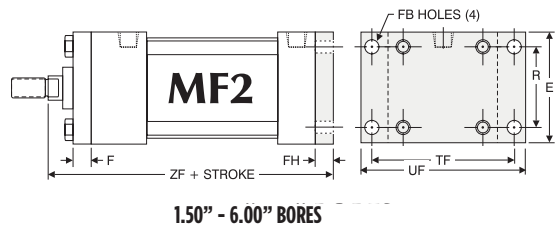
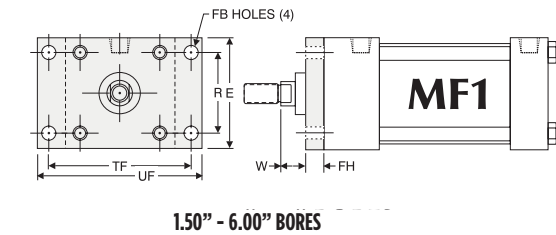


TIE ROD EXTENDED 'MX1', 'MX2' & 'MX3' MOUNT DIMENSIONS						
BORE	ROD DIA. (MM)	AA	BB	DD	FH	R
1.50	0.625	2.020	1.000	1/4-28	0.375	1.438
	1.000					
2.00	0.625	2.600	1.125	5/16-24	0.375	1.844
	1.000					
2.50	0.625	3.100	1.125	5/16-24	0.375	2.188
	1.000					
3.25	1.000	3.900	1.375	3/8-24	0.625	2.766
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

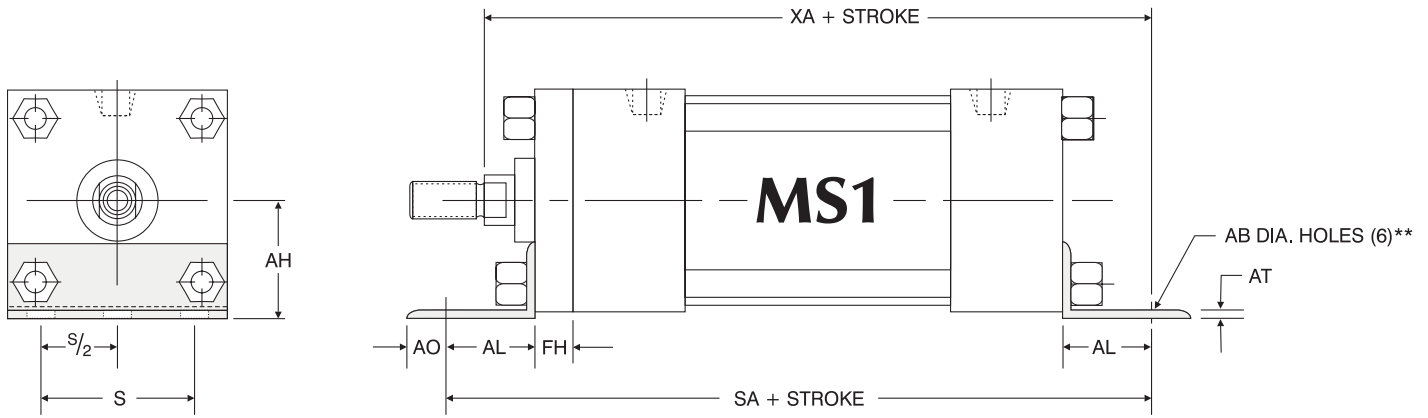
\*\*BB dimension from face of head.



'MF1', 'MF2' FLANGE & 'ME3', 'ME4' CAP MOUNT DIMENSIONS											
BORE	ROD DIA. (MM)	E	F	FB	FH	R	TE	TF	UF	ADD TO STROKE	
										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	
2.00	0.625	2.500	0.375	0.375	0.375	1.840	-	3.375	4.125	0.625	5.000
	1.000									1.000	
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	
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	

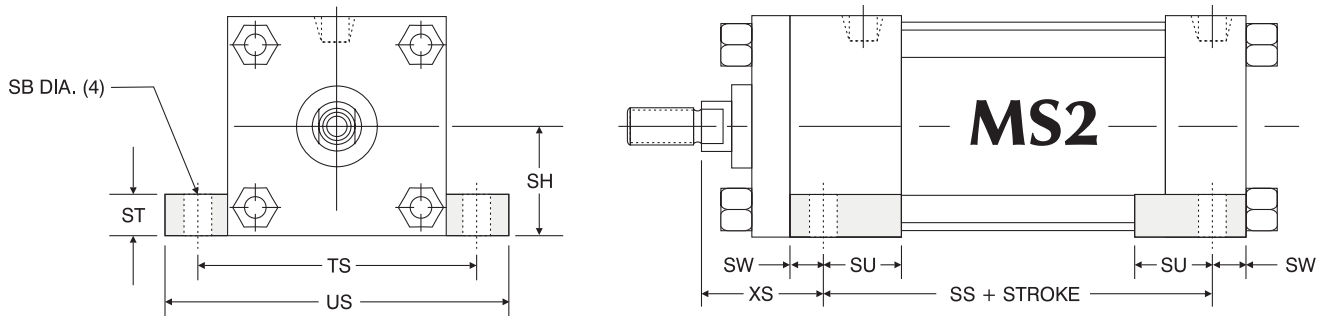
'MF1', 'MF2' FLANGE & 'ME3', 'ME4' CAP MOUNT DIMENSIONS											
BORE	ROD DIA. (MM)	E	F	FB	FH	R	TE	TF	UF	ADD TO STROKE	
										W	ZF
4.00	1.000	4.500	0.625	0.438	0.625	3.313	-	5.438	6.250	0.750	6.250
	1.375									1.000	
5.00	1.000	5.500	0.625	0.563	0.625	4.125	-	6.625	7.625	0.750	6.500
	1.375									1.000	
6.00	1.375	6.500	0.625	0.563	0.750	4.875	-	7.625	8.625	0.875	7.375
	1.750									1.125	
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	

# SERIES 'TS' DIMENSIONS: BASE MOUNTS



'MS1' ANGLE MOUNT DIMENSIONS										
BORE	ROD DIA. (MM)	AB	AH	AL	AO	AT	FH	S	ADD TO STROKE	
									SA	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

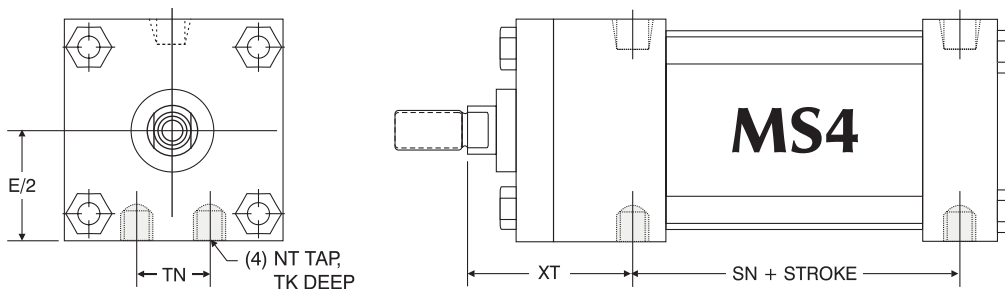
\*\*1.50" bore has four (4) AB diameter holes.  
\*8.00" bore utilizes a round retainer.



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

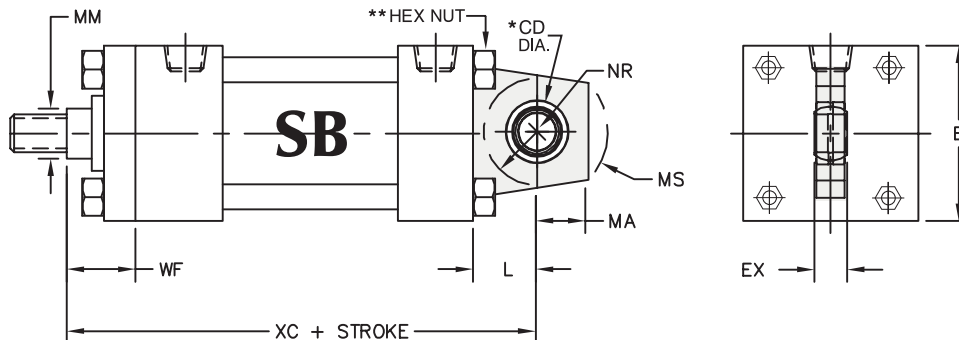
\*8.00" bore utilizes a round retainer.

## SERIES 'TS' 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	

## SERIES 'TS' 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								5.750	
2.00	0.625	0.500	2.500	0.437	0.750	0.750	0.938	0.625	1.000	5.375
	1.375								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								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								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								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								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								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								8.500	

\*Clevis pins are provided with pivot mounts.

\*\*Hex nuts are located on cap end (4.00"-8.00" bores).

Notes: 8.00" bore utilizes round retainer.

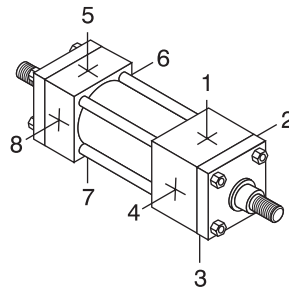
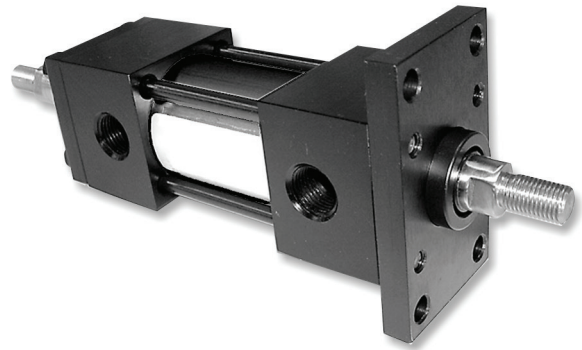
Must specify KK3 rod end if to be used with "MSRE" rod eye.



# SERIES 'TS' 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.

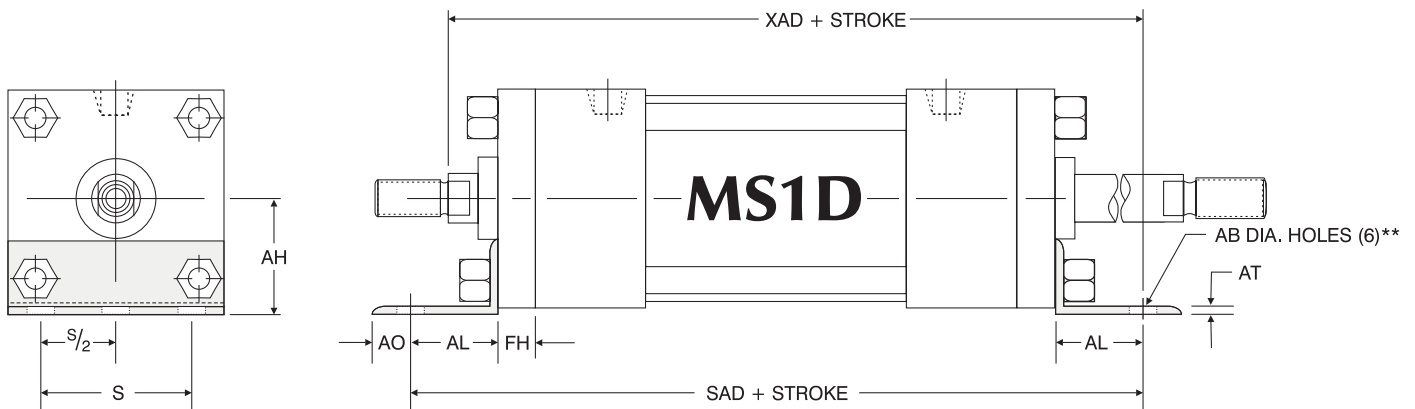


### STANDARD PORT AND CUSHION ADJUSTMENT POSITIONS

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

TS / DOUBLE ROD MOUNTS

## SERIES 'TS' DIMENSIONS: DOUBLE ROD END BASE MOUNTS

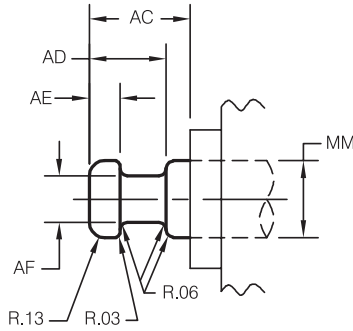
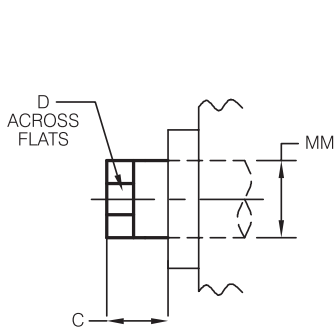
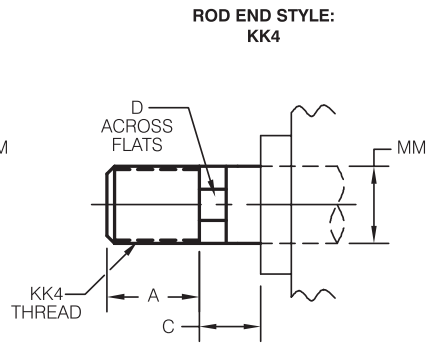
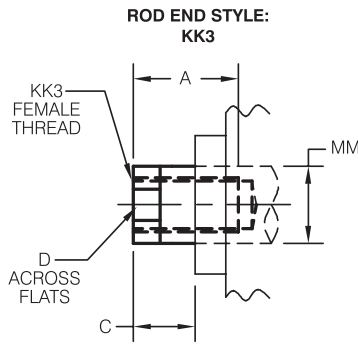
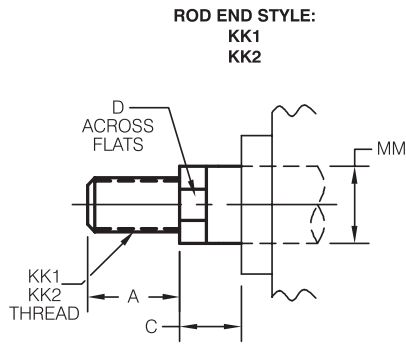


'MS1D' ANGLE MOUNT DIMENSIONS										
BORE	ROD DIA. (MM)	AB	AH	AL	AO	AT	FH	S	ADD TO STROKE	
									SAD	XAD
1.50	0.625	0.438	1.188	1.000	0.375	0.188	0.375	1.250	6.875	6.500
	1.000									6.875
2.00	0.625	0.438	1.438	1.000	0.375	0.188	0.375	1.750	6.875	6.500
	1.000									6.875
2.50	0.625	0.438	1.625	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.

# SERIES 'TS' DIMENSIONS: THREADS



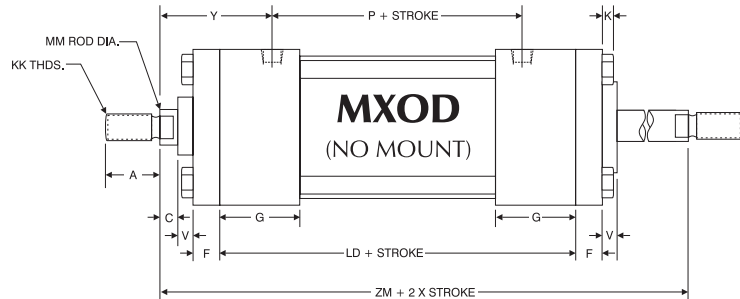
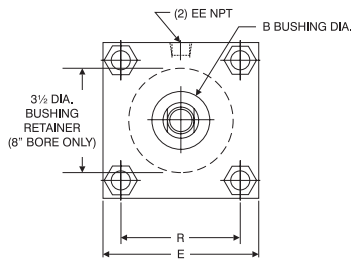
ROD END STYLE: KK5

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.

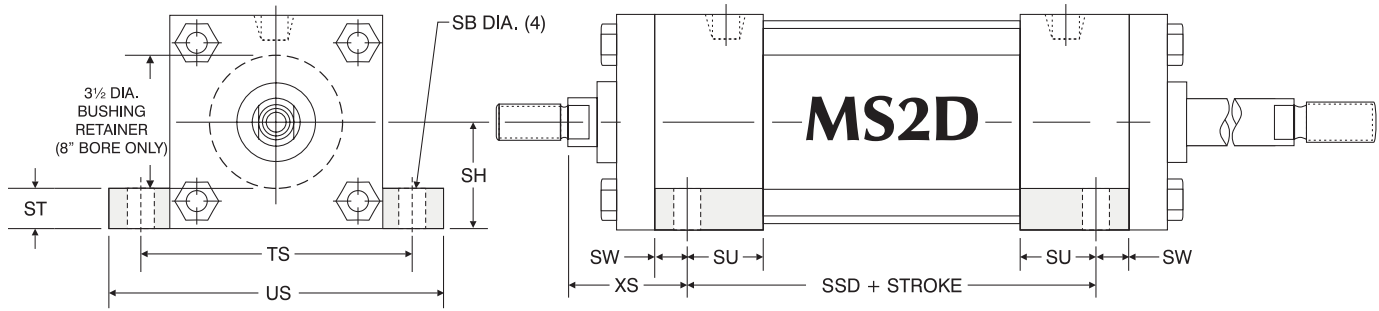
## DOUBLE ROD END DIMENSIONS: BASIC CYLINDER (NO MOUNT)



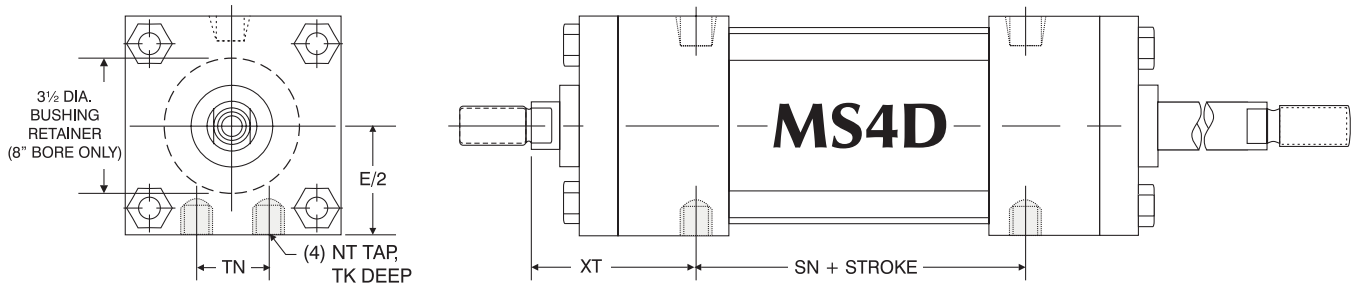
BORE	ROD DIA. (MM)	A	B	C	E	EE	F	G	K	KK	R	V	Y	ADD TO STROKE		ADD 2x STROKE
														LD	P	ZM
1.50	0.625	0.750	1.125	0.375	2.000	0.375	0.375	1.500	0.250	7/16 -20	1.438	0.250	1.875	4.125	2.375	6.125
	1.000	1.125	1.500	0.500						3/4 -16		0.500	2.250			6.875
2.00	0.625	0.750	1.125	0.375	2.500	0.375	0.375	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



# SERIES 'TS' DIMENSIONS: DOUBLE ROD END BASE MOUNTS

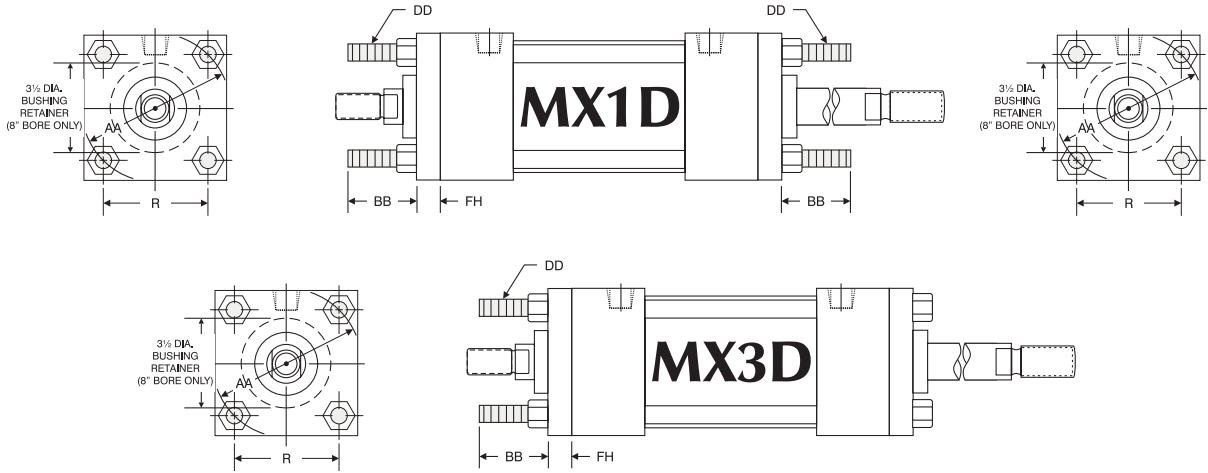


DOUBLE ROD END 'MS2D' SIDE LUG MOUNT DIMENSIONS										
BORE	ROD DIA. (MM)	SB	SH	ST	SU	SW	TS	US	XS	ADD TO STROKE
										SSD
1.50	0.625	0.438	1.000	0.500	1.125	0.375	2.750	3.500	1.375	3.375
	1.000									
2.00	0.625	0.438	1.250	0.500	1.125	0.375	3.250	4.000	1.375	3.375
	1.000									
2.50	0.625	0.438	1.500	0.500	1.125	0.375	3.750	4.500	1.375	3.500
	1.000									
3.25	1.000	0.563	1.875	0.750	1.250	0.500	4.750	5.750	1.875	3.750
	1.375									
4.00	1.000	0.563	2.250	0.750	1.250	0.500	5.500	6.500	1.875	3.750
	1.375									
5.00	1.000	0.813	2.750	1.000	1.063	0.688	6.875	8.250	2.063	3.625
	1.375									
6.00	1.375	0.813	3.250	1.000	1.313	0.688	7.875	9.250	2.313	4.125
	1.750									
8.00	1.375	0.813	4.250	1.000	1.563	0.688	9.875	11.250	2.313	4.250
	1.750									



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
	2.313						
2.00	0.625	1.250	5/16-18	0.500	0.875	1.938	2.250
	2.313						
2.50	0.625	1.500	3/8-16	0.625	1.250	1.938	2.375
	2.313						
3.25	1.000	1.875	1/2-13	0.750	1.500	2.438	2.625
	2.688						
4.00	1.000	2.250	1/2-13	0.750	2.063	2.438	2.625
	2.688						
5.00	1.000	2.750	5/8-11	1.000	2.688	2.438	2.875
	2.688						
6.00	1.375	3.250	3/4-10	1.125	3.250	2.813	3.125
	3.063						
8.00	1.375	4.250	3/4-10	1.125	4.500	2.813	3.250
	3.063						

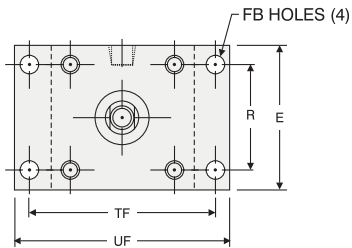
# SERIES 'TS' DIMENSIONS: DOUBLE ROD END TIE ROD & FLANGE MOUNTS



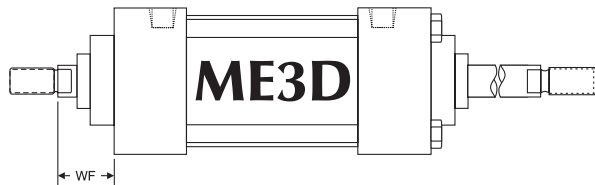
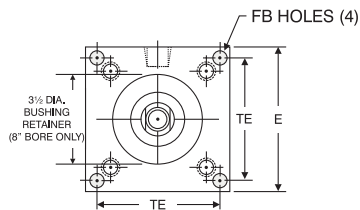
TIE ROD EXTENDED 'MX1D' & 'MX3D' MOUNT DIMENSIONS						
BORE	ROD DIA. (MM)	AA	BB	DD	FH	R
1.50	0.625	2.016	1.000	1/4 -28	0.375	1.438
	1.000					
2.00	0.625	2.594	1.125	5/16 -24	0.375	1.844
	1.000					
2.50	0.625	3.109	1.125	5/16 -24	0.375	2.188
	1.000					
3.25	1.000	3.906	1.375	3/8 -24	0.625	2.766
	1.375					

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.



1.50" - 6.00" BORES

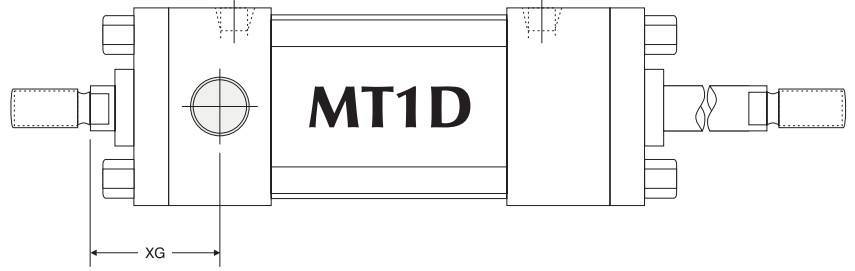
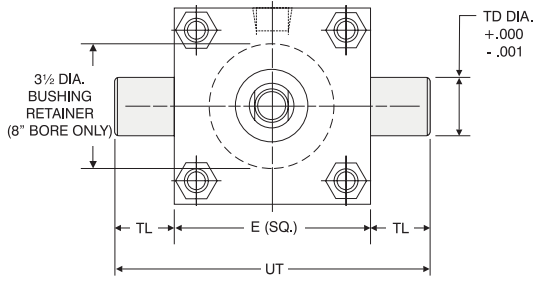


8.00" BORE ONLY

'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								N/A	
2.00	0.625	2.500	0.375	0.375	1.844	-	3.375	4.125	0.625	N/A
	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								N/A	
3.25	1.000	3.750	0.438	0.625	2.766	-	4.688	5.500	0.750	N/A
	1.375								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								N/A	
5.00	1.000	5.500	0.563	0.625	4.109	-	6.625	7.625	0.750	N/A
	1.375								N/A	
6.00	1.375	6.500	0.563	0.750	4.875	-	7.625	8.625	0.875	N/A
	1.750								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

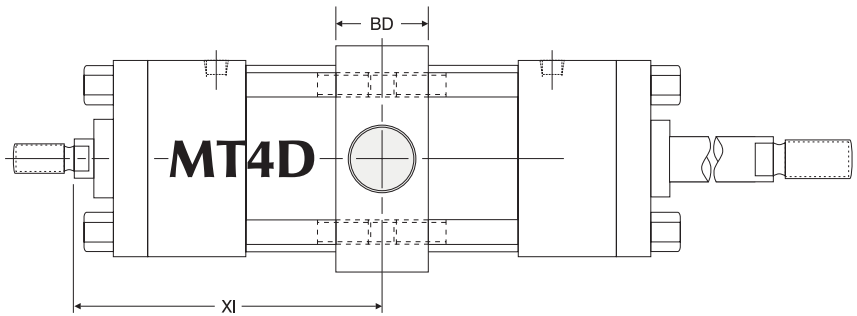
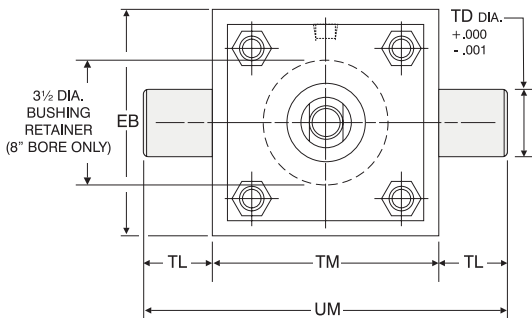
# SERIES 'TS' DIMENSIONS: DOUBLE ROD END PIVOT MOUNTS



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.



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

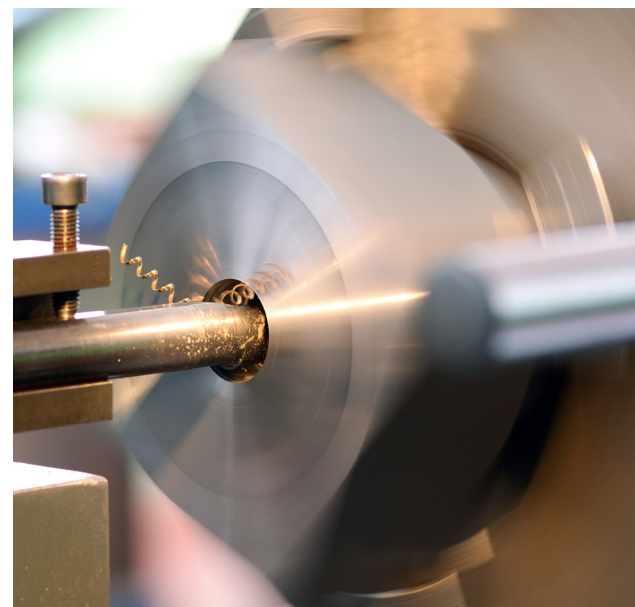
Note: MT4D Trunnions and Intermediate Section are one-piece solid steel construction.

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	

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

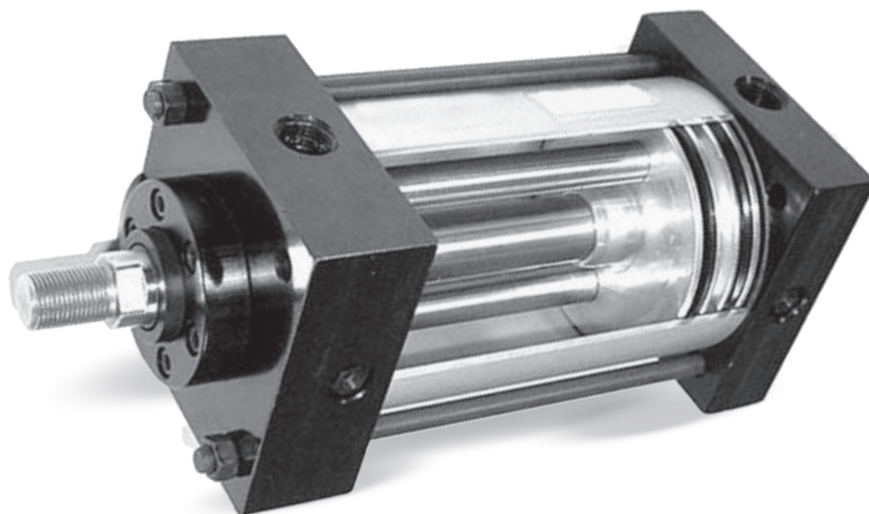
Note: Ports or cushions cannot be on same side as MT1D Trunnions.

8.00" bore utilizes round retainer.

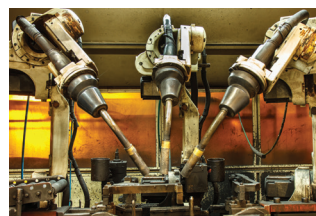
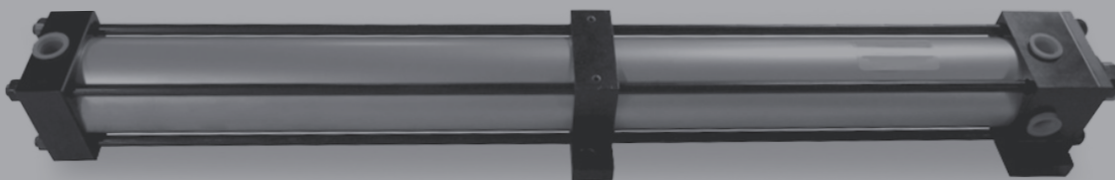


## Basic Cylinder Options | Uncommon Options & Specials

PNEUMATIC



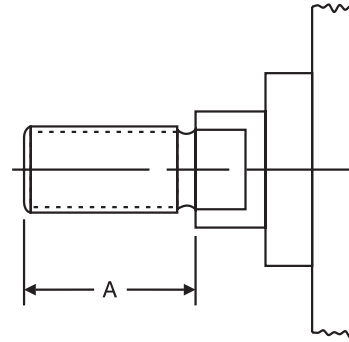
- Basic Options .....112
- Uncommon Options ..... 128



## BASIC OPTIONS

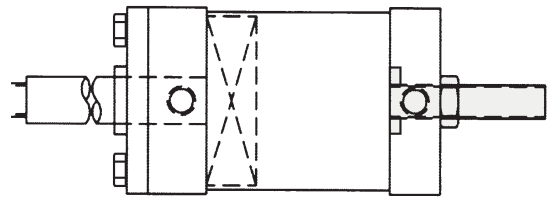
### **A=** Extended Piston Rod Thread

“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”)



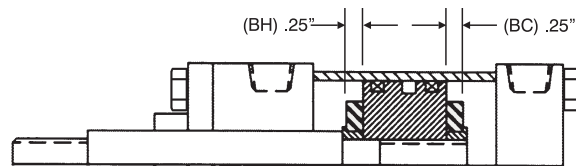
### **A/O** Extended Piston Rod Thread

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)

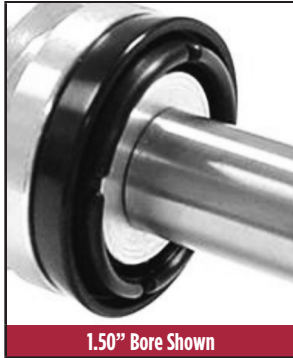




# BASIC OPTIONS

**BP**

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



HYDRAULIC CYLINDERS INC.'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 (-29°C to 93°C)

**Optional Material: Fluorocarbon**

Available in 1.50"-8.00" Bores

Operating Temp: 0°F to 400°F (-18°C to 204°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)**

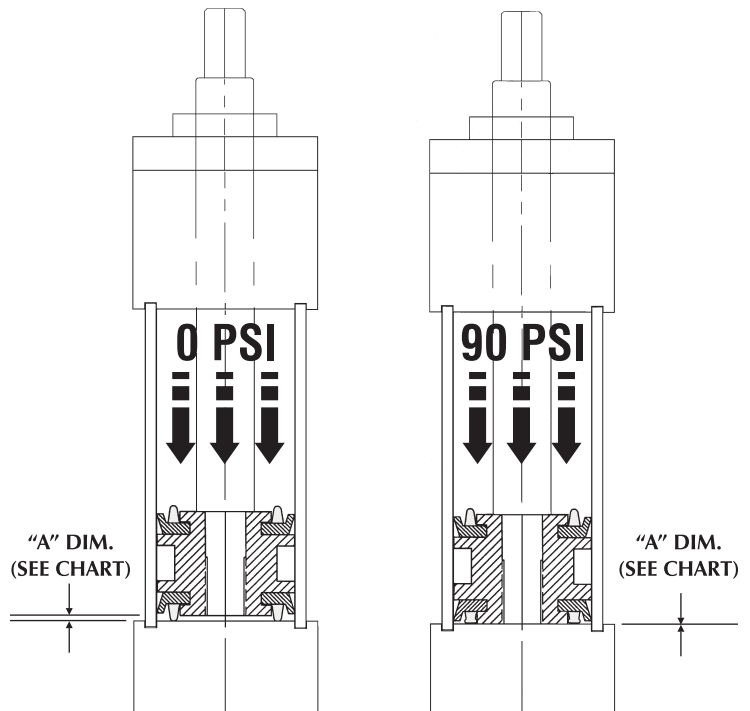
### Design Tips

- 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



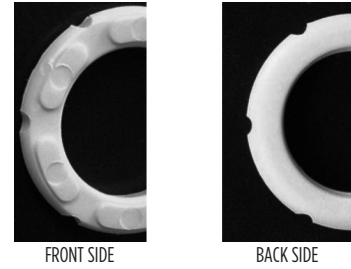
# BASIC OPTIONS: ADJUSTABLE CUSHIONS

- H**   **C**   **LH**   **LC**   **ELH**   **ELC**   Cushions

HYDRAULIC CYLINDERS INC.'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:**

$$\text{energy} = \left( \frac{W}{64} \times V^2 \right) + (P \times K)$$

- W = Total weight of load in pounds (including piston rod)
- V = Velocity (in feet per second)
- P = Driving pressure in PSI (usually the air line pressure)
- K = Bore constant value (see chart below for "K" values)

**SIZING EXAMPLE:**

How to figure the energy for a 2.50" bore cylinder, 10" stroke, 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 (6²) 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	LH or LC	ELH or ELC
		Standard Cushion Series Max Energy (ft.-lbs)	Long Cushion Series Max Energy (ft.-lbs)	Extra-Long Cushion Series Max Energy (ft.-lbs.)
1.50	.06	8.2	12.8	26.9
2.00	.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:**

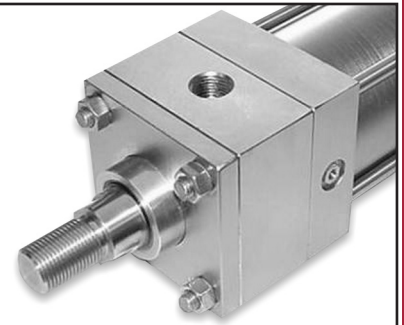
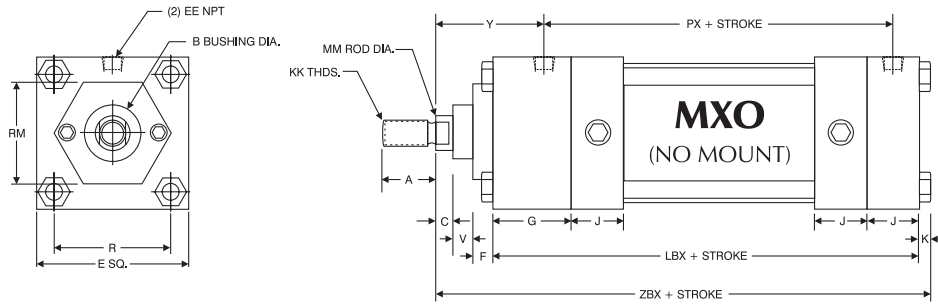
- Cushions Adjustment screws can be ordered on same side as ports.
- BP Seals provide additional impact dampening and noise reduction

# 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.



(HCA-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		
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
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
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
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
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
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			1 1/2 -12				2.000		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

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 HYDRAULIC CYLINDERS INC.® 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. HYDRAULIC CYLINDERS INC.® developed a 3.50" long head and cap cushion to meet the operating specifications.



BASIC OPTIONS

# 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

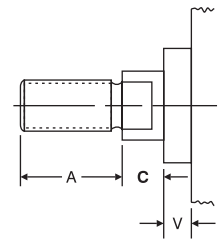
### British Standard Pipe Parallel

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)

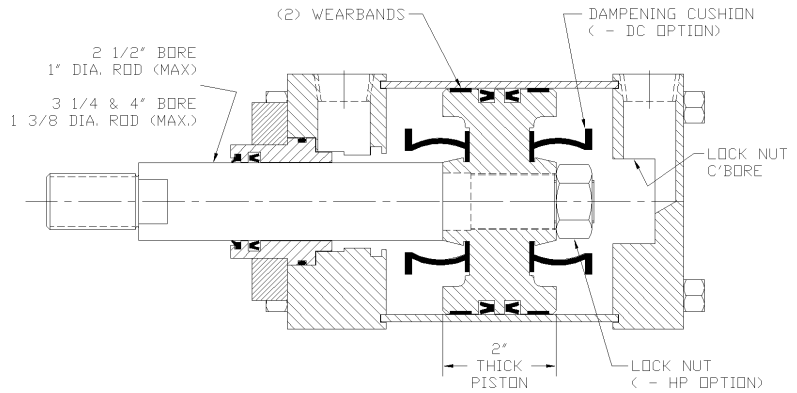
The DC option, available on 2.50", 3.25" and 4.00" bore cylinders, greatly expand the range of available cylinder internal cushioning options. The DC option incorporates dual NuCushion bumpers, dual wear bands and an extended length piston to achieve outstanding performance.

**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 3μ years of trouble-free service.



#### DAMPENING CUSHIONS

### DC

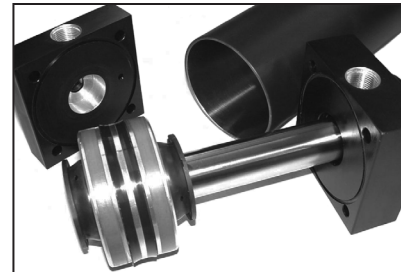
Dampening Cushion at Head & Cap

### 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 devices including hard drives.

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

#### HYDRAULIC CYLINDERS INC.® PART NUMBER REVISION:

The "EN" Series used to be ordered as:

EN - MS4 - 2 x 10.

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

By offering "EN" as an option, you can now make any HYDRAULIC CYLINDERS INC.® Series an Electroless Nickel Plated cylinder!

**New Part Number:** HCA - 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:

**FRICTION:** Low

**FINISH:** Bright and very smooth

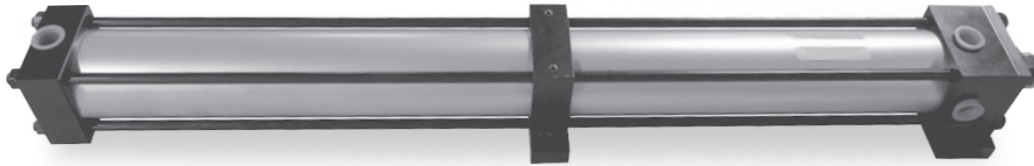
**Other types of EN plating are available. Contact HYDRAULIC CYLINDERS INC.® with your specifications for a prompt quote.**

# BASIC OPTIONS

## CS Center Supports

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

HYDRAULIC CYLINDERS INC.® 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.

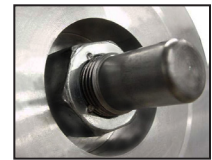
The high impact piston option consists of a steel hex locking nut in addition to the standard piston to rod connection. The hex locking nut is also staked to the piston rod for added durability.

### Special Features

Counter bored Piston, Zinc Plated Steel Lock Nut

### Standard Features

Staked Rod End, Permanent Loctite®, Threaded Piston to Rod Connection

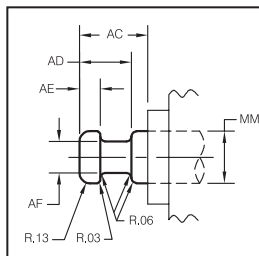


## KK10 Rod Coupler End

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: HCA-ME3-12x10-KK10

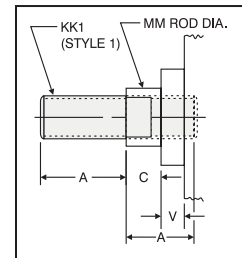
ROD DIAMETER (MM)	AC	AD	AE	AF
0.625	1.125	0.625	0.250	0.375
1.000	1.625	0.938	0.375	0.688
1.375	1.750	1.062	0.375	0.875
1.750	2.000	1.313	0.500	1.125
2.000	2.625	1.688	0.625	1.375
2.500	3.250	1.938	0.750	1.750



## 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

HYDRAULIC CYLINDERS INC.® 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: HCA-MX0-2x6-KKX=1/2-13 UNC

## KKM Metric Rod Thread

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.

HYDRAULIC CYLINDERS INC.® can provide cylinders with metric piston rod end threads to assist customers in mating replacement cylinders to existing equipment.

Example: HCA-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 HCR 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](http://www.magnalube.com) for more information.

**Color: Green**

**Recommended temperature range: -20° F to 200° F (-29° C to 93° 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 (-29° C to 93° 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 HYDRAULIC CYLINDERS INC.® for assistance.

**Color: White-Gray**

**Recommended temperature range: -20° F to 375° F (-25° C to 190° C)**

## L008 HCR 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**

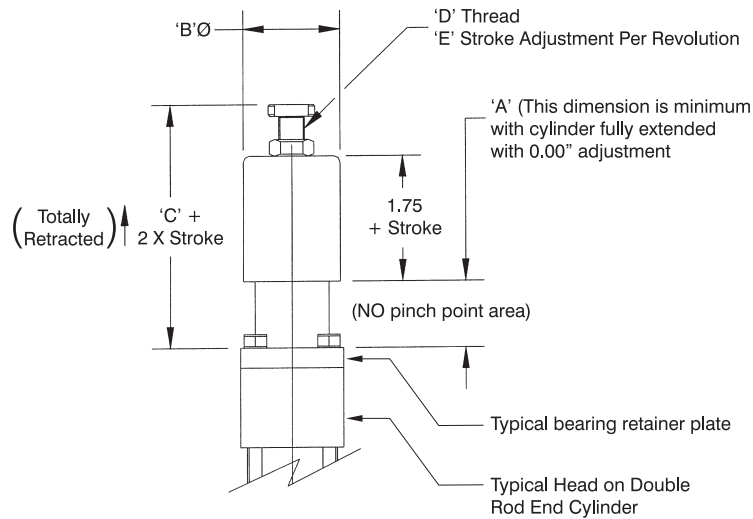
**Recommended temperature range: -30° F to 300° F (-34° C to 149° C)**

# 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 12" stroke and adjustment\*

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



TA-MF1D-MA (SHOWN)

MICRO-ADJUST DIMENSIONS					
BORE	A	B	C	D	E
1.50	1.000	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.

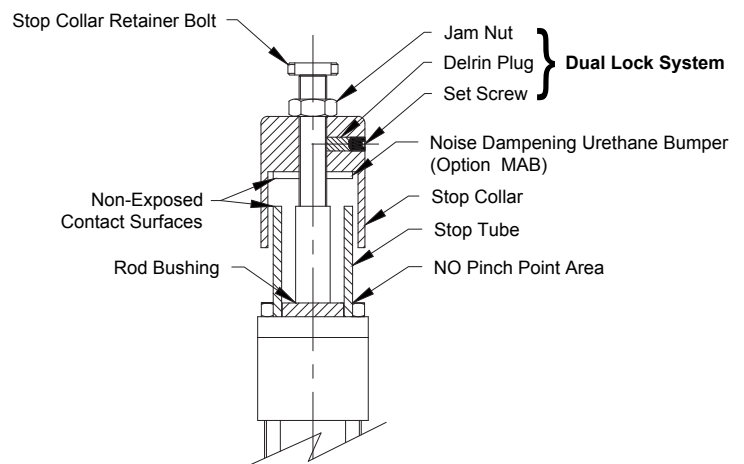
### MICRO-ADJUST SET-UP INSTRUCTIONS:

- 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.**



## 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 HYDRAULIC CYLINDERS INC.® We can accommodate most requests.**

# BASIC OPTIONS

**MPR MPH** **Magnetic Piston**

Magnetic Pistons (MPR) are used in conjunction with HYDRAULIC CYLINDERS INC.® RIO, RIOP, RHT, RAC Reed and MCS Solid State Switches. Magnetic Pistons (MPH) are used with HYDRAULIC CYLINDERS INC.® 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)**

**Benefits**

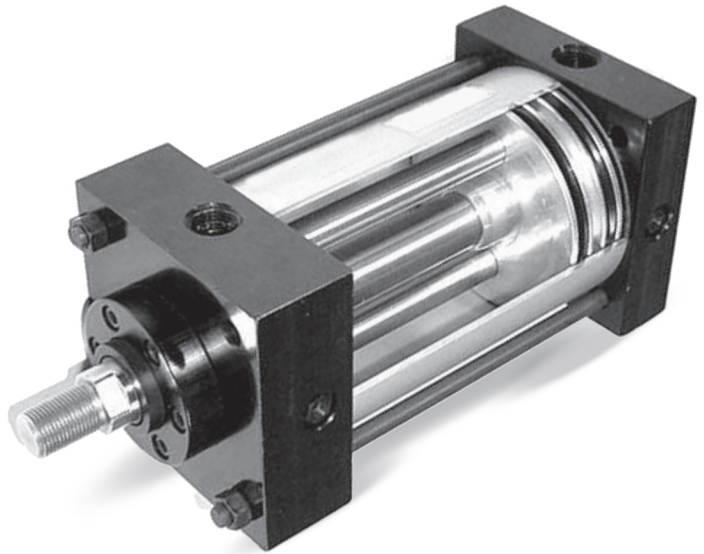
- Two internal guide rods throughout stroke
- High repeatability at each end of stroke (+/- 1 degree)
- All external dimensions are the same as standard cylinder (no additional length or width required)
- Standard Diameter Guide Rod Seals & Bronze Bearings for long life and reliable operation
- Available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

**Application Possibilities:**



**HYDRAULIC CYLINDERS INC.® PART NUMBER REVISION:**  
 The "NR" Series used to be ordered as:  
 NR - MS4 - 2 x 10.  
 (Note: The "NR" Series was the "HCA" Series with "NR" feature)  
 By offering "NR" as an option, you can now make any HYDRAULIC CYLINDERS INC.® Series a Non-Rotating cylinder!  
**New Part Number:** HCA - MS4 - 2 x 10 - NR

'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"
	0.625 Standard	Cap Only	0.312	12"
2.50	1.000 Oversize	N/A	0.312	12"
	1.000 Standard	Available	0.375	18"
3.25	1.375 Oversize	Cap Only	0.375	18"
	1.000 Standard	Available	0.625	30"
4.00	1.375 Oversize	Available	0.625	30"
	1.000 Standard	Available	0.625	30"
5.00	1.375 Oversize	Available	0.625	30"
	1.375 Standard	Available	0.625	30"
6.00	1.750 Oversize	Available	0.625	30"
	1.375 Standard	Available	1.000	40"
8.00	1.750 Oversize	Available	1.000	40"
	1.750 Standard	Available	1.000	40"
10.00	2.000 Oversize	Available	1.000	40"
	2.000 Standard	Available	1.000	40"
12.00	2.500 Oversize	Available	1.000	40"
	2.000 Standard	Available	1.000	40"



# BASIC OPTIONS

**OP**

## Optional Port Location

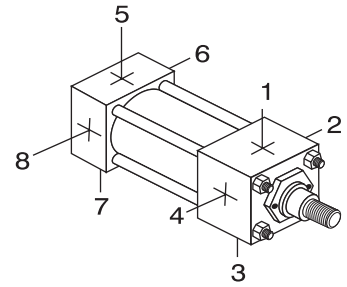
Optional port locations can be ordered simply by calling out the location numbers:

**Example:**

**HCA - 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**



BASIC OPTIONS

## Optional Port and Cushion at Same Location ('HCA' Series)\*

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

**Ordering Examples:**

**HCA - MS4 - 2 x 10 - H1C5 - OP= 1 & 5**

(Ports and Cushions @ 1 & 5)

**HCA - MS4 - 2 x 10 - H2C6 - OP= 2 & 6**

(Ports and Cushions @ 2 & 6)

**HCA - 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**

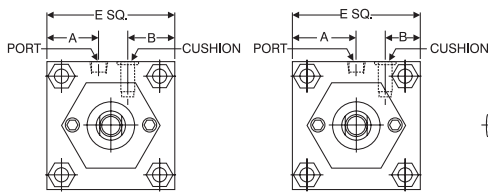
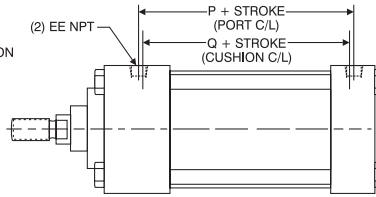


FIGURE #1

FIGURE #2



**CAP VIEWS**

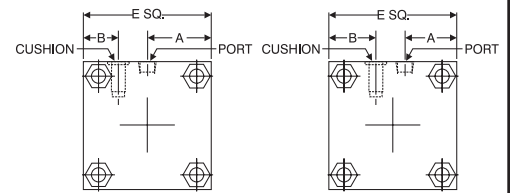


FIGURE #2

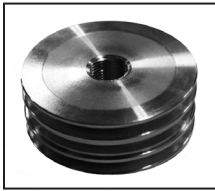
FIGURE #1

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

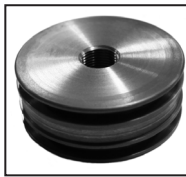
### PMB Solid Brass Pistons



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 'H' and 'M' series. They can be ordered as an option for any other HYDRAULIC CYLINDERS INC.® 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

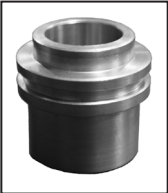
Material: SAE 660 Bronze

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: HYDRAULIC CYLINDERS INC.® 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 'HCR' 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: HYDRAULIC CYLINDERS INC.® 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 wash 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 carboxylated nitrile seals. Round-lip seals hydroplane on opposed sealing surfaces, and have a lower running and break-away friction.

**BORE SIZES:** 1.50" to 8.00" Bore

**MATERIAL:** Carboxylated Nitrile

**OPERATING TEMPERATURE:** -20°F to 200°F (-29°C to 93°C)

**OPERATING PRESSURE:** 250 PSI AIR (17 BAR)

#### HYDRAULIC CYLINDERS INC.® PART NUMBER REVISION:

The "LF" Series used to be ordered as: LF - MS4 - 2 x 10.  
(Note: The "LF" Series was the "HCA" Series with "LF" Low Friction feature.)

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

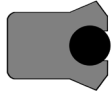
**New Part Number:** HCA - MS4 - 2 x 10 - LF

## 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 (-29°C to 93°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)

'HCA', 'TRA' and 'HCF' 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

#### HYDRAULIC CYLINDERS INC.® PART NUMBER REVISION:

The "TH" Series used to be ordered as:

TH - MS4 - 2 x 10.

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

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

**New Part Number:** HCA - 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 (-18° C to 204° C)

• Higher chemical resistance: Resists most wash down solutions

Many other seal materials are available. Contact HYDRAULIC CYLINDERS INC.® for proper seal material selection in tough applications or environments.

# BASIC OPTIONS

**OS** **Enlarge Rod**

**OVERSIZED PISTON ROD**      **STANDARD PISTON ROD**

Applications requiring long strokes may require oversized 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**
- SSR** **Stainless Steel Piston Rod (Hard-Chrome Plated)**
- SSC** **Stainless Steel Cushion Needle (External Adjustment Components)**

- SSF** **Stainless Steel Fasteners (Bushing Retainer Screws)**
- SST** **Stainless Steel Tie Rods and Nuts**
- SSN** **Stainless Steel Sleeve Nuts ('HCF' 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: HYDRAULIC CYLINDERS INC.® 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:

HCA - MP1 - 3.25" x 40"ES - ST=2

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

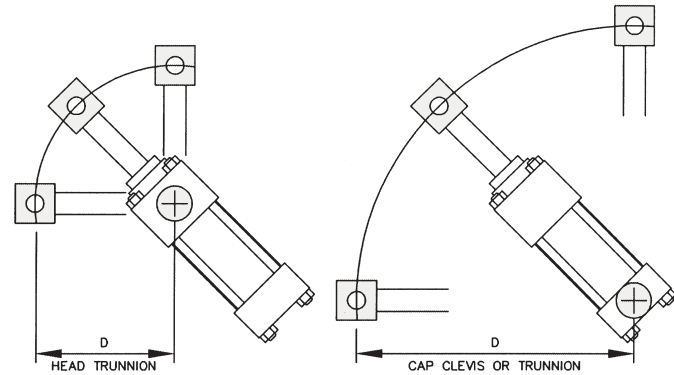
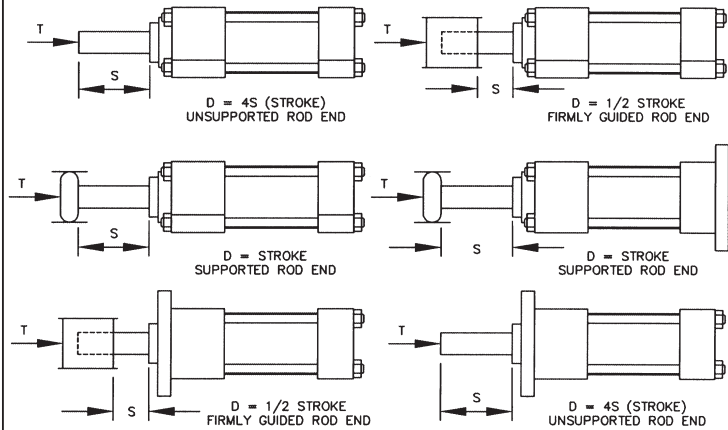
### Chart 1

Find the value of "D" for your application

"D" = Stroke, adjusted for mounting condition

"S" = Actual cylinder stroke

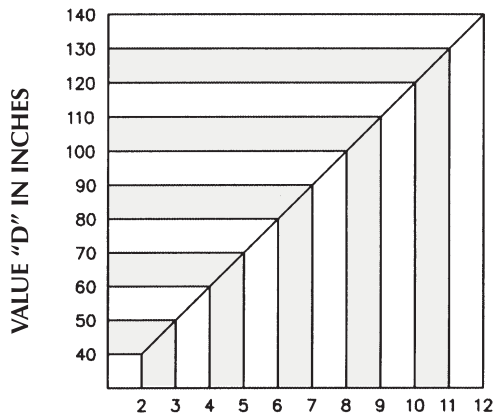
"T" = Axial thrust (refer to Chart 3)



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

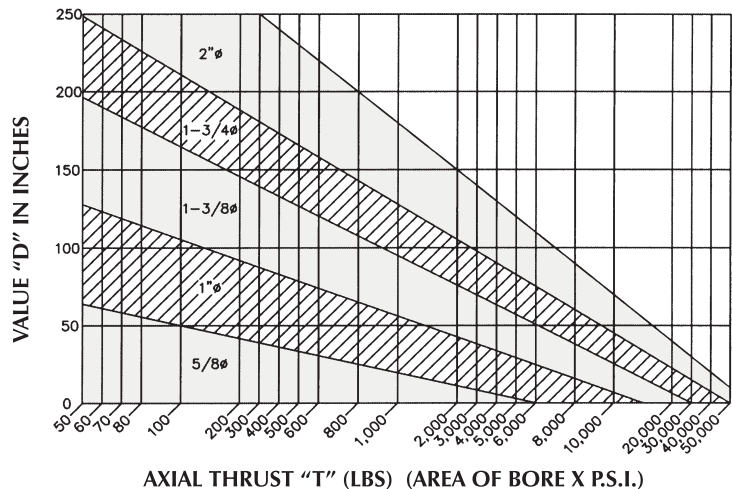
### Chart 2

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



### Chart 3

ROD SIZE SELECTION



# 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. HYDRAULIC CYLINDERS INC.® 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 'HCA' Series mounts are standard, they may not offer adequate strength to replace 1-piece all steel pivot style mount applications. As an option, HYDRAULIC CYLINDERS INC.® 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

Since HYDRAULIC CYLINDERS INC.® uses the exact same design in our basic HCA, HCF, TD, SS and TS 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.

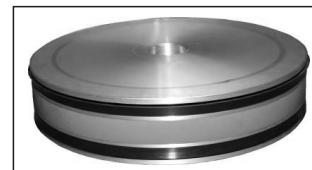


## WB Piston Wear Band

Piston wear bands are standard on all HYDRAULIC CYLINDERS INC.® series (except for MSE, MSR and PFLF series) and cylinder model numberers 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



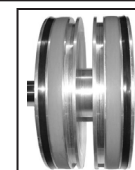
## SPECIAL WEAR BANDS

HYDRAULIC CYLINDERS INC.® 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

HYDRAULIC CYLINDERS INC.® is pleased to announce the availability of affordable, custom made private labels. Thanks to recent capital expenditures, HYDRAULIC CYLINDERS INC.® 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 HYDRAULIC CYLINDERS INC.® 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!

HYDRAULIC CYLINDERS INC.® 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.

HYDRAULIC CYLINDERS INC.®'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 HYDRAULIC CYLINDERS INC.® 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 HYDRAULIC CYLINDERS INC.® for more information on setting up private labels for your customers.



**LION'S HEAD  
BOTTLING**

P/N: AE4-MR3-0407      Bore/Stroke: 2" x 1"  
S/N: 07-07145      125 PSI AIR MAX




**INFINITYAIR**

P/N: 3¼" x 6"  
S/N: 07-01487  
250 PSI AIR MAX



**Bore / Stroke:  
2 1/2" x 28"**

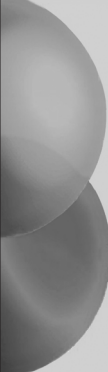
S/N: 06-16469 (L1)  
250 PSI AIR MAX



**STEEL WORKS  
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Los Angeles, CA 90036  
(323) 575-2458  
www.steelworksmachines.com

P/N: SS0324-AC  
S/N: 07-04195  
8" x 36"  
250 PSI AIR MAX



**HASTINGS  
ROBOTICS**


123 Washington St  
Dallas, TX 75201  
(214) 987-6500

P/N: C15.500.150.AB  
S/N: 06-06278 / 0806  
250 PSI AIR MAX



**Bore / Stroke:  
2 1/2" x 28"**

S/N: 06-16469 (L1)  
250 PSI AIR MAX



**CHI TEC**  
1-800-765-4321

Bore/Stroke: 2½" x 12"  
S/N: 07-57421  
250 PSI AIR MAX

AE-175-600-BK  
07-14213  
AUG2007  
125 PSI Air Max

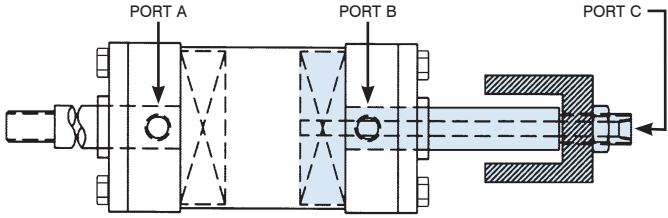


# UNCOMMON OPTIONS

## 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.

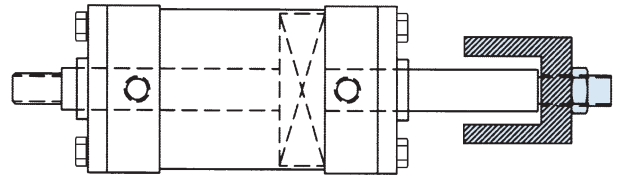
To order, specify "AS3POS" and length of adjustment. (Example: AS3POS = 4")



## 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:** HYDRAULIC CYLINDERS INC.® can provide paint in any color or type. Contact HYDRAULIC CYLINDERS INC.® with your specifications.

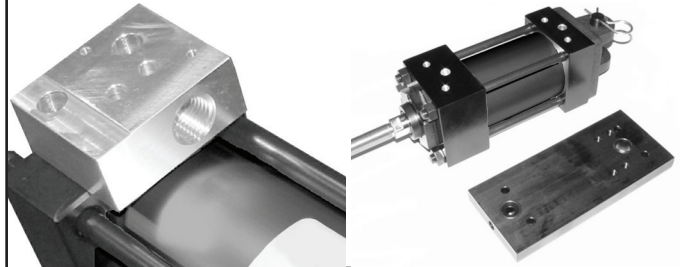
**Additional Finishes:** HYDRAULIC CYLINDERS INC.® can provide special finishes, i.e., Nutride Plate Contact HYDRAULIC CYLINDERS INC.® with your specifications — we would be pleased to provide a quote!

**Heavy Chrome Plated Piston Rods.** Contact HYDRAULIC CYLINDERS INC.® for more information.

## MANIFOLD BLOCK or PLATE

For OEM's, HYDRAULIC CYLINDERS INC.® can design and provide custom made manifolds in high quantity.

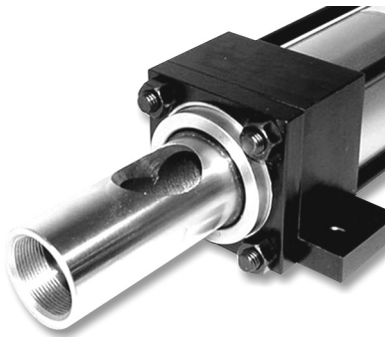
Contact HYDRAULIC CYLINDERS INC.® with your specifications.



## 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.

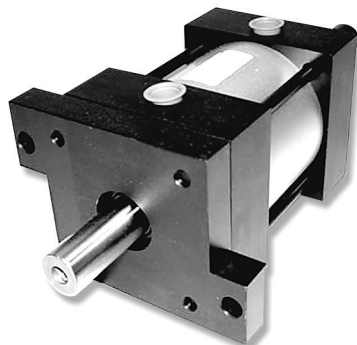
(Note: Rod Boots add length to cylinder rod extension—contact HYDRAULIC CYLINDERS INC.® for specifications)



## SPECIAL MFI FLANGE

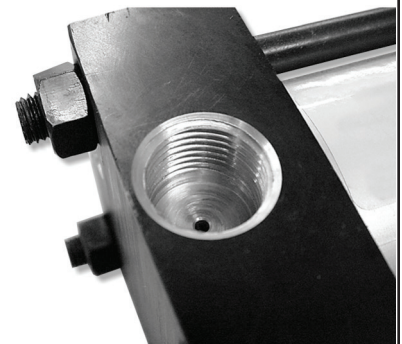
Customer needed front flange mounting but didn't have the room for the standard flanges.

HYDRAULIC CYLINDERS INC.® provided flanges that were notched for a more compact design.



## SPECIAL SHORT TAP WITH ORIFICE

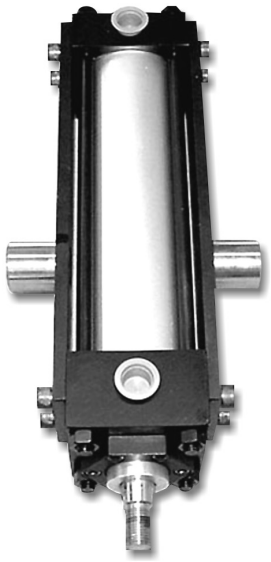
Customer required a special short pipe tap, and different size drilled orifices at each end of cylinder, for built-in speed control.



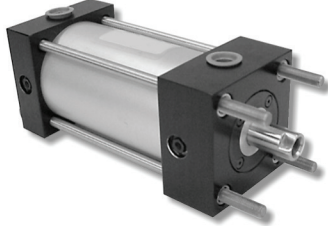


# UNCOMMON OPTIONS AND SPECIALS

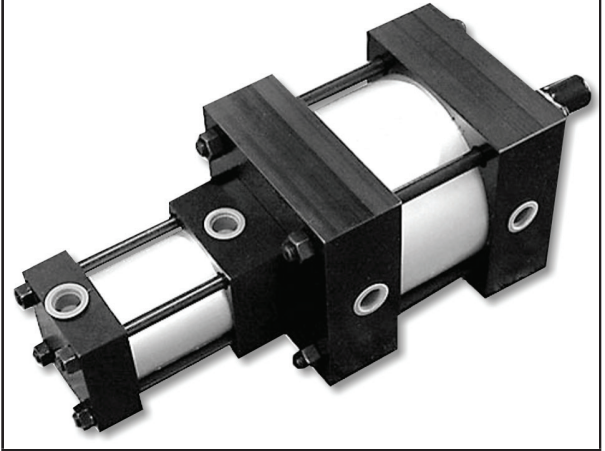
**MT4X BOLT-ON SIDE PLATES**



**'HCF' WITH FLUSH ROD BUSHING**



**TANDEM WITH DIFFERENT SIZE BORES**



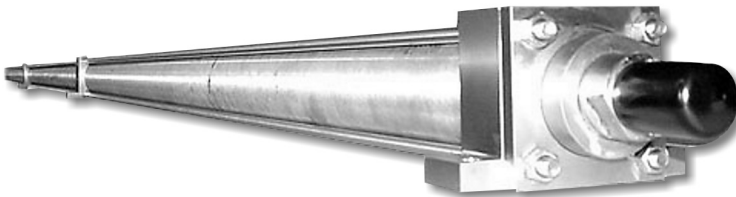
**SPECIAL STEEL MOUNTS**



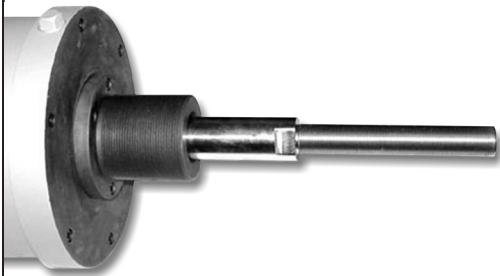
**GREASE ZERKS (FOR HIGH CYCLE APPLICATIONS)**



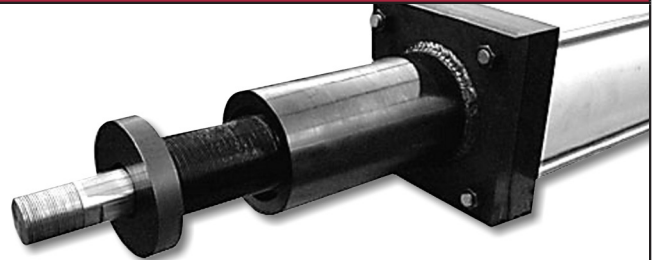
**168" STROKE STAINLESS STEEL**



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



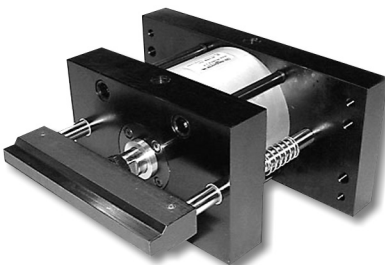
**8.00" BORE - FRONT EXTENSION ADJUSTABLE STROKE**



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



**EXTERNAL NON-ROTATING WITH SPECIAL TOOL PLATE**



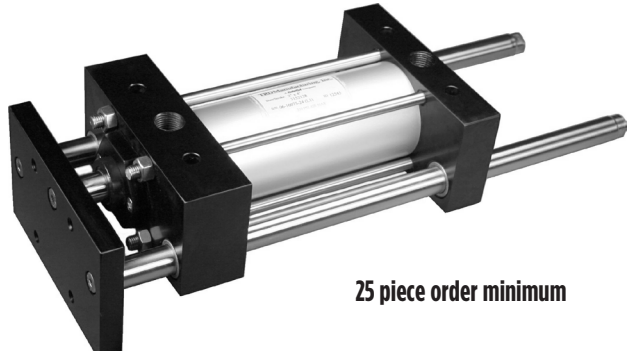
# UNCOMMON OPTIONS AND SPECIALS

UNCOMMON OPTIONS

**TWIN PISTON ROD 6.00" BORE,  
NON-ROTATING**

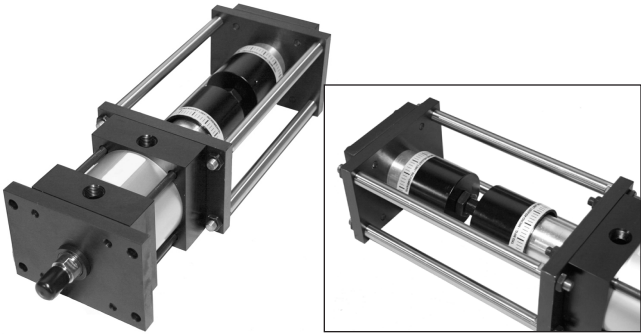


**2.00" BORE WITH EXTERNAL GUIDE RODS AND TOOL PLATE, SS HARDWARE  
FOR WASH-DOWN**

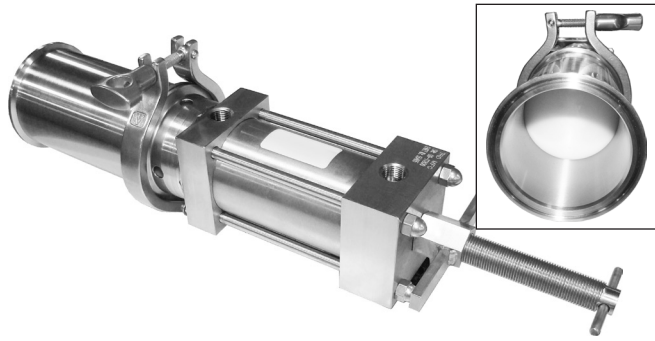


25 piece order minimum

**'MA' MICRO ADJUST ON EXTEND AND RETRACT STROKE FOR PROCESS WEB  
CONTROL**



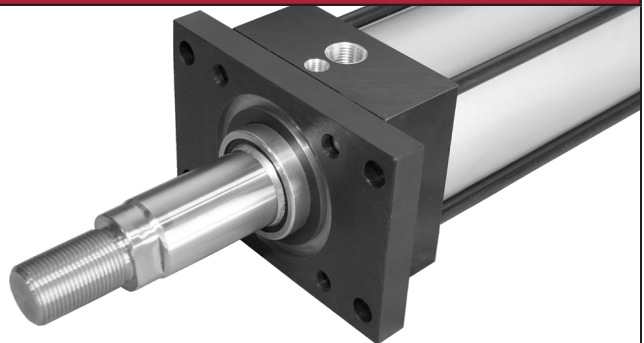
**3A SANITARY SS COUPLING WITH CYLINDER FOR MEASURING AND  
DISPENSING FOOD**



**CLOSE TOLERANCE PISTON ROD MACHINING AFTER CYLINDER IS ASSEMBLED**



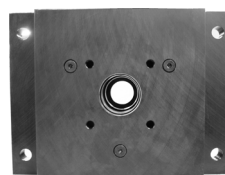
**VACUUM SEAL FACE WITH BUSHING VENT (FOR FURNACE AND SILICON  
WAFER PROCESSES)**



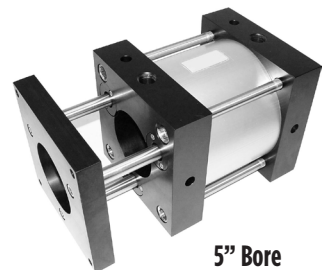
**AIR/OIL BOOSTER PUMP**



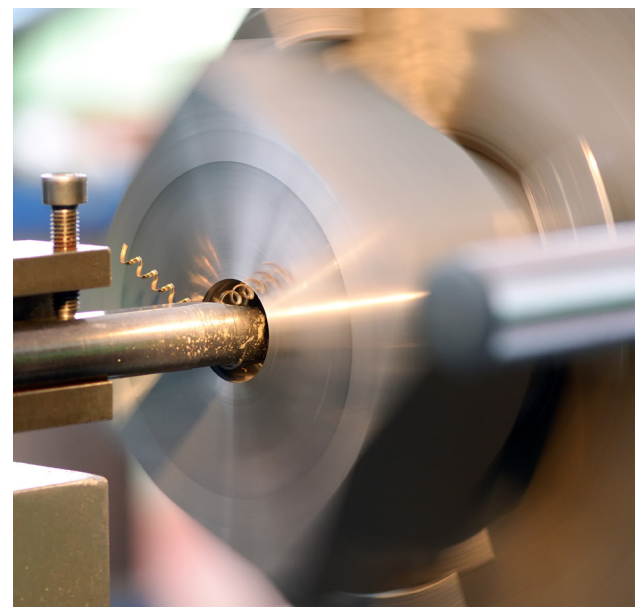
**TRA SERIES WITH THROUGH HOLE**



10" Bore Special

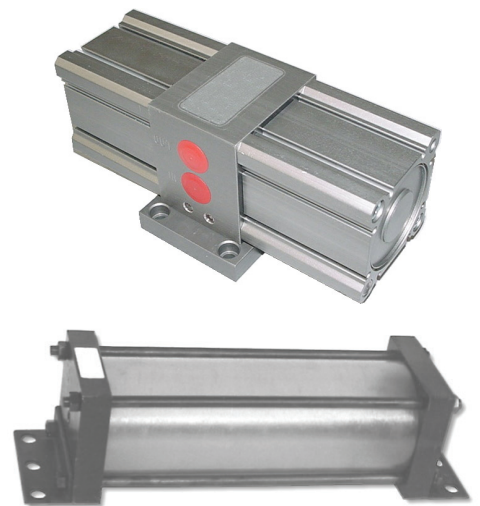
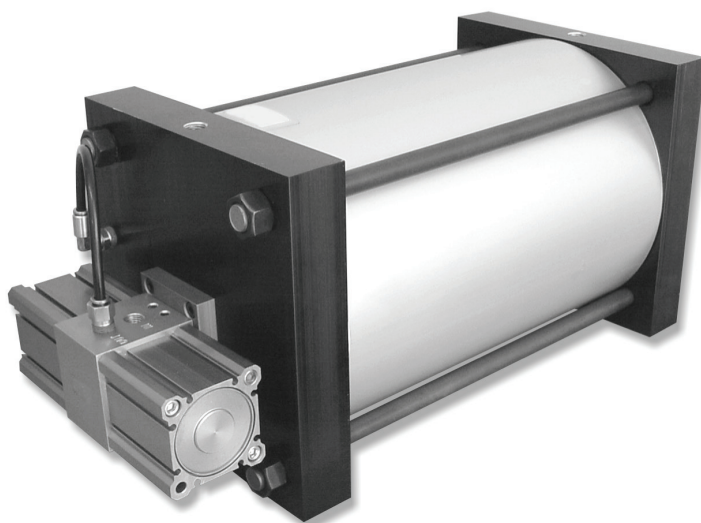


5" Bore

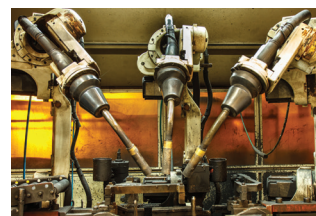
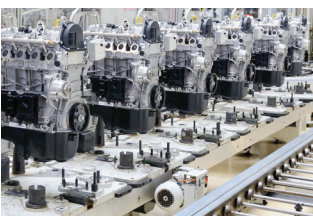


## Series IT AB121 | Intensifiers | Series AT (Air/Oil Tanks) | Air Reservoirs

PNEUMATIC



- Series IT AB121 .....131
- Intensifiers .....134
- Series AT (Air/Oil Tanks) .....136
- Air Reservoirs .....138



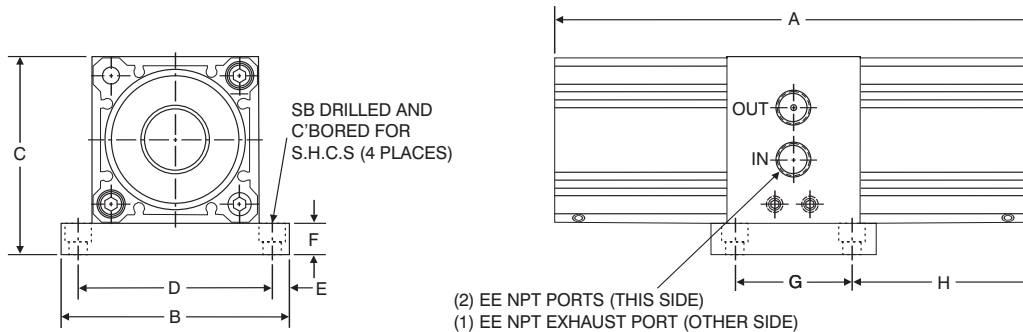
# SERIES: AUTO RECIPROCATING AIR BOOSTER

Model Numberers: AB121 & AB221

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.

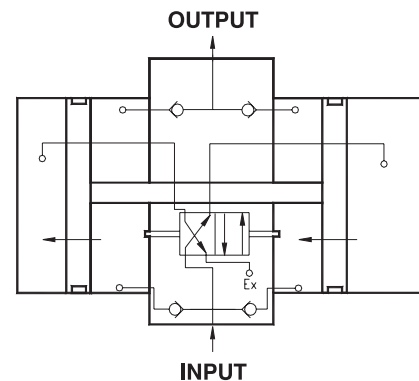


AUTO RECIPROCATING AIR BOOSTER DIMENSIONS										
PART NO.	A	B	C	D	E	F	G	H	EE NPT	SB DIA.
AB121	7.33	3.50	3.04	2.98	0.26	0.48	1.79	2.77	1/4 NPT	1/4
AB221	14.20	7.00	6.00	5.95	0.53	1.00	3.58	5.31	1/2 NPT	1/2

## Engineering Specifications

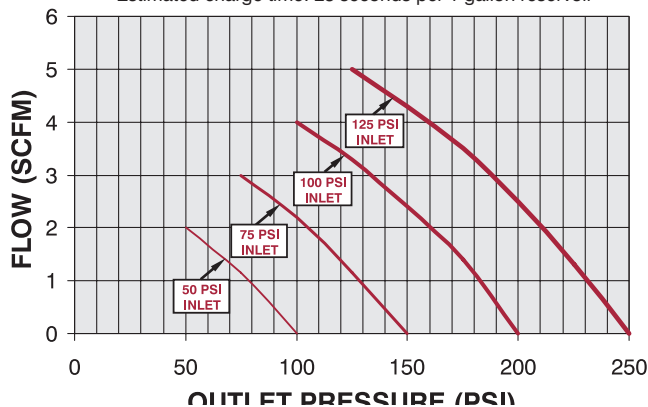
- Maximum Input Pressure:** 125 psi
- Operating Temperature:** 15° to 160° F
- Lubrication:** HT-99 oil; Pre-lubricated
- Bodies and Center Section:** Aluminum; Hard Coat with PTFE
- Mounting Plate:** Anodized Aluminum

**NOTE:** HYDRAULIC CYLINDERS INC.® Air Boosters are designed for intermittent duty usage such as maintaining pressure in an air reservoir. Continuous cycling decreases seal life. Max boosted pressure will be 10% to 20% less than 2x input pressure due to system pressure drops.



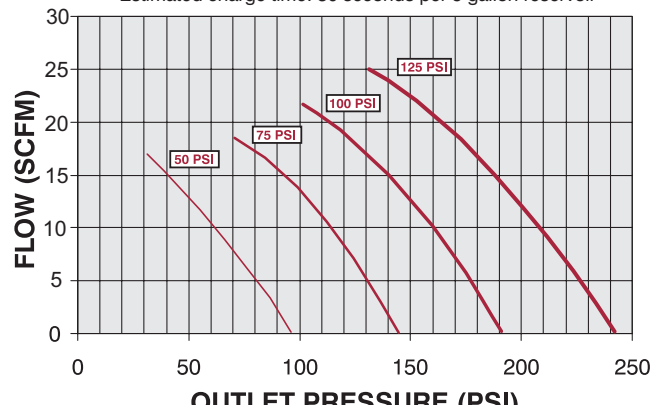
### AB121 FLOW DATA

Estimated charge time: 28 seconds per 1 gallon reservoir



### AB221 FLOW DATA

Estimated charge time: 30 seconds per 5 gallon reservoir

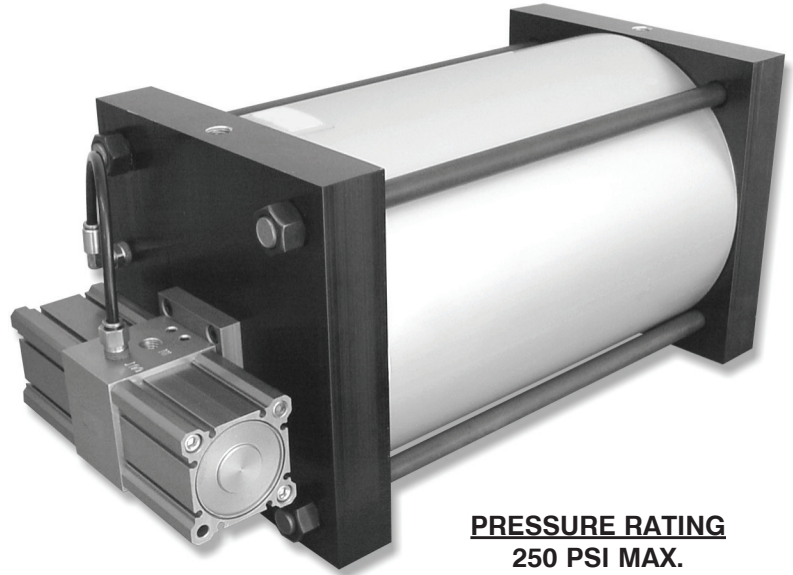
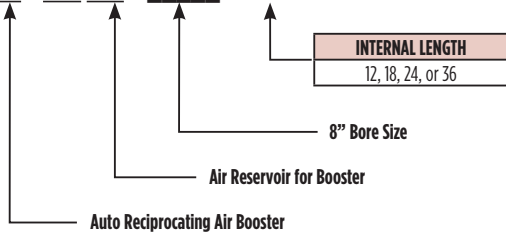


# SERIES: AB121 WITH AIR RESERVOIR

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

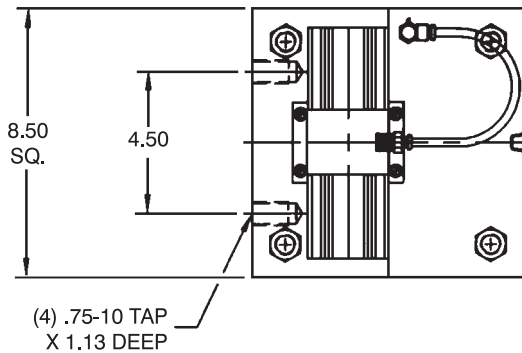
## How to order:

**AB121 - ARB 800 X**

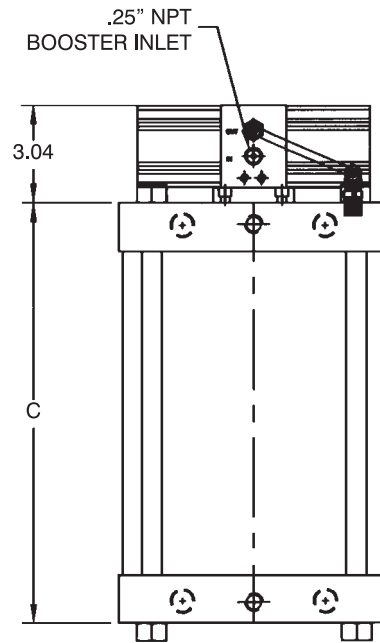
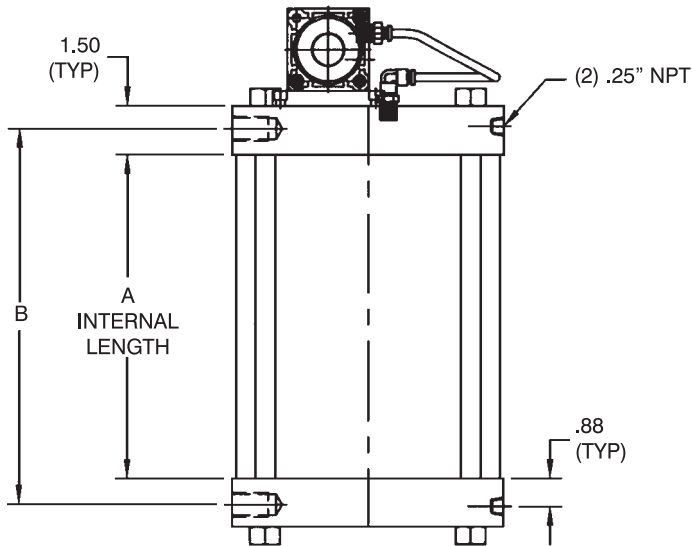


**PRESSURE RATING  
250 PSI MAX.**

AB121 / AIR BOOSTER



(4) .75-10 TAP  
X 1.13 DEEP



## SERIES AB121-ARB800 X \_\_\_\_\_ AIR BOOSTER MODEL AB121 MOUNTED AND PIPED TO ARB800 AIR RESERVOIR

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

\*Internal Volume of reservoir.

# SERIES: AIR 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

**AIR INTENSIFIERS**

**SERIES**

HCA	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.

CODE	DESCRIPTION
X 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 - HYDRAULIC CYLINDERS INC.® MODELS: R10, RAC, AND MCS (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)

Example Part Number: **AI - HCA - MS4 - 5 x 10 - MPR WITH MXO - 2.50 X 10 - TH**

### ABOUT OUR PART NUMBER SYSTEM

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

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

**Part Number:**  
AI - HCA - MS4 - 5 x 10 - MPR with  
HCA - 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 HYDRAULIC CYLINDERS INC.® STANDARD COMBINATIONS

CYL. #1 BORE	CYL. #1 AREA	CYL. #2 BORE	CYL. #2 AREA	INTENSIFIER RATIO	OUTPUT (PSI) OF CYL. #2 @ INPUT PRESSURE OF:		
					50	80	100
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	2.57	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
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 =  $\frac{\text{CYL. \#1 AREA}}{\text{CYL. \#2 AREA}}$

Output pressure = INPUT PRESSURE X INTENSIFIER RATIO

#### AIR TO HYDRAULIC INTENSIFIERS HYDRAULIC CYLINDERS INC.® STANDARD COMBINATIONS

CYL. #1 BORE	CYL. #1 AREA	CYL. #2 BORE	CYL. #2 AREA	INTENSIFIER RATIO	OUTPUT (PSI) OF CYL. #2 @ INPUT PRESSURE OF:			
					50	80	100	120
3.25	8.296	1.50	1.767	4.69	235	375		
		2.00	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	
5.00	19.635	2.50	4.909	2.56	128	205	256	307
		3.25	8.296	6.25	313			
6.00	28.274	2.50	4.909	4	200	320	400	
		3.25	8.296	3.41	171	190	237	284
8.00	50.265	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
10.00	78.54	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
12.00	113.10	6.00	28.274	1.78	89	143	178	214
		5.00	19.635	6.25	313			
		6.00	28.274	2.78	139	223	278	334
12.00	113.10	5.00	19.635	5.76	288			
		8.00	50.265	2.25	113	180	225	270

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

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

Output pressure = INPUT PRESSURE X INTENSIFIER RATIO

# SERIES: AIR TO AIR INTENSIFIER AIR TO HYDRAULIC INTENSIFIERS

## BASIC DIMENSIONS:

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

### AIR TO AIR INTENSIFIERS BASIC DIMENSIONS

BORE	LB	BORE	LB	BORE	LB
1.50	3.625	4.00	4.250	10.00	6.375
2.00	3.625	5.00	4.500	12.00	6.875
2.50	3.750	6.00	5.000		
3.25	4.250	8.00	5.125		

### CYLINDER VOLUMES (PER INCH OF CYLINDER STROKE)

BORE	AREA	GAL. PER IN. OF STROKE	BORE	AREA	GAL. PER IN. OF STROKE	BORE	AREA	GAL. PER IN. OF STROKE
1.50	1.767	.0076	4.00	12.566	.0054	10.00	78.54	.340
2.00	3.142	.0136	5.00	19.635	.085	12.00	113.10	.4896
2.50	4.909	.0213	6.00	28.274	.122			
3.25	8.296	.0359	8.00	50.265	.2175			

**Notes:** (To Figure Volumes)  
Cubic Inches = AREA X STROKE  
Gallons = (AREA X STROKE) / 231

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

### AIR TO HYDRAULIC INTENSIFIERS BASIC DIMENSIONS

BORE	LB	BORE	LB	BORE	LB
1.50	3.625	4.00	4.250	10.00	6.375
2.00	3.625	5.00	4.500	12.00	6.875
2.50	3.750	6.00	5.000		
3.25	4.250	8.00	5.125		

### CYLINDER VOLUMES (PER INCH OF CYLINDER STROKE)

BORE	AREA	GAL. PER IN. OF STROKE	BORE	AREA	GAL. PER IN. OF STROKE	BORE	AREA	GAL. PER IN. OF STROKE
1.50	1.767	.0076	4.00	12.566	.0054	10.00	78.54	.340
2.00	3.142	.0136	5.00	19.635	.085	12.00	113.10	.4896
2.50	4.909	.0213	6.00	28.274	.122			
3.25	8.296	.0359	8.00	50.265	.2175			

**Notes:** (To Figure Volumes)  
Cubic Inches = AREA X STROKE  
Gallons = (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 AIR INTENSIFIERS

## 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



(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.

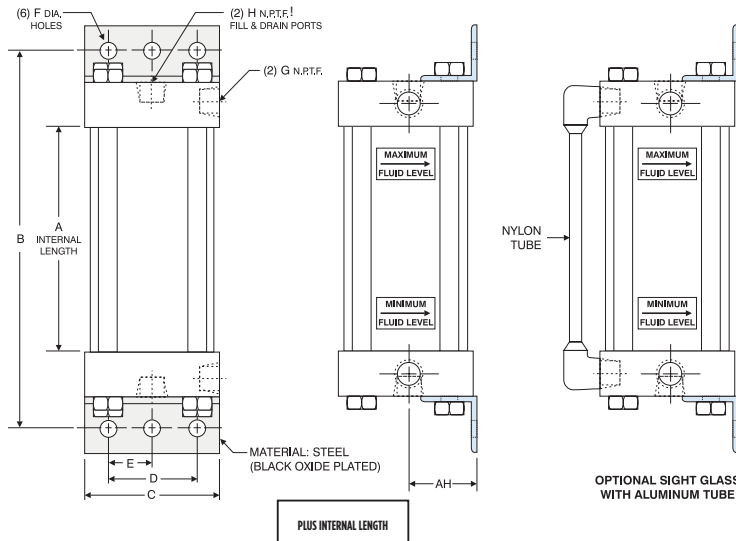
### 3. HOW TO ORDER:

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).

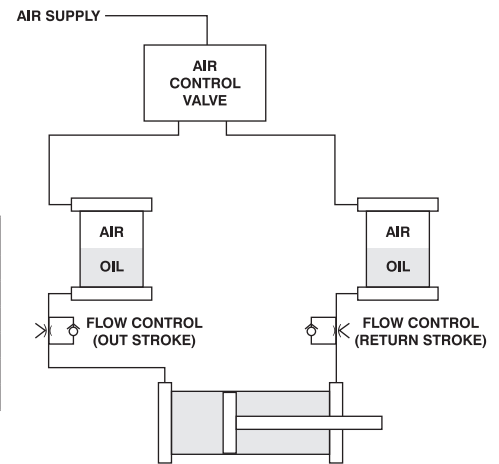
Example 2: Same as above, with optional sight glass and aluminum tube — AT250 x 14 - ALUMINUM TUBE AND SIGHT GLASS



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.

## TYPICAL AIR-OIL CIRCUIT



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

BORE	AREA	ACTUAL INTERNAL LENGTH OF TANK																
		5	6	7	8	9	10	12	14	16	18	20	25	30	35	40	45	
2.50	4.91	17	20	24	27	31	34	41	48	55	61	68	86	103	120	137	154	
3.25	8.30	29	34	40	46	52	58	69	81	93	104	116	145	174	203	232	261	
4.00	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 'HCS-AT': AIR/OIL TANKS

## Series 'HCS-AT' features:

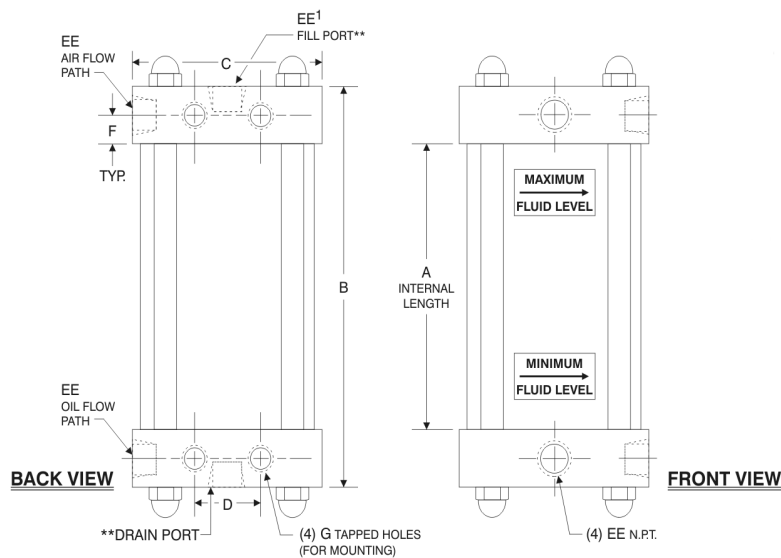
- 303/304 Stainless Steel Hardware
- 200 PSI Operating Pressure
- Internal Steel baffles to reduce aeration and foaming
- Fiber wound translucent tube (non-FDA material)
- Optional stainless steel tube, fittings and sight glass (FDA approved materials)
- Standard mount (MS4; four-tapped mounting holes 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 HYDRAULIC CYLINDERS INC.® 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.

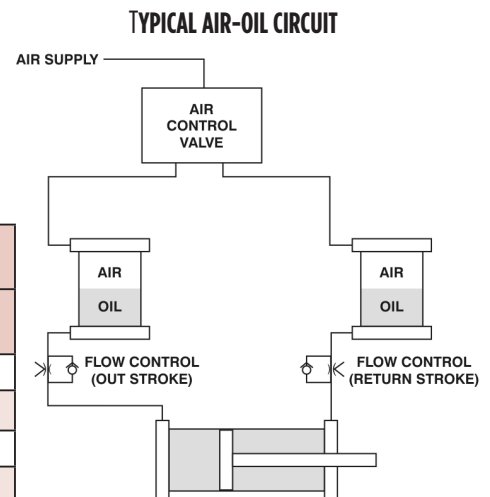
## Sizing your air/oil Tank:

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: HCS-AT250 x 14 (2.50" Bore, 14" internal Tank length, with a usable volume of 52 cubic inches).



HCS-AT MODEL			PLUS INTERNAL LENGTH		TANK DIMENSIONS						
PART NO.	BORE	*GALS PER INCH TANK	A	B	C	D	F	G	EE	EE <sup>1</sup>	
HCS-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	
HCS-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	
HCS-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	
HCS-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	
HCS-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.



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

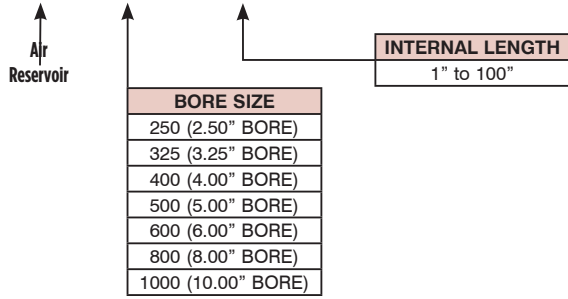
BORE	AREA	ACTUAL INTERNAL LENGTH OF TANK															
		5	6	7	8	9	10	12	14	16	18	20	25	30	35	40	45
2.50	4.91	17	20	24	27	31	34	41	48	55	61	68	86	103	120	137	154
3.25	8.30	29	34	40	46	52	58	69	81	93	104	116	145	174	203	232	261
4.00	12.57	44	52	61	70	79	88	105	123	140	158	176	220	264	308	352	396
5.00	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

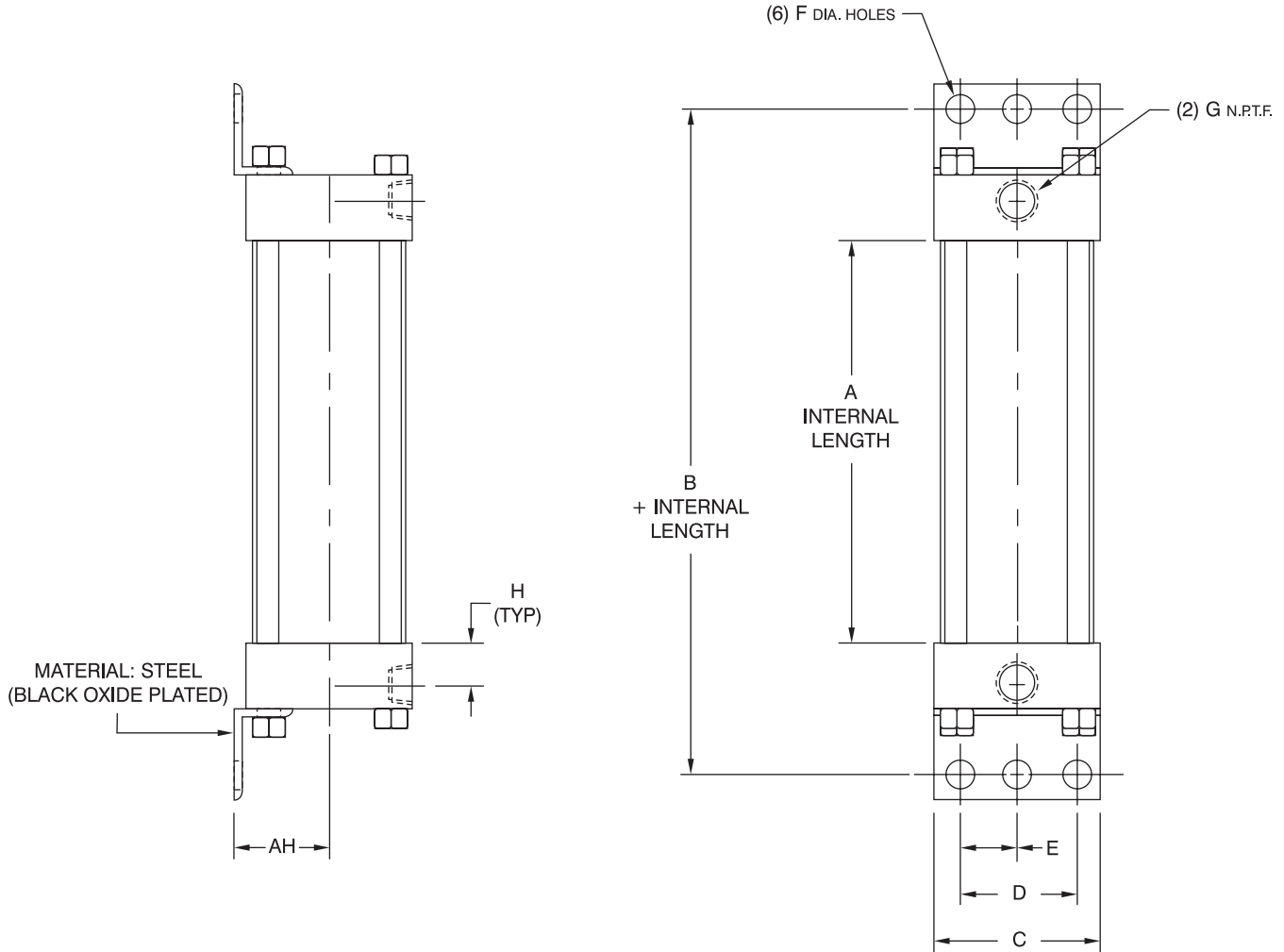
Stand-alone Air Reservoir from 2.50" to 10.00" bore size. Anodized Aluminum Tube and End Cap, Steel Mounting Bracket construction.

## How to order:

AR - \_\_\_\_ X \_\_\_\_



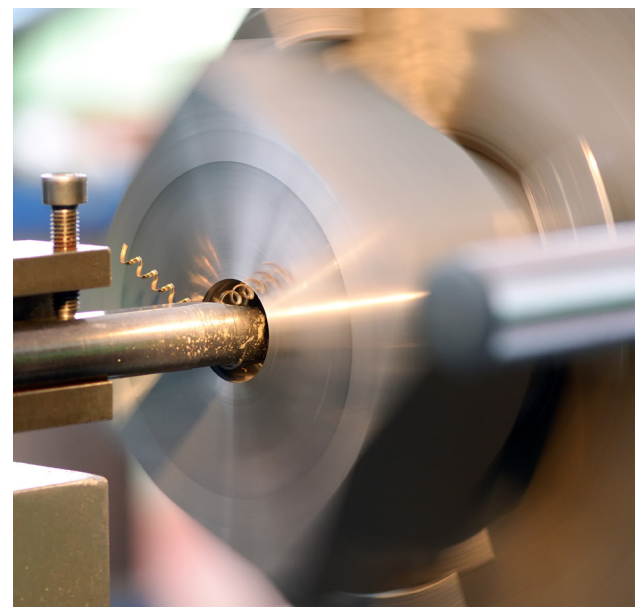
**PRESSURE RATING**  
250 PSI MAX.



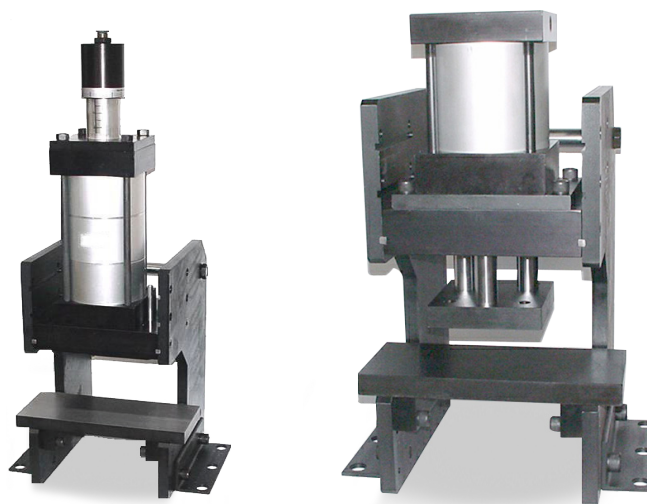
## AR SERIES (AIR RESERVOIR)

PART NUMBER & VOLUME				DIMENSIONS								
PART NUMBER	BORE	AREA	GAL. PER IN. OF RESERVOIR*	+ INTERNAL LENGTH		AH	C	D	E	F	G	H
				A	B							
AR-250	2.50	4.909	.0213	0	4.000	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

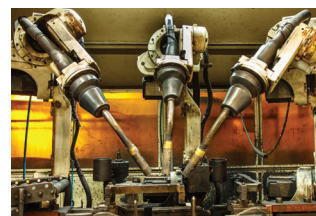
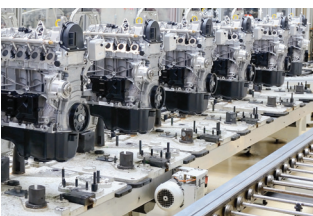
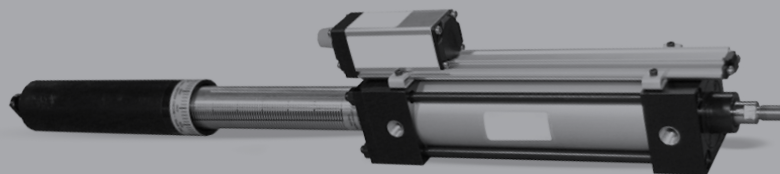
\*Internal volume of reservoir.



## BTP Series | Bench Top Press & Cylinders



• Bench Top Press .....	140
• Press Cylinders .....	143



PNEUMATIC

# HEAVY DUTY BENCH TOP PRESS



## MODEL: BTP-501

FOR SINGLE PISTON ROD,  
5.00" BORE, MFI 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

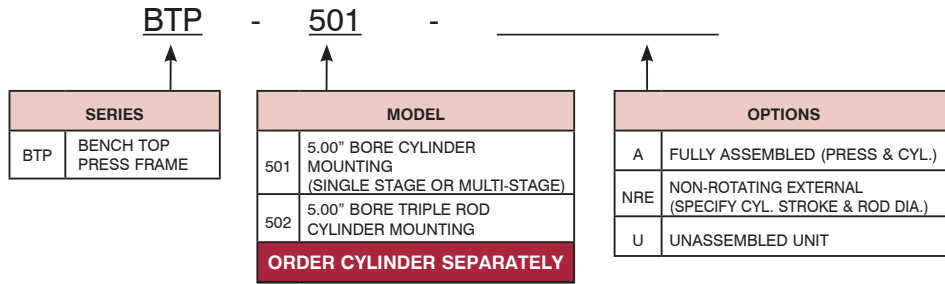
FOR 'TRA' TRIPLE PISTON  
ROD, 5.00" BORE, MFI MOUNT  
CYLINDERS

Heavy Duty Bench Top Press shown with 5.00" Bore Single-Stage Triple Rod Cylinder and Tooling Plate

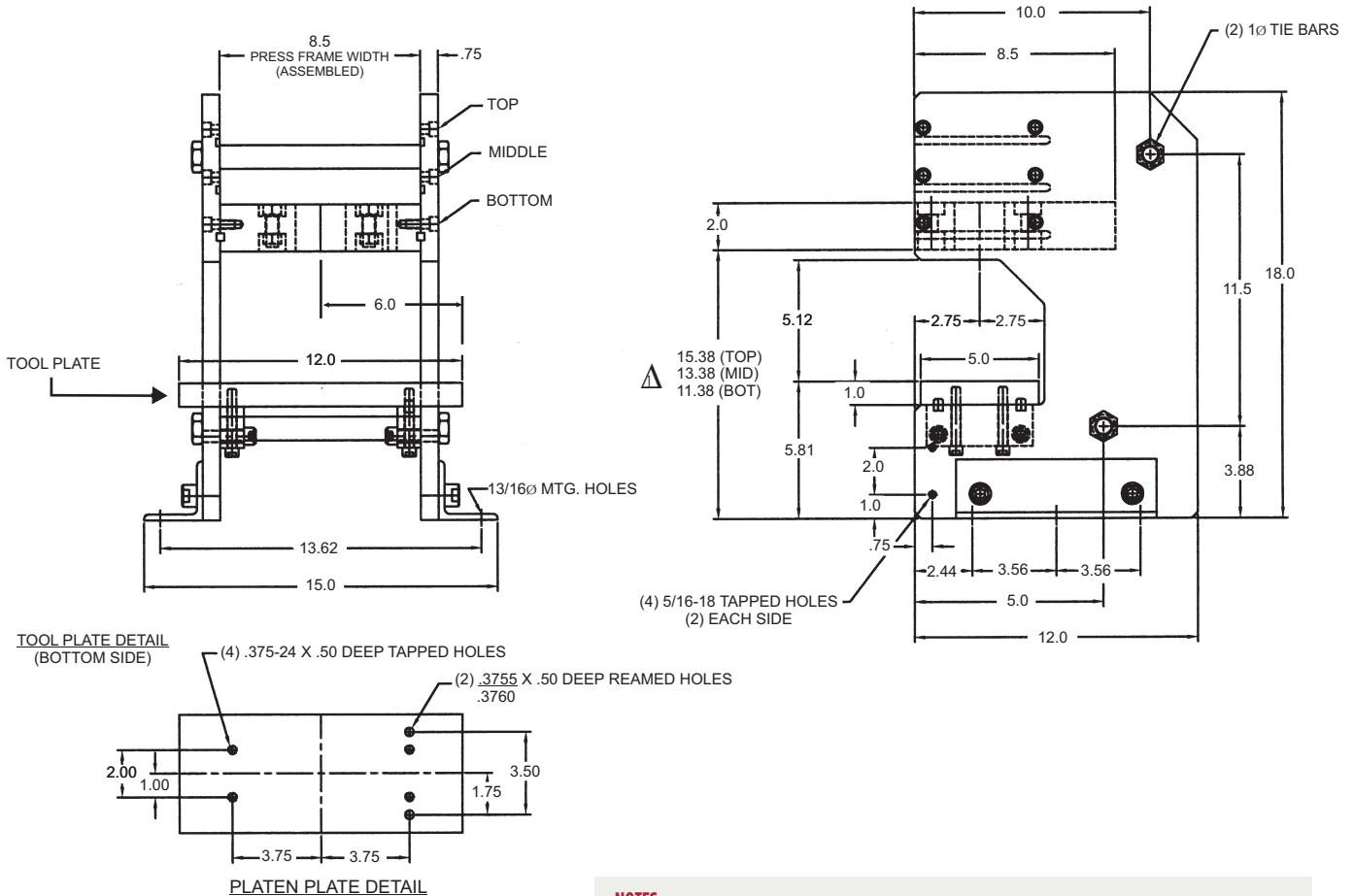
## HEAVY DUTY BENCH TOP PRESS FEATURES

- 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



## 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)

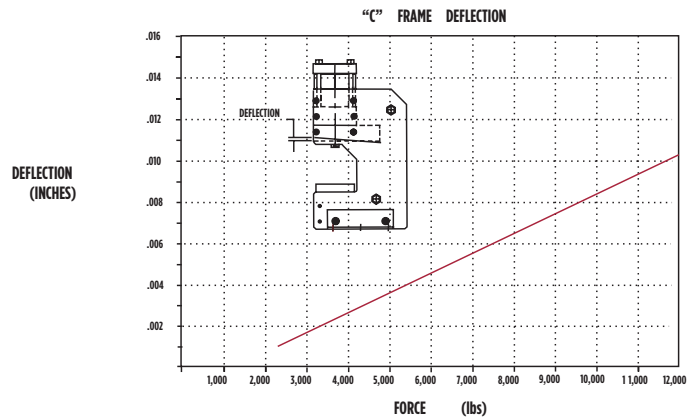
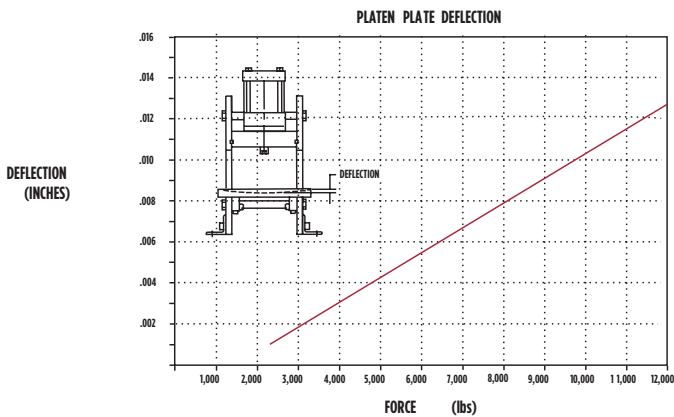
# BENCH TOP PRESS: TECHNICAL DATA

## 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-HCA	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 multiplies 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

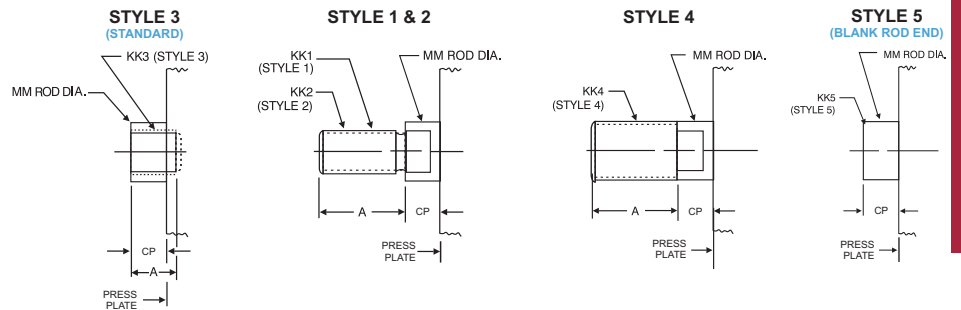
Other NFPA Styles can be specified (see chart).

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**

MX3

**BORE**

5

**STROKE**

0" to 6" MADE-TO-ORDER

1

**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)

**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)

**PORT & CUSHION POSITIONS**

**FRONT OF PRESS**

STANDARD PORT POSITIONS @ 3 AND 7 (BACK OF PRESS)

STANDARD CUSHION POSITIONS @ 1 AND 5 (FRONT OF PRESS)

SPECIFY NON-STANDARD LOCATIONS WHEN ORDERING

**ROD STYLE END & MODIFICATIONS**

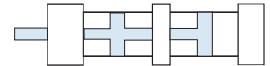
KK3	FEMALE ROD THREAD (LEAVE BLANK)
KK3S	STUDDED PISTON ROD (WITH KK3)
KK1	SMALL MALE ROD THREAD
KK2	LARGE MALE ROD THREAD
KK4	FULL DIAMETER MALE ROD THREAD
KK5	BLANK ROD END
"A"	EXTENDED PISTON ROD THREAD (SPECIFY)
"C"	EXTENDED PISTON ROD (SPECIFY)

**MICRO-ADJUST**

MA	MICRO-ADJUST
MAB	WITH NOISE DAMPENING BUMPER INSTALLED

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

# 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	STAGES								
		0.5" to 6" MADE-TO-ORDER *0.125 FOR MSEP	<table border="1"> <tr><td>2S</td><td>TWO</td></tr> <tr><td>3S</td><td>THREE</td></tr> <tr><td>4S</td><td>FOUR</td></tr> <tr><td>5S</td><td>FIVE</td></tr> </table>	2S	TWO	3S	THREE	4S	FOUR	5S	FIVE
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

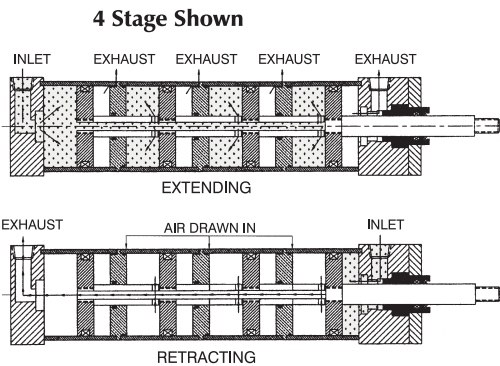
## HOW THEY WORK

### Model MSEP

Extension-air supplied to multiple pistons

Retraction-air supplied to one piston

NOTE: Cap cushion not available on MSEP



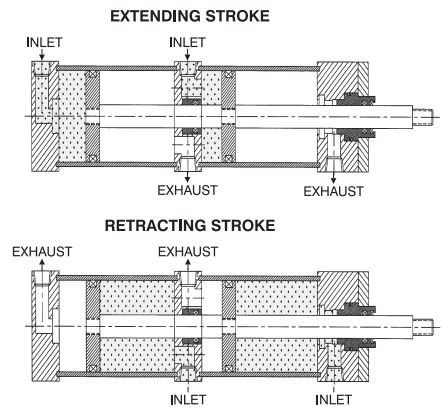
### Model MSEP/MSRP

Extension AND Retraction-air supplied to multiple pistons

HEAD AND CAP CUSHION AVAILABLE

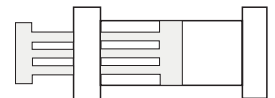
To Order, specify: "MSEP/MSRP" (as model number)

Note: Overall lengths are increased



### 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)

BORE	STROKE	STAGES								
	0" to 6" MADE-TO-ORDER	<table border="1"> <tr><td>2S</td><td>TWO</td></tr> <tr><td>3S</td><td>THREE</td></tr> <tr><td>4S</td><td>FOUR</td></tr> <tr><td>5S</td><td>FIVE</td></tr> </table>	2S	TWO	3S	THREE	4S	FOUR	5S	FIVE
2S	TWO									
3S	THREE									
4S	FOUR									
5S	FIVE									

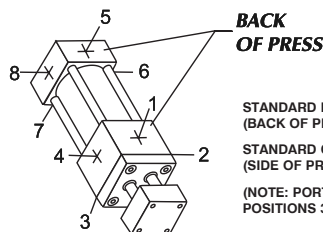
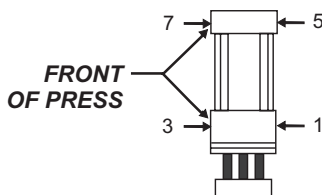
CUSHIONS
NON-CUSHION (LEAVE BLANK)
H = HEAD CUSHION POSITION 2 STANDARD SPECIFY FOR POSITIONS 1 OR 4 (Example = H2)
C = CAP CUSHION (TRP ONLY) POSITION 6 STANDARD SPECIFY FOR POSITIONS 5 OR 8 (Example = C6)

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

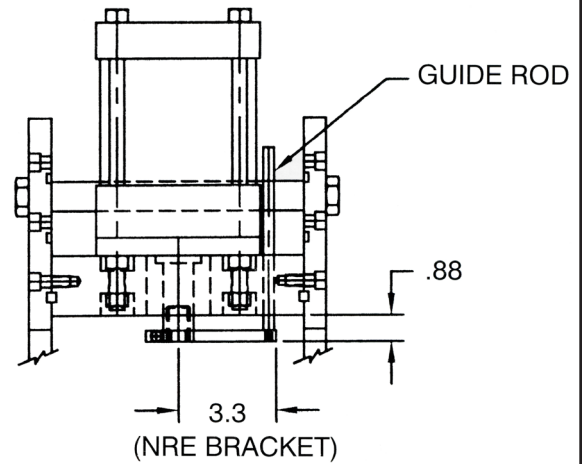
## NRE External Non-Rotating

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.

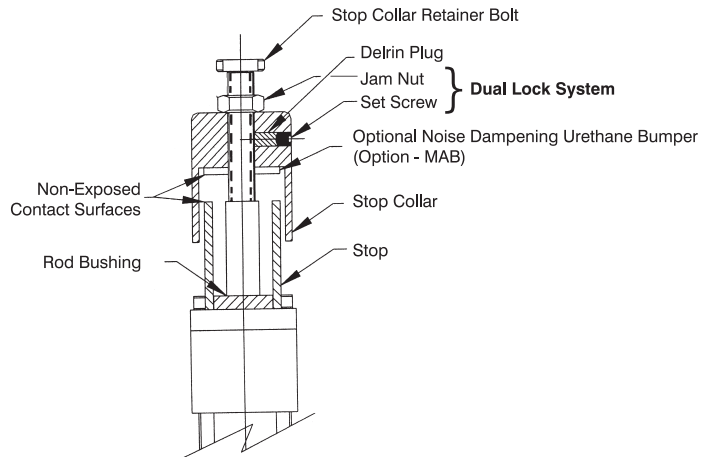
For high torsional load applications, cylinder can be equipped with a twin guide rod internally (“NR” cylinder option).

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 12" stroke and adjustment over full range of stroke

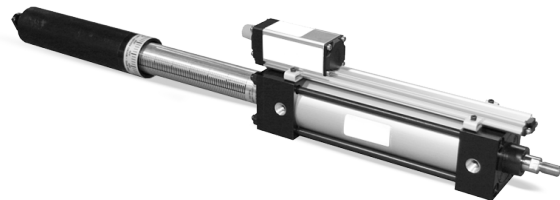


## BALLUFF TRANSDUCER

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.

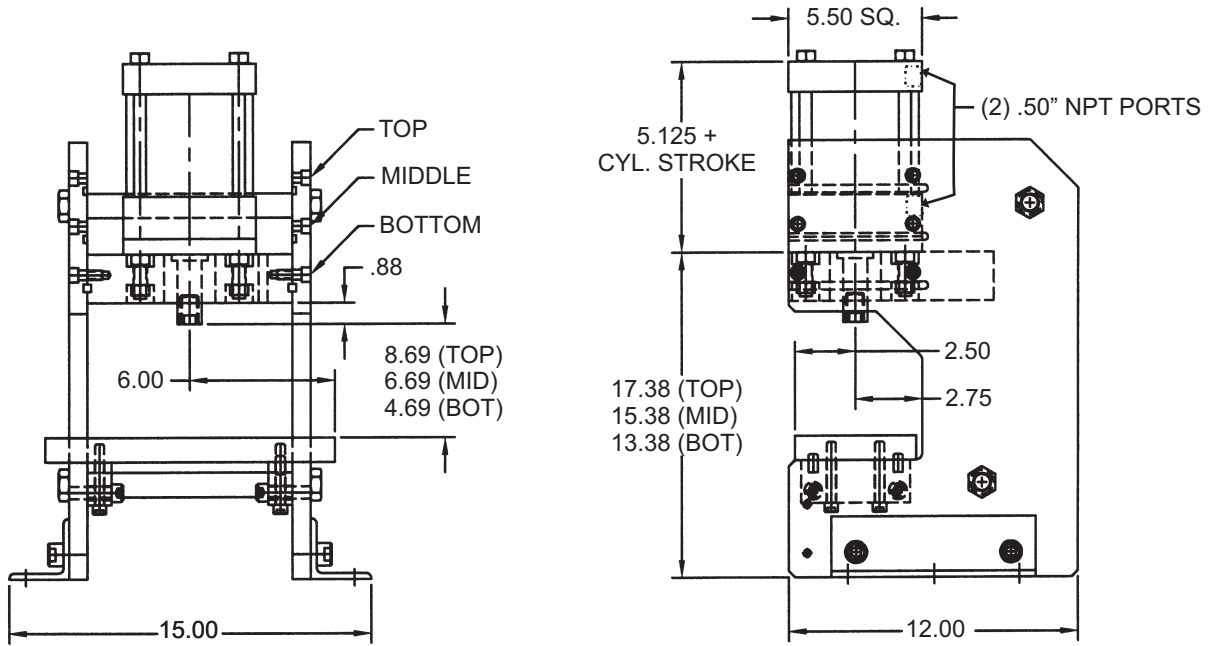
### Ideal Applications:

- Pressing bearings into housings and depth control is critical.
- Parts assembly
- Parts positioning for joining operations (i.e. riveting)

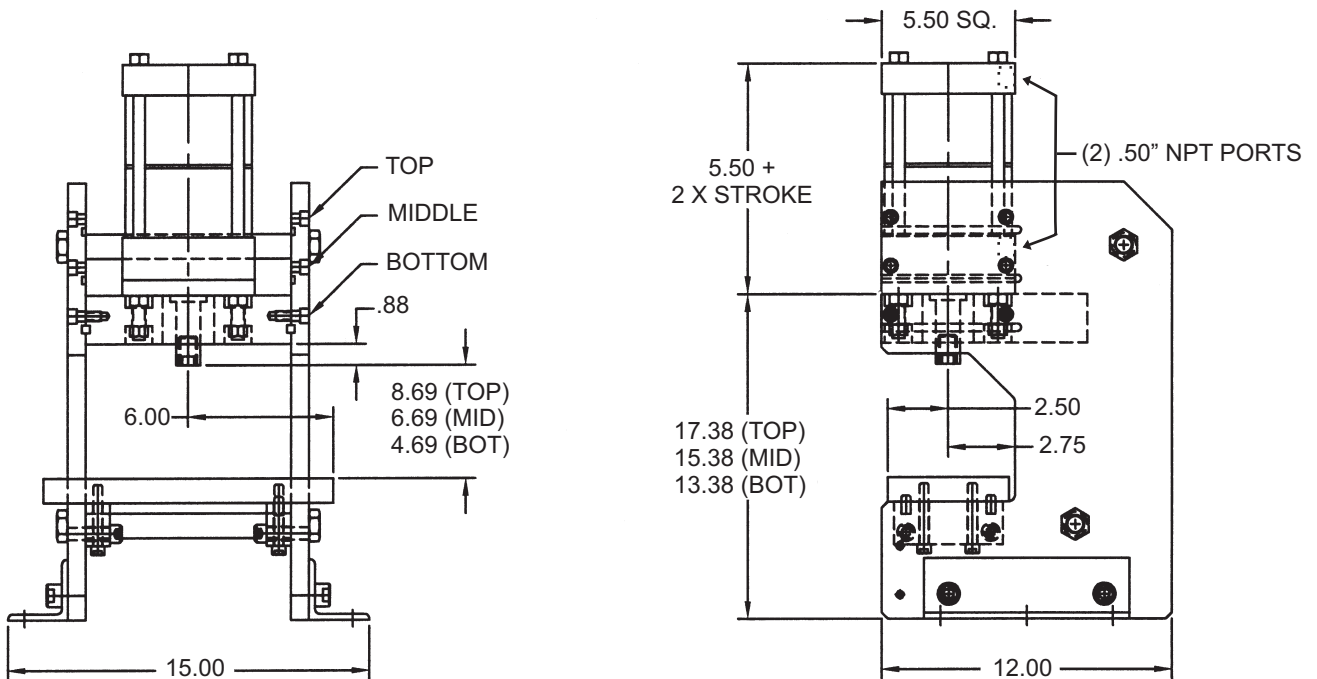


# PRESS FRAME CYLINDER: DIMENSIONS

## TAP (SINGLE STAGE): DIMENSIONS

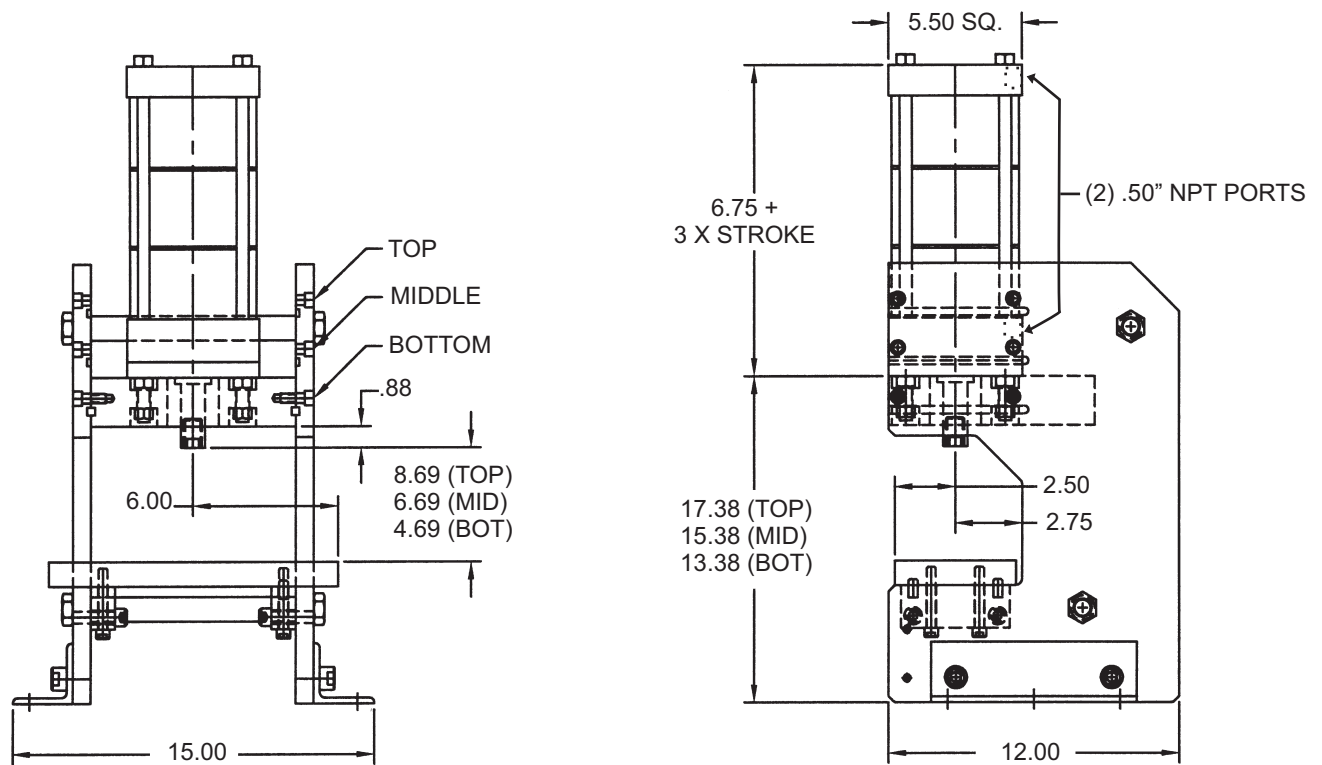


## MSEP 2S (2 STAGE): DIMENSIONS

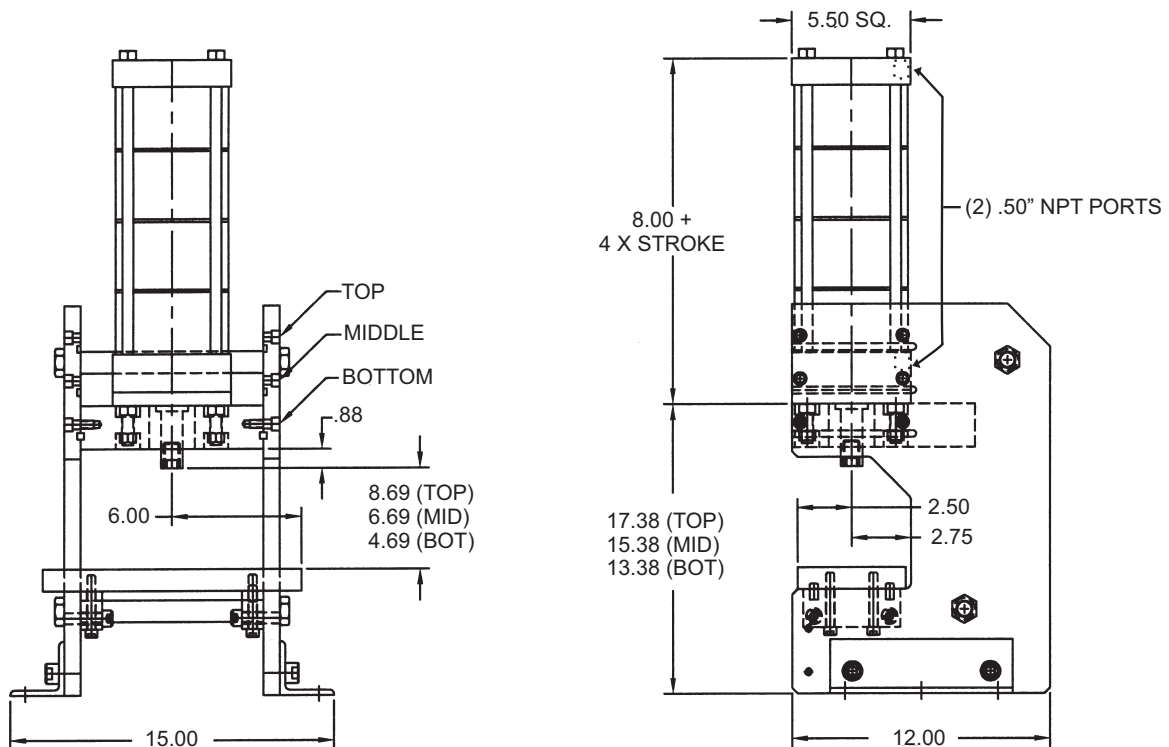


# PRESS FRAME CYLINDER: DIMENSIONS

## MSEP 3S (3 STAGE): DIMENSIONS

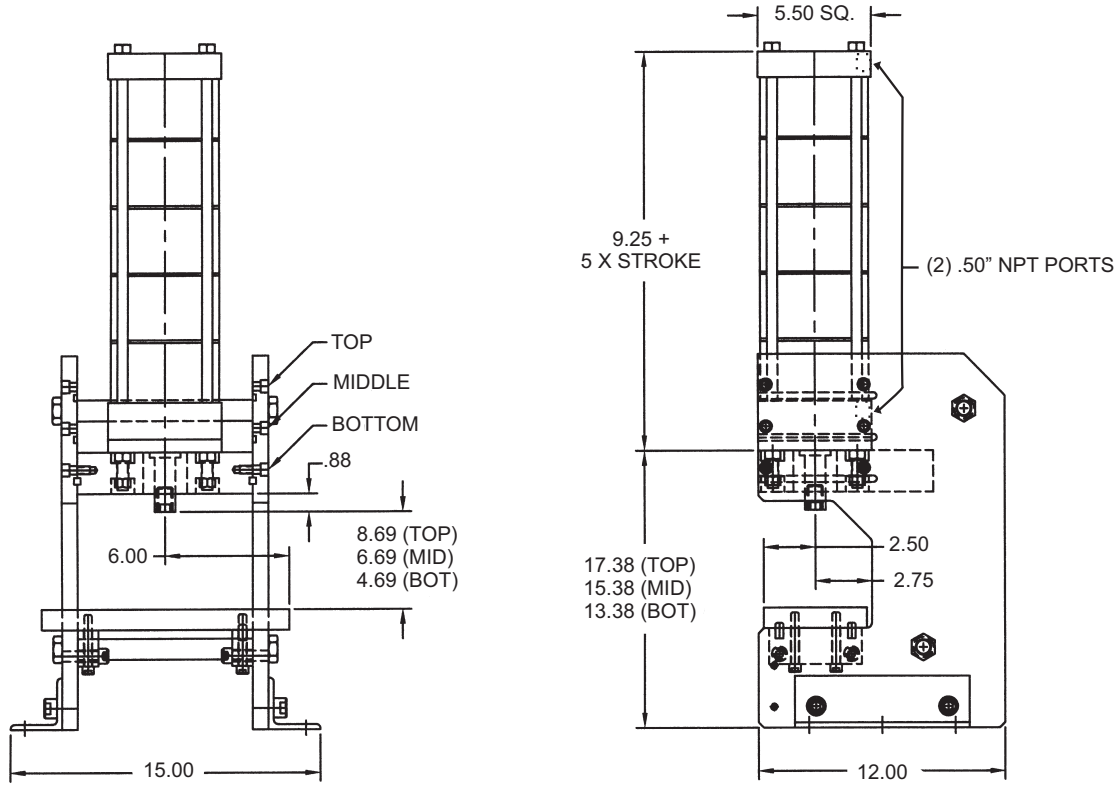


## MSEP 4S (4 STAGE): DIMENSIONS

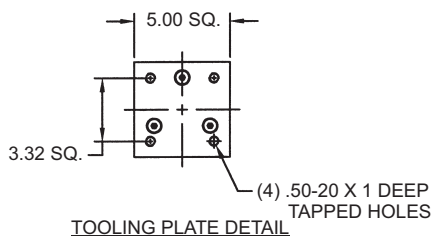
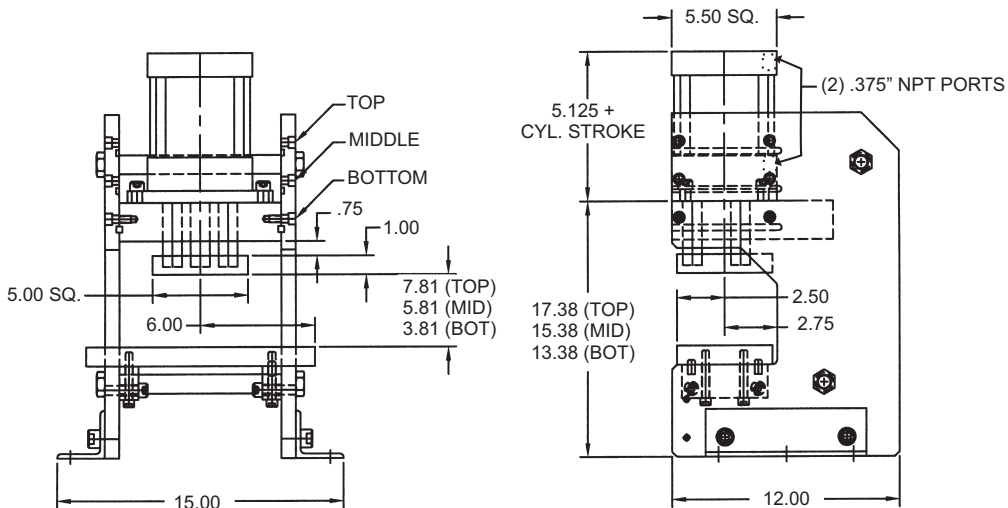


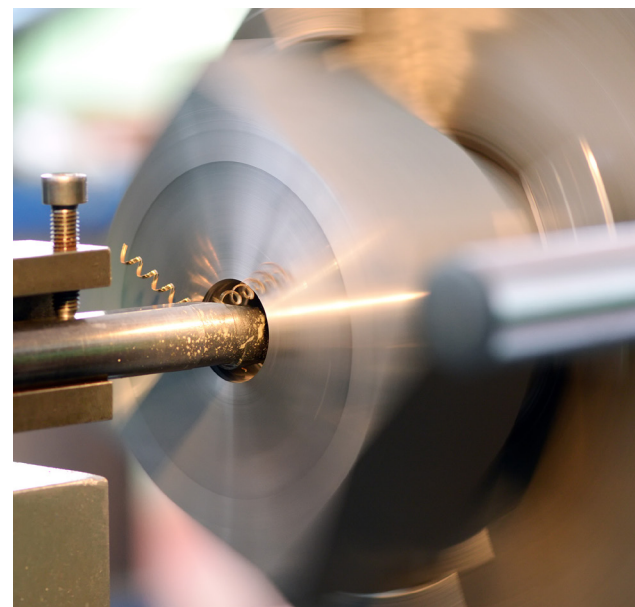
# PRESS FRAME CYLINDER: DIMENSIONS

## MSEP 5S (5 STAGE): DIMENSIONS



## TRP (TRIPLE ROD): DIMENSIONS



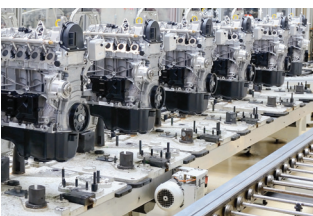


Clevis Pins & Mounts | Spherical Rod Eye | Trunnion Blocks  
Alignment Couplers | Flow Controls

P N E U M A T I C



- Clevis Pins & Mounts ..... 150
- Spherical Rod Eye ..... 154
- Trunnion Blocks ..... 155
- Alignment Couplers ..... 158
- Flow Control ..... 160



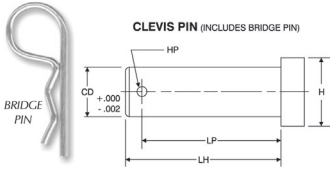
# ACCESSORIES: CLEVIS, PINS & MOUNTS

## Accessories Cross Reference Chart

ACCESSORIES / CLEVIS, PINS & MOUNTS

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
	2.000	#2	KK2	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
		#1 (STANDARD)	KK1	1 1/2 -12	RC1500	RE1500	CP1750	CB1750	EB1750

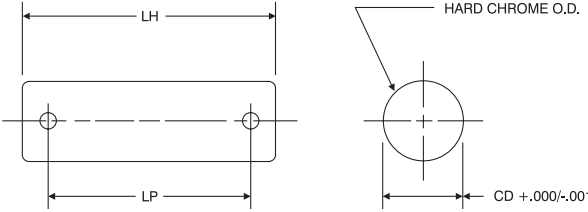
CLEVIS PIN (WITH BRIDGE PIN - STANDARD)					
PART NUMBER	CD	H	HP	LH	LP
CP500	0.500	0.625	0.156	2.250	2.094
CP750	0.750	0.938	0.156	3.000	2.844
CP1000	1.000	1.188	0.203	3.500	3.313



**CLEVIS PIN (INCLUDES BRIDGE PIN)**

MATERIAL: 1018 CRS  
FINISH: BLACK OXIDE

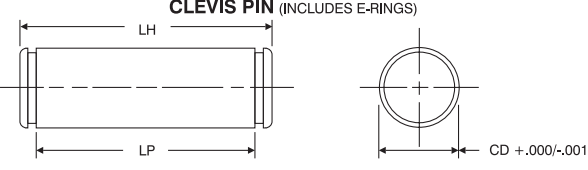
CLEVIS PIN (WITH COTTER PINS)			
PART NUMBER	CD	LH	LP
CP500C	0.500	2.250	1.938
CP750C	0.750	3.000	2.719
CP1000C	1.000	3.500	3.219
CP1375C	1.375	5.000	4.250
CP1750C	1.750	6.000	5.500
CP2000C	2.000	6.000	5.500



**CLEVIS PIN (INCLUDES COTTER PINS)**

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

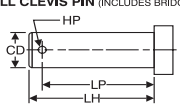


**CLEVIS PIN (INCLUDES E-RINGS)**

MATERIAL: 1045 CRS  
FINISH: NITROTECH PLATED\*

\*HARD CHROME PLATED O.D. AVAILABLE

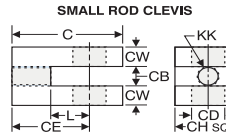
SMALL CLEVIS PIN (WITH BRIDGE PIN)				
PART NUMBER	CD	HP	LH	LP
CP500CCS	0.500	0.156	1.375	1.250
CP750CCS	0.750	0.156	2.000	1.875



**SMALL CLEVIS PIN (INCLUDES BRIDGE PIN)**

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



**SMALL ROD CLEVIS**

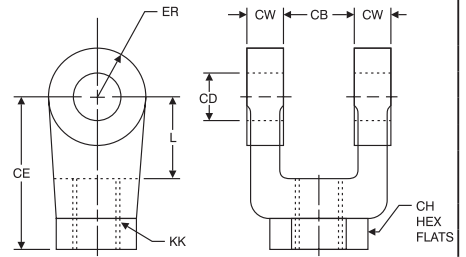
MATERIAL: 1018 CRS  
FINISH: BLACK OXIDE

# ACCESSORIES: CLEVIS, PINS & MOUNTS

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 CLEVIS

MATERIAL: CAST STEEL  
FINISH: BLACK OXIDE



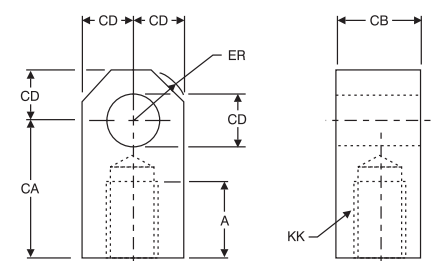
(Clevis Pins sold separately from Rod Clevises)

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 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
RE875	8400	1.125	2.063	1.250	0.750	0.875	7/8-14
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

## ROD EYE

MATERIAL: 1018 CRS  
FINISH: BLACK OXIDE



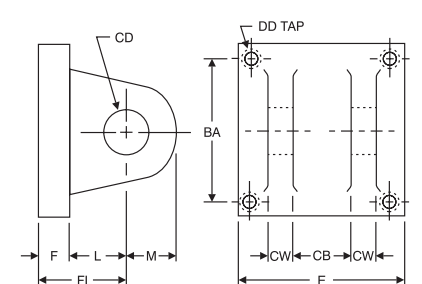
(Clevis Pins sold separately from Rod Eyes)

Note: When using a Rod Eye in combination with a Clevis Bracket, the operating angle is +/-90° from the bracket center line.

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

## CLEVIS BRACKET

MATERIAL: CAST STEEL  
FINISH: BLACK OXIDE

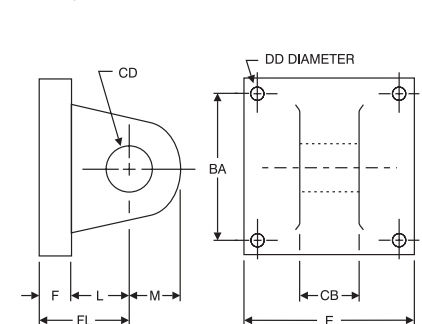


(Clevis Pins sold separately from Clevis Brackets)

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

## EYE BRACKET

MATERIAL: CAST STEEL  
FINISH: BLACK OXIDE



(Clevis Pins sold separately from Eye Brackets)

# ACCESSORIES: STAINLESS STEEL CLEVIS, PINS & MOUNTS

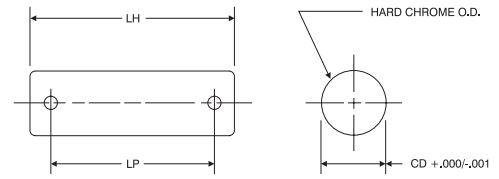
## Stainless Steel Accessories Cross Reference Chart

BORE	ROD SIZE	CYLINDER MODEL			ACCESSORIES				
		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 (STD-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 (STD-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 (STD-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

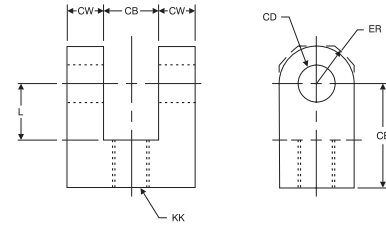
CLEVIS PIN (INCLUDES COTTER PINS)



(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	0.750	0.500	1.500	0.500	0.500	1/2 -20	0.750
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

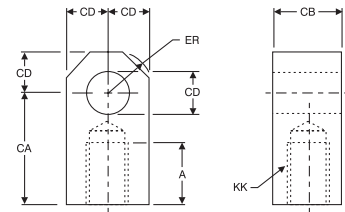
ROD CLEVIS



(Clevis Pins sold separately from Rod Clevis)

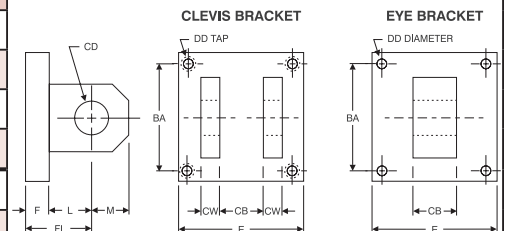
ROD EYE						
PART NUMBER	A	CA	CB	CD	ER	KK
SS-RE437	0.750	1.500	0.750	0.500	0.625	7/16 -20
SS-RE500	0.750	1.500	0.750	0.500	0.625	1/2 -20
SS-RE750	1.125	2.063	1.250	0.750	0.875	3/4 -16
SS-RE1000	1.625	2.813	1.500	1.000	1.188	1-14
SS-RE1250	2.000	3.438	2.000	1.375	1.563	1 1/4 -12
SS-RE1500	2.250	4.000	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	3/8 -24	2.500	0.375	1.125	0.750	0.625	
	SS-CB750	2.563	1.250	0.750	1/2 -20	3.500	0.625	1.875	1.250	0.750	
	SS-CB1000	3.250	1.500	1.000	5/8 -18	4.500	0.750	2.250	1.500	1.000	
	SS-CB1375	3.813	2.000	1.375	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



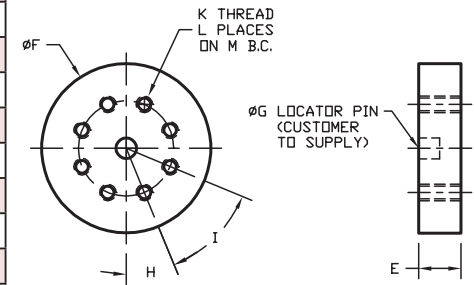
(Clevis Pins sold separately from Clevis & Eye Brackets)



# ACCESSORIES: CLEVIS, PINS & MOUNTS

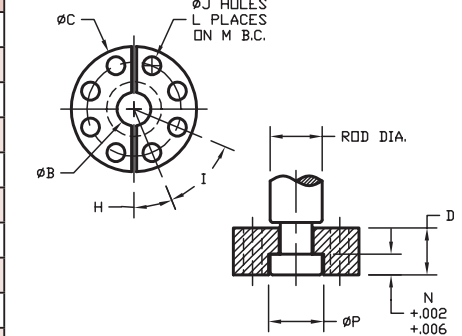
WELD PLATE DIMENSIONS									
PART NUMBER	ROD DIA.	E	F	G (DIA.)	H	I	K	L	M
WP625	0.625	0.500	2.000	0.250	45.0°	90.0°	10-20	4	1.125
WP1000	1.000	0.500	2.500	0.250	30.0°	60.0°	1/4-20	6	1.500
WP1375	1.375	0.625	3.000	0.250	30.0°	60.0°	5/16-18	6	2.000
WP1750	1.750	0.625	4.000	0.250	22.5°	45.0°	5/16-18	8	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



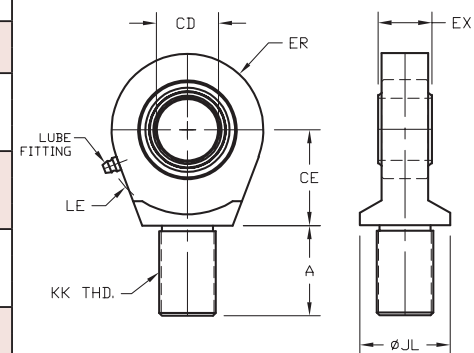
FLANGE END COUPLER DIMENSIONS											
PART NUMBER	ROD DIA.	B	C	D	H	I	J	L	M	N	P
FEC625	0.625	0.406	1.500	0.563	45.0°	90.0°	0.219	4	1.125	0.250	0.656
FEC1000	1.000	0.750	2.000	0.875	30.0°	60.0°	0.281	6	1.500	0.375	1.063
FEC1375	1.375	0.938	2.500	1.000	30.0°	60.0°	0.344	6	2.000	0.375	1.438
FEC1750	1.750	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



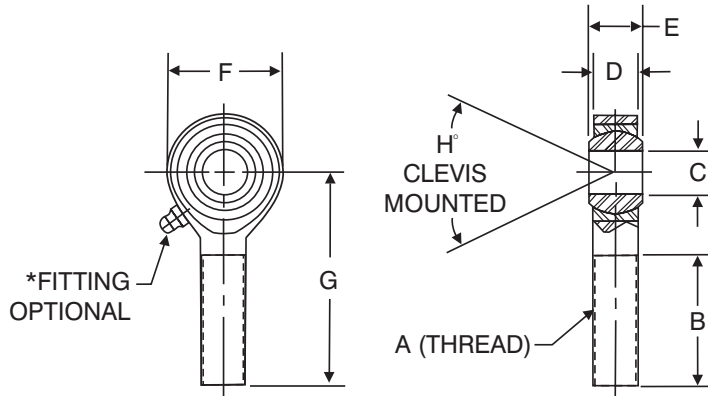
MALE SPHERICAL ROD EYE DIMENSIONS											
PART NUMBER	BORE (REF.)	ROD DIA.	A	CD	CE	ER	EX	JL	KK	LE	LOAD CAPACITY LBS
HH-MSRE-500	1.50	0.625	0.688	0.500	0.875	0.875	0.437	0.875	7/16-20	0.750	2600
		1.000									
HH-MSRE-750	2.00	1.000	1.000	0.750	1.250	1.250	0.656	1.313	3/4-16	1.063	9400
		1.375									
		1.750									
HH-MSRE-750	2.50	1.000	1.000	0.750	1.250	1.250	0.656	1.313	3/4-16	1.063	9400
		1.375									
		1.750									
HH-MSRE-1000	3.25	1.375	1.500	1.000	1.875	1.375	0.875	1.500	1-14	1.438	16800
		1.750									
		2.000									
HH-MSRE-1375	4.00	1.750	2.000	1.375	2.125	1.813	1.188	2.000	1 1/4-12	1.875	28500
		2.000									
		2.500									
HH-MSRE-1750	5.00	2.000	2.125	1.750	2.500	2.188	1.531	2.250	1 1/2-12	2.125	43000
		2.500									
		3.000									
		3.500									
HH-MSRE-2000	6.00	2.500	2.875	2.000	2.750	2.625	1.750	2.750	1 7/8-12	2.500	70200
		3.000									
		3.500									
		4.000									

MALE SPHERICAL ROD EYE



# ACCESSORIES: SPHERICAL ROD EYES

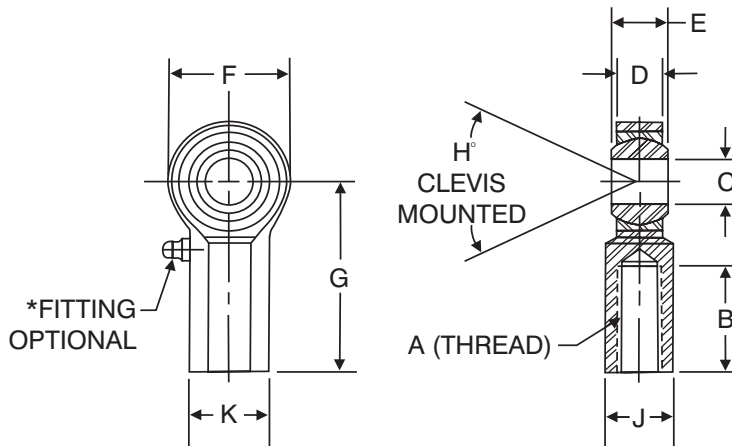
## MALE SPHERICAL ROD EYE



Assortment of Male Spherical Rod Eyes.

MALE SPHERICAL ROD EYE DIMENSIONS											
PART NUMBER	A	B	C	+0.0015 -0.0005	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	+0.0015 -0.0005	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.

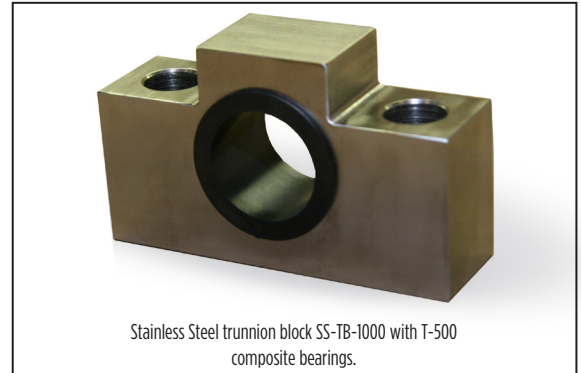
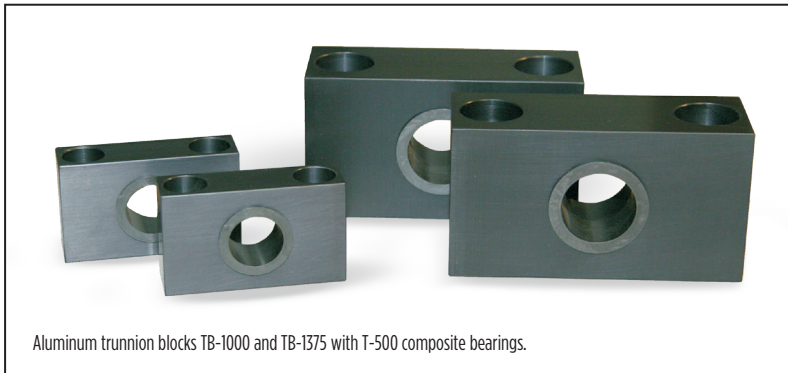
## ACCESSORIES: TRUNNION BLOCKS

HYDRAULIC CYLINDERS INC.® is making it easier to set up trunnion style actuation solutions. HYDRAULIC CYLINDERS INC.® 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 IGNUMS® “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.

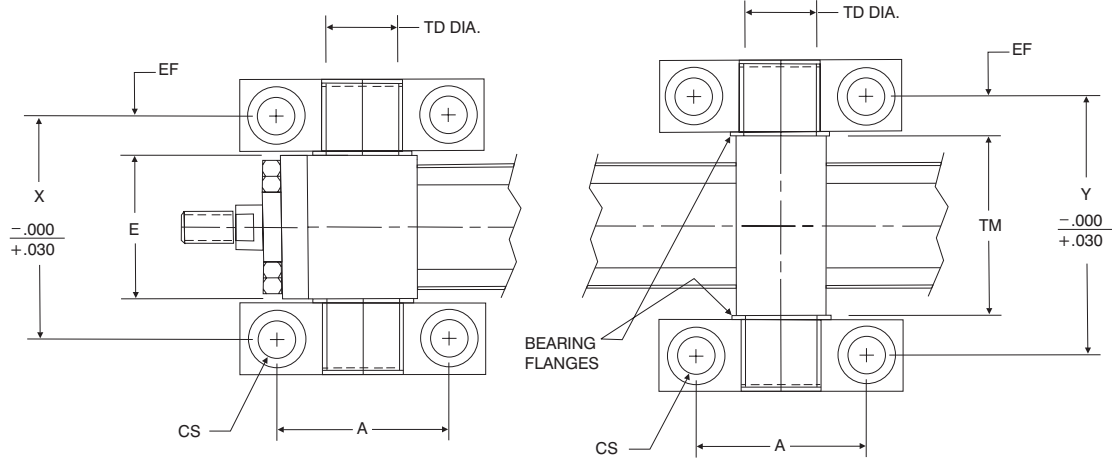
Trunnion supports can be used with all NFPA mounts MT1, MT2 and MT4, as well as HYDRAULIC CYLINDERS INC.® solid one-piece steel trunnion styles SMT1 and SMT2.

All trunnion blocks are in stock and available for immediate order. Contact Factory for delivery for large orders or special requirements.



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**

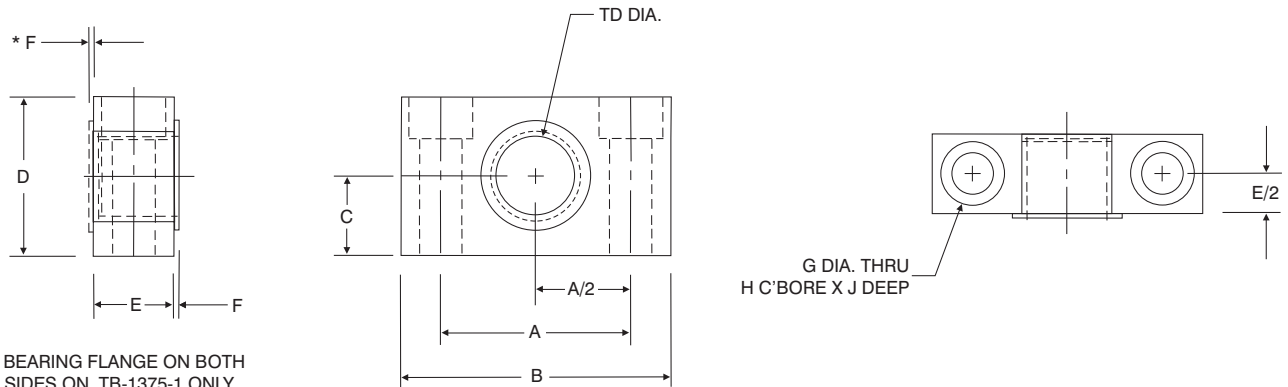
**MT4  
INTERMEDIATE TRUNNION  
MOUNTING DIMENSIONS**

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

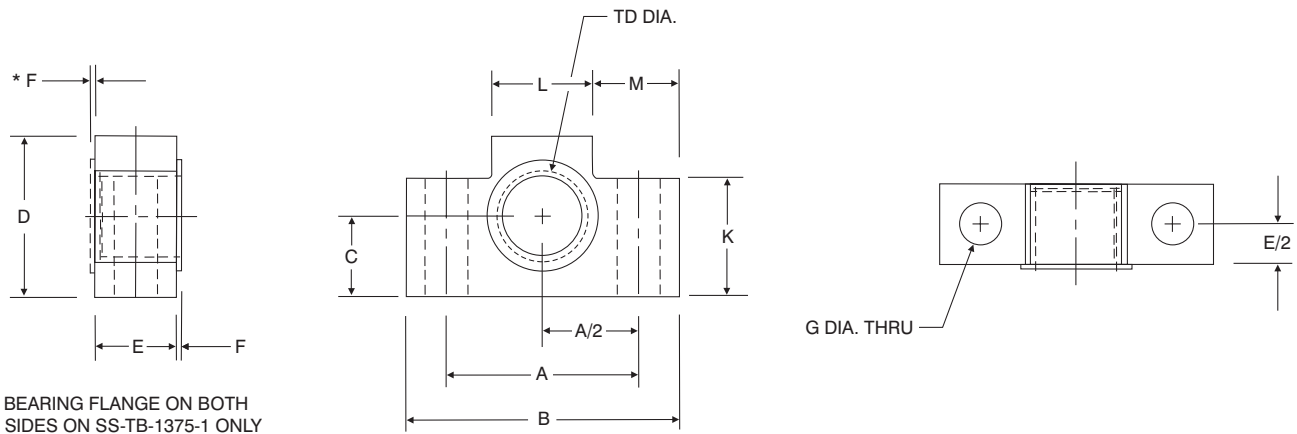


\* BEARING FLANGE ON BOTH SIDES ON TB-1375-1 ONLY

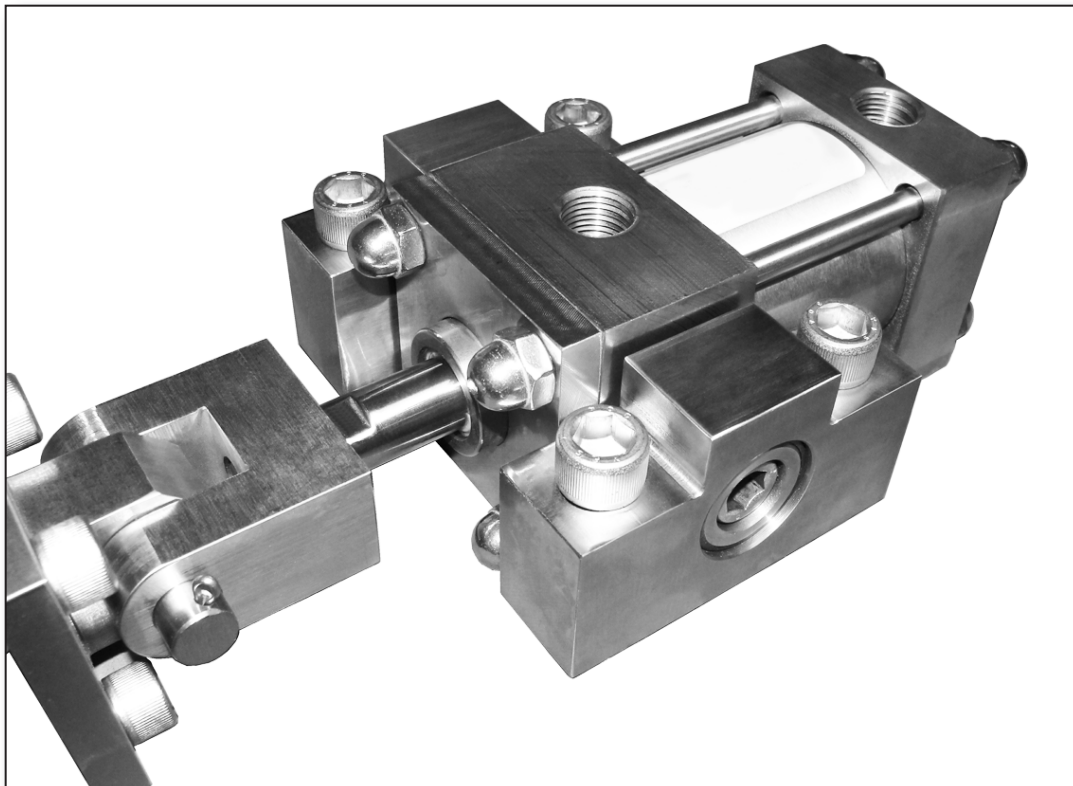
PART NUMBER	A	B	C	D	E	F	G	H	J	TB
TB-1000-1	2.375	3.375	1.000	2.000	1.000	0.062	0.531	0.797	0.531	1.000
TB-1375-1	4.000	5.500	1.500	3.000	2.000	0.078	0.781	1.187	0.781	1.375

# ACCESSORIES: TRUNNION BLOCKS

## STAINLESS STEEL TRUNNION BLOCKS WITH BEARING



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

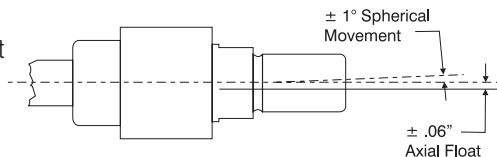
## Benefits

- 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.

## 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).

**MATERIAL:** 100,000 MIN. YIELD STRESS-PROOF™



**Standard AC Coupler**  
AC250 - AC5000



**ACH Coupler**  
ACH250 - ACH1250



**Stainless Steel Standard AC Coupler**  
SS-AC250 - SS-AC5000

## How to Order:

SERIES
AC
ACH

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:

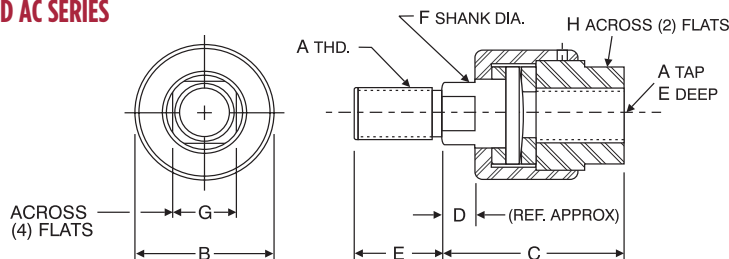
**AC250** (AC with male & female 1/4 -28 thread)

**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

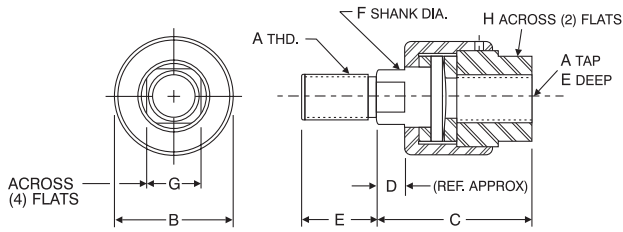
## METRIC ROD AC SERIES



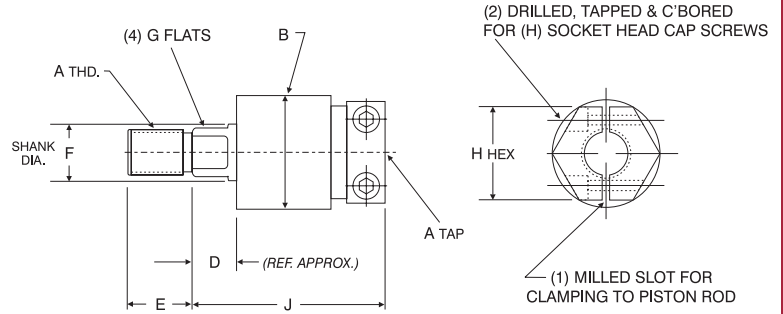
METRIC ROD ALIGNMENT COUPLERS (STEEL)									
PART NUMBER	A	B	C	D	E	F	G	H	MAX PULL POUNDS (3:1 SAFETY FACTOR)
MAC250-M4x0.7	M4x0.7	1.125	1.750	.375	.500	.500	.375	.687	251
MAC250-M6x1.0	M6x1.0	1.125	1.750	.375	.500	.500	.375	.687	687
MAC312-M8x1.25	M8x1.25	1.125	1.750	.375	.500	.500	.375	.687	1,349
MAC437-M10x1.25	M10x1.25	1.250	2.000	.437	.750	.625	.500	.812	2,435
MAC500-M12x1.25	M12x1.25	1.250	2.000	.437	.750	.625	.500	.812	3,860
MAC625-M16x1.5	M16x1.5	1.250	2.000	.437	.750	.625	.500	.812	7,299
MAC750-M20x1.5	M20x1.5	1.750	2.312	.437	1.125	.968	.812	1.125	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	1.250	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).

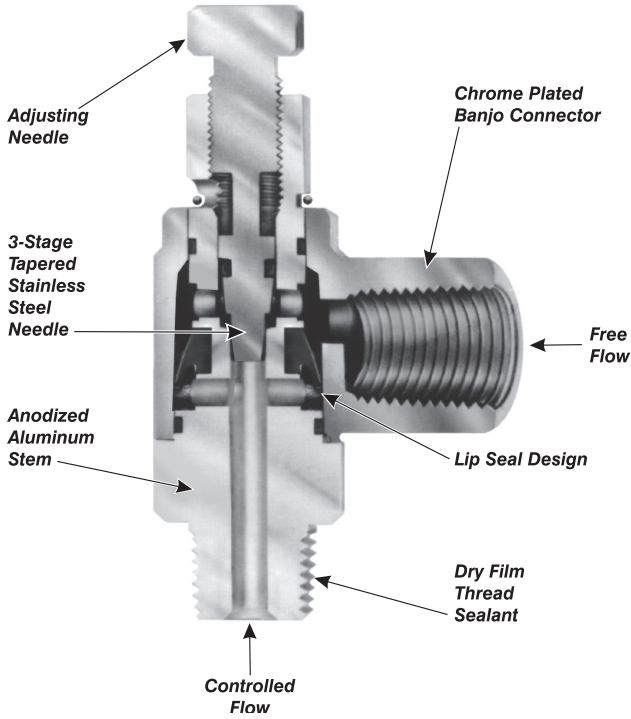
# STAINLESS STEEL ALIGNMENT COUPLERS

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:**

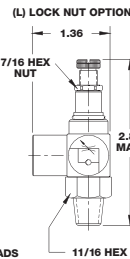
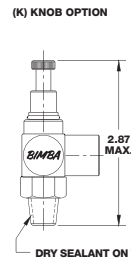
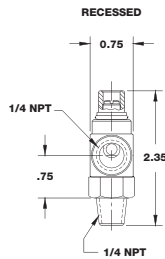
-20° F to +200° F  
(-25° C to +95° C)

FCP4

FCP4K

FCP4L

For 1/4" port

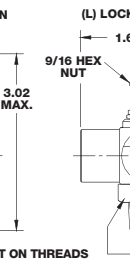
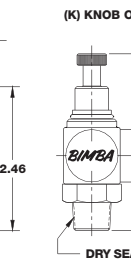
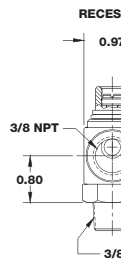


FCP6

FCP6K

FCP6L

For 3/8" port

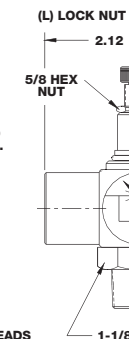
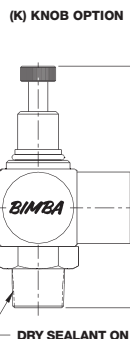
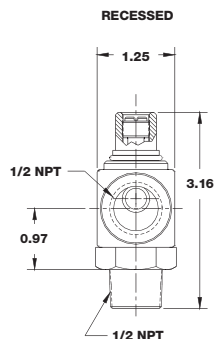


FCP8

FCP8K

FCP8L

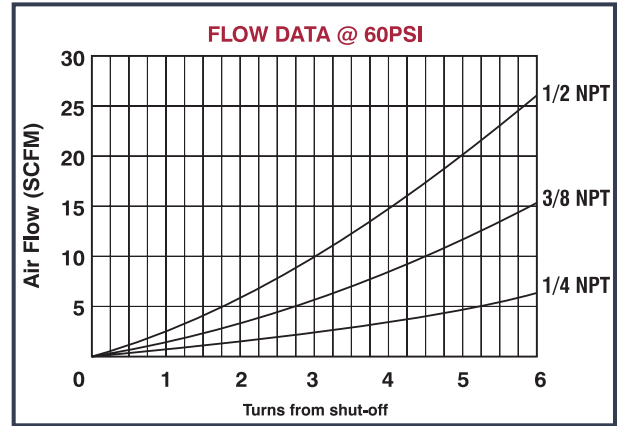
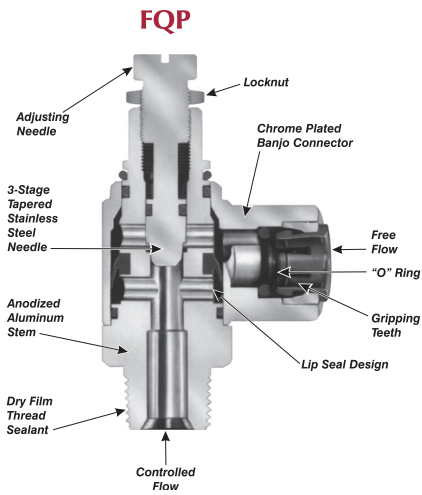
For 1/2" port





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

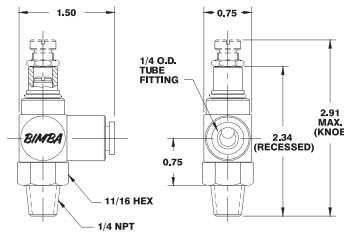
## FQP & FCP Series



**FQP44**

**FQP44K**

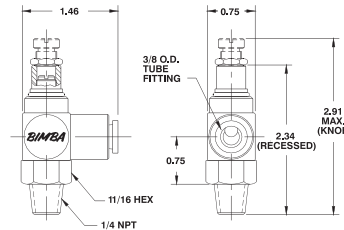
For 1/4" port, 1/4" OD tubing



**FQP4**

**FQP4K**

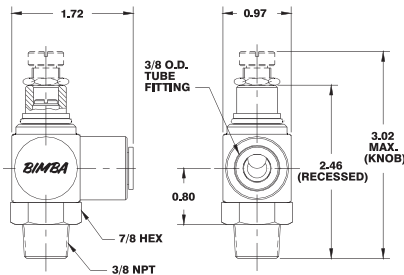
For 1/4" port, 3/8" OD tubing



**FQP6**

**FQP6K**

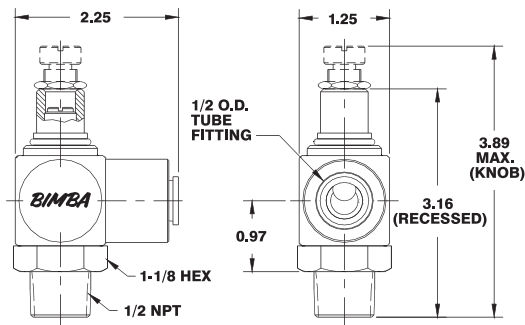
For 3/8" port, 3/8" OD tubing



**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

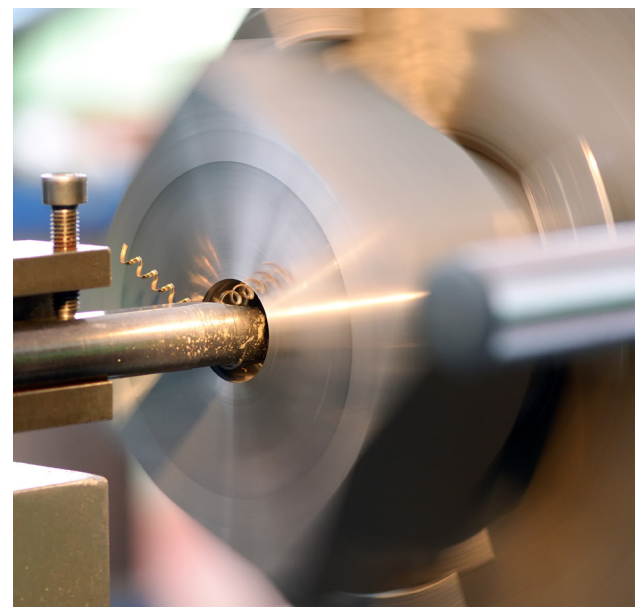
### Maximum Operating Pressure:

150 PSI Air Only

### Operating Temperature Range:

-20° F to +200° F  
(-29° C to +93° C)

# NOTES

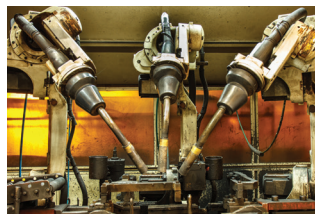
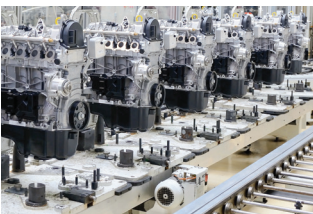


Switches | Strokemaster | Balluff Transducers

PNEUMATIC



- Switches ..... 164
- Strokemaster ..... 171
- Balluff Transducers ..... 175



## 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

**HYDRAULIC CYLINDERS INC.® 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 HYDRAULIC CYLINDERS INC.® Switches.**
- Can be used with all HYDRAULIC CYLINDERS INC.® 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.**

# ACCESSORIES: SWITCHES — REED

## Electrical Specifications

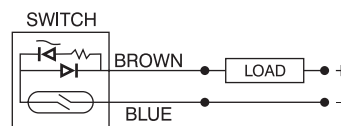
## Schematics



<b>R10</b>	<b>Miniature Reed Switch, 24" (24 AWG Wire, PVC Jacket) Plain Cable Lead, (2 wire Switch)</b>
<b>R10X</b>	<b>Miniature Reed Switch, 120" (24 AWG Wire, PVC Jacket) Plain Cable Lead, (2 wire Switch)</b>
<b>R10Q</b>	<b>Miniature Reed Switch, 8mm Male Quick Connect, 24 AWG Wire, PVC Jacket (2 wire Switch)</b>
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

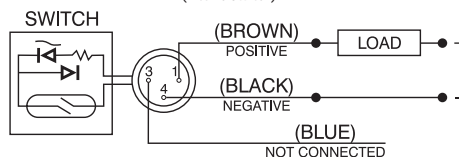
Miniature Reed Switch, Cable Type, (2 Wire Switch)



**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)



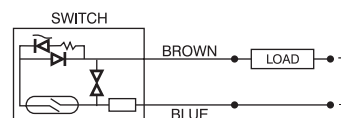
**Input Voltage** 120 Volts Max. AC/DC  
**Maximum Load Current** 500 mA Max. (Resistive)



<b>R10P</b>	<b>Miniature Reed Switch, 24" (24 AWG Wire, PVC Jacket) Plain Cable Lead, Circuit Protection (2 wire Switch)</b>
<b>R10PX</b>	<b>Miniature Reed Switch, 120" (24 AWG Wire, PVC Jacket) Plain Cable Lead, Circuit Protection (2 wire Switch)</b>
<b>R10PQ</b>	<b>Miniature Reed Switch, 8mm Male Quick Connect, (24 AWG Wire, PVC Jacket) Circuit Protection (2 wire Switch)</b>
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

### R10P / R10PX

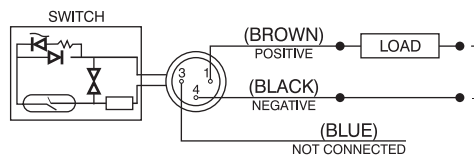
Miniature Reed Switch, Cable Type, (2 Wire Switch)



**Input Voltage** 120 Volts Max. AC/DC  
**Maximum Load Current** 150 mA Max.

### R10PQ

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



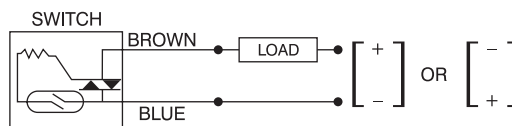
**Input Voltage** 120 Volts Max. AC/DC  
**Maximum Load Current** 150 mA Max.

**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.



<b>RAC</b>	<b>High Power AC Reed Switch, 24" (20 AWG Wire, PVC Jacket) Plain Cable Lead, (2 wire Switch)</b>
<b>RACX</b>	<b>High Power AC Reed Switch, 120" (20 AWG Wire, PVC Jacket) Plain Cable Lead, (2 wire Switch)</b>
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

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

### RAC / RACX

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

# ACCESSORIES: SWITCHES — REED

## Electrical Specifications

## Schematics



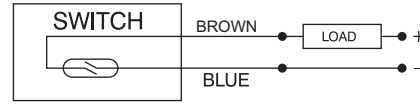
**RHT** Extended Temperature Range Miniature Reed Switch, 24" (24 AWG Wire, Silicone rubber insulation with gray outer sheath, 4.5mm O.D.) Plain Cable Lead, (2 wire Switch)

**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

RHT / RHTX

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



Maximum Load Current 500 mA Max. (Resistive)

Input Voltage 120 Volts Max. AC/DC

## 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,

**\*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.

(2 Wire Switch)



Typical Current Sourcing (PNP) Configuration



Typical Current Sinking (NPN) Configuration



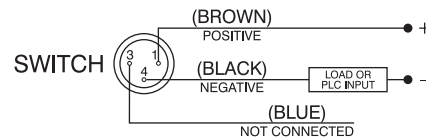
**MSSQ** Miniature Solid State Switch, 8mm Male Quick Connect, 24 AWG Wire, PVC Jacket (2 wire Switch)

*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

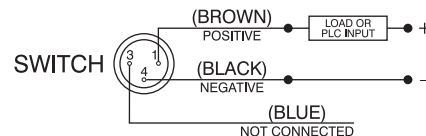
MSSQ

**\*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.

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



Typical Current Sourcing (PNP) Configuration



Typical Current Sinking (NPN) Configuration

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

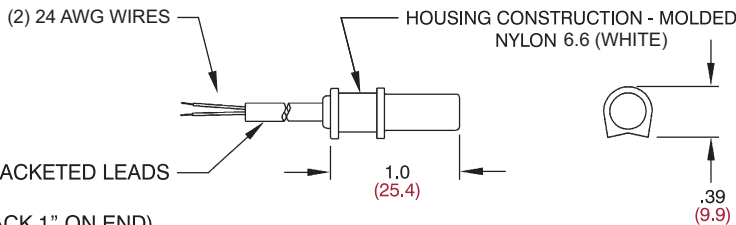
# ACCESSORIES: SWITCHES AND BRACKET DIMENSIONS

**FOR SWITCHES: R10 / R10X**

**RHT / RHTX  
MSS / MSSX**

**PLAIN CABLE LEADS**

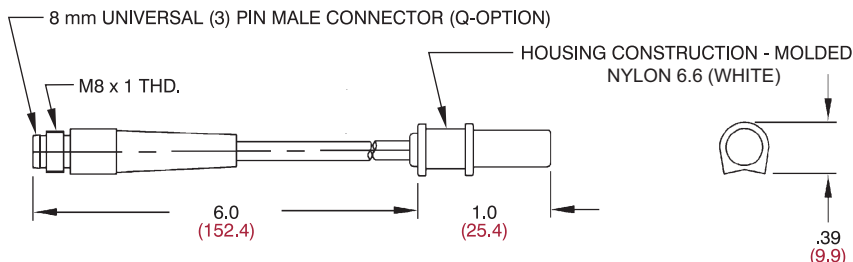
R10 / RHT / MSS = 24" (0.6m) PVC JACKETED LEADS  
R10X / RHTX / MSSX = 120" (3.0m)  
(JACKET CUT BACK 1" ON END)  
(25.4)



**FOR SWITCHES: R10Q**

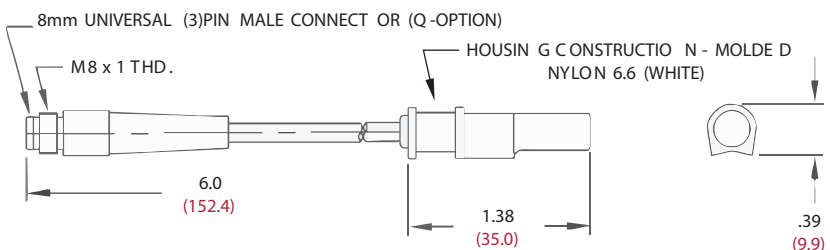
**MSSQ**

RUGGED THREADED CONNECTION FOR POSITIVE LOCK



**FOR SWITCHES: R10PQ**

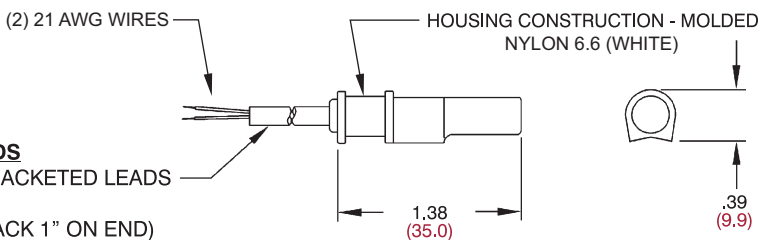
RUGGED THREADED CONNECTION FOR POSITIVE LOCK



**FOR SWITCHES: RAC / RACX  
R10P / R10PX**

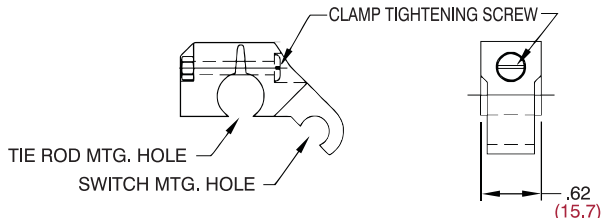
**PLAIN CABLE LEADS**

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



**SWITCH BRACKET: SB15**

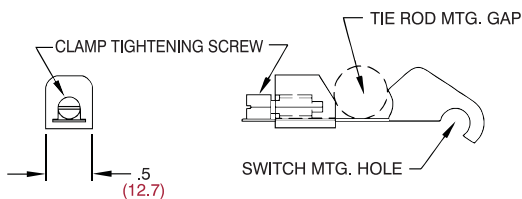
(For 1.50" Through 2.50" Bore Cylinders)



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**

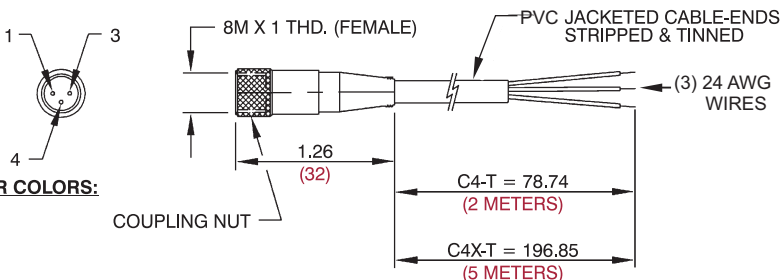
(Used with "Q" Type Switch Leads)

**FOR CABLES:  
C4-T (2 METER CABLE LENGTH)  
C4X-T (5 METER CABLE LENGTH)**

**CONDUCTOR COLORS:**

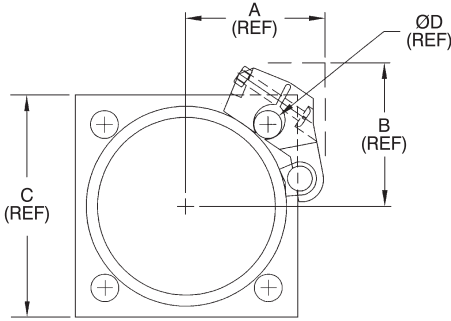
- 1. BROWN
- 3. BLUE
- 4. BLACK

All Dimensions are in INCHES  
(mm in parentheses)

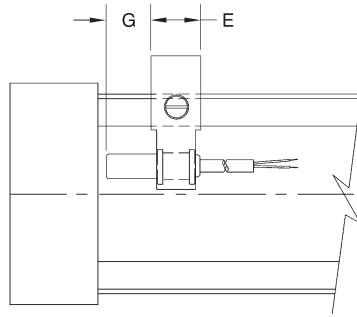


Specify 'MPR' Option for ALL switch models when ordering actuators.

## ACCESSORIES: SWITCH MOUNTING DIMENSIONS



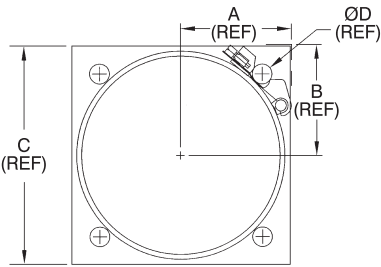
**SB15**



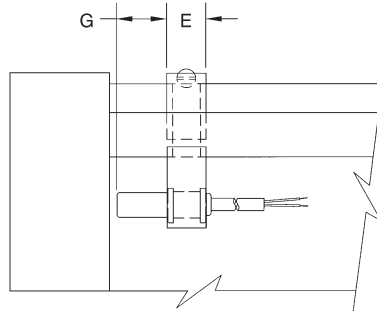
**SB15**

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	0.375	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.



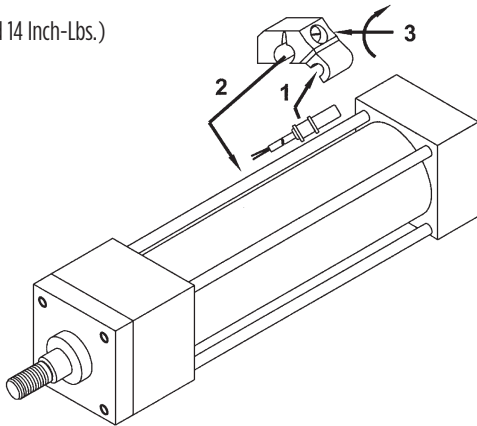
**SB32**



**SB32**

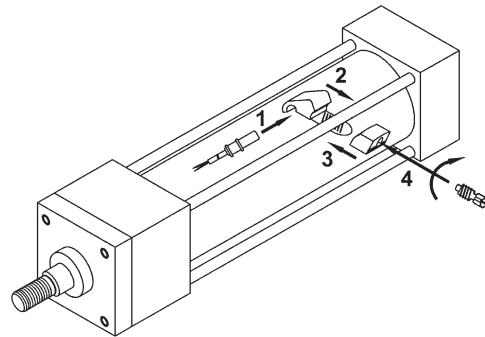
## How To Assemble Switch and Brackets

**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.



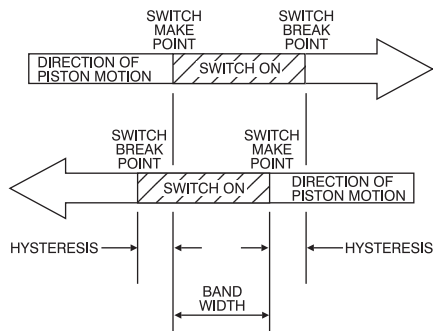
# ACCESSORIES: SWITCHES HYSTERESIS & BAND WIDTH

## HYSTERESIS:

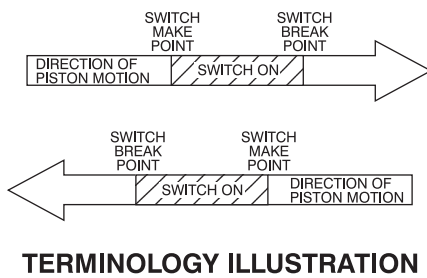
THE DISTANCE BETWEEN THE SWITCH BREAK POINT MOVING IN ONE DIRECTION AND THE SWITCH MAKE POINT MOVING IN THE OPPOSITE DIRECTION.

## BAND WIDTH:

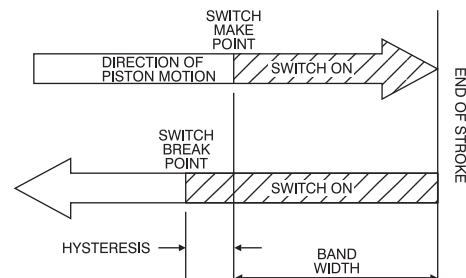
THE DISTANCE THE PISTON MOVES WHILE THE SWITCH IS MADE (IN EITHER DIRECTION), LESS THE HYSTERESIS.



MID STROKE OPERATION

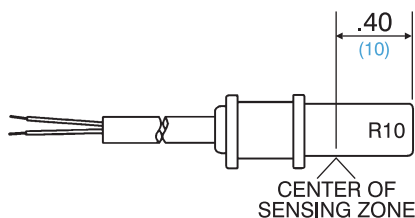


TERMINOLOGY ILLUSTRATION

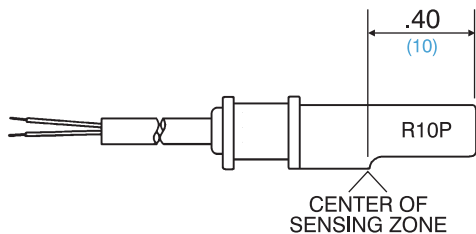


END OF STROKE OPERATION

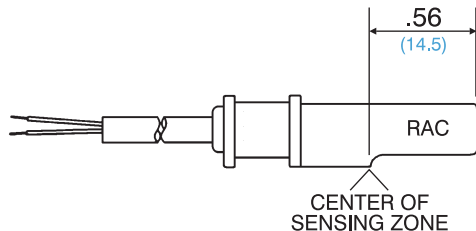
ACCESSORIES / SWITCH & BRACKET DIMENSIONS



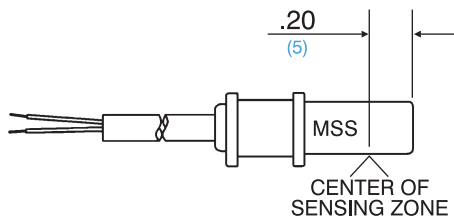
SWITCH		REPEATABILITY	HYSTERESIS (MAX)	BANDWIDTH (MAX)
R10	RHT	±.010" (±.25)	.040" (1)	.200" (5)
R10X	RHTX			
R10Q				



SWITCH		REPEATABILITY	HYSTERESIS (MAX)	BANDWIDTH (MAX)
R10P		±.010" (±.25)	.040" (1)	.200" (5)
R10PQ				
R10PX				



SWITCH		REPEATABILITY	HYSTERESIS (MAX)	BANDWIDTH (MAX)
RAC		±.010" (±.25)	.085" (2.1)	.345" (8.8)
RACX				



SWITCH		REPEATABILITY	HYSTERESIS (MAX)	BANDWIDTH (MAX)
MSS		±.010" (±.25)	.075" (1.9)	.315" (8)
MSSX				
MSSQ				

### Note:

Dimensions are in inches (mm in parentheses).

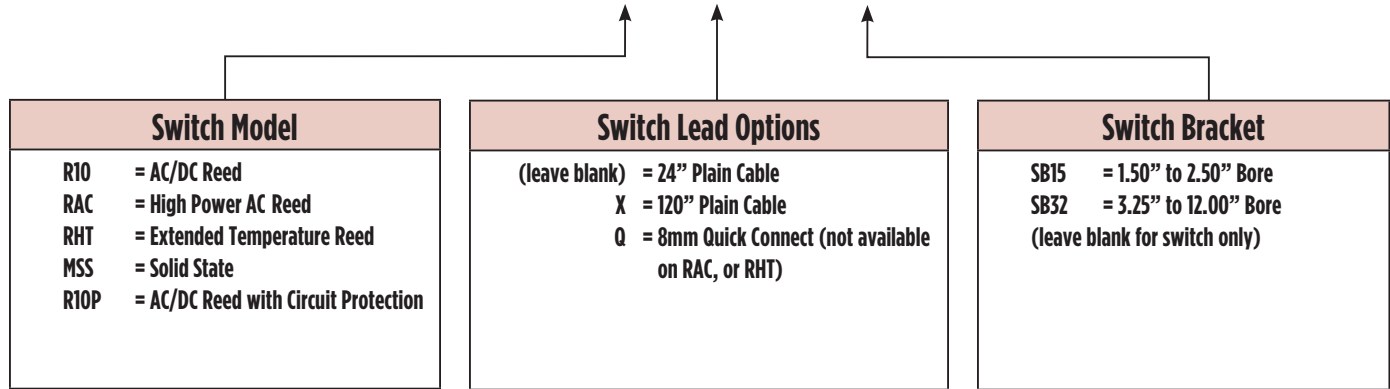
Results are based upon HYDRAULIC CYLINDERS INC.® piston and magnet assemblies. Results may vary if used with other manufacturers cylinder products.

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 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. HYDRAULIC CYLINDERS INC.® designed our magnet to have 50-100% more power than required to operate our switch! The combination of HYDRAULIC CYLINDERS INC.® 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.

## SERIES: BALLUFF INDUCTIVE SENSORS

# BALLUFF **STROKEMASTER**™ Inductive Sensors

### Flexible Solutions for an Often Inflexible World

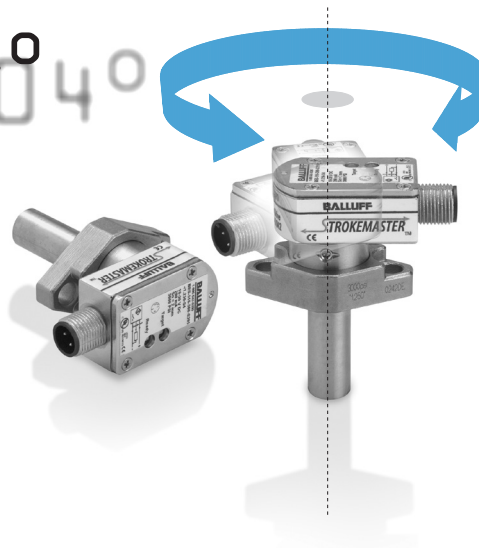
Balluff's Strokemaster® cylinder-piston sensors provide precision end-of-stroke sensing for hydraulic cylinders. The sensor body allows 304° of rotation to eliminate the hassle of post-installation cable management, which in some competitive designs requires unbolting the flange and breaking the hydraulic 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 HYDRAULIC CYLINDERS INC.® 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 HYDRAULIC CYLINDERS INC.® 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.

304°



STROKEMASTER™

# SERIES: BALLUFF INDUCTION SENSORS

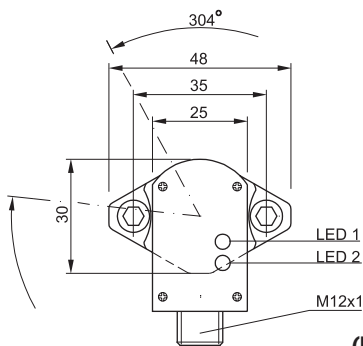
## DC INDUCTIVE SENSORS



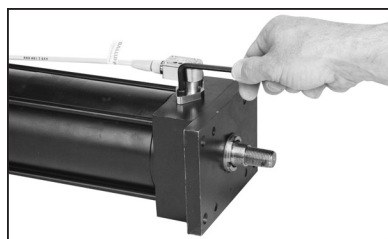
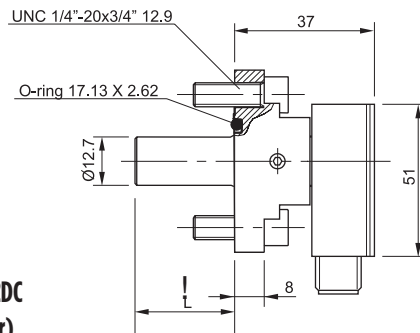
### Features/Advantages

Inductive cylinder switch for piston position feedback in cylinders.

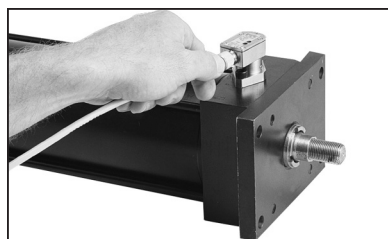
- Magnetic field immune, for use with welding equipment
- Available in DC or all current (AC/DC) versions
- Easy installation - sensor mounts to cylinder with two (2) fasteners
- Sealed directly at flange, connector can be oriented after installation
- Various lengths available for different cylinder sizes



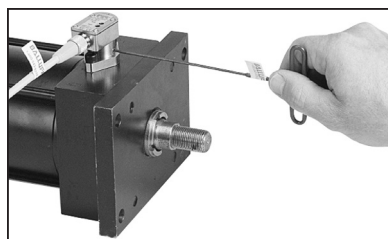
(Micro M12DC Connector)



Bolt sensor to cylinder.



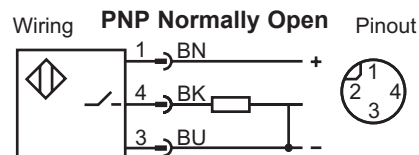
Position cable to desired orientation (even over mounting bolts).



Lock chosen position with one or both of the two integral set screws.

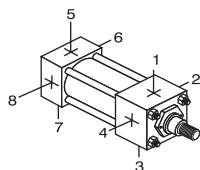
PNP	Normally-open
Rated operational voltage U	24 V DC
Supply voltage U	10...30 V DC
Voltage drop U <sub>at I</sub>	< 2.5 V
Rated insulation voltage U	75 V DC
Rated operational current I	200 mA
No-load supply current I <sub>d./und.</sub>	< 18 mA / < 10 mA
Off-state current I	< 80 µA
Protected against 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)
<b>Recommended connector</b>	<b>C04 AEL-00-VY-050M</b>

BES 516-300-S 295-S 4	
24 V DC	
10...30 V DC	
< 2.5 V	
75 V DC	
200 mA	
< 18 mA / < 10 mA	
< 80 µA	
yes	
yes/yes	
< 1.0 µF	
< 5 %	
-25...+70° C	
10 Hz	
DC 13	
yes/yes	
IP 67/connector IP 65	
stainless steel/aluminum	
ceramic	
Micro connector	
cULus	
207 bar (3000 PSI)	
<b>C04 AEL-00-VY-050M</b>	



! HYDRAULIC CYLINDERS INC.\* 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)

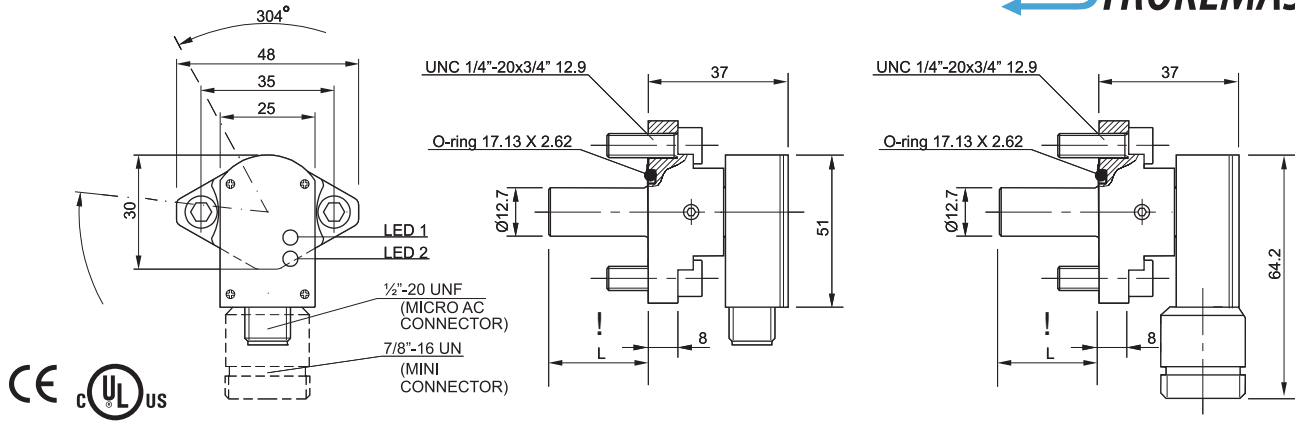
- Cylinder Model Number → TA - MS2 3.25 X 6 - HC
- SENSOR MODEL (HEAD) → -BES 516-300-S 295-S4 (Head)
- SENSOR MODEL (CAP) → -BES 516-300-S 295-S4 (Cap)
- (Include ALL Sensor positions) → -Sensors at 4 & 8

**How To Order:**

**Note:** HYDRAULIC CYLINDERS INC.\* 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

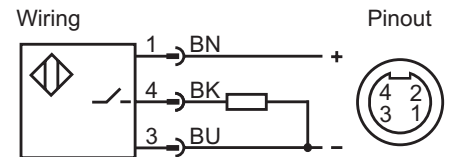
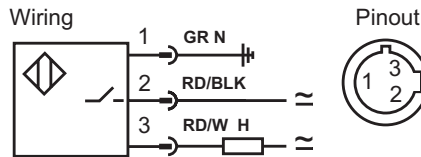
## AC/DC INDUCTIVE SENSORS



Normally-open
Rated operational voltage U
Supply voltage U
Voltage drop U <sub>at I</sub>
Rated insulation voltage U
Rated operational current I
Minimum operational current I
Off-state current I
Inrush current I (t = 20 ms)
Protected against polarity reversal
Short circuit protected
Repeat accuracy R
Ambient temperature range T
Frequency of operating cycles f
Utilization categories
Function/Operating voltage indication
Degree of protection per IEC 529
Insulation class
Housing material
Material of sensing face
Connection
Approvals
High pressure rated up to
<b>Recommended connector</b>

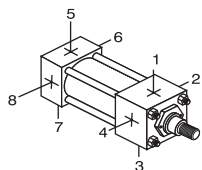
BES 516-200-S 2-S21
110 V AC
20...250 V AC/DC
< 6 V
250 V AC
500 mA
5 mA
< 1.7 mA @ 110 V AC
3 A max./1 Hz
yes
yes
< 5 %
-25...+70°C
< 50 Hz
AC 140/DC 13
yes/yes
IP 67
1
stainless steel/aluminum
ceramic
Micro connector
cULus
207 bar (3000 PSI)
<b>C21 AE3-00-VY-150F</b>

BES 516-200-S 2-S5
110 V AC
20...250 V AC/DC
< 6 V
250 V AC
500 mA
5 mA
< 1.7 mA @ 110 V AC
3 A max./1 Hz
yes
yes
< 5 %
-25...+70°C
< 50 Hz
AC 140/DC 13
yes/yes
IP 67
1
stainless steel/aluminum
ceramic
Mini connector
cULus
207 bar (3000 PSI)
<b>C05 AE1-00-VY-150F</b>



! HYDRAULIC CYLINDERS INC.® 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:** HYDRAULIC CYLINDERS INC.® 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.

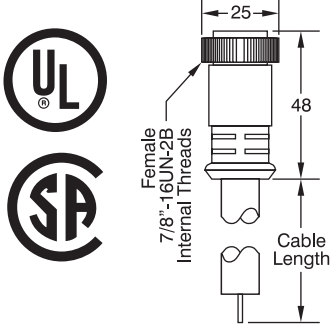
# SERIES: BALLUFF INDUCTION SENSORS

## CABLE CONNECTORS



### S5 - Mini Connectors (7/8"-16 UNF Threads)

Connector	3-5 Pole Mini
Style	Mini Size A
Configuration	Straight Female
Recommended Connector	<b>C05 AEI-00-VY-150F</b>

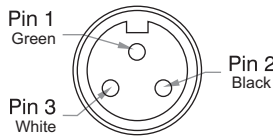


ORDER NUMBER	
3 Pole	C05 AEI 00 * Y 150

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

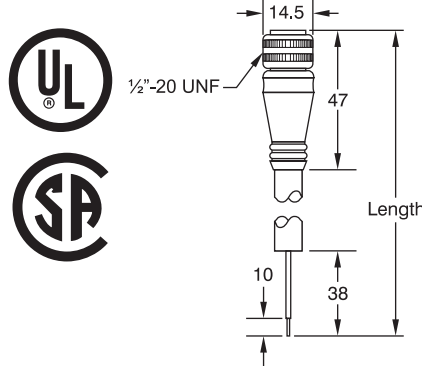
\* Insert **V** = PVC Cable  
**T** = TPE Cable  
 For 3 pole versions only

Female 3-pin - Face view



### S2I - Micro Connectors (1/2"-20 UNF Threads)

Connector	Micro AC 1/2" x 20 UNF
Style	3 Pin Dual Keyway
Configuration	Straight Female
Recommended Connector	<b>C21 AES-00-VY-150F</b>



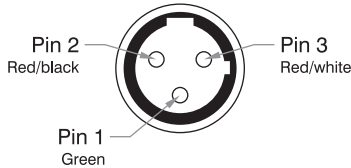
ORDER NUMBER	
3 Pin Dual Keyway	C21 AES 00 * Y 150F

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)

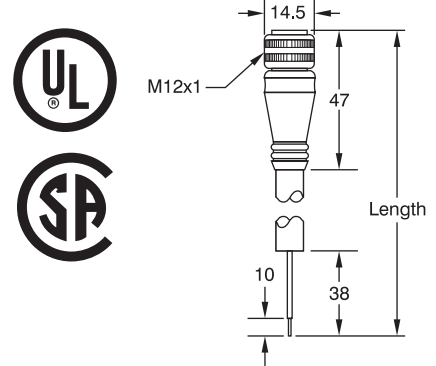
\* Insert **V** = PVC Cable  
**T** = TPE Cable  
 For 3 pole versions only

Female - Face view



### S4 - Micro Connectors (M12x1 Metric Threads)

Connector	Micro
Style	M12 DC Single Keyway
Configuration	Straight Female
Recommended Connector	<b>C04 AEL-00-VY-050M</b>



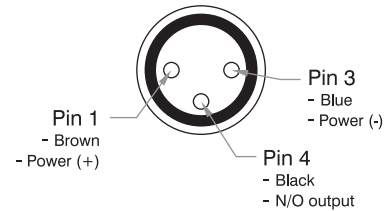
Note		ORDER NUMBER
<b>3 Wire DC</b>		
3 Wire Normally Open, non-LED	<b>1,2,3</b>	C04 AEC 00 * Y 050M
3 Wire Normally Open PNP w/ LED		C04 AEH 00 * Y 050M
<b>4 Wire DC (NO/NC)</b>		
4 Wire (Universal), non-LED	<b>1,2,3</b>	C04 AEL 00 * Y 050M
4 Wire PNP w/LED	<b>1,3</b>	C04 AEM 00 * Y 050M
Voltage Rating	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)

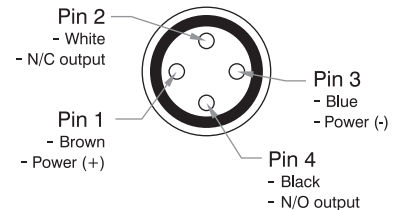
\* Insert **V** = PVC Cable  
**T** = TPE Cable  
 For 3 pole versions only

**Note:** 1 Add **B** = Braided 80% Metallic Braid, i.e. 050 MB  
 2 Add **S** = Shielded 360 Degree Shield through Coupling Nut, i.e. 050 MS  
 3 Stainless Steel Couple Nut: Change **E** to **S**, i.e. C04ASC00TY050M

Female - Face view



Female - Face view



Refer to Balluff Catalog for additional cable connectors.

## Enhanced Magnetostrictive Technology

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

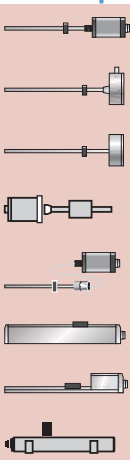
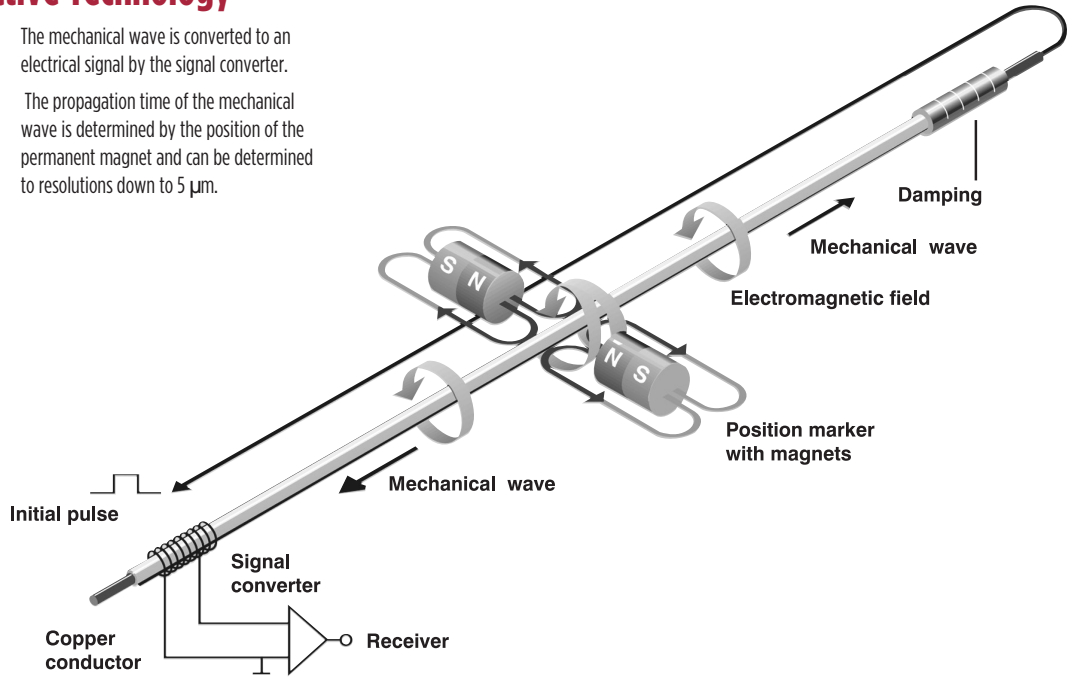
A copper conductor is introduced through the length of this tube. The start of measurement is initiated by a short current pulse. This current generates a circular magnetic field which rotates around the waveguide.

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  $\mu\text{m}$ .



**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

Sensor Output Options	Z	W	K
<b>Analog</b>			
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	•	•	•
<b>Digital</b>			
Start/Stop, RS422	•	•	•
Pulse-Width Modulated, RS422	•	•	•
PWM (w/ recirculation), RS422	•	•	•
<b>Specialized</b>			
Synchronous Serial Interface*	•	•	•
CANopen	•	•	•
Profibus DP	•	•	•
Quadrature	•	•	•
<b>Resolution</b>			
0.1 mV (analog)	•	•	•
0.2 $\mu\text{A}$ (analog)	•	•	•
16 bit (analog)	•	•	•
Controller-dependent (Start/Stop & PWM)	•	•	•
1, 2, 3, 5, 10 $\mu\text{m}$ selectable (Quadrature output)	•	•	•
1, 5, 10, 20, 40 $\mu\text{m}$ selectable (SSI output)	•	•	•
5 $\mu\text{m}$ increments selectable (CANopen & Profibus)	•	•	•
10 $\mu\text{m}$	•	•	•
<b>Stroke Length</b>			
Active measurement area: 2" to 156" (Consult factory for longer lengths)	2" - 156"	2" - 156"	2" - 156"
<b>Wiring Options</b>			
Quick disconnect	•	•	•
Cable-out	•	•	•
<b>Operating Voltage</b>			
24 V DC ( $\pm 20\%$ )	•	•	•
$\pm 15$ V DC ( $\pm 2\%$ )	•	•	•
*(24 or 25 bit binary or gray code)	•	•	•

# BALLUFF TRANSDUCERS

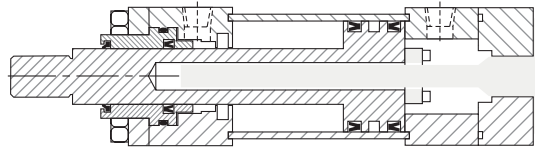
**HYDRAULIC CYLINDERS INC.® will build your cylinder with the proper magnet, spacer plates (if required), drilling and tapping, intermediate supports (if required) and furnish the transducer as a complete unit.**

**All cylinder/transducer assemblies are 100% tested at HYDRAULIC CYLINDERS INC.® before shipping.**

## INTERNAL MODELS (BALLUFF Z, W, K SERIES)

- Not available on MPI 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

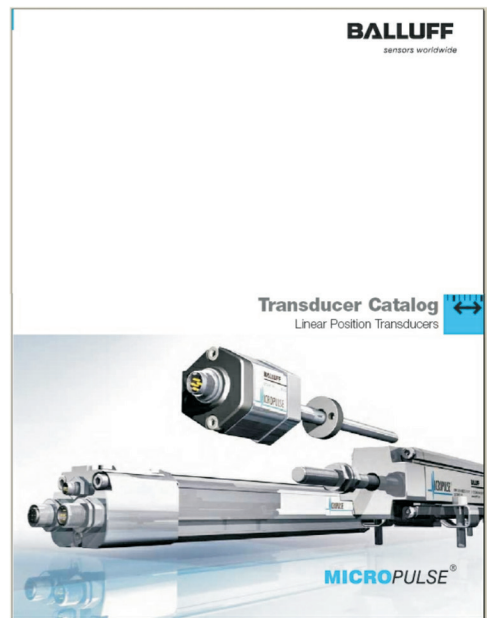
## SERIES "Z" SHOWN



- Complete BALLUFF MICROPULSE™ Transducer information is available in catalog form or electronic PDF downloads.

Visit [www.balluff.com](http://www.balluff.com)

- Other Balluff models are available. Call HYDRAULIC CYLINDERS INC.® Mfg. (800-654-2535) for information and cylinder design assistance.



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

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2008 Photoelectrics

**MICROPULSE**

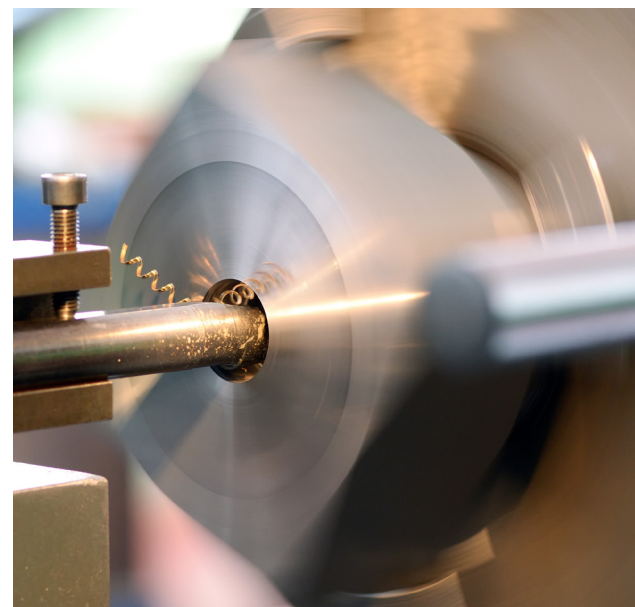
Micropulse Linear Position Transducers Catalog

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

Micropulse Catalog Contents

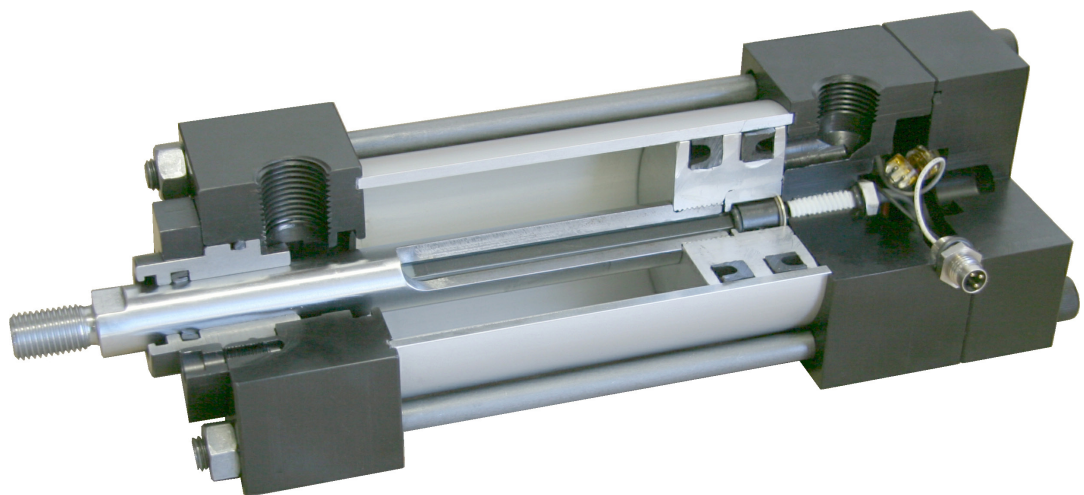




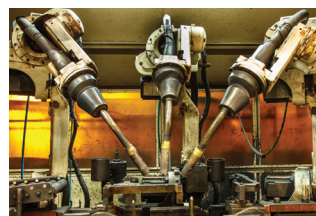
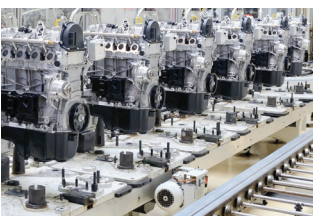
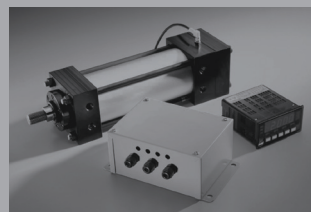


# PELF Series POSITION FEEDBACK | Aluminum Cylinders | 1.50" to 8.00" Bore

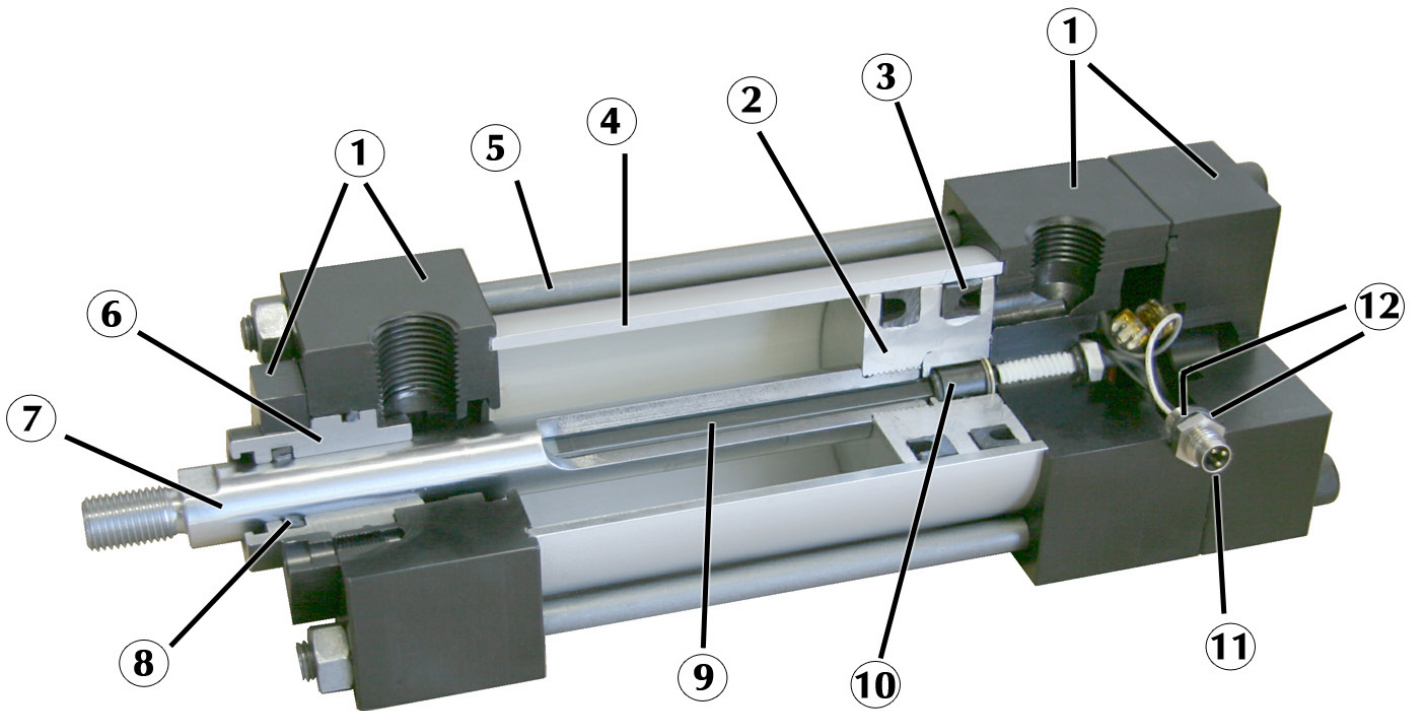
PNEUMATIC



- PELF Series POSITION FEEDBACK ..... 178
- PCS Position Control System ..... 190



# 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  $\pm 1$  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 contaminants or liquids from entering cylinder cavity and affecting cylinder performance.

## FEATURES OF THE PFLF CYLINDER

- Continuous Position Sensing
- Highly Accurate: Infinite resolution, linearity of  $\pm 1$  percent of full stroke,  $\pm .001$ " 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**

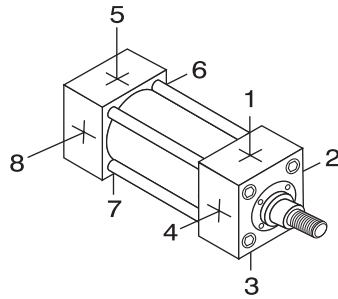
SERIES		NFPA MOUNTS		BORE		STROKE		CYLINDER OPTIONS	
PFLF	ANODIZED ALUMINUM	MX0	NO MOUNT (1.50"- 8.00" BORE)	1.50	2.00	2"-24"	(1.50" - 2.50")	B*	.25" URETHANE BUMPER BOTH ENDS
		MP1	REAR PIVOT CLEVIS (1.50"- 8.00" BORE)	2.50	3.25	3"-24"	(3.25" - 8.00")	BC*	.25" URETHANE BUMPER CAP ONLY
		MP2	REAR PIVOT CLEVIS (1.50"- 6.00" BORE)	4.00	5.00			BH*	.25" URETHANE BUMPER HEAD ONLY
		MP4	REAR PIVOT EYE (1.50"- 4.00" BORE)	6.00	8.00			A =	EXTENDED PISTON ROD THREAD - SPECIFY (EXAMPLE: A = 2")
		MT1	FRONT TRUNNION (1.50"- 8.00" BORE)					C =	EXTENDED PISTON ROD - SPECIFY (EXAMPLE: C = 1.5")
		MT2	REAR TRUNNION (1.50"- 8.00" BORE)					EN	ELECTROLESS NICKEL PLATED
		MT4	INTERMEDIATE TRUNNION (1.50"- 8.00" BORE)					KK2	LARGE MALE ROD THREAD
		MX3	EXTENDED TIE-RODS (HEAD) (1.50"- 8.00" BORE)					KK3	FEMALE ROD THREAD
		MF1	FRONT FLANGE (1.50"- 6.00" BORE)					KK4	FULL DIAMETER MALE ROD THREAD
		MF2	REAR FLANGE (1.50"- 6.00" BORE)					MPR	MAGNETIC PISTON FOR REED SWITCHES
		ME3	FRONT MOUNTING HOLES (8.00" BORE)					MPH	MAGNETIC PISTON FOR HALL SWITCHES
		MS1	FRONT & REAR END FOOT (1.50"- 8.00" BORE)					OP	OPTIONAL PORT LOCATION - SPECIFY (EXAMPLE: PORTS @ 3 & 7)
		MS2	SIDE LUG (1.50"- 4.00" BORE STANDARD 5.00"- 8.00" CONSULT FACTORY)					XX	SPECIAL VARIATIONS (SPECIFY)
		MS4	BOTTOM TAPPED HOLES (1.50"- 8.00" BORE)						

\*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

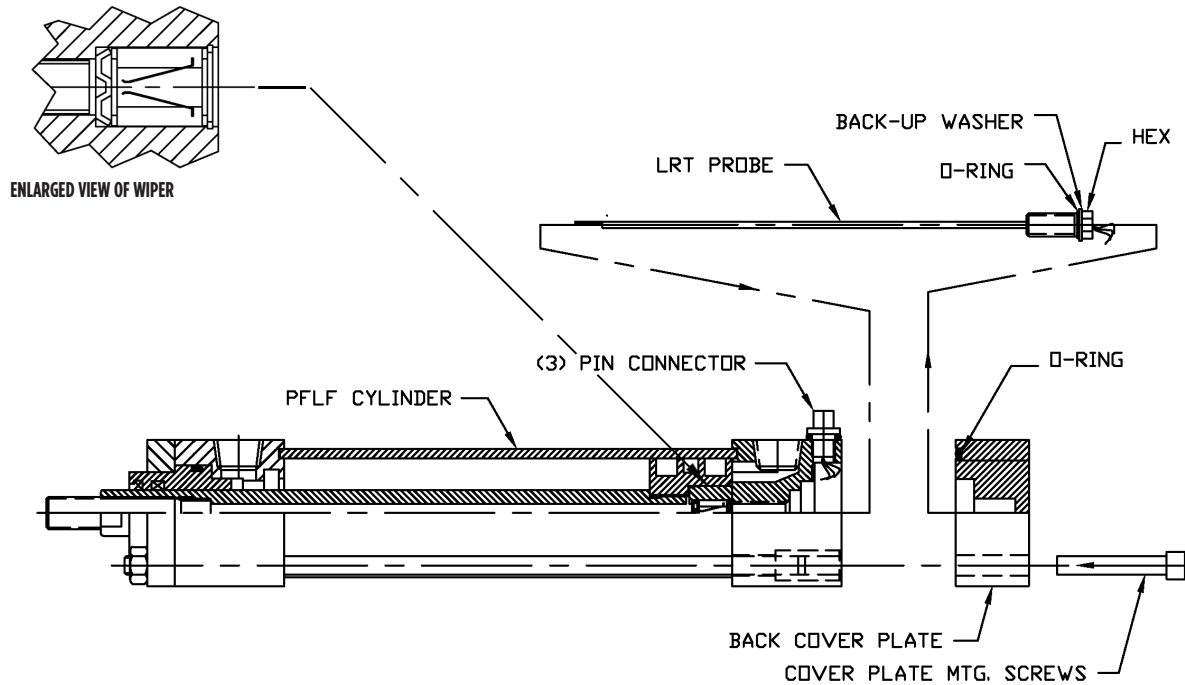
- Ports - Positions 1 and 5
- Cushion Adjustment - Positions 2 and 6
- Specify Non-Standard Positions When Ordering



## PFLF MOUNTS

<b>MX0</b>  1.50"-8.00" Bores	<b>MS4</b>  1.50"-8.00" Bores	<b>MP1</b>  1.50"-8.00" Bores	<b>MP2</b>  1.50"-6.00" Bores	<b>MP4</b>  1.50"-4.00" Bores
<b>MT1</b>  1.50"-8.00" Bores	<b>MT2</b>  1.50"-8.00" Bores	<b>MT4</b>  1.50"-8.00" Bores	<b>MF1</b>  1.50"-6.00" Bores	<b>MF2</b>  1.50"- 6.00" Bores
<b>MX3</b>  1.50"-8.00" Bores	<b>MS1</b>  1.50"-8.00" Bores	<b>MS2</b>  1.50"-4.00" Bores Consult factory for larger size.	<b>ME3</b>  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.

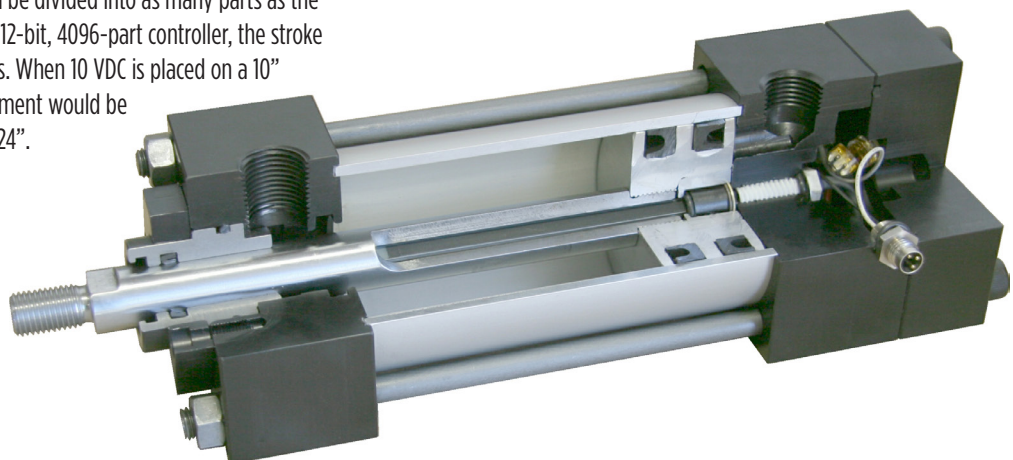
The accuracy of an LRT is determined by three factors: resolution, linearity and repeatability.

**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  $10 \text{ VDC} \div 4096 = 2.4 \text{ millivolts}$  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  $\pm 1$  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 HYDRAULIC CYLINDERS INC.® Position Feedback Cylinder is  $\pm 0.001"$ .



# 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?

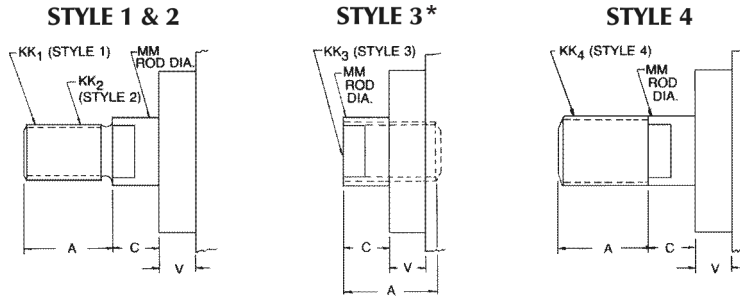
NO PROBLEM! Each Piston Rod is made-to-order and does not delay shipment. Coarse (UNC) threads, Metric threads or just plain rod ends are common. Thread lengths are also made-to-order (Specify: "A"=Length).

NEED SOMETHING NOT LISTED?

Just send us a sketch.

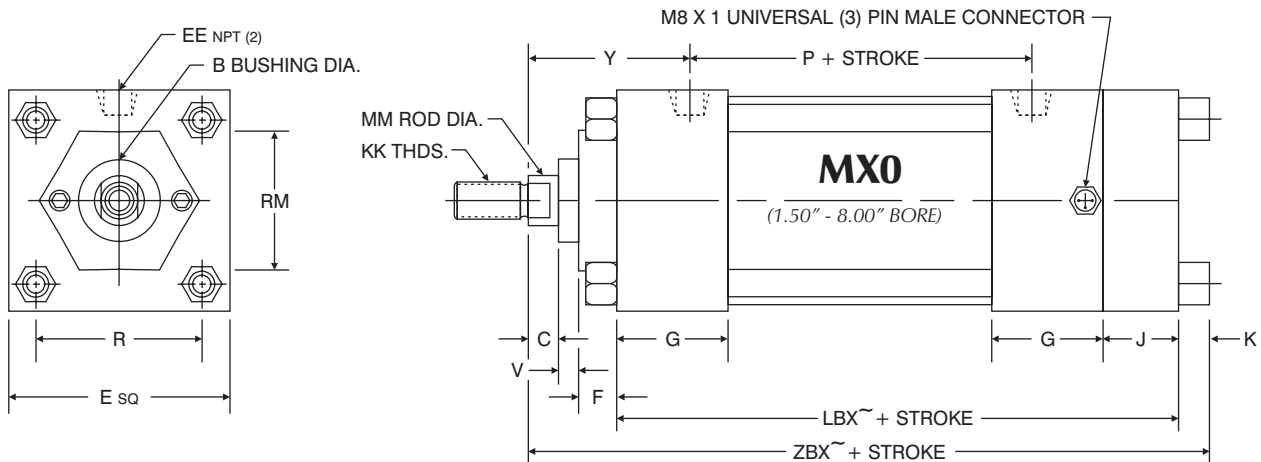
In most cases, quotes are turned around in one day!

## PISTON ROD END STYLES



BORE	MM ROD DIAMETER	STANDARD		OPTIONAL						C	V
		Style 1 - Male		Style 2 - Male		Style 3 - Female		Style 4 - Male			
		KK1	A	KK2	A	KK3	A	KK4	A		
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.

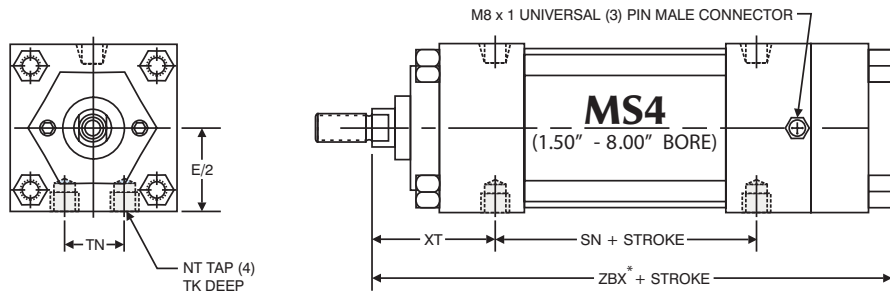


‘MX0’ PFLF CYLINDER DIMENSIONS - STANDARD ROD ONLY																			
BORE	ROD DIAMETER	A	B	C	E	EE	F	G	J	K	KK	LBX-	MM	P	R	RM	V	Y	ZBX-
1.50	0.625	0.750	1.125	0.375	2.000	0.375	0.375	1.500	1.000	0.250	7/16 -20	5.125	0.625	2.375	1.430	2.000 sq.	0.250	1.875	6.375-
2.00	0.625	0.750	1.125	0.375	2.500	0.375	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

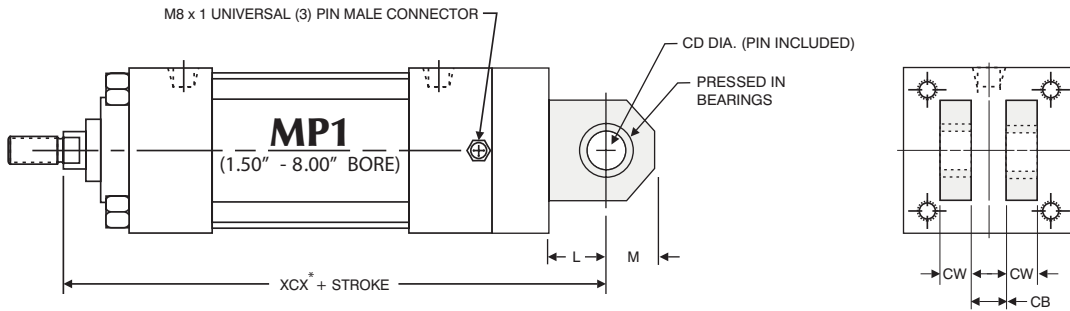
- NON-NFPA Dimensions

# POSITION FEEDBACK LOW FRICTION CYLINDER: DIMENSIONS



'MS4' PFLF CYLINDER DIMENSIONS - STANDARD ROD ONLY								
BORE	ROD DIAMETER	E/2	NT	TK	TN	XT	ADD STROKE	
							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

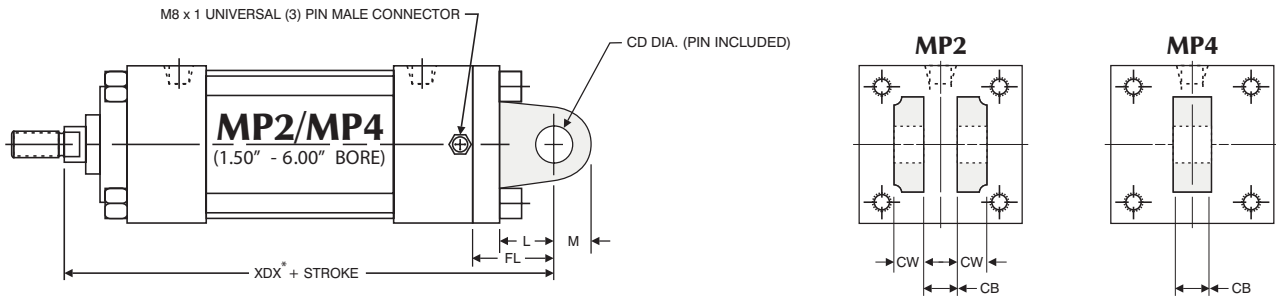
NOTE: All cylinder dimensions not shown are standard 'MX0' cylinder dimensions.  
 \* NON-NFPA Dimensions



'MP1' PFLF CYLINDER DIMENSIONS - STANDARD ROD ONLY							
BORE	ROD DIAMETER	CB	CD	CW	L	M	ADD STROKE
							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

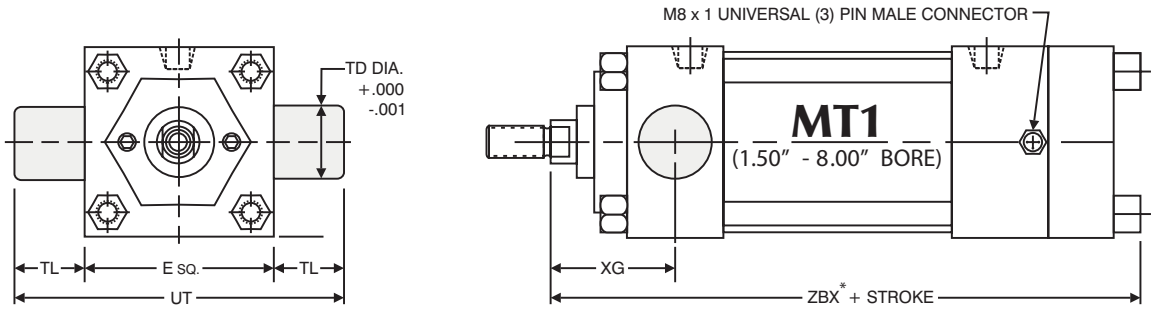
NOTE: All cylinder dimensions not shown are standard 'MX0' cylinder dimensions.  
 1.50" & 2.00" bore MP1 extruded mounts are through tie rod construction.  
 2.50" bore and larger the rear MP1 cap is bolted on.  
 \* NON-NFPA Dimensions

# 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

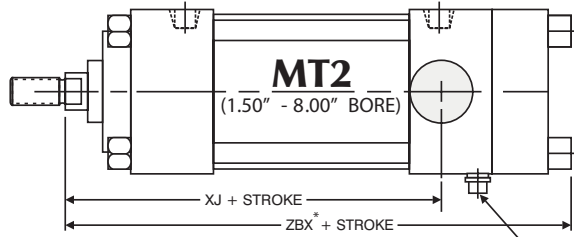
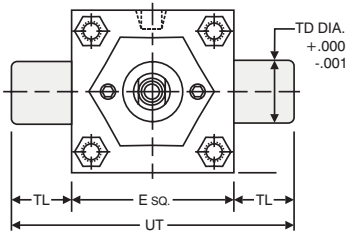
NOTE: All cylinder dimensions not shown are standard ‘MX0’ cylinder dimensions.  
 MP4 CAST MOUNT not available for 5.00" & 6.00" bores.  
 Special WELDED MOUNTS are available. Consult factory for more information.  
 \* NON-NFPA Dimensions



‘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

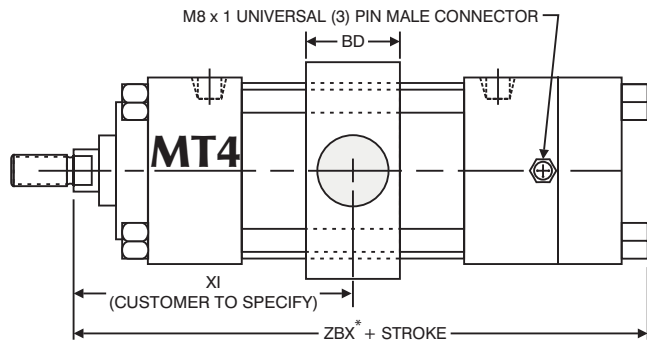
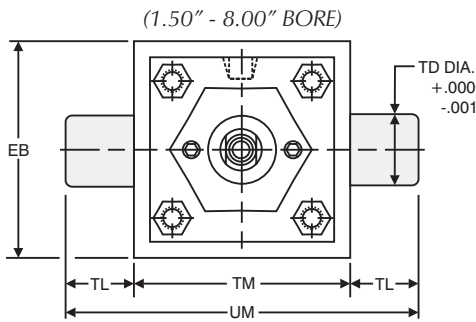
# POSITION FEEDBACK LOW FRICTION CYLINDER: DIMENSIONS



M8 x 1 UNIVERSAL (3) PIN MALE CONNECTOR  
LOCATED 90° TO TRUNNION (POSITION 7)

"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

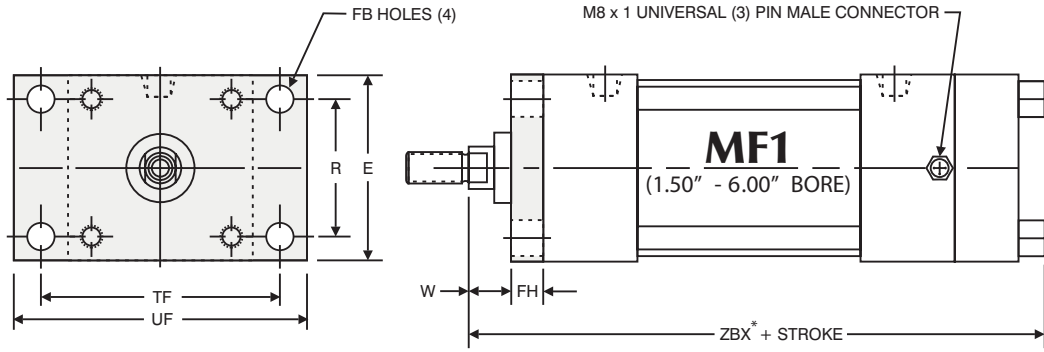


"MT4" PFLF CYLINDER DIMENSIONS - STANDARD ROD ONLY									
BORE	ROD DIAMETER	BD	EB	TD	TL	TM	UM	XI	ADD STROKE
									ZBX*
1.50	0.625 Standard	1.250	2.500	1.000	1.000	2.500	4.500	CUSTOMER TO SPECIFY	6.375
2.00	0.625 Standard	1.500	3.000	1.000	1.000	3.000	5.000		6.438
2.50	0.625 Standard	1.500	3.500	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

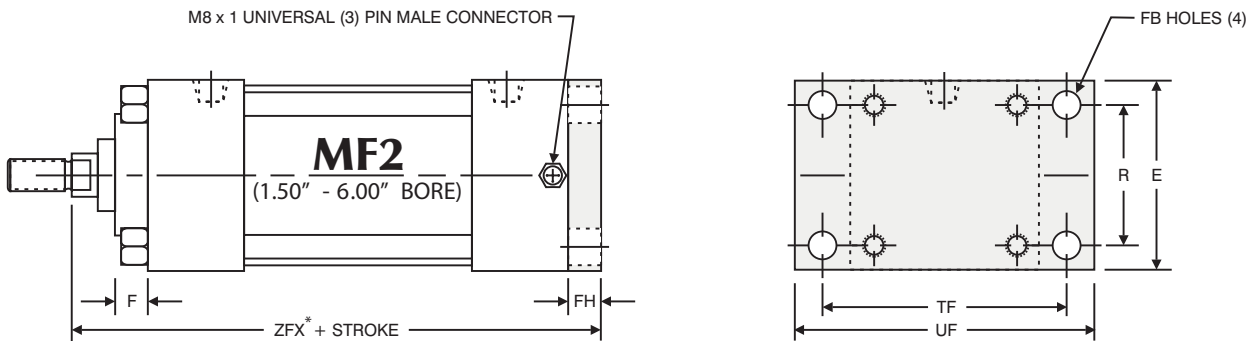


# POSITION FEEDBACK LOW FRICTION CYLINDER: DIMENSIONS



‘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

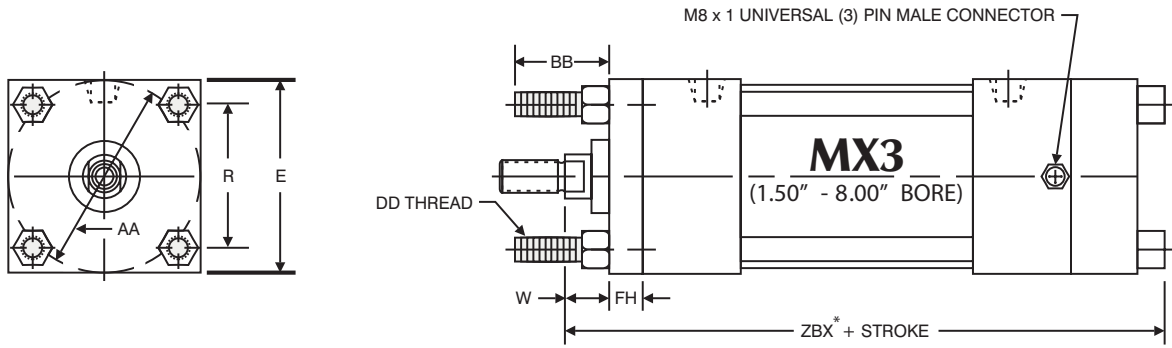
NOTE: All cylinder dimensions not shown are standard ‘MX0’ cylinder dimensions.  
\* NON-NFPA Dimensions



‘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



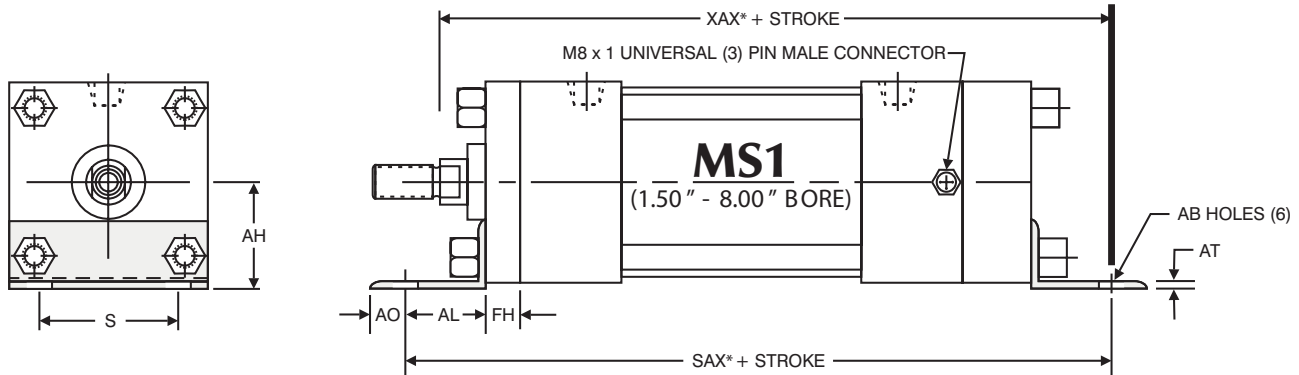
‘MX3’ PFLF CYLINDER DIMENSIONS - STANDARD ROD ONLY										
BORE	ROD DIAMETER	E	FH	R	AA	BB	DD	W	ADD STROKE	
									ZBX*	
1.50	0.625 Standard	2.000	0.375	1.430	2.020	1.000	1/4 -28	0.625	6.375	
2.00	0.625 Standard	2.500	0.375	1.840	2.600	1.125	5/16 -24	0.625	6.438	
2.50	0.625 Standard	3.000	0.375	2.190	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.



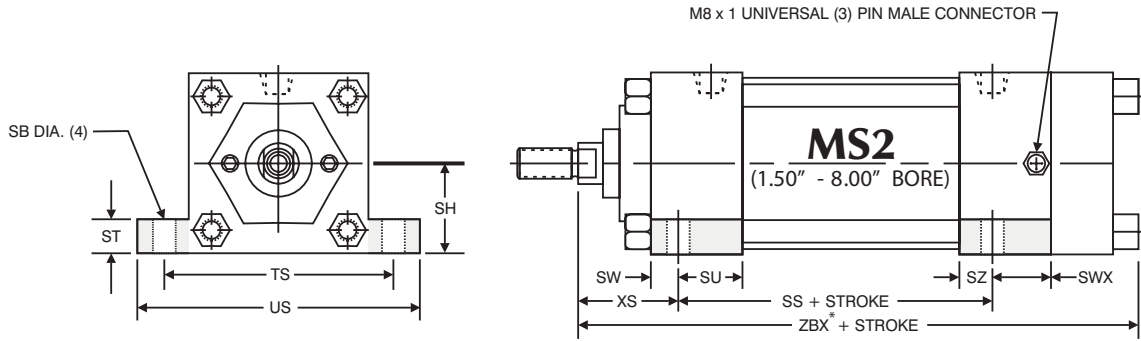
‘MS1’ PFLF CYLINDER DIMENSIONS - STANDARD ROD ONLY										
BORE	ROD DIAMETER	AB	AH	AL	AO	AT	FH	S	ADD STROKE	
									SAX*	XAX*
1.50	0.625 Standard	0.438	1.188	1.000	0.375	0.125	0.375	1.250	7.500	7.125
2.00	0.625 Standard	0.438	1.438	1.000	0.375	0.125	0.375	1.750	7.500	7.125
2.50	0.625 Standard	0.438	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

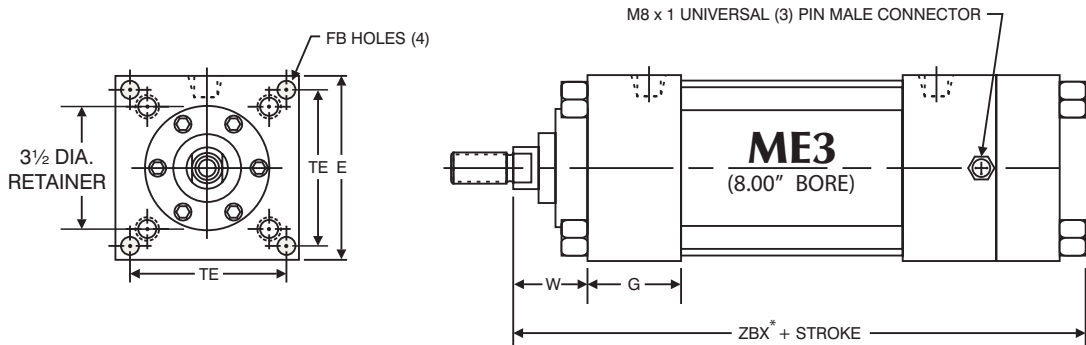


MS2 PFLF CYLINDER DIMENSIONS - STANDARD ROD ONLY												ADD STROKE	
BORE	ROD DIAMETER	SB	SH	ST	SU	SW	SZ	TS	US	XS	SWX*	SS	ZBX*
1.50	0.625 Standard	0.438	1.000	0.500	1.125	0.375	0.625	2.750	3.500	1.375	0.875	2.875	6.375
2.00	0.625 Standard	0.438	1.250	0.500	1.125	0.375	0.625	3.250	4.000	1.375	0.875	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: 0 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: 0° to 200° F**

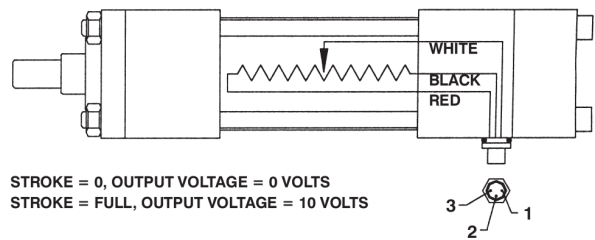
(Cylinder & Probe)

**Maximum Speed: 25 in./sec.**

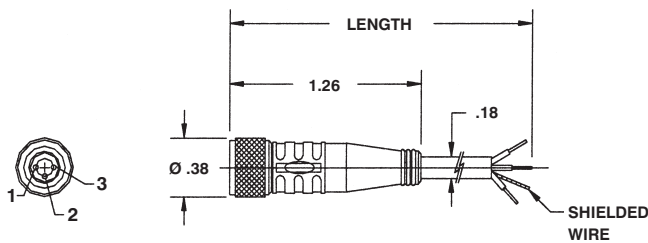
**Interface: 8mm DIN connector**

**NEMA: 6 (IP67)**

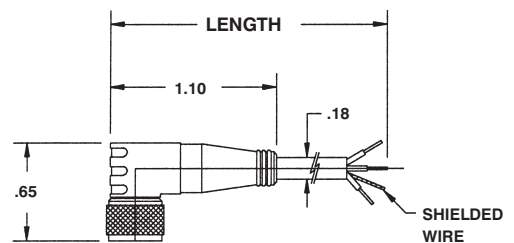
WIRE DESCRIPTION	PROBE/ PLUG WIRE COLORS	PLUG PIN NUMBERS	QUICK CONNECT CABLE/ WIRE COLORS
INPUT (+)	RED	3	BLUE
GROUND (-)	BLACK	2	BLACK
OUTPUT	WHITE	1	BROWN



## Straight-Models C4-S (2m), C4X-S (5m)

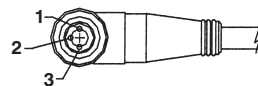


## Right Angle-Models C5-S (2m), C5X-S (5m)



**CONDUCTOR COLORS:**

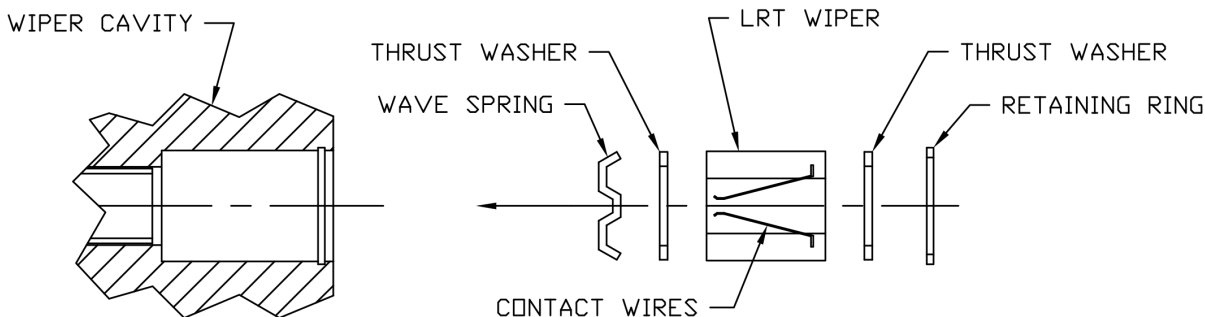
- 1 - BROWN
- 2 - BLACK
- 3 - BLUE



**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

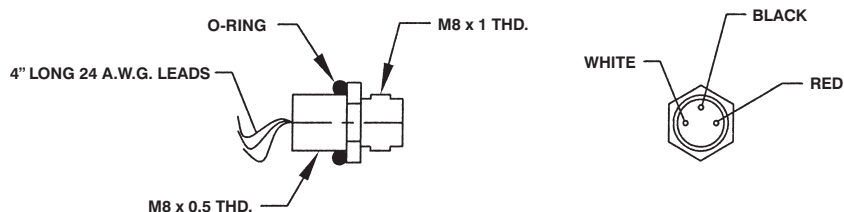


**PROBE WIRE COLORS:**  
 RED = SUPPLY (+)  
 BLACK = GROUND (-)  
 WHITE = OUTPUT

### 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 HYDRAULIC CYLINDERS INC.® Pneumatic Control System (Model PCS) is designed to control any 1.50”-4.00” bore pneumatic HYDRAULIC CYLINDERS INC.® 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.

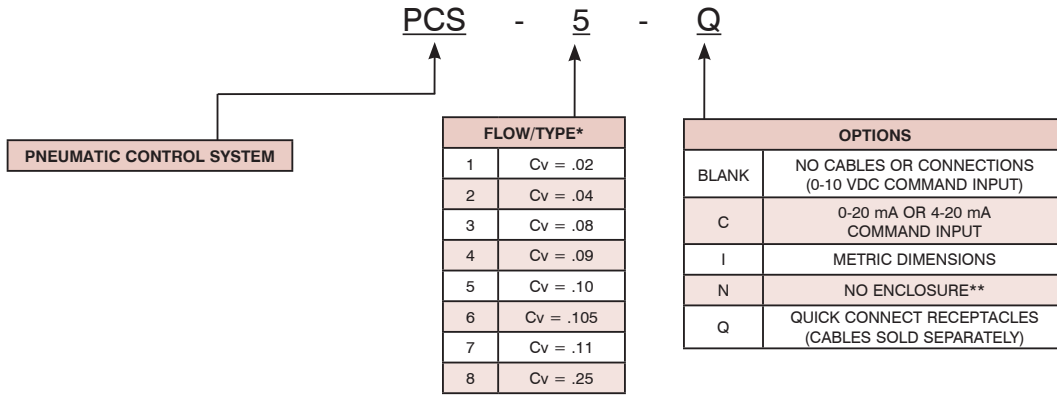
The system utilizes the feedback from the actuator to close the control loop. The control loop compares the system’s command signal (the 0-10 VDC, 0-20 mA, or 4-20 mA input command signal) to the feedback signal from the actuator. The difference between the command and feedback is referred to as the 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



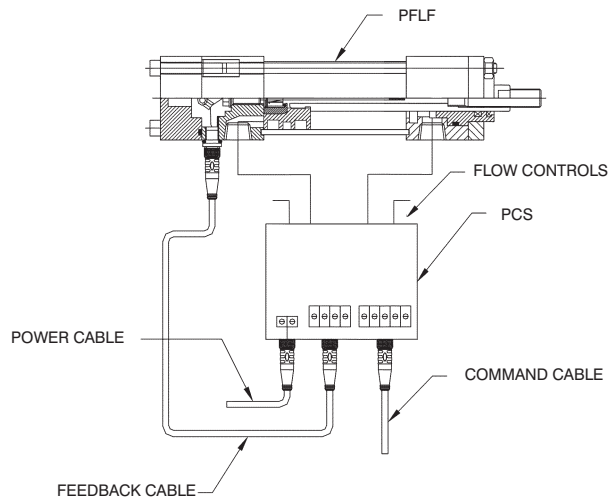
\* The Cv values are approximated. The velocities for the different systems are shown in the sizing recommendations chart.

\*\* 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 <b>100°F</b> (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:  $w=0.1(V) \times t$ , 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,  $w=0.1 (0.02) \times 6=\pm 0.012$  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:

$$CS = 2 \times 10 / 7.5 + 0 = 2.667 \text{ VDC Command Input Signal}$$

If a 4-20 mA signal is used, the command input signal would be calculated as follows:

$$CS = 2 \times 16 / 7.5 + 4 = 8.267 \text{ mA Command Input Signal}$$

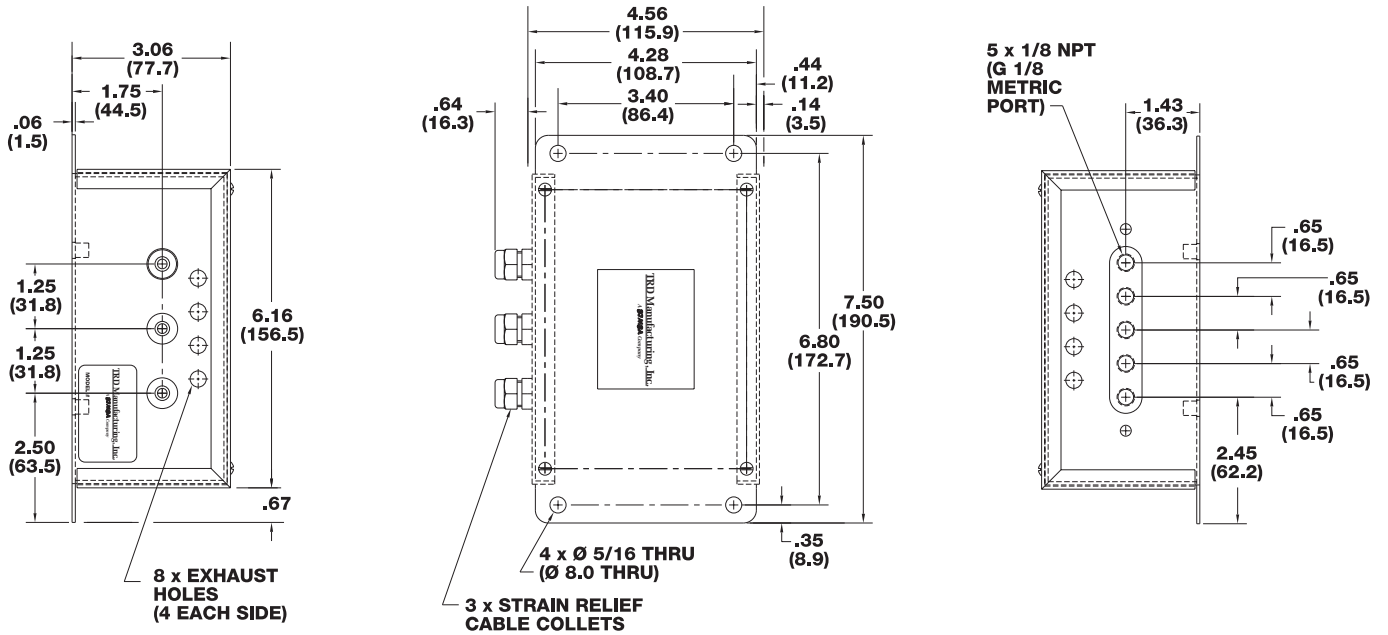
Note: The positional repeatability of the system will be determined by the Dead-band adjustment. If the dead-band was adjusted to  $\pm 20\text{mV}$  in this example, the system would position to the 2 inch position within  $\pm 0.015"$  ( $w=0.1 \text{ (V)} * t$ ).

# PNEUMATIC CONTROL SYSTEM (PCS): DIMENSIONS

## PCS1 THROUGH PCS3

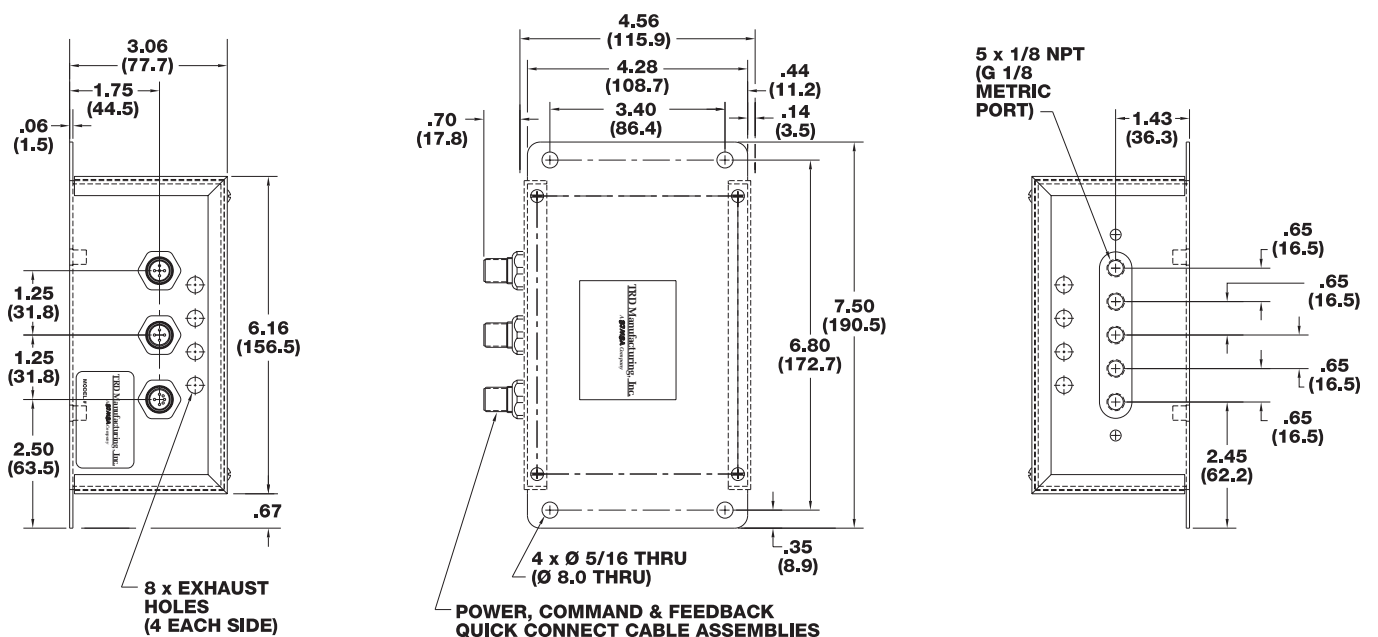
Shown in inches (millimeters are in parenthesis)

### ENCLOSURE



### OPTION Q

(Quick Connect Receptacle)

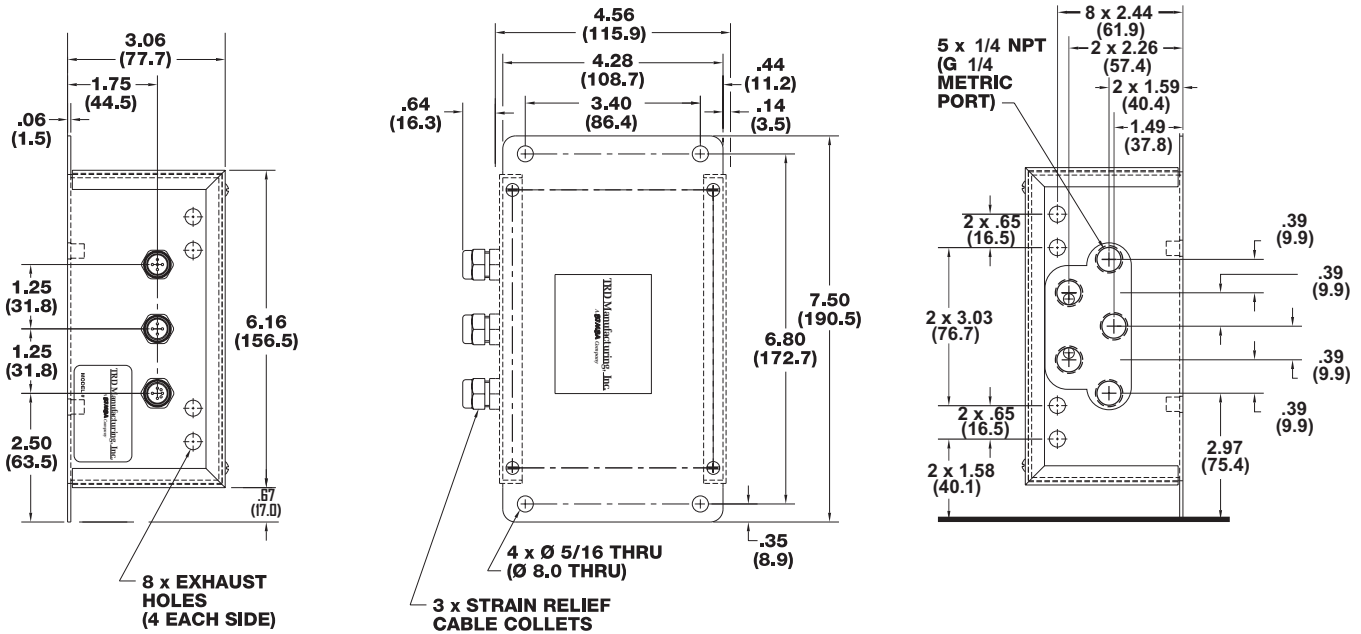


# PNEUMATIC CONTROL SYSTEM (PCS): DIMENSIONS

## PCS4 THROUGH PCS8

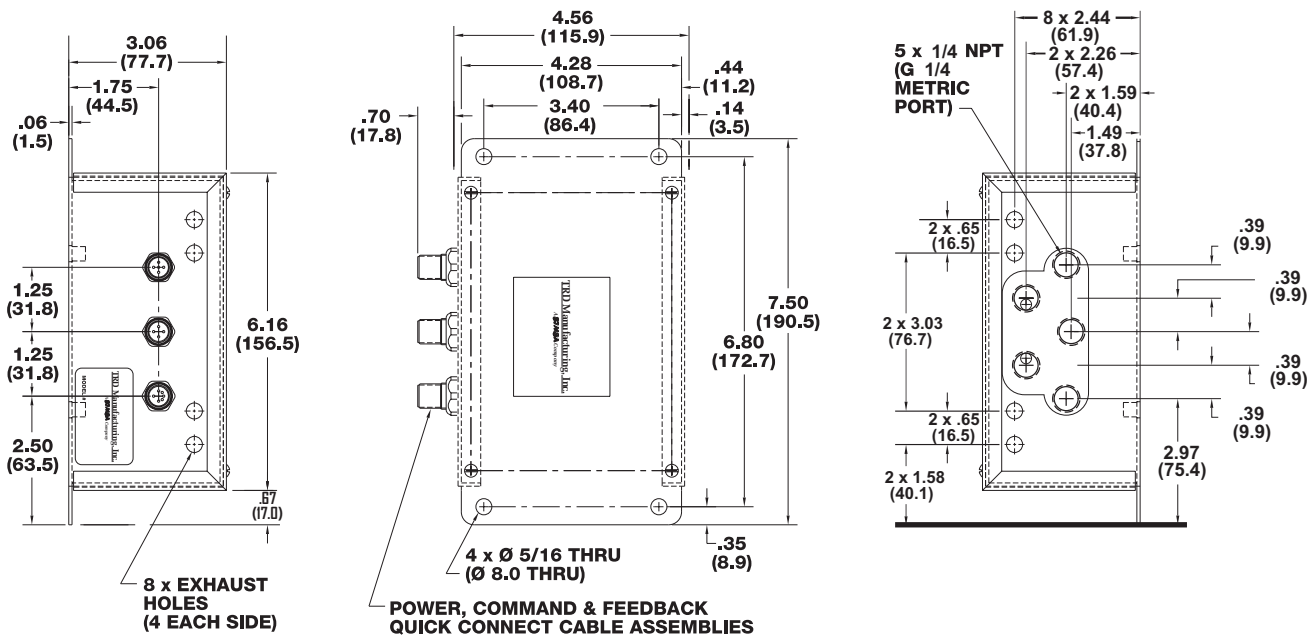
Shown in inches (millimeters are in parenthesis)

### ENCLOSURE



### OPTION Q

(Quick Connect Receptacle)

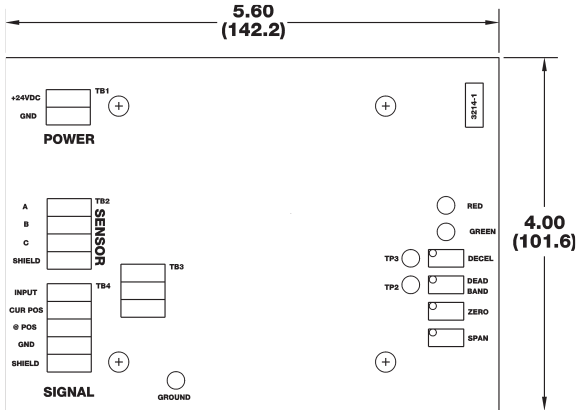


# PNEUMATIC CONTROL SYSTEM (PCS): DIMENSIONS

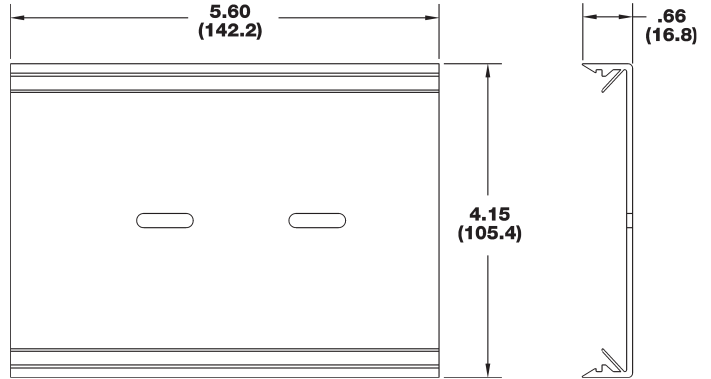
Shown in inches (millimeters are in parenthesis)

## OPTION N (No Enclosure)

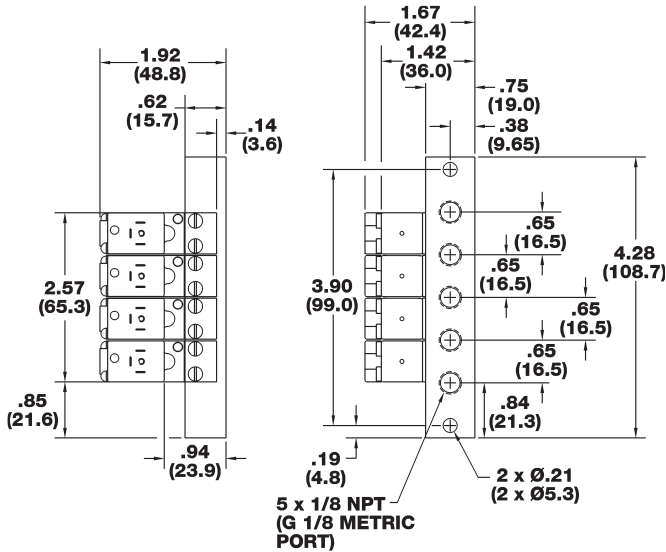
### PC BOARD



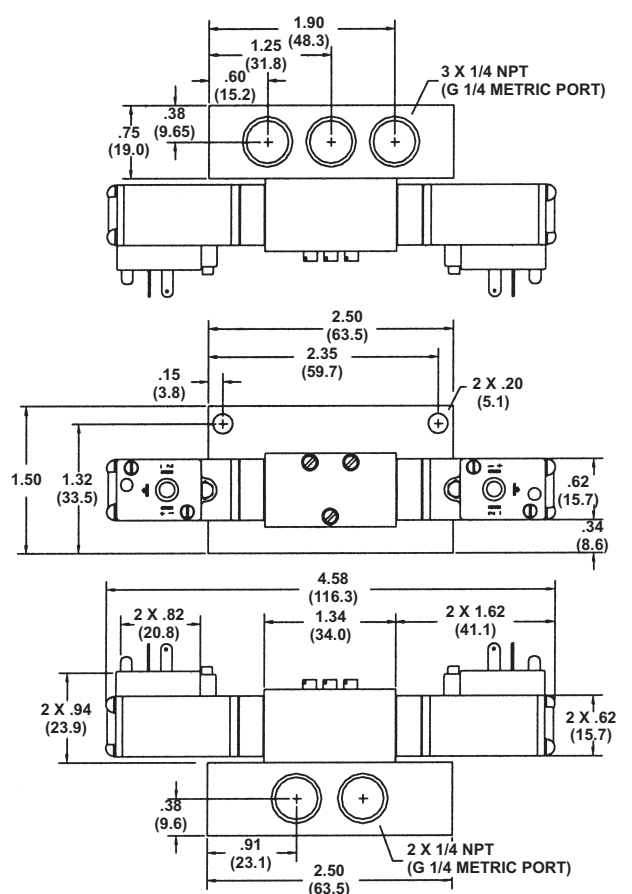
### SNAP TRACK



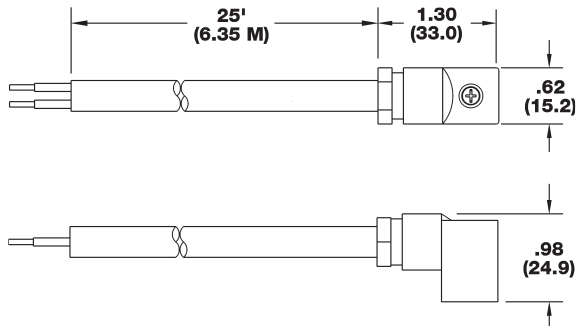
### VALVE/MANIFOLD PCS1 THROUGH PCS3



### VALVE/MANIFOLD PCS4 THROUGH PCS8



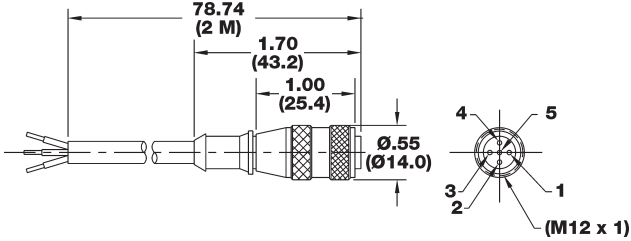
### VALVE CABLE



# PNEUMATIC CONTROL SYSTEM (PCS): ACCESSORIES

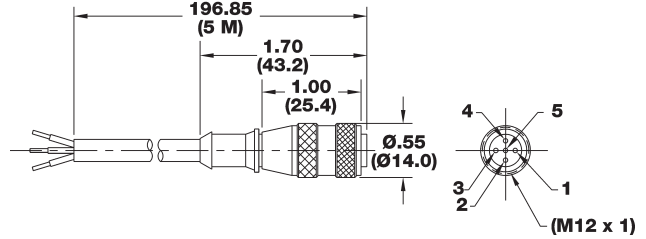
## PCS-CBL-PWR

**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

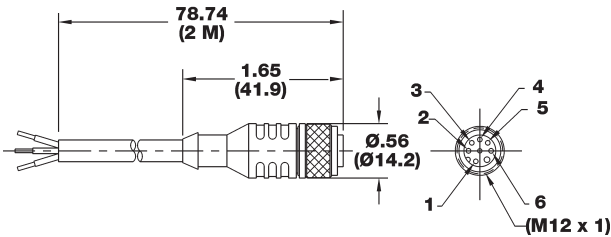
COLOR	PIN	DESCRIPTION
BROWN	1	POSITIVE
WHITE	2	N/C
BLUE	3	NEGATIVE
BLACK	4	N/C

### 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

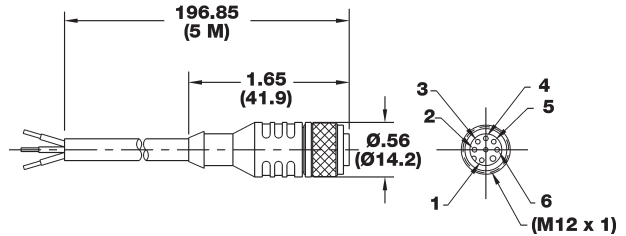
## PCS-CBL-CMD

**SPECIFICATIONS**  
6 CONDUCTORS OF 24 AWG LEADS RATED TO EITHER 30 VAC OR 36 VDC AT 4 AMPS SHIELDED



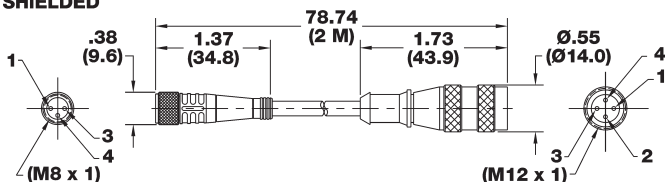
## PCS-CBL-CMD-X

**SPECIFICATIONS**  
6 CONDUCTORS OF 24 AWG LEADS RATED TO EITHER 30 VAC OR 36 VDC AT 4 AMPS SHIELDED



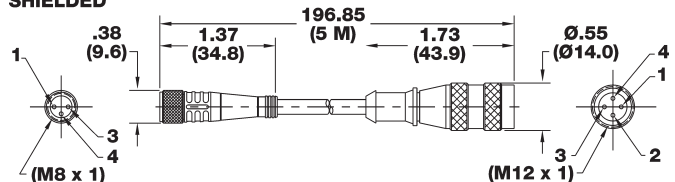
## PCS-CBL-FBK

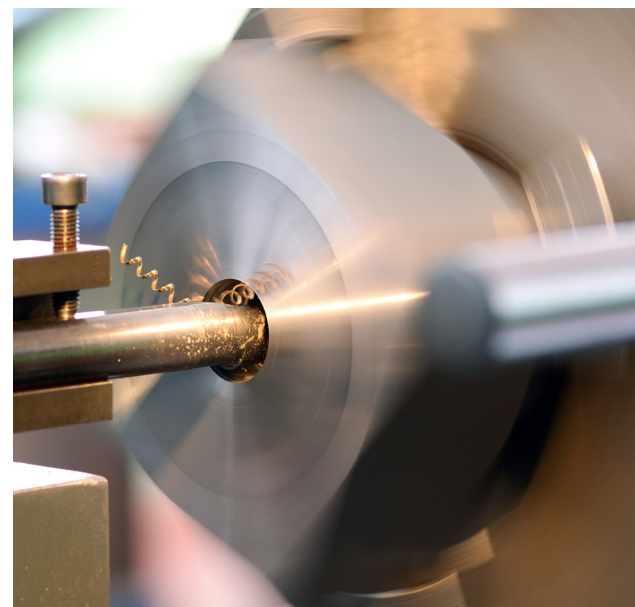
**SPECIFICATIONS**  
3 CONDUCTORS OF 24 AWG LEADS RATED TO 120 V AT 4 AMPS SHIELDED



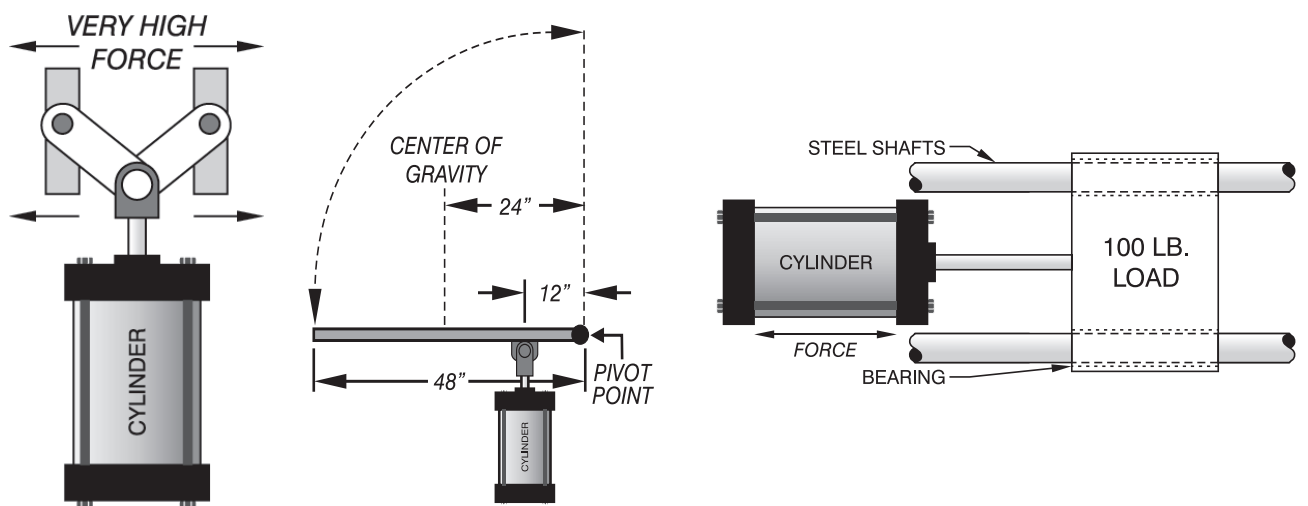
## PCS-CBL-FBK-X

**SPECIFICATIONS**  
3 CONDUCTORS OF 24 AWG LEADS RATED TO 120 V AT 4 AMPS SHIELDED



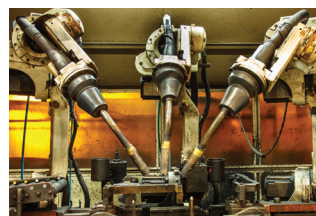
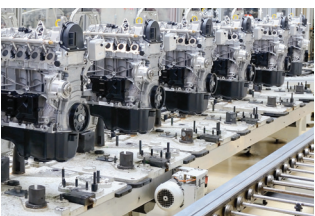


## Technical Data



PNEUMATIC

- General "How To" Info ..... 193
- Force Charts ..... 195
- Weight Charts ..... 197
- Seal Kits ..... 199
- Cylinder Charts & Fluid Power Formulas ..... 202
- HYDRAULIC CYLINDERS INC.® Checklist ..... 202



# 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.

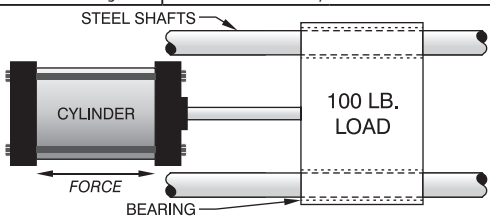
Once you've determined the force you need to move the load at the desired velocity and allow for friction, here's how to find the cylinder bore that meets your specifications.

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).

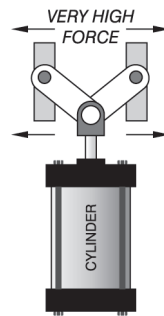
Plain Bearing Material	Cylinder Force	
	Dry Bearing	Oiled Bearing
PTFE	10 lbs.	10 lbs.
UHMW	20 lbs.	20 lbs.
Hardened Steel	25 lbs.	20 lbs.
Brass	40 lbs.	25 lbs.
Cast Iron	45 lbs.	25 lbs.
Steel (soft)	85 lbs.	25 lbs.
Ball Bearing	5-10 lb. Cylinder Force	



## GENERAL MECHANICS

### TOGGLE

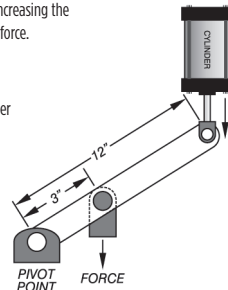
Toggles are complex mechanisms that can achieve very high force.



### FORCE MULTIPLYING LEVER

Force Multiplying Levers reduce the cylinder output stroke, while increasing the output force.

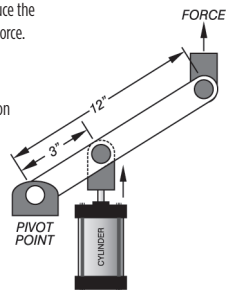
4:1 Force Multiplier (400%)



### FORCE REDUCING LEVER

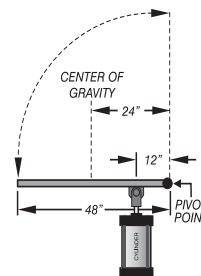
Force Reducing Levers increase the cylinder output stroke but reduce the output force.

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.



$$\text{LOAD CENTER OF GRAVITY} = \frac{48''}{2} = 24''$$

$$\text{LEVER} = \frac{24''}{12''} = 2:1$$

$$\text{FORCE} = 2 \times 2,000 \text{ LBS.} = 4,000 \text{ LBS.}$$

$$\text{FORCE (INCLUDING} = 4,000 \times 1.25 = 5,000 \text{ LBS.}$$

AT 100 PSI AIR PRESSURE, THE FORCE CHART (ON PAGE 119) SHOWS THAT AN 8" BORE HAS 5,026 LBS. FORCE.



# TECHNICAL DATA

## 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 its service life. The wrong mounting or incorrect installation, can result in side load, which creates excessive wear on the piston, piston rod, rod bearing and seals. When wear occurs, leakage usually follows and that's how cylinders fail.

Side load occurs when a load is placed on the piston rod without guidance or support, or when the mounting and piston rod connection are misaligned. It can also occur in pivot type mounts when the weight of the cylinder places load on the piston and rod bearing points.

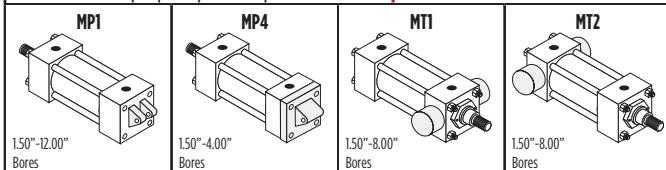
There are cylinder mounts and options to suit virtually every application.

### Pivot Type Mountings: Clevis & Trunnion

Pivot type of mounts can eliminate side load in one plane, but careful alignment in the other plane is crucial. Since HYDRAULIC CYLINDERS INC.® 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

#### Samples of Pivot Mounts:

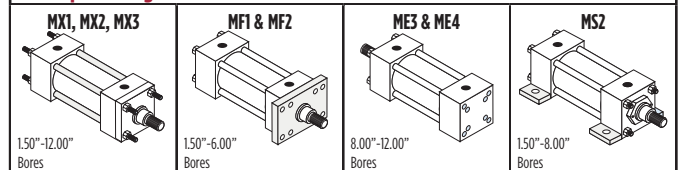


### Rigid Mount Cylinders

Base mounted, flange mounted and tie-rod mounted cylinders must be carefully aligned with the direction of load travel to avoid side loads.

If for some reason, proper alignment cannot be maintained throughout the entire cylinder stroke, a rod end connection that allows for some lateral misalignment should be used. HYDRAULIC CYLINDERS INC.® 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:



## Choose options that enhance and extend the working life of your cylinders.

**Cushions** can be designed into either one or both ends of the cylinder to provide controlled deceleration. This option prevents excessive end-of-stroke impact, reducing vibration and noise. Cushions are designed to stop light loads at moderate speeds. Heavy loads or higher speed applications may require shock absorbers. Your local distributor representative is qualified to provide expert advice on what options are best suited for your application.

**Bumper Piston Seals.** Whether used by themselves or with cushions, bumper piston seals provide additional controlled deceleration at end of stroke.

**Wear band.** A .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-borne particles associated with the normal cylinder operation.

**Switches.** Position sensing switches give you the potential for expanding the capabilities of your cylinder functions to include accurate piston sensing, event timing, sequencing and more. Magnetically operated, the switches are mounted to the exterior of the cylinder where they are actuated by a magnet contained on the piston.

# 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	.00156
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	1051	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	1151	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.

\*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	2.2	2.5	.20
2.00	2.4	2.9	2.4	3.2	3.3	3.2	3.2	3.2	3.6	.25
2.50	3.3	3.9	3.3	4.3	4.5	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	10.0	9.0	.51
4.00	8.8	10.5	8.8	12.1	13.3	13.2	13.2	13.2	11.1	.55
5.00	13.2	14.3	13.2	17.8	19.9	N/A	20.0	20.0	17.5	.59
6.00	21.5	25.2	21.5	29.7	32.2	N/A	32.2	32.2	27.2	.84
8.00	35.4	36.5	35.4	43.5	N/A	N/A	35.4	N/A	N/A	1.25
10.00	70.3	N/A	70.0	72.0	N/A	N/A	70.3	N/A	N/A	1.60
12.00	107.9	N/A	N/A	109.9	N/A	N/A	107.5	N/A	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								ADD PER IN. OF STROKE	ROD LOCK UNIT ONLY
		MXO	MS1 MT1/MT2	MS4	MP1	MP2	MP4	MF1 MF2	MS2 BASEBAR		
1.50	0.625	3.3	3.7	3.3	3.8	3.9	3.9	3.9	4.2	0.20	1.23
	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
		MXO/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
		MXO/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 MX0	MX1 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	

TECHNICAL DATA / WEIGHT CHARTS

## 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 HYDRAULIC CYLINDERS INC.® 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 HYDRAULIC CYLINDERS INC.® 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 HYDRAULIC CYLINDERS INC.® serial number.

## 3-POSITION & TANDEM

BORE	STANDARD SINGLE ROD END			
	PART NUMBER	WITH CUSHIONS		
		H	C	HC
1.50	TSK625-150	TSK625-150-H	TSK625-150-C	TSK625-150-HC
2.00	TSK625-200	TSK625-200-H	TSK625-200-C	TSK625-200-HC
2.50	TSK625-250	TSK625-250-H	TSK625-250-C	TSK625-250-HC
3.25	TSK100-325	TSK100-325-H	TSK100-325-C	TSK100-325-HC
4.00	TSK100-400	TSK100-400-H	TSK100-400-C	TSK100-400-HC
5.00	TSK100-500	TSK100-500-H	TSK100-500-C	TSK100-500-HC
6.00	TSK137-600	TSK137-600-H	TSK137-600-C	TSK137-600-HC
8.00	TSK137-800	TSK137-800-H	TSK137-800-C	TSK137-800-HC

BORE	OVERSIZE SINGLE ROD END			
	PART NUMBER	WITH CUSHIONS		
		H	C	HC
1.50	TSK100-150	N/A	TSK100-150-C	N/A
2.00	TSK100-200	TSK100-200-H	TSK100-200-C	TSK100-200-HC
2.50	TSK100-250	TSK100-250-H	TSK100-250-C	TSK100-250-HC
3.25	TSK137-325	TSK137-325-H	TSK137-325-C	TSK137-325-HC
4.00	TSK137-400	TSK137-400-H	TSK137-400-C	TSK137-400-HC
5.00	TSK137-500	TSK137-500-H	TSK137-500-C	TSK137-500-HC
6.00	TSK175-600	TSK175-600-H	TSK175-600-C	TSK175-600-HC
8.00	TSK175-800	TSK175-800-H	TSK175-800-C	TSK175-800-HC

## SERIES 'TD'

BORE	STANDARD SINGLE ROD END		KITS INCLUDE CUSHION SEALS AND WEAR BAND
	PART NUMBER		
1.50	TDSK625-150		
2.00	TDSK625-200		
2.50	TDSK625-250		
3.25	TDSK100-325		
4.00	TDSK100-400		
5.00	TDSK100-500		
6.00	TDSK137-600		
8.00	TDSK137-800		

BORE	OVERSIZE SINGLE ROD END		KITS INCLUDE CUSHION SEALS AND WEAR BAND
	PART NUMBER		
1.50	TDSK100-150		
2.00	TDSK100-200		
2.50	TDSK100-250		
3.25	TDSK137-325		
4.00	TDSK137-400		
5.00	TDSK137-500		
6.00	TDSK175-600		
8.00	TDSK175-800		

**NOTE:** To insure proper seals are supplied for all models, ALWAYS supply HYDRAULIC CYLINDERS INC.® serial number.

## SERIES 'NR' (Internally Guided Non-Rotating)

BORE	PISTON ROD DIA.	PART NUMBER
2.00	0.625	SK625-200-NR
	0.625	SK625-250-NR
2.50	1.000	SK100-250-NR
	1.000	SK100-325-NR
3.25	1.375	SK137-325-NR
	1.000	SK100-400-NR
4.00	1.375	SK137-400-NR
	1.000	SK100-500-NR
5.00	1.375	SK137-500-NR
	1.375	SK137-600-NR
6.00	1.750	SK175-600-NR
	1.375	SK137-800-NR
8.00	1.750	SK175-800-NR
	1.750	SK175-1000-NR
10.00	2.000	SK200-1000-NR
	2.000	SK200-1200-NR
12.00	2.500	SK250-1200-NR

**NOTE:** Add suffix H and/or C to indicate if cushion seals are required on Head and/or Cap.

**Example:** SK100-400-HC-NR

## 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	MSESK625-150-2S	1.50	MSESK100-150-2S
	MSESK625-150-3S		MSESK100-150-3S
	MSESK625-150-4S		MSESK100-150-4S
2.00	MSESK625-200-2S	2.00	MSESK100-200-2S
	MSESK625-200-3S		MSESK100-200-3S
	MSESK625-200-4S		MSESK100-200-4S
2.50	MSESK625-250-2S	2.50	MSESK100-250-2S
	MSESK625-250-3S		MSESK100-250-3S
	MSESK625-250-4S		MSESK100-250-4S
3.25	MSESK100-325-2S	3.25	MSESK137-325-2S
	MSESK100-325-3S		MSESK137-325-3S
	MSESK100-325-4S		MSESK137-325-4S
4.00	MSESK100-400-2S	4.00	MSESK137-400-2S
	MSESK100-400-3S		MSESK137-400-3S
	MSESK100-400-4S		MSESK137-400-4S
5.00	MSESK100-500-2S	5.00	MSESK137-500-2S
	MSESK100-500-3S		MSESK137-500-3S
	MSESK100-500-4S		MSESK137-500-4S
6.00	MSESK137-600-2S	6.00	MSESK175-600-2S
	MSESK137-600-3S		MSESK175-600-3S
	MSESK137-600-4S		MSESK175-600-4S
8.00	MSESK137-800-2S	8.00	MSESK175-800-2S
	MSESK137-800-3S		MSESK175-800-3S
	MSESK137-800-4S		MSESK175-800-4S

# TECHNICAL DATA: SEAL KITS

## SERIES 'TAS'

**NOTE: To insure proper seals are supplied for all models, ALWAYS supply HYDRAULIC CYLINDERS INC.® serial number.**

BORE	STANDARD SINGLE ROD END				STANDARD DOUBLE ROD END		
	PART NO.	WITH CUSHIONS			PART NO.	WITH CUSHIONS	
		H	C	HC		H	HC
1.50	SK 625-150-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

BORE	OVERSIZE SINGLE ROD END				OVERSIZE DOUBLE ROD END		
	PART NO.	WITH CUSHIONS			PART NO.	WITH CUSHIONS	
		H	C	HC		H	HC
1.50	SK 100-150-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 HYDRAULIC CYLINDERS INC.® serial number.**

BORE	STANDARD SINGLE ROD END				STANDARD DOUBLE ROD END		
	PART NO.	WITH CUSHIONS			PART NO.	WITH CUSHIONS	
		H	C	HC		H	HC
1.50	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

BORE	OVERSIZE SINGLE ROD END				OVERSIZE DOUBLE ROD END		
	PART NO.	WITH CUSHIONS			PART NO.	WITH CUSHIONS	
		H	C	HC		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				CELSIUS TO FAHRENHEIT CONVERSION			
F°	C°	F°	C°	C°	F°	C°	F°
-30	-34.4	130	54.4	-30	-22	65	149
-20	-28.9	140	60.0	-20	-4	70	158
-10	-23.3	150	65.6	-10	14	75	167
0	-17.8	160	71.1	0	32	80	176
10	-12.2	170	76.7	5	41	85	185
20	-6.7	180	82.2	10	50	90	194
30	-1.1	190	87.8	15	59	95	203
40	4.4	200	93.3	20	68	100	212
50	10.0	210	98.9	25	77	105	221
60	15.6	220	104.4	30	86	110	230
70	21.1	230	110.0	35	95	115	239
80	26.7	240	115.6	40	104	120	248
90	32.2	250	121.1	45	113	125	257
100	37.8	300	148.9	50	122	130	266
110	43.3	350	176.7	55	131	150	302
120	48.9	400	204.4	60	140	200	392

C° = (F° - 32) ÷ 1.8

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	1778.0	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

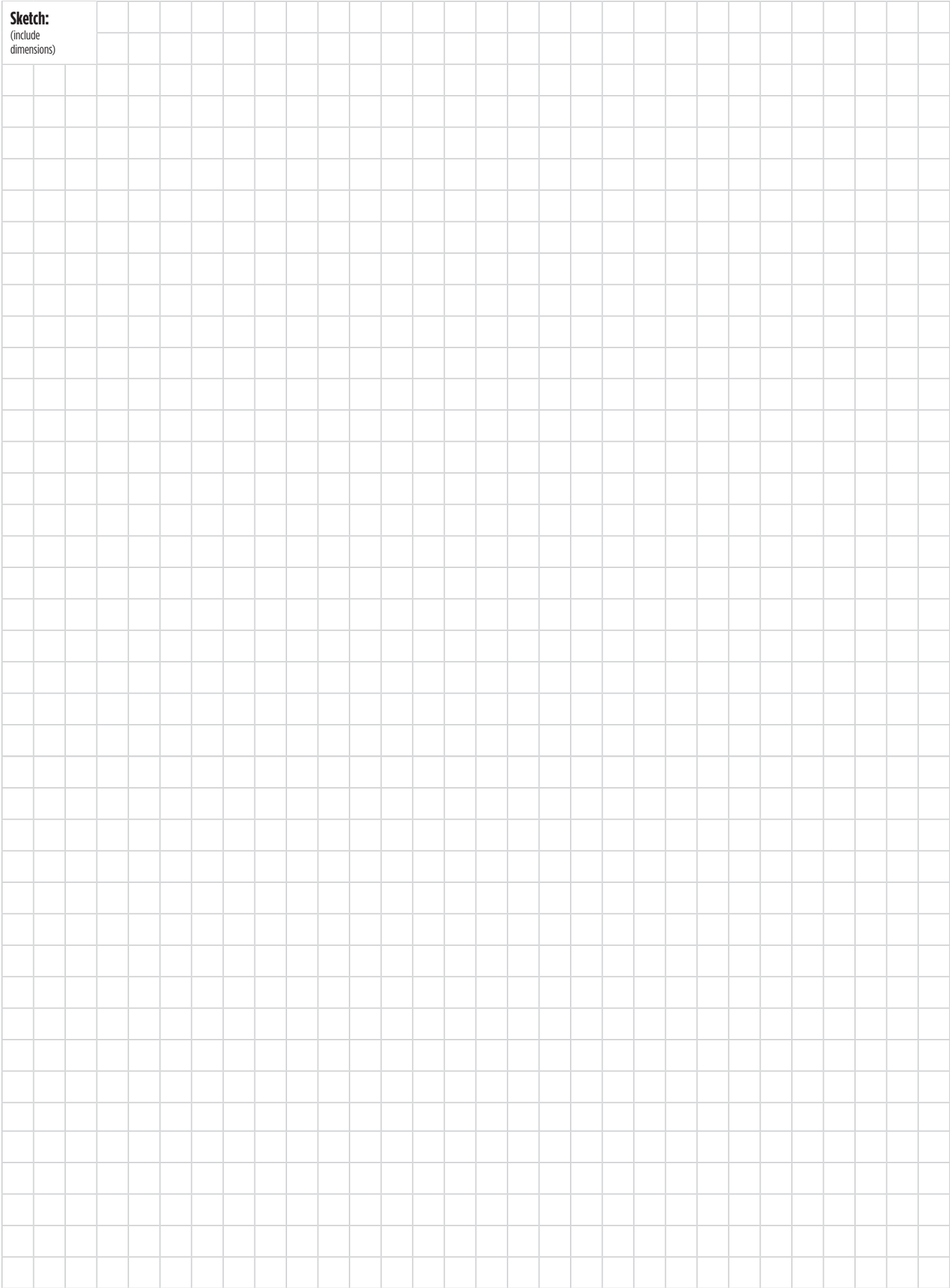
in. = cm x .394

# TECHNICAL DATA

## COMMON FLUID POWER FORMULAS

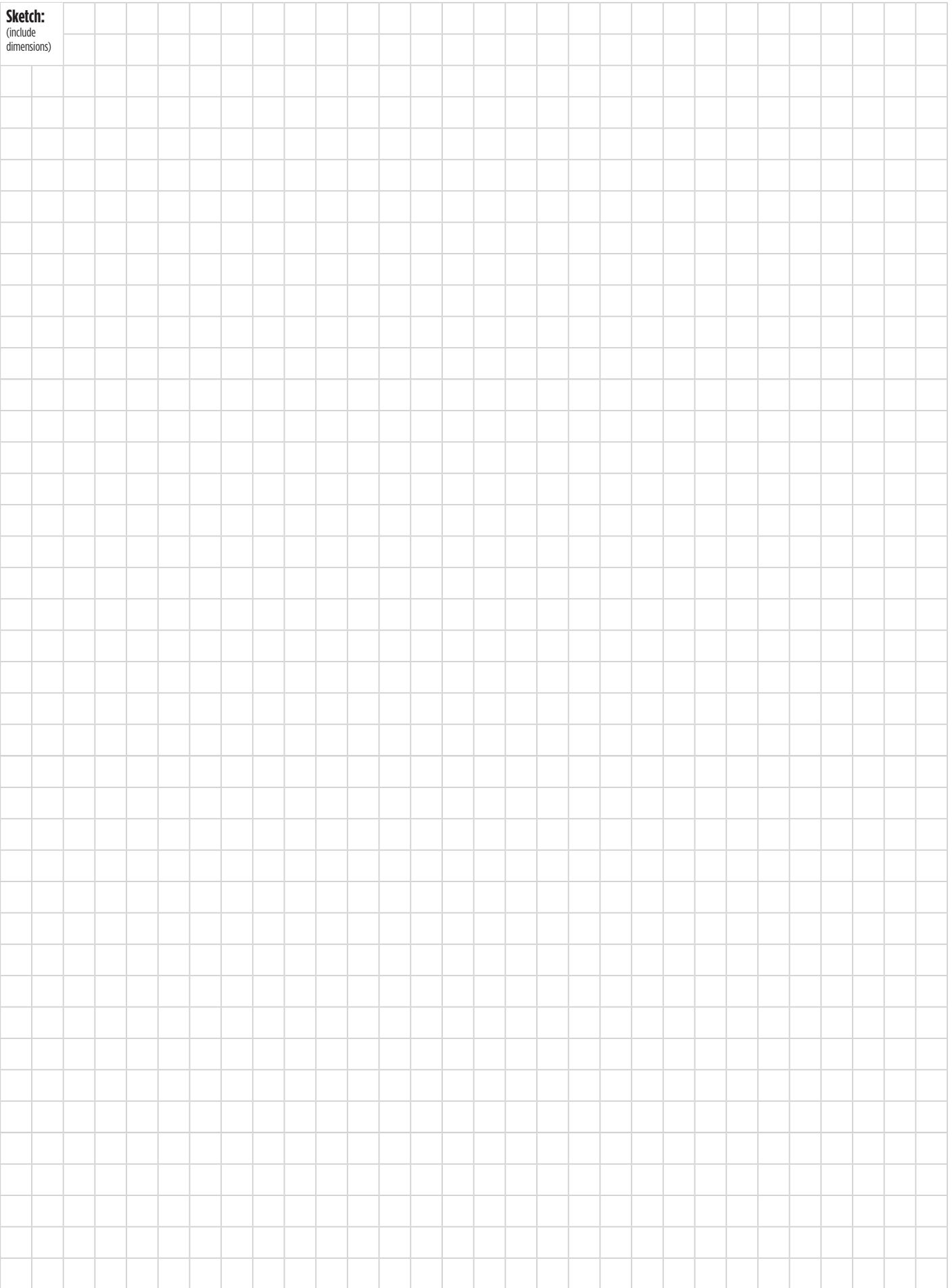
PROPERTY	WORD FORMULA	MATHEMATIC EQUATION
<b>FLUID PRESSURE</b> psi (Pounds per Square Inch)	Pressure = $\frac{\text{Force (lbs)}}{\text{Area (in}^2\text{)}}$	$P = \frac{F}{A}$
<b>CYLINDER AREA EXTEND</b> in <sup>2</sup> (Square Inches)	Area = $\frac{\pi}{4} \times \text{Diameter}^2$ (inches)	$A = .7854 D^2$
<b>CYLINDER AREA RETRACT</b> in <sup>2</sup> (Square Inches)	Area = $(\frac{\pi}{4} \times \text{Bore Diameter}^2) - (\frac{\pi}{4} \times \text{Rod Diameter}^2)$	$A = (.7854 D_b^2) - (.7854 D_r^2)$
<b>CYLINDER FORCE</b> lbs. (Pounds of Force)	Force = Pressure (psi) x Net Area (in <sup>2</sup> )	$F = PA$
<b>CYLINDER VELOCITY</b> ft/s (Feet per Second)	Velocity = $\frac{231 \times \text{Flow Rate (GPM)}}{12 \times 60 \times \text{Net Area (in}^2\text{)}}$	$v = \frac{.3208 Q}{A}$
<b>CYLINDER VOLUME</b> G (Gallons of Fluid)	Volume = $\frac{\text{Net Area (in}^2\text{)} \times \text{Stroke (in)}}{231}$	$V = \frac{A L}{231}$
<b>CYLINDER FLOW RATE</b> GPM (Gallons per Minute)	Flow Rate = $\frac{12 \times 60 \times \text{Velocity (ft/s)} \times \text{Net Area (in}^2\text{)}}{231}$	$Q = 3.117 v A$
<b>CYLINDER POWER</b> hp (Horsepower)	Horsepower = $\frac{\text{Pressure (psi)} \times \text{Flow Rate (GPM)}}{1714}$	$hp = \frac{P Q}{1714}$
<b>FLUID MOTOR TORQUE</b> 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 = $\frac{\text{Horsepower} \times 63025}{\text{RPM}}$	$T = \frac{63025 \text{ hp}}{n}$
	Torque = $\frac{\text{Flow Rate (GPM)} \times \text{Pressure (psi)} \times 36.77}{\text{RPM}}$	$T = \frac{36.77 Q P}{N}$
<b>FLUID MOTOR SPEED</b> RPM (Revolutions per Minute)	Speed = $\frac{231 \times \text{Flow Rate (GPM)}}{\text{F.M. Displacement (in}^3\text{/rev.)}}$	$n = \frac{231 Q}{d}$
<b>FLUID MOTOR POWER</b> hp (Horsepower)	Horsepower = $\frac{\text{Torque (lbs-in)} \times \text{RPM}}{63025}$	$hp = \frac{T n}{63025}$
<b>PUMP OUTLET FLOW</b> GPM (Gallons per Minute)	Flow = $\frac{\text{RPM} \times \text{Pump Displacement (in}^3\text{/rev.)}}{231}$	$Q = \frac{n d}{231}$
<b>FLOW RATE THROUGH PIPING</b> ft/s Velocity (Feet per Second)	Velocity = $\frac{.3208 \times \text{Flow Rate Through I.D. (GPM)}}{\text{Internal Area (in}^2\text{)}}$	$v = \frac{.3208 Q}{A}$
<b>TORQUE REQUIREMENT</b> lb-in (Inch Pounds)	Torque = Lever Length (in.) x Pull (lbs.)	$T = L \times F$

**Sketch:**  
(include  
dimensions)



SKETCHES

**Sketch:**  
(include  
dimensions)



**Sketch:**  
(include  
dimensions)



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